BREEDING BEHAVIOR OF THE BLACK-HEADED GROSBEAK

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In this study of the breeding behavior of the Black-headed Grosbeak (*Pheucticus melanocephalus*), particular attention has been given to the role of the sexes at the nest. Observations were made in Strawberry Canyon, on the campus of the University of California at Berkeley, from April to September, 1945, and from April to June, 1946.

HABITAT

Strawberry Canyon cuts into the west slopes of the Berkeley Hills; it is about a mile long and one-third of a mile wide and ranges in altitude from 400 to about 1800 feet. The plant cover of the canyon consists of evergreen oak-laurel woodland chiefly on the lower slopes and along the small side draws, willows and alders along the creek, and chaparral and grassland on the higher and more exposed slopes. Here up to eight pairs of breeding grosbeaks occur within a half mile's distance in areas of favorable habitat along the canyon.

Grosbeaks may ordinarily be found in the woodland or in riparian groves and thickets: in these two major types of plant cover, the trees and marginal or understory bushes are used for almost all routine activities. In general grosbeaks are most often found in the open woods. The extensive peripheral foliage characteristic of open woods is advantageous to grosbeaks in foraging for food; for singing perches, grosbeaks appear to require fair visibility, and this feature is again best afforded by open woods. Nesting occurs most commonly in streamside bushes and trees and in the live oaks of open woods. Along edges or transitions between grassland and woodland or chaparral, grosbeaks are also common; but they enter chaparral and grassland only infrequently and then only in search of food.

SEASONAL OCCURRENCE

Occurrence of the Black-headed Grosbeak in the San Francisco Bay region is limited normally to the months between April and September, inclusive. Records for the years 1911 to 1946, based on field notes of several ornithologists, show that grosbeaks usually arrive at Berkeley in the first three weeks of April. The earliest recorded arrival date is April 4, the latest, April 21. According to my observations in 1945, female grosbeaks did not arrive on the breeding grounds in Strawberry Canyon until the sixth day after the arrival of the males. A careful search was made of the area each day and all individuals seen were recorded, as follows:

April 13, 1945, none present.
April 14, 1945, 9 a.m., one male, no females.
April 15, 1945, 1 p.m., two males, no females.
April 16, 1945, 7 a.m., three males, no females.
April 17, 1945, 7 a.m., two males, no females.
April 18, 1945, 7 a.m., three males, no females.
April 19, 1945, 7 a.m., three males, no females.
April 20, 1945, 7 a.m., three males, one female.
April 21 and 22, 1945, no counts made.
April 23, 1945, 7 a.m., three males, one female.
April 24, 1945, 7 a.m., three males, one female.
April 25, 1945, 7 a.m., four males, three females.

Fall departure is apparently irregular. Late in the season all individuals are quiet. The males cease singing after mid-July and are the first to leave, generally disappearing late in July. Females and young remain several weeks longer and usually begin to leave in mid-August. In the past thirty-two years, the last-seen dates at Berkeley have ranged from August 11 to October 9. Records after early September are probably those of transients rather than local residents.

There are a few records of winter occurrences: On November 20, 1938, E. R. Hall shot an adult male (M.V.Z. no. 74900) at Lafayette, Contra Costa County, California;

according to Hall (MS), this bird, or one indistinguishable from it, had been seen near his home almost daily for two weeks prior to time of collecting. H. W. Grinnell (1942) reported a dead grosbeak found in Berkeley on February 19, 1942; her report also contains two records of observations, February 16 or 17 and February 24, in the same year.

COURTSHIP AND TERRITORIAL BEHAVIOR

Courtship and selection of mates occurs after the grosbeaks arrive on their breeding grounds. The males arrive singly rather than in flocks and are solitary for the few days preceding arrival of females. They begin singing upon arrival, and their activities before the females appear consists largely of foraging in the live oaks and willows and uttering frequent songs from exposed perches. Males appeared to be spaced, but I saw no conflicts between them until after the arrival of females.

In 1945 lone females arrived six days after the males, and the grosbeaks engaged actively in courtship soon after. Two or even three males would be singing and flying about in the vicinity of one female, occasionally chasing her. Rival males also frequently chased one another.

The only type of display seen was a nuptial flight. Loud songs were uttered from some exposed perch near a female and then the male would suddenly fly up and out, performing a song-flight in the air above her. Flying forth on a horizontal course, the male would circle out from the summit of a tree, with wings and tail spread, uttering an almost continuous song. In the air for eight to ten seconds, he would then fly back, usually to the perch just vacated. I have never seen this display before a female coming more often than four minutes apart. Song-flights are not restricted to the courtship period but also occur, although less frequently, while the female is incubating.

Early in the season the males of the newly paired birds contend with unmated males. For instance, on April 25, 1945, I saw a male follow a female into a live oak; six seconds later a second male flew to the same tree and drove the first male off. Both male and female then flew off, returning five minutes later. This time, as the male perched at the apex of a live oak, the female gathered nesting material near by; they flew off together a few moments later. Again, on April 30, a male flew into an elderberry bush and drove a second male out; the pursued bird flew off, the second male following only twenty feet or so and then returning to the bush. No vocal sounds were uttered by either bird. Forty-five seconds passed and a female flew out of bushes fifteen feet away, carrying nesting material in her bill in the direction of a nest site; the male followed. Ten minutes later this male again chased another male from the trees in which the female had disappeared ten minutes before. The pair was occupied in this territory all morning, the male following the female about. On May 1, the male of this pair was again observed driving other males away.

During the early part of the season the paired birds forage together, and at this time the male is distinctly aggressive. On May 2, 1945, a lone male was foraging silently in a live oak. A female followed by a male suddenly flew to the same oak. Immediately upon arrival, the second male drove the first male away. The pair remaining then began foraging. The female searched for food almost continuously but the male spent most of his time peering around.

An instance of territorial competition apparently between established pairs was recorded on April 30, 1946, beginning at 10:33 a.m.: Two males and two females were observed fighting one another in the dense willow and thimbleberry thickets bordering Strawberry Creek. The entire ensuing action was restricted to the interior of the willow and thimbleberry thickets and followed an extremely irregular weaving course through

the branches and foliage. The activities of the four also were restricted to the vegetation immediately along a 100-foot section of the creek bed. No other species of birds were attracted by their activities. Clearly the birds were in pairs, one attempting to drive the other away. After a few moments of observation, it became evident that the females were the more aggressive, doing most of the fighting; they repeatedly postured and flew at each other, and at each attack, loud songs, calls and sounds of bodily contact could be heard. The calls and songs of both sexes made a loud chorus. The fighting between the two females seemed to disturb rather than incite the males, and they only added to the confusion by flying at the two females. In the twenty-two minutes I watched, the two males did not attempt seriously to fight each other; on several occasions, however, one would chase the other. In the remaining time, the males sang and called loudly as they nervously and rapidly hopped and flitted about near the females. The females repeatedly clashed, one flying at the other, both fighting and then one flying off, the other following. The males would follow on each such occasion. Yet every few minutes there were lulls in the activities of the four; no sounds were uttered and the four remained quietly on their respective perches or foraged. During one such lull, one of the females leaned forward on her perch, partly opened her wings, spread her tail slightly and opened her bill; she then rushed at the other female and struck her with her body, and immediately all four birds again began a varied chorus of songs and calls. The two females, when meeting in mid-air, slowly fluttered toward the ground, separating to fly up higher, only to clash again. In one of these encounters, four loud screech-like calls were uttered by one of the females apparently suffering pain. These screeches visibly disturbed both males, causing them to fly at the females who were locked in battle and to separate them. Three such bodily encounters occurred before the female on the defensive finally flew off, followed by the other female and both males at 10:55 a.m. One pair eventually disappeared upstream, the other moved downstream.

In this conflict between two pairs, it appeared significant that one female was obviously more aggressive than the other and that neither male actually entered into any offensive fights nor even paid very much attention to the other male. The conclusion that here one pair was encroaching upon the territory of the other was strengthened by the fact that about ten days later two nests were situated near the site of the conflict, about one hundred feet apart, the site of conflict being about half-way in between.

