INCUBATION STUDIES OF THE YELLOW-HEADED BLACKBIRD [1]

BY REED W. FAUTIN

ALTHOUGH the Yellow-headed Blackbird, *Xanthocephalus xanthocephalus* (Bonaparte), is a fairly common bird within its breeding range, the details of its incubating activities have been given but little attention, even though its nesting habits afford several advantages for making a study of this kind. This species nests in colonies of considerable size, thereby making it easy for the investigator to keep a large number of nests under observation within a comparatively small area, to obtain incubation data on a large number of eggs, and to make observations on the incubating activities of many individual birds.

During the spring and summer of 1937 two colonies of "Yellowheads" were kept under observation from April until September. The larger of the two colonies, occupying an area 5 acres in extent, was situated at the mouth of the Provo River on the east shore of Utah Lake and will be referred to as the "Provo River colony." The height and density of the vegetation, *Tamarix gallica* and *Salix* sp., made the determination of the exact number of males present very difficult, their maximum number being estimated to be 35 at the height of the nesting season. Eighty-three females nested in this colony, thus making a maximum population of 118 birds.

The smaller colony, consisting of 40 females and 12 males, was located northeast of the Provo River colony about two miles east of Utah Lake and will be referred to as the "Lakeview colony." This colony was confined to a small bulrush marsh, 0.37 acre in size, situated in a low depression surrounded by higher ground and open pastures. The entire area occupied by this colony could be observed from any one position around its border, thus making it convenient to observe the behavior of individual birds and to check on the exact number of birds in the colony. Observations on the behavior of the incubating females were restricted to birds of the Lakeview colony because of the location as described above.

Most of the nests were located during the time of their construction and the progress of each nest was followed until the young birds had left. Each nest was given a number when it was first located, a parchment tag with the number being attached to the vegetation near the nest. The location of each nest in the Lakeview colony was marked by sticking a tall willow into the mud within a few feet of the nest. The presence of these tall willows, in contrast to the shorter bulrushes, made

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it very easy to locate and identify the various nests in the colony at a distance.

During the early part of the season, the nests were visited daily but as more nests were located and more time was consumed in visiting nests, weighing young, and observing individual birds, it became necessary to visit each of the colonies on alternate days. The eggs were marked with India ink to facilitate identification at the time of hatching.

Egg-laying

The laying of eggs began within one to 7 days after the nests were completed. Sixty-one and eight-tenths per cent of the females laid their first egg the first day after their nests were completed; 23.7 per cent the second day; 10.5 per cent the third day; and 4 per cent the fourth day.

The deposition of eggs began about the same time in both colonies, the first egg being recorded May 7 in the Provo River colony and the first one May 8 in the Lakeview colony. The period between the first and last eggs laid was approximately 7 weeks, the last egg recorded in the Provo River colony being laid June 10 and the last one in the Lakeview colony June 22.

The number of eggs present varied from 2 to 5, with 4 the most common number (Table 1). One egg was laid each day until the clutch was completed. Most of the eggs laid during the fore part of the season were 4-egg sets, but as the season progressed there was a tendency for more sets of 3 to be laid. The 2-egg sets were the result of second attempts at nesting by females whose first clutch had previously been destroyed.

TABLE 1

Nesting Statistics

	Provo River colony		Lakeview colony	
	No.	Per Cent	No.	Per Cent
Nests recorded	84	100.0	44	100.0
Nests completed	82	97.7	42	93.2
Incomplete sets of eggs	3	3.7	3	7.1
Total completed sets of eggs	79	96.3	39	92.9
a. Two-egg sets	1	1.3	3	7.7
b. Three-egg sets	16	20.2	10	25.6
c. Four-egg sets	59	74.7	24	6.15
d. Five-egg sets	3	3.8	2	5.2
Average number of eggs per set	3.8		3.6	
Total number of eggs laid	301		142	
Number of young hatched	228	75.7	86	60.6
Eggs failing to hatch	73	24.3	56	39.4
a. Infertile or addled	29	9.7	10	7.0
b. Destroyed before hatching	44	14.6	46	32.4

Beginning and Duration of the Incubation Period

The beginning of incubation varied from the time the first until the third egg was laid, but in most cases began with the deposition of the second egg (Table 2).

