# BREEDING HABITS OF McCOWN'S LONGSPUR

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## INTRODUCTION

THE McCown's Longspur, *Rhynchophanes mccowni,* is a bird typical of the western plains. Early explorers of the great Northwest reported it nesting on the vast, rolling prairie benches of the Rocky Mountains. These longspurs now confine their nesting to the uncultivated stretches of this region from northeastern Colorado to southern Canada.

During the spring and summer months of 1938, 1939 and 1940, I studied the longspur population of a forty-acre field east of Laramie, Wyoming. This field had never been cultivated, and it had not been grazed since being fenced about ten years before. The rocky soil supported a growth of prairie grasses and low shrubs. The water supply was restricted to dew and to puddles left after showers.

This study was conducted mainly by observation during repeated censuses of the field. The observations contained in this paper include notes on spring migration, the relationship of song to the establishment of territory, courtship, parental activities relating to nest building, laying of the eggs, incubation, guarding of the nest, and care of the young, and growth records for forty young birds. Each year a large-scale map was prepared, upon which the approximate territories of each male were plotted and the nest sites marked. During 1938, the eggs of each set found were measured and then marked with indelible pencil, in order to secure consecutive weights throughout the incubation period, and information concerning hatching. In order to keep separate records of the growth and development of the forty nestlings, the down on the top of each head was daubed with colored, waterproof ink. Five colors—red, black, yellow, blue and white—were used and repeated in the various nests. By the time the down had worn off the head, the young bird was large enough to be banded.

## MIGRATION NOTES

McCown's Longspurs winter in the southwestern United States and northern Mexico. Their breeding range covers most of the "Transition Zone from central Alberta and southern Saskatchewan to southeastern Wyoming, northeastern Colorado, northern North Dakota, and southwestern Minnesota" (1). McCreary (9) reported that, while this longspur is "the most numerous nesting bird" in southeastern Wyoming, its distribution throughout the state is "quite spotted."

The vanguard of migrating males usually arrived on the Laramie plains during the first week of April. Early arrival dates for southeastern Wyoming have varied from the exceptionally early record of March 12 (observed by Frank Bond at Cheyenne in 1889) to as late as April 24 (observed by O. C. McCreary in the Sand Creek region of Albany County in 1927). Ordinarily one might expect to see the first male between the 6th and 8th of April (9). By the third week in April large flocks of male longspurs were common. These flocks spent most of the time feeding. However, those among them who were selecting territories sang a great deal, not only in characteristic flight-song, but also from perches on the tops of rocks or shrubs within their chosen areas. At this time scattered groups of females made their appearance. By the last of April the females became numerous. Later than this, females were seldom seen in groups, for the transients had moved on, and the resident females had separated and spread out over the areas being defended by singing males. After a female settled in a territory, the pair of birds usually kept together.

DuBois (7), in Montana, observed early arrivals from April 13 to 18, with an increase in numbers between the 18th and 20th, after which they decreased in numbers. They became common by the first of May and abundant by the 4th. He made no mention of the ratio of the sexes present at any given time, but it seems likely that the second increase was due to the arrival of the females.

Tinbergen (15) reported that female Snow Buntings in Greenland behaved much the same. They arrived on the breeding grounds about a month later than the males, and remained in flocks only a short time. Then, one by one, the females left the flock and entered some male's territory.

## TERRITORY

McCown's Longspurs, being gregariously inclined, tended to retain something of a colonial formation even during the breeding season. Within the loosely-formed flocks each pair was in possession of its own territory; but, as soon as the young were on the wing in the fall, territories were abandoned.

The male proclaimed his right to a territory chiefly by a characteristic flight-song. In the early spring he was a persistent and exuberant singer. He mounted into the air, spread his wings and floated downward, repeating over and over the phrases of his song, *see, see, see me, see me, hear me, hear me, see.* Sometimes the bird did not alight after one descent, but rose immediately for another song.

A fairly good estimate of the size of a particular territory could be

determined by marking the places where the songster alighted. Occasionally he was seen flying low along what seemed to be the territorial boundaries, singing as he flew.

