

FIG. 2. Number of aggressive acts among family members of Black-capped Chickadees at various times after fledging. Observations per day were 3-6 hr.

group lives in) and young of a variety of different families. Similar flock formation has been suggested to occur in this species by Wallace (Bird-Banding, 12:49-67, 1941) and in the Carolina Chickadee (*P. carolinensis*) by Dixon (Proc. XIII Internat. Ornithol. Congress: 240-258).

I thank Dr. Millicent Ficken and Dr. Charles Weise for advice on the conduct of this study and criticisms of the manuscript. Dr. Weise and John Meyer banded the birds. This study was supported by a National Science Foundation Undergraduate Research Participation Grant. This is publication No. 9 of the University of Wisconsin-Milwaukee Field Station.—MARY HOLLEBACK, *Department of Zoology, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53211. Present address: 605A North 59th St., Wauwatosa, Wisconsin 53213. Accepted 14 June 1974.*

Is the Golden-winged Warbler a social mimic of the Black-capped Chickadee?

—The Golden-winged Warbler (*Vermivora chrysoptera*) and the Black-capped Chickadee (*Parus atricapillus*) exhibit similarities in plumage and vocalizations, and we have also found that they engage in behavioral interactions. We suggest that the similarities and interactions are, in the case of the warbler, the result of direct selection. In arriving at this conclusion, we rely in part on our studies of the two species at Lake Itasca (Clearwater Co.), Minnesota, during June and July 1968-1970 and at the University of Wisconsin-Milwaukee Field Station (Ozaukee Co.), Wisconsin, in May and August 1971-1973.

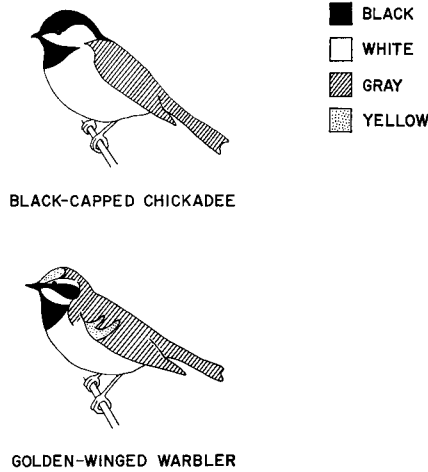


FIG. 1. Plumage patterns of the two species.

The Golden-winged Warbler resembles this chickadee in having a gray back, white breast, and black bib (Fig. 1). The chickadee has a black cap and the warbler a black face patch; the latter feature, at a distance, gives a similar impression in relation to the bib as the cap of the chickadee, i.e., a black patch separated from another by a white patch.

Although the *bee-buzz-buzz* song of the warbler and the *chick-a-dee-dee* call of the chickadee are quite different in pitch and duration, they are strikingly similar in general patterning (Fig. 2). Both frequently have a higher-pitched introductory syllable, usually followed by two to four equally spaced repetitions of a single syllable type. Despite certain dissimilarities, the vocalizations appear to have sufficient features in common to elicit interspecific responsiveness. We tested this through experiments in Minnesota, playing these vocalizations to both species along with the Ending Song (Ficken and Ficken, *Wilson Bull.*, 77:363-375, 1965) of the Chestnut-sided Warbler (*Dendroica pensylvanica*). In randomized presentations of 36 songs at 10 sec intervals, the warbler approached in response to the calls of the chickadee in nine out of 16 experiments; and in seven out of 16 experiments the chickadee approached the Golden-winged Warbler song. Neither species responded to playback of the Chestnut-sided Warbler songs. Approach responses to conspecific vocalizations were stronger than in the interspecific situation.

The Golden-winged Warbler and the chickadee have an extensive overlap in range and in habitat. The warbler inhabits shrubby fields with small trees, often with borders of taller trees. The chickadee seems to prefer somewhat taller trees, but often enters shrubbier areas to forage. The two species also have considerable territorial overlap; in Minnesota, at least 13 out of 22 Golden-winged Warbler territories were overlapped by those of chickadees.

Methods of foraging and foraging sites are also similar in the two species. In the spring the warbler obtains much of its food by probing in buds, inserting and opening its slender bill slightly to pry the new growth apart and obtain small insects. The chickadee is a

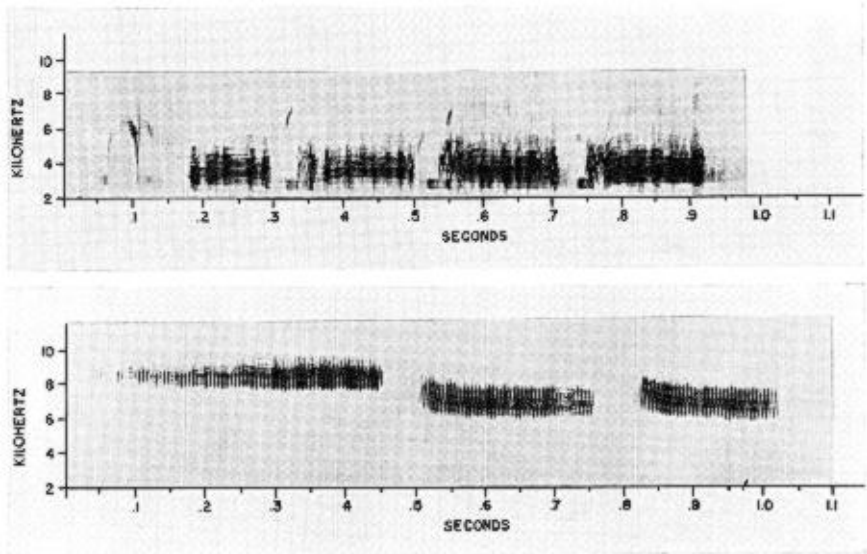


FIG. 2. Sonograms of vocalizations: top—Black-capped Chickadee call (*chick-a-dee-dee*); bottom—Golden-winged Warbler song (*bee-buzz-buzz*).

