

Avoiding Extreme Environments: Migratory Birds

*Scott R. McWilliams, Assistant Professor
Department of Natural Resources Science*

Songbird Survey: Mistnet capture and banding of songbirds are used to document phenology, abundance, and distribution of songbirds at Block Island and Kingston, Rhode Island, coastal stopover sites during migration. Photo by Megan Whitman.

Most terrestrial animals living in seasonal environments like New England survive the winter by either reducing their activity and exposure during extreme conditions or by simply leaving and thus avoiding extreme conditions altogether. Familiar examples of the former are mammals such as ground squirrels and bats that hibernate and bears that suspend much of their activity during winter but do not truly hibernate. The more common strategy for birds is to leave and migrate to regions with more favorable winter conditions. Among the most famous and familiar group of migratory animals are the

Scott McWilliams earned a BS in psychobiology and environmental studies from Hiram College, an MS in animal ecology from Iowa State University, and a PhD in ecology from The University of California, Davis. He has been at URI since 1998. He teaches wildlife ecology and management, wildlife management techniques, and physiological ecology. His research focuses on the nutrition, physiology, ecology, and behavior of wild vertebrates, especially amphibians, migratory waterfowl, and songbirds.



songbirds. However, insects, fishes, and mammals (including snowbirds of our own species) also provide fascinating examples of migration.

Migration is not a particularly simple solution to the problems presented by extreme conditions in northern, seasonal environments. Consider a year in the lives of migratory songbirds. They often leave their breeding areas when food is still abundant. They travel long

distances between breeding and wintering areas and contend with uncertain weather and often unfamiliar environments as they attempt to rest, avoid predators, and refuel at stopover sites. On wintering areas (mostly in the southern United States and the tropics for migrants that breed in New England), migrants must compete with other migratory species and with residents more familiar with this relatively benign but crowded environment. Finally, if they survive the fall and winter, migratory birds often return north to breeding areas before food is abundant. In short, while it allows birds to avoid cold, food-poor environments during winter, migration clearly poses other challenges.

Much of what we know about bird migration comes from banding programs around the globe. At banding stations, birds are passively captured with fine mesh nets (mistnets), banded, and released. Research biologists at URI, including Peter Paton, myself,

and a small flock of graduate and undergraduate students, maintain a banding station during fall migration in Kingston, Rhode Island, and intermittently on Block Island. Doug Kraus, a former professor of chemistry at URI, banded birds each year for more than 35 years at the Kingston Wildlife Research Station.

Long-term data from banding programs provide important information about timing and routes of migration and long-term changes in populations of migratory birds as a consequence of changes in the environment. Banding programs in eastern North America, including our program in Rhode Island, have demonstrated that young birds making their first southward migration are especially common along the coast. It is hypothesized that this "coastal effect" occurs because young birds stray more than adult birds and because the Atlantic Ocean provides an obvious boundary that concentrates off-course young birds. Regardless of its cause, the phenomenon has clear implications for conservation. Effective management of coastal habitats for migrants during stopover would enhance many songbird

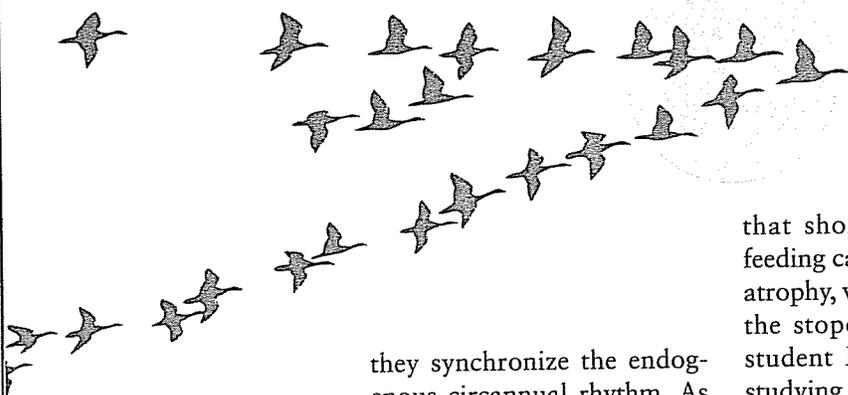
populations by improving survival of first-year birds.