The first males to settle in a region claimed territories that were larger than necessary. As more and more resident males arrived, they tried to establish themselves on ground already claimed by others. The newcomers that I observed succeeded in holding the territories that they appropriated. However, these were instances in which the original territories had been sizable and the adjusted territories were seldom less than 250 feet in diameter. As their territories decreased in size the birds increased the vigor of their defense, in order to keep an area of sufficient size around the nest from which the adults could secure the large quantities of food needed by the young nestlings and still be able to brood them for long periods. The fact that both male and female longspurs fed and brooded the nestlings, as will be discussed later, indicated that prolonged brooding during the first few days was as essential to the survival of the nestlings as sufficient food.

For the male longspurs, who held small territories in areas where more birds congregated, the conspicuous flight-song and occasional chasing of an intruder were not sufficient to hold their territories; they often had to fight neighboring males. The bird defending a territory challenged the trespasser by flying at him, singing and rapidly fluttering his wings. If the intruding bird was easily intimidated, he was chased off the territory; if not, the two males rose in the air fighting.

The two notations that follow are descriptions of typical territorial defense, or 'sexual fighting' as it is termed by Tinbergen:

(a) On April 27, 1940, M26 descended from a flight-song and alighted in the territory claimed by M25. Immediately M25 crouched and ran rapidly through the grass to peck the trespasser. Both birds rose in the air, bill to bill, singing and fluttering their wings. After they came down M26 retreated into his own territory. He was not followed by M25.

(b) An interesting situation arose early in June, 1938, when a new bird, M10, attempted to encroach upon the territory of an established bird, M2, at the same time and close to the same place that a nest was being constructed by M2's mate. M10 was an aggressive bird and finally succeeded in establishing himself in a small area, about 250 feet in diameter, in spite of many fights. When he secured a mate, it so happened that she chose a site for her nest close to the disputed boundary. On July 7, I watched these two pairs of birds for an hour or more. M10 was engaged in flight-song within his own territory when I arrived. After each descent, he hovered over the nest site, and then flew directly over into M2's territory, uttering a sharp *tweet-twur* on the way. M2 immediately flew toward M10, singing. They met head on and rose high in the air; then, bill to bill, singing lustily and with wings beating vigorously, they dropped to the ground, and each

retired to his own territory. This performance was repeated eight times within twenty minutes. Once M10 was joined by his mate; the two of them flew into M2's territory, but both were driven back. During these fights, another male, M1, whose territory also adjoined that of M10, kept singing over his own territory. When not in flight-song, he sang from a rock near the boundary. This group of birds continued to behave this way for several days. Every so often during the next two weeks, both M10 and M2 were seen flying low along the boundaries of their respective territories. Neither male rose to challenge the other at such a time.

Territorial defense by male longspurs was directed against intruding male longspurs, who by their song and actions indicated that they were trying to establish themselves on a territory. It was not directed against non-competing males, nor those busy feeding immature birds, nor against males of other species frequenting the area.

Similar behavior in regard to territorial activities was noted by Tinbergen in Snow Buntings and by Pickwell in Horned Larks (13).

Tinbergen (15) stated that singing on the Snow Bunting territories developed gradually. At first the males sang on their territories in the early morning, but during the remainder of the day, they foraged on neutral feeding areas. Song and time spent within the territory increased, until by the middle of May "foraging was done more exclusively within the territory."

After longspurs settled on their territories, they sang from or over these areas at intervals throughout the day and well into the evening. They seldom left their territories, but when they did, their departures were of two types:

(a) Several birds would fly up, usually in response to a particularly sharp chirp uttered by some one individual, and would circle over the field in flock formation, chippering continually. After a few minutes the little group would settle quietly in the grass and disperse, feeding as they went. Such short flights were most common in early spring and in late July and August.

(b) At times longer, solitary flights were made. These were as common with the female as with the male, and might occur at any time during the breeding season. With field glasses, I have watched a bird fly away until it was completely lost from view. I am not certain as to the purpose of these flights. I doubt that food or water played any part in instigating them, for individual territories contained as much food as any other portion of the prairie. There were few late-spring snows heavy enough to cause a concentration of food, such as Tinbergen reported as occurring in Greenland with Snow Buntings. Although there were two ponds a short distance from the field, I have never seen longspurs visiting them during the nesting season.

