CERTAIN MOLTS AND PLUMAGES OF ACADIAN AND YELLOW-BELLIED FLYCATCHERS

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DIFFICULTIES in identifying certain *Empidonax* flycatchers recently led me to survey the literature concerning the molts and plumages of birds of this genus and to examine a large number of specimens. In the course of this inquiry it became evident that there has been much confusion in regard to the molts and plumages of some of the species and that the literature is often misleading or actually incorrect. In the cases of the Acadian Flycatcher, *Empidonax virescens*, and the Yellow-bellied Flycatcher, *E. flaviventris*, among others, this situation can lead to some difficulty in the allocation of specimens, and it is with these two species that this paper deals. Griscom (1923: 234) emphasized the close similarity of Acadian, Least (*E. minimus*) and Alder (*E. traillii*) flycatchers in the fall, but it seems not to have been generally recognized that any special difficulty attends the separation of any of these from the Yellow-bellied Flycatcher. Actually, during the fall a substantial proportion of *virescens* closely resembles *flaviventris* and can be most perplexing for this reason, especially to those not familiar with the genus. The possibility of misidentification is suggested by the fact that the only extant specimens of "*flaviventris*" for South Carolina, taken and recorded by the veteran ornithologist Arthur T. Wayne, were referred to *virescens* upon subsequent re-examination by Allan R. Phillips and E. B. Chamberlain (Sprunt and Chamberlain, 1949: 354). Inadequate description of the plumages of the Acadian Flycatcher is largely responsible for confusion such as this.

I first became aware of this problem when H. B. Tordoff and I attempted to identify a number of specimens we had collected near Henderson, Kentucky, in early September, 1949. We found that in a series of six specimens, which we had assumed in the field to be *flaviventris*, there were actually some individuals of *virescens*. Nowhere in the literature could we find reference to such a "*flaviventris*-like" plumage of that species. My material, supplemented by additional specimens in the University of Michigan Museum of Zoology (hereafter referred to as U. M. M. Z.), fortunately contains a nearly complete molting series of *virescens*, permitting more thorough analysis of its molts and plumages than has hitherto been possible.

I am indebted to Mr. H. B. Tordoff for help in collecting some of the material used in this study and for suggestions leading, in part, to

its inception. Thanks are due to the authorities of the University of Kansas Museum of Natural History and to Dr. George M. Sutton, for making their respective collections available to me. Dr. Ernest P. Edwards showed me two interesting specimens of his.

MOLTS AND PLUMAGES OF THE ACADIAN FLYCATCHER

The following is not intended to be a complete account; I shall emphasize only those plumages which appear to have been misinterpreted.

Juvenal Plumage.—The term "juvenal" is here used throughout as defined by Dwight (1900: 99, 106), or as the second plumage of the species, directly succeeding the natal down. This plumage does not seem to have been formally described for the Acadian Flycatcher. As will be mentioned more fully below, Dwight (1900: 146) in his description of the "juvenal plumage" was actually discussing the succeeding or "first winter plumage." The real juvenal plumage is referred to by Coues (1903: 528) who wrote, "When very young, said to be mottled transversely with pale ochraceous." Ridgway (1907: 532) under the heading of "Young" said, "Similar to adults, but feathers of the upperparts narrowly tipped with pale buffy . . ." and (footnote) ". . . the only *Empidonax* thus marked." Although it is clear that both authors were describing the true juvenal plumage, the descriptions are incomplete. In that day, moreover, the term "young" meant very little, and it is unfortunate that Ridgway did not use the more specific term "juvenal" which must by then have been available. As to the uniqueness of the buffy margins of the dorsal feathers I can not comment, except to say that juvenal-plumaged Least Flycatchers lack them.

I have examined nine specimens in juvenal, or partly juvenal, dress, two (Maryland) in the University of Kansas Museum of Natural History, and seven (Michigan, Ohio, and Indiana) in the U. M. M. Z. All of these but one are August- and September-collected specimens. They range in development from individuals with one-third-grown stub tails to fully grown birds which have commenced the molt into the succeeding plumage.

The juvenal plumage may be described briefly as follows: above, including sides of head, grayish or brownish olive, all feathers narrowly tipped with dull, ochraceous buff; tertials and secondaries edged with pale, grayish buff; greater and median coverts broadly margined with clear, chestnut buff, forming two wing-bars; rectrices and remiges dull, grayish brown or brownish olive; throat, belly, and flanks dull

white, sometimes (two of nine) faintly suffused with pale, sulphur-yellow; and band of grayish olive across chest.

