

# Changing Chickadees

By Robert L. Curry, Ph.D.

One lonely, fully grown chickadee nestling, together with seven unhatched eggs. Again.

Most eggs of cavity-nesting birds like chickadees typically hatch, so this type of observation represents evidence that hybridization may be occurring. Over the last several years, my students and I have documented poor hatching success—caused by genetic mismatches between parents of two different species—in many nests at Hawk Mountain.

The Sanctuary's chickadees are changing, from a population of entirely Black-capped Chickadees to a mixture that includes birds with at least some Carolina Chickadee ancestry. Hawk Mountain now lies at the leading edge of a zone of hybridization that is marching northward, with Carolina Chickadees taking over. Our research over more than a decade seeks to understand the causes and consequences of these changes.

Chickadees are familiar backyard songbirds throughout much of North America. The Black-cap range extends from Newfoundland to Alaska, stretching south to New Jersey, into the higher elevations of the Appalachian Mountains, and across the upper tier of states to Oregon. Carolina Chickadees are mainly denizens of the Deep South, inhabiting forests from Florida to Texas and extending north to Illinois, Ohio, and Pennsylvania. In a nar-

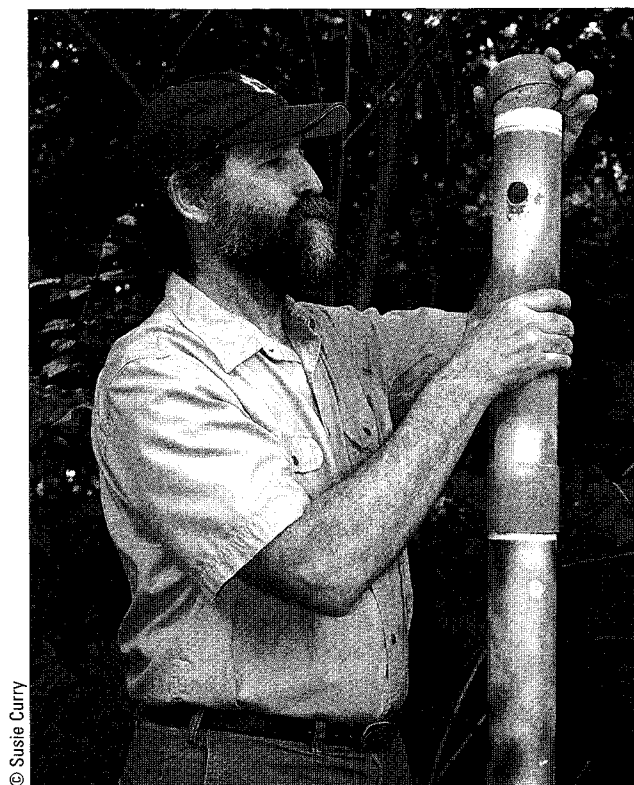
row zone from New Jersey to Kansas, both species occur.

## Here, chickadees hybridize.

That wild birds frequently hybridize may come as a surprise. Behavioral and physical cues allow most animals to select mates of their own species, but a recent review documented that at least 10 percent of the world's roughly 10,000 bird species engage in hybridization at least occasionally. While these events might seem to contradict textbook definitions of species, most

biologists recognize that limited interbreeding does not necessarily confound species boundaries, as long as the two forms remain distinct for the most part.

We began research on chickadees in southeastern Pennsylvania to investigate general questions about hybridization using birds that are common and easy to study. We knew that Black-capped and Carolina Chickadees were suspected of interbreeding in our area. Evidence suggesting that the hybrid zone was moving northward at up to a mile a year along most of its length intensified our interest. The trend



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The author checks one of his 150 artificial snags.



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An adult hybrid chickadee shows very little white in the wing. This bird is the father of the pictured chick on page 20.

**A chickadee nest  
inside an artificial  
snag produced eight  
eggs but only  
one chick.**

raises questions regarding the causes of movement, beyond more basic issues about the reasons for interbreeding in the first place.

To tackle this problem, we initiated field studies at Hawk

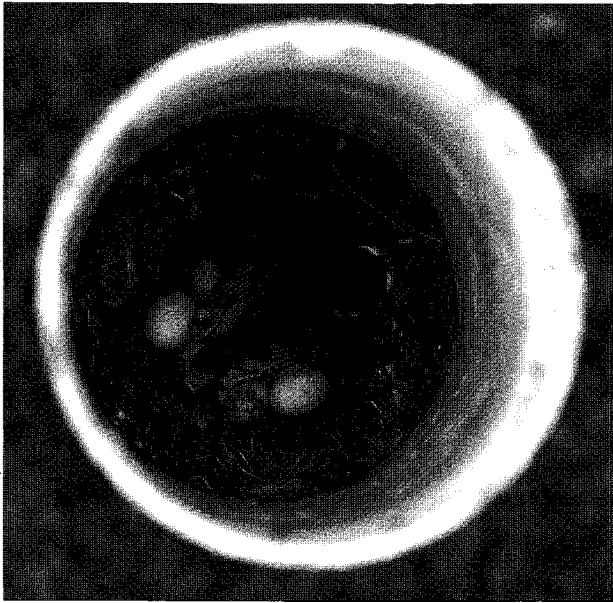
Mountain and at Nolde Forest State Park, near the hybrid zone's trailing edge; further south at the Nature Conservancy's Woolman Preserve, where only Carolina Chickadees live; and to the north at Tuscarora State Park, where exclusively Black-capped Chickadees occur.

