YEARLY FLUCTUATIONS IN A POPULATION OF PURPLE MARTINS

HAROLD MAYFIELD

WE would like to know how the population of an animal species varies from year to year. But a complete census of wild creatures is seldom possible even in a small area, and usually we must infer the amount of change in a population from some gauge of it we can observe. Among birds, for example, the most convenient sample may consist of the singing males we hear or the individuals we see, although we are aware that some may have eluded us and others may have been counted twice; or there may be some other available measure of the number present without direct observation of the birds themselves.

A count of nests may be a convenient indicator of the number of birds of some species, such as those nesting in colonies and ranging widely for their food. A count of nests will be particularly satisfactory as a measure of a population if the bird builds only one nest a year, if there is no large non-breeding segment of the population, and if the males and females are nearly equal in numbers.

The Purple Martin (*Progne subis*) is such a species.

CIRCUMSTANCES OF THIS STUDY

I have had an opportunity to investigate fluctuations in a local breeding population of Purple Martins as a result of my membership on the Advisory Committee of the Toledo Area Sanitary District. This agency maintains a number of martin houses as a part of its mosquito-control efforts in Lucas County, Ohio. The houses are scattered widely enough to seem representative of the area as a whole, and the number of nesting cavities is large enough to lend itself to statistical analysis.

This region is well within the normal nesting range of the species, and the martin here, therefore, should not be subject to any special stresses of a peripheral population. However, in this climate, as elsewhere in the northern part of the range, early arrivals in the spring sometimes starve in their houses during protracted spells of cold weather.

This report covers 10 years, 1953 through 1962, and I hope to continue gathering similar information into future years.

The first 18 houses were in place for the 1953 nesting season. Other houses were added later, and a few were destroyed and not replaced. The largest number of houses in any year was 28. They were placed in widely scattered locations, but all were within 10 miles (16 km) of the Toledo courthouse. The houses were identical in construction, with 16 cavities,

four on a side, and two stories. Each was held aloft on a pole 13 feet (4 m) high.

Each fall, usually in November, long after the martins have migrated south, workmen of the Toledo Area Sanitary District take down the martin houses and haul them to headquarters. There the houses are dismantled and the nests counted, including any of the House Sparrow (*Passer domesticus*) and Starling (*Sturnus vulgaris*). Then the houses are cleaned and reconditioned so they can be returned to their places, "like new," in readiness for the next nesting season.

In all but the first three years of this study, the nest counts were made by one man, James R. Halstead, who has taken a particular interest in this project. In November, 1962, I accompanied the crew of men on this job, taking notes on peculiarities of house locations and observing the count of nests.

NEST COUNTS OF MARTINS

The cavities used by martins are well marked even though some of the contents are jostled about in the handling of the houses. The materials of the nest are distinctive, and a dam of mud and droppings near the entrance is characteristic. I have consulted with friends who have had long experience with martins (particularly Russel Burget of Waterville, Ohio, and Karl Bartel of Blue Island, Illinois) and they express confidence that a count of nests at the time of house cleaning in fall will correspond closely with a count of pairs at the house during the nesting season.

Most published comments about Purple Martins state the number of cavities occupied. Usually, in contrast with this report, the counts are made by sightings of martins as they enter the house openings during the nesting season. Such counts are likely to be accurate if based on observation over a period of days and particularly if the nests endure until young appear at the entrances. However, a casual observer might err by counting empty cavities that are merely being visited at the moment. A male martin often tries to extend his domination over more than one cavity, and birds of both sexes sometimes carry building materials into unoccupied cavities near their own (R. W. Allen and M. M. Nice. A study of the breeding biology of the Purple Martin [*Progne subis*]. *Amer. Midl. Nat.*, 47: 617, 621, 1952.).

