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TWO METHODS OF SEXING ADULT TREE SWALLOWS BEFORE THEY BEGIN BREEDING

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Abstract.—We present data on two methods of sexing adult Tree Swallows before they develop a brood patch or cloacal protuberance. Based on measurements of 219 adults, 100% of the birds with a brown forehead ($N = 85$) were females. Among the 140 known adult females examined, 61% had a brown forehead. The sex of adults could also be classified with 95% accuracy based on a flattened and straightened wing length of ≤ 113 mm (females) or ≥ 122 mm (males). Almost half of the adult Tree Swallows caught early in the season (before egg-laying) could be sexed using a combination of these criteria.

DOS METODOS PARA DETERMINAR EL SEXO EN GOLONDRINAS (*TACHYCINETA BICOLOR*)

Sinopsis.—Se determinó el sexo de especimenes de *Tachycineta bicolor* (previo a que estos desarrollaran la protuberancia cloacal o el parcho de incubación) mediante analisis morfométrico y diferencias en coloración. Todos los adultos con la frente parda resultaron ser hembras (85 de 219). El 61% ($N = 140$) de todas las hembras examinadas mostró pardo en la frente. Tomando en consideración el largo del ala se determinó el sexo de los adultos con un 95% de confiabilidad. Los especimenes con medidas menor a 113 mm resultarón hembras, aquellos con tamaño mayor a 122 mm, machos. Utilizando una combinación de ambos criterios (color y medidas) se determinó el sexo de mas del 50% de todos los adultos examinados, previo a que estos se reprodujeran.

The Tree Swallow (*Tachycineta bicolor*) is one of many avian species in which the sexes are similarly colored during the breeding season. In such species the sex can often be determined by the presence of a brood patch or cloacal protuberance; however, this distinction is not possible before the birds begin breeding. The purpose of this study was to identify criteria for sexing adult Tree Swallows before they begin breeding.

In the Tree Swallow, at least 95% of second year (one-year-old) females can be identified by their brown subadult plumage on the upperparts (Hussell 1983). However, over 95% of after-second-year females and all males have between 90 and 100 percent blue-green iridescent adult plumage on the upper parts of the body (Hussell 1983). The 1980 revision of the key to the age and sex of Tree Swallows in the North American bird banding manual (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1977) classifies birds with adult plumage as females if they have the forehead and feathers at the base of the nostrils brown. Although several authors have noted that females sometimes have a brown forehead (Cohen 1984, Hussell 1983, Kuerzi 1941), there are no published data on the accuracy of this method for sexing adults, or the proportion of adult females that have a brown forehead.

Adult Tree Swallows often arrive at the breeding grounds 5–6 wks before egg-laying (Kuerzi 1941), so studies of their early season breeding ecology such as arrival time, nest site selection, mate choice, and huddling behavior (Weatherhead et al. 1985), would be enhanced by some method of sexing adults before they develop a brood patch or cloacal protuberance. Although Cohen (1984) suggests that differences in behavior can be used to distinguish the sexes, such differences are not useful for sexing birds in the hand. Our study examines the extent to which brown plumage on the forehead and wing length can be used to sex adult Tree Swallows.

METHODS

The Tree Swallows in this study were captured in 1985 and 1986 from two populations that breed in grids of nest boxes at the Queen's University Biological Station, Chaffey's Lock, 50 km north of Kingston, Ontario. The New Land (NL) population consists of about 70 nest boxes distributed throughout several hayfields. The Northeast Sanctuary (NES) population has about 40 nest boxes over open, shallow water. Beginning in early April and continuing through the breeding season, Tree Swallows were captured using mist nets and nest box traps (Stutchbury and Robertson 1986). We avoided capturing birds in their nest boxes during egg-laying, since they have a tendency to abandon their nests at this time (Burtt and Tuttle 1983, Cohen 1985). Each bird was banded with a Canadian Wildlife Service numbered band. Birds with less than 90% iridescent blue-green plumage over the upper parts of the body (subadult plumage) were classified as females (Hussell 1983). Once breeding had begun, birds with adult plumage were sexed by the presence of a brood patch (female) or cloacal protuberance (male). In many cases, the sex of resident birds was later confirmed by observations of copulations, and identifying the mate of known females by observing territorial and parental behavior.