Poor hatching success is just one indication of hybridization. Another is the appearance of the birds themselves, starting with breeding adults: if the female and male attending a nest are members of different species, the chicks are probably hybrids. If interbreeding involves two species that are very different from each other, such observations are straightforward. Our challenge is greater, however, because differences in chickadee appearance are small. Black-capped Chickadees are slightly larger than Carolina Chickadees, but the difference is usually not noticeable in the field. Black-caps have proportionally longer tails, but this also is difficult to discern on free-flying birds.

Plumage patterns are a bit more helpful: Black-capped Chickadees have more extensive areas of white on the edges of their flight feathers and, especially, on the small feathers that cover the base of the feathers of the inner wing. These form a white 'shoulder' patch that is missing on Carolina Chickadees, because their secondary coverts are gray.

If two interbreeding species produce viable offspring, their appearance can provide additional evidence that hybridization has occurred. In some birds, plumage of first-generation hybrids is so distinctive that they were once named as distinct species, such as "Brewster's" and "Lawrence's" warblers, which are now known to be Blue-winged x Golden-winged Warbler hybrids. These hybrids stand out because they exhibit mismatched color patches drawn from each species. The appearance of chickadee hybrids, however, is intermediate between that of their parents—whose differences are subtle to begin with. Picking out hybrid chickadees based on appearance alone is challenging even for experienced naturalists.

Vocalizations also can provide clues about hybridization, but with some nasty complications. As in most songbirds, chickadee males sing to attract mates and



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defend territories. Black-caps produce a simple *fee bee* whistle, whereas Carolinas have a larger repertoire of at least two songs, including a common *see bee see bay*. Distinguishing these songs in the field is simple, but there's a catch: chickadees learn their songs, and our research has shown that a male's song is not a reliable indicator of his genetic makeup. Also, some males in the zone of overlap produce both songs, but this does not necessarily indicate that the 'bilingual' bird is a hybrid.

Other vocalizations are a bit more informative. Besides song, all chickadees produce a variety of calls, including the common *chick-a-dee* that gives the birds their name. While the calls of Black-capped and Carolina Chickadees are similar, the *dee* notes of the former are longer and lower in frequency. Development of these calls appears to be more strongly influenced by genes than are songs, such that hybrid chickadees produce *dee* notes that are intermediate in speed and pitch. With practice, field observers can pick out individual chickadees with "hybrid" calls, or those whose call does not match their song.

Because identifying hybrid chickadees poses observational challenges, we rely heavily on genetic analyses. To obtain samples, we provide the birds with artificial snags, which are plastic tubes resembling the dead trees in which chickadees would naturally nest. These snags increase our chances of finding nests, and of catching breeders using mist nets when they are bringing food to nestlings. Once we catch the parent chickadees, we band them and take a tiny blood sample before releasing the bird unharmed.

One drop of blood provides ample DNA for genetic tests. Black-capped and Carolina Chickadees differ by 5% in their mitochondrial genomes (mtDNA). We can classify each bird's mtDNA relatively easily, but because all individuals inherit this subset of their genome from their mother only, this only provides a partial picture. To fully characterize a chickadee's ancestry, we also examine microsatellites—the same DNA markers used in forensic science, as featured on television shows such as CSI.

Our genetic analyses have confirmed suspicions about Hawk Mountain's changing chickadees: whereas all of the birds near the Sanctuary as recently as 1998 were Black-caps, the proportion of hybrid chickadees has increased to 30% of the population today. Were it not for our genetic work, we might have overlooked this trend—because all Hawk Mountain males continue to produce only Black-capped song. This behavioral 'lag' matches patterns we observed previously at Nolde Forest.

What lies ahead for chickadees at Hawk Mountain? Our evidence suggests that hybrids will become increasingly common, and that Carolina Chickadees—and their songs—will arrive within the next decade. We expect Carolina breeders eventually to have higher reproductive success than mixed pairs, leading to complete replacement, a process now underway 25 miles away at Nolde.

This begs the question: why are Carolina Chickadees "winning" at the expense of Black-caps? Warming of the regional climate is a likely underlying factor, but one that is difficult to study without complex and long-running experimentation. Other mechanisms, such as behavioral dominance of Carolina Chickadees, could also be involved. This explanation, amenable to study using our methods, is one we hope to assess in our continuing Hawk Mountain research.

*About the Author: Professor of Biology at Villanova University, Dr. Curry is chair of the Ornithological Council, and second vice-president of the Wilson Ornithological Society. He has been studying chickadee hybridization for more than a decade.*