

TABLE 2  
LENGTH OF NINTH PRIMARY (MM) OF 16-DAY-OLD TREE SWALLOWS

Location	Nestlings raised by	Brood size		
		3	6	7
Sewage Lagoon	male and female	51.2 (3) <sup>a</sup>	49.2 (15)	48.8 (6)
	female only	52.3 (1)		40.7 (1)
	male only			35.3 (1)
Backus Field	male and female	45.1 (7) <sup>b</sup>	49.0 (4) <sup>b</sup>	

<sup>a</sup> (Number of broods.)

<sup>b</sup> Excludes measurements from one brood where all nestlings died, apparently from starvation.

Delivery rates indicate that, on average, broods of 6 young, 4–16 days old raised by both parents, received about 2300 mg wet weight of insects per h. Weatherhead (Condor 86:187–191, 1984) estimated that the mean maximum weight of a fecal sac voided by a nestling 4–16 days old was about 390 mg. Therefore, parents at Sewage Lagoon removed about 1300 mg of fecal sacs hourly, or about 57% of the wet weight of insects delivered to their young.

*Discussion.*—Broods of six young received an average of about 250 meals per day through the 20-day nestling period. Each parent provided meals of the same size and in equal proportions to their nestlings. The equitable allocation of food provisioning duties by the sexes is consistent with the hypothesis that male assistance in brood-rearing is substantial in monogamous species raising altricial offspring. I cannot explain why males generally removed a disproportionate number of fecal sacs (57%) or why the number of fecal sacs removed by each sex was more variable than the number of food deliveries. Perhaps age and experience are important in this regard. Sample sizes were small, but my results indicate that although both parents were not required to raise nestling Tree Swallows when food was abundant (see also Gowaty, Am. Nat. 121:149–157, 1983), the growth of nestlings in large broods raised by single parents was inferior to that of nestlings raised by both parents (see also Weatherhead, Auk 96:391–401, 1979). Furthermore, I do not know whether the survival of single parents was affected by their increased workload. Emancipation of male Tree Swallows would facilitate polygynous matings. An important test would compare the behavior of assisted and unassisted females, and the growth and survival of their nestlings in both marginal and good food habitats.

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**Extrapair copulations in the Tree Swallow.**—Observations of extrapair copulations and male mate guarding are varied in the Hirundinidae. Beecher and Beecher (Science 205: 1282–1285, 1979) reported that male Bank Swallows (*Riparia riparia*) guarded their mates

closely during the female's fertile period. Similar observations were recorded by Samuel (Ohio J. Sci. 71:125–128, 1971) and Woods (Abstract presented at 100th annual meeting of the American Ornithologists' Union, Chicago, Illinois, 1982) on Barn Swallows (*Hirundo rustica*). Emlen (Auk 71:16–35, 1954) observed forced copulation attempts of female Cliff Swallows (*H. pyrrhonota*) and Butler (Auk 99:758–761, 1982) suggested that wing fluttering by Cliff Swallows collecting mud was a means by which females avoid extrapair copulations. He did not observe mate guarding. Both mate guarding and extrapair copulations are well known in Purple Martins (*Progne subis*) (Allen and Nice, Am. Midl. Nat. 47:606–665, 1957; Brown, Auk 95:588–590, 1978; Morton, Abstract presented at 102nd annual meeting of the American Ornithologists' Union, Lawrence, Kansas, 1984). Leffelaar and Robertson (Behav. Ecol. Sociobiol. 16:73–79, 1984) did not observe extrapair copulations in the Tree Swallow (*Tachycineta bicolor*) and demonstrated that males do not guard their mates.

In this note I report two dissimilar cases of extrapair copulations observed during a 4-year study (1980 to 1983) of Tree Swallow social behavior. The study site was a salt marsh on the south shore of Long Island, New York (for a description of the area see Schaeffer, East. Bird Band. Assoc. News 34:216–222, 1972).

