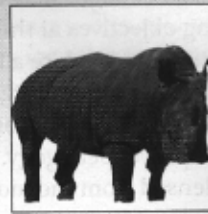


Preface



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Animal Diversity is tailored for the restrictive requirements of a one-semester or one-quarter course in zoology, and is appropriate for both nonscience and science majors of varying backgrounds. This eighth edition of *Animal Diversity* presents a survey of the animal kingdom with emphasis on diversity, evolutionary relationships, functional adaptations, and environmental interactions.

Organization and Coverage

The sixteen survey chapters of animal diversity are prefaced by four chapters presenting the principles of evolution, ecology, animal architecture, and taxonomy. Throughout this revision, we updated references and worked to improve pedagogy.

Chapter 1 begins with a brief explanation of the scientific method—what science is (and what it is not)—and then introduces evolutionary principles. Following a historical account of Charles Darwin's life and discoveries, we present the five major components of Darwin's evolutionary theory, the important challenges and revisions to his theory, and an assessment of its current scientific status. This approach reflects our understanding that Darwinism is a composite theory whose component parts guide active research and can be modified by new discoveries. It also prepares the student to dismiss the arguments of creationists who misconstrue scientific challenges to Darwinism as contradictions to the validity of organic evolution. The chapter summarizes the major principles of molecular genetics, population genetics, and macroevolution.

Chapter 2 explains the principles of ecology, with emphasis on populations, community ecology, and variations in the life-history strategies of natural populations. The treatment includes discussions of niche, population growth and its regulation, limits to growth, competition, energy flow, nutrient cycles, and extinction.

Chapter 3, on animal architecture, is a short but important chapter that describes the organization and development of the body plans that distinguish major groups of animals. This chapter includes a picture essay of tissue types and a section

explaining important developmental processes responsible for the evolutionary diversification of the bilateral animals.

Chapter 4 treats taxonomy and phylogeny of animals. We present a brief history of how animal diversity has been organized for systematic study, emphasizing current use of Darwin's theory of common descent as the major principle underlying animal taxonomy. Our summary of continuing controversies over concepts of species and higher taxa includes discussion of how alternative taxonomic philosophies guide our study of evolution. We give special attention to phylogenetic systematics (cladistics) and the interpretation of cladograms. Chapter 4 also emphasizes that current issues in ecology and conservation biology depend upon our taxonomic system.

The sixteen survey chapters provide comprehensive, current, and thoroughly researched coverage of the animal phyla in the context of eukaryotic diversity and evolution. We emphasize the unifying phylogenetic, architectural, and functional themes of each group, and illustrate them with detailed coverage of representative forms. Each chapter includes succinct statements of the diagnostic characteristics and major subgroups of the focal taxa. Discussions of phylogenetic relationships take a cladistic viewpoint, with cladograms showing the structure of each group's history and the origin of the principal shared derived characters. Phylogenetic trees add temporal evolutionary hypotheses to the cladistic analyses.

Changes in the Eighth Edition

We continue in updated form the major new structural feature of the previous two editions: a cladogram depicting phylogenetic relationships among animal taxa appears in the inside front cover and serves to order our coverage of animal diversity in Chapters 5–20. The reformatted cladogram from the inside front cover appears in small form at the start of each taxonomic chapter, with the chapter's taxonomic coverage highlighted on it. Following our seventh edition, two phyla were merged with others, reducing the number of phyla from 34 to 32. Sipuncula is now placed within Annelida, and Xenoturbellida is merged

with Acoelomorpha to form the new taxon Xenacoelomorpha. Our summary cladogram is adjusted accordingly.

A major new feature of the eighth edition is a list of learning objectives at the start of each chapter. These objectives help students to place a chapter's detailed information into the context of its major organizing principles.

