MARINE HISTORICAL ECOLOGY IN CONSERVATION: APPLYING THE PAST TO MANAGE FOR THE FUTURE

Kittinger, J.N., McClenachan, L.M., Gedan, K.B. & Blight, L.K. (Eds.). 2014. Berkeley, CA: University of California Press, 312 pp. Hard cover ISBN 978-0-520-27694-9, e-book ISBN 978-0-520-95960-6. US$45.

Shifting baselines (Dasmann 1988, Pauly 1995) are what most ecologists work to ignore, albeit unconsciously, in striving to make their work immediately relevant. They are what many resource exploiters work to hide, for obvious reasons. But they are also what "conservationists" work to reveal. If there is an actual field of "restoration ecology" or "conservation biology" that differs from "ecology," then identifying how ecological baselines have shifted is an absolute requirement, whether by analyzing proxy data sets (e.g., ice and sediment cores, tree rings), ancient people's middens and myths, animal middens, museum collections, print and photograph archives, long-term data sets conducted by "proper" science, and, yes, anecdotes judiciously reviewed. One has to know what was lost, before anything can be restored!

Modern ecology took form in the 1950–1960s, led by the ideas in Odum's *Fundamentals of Ecology* (1953) or Elton's *The Ecology of Invasions by Plants and Animals* (1958). University ecology departments soon began to appear like the blooming of spring wildflowers, but students, and their instructors, then and even now learned their ecology in ecosystems that had been devoid of top or mesopredators for decades, even centuries. Perceptions of community ecology and even species' ecology were unknowingly warped. More recently, however, time series have saved us, with many of these begun at about the time of the first Earth Day in 1970. Hairston *et al*. (1960) introduced the "green world hypothesis," questioning why the terrestrial Earth is green. This question remained unanswered until somewhat recently, when a long-term experiment proved the critical ecosystem services offered by animals of upper trophic levels as they structured food webs through downward pressure (e.g., Terborgh *et al.* 2006, Prugh *et al*. 2009). Such a concept is even being extended to the oceans, thought until recently to be too vast to be structured other than by production (e.g., Jackson *et al*. 2001, Estes *et al*. 2011) or to be altered by humans (e.g., Pauly *et al*. 1998, Hutchings 2001, Halpern *et al*. 2008). Even the remote Antarctic has not been immune, given the loss of a million whales and, concomitantly, their prey (Ballance *et al*. 2006, Nicol *et al*. 2010, Willis 2014), followed by the benthic fishes (Ainley & Pauly 2014).

The emergence of ecology brought us not just the first Earth Day, but also burgeoning efforts to start and maintain methodical time series to measure man's influence on the natural world, including its marine component. More recently, as restoration efforts bear fruit, some seabird biologists are acquiring a new appreciation of marine food web structuring, although learning it the hard way. For instance, as coastal eagles *Haliaeetus* spp. return from their near extirpation in the 1960s, numerous long-present seabird colonies—researched and monitored to assess their "health" or that of the ocean they exploit (!)—have begun to decrease and disappear. This has been the result of either fear of predation ("the ecology of fear") or of outright consumption by the eagles (Hipfner *et al.* 2012). In some instances, we are now blaming seabirds themselves for eating too much in systems we are trying to conserve, e.g., the Columbia River salmon. Wow, has this "systems ecology" turned out to be complex or what?!

Thus, not only must we ask what to restore, as we consider diminished habitats and species numbers, but consider what portion of a given time series is useful in deducing how to do so. How far in time should we go back? What sources of data exist? These are the sorts of questions that are integral to Kittinger *et al.*'s *Marine Historical Ecology in Conservation: Applying the Past to Manage for the Future,* which is a place to start to read and then think about addressing these questions, especially if you consider yourself on the "management" side of conservation. The book is all about how various time series provide perspective on restoration of broken marine ecosystems (or just on conservation of their present state), and how to use these time series.

