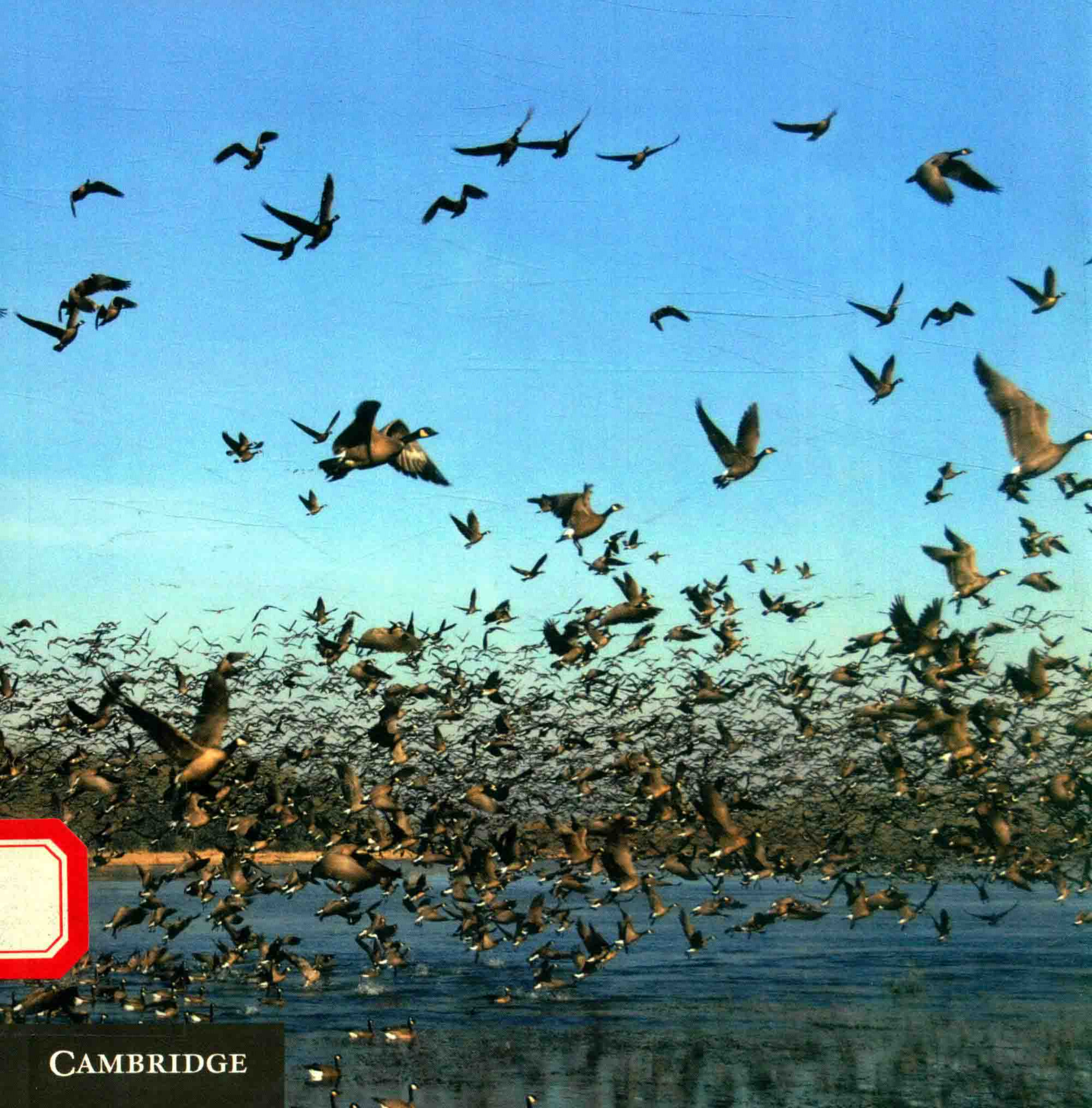
# The Ethics of Species

## An Introduction

**Ronald L. Sandler**



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# The Ethics of Species

We are causing species to go extinct at extraordinary rates, altering existing species in unprecedented ways, and creating entirely new species. More than ever before, we require an ethic of species to guide our interactions with them. In this book, Ronald L. Sandler examines the value of species and the ethical significance of species boundaries, and discusses what these mean for species preservation in the light of global climate change, species engineering, and human enhancement. He argues that species possess several varieties of value, but they are not sacred. It is sometimes permissible to alter species, let them go extinct (even when we are a cause of the extinction), and invent new ones. Philosophically rigorous, accessible, and illustrated with examples drawn from contemporary science, this book will be of interest to students and researchers of philosophy, bioethics, environmental ethics, and conservation biology.