On 28 May 1982, I observed a pair of Tree Swallows that had completed egg laying on 23 May. I had previously observed a female in full iridescent blue-green plumage making several trips to the box to incubate. Only females incubate in this species. Observations began at 09:55. At the start of the observation period, the male was perched on the nest-box pole, and the female was in the nest-box hole looking out. At 10:07 a female in immature, brown plumage (Cohen, J. Colo.-Wyo. Acad. Sci. 12:44, 1980; Hussell, J. Field Ornithol. 54:312–318, 1983) approached the nest box. The male left his perch immediately and attacked the brown female as his mate watched from the nest-box hole. The male aggressively chased the brown female for a short distance, and she flew from view. The male returned to his perch on the nest-box pole. Less than one min after the chase, the resident female left the box and flew from view. After the resident female departed, a brown female approached the box (it is unknown whether she was the same brown female observed earlier) and landed on the top of the nest box. Almost immediately, the male copulated with the brown female. The brown female then flew from view, and the male returned to the top of the nest box. The blue-green female returned and was seen incubating later that day. Because no nonresident females were ever captured incubating (N = 78 breeding attempts), I am confident that the blue-green female was the mate of the male. It is unlikely that the copulation between the male and brown female was between a male and a secondary mate because none of the 78 breeding attempts in which both males and females were uniquely color marked was polygynous.

On 12 June 1982, I observed a male and female feeding their brood of two 13-day-old nestlings. Both male and female were color marked. Observations began at 11:03. At 11:36 an unmarked male copulated with the female on the nest box top. The copulation was not forced. At the time the resident male was out of view, presumably foraging. The copulating male was unmarked, indicating that he was not a paired breeder at my study site because all known breeders were color marked. Mated pairs were often seen copulating after incubation had begun. One pair even copulated after their eggs had hatched. Why a female would copulate with a male not her mate when her nestlings were 13 days old is not apparent. Tree Swallows never had second broods at my study site. Power and Doner (Am. Nat. 116: 689–704, 1980) suggest several reasons for copulation after the fertilizable period.

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**Polygyny in the Yellow Warbler.**—Observations of polygynous matings in Parulinae are rare. Ford (*Curr. Ornithol.* 1:329–356, 1983) lists 12 species of North American Parulinae, including the Yellow Warbler (*Dendroica petechia*), that are reported to practice polygyny. S. G. Sealy (pers. comm.) and coworkers have noted two apparent cases of polygynous Yellow Warblers at their study site near Delta Manitoba. Here, I report detailed observations of color-marked birds to verify the existence of polygyny in Yellow Warblers and compare the behavior of polygynous and monogamous males.

Yellow Warblers were studied in 1980 and 1981 at the University of Michigan Dearborn Biological Station (Wayne Co., MI) and in 1981 at Metrobeach Metropark (Macomb Co., MI). Birds were banded with U.S. Fish and Wildlife aluminum bands and with celluloid color bands, permitting detailed observations of individuals engaged in territorial disputes and nesting activities. Territories were mapped by following males and plotting the locations of boundary disputes on gridded maps of each study area. I searched daily for all females associated with color-banded males. Observations were kept on nesting behavior and pair-bonds.

Polygyny was observed for Yellow Warblers at Dearborn and Metrobeach. During the two breeding seasons, 21 nesting birds were observed for at least 54 days (Table 1). Three polygynous males were paired with 5 females who built 9 nests. (One of the males was paired with the same female in consecutive years.) Simultaneous associations occurred when polygynous males were paired with females nesting at the same time. When females nested

TABLE 1  
OBSERVATIONS OF POLYGYNOUS YELLOW WARBLERS AT DEARBORN AND METROBEACH,  
MICHIGAN, 1980–1981

Location	Year	Observation period (days)	Duration of simultaneous associations	Male behavior during associations
Dearborn	1980	60	17 June–7 July	Feeding female
	1981	54	17 June–25 June	Feeding young Territory defense
Metrobeach	1980	62	28 May–7 July	Alarm calls

FIG. 1. The breeding period of polygynous Yellow Warblers at Dearborn and Metrobeach, Michigan, 1980–1981. Thin lines represent time females were on the breeding site prior to nesting. Medium lines are based on presumed nesting activities obtained by dating