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POST-FLEDGING BEHAVIOR OF PURPLE MARTINS

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The published accounts of the life history and behavior of the Purple Martin (*Progne subis*) make little or no mention of behavior of adult or young martins immediately after fledging (Bent 1942, Allen and Nice 1952, Johnston and Hardy 1962, Finlay 1971a). Stone (1937:709) noted post-fledging behavior of Purple Martins in New Jersey. Finlay (1971b) reported post-breeding nest defense in adults, but he did not study young martins after they fledged.

Between 1972 and 1977 I located and studied martin broods after they had left their nests in north central Texas. This paper presents a descriptive and quantitative report of post-fledging behavior of young Purple Martins and behavior of associated adults.

METHODS

A substantial amount of this report is based on observations made in 1974 and 1975. Each of the 41 Purple Martin broods at the study colony in 1974–75 were banded with standard aluminum bands painted distinctive colors. Each brood had its own color code. Parents of 20 of these broods had been banded similarly in previous years or during the present study. Parents of 11 additional broods could be identified by distinctive plumage characters. I searched on foot, on a bicycle, and in an automobile for martin broods out of the nest and used 7× and 8× binoculars to observe the birds. I spent much time in daily observation of martins at the study colony in a residential section of Sherman, Grayson County, Texas. Nests in the colony were numbered and watched throughout the season. Twenty martin pairs comprised the colony in 1974 and 21 pairs were present in 1975. Data from only the 1974–75 breeding seasons were used in a quantitative analysis, but observations from 1972 through 1977 were used in forming the descriptive account.

All-purple male martins were termed "adults," and males in first nuptial plumage were termed "subadults." I did not separate adult and subadult females. Young ready to fledge or ones recently fledged were termed "juveniles." The term "fledge" is used here to indicate a young bird's first flight from the nest.

RESULTS

Leaving the nest.—Young Purple Martins that were reared in martin houses which were equipped with ledges or porches beneath the nest hole invariably came out onto the porch 1 to 4 days before fledging. Here they sat, flapped their wings, and were fed. Allen and Nice (1952) state that the parents pull the young off the ledges when time to fledge. I never saw any parent martin attempt to pull off its own young, although if a juvenile from another

nest *of different age* joined the brood, the parent attacked the newcomer. Shortly before leaving the nest and throughout the post-fledging period, parent Purple Martins could not apparently recognize their own young from others of the same age. Vagrant martins that were not nesting at the time and were simply visiting the colony often tried to pull juveniles off the ledges when the parents were away. Occasionally they succeeded, but more often the juveniles escaped them and retreated inside the nest compartment. These visitors were chased away by the parents when the parents returned. Vagrant subadult males in particular engaged in harassment of juveniles to a great degree.

Normally young Purple Martins first left their nests in the early morning, usually during the first 2 h of daylight. If a juvenile of a brood had not fledged by noon on a given day, it was likely to leave on that day only if disturbed by me or a visiting martin. I recorded only 1 instance of a seemingly-undisturbed juvenile fledging in the afternoon. In 20 instances which I observed, a juvenile first flew from the nest immediately after one of its parents had flown from the nest. The juvenile followed closely behind its parent. At that point many of the resident and non-resident martins at the colony commonly pursued the juvenile. They appeared to attack the juvenile, hitting it on the back with their wings and pecking it on the tail and rump. I observed at least 75 instances of adults attacking juveniles in this fashion. Parents led the juveniles away from the immediate vicinity of the colony and then attacked the pursuing martins and dispersed them.

After the parents led the juveniles away from the colony, the juveniles soon found a perch. Then the parents returned to the nest. On mornings when the young were leaving, the parents seemed very excited and did not feed the young. When at the martin house they were very alert and extremely aggressive toward any other martins that were nearby. Usually 1 young at a time left, although on 6 occasions I saw 2 or 3 juveniles leave the house simultaneously. I occasionally saw broods containing as many as 5 juveniles all leave on the same morning, but in most broods of 3–6 young, all did not leave on the same day. Broods of 6 young often took 3 days to fledge (Table 1).

Assembling the brood.—This was a remarkable phase of post-fledging behavior of Purple Martins, and still it is not clear how brood assembly is accomplished. After leaving the nest, most young martins landed in trees or on utility wires and home television (TV) aerials. A brood when leaving became scattered throughout the neighborhood. At that time the juveniles constantly uttered a "*choo-choo*" note. Apparently the call helped parents in locating the young, as the juveniles began calling loudly whenever a mature bird flew past.

