Species: New Interdisciplinary Essays

edited by Robert A. Wilson

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Introduction

This volume of twelve specially commissioned essays about species draws on the perspectives of prominent researchers from anthropology, botany, developmental psychology, the philosophy of biology and science, protozoology, and zoology. The concept of species has played a focal role in both evolutionary biology and the philosophy of biology, and the last decade has seen something of a publication boom on the topic (e.g., Otte and Endler 1989; Ereshefsky 1992b; Paterson 1994; Lambert and Spence 1995; Claridge, Dawah, and Wilson 1997; Wheeler and Meier 1999; Howard and Berlocher 1998). *Species: New Interdisciplinary Essays* is distinguished from other recent collections on species and the species problem in two ways.

First, by attempting to be more explicitly integrative and analytical, this volume looks to go beyond both the exploration of the detailed implications of any single species concept (cf. Lambert and Spence 1995, and Wheeler and Meier 1999) and the survey of the ways in which species are conceptualized by researchers in various parts of biology (cf. Claridge, Dawah, and Wilson 1997). As a whole, it takes a step back from much of the biological nitty-gritty that forms the core of these recent books on species in order to gain some focus on general claims about and views of species. Authors for the current volume were explicitly encouraged to address some subset of five general themes that tied their particular discussions to broader issues about species with a philosophical edge to them. Half the contributors have their primary training in philosophy. The volume is thus deliberately more philosophical in its orientation and in the content of the essays. Yet the biological detail in *Species: New Interdisciplinary Essays* is, I believe, rich enough for the volume as a whole to contribute both to the philosophy of biology and to evolutionary biology itself.

Second, the volume adds historical and psychological dimensions typically missing from contemporary discussions of species. The historical slant is reflected in essays that consider the Linnaean hierarchy (e.g., Ereshefsky) and the Modern Synthesis (e.g., Nanney), as well as in those essays that draw on more general considerations from the philosophy of science (e.g., Boyd) and in those that offer particular solutions to the species problem (e.g., de Queiroz). Although the principal purpose of these essays is not to contribute

to the history of biology, they are often able to appeal to that history in order to enrich our understanding of species and the biological world. The psychological perspective is most explicit in the essays by Atran and by Keil and Richardson, but also underlies central arguments in several other papers (e.g., by Wilson and by Griffiths). Together, these two features of the volume provide for a broad perspective on species and on the issues in the philosophy of biology and in biology proper to which species are central.

The papers have been organized into five sections that seemed to me to represent the most cohesive clusters of views and the most interesting sequence of papers to read from beginning to end. Those sections are: "Monism, Pluralism, Unity and Diversity"; "Species and Life's Complications"; "Rethinking Natural Kinds"; "Species in Mind and Culture"; and "Species Begone!" The rest of this introduction mainly provides an overview of the papers in the order that they appear. There are, of course, other thematic commonalities, shared perspectives, and oppositions that this organization (or any single artifactual classification scheme, such as a table of contents) will obscure. One alternative way of thematically locating particular papers in the volume and of viewing the orientation of the volume as a whole is to consider the five themes that authors were invited to address and the pair of themes each paper concentrates on most intensely. Those themes, ranked in order from those that feature in the highest number of papers to those that feature in the smallest number, together with some accompanying questions, are:

1 Unity, Integration, and Pluralism

Given the proliferation of species concepts in recent years, how should these concepts be viewed? In what ways do they compete with one another? Which proposals should be seen as the main contenders for "the" species concept, and by which criteria should they be evaluated? What are the prospects for developing an integrated species concept? Should one be a *pluralist* about species? [Dupré, Hull, de Queiroz, Boyd, Wilson, Atran, Mishler]

2 Species Realism

What sort of realism, if any, should one adopt with respect to species? In what ways does our answer to this question both reflect and influence our view of other elements in the Linnaean hierarchy? What interplay is there between a stance on the realism issue and broader issues in both the philosophy of biology and the philosophy of science more generally? [Dupré, Sterelny, Boyd, Wilson, Griffiths, Keil and Richardson, Ereshefsky]

