Preface

BOB GOLDSTEIN
Department of Biology and Lineberger Comprehensive Cancer Center,
The University of North Carolina at Chapel Hill, Chapel Hill, NC,
United States

MANSI SRIVASTAVA
Department of Organismic and Evolutionary Biology, Museum of
Comparative Zoology, Harvard University, Cambridge, MA,
United States

A full understanding of the biological principles upon which life operates requires the study of diverse systems. Prior to the establishment of “model” organisms in the 20th century, biologists worked on diverse species— whatever they could get their hands on, be it in their backyards or from the sea at marine stations.

The focus on model organisms such as fruit flies (Drosophila melanogaster), nematodes (Caenorhabditis elegans), zebrafish (Danio rerio), and mice (Mus musculus) has revealed many of the fundamental principles upon which genomes, genes, cells, and embryos operate. This work has also generated rigorous experimental and analytical frameworks as well as new tools and resources, which have enabled scientists once again to venture out to explore diverse research organisms. This apparent hourglass shape of species used in laboratory research over time leaves us at an exciting moment in biological research.

New or long-neglected research organisms offer some special opportunities. They allow us to study the mechanisms for biological processes that cannot be studied in well-established model systems. For example, model organisms like flies, nematodes, or mice lack extensive regeneration or pluripotent stem cells in adults, but these features are widespread across the tree of animal life. Additionally, even for processes that can be studied in established model systems, sampling of species from varied branches across the tree of life is necessary to build a thorough understanding of how life works. For example, although all animals make germ cells, studying germline formation only in flies and vertebrates is not sufficient to make inferences about the shared molecular/cellular principles or the evolution of germline formation. Comparative studies involving diverse species, or species in key phylogenetic positions, are foundational for evolutionary developmental biology (evo-devo).

Our objective in putting together this volume was to highlight a growing panel of research organisms that can illustrate different values that studying a new system brings to a field of study. We invited as authors some of the people who played central roles in the emergence of these model systems, and we encouraged them to tell their origin stories, i.e., the scientists’ personal journeys to the model systems. We gave the authors great flexibility in the length and format of their contributions, and, therefore, the chapters themselves are diverse in style.

Some authors have focused on explaining the system and the questions that the species they study can address; other authors have provided a narrative of their own journeys in seeking and establishing or reestablishing a new system; and some authors have contributed chapters that represent a combination of these two approaches.

This volume is by no means a comprehensive catalog of all new and exciting systems. We appreciate that there are many more emerging model organisms than we could fit in a volume and that other scientists will have other origin stories for their own work on those organisms and indeed on some of the organisms represented here, in cases where multiple scientists made major contributions to developing an emerging model.

We expect that the chapters in this volume will serve many functions. The chapters can be resources and potential inspiration for young trainees looking to undertake studies in nontraditional model systems. They can also serve as tools for educating funding agencies and reviewers about the value of these systems. The species covered by these chapters were chosen to show the phylogenetic breadth across which biologists are pursuing new systems in developmental biology and in some neighboring fields. These chapters should provide a definitive and formal introduction (or reintroduction in some cases) to some of the model systems that are poised to answer major questions in developmental biology and beyond.