A comparison of the territorial activities of McCown's Longspurs with those of Horned Larks, Song Sparrows and Snow Buntings (as described respectively by Pickwell, Nice and Tinbergen) showed similar behavior on the part of the males of all four species. The males, which arrived early, claimed large territories. As new resident males continued to arrive and establish themselves, these large territories decreased in size until a certain minimum was reached, below which the territory would not have answered the needs of the birds. Defense efforts increased inversely with the size of the territory, until, when the minimum size had been reached, a newcomer was no longer able to establish himself. Territories were proclaimed by song and defended by song in combination with threatening actions and aërial fighting.

## COURTSHIP

The presence of the female within the territory stimulated the male to behave in a definite way. Observations on M25, which had been an extremely vigorous singer prior to mating, indicated that after mating, he spent less time in flight-song and more time in the company of the female. He was frequently seen singing softly from the top of a small rabbitbrush, meanwhile making little bows to the female in the grass below. Occasionally he would hold up one wing while he sang. At another time, while on the ground, he raised the wing nearest the female and held its silver lining before her. Then he ran over to the female; they both flew up and settled in the grass some ten feet away. This behavior might be comparable to reactions of the female Snow Bunting to the first attempts at copulation by the male, which usually result in flight because the two birds are not in the same physiological state.

DuBois (7) related how a male, which had been singing with one wing aloft, ran past his mate, singing and "hoisting his white sail on the side toward her" after she had responded by raising quivering wings. This female was probably in a physiological state more nearly identical with that of the male.

Some few cases of bigamy have been reported in Snow Buntings and in Song Sparrows. The closest observation of such a nature that I have on longspurs was the following odd case of two males and one female in the same territory:

On May 20, 1940, I came upon a pair of longspurs feeding side by side at the edge of the field. The female flushed and was followed by the male; as they settled in the grass, another male alighted beside them. Both males rose fighting; finally one was driven off. The victorious male returned to the female, which

had remained on the ground, and started bowing to her. The other male returned; again they fought and chased each other about until the female flew a short distance into the field. One male followed and dropped close beside her; the other perched on the nearby fence. On May 24, the nest in this territory was practically finished, but the two males were still fighting each other. Two weeks later, this nest was destroyed and one of the males disappeared. I am not sure that there was any connection between these two events.

Tinbergen (15) stated that one of the conspicuous features of the behavior of a newly-mated Snow Bunting was the abrupt cessation of his song. The male sang again whenever his mate disappeared, regardless of whether the female had merely moved out of sight or was incubating within the nesting hole. In contrast, the male longspur did not stop singing after mating. There was a short interval—from the time of mating until the female started her nest—in which the male performed few if any flight-songs, but he often sang from a perch on top of a rock or shrub within his territory. As soon as the nest was under way flight-song was resumed and continued until the eggs hatched. The following instance will serve to illustrate:

I approached M2 after he had descended from a flight-song and was perched on the top of a small rabbitbrush (he had not been seen in flight-song during the preceding two days). The female was flushed from beside this bush where she had been scratching out a nesting hollow. M2 continued his flight-songs, not only during the following three days when his mate was working at the nest, but also after she started laying.

With the beginning of each new nesting cycle, the male engaged in flight-song. Prior to the last brood of the season, song was much abbreviated; the males neither rose as often nor did they sing during the entire descent.

A new nest was constructed for each brood, usually at some distance from the old one, either within the previous boundaries of the territory or close enough to it so that, in uncrowded portions of the field, adjustments in the boundaries could easily be made. The male usually changed his song center so as to be closer to the new nest. In some cases this resulted in fighting the male of an adjoining territory. If the female built outside of the original territory, the male incorporated the new nest site into his territory even though it involved fighting the former owner. Similar actions have been reported by Nice for Song Sparrows (12), by Dewar for European Blackbirds (4), and by Tinbergen for Snow Buntings (15).

## NESTS

The nests were built by the females in shallow depressions in the ground. In several instances there was evidence that at least some

excavating had been done by the birds, although they may have taken advantage of the numerous hollows already existing, when these met their requirements for nest sites.

The depression was lined with a variety of materials ranging from dried grasses to shredded plant stems. To this an inner lining of softer, finer material was added. The majority of the nests were constructed entirely of grasses, the body consisting of coarse stems and blades, and the inner lining of finer grasses. There were some exceptions to this, however; the body of nest 2 contained bits of lichen along with the coarse grass; that of nest 23 was constructed from the coarse, shredded bark of horsebrush and rabbitbrush; nest 10 had three down feathers worked into its inner lining; bits of wool were found in the lining of nest 11; while nest 8 was lined entirely with wool.