3 Practical Import

In what ways are answers to the questions asked under the other four themes important for the practice of evolutionary biology and related

sciences? Should we view the resolution of the cluster of issues often called "the species problem" as foundational in some way? To what extent is the species problem (merely) definitional? What is the relationship between the species problem and empirical practice within the biological (and other) sciences? [Hull, de Queiroz, Nanney, Sterelny, Griffiths, Mishler]

4 Historical Dimensions

In what ways are the views of major historical figures or movements in evolutionary biology of significance for contemporary views of species? Is our own view of important historical episodes (e.g., formation of the Linnaean hierarchy, the Modern Synthesis) skewed in important ways? How can we shed light on contemporary discussions by reflecting on the recent history of evolutionary biology? [Nanney, Ereshefsky]

5 Cognitive Underpinnings

To what extent do the literature on children's naive biology and anthropological work in cross-cultural psychology support nativist and universalist views of species? What fruitful interplay exists between explorations of the mental representation of biological knowledge and the philosophy of biology as it has been traditionally circumscribed? [Atran, Keil and Richardson]

The summaries of the sections and essays indicate that many other issues are raised in *Species: New Interdisciplinary Essays*, including the plausibility of the individuality thesis about species, the death of essentialism, the interplay between ecology and evolution, the relationship between common sense and scientific taxonomies, and the challenge that recent developmental systems theory poses to taxonomy in terms of evolutionary homologies. *Species: New Interdisciplinary Essays* advances debate about all of these issues. Between the overviews of contemporary debates and the novel insights provided in many of the essays, the volume should prove invaluable for professionals working in the contributing fields and useful for advanced undergraduate and graduate courses in either the foundations of evolutionary biology or the philosophy of biology.

Let me turn more directly to the individual essays and the sections into which they are organized, beginning with "Monism, Pluralism, Unity, and Diversity", containing papers by John Dupré, David Hull, and Kevin de Queiroz. As the title of his essay ("On the Impossibility of a Monistic Account of Species") suggests, Dupré argues for the rejection of monism about species. He claims, moreover, that this conclusion is the proper one to draw from the complete assimilation of Darwin's insights about the organization of the biological world. There are no perfectly sharp boundaries between preexisting natural kinds—species—that would allow for a monistic account of species. Rather, what we find when we investigate the biological world is

diversity, and our schemes of classification should reflect both this diversity and our various theoretical and practical ways of exploring the biological world. As well as recounting familiar objections to the numerous attempts to provide a monistic account of species, Dupré also offers novel responses to some putative problems facing pluralism. However, he tempers his pluralism, and the acknowledgment that our taxonomic system is the product of a highly contingent process, with a concession to monism: because one of the points of biological taxonomy is to facilitate communication between scientists, we ought to view species as the basal unit in one overarching taxonomic hierarchy. Thus dispensing with overlapping taxonomies, this view represents a less radical version of pluralism than Dupré himself has advocated in the past (e.g., Dupré 1993; cf. Kitcher 1984).

Hull is more sceptical about the prospects for pluralistic accounts of species in his essay, "On the Plurality of Species: Questioning the Party Line." After sketching some broad issues that arise more generally with respect to pluralist views, he turns to examine some of the prominent expressions of pluralism by Kitcher (1984), Ereshefsky (1992a), and Stanford (1995). Hull then turns to compare his own (1997) attempts to classify and evaluate the plethora of species concepts with Mayden's attempts (1997). Whereas Hull reached the "grudging conclusion," as he calls it here, in 1997 that no *one* species concept won out within the criteria he proposed, Mayden arrived at a form of monism. Returning to one of the earlier themes of his essay, Hull attributes the difference here in part to the fact that as a practicing scientist, Mayden has to make more definitive theoretical commitments than a philosopher who stands outside the practice of science and surveys options. Stances on the pluralism issue typically reflect social and institutional facts about the advocates of those stances, rather than bias-free views argued out from first principles.