Another example of territorial encroachment was witnessed near Strawberry Pool on April 25, 1946. I heard two males singing about 50 yards apart. One, male A, took wing, singing as he approached male B. The latter drove male A away by flying at him, uttering a loud song as he did so, and pursuing him half-way back to male A's original post before turning back. Low *spic* calls could be heard from the mate of male B during this incident. Four minutes later, as male B was singing from an exposed perch in the live oaks, male A again flew across the pool, this time uttering no sounds; on this occasion, however, the intruder was not driven out and, in fact, no visible attention was paid to him by male B. A minute later, male A flew back across the pool, again singing loudly; as he disappeared, all of the birds became quiet. Subsequently, a female was seen carrying nesting material to the oaks where pair A was present earlier, and upon her arrival there a male uttered several calls. Several days later, a nest was found in this same group of oaks. I concluded, therefore, that the first time the intruding male had flown into these trees, the female had been at the nest site and the invader was driven off by her mate; he was probably not driven away the second time because the female was not at the nest.

Practically all local species of birds except predators and other grosbeaks are tolerated

at the nest. Wren-tits (*Chamaea fasciata*) were seen picking at one occupied nest, Bush-tits (*Psaltriparus minimus*) were seen foraging on a nest, a Pileolated Warbler (*Wilsonia pusilla*) was seen standing on the rim of another nest, and none caused any apparent alarm on the part of the grosbeaks. But male grosbeaks generally did not allow other birds in the immediate vicinity of their singing perches. An exception to this was seen on April 30, 1945. At 7:42 a.m., I saw and heard a male grosbeak singing from a perch near the apex of a fir. Perched two feet above him was a male Purple Finch (*Carpodacus purpureus*), also singing. Both completely disregarded each other and at 7:44 a.m. the grosbeak flew off down the canyon and out of sight.

NESTS FOUND IN STRAWBERRY CANYON, 1945-1946

Nest 1–45.—The nest tree, a 15-foot coast live oak, and another oak of similar size ten feet upslope, were situated in the center of an open, grass-covered clearing in a woodland, on a 25-degree southwest-facing slope, 125 feet upslope from a stream. The nest was 11½ feet above ground, resting three feet from the central axis in a three-way fork and concealed on all sides by clusters of leaves and twigs, as were all the remaining nests.

On May 3, 1945, the nest held four fresh eggs. Three eggs hatched before 8:30 a.m. on May 14; the fourth egg disappeared prior to May 14. Three young left the nest on May 26.

On August 30, this nest showed evidence of use by some small mammal. In the nest cup were 20 fecal pellets, several of them no more than 24 hours old. With these pellets were 14 small seed pods of several unidentified species of plants. A partial canopy of twigs and grass stems over the nest cup had been built. The size and shape of the fecal pellets closely resembled those of a white-footed mouse (*Peromyscus*). No further signs of activity were detected.

Nest 2–45.—The nest tree, a 32-foot coast live oak, was located in oak-laurel woodland on a 35-degree south-facing slope next to Strawberry Pool. The nest was 28 feet above ground and rested ten feet from the central axis in a two-way fork.

Nest material was carried into this tree on April 30. When first discovered on May 8, 1945, the nest contained three eggs. Several days later it was deserted, the eggs having been destroyed. Apparently the same pair started a second nesting (6-45) in a laurel 100 feet away.

Nest 2-45 consisted entirely of dry material from the following four herbaceous plants: *Convolvulus,* small stems with a total of six dry capsules attached; *Conium,* small stems; *Clematis,* small stems with attached tendrils and parts of three dry leaves; *Eriogonum,* fine stems.

Nest 3–45.—The nest tree, a 28-foot coast live oak, was located in oak-laurel woodland on a 30-degree south-facing slope next to Strawberry Creek. The nest was 25½ feet above ground, resting 15 feet from the central axis in a two-way fork.

On May 11, 1945, the nest contained three eggs. These hatched on May 19. All three young left the nest on May 31.

Nest 4–45.—The nesting site, a thicket of mixed deciduous shrubs about 40 feet in diameter, was situated on an open 25-degree south-facing slope adjacent to Strawberry Creek. The thicket consisted of hazel-nut, blackberry, thimbleberry and *Baccharis,* averaging six to eight feet in height and was surrounded by an open, live-oak woodland. The nest was seven feet above ground near the center of the thicket and rested on a cross of two branches.

On May 14, 1945, the nest contained three eggs. On May 23 one egg hatched; one infertile egg remained in the nest, but the other disappeared before departure of the lone nestling on June 4.

Nest 5–45.—The nest tree, a 27-foot coast live oak, was located on a 25-degree south-facing slope in a closed woods adjacent to Strawberry Creek. The nest was 18 feet above ground and rested nine feet from the central axis, astraddle a fork.

On May 17, 1945, the nest consisted of only a very thin network-like platform of plant stems, construction having just started. It was completed on May 19, and the first egg appeared on May 22. The set of three eggs was completed on May 24, but on May 26 the nest and eggs were deserted. Five days after the desertion took place, the eggs were found destroyed.

Nest 6–45.—The nest tree, a 45-foot California laurel, was situated on a level area of open woodland at the upper end of Strawberry Pool. The nest was 32½ feet above ground and rested 18 feet from the vertical axis at a three-way fork.

Nest material was carried into this tree on May 16. When found on May 21, the nest held two eggs, both of which hatched on May 31. One nestling fell out of the nest and was killed; the other left the nest on June 11. (See also nest 2–45.)

On September 12, I found that this nest was being used by a dusky-footed woodrat (*Neotoma fuscipes*) as a feeding station. On three horizontal limbs, one to four feet from the nest, I found woodrat fecal pellets and urine stains. At the nest were placed 10 twigs four to eight inches in length,

arranged in a manner suggesting the beginning of a cover over the nest. Each twig was clean-cut at each end. In the nest cup itself, I found one acorn (*Quercus agrifolia*) and three partly chewed green laurel fruits (*Umbellularia californica*). In addition, pieces of the exocarp of chewed bay fruit were scattered about in the nest. This evidence leads me to believe that the woodrat had been using the nest as a place of storage and feeding, while at the same time enlarging and covering it. Use of this nest ceased after September 12.

Nest 1–46.—The nest tree, a 20-foot coast live oak, was located on a 35-degree south-facing slope at the upper end of Strawberry Pool near the site of nest 6–45. The nest was 15 feet above ground, and rested ten feet from the central axis in a three-way fork.

On May 5, 1946, four fresh eggs were in the nest. On May 15 one of the eggs hatched and one had disappeared; on May 16 a second egg hatched. The remaining egg was not fertile. Both young left the nest on May 27.

Nest 2–46.—The nest tree, a 25-foot, old, sprawling coast live oak, was located on a 25-degree south-facing slope in open woodland 100 feet above Strawberry Creek. The nest was 18 feet above ground in the live oak, and rested in a three-way fork in a vertical secondary branch.

When found on May 19, 1946, the nest held three eggs, two of which hatched on May 29, the third on May 30. Two nestlings died, one ten days old, the other 11 days old. The third nestling left the nest on June 10.