The molt into first winter plumage begins about the time the tail is fully grown, new feathers appearing first on the flanks, chest, and back. The juvenal feathers tend to persist somewhat longer on the throat, belly, and crown than elsewhere. Dwight (1900: 146) was apparently correct in assuming that the flight feathers are retained at this time; at least I have found no evidence that they are molted.

First Winter Plumage.—This is the plumage likely to cause trouble in identification, which is not surprising, since it has apparently never been described *as such.* In view of the foregoing discussion, it is obvious that Dwight (1900: 146) was referring not to the juvenal but to the first winter plumage when he wrote, "Above, including sides of head and neck olive-green, the crown feathers darker centrally, the pileum not darker than the back. Wings and tail deep olive-brown, median and greater wing coverts edged with rich buff forming two wingbands, edgings of secondaries and tertiaries paler buff. Below, pale greenish sulphur-yellow, the chin white, a faint olive-gray pectoral band." As far as it goes, this is a good description of the first winter plumage. It should be modified, however, in two important respects: (1) The color of *the entire underparts may be clear uniform lemon-yellow* (or sulphur-yellow), approaching the extreme in *flaviventris* in this coloring and yellower than many of that species; (2) *The throat may be suffused with pale yellow,* invalidating a character that has frequently been used to separate this species from the Yellow-bellied Flycatcher. The median and greater coverts are often no buffier than those of the fresh adult winter plumage.

Three of my Kentucky specimens (males, R. M. M. Nos. 1051 and 1077; female, No. 991, September 5–9) were just completing the post-juvenal molt, and one still shows a few worn, white juvenal feathers on its belly. They are almost uniformly lemon-yellow below (except for a few veiled white feathers), and two have the throat suffused with pale yellow. Other specimens in this plumage are in the Sutton collection (male, Lake County, Florida, August 15), and in the Max Minor Peet collection at the U. M. M. Z. is a female taken at Athens, Georgia (August 28). Some of these resemble *flaviventris* to such a degree that they would be difficult to separate except with the aid of other characters to be discussed later. The postjuvenal molt as seen in the September specimens is one clue to their identity (see discussion of Yellow-bellied Flycatcher).

That this "yellow-bellied" plumage has escaped full attention in the literature is evidenced by the statements of various authors. For

example, Todd (1940: 348) stated, "In fresh fall plumage the underparts are more heavily suffused with yellowish-green, although *never so uniformly or so richly as in the Yellow-bellied Flycatcher* [italics mine]." Todd did, however, assume an early fall molt. Peterson (1947: 149) said, under Yellow-bellied Flycatcher, "Others of this group have a tinge of yellow beneath, especially in the fall, but none of the rest has uniform yellow from throat to belly." He came closer to the truth in adding, "Many Acadians look suspiciously like Yellow-bellies in the fall . . . these two can not be safely distinguished [in the field] in autumnal migration." Bent (1942: 190) apparently relied mainly on Dwight's account, but ventured the ill-advised opinion that the first winter plumage is "not very different" from the juvenal.

Postnuptial Molt.—It has become evident that Dwight's statement (p. 146), "Young and old pass south before molting . . ." is not so in regard to the former. That this is equally untrue of adults is shown by two molting specimens from Kentucky. One (R. M. M. No. 989, singing male, Henderson, September 4) is extremely worn and faded and has just started postnuptial molt on the sides of the chest and flanks. The other (R. M. M. No. 1049, adult female, September 8) has nearly completed molting but has the central rectrices and outer remiges not quite full grown. In addition, a number of adult September specimens from Michigan (U. M. M. Z.) are in various stages of postnuptial molt. Two of these (male, No. 48846, Oakland County, August 26; male, No. 44126, Wayne County, August 30) have the outer primaries and tail so short that their powers of flight must have been seriously handicapped, an interesting situation in a fly-catching species. The body molt has almost been completed in all of them. This may be the only *Empidonax* which completes its fall molts on the breeding grounds (*cf.* Dickey and van Rossem, 1938: 376–382).

Adult Winter Plumage.—This plumage does not differ greatly from the nuptial plumage of spring birds newly arrived in the United States, although there is usually a more prominent yellow wash on flanks and lower belly, and the wing-bars may be of a richer buff. It differs from the first winter plumage just described in that the feathers of the belly are partially to entirely white. I must challenge Dwight's belief (1900: 146) that wear in the species is insignificant at all seasons. The many July birds I have examined are all somewhat frayed and faded, so that fresh plumage is instantly distinguishable from worn breeding plumage. I wish to emphasize that it is not my intention to detract from the importance and value of Dwight's classical work. By his own admission he was handicapped by inadequate *Empidonax* material, and his conclusions were tentative.