The third essay in this section, de Queiroz's "The General Lineage Concept of Species and the Defining Properties of the Species Category," develops a solution to the species problem that de Queiroz has recently (1998) defended: what he calls the *general lineage* concept of species. This view equates species with segments of population lineages, and de Queiroz argues not only that it underlies "virtually all modern ideas about species," but that it illuminates a wide range of issues about species, including debates about speciation, the individuality thesis, and species realism. de Queiroz also proposes that it allows one to dissolve the debate between monists and pluralists. He continues by tracing the history of the population lineage concept from Darwin through the early part of the Modern Synthesis in the work of Huxley, Mayr, Dobzhansky, and Wright, to the more explicitly lineage-focused concepts of Simpson, Hennig, and Wiley. Although this historical sketch constitutes a minor part of de Queiroz's wide-ranging essay, it serves to buttress his proposals about the ways in which the population lineage concept underlies many apparent disagreements between advocates of different species concepts. The paper concludes with a philosophical diagnosis

of why this underlying unity has been largely unrecognized in contemporary debates.

The two papers in the next section, "Species and Life's Complications," look at very different issues that arise for particular species concepts. David Nanney's "When Is a Rose?: The Kinds of *Tetrahymena*," probes Mayr's biological species concept (BSC) and the notions that it employs, such as a closed gene pool, from the perspective of a longtime practicing ciliate biologist. Nanney conveys interesting information about the ciliates (*Tetrahymena* in particular)—such as the relative independence of genetic and morphological subdivisions, and the clonal propagation of these ancient protists (some of which include asexually reproducing populations)—that pose problems for the BSC; he also reveals enough of the history of protozoology to suggest why the field has a strained relationship to the Modern Synthesis and concepts forged during it. One striking conclusion of the essay is that microbiology, having essentially bypassed the Modern Synthesis, awaits a new synthesis that focuses on more than the most recent snapshot of a history of life that stretches back almost four billion years.

Kim Sterelny's essay, "Species as Ecological Mosaics," offers a defense of a form of realism about species committed neither to universalism about any species concept or definition nor to any type of species selection. Some (but not all) species form what Sterelny calls *ecological mosaics*; which are made up of ecologically diverse populations of organisms. As structured and diverse metapopulations, such mosaics are subject to evolutionary change when there is an ecological or geographic fracturing of the metapopulation, but they are also stabilized by what he calls *Mayr's Brake*, the mechanisms of reproductive isolation central to Mayr's well-known account of speciation. Sterelny explores this idea through a discussion of Vrba's and Eldredge's views of evolutionary change in which he argues, amongst other things, that those views should be divorced from their authors' own fondness for Paterson's (1985) recognition concept of species. Sterelny's scepticism about universalism and thus monism draws on the claim that, like organisms, species and the complex, ecological organization they possess were invented at some point in evolutionary time, forming a grade of biological organization that, like organismal individuality, only some clusters of biological entities have.

The essays by Richard Boyd, Paul Griffiths, and Rob Wilson in the next section, "Rethinking Natural Kinds," revive the ontological issue of whether species are natural kinds or individuals by offering a reexamination of the notion of a natural kind. Boyd's paper, "Homeostasis, Species, and Higher Taxa," develops the conception of *homeostatic property cluster* (HPC) kinds that he briefly introduced in earlier work (1988, 1991). Here, Boyd both provides the broader philosophical context in which that conception functions and shows how it applies to several issues concerning species. More specifically, he defends the idea that HPC kinds are an integral part of an overall, realist view of science that accommodates the inexactitude, natural

vagueness, and historicity of many sciences, including the biological sciences. He then argues that species and at least some higher taxa are HPC kinds, and indicates how his view makes plausible a form of pluralistic realism. A passing theme in the essay is that in the HPC conception of natural kinds, the contrast between natural kinds and individuals is of less importance than it is in a traditional notion of natural kinds, thus deflating the significance of the individuality thesis about species defended by Hull (1978) and Ghiselin (1974, 1997), and the subsequent debate over it.