NEST BUILDING

Nest site.—Nesting usually takes place in deciduous bushes and trees bordering streams. Nests are built also in bushes or trees away from stream courses in gardens, dense brushland, closed woods and parklands; but these occurrences form a small per-

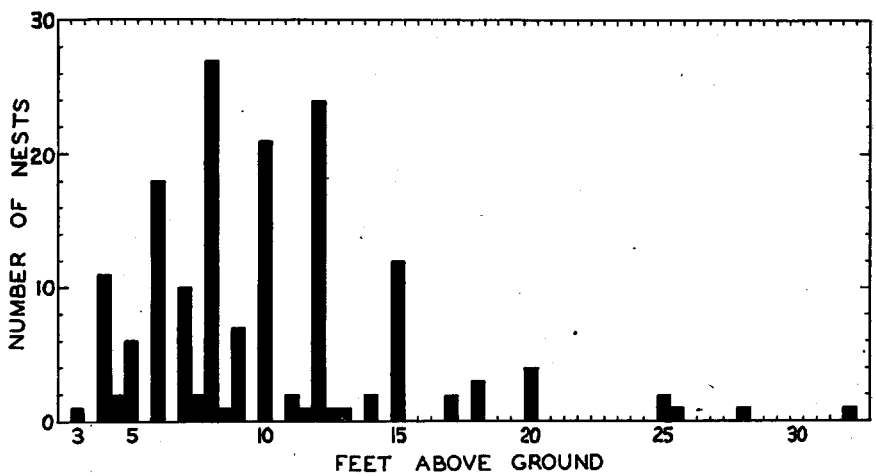

Fig. 10. Height above ground of 163 nests of the Black-headed Grosbeak.

centage of the total when compared with nestings near streams. Records of one hundred and twenty nests, from literature and specimens, show nests placed in twenty-nine different species of plants. Close to eighty per cent of the plants used were deciduous; willows were represented most frequently and constituted approximately thirty-five per cent of the total. Second in species representation, however, is the evergreen coast live oak (*Quercus agrifolia*), with twelve per cent of the total. Nevertheless, species of next-ranking frequency are all deciduous; these are, in order, alder (*Alnus rhombifolia*), big-leaf maple (*Acer macrophyllum*), blackberry (*Rubus vitifolius*), cottonwood (*Populus*), and elderberry (*Sambucus glauca*).

Nests are placed in trees and bushes, usually at a height of six to twelve feet above the ground. Among height records of 163 nests from various localities in California (see fig. 10), I found the average to be ten feet above ground. Seventy-eight, or 66 per cent, of these nests were placed between four and twelve feet above ground. The support for

the nest usually consists of a crotch or fork in a group of horizontal or vertical secondary branches. The location within the tree or bush varies; all eight nests studied in Strawberry Canyon were placed in the peripheral clusters of twigs or trees or bushes.

Table 1

Summary of Dimensions of Twenty-five Nests

	Outside depth	Inside depth	Outside diameter	Inside diameter
Maximum	10.0 cm.	5.5 cm.	17.0 cm.	9.5 cm.
Minimum	5.0	2.5	12.0	7.0
Average	6.7	4.1	13.8	8.1

Nest construction.—The nest is a bulky, loosely constructed affair, ordinarily composed of slender twigs, plant stems and rootlets, in the base and outer walls, and of finer stems and rootlets in the lining. Its shape varies from that of a saucer-like platform to one resembling a cup. Literature on this subject almost invariably mentions the flimsy construction of grosbeak nests; Grinnell and Storer (1924:487), for example, write that it "is so thin in weave that the contents can be seen at least in outline from beneath." This, however, was not true of any of the eight nests I studied in Strawberry Canyon.

Measurements of twenty-five nests from various localities in California are summarized in table 1. Dry weights of fifteen nests ranged from 12.7 to 27.5 grams and averaged 16.2 grams. Included in these fifteen are six nests collected in Strawberry Canyon in 1945; these varied in weight from 13.5 to 14.3 grams and averaged 13.9 grams.

Nests from Strawberry Canyon resembled each other not only in weight, but also in composition, size, shape, and color. This was undoubtedly due to the fact that nesting

Table 2

Nest-building Activity of Female at Nest 5–45

Date	May 17	May 17	May 18	May 19
Stage of construction	1st day	1st day	2nd day	3rd day
Time of day	6:39-7:30 a.m.	12:50-4:30 p.m.	7:29-11:45 a.m.	10:10 a.m.-12:15 p.m.
Total of time	51 min.	3 hr. 40 min.	4 hr. 16 min.	2 hr. 5 min.
Weather	high fog	50% cloudy	50% cloudy	25% cloudy
ATTENTIVE PERIODS				
Total number	5[1]	3[3]	32	8
Average time			50.4 sec.	34.9 sec.
Longest period			4 min. 2 sec.	65 sec.
Shortest period			12 sec.	18 sec.
Total time at nest	4 min. 54 sec.	101 sec.	27 min. 42 sec.	4 min. 39 sec.
Per cent total time	9.0	0.7	10.5	3.8
INATTENTIVE PERIODS				
Total number	4[2]	2[4]	31	7
Average time			7 min. 8 sec.	14 min.
Longest period			31 min. 10 sec.	26 min. 30 sec.
Shortest period			80 sec.	6 min. 21 sec.
Total time at nest	46 min.	3 hr. 38 min.	3 hr. 48 min.	2 hr.
Per cent total time	91.0	99.3	89.5	96.2

[1] 41, 43, 80, 62, 68 sec.
[2] 3½, 9½, 1½, 26½ min., also incomplete period of 4½ min.
[3] 22, 34, 45 sec.
[4] 6, 27¾ min.; also incomplete period of 2½ hr., 33 min.

materials available to the local population were similar. Presumably relative availability of various nesting materials at different nesting localities is responsible for the observed varations in weight as well as composition.

Building of the nest is done by the female. Suitable nesting material is normally sought within one or two hundred feet of the nest site and occasionally as far as 350

feet. The male usually follows her while she is gathering nesting material and he may accompany her to the general vicinity of the nest; however, I have never seen a male carry nesting material nor in any way aid in the actual construction of the nest. Finley (1907:46) mentions seeing a male grosbeak carrying a stick in his beak, but this is the only evidence known to me suggesting that the male may participate in nest-building.

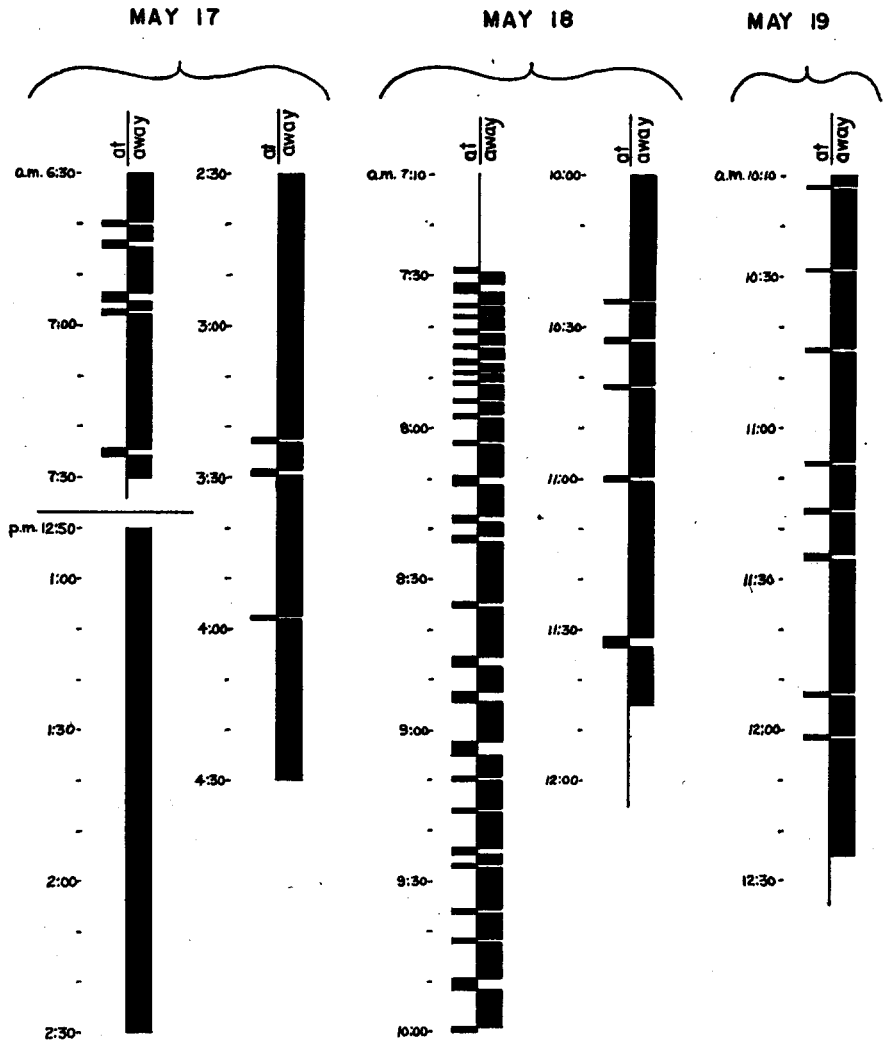

Fig. 11. Nest-building activity of female at nest 5–45.