By mid-afternoon on the day the young left, the parents had assembled

TABLE 1

MEAN NUMBER OF MARTIN YOUNG FLEDGED PER BROOD PER DAY OF FLEDGING, 1974–1975

Brood size	Number of broods	No. fledged on		
		1st Day	2nd Day	3rd Day
3	5	2.4	.6	0
4	6	3.1	.9	0
5	20	3.5	1.5	0
6	10	2.5	2.75	.75

their brood on a convenient perch, usually on wires or TV aerials. Here the young remained for the rest of the day and often several days afterward. The parents showed great success in finding and assembling all the members of their brood. Of the 26 broods on which I was able to make post-fledging observations in 1974 and 1975, 20 (76.9%) assembled 100% of their brood.

Observations of marked birds showed that parents were able to gather their own brood even when several nests were leaving on the same morning at a large martin colony. However, the broods mixed somewhat, and "adoptions" by the parents were frequent. I did not collect quantitative figures on adoptions. Parents accepted any young which were within 2 or 3 days of the age of their brood. Since broods returned to the colony to roost in the evenings, the parents reassembled their broods each morning for the first few days after fledging.

The grouping area.—The locations where parent Purple Martins assembled their broods immediately after fledging I termed "grouping areas." In 1974–75 I located the grouping areas of 26 of the 41 martin broods (63%). The distances of these grouping areas from the study colony are shown in Fig. 1. The remaining 15 broods and their parents were not found after fledging, although I searched within a 1.6 km radius of the colony.

These grouping areas were usually within 1 km of the colony and consisted of 2 or 3 home TV aerials or wires. Thirteen of the 26 broods grouped in clusters of wires around light poles, while the remaining broods grouped largely on aerials. The broods did not seem to be bothered by heavy automobile and pedestrian traffic below them. Eighteen of the 26 broods (69.2%) congregated on wires or aerials near a large open field. The field provided insects for food and an open area for flight. Only once did the parents group their brood within sight of an active martin colony. The habit of broods assembling on wires was noted by Stone (1937:709).

While in the grouping area, broods perched quietly and remained tightly grouped. The juveniles made short flights around the area, but I never saw

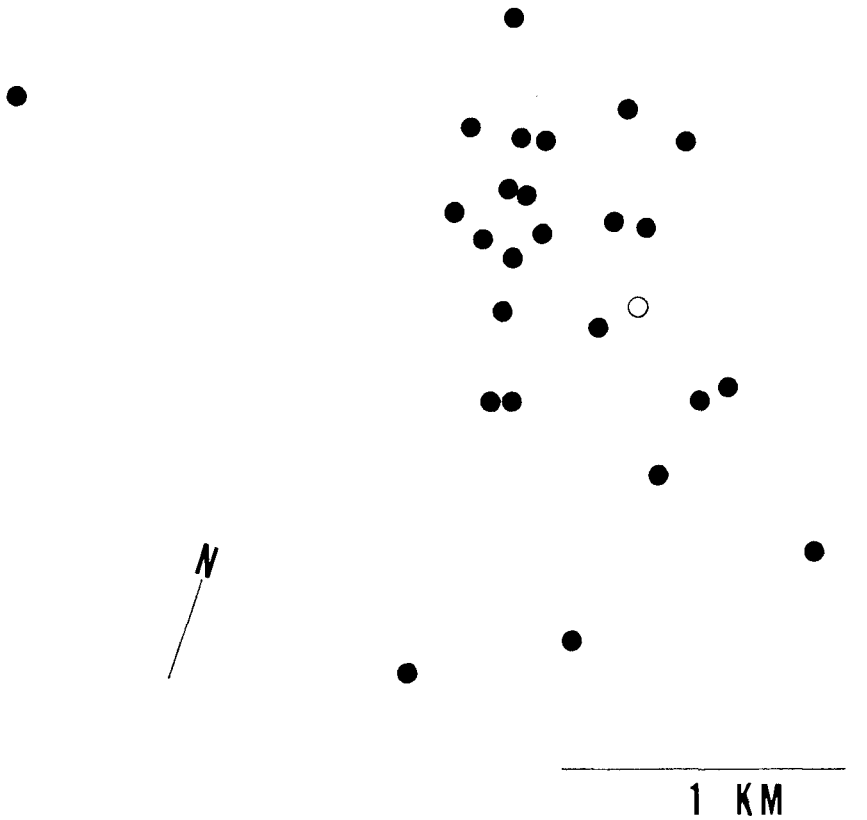

FIG. 1. Distances of grouping areas from study colony. Open circle indicates location of colony; closed circles show grouping areas.

one stray from the vicinity. The juveniles spent much time preening and sunning themselves. They continued their "*choo-choo*" notes while in the grouping area, especially whenever other martins passed by.

