

Underestimating the Challenges of Avoiding a Ghastly Future

Scientists Warning 2020 Summary

Seventeen leading scientists from Australia, Mexico and the United States have issued a stark warning of a future of mass extinction, declining health, and climate disruption upheavals, including massive migrations and resource conflicts this century.

Only a realistic appreciation of the colossal challenges facing the international community might allow it to chart a less-ravaged future. It is therefore incumbent on experts in any discipline that deals with the future of the biosphere and human wellbeing to eschew reticence, avoid sugar-coating the overwhelming challenges ahead and “tell it like it is.” Anything else is misleading at best, or negligent and potentially lethal for the human future at worst.

We ask what political or economic system, or leadership, is prepared to handle the predicted disasters, or even capable of such action. The added stresses to human health, wealth, and wellbeing will diminish our political capacity to mitigate the relentless erosion of ecosystem services and bio-diversity loss on which society depends. The science underlying these issues is strong, but awareness is weak. Without fully understanding the scale of the problems and the enormity of the solutions required, society will fail to achieve even modest sustainability goals.

Disciplinary specialization and insularity encourage unfamiliarity with the complex adaptive systems in which problems and their potential solutions are embedded. Biodiversity decline, climate disruption, human consumption and population growth demonstrate the near certainty that these problems will worsen over the coming decades.

BIODIVERSITY LOSS

Major changes in the biosphere are directly linked to the growth of human systems. While the rapid loss of species and populations differs regionally in intensity, certain global trends are obvious. Since the start of agriculture around 11,000 years ago, the biomass of terrestrial vegetation has been halved, with a corresponding loss of >20% of its original biodiversity, together leading to >70% of the Earth's land surface being altered by Homo sapiens. There have been over 700 documented vertebrate and 600 plant species extinctions over the past 500 years. Population sizes of vertebrate species have declined by an average of 68% over the last five decades, with certain population clusters in extreme decline, pointing to imminent extinction of their species. Overall, perhaps 1 million species are threatened with extinction in the near future out of an estimated 7–10 million eukaryotic species on the planet, with around 40% of plants alone considered endangered. 75% of rivers over 1,000 km long no longer flow freely along their entire course. More than two-thirds of the oceans have been compromised to some extent by human activities, live coral cover on reefs has halved in less than 200 years. Kelp forests have declined by 40%, and the biomass of large predatory fishes is now 33% of what it was last century.

With such a catastrophic loss of biodiversity, the ecosystem services it provides have also declined. These include reduced carbon sequestration, reduced pollination, soil degradation, poorer water and air quality, more frequent and intense flooding, fires and compromised human health. As telling indicators of how much biomass humanity has transferred from natural ecosystems to our own use, of the estimated 0.17 Gt of living biomass of terrestrial vertebrates on Earth today, most is represented by livestock (59%) and human beings (36%)—only ~5% of this total biomass is made up by wild mammals, birds, reptiles, and amphibians. As of 2020, the overall material output of human endeavour exceeds the sum of all living biomass on earth.

ECOLOGICAL OVERSHOOT: POPULATION SIZE AND OVERCONSUMPTION

The global human population has approximately doubled since 1970, reaching 7.8 billion people today. While some countries have stopped growing and even declined in size, world average

fertility continues to be **above replacement at 2.3 children per woman** with an average of 4.8 children woman in Sub-Saharan Africa and fertilities over 4 children per woman in many other countries (e.g., Afghanistan, Yemen). The 1.1 billion people today in Sub-Saharan Africa - a region expected to experience particularly harsh repercussions from climate change - is projected to double over the next 30 years. By 2050, the world population will likely grow to 9.9 billion (prb.org), with growth projected by many to continue until well into the next century, although more recent estimates predict a peak toward the end of this century. Large population size and continued growth are implicated in many societal problems. The impact of population growth, combined with an imperfect distribution of resources, leads to massive food insecurity.

