CLUTCH SIZES, HATCHABILITY RATES, AND SEX RATIOS OF SPARROW HAWKS IN EASTERN PENNSYLVANIA

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WITHIN recent years many biologists, including Clement (1965) and Broun (1966), have expressed alarm over the possibility that a rapid and serious decline is occurring in the population of birds of prey of the United States and Canada. If objective evaluations of the population levels of our raptors are to be made, detailed information is required, from many areas, on the success, failure, and rates of reproduction of each raptor species. Relatively little detailed information of this type is currently available. This paper presents data obtained from a study of clutch sizes, hatchability rates, and sex ratios of Sparrow Hawks (*Falco sparverius*) living on Charlex Farm in Albany Township, Berks County, Pennsylvania. From 1959 through 1966, 21 active Sparrow Hawk nests were located on the study area. The positions of 11 of these nests during the years 1960 through 1963 have been shown in a previous paper (Heintzelman, 1964). In order to limit human disturbances at nests, only 14 of the available 21 active nests were studied in varying degrees of thoroughness.

During this investigation, Heintzelman was active in the field from 1959 through 1963, and Nagy was active from 1961 through 1966. Previous papers have been published dealing with the population changes of these Pennsylvania falcons (Nagy, 1963; Heintzelman, 1964), their food habits (Heintzelman, 1964), and their aerial capture of prey (Heintzelman, 1966*b*).

METHODS

Our field methods were routine. All nests were in man-made boxes placed at favorable sites in trees along secondary roads and hedge-fence rows. Nest boxes were assigned permanent letters. Thus box B, for example, was the same box during all years of the investigation. Contents of nest boxes were determined by climbing to a particular box and examining its interior. Eggs were numbered with an ordinary soft lead pencil in the order in which they were deposited. This enabled us to determine the exact egg hatching sequence at certain selected nests. Data were recorded on printed field data forms designed for use on this research project.

EGGS

None of the Sparrow Hawks observed during our investigation made any attempt to construct a nest. Our falcons deposited their eggs directly on the bottoms of nest boxes. Sometimes debris from previous nesting seasons

FIG. 1. Sparrow Hawk nest 1962-B, showing a completed clutch of falcon eggs which were deposited upon materials remaining in the nest box as a result of a previous nesting attempt by Starlings.

littered the bottom of a box, and eggs were placed on this old material. In other cases, we placed sawdust on the bottoms of the newly constructed boxes and eggs were deposited on this. One nest, 1962-B, contained plant material remaining from the nesting activities of a pair of Starlings (*Sturnus vulgaris*), and the Sparrow Hawks deposited their eggs directly upon this material (Fig. 1).

Early in this investigation, Heintzelman attempted to determine the actual date on which the first egg was deposited in each of three nests. The exact date, 23 April 1960, was determined for nest 1960-B. In the literature, Bent (1938:120) lists 86 egg dates for New Jersey and Pennsylvania. For 57 records, they range between 17 April and 3 June, and for 29 records between 28 April and 14 May. Our egg dates (although not necessarily first dates) for the years 1959 through 1963 range from 15 April (1961) to 4 July (1959). The latter date is extremely late and may be the result of a second nesting attempt. It is later than any record which we find recorded in the literature.

TABLE 1
CLUTCH SIZES, HATCHABILITY, AND SEX RATIOS

Nest Number	Number Eggs in Completed Clutch	Number Eggs Hatched	Per Cent Eggs Hatched	Number Females	Number Males
1959-B	2	2	100	1	1
1960-A	5	0*	0	0	0
1960-B	5	5	100	3	2
1961-A	5	5	100	3	2
1961-B	6†	5	83	1	4
1961-E	No Data	No Data	—	2	1
1961-F	3	3	100	1	2
1962-B	4	3	75	0	3
1962-E	3	3	100	0	3
1962-F	6	6	100	4	2
1963-B	5	5	100	3	2
1964-J	5	2	40	2	0
1965-B	5	4	80	3	1
1966-B	1	0	0	0	0
Totals	55	43		23	23

* Eggs disappeared before hatching.
† One egg accidentally destroyed while being numbered.

During 1960 and 1961, Heintzelman attempted to determine the interval between egg laying at three Sparrow Hawk nests. Each nest was visited at least once each day. During the period of oviposition, two and three visits were made each day. In the three nests which were intensively studied, all eggs were deposited on alternate days (that is, if an egg was laid on a Monday the next egg was laid on a Wednesday, etc.) except for nest 1961-B which followed this pattern up to and including the fifth egg. A sixth egg was deposited on a different time schedule, and we were unable to determine exactly when it was deposited. However, we know that it was not laid on a schedule of alternate days. It probably required an extra day which is in disagreement with the findings of Sherman (1913).

