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Notes on the Development of Immature Black-headed Grosbeaks (*Pheucticus melanocephalus*)

By HENRY G. WESTON, JR.

From April to September, 1945, and from April to June, 1946, a field study was undertaken on the natural history of the common black-headed grosbeak (*Pheucticus melanocephalus*) in the breeding season (Weston, 1947). The following discussion, related to the development of immature birds, covers but one phase of this study. Observations were in Strawberry Canyon, on the campus of the University of California, Alameda County, California.

Eight nests were studied in detail, six in 1945 and two in 1946. The usual set of eggs in this species consists of three to four eggs. Occasionally sets of two and five eggs are recorded. A study of 192 nests from the literature and other sources disclosed a mean clutch size of 3.31 eggs. Incubation lasts twelve days as does the following nestling period. Data were gathered on the development of eleven nestlings.

DEVELOPMENT OF THE YOUNG

First day. At hatching, the grosbeak is typically altricial, being blind and naked except for the sparse white neosoptiles. It weighs three grams, about ten percent of what its weight is when it leaves the nest after twelve days and 7.5 percent of the average weight of the adult bird. The entire body is an even apricot orange color, the bill, legs and feet being a slightly lighter shade, while the claws are colorless. The margin of the mouth is swollen and ivory-white in color; the interior lining is a deep, reddish apricot. Also ivory-white in color is the egg tooth, at the tip of the upper mandible. The eye region, 6.5 millimeters in diameter, is large, dark and swollen, but shows no opening at this time. However, a 2 mm. slit at the center shows the future location of the lids. The skin is smooth with only a few wrinkles, the chief feather tracts being discernable only upon close inspection. The abdomen bulges noticeably and the wall is extremely thin, so that the internal organs—such as the coils of the intestines—show clearly. Scattered about under the transparent skin are blood vessels, many of which are also visible, as are the ribs. The down is white, 1 centimeter in length, and arranged in rows where present. Such rows are on either side of the head in the occipital and superciliary regions, along the

spine from the middle of the back to the oil gland, on the femoral tract, on the lateral portion of the crural tract, on the humeral tract in the region of the elbows and a few wisps on the wings along the position of the upper coverts. No down is present on the ventral surfaces of the body.

The latter part of the first day the young assumes a posture of keeping upright, resting on its abdomen, the legs drawn up along the sides of the body. Activities at this stage consist mainly of various simple reflexes relating to lifting the head to beg, opening the mouth, swallowing, defecating and, as mentioned previously, keeping the body upright. When handled, the young occasionally raised their heads and opened their mouths at no observable stimulus. Vocal sounds heard from the young at this stage were very faint *peep*-like notes, audible only a few inches away from the birds themselves.

By the end of the first day the primaries, in sheaths, are visible, 2 mm. in length, under the surface of the skin on the wings. The swollen rims of the bill at the corners of the mouth begin to take on a slight yellowish tinge and scattered dots of dark pigment begin to appear on the dorsal feather tracts.

Second day. During the second day the most noticeable change in appearance is an increase in size, which is almost doubled. The skin darkens slightly, and a few wrinkles appear at the joints of the wings and feet. The feather tracts are a little more conspicuous, dark pigment continuing to form along them, and the sheaths of the remiges begin to break through the skin. Both eyes are still tightly shut, with only a tiny slit in the center of each to indicate the position of the lids. The vocal sounds, faint high-pitched *peeps*, can be heard only within the immediate vicinity of the young and usually occur when they raise their heads and open their mouths to beg. They still have trouble maintaining upright positions and cool off readily when handled.

Third day. There is, by this time, a great increase in bulk, the average weight being slightly more than ten grams. The neosoptiles have grown and the skin in the regions of the feather tracts shows slight surface irregularities made by the growth of individual feathers under the skin. These tracts continue to darken due to the pigmentation under the skin. The tips of the sheaths of the remiges, out 1.5 mm., become more apparent, a white neosoptile marking the location of each. The alular feathers at this stage protrude 1 mm. out of the skin.