Many revisions to the eighth edition are primarily to improve pedagogy. The content of *Animal Diversity* is condensed from the more comprehensive textbook, *Integrated Principles of Zoology*. The recently completed seventeenth edition of *Integrated Principles of Zoology* was guided by an electronic tabulation of students' responses to questions linked to the book. Authors received a "heat map" showing for each paragraph the percentage of correct student responses for the material covered. We focused our revisions on improving explanations wherever the heat map showed that correct responses were below 50%. With this detailed and insightful guidance, we made our text more accessible and memorable to its readers. We import these pedagogical improvements from the seventeenth edition of *Integrated Principles of Zoology* to the corresponding sections of the eighth edition of *Animal Diversity*.

Most of these revisions comprise more detailed explanations, including new illustrative examples. For example, to reinforce the statement in Chapter 1 that Charles Lyell's geological studies convinced him that earth's age must be measured in hundreds of millions of years, we add the supporting information "For example, as skeletal remains of corals, foraminiferans, and mollusks accumulate on the sea floor, they form sediments of calcium carbonate that eventually become compressed into limestone. Measured rates of sedimentation are much too slow to have produced earth's sedimentary rock formations in a shorter period of time." Potassium-argon dating of rock strata was another point that required some further explanation to be fully accessible, "to our explanation in Chapter 1 we added". "Argon is a noble gas that evaporates from liquid media. It accumulates in the crystal structure of rock only after the rock has solidified and the nuclear decay of potassium-40 produces a trapped atom of argon." Comparable changes occur throughout our eighth edition.

Additional changes to Chapter 1 include greater explanation of adaptive radiation in oceanic islands and in lakes. The classic example of adaptive radiation of Galápagos finches is updated to include new information that questions whether the ecologically discrete forms are in fact discrete species, as traditionally interpreted, or whether they are alternative developmental modes that constitute polymorphisms within a set of genetically connected, geographic populations. To illustrate punctuated equilibrium, we replace an earlier example that was not well understood by students with the best-documented case: evolutionary history of the ectoprost genera *Metrarhabetos* and *Stylopoma* in the Caribbean Sea. We reorder and expand our coverage of microevolutionary processes under a new heading "Forces of Evolutionary Change" near the end of Chapter 1.

Revisions to Chapter 2 include a greater emphasis on process of inquiry, explaining that "population" and "metapopulation" constitute conceptual models that investigators use to

measure distributions and abundances of diverse organisms. We increase consistency in terminology; for example, we use "sigmoid" rather than a mix of "sigmoid" and "logistic" in text discussions of population growth, while explaining the relationship between these concepts in a boxed essay. Likewise, use of "abundance" rather than "fitness" in some places avoids confounding the ecological concept with population-genetic "fitness" as discussed in Chapter 1. We expand the explanation of how primary producers fix carbon and nitrogen from atmospheric gases, following evidence from our heat map that this concept often is not an intuitive one.

In Chapters 3 and 4, many revisions increase precision and consistency in key concepts. For example, "cytoplasmic" replaces the more nebulous term "protoplasmic" in Chapter 3, and references to current taxonomic groups replace the now archaic terms "protozoan" and "metazoan." Chapter 4 makes a stronger distinction between "classification" and "taxonomy" as central concepts. Chapter 4 also expands examples drawn from human evolution and the salamander genus *Ensatina* to illustrate the main issues that separate contrasting concepts of the species category. In asking how contrasting concepts of species would yield different species-level taxonomies of *Ensatina* populations, we lead students through the actual debates from relevant literature. Revisions clarify the relationship between the key phylogenetic concepts of clade and synapomorphy; definition of a clade makes no reference to synapomorphy, but synapomorphy is critical for testing the hypothesis that a particular grouping of species constitutes a clade. The explanation of evolutionary taxonomy is revised to emphasize that it retains pre-evolutionary Linnaean taxonomic principles that cladistic taxonomy rejects. Subsections "Major Divisions of Life" and "Major Subdivisions of the Animal Kingdom" are greatly rewritten, replacing archaic schemes (such as Whittaker's five kingdoms) with newer rank-free taxonomies that follow cladistic principles and current molecular phylogenetic results.

