

## TARSAL COLOR OF AMERICAN COOTS IN RELATION TO AGE

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Gullion (1952) suggested from data collected on 14 captive individuals that tarsal color of juvenile American Coots (*Fulica americana*) was blue or gray-green, yellow-green in yearlings, and yellow, yellow-orange, or red-orange in older adults. Burton (1959) examined tarsal colors of 970 coots and suggested that many yearlings have green tarsi. While studying age-specific breeding biology of American Coots in northwestern Iowa during 1972-1974, I collected data on tarsal color relative to age. Coots were studied at Dan Green Slough and Dewey's Pasture, 2 glacial marsh systems described by Sooter (1941) and Bennett (1938), respectively. This paper includes an analysis and discussion of the tarsal color variation I observed.

### METHODS

Breeding and nonbreeding coots were captured by several methods (Crawford 1977) and were banded with U.S. Fish and Wildlife Service leg bands and color-marked with nasal saddles (Sugden and Poston 1968). All trapped birds were placed in 1 of 5 age classes based initially on Gullion's (1952) tarsal color scheme. Photographs were taken of the lateral side of the tarsus of each bird, and tarsi of all individuals retrapped in subsequent years after banding were again photographed with the same type of film. Tarsal colors were described qualitatively in the field immediately after each individual was captured. More precise designations of color were later taken from the slides.

Thirty-three individuals of various ages were placed in captivity at the Ledges Research and Exhibit Station, Boone, Iowa, in August 1972. Tarsal color changes of 18 of these birds were observed until May 1974.

### RESULTS

I will first describe my aging scheme by using the qualitative color descriptions of Gullion (1952). I will then describe the various colors precisely by using a standard color code.

*Tarsal color changes of free-living coots.*—I banded and color-marked 334 coots, of which 22 (14 females and 8 males) were retrapped in later years (Table 1). On the basis of observations on these individuals, plus data from Gullion (1952) and Burton (1959), the study populations were redivided into 5 age classes (Table 2). Age-class 0 represents juveniles the same summer they hatched. I found that the tarsal color of newly hatched coots is tan and that by 30-45 days of age the tarsal color has changed to blue-

TABLE 1  
TARSAL COLOR CHANGES OBSERVED IN FREE-LIVING AMERICAN COOTS

| Number of Individuals Showing Changes | Sex    | 1972            | 1973 | 1974 |
|---------------------------------------|--------|-----------------|------|------|
| 1                                     | female | BG <sup>1</sup> | G    |      |
| 1                                     | female | BG              | G    | YG   |
| 2                                     | female |                 | BG   | G    |
| 2                                     | female | G               | YG   |      |
| 1                                     | male   | G               | YG   |      |
| 3                                     | male   |                 | G    | YG   |
| 1                                     | female |                 | G    | YG   |
| 1                                     | female | YG              | YG   |      |
| 3                                     | male   | YG              | Y    |      |
| 1                                     | female | YG              | Y    |      |
| 2                                     | female |                 | YG   | Y    |
| 1                                     | male   |                 | YG   | Y    |
| 1                                     | female | Y               | YO   |      |
| 1                                     | female |                 | Y    | YO   |

<sup>1</sup> BG = Blue-green, G = Green, YG = Yellow-green, Y = Yellow, YO = Yellow-orange.

green. Age-classes 1, 2, and 3 represent probable age in years, and age-class 4 includes all birds believed to be 4 years old or older.

Twenty-one of the 22 returns in Table 1 (96%) showed color changes consistent with the age classes established in Table 2, and both male and female coots showed similar changes. Only 1 bird returned in 2 successive years. This bird was a juvenile with blue-green tarsi when trapped in 1972 and returned in 1973 with green tarsi and in 1974 with yellow-green tarsi.

*Tarsal color changes of captive coots.*—The 18 captive coots were trapped in July, and tarsal colors were checked monthly until the following May. By late August, changes in tarsal color of some of the birds were evident,

TABLE 2  
AGE CLASSES OF AMERICAN COOTS BASED ON TARSAL COLOR

| Age-class | Probable Age (years)     | Tarsal Color                |
|-----------|--------------------------|-----------------------------|
| 0         | Juveniles (<90 days old) | Tan to blue-green           |
| 1         | 1                        | Green                       |
| 2         | 2                        | Yellow-green                |
| 3         | 3                        | Yellow                      |
| 4         | 4 or greater             | Yellow-orange to red-orange |

TABLE 3  
TARSAL COLOR CHANGES OF CAPTIVE COOTS (1972-1973)

| Age-class | N | Tarsal Color    |           |     |
|-----------|---|-----------------|-----------|-----|
|           |   | July            | September | May |
| 0         | 5 | BG <sup>1</sup> | BG        | BG  |
| 1         | 7 | G               | BG        | BG  |
| 2         | 5 | YG              | G         | G   |
| 3         | 1 | Y               | YG        | YG  |

<sup>1</sup> See Table 1 for explanation of letter designations.

and by late September, the tarsal color of all adults had faded from the vivid colors typically found during the breeding season (Table 3). By late September, tarsal colors of age-classes 0 and 1 were indistinguishable. No change in tarsal color was noted from September through May, and none of the birds regained their normal tarsal color by the following May.