By some estimates, 700–800 million people are starving and 1–2 billion are malnourished with prospects of many more food problems in the near future. Large populations and their continued growth are also drivers of soil degradation and biodiversity loss. More people means that more synthetic compounds and dangerous throw-away plastics are manufactured, many of which add to the growing toxification of the Earth. It also increases chances of pandemics. Population growth is also a factor in many social ills, from crowding and joblessness, to deteriorating infrastructure and bad governance. Environmental stressors such as drought, deforestation, and land degradation add to the problems. There is mounting evidence that when populations are large and growing fast, they can spark internal and international conflicts that lead to war.

Simultaneous with population growth, humanity's consumption as a fraction of Earth's regenerative capacity has grown from 73% in 1960 to 170% in 2016, with substantially greater per-person consumption in countries with highest income. With COVID-19, this overshoot dropped to 56% above Earth's regenerative capacity, which means that between January and August 2020, humanity consumed as much as Earth can renew in the entire year (overshootday.org). While inequality among people and countries remains staggering.

Over 70% of all people currently live in countries that run a bio-capacity deficit while also having less than world-average income. The consumption rates of high-income countries continue to be substantially higher than low-income countries, with many of the latter even experiencing declines in per capita footprint.

This massive ecological overshoot is largely enabled by the increasing use of fossil fuels. These convenient fuels have allowed us to decouple human demand from biological regeneration: 85% of commercial energy, 65% of fibres, and most plastics are now produced from fossil fuels. Also, food production depends on fossil fuel input, with every unit of food energy produced requiring a multiple in fossil-fuel energy (e.g., 3 × for high-consuming countries like Canada, Australia, USA, and China; overshootday.org). This, coupled with increasing consumption of carbon-intensive meat has exploded the global carbon footprint of agriculture.

Climate change demands a full exit from fossil-fuel use well before 2050, pressures on the biosphere are likely to mount prior to decarbonization as humanity brings energy alternatives online. Consumption and biodiversity challenges will also be amplified by the enormous physical inertia of all large “stocks” that shape current trends: built infrastructure, energy systems, and human populations.

While population-connected climate change will worsen human mortality, morbidity, development, cognition, agricultural yields, and conflicts, there is no way - ethically or otherwise (barring extreme and unprecedented increases in human mortality) - to avoid rising human numbers and the accompanying overconsumption. That said, instituting human-rights policies to lower fertility and reining in consumption patterns could diminish the impacts of these phenomena. (A weak and fatalistic response?)

FAILED INTERNATIONAL GOALS AND PROSPECTS FOR THE FUTURE

Stopping biodiversity loss is nowhere close to the top of any country's priorities, trailing far behind other concerns such as employment, healthcare, economic growth, or currency stability. It is therefore no surprise that none of the Aichi Biodiversity Targets for 2020 set at the Convention on Biological Diversity's in 2010 conference was met. More broadly, most of the nature-related United Nations Sustainable Development Goals (SDGs) (e.g., SDGs 6, 13–15) are also on track for failure, largely because most SDGs have not adequately incorporated their interdependencies with other socio-economic factors such as population pressures.

In other words, humanity is running an ecological Ponzi scheme in which society robs nature and future generations to pay for boosting incomes in the short term. Even the World Economic Forum, which is captive of dangerous greenwashing propaganda, now recognizes biodiversity loss as one of the top threats to the global economy. The emergence of a long-predicted pandemic, likely related to biodiversity loss, poignantly exemplifies how that imbalance is degrading both human health and wealth.

With three-quarters of new infectious diseases resulting from human-animal interactions, environmental degradation via climate change, deforestation, intensive farming, bushmeat hunting, and an exploding wildlife trade mean that the opportunities for pathogen-transferring interactions are high. That much of this degradation is occurring in Biodiversity Hotspots where pathogen diversity is also highest, but where institutional capacity is weakest, further increases the risk of pathogen release and spread.