On the one hand, there is not a lot in this book specifically about seabirds, other than some text by one of the authors and editors, Louise Blight, who investigated changes in the natural history of Glaucous-winged Gull *Larus glaucescens* over the past 100 years (Blight 2012), and a review by Heike Lotze of century-long changes in several European coastal seabird populations. On the other hand, what you will find is a huge amount of detail on how human use, including the removal of upper level predators and grazers, has degraded various coastal ecosystems, such as rocky and coral reefs or shallow bays and estuaries. These are the sources of much of the food of coastal seabirds, and have been for millennia, often in the form of the pelagic juveniles of large, benthic predatory fishes. Their removal has provided a much-altered view of the food webs that feed seabirds and that biologists measure (Ainley & Blight 2009; e.g., Paleczny *et al*. 2015 for a more direct connection between seabirds and their diminishing food). More importantly, though, you will read about efforts, sometimes quite successful, to use "conservation ecology" to restore species and habitats. You will also read about the steps to achieve that success, beginning with identifying the altered baselines. Kittinger *et al*. not only provide North American examples, but also include examples from Asia and Africa, the Caribbean, and the mid-Pacific. One area not covered is the long time series fully documenting the demise of Southern Ocean whales, and the enactment of two major international treaties to foster their recovery, which after several decades is beginning to show signs of success (Hofman 2016). The recovery of Antarctic benthic fish stocks has also been incredibly slow, even after several decades of prohibited exploitation (Barrera-Oro *et al*. 2017). The lesson in these two examples is that the field of "restoration ecology" requires its practitioners to have a huge amount of patience, a message that Kittinger *et al*. do not necessarily shirk.

This book, with a foreword by Daniel Pauly, has 12 chapters organized into four parts: (1) Recovering endangered species (ideal for biologging, the current "rage"), (2) Conserving fisheries (seabirds' food), (3) Restoring ecosystems (making them more resilient to a multitude of negative factors), and (4) Engaging the public. The latter is needed if efforts detailed in the first three sections have any chance for success, regardless of the scientific basis. Within each chapter—which in many cases is a review of the need for and success in restoration of coastal and reef ecosystems and species—are sidebars called "Viewpoints from a Practitioner." These are written by people such as national marine sanctuary, reserve, or fishery managers, and provide real-life experiences relevant to the chapter's message. Also included in the chapters are descriptions of how long-term baselines were tallied, and how they can be analyzed or assembled to support the argument, to convince the all-important public—including other stakeholders and scientists—that steps for restoration or conservation need to be made—and, critically, financed—within the context of society's myriad problems. Each chapter has a complete reference list, and the book ends with an index covering all chapters, thus helping in the integration of the thoughts expressed throughout the book.

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LONG HOPS: MAKING SENSE OF BIRD MIGRATION

Denny, M. 2016. Honolulu, HI: University of Hawaii Press. 241 pp., 67 black and white, 13 color illustrations. Paperback: ISBN 978-0-8248-6630-3, $26.97, and e-book edition $19.99.

This is the best book I have ever read on bird migration. Mark Denny summarizes all aspects of bird migration, starting with why birds migrate and ending with the evolution of migration. This book is for both the scientist researching migration and the layperson who is interested in migration.

Denny's book covers migration research throughout the world—both in the lab and in the field—with seven information-packed chapters and excellent explanatory diagrams. He is a physicist by training, and this may be why his explanations of flight and hypotheses about how birds can migrate are so well explained. He covers plate tectonics (which explains migration paths of different species' populations), magnetism, trade winds, polarized light, the physics of thermals, wing design, great-circle routes, the Coriolis effect, the effect of the tilt of Earth's axis (there would be no seasonal migration without it), power versus distance approaches of flight, as well as the importance of fat for migration. In short, this is the Unified Field Theory of Bird Migration.

Many seabirds undertake long, often non-stop, migrations, and the details in this book will enable researchers to refine their questions and even modify their methods. The general public will gain not only a broad overview of why birds migrate and how they might accomplish migration, but also some basic physics concepts of flight, which are explained in a very accessible way.

At the end of the book there is an excellent "Technical Approach" outlining the physics of bird flight, which is the best summary I have ever seen, complete with mathematical formulas (for those who care). The end notes for each chapter cover 18 pages, further explaining concepts introduced in each chapter. There are two glossaries—one of bird names and one of terms the reader might not be familiar with.

You can pick up this book, put it down, and then continue the idea of migration with no interruption in thought, and you can also just open the book to a random page and start reading—it is that good. Denny also writes with humor, while presenting difficult facts or raising questions you never thought to ask. In the Introduction, he questions why writing "*Birds migrate by flying above sea level*" would not suffice because the reader might conclude that (1) not all birds migrate, (2) of those that do migrate, not all fly, and (3) of birds that migrate by flying, not all do so above sea level. And then he states that the last two points probably raise questions in the reader's mind. This immediately makes one want to read the entire book to find the answers. He also has good tangents, like using a computer simulation model to answer the question *Why does a chicken cross the road?* and says, "Stay with me—I am not being entirely frivolous." He then goes on to explain beautifully why the chicken might do that.

