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THE JUVENAL PLUMAGE AND POSTJUVENAL MOLT OF THE VESPER SPARROW*

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IN MY paper, "The Juvenal Plumage and Postjuvenal Molt in Several Species of Michigan Sparrows,"[1] statements are made to the effect that in the Eastern Vesper Sparrow, *Pooecetes gramineus gramineus* (Gmelin), the postjuvenal molt begins "when the individual is about fifteen or sixteen days old"; that this molt must therefore start, in young of the first brood, "in late June or in July" rather than during "the latter half of August"[2]; and that the juvenal plumage is never, strictly speaking, a complete plumage, since "by the time the juvenal flight feathers are of full length the molt of the body plumage has begun."

During the summer of 1940 I was able, through the interest

* Contribution from the Edwin S. George Reserve.

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1 *Cranbrook Inst. Sci. Bull.*, 3 (1935): 26–28.

2 The phrase "the latter half of August" is quoted from Jonathan Dwight, Jr., "The Sequence of Plumages and Moults of the Passerine Birds of New York," *Ann. N. Y. Acad. Sci.*, 13 (1900): 185.

and co-operation of the Museum of Zoology of the University of Michigan, to continue my study of Fringilline plumages and molts at the Edwin S. George Reserve. Here, ensconced in the fine new Camburn Laboratory at the south entrance, I reared three Vesper Sparrows, an approximately twelve-day-old bird captured on August 2; and two six-day-old siblings which were brought to the laboratory in their nest on August 6.[3] Careful observation of these three birds for a period of several weeks has convinced me that the first of the above-quoted statements is slightly erroneous, that corroboration of the second will require a careful, summer-long study of young of the first brood, and that the third is quite correct.

Each of my three captive birds began its postjuvenal molt when approximately eighteen days old. I say "approximately," for I might easily have missed the first feathers that dropped out. Furthermore, with captive birds it is not always possible to be certain that a molt is normal, for feathers are sometimes knocked or pulled out, but I regard it as significant that in three healthy, perfectly contented, well-fed captives an obviously regular sort of molt should start, in each bird, on the eighteenth day. So much for the erroneousness of the first statement.

As for the time at which the postjuvenal molt begins in the young of first broods, until we have more facts it is unwise to make further assertions. A late postjuvenal molt would, we assume, ensure perfectly fresh body plumage for fall and winter wear. A worn, faded, much-used juvenal plumage would be adequate for summer weather. It is quite possible, therefore, that the young of first broods molt more slowly than do the young of second (and third) broods or that, quite independently of age, all young birds of a given summer begin their postjuvenal molt more or less simultaneously.

[3] The nest, containing two fresh eggs, was found on July 18. The following day a third egg was laid, and incubation began forthwith. All three eggs were fertile. The incubation period was twelve days. Two eggs hatched on the morning of July 31. In the third the embryo died, perhaps from exposure to the sun. The birds were thus six days old when brought to the laboratory on August 6.

The molting of body plumage of my three captives began long before the flight feathers were fully grown. Since I have yet to collect or handle a full-winged and full-tailed "wild" young Vesper Sparrow in which there was no trace of molt of body plumage, I feel we are justified in restating that there is no such thing as a really complete juvenal plumage in this species.

History of Twelve-day-old Bird

The twelve-day-old bird weighed 19.8 grams at the time it was captured. The distance from the nipple of the oil gland to the tip of the longest rectrix was 18 mm., roughly the length of the tail.[4] Close examination revealed the fact that the distal lesser coverts, all the middle coverts, and certain feathers of the crown, nape, middle of the back, and sides of the chest were free of sheath at the base; that many feathers (some on the chin and face, a narrow patch along either side of the rump, a few proximal lesser coverts, and some humerals) were still wholly sheathed; and that the most noticeable feathers of the wings were the greater coverts, the exposed part of which was considerably greater than that of the secondaries.

On August 3 the bird weighed 20.7 grams (gain of 0.9 grams); the distance from oil-gland to tail-tip was 21 mm. (indicating a rectricial growth of about 3 mm.); the greater coverts had all attained full length and had lost their sheaths; and many feathers of the dorsal, scapular, and ventral tracts had become full grown. The exposed portion of the secondaries now equaled that of the greater coverts.