CLIMATE DISRUPTION

The dangerous effects of climate change are much more evident to people than those of biodiversity loss, but society is still finding it difficult to deal with them effectively. Civilization has already exceeded a global warming of 1.0°C above pre-industrial conditions, and is on track to cause at least a 1.5°C warming between 2030 and 2052. In fact, today's greenhouse-gas concentration is >500 ppm CO₂-e, while according to the IPCC, 450 ppm CO₂-e would give Earth a mere 66% chance of not exceeding a 2°C warming. Greenhouse gas concentration will continue to increase (via positive feedbacks such as melting permafrost and the release of stored methane), resulting in further delay of temperature-reducing responses even if humanity stops using fossil fuels entirely well before 2030. The IPCC's reliance on averages from several models and the language of political conservativeness inherent in policy recommendations seeking multinational consensus are at odds with the latest climate models (CMIP6) showing greater future warming than previously predicted. Nations have in general not met the goals of the 5 year-old Paris Agreement, and while global awareness and concern have risen, and scientists have proposed major transformative change (in energy production, pollution reduction, custodianship of nature, food production, economics, population policies, etc.), an effective international response has yet to emerge. Even assuming that all signatories do, in fact, manage to ratify their commitments (a doubtful prospect), expected warming would still reach 2.6–3.1°C by 2100 unless large, additional commitments are made and fulfilled. Without such commitments, the projected rise of Earth's temperature will be catastrophic for biodiversity and humanity.

POLITICAL IMPOTENCE

If most of the world's population truly understood and appreciated the magnitude of the crises we summarize here, and the inevitability of worsening conditions, one could logically expect positive changes in politics and policies to match the gravity of the existential threats. But the opposite is unfolding. The rise of right-wing populist leaders is associated with anti-environment agendas as seen recently for example in Brazil, the USA, and Australia. Large differences in income, wealth, and consumption among people and even among countries render it difficult to make any policy global in its execution or effect. A central concept in ecology is density feedback - as a population approaches its environmental carrying capacity, average individual fitness declines. But for most

of history, human ingenuity has inflated the natural environment's carrying capacity for us by developing new ways to increase food production, expand wildlife exploitation, and develop access to other declining resources. But with the availability of fossil fuels, our species has pushed its consumption of nature's goods and services beyond the Earth's long-term carrying capacity. A growing human population will only exacerbate this, leading to greater competition for an ever-dwindling resource pool. The consequences are many: continued reduction of environmental intactness, reduced child health (especially in low-income nations), increased food demand exacerbating environmental degradation via agro-intensification, vaster and possibly catastrophic effects of global toxification; growing violence exacerbated by climate change and environmental degradation, terrorism, and an economic system even more prone to grasp remaining wealth among fewer super rich individuals. The predominant paradigm is still one of pegging "environment" against "economy"; yet in reality, the choice is between exiting overshoot by design or disaster. Even the USA's much-touted New Green Deal has in fact exacerbated the country's political polarization, mainly because of the weaponization of 'environmentalism' as a political ideology rather than being viewed as a universal mode of self-preservation and planetary protection that ought to transcend political tribalism. Indeed, environmental protest groups are being labelled as "terrorists" in many countries, Most of the world's economies are based on the political idea that meaningful counteraction now is too costly to be politically palatable. Combined with financed disinformation campaigns in a bid to protect short-term profits, it is doubtful that any needed shift in economic investments of sufficient scale will be made in time.

Climate change and other environmental pressures will trigger more mass migration over the coming decades, with an estimated 25 million to 1 billion environmental migrants expected by 2050. Because international law does not yet legally recognize such "environmental migrants" as refugees (although this may change), we fear that a rising tide of refugees will reduce international cooperation in ways that will further weaken our capacity to mitigate the crisis.

CHANGING THE RULES OF THE GAME

While it is neither our intention nor capacity in this short Perspective to delve into the complexities and details of possible solutions to the human predicament, there is no shortage of evidence-based literature proposing ways to change human behaviour for the benefit of all life. The remaining questions are less about what to do, and more about how? With many organizations devoted to these issues (e.g., ipbes.org, goodanthropocenes.net, overshootday.org, mahb.stanford.edu, populationmatters.org, clubofrome.org, steadystate.org, to name a few).

The gravity of the situation requires fundamental changes to global capitalism, education, and equality, which include, among other things, the abolition of perpetual economic growth, properly pricing externalities, a rapid exit from fossil-fuel use, strict regulation of markets and property acquisition, reigning in corporate lobbying, and empowerment of women. These choices will necessarily entail difficult conversations about population growth and the necessity of dwindling but more equitable standards of living. (2,323 words)

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