RONALD SANDLER is an Associate Professor of Philosophy and the Director of the Ethics Institute at Northeastern University. He is also a senior researcher in Northeastern's Environmental Justice Research Collaborative and its Nanotechnology and Society Research Group. Sandler is author of *Character and Environment: A Virtue-oriented Approach to Environmental Ethics* (2007) and *Nanotechnology: The Social and Ethical Issues* (2009). He is co-editor of *Environmental Virtue Ethics* (with Philip Cafaro, 2005) and of *Environmental Justice and Environmentalism: The Social Justice Challenge to the Environmental Movement* (with Phaedra C. Pezzullo, 2007).

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To
Elijah Reed Sandler
and
Ruth Sydney Sandler

# Preface

Our technology provides us with enormous and wide-ranging power with respect to species. We are causing species to go extinct at extraordinary rates, altering existing species in unprecedented ways, and creating entirely novel species. More than ever before, we require an ethic of species to guide our interactions with them and our choices regarding them. Central to an ethic of species are accounts of the value of species and the ethical significance of species boundaries. Developing these is the core theoretical project in this book. The core applied issues are what the value of species and ethical significance of species boundaries imply for species preservation under conditions of global climate change, modification of existing species (including ourselves), and engineering novel species. Species and the individuals that comprise them possess myriad varieties of value that need to be appreciated and considered in action, practice, and policy contexts. But species are not sacred. They do not have absolute or unconditional value, and they are not untouchable. It is sometimes permissible to alter them; it is sometimes permissible to let them go extinct (even when we are a cause of the extinction); and it is sometimes permissible to invent new ones. In fact, sometimes we ought to do these things, in just, caring, compassionate, and ecologically sensitive ways.

# Acknowledgments

I am grateful to Northeastern University and the Department of Philosophy and Religion for a sabbatical from teaching during the fall 2010 semester to write the first draft of the manuscript for this book. I am fortunate to be a member of such a supportive and collegial department.

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Some of the material in this book draws from research that I have done with John Basl on artifacts and Judith Crane on species. I am deeply appreciative of the contributions they have made to my understanding of those topics. I am fortunate to have collaborators who are so philosophically astute and such good fun.

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Most of all, I thank my family. Without the love and support of my wife, Emily, this book, like all good things in my life, would not have been possible. The book is dedicated to my children, Elijah and Ruth. Their wonder and enthusiasm toward the world make every day an unpredictable adventure. I love them everywhere and all the time.

# Contents

# 1 Introduction

## 1.1 Why an ethic of species?

Humanity's relationship to other species has reached critical junctures. We are causing species to go extinct at an unprecedented rate in comparison with any other time in the last 65 million years.[1] The background or normal historical rate of extinctions is approximately one species per one million per year.[2] There is no precise data, and estimates vary, but many leading experts on biodiversity believe there are around ten million eukaryotic (or plant and animal) species.[3] Therefore, in normal times, there would be around ten species extinctions per year. However, as a result of human activity – for example, pollution, extraction, and habitat destruction – species extinctions already exceed one thousand species per million per year.[4] Moreover, the rate of extinction is expected to substantially increase due to global climate change, according to several scenarios surpassing 10,000 species extinctions per million per year,[5] over a quarter of species committed to extinction by 2050,[6] and one half of species extinct by 2100.[7] Even on optimistic (and increasingly unlikely) scenarios, in which the increase in the global mean surface air temperature of the planet is limited to around 2°C above pre-industrial temperatures, 20–30 percent of species are expected to be at increased risk of extinction by 2100.[8] The Earth's

[1] Magurran and Dornelas (2010).

[2] Baillie et al. (2004) calculates the historical rate of extinction as .1–1 E/MSY.

[3] Vié et al. (2009); Strain (2011).

[4] Baillie et al. (2004); IUCN (2011). For a review of the rates for vertebrates, see Hoffman et al. (2010).

[5] Wilson ([1999] 2010); IUCN (2011). Assuming 10 million species, this is approximately 275 species per day.

[6] Thomas et al. (2004). [7] IPCC (2007a). [8] IPCC (2007a).

next major extinction event appears to have begun, and this time it is anthropogenic.[9]

In addition to eliminating species, we are engineering them in unprecedented ways. Intentional manipulation of species has been occurring since at least the beginning of agriculture – through selective breeding, hybridization, and grafting – and recombinant DNA techniques have been used for decades to insert genes from one individual into another, including across species. However, advances in genetic engineering have substantially scaled up the precision, intensity, and comprehensiveness of these modifications.

