ISSN: 2639-7455

Review Article

Earth & Environmental Science Research & Reviews

The Myth of Sustainability

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Submitted: 26 June 2020; **Accepted:** 02 July 2020; **Published:** 08 July 2020

Abstract

Humans are able to sustain neither industrial civilization nor our species, Homo sapiens. *Whereas many pre-civilized groups practiced sustainability, contemporary industrial civilization is not sustainable. Indeed, global industrial civilization underlies abrupt, irreversible climate change and also the ongoing Mass Extinction Event. We continue to overheat Earth, which is already at the highest global-average temperature with our species present. The rapidity of environmental change is increasing and will continue to accelerate with either increased industrial activity or, paradoxically, diminished industrial activity. This paper offers a path forward for all of us, and especially those who wish to educate others, in light of these daunting facts. If our species is destined for extinction, as all species are, then how shall we proceed? If our species is destined for extinction in the near term, as seems apparent, then how shall we proceed? What is the role of educators in the face of an existential threat?*

Keywords: Aerosol Masking Effect, Abrupt Climate Change, Global Warming, Mass Extinction Event.

Introduction

Many pre-civilized societies learned and practiced sustainability [1-4]. A classic and often-cited example is the Iroquois Confederacy, a collection of five indigenous North American tribes that subscribed to the idea of making decisions only after considering the impacts seven generations in the future (Padgett 2016 provides an education-based overview) [5]. Clearly, learning was an important part of sustainable living for the Iroquois Confederacy and other pre-civilized societies.In contrast, the evidence presented herein indicates that contemporary humans have not learned sustainability. As a result, we are incapable of sustaining either industrial civilization or habitat for our own species. This paper relies upon a critical review of abundant peer-reviewed literature to illustrate the inability of contemporary humans to practice sustainability, with a focus on global climate change. For example, industrial civilization is overheating the planet [6], so far to the hottest global-average temperature experienced by humans on Earth [7].

A critical analysis of recent literature indicates the inability of vertebrates and mammals, respectively, to adapt to the ongoing rate of environmental change [8, 9]. The rapidity of environmental change is accelerating and will accelerate further with diminished or halted industrial activity as a result of loss of the aerosol masking effect, thereby presenting a daunting Catch-22 with respect to industrial activity [10]. The aerosol masking effect has been described in the peer-reviewed literature since at least 1929, yet promulgation of this information has been surprisingly slow [11]. Few have learned from this 91-year-old example. Slower yet have been proposed means to mitigate for loss of the aerosol masking effect, which poses a profound existential threat. Finally, this article will demonstrate the various means by which habitat is being quickly lost for our species, as with many other species on Earth [12, 13].We have been warned about abrupt, irreversible climate change[14]. "Meadows [15] …" outlined "four obstacles that appear to prevent world society from adopting a positive approach to climate change: (a) general ignorance about the dynamics of climate change, (b) the long time needed for action to produce effective results, (c) the blocking power of the rich and powerful (those with vested interests in greenhouse gas industries), and (d) the ever increasing worldwide demands for energy and resources." Meadows' warning came far too late, and contemporary human society has not adopted the positive approach he outlined [15].

Our planetary home is in the midst of a Mass Extinction Event [12]. Earth is in the midst of abrupt, irreversible climate change[16]. Either phenomenon poses a tremendous existential threat. In addition, the ongoing pandemic poses a threat to all life on Earth [17]. The combination of a Mass Extinction Event, abrupt, irreversible climate change, and the COVID-19 pandemic suggests *Homo sapiens* has little time remaining on Earth.

The abundant evidence reviewed below indicates that pre-civilized societies lived far more sustainably than we do. These societies clearly learned behaviors and skills that we have lost. Had we retained the lifestyles that dominated human societies during our first 300,000 years as a species, then we doubtless would have persisted many more years on Earth. However, the contemporary, civilized version of global society that is largely responsible for the ongoing Mass Extinction Event and abrupt, irreversible climate change will doubtless become an unwilling subject of these phenomena. Because we did not learn proper behaviors and skills, our days as witnesses are drawing to a close. Barring unforeseen positive changes in the number and behavior of humans, our days as victims draws near.

