

CRITERIA FOR SEXING AND AGING EUROPEAN STARLINGS  
(*STURNUS VULGARIS*)

BY BRINA KESSEL

The following study on age and sex criteria in the European starling (*Sturnus vulgaris*) is based on the results of a three-year field study at Ithaca, New York. During this time over 1000 birds have been examined, and a collection of about 350 skins has been made as a reference collection. Many of the results of this study corroborate the works of earlier authors—Dwight (1900), Harrison (1928), Hicks (1934), Banzhaf (1937), Witschi and Miller (1938), Bullough (1942a, 1942b), and others. Additional criteria have been noted and some of the previous work put on a more definite basis.

## SEX CRITERIA

The final criterion of sex is the gonad; frequently this is the only known method of sexing an animal. The examination of gonads is not feasible, however, when studies require the use of living birds.

In the European starling there are at least two external characters that are quite reliable as sex criteria. The color of the rami of the lower mandible during the breeding season is one of these. It is pale pink in the female, and blue to blue-black in the male. This character is useful from November through the breeding season, during which period the rest of the bill is either completely yellow or has the yellow pigment in the basal region. The developing yellow in the bill advances from the base toward the tip, showing first at the base of the lower mandible in late November. After the proximal two-thirds has become yellow it is possible to use the color of the mandibular rami as a reliable sex indicator. Immediately following the nesting season the bills begin to darken, coincident with the start of the post-nuptial molt. As this darkening process likewise begins at the proximal end of the bill, the pink or blue coloring becomes masked and the character is no longer valid. In 600 yellow-billed birds examined for this character and then dissected, the color of the base of the bill gave complete accuracy. In dried museum skins, the dimorphic color of the rami is still a reliable criteria for sexing starlings: In the males the color deepens to almost black, while in the females the pink may fade, leaving the rami cream-colored.

The color of the eye is another character that can be used as a sex criterion in starlings. Although the eyes are not quite as reliable as the color of the lower mandible, they can be used during the entire year. In the male starling the iris is a deep brown color throughout; in the female the outer edge of the iris becomes yellowish, making a light-colored, conspicuous ring around it. Usually this difference is distinct, and some females show the character when only six weeks of age. Occasionally, however, the yellow ring in the female eye is difficult to discern; or at times in the male eye a faint, light ring is discernible about the iris, but it is farther back under the eyelids and much less distinct than in most females.

In addition to these two characters, there are several others that seem correlated with sex and that aid in sex determination when used in conjunction with the above characters. The color of the underwing coverts is one of these. Those birds in which the centers of the underwing coverts are dark, nearly black in contrast to their buff-colored margins, are almost always adult males. Those with light underwing coverts whose brownish centers show little contrast with the buffy margins are usually first-year females. The underwing coverts of the first-year males and the adult females fall between the adult males and first-year females in coloring. This underwing covert color has a wide variation in each age and sex group, but it is helpful, particularly in the determination of adult males.

Weight and length measurements are also somewhat indicative of sex, but one must be careful in using them. Unusually large birds are almost always adult males, and small birds, first-year females. In Table 1 length measurements have been tabulated by age and sex for birds collected from October through December, 1947 and 1948. These birds were sexed internally and were aged on the basis of skull ossification (discussed later). The length of exposed culmen and the length of tarsus are so similar in the different groups that with the present numbers no significant difference can be noted. The mean weights (Table 2) are also similar, the adult males being the only ones significantly different. It is likely, however, that a larger sample would show the first-year females to be a significantly lighter group. The wing length is indicative. Adult male wings average longest; those of the first year male and adult female are intermediate; and those of the first year female are the shortest. An analysis of variance shows that these wing differences are highly significant.<sup>1</sup>

Persistence of white feather tips and the brilliancy of plumage have been used for sex determinations by several authors. In birds examined in the present study the female white feather tips seem to wear away less rapidly than do those of the male, leaving the female commonly with more white tips. Feathers on the sides, abdomen, and back seem to be more brilliant in males than females, but this varies greatly. Again, because of the overlapping of these characters, they can be used only as indicators.

The lower throat feathers, or hackle feathers, and the tail feathers can also be used to some extent as a sex indicator, but this is discussed later in conjunction with age criteria.

#### AGE CRITERIA

Differentiating first-year starlings from adults (more than one year) is more difficult than determining the sex. Juvenal feathers are mouse-brown and thus form a distinguishing age characteristic until molted. The last juvenal feathers to be lost are those directly behind the eye and just dorsal to the auricular region. A few birds will retain one or more of these feathers until almost November 1, but most have lost their last brown feather by the middle of October. The presence of this

<sup>1</sup>With 3 degrees of freedom between treatments and 78 within treatments, it is necessary to have a minimum F value of 2.72 for significance at the 5 per cent level. The starling wing lengths gave an F value of 8.7.