One research group has engineered a yeast (*Saccharomyces cerevisiae*) that produces high concentrations of artemisinic acid – the precursor for artemisinin, an antimalarial drug – by transplanting genes from sweet wormwood (*Artemisia annua*), the traditional source of artemisinin, and several bacteria species, which code for the requisite metabolic pathway, into the yeast.[10] Another research group has chemically synthesized the entire genome of a *Mycoplasma mycoides* bacteria, inserted it into a non-*M. mycoides* host cell, and "booted it to life" – that is, started up the metabolic processes of the *M. mycoides*.[11] Engineering biology has become sufficiently accessible that there is now an annual genetically engineered machine competition in which high school and undergraduate teams use and contribute to "a continuously growing collection of genetic parts that can be mixed and matched to build synthetic biology devices and systems."[12]

While some researchers are intensively reengineering existing biological parts and systems, others are developing life forms that are not derived from prior organisms. One research team has created "self-replicating cells assembled from nonliving organic and inorganic matter."[13] These entities are approximately one million times smaller than bacteria and do not contain any biomolecules found in modern living cells. They are artificial, evolving life forms (or life-like forms) that are unrelated to any existing or prior life forms.

Technologies that are used to modify ourselves, members of the species *Homo sapiens*, are also increasingly powerful. People are eager to incorporate

[9] Barnosky et al. (2011). [10] Ro et al. (2006). [11] Gibson et al. (2010).
[12] Registry of Standard Biological Parts (2010). [13] AAAS (2005).

technologies into their lives if they believe they will improve their abilities or health. The human growth hormone industry, although largely illegal, is estimated to be worth several billion dollars annually;[14] and 7 percent of college students[15] and 20 percent of research scientists use off-label prescription pharmaceuticals (e.g., methylphenidate [Ritalin] and modafinil [Provigil]) to increase alertness and productivity.[16] This is not a historical aberration. People have been enthusiastically ingesting natural and engineered chemical compounds to improve or repair biological functioning for millennia, and coffee, an effective stimulant, has long been among the most traded commodities in the world. The difference with emerging technological enhancements – such as genetic technologies, brain-machine interfacing, and nootropics ("smart drugs") – is the magnitude of augmentation that they will enable, as well as the extent to which they will do so by modifying or integrating with our biological systems. Already people are controlling computers with their brain states;[17] people have bionic arms that are spontaneously integrating with their nervous system;[18] researchers are successfully combining human and nonhuman genomic material;[19] and pharmaceuticals intended to increase longevity have gone into clinical trials.[20]

It is because we have the power to cause mass extinctions, substantially modify existing species, and create novel species that we require an ethic of species. Central to an ethic of species are an account of the value of species and an account of the ethical significance of species boundaries. The former concerns the sorts of value that species have and the bases for their having it. The latter concerns whether species boundaries carry normative significance, such that mixing species, modifying species, or intentionally creating individuals outside existing species boundaries is intrinsically problematic. These are the core theoretical issues of this book. The core applied issues are what the value of species and normative significance of species boundaries imply for species preservation under

14 Olshansky and Perls (2008).

15 McCabe et al. (2005). Others have suggested that the rate could be as high as 35 percent (University of Michigan Health System 2008).

16 Maher (2008). 17 Hochberg et al. (2006). 18 McGrath (2007).

19 Ourednick et al. (2001); Almeida-Porada et al. (2005); Jacobs et al. (2007).

20 Keim (2008).

conditions of rapid climate change, modification of existing species (including ourselves), and engineering novel species.

In the remainder of this Introduction, I explicate the conception of species that is operative in the book and then provide an overview of the book's organization, central claims, and arguments.

## 1.2 Species as forms of life

There is no widely agreed upon definition of "species," but rather a host of competing species concepts. Species are sometimes conceived in terms of reproductive isolation: that is, as interbreeding (or potentially interbreeding) populations.[21] They are sometimes conceived phylogentically or evolutionarily: that is, as a lineage of ancestral descendant populations.[22] They are sometimes conceived ecologically: that is, as populations that occupy an ecological niche different from that of any other lineage in its range.[23] They are sometimes conceived genetically: that is, in terms of overall genotypic similarity distinct from that of other organisms.[24] And they are sometimes conceived morphologically: that is, in terms of shared anatomical features different from those of other groups of organisms.[25] That there are so many different conceptions of species has given rise to the issue of whether there is one correct account of species (*species monism*), or whether there is a plurality of legitimate species concepts (*species pluralism*). A related issue is whether species are real categories into which biological organisms are divided based on their features (*species realism*); or whether species are merely conventions (*species conventionalism*), that is, useful ways to organize the living world, but not reflective of the fundamental features of living things.[26] The status of species boundaries tracks that of species. If species are real, then so too are species boundaries; if species are conventions, then species boundaries are as well.