versatile feeder, but in spring it also obtains much of its food from buds. Because its bill is stubbier than that of the warbler, it cannot open buds in the manner of that species; instead it laboriously pounds them open. Both the warbler and chickadee often feed at the tips of small branches by hanging with the back downward.

During our studies, we observed Golden-winged Warblers interacting with chickadees, but not with several other small passerine species in the same habitat. An exception was behavior of Golden-winged Warblers toward Chestnut-sided Warblers; this interaction is possibly related to a releaser effect involving the yellow crowns that the species have in common. Interactions between chickadees and Golden-winged Warblers involved close approaches and following, with little aggression. This behavior was noted in fall migration and the breeding season, as well as during the spring. Either species may follow and approach the other. On one occasion during spring migration, a warbler followed a pair of chickadees (usually staying as close as 3–5 m) as they moved about 100 m through their territory. Eleven times during this association, a chickadee went directly to and inserted its bill in a bud where the warbler had been feeding. Despite a close association for at least two hr, only one aggressive interaction was noted; in all other cases when a chickadee approached a bud on which the warbler was feeding, the latter moved away. Some interactions were also observed between these species during the breeding season. On six occasions a chickadee was observed following a singing Golden-winged Warbler, as it flew from tree to tree. In addition, the use by chickadees of buds opened by warblers was also noted during the early part of the breeding season. Golden-winged Warblers also occur frequently in chickadee flocks during late summer and fall migration, although this is also true of other warbler species. Finally, although Golden-winged Warbler comprised only five percent of the arboreal warblers present during one spring migration, 50 percent of the warblers seen within five m of a chickadee were of that species.

There are several possible explanations for combinations of similarities and interaction between these two species, four of which bear mention. 1, the situation could be a case of commensalism with only the chickadee benefitting. However, if this were the case, it is difficult to explain the similarities in plumage and voice in the warbler to those of the chickadee. These features suggest that the warbler has probably converged in plumage and vocalizations, as these types of coloration and vocalization are widespread in *Parus*. 2, commensalism could be operating, with only the warbler benefitting. This would explain the convergences, but is not borne out by the behavioral interactions. 3, the similarities could be due to chance. This seems unlikely in view of the multiplicity of features and because of the behavioral interactions. 4, the warbler and chickadee may exhibit mutualism. We think that this is the best hypothesis, based on our current state of knowledge. The activities of the warbler during spring provide the clearest case. The warbler is a migrant, and the chickadee is a resident. Presumably the chickadee utilizes the best feeding areas on its territory and also might be particularly aware of predators in the area. Thus, the warbler may benefit in these two regards by seeking out the chickadees. On the other hand, the chickadee gains access to buds opened by the warbler which it would otherwise have to hammer open. We suggest that the Golden-wing may not take all the insects available from buds because the warbler is rapidly displaced by the approach of the chickadee. Interactions during the breeding season are less obvious, although the two species seem attracted to each other.

Plumage similarities between birds may result from selection for similarity in aggressive releasers related to territoriality (Cody, *Condor*, 71:223-239; Cody and Brown, *Evolution*, 24:304-310, 1970), or they may be instances of "social mimicry," involving releasers facilitating interspecific flocking (Moynihan, *Evolution*, 22:315-331, 1968). The warbler-chickadee relationship described here seems more likely a case of social mimicry, as aggression between the two is uncommon while attraction is rather frequent. The interactions of these species deserve further attention to clarify the nature of the relationship and the selection pressures acting to produce it.

We thank Dr. Jack Hailman for his criticisms of the manuscript. The study was supported by NSF grant GB 20248. Contribution No. 8 of The University of Wisconsin-Milwaukee Field Station.—MILLCENT S. FICKEN and ROBERT W. FICKEN, *Department of Zoology, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53211. Accepted 12 June 1974.*

Species-specific foraging behavior in some Hawaiian honeycreepers (*Loxops*).

—Four congeneric species of Drepanididae coexist without apparent competition in the native Ohia forests of the Hawaiian island of Kauai. The species are distinguished from one another by differences in the shape of the bill and in foraging habits. In 1970-71, I had an opportunity to observe these forms in the Kokee Forest of Kauai, and I also studied in detail the exploratory behavior of three of the species in captivity. The captive specimens were raised indoors from the nestling stage by A. J. Berger and C. R. Eddinger and never foraged for food in nature. This afforded an opportunity to test whether species-specific foraging behavior was innate, or whether it was learned in the face of competition with other closely related species.

I will briefly review the feeding habits of each species as an introduction to the behavior analysis in this study. The information is from Berger (*Hawaiian Birdlife*, Univ. Press of Hawaii, Honolulu, 1973) and my own field observations. For the purpose of this paper the type of substratum used and the postures and movements of the birds are of primary interest.