Lonnie Aarssen

WHAT WE ARE

The Evolutionary Roots of Our Future

Springer

What We Are: The Evolutionary Roots of Our Future

Lonnie Aarssen

What We Are: The Evolutionary Roots of Our Future

Springer

Lonnie Aarssen
Department of Biology
Queen's University
Kingston, ON, Canada

1st edition: © Author 2015

Cover art by Christiane Beauregard—http://www.christianebeauregard.com/

ISBN 978-3-031-05878-3 ISBN 978-3-031-05879-0 (eBook)
https://doi.org/10.1007/978-3-031-05879-0

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

TO

WILLIAM CHARLES LAWRENCE

Prelude

This book is an update of my earlier book with a similar title: Aarssen (2015) *What Are We? Exploring the Evolutionary Roots of Our Future*. Chapter titles are the same here but with a new chapter added at the end. Many additional—including of course more recent—references have been added with associated expansion and further development of key concepts, ideas, and hypotheses supported by these references.

For many insightful discussions of topics in this book, I am grateful to my best friend and beloved partner in life, Janice, and to my many colleagues and students, too numerous to name. For their endless patience and resourcefulness, I also thank Catherine DeNoble for helping me to secure image copyright credits and attributions, and Shina Harshavardhan, Kenneth Teng, and the rest of the Springer Nature editing and production team for guiding this project to completion.

Preface

[From Aarssen L (2015) What are we? Exploring the Evolutionary Roots of Our Future. Queen's University, Kingston]

Paul Gauguin (1897) *D'où venons-nous*? *Que sommes-nous? Où allons-nous? (Where do we come from? Who are we? Where are we going?)*/Wikimedia Commons/Public Domain

Humans are fascinated with themselves. What are we? Do our lives mean something? Our obsession with these questions is why the arts and humanities exist. They have given us a rich and bewildering variety of aesthetics, symbolisms, ideologies, narratives, melodies, myths, meditations, beliefs, philosophies, customs, gods, rituals, entertainments, and institutions that have come and gone across recorded history. As acclaimed writer John Updike put it:

> *To be human is to be in the tense condition of a death-foreseeing consciously libidinous animal. No other earthly creature suffers such a capacity for thought, such a complexity of envisioned but frustrated possibilities, such a troubling ability to question the tribal and biological imperatives. So conflicted and ingenious a creature makes an endlessly interesting focus for the meditations of fiction.* (Updike 2000, *The Tried and the Treowe*)

The arts and humanities, accordingly, have always thrived from pluralism of interpretation for the human experience, particularly one's mental life—the "inner self." In other words, the "What are we?" question must remain

unanswered—celebrated as an enduring and revered mystery. After all, humans are fascinated with not just themselves but also with mystery and novelty, and with stories and surprises—especially about themselves. These are enjoyed daily by billions of people watching films and theater, reading novels and other literature, attending concerts and carnivals, and studying, worshiping, and otherwise indulging in countless other products of culture. We humans are creatures of emotion, impulsively drawn to come back again and again to indulge in more. Perhaps it reassures us that we are alive.

Nevertheless, answers—or where to discover them—have indeed been found. Science has, with wide consensus in recent decades, given us a very clear and certain perspective of what we are: We are an animal among many millions of others, the vast majority of which have long been extinct—a species that is only about 300,000 years old, but descended from a long lineage, most of which was not human. This deep history of our origin and our placement and function in the biosphere through time—as for all other species—unfolded because of Darwinian evolution by natural selection. And this discovery has given us what the arts and humanities never could, and never aspired to find: vital insight into how and why human nature, social life, and culture have come to be what they are, and so profoundly different from other species.

Insights from evolution, however, particularly about what humans are, have never been met with enthusiasm from the general public, nor from many professionals. Unfortunately, they are commonly misinterpreted as deliberately threatening, insulting, or even sinister. Darwinism has always been an uncomfortable truth—unintentionally but bluntly challenging the heartfelt beliefs and sensibilities of many good and well-intentioned people. And Darwinism also inadvertently calls upon the arts and humanities—and much of the social sciences—to re-examine what *they* are, and to imagine anew what they have potential to be, now that many of the ageless curiosities and perplexities of the human condition are being answered, with growing precision, by evolutionary biology.

This book is a brief survey of this evolutionary interpretation of what we are, and where we came from—drawing from, and integrating across, several fields of study. It includes emphasis on some recent discoveries, and also explores some new ideas and hypotheses, pointing to inspiration for future research, including with potential to develop more common ground for the life sciences to share together with the arts, humanities, and social sciences.