In some clutches each of the eggs hatched consecutively on the thirteenth day after they were laid, indicating that incubation had begun at the time the first egg was deposited and that the length of the incubation period in such instances was 12 days. The eggs of other clutches hatched consecutively in the order in which they were laid on the fourteenth day after being deposited, indicating that incubation

Figure 1. Nesting area of the Lakeview colony.

was begun in such clutches at the time the first egg was laid and that their incubation period was 13 days in length.

In those clutches where 2 eggs hatched the first day and each of the remaining ones on consecutive days, incubation was considered to have begun at the time the second egg was laid. When incubation began at the time the third egg was laid the first three eggs deposited all hatched the same day.

Although there was a definite tendency for all the eggs of the same clutch to require the same length of time for incubation, yet there were a few exceptions in which the eggs did not hatch with such regularity. In one particular set the first 2 eggs laid hatched after 12 days of incubation in the order in which they had been laid, but the third egg did not hatch until 2 days after the second, making its incubation

period 13 days in length. This delay may have been due to a sudden drop in the temperature of the air caused by a cold rain accompanied by wind during the twelfth day of incubation of this particular egg. This storm was not responsible, however, for another type of variation in which 2 eggs would hatch the second day after hatching began instead of the first. If incubation began at the time the first egg was deposited, in such cases, then, two of the eggs would have an incubation period of 13 days duration and the other two 12 days. If, on the other hand, incubation began at the time the second egg was laid, 3 of the eggs would have an incubation period of 12 days and the other one 13 days. Such irregularities occurred in only a very few nests and may have been due to differences in the degree of attentiveness of different females or of the same female at critical times during the incubation period, or possibly to the eggs not receiving identical incubation conditions in the nest.

From Table 2 it can be seen that incubation began before any of the clutches were completed and that there was a tendency for it to begin sooner, with respect to the time the eggs were laid, the smaller the clutches were, being delayed until the third egg was laid in only the 4- and 5-egg sets. Incubation began at the time the first eggs were deposited in all 2-egg sets.

In Table 3 are given detailed data concerning the length of the incubation periods for the different sized sets of eggs in each colony. These data include only sets in which all the eggs in the same set had the same incubation periods and indicate that there is no correlation between the size of the sets and the length of the incubation periods. In both colonies the majority of the sets had a 12-day incubation period, but the 2-egg sets were the only ones in which the incubation period was restricted to 12 days. When the data for all sets are combined it is found that 74.6 per cent of the eggs had a 12-day incubation period and 25.4 per cent of them a 13-day period.

There was a tendency for fewer of the eggs which hatched later in the season (June) to have a 12-day incubation period than those which hatched earlier (May). In the Provo River colony 86 per cent of the eggs which hatched in May had an incubation period of 12 days, whereas only 58.5 per cent of those which hatched in June hatched in 12 days. This phenomenon also occurred in the Lakeview colony in which 89.9 per cent of the eggs that hatched in May required only 12 days for incubation while only 51.4 per cent of those in June hatched in 12 days. The difference in the mean monthly temperatures for May and June would apparently be of little significance since it amounted to only 2.6° F. As has been shown by some investigations (the Oven-bird, Hann, 1937; Song Sparrow, Nice, 1937), there seems to be no correlation between the length of the incubation period, within the normal range for the species, and the time of year that incubation occurs.

