

- FOGDEN, M. P. 1972. The seasonality and population dynamics of equatorial forest birds in Sarawak. *Ibis* 114:307–343.
- HEIJL, S. J. AND J. VERNER. 1990. Within-season and yearly variations in avian foraging locations. *Stud. Avian Biol.* 13:202–209.
- LORIMER, C. G. 1989. Relative effects of small and large disturbance on temperate hardwood forest structure. *Ecology* 70:565–567.
- MARTIN, T. E. AND J. R. KARR. 1986. Patch utilization by migrating birds: resource oriented? *Ornis Scand.* 17:165–174.
- MORSE, D. H. 1993. Black-throated Green Warbler (*Dendroica virens*). Pp. 1–20 in *The birds of North America*, No. 55. (A. Poole and F. Gill, eds.). Acad. Nat. Sci. of Philadelphia; Am. Ornithol. Union, Washington, D.C.
- WHITE, P. S. AND S. T. PICKETT. 1985. Natural disturbance and patch dynamics: an introduction. Pp. 3–13 in *The ecology of natural disturbances and patch dynamics*. (S. T. Pickett and P. S. White, eds.). Academic Press, Orlando, Florida.
- ZAR, J. H. 1984. *Biostatistical analysis*. 2nd ed. Prentice-Hall, Inc., Englewood Cliffs, New Jersey.

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Courtship behavior of Golden-cheeked Warblers.—The Golden-cheeked Warbler (*Dendroica chrysoparia*) is an endangered species with a known breeding range mostly confined to the Edwards Plateau of Texas. These warblers inhabit oak-juniper woodlands and are dependant on *Juniperus ashei* bark for nesting material (Sexton, *Birding* 24:373–376).

Pulich (1967, *The Golden-cheeked Warbler, a Bioecological Study*, Texas Parks and Wildlife) described courtship displays in Golden-cheeked Warblers in which males attentively followed females and briefly displayed before copulation. There are no other published accounts of this type of behavior in this species. Courtship behavior in Golden-cheeked Warblers was observed on two occasions during spring 1995. The following observations were made at Pedernales Falls State Park, Blanco Co., Texas on 27 March 1995 and at Colorado Bend State Park, San Saba Co., Texas on 4 April 1995. In both cases, a female Golden-cheeked Warbler was discovered constructing the base platform of a nest prior to the observations of courtship behavior. The female warbler would make short forays into neighboring *Juniperus ashei* to collect strips of bark. All of the nesting material gathered during these observations was from trees within 15 m of the nest tree. The nest at Pedernales Falls was 5.3 m high in *J. ashei*, and the nest at Colorado Bend was 4.7 m high in *Ulmus crassifolia*. While observing the female's activities, a quiet, warbler-like song was heard that was unlike either of the primary songs of the Golden-cheeked Warbler (Pulich 1976). This song was muted, but more rapidly paced, than the typical songs of the species. This combination gave the song a more twittery quality than the primary songs. However, despite these differences, the song had tonal qualities similar to the other songs of the species. The

male warbler was observed singing this song in trees near the nest. He sang for two to three minutes during which the female continued nest construction; no change in her behavior was noticed. The male stopped singing as he approached the nest site. On both occasions the male was carrying strips of juniper bark. The bark was given to the female. The female then placed bark strips in the nest. While the female was placing the bark, the male quietly sang the twittery song and spread his tail while slowly lowering and flicking his wings closed. When the female finished placing the bark strips, she faced the male, quietly chipped, and crouched with her wings slightly spread and her head down. Similar behavior was noted in both cases. During the first observation, copulation occurred on the nest platform. The nest of the second pair was farther along in construction and the copulation occurred next to the nest. After copulation the male repeatedly sang the same twittery song while flying from perch to perch, widely circling the nest tree. During this time, the male constantly flitted its wings and fanned its tail. Tail and wing fanning are not limited to courtship displays; I have observed similar behavior in Golden-cheeked Warbler territorial interactions as well as toward Texas rat snakes (*Elaphe obsoleta lindheimeri*) and when a female Brown-headed Cowbird (*Mothrus ater*) was near the nest.

Nest building in Golden-cheeked Warblers is reported to be done entirely by the female (Pulich 1976, Oberholser, 1976, *The bird life of Texas*, Univ. of Texas Press). During the early spring of 1994 and 1995 I observed males carrying nesting material on five occasions. Other workers also have observed male Golden-cheeked Warblers visiting nests under construction (Keddy-Hector, pers. commun.). This suggests that male warblers may have some role in nest construction.

These observations suggest that male Golden-cheeked Warblers carrying nesting material may have been part of courtship. This does not eliminate the possibility that, at least occasionally, the male may have a minor role in nest construction. However, no direct observations were made of males adding materials to a nest. In addition, no specific male was observed carrying nesting material on more than one occasion. During previous observations of male Golden-cheeked Warblers carrying nesting material, there was no evidence of a female in the vicinity and the twittery song that was given prior to and following the courtship behavior was not heard.

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