But the primary goal of this book is much more profound and far-reaching. Arriving at a concise and broadly public understanding of what we are has never been more urgent—because of *what we have done*. Over the short time span of human evolution, *Homo sapiens* have become the hyper-dominant animal on the planet, recklessly overharvesting Earth's resources, obliterating other species, and degrading or destroying the ecosystem services upon which human wellness depends. The scale and impact of these effects have multiplied severalfold over just the few decades of my lifetime, and we are now faced with some very alarming questions—and a growing number of frightening certainties—about where our species is headed. I am not normally inclined to be a doomsayer, and I am as weary as

any from all of the bad news. Nevertheless, indications from several reliable sources all point to an impending collapse of "business as usual" for human civilization. And very few people are paying any attention.

In response to this crisis, I developed a course at Queen's University in 2008, called *Evolution and Human Affairs*. The goal was, and remains, not just to help students find greater awareness of the converging catastrophes of modern civilization but also to find a deeper understanding of how our evolutionary roots—by shaping what we are—have brought us to this critical point in the history of humanity. This book is an account of what my students and I are learning together about our human journey. Some of it points to hope for the future—but some of it, not so much. Our greatest limitation may be that we don't really know ourselves very well at all.

Even more concerning is that we may actually prefer not to know ourselves too well. As poet T.S. Eliot mused, "… humankind cannot bear very much reality" (Eliot 1943, No. 1 of *Four Quartets*). In this book, we explore how it is easier to confront what we are by discovering how we got that way, and that this in turn prepares us for deeper insight into where we and our planet are likely to be headed. Only recently have we acquired the tools of science needed to study and discover these things. From the arts and humanities, we have enjoyed a long and enchanting history of wonder, introspection, and imagination about the human condition. And for the future, we can expect continuing enrichment from these pursuits. But as global citizens in the twenty-first century, we can no longer afford to remain content with just the allure of intrigue, the excitement of serendipity, the charm of stories, the visions of mystics, the superstitions of theology, and the bliss of ignorance.

The critical question then is this: *Has our evolution, as a species, equipped us to respond effectively to the converging catastrophes of the twenty-first century?* It is my belief that students, and others who read this book, will be better equipped to answer this question, and thus to capture a glimpse of the evolutionary roots of our future, and so to participate in prescribing a way forward for the design of a new, more sustainable, and more humanistic model of civilization. Whether there is enough time left to do so, I am less certain.

Kingston, ON, Canada Lonnie Aarssen
August 2015

Man has not only evolved; for better or worse, he is evolving. Our not very remote ancestors were animals, not men; the transition from animal to man is, on the evolutionary time scale, rather recent. But the newcomer, the human species proved fit when tested in the crucible of natural selection; this high fitness is a product of the genetic equipment which made culture possible. Has the development of culture nullified the genes? Nothing could be more false. Culture is built on a shifting genetic foundation. It is fairly generally admitted that genetic changes in the human species are influenced by culture. But many people are reluctant to credit that genetic changes may influence culture. The reluctance comes from an almost obsessive fear that biological influences on culture are somehow incompatible with democratic ideals; social sciences must be guarded against the encroachment of biology. … But the estrangement must be overcome. Man's future inexorably depends on the interactions of biological and social forces. Understanding these forces and their interactions may, in the fullness of time, prove to be the main achievement of science.
—Theodosius Dobzhansky (1962) *Mankind Evolving*

Contents

About the Author

Lonnie Aarssen is Professor of Biology at Queen's University, Kingston, Canada. He has served on the editorial board of several academic journals and is the founding editor of the open-access journal *Ideas in Ecology and Evolution* published at Queen's University. He has authored or co-authored more than 170 peer-reviewed publications and has disseminated his work in Tedx talks and Science Animated videos. In his recent teaching and writing, he explores how evolutionary thinking can affect our understanding of our lives, our species, and our ability to share the planet with other species.

Chapter 1
What Have We Done?

… the impact of our race upon the environment has so increased in force that it is has changed in essence. … Our present combustion of fossil fuels threatens to change the chemistry of the globe's atmosphere as a whole, with consequences which we are only beginning to guess. With the population explosion, the carcinoma of planless urbanism, the now geological deposits of sewage and garbage, surely no creature other than man has ever managed to foul its nest in such short order. (White 1967)

Paulisson Miura (2012) *Paisagem caótica (Chaotic Cityscape)* (https://www.flickr.com/photos/paulisson_miura/). (Used with permission)

Princeton professor Lynn White Jr. delivered the above diagnosis in a now famous lecture—'The Historical Roots of Our Ecological Crisis'—at the Washington