TABLE 2
TIME OF BEGINNING INCUBATION

Size of set	3 Eggs				4 Eggs						5 Eggs			
Beginning of incubation	1st Egg		2nd Egg		1st Egg		2nd Egg		3rd Egg		2nd Egg		3rd Egg	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Provo River	4	66.7	2	33.3	15	33.3	25	55.6	5	11.1	2	100	0	0
Lakeview	1	50.0	1	50.0	4	23.5	12	70.6	1	5.9	1	50	1	50.0
Total	5	62.5	3	37.5	19	30.6	37	59.7	6	9.7	3	75	1	25.0

Beginning of incubation in all sets	First Egg		Second Egg		Third Egg	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
	24	32.3	43	58.1	7	9.6

TABLE 3
LENGTH OF INCUBATION PERIODS

Size of sets	2-egg		3-egg				4-egg				5-egg			
Length of period	12 day		12 day		13 day		12 day		13 day		12 day		13 day	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Provo River colony														
Sets of eggs	1	100	4	66.7	2	33.3	30	76.9	9	23.1	2	66.7	1	33.3
Lakeview colony														
Sets of eggs	1	100	1	50.0	1	50.0	13	72.2	5	27.8	1	100	0	0
Both colonies	2	100	5	62.5	3	37.5	43	75.4	14	24.6	3	75.0	1	25.0

However with the European Wren (*Troglodytes t. troglodytes*) Kluijver et. al. (1940) found that the average incubation period in April lasted 17.5 days, in May 16.3 days, in June 15.3 and July 14.5. Although there is no obvious reason why a higher percentage of the eggs hatched in May should have a 12-day incubation period than those which hatched in June, it is possible that this is the result of the incubation rhythm and attentiveness of the females being more constant and regular during the earlier part of the nesting season.

Attentiveness and Inattentiveness

The females were found to do all the incubating of the eggs, not assisted by the males in any way. This seems to be characteristic of many members of the Icteridae, occurring in the Red-wings (Allen, 1914); the Tri-colored Blackbird (Lack and Emlen, 1939); the Boat-tailed Grackle (McIlhenny, 1937); and the Eastern Meadowlark, (Saunders, in letter), Bobolinks, and orioles.

In many of the Icteridae sexual dimorphism in regard to size is very marked, especially in such birds as the Boat-tailed Grackle and the Yellow-headed Blackbird. This larger size of the males may be an important factor in preventing them from occupying nests constructed by the smaller females and consequently only large enough to accommodate themselves. Polygamy may also play a part in discouraging the males from attempting to aid their several female mates with incubating activities.

During the incubation period the females divided their time between alternating attentive periods (on) and inattentive periods (off) the nest. The length of these periods was determined by observing individual females from a blind, timing them as they left and came back to the nest. These periods were found to vary in length with different females and with the same female during different parts of the day and during different parts of the incubation period. Unfortunately hourly temperatures were not recorded during the periods of observation and consequently no information can be presented relative to the possible effects of temperature changes on the length of the attentive and inattentive period. Daily mean temperatures were recorded but there seems to be no correlation between them and the nesting rhythm of the birds concerned. With Song Sparrows (Nice, 1937) and Oven-birds (Hann, 1937) it was found that the cooler the weather, the shorter the inattentive periods.

The periods of inattentiveness were more uniform in length than were the periods of attentiveness, having a range of one to 18 minutes, whereas the periods of attentiveness ranged from one to 41 minutes in length. The average length of the attentive periods for all females observed was 9.1 minutes, whereas the average length of the inattentive

periods was 5.4 minutes. During more than 80 hours of observation the females spent an average 63.9 per cent of their time on their nests and 36.1 per cent off (Table 4).