The extent of brown plumage on the forehead was measured by placing the end of a ruler firmly against the beak, and recording to the nearest millimeter the height of the brown band across the forehead. In many cases there were just a few brown feathers at the base of the forehead that did not form a distinct band, so this was recorded as "slight."

The flattened and straightened wing length was measured to the nearest millimeter using a ruler with an upright stop secured to the end. The bend of the wing, held in a natural position, was held firmly against the stop, and the wing was flattened along the ruler to obtain a maximum length (Svensson 1984). This method provided a more repeatable measure than the unflattened wing chord length.

To reduce the variation in wing length measurements only birds caught early in the season (before 10 May) were used in this analysis. Wing tips may become worn or damaged over the season as birds make frequent trips into their nest boxes. Females of our study population began egg-laying shortly after 10 May, so after this time adult birds can be sexed based on whether they have a brood patch or cloacal protuberance. Before combining the data from 1985 and 1986, we tested whether the mean wing lengths were the same in both years. For these two years, there was no significant difference between mean wing length of adult males (Student's t-test: $t = 0.01$, df = 59, $P > 0.90$), adult females ($t = 1.08$, df = 109, $P > 0.20$), or subadult females ($t = 0.42$, df = 73, $P > 0.90$).

We scored the forehead plumage and measured the wing length of birds regardless of whether or not the sex was known at that time, but only those of known sex or that were subsequently sexed were used for analysis. Only the first measurement of an individual caught several times in 1 yr was included in the sample. If an individual was measured in both years, then only the measurement from 1985 was included. Sample sizes for forehead and wing length measurements are not equal because some individuals were not measured for both variables.

RESULTS

Over the entire breeding season in both years, we measured the extent of brown forehead on 79 males and 140 adult females. All 59 adult birds with a distinctly brown forehead (≥1 mm), and all 26 birds with a slightly brown forehead were females. The extent of brown plumage on the forehead of these females ranged from 0–8 mm (Fig. 1). Although there was a relatively large sample of males in which we scored the forehead plumage, none had a brown forehead.

To evaluate the repeatability of our measure of the brown forehead plumage, we classified females as having no brown, slightly brown, or ≥1 mm brown. Of the 17 females that we measured twice in 1 yr, the measurement of 12 (71%) females did not change categories, 4 (24%) changed between no brown and slight, and 1 (5%) changed between slight and ≥1 mm.

The proportion of all adult birds in this sample that would be sexed as females based on any brown on the forehead was 39% (85/219). This proportion is biased because females are easier to catch than males, especially during egg-laying and incubation. In this sample of 140 adult females, 61% could be sexed based on the presence or absence of brown plumage on the forehead.

The extent of brown forehead plumage tended to decrease with age. Of the 23 adult females that were measured in both years, 15 (65%) had less brown the second year, 8 (35%) did not change, and none had an increase in the amount of brown forehead plumage. This is significantly different from a random change (Sign test: $P < 0.001$).

We measured the wing length of 99 adult females and 61 males (Fig. 2). The mean (±SD) wing length of adult females (115.26 ± 2.59 mm) and males (119.26 ± 2.63 mm) was significantly different ($t = 9.46$, df = 148, $P < 0.001$). Of the 37 birds with a wing length ≤114 mm, 35 (94.6%) were females. For birds with a wing length of ≥121 mm, 95.7% (22/23) were males. These results suggest that Tree Swallows with adult plumage can be sexed with 95% accuracy early in the season using wing length criteria based on ≤114 mm for females, and ≥121 mm for males. Using these criteria, 38% (60/160) of this sample could be sexed.