DuBois (6) reported that of the thirty-four nests observed by him, the bodies or the 'primary linings' of thirty-one of them consisted of dried grasses, the other three contained weed stems or roots. In regard to the inner linings, he stated that ten nests were lined with the same type of material as used in the body, twelve contained horse or cow hair, three contained finer grasses, one contained hair and bird feathers, one included fresh grass and plant fiber, and another the outer husks of wheat stubble. A nest taken by J. A. Allen, July 7, 1873, on Heart River, Dakota, was "constructed of decomposing woody fibre and grasses, with a lining of finer grasses" (3). Bailey (2) stated that the nests were built largely of grass and generally lined with hair and feathers.

The female gathered the nesting material within the territory. No wanderings in search of material, such as those observed by Tinbergen (15) in the case of the Snow Bunting, were noted in this species, since within the territory itself there was a great abundance of the grasses and fibers used. Very likely the nests constructed entirely of grass represented the primitive type of material used for nests before sheep, horses and cattle were introduced into this region. However, when such materials as wool and hair became available, the birds made use of them. Wool for the linings of nests 8 and 11, mentioned above, was collected from bits of wool which clung to the barbed-wire fence bordering the territories in which these nests were located.

In all the nests which I observed, the rim of the nest was flush with the ground. DuBois (6) observed two exceptions: in one case the rim of the nest was below the surface of the ground; in the other it was above. In the latter case, the foundation of the nest had been woven into the grass surrounding the excavation.

Dimensions of six longspur nests were taken. Of these the outside diameters varied from 3.125 to 3.5 inches, the average being 3.4. The inside diameters varied from 2.25 to 2.625 inches, the average being 2.46. The depth of these six nests ranged from 1.75 inches for the shallowest to 2.25 for the deepest, with an average of 2.08. DuBois (6) reported the average of four internal diameters to be 2.34 inches and the average depth to be 1.94. On the whole the nests tended to be wider than deep. I found only one case in which a nest was deeper than wide. This was nest 11, which had an inner diameter of 1.25 inches and a depth of 2.5. DuBois (6) mentioned one instance in which the inner diameter and depth were identical.

Three nests which had been used by the birds were collected and weighed; they averaged 9.0 grams. The average of eight ground nests of Song Sparrows was 16.15 grams, that of eight Prairie Horned Lark nests in Illinois was 15.28 grams, and that of five Prairie Horned Lark nests in New York was 9.88 grams (11).

The manner of concealment varied from those nests placed beside a few spears of grass to those well concealed beneath overhanging branches of rabbitbrush. Out of a group of forty nests, nineteen were beside grass clumps, fifteen beside rabbitbrush, five beside horsebrush, and one between rabbitbrush and horsebrush.

There are several dissimilarities between the nests of McCown's Longspurs and Snow Buntings. Although the nests of both species were placed in hollows, the longspur nests were built in the open and constructed mainly of dried grasses, whereas the Snow Bunting nests were placed in hollows in the bottom of rock crevices and were constructed of moss and earth with a layer of *Carex* leaves and a lining of feathers. The female Snow Bunting commonly made several nesting attempts before the final nest was completed (15). Only three unfinished longspur nests were found.

## LAYING OF THE EGGS

Presumably the female longspur laid early in the morning. I have the following two notations in regard to laying:

(a) On July 8, 1939, at 7 a. m. I observed F18 flying about in small circles just above the top of the grass in the vicinity of her nest. When I came into the territory, she flew away. Then her mate flew around me as if he were trying to drive me off; so I walked a short distance away and sat down. About five minutes later the pair returned to the nest site; the female dropped into the grass, the male perched on the top of a nearby rabbitbrush. After a while he hopped down and fed. I walked over and flushed the female from her nest, which contained one warm egg.

(b) Nest 27 was visited at 6:30 a. m. on May 21, 1939. At this time it con-

tained two eggs. At 7 p. m. it still contained two eggs, but at 6 a. m. on the following day there were three eggs in the nest.

From these two instances, I presumed that McCown's Longspurs deposited their eggs early in the morning, although possibly not as early as the Snow Buntings. Tinbergen (15) stated that Snow Bunting eggs were laid between 3 and 4 a. m. The females of both species exhibited some restlessness prior to laying an egg.