TABLE 4

INATTENTIVENESS

Nest No.	Stage of incubation	Time of observation	Mean temp.	Periods per hour	Aver. length (minutes)	Range (minutes)	Per cent of time off nest
39	4th day	6:30 a.m.–6:36 p.m.	57.8	3.3	6.4	2–18	34.5
43	4th day	10:09 a.m.–7:00 p.m.	58.0	3.6	5.8	2–9	31.5
43	8th day	4:42 a.m.–8:00 p.m.	68.0	3.3	6.0	2–12	32.4
35	8th day	9:23 a.m.–6:22 p.m.	55.5	3.8	5.8	2–11	39.9
41	10th day	2:52 p.m.–8:00 p.m.	60.5	4.3	6.5	1–13	46.9
42	11th day	3:09 p.m.–8:00 p.m.	60.0	5.0	5.3	2–15	39.8
42	12th day	5:47 a.m.–8:00 p.m.	71.5	5.2	3.8	1–9	31.0
41	12th day	5:45 a.m.–7:52 p.m.	70.0	5.5	3.5	1–16	33.0
Grand Average				4.3	5.4		36.1

The amount of time spent on the nest varies in different passerine species as well as in the same species during different times of the day. When the percentage of time spent on the nest by the Yellow-headed Blackbird is compared with recent studies of several other species (Table 5), it is found that it is rather low, the Song Thrush being the only bird with a lower percentage of attentiveness.

TABLE 5

PER CENT OF TIME SPENT ON NEST BY VARIOUS PASSERINE SPECIES

Species	Reference	Period of observation	Average per cent of time on nest
Song Thrush (*Turdus philomelus*)	Bussman (1933)	7 hours, 40 min.	58.7
Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*)	Fautin	83 hours, 23 min.	63.9
Hedge Sparrow (*Prunella m. modularis*)	Steinfatt (1938)	2 all day periods	66.4
European Nuthatch (*Sitta europea homeyeri*)	Steinfatt (1938)	11 hours, 17 min.	73.0
Song Sparrow (*Melospiza melodia*)	Nice (1937)	92 hours	76.5
Chiffchaff (*Phylloscopus collybita*)	Steinfatt (1938)	33 hours	77.5
Oven-bird (*Seiurus aurocapillus*)	Hann (1939)	4 all day periods	82.5
Marsh Tit (*Parus p. palustris*)	Steinfatt (1938)	12 hours	84.0

At the time the eggs began to hatch the females become more nervous and there was a tendency for the range in both the attentive and inattentive periods to become greater (Figure 2). Because of this difference in the behavior of the females before and at the time hatching began, the data concerning the length of the periods of attentiveness and inattentiveness during these two stages of the incubation period are considered separately. The average length of the periods of attentiveness was greatest at the beginning of the day followed by a gradual decrease during the morning hours, which seems to be correlated with the feeding activities, until about 11:00 A.M., when the length of the periods begin to increase again until about 2:00 P.M., after which time they again decrease in duration reaching a second low point about 5:00 P.M. when the females were again doing most of their feeding (Figure 2). Although the females did some feeding throughout the day, feeding

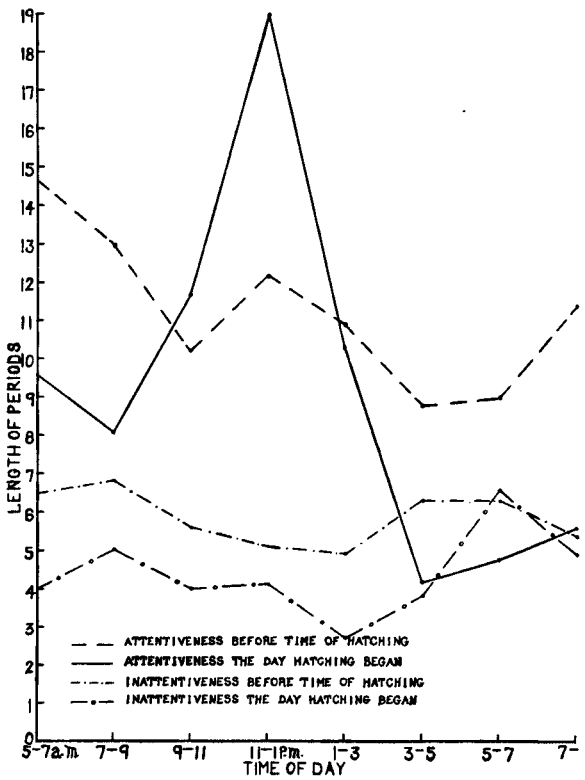

FIGURE 2. Average length in minutes of the periods of attentiveness and inattentiveness at two-hour intervals throughout the day prior to hatching and the days that hatching began.