Gathering of nest material in Strawberry Canyon was first observed in 1945 on April 25. On this occasion as well as on April 27 and 30 and May 16, the male of a pair was observed near or with a female searching for and collecting nest materials. On one occasion one male chased another from a spot where a female was gathering dry grass culms, the former male returning to a prominent perch after a short chase and following the female when she left. On May 17, a male remained fifteen to twenty feet

away from a female engaged in nest-building and uttered frequent songs of two-second to four-second duration at irregular few-second intervals as well as occasional *spic* notes; he followed her in several trips to and from the nest.

Construction of the nest takes from three to four days. Most of the building occurs in the mornings. Visits to the nest become less frequent and more irregular, as the day progresses, and in the afternoon the nest is visited occasionally without any nesting material. Close watch was kept on the construction of nest 5-45; my findings during this period have been summarized in table 2. In this instance, nest building occupied three days. During the last stages of construction, on the third day, the female spent noticeably little time in placing new material in the nest and, instead, spent most of her time readjusting material already there (fig. 11).

The male sang vigorously during the period of nest construction. Frequent call notes also were uttered. These songs and calls ordinarily came as the male waited while the female was gathering nesting material or was at the nest. In the afternoon of the first day of nest construction, however, the male did not attend the female on the female's first two trips to the nest (table 2). No song flights by the male were seen during the period of actual nest construction, but they did occur in the afternoons when nest construction ceased for periods up to two and one-half hours in length.

Periods spent at the nest by the female in actual construction work varied from 12 to 242 seconds in length, the average being 43. The number of visits apparently is greater in the mornings than later in the day (see table 2). Extremes of the inattentive periods away from the nest were from one minute to more than two and one-half hours. On a typical day of nest-building, the female spends about ten per cent of the time at the nest in the morning and less than one per cent of the time in the afternoon.

The amount of nesting material carried by the female on her trips to the nest varied from no material to three pieces, the usual number being one. Length of plant stems and twigs carried varied from five to thirty centimeters in length, the average being about twelve. The longer pieces went into the construction of the outer walls and the base of the nest, the shorter ones were placed into the more closely woven inner walls of the cup.

EGGS

The usual set of the Black-headed Grosbeak consists of three or four eggs. I have records of sets of two and five eggs, however; 192 sets average 3.31 eggs. Table 3 lists the distribution as to size of these sets. In Strawberry Canyon, I have found one set of two eggs, four sets of three and two sets of four.

Table 3

Number of Eggs in 192 Sets

Number of eggs per set	Number of sets	Per cent of total
2	18	9.5
3	96	50.0
4	75	38.9
5	3	1.6

My measurements of 207 eggs averaged 24.48 x 17.75 mm. If measurements from sets of comparable size from a total of 62 sets are averaged (table 4), it is found that the larger the size of the set, the smaller the eggs. The average egg of seven two-egg sets is 1.5 per cent longer and 2.4 per cent wider than the average egg of 32 three-egg sets. In turn, the average of these 32 three-egg sets is 1.7 per cent longer and 2.2 per cent wider than the average of 23 four-egg sets. No measurements from five-egg sets were available.

Nice (1937:114) found a parallel difference in comparing size of eggs with size of set in the Song Sparrow.

Grosbeaks normally lay only one clutch of eggs each season. No evidence of repetition of the nesting cycle, once it is completed, has been found either in the field or in

Table 4

Egg Size in Relation to Clutch Size

Size of sets	Total no. of sets	Length		Width	
		Average	Extremes	Average	Extremes
2	7	25.08 mm.	23.00-28.60 mm.	18.19 mm.	17.60-19.40 mm.
3	32	24.70	22.70-27.20	17.75	16.00-18.90
4	23	24.28	22.00-27.40	17.36	15.00-18.20

literature. If eggs or nestlings are lost, a second attempt at nesting frequently occurs. No records are available, however, of more than two attempts in a single season.

Following the completion of the nest there is a period of from two to three days before the female grosbeak begins to lay the eggs. The eggs, laid at intervals of approximately twenty-four hours until the set is complete, are, as near as I was able to determine, usually deposited before 7 a.m. Visits made to a nest at the end of the day would fail to disclose any change in nest contents, while a visit to the same nest at 7 o'clock the following morning would disclose an increase in the number of eggs present.

INCUBATION

Continuous incubation normally starts with the laying of the next-to-last egg of the set. At the nest the behavior of the male and female, who share the task of incubation, is similar. During this period the male does not feed the female and she consequently has to leave the nest to forage for food. During her absence from the nest, the male takes over the duties of incubation.

The female incubates the eggs at night. The first activities in the morning are songs by the male from his roosting perch. These songs come before sunrise and are among the first songs heard in the canyon in the morning. They seem to stimulate the female, as she will utter frequent loud *spic* call notes in response. From twenty minutes to a half hour after the first signs of activity, the male appears at the nest tree. As he appears, the female leaves the nest, pauses on a nearby perch to stretch for ten to fifteen seconds, and then disappears. After fifteen to twenty minutes the female returns to resume incubation.

During incubation the activities of the pair follow a set pattern so closely that they can be predicted with surprisingly great accuracy. As the day progresses, the periods of incubation lengthen; but toward the end of the day they tend to shorten, being similar in length to those of early morning. On an average day the eggs are incubated about 99 per cent of the time, about 40 per cent of the time by the male and 60 per cent by the female (table 5). The average length of each incubation period of the male is close to 20 minutes, of the female 25 to 30 minutes. Extremes in periods on the eggs are 6.3 minutes and 53.2 minutes; the former was by a male, the latter by a female. Their alternation of attentiveness at the nest goes on throughout the day.

An example of typical exchanges of incubating positions follows: On May 4, 1945, at 7:46 a.m., the male was incubating. A female flew into view and perched on a branch eight feet from the nest. At this perch, at nest level, she paused and uttered six loud single *spic* calls at two-second intervals. Between calls she wiped her bill from side to side on her perch. As if in answer to the calls from the female, the male uttered three songs each of two seconds' length at three-second intervals from his position on the eggs. He also uttered several *spic* calls. The female then flitted to a perch five feet from the nest. As she did so, the male, who had been raising himself off the eggs, watching her, hopped up to the rim of the nest and flew silently off out of sight. Eight seconds later the female flitted to the

Table 5

Attentiveness of Both Sexes at Nest 1–46

Date	May 5, 1946	May 7, 1946	May 9, 1946
Stage of incubation	4 days	6 days	8 days
Time of day	7:00-11:25 a.m.	6:00-12:00 a.m.	1:10-5:15 p.m.
Total time	4 hr. 25 min.	6 hr.	4 hr. 5 min.
Both sexes:			
ATTENTIVE PERIODS:			
Total number	8	17	9
Average time	29 min. 12 sec.	17 min. 36 sec.	25 min. 25 sec.
Longest period	53 min. 10 sec.	36 min. 46 sec.	46 min. 17 sec.
Shortest period	22 min. 36 sec.	6 min. 18 sec.	14 min. 25 sec.
Per cent total time	99.5	99.0	99.1
INATTENTIVE PERIODS:			
Total number	8	18	9
Average time	10.3 sec.	12.6 sec.	15.8 sec.
Longest period	12 sec.	40 sec.	34 sec.
Shortest period	6 sec.	6 sec.	8 sec.
Per cent total time	0.5	1.0	0.9
Male:			
ATTENTIVE PERIODS:			
Total number	4	9	5
Average time	24 min. 12 sec.	16 min. 42 sec.	20 min. 30 sec.
Longest period	26 min. 54 sec.	36 min. 46 sec.	28 min. 39 sec.
Shortest period	22 min. 36 sec.	6 min. 18 sec.	14 min. 25 sec.
Per cent total time	36.7	41.8	40.8
Female:			
ATTENTIVE PERIODS:			
Total number	4	8	4
Average time	35 min. 42 sec.	19 min. 35 sec.	30 min. 16 sec.
Longest period	53 min. 10 sec.	36 min. 7 sec.	46 min. 17 sec.
Shortest period	22 min. 48 sec.	6 min. 56 sec.	21 min. 12 sec.
Per cent total time	62.8	57.2	58.2
Total time eggs incubated	4 hr. 23.6 min.	5 hr. 56.2 min.	4 hr. 2.6 min.
Total time eggs unattended	1 min. 23 sec.	3 min. 48 sec.	2 min. 23 sec.

rim of the nest. Standing there, she peered around and down at the eggs for four more seconds, uttering two sharp *spic* calls as she did so. She then hopped down into the nest, spread out the feathers on her abdomen and settled down on the eggs. Then, after one more *spic* call, she became silent. As she incubated, she occasionally turned her head from side to side, usually in response to some noise or movement in the vicinity. At 8:12 a.m., the male appeared in a laurel downslope from the nest tree. There he uttered a three-second song. While he sang, the female uttered a single *spic* call from the nest. She then raised her body off the eggs, hopped to the rim of the nest and flew off on the opposite side of the nest from the male. Six seconds passed before the male flew to the rim of the nest. He uttered a two-second song while standing there, and then hopped down into the nest. Fluffing out his abdominal feathers and settling himself on the four eggs, he uttered a one-second song, then three seconds later another, after which he was quiet.