Parent martins frequently fed their brood, but they only occasionally sat and preened with the young in the grouping area. However, the parents were probably nearby much of the time, since they arrived to defend their young whenever danger threatened. I do not believe that the parents returned to the martin colony during the day at that time. Male and female parents equally cared for and fed their young out of the nest. In cases when part of the brood left and part remained in the nest, either parent might attend either group almost exclusively, or they might both attend both groups.

Vagrant martins, finding a brood in its grouping area, often harassed it

in the same fashion that vagrants tried to pull juveniles off the ledges of the martin houses. The vagrants that engaged in this activity I termed "raiders." A raider often perched on the back of a juvenile and pecked and harassed it until it fell off the perch. Then the raider pursued the juvenile and continued to harass it in flight. Raiders were most often subadult males, but adult males and females also behaved this way. When a raider began to harass a juvenile, that young bird stopped calling and sometimes gaped slightly at or feebly pecked at the raider, but the juveniles did little to fend off the raiders and depended on their parents for defense.

Parent martins continued to be highly aggressive and defensive when their brood was in the grouping area. They drove away any raider, and they would not allow any other martins to sit near their young. I also observed parent martins attack Turkey Vultures (*Cathartes aura*), Red-tailed Hawks (*Buteo jamaicensis*), Swainson's Hawks (*B. swainsoni*), Scissor-tailed Flycatchers (*Muscivora forficata*), Eastern Kingbirds (*Tyrannus tyrannus*), Western Kingbirds (*T. verticalis*), Blue Jays (*Cyanocitta cristata*), Mockingbirds (*Mimus polyglottos*), Starlings (*Sturnus vulgaris*), House Sparrows (*Passer domesticus*), Great-tailed Grackles (*Quiscalus mexicanus*), Common Grackles (*Q. quiscula*), and Lark Sparrows (*Chondestes grammacus*) that sat near the young or flew nearby.

Twice I observed sexual behavior in juvenile martins while they were grouped as broods in the grouping areas. On 16 June 1974 I observed copulation by two 29-day-old juveniles. I could not sex the individuals involved, but I assumed it was not reverse mounting. The young birds were quite clumsy, but one mounted the other in typical Purple Martin fashion. On 7 June 1977 I observed a 30-day-old juvenile, presumably a male, in the "Stooped-Submissive" posture of Johnston and Hardy (1962). This posture consists of flight "with the upper back humped, with head lowered, and with tail held low; the rectrices are abnormally constricted so that the tail resembles a tapered spine." The juvenile maintained this posture for only 10–15 sec. (Contrary to Johnston and Hardy's belief, my studies suggest that this posture is sexual, not aggressive behavior.)

Leaving the grouping area.—Broods commonly remained at their grouping areas for 2–3 days after the last young fledged. Extremes were less than 1 day and 5 days, with a mean of 2.5 days (N = 26). It appeared that broods left the grouping areas before the juveniles were independent. I did not determine where the broods went after leaving the grouping areas. Most broods left during the early morning. However, they continued to remain near, as many broods kept coming back to the nest to roost at night after leaving the grouping areas. The parents did not return to the colony during the day at that time.

Only once did I relocate a brood after it left its grouping area. In 1974 one brood remained at its grouping area for 5 days. On the 6th day I found this brood grouped on wires along a rural road 2.1 km from their grouping area. This new area was largely open with cultivated fields predominant. I saw other broods in that area, and the juveniles were mingling freely. I suspect that other broods also had arrived there after leaving their grouping areas.

Returning to the nest.—Many Purple Martin broods returned to the nest to roost at dusk each day for a short time after fledging. In 1974–75, 35 pairs led their broods back to the nest to roost for 1 day or more. The 6 pairs that did not bring their young back nested late in the season, and by then most martins were using trees for roosting. The mean number of days after the last young fledged on which a brood returned to roost ($N = 35$) was 4.85. Extremes were 1 and 12 days.

The broods began returning 45–70 min before dark. In a large colony the broods mingled freely when several were returning at once, and few juveniles actually roosted in their own nest. They separated into their respective broods again the next morning. If, when returning to roost, a juvenile tried to enter a martin nest containing small nestlings or eggs, the owners attacked the intruding juvenile, as did House Sparrows whenever juvenile martins tried to enter their nests. Some juveniles were unable to find a room at the colony to roost in until dark.