*Description of tarsal colors.*—Gullion (1952) assigned qualitative color descriptions to the coot tarsi in his study (e.g. blue-green). Because these descriptions do not necessarily correspond to notations used in standard color codes, I will describe more fully the colors found on the tarsi by using a standard color code. Smithe's (1975) system used swatch color names (e.g. olive-gray) with corresponding swatch color numbers (e.g. 42). He also gave corresponding Munsell notations for his swatches. The Munsell system involves numerical specification of colors (e.g. 6/2 7.5Y = Value/Chroma Hue). Wood and Wood (1972) explained the utility of the Munsell system to avian study. The following age-class descriptions give the color used by Gullion (1952), swatch color name and number used by Smithe (1975), and the Munsell notation also taken from Smithe.

Age-class 0 (juvenile)—Blue-green of Gullion; using Smithe's color code, grayish olive (43, 5/2.5 5Y) to yellowish olive-green (50, 4.5/6 8Y) on the leading edge of the tarsus fading into olive-gray (42, 6/2 7.5Y) or plumbeous (78, 4/1.5 5PB) on the trailing edge.

Age-class 1 (1-year-old)—Green of Gullion; using Smithe, olive-green (46, 4/4 8.5Y) to yellowish olive-green over entire tarsus.

Age-class 2 (2-year-old)—Yellow-green of Gullion; using Smithe, entire tarsus olive-yellow (52, 7/7 7.5Y), or spectrum yellow (55, 8.5/12 6Y) on leading edge of tarsus fading into yellowish olive-green on trailing edge.

Age-class 3 (3-year-old)—Yellow of Gullion; using Smithe, entire tarsus spectrum yellow.

Age-class 4 (4-year-old or older)—Yellow-orange or red-orange of Gullion; following Smithe, tarsus with a base color of spectrum yellow or orange-

yellow (18, 8/14 10YR) with spots of chrome orange (16, 6/16 2.5YR) or flame scarlet (15, 5/16 10YR). Tarsal colors evidently tend to become almost entirely chrome orange or flame scarlet as the coots get older (Gullion 1952).

Most field biologists will have little difficulty distinguishing tarsal colors of trapped birds. The differences between age-classes 1 and 2, however, can be difficult to discern for some individual coots. Based on my observations, most age-class 1 birds will have tarsal colors distinctly greener than those in age-class 2. When the differences are slight, another criterion might be used as an aid to classification: Of 42 age-class 1 birds I examined, only 5 had red-orange color on the distal end of the tibia, but 36 of 38 age-class 2 and all older coots showed this characteristic.

Field determination of tarsal colors while coots are standing out of water is possible, but should be attempted only after experience with trapped individuals. I found that color determinations made in the field under conditions of poor light and visibility were often incorrect.

Because Gullion's (1952) color descriptions have been used elsewhere (Burton 1959, Giles 1969), I suggest continuing use of these color names in future work, but future users should be fully aware of the above descriptions when interpreting the color names used.

#### DISCUSSION

*Tarsal color changes.*—Twenty-one of 22 free-living coots showed color changes consistent with the aging scheme proposed (Tables 1 and 2). My aging scheme is similar to that proposed by Gullion (1952), except that his system is 1 year behind mine (i.e. he suggested that juveniles had blue-green or green tarsi and yearlings had yellow-green tarsi). Gullion (1952) based his aging scheme primarily on 14 individuals that he captured in October and January and for which he traced tarsal color changes through the following July. He stated (p. 192) that "11 of the 14 birds, when originally taken, had gray-green legs like 90-day-old immatures." I have shown (Table 3) that apparently both juvenile and 1-year-old coots have gray- or blue-green tarsi during the fall and winter periods. In addition, Gullion (1954: 396) stated that juvenile coots 4-5 months old cannot be distinguished from adults by plumage characteristics alone. The possibility exists, therefore, that he captured 1-year-old coots rather than juveniles as he had suspected. If this is true then our aging schemes are completely compatible.