?*Prenuptial Molt.*—Dwight surmised that the nuptial plumage is acquired by wear. However, he was operating on the erroneous assumption that postnuptial and postjuvenal molts occur in winter quarters, and he may have thought of these molts as being rather late in the year. Dickey and van Rossem (1938: 378–379) have already shown that *Empidonax traillii* and *E. minimus* acquire the nuptial plumage by a molt, rather than by wear as Dwight supposed. Moore (1940: 352) mentioned a Honduras specimen of *virescens* (female, Cofradia, March 11) with "freshly molted wings and tail." It seems probable to me that a prenuptial molt, partial or complete, occurs in early spring as in related forms. Spring birds newly arrived in the United States are in uniformly sleek, fresh-looking plumage. In fact, they are very similar to freshly-molted fall adults, as I have already mentioned. Chapman (1917: 473) remarked that, "December specimens are much yellower below than those taken in February and March [Colombia]." However, I have noted considerable variation in the amount and brightness of ventral yellow in spring specimens. It is impossible to say whether the amount of this yellow is correlated with age, as it is in the fall; I have seen no spring birds approaching fall immatures in yellowness of underparts. The occurrence of a prenuptial molt remains to be conclusively demonstrated.

MOLTS OF THE YELLOW-BELLIED FLYCATCHER

Dickey and van Rossem (1938: 376), through examination of many winter specimens from El Salvador, were able to shed much light on the previously little-known molts of this species. Briefly stated, they agreed with Dwight (1900: 145) that the postjuvenal molt is not completed until late in the fall, after migration, and does not involve the flight feathers. They stated that, contrary to Dwight's belief, a prenuptial molt (said to be complete in young birds) occurs in spring, and that adults complete the postnuptial body molt at various times during the fall. A slow primary molt of adults, begun with the conclusion of the body molt, takes up the better part of the winter. They cited specimens in various stages of primary molt, taken from December 1 to March 25. Adults then undergo a spring molt of the entire body plumage in March and April. They did not say how they distinguished young from adults in late winter and spring.

The only one of nine early fall *flaviventris* I have handled in the flesh (eight from Kentucky, one from Ohio) which was molting is R. M. M. No. 1073, an adult female (skull completely ossified), from Henderson, Kentucky, September 8, 1949. This bird is so intermediate in its various characters that I have never been absolutely

certain as to its species, but I have tentatively identified it as *flaviventris* (see "identification," following). It still bears a sheath about seven millimeters long at the base of each outer primary, indicating that all the primaries (since the outermost are typically the last molted) have been recently replaced.

Of interest also are two specimens collected by the recent Lea-Edwards expedition in Chiapas, Mexico. In one (E. P. Edwards No. 1222, adult male, August 15, 1950) all the rectrices are fresh and new except the central pair which is markedly worn and faded. The other (R. B. Lea No. 890, same sex and date) has the entire tail fresh, but the central rectrices are only two-thirds grown. These specimens appear to be in successive stages of a complete tail molt. The specimens described suggest that the molt of adult flight feathers may be even more erratic and protracted than Dickey and Van Rossem suspected.

Additional evidence of spring (prenuptial) molt is provided by four March and April specimens from Chiapas (U. M. M. Z.) which are definitely worn above and on the wings and tail, and fresh and bright yellow below. No. 102626, male, April 21, 1939, lacks the tertials (often lost in preparation when these feathers are molting) and has the entire crown in molt. Aldrich and Bole (1937: 104) recorded a specimen from Panama (male, March 25, 1932) with the wings and head in molt.

Some doubt remains in my mind in connection with the fall molts of the species. Carefully annotated late summer specimens from the breeding grounds are desirable; many fall migrants are in such fresh appearing plumage it is difficult to believe that they have not recently completed a molt, especially since unmolted Acadians of corresponding date are visibly worn. It must be remembered that *flaviventris*, breeding as it does in coniferous forest areas, might be expected to become more worn than *virescens* during the summer, due to contact with this abrasive foliage.

IDENTIFICATION OF SPECIMENS

A review of the characters useful in separating the two species is in order.