The parents' role in return of the young at night was limited. They initiated the return by leading the juveniles to the colony, but once reaching the colony, the parents could do little to help the young find the correct nest. Sometimes a juvenile followed its parent closely and thus reached the nest when the parent alighted at the nest entrance. In at least 30 cases, female parents seemed to have a more dominant role in the returning than did male parents. On several occasions while watching a brood at its grouping area late in the day, I saw the female parent arrive, feed one of the juveniles, then utter a soft, almost inaudible note similar to the "choo-choo" call of the juveniles. Apparently the female's call had leadership function, because then the entire family suddenly flew straight to the colony, the female leading. I could usually follow them on a bicycle.

On at least 6 occasions I recorded broods returning to the nest at midday when storms approached. The parents and juveniles behaved much as they did when returning to roost. In most instances the storms were of short duration, and the parents and their broods departed when they ceased.

I detected a correlation of fledging date and number of days a brood returned to roost. The 25 broods that fledged before 15 June in 1974–75 returned a mean of 2.6 days longer than the 16 broods that fledged after

15 June. Purple Martins in north-central Texas begin to exhibit traces of pre-migratory behavior after 15 June, notably by roosting in trees of the neighborhood. This likely accounted for the reduced time of returning for later-nesting pairs.

Feeding.—Stone (1937:709) commented on post-fledging feeding of Purple Martins. During the time spent at the grouping area, broods were virtually dependent on their parents for food. Since most broods left their grouping area a few days after fledging and I could not find them, I had limited opportunity to observe the juveniles begin catching insects. Also, I was not able to determine unequivocally how long after fledging the juveniles were dependent on their parents for food.

By noon on the day the young fledged and after the brood was assembled, the parents began to feed the young. On the first 2 days after fledging, the parents alighted beside the young and fed them. They continued to feed them large insects, such as dragonflies (Odonata) as noted by Stone (1937: 709). By the 3rd day the parents often hovered above the perched young and dropped the insect into the juvenile's mouth. On the 4th day out of the nest the juveniles and parents began in-flight transfers of food, also briefly mentioned by Stone (1937:709). I never saw any young make in-flight transfers before the 4th day out of the nest.

The juveniles apparently initiated the in-flight transfers. Seeing a parent approaching with food, a juvenile flew out to meet the parent. The transfer was made when both juvenile and parent hovered briefly. The insect was either seized by the juvenile while the parent held it, or the parent dropped the insect and the juvenile caught it. If the juvenile failed to catch a dropped insect, the parent seized it before it reached the ground. After the transfer the juvenile returned to its perch, and the parent briefly perched with the young or flew away. Occasionally a juvenile flew out to meet an incoming martin that was not its parent, or the parent did not have food. By the time of the in-flight transfers the parents brought smaller insects, and I never saw a dragonfly transferred in flight. In-flight food transfers are common after the 4th day out of the nest and probably continue until the juveniles reach independence.

While watching broods grouped on TV aerials near a large field, twice I saw a male and female parent, respectively, fly near the young and give the soft "*choo-choo*" note which was used to lead the young back to the nest. In each instance a juvenile left its perch and followed the parent. The parent led the juvenile over the field, and flying only a few meters above the tops of the grass, the parent apparently began pursuing and catching insects. The juvenile also appeared to pursue insects, but I do not know if it captured any.

Whenever perched juveniles saw another martin approaching, they be-

gan to rapidly quiver their half-opened wings. They did this even if the incoming martin was a raider or another juvenile. The parent with food often fed the individual that started quivering first, but this was not a rule. Wing-quivering preceded a juvenile leaving the perch to transfer food in flight.

I saw several juveniles begin to catch insects on the 4th and 5th days out of the nest. In these instances I carefully watched a flying juvenile with binoculars. By the 4th and 5th days they flew readily. They pursued insects large enough for me to see, and they captured a few, although they seemed to have difficulty in locating insects. They apparently had the speed and coordination necessary to capture insects once found.

Other activity.—Parent Purple Martins started returning to the colony during the day 7–10 days after the young fledged. At that time they sat on wires or martin houses for long periods. Apparently the young were then independent. If their nest had not been usurped by House Sparrows or other martins, the parents displayed post-breeding nest defense, or in rare instances they began a 2nd brood (Brown 1978). Finlay's (1971b) martins that displayed post-breeding nest defense were not the same birds that nested earlier. I observed both vagrants and past breeders display such behavior. In many aspects this stage closely paralleled martin behavior in early spring when pairs were forming. Males defended a room and courted females, and females visited several males. As the season wore on, post-breeding nest defense became less common, and the birds mainly sat on wires and preened and sunned.