The skin itself begins to darken, the legs, feet and bill begin to assume a flesh color and the yellow color of the corners of the mouth continue to deepen. The swollen and protruding eyes, still closed, measure close to 8 mm. in diameter, while the slit at the center, marking the position of the lids, is 2.4 mm. long.

The nestling is also steadier than before, the head being held up with more energy and less tremor. The body still rests on the abdomen, the legs held along the sides of the body, although the feet are beginning to grasp at the bottom of the nest.

Fourth day. By the fourth day the skin is darkening noticeably and still further darkening of the feather tracts is also to be noted. The legs and feet are assuming a flesh color, the scales becoming more evident each day. The bill is darkening and the interior of the mouth is dulling slightly in color. The skin continues to become more wrinkled and the bulging abdomen is definitely reduced in size. At this stage the coils of the intestine are still visible through the skin of the abdomen but there is no evidence of the yolk mass visible up to this point.

For the first time, feather sheaths begin to appear as pin points along all the main feather tracts. The sheaths of the primaries and secondaries have pierced the skin and protrude several millimeters. No apparent loss of down is noticeable as yet.

The young at this age spend most of the time sleeping in the nest, showing no activity except during periods of feeding. Heads are jerked up and bill opened in response to any disturbance at the nest, although the eyes are still closed.

Fifth and sixth days. By now the young weigh half as much as they do when they leave the nest at the end of twelve days. Their calls begin to increase in volume over the former faint *peeps* audible only at short distances from the nest. The eyes are still normally tightly closed, although at nest 2-46 an exception to this general rule took place. One of the young at this nest began to open its eyes partially on the fifth day while the other two young acted similarly on the sixth day. These three young varied from the remainder of the eleven young grosbeaks studied, none of which opened their eyes before the eighth day.

Parts of the ventral tracts on the fifth day still have no feather sheaths protruding from the skin. By the sixth day, however, feather sheaths are prominent on all tracts, projecting as rows, although the feathers still have not begun to break out of the sheaths. Wisps of down are located at the ends of many of the sheaths except on the ventral parts of the body, where no down

at all is present. A great majority of the feather sheaths are a blue-gray in color in contrast to the sheaths on the breast and down along the sides of the abdomen, which are a tawny color. The developing primaries are perhaps the most conspicuous of the feather sheaths and the most rapid in growth. On the fifth day they average about 4 mm. in length while on the sixth day, they average about 9 mm. in length, thus showing a 5 mm. growth in twenty-four hours. The rectrices do not break through the surface of the skin during this period.

At nest 1-46, while handling a six-day-old young, it defecated in my hand. This is the earliest stage at which this occurs. From the sixth day on, however, this reaction is typical, a fecal sac being deposited almost every time the young are handled.

Seventh day. On the seventh day of nest life, marked changes occur. Many feathers on most of the main feather tracts begin losing their sheaths for the first time. The contour feathers, especially those on the ventral tract, lose their sheaths almost upon appearance. The feathers on the breast, as they break out of the sheaths, are tawny while those along the sides of the abdomen are almost whitish. None of these contour feathers is more than a few millimeters in length. Feathers on the back, head and in the tail have not yet emerged from the sheaths.

By the seventh day, the primaries average about 15 mm. in length and have just begun to unsheath. The tips protrude 1 mm. out of the tips of the sheaths. Coverts on the wings are also just commencing to unsheath. Many of the feathers yet to unsheath have single down feathers attached to the tip. The rectrices, only about 1.5 mm. in length, are far behind the development of other feathers on the body, for even at this stage they are still within sheaths.

The eyes ordinarily are not yet open, the eyelids still being recognizable only by the tiny slit in the center of each. The legs and feet are now a blue-gray color, having a slight tinge of pink in them. The feet have developed the ability to grasp, and the young bird now tries to grasp at anything with which it comes in contact. The young have gained enough strength in their feet to make it difficult to remove them from the nest. Several times the young have resisted vigorously and as I pulled them out parts of the bottom of the nest came with them.