Other evidence exists to suggest that yearling coots have green tarsi rather than yellow-green during the breeding season. I found that approximately 57% of May-July populations had green tarsi (Crawford 1975); one would

expect the yearling cohort to be more numerous than older cohorts. Burton (1959) examined tarsal colors of 970 coots, some of which were killed by hunters during October and some of which were accidentally caught in muskrat traps in November; he suggested that many yearlings have green tarsi. His data are difficult to interpret, however, because he used birds captured during the fall and winter, the time when ages seemingly are difficult to distinguish by tarsal colors alone. Kornowski (1957) and Blums (1973) found that yearlings of the similar European Coot (*Fulica atra*) had gray or green tarsi and that older adults had yellow, orange, or red tarsi. Some of the disparity might be related to semantics used in describing colors.

Testosterone has been shown to cause soft part color changes in several species (Witschi and Miller 1938, Noble and Wurm 1940, Witschi 1961); some exceptions, however, have been noted (Witschi 1955, Lofts and Murton 1973, Lofts et al. 1973). I hypothesize that testosterone or a similar derivative causes color changes in coot tarsi because both sexes show similar color changes. If testosterone is influencing tarsal color in coots, it seems likely that tarsal colors would be more vivid during the breeding season because testosterone secretion is known to increase in at least some species at this time (Assenmacher 1973, Lofts 1975). In addition, Trauger (1974) suggested that testosterone was influencing fall or winter regression or darkening of female Lesser Scaup (*Aythya affinis*) iris color. Seasonal changes in tarsal color were shown for captive coots in this study (Table 3) and suspected for at least 1 wild bird (Table 4). On the basis of these observations, I recommend that the tarsal color aging scheme outlined here be used only during the breeding season. Perhaps additional study will further elucidate tarsal color changes during the nonbreeding season.

The fading of the tarsal colors of captive individuals also might explain why 1 female wild bird had yellow-green tarsi in both 1972 and 1973. She was captured in July 1972 while incubating, but not again until August 1973, apparently after she had nested.

Little use has been made of tarsal colors as indicators of age in studies of other birds. Shortt (1943) used tarsal color for age discrimination of Black Ducks (*Anas rubripes*). Table 4 presents evidence from other authors to suggest that a range of tarsal colors similar to that found in the American and European coots occurs in the Sora (*Porzana carolina*), Purple Gallinule (*Porphyryla martinica*), and Common Gallinule (*Gallinula chloropus*).

*Behavioral significance of tarsal color variability.*—Further study is needed to determine the behavioral significance, if any, of variable tarsal colors to coots. Two possibilities, however, will be mentioned. (1) Bright colors often are used to indicate dominance in many species. Older adult male Red-winged

TABLE 4  
 VARIATION IN TARSAL COLOR OF OTHER RALLIDAE

| Species          | Tarsal Color | Authority          |
|------------------|--------------|--------------------|
| Sora             | Green        | Samuels (1867)     |
|                  | Yellow-green | Ridgway (1941)     |
| Purple Gallinule | Green        | Coues (1903)       |
|                  | Yellow-green | Forbush (1925)     |
|                  | Yellow       | Pearson (1923)     |
| Common Gallinule | Green        | Chamberlain (1891) |
|                  | Yellow-green | Reilly (1968)      |
|                  | Yellow       | Coues (1903)       |

Blackbirds (*Agelaius phoeniceus*), for example, are more brightly colored than yearlings. Nero (1956) suggested that this brighter color was used to the older male's advantage in territorial establishment and defense. Both male and female coots participate in territorial defense (Gullion 1953), and limited data indicate that coots use their feet in fighting so that the tarsi are visible above water for short periods of time (pers. observ.). Thus, tarsal color might be used to indicate dominance among both males and females. (2) Females of most bird species normally choose their partner and often rely on visual cues for recognition (Lofts and Murton 1973). I do not know if female coots choose their mates, but if they do, they may use tarsal color of males in this process.

#### SUMMARY

Data obtained from 22 color-marked coots recaptured in years subsequent to their banding indicate that during the breeding season yearling coots have green tarsi, 2-year-old coots have yellow-green tarsi, 3-year-old birds have yellow tarsi, and all older coots have tarsi ranging from yellow-orange to red-orange. Discrepancies between this aging scheme and ideas expressed by earlier workers are discussed. Data from captive coots indicate that tarsal colors fade outside of the breeding season. I recommend that without further study the aging scheme described be used only during the breeding season. The possible behavioral significance of age-specific tarsal color in coots is discussed.

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