SWAINSON'S HAWKS ON THE LARAMIE PLAINS, WYOMING

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ABSTRACT.—The biology of Swainson's Hawk (*Buteo swainsoni*) was studied during the breeding season of 1964 on a 1,554 km^2 area west of Laramie, Wyoming. The hawks show a statistically significant preference for mates of the same color phase. The study tract supported 55 pairs and 5 single adult Swainson's. Based on various considerations, the area within 0.8 km of possible nesting sites added up to 401.5 km^2 of Swainson nesting habitat to give a population density of 1 pair or unmated adult per 6.7 km^2. Eggs were laid in 49 nests located with no significant preference for dry grass, irrigated meadows, or the edge between those habitats. The 31 probably complete egg clutches seen contained two or three eggs (mean 2.55). Young birds were fledged by 33 pairs for an average of 2.06 young per pair, or 1.24 young per pair for each of the 55 pairs in the study area. In the 33 nests fledging young, 15% of the eggs were lost to infertility, death of the embryo, and unknown causes. No second sets of eggs were laid after destruction of the first set. One-third of the nests in which eggs were laid were destroyed by crows, owls, the wind, and unknown causes. Food used by the Swainson's included 115 small mammals, 42 birds, 11 other vertebrates embracing aquatic vertebrates, and a few insects. Notes on nest placement, behavior, causes of mortality, numbers of other raptors in the study area, and relationship with other large birds are given.—*250 W. Bullard, Apt. 204, Clovis, California 93612.* Accepted 5 June 1975.

I studied the breeding biology of Swainson's Hawk (*Buteo swainsoni*) during 1964 on a 1,554 km^2 tract just west of Laramie, Wyoming. This tract is part of an intermontane plateau at an elevation of 2,200 m with an annual precipitation of 28 cm. Swainson's Hawk occupied the study tract from 18 April 1964 to 22 September 1964 during which time 16.3 cm of rain fell. The tract includes 113 km of the Big Laramie River plus tributary streams and canals, small lakes totaling 20 km^2, and approximately 288 km^2 of irrigated sedge meadows, while the rest of the land was shortgrass plains with some sagebrush (*Artemisia*) and greasewood (*Sarcobatus vermiculatus*) zones.

I climbed to most nests in the study plot whether or not any hawks were seen in the vicinity. Where practicable before the eggs hatched, I climbed trees near the nest tree to disturb the birds less. Visits to active nests were made at irregular intervals according to what I thought provided the least disturbance to the hawks, averaging about five visits per nest. My experience prior to the present study showed that Swainson's Hawk sometimes deserts the nest with little provocation, as Bent (1937) also noted.

PRENESTING BEHAVIOR

My first sighting of a Swainson's in its breeding territory was on 18 April and the latest breeding pair arrived on their territory on 10 June. Pairs were seen on their territories from 16 to 51 (mean 32) days before laying eggs. Bendire (1892) found that Swainson's Hawks are in their territories at least a month before laying eggs.

As soon as they arrived in spring I noted that the birds usually gave alarm cries when I entered their territories. I saw them arranging twigs in their nests as early as 25 days and sitting in the nest 13 days before laying eggs.

I classified the birds in 42 pairs as being either light or dark phase, considering

most intermediate plumages as light phase. Of 42 males, 8 were dark phase, as were 11 of 42 females. Both birds in 29 pairs were light phase, both in 6 pairs were dark phase, and 7 pairs were mixed. I assumed the smaller bird that was generally less aggressive to humans was the male. Preference of the birds for a mate of the same color phase was significant at the 0.95 level of confidence using the Chi-square test. Williams and Matteson (1948) found that most Wyoming Swainson's were light phase although some areas had more dark phase birds than others. In California, Sharp (1902) reported the dark phase to be more numerous. These three authors may have classified intermediate plumages differently than I did.

NESTING

I found eggs in 49 nests in the study plot. One nest built on the crossbars of a telephone pole was later destroyed, probably by linemen. Of the remaining 48 nests, 43 were in trees, either narrowleaf cottonwood (*Populus angustifolia*) or peachleaf willow (*Salix amygdaloides*), and the other five nests were in relatively isolated willow shrubs (*Salix* with several woody stems and less than 5 m). Munro (1935) found that Swainson's Hawks often nested on telephone poles in Saskatchewan and thought that this was due to lack of trees. The nest on the telephone pole in the present study was several kilometers from any trees. None of the few buttes in the study tract were used by Swainson's for nesting, and Williams and Matteson (1948) noted no ground nests in Wyoming; but others (Seton 1890, Bent 1937) have reported nests on the ground, on buttes, or on cutbanks.