The remaining chapters cover the details of animal evolutionary origins and diversification using the theoretical framework presented in Chapters 1-4. In each case, updates to species diversity and taxonomic relationships replace earlier hypotheses that new data have rejected. New opening essays for Chapters 5 and 6 reflect new ideas on the origin of the eukaryotic cell and the advent of multicellularity, respectively. Chapter 7 presents a new phylogenetic hypothesis for parasitic cnidarians of the clade Myxozoa. Chapter 8 now includes coverage and illustrations of the new taxon Xenacoelomorpha, consolidating some material on the former Xenoturbellida from Chapter 14. A new cladogram in Chapter 11 illustrates new phylogenetic results that place Sipuncula within Annelida.

Updates to Chapter 14 include new hypotheses on early evolution of deuterostomes and of echinoderms, with correspondingly revised cladograms. Revisions to Chapter 15 update phylogenies for the early chordates and fishes using new paleontological results. Coverage of the role of *Hox* genes is reduced following rejection of some earlier hypotheses that overestimated their roles in chordate evolutionary diversification, and coverage of paraphyly of the traditional Class Reptilia is

consolidated with related material in Chapter 18. Changes to Chapter 16 include extensive replacement of photographs with improved ones, plus a new figure describing aestivation in lungfishes. Changes to the narrative on the origin of terrestrial vertebrates in Chapter 17 emphasize that this was a fortuitous rather than a directed, progressive process. Chapter 18 incorporates new information on early events in turtle evolution, and Chapter 19 updates the species inventory and taxonomy of birds. In Chapter 20, early diversification of mammals is revised in light of data rejecting the hypothesis that most mammal groups arose after the end-Cretaceous mass extinction. Chapter 20 also includes an expanded and clarified discussion of mammalian feeding specializations, and incorporation of new fossil finds in understanding human evolution. Some material formerly included on density-dependent versus density-independent control of mammal populations is now consolidated with coverage of that topic in Chapter 2.

Teaching and Learning Aids

Vocabulary Development

Key words are boldfaced, which serves as a cross-reference to the glossary for definition, pronunciation, and derivation of each term. Derivations of generic names of animals are given where they first appear in the text. In addition, derivations of many technical and zoological terms are provided, allowing students to recognize the more common roots that recur in many technical terms.

Learning Objectives

Each chapter begins with a list of learning objectives that identify the major organizing principles of the chapter. Students enhance their understanding by using these guiding principles as they read a chapter's detailed material.

Chapter Prologues

A distinctive feature of this text is an opening essay at the beginning of each chapter. Each essay presents a theme or topic relating to the subject of the chapter to stimulate interest. Some present biological, particularly evolutionary, principles; others illuminate distinguishing characteristics of the animal group treated in the chapter.

Chapter Notes

Chapter notes, which appear throughout the book, augment the text material and offer interesting sidelights without interrupting the narrative.

For Review

Each chapter ends with a concise summary, review questions, and a list of annotated selected references. The review questions enable students to test themselves for retention and understanding of the more important chapter material.

Art Program

The appearance and usefulness of this text are much enhanced by numerous full-color paintings by William C. Ober and Claire W. Garrison. Bill's artistic skills, knowledge of biology, and experience gained from an earlier career as a practicing physician have enriched the authors' zoology texts through many editions. Claire practiced pediatric and obstetric nursing before turning to scientific illustration as a full-time career. Texts illustrated by Bill and Claire have received national recognition and won awards from the Association of Medical Illustrators, American Institute of Graphic Arts, Chicago Book Clinic, Pfaffing Industries of America, and Bookbuilders West. Bill and Claire also are recipients of the Art Directors Award.

Supplements

Instructor's Manual

Each chapter of the Instructor's Manual provides a detailed chapter outline, lecture enrichment suggestions, a commentary, and critical thinking questions. This material should be particularly helpful for first-time users of the text, although experienced teachers also may find much of value. The Instructor's Manual is available on this text's Online Learning Center through Connect.

Acknowledgments

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