Differentiating Between Pre-Civilized and Contemporary Societies

Civilizations are characterized by the willingness and ability to store food. Largely dependent upon grains because they are relatively easily stored for extended periods, early civilizations followed a similar pattern of population overshoot and collapse[18]. Although civilizations had not previously been documented, several came into being a few thousand years after the last Ice Age. A relatively cool and stable global-average temperature of about 13.5 C likely contributed to the ability to grow, store, and distribute grains for the first time in the history of *Homo sapiens*. Many civilizations arose around the globe shortly after Earth warmed and stabilized at about 13.5 C, apparently for the first time in the last two billion years. The relatively recent development of several civilizations in response to a cool, stable temperature suggests the importance of food storage to the creation and maintenance of the cities that underlie civilization[19-21].Pre-civilized societies, including some that still remain relatively unoccupied by latter-day colonists, are characterized by food acquisition in the forms of hunting and gathering. Food storage within these societies is minimal and typically short-term [2]. These pre-civilized societies pass down information from generation to generation and therefore retain the behaviors and skills necessary for sustainable living. The contemporary status quo, rooted in exploitation and acquisition of personal possessions, poses quite a contrast to many pre-civilized models.

The cognitive revolution of 70,000 to 30,000 years ago forever shaped the role and importance of humans on Earth [22]. Before this revolution, the power and importance of humans were similar to those of other animals. The rewiring of the human brain during the cognitive revolution gave humans the power, and apparently the desire, to rise greatly in importance. The cognitive revolution separated us from non-human animals in ways that transformed Earth. The means by which we transferred knowledge became increasingly impersonal, thereby promoting the plunder of finite materials and dissociation of humans from other species. However, it was not until the agricultural revolution that humans created cities and therefore greatly overshot their carrying capacity [18]. In other words, the cognitive revolution set us up for failure as a species. The agricultural revolution was the path by which we achieved failure, primarily due to the ongoing Mass Extinction Event and abrupt, irreversible climate change.The following two sections provide examples of differences between pre-civilized and civilized societies that have produced unexpectedly poor outcomes. These disparate outcomes offer teachable moments, as explained in the final section of this paper.

Example 1: Global Climate Change

Climate change is one outcome of civilization. Because civilizations rely upon hierarchical organization, there are many other outcomes that have resulted from other civilizations, including racism, misogyny, poverty, and the myth of human supremacy. I focus on climate change because it poses a serious existential threat about which I have knowledge relative to these other factors. Earth is in the midst of a Mass Extinction Event [12]. Previously believed to be the Sixth Mass Extinction on Earth, we now know the ongoing Mass Extinction Event is at least the Seventh [23]. We are not in the beginning of this event, nor does it lie in the near or distant future; as indicated by [14], we have known we were in the midst of the current Mass Extinction Event for at least a decade. Earth passed the 2 C threshold by March, 2020 [16].

Earth is in the midst of abrupt, irreversible climate change. The ongoing rate of temperature rise indicates that, as early as 2030, the climate of Earth will resemble that of the Pliocene. The mid-Pliocene was at least 2 C warmer than contemporary Earth, and this rate of change is occurring rapidlyenough to ensure the increasing inability of vertebrates and mammals to "keep up." The paper by by Burke et al. [55], relies upon the Representative Concentration Pathways of the Intergovernmental Panel on Climate Change (IPCC), thereby ignoring many self-reinforcing feedback loops and also the aerosol masking effect. In other words, the observed rate of rapid global-average temperature rise is unprecedented in planetary history [24].

Thus, the evidence indicates Earth is in the midst of abrupt climate change.Earth is also in the midst of irreversible climate change, according to a report issued by the conservative IPCC in November, 2019 [25]. The IPCC attributes the irreversibility of climate change to an overheated ocean. The ocean acts as a "battery" by storing heat and carbon dioxide, and both heat and carbon dioxide are released from the ocean into the atmosphere during El Niño Southern Oscillation events.The projected rate of climate change based on the gradual approach assumed by the IPCC outstrips the adaptive response of vertebrates by a factor of 10,000 times [8]. Mammals cannot evolve rapidly enough to escape the current extinction crisis [9]. Humans are classified as vertebrate mammals, indicating that we will not avoid the fate of extinction faced by an estimated 150-200 species of plant, insect, bird, and mammal each day (United Nations Environment Programme 2010, quoted in [26]).