My own contribution—"Realism, Essence, and Kind: Resuscitating Species Essentialism?"—takes its cue from Boyd's earlier work on HPC kinds. After outlining how both the individuality thesis about species taxa and pluralism about the species category have been developed because of problems with traditional realism, I use two examples from the taxonomy of neural states to suggest that there is more than merely conceptual space for a view closer to traditional realism than either of these fairly radical proposals. This middle-ground position is a version of the HPC view of natural kinds, and in contrast to Boyd's own development of this view, I argue that this position is incompatible with both the individuality thesis and pluralistic realism. This essay thus steps outside of the philosophy of biology to the philosophy of psychology and neuroscience to shed some light on natural kinds more generally and on realism and pluralism about species in particular.

Griffiths's "Squaring the Circle: Natural Kinds with Historical Essences" looks at the treatment of the notion of natural kinds by a variety of researchers across the biological sciences, including systematists (regarding species taxa) and process structuralists (regarding developmental biology). Griffiths defends the idea that natural kinds can have historical essences, using this idea to address the claim that there are no (or few) laws of nature in the biological sciences. For Griffiths, concepts of taxa and of parts and processes in biology can be based on the idea of an evolutionary rather than a distinctly structural or developmental homology. Griffiths sees phylogenetic inertia and its basis in the developmental structure of organisms as a mechanism for producing what Boyd calls the "causal homeostasis" of natural kinds.

The two papers in the next section, "Species in Mind and Culture," present perspectives on the issues surrounding the psychological and cultural representations of central biological concepts, such as the species concept. In "The Universal Primacy of Generic Species in Folkbiological Taxonomy: Implications for Human Biological, Cultural, and Scientific Evolution", Scott Atran draws on recent cross-cultural experimental research with the Maya in Guatemala and with midwestern urban college students that probes the strength of inductive inferences across various levels of biological categories. Atran has found surprising similarities across these forest-dwelling and urbanized populations that cry out for psychological explanation. He argues for the universality across cultures of what he calls *generic species*, a level of

organization in the biological world that doesn't distinguish the Linnaean species and genus categories; he proposes a domain-specific representation of this category and explores its relationship to essence-based habits of the mind and the cultural development of various species concepts in Western science. Atran concludes his paper with some thoughts about recent views of pluralism and species and about what these views imply about the relation between common sense and science.

Frank Keil and Daniel Richardson discuss the psychological representation of species and of biological knowledge more generally in their essay, "Species, Stuff, and Patterns of Causation." They argue that the substantial developmental literature on biological knowledge often presents a misleading conception of what intuitive or folkbiology must be like in order for species and other biological categories to have the distinctive psychological features that they do, suggesting several new lines of empirical research. By exploring what has been called "psychological essentialism" about biological kinds and its relationship to essentialism in the philosophy of biology, Keil and Richardson call for more careful empirical examination of the nature of our mental representation of the biological world and identify a number of cognitive biases that contribute to what they call the "vivid illusion of species." They claim that although species do seem to have a distinctive psychological representation, the specific form that representation takes remains largely an open empirical question.

The concluding section—"Species Begone!"—contains two essays that, in their own ways, express some skepticism about the *special* reality of species that is the focus of biological and philosophical controversy regarding species (as in "the species problem"). Both authors feel that species are as real as higher taxa, but no more than the genuses, families, orders, and so on that those species constitute. Marc Ereshefsky's "Species and the Linnaean Hierarchy" offers a review of our current thinking about the species category, advocating a replacement of the entire Linnaean system of classification. Ereshefsky questions the distinctive reality of the species category by pointing to the problems in drawing the distinction between species and higher taxa and by using the critiques of monistic accounts of species that motivate pluralism to suggest the heterogeneity of the species category. Because the point of the Linnaean hierarchy and the distinctions that it draws (e.g., between species and higher taxa) has been lost through the Darwinian revolution, our current taxonomic practice creates problems that alternative systems of classification may avoid. Ereshefsky concludes by examining two such systems, though he acknowledges that any change should not be made lightly.

