Preface

Interest in the bold and brilliant colors of birds comes naturally. Like birds, but unlike most other mammals, humans are visual animals. We think visually; we express ourselves visually; we respond strongly to visual stimuli. Much more than the family dog or cat, we are struck by the vivid scarlet wings of a Ross's Lourie or the iridescent blue chest of a Fork-tailed Woodnymph. To wonder how and why birds should display such pleasing coloration is inescapable.

Interest in the colorful displays of birds has followed an interesting cycle over the past 150 years, from an initial focus on evolution and function by Darwin and Wallace, to an almost exclusive focus on mechanistic control through the first three-quarters of the twentieth century, and back to a focus on function and evolution with relatively little interest in mechanisms through the last quarter of the century. At the close of the twentieth century and into first few years of the new millennium, a more balanced approach to the study of bird color displays is emerging. It has become clear to scientists interested in bird coloration that a firm understanding of function and evolution can only be achieved through an understanding of the mechanistic basis for coloration, and likewise that the mechanisms of avian coloration can only be fully understood in the context of their function and evolution. An approach combining the studies of proximate control, function, and evolution is becoming the paradigm in research on bird coloration. Thus it is fitting that the first of our two volumes on bird coloration is a thorough review of the measurement, analysis, and mechanisms of avian color displays.

The mechanistic basis of the color displays of animals was nicely summarized in several books in the mid-twentieth century (Fox and Vevers 1960; Needham 1974; Fox 1976), but breakthroughs in melanin and carotenoid analytical techniques and a new theoretical and microscopic approach to the study of the nanostructural basis of nonpigment colors have left these reviews of color mechanisms long out of date. Light environment was rarely considered before John Endler took up the topic in detail in the late 1980s, so this line of research represents an entirely new topic since previous reviews of the proximate control of bird coloration were written. Likewise, avian perception, and particularly the importance of the ultraviolet vision in birds, is a new topic, not previously incorporated into comprehensive reviews of avian coloration.

Not only do we know more about the pigments and the structural mechanisms involved in color displays, but the tools for studying bird colors have improved tremendously in the past two decades. Quantification of color displays with subjective rankings or by visual comparison to color plates has given way to accurate spectrometric techniques that now routinely include the ultraviolet portion of the spectrum that is part of the perceptual world of birds. New and better means to analyze spectral data are also now available. New mathematical models have been developed to account for the light environment and the visual sensitivity of intended receivers when quantifying color. Since the topic was last comprehensively reviewed, many experiments have been conducted exploring the role of genes and the environment in shaping color expression, and bird colors have emerged as a model system in behavioral ecology for understanding how different types of sexual signals may communicate different sets of information about an individual.

The need for a review and synthesis of this tremendous and growing literature on avian coloration was clear, but the task was too big to be undertaken by a single author or pair of authors. So we solicited the aid of the world's leading experts on avian coloration to summarize the current state of knowledge. From the outset, we intended this to be an edited volume that was tightly structured. We began with a table of contents of the topics that we thought were most important to be covered in such a review and then searched for leading experts on each topic to write the chapters. The authors were instructed to create a thorough synthetic review of their topic, rather than a showcase of their own research programs. The result is a comprehensive review of the literature on avian coloration. Originally we intended one volume to include measures, mechanisms, function, and evolution, but with comprehensive treatment of topics came large chapters and a manuscript too long for one volume.

The topics fell naturally into two volumes, however, and nothing of our original goal was sacrificed when we divided one long manuscript into two more manageable parts.

We divided this volume into three sections. The first section, on perception and measurement, provides the necessary background for the studies of avian coloration. The second section of the book focuses on the mechanisms of production. Chapters in this section review the pigment literature and approaches to studying the mechanisms by which nanostructures produce coloration. The third section of the book considers factors that control color expression. Here the effects of genes, environment, and hormonal control, which connects genetic and environmental effects, are discussed as a prelude to considerations of trait function. We are now at the inception of studies that map color traits onto avian genomes, and the potential for such gene mapping on the study of ornamental coloration is enormous.

It is truly an exciting time to be studying avian coloration. We hope that this book serves as a basic reference for a broad range of topics related to bird coloration, and that it will act to stimulate new studies to fill gaps in our current understanding of the proximate controls of the brilliant, striking, and varied color displays of birds.

References

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