was most in evidence during the morning and evening hours. After 7:00 P.M. there was a marked increase in the length of the periods of attentiveness with the beginning of nightfall and a drop in the temperature of the air.

The day that hatching began, the general trend of the attentive periods was similar to what it had been prior to that time, but the variations in range tended to increase, the average length of the periods varying from 4.2 minutes in the evening to 19 minutes for the 11:00 to 1:00 interval, and amounted to 26 minutes in the case of one female. This increase during the middle of the day seems to be a response on the part of the female to protect her eggs from the direct rays of the sun during that part of the day. The nest of the Yellow-headed Blackbird is of the open type and is attached to the upright stalks of vegetation which afford very little protection to the contents of the nest especially during the middle of the day when the sun is directly overhead. At the time of hatching the need of protecting the newly-hatched young from the heat of the sun may be even greater than in the case of the eggs as shown by the response of the female in increasing the length of the periods spent at the nest during that time (Figure 2).

The periods of inattentiveness were much shorter than the periods of attentiveness and their range of variation throughout the day was less. The average length of these periods was considerably reduced at the time hatching began, but prior to the time of hatching and at the time hatching began there was the same general trend in the length of these periods, which was somewhat the reciprocal of the periods of attentiveness, being longest in the morning and evening, when the birds were doing most of their feeding, and shortest during the middle of the day when the eggs and young were being protected from the heat of the sun.

The average duration of both periods was reduced 2.4 minutes after the eggs began to hatch (Table 5), but the greatest percentage of reduction occurred in the periods of attentiveness. Prior to the time of hatching the average length of the inattentive periods was 60 per cent as long as the average for the attentive periods, whereas after hatching

TABLE 6

ATTENTIVENESS AND INATTENTIVENESS IN RELATION TO THE TIME OF HATCHING

	Hours of observation	Ave. length of periods in minutes	Ave. No. periods per hour	Total No. of periods	Per cent of total time
Before hatching began					
a. Attentiveness....	55.2	10.0	3.8	205	62.5
b. Inattentiveness...		6.0		205	37.5
First day of hatching					
a. Attentiveness....	28.5	7.6	5.3	142	68.0
b. Inattentiveness...		3.6		141	32.0

began it amounted to only 47.4 per cent. The amount of time spent on the nest was thus increased from 62.5 per cent prior to the time of hatching to 68.0 per cent at the time that hatching began.

Behavior of Females

The females seldom flew directly to their nests but would alight in the vegetation about 5 or 6 feet away and then make their way through the vegetation to the nest, each female approaching her nest from some one particular direction.

Just before leaving their nests the females would always emit a series of chirps and while off their nests they spent most of their time feeding. During the middle of the day this feeding was primarily confined to the vegetation of the nesting area and around the margin of the marsh, but during the morning and evening feeding periods they sometimes fed outside the nesting area, going to the adjacent fields and pastures.

The incubating females were very easily disturbed and were seldom found on their nests unless they were observed from a blind. When their nests were being visited they would usually leave very silently before the investigator was near enough to witness their departure. However, they exhibited considerable individuality and two particular females strongly resented the presence of the writer each time their nests were approached. None of them would hesitate to drive an intruding bird, of their own species or a different species, away if their nests were approached too closely. The females exercised dominion over a small area immediately around their nests, but failed to recognize the boundaries of the male's territory in which they nested (Fautin, 1940). The emitting of an alarm call by one of the members of the colony would also cause them to leave their nests and fly to the assistance of the one that had sounded the alarm. Such cooperative behavior was witnessed on several occasions. On one occasion, when an American Bittern (*Botaurus lentiginosus*) visited the marsh, it was so severely attacked that it could not escape by flight and crawled down among the dead bulrush stems to avoid the onslaught until the confusion subsided and part of the Yellow-heads had retired from the scene of the conflict.

