
Presentation

The world is a colorful place whether you are watching damselfish darting about a coral reef, butterflies sipping nectar from flowers, or courtship displays of birds of paradise. Most of us accept a colorful world without question. Our earliest memories include color as one of many features of that memorable event, but why is color ubiquitous? Why are birds so colorful? Why are some colors more common than others? Why is there little variation in the color of some features, for example the dark feathers of the wing tips, and riotous variation in the color and pattern of other features, for example the head which may have eye rings, eye lines, eyebrow stripes, crown patches that can be hidden or exposed, moustache marks, contrastingly colored lores or throat, some of these marks, all of them or none of them. How did all this color and variation come to be? That is the subject of Dr. Senar's research and of this concise, thought-provoking book.

Studies of avian color are numerous and Dr. Senar does an excellent job of distilling the core concepts from the vast literature, but his book is more than a distillation supported by fascinating examples. Dr. Senar introduces the reader to the process of science; the anatomy, development, and terminology of feathers; and the measurement of color and pattern. Equipped with this basic knowledge the reader is invited to consider the different hypotheses that have been suggested to explain color. Dr. Senar describes the color and pattern, poses the question, and the reader has an opportunity to pause and think about the potential function of the color and pattern, to anticipate the observations and experimental manipulations that led ornithologists to our current understanding of, for example, the Swallow's (*Hirundo rustica*) tail spots and streamers or the variation in the ultraviolet reflectance of the Blue Tit's (*Parus cerulea*) crown feathers. This makes the book exciting to read and ponder. Dr. Senar has succeeded in bringing the reader into the scientific process, into the ongoing discussion, the exchange of ideas, and into the shared excitement that attends science.

Dr. Senar provides a brief overview of what I consider the structural and physiological functions of color. These functions depend on the chemical properties of melanins, carotenes, and porphyrins. The predicted patterns of color reflect underlying structural and physiological needs of the organism. For example, abrasion by airborne particles can severely damage flight feathers between molts. Since feathers with melanin are more resistant to abrasion by airborne particles, the flight feathers of most birds are melanic, which turns them black or dark brown.

The heart of the book is the transmission of signals by the color and pattern of color. As most research, including that of Dr. Senar, has dealt with color as a signal, focus on this aspect is appropriate and exciting. Birds, like us, are visual animals and their colors and patterns of color are used to express dominance, attract mates, and repel rivals.

Evolution is the process by which signals appear and are elaborated, but the question is what were and are the selective forces that led to particular colors and patterns, not only within species, for example the black bib of the House Sparrow (*Passer domestica*), but also within families or more broadly, for example the light colored spots that occur on the outer tail feathers of many species of birds. Dr. Senar not only explains the methods and results of experiments so that the reader can compare his or her interpretation with

that of the scientists, but he also raises alternative hypotheses. For example, are so-called dominance signals simply correlations with age and sex, which are also correlated with dominance? And what of cheating, signals that exaggerate the owner's status? Presentation of the alternatives gives the reader a chance to appreciate the complexity of the selective forces and the difficulty of designing clean, conclusive experiments. Similarly Dr. Senar presents the many hypotheses that address sexual selection and delayed plumage maturity thereby enriching the reader's understanding of the topics and appreciation of the elegant experiments that have been used to tease apart some of the hypotheses. Camouflage is considered in a separate chapter, but Dr. Senar addresses not only colors of the prey, which are the subject of much study, but also the color of predators, which is far less studied. Consideration of color as a bioindicator is a novel approach advocated toward the close of the book. This is the first time I have been asked to consider this possibility, but, as Dr. Senar points out, if birds assess the quality of the habitat by the color of the potential mate which occupies the habitat, then certainly we should be able to measure habitat quality by similar means. As throughout the book, Dr. Senar describes experiments that allow the reader to evaluate this approach.

The book closes with an eloquent plea to remember that the colors and patterns of color are more than the sum of the hypotheses, that the selective forces interact to produce colors and patterns that are a compromise, that reductionism as represented by individual hypotheses and experiments needs to be grounded in consideration of the totality of color and pattern and the many different, often conflicting functions that avian colors must perform throughout the life of the bird.

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