According to an overview published by European Strategy and Policy Analysis System in April 2019 [27], an "increase of 1.5 degrees is the maximum the planet can tolerate; … at worst, [such a rise in temperature above the 1750 baseline will cause] the extinction of humankind altogether." In other words, according to this major synthesis, we have passed the point beyond which human extinction is likely to occur. After all, Earth is currently at least 2 C above the 1750 baseline [14].One common suggestion in response to our fossil-fueled dilemma is to reduce fossil-fuel emissions. However, slowing or stopping industrial activity heats Earth even faster than the ongoing planetary heating resulting from industrial civilization. Industrial activity not only produces the greenhouse gases that heat Earth, but industrial activity also produces the aerosol masking effect that keeps Earth cool [11]. The aerosol masking effect has been greatly underestimated, as pointed out in recent research by [28-30]. The collective evidence indicates a 1 C rise in global-average temperature will occur within a few days or weeks after industrial activity is reduced by as little as 20%, as summarized by [10, 14].

Such a rapid rate of change will outstrip the ability of nearly all life on Earth to keep pace.The aerosol masking effect presents a dire Catch-22 with respect to abrupt climate change. The rapidity of environmental change associated with this phenomenon indicates our inability to retain habitat for vertebrates and mammals on Earth. A modest decline in the aerosol masking effect translates to loss of habitat for human animals, with human extinction soon to follow. In addition, cessation of industrial civilization results in the meltdown of additional nuclear power plants, which will lead to the near-term death of plants, which form the base of the food web for humans and other animals [31].

The ongoing, abrupt rise in global-average temperature as a result of industrial activity indicates humans and other organisms face extinction within a few years. The abrupt rise in global-average temperature resulting from a reduction in industrial activity, as indicated by the aerosol masking effect, indicates that a reduction in industrial activity will further exacerbate and accelerate the ongoing Mass Extinction Event. Thus, our species faces the ultimate, near-term existential Catch-22.Continued industrial activity is driving a rapid global-average rise in temperature that underlies the ongoing Mass Extinction Event. Slowing or stopping industrial activity will rapidly heat Earth as a result of loss of the aerosol masking effect, which presents a daunting Catch-22. In addition, there are several other means by which a global-average temperature rise could cause loss of habitat for *Homo sapiens*, as explained below.

To my knowledge, the first of the several means by which we could lose habitat was reported by at the European Geophysical Union meeting more than a decade ago: a burst of methane from beneath the Arctic Ocean [32]. They reported the "up to 50 Gt … hydrate storage as highly possible for abrupt release at any time." They did not indicate that an ice-free Arctic was required for such a release of methane. Methane is at least 84 times more powerful than carbon dioxide as a greenhouse gas within the first 20 years of release [24], and the abrupt release of even half the 50 Gt concluded upon by Shakhova and colleagues would cause loss of habitat for humans within a matter of months.

The relatively shallow seabed of the Arctic Ocean is not the only source of methane on our fragile planet. This potent greenhouse gas is also being released at exceptionally high levels from terrestrial permafrost in the Arctic region [33]. The abrupt release of methane from at least these two sources is contributing to an exponential rise in atmospheric methane. Planetary overheating is already causing loss of habitat for humans, particularly in subtropical and tropical areas [34].

The ability to grow, store, and distribute grains at scale is a defining element of industrial civilization, as with all civilizations. A significant decline in grain harvest will surely drive this version of civilization to its demise. Considering the 83.3 percent decline of earthworms in agrichemical fields relative to other areas reported by as well as the alternating "land hurricanes" and drought recently plaguing the midwestern United States, it is apparent the ability to grow grains is increasingly constrained [35].

The looming ice-free Arctic Ocean, incorrectly projected to occur in 2016 + 3 years will represent the first such event in history [36]. That it has not yet occurred does not promise that it will not occur. The profoundly negative scientific impacts of this eventuality were summarized by the President of Finland during a press conference with President Donald Trump in August, 2017, and many times since then [37]: "If we lose the Arctic, we lose the globe. That is reality." The rapid heating resulting from an ice-free Arctic Ocean likely would drive the 5-6 C temperature rise sufficient to cause the loss of all life on Earth [13]. Finally, a looming El Niño-Southern Oscillation (ENSO) will release heat from the ocean to the terrestrial biosphere, as is typical for ENSO events. Such an event is predicted during autumn of 2020 in the Northern Hemisphere [38]. The subsequent planetary warming would exacerbate existing self-reinforcing feedback loops and likely trigger additional ones, thus triggering loss of habitat for humans.