Weather conditions exert a marked influence on attentiveness: During cold, wet weather the periods are longer than those during warm clear weather. In four and one-half hours of one morning (table 5), the attentive periods of both sexes totaled eight. The eggs were covered 99.5 per cent of this time, the average length of each attentive period being 29.2 minutes. The eggs were left uncovered eight times, the average for each such occasion being ten seconds. During this same period the male incubated 36.7 per cent of the time, the female 62.8 per cent. A high fog was present all morning. In contrast, on a bright sunny day, during a six-hour period in the morning, the attentive

periods totaled 17. The eggs were covered 99 per cent of the time, the average of each attentive period being 17.6 minutes. The eggs were left uncovered 18 times, the average for each such occasion being 12 seconds. During this period the male incubated 41.8 per cent of the time, the female 57.2 per cent. The average time on the eggs for the male was 16.7 minutes, for the female 19.6 minutes.

The male occasionally sings while incubating. These songs, coming at irregular intervals, are generally about four seconds long. Their volume, although not so great as in the songs uttered while the male is away from the nest, is sufficient to carry several hundred feet. When searching for nests early in the season, I have used these songs from incubating males as a means of locating nests. The female also sings while incubating; her songs, however, come at infrequent, irregular intervals. Although the male sings while alone at the nest, the female usually sings only when the male is in the near vicinity. Her songs are faint, being audible only 50 feet or so from the nest. Both sexes frequently utter very faint songs when exchanging incubating positions. Almost whisper songs, these are audible only up to about 15 feet from the nest.

Call notes, which I describe as a sharp *spic,* are given frequently by both sexes, most often immediately before an exchange of incubating positions. Occasionally the incubating male will utter several of these notes, as if to notify its mate that it wants to leave the eggs. Several will be given in a series. If no answer is received, the bird will remain silent for 15 to 20 seconds and then utter another series of calls. I have seen the male utter several series while he was incubating, get no answer from the female each time, and then suddenly leave the eggs unattended. On each such occasion the female finally appeared and continued the incubation. Three minutes is the longest interval in which I have seen the eggs left unattended on such an occasion. The female also seems to express her desire to leave the eggs by calling to her mate, but I have never seen her leave before he appeared to take over the incubation duties. However, as a general rule, the incubating bird waits until its mate appears before calling, and then departs.

The eggs begin hatching on the twelfth day of incubation. In each of three nests containing three eggs each, the last egg hatched twenty-four hours after the others. In two of these cases, nests 3-45 and 2-46, the first two eggs hatched within a few hours of one another. In the third set, 1-46, one of the eggs, apparently infertile, did not hatch. In nest 6-45, holding two eggs, the eggs hatched within a few hours of one another. In nest 4-45, only one egg out of three hatched. Three of four eggs in nest 1-45 hatched within a few hours of one another, the fourth not hatching.

During the day previous to hatching a single hole is picked by the young near the region of the greatest diameter of the egg. At nest 2-45 I found the larger half of an egg shell fifty feet downslope from the nest tree. Apparently the parents carry the egg shells away from the nest and drop them; no other evidence of disposal of egg shells was obtained.

PARENTAL CARE

The change in the daily cycle of the adults with the hatching of the young is surprisingly small. Male and female cooperate in the care of the young, brooding and feeding them, attending to nest sanitation and acting in their defense.

The activities of a pair of grosbeaks for three hours on the first day of life of the young in the nest are summarized in table 6. They are also described in the following text. These activities show the behavior of the adults to be similar to that during incubation except that food is brought to the nest. The young are brooded continuously except during short intervals when the parents are exchanging positions on the nest.

After each feeding the young are brooded. Both calls and songs are uttered at and away from the nest by both sexes but not as often as during incubation.

Table 6

Feeding and Brooding Activities at Two Nests

Age of nestlings	1 day (May 14)	2 days (May 15)	7 days (May 20)	12 days (May 27)
Period of observation	3 hr., 8 min. (7:37-10:45 a.m.)	2 hr., 14 min. (7:16-9:30 a.m.)	12 hr. (6:00 a.m.-6:00 p.m.)	3 hr., 5 min. (8:10-11:15 a.m.)
Number of nestlings	3 (nest 1-45)	3 (nest 1-45)	3 (nest 1-45)	2 (nest 1-46)
Total visits	11[1]	10[1]	67[2]	14
Average number per hour	3.1	4.4	5.5	4.3
Extremes per hour	3 to 4	3 to 5	2 to 10	3 to 5
Intervals	10	9	65	12
Average length	18.5 sec.	1 min. 25 sec.	11 min.	12.3 min.
Total time at nest	3 hr. 4.9 min.	2 hr. 1.1 min.	5 hr. 55 min.	53.6 min.
Average time per visit	16.8 min.	12.1 min.	5.3 min.	3.8 min.
% time young attended	98.3	90.3	49.3	28.9
% time young brooded	96.8	80.8	45.9	26.9
% time young unattended	1.7	9.7	50.7	71.1
Visits to feed and brood	10	9	26	3
Visits to feed only	0	0	33	10
Visits to brood only	0	0	7	1
Male				
Total visits	5	5[2]	32	3
Average number per hour	1.6	2.2	2.6	1
Extremes per hour	1 to 2	2 to 3	0 to 5	1 to 2
Intervals	4	4	31	2
Average length	22.1 min.	17.9 min.	21.1 min.	52.5 min.
Total time at nest	1 hr. 42.2 min.	51.3 min.	1 hr. 9 min.	1.1 min.
Average time per visit	20.4 min.	10.2 min.	2.1 min.	12.5 sec.
Visits to feed and brood	5	5	7	0
Visits to feed only	0	0	25	3
Visits to brood only	0	0	0	0
Female				
Total visits	6[1]	5[2]	35[2]	11
Average number per hour	2	2.2	2.9	3.3
Extremes per hour	1 to 2	2 to 3	2 to 5	3 to 4
Intervals	5	4	34	10
Average length	17.9 min.	14.1 min.	12.6 min.	12.8 min.
Total time at nest	1 hr. 39.3 min.	1 hr. 9.8 min.	4 hr. 29 min.	52.5 min.
Average time per visit	16.5 min.	13.9 min.	7.6 min.	5.2 min.
Visits to feed and brood	5	5	19	3
Visits to feed only	0	0	8	7
Visits to brood only	0	0	7	1

[1] Two periods incomplete.
[2] One period incomplete.