The bill, as with the legs and feet, continues to darken. The swollen ridges at the corners of the mouth are slowly shrinking to normal size. Early in nest life the color of this part of the mouth

was shown to be an ivory-white with a slight yellow tinge. Now, at the seventh day of development this yellow is beginning to disappear, fading to the original whitish appearance.

Eighth day. The eyes generally open for the first time on the eighth day, although the lids do not open all the way until the ninth day. At first they crack open about half way, and with this opening the young begin to become noticeably more active.

Probably one of the most perceptible changes occurring on the eighth day is the acquisition of colors in the various tracts as the feathers continue to unsheath. The body feathers on the breast are a light buff. The feathers on the ventral tract on each side of the abdomen vary from a light buff to white. The head is becoming a blackish-brown with white appearing along the superciliary lines over the eyes. The back is a uniform blackish-brown, beginning to appear spotted. The flight feathers are also a blackish-brown and the coverts appear as a pale buff.

At this period the feathers are growing rapidly, the bare pterylae being covered with feathers from the adjacent tracts. The natal down is disappearing and only wisps are still attached to the ends of feathers on various parts of the body. The primaries, now about 20 mm. in length, are 3 mm. out of the ends of the sheaths. The rectrices, still not out of the sheaths, are close to 3 mm. long. The skin is assuming a flesh color, in places being well wrinkled, and the legs, feet and bill continue to darken. At the corners of the mouth the yellowish swollen ridges continue to fade, assuming a whitish color.

Ninth day. On the ninth day the eyes are wide open and, as a result, the young are more active than ever before. They move about more in the nest, uttering frequent faint call notes and occasionally even utter loud harsh call notes. I heard these latter calls only when reaching down into the nest to lift one out for weighing and measuring. In being handled at this stage, the young try to stand up but are unable to maintain their balance toppling over in their attempts. While being handled the head is kept up for most of the time and the feet continue to grasp at anything within reach. No fear reaction is observable as yet.

The feathers of the young continue to take on a definite color pattern. As a result, the grosbeaks at this point begin to resemble the adult females in general coloration. Many of the feathers are breaking well out of their sheaths. Such a process is probably speeded up by the use of the bill by the nestling birds. A bobbed tail seems to appear overnight, although the rectrices, now about

6 mm. in length, still remain in their sheaths. The primaries now are close to 27 mm. in length, the tips being about 4 mm. out of the sheaths. With the growth of these flight feathers, the vane of the wing begins to appear as one continuous surface.

Tenth day. The young now impress one as being completely covered with feathers. However, closer inspection will reveal that except when the young are huddled down in the nest, the feathers do not completely cover the apteria. The abdomen, which is now of normal size, still is the only large area of the body not covered with feathers, the skin there being a dark flesh-color. The color pattern of the bird in general becomes more like that of the adult female, except that it has a cleaner, fresher appearance. Natal down is present only as scattered wisps on the feather tips. Down is however, most prominent in rows along the superciliary lines on the head. The head is now for the first time completely covered with feathers, the skin there being a dark flesh-color. The color have broken out of their sheaths at least 13 mm. The rectrices, 9 mm. long, however, still have not emerged from their sheaths.

The young show no reaction to handling except to cuddle down in the hand, drawing the head down and back between the shoulders. The fear reactions are more pronounced while the young are in the nest. There they cringe down when intruders approach. When taken away from the nest and handled, they seem to lose most of their fear. When first lifted from the nest, they still defecate, leaving fecal sacs to be removed by the adults. At this age the young are able to stand upright on objects, such as a person's forefinger, balancing there unaided.

Eleventh day. By the eleventh day, the apteria are covered except for the abdomen, which still is bare. The feathers continue to lose their sheaths and for the first time, the rectrices, about 12 mm. in length break free at the tips of the sheaths. The remiges, 37, mm. in length, have the outer 20 mm. out of the sheaths. Only scattered wisps of down remain on the body and these can be readily picked off.