Long-term data from banding stations, however, tells us little about the process of bird migration, how the birds actually do the work of migrating. Much of my research in association with graduate and undergraduate students at URI is focused on this aspect of bird migration.

Birds prepare for migration by increasing their body weight, sometimes by as much as 100 percent, while storing fat and protein. Birds accumulate fat and protein reserves by eating more and by being selective in what they eat. Migrating birds may increase their feeding rates fourfold. They are able to eat more food in part because the size of their guts increases. Without changes in their digestive system, the size of the gut would limit food intake and slow the accumulation of fat and protein reserves. Interestingly, this increase in feeding rate and gut size can be induced in captive migratory birds by decreasing daylight hours in the fall or increasing daylight hours in the spring. Seasonal changes in daylength initiate hormonal changes that mediate a host of physiological changes that include eating more, gaining

weight, and flight activity at night. The ability to respond to reliable environmental cues such as photoperiod is critical for migrating birds because they can anticipate seasonal changes in environments and then prepare for migration by storing energy and nutrients.

The astute reader may wonder what happens to migrating birds as they move from southern New England in the fall where days are shortening to south of the equator where days are lengthening? If photoperiod alone synchronized annual cycle events, birds would begin preparing for the reproductive season prematurely with regrowth of the gonads and an immediate return to the north. Birds circumvent this problem because the timing of migration, reproduction, and molt are determined by photoperiod in conjunction with an endogenous circannual rhythm (a cycle of approximately one year). This endogenous timing mechanism can be demonstrated by maintaining animals in constant conditions. Birds maintained in constant photoperiod display a cycle of gonadal growth, molting, and migratory fattening with a period of about one year. Environmental stimuli such as photoperiod are important because



they synchronize the endogenous circannual rhythm. As one might expect, birds that breed in more northerly latitudes are induced to reproduce or migrate with longer day lengths than birds that breed in more southerly latitudes.

After accumulating the necessary fat and protein reserves, birds begin their migration from breeding to wintering areas. For most temperate zone breeding songbirds, migration itself involves many flights interspersed with stopovers to rebuild energy and nutrient reserves. Thus, during migration, birds alternate between periods of high feeding to rebuild their reserves at stopover sites and periods devoid of feeding when they expend their reserves as they travel between stopover sites. We have shown

that short periods without feeding cause the bird's gut to atrophy, which in turn extends the stopover. URI graduate student Megan Whitman is studying how birds stopping over on Block Island rapidly rebuild fat and protein reserves in certain habitats. Her work will help determine which habitats are most desirable for birds during their migratory stopover on Block Island.

Selective feeding and high feeding rates allow birds to satisfy the high energy and nutrient demands of migration. Many insectivorous songbirds switch to feeding primarily on fruits during migration, which may conserve energy since harvesting abundant fruits requires less energy than pursuing insects. Fruit may also be a good source of certain unsaturated fats that are important during migration. URI graduate student Barbara

Wilson and undergraduate student Wendy Wehunt have shown that certain unsaturated fats preferred by migrating birds may facilitate rapid fattening and enhance performance during migration. This recent work is among the first studies to demonstrate that wild birds discriminate between diets that differ slightly in fat content.

Songbirds provide those of us in seasonal environments like New England with an obvious harbinger of spring and fall. Their absence in winter is a testament to the difficulties of survival for small birds living in places with limited food and cold temperatures. Avoiding winter by migrating south requires a suite of physiological adjustments and adaptations that we are just beginning to fully understand. Our immediate challenge is to learn enough about the migration process so we can conserve and manage the natural areas that are important for birds during migration. ■