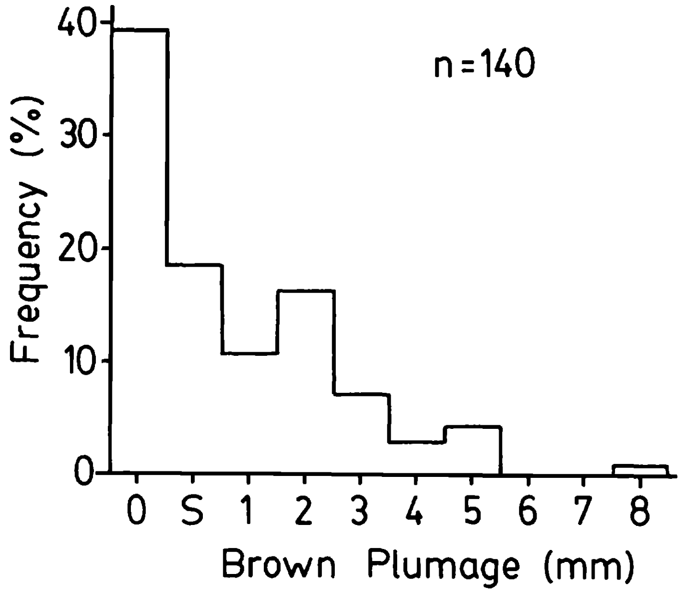

FIGURE 1. The frequency distribution of the extent of brown plumage on the forehead of adult females. "S" refers to a slight amount of brown.

Individual birds whose wing length was measured twice before 10 May in a given year were used to assess the repeatability of this measure. Of 65 second measurements, 74% differed from the first measurement by 1 mm, 19% differed by 2 mm, and 7% differed by 3 or 4 mm. Some of this variation could be due to true changes in the wing length of some individuals, since multiple measurements were not taken the same day. We feel that our measurement of wing length was reasonably accurate within an error of ±1 mm. Taking this measurement error into account, more accurate criteria for sexing adults using wing length would be ≤113 mm for females, and ≥122 mm for males. Using these more conservative criteria, 26% (41/160) of this sample could be sexed by wing length.

The mean (±SD) wing length of subadult females (112.78 ± 2.33 mm, $N = 74$) was significantly shorter than adult females ($t = 6.49$, df = 170, $P < 0.001$). This suggests that many of the males at the lower end of the wing length distribution could be second year birds. The males that could be identified as second year through banding records had wing lengths that ranged from 114 to 120 mm. Although second year males tended to have relatively short wing lengths, their mean (±SD) wing length (118.00 ± 2.33 mm, $N = 8$) was not significantly different from the other males in this sample ($t = 1.46$, df = 60, $P > 0.05$).

Of the sample of 160 individual adult Tree Swallows that were captured before 10 May, 46 (29%) could be sexed by the presence or absence of brown plumage on the forehead, and a further 26 (16%) that had blue

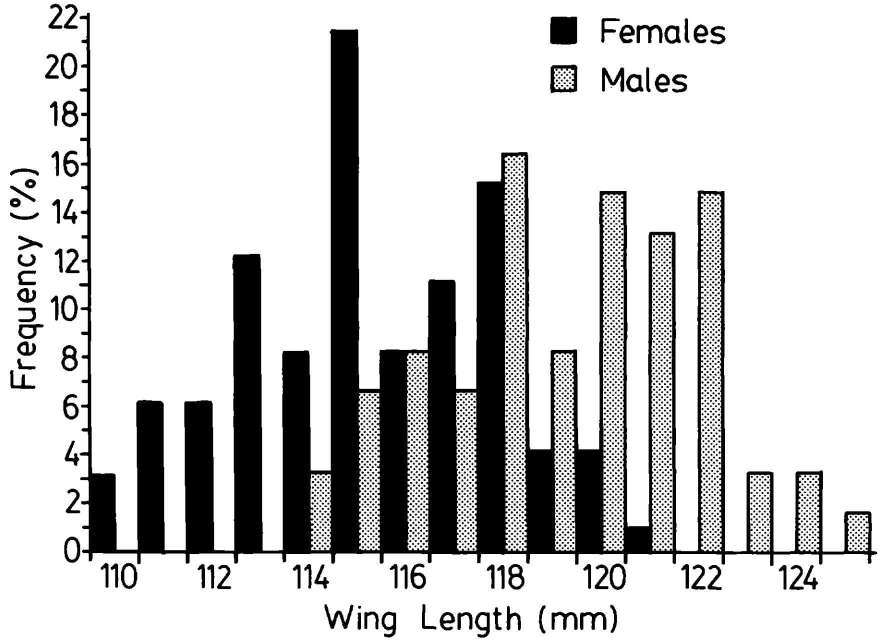

FIGURE 2. The frequency distribution of the flattened and straightened wing length of adult females ($N = 99$) and males ($N = 61$).

foreheads could be sexed by wing lengths of ≤113 or ≥122 mm. Therefore, using a combination of forehead plumage and wing length enabled us to accurately sex 45% of the birds in adult plumage before they began to breed.