Example 2: Planting Trees to Sequester Carbon

McPherson [39] reviews the evidence regarding the idea of planting trees to sequester carbon. A summary follows [39]. Efforts to quantify the sequestration capacity of urban flora have been examined [40].

Efforts to quantify the sequestration capacity of urban flora, combined with an effort to quantify that sequestration capacity, are described as follows [40]. A Vancouver neighborhood sequestered about 1.7 percent as much carbon as human activities produced, while in Mexico City the figure was 1.4 percent. The results were worse in Singapore. Overall, the authors concluded, "The impact of urban vegetation to reduce greenhouse gas emissions directly through carbon sequestration is very limited or null." In other words, planting trees in urban areas is not a viable means by which to sequester carbon in quantities sufficient to make a significant difference.

What about planting trees in non-urban areas? This question is addressed by [41], who found that the most effective place. Found that the most effective place to plant trees with respect to climate change is in the tropics and subtropics [41]. Most forest-restoration commitments are found in these tropical and subtropical areas. In addition, trees sequester carbon relatively quickly near the equator, and land is inexpensive and available compared to temperate regions. Furthermore, establishing forests near the equator has little effect on the albedo (reflectivity) of the land surface, in contrast to high latitudes where trees obscure snow that would otherwise reflect incoming sunlight and therefore help keep the planet cool. Well-managed forests in the tropics and subtropics also can help alleviate poverty in low-income regions, conserve biological diversity, and support the United Nations Sustainable Development Goals.

According to [41], the Intergovernmental Panel on Climate Change (IPCC) suggests in its October, 2018 reportthat atmospheric carbon sequestration by 2100 must total about 730 billion tonnes of CO2 (730 petagrams of CO2, or 199 petagrams of carbon, Pg C) [41, 42]. In the near term, this means adding up to 24 million hectares (Mha) of forest every year between now and 2030. These 24 Mha of forest would be comprised of plantations. This is equivalent to all the CO2 emitted by the United States, the United Kingdom, Germany, and China since the Industrial Revolution began in 1750. There is no known means to capture so much CO2.Fast-growing trees within plantations, such as *Eucalyptus* and *Acacia*, sequester up to 5 tonnes of carbon per hectare per year. After such trees are harvested and the land is cleared for replanting — typically once per decade — the carbon is released into the atmosphere through decomposition. In other words, planting trees into plantations is a temporary measure. Worse yet, according to an analysis conducted by Bala and colleagues and published in the Proceedings of the National Academy of Sciences on 17 April 2007, "afforestation projects ... would be counterproductive if implemented at high latitudes and would offer only marginal benefits in temperate regions [43]."

Recognizing the inability of tropical and subtropical plantations to rise to the challenge posed by IPCC goals, Lewis et al. call on the "restoration community, forestry experts, and policymakers to prioritize the regeneration of natural forests over other types of tree planting — by allowing disturbed lands to recover to their previous high-carbon state [41]." They go on to write that this task "will entail tightening definitions, transparently reporting plans and

outcomes and clearly stating the trade-offs between different uses of land." They conclude that restoration of extant forests, along with reforestation of deforested areas, is the most effective strategy for storing carbon.

Carbon-storage potential is currently being sabotaged by clashing global priorities. The best-case scenario offered by requires the entire area available to management to regenerate as natural forest [41]. However, even under this unlikely scenario, only 42 Pg of carbon would be stored in tropical and subtropical ecosystems by 2100 (vs. the stated goal of 199 Pg).

Finally, with respect to this example, planting trees reduces surface water. Several peer-reviewed studies have linked increased forest cover with reduced river flow and potentially detrimental effects downstream, as reviewed by [45]. The meta-analysis of 43 published studies conducted by found that forests reduced annual river flow by 23% after 5 years and 38% after 25 years [45]. These adverse effects persisted for five decades after forests became established.In addition to technical obstacles directly related to the task of planting billions or trillions of trees, other issues must be considered. For example, the economic cost of managing forests must be paid. By whom? Under what set of contracts? Who would derive financial benefits under these contracts? In addition to these financial concerns, at least three additional issues must be addressed: ongoing overheating of Earth, the aerosol masking effect, and the environmental consequences of water uptake by trees.