Height of nests in trees from the top of the nest vertically to the ground ranged from 2 to 11.6 m (mean 7.6). Nests in shrubs ranged from 2 to 4.3 m in height above ground (mean 2.4). Average height of all 48 nests was 7 m. For each of the five nests in bushes, apparently suitable trees were available within 75 m, and in fact in four out of five cases, the trees contained old hawk nests. All of the six lowest nests, 2.5 m or less from the ground, fledged young successfully. Williams and Matteson (1948) noted that nests near Laramie were placed in willow bushes, but "in areas where there were no cottonwoods."

The heights of nests observed in this study were similar to those recorded by others for similar habitat (Bowles and Decker 1934, Bent 1937). Sharp (1902) noted heights between 10.6 and 22.9 m in tall cottonwoods and sycamores in California. Among the nests in trees in my study, 30 were in a main fork near the top, 7 were placed against the trunk, and 6 were on side branches. A few nests were so enclosed by branches that the hawks had to thrash their way free when flushed.

Half of the tree nests were in isolated trees. Of 16 pairs that appeared to have a choice between nesting in a clump or in an isolated tree close by, 6 used the clump and 10 the tree. Half the nests in clumps or rows of trees were located at the edge of the clump or the end of the row. Bendire (1892) mentioned that isolated trees of any size with a commanding view were Swainson's favored nesting sites in Oregon, Washington, Idaho, and Montana.

In this study, 12 pairs used nests built prior to 1964. Black-billed Magpies (*Pica pica*) had originally built four of these nests. Whether the other pairs of Swainson's Hawks used old nests or built new ones was not known. About 80% of the active nests had at least one other nest nearby.

McCreary (1939) believed that Swainson's Hawk will build from one to three nests within their home range to which they return season after season and that a nest

may be used several years in succession. Bowles and Decker (1934) and Seton (1890) reported that Swainson's prefer to repair an old nest they had used previously, but all 14 pairs Cameron (1913) watched in Montana built new nests.

The study plot contained 123 separate locations with tree or bush nest sites, probably not subject to much human interference and 1 km or more apart, that I judged to be suitable for Swainson's nests; 43 were in a dry grass situation, 21 in irrigated meadows, and 59 were at the edge between those vegetation types. The 49 pairs laying eggs were distributed as follows: 15 in dry grass, 5 in irrigated meadows, and 29 in the edges. The Chi-square test at the 0.95 level shows no preference for any of these nesting habitats.

Population Density

I found 55 pairs and 5 single adult Swainson's Hawks within the boundaries of the study tract. Birds were never seen more than 2 km from known nests. For a study of density, 17 pairs of nests were selected, the criteria being that the pairs of hawks interacted with their neighbors and yet had unused nest sites between the active nests. Distances between these pairs of active nests ranged from 0.58 to 2.88 km (mean 1.77). In several cases the territorial boundary appeared to be at the halfway point between adjacent nests as observed when the hawks were both undisturbed and disturbed by me. Craighead and Craighead (1956) plotted home ranges of pairs of Swainson's Hawks and found that they averaged 2.6 km^2 with an average maximum diameter of 2.4 km. The ranges of separate pairs rarely overlapped. Macoun (1903) found that no more than one pair occupied the same bluff (probably vernacular for clump of trees) and that the nests were usually at least 0.4 km apart. In California Sharp (1902) noted that Swainson's never strayed far from the nest, while in Manitoba, Criddle (1915) saw that they traveled up to 8 or more km to a hunting ground. Based on the above considerations, I tried to estimate the actual Swainson nesting habitat within my study plot. The area within 0.8 km of all possible nesting sites totaled about 401.5 km^2. Considering unmated adults to have the same home range size as mated pairs, the population density was 1 pair per 6.7 km^2. Craighead and Craighead (1956) found five pairs of Swainson's in their 31.2 km^2 study area in Jackson Hole, Wyoming, for a population density of 1 pair per 6.2 km^2. McCreary (1939) estimated that in late May of 1938 more than 50 pairs of Swainson's were nesting within 24 km of Laramie. Williams and Matteson (1948) noted that in 1942 numbers were less than in 1938, and 1943 saw a marked absence of *Buteos* in southeastern Wyoming. Mathisen and Mathisen (1968) in comparable yearly roadside counts in the Nebraska panhandle recorded 65 Swainson's in 1957, 78 in 1958, and 29 in 1959. Thus the population appears to fluctuate considerably, superimposed on whatever other trends in numbers exist.