A count of nests taken after the nesting season should give a fairly accurate count of the number of breeding pairs present, since the martin normally lays only one set of eggs a year and builds only one nest per year. If a nest is lost early in its development—that is, with eggs or very small young—the adults may nest again; but the scarcity of such reports would lead me to believe renesting to be an infrequent event in this species. I

find only one credible account of martins producing two broods in a year, and this event occurred in a season with an abnormally mild and early spring in southern Illinois (R. F. Johnston and J. W. Hardy. Behavior of the Purple Martin. *Wilson Bull.*, 74: 244, 1962.).

The colonial nature of the martin would lead me to believe that all members of the species congregate at the nesting houses. It is also my impression at my own martin house that all or nearly all of the females attempt to nest and that males and females are about equal in number. The published studies of the bird make no mention of non-breeding females nor of significant numbers of unmated males. Therefore, I believe a count of nests should give a fairly accurate approximation of the local population.

Some of these impressions need verification through intensive study. The circumstances might also present an exceptional opportunity for studying mortality in the species by noting the ratio of first-year males to adult males, since the first-year males can be distinguished, presumably in every case, by very dark feathers on the gray breast of an otherwise female-like plumage.

I know of no reason to suppose there are a large number of non-breeders in this species; but, if there are a few, annual censuses of nests will still offer a reasonably good measure of population changes over a long period of time.

Where a limited number of cavities are under observation, upward swings in population will be registered adequately only as long as there are still vacancies. It is significant, therefore, that in only 2 out of 10 years were any houses filled to capacity. In 1960, 2 houses were filled out of 25; and in 1962, 7 were filled out of 23. And even in the year of maximum population, 1962, nearly half the habitable houses had at least 25 per cent of their cavities vacant.

It is possible that intraspecies pressure may tend to push late-arriving males toward less crowded boxes even before a box is completely filled. Although the gregariousness of the species tends to draw martins to houses that are occupied, territorial pressure is still evident. The first males to arrive in the spring tend to spread out, and each one tries to hold several adjacent cavities; so at first there is only one male on each side of each story of a house, and the residents fight each newcomer vigorously (Allen and Nice, *op. cit.*: 617). However, as long as some houses in the sample remain unfilled, the count should still register an upward swing in the population.

DISCUSSION

The full count of houses and nests for 10 years is reported in Table 1. The gross totals, however, do not reflect accurately the changes from

TABLE 1

PURPLE MARTIN NESTS OVER A TEN-YEAR PERIOD

Location number	*Number of nests per year, 1953–1962 (numbered 1–10)**										*Total*	*Average number of nests per year*
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*		
1	9	12	7	5	8	8	11	14	8	11	93	9.3
2	13	11	8	9	1						42	8.4
3	8	10	8	5	11	10	12	15	10	15	104	10.4
4	D	D	3	6	12	12	9	1	2	0	45	5.6
5	12	12	9	7	5	7	5	12	8	10	87	8.7
6	D										0	
7	13	12	9	13	13	2	7	16	8	16	109	10.9
8	2	5	9	8	6	3	8	8	9	12	70	7.0
9	5	D	0	3	D	4	13	12	7	D	44	6.3
10	14	10	11								35	11.7
11	3	5	1	4	8	3	7	12	0	0	43	4.3
12	7	3	4	8	8	1	7	3	3	8	52	5.2
13	0	0									0	
14	3	7	5	12	5	D					32	6.4
15	9	3	5	6	8	3	8	D			42	6.0
16	8	6	3	2	6	5	5				35	5.0
17	7	10	3								20	6.7
18	0	1	0	3	5	10		0	0	0	19	3.1
19		1	6	4	10	4	13	12	9	14	73	8.1
20		0	0								0	
21		0	4	8	13	4	9	14	12	15	79	8.8
22		11	12	0	5	4	3	2	9	2	48	5.4
23			3								3	3.0
24				0	D						0	
25				12	9	6	10	9	14	16	76	10.9
26				7	13	8	11	14	10	9	72	10.3
27				0	D						0	
28				12	6	3	3	14	4	5	47	6.7
29				7	D	5	6	5	5	D	28	5.6
30				3	5	4	7	11	9	11	50	7.1
31				8	11	1	6	8	7	14	55	7.9
32				4	7	0	10	9	4	16	50	7.1
33				5	13	9	14	16	15	16	88	12.3
34						5	13	14	15	16	63	12.6
35						0	0	0	0		0	
36						4	9	10	4	16	43	8.6
37						4	10	11	11	11	47	9.4
38								5	6	16	27	9.0
39										D	0	
Totals	113	119	110	161	188	129	216	247	189	249	1,721	7.7**

* D = Destroyed by vandalism; blank space = house not in place for nesting season.