TABLE 1.  
MEASUREMENTS (in millimeters) OF STARLINGS COLLECTED DURING OCTOBER, NOVEMBER, AND DECEMBER, 1947 AND 1948.\*

	Flattened Wing Length	S.D.	Exposed Culmen	S.D.	Tarsus	S.D.	Hackle Iridescence	S.D.	# of Speci- mens**
Adult ♂	130.2 (126.0-133.0)	2.19	25.3 (22.5-27.5)	1.22	30.0 (28.5-31.0)	.78	13.4 (11.0-15.5)	1.20	24
First Year ♂	128.2 (121.0-136.0)	2.85	25.4 (22.0-27.0)	1.19	29.2 (26.0-31.0)	1.08	8.3 ( 5.5-11.0)	1.31	28
Adult ♀	128.2 (124.0-133.0)	2.77	24.8 (22.5-26.0)	1.05	29.2 (28.0-31.0)	.81	8.5 ( 6.5-11.0)	1.31	16
First Year ♀	126.8 (123.0-132.0)	2.42	25.0 (22.5-27.0)	1.07	29.2 (28.0-31.0)	.84	4.1 ( 1.0-5.5 )	1.20	21

\*Measurements after Baldwin et al (1931).

\*\*In some instances it was not possible to get all measurements from all birds, therefore a few averages do not have a full complement of birds.

TABLE 2.

WEIGHTS OF STARLINGS COLLECTED DURING OCTOBER, NOVEMBER, AND DECEMBER,  
1947, 1948, AND 1949.

	Weight in Grams	S.D.	# Specimens
Adult ♂	87.6 (79.0-100.5)	4.85	37
First Year ♂	85.2 (70.5-103.0)	7.13	35
Adult ♀	84.4 (76.3-92.0)	4.16	28
First Year ♀	83.6 (73.8-97.0)	5.36	34

feather in birds of the year cannot be depended upon beyond the last week in September.

After the young birds have completed their post-juvenal molt, all starlings look superficially alike in plumage. Closer examination, however, shows that the hackles of the fore-neck in the different age and sex groups differ; they fall into three distinct groups (Figure 1).

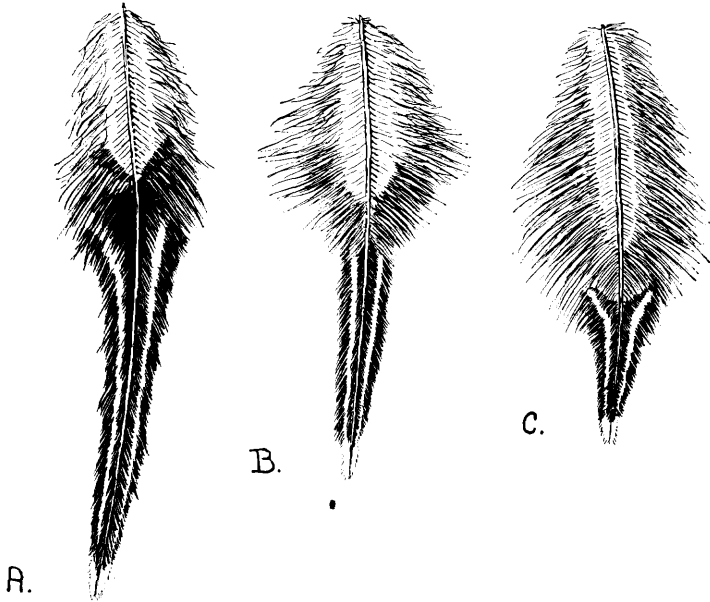


Figure 1. Starling hackle feathers, 3 times natural size: A. adult male; B. adult female or first year male; C. first year female. Drawing by E. M. Reilly.

The adult male has the longest, most attenuate hackle with the iridescence extending farther up the rachis of the feather than it does on either the first-year males or either group of females. The iridescent part of the hackle is seldom less than 12 millimeters long (excluding the white tips), and this length in turn frequently is one-half to two-thirds the length of the entire feather. The young male in contrast to the adult has a much stubbier hackle with less iridescence. The length of iridescence seldom exceeds 10.5 mm. and this is usually only about one-half, or less, the total length of the feather. The adult female hackle is similar to that of the first-year male, and as yet no consistent difference has been found. The first-year males and the adult females can be distinguished, however, by characters described above for sex determination. The first-year female is differentiated from the adult female by having the stubbiest hackle of all, with short iridescent tips. The first-year female iridescence seldom exceeds 5.5 mm. in length. The iridescence of the adult female is usually longer than 6.0 mm., but even where it is shorter the adult female has a more attenuate, pointed hackle than the first-year female which has short, blunt tips. The upper throat feathers of the first-year female are also peculiarly short and dull colored.