Relationship with Other Large Birds

The Swainson's Hawks shared the area I studied with 5 pairs and 2 unpaired Red-tailed Hawks (*Buteo jamaicensis*), 10 pairs and 2 single Ferruginous Hawks (*B. regalis*), 13 pairs of Marsh Hawks (*Circus cyaneus*), 3 pairs and 3 unpaired Golden Eagles (*Aquila chrysaetos*), 39 pairs and 5 single Great Horned Owls (*Bubo virginianus*), 1 pair of Prairie Falcons (*Falco mexicanus*), 1 pair of Long-eared Owls (*Asio otus*), and a minimum of 35 pairs of Common Crows (*Corvus brachyrhynchos*).

The Ferruginous Hawks nested on buttes, barren hillsides on the ground, or in pine trees. The Red-tailed Hawks nested only in the tall dense continuous stand of cottonwoods along the Big Laramie River southwest of Laramie. Craighead and Craighead (1956) found Swainson's and Redtails nesting in the same area in Jackson Hole, Wyoming, but thought that the Redtails acquired the better nest sites because of their earlier establishment of territories and more aggressive nature. Two pairs of Golden Eagles occupied clumps of trees that might otherwise have been used by Swainson's. The Long-eared Owls occupied a clump of willow bushes.

Swainson's Hawks and Great Horned Owls were found nesting simultaneously in the same small groves of trees in five cases. All but one of these Swainson's nests were destroyed in the egg stage. An additional nine nests were located in the probable hunting ranges of Great Horned Owls, and three of these failed. Owl feathers at one nest where two almost fledged Swainson's nestlings disappeared indicated a Great Horned Owl probably killed them. Horned owls nested near occupied ranch houses, where Swainson's did not.

Flushing a Great Horned Owl into the open near a Swainson's nest was sure to produce an attack, although an owl was actually struck in only one case.

One magpie nest, but no other passerine nest, was found in the same tree as a Swainson's nest. The magpie nest failed while the Swainson's nest in the upper part of the tree was successful. The literature (e.g. Sharp 1902) cites instances of small birds nesting close to and even in the sides of Swainson's nests. One unsuccessful Swainson's nest was at the edge of a Great Blue Heron (*Ardea herodias*) colony in which Great Horned Owls were also nesting.

At least 7 of 10 crow nests close to Swainson's nests were destroyed. Feathered young were in two of the crow nests. Several of the destroyed crow's nests were lined with green leaves, a characteristic habit of Swainson's Hawks. Where crows were nesting in the vicinity, 5 of 13 Swainson's nests were destroyed in the egg stage with some of the eggs apparently pecked open. In five cases where Swainson's, crows, and Great Horned Owls were nesting in the same locality, two Swainson's nests were destroyed, two crow nests were destroyed, and in one case both the Swainson's and crow nests were destroyed. Swainson's nesting success, 22 out of 29 nests, was higher where neither crows or owls nested in the vicinity.

BEHAVIOR

I did not see male Swainson's Hawks brood or feed young, and only once did I see one incubate. Cameron (1913) and Seton (1890) give instances of flushing incubating males, but indicate these were exceptional cases. Bendire (1892) wrote that both sexes assist in incubation. In my study females performed these duties until the young were about 20 days old after which the females spent considerable time hunting. Males were absent on about 60% of first visits to nests but only 30% of second and subsequent visits. Possibly their hormone levels were changed on the second visit or they had learned I wasn't dangerous. The hawks vocalized at about 66% of the first visits and in all but a few cases on remaining visits. The calls of females were shorter and lower pitched. Aggressiveness toward humans varied, some females coming within a few meters while others stayed hundreds of meters away. Usually the male stayed twice as far away as the female. Approximately one-third of incubating females did not flush from the nest until I threw a stick near the nest or climbed the tree. Females brooding young seldom waited until a human stopped walking near the

nest before flushing. In a few cases the male called before the female flushed, but usually he was silent until she left the nest.

Eggshells were evidently carried from nests shortly after the hatchlings dried. Signs of nest occupancy on the ground were very few until the young hatched. Almost all active nests were lined with leaves including those of the nest tree. Two females were seen to break leafy twigs with their beaks from the outside of the nest tree and fly to the nest with them. Often the pairs lined old nests near active ones and pairs that laid no eggs lined one or more nests. Young of the year evidently remained in their parents' territories until migration. In 6 of 20 possible cases one or more circled and called with the parents when I intruded into the territory.

Productivity

In the study tract I found 49 pairs of Swainson's with active nests, 6 pairs without eggs, and 5 single birds. Thus 17 of 115 birds or 14.8% of the population in 1964 was not breeding. All these nonbreeders were in adult plumage.