On August 4 the bird weighed 21.9 grams (gain of 1.2 grams); the tail had grown 3 mm.; and the exposed portion of the secondaries had become noticeably greater than that of the greater coverts.

On August 5 (bird approximately fifteen days old), a pronounced change became apparent in the region of the face. Here the tiny feathers had burst so rapidly from their sheaths

[4] Fearing that the point of the dividers might damage the bases of the growing middle rectrices, I measured carefully from the oil gland to the tip of the longest rectrix.

that the lores had turned from dark to light gray and a distinct white eye-ring had appeared. Weight, 23.9 grams (gain of 2 grams); tail growth, 4 mm.

On August 6 feathering out of the tiny facial feathers had continued, and incoming feathers in rows at either side of the ventral apterium had become much longer. Weight, 24.6 grams (gain of 0.7 grams); tail growth, 3 mm.

On August 7 the bird was sketched from life (see Pl. I). The drawing represents what I feel should be called the species' full juvenal plumage. No feathers are dropping out. Many, primarily the remiges and rectrices, are only about half-grown, but the distal lesser coverts and all the middle and greater coverts are fully developed and extensive feather-areas (middle of back, hind neck, nape, and chest) are ready to drop out and to be replaced. On this date the bird was approximately seventeen days old. Weight, 25.6 grams (gain of 1 gram). Tail growth, 3 mm.

On August 8 (bird approximately eighteen days old), the postjuvenal molt began. The first feathers to drop out were the lesser coverts, small feathers from the crown, and rounded, plumulaceous, unworn feathers from the back and chest. Weight, 25.9 grams (gain of only 0.4 grams). Tail growth, 2.5 mm.

On August 9, more crown, neck, back, and chest feathers had dropped out, and several times I noticed the bird scratching its nape with its foot. Weight, 26.1 grams (gain of 0.2 grams). Tail growth, 3.5 mm.

On August 10 (bird approximately twenty days old), many distal lesser coverts from each wing and several more back and chest feathers had molted. Weight, 25.2 grams (loss of 0.9 grams). Tail growth, 3.5 mm.

On the following day the molt was on apace. Most of the feathers I succeeded in retrieving were fair-sized ones from the chest and back. Weight, 25.7 grams (gain of 0.5 grams). Tail growth, 2.5 mm.

On August 12 (bird approximately twenty-two days old), the following molted feathers were retrieved: fifty-seven from

the chest, sides, and flanks (white with a gray streak); nine from the middle of the back (fuscous, margined with buffy white); four lesser coverts; eight middle coverts; and about twenty small feathers from the crown, nape, and hind neck. Weight, 26.6 grams (gain of 0.9 grams). Tail growth, 3 mm.

On August 13, eleven boldly streaked breast feathers, seven less boldly streaked feathers from the sides and flanks, seven feathers from the back, three lesser coverts, five middle coverts, one greater covert, and several little feathers from the crown, nape, and face were retrieved. Weight, 26.9 grams. Tail growth, 3 mm.

On August 13 I collected a "wild" Vesper Sparrow of about the same age as the captive bird. While the specimen was being skinned about twenty back feathers came out, all of them rounded and plumulaceous, but fully developed, juvenal feathers, no doubt the very set that had *first* broken from their sheaths while the tail-less bird was lying in the nest. Such middle-of-the-back feathers as did not come out during the skinning process I examined closely, finding every one of them to be perched on the tip of an incoming blood-quill about 4 mm. long. If I stroked or blew at these feathers they came out instantly. Another notable fact about this wild bird's plumage was that the middle and greater coverts, which were all present, were *all juvenal,* whereas practically all of the lesser coverts were of the first winter plumage.

Examining my captive once more, I was glad to find a few of its plumulaceous back feathers still unmolted. They were recognizable not alone from their color (their margins were grayish white), but also from their somewhat coarse or hair-like appearance and their slightly disheveled or upcurled sides. These, too, were perched on the tips of incoming blood-quills 4 or 5 mm. long. Such a condition I did not find anywhere in the region of the breast, sides, or flanks—parts of the body that presumably are subject to more "wear and tear" than is the middle of the back.

On August 14 the approximately twenty-four-day-old captive had lost two more greater coverts and one more middle

covert from each wing, and several crown and neck feathers. No juvenal lesser covert now remained, the feathered-out tips of the incoming quills in that tract being strongly reddish brown. Several new middle coverts were putting in their appearance also, most of them slightly unsheathed at the tip. Weight, 26.6 grams (slight loss). Tail growth, 2 mm.