On May 14, 1945, at 7:37 a.m., as a light rain was falling, the female was brooding three young at nest 1–45. She remained quiet until 7:38, when the male flew to a perch two feet from the nest. Fifteen seconds later she stood up in the nest, backed off the young, and flew off down canyon. After four seconds the male flitted to the rim of the nest. After feeding the young in a slow deliberate manner, he settled down and covered them from the rain. At 7:53 the female returned and perched in a laurel 50 feet downslope from the nest. Perching there for 15 seconds, she wiped her bill back and forth several times on her perch and then flew to a perch one foot from the nest. Upon her silent arrival the male hopped to the opposite side of the nest, peered around for four seconds and then flew off. After four more seconds, the female hopped to the rim of the nest and fed the three young a total of seven times. After feeding, the female reached down, picked up a fecal sac with her bill, and swallowed it. Then she hopped into the nest and arranged herself on the young. At 8:16 a male grosbeak hidden from view in the nearby live oaks uttered several songs. The female on the nest uttered several *spic* call notes, as if in response to the songs, and then left the nest and flew down canyon. Fourteen seconds passed before the male flew into view and to the rim of the nest, where he fed the young. Twenty-four seconds after arriving he hopped down into the nest and continued the brooding. This feeding-brooding process was maintained during the entire three hours I was at the nest. On the morning of the second day, activities of the parents at the nest were similar to those of the first day (see table 6). Departure and return to the nest were deliberate. Songs and calls were uttered occasionally by both parents.

During the first four days, the young are fed a soft pale green mash (see Ivor, 1943). At each exchange of positions on the nest the parent bird brings food and slowly feeds the young, on the average of three to four times each hour (table 6). The bills of the adult and the nestling it feeds are held at right angles. The food is then placed well back in the mouth, the nestling swallowing it without closing its mouth. Toward the

end of the fourth day, such whole material as lepidopterous larvae is introduced into the diet of the young. The routine of feeding and brooding alternately by male and female during the first and second days of nest life is shown graphically in figure 12.

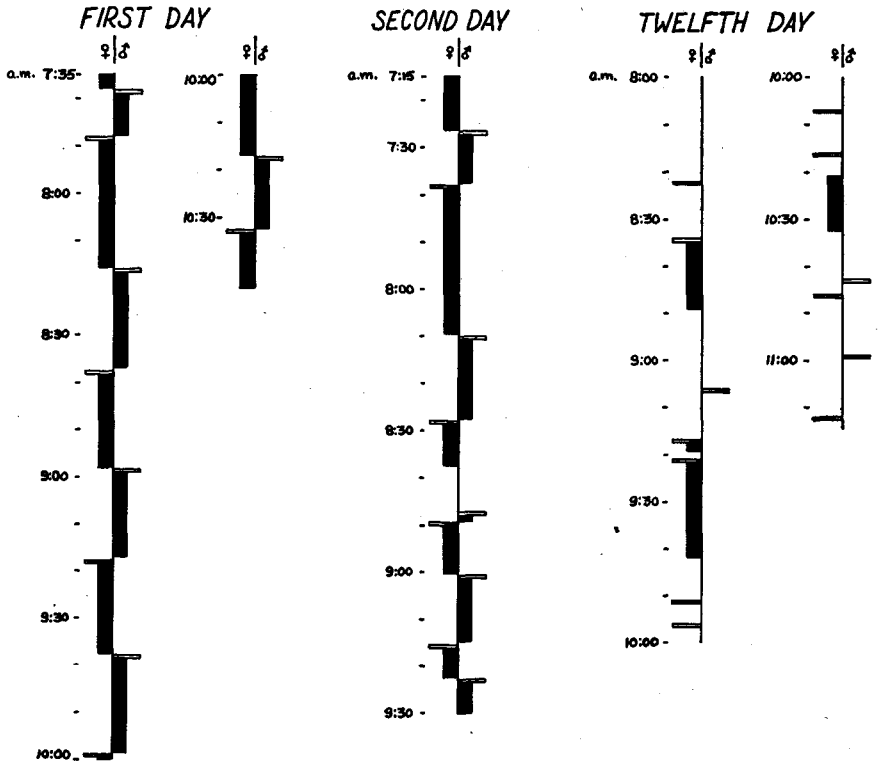

Fig. 12. Attentiveness at nest with young at three different ages. Open rectangles indicate parent feeding young; solid areas indicate brooding.

Although the young need more food as they grow, the number of trips to the nest with food by the parents is not increased; instead, the bulk of the food brought on each trip increases. The size of the brood exerts an influence on the amount of food brought and the number of trips made. Thus, at nest 4-45, daily weights were taken of a lone young and it was found, in comparing its growth with nestlings in broods of two or three, it weighed not quite a gram more than the others. Apparently it weighed slightly more because it received all the attention of both parents.

On the fifth and sixth days, when there are two or more young in the nest, each is fed one-third to one-half the total times the parents visit the nest with food. Generally one and sometimes two nestlings are fed on each visit. No rotation of feeding is evident, and usually the first bird to raise its head receives the food. Invariably all the young beg for food on each visit, by raising their heads, and those that do not receive food often hold their heads up several seconds longer than the one that is fed. At this age the young begin to call loudly and beg whenever one of the parents appears at the nest with food.

As the young develop, both parents spend progressively longer periods off the nest. By the seventh day (table 6) the parents brood much less constantly, although the

young are covered a good part of the time. The young still respond to calls and touches on the nest by raising their heads to beg food. The activities of the parents at nest 1-45 for an entire day are summarized in figure 13 and table 6.

On the eighth day the eyes of the young usually begin to open, and by the ninth day they are wide open; as a result the young are more active than before. At this

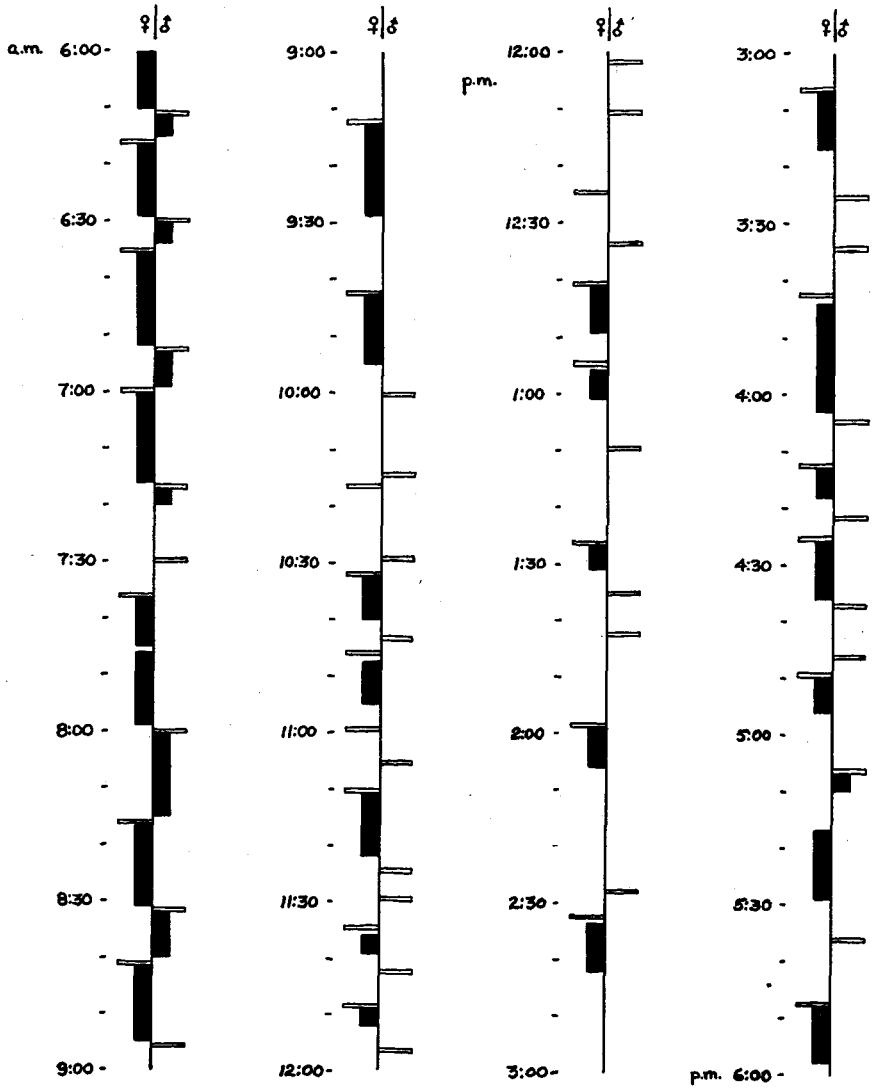

Fig. 13. Record of activities of parents at nest 1–45, on May 20, 1945, from 6 a.m. to 6 p.m. Young seven days old. Symbols as in figure 12.

time and in the following few days the weather is important in determining how attentive the parents are. On warm clear days the parents spend less time actually brooding the young than on cold wet days. For instance, late in the afternoon of May 25, 1945, I visited nest 1-46. It had been raining most of the day and was still raining as I reached

the nest. The female was brooding, sitting high in the nest, wings held partly open, helping to cover the two young. The female here was quite wet. I approached to within two feet of the nest before she would fly; then she did so with seemingly great reluctance, fluttering about nearby and uttering loud distress calls. In a few seconds, she was joined by the male. The young were perfectly dry, as was the cup of the nest, showing they had been covered effectively by the parents during most of the rain. As I left the nest tree with both young, she stopped calling and returned to the nest. First she ate one fecal sac that had been dropped there as I lifted the young from the nest and then she hopped down into the nest and spread her feathers out, showing no apparent concern at the absence of her young. The only object in the nest was one egg that had failed to hatch. When I returned the young to the nest, she went through similar actions and resumed brooding promptly after I left.