Twelfth day. The twelfth day is normally the last day in the nest. The young are extremely active, moving about in the nest, stretching, preening and uttering almost continuous *pee urr rrr* calls. Their plumage is similar to that of the adult female except that the underparts are paler and lack the yellow on the abdomen. The back is more spotted than streaked and the superciliary and malar stripes are a much purer white. Some young at this age have no

down left, while others have just a few wisps. All the apteria are closed over except for part of the abdomen, but the feathers there are fast closing in. The feather sheaths remaining are hidden except for those of the bobbed tail. There, the rectrices are 13.5 mm. in length, being 5 mm. out of the sheaths at the tips. The primaries are almost 39 mm. in length, only the lower one-third of each being enclosed in a sheath.

The bluish-gray legs and feet are beginning to harden, although they are still largely fleshy when compared with their condition in the adult. The claws on the feet are also darkening. Similar in color to the legs and feet is the bill, where the swelling at the corners of the mouth continues to recede. The yellowish color has almost entirely disappeared, being replaced by white. The interior of the mouth is now pink as in the adults. The iris of the eye is brown, the pupil a dark brown, almost black.

On this twelfth day the young develop an urge to leave the nest and frequently will leave prematurely if approached too closely. On June 11, 1945, I weighed the twelve-day-old nestling at nest 6-45 and placed it back in the nest. It promptly hopped up to the rim of the nest and half fluttered, half fell down through the adjacent foliage. I returned it to the nest four times and each time it climbed out of the nest and fell to the ground thirty feet below. I then placed it in a cardboard box on the ground, leaving it there for ten minutes. During this time, it repeatedly tried to get out of the box, half hopping, half fluttering up against the sides of the box. It defecated five times in the ten minutes while in the box. The thin mucous envelope was no longer around the fecal material, which was quite loose, and mottled white, brown and black in color. When first handled at the nest it had deposited feces enclosed in a sac. I found that with many of the young at this age, when disturbed, the first mass of fecal material deposited was enclosed in a sac. Then, if the disturbance continued, more fecal material was passed off but without the enclosing sac. Possibly the sac did not have time to form around the excreta.

Normally, when leaving the nest on this last day, the young, instead of trying to fly, merely climb through the surrounding vegetation. Frequently they will rapidly flutter their wings and perhaps fall a short distance, but this is usually because they lose their balance. In nests where one of the young is a day behind the others in age, it will climb out of the nest in an attempt to follow the older birds. Unfortunately I have never witnessed young leaving the nest of their own volition.

Their development after they leave the nest was observed in only one instance, that of an immature grosbeak which I had captured. In this case, records were made of the daily change in weight. However, my other observations could not be utilized, since the bird's growth was obviously retarded and the feather

Table 1

Change in body weight of young grosbeak, one of two raised in nest 6-45.

Date	Wt. in grams	Gram gain	Hour interval	Age in days
May 31	—	—	—	1
June 1	—	—	—	2
June 2	—	—	—	3
June 3	—	—	—	4
June 4	15.9	—	—	5
June 5	19.2	3.3	24:03	6
June 6	22.2	3.0	24:05	7
June 7	25.6	3.4	24:55	8
June 8	28.2	2.6	23:02	9
June 9	31.4	3.2	23:25	10
June 10	33.2	1.8	30:10	11
June 11	31.2*	-2.0	19:30	12
June 12	33.8	2.6	26:10	13
June 13	34.0	0.2	23:00	14
June 14	37.2	3.2	24:00	15
June 15	38.8	1.6	25:30	16
June 16	36.1	-2.7	22:45	17
June 17	37.2	1.1	24:00	18
June 18	—	—	—	19
June 19	38.0	0.8	45:00	20
June 20	38.5	0.5	24:00	21
June 21	39.5	1.0	24:10	22
June 22	40.0	0.5	24:00	23
June 23	40.5	0.5	23:50	24
June 24	41.1	0.6	24:15	25
June 25	41.7	0.6	24:00	26
June 26	40.5	-1.2	21:00	27
June 27	40.0	-0.5	24:10	28
June 28	40.0	0.0	24:05	29
June 29	41.0	1.0	24:00	30
June 30	41.0	0.0	32:00	31
July 1	—	—	—	32
July 2	39.4	-1.6	40:00	33
July 3	40.1	0.7	24:10	34
July 4	39.0	-1.1	23:55	35
July 5	38.9**	-0.1	24:15	36