Behavior of the Males

Although the males did not assist in the incubation of the eggs, they were usually stationed in their respective territories and on guard to prevent the intrusion of any trespassers. They were very cooperative whenever an intruder visited the colony and entered into the conflicts described above jointly with the females. After such conflicts had subsided they would retire to their respective territories and reassert their territorial intolerance for each other (Fautin, 1940). Whenever the nests were being investigated, the males were very hesitant about leaving and would often sit near the nest and chirp. Such behavior was

frequently used to a good advantage in locating new nests during the early part of the nesting season.

The males were never observed to call the females from their nests. There was no evidence that they assisted the females in any way during the incubation period except to prevent the intrusion of trespassers.

No yearling males remained in the areas within which the nesting colonies were situated, although they were present during migration and in the adjacent vicinity. A flock of 28 females and 59 first-year males were located May 7 in the tamarix about one-half mile south of the Provo River colony. This flock remained in that area until the nesting season was practically over and by May 16 had increased to 225 or 250 members of which more than half were yearling males. The habitat occupied by this non-breeding flock was very similar to that of the Provo River colony, and nesting conditions were apparently just as favorable, yet none of these birds nested. Since no yearling males occurred in either of the breeding colonies and were not found breeding elsewhere, it is very probable that they do not breed until the second year as in the case of the Boat-tailed Grackle (McIlhenny, 1937:277). Although the yearling males were more numerous in the non-breeding flock, the females outnumbered the males in the breeding colonies about 3 or 4 to 1, which would make it appear as if the yearling females may breed even though the yearling males do not.

Interruptions in Incubating Activities

Twenty-nine or 24.6 per cent of the completed sets of eggs were destroyed or disappeared from the nests before the time of hatching. The causes of these interruptions were extremely varied and some of them were never determined. Windstorms accompanied by rain were responsible for the destruction of most of the destroyed nests. The action of the wind caused the nests to be torn from their moorings or so loosened them that eventually one side would give way causing the nest to tip over and the contents to roll out. The bottom of one nest was apparently not strong enough to support the weight of the female and broke through, allowing the contents to drop into the water. Another became infested with small black ants which the female attempted to eradicate and in so doing she tore out the bottom of the nest. Two females were recorded as deserting their nests but they may have been killed, for they disappeared from the colony. One female was taken from her nest by a predator of some sort, the nest and supporting vegetation being showered with her feathers. Mashed egg shells were found in the bottoms of 2 nests in the Lakeview colony although the nests remained intact. The eggs from 11 other nests suddenly disappeared, leaving no evidence of their fate. The cause of these last types of interruptions was never determined, although it was evidently the work of an animal of some kind. Similar interruptions have been reported by T. S. Roberts (1909) and Linsdale (1938).

Success and Failure in Hatching

One hundred and twenty-nine eggs, or 29.1 per cent of all the eggs laid, failed to hatch, with the result that 314 young were hatched from a total of 443 eggs (Table 1). Of this number, 90 or 20.3 per cent were destroyed or disappeared from the nests before the time of hatching. The other 8.8 per cent failed to hatch because of being infertile or addled. The percentages given for infertile and addled eggs in Table 1 are based on the total number of eggs laid, but since some eggs were destroyed before the time of hatching these percentages do not represent the true rate of occurrence of addling and infertility. If only those eggs are considered which occurred in undisturbed sets the percentages for addling and infertility become 11.7 and 10.4 per cent in the Provo River and Lakeview colonies respectively.