On August 15, another covert of the left wing had dropped out, but the corresponding covert of the right wing had not. Chest feathers continued to drop out, several being found in the cage. Only one juvenal middle covert now remained (on right wing). The breast, side, and flank feathers whose tips had been well out-of-sheath at the time when the bird left the nest were now mostly, if not altogether, gone. Weight, 27.7 grams (gain of 1.1 grams). Tail growth, 2 mm.

On August 16 two greater coverts had dropped from the left wing, one from the right; the last of the middle coverts had come out; and numerous long pinfeathers were noted in the deep, rather sparse plumage of the rump, but the most noticeable development was the incoming of a whole patch of feathers along either side of the chest. The visible tips of these were buffy white. Weight, 28 grams (gain of 1.3 grams). Tail growth, 2.5 mm.

On August 17 two more greater coverts had dropped—the last one from the right wing, the next to the last from the left. This one remaining juvenal greater covert clung to the left wing unmolted until August 26. Weight, 26.9 grams (loss of 0.8 grams). Tail growth, 1 mm.

From August 18 to August 21 the bird's weight fluctuated considerably, though no change in appetite or capacity was observed; and the tail grew slowly (1 mm. on the eighteenth, 1.5 mm. on the nineteenth, 1 mm. on the twentieth). On the twenty-first, when the bird was approximately thirty-one days old, absence of all sheathing at the base of the rectrices indicated that the tail was at last full-grown. The remiges were now full-grown also. The postjuvenal molt in this individual began, therefore, thirteen days before the first flight feathers had reached full development. By the time when these first

flight feathers had reached full development the juvenal lesser coverts had all dropped out and had been fully replaced by the richly red-brown feathers of the first winter plumage, the juvenal middle coverts had dropped out and had virtually been replaced, and incoming crown, breast, side and back feathers of the first winter plumage were so well developed that no sheathing was visible without careful lifting and parting of the plumage.

By August 27 (bird thirty-eight days old), the row of first winter greater coverts was practically full-grown (all, that is, save that replacing the feather molted on the twenty-sixth). These new greater coverts were strikingly longer than the juvenal ones; they were brown-edged rather than buffy-tipped; and their general appearance was much like that of the unmolted tertials.

The last plainly visible juvenal feathers to be molted were a row along either side of the back, the outer of each scapular tract, and the tail coverts. These gray- or white-edged back and scapular feathers disappeared about August 28. Nine days later (September 6) the new under-tail coverts were almost full-grown. By September 10 (bird fifty-two days old) the first winter plumage was virtually complete.

That such an assumption of first winter plumage *may* be quite normal is proved by the fact that on September 6 I collected a "wild" young female in which *no* juvenal feathers whatever were present. In this specimen the outermost primary of each wing was short (12 mm. shorter than the longest of the wing) and noticeably sheathed at the base, however, indicating that the postjuvenal molt may sometimes involve this feather. All the other primaries and all the rectrices were full-grown.

The Two Other Young Vesper Sparrows

The six-day-old nestlings taken August 6 were not of exactly the same age, one having hatched in advance of the other.[5]

[5] The younger bird hatched between 10:30 and 11 A.M. on July 31, the older sometime between 6 and 10 A.M. the same day.

The older bird consequently weighed more and looked more mature for some time—specifically, until August 23, when both birds weighed the same (26.4 grams).

The older bird refused to roost in the nest on the night of August 8. The following day neither bird would sit in the nest. For four days after leaving the nest neither bird grew heavier, the older one weighing about 20 grams during this period, the younger about 18.6 grams. The rectrices and remiges grew steadily, however, the former pushing out at from 3 to 4 mm. per day in both birds.

Once the birds began to gain weight after this period of adjustment, the younger tended to overtake the older. Thus, the greater coverts reached full length and lost all traces of sheath on the twelfth day (August 12).