*Left nest

**Died

development stunted. Despite precautions, dietary deficiencies caused the death of this bird on the 36th day of life. See Table 1 for weight changes of this bird. Table 2 summarizes weight changes of a lone bird raised by its parents in nest 4-45. Note the differences in weight of this bird raised alone in a nest, the weight of the bird (Table 1) raised in a nest with one other nestling, and the weight of the bird (Table 4) raised in a nest with two other nestlings. The bird receiving all of the food brought by the adults weighed more than the bird sharing the food with one other nestling. The bird sharing the food with two other nestlings weighed even less.

Table 3 summarizes the body weights of 70 males and 31 female black-headed grosbeaks. Table 4 represents in some detail in tabular form, the development of a young grosbeak at nest 2-46.

Table 2

Change in body weight of young grosbeak, only one raised in nest 4-45.

Date	Wt. in grams	Gram gain	Hour Interval	Age in days
May 23	—	—	—	1
May 24	7.0	—	—	2
May 25	9.8	2.7	23:30	3
May 26	14.4	4.4	24:00	4
May 27	18.5	4.1	26:17	5
May 28	22.1	3.6	21:43	6
May 29	24.6	2.5	23:53	7
May 30	26.9	2.3	23:53	8
May 31	29.0	2.1	24:02	9
June 1	32.7	3.7	23:53	10
June 2	33.7	1.0	23:50	11
June 3	34.8	1.1	27:01	12
June 4	Gone from nest		—	13

Table 3

Sexual differences in body weight of adults regardless of season or exact locality. Weight in grams.

	Male	Female
Number	70	31
Mean	43.0	43.6
Minimum	32.6	34.4
Maximum	58.3	56.7
Range	25.7	22.5

Table 4

Development of a young grosbeak at nest 2-46,
Strawberry Canyon, May-June, 1946.

Age	Wt. in grams	Culmen in mm.	Gape in mm.	Wing in mm.	2nd primary	Tail in mm.	Tarsus in mm.	Total length (bill to preen gland)
0	3.1	4.9	8.5	7.2	0.0	0.0	8.9	40.5
1	4.6	5.3	9.3	8.1	0.0	0.0	10.0	45.2
2	6.4	7.5	10.6	11.0	0.5	0.0	12.2	48.2
3	8.4	8.0	10.8	12.5	1.5	0.0	13.5	50.8
4	—	—	—	—	—	—	—	—
5	13.0	8.1	12.3	19.9	6.7	0.0	17.0	57.0
6	15.6	8.8	13.1	23.2	9.6	0.0	18.8	64.8
7	16.7	9.1	13.4	27.8	13.6	1.2	19.8	67.0
8	18.8	9.2	13.8	33.5	18.4	2.1	20.3	71.0
9	19.9	9.5	14.1	37.9	21.0	3.5	21.5	76.2
10	22.4	9.8	14.8	42.4	25.4	4.9	22.3	81.0
11	25.5	10.0	15.2	43.5	27.5	6.5	23.0	85.0
12	Left nest							

SUMMARY

Black-headed grosbeaks were studied during the spring and summer seasons of 1945 and 1946. One phase of this study entailed recording data on the development of the young of this species during the nestling period. The nestling period is twelve days.

At hatching the altricial nestling black-headed grosbeak is blind and naked except for sparse white down. It weighs about three grams or ten percent of its weight when it leaves the nest and about seven percent of the mean weight of the adult bird. The entire body is an even apricot orange color, the interior of the mouth being a deep reddish apricot. On the second day the sheaths of the remiges begin to break through the skin. On the fourth day the feather sheaths begin to appear as pin points along all of the main feather tracts. By the seventh day the sheaths of primaries began to break. The eyes generally open on the eighth day. On the tenth day, the young appear completely feathered. The twelfth day is normally the last day in the nest.

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