L. Aarssen, *What We Are: The Evolutionary Roots of Our Future*,
https://doi.org/10.1007/978-3-031-05879-0_1

meeting of the American Association for the Advancement of Science in 1966. More than half a century later, the nest of humanity is fouler still. Climate change is now the poster child of the environmental movement. Since 1988, its pace, causes, and consequences have been the subjects of intense study and lucid forecasting by the Intergovernmental Panel on Climate Change. Its mission has become one of the largest and most in-depth analyses of human impact on the planet ever organized, involving contributions from dozens of countries, hundreds of researchers and authors, and many thousands of peer reviewers. Each of its reports is more alarming than the previous one, and the most recent synthesis report (at the time of writing) (https://www.ipcc.ch/report/ar5/wg2/) is especially daunting, with increasingly certain predictions for dramatic and large-scale deterioration and loss of ecosystem services and human well-being over the course of this century (IPCC 2021).

Climate change of course is only one of several environmental disasters that are threatening human civilization as we know it. The alarm began sounding conspicuously in the 1960s, famously with Rachel Carson's (1962) *Silent Spring*, Paul Ehrlich's (1968) *The Population Bomb*, Garrett Hardin's (1968) *Tragedy of the Commons*, and *The Limits to Growth* (Meadows et al. 1972). But human societies in the developed world were caught up then in the excitement of the 'great acceleration' (Steffen et al. 2015) and its false promise of a prosperous future for humanity. New technologies and opportunities for economic growth began to emerge rapidly in the middle of the last century, bringing huge increases in agricultural productivity and extraction/harvesting rates of natural resources (oil, water, timber, fisheries) and, with this, a growing addiction to consumerism.

By the 1990s, many groups of scientists were trying hard to reign in this exuberance, with public calls for restraint and cautionary appeals for greater understanding of impact in the longer view, involving sharp increases in human population growth rate, carbon emissions, pollution, and loss of wildlife habitat and biodiversity on global scales. In 1992, about 1700 of the world's leading scientists, including the majority of Nobel laureates, issued the *World Scientists' Warning to Humanity*. The Introduction pulled no punches:

> *Human beings and the natural world are on a collision course. Human activities inflict harsh and often irreversible damage on the environment and on critical resources. If not checked, many of our current practices put at serious risk the future that we wish for human society and the plant and animal kingdoms, and may so alter the living world that it will be unable to sustain life in the manner that we know. Fundamental changes are urgent if we are to avoid the collision our present course will bring about (http://www.ucsusa.org/about/1992-world-scientists.html).*

In the same year, a similar appeal was issued jointly by the Royal Society and the National Academy of Sciences (reproduced in the journal *Population and Development Review* 18: 375–378). This was followed in 1994 by a Science Summit on World Population: A Joint Statement by 58 of the World's Scientific Academies (*Population and Development Review* 20: 233–238). From the latter: 'In our judgement, humanity's ability to deal successfully with its social, economic, and environmental problems will require the achievement of zero population growth within the lifetime of our children'.

Deaf Ears

While these warnings continued to fall mostly on deaf ears, many groups of scientists and other experts ramped up their efforts vigorously in the new millennium, issuing several detailed reports documenting the imperilled trajectory of human civilization:

The Living Planet Reports (beginning in 2000):

(http://www.footprintnetwork.org/en/index.php/GFN/page/living_planet_report2/).

Global Environment Outlook Reports (beginning in 2000):

(http://www.unep.org/geo/).

Millennium Ecosystem Assessment (2005):

(http://www.millenniumassessment.org/en/index.html).

Earth System Science for Global Sustainability – Grand Challenges (Reid et al. 2010):

> *We know enough to state with a high degree of scientific confidence that without action to mitigate drivers of dangerous global change and enhance societal resilience, humanity has reached a point in history at which changes in climate, hydrological cycles, food systems, sea level, biodiversity, ecosystem services and other factors will undermine development prospects and cause significant human suffering associated with hunger, disease, migration and poverty. If unchecked or unmitigated, these changes will retard or reverse progress towards broadly shared economic, social, environmental and developmental goals.*

State of the Planet Declaration (Brito and Stafford-Smith 2012):

> *Research now demonstrates that the continued functioning of the Earth system as it has supported the well-being human civilization in recent centuries is at risk. Without urgent action, we could face threats to water, food, biodiversity and other critical resources: these threats risk intensifying economic, ecological and social crises, creating the potential for a humanitarian emergency on a global scale.*

