Book Review

Tipping Point for Planet Earth: How Close Are We to the Edge?
by Anthony D. Barnosky and Elizabeth Anne Hadly. 2016.
First US Edition. Thomas Dunne Books. New York, NY, USA 264 pp.
ISBN-10:1250051150, ISBN-13:978-1250051158[1]

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Scientists Anthony Barnosky and Elizabeth Hadly have written extensively on climate change. Their latest book, Tipping Point for Planet Earth: How Close Are We to the Edge?, discusses the precipice on which the human population is delicately balanced, and how the next ten to twenty years will serve as the critical tipping point for the future of humanity. The authors start off providing the background of climate shifts over time on the planet, discuss human impacts on the environment since the Industrial Revolution, and propose practical solutions to solve the most devastating problems humanity faces today. The book is subdivided into chapters that discuss interconnected aspects of climate change that need to be addressed to bring about real change – human overpopulation and overconsumption, green energy, food scarcity, water shortages, pollution, disease, as well as war. The cyclical nature of this global problem permeates into every facet of society, which any scientist in the field already knows. Where Barnosky and Hadly stray from many of the other vast array of books on this topic is in their enduringly hopeful tone. They do not simply seek to lay out the litany of problems and just offer up solutions that are within grasp if lawmakers would take heed – they have refreshingly not given up, and urge their readers to stay hopeful as well.

The authors do not focus solely on scientific figures, but use pertinent data to support their stance which is presented to an audience not necessarily of the scientific persuasion. Their book aims to discuss the many ways in which the impacts of climate change can already be felt, and how things will progress if we continue at our current rate. Furthermore, those most affected are the impoverished populations, for "the farther you get from our creature comforts, the closer you live to the land, and the more apparent is our dependence on Earth's natural resources." (p. 12).

The numbers alone used in describing the damage that has already been done to the planet are staggering. The Earth is expected to heat up by 4-7 degrees Celsius

[1] Submitted on September 9, 2016. Accepted on September 11, 2016. Last revisions received on September 18, 2016.
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DOI: 10.9784/LEB4(3)Jahangeer.01
Electronically available on November 28, 2016. Mailed on November 28, 2016.

over the next few decades. To put this in perspective, in the over 600 million years that complex life has existed on the planet, the average temperature increase has been just about 10 degrees Celsius. "Where humans arrived on a continent before climate change hit...they caused more extinctions than happened with climate change alone…but where human arrival and climate change hit at the same time…the number of extinctions was multiplied many times over what you'd expect." (p. 19). At this rate, the next six decades will see hotter temperatures than have existed in the last fifteen million years. Places where the temperatures are too hot will become uninhabitable.

The authors discuss how mercury levels in the ocean surface have tripled since the Industrial Revolution. Over 40% of the world's forests have been cut down, and we have fished 90% of the big fish out of the oceans. Nearly half of the land on Earth has been altered from prairies and forests to farms and pavement, and each person on Earth needs roughly two acres of land to survive. According to Barnosky and Hadly, the average person uses 4.6 barrels of oil per year. The average American's water footprint is approximately 665,000 gallons annually – enough to fill an Olympic size swimming pool. The global population has doubled since 1969 – in a mere 47 years! When accounting for over seven billion people on the planet, the scale of this problem becomes even more alarming. Conservative estimates predict that in the next 35 years an additional 2-3 billion people will be added to the world, and due to the benefits of modern medicine, people are living longer and using resources for more years than ever before. The authors forewarn that by the year 2050, it is predicted that there will be 9-10 billion people on the planet. Currently, 80% of the world's population (5.6 billion people) live below the poverty level; one third (2.6 billion) lack basic sanitation services; over 1 billion have inadequate access to water; one out of every eight people (870 million) lack enough food, and one billion do not have access to basic health care. In general, the poorer the population, the faster their rate of population increase (p. 24). At this rate, the planet cannot keep up. If there are no improvements, the equivalent of two Earths would be required to sustain human life by the year 2030, and three Earths by the year 2050.

The authors utilize examples that non experts can understand to bolster their argument. Smartphones are made of rare earth minerals, which come from mining. Eventually the supply will run out at the rate they are being produced, not to mention that processing one ton of rare earth minerals yields about two thousand tons of toxic waste. "Natural disasters" are occurring with more intensity and severity and at an increasingly devastating rate all across the globe. Extensive droughts that result in wildfires, more powerful hurricanes, and flooding (Hurricane Sandy flooded the New York City subway system) are just some weather events that are soon going to become the norm. Since 1980, weather catastrophes that cost more than $1 billion have been increasing at a rate of 5% per year.