On the twelfth and last day at the nest the young are brooded only at infrequent intervals, depending on the weather. Activities of a pair of grosbeaks at nest 1-46 containing two nestlings twelve days old are shown in figure 12 and table 6. These data, together with the following discussion of the same nest, record typical activities on the last day of nest life.

On May 27, 1946, at 9:10 a.m., the two young at the nest were unattended. The weather was clear and warm, and the sun was shining into the nest. At 9:17 the female flew up to the nest and fed both of the nestlings. Ten seconds after her arrival she hopped into the nest and began brooding them. In doing so, she sat quite high in the nest, having a little trouble covering both young. She continued to brood the young quietly until 9:41, when she stood up in the nest and began uttering single *spic* calls at two-second intervals, peering from side to side as she did so. After twelve calls, she flew off. The male flew to the nest tree at 9:48 with several insects in his bill, but did not visit the nest. For a 40-second period he hopped and flitted about in the tree, uttering several *spic* calls before flying off.

At 9:43 the older nestling began to move about restlessly. It stood up in the nest, stretched both wings and flapped them several times. Then it began preening, picking first at its breast feathers and then at its wing feathers. Reaching under one of its wings, the nestling picked at the bases of several of the remiges and then ran its bill out the full length of one to the tip. Several times the nestling shook itself and once it toppled over as it stood in the center of the nest. Twice it hopped to the rim of the nest to peer about. After three minutes of such activity it quieted down, sinking out of sight into the nest cup. During this time, the younger nestling remained out of sight in the nest.

At 9:51 the female returned to the nest where both young were active and were begging for food. The older one hopped up to the edge of the nest and was fed six times, the younger one receiving none of the food. After being at the nest for 25 seconds the female flew away but returned again at 9:56. As before she was greeted at the rim of the nest by the older nestling, which again received all the food, being fed five times. In begging for food at this age, the nestling stretches its neck and head up, opens its mouth wide and shakes its wings with a kind of quivering motion. The female departed 25 seconds later and at 10:07 the male appeared. Once again the older nestling hopped up to the rim of the nest and received all of the food, even though the other one actively begged from the nest cup. Fifteen seconds later the male flew away and at 10:16 the female flew up to the nest, uttering no vocal sounds as she did so. Both young begged from the nest cup and this time the younger bird received all the food.

During the absence of the parents from the nest both young kept up a continuous chorus of faint *wheé-urr* calls, each uttering a call about once every one to two seconds. With the appearance of one of the parents at the nest, both young would increase both the volume and number of calls as they begged. As soon as the parent left, the call would return to the original volume and number.

During the three-hour period that I watched this nest, the parents made 14 trips to the nest, ten by the female and three by the male (figure 12). The male did not brood the young at all and the female did so only four times. Three of the latter four times were to feed and then brood the young, while the remaining visit was made just to brood them.

At the time of feeding the young birds usually pass fecal material. Excreta, enclosed in mucous sacs, are normally eaten throughout the nestling stage by either parent; fecal sacs are eaten on the average of about 25 per cent of the visits to the nest, generally immediately following the feeding of the young. At nest 1-46 the young were

weighed daily, and when removed from the nest for weighing they usually defecated, leaving two fecal sacs in the nest. Each time the female returned to the nest, which held only one infertile egg and the fecal sacs, she proceeded to eat the sacs, gulping them down one at a time, and then hopped into the nest appearing as unconcerned as though the young were still there.

The activities of the parents and young for several days after the latter leave the nest are difficult to observe as all become quiet and extremely secretive in their movements. Late in the afternoon of the day after the young left nest 1-46, I returned to the nest site. The nest was unoccupied. In the trees about 50 feet down the slope I could hear faint *peé-urr* calls from a young bird. I answered, imitating the whistle-like call, and attracted the female, who came up within five feet of me. She did not utter a sound as she hopped and flitted about, watching me. As I moved downslope toward the sound of the calling young, the male suddenly flew up out of a 15-foot elderberry bush, uttering loud sharp *spic* notes. The hidden young promptly stopped calling. While I was searching the vegetation for the young, the female flew into the same bush and watched me, still not uttering any sounds. While I was at this bush, the male's calls increased in frequency, but when I moved away from the same bush, he quieted down. The fledgling was not located.

In the latter part of the season the young follow the females, the males having left soon after nesting is over. I have even seen females feeding well grown young as late as the early part of August, although I have no definite information on the actual length of the dependent period of the young after they leave the nest.

SONG AND CALL NOTES

Song of male grosbeaks resembles closely that of the Robin (*Turdus migratorius*); parts of the song are also reminiscent of that of the Western Tanager (*Piranga ludoviciana*). Length of individual songs varies considerably. The shortest that I have timed lasted one second, the longest eighteen; the average song is five seconds in length. The intervals between songs in a series vary from one second to twenty-seven seconds. In general, songs in the early morning are longer, louder, and richer in quality than those at other times during the day.

Male grosbeaks may sing more or less continuously up to twelve minutes or so at a time, but usually a series of songs lasts about five minutes. I have never heard males in series of songs during incubation or brooding that lasted over three minutes; at this time, songs usually consist only of short bursts lasting a few seconds each and marked by up and down twitchings of the tail, which projects up over the rim of the nest (see table 7).

The male sings on the wing during the period of courtship (see page 55) and occasionally during the nesting period as he moves from tree to tree. The latter flights follow a straight line and extend as far as three hundred feet.

Songs may be given repeatedly from a single prominent, elevated perch or as a momentary interruption while the bird is foraging. The male also utters single call-notes frequently while foraging. His songs and calls are quite loud when he forages alone, but when both sexes forage together, the songs are low and much softer.

In general, the songs of female grosbeaks are infrequent and never more than four seconds in duration and are never loud. They are uttered while the female is incubating or brooding, usually as the male comes to take his place on the eggs or young. Several times during nest-building, the female uttered songs in the vicinity of the nest and always in the presence of the male. The female will also occasionally sing while foraging

in the peripheral foliage of trees, but only when the male is close by. I have not heard female song after the nesting is completed, nor have I heard it before nesting begins.

During the early stages of nest life the vocal sounds of young consist of faint *peep* calls uttered when the parents are present or when the young are being handled. Toward the end of the nest life, the young develop a distinct soft musical *pee-urr'-rrr,* whistle-

Table 7

Records of Songs of Male Grosbeaks in Different Phases of the Breeding Cycle

	Before arrival of female	During courtship period	Near nest with eggs	While incubating
Number of observation periods	9[1]	9[2]	6[3]	5[4]
Total observation time	34.7 min.	37.2 min.	14.6 min.	11.2 min.
Total number of songs recorded	182	283	78	136
Average length of songs	6.3 sec.	5.2 sec.	6.8 sec.	1.9 sec.
Longest song	18	17	18	5
Shortest song	1	1	2	1
Average length of intervals between songs	4.9	3.2	3.0	2.8
Longest interval	27	24	6	7
Shortest interval	1	1	1	1

[1] April 16-18, 1945, all between 7:27 and 8:39 a.m.
[2] April 19-30, 1945, all between 7:38 and 9:08 a.m.
[3] May 3-5, 1945, all between 7:25 and 9:24 a.m.
[4] May 3-5, 1945, all between 8:14 and 9:34 a.m.

like in quality. When the parents are absent, the young frequently stand up in the nest, peering around and calling intermittently. After leaving the nest, the young continue to give this hunger call. It also serves as a location call. Song of the young male was not heard; Wheelock (1904:256) states grosbeaks only eight weeks old utter a low warble.