Most of humanity has continued not to listen or not to care (Tollefson and Gilbert 2012). Remaining undeterred, a 2013 'Consensus Statement from Global Scientists', on 'Maintaining Humanity's Life Support Systems in the 21st Century', sounds eerily like the World Scientists' Warning to Humanity from two decades earlier:

> *Earth is rapidly approaching a tipping point. Human impacts are causing alarming levels of harm to our planet. As scientists who study the interactions of people with the rest of the biosphere using a wide range of approaches, we agree that the evidence that humans are damaging their ecological life-support systems is overwhelming. We further agree that, based on the best scientific information available, human quality of life will suffer substantial degradation by the year 2050 if we continue on our current path (https://consensusforaction.stanford.edu/see-scientific-consensus/consensus_english.pdf).*

And 25 years after the first World Scientists' Warning to Humanity, the Alliance of World Scientists tried again with 'A Second Notice' (Ripple et al. 2017), this time with 15,364 signatories from 184 countries and a presentation of time series data with predictably staggering implications:

By failing to adequately limit population growth, reassess the role of an economy rooted in growth, reduce greenhouse gases, incentivize renewable energy, protect habitat, restore ecosystems, curb pollution, halt defaunation, and constrain invasive alien species, humanity is not taking the urgent steps needed to safeguard our imperilled biosphere.

Similarly, more than 40 years after the iconic report, *The Limits to Growth* (Meadows et al. 1972), an update of that analysis gives sharp warning of a looming catastrophe: 'There is high risk for pushing the Earth's life supporting systems beyond irreversible trigger-points by 2050' (von Weizsacker and Wijkman 2018). Yet still, as I prepare this opening chapter, another plea from leading scholars in environmental and conservation science has landed on my desk, predicting a 'ghastly future' for humanity (Bradshaw et al. 2021).

Sources and Sinks, Footprints and Capacities

Much has been written about the details of our environmental crisis, including in the reports cited above. Only a brief summary is needed here. Modern civilization depends on the use of materials and energy. It thus requires resource inputs ('sources') from nature and the physical environment, and it necessarily produces waste outputs ('sinks') back into the environment. As with any source/sink relationship, it can be sustained only if sources are not overly depleted and if sinks are not overly filled, and this depends critically on the rate of resource use. In other words, extracted resources must be regenerated, and accumulated wastes must be recycled (thus replenishing the 'sources') or they must be broken down into harmless components. If this fails perpetually, then vital ecosystems services are lost and civilization collapses.

The degradation of ecosystem services is now critical and is in large part a consequence of the rapid growth in human population size, particularly since the beginning of the last century. The earth is now more than full of *Homo sapiens*. But it is fuller in some places than in others. In poor, overcrowded countries, the Human Development Index (quality of life measured by life expectancy, literacy and education, and per capita GDP) is unacceptably low, but the demands on ecosystem services–the 'ecological footprint'–are relatively small (Living Planet Report 2020). In contrast, in more developed countries, Human Development Index is higher of course, not just because population density is lower but also because of greater affluence supported by higher rates of consumption per capita and availability of the modern technologies and economies required to access the energy production and resource extraction rates (with their attendant emissions/wastes) that enable this affluence. The latter generally imposes a disproportionately large negative impact on ecosystem services (a large ecological footprint), even though population size is relatively small. A summary of the main variables is given by what is sometimes referred to as the 'IPAT' equation:

$$\begin{aligned}&\text{IMPACT of humans on the degradation of ecosystem services}\\&= \text{POPULATION size}\left(\text{affecting total consumption and waste production}\right)\\&\times \text{AFFLUENCE}\left(\text{consumption per capita}\right)\\&\times \text{TECHNOLOGY}\left(\text{allowing affluence; but with negative effects, e.g. pollution}\right)\end{aligned}$$

The continuing destruction of natural habitat for wildlife has now set in motion the earth's sixth mass extinction event (Dirzo et al. 2014, Gilbert 2018), affecting everything from the smallest invertebrates to the largest mammals. The overall impact of our species on the planet is now more than 50% greater than what nature can renew. In other words, it would take 1.54 earths to sustainably meet the demands that humanity currently makes on nature (Living Planet Report 2020). With a global population size now over 7.5 billion and rising, it is clearly not possible to achieve and maintain an acceptable Human Development Index without imposing an ecological footprint that exceeds the global capacity of ecosystem services to regenerate. And most of the less developed world is of course aiming to enjoy – as soon as possible – the consumerism and affluence long enjoyed by more developed nations, and many are managing to do so. Civilization cannot continue with 'business as usual' for much longer.

