

data Although the relative abundance and timing of eastern vagrants in California is well known, attempts to refine our knowledge of year-to-year variation in vagrant numbers, variation in the timing of migration, of differences in latitudinal effects on vagrants must increasingly rely on census data or some effective measure must be constructed to quantify observer effort. An ability to more closely assess these parameters will reflect an increased ability to monitor changes in our environment.

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MANAGEMENT

The impact of Starlings on Purple Martin populations in unmanaged colonies

“Starlings are capable of seriously reducing martin populations whenever human beings fail to manage colonies”

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THERE HAS BEEN recent concern for populations of the Purple Martin (*Progne subis*) in North America (Arbib 1978); the species has been Blue-Listed since 1975. Inclement weather in the Appalachian Region in 1972 and heavy May freezes in the northeastern states in 1966 and 1967 drastically reduced numbers of martins there (Hall 1972, Rosche 1968), and recovery has generally been slow. One might also assume that populations in other parts of the United States have declined, as evidenced by the martin's Blue-Listed status in recent years. Yet, hypotheses other than that of inclement weather have not been advanced to account for these declines. The theory here presented may be inadequate to fully account for Purple Martin population depressions in all parts of the species' range. However, the implications of the following data require that

at least the theory be considered a strong possible factor influencing population declines.

The introduction of the Starling (*Sturnus vulgaris*) and the House Sparrow (*Passer domesticus*) into North America was followed by their subsequent rapid spread. Martins and other cavity nesters are forced to compete with these foreign species for nest sites. Purple Martins in particular have faced severe competition, because martins in the eastern United States now nest largely in man-made birdhouses which are usually erected in areas of human habitation. These habitats are also preferred by the House Sparrow and Starling.

The literature has been rather scant regarding martin competition with Starlings and House Sparrows. Most authors (e.g. Deusing 1942, Sprunt in Bent 1942, Bent 1950, Allen and Nice 1952, Olm-

stead 1955, Gaunt 1959, Kessel 1959), simply mention that competition occurs but offer little or no assessment of its impact on martin populations. The few studies concerned with interspecific relations (Jackson and Tate 1974, Brown 1977) were conducted in managed or semimanaged martin colonies. That is, owing to human manipulation, martin occupancy was maximized, and Starling and House Sparrow occupancy was minimized. “Manage” here means general upkeep and maintenance of the martin colony, periodic sparrow and Starling nest cleanout during the nesting season, cleaning and closing of martin houses when Purple Martins are gone, etc. In addition, where legal and feasible, some people manage their colonies by eliminating sparrows and Starlings. However, results of studies conducted in managed colonies are biased and do not

reflect natural competition between martins and sparrows and Starlings. Evidence suggests that managed colonies may be less numerous than unmanaged ones, and it is important to understand interspecific relations in the colonies where there is no human intervention. Here I present a study of competition between martins and Starlings in unmanaged colonies and an assessment of the impact of Starling competition on Purple Martins.

DURING 1972-1976, I was involved in a study of Purple Martin breeding biology (Brown 1978a), in which I regularly visited and gathered data at 36 colony-locations in Grayson County, north-central Texas. All of these colonies were either regularly managed or semimanaged. Although I was primarily interested in obtaining information on clutch size and reproductive success in martins, I also recorded population numbers for martins and Starlings at these colonies. House Sparrow impact cannot be fully considered here as it was impossible to get accurate counts of sparrow numbers. Accurate sparrow counts were not possible since (1) many of the proprietors regularly cleaned out House Sparrow nests and (2) House Sparrows were so numerous at most of the colonies that the proprietors could not accurately estimate their numbers nor could I on my brief visits. However, if any Starlings were using their birdhouses the proprietors were aware of it and their population estimates were much more reliable for this not-so-numerous and more conspicuous species. Starling activity also was usually apparent to me on my regular visits, either by there being visible Starlings present or by seeing sparrow and martin nests which had been pulled out of the rooms by Starlings and left hanging off the porches. I feel that I accurately estimated Starling numbers at the colonies. Martin numbers were determined by counting active martin nests.

My visits to the colonies and frequent discussions with the human proprietors, plus a weekly local newspaper feature on birds, combined to make the proprietors aware of and interested in martins, and most of them managed their colonies to a great degree during that period. When my breeding biology research ended in 1976, I stopped visiting most of the colonies. The newspaper feature also ended at that time. Both of these events combined to lower colony proprietors' inter-

est in Purple Martins, and beginning in 1976 management activities were reduced at many of the colonies.

IN 1977-1978, I succeeded in identifying 10 colonies, previously managed to a high degree, which had been allowed to deteriorate with only occasional management efforts, if any at all. I surveyed martin and Starling populations at these colonies again in 1977 and 1978. The 1977-1978 survey was accomplished by my entering the proprietors' yards unnoticed to count nests and by visually surveying the colony from a distance. At that time I avoided contacting the proprietors, because such contact would have stimulated them to undertake at least token management, and I wanted data from totally unmanaged colonies. Results of the population surveys at these colonies with (1973-1976) and without (1977-1978) management are shown in Table 1. Starlings increased significantly and martins decreased significantly (t -test, $P < 0.05$). In all but one colony, the number of available martin house rooms remained constant with and without management, so population shifts could not be attributed to a change in number of available nest sites.

Table 1. Average yearly number of Purple Martins and Starlings at 10 colonies which were managed in 1973-76 and unmanaged in 1977-78

<i>Species</i>	<i>Pairs</i> 1973-76	<i>Pairs</i> 1977-78
Purple Martin	108.3	42.0
Starling	2.1	25.5

Table 2. Average yearly number of Purple Martins and Starlings at 8 colonies which were managed in 1973-78.