** Average number of nests per box per year.

year to year in Purple Martin population, because some of the variation is plainly caused by extraneous factors: the number of houses was not constant; some houses were destroyed by vandals; some houses, for reasons that were not always clear, seemed completely unacceptable to the martins. These latter were usually subsequently moved to other locations, and since they were, in effect, not in the sample, they have been dropped from the totals when judged unusable.

The houses judged unacceptable to the martins are an interesting subgroup. Sometimes the reasons appeared self-evident, such as disturbance from a construction project nearby, or the gradual encompassing and overshadowing of the site by trees and buildings. In one instance (Number 18 in Table 1), a house formerly used was then no longer occupied for three successive years. The possible cause was a strong odor emitted intermittently from a small chemical plant nearby. That martins may be intolerant of offensive odors was suggested by I. H. Johnston, who said that fumes from a burning tar barrel caused martins to abandon a roost (*Birds of West Virginia.* Charleston, West Virginia, State Dept. of Agric., 1923. Sup. 61.). There may be other factors also, still unidentified, that disqualify a site. The workmen who handle these houses think that, if there are no wires nearby for perching, a site is likely to be unattractive.

One might suspect that a house would be occupied less fully in its first year than in later years after martins have had more time to become acquainted with it. However, Table 1 shows no pronounced tendency of this kind.

For purposes of analysis and comparison (Table 2), we may focus our attention on those houses that are habitable, ignoring those destroyed and those totally unsuitable for other reasons.

The yearly variation in the percentage of habitable cavities with nests gives a fairly good indication of trends in the population. But it has a potential long-term error resulting from the efforts of the men in charge of these boxes to increase their use by moving boxes to more promising locations. Hence, there is a tendency for men to upgrade the attractiveness of the average site in the sample and thus bring about a spurious indication of an increase in the population.

TABLE 2

SUMMARY OF PURPLE MARTIN NESTS, 1953–1962

Variable	*1953*	*1954*	*1955*	*1956*	*1957*	*1958*	*1959*	*1960*	*1961*	*1962*
Number of boxes erected	18	21	21	27	27	28	26	27	26	26
Number of boxes habitable*	15	17	20	25	23	26	25	25	24	22
Per cent of habitable cavities used**	47	44	34	40	51	31	58	62	49	70
Number of nests habitable in this and succeeding year	108	119	93	151	182	119	203	247	177	
Number of nests habitable in this and preceding year		107	104	103	188	107	216	242	189	249
Difference in number of nests as a percentage of preceding year		−1	−13	+11	+24	−41	+82	+19	−23	+41
Yearly index (1953 = 100)	100	99	86	95	118	70	127	151	116	164

* See text for explanation.

