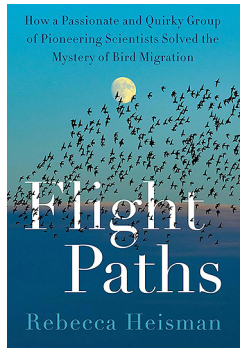
Ornithology

Flight Paths: How a Passionate and Quirky Group of Pioneering Scientists Solved the Mystery of Bird Migration

By Rebecca Heisman. 2023. HarperCollins. 288 pages, 37.00 CAD, Hardcover, 18.99 CAD, E-book.



In the last few decades an explosion of new technologies has resulted in stunning revelations about bird migration and, subsequently, more books that chronicle these amazing feats. Two of these books I have reviewed in these pages (Smith 2021a,b): *Flights of Passage: an Illustrated Natural History of Bird Migration* by Mike Unwin and David Tipling (Yale University Press, 2020) and *A World on the Wing: the Global Odyssey of Migratory Birds* by Scott Weidensaul (W.W. Norton, 2022). Unwin and Tipling celebrated bird migration through stunning photographs of 67 species, while Weidensaul delved into the scientific methods used by researchers he visited around the globe. In this newest book, *Flight Paths*, Rebecca Heisman concentrates on how the science of bird migration has evolved, emphasizing the human angle, as hinted at in the subtitle.

Heisman starts with a history of the trapping and banding of birds (Chapter 1, A Bird in the Hand). People have been observing birds for centuries but were limited by their inability to identify individuals. Ornithologists started marking birds in the 1800s: John James Audubon tied silver threads on the legs of Eastern Phoebes (*Sayornis phoebe*), and Ernest Thompson Seton marked the breasts of Snow Buntings (*Plectrophenax nivalis*) with printer's ink. In 1899, Danish ornithologist Hans Christian Cornelius Mortensen was the first to mark birds with small metal bands engraved with his initials or banding locations. Still, the marking of individual birds was *ad hoc* until Leon J. Cole started advocating for centralized record-keeping in the early 1900s. This culminated in the United States federal government taking on the oversight of bird banding in 1920 and the start of the North American Bird Banding Program. Unfortunately, Heisman makes no further reference to whether there was a similar trajectory in Europe.

In Chapter 2 (Looking and Listening), Heisman leaves individual birds behind to follow the study of masses of birds through nocturnal flight calls. Most birds migrate at night, which creates an obvious gap in understanding their activities. Moreover, many of the species that vocalize regularly during long night flights produce nocturnal calls that are very different than those they use during the day. Starting in the 1980s, Bill Evans made it his life's work to record the sounds of migration and identify night calls (on his website, http://oldbird.org, material from his guide to flight calls is available for free). More recently, computer scientists are using artificial intelligence to not only detect individual calls in nocturnal recordings (a tedious task for humans), but to also automatically identify species. The availability of low-cost recording equipment, open-source software, and identification databases has brought this research into the realm of hobbyists. The "Looking" part of the chapter title refers to the limited study of migration by watching birds pass in front of the full moon using a telescope.

During World War II radar operators dubbed mysterious blobs they found on their screens "angels" (Chapter 3, Chasing Angels). Researchers discovered that radar beams reflect off the water within the blood and muscles of masses of birds in flight. While individual species cannot be identified with radar, radar images can be studied on a larger scale to track the abundance, distribution, and seasonality of migrating birds. The technology has improved dramatically since World War II, and migration intensity predictions are being used to issue lights-out alerts for participating cities to reduce bird mortality from lit buildings (check out https://birdcast.info).

Chapter 4 (Follow That Beep) and Chapter 5 (Higher, Further, Faster) explore the many advancements in radio telemetry, from its beginnings in the 1970s when researchers followed migrating birds from their vehicles, to the present-day when they follow them from the office via computer and satellite links. The Motus Wildlife Tracking System is a recent Canadian innovation that uses a network of towers to automatically pick up signals from the radio tags of birds flying by. Radio tags have become increasingly complex, smaller, and more precise, and their uses are too numerous to go into here—but knowing migration routes, stopover sites, and wintering and breeding areas all aid in land conservation. As with improvements in radar technology, advancements in radio telemetry have relied on collaborations between engineers and ornithologists, both professional and amateur.

The need for lighter devices to attach to birds led to the development of the light–level geolocator, which contains a light sensor, clock, memory chip,

and batteries (Chapter 6, Navigating by the Sun). A geolocator uses daylight to determine its latitude (because the length of day varies with latitude)—this was a technique used by seafarers as early as the 1530s. British biologist Rory Wilson pioneered this work by studying Magellanic Penguins (*Spheniscus magellanicus*). The downside to these extremely light (and relatively cheap) devices is that they need to be physically retrieved to download data.

I expect that most readers of this journal know of Keith Hobson, a prolific researcher with Environment and Climate Change Canada. Hobson pioneered the use of stable isotopes to determine where a bird originated from geographically (Chapter 7, You Are Where You Eat). The isotope of most use to bird researchers is deuterium, a hydrogen molecule with an extra neutron that can be isolated from feathers. Feathers are moulted each year and retain the deuterium signature from the location where they are grown. Analysing the specific ratio of normal hydrogen to deuterium in a feather can be compared to maps (isoscapes) of deuterium across a landscape. There is more deuterium towards the equator and less towards the poles, which helps determine where a bird lived when the feather was grown. Samples can even be taken from museum specimens to compare historical and current breeding ranges. Hobson is an excellent example of cross-disciplinary thinking, having come to his work with a background in physics and a passion for birdwatching.

Feathers are also being used in the Bird Genoscape Project, which is mapping migration routes using the DNA in feathers (Chapter 8, The Feather Library). A genoscape is a map showing where genetically distinct populations of birds are distributed across a landscape. The term was coined by evolutionary biologist Thomas Smith, who began saving feathers from study birds in the 1980s hoping that someday genetic techniques would improve to the point where DNA could be extracted from them—which didn't happen until the early 2000s. Genoscape mapping brings population structure and migratory connectivity down to the regional scale from the more usual species-wide range maps. The regional space is often where population declines occur and conservation planning takes place.

In Chapter 9 (Vox Populi), Heisman switches from highlighting professional research to exploring the role of citizen scientists in gathering data for programs such as the North American Breeding Bird Survey and eBird, which are used to determine the statuses and trends of species. Then, in the final chapter (Sky Full of Hope), she expresses the concern of many researchers who wonder if these new technologies are

> allowing us to understand the intricacies of migration with greater clarity than ever before, [or] are actually just helping us document, in excruciating detail, the final decline of one of the natural world's most inspiring phenomena. (p. 105)

For any reader interested in delving deeper into these technologies there are 35 pages of Notes (by chapter) and two pages of links to websites. The 49 colour photos illustrate many of the technologies discussed in the book.

More than anything else, the technologies and studies referenced in this book highlight that bird conservation requires coordination on a global scale. While I doubt that any of the researchers that Heisman writes about would claim to have "solved the mystery" of bird migration, they have all contributed to the incremental growth in our understanding of it. This book is an excellent chronicle of that journey of discovery.

Literature Cited

Smith, C. 2021a. [Book Review] Flights of Passage: an Illustrated Natural History of Bird Migration, by Mike Unwin and David Tipling. Canadian Field-Naturalist 135: 89–90. https://doi.org/10.22621/cfn.v135i1.2843

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Cyndi M. Smith
Canmore, AB, Canada