The clutch sizes of these nests ranged from one to six eggs (Table 1). The mean clutch size for 13 of these nests was 4.23 eggs. The mean clutch size for 13 Sparrow Hawk nests recorded on Cornell University Nest Cards is 4.69 eggs. In experimental, captive Sparrow Hawks, Willoughby and Cade (1964:77) state that 12 clutches of Sparrow Hawk eggs averaged 3.66. The range was three to four eggs per clutch.

It is difficult to determine the period of incubation of wild birds. Sherman (1913) states that the incubation period for the Sparrow Hawk eggs in the nest which she had under observation was 29 and 30 days, Roest (1957)

recorded 30 to 31 days, and Willoughby and Cade (1964) recorded an average of 28.4 days with a range of 27 to 33 days. The eggs in our nest 1960-A were destroyed during the incubation period due to unknown causes. However, in nest 1960-B, the first three eggs hatched on the same day. If we assume that incubation began with the laying of egg number three, then the incubation period for eggs number one, two, and three was 30 days when the day egg number three was deposited is considered as day 0 of incubation. On the other hand, if we follow the method used by Nice (1954) in which the incubation period is calculated from the time that the last egg is deposited to the time that the last egg hatches, where the day the last egg was deposited is considered as day 0, then the incubation period for this last Sparrow Hawk egg (number five) was 28 days. Egg number four in this clutch required 30 days of incubation.

Six eggs formed the full clutch in nest 1961-B. We do not know the exact dates when the first two eggs were deposited, and the sixth egg was broken as it was being numbered. Of the remaining eggs, number three required 35 days of incubation, number four required 33 days, and number five required 32 days. The mean period of incubation, in days, for eight marked eggs from two Sparrow Hawk clutches on Charlex Farm was 30.9 days.

HATCHABILITY RATES AND SEX RATIOS OF NESTLINGS

We were particularly interested in the hatchability rates of our Sparrow Hawk eggs because this species is one which is widely exposed to a variety of agricultural chemicals which might have adverse effects on the species' reproductive capacity. Table 1 shows that the hatchability rate of specific clutches varied greatly, but the over-all rate of the 55 eggs which were deposited was about 78 per cent. This seems to be a fairly high rate in view of the ecology of the species.

On Charlex Farm, the sex ratios of nestling Sparrow Hawks varied from nest to nest and from year to year (Table 1). However, the ratio of males to females during the eight years of this investigation was exactly 50 per cent males to 50 per cent females. In contrast, other studies have generally shown that a population of Sparrow Hawks contains more males than females. Roest (1957:16–18) sampled the sex ratios of Sparrow Hawks during late summer, fall, and winter, and found that 67 (63 per cent) of 107 birds observed were males. Broun (1949:171) states that about 65 per cent of migrant Sparrow Hawks passing Hawk Mountain are males. The sample size is not given. At Bake Oven Knob, Lehigh County, Pennsylvania, observations on migrant hawks were conducted from 1961 through 1966. During this time, 665 Sparrow Hawks passed Bake Oven Knob (Heintzelman and Armentano, 1964; Heintzelman, 1966*a*; Heintzelman, unpublished data).

Sexes were recorded for 177 of these birds, with 107 (60.4 per cent) being males. An exception to this is the population of Sparrow Hawks which Cade studied in southern California (Willoughby and Cade, 1964:78). Of 728 Sparrow Hawks which were identified to sex, 277 were males. This is a ratio of one male to 1.62 females, or about 38 per cent males.

Cade was unable to explain the significance of the difference between the sex ratio composition of the southern California Sparrow Hawk population as compared with other areas where males predominate. Likewise, we do not know why our Charlex Farm population of nestling Sparrow Hawks deviated so far from other populations in respect to sex ratios. Perhaps it was a somewhat atypical population, perhaps female Sparrow Hawks have a higher mortality rate than males over a given period of time, or perhaps there is a difference in the migration pattern of the two sexes.

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NEW LIFE MEMBER

A recent addition to the roster of Life Members of the Wilson Ornithological Society is Mr. J. de Navarre Macomb, Jr. of Chicago, Illinois. Mr. Macomb holds degrees from Princeton University and Illinois Institute of Technology. At present he is Assistant to the Director of Public Relations of Inland Steel Company. He is a member of the AOU, Cooper Society, several Audubon Societies, as well as the Explorer's Club of Chicago, and several professional engineering societies. His interests in ornithology have centered about bird photography and he has specialized in tropical and subtropical birds. The photograph shows him in a Flamingo colony on Bonaire, N.W.I., examining some eggs which having fallen from the nest have become cooked in the high temperatures prevailing there. On his photographic expeditions Mr. Macomb is usually joined by his wife Marjorie.