### NUMBER OF EGGS

The complement varied from three or four to an occasional five. Out of the thirty-eight nests in which I took an egg count, eighteen contained sets of three eggs each, eighteen contained sets of four eggs, and two contained sets of five eggs.

DuBois (6) reported twenty-four sets of three eggs each, twenty-six sets of four eggs, and two sets of five eggs from birds nesting in Montana. Nice (11) in Oklahoma, reported one set of five eggs and one set of six eggs. John Macoun (8) found two sets of four eggs each at Crane Lake, western Canada, in 1894 and 1895. Of the eleven nests located by Brown (14) in Minnesota from 1891 to 1899, six contained three eggs each and five held four eggs each.

Neilson (10) reported full sets of eggs at Wheatland, Wyoming, by May 20. McCreary (9) located a full set of eggs at Laramie, Wyoming, on June 2, 1927. On June 3, 1936, he found young longspurs that were able to fly, which would indicate that the eggs may have been laid as early as May 9. DuBois (6), in Montana, found sets complete by May 9, and young out of the nest, but unable to fly on May 23, 1915, from which fact he presumed eggs deposited as early as the first of May. Brown (14), in Minnesota, reported five nests with nearly fresh eggs on May 17.

In the field under my observation, the earliest nest was number 27, found on May 20, 1939. At that time it contained one egg; the full complement of four eggs was complete on May 25. The last egg in nest 23 hatched on August 8, 1938. The latest date for a full clutch was August 6. DuBois (6) reported July 28 as the latest date for eggs in Montana.

### COLOR OF EGGS

The ground color of McCown's Longspur eggs varied from white to pale olive. The markings consisted of various combinations of lines, scrawls, spots, and speckles of lilac, rusty-brown, mahogany, and in one case black. The sets showed some variation, but ordinarily the eggs within a set were quite uniform in color and arrangement of markings. Some eggs were marked over the entire surface, while

on others the markings were confined to the larger end. The scrawls might be either bold and heavy or very faint, in which case a fine speckling usually covered the shell.

The following descriptions will give some idea as to the variation in color. The eggs in nest 6 were a dirty white, heavily streaked with mahogany and rusty-brown scrawls. In direct contrast was the clutch in nest 19, which was so finely stippled with lilac and rust that the eggs appeared to be a plain lilac color. The eggs in nest 8 were white with fine spots of rust, lilac and mahogany at one end and heavy scrawls of dark brown at the other. The set in nest 10 was finely speckled with a few heavy scrawls encircling the middle of each egg. In nest 16 the eggs appeared lighter than usual due to the fine, sparse dotting on a pale, buffy ground. The one egg in nest 18 had a purplish band of fine spots encircling the wider end. The eggs in nest 42 were pale gray, sparsely speckled with lilac.

Bailey (2) described the eggs as "green or white, spotted with blackish or shades of brown; or white unmarked." I did not find any unmarked eggs.

Brown (14) stated that there was a remarkable variation in the color pattern of sets, but that the eggs within a set were alike in ground color and markings. The pale greenish ground color varied in intensity, occasionally being obscured by a buffy tinge. Some sets were marked over the entire surface; others were sparsely marked with dots, splashes and scroll markings of various shades of brown, from light reddish to almost black. On some eggs there were purplish areas due to buried pigment.

### SHAPE OF EGGS

Most of the eggs were oval in shape. A few exceptions were found: in nest 6 there were three elliptical eggs and one pyriform one, and in nest 8 there were three elliptical eggs.

### SIZE OF EGGS

Seventy-two eggs were measured. They ranged in length from 1.9 to 2.25 cm., and in width from 1.45 to 1.65 cm. The longest egg, which also happened to be the largest, measured *2.25* by 1.60 cm. The shortest egg measured *1.90* by 1.60 cm., the widest egg 2.05 by *1.65 cm.*, and the narrowest egg 2.05 by *1.45 cm.*

The average size of these seventy-two eggs was 2.055 by 1.546 cm., or 0.8089 by 0.6086 inches. Brown (14) reported that the average size of thirty-four eggs which he measured was 0.81 by 0.57 inches.