The number of eggs failing to hatch in undisturbed nests in May was much lower than the ones which were laid later and which were due to hatch in June. During the month of May no more than one egg failed to hatch in any one set in either colony, whereas in June two eggs failed to hatch in one three-egg set, one four-egg set, and one five-egg set; and 3 eggs failed to hatch in one four-egg set. Only 2 eggs failed to hatch in one set of 3 eggs during the month of June in the Lakeview colony, while in all other sets no more than one egg failed to hatch in any one set.

When the hatching success attained by these colonies (Table 1) is compared with that of other species, given in the following table, it

TABLE 7

Hatching Success

Species	Reference	Number of eggs	Young hatched	
			No.	Per cent
Red-winged Blackbird	Williams, 1940	214	156	73.0
Yellow-headed Blackbird	Fautin	443	314	70.9
Oven-bird	Hann, 1937	161	102	63.4
Song Sparrow	Nice, 1937	854	510	59.7
Yellow-headed Blackbird	Roberts, 1909	123	55	45.8

will be seen that the success attained in the Provo colony (75.7 per cent) is greater than that of any of these other studies, approximating that of the Red-winged Blackbird (Williams, 1940). The success attained in the Lakeview colony (60.6 per cent) is about the same as that of the Song Sparrow (Nice, 1937) and a little lower than that of the Oven-bird (Hann, 1937). However, it is much higher than that of the colony of "Yellow-heads" studied by T. S. Roberts (1909) in Minnesota. Predation was evidently abnormally high in the colony studied by

Roberts since all of the progeny of the colony were eventually destroyed. Nice (1937:143) has compiled the data from six studies of passerine birds that nest in the open in which 1,225 young were hatched from 1,994 eggs, thus giving a nesting success of 61.4 per cent.

The Provo River colony, being situated on the edge of Utah Lake, was subjected to much more wind than the Lakeview colony and the tamarix and willows being tall and slender were often vigorously whipped back and forth with the result that nests were sometimes completely destroyed or torn loose from their moorings and the contents tipped out into the water. The nests of the Lakeview colony were not subjected to this sort of damage because the vegetation was more dense, the nests were placed nearer the water, and the wind movement was not so great. During one storm 4 nests were completely destroyed and 7 others torn loose and tipped over in the Provo River colony, whereas only one nest was damaged in the Lakeview colony. In spite of the fact that the nests of the Lakeview colony were better protected from the hazards of wind and storm, the hatching success in this colony was 15 per cent less than in the Provo River colony. The per cent of addled and infertile eggs was much the same in both colonies but the per cent of eggs destroyed, principally by predation, in the Lakeview colony was more than double that of the Provo River colony (Table 1).

The size of the colony has been found by Darling (1938) to affect the nesting success of the colonial-nesting Lesser Black-backed and Herring Gulls. He advances the idea that the social interactions and relation of the members of the colony has a cumulative stimulating effect on the reproductive functions of the members which speeds up the breeding cycle and thus shortens the nesting period in the larger colonies. The interval of time during which predation of eggs and nestlings can occur is thus reduced and the chances for a higher degree of nesting success being attained are increased. The occurrence of a greater number of available predatees, in the case of the larger colonies, would also tend to reduce the total percentage taken by predators during that time and thus contribute to a higher degree of nesting success.

The nesting period of the smaller Lakeview colony was about two weeks longer than that of the Provo River colony and consequently afforded a longer period for predation to occur, which may have contributed to the smaller degree of nesting success. Whether or not the longer nesting period of the Lakeview colony, in comparison with that of the Provo River colony, was due to a lesser degree of functional reproductive stimulation in keeping with "Darling's Principle" or whether it was merely coincidence, is a controversial matter and is in need of further study. Social stimulation during the breeding cycle probably varies in its importance in different species because Brian Roberts (1940) has found in his study of the breeding habits of penguins that there was no evidence of a minimum threshold number of

birds necessary to enable them to complete the reproductive cycle; that egg-laying began no earlier in the larger colonies than the smaller ones; and that ovulation was not restricted to a shorter period of time in the larger colonies.