** Based on 16 habitable cavities per habitable box. Average for 10 years = 48 per cent.

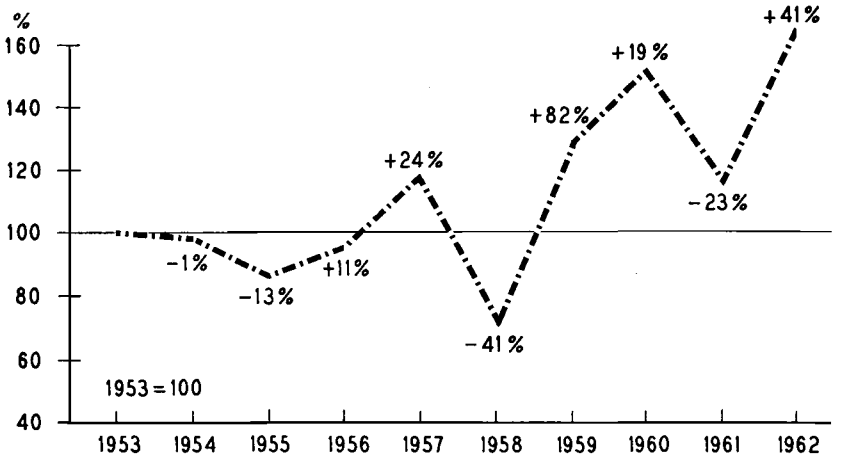

Figure 1. Changes in Purple Martin population index. Each number along the broken line shows the increase (+) or decrease (–) as a percentage of the population in the preceding year.

This source of error can be minimized by pairing each year with the next and by using for comparison only the nest counts from the *same* locations in adjacent years. For example, starting with 1953, and considering only the same boxes habitable in 1954 also, I find in 1954 a decline of one per cent of the 1953 population. And continuing similarly, I find in 1955 a loss amounting to 13 per cent of the 1954 population. Thus, by calculating the trend one year at a time, I can portray the changes in the population, not in terms of numbers of birds, but in terms of percentage increases and decreases from each preceding year. This trend can be charted as a population index. I have arbitrarily selected the population in my starting year, 1953, to represent the figure 100 on the scale. The result is shown in Figure 1.

Even here, we need to remind ourselves that not all the variables are held constant. At the same martin house, the environment is always changing for better or worse. People improve a location by putting up wire perches or by opening the area around a house. But in another location, trees are growing up around a house, or new buildings are encroaching on the open space needed by martins. However, since the sample includes a wide variety of situations, I think many of these positive and negative influences may offset one another, and the quality of the habitat for the whole group of boxes is not greatly altered from one year to the next.

Figure 1 reveals that the greatest annual decline was 41 per cent in

1958, and the greatest annual increase, 82 per cent, occurred in the very next year, 1959. Observers in southern Florida had reported many Purple Martins among other species killed by a late-winter cold spell in 1958 (D. James. A summary of the winter season. *Aud. Field Notes*, 12: 259, 1958.). Subsequently, however, there seems to have been no general recognition of a decrease in martins during the spring migration or the nesting season. Therefore, perhaps the decrease in Toledo was merely a local effect, or perhaps a sizable decline in a species that is still abundant is likely to pass unnoticed except by census takers.

It is of interest that Hickey, commenting on a group of birds taxonomically distant from the swallows but comparatively well studied with regard to population dynamics, concluded "that on good range gallinaceous populations fluctuate with annual increases of less than 100 per cent and with annual decreases of less than 50 per cent" (J. J. Hickey. Some American population research on gallinaceous birds. Pp. 326–396 *in Recent studies in avian biology* [A. Wolfson, ed.], Urbana, Illinois, Univ. Illinois Press, 1955.).

The 10 years of the present study were too short a period to reveal cyclic periodicity, if any exists.

ACKNOWLEDGMENTS

I would like to express special appreciation to Bruce Brockway, Jr., Superintendent of the Toledo Area Sanitary District, under whose direction the martin houses were built and the nest counts made, and also to Harrison B. Tordoff, who read an earlier draft of the manuscript.

SUMMARY

Fluctuations in a local breeding population of Purple Martins (*Progne subis*) were measured by annual counts of nests over a 10-year period, 1953 through 1962. The sample was provided by 18 to 28 identical martin houses, each with 16 cavities, placed at scattered locations in and near Toledo, Ohio. To minimize the effect of variations from year to year in the number of habitable houses and the effect of moving some houses from one location to another, the nest counts in just those houses considered habitable and unchanged in location for two consecutive years were compared. These pairings of years were used to yield a percentage increase or decrease for each year, charted as a fluctuating index (1953 = 100). The greatest annual decline, 41 per cent, occurred in 1958; and the greatest annual increase, 82 per cent, occurred in 1959.

River Road RFD, Waterville, Ohio.