Among the 49 active nests, some clutches were destroyed, possibly before they were completed, and six had hatched by the time I found them. The 49 pairs produced a total of 109 or more eggs, giving a mean clutch size based on these numbers of 2.22 or more.

The 31 probably complete egg clutches that I saw contained two or three eggs with a total of 79 eggs for a mean clutch size of 2.55. Several authors (Bendire 1892, Sharp 1902, Cameron 1913, Bowles and Decker 1934, Williams and Matteson 1948) also found two or three eggs per clutch to be the usual number. Sharp (1902) in California found one instance of an apparent complete clutch of one. Criddle (1915) in Manitoba said that the usual number of eggs was four, sometimes three, and ranged up to seven.

In my study area 33 of 55 or 60.0% of the pairs fledged at least one young. The 33 pairs succeeded in fledging 68 young for an average of 2.06 young per pair, which was 1.39 young for each pair laying eggs or 1.24 young for each of the 55 pairs in the study area. No second sets of eggs were laid after the destruction of a first set, but I believe one female laid her second and third eggs in a different nest after her first egg was destroyed. The second nest was already built close by and the second and third eggs were laid shortly after the first. One pair built two new nests following destruction of their eggs, and another pair not known to have had any eggs built a second nest. These three nests were flimsy in construction and at the extreme top of a tree in the vicinity of the original nest tree. Sharp (1902) noticed the same characteristics of renesting attempts. One apparently unmated female laid a set of eggs that were destroyed. She then built a new but unlined nest a few feet higher in the same isolated tree. No male was ever seen within several kilometers of this nest.

Mortality

Several owl and fledgling hawk feathers on the ground near the nest tree indicated that a Great Horned Owl probably killed the two large young in one nest. Probable causes for the destruction of whole clutches of eggs were: three destroyed by crows, two blown down by the wind, and one destroyed by man. Eggs were smashed from an unknown cause in one nest and the eggs disappeared from eight other nests. Thus 16 of 49 or 33% of the nests in which eggs were laid were destroyed. Whether any

pairs deserted the nest before it was destroyed is not known. Of the 15 pairs whose nests were destroyed in the egg stage six pairs were not seen in their territories again and two other pairs no longer vocalized at me.

In the 33 nests that were successful, 12 of 80 or 15.0% of the eggs were lost. Four eggs were apparently infertile, the embryo died in two, and six others disappeared. Cameron (1913) wrote that in about half of the clutches of three he observed, one egg did not hatch. In my study, three of the four infertile eggs were in clutches of three. The total mortality of the 109 or more eggs and young produced until the fledglings left the nest was a minimum of 41 or 37.4%. Probably no eggs were kicked out of nests because none seemed to be misplaced even when a parent bird flushed hastily. Small biting flies, ants, mosquitoes, and fly larvae in the ears bothered the nestlings but were not known to have caused any mortality. No cannibalism or disease was known to have occurred.

FOOD

Analysis of prey I saw taken to nests or found fresh in the nest, along with bones in the nest and regurgitated pellets indicated the hawks used the following as food: 115 small mammals, 42 birds, 5 fish, 4 salamanders, a frog, a snake, a few insects. Thus 68% of the vertebrates taken were mammals and 25% were birds. The highest prevalence of birds in the diet of Swainson's Hawk given in the literature is 10 found in 111 stomachs (McAtee 1935). Criddle (1915) stated that 80% of the food is rodents but many birds are also taken.

Among the mammals I recorded taken by the Swainson's Hawks in this study were thirteen-lined ground squirrels (*Citellus tridecemlineatus*), Richardson's ground squirrels (*C. richardsoni*), desert cottontail rabbits (*Sylvilagus auduboni*), northern pocket gophers (*Thomomys talpoides*), white-tailed prairie dogs (*Cynomys leucurus*), and long-tailed weasels (*Mustela frenata*). Among the birds were blackbirds, Western Meadowlarks (*Sturnella neglecta*), ducks, sparrows, Sage Grouse (*Centrocercus urophasianus*), Horned Larks (*Eremophila alpestris*), and crows. The insects were Orthoptera (*Stenopalmatus* and grasshoppers) and *Coleoptera*. Aquatic animals eaten were white suckers (*Catastomus commersonnii*), a frog, and tiger salamanders (*Ambystoma tigrinum*) Sexton and Marion (1974) wrote recently of seeing Swainson's Hawks apparently catching swimming toads (*Scaphiopus bombifrons*). The majority of prey items in my study were young animals. Parents carried unused portions of prey from the nest and dropped them at a distance.

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