In the oceans, if worst case scenario predictions are correct, the sea level will rise by over one foot (30 centimeters) by 2050, which would displace over one

hundred million people from their homes. Pacific Islanders in the Carteret Islands (Papua New Guinea) have already had to relocate; they are among the world's first climate refugees (p. 94). More unpredictable are the rates at which the Greenland Ice Sheet and West Antarctic Ice Sheet will continue to melt. With the melting of the Greenland Ice Sheet, the sea level would rise 13-20 feet; with the West Antarctic Ice Sheet melting, the sea level would rise 10-16 feet (3-6 meters). Over half of the Great Barrier Reef system was bleached in 1998 and again in 2002. Most coral reefs will be destroyed by 2070, and as they are considered the rainforests of the oceans with the amount of diverse life they support, this will have devastating consequences. The loss of the Great Barrier Reef would mean a quarter of all ocean life will become extinct, eliminating 10% of world's fisheries. Coral reefs provide more than half of the vital minerals and protein for more than four hundred million people who live in the poorest countries of Africa and South Asia (p. 98).

"Traces of pesticides and industrial pollutants are routinely found in samples of soil or tree bark from virtually any forest in the world, in the blubber of whales, in polar bear body tissues, in fish from most rivers and oceans, and in the umbilical cords of newborn babies." (p. 164). This is perhaps one of the more disturbing lines from the book. The authors very effectively illustrate just how vast the reaches of climate change are, and why it is so urgent to take action now.

After addressing how the scope of this problem permeates into every aspect of human life, the authors discuss their belief in how the largest issues are solvable. Technology exists at this time that would allow for switching from a greenhouse gas (GHG) dependent system to a GHG neutral one. Barnosky and Hadly estimate that this could be implemented within three decades if the proper economic incentives were put in place. Of course, this is much easier to theorize than it is to put into practice, due to the political resistance and lobbying efforts of industries that stand to lose money in an energy changeover. Economic incentives must be put in place, such as carbon taxes and tax breaks for carbon neutral industries, yet even that assumes the worldwide acceptance that climate change is in fact real, and involves cooperation at the international level in order to achieve any amount of success. While acceptance is becoming more widespread, this is still an uphill battle.

The authors insist that greenhouse gas emissions are not the only issue with persuasive arguments. As the human population grows, sustainability of food production becomes more insecure, for even at the present time, everyone on the planet does not have adequate food to survive. While a more efficient crop production system would help, eating less meat would greatly alleviate this problem. Meat production has increased six times since 1950 (as the ability to afford to eat meat indicates social stature) however the grain that could be used to feed people instead goes towards feeding livestock. From a food production standpoint, it is more efficient to harvest the calories directly from plants than it is to feed those calories to livestock, and then consume the livestock (p. 121). In addition, 25% of cropland is devoted to feeding livestock, and not people (if pastureland and cropland are combined, this figure rises to 75%). If everyone were to become a vegetarian,

the calories produced that went into people's stomachs would increase by 50%, and with less livestock, there would be less methane gas (34% of methane emissions come from agricultural animals and their waste). Also, in developed countries people waste 40% of the food they purchase, which needs to be reduced by better education practices. By the year 2040, with a 2 degree Celsius warming, wheat crop yields will drop by over 30%, barley by over 20%, and maize by more than 10%, without adaptation to better farming techniques (with adaptation those figures would not change much) – and any decrease is a problem with an ever increasing global population (p. 120). Water is also going to become increasingly scarce in the coming years and decades; water sharing will need to be utilized to alleviate this problem.

The authors are also deeply concerned how similar current tensions between religious and racial groups could result in another situation like the Rwandan genocide where the Tutsis and Hutus slaughtered each other. "The projected effects of climate change…are threat multipliers that will aggravate stressors abroad such as poverty, environmental degradation, political instability, and social tensions – conditions that can enable terrorist activity and other forms of violence." (p. 210).

Barnosky and Hadly concede that they too felt despondent and thought it was already too late as they conducted their research, until they recently started observing how more and more people care about this global issue, that fall outside of the scientific community. In that same vein, this book will appeal to readers not just in the hard sciences, but those simply interested in environmental issues and those interested in the survival of the human race. Barnosky and Hadly make a crucial point – that typically those discussing climate change are already believers, advocates, and fighters for change – the percentage of the population unconvinced is the true intended target not just for the book, but for awareness in general. The authors implore their readers to communicate the information they present in their book to as many people as possible. Family, friends and coworkers are more likely to trust information from someone they know as opposed to hearing about it from another source. According to the authors, about 20% of the population is made up of 'altruists,' 20% are 'free riders' who look out for their own self-interests above all else, but the remaining 60% is the target group that needs to be convinced. Similarly, about 20% of the population have decided that climate change is not worth worrying about, 20% want to see it fixed, and 60% have not yet formed an opinion. It is unlikely that anyone in either of the 20% groups will change their positions, but with having 60% of the population undecided comes a great deal of hope. To echo Barnosky and Hadly's closing words, please tell those in your inner circle about this book, these issues, and hope that they will pass this word on until a majority is reached and real change can come to fruition for our own survival and betterment of life.