The figures and graphs in each chapter are well laid out, with detailed explanations, and enhance the facts in each chapter. His physics background allows him to play with ideas and present things such as altitude switching in migration—perhaps something that the reader has never considered.

Chapter One, Migration, starts with four simple questions: Who, Why, Where, and When, and the answers are drawn from many different studies of bird migration. He brings up site and route fidelity, altitudinal migration, irruptions, food and territory availability, predator and disease avoidance, genetics, molting, and environmental changes, and illustrates with examples of lab and field research.

Chapter Two, How We Study Migration, starts with research from Aristotle to Linnaeus, and continues through the 21st century. Subjects he brings up include biases in counting; sampling methods (using yet another easy-to-understand simulation); and use of telemetry, satellite tracking, and geologgers. These subjects are accompanied by very good figures and graphs, explanations of how each works, and their drawbacks and advantages.

Chapter Three is simply How Birds Fly. This is where the reader learns exactly how airplanes fly, and how bird flight is similar and how it differs. Denny covers evolution and adaptation, types of wings and flight power, energy, and patterns. He provides good descriptions of how thermals—and wind in general—work on the planet.

Chapter Four, The Birds' Earth, is the chapter that puts migratory flight in the physical context in which migration occurs, and how physical forces of our planet work. He starts with astronomy—how Earth orbits the sun and what this means for birds. The physics of the atmosphere also factor into migration, including polarization of light, winds, and looking at the planet as a globe and not as a Mercator projection. Denny makes clear how magnetism and plate tectonics influence patterns of bird migration.

Chapter Five, Maps and Compasses, describes ways to get from Point A to Point B via various methods, e.g., piloting ("entry-level strategy") and dead reckoning. Denny gives examples of dead reckoning algorithms using landmarks and ability to know directions, and describes how some birds, often juveniles, have some of this genetically built in. Piloting demands "more processing," better memory, a compass, and a clock. He supplements the differences among these methods with good graphs and pencil-simulations that the reader can try. He also suggests how use of different methods can be tested.

Denny further clarifies differences between orientation and true navigation—ideas that many readers may not have considered. In this chapter, he touches on bird senses such as vision and hearing. The section explaining various compasses, including sun, star, and polarized light compasses, as well as magnetic inclination and magnetic polarity compasses. All of these explanations include examples from research worldwide. Denny also alludes to possible use of quantum mechanics by birds.

Chapter Six, Long Migratory Journeys, summarizes different kinds of migration by a myriad of species worldwide, summarizing differences between short and long hops, and how some species divide up long hops into short stages. Denny's main point is that there is huge variety of how birds migrate and their migratory habitats—both on the winter and breeding grounds and during migration. The bottom line for long-distance migrants, of which seabirds are a large group, is that they need to stockpile a large fuel load, to navigate (thus needing both a map and a compass), and to figure out timing (e.g., when to start and how to adjust for adverse conditions and still make the goal). Speed, altitude, meteorological conditions, and presence of predators all force migrants to make adjustments in their flight paths.

Chapter Seven, Migration Evolution, cycles back to Chapter One, briefly recalling how ice sheets and plate tectonics have influenced current routes. Denny also looks ahead in this chapter to how migration might change, given the many shifts that the planet is going through. He summarizes variation in migration types and adaptation, including detours, giving yet again a pencil-simulation that the reader can try to find the optimum route for a bird. Denny finishes the chapter with the necessary comments on Climate Change and how this will probably affect migration in the future. A parting comment is that the observation of migrating birds today is “the observation of the survivors—the rest are not here to tell their sorry tale.” The takeaway message is that some species will adapt and survive, no matter what.

Denny finishes the book (Summary and Further Thoughts) with a series of rhetorical questions that one should return to time and again. Examples are (1) suppose that there exists a planet exactly like Earth but with no axial tilt, (2) what is “home” for a migrant—the winter or summer grounds—and why they are not necessarily symmetrical, (3) what birds can see that we cannot and how this affects their migration, (4) how many birds drown while on over-ocean migration, and (5) why migration is expressed genetically. He ends the book with a vignette that perhaps only a Monty Python aficionado will appreciate: of a man pulling into his driveway in an Aston Martin One-77. You will have to read the book to find out how this is connected to bird migration.

The reason this book works so well—and why I think that it is the best and most definitive book on migration—is that Mark Denny is a physicist with a strong interest in birds. He wants people to understand the multitude of complexities in bird migration, while explaining how these interact and how they have enabled birds to become the planet’s supreme nomads.

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