The Role of Education

If our species is destined for extinction, as all species are, then how shall we proceed? If our species is destined for extinction in the near term, as seems apparent, then how shall we proceed? As educators, what is our role in the face of an existential threat?

As I wrote recently, hope offers no rational path [10]. Rather, becoming hope-free in the face of our imminent demise is the only rational approach. After all, to incur hope is to believe in a favorable future. Hope is based on faith. Faith requires no evidence. Indeed, evidence generally interferes with faith: witness the spiritually religious. Belief in a favorable future (i.e., hope) presents significant impediments to a rational approach. with "Rogers et al. conclude that belief in a favorable future tends to negate action toward a positive future [44].

Physicians, especially oncologists, used to lie regularly to their patients. Through the 1960s, lying was considered perfectly appropriate. After all, hope was viewed as unimpeachably good, and removing hope by presenting the facts was therefore undesirable. More recently, and with much discussion among medical doctors and ethicists, it has become acceptable to tell the full truth to patients. Based on research conducted during the last few decades, hope is no longer viewed as a motivator for many patients [46-49]. In response, physicians tend to reveal the full truth to patients.Once hope is removed, the full truth remains. Educators must reveal all the evidence regarding any issue under study while not abandoning compassion and empathy. Just as a patient in the final stage of a terminal disease must be informed, so too must the citizenry be informed. To withhold information, regardless of the resulting loss of privilege, is unprincipled.

I am not proposing "giving up," whatever that means in the midst of a Mass Extinction Event, abrupt, irreversible climate change, and a pandemic. Rather, my ongoing scholarly efforts are focused on minimizing suffering. How do we minimize suffering? Is such a quest restricted to humans, or are other organisms included? What is the temporal frame of the quest? Does it extend beyond the moment, perhaps to months or years? Does it extend beyond the personal to include other individuals? These are the questions on which I have chosen to focus.Perhaps others will join me in my quest to understand suffering and its causes. Perhaps doing so will alleviate further suffering. I can imagine worse pursuits than the final individuals of our species exhibiting ethical, responsible behavior. Had we learned and promulgated sustainable practices from our pre-civilized predecessors, we would undoubtedly face a different future. Unfortunately, sustainable behaviors exhibited by *Homo sapiens* for more than 300,000 years were ignored. Our failure to learn has led to the most disastrous of outcomes.

The commitment to the facilitation of learning, which goes beyond teaching, is fundamental to the acquisition and promulgation of knowledge. After a couple of misspent years in the academy as a conservative, "sage on the stage" teacher, I came to realize there is a huge difference between the act of teaching and the practice of facilitating learning. Sadly, many teachers still have not realized this difference.That teaching differs from learning is easily explained by example: I taught my dog to whistle. I taught, and I taught. Of course, my dog never did learn to whistle.

The failure of most people, and contemporary society, to learn the most important of lessons about sustainability brings to mind not only what we learn, buthow we learn. Learning occurs one life at a time, and it is largely autodidactic. Many people cannot be educated because their beliefs interfere with rational thought. Accepting the challenges associated with the facilitation of learning provides considerable solace in what could otherwise feel like failure. That nearly all of my students chose procreation after my dire, contrary warnings suggests the power of cultural messages. This anecdote also serves as a reminder that attachment to the outcome can be maddening and is therefore a poor approach.

Are there better ways to learn than the ones we have employed? Are there better ways than the customary ones to learn about sustainability? Never mind that it is likely too late to avoid the collapse of industrial civilization and extinction of *Homo sapiens:* Beyond abandoning approaches such as "sage on the stage" and "student as customer," learning sustainable behaviors seems a moot point in a world with 7.8 billion rabid consumers. It is too late to turn off the evolutionary processes that brought us to the existential brink [50-54].

Acknowledgments

I thank reviewers of earlier drafts of this paper, including David Crookall, Pauline Schneider, Mimi German, Margaret Brocx, Charlotte Weber, and four anonymous reviewers.

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