Looking Ahead by Looking Back

Our species is faced with a profound reckoning for what it has done. The urgency and far-reaching implications of the above warnings and predictions have made major news headlines, periodically, over the past several decades. Yet most in the general public (and hence most governments) have so far reacted with little, short-lived, or no significant alarm. Humans seem generally ill-equipped to respond effectively to the converging catastrophes of the twenty-first century. Clearly, the problem is *us*. The great challenge for humanity then is to transform 'us' from being the problem, into being the solution. But if we are to become the 'solution', we need to first understand how/why we became the 'problem'. In this book we will examine how our collapsing civilization as well as our dysfunctional reaction to it are products of our own biocultural evolutionary history. In other words, they are products of human motivations that generously rewarded the reproductive success of our ancestors – motivations therefore that define what we are today: our behaviours, social lives, and cultures.

In the last two chapters, we explore how a deep understanding of these evolutionary roots of what we are is critical for the next 'episode' of the human journey: designing a new and improved project of civilization for our descendants. Their future lies in what we are. And what we are is from the past.

> *If uncomfortable truths are out there, we should seek them and face them like intellectual adults, rather than eschew open-minded inquiry or fabricating philosophical theories whose only virtue is the promise of providing the soothing news that all our heartfelt beliefs are true.* Joyce (2006).

References

Bradshaw CJA, Ehrlich PR, Beattie A, Ceballos G, Crist E, Diamond J, Dirzo R, Ehrlich AH, Harte J, Harte ME, Pyke G, Raven PH, Ripple WJ, Saltré F, Turnbull C, Wackernagel M, Blumstein DT (2021) Underestimating the challenges of avoiding a ghastly future. Front Conserv Sci 1:615419. https://doi.org/10.3389/fcosc.2020.615419

Brito L, Stafford-Smith M (2012) State of the planet declaration. Planet under pressure: new knowledge towards solutions conference, London, 26–29 Mar 2012. Available at: http://www.igbp.net/download/18.6b007aff13cb59eff6411bbc/1376383161076/SotP_declaration-A5-for_web.pdf

Carson RL (1962) Silent spring. Houghtoon Mifflin, New York

Dirzo R, Young HS, Galetti M, Ceballos G, Isaac NJB, Collen B (2014) Defaunation in the anthropocene. Science 345:401. https://doi.org/10.1126/science.1251817

Ehrlich P (1968) The population bomb. Ballantine Books, New York

Gilbert N (2018) Top UN panel paints bleak picture of world's ecosystems. Nature, News 27 Mar 2018. https://www.nature.com/articles/d41586-018-03891-1

Hardin G (1968) The tragedy of the commons. Science 162:1243–1248. http://www.sciencemag.org/content/162/3859/1243.full.pdf

IPCC (2021) Climate change 2021: the physical science basis. Contribution of working group I to the sixth assessment report of the intergovernmental panel on climate change. In: Masson-Delmotte V, Zhai P, Pirani A, Connors SL, Péan C, Berger S, Caud N, Chen Y, Goldfarb L, Gomis MI, Huang M, Leitzell K, Lonnoy E, Matthews JBR, Maycock TK, Waterfield T, Yelekçi O, Yu R, Zhou B (eds). Cambridge University Press, In Press. https://www.ipcc.ch/report/ar6/wg1/#FullReport

Joyce R (2006) The evolution of morality. MIT Press, Cambridge

Living Planet Report. (2020) https://www.footprintnetwork.org/content/uploads/2020/09/LPR2020-Full-report-lo-res.pdf

Meadows DH, Meadows DL, Randers J, Behrens WW III (1972) The limits to growth: a report for the club of Rome's project on the predicament of mankind. Universe Books, New York

Reid WV, Chen D, Goldfarb L, Hackmann H, Lee YT, Mokhele K, Ostrom E, Raivio K, Rockström J, Schellnhuber HJ, Whyte A (2010) Earth system science for global sustainability: grand challenges. Science 330:916–917

Ripple WJ, Wolf C, Newsome TM, Galetti M, Alamgir M, Crist E, Mahmoud MI, Laurance WF (2017) World scientists' warning to humanity: a second notice. Bio Science 67:1026–1028. https://doi.org/10.1093/biosci/bix125

Steffen W, Broadgate W, Deutsch L, Gaffney O, Ludwig C (2015) The trajectory of the anthropocene: the great acceleration. Anthropocene Rev 2:81–98

Tollefson J, Gilbert N (2012) Rio Report Card. Nature 486:20–23

von Weizsacker E, Wijkman A (2018) Come on! capitalism, short-termism, population and the destruction of the planet: a report to the club of Rome. Springer, New York

White L (1967) The historical roots of our ecologic crisis. Science 155:1203–1207