The common call-note, a sharp *spic,* closely resembles that of the Rose-breasted Grosbeak (*Pheucticus ludovicianus*). It is commonly emitted while both sexes are foraging and at these times the calls are especially frequent, being repeated over and over at regular intervals. Its use at the nest has been described on page 62.

FOOD HABITS

Insects and other animal matter eaten by grosbeaks amount to more than the bulk of the vegetable food and should probably be regarded as their main food (Beal, 1904; McAtee, 1908). However, it should be kept in mind that perhaps this conclusion has been reached through analysis of stomach contents alone; in such a procedure, insect material is easier to find and identify than the vegetable material.

During their spring and summer residence in the San Francisco Bay region, Black-headed Grosbeaks forage predominantly in trees, feeding on fruits, buds and similar soft succulent vegetable matter. Their food additionally consists of arboreal insects. Grosbeaks may occasionally be seen flying out in midair in pursuit of insects. Grosbeaks may also frequent the ground in search of food; observations would indicate that the main items they seek on the ground are seeds and, to a lesser degree, insects.

In my field studies I noted a seasonal shift in food, probably due mainly to change in availability. For several weeks after their arrival on their summering grounds, grosbeaks fed mainly on such soft succulent vegetable matter as leaf buds, flowers and flower buds, as well as on early forming fruits. Worm-like larvae of various lepidopterous insects were also conspicuous in the diet at this time. As the weeks passed a slow change was discernible. With the maturing of other fruits, the grosbeaks resorted to them in

turn and fruit then became predominant in the diet. Early in the summer, with the disappearance of many of the fruits, the vegetable diet shifted to one consisting mainly of seeds, found in foraging about on the ground and in bushes. Except for the seasonal changes in the forms of lepidopterous insects and the accompanying change in diet, I noticed no appreciable shift in the animal diet of the adult birds.

A shift in animal diet of the young was noted. Early in life the young grosbeaks are fed only on soft animal matter such as caterpillars, but as they grow older, their diet becomes increasingly more like that of the adults. This change involves increased use of vegetable matter. There is also an increase in the hard elements of animal food, such as beetles and other harder insects, with a simultaneous decrease in caterpillars.

A high percentage of the grosbeaks' animal food in Strawberry Canyon is made up of the California oak moth (*Phryganidia californica*). This moth is known to attack coast live oaks (*Quercus agrifolia*) annually in the Berkeley area. During the spring of 1945 no oaks in Strawberry Canyon escaped defoliation except those along the roads, which had been sprayed with a solution of arsenate of lead. I frequently witnessed grosbeaks eating the worm-like larvae. On several occasions I saw pupa cases broken into, dropped and the pupae eaten. Innumerable winged adults were also captured and eaten, although the wings were dropped before the bodies were eaten. Of the three forms here discussed, however, the larvae were consumed most frequently, and these were the principal food of the young nestlings.

One other insect used for food in Strawberry Canyon was identified; on May 5, 1945, I found a partly eaten European earwig (*Forficula auricularia*) in the cup of a nest under the young birds. On several occasions I witnessed grosbeaks picking at oak galls and willow galls, apparently eating the insect larvae within.

In 1945, parts of eighteen different species of plants were used as food. For each species in the following list, parts eaten are stated together with the number of observations.

Wild oat (*Avena fatua*), seeds taken twice.
Black mustard (*Brassica nigra*), seeds taken three times.
Thimbleberry (*Rubus parviflorus*), berries picked at once.
Blackberry (*Rubus vitifolius*), berry picked at once.
Wild rose (*Rosa gymnocarpa*), fruits picked at, flesh and seeds eaten once.
Cotoneaster (*Cotoneaster orientalis*), parts of berries eaten once.
Wild plum (*Prunus serrulata*), flesh of berries eaten three times.
Locust (*Robinia pseudoacacia*), buds and flowers picked at and eaten once.
Red-stem filaree (*Erodium cicutarium*), seeds taken once.
Poison oak (*Rhus diversiloba*), fruit picked at once.
Coffee berry (*Rhamnus californica*), flesh of berries eaten once.
Cow parsnip (*Heracleum lanatum*), parts of green fruits eaten once.
Amsinckia (*Amsinckia intermedia*), nutlets taken once.
Elderberry (*Sambucus glauca*), flesh and seeds, but not skin, taken twice.
Bristly ox-tongue (*Picris echioides*), seeds taken twice.
Common sow-thistle (*Sonchus oleraceus*), seeds taken twice.
Thistle (*Cirsium occidentale*), seeds taken twice.
Yellow star-thistle (*Centaurea solstitialis*), seeds taken twice.

LONGEVITY

Cooke (1937:154; 1942:117) reports banding returns of grosbeaks as follows: 3, 3, 4, 4, 5, 5, 5, 5, 5 years. Since some of these individuals were banded in mid-spring, it may be concluded that grosbeaks live at least six years in the wild. Linsdale (1943:14) writes that a grosbeak caught in 1918 died in February, 1943, after 25 years in captivity.

In addition there is in the Museum of Vertebrate Zoology a skeleton of a Black-headed Grosbeak that died in 1946 after 19 years in captivity.

SUMMARY

The Black-headed Grosbeak occurs in the San Francisco Bay region from April to September, inclusive. Here it breeds characteristically in oak-laurel woodland and in riparian groves and thickets.

Courtship and the selection of mates occurs after arrival on the breeding grounds; males, arriving singly, precede females by several days. The only type of display observed during the courtship period was a song-flight. Singing males occurred singly in areas of suitable breeding habitat. Active competition among males appeared to occur only in the presence of females. In one instance of conflict between established pairs, active fighting occurred between the females only.

Eight nests were studied in 1945 and 1946, in Strawberry Canyon, Alameda County, California. Nesting usually takes place in shrubbery and woodlands bordering streams; deciduous bushes and trees are the plants most frequently selected. Nests are usually placed at a height of from six to twelve feet above ground. The nest is bulky and loosely constructed and is ordinarily composed of twigs, plant stems, and rootlets; its shape varies from that of a saucer-like platform to one resembling a cup.

The female builds the nest in three to four days. Periods spent at nest building vary from 12 to 242 seconds, the average being 43. Material for the nest is gathered at varying distances from the nest, generally within one to two hundred feet of the nest. The male usually accompanies the female on these trips.

One egg per day is laid beginning the third day after completion of the nest. The usual number of eggs in a clutch is three or four. Continuous incubation normally begins with the laying of the next to last egg. Both sexes incubate. On an average day, eggs are covered about 99 per cent of the time, about 40 per cent by the male and 60 per cent by the female. During incubation, each attentive period of the male averages close to 20 minutes, that of the female 25 to 30 minutes. The female incubates at night. Incubation lasts 12 days; all eggs hatch within 24 hours.

Both sexes care for the young. During the first four days after hatching, young are fed with a soft mash. On the fourth day, whole material is introduced into the diet. Early in the nestling period, fecal sacs are eaten by either parent. As the young develop, both parents spend progressively longer periods off the nest. The nestling period is twelve days. After departure from the nest the young follow the female.

Black-headed Grosbeaks forage predominantly in trees, feeding on fruits, buds and similar soft succulent vegetable matter, as well as on insect life. During residence on the breeding grounds, buds, fruits, and seeds are eaten mainly in the order of their seasonal availability.

Male grosbeaks are in song upon their arrival in spring and continue to sing until mid-July. Both sexes sing while incubating eggs and brooding young. Both frequently utter low, short songs and calls while foraging for food. Males sing chiefly from some elevated perch; shortly after spring arrival and through the courtship period, they also sing on wing.

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