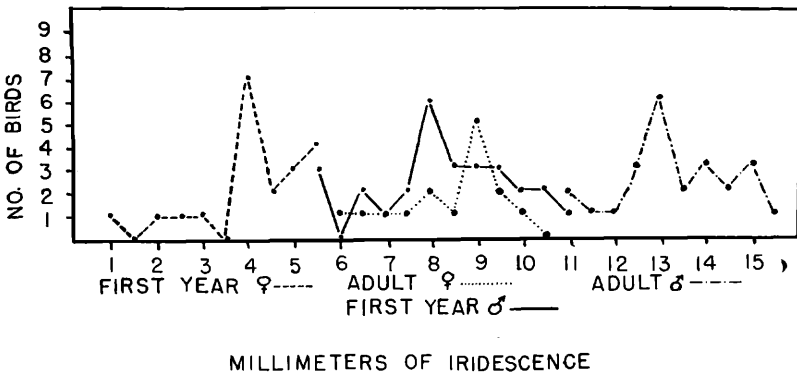


Figure 2. Extent of hackle iridescence among the age and sex groups.

Figure 2 portrays graphically the distribution of the amount of hackle iridescence among the age and sex groups. It will be seen that there is a slight overlap between groups, but since this overlap occurs most frequently between different sexes where other criteria can be used, it is not of great importance.

The color markings on the tail feathers of the adult male starling are distinctive. When viewed from the ventral side each feather is bordered by a distinct buff-colored margin which extends along the entire outer edge of the feather, around the tip, and up one-third of the inner edge. In all the other age and sex groups the inner buffy edge is not sharply defined, but grades imperceptibly into the darker part of the feather. This character is not completely accurate, however. The degree of contrast in the adult males varies slightly, and occasionally a first-year male will approach one of the less distinctly contrasted adult males.

Two other characters have been studied that can be used for accurate age determination, but both are internal, and both are lost by the time the first-year birds are about seven months old. One is the bursa of Fabricius, which has been used in age determinations on game birds. The bursa of Fabricius is a glandular sac that grows from the anterior, dorsal side of the proctodaeum of the cloaca. It is present in young birds, but before the end of the first year its opening closes and the bursa degenerates. Many young starlings lose the bursa by the first week in December, and all have lost it before the last week of that month.

The extent of the ossification of the skull is another method for age determination, and its usefulness lasts a little longer than that of the bursa of Fabricius. In young birds the frontal bones are thin and transparent, but as the ossification progresses the two thin layers of transparent bone over the brain are joined by bony pillars, causing the skull to become heavier and harder, with the ends of the pillars appearing as little white dots on the cranium. In starlings this pillar ossification of the frontal bones begins near the parietals and progresses anteriorly. The area just over the posterior edge of the orbit is usually the last to ossify, but in a few birds, a small area directly behind the orbit on the sides of the head is later. The amount of ossification offers a high

degree of accuracy for age determinations until January, although a few birds in early December have an area of only 2mm. left unossified. According to Miller (1946) this method of age determination can be used on living birds by making an incision in the skin of the head, examining the skull, and sealing the incision safely with a celloidin solution.

#### AGE AND SEX DIFFERENCES IN THE SEASONAL CYCLE

The differences in seasonal changes in starlings are of some help in determining sex and age, but they should be used in conjunction with the characters already listed. In the progression of the sexual cycle, the adult males lead; the adult females come next; the first-year males follow; and the first-year females are last.

The change in bill color is perhaps the easiest character of the seasonal change to follow. During September and most of October all starlings have dark bills. By the last week in October the starling begins to show signs of vernal conditions. An adult male collected October 24 shows some paleness on the lower mandible, and by the last half of November many adult males have the basal half of the lower mandible light. The majority of females during this period have dark bills, with a few beginning to get pale. An unusual adult female collected November 8, however, shows definite yellow about half way out the lower mandible with some yellow on the upper mandible. In December many of the adult male bills are all yellow except for dusky tips, and by January most of them are completely yellow with only a few retaining the dusky tips. The females' bills become yellow later and less rapidly than the males'. One adult female, taken December 20th, has the basal two-thirds of the bill yellow, but most other adult females at this time have bills still black or showing only yellowish traces. By the end of February most of their bills are yellow with dusky tips.

