

ScienceWatch-When Habitat is Limited the Early Bird Gets It All

Many Neotropical migratory birds spend three to five months on their temperate breeding grounds, one to two months on autumn migration six to seven months on tropical wintering ranges and another month on spring migration. For many species, like the American redstart (*Setophaga ruticilla*), it's the healthiest birds that arrive first and achieve reproductive success. Healthy males gain the choicest nesting sites, while healthy females have more time to replace lost clutches or squeeze in an extra one. We are familiar with the intense competition for nesting sites occurring when migrants arrive here in the spring. But what effect, if any, does winter habitat have on their reproductive success?

In a ground-breaking study published in the December 4th issue of *Science*, avian ecologists Peter Mara and Richard Holmes of Dartmouth College in Hanover, NH, and Keith Hobson of the Canadian Wildlife Service in Saskatchewan have been able to link events in the tropical wintering grounds with those in the temperate breeding areas. Life down south for the redstart is not so idyllic. The birds compete for choice insect-rich mangrove forest with the losers forced to scrounge in the less favorable dry lowland scrub—a contest often lost by young and female redstarts to older males. The study is the first to show that the quality of a tropical winter habitat directly affects the survival and breeding success of a migratory songbird. The scientists expected that individuals claiming the better winter habitat should be more likely to breed in the spring and that's exactly what happens.

Researchers have long sought a means to track small songbirds like the redstart, but color banding has not worked and radio transmitters are just too much for these tiny creatures to carry during migration. Now Holmes, et al., have devised an ingenious way, based on differences in the natural isotopes found in the winter habitats, to do just that. Carbon, an element central to the chemistry of life, has several isotopes or atomic forms. Most common is C-12, weighing twelve atomic mass units (amu). Heavier forms, C-13 and C-14 also exist, and weigh 13 and 14 amu, respectively. The slight weight difference affects the efficiency with which a carbon dioxide (CO₂) molecule is used by plants in photosynthesis. Heavier CO₂ molecules are less likely to be used in photosynthesis, but plants living in drier habitats must be more efficient with respect to water use and photosynthesis so they are less likely to discriminate against C-13-containing CO₂. The net result is that plants in the choice wetter habitats have less C-13 than plants in the dry lowland scrub. The isotopic signature in the plants is passed up the food chain and appears in the blood of plant-eating insects and insect-eating birds. Consequently, the ratio of C-12 and C-13 to be found depends upon the type of habitat they live in.

To determine isotopic ratios, the scientists captured and bled redstarts finishing their winter in Jamaica and Honduras. As expected, birds that had wintered in the wet habitats had less C-13 than did those foraging in the dry scrub. Moreover, birds from the wet habitats were 65% male, and had maintained or gained weight, while those in the dry scrub were 70% female, had lost as much as 11% of their body weight and had high

levels of stress hormone. Earlier studies had shown that the older males used aggressive tactics to force the females and the younger males into habitats of poorer quality. The researchers predicted that, being in better physical condition, birds wintering in the wetter habitats would start their spring migration earlier. As expected, birds from the mangrove forest departed north 10-14 days ahead of those from the scrub. Testing of spring arrivals to a New Hampshire forest showed it was those bearing the wet habitat signature—mostly older males—that were first. Later arrivals typically carried the dry scrub signature, were mostly females and younger males, and were in poorer physical condition. Females arriving late could still breed with established males, but would have less time to produce offspring. Later-arriving males were probably even worse off, being unable to compete with males already established.

These results are significant for conservationists because they show that protecting breeding grounds is not enough. As prime winter habitat declines redstart populations become less physically fit and may be lost because of breeding failure. Redstart populations in the Adirondacks and New Hampshire are declining by about 3% per year. The Caribbean lost about 10% of its mangrove forests in the 1980's and continues to lose about 1% per year. This habitat decline may already be negatively impacting populations of redstarts and other migratory birds.

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