<i>Species</i>	<i>Pairs</i> 1973-76	<i>Pairs</i> 1977-78
Purple Martin	55.4	61.0
Starling	0.5	0.0

To determine whether lower numbers of Purple Martins in 1977-1978 were indicative of an overall martin decline in north Texas, or whether Starling populations perhaps had suddenly increased, I also surveyed eight colonies which had continued high proprietor management in 1977-1978. Table 2 illustrates that martins had not decreased at these colonies but in fact had slightly increased, and Starlings had not increased. These data suggest that a decrease in martin numbers at the unmanaged col-

onies is attributable to lack of management and hence probably to Starling competition. It is possible that sparrow competition also could be responsible for the decrease in martins, but I think House Sparrows had much less effect than Starlings. Unlike Starlings, sparrows generally cannot prevail over martins in behavioral interactions, especially early in the season (Brown 1977). Sparrows adversely effect martins primarily by clogging potential nest holes with bulky nests, and at the time of my survey not enough time had elapsed since the days of management to allow sparrows to clog a significant number of holes

Behavior of Purple Martins and Starlings differed in managed and unmanaged colonies. In managed colonies, rarely did more than one Starling pair occupy a single martin house (Brown 1977), but in unmanaged colonies several pairs of Starlings commonly used a single martin house. In large managed colonies, Starlings were timid, rarely interfered with martins, and were present only early in the nesting season (Brown 1977). But in large unmanaged colonies, Starlings were quite aggressive and often chased martins away. They entered martin nests and were present throughout the nesting season. Purple Martins appeared more agitated and less defensive of their territories in the unmanaged colonies.

I should stress that the eight colonies in Table 2 were the only colonies of 25 surveyed in 1977-1978 in which I determined that management was continuing at a level comparable to previous years. The remaining 17 consisted of the 10 unmanaged ones and seven in which it appeared that management might still be occurring but at a substantially reduced rate. (Eleven others which had been visited in 1972-1976 were not checked in 1977-1978.) I thus concluded that by 1978 the majority of Purple Martin colonies in Grayson County, Texas, were unmanaged or only semi-managed.

IF THE MAJORITY of Purple Martin colonies throughout North America are unmanaged or only semi-managed, what does the future hold for Purple Martins in artificial colonies? It appears that Starlings are capable of seriously reducing martin populations whenever human beings fail to manage colonies, and since most Purple Martins in North America nest in birdhouses, the future may not be hopeful for this species. Purple Martins still nest in woodpecker holes of trees in forested regions of the

western United States (Phillips *et al.* 1964, Behle 1968) and in parts of Canada (Finlay 1975), but populations there probably are only a fraction of those nesting in birdhouses and gourds in the eastern and southern United States. Further, House Sparrow competition is another factor to be considered in unmanaged colonies, although it is doubtful that it is as significant as Starling competition (but see Jackson and Tate 1974).

Perhaps I am being unduly alarmed too soon and without justification. Perhaps the ratio of unmanaged to managed colonies is much lower in other parts of the martin's range. Perhaps Starlings are only minor competitors in some areas, as appears to be the case in Duncanville, Texas (R. Dellinger *pers. comm.*) and Gainesville, Florida (E.J. Bitterbaum *pers. comm.*). Studies of Starling competition are especially needed from areas where martins nest in gourds and Starling impact may be slight (R.K. Crawford *pers. comm.*). But the drastic changes I observed in martin and Starling populations in only one year's time when management was curtailed, impresses and alarms me.

STARLING NEST SITE competition with Purple Martins may be more significant and serious than similar competition between Starlings and other North American cavity nesters. Purple Martins are more colonial than woodpeckers, Tree (*Iridoprocne bicolor*) or Violet-green (*Tachycineta thalassina*) swallows, Eastern Bluebirds (*Sialia sialis*), Myiarchus flycatchers, and other hole-nesting species. Hence, a relatively few Starlings are able to dominate many martin nesting cavities, and they can exclude a large proportion of martins. Also, martins nest in urban areas more commonly than other hole nesters where they come into greater contact with Starlings.

Jackson and Tate (1974) concluded from analyzing information provided to them by martin colony proprietors, that Starlings did not represent serious threats to martins. However, their data were from managed colonies; anyone who is knowledgeable enough about

their colony to provide population figures undoubtedly manages his colony also. Jackson and Tate do acknowledge that time may be the only factor which has kept Starlings from becoming serious threats to martins, and as Starlings continue to disperse from the northeast and east-central United States and build up populations elsewhere, they could become serious competitors.

Starling competition may be one factor responsible for the slow recovery of Purple Martins after the 1972 nesting failures in the Northeast. Proprietors of colonies there may have become less aware of and interested in martins following the birds' immediate absence after 1972, and possibly the proprietors have made fewer management efforts in subsequent years. Starlings thus have taken over the unmanaged colonies, making re-establishment of martins in that area difficult. Starling competition may also be a factor in other areas where the species has shown declines.

The only real adaptation of martins to interspecific competition so far postulated is early spring arrival (Brown 1978b), although this adaptation originally may have evolved due to intraspecific factors (Rohwer and Niles 1977). It is conceivable that Purple Martins eventually may adapt to nest site competition with Starlings, although martins have come into widespread contact with Starlings only during the last 50 years and such adaptations are not yet evident.

However, I may end on an optimistic note. In colonies that are managed, Starlings represent only a moderate threat to martins and certainly do not constitute any major threat to the species' survival (Brown 1977). If a majority of Purple Martin colonies are managed regularly, there is no cause for alarm. If regular management is supplemented by occasional elimination of Starlings, there is reason to think that Purple Martins will recover in areas where they are scarce and will continue as a component of the North American avifauna for a long time to come.

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