In "Getting Rid of Species?" Brent Mishler explores the application of phylogenetics to species taxa. Like Ereshefsky, Mishler views the Linnaean hierarchy as outdated, and like de Queiroz (1992; cf. de Queiroz, chapter 3 in this volume), he thinks that phylogenetic schemes of classification are necessary. Mishler argues that taxa at all levels, including the least inclusive,

should be recognized because of evidence for monophyly. He believes that the failure of the various species concepts to uniquely define the species rank in the phylogenetic hierarchy reflects reality, thus highlighting the need to get rid of the species rank altogether. Thus, a rank-free phylogenetic taxonomy should be applied consistently to all taxa, including the least inclusive. Mishler concludes by reflecting on the implications of his proposed reform on our ecological thinking about biodiversity and conservation.

REFERENCES

Boyd, R. (1988). How to be a moral realist. In G. Sayre-McCord, ed., *Essays on moral realism.* Ithaca, N.Y.: Cornell University Press.

Boyd, R. (1991). Realism, anti-foundationalism, and the enthusiasm for natural kinds. *Philosophical Studies* 61, 127–148.

Claridge, M., H. Dawah, and M. Wilson (1997). *The units of biodiversity.* London: Chapman and Hall.

de Queiroz, K. (1992). Phylogenetic definitions and taxonomic philosophy. *Biology and Philosophy* 7, 295–313.

de Queiroz, K. (1998). The general lineage concept of species, species criteria, and the process of speciation: A conceptual unification and terminological recommendations." In Howard and Berlocher.

Dupré, J. (1993). *The disorder of things: Philosophical foundations for the disunity of science.* Cambridge, Mass.: Harvard University Press.

Ereshefsky, M. (1992a). Eliminative pluralism. *Philosophy of Science,* 59, 671–690.

Ereshefsky, M., ed. (1992b). *The units of evolution: Essays on the nature of species.* Cambridge, Mass.: MIT Press.

Ghiselin, M. (1974). A radical solution to the species problem. *Systematic Zoology* 23, 536–544. Reprinted in Ereshefsky 1992b.

Ghiselin, M. (1997). *Metaphysics and the origins of species.* Albany, N.Y.: SUNY Press.

Howard, D. J., and S. H. Berlocher, eds. (1998). *Endless forms: Species and speciation.* Oxford: Oxford University Press.

Hull, D. (1976). Are species really individuals? *Systematic Zoology* 25, 174–191.

Hull, D. (1978). A matter of individuality. *Philosophy of Science* 45, 335–360. Reprinted in Ereshefsky 1992b.

Hull, D. (1997). The ideal species definition and why we can't get it. In Claridge, Dawah, and Wilson.

Kitcher, P. (1984). Species. *Philosophy of Science* 51, 308–333. Reprinted in Ereshefsky 1992b.

Lambert, D., and H. Spence, eds. (1995). *Speciation and the recognition concept.* Baltimore: Johns Hopkins University Press.

Mayden, J. (1997). A hierarchy of species concepts: The denouement in the saga of the species problem. In Claridge, Dawah, and Wilson.

Otte, D., and J. Endler, ed. (1989). *Speciation and its consequences.* Sunderland, Mass.: Sinauer.

Paterson, H. (1985). The recognition concept of species. In E. Vrba (ed.) Species and Speciation. Pretoria: Transvial Museum Monograph No. 4. Reprinted in Ereshefsky 1992b and Paterson 1994.

Paterson, H. (1994). *Evolution and the recognition concept of species: Collected writings*. Baltimore: Johns Hopkins University Press.

Stanford, K. (1995). For pluralism and against monism about species. *Philosophy of Science* 62, 70–91.

Wheeler, Q., and R. Meier, eds. (1999). *Species concepts and phylogenetic theory: A debate*. New York: Columbia University Press.