Primary Formula.—The relationship in length of the tenth (outermost) primary to the fifth has been much used as a key character in this genus (*cf.* Ridgway, 1907: 546). However, as Moore (1940: 350) has pointed out, some of the species are extremely variable in this respect. This is true of the present forms. A little-publicized distinction between *virescens* and *flaviventris* is that of Coues (1903: 528,

530) who gave the first (= tenth; Coues numbered from the outside in) primary as equal to the fifth (= sixth) in the Acadian Flycatcher, and equal to the sixth (= fifth) in the Yellow-bellied. Thus, numbering conventionally, 10 = 6 in *virescens*, 10 = 5 in *flaviventris* (Fig. 1). In testing this system I found that of 118 *flaviventris* examined, 31 were intermediate toward the condition alleged for *virescens* and 10

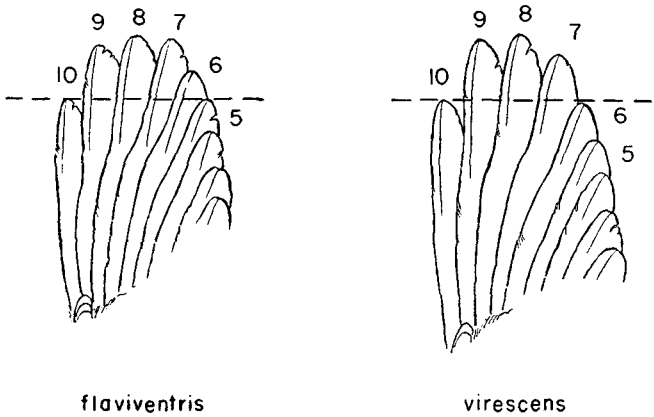

FIGURE 1. "Typical" wingtips of Yellow-bellied and Acadian flycatchers, showing the ideal relationships of the outermost primary as pointed out by Coues. Note the more rounded profile in *flaviventris*.

actually possessed the formula attributed to *virescens*. In a series of 89 Acadians, 16 were intermediates and three had the formula given for *flaviventris*. The intermediates, being neither here nor there, must be classed as "bad." Therefore, the formula breaks down in 34 per cent of the Yellow-bellies and 21 per cent of the Acadians in these series. Further, it is useless in the event of a wing molt, or if the primaries are broken. The primary formula can serve as a suggestive, but not as a definitive, character. It should be mentioned that the shape of the wingtip, as shown in the figure, is useful as a clue to identity, even when the relative length of the outer primary varies. The wing tends to be more rounded in *flaviventris*. Moore (1940: 350) claimed that, in western forms with variable length of the outer primary, especially in *difficilis*, this feather tends toward shortness in the more southern populations. This may be true of *virescens* also, as more of the intermediates and all in my series with the *flaviventris* type of wingtip, are from Texas, Louisiana, and other southern states.

Size.—The Yellow-bellied Flycatcher averages smaller than the Acadian, but there is a considerable size overlap. Males average

larger than females in each species, male *flaviventris* approaching, but not quite equalling, female *virescens*. Since the overlap between the species thus varies considerably, depending on which sex is being compared with which, it follows that *correct sexing is of the utmost importance in making identifications.*

TABLE 1

STATISTICS OF LENGTH OF WING AND TAIL

	Observed minimum	*Observed maximum*	*Mean with standard error*	*Standard deviation*	*Coefficient of variation*	*Size of sample*
Wing						
Male *virescens*	70 mm.	79 mm.	74.62±.28	2.08	2.79	55
flaviventris	62	71	67.64±.21	1.74	2.57	70
Female *virescens*	67	74	70.17±.40	1.91	2.72	23
flaviventris	60	70	64.29±.40	2.24	3.48	31
TAIL						
Male *virescens*	53	62	57.46±.30	2.23	3.87	54
flaviventris	48	55	50.88±.18	1.49	2.92	68
Female *virescens*	52	57	54.14±.27	1.25	2.30	22
flaviventris	46	53	49.00±.33	1.80	3.67	29

In *virescens* the bill tends to be longer and relatively narrower, the tarsus slightly longer and heavier, the wingtip relatively longer, and the feet larger than in *flaviventris*, but since there is much overlap in these features, and they are difficult of accurate measurement, they will not be considered in detail here. The wing and tail of *virescens* average larger, being the longest of any eastern *Empidonax*. For measurements which suggest the size differences see Ridgway (1907: 550, 553). His measurements were based on small series (5 to 24 specimens) and simply show the ranges observed in limited samples; in short, they are not very reliable in separating questionable individuals. Statistical treatment of my own measurements leads me to believe that Ridgway measured some mis-sexed birds (for example, his maximum tail measurement of 61 mm. for female *virescens* is incredibly large).

With the intention of establishing more useful ranges as an aid to identification, I have undertaken a statistical analysis of the variation in length of wing and tail in the species under consideration (Table 1).