DISCUSSION

Our results confirm that adult birds with a brown forehead are females (Canadian Wildlife Service and U.S. Fish and Wildlife Service 1977, Hussell 1983). The category of a slightly brown forehead is somewhat subjective, and therefore more difficult to standardize. There were several cases where our score changed between no brown and a slightly brown forehead when birds were measured a second time. If there is any doubt as to whether an adult has no brown, or is slightly brown, it should be classified as no brown, since this will not lead to errors in sex identification. Using the presence of a brown forehead to sex adult Tree Swallows is potentially very useful, since 61% of the females in our sample had some brown on the forehead. It is also very reliable, since there was 100% accuracy in assigning sexes using this criterion.

There was a wide range in the extent of brown plumage on the forehead of adult females (Fig. 1). The extent of brown on the forehead is age-related, since individual females either were unchanged or had less brown when caught one year later. Some adult females could have a brown forehead due to an incomplete post-nuptial molt from the subadult plumage. However, one-year-old males are not constrained in molting their forehead feathers during their post-juvenal molt, so it is not clear why adult females would be constrained in molting their forehead feathers. Although there is no obvious adaptive significance of a brown forehead in adult females, it is noteworthy that this age-related pattern is probably linked to the subadult plumage of one-year-old females. The brown forehead covers a small area, but since it is in a conspicuous location it could potentially have some adaptive role in signaling the age status of adult females (Rohwer 1975, Watt 1986).

Although adults could be sexed with 95% accuracy based on wing lengths of ≤114 mm (females) or ≥121 mm (males), we recommend the more conservative sexing criterion of classifying birds with a wing length ≤113 mm as females, and those with a wing length ≥122 mm as male. There was a tendency for second year males to have a smaller wing length than older males (as with subadult and adult females), and with a larger sample size this may prove to be a means of aging males as second year or after-second-year.

The proportion of a sample of adults that can be sexed early in the season using these methods will vary with the sex ratio of the sample. The extent to which these characteristics vary geographically is not known. More detailed studies of other morphological variation between the sexes would increase the proportion of adults that could be sexed early in the breeding season.

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LITERATURE CITED

BURTT, E. H., JR., AND R. M. TUTTLE. 1983. Effect of timing of banding on reproductive success of Tree Swallows. J. Field Ornithol. 54:319–323.

CANADIAN WILDLIFE SERVICE AND U.S. FISH AND WILDLIFE SERVICE. 1977. North American bird banding techniques, Vol. II. Fisheries and Environment Canada, Ottawa.

COHEN, R. R. 1984. Criteria for distinguishing breeding male Tree Swallows from brightly colored females prior to capture. N. Am. Bird Bander 9:2–3.

———. 1985. Capturing breeding male Tree Swallows with feathers. N. Am. Bird Bander 10:18–21.

HUSSELL, D. J. T. 1983. Age and plumage color in female Tree Swallows. J. Field Ornithol. 54:312–318.

KUERZI, R. G. 1941. Life history studies of the Tree Swallow. Proc. Linn. Soc. N.Y. 52–53:1–52.

ROHWER, S. 1975. The social significance of avian winter plumage variability. Evolution 29:593–610.

STUTCHBURY, B. J., AND R. J. ROBERTSON. 1986. A simple trap for catching birds in nest boxes. J. Field Ornithol. 57:64–65.

SVENSSON, L. 1984. Identification guide to European passerines, 3rd ed. British Ornithology Trust, England.

WATT, D. J. 1986. Relationship of plumage variability, size, and sex to social dominance in Harris' Sparrows. Anim. Behav. 34:16–27.

WEATHERHEAD, P. J., S. G. SEALY, AND R. M. R. BARCLAY. 1985. Risks of clustering in thermally-stressed swallows. Condor 87:443–444.

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