Part of the explanation for why there are myriad conceptions of species is that biologists with different concerns and research projects refer to

[21] Mayr and Ashlock (1991). [22] Wiley (1978). [23] van Valen (1976).

[24] Sokal and Crovello (1970). [25] Cronquist (1978); Kitcher (1984); Stamos (2003).

[26] In addition to the monism/pluralism and real/conventional aspects of "the species problem," there is a metaphysical dimension, i.e., whether species are collections of individuals, abstract forms, or historical individuals distinct from the organisms that comprise them (Crane 2004).

different kinds of groups as "species." For instance, the ecological species concept is more useful for ecologists formulating and studying questions about ecological relationships and functions than is the phylogenetic species concept; whereas the phylogenetic species concept is better suited to the work of evolutionary biologists interested in ancestral relationships than is the ecological species concept. And while reproductive isolation is a useful approach to categorization when trying to distinguish groups of sexually reproducing organisms whose ranges overlap, it is less useful where populations do not overlap geographically, and it is not at all useful when studying populations of asexually reproducing organisms. That there is a multiplicity of species concepts that are used productively to study and explain the biological world provides support for species pluralism. It suggests that each of the various concepts picks out biologically significant features of organisms. The monistic idea that there is a single best way to divide organisms into species seems belied by productive biological practice.

Species pluralism garners additional support from the fact that no one species concept captures an aspect of organisms or the biological world that is more fundamental than all other aspects. For example, all natural (or nonengineered) organisms have ancestor relationships, so it is possible to categorize the natural world, including at the species level, phylogenetically. But all organisms are also inextricably ecologically situated, and this is crucial for understanding why organisms and populations have the characteristics they have and behave as they do. In fact, the ecological situatedness of populations turns out to be important for understanding phylogeny, since environmental changes are crucial in explaining evolutionary history, while phylogenetic information can be useful for understanding the functioning of ecological communities.[27] So it is not the case that either phylogenetic relationships or ecological ones are more explanatorily fundamental. Each captures something important about life in an evolved biological world, which is why they are powerful and influential species concepts.

Organisms have phylogenies, ecological niches, genetic features, and reproductive communities. These are all explanatorily important, and no one of them picks out the fundamental causal structure of the biological world. For these reasons, species pluralism is the more plausible view.

[27] Tan et al. (2011).

However, species pluralism does not imply full-blown relativism. Biological reality places constraints on what counts as a legitimate species concept, otherwise species divisions would be arbitrary and we would have to accept "the suggestions of the inexpert, the inane, and the insane."[28] At a minimum, a legitimate species concept needs to classify organisms into groups, since the point of a species concept is to divide and organize organisms. Moreover, it must do so by features that are biological properties of organisms or groups of organisms. These properties can be either internal (e.g., genetic) or relational (e.g., ancestral). A legitimate species concept must also be explanatorily useful. It must help make sense of the world by organizing it in ways that increase our understanding of it or increase our ability to make predictions regarding it.[29]

The conception of species that is primarily used in this book is that species are groups of biologically related organisms that are distinguished from other groups of organisms by virtue of their shared *form of life*. A species' form of life refers to how individuals of the biological group typically strive to make their way in the world. For example, it concerns what sorts of things they consume and how they acquire it; how they reproduce; how (and when and whether) they move; how they avoid predators; and how they repair themselves when damaged. It is straightforward to distinguish a group of organisms on this basis. The form of life of a cottonmouth snake (*Agkistrodon piscivorus*) is clearly different from that of a silver maple (*Acer saccharinum*), a black swallowtail butterfly (*Papilio polyxenes*), and an Arctic fox (*Alopex lagopus*). It is also quite different from that of eastern garter snakes (*Thamnophis sirtalis sirtalis*) and timber rattlers (*Crotalus horridus*). These species have distinct life cycles, behaviors, habitats, predators, prey, and protections. Of course, they do so largely because of differences in their biological parts and processes: that is, their phenotypes. These, in turn, are largely explained by their genetic differences: that is, their genotypes. It is for genetic reasons that individual grey wolves have a sufficiently common biological form and a sufficiently common set of behaviors (e.g., sociability and diet) under sufficiently common environmental conditions that they constitute a form of life (*Canis lupus*) that is distinct from that of coyotes (*Canis latrans*), zebra mussels (*Dreissena polymorpha*), and green herons (*Butorides virescens*).

[28] Kitcher (1987: 190). [29] Crane and Sandler (2011).