The first-year birds usually do not begin to show lightening in bill color until the end of December, and the males again lead the females by a week or so.

During the breeding season all but 2 to 4 percent (Hicks, 1934) of the starling population have yellow bills; this small percentage is composed primarily of either diseased birds or sexually undeveloped first-year birds, usually females. By banding, Hicks found that most five-year and six-year-old starlings retain dark bills during the breeding season.

At the end of the breeding season the starling bills begin to darken again. This is coincident with or begins just before the commencement of the post-nuptial molt. Nichols (1945) records starlings with darkening bill bases as early as June 11, at Long Island, N. Y., some still feeding young. He records one with a completely dark bill on June 27. By July most of the starlings have dark bills. An adult male starling collected on August 17, at Ithaca, N. Y., still has a little yellow at the tip, but it is somewhat masked by the advancing darkness.

From the above it will be seen that changes in bill color are not a definite indicator of age or sex. It might be generalized that birds with yellow on their bills during October and early November are probably

adult males; this would also be true, though for a lesser degree, in late November and early December when females begin to show some yellow. Any birds in January with completely yellow bills are adult males. And finally, any birds that have any yellow in their bills before January 1 are probably adult birds.

Feather wear and white spangles are also used to indicate age and sex in starlings during the winter months, but they are not fully reliable since much variation is found within each age and sex group. Dwight (1900) states that in the first winter plumage the cinnamon spots and edgings are darker in color and deeper in extent than in the winter plumage of adults. In the present study it was found that the ventral feathers of the first-year birds generally, though not invariably, have larger white spots with broader tips than those of adults. The adult males, again, tend to lose much of their heavy spangling before the other groups. One finds specimens as early as the middle of November that have lost much of the ventral spangling. By the middle of January individuals with no breast and abdominal spangling and very few head spots can be found. By March this full breeding plumage is frequent. It is interesting to note that the amount of yellow in the bill and the amount of wearing of the spangles are not correlated. Birds whose feathers have completely lost their spots can have a considerable amount of dark still in the bill, and birds with completely yellow bills can have comparatively heavy spangling. The adult females and first-year birds, likewise, lose their spangling as the season progresses, but they lose it less rapidly. An occasional adult female is found in early February with very little spangling even on the abdomen, but the majority carry the abdominal spots well into March and even through the actual breeding season.

Gonadal development can also be used as an indicator of age. The gonads of the adult birds are usually, but not always, larger than those of the first-year birds; this holds true especially from October to April. During early March, for instance, the adult male gonads are about 3-4 mm. long, while those of the first year males are only 2-3 mm. long. In the adult females during this period the ovary is slightly larger than that of the first-year females, but more important is the fact that some of the ovules are enlarging. The first-year female ovaries are enlarging somewhat, too, but all the ovules in the ovary are still very small and about equal in size.

#### SUMMARY

The European starling, *Sturnus vulgaris*, has a number of characters that are useful as age and sex criteria. The dimorphic color of the mandibular rami and that of the eyes are the most reliable external sex characters; but the color of the underwing coverts and rectrices, size, brilliancy of plumage, persistence of white feather tips, and hackle feathers can also be used as indicators. Some of the above characters can be an aid in external age determinations, but the length, shape, and extent of iridescence on the hackle feathers provide the best method. Seasonal characters of plumage, and bill color are useful, too. The extent of ossification of the skull, and the presence or absence of the bursa of Fabricius are reliable internal aging criteria.

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PLUMAGE COLORATION AND AGE OF EVENING GROSBEAKS

By G. HAPGOOD PARKS

During the six winters that Evening Grosbeaks (*Hesperiphona vespertina vespertina* Cooper) have come to our banding station at Hartford, Connecticut, we have trapped and banded 2,867 of them. These banded birds have supplied us with 2,417 repeat records and 36 of them have returned to us again during some season subsequent to its banding. Ninety-one foreign recoveries have also been trapped. In short, we have actually held in our hand on not less than 5,411 distinct occasions, one of these fascinatingly temperamental, gloriously plumaged birds.

Some of our experiences have already been described in *Bird-Banding*, in the *Bulletin* of the Maine Audubon Society, and in *Audubon Magazine*. Each season has brought its new adventure. First, there was the thrilling experience of becoming acquainted, of learning how best to attract and trap these birds, and how to handle them without inviting more than that necessary minimum of pain which the ample mandibles of excitable individuals can inflict. Another winter afforded us the opportunity of studying vocal characteristics, food preferences, and individual temperaments. Still another season revealed to us the miracle of the pigmentation change in their mandibles which accompanies the approach of spring. Then we felt the challenge of learning how to distinguish with certainty the immature individuals from the adults.