When these nine-day-old bantlings left the nest their tails measured 13 mm. and 11 mm. respectively; traces of light mouse-gray down clung to the tips of several crown, nape, and back feathers and even to a few scapulars and greater coverts; and the greater coverts were the most noticeable feathers of the wing, the exposed portion of these measuring about 18 mm., whereas that of the secondaries measured but 3 or 4 mm. Most of the lesser coverts were full-grown. So were the middle coverts, though some of these had a bit of sheath at the base. No other feather anywhere on the birds was fully out of its sheath, so far as I could determine from a not wholly satisfactory examination of the sturdy, wriggling captives.

On the following day (August 10) all the middle coverts had lost what remained of their sheathing, and the greater coverts had feathered out considerably, the proximal two or three on each wing retaining more sheath at the base than the others. On the twelfth (as stated above), all the greater coverts had reached full length and had promptly lost their sheaths. The birds preened and intermittently fluttered their wings for more than an hour (from about 10 : 30 to 11 : 30 A.M.) on this date.

On August 13 (birds thirteen days old), it was noted that certain small nape and posterior crown feathers were fully

grown; that a patch of feathers in the very middle of the back was free of basal sheathing, and that much of the plumage of the lower throat, breast, sides, and flanks was fairly well grown. Close inspection of the belly revealed whole rows of new feathers coming in at either side of the ventral apterium.

The postjuvenal molt of the nest-mates began on their seventeenth day (August 17). Their tails measured 39 mm. and 36.5 mm. respectively on that date. The first feathers to go were small ones from the forehead and crown and lesser coverts. The following day a few lesser coverts and capital feathers dropped out. On the nineteenth, more lesser coverts, one or two proximal middle coverts, and what appeared to be two whole rows of chest feathers from each side were molted. All at once the birds lost their tidy, well-fed appearance and became bedraggled and dowdy. Much of their time they spent in preening. Feathers flew each time they shook themselves or fluttered.

On August 21 the last of the juvenal lesser coverts had dropped from both birds and it was noted that certain distal feathers of this tract had even been replaced. Numerous chest, back, and head feathers had molted. A bunch of thin pinfeathers was discovered coming in along either side of the rump, but no more middle coverts had dropped out and no greater covert showed any sign of coming loose.

The tails of both birds had become fully developed on the last day of August. Each thirty-one-day-old bird now had a noticeable patch of incoming buffy feathers at either side of the chest; crown feathers were new; but most of the middle, and all of the greater, coverts were still *juvenal,* the upper and under tail coverts were juvenal, and the sides of the head and throat were plainly in molting condition. No middle coverts had dropped out since August 20, and the distal ones that had dropped out were now so nearly replaced that the row appeared to be complete. The new coverts of the row were much more reddish brown than were the unmolted juvenal ones. The remaining juvenal scapulars (virtually the whole outer row) were easily distinguishable because of their whitish edging or tipping.

Summary and Conclusions

1. Each of three young Vesper Sparrows reared at the George Reserve during the late summer of 1940 began its postjuvenal molt when about eighteen days old.

2. The rectrices became full-grown when the birds were thirty-one days old. By this time many feathers (chiefly of the crown, middle of back, sides of chest, and the lesser coverts) had been molted and some had been completely replaced. In none of these birds, therefore, was the juvenal plumage ever really a *complete* separate plumage.

3. Molting of the middle and greater coverts was not uniform. In one bird all dropped out, and many were replaced, before the flight feathers were full-grown. In the other two molting did not occur until well after the flight feathers had become full-grown.

4. The first body-feathers to molt invariably were those which had been feathered out at the tip about the time the birds left the nest. Eighteen-day-old body feathers may therefore be said to be worn-out feathers, whether frayed and broken or not. Most molted feathers picked up in the cages appeared to be in perfectly good condition.

5. Two of the three birds left the nest when they were nine days old. Their tails were very stubby, about 12 mm. long, indicating an average growth per day of about 1 mm. during the nestling period. From the ninth to the twenty-fifth day, however, growth was much more rapid, averaging about 2.8 mm. per day. From the twenty-fifth to the thirty-first day growth was retarded and irregular.

6. The greater coverts of the first winter plumage are much longer and browner than those of the juvenal plumage.

7. The postjuvenal molt occasionally involves the outermost primary, but not the other remiges or the rectrices.

PLATE I

Drawing in water color by the author.

Portrait from life of an Eastern Vesper Sparrow in the most completely juvenal plumage the species ever wears. The bird is seventeen days old. Edwin S. George Reserve, Livingston County, Michigan, August 7, 1940.