## WEIGHT OF EGGS

Fresh eggs varied in weight from 2.3 to 2.5 grams; the average of six was 2.4. Eggs weighed the day before hatching varied from 1.7 to 2.15 grams; the average of seven was 1.914 grams. The daily loss in weight of approximately 0.05 of a gram would, during the period of incubation, amount to a loss of about twenty per cent in the weight of an egg.

The average total weight of a three-egg set was 7.21 grams as compared to 9.5 for a four-egg set and to 11.4 for the one five-egg set weighed. A comparison of the weights of these sets showed that the actual weight and size of the individual egg in a three-egg set was slightly more than that of the individual egg in either the four-egg or the five-egg set, as shown in the following table:

TABLE 1

THE DIFFERENCES IN WEIGHT AND SIZE OF AN EGG IN SETS OF DIFFERENT SIZES

| *Number of eggs in set* | *Number of sets weighed* | *Average weight of egg in grams* | *Number of sets measured* | *Average size of egg in centimeters* |
|---|---|---|---|---|
| 3 | 4 | 2.40 | 4 | 2.05 x 1.58 |
| 4 | 5 | 2.37 | 12 | 2.06 x 1.54 |
| 5 | 1 | 2.28 | 1 | 2.06 x 1.51 |

The eggs within a set were usually quite uniform in all respects, but occasionally there were some variations. The exceptions in size, shape and weight do not follow the chronological order of laying as may be seen from the following:

In nest 7, two eggs of exactly the same size and shape were laid on successive days; on the third day, a slightly narrower, lighter egg was deposited. This clutch was not completed on the fourth day, as would normally be expected, but on the fifth day. The last egg was of the same size and shape as the third.

In nest 21, the first two eggs laid were identical in size and shape, the third egg was slightly shorter and lighter, while the fourth was definitely lighter and somewhat shorter and wider.

1—2.50 grams; 2.20 by 1.55 cm.
2—2.50 grams; 2.20 by 1.55 cm.
3—2.45 grams; 2.10 by 1.55 cm.
4—2.30 grams; 2.00 by 1.60 cm.

At nest 8, one large egg was deposited on the first day, followed on the second and third days by lighter, smaller eggs.

1—2.50 grams; 2.05 by 1.65 cm.
2—2.45 grams; 1.90 by 1.60 cm.
3—2.40 grams; 1.90 by 1.60 cm.

In nest 6, thought to be an earlier attempt by the same female as at nest 8, there were one large egg and three smaller ones.

In all of the above cases the larger, heavier eggs were the first to be deposited, but in nest 3 the procedure was reversed. This nest contained three eggs weighing 2.65, 2.40, and 2.30 grams when found. On the next day the nest contained a fourth egg, which weighed 2.70 grams.

The eggs in nests 11, 12, and 16 were all of a different size and weight. The weights and dimensions of the eggs in nest 12 were:

1—2.25 grams; 1.90 by 1.60 cm.
2—2.35 grams; 2.05 by 1.55 cm.
3—2.40 grams; 2.00 by 1.60 cm.

The eggs in nest 14 were very uniform in size, shape, weight and color.

1—2.47 grams; 2.05 by 1.55 cm.
2—2.50 grams; 2.05 by 1.55 cm.
3—2.50 grams; 2.05 by 1.55 cm.
4—2.48 grams; 2.05 by 1.55 cm.

Nest 20 contained the largest of all the eggs found.

1—2.70 grams; 2.20 by 1.60 cm.
2—2.70 grams; 2.25 by 1.60 cm.
3—2.70 grams; 2.25 by 1.60 cm.
4—2.25 grams; 2.20 by 1.60 cm.

Tinbergen (15) reported that the Snow Bunting clutch ordinarily contained five or six eggs, and that the one second clutch which he observed contained only three eggs. Late sets of longspur eggs were just as likely to contain four eggs as those laid earlier in the season. Of the two five-egg sets which I observed, one was laid in early June, the other in July.

## INCUBATION

Incubation is thought to be performed entirely by the female. I did not at any time flush a male from a nest containing eggs. DuBois (7) stated that he had "never seen a male on the nests before hatching." The female was a close sitter and usually did not flush until practically stepped upon. If the bird did not catch your eye, she did not disclose her nest even though you passed close beside it.