Discussion

The period from the day that the last egg is laid until the first egg hatches is often the interval of time used in determining the length of the incubation period for a particular species of bird. This interval of time is used on the assumption that incubation is not begun until the last egg is laid and is not valid unless such has been shown to be the case. Such an assumption is not always true because many birds begin incubating their eggs before the clutch is completed. Consequently the time that each egg is laid and the time that it hatches must be known before the length of the incubation period can be accurately determined, otherwise it will appear to be considerably shorter than it really is.

T. S. Roberts first (1909) gave the incubation period of the Yellow-headed Blackbird as 10 days, stating that from the time the last eggs were deposited until the first ones hatched varied from 9 to 11 days, being 12 days in one case. He points out that the eggs hatched very irregularly, in some cases 2 eggs hatching the first day and then one each consecutive day, while in other sets only one egg hatched each day. An analysis of Roberts' nesting records, taking into consideration the sequence in which the eggs of each set hatched, indicates that the incubation period of these birds is 12 to 13 days in length and that incubation was usually begun at the time the first or second egg was deposited, being delayed until the third egg in only one set. Roberts later evidently recognized this error because in his "Birds of Minnesota" (1932, vol. 2:297) he gives the incubation period as 12 to 14 days.

The length of the incubation period of most members of the family Icteridae ranges from 11 to 14 days, being 11 or 12 days in the Red-winged Blackbird (Allen, 1914); 11 to 14 days in the Cowbird (Nice, 1937; and Hann, 1937); 14 days in the Boat-tailed Grackle (McIlhenny, 1937) and the Eastern Meadowlark (Saunders, in letter) and about 11 days in the Tri-colored Blackbird (Lack and Emlen, 1939). It is to be expected therefore that the incubation period of the Yellow-headed Blackbird would fall within this range.

Summary

The nesting activities of two colonies of Yellow-headed Blackbirds, located in the vicinity of Utah Lake west of Provo, Utah, were studied from April to mid-September. Eighty-three females nested in the Provo River colony and 40 in the Lakeview colony.

Egg-laying began May 7 and 61.8 per cent of the females laid their first egg within one day after the completion of the nest. The number

of eggs per set varied from 2 to 5, with 4 the most common number (68.1 per cent).

The females were not assisted by the males in any way in the incubation of the eggs, 56.6 per cent of them beginning incubation at the time the second egg was laid, with a tendency for the beginning of incubation to be delayed longer the larger the clutch. The length of the incubation period varied from 12 to 13 days, 74.6 per cent of the eggs hatching in 12 days.

The attentive periods during incubation ranged in length from one to 41 minutes, with an average of 9.1 minutes. These periods were longest during mid-day when the females were seemingly protecting their eggs from the sun. During 83 hours of observation the females spent an average of 63.9 per cent of their time on the nest, with a range from 53.1 to 69 per cent.

The inattentive periods ranged in length from one to 18 minutes, with an average of 5.4 minutes. These periods tended to be longest during the morning and evening hours when feeding was most intensive.

The hatching success of the larger Provo River colony amounted to 75.7 per cent, while that of the smaller Lakeview colony was only 60.6 per cent, giving an average of 70.9 per cent for the two. Wind and predation were responsible for the destruction of 90 (20.3 per cent) of the eggs before the time of hatching, and 39 (8.8 per cent) failed to hatch because of being addled or infertile. The lesser degree of nesting success of the Lakeview colony was due to a greater amount of predation which in turn may have been the result of a more prolonged nesting season.

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DEPARTMENT OF ZOOLOGY, UNIVERSITY OF ILLINOIS, CHAMPAIGN, ILLINOIS.