The specimens measured were all birds of undoubted identity with primaries and rectrices unworn. Measurements of wing (chord) and tail were taken as recommended by Baldwin, Oberholser, and Worley (1931: 76, 92–93) and to the nearest millimeter. The principal difficulty encountered was that of eliminating incorrectly sexed birds from the sample. Since my choice of these was unavoidably sub-

jective, I attempted to compensate by discarding all the specimens taken by collectors any of whose sex determinations were questioned. As far as possible I relied on material taken by experienced collectors. Despite these precautions it is probable that some error in sexing remains in one or more of the series. Troubles of this sort will con-

TABLE 2

THEORETICAL EXTREMES ($M \pm 3\sigma$) IN LENGTH OF WING AND TAIL

	Theoretical minimum	*Theoretical maximum*	*Theoretical separability**
WING			
Male *virescens*	68.38 mm.	80.86 mm.	78 % should fall above 72.86
flaviventris	62.42	72.86	65 % should fall below 68.38
Female *virescens*	64.40	75.90	33 % should fall above 71.01
flaviventris	57.57	71.01	52 % should fall below 64.40
TAIL			
Male *virescens*	50.77	64.15	82 % should fall above 55.35
flaviventris	46.41	55.35	47 % should fall below 50.77
Female *virescens*	50.39	57.89	41 % should fall above 54.40
flaviventris	43.60	54.40	77 % should fall below 50.39

*Per cent of Acadians which should be larger than largest expected Yellow-belly. Per cent of Yellow-bellies which should be smaller than smallest expected Acadian.

tinue until a majority of collectors adopt the commendable habit of indicating on labels, by drawings or otherwise, that gonads have actually been seen.

Those unfamiliar with statistical methods may refer to Table 2, which shows the theoretical upper and lower extremes of wing and tail lengths to be expected (Mean $\pm$ three standard deviations) on the basis of the samples analyzed. It shows also the percentage of each sex of the larger species which should fall above the theoretical maximum of the corresponding sex of the smaller in a given measurement, and *vice versa*. The percentages are based on the theoretical distribution of individuals within a normal population curve. Amadon (1949: 251–256) presented an excellent discussion of the characteristics of the normal curve as applied to ornithological work.

The table will be of some help as an aid in identifying specimens whose other characters cause difficulty, so long as it is kept in mind that statistics prove nothing, but indicate probabilities. At least the table is more conservative (less separation) than any system based on observed ranges alone is likely to be. Those desiring still greater assurance of accuracy may wish to make some allowance for the standard errors of the means, or to compute "standard ranges" ($M \pm 3.24\sigma$) as proposed by Simpson (1941).

Other Characters.—In addition to the foregoing, in *flaviventris* the yellow underparts are often more heavily suffused with dull olive than

in immature *virescens*, and the dorsal color seems to average slightly deeper olive. It is difficult to understand how the popular notion got started that the Acadian is the "greenest of the *Empidonaces*."

It is quite possible that certain specimens may never be identified with absolute confidence. Indicative of this is R. M. M. No. 1073, mentioned earlier in connection with the molts of the Yellow-bellied Flycatcher. The bird is a female (ovary clearly visible upon dissection) with the wing measuring 71 (near the maximum expected for female *flaviventris*). The tail is 54 mm. in length (large), the primary formula is intermediate, the bill medium-sized, and the plumage characters are possible for either species. The fact that the skull was completely ossified, indicating an adult, tips the balance in favor of *flaviventris*. Were it not for this the specimen would be essentially unidentifiable. Hence, correct aging of "yellow-bellied" flycatchers in early fall is very important.

SUMMARY

The molts and plumages of the Acadian Flycatcher have been poorly understood and have been misinterpreted in some details. The juvenal plumage is olive above, with buffy feather margins, and white below. Contrary to some previous statements in literature, a post-juvenal body molt takes place before the birds leave the breeding range. The first winter plumage, which has not heretofore been described as such, is yellower below than any other plumage of the species, equalling or exceeding some Yellow-bellied Flycatchers in this respect. The adults undergo a complete postnuptial molt before leaving the breeding range. The Acadian may be the only *Empidonax* of the United States, which has its fall molts before migration. A prenuptial molt may occur in the winter range, but this remains to be demonstrated.

Although the molts of the Yellow-bellied Flycatcher have been described previously in some detail, there are still points in need of clarification, particularly in regard to the fall molts. Some additional evidence of two molts per year, spring and fall, is presented.

Separation of "yellow-bellied" immature *virescens* from *flaviventris* in fall can be very difficult, though large Acadians are readily separable from small Yellow-bellies. A previously proposed primary formula is rather unreliable for separating the species. Extreme care in sexing and aging of specimens is important, and careful notes should be recorded on any molting specimens of *Empidonax*.

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