Independent juveniles frequently appeared at the colony at that time. They also sat on wires and preened and occasionally visited the martin houses, but they showed no nest defense behavior.

DISCUSSION

It was readily apparent in my study that survival rates of juvenile Purple Martins are quite high for at least 4–5 days after fledging and probably longer. Twenty of the 26 broods I studied in 1974–75 showed a 100% survival rate from time of fledging until they left their grouping areas. The remaining 6 broods lost a member, but I do not know if the lost member actually died or if it was adopted by another family. A high survival rate for nestlings and fledged juveniles is necessary in Purple Martins, since they are specialized secondary hole-nesters, usually raise only 1 brood of 4–6 young, and must compete with House Sparrows and Starlings for nesting sites.

Certain behavior during the post-fledging period contributes to a high survival rate. Juveniles' following their parents when fledging enables parents to better assemble the brood at a later time. If juveniles fledged when their parents were away, they likely could become lost and scattered. The "*choo-choo*" notes of the juveniles evidently are helpful to the parents when locating

and assembling the brood. If the juveniles were scattered, too much time and energy might be required to care for them and greater post-fledging mortality of young might occur. The parents' inability to recognize their own young also has survival advantages. (However, in Bank Swallows [*Riparia riparia*] parents can recognize their own young and will not care for foreign young [Hoogland and Sherman 1976].) When several martin broods fledge at once, any juvenile is adopted and cared for by parent martins. If a juvenile is separated from its own brood, it can likely find and join another brood nearby. The habit of broods grouping on exposed perches probably serves to assist lost juveniles in finding their own or another brood, although this may not be the primary function of perching in the open.

Returning to the nest to roost at night has very obvious survival advantages. High winds and heavy rains at night could cause severe mortality among juvenile Purple Martins, but this threat is minimized by roosting in the nest. To partially counteract this advantage are the opportunities for broods to become scattered when returning to roost. However, the juveniles are able to regroup at their grouping areas on the following mornings. Perhaps the grouping areas are partially imprinted upon them on the day of fledging.

I can find no explanation of why 63% of the martin pairs (N = 41) assembled their broods in grouping areas within 1 km of the study colony while the remaining pairs and their broods disappeared after fledging. There was no correlation between age of parents or brood size and whether a family grouped within 1 km of the colony. Also, I do not know why the broods in grouping areas similarly disappeared after a mean of 2.5 days.

During post-fledging feeding, the manner of feeding is significant. Feeding by dropping an insect into a juvenile's mouth from above and transferring food in flight may be important in imprinting insect-catching techniques upon the juveniles.

A curious aspect of post-fledging behavior in Purple Martins is the activity of raiders. The raiders may serve to increase awareness or reflex actions of the young, thus helping to make the juveniles better able to avoid predators. But raiders that harass juveniles in and out of the nest contribute to scattering of the brood with possible resulting mortality of juveniles if parents cannot find the young. A further disadvantage of this behavior is energy expenditures by juveniles that are harassed and by parents that must fend off the raiders. Parents rarely assembled their brood within sight of an active martin colony; this may have been to minimize disturbance by raiders.

The habit of mature martins pursuing and attacking a fledging juvenile closely paralleled raider behavior. This may be advantageous in keeping the young bird aloft during its initial flight. When many martins are harrassing a flying juvenile, it is very difficult for that juvenile to alight. The young

birds are usually able to survive if kept off the ground on their initial flight. A juvenile finds it very difficult to fly from the ground, and parent martins desert grounded young (Forbush 1929, pers. observ.). Harassment also may be important in directing parents' attention to a member of the brood that they otherwise might fail to notice, thereby assisting parents in grouping their broods. It is quite probable that juveniles become independent 7–10 days after fledging, since at that time parents return to the colony and sit for great periods. Yet this has not been determined by observations of the young actually becoming independent. I concur with Finlay's (1971b) suggestion that post-breeding nest defense may imprint the location of future nesting sites.

SUMMARY

I studied post-fledging behavior of Purple Martins in north central Texas from 1972 through 1977. Detailed studies were made during 1974 and 1975. This report describes various aspects of post-fledging behavior of juvenile, subadult, and adult martins, including accounts of leaving the nest, assembling the brood, feeding, returning to the nest, and post-breeding nest defense. Grouping areas in which broods assembled after fledging are described, as is the habit of leaving these grouping areas. Certain behavior by adults and young during the post-fledging period likely contributes to a very high survival rate of juvenile Purple Martins during the first 4–5 days after fledging.

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