On my second visit to nest 2, I was having difficulty spotting the nest in spite of a stone marker. I was standing less than a foot from

the incubating bird when I saw her. Not until I looked directly at her did she fly. This time she did not rise up with the customary flutter; instead she hopped off the nest and flapped a short distance over the ground before flying away. In the air she was joined by her mate, and both settled in the grass about two hundred feet from the nest. The next day I approached the incubating bird very cautiously and sat down about eighteen inches from her. She watched me intently for about ten minutes, during which time neither of us moved. She did not fly until I reached my hand toward her. This bird was much tamer than the skittish female on nest 4, which usually left the nest if I came closer than ten feet.

DuBois (7) stated that the eggs were deposited at the rate of one a day and that incubation started with the laying of the last egg. It seemed to me that the birds were somewhat erratic in this respect; for I found that the eggs of a complement were not always deposited on successive days, nor did the female always wait for the completion of the clutch before starting to incubate.

At each of ten nests (numbers 1, 9, 10, 13, 20, 24, 29, 35, 40 and 41) the entire complement hatched within a twenty-four-hour period. At nine other nests (numbers 3, 4, 5, 11, 15, 16, 22, 23 and 28) hatching was prolonged over a two-day period.

At nest 7, the female was incubating on July 26, the day on which she deposited her third egg. On July 27 the female was still incubating three eggs. On July 28 there were four eggs in the nest. A day had been skipped between the laying of the third and fourth eggs, but incubation had begun with the laying of the third egg. Unfortunately the nest was destroyed before incubation was complete, so no hatching information was secured.

At nest 3, the female was incubating three eggs when the nest was located on June 21. These eggs were marked. On the following day a fourth egg was present. It was also marked. The first three eggs hatched on July 3, the fourth egg on July 4.

The female at nest 8 was incubating two eggs on June 29, but her complement was not complete until June 30. This nest was destroyed on July 2. It was thought to be an earlier attempt by the same pair that were later successful at nest 13, although at nest 13 all the eggs hatched within a period of twenty-four hours, which would indicate that this later set had been complete at the start of incubation.

I have data on two pairs that were successful in hatching more than one brood. Nests 3 and 23 were thought to be those of the same pair, as were nests 5 and 22. In each of these four nests hatching required

two days. These two females were consistent in the manner of laying and the time of starting incubation.

The length of the incubation period was twelve days. This was calculated from the laying of the last egg until the time of its hatching, from June 22 to July 4, at nest 3.

A comparison of the incubating procedure between McCown's Longspurs and Snow Buntings showed that females of both species incubate without assistance from the male, but that there is a difference in the amount of time elapsing between the completion of the clutch and the start of incubation. The female longspur either started incubating before laying the last egg of the set or as soon as the last egg was deposited in the nest. In contrast, the female Snow Bunting did no incubating on the day that the last egg was laid, made only spasmodic attempts on the second day, and not until the third day after completing the clutch did she 'incubate constantly' (15).

### ACTIVITIES OF THE MALE DURING INCUBATION

While the female incubated the eggs, the male longspur spent a great deal of time (a) guarding the nest from some nearby rock or shrub, (b) engaging in flight-song, or (c) defending his territory, particularly if nests were close together.

Sometimes the male was seen guarding the nest during the female's absence; at other times neither bird was near the nest. M4 was never in the vicinity of the nest when the female was absent. M6 was usually on guard from a pile of stones close to the nest, not only while the female was off the nest, but also while she incubated. He often sang from this stone pile. Whenever I came near the nest he would give an alarm note, at which the female would fly away. During the time I spent weighing the nestlings, he either flew about over the nest or circled about in the grass nearby, making some pretense of collecting food.

DuBois (5) once observed a male longspur feed the female while she incubated.

Tinbergen (15) reported an increase in song of the male Snow Bunting during the incubation period, and one case in which a male mated a second time while his first mate was incubating. Tinbergen interpreted the increase of song as meaning that 'sexual potency' still existed in the male.

Male longspurs sang during the incubation period, but with less intensity than prior to mating. This difference might be explained by the fact that the Snow Bunting tended to be a single-brooded bird, whereas the longspurs commonly raised more than one brood a year.

Sexual behavior of both male and female longspurs seemed to be cyclic. If song is a measure of 'sexual potency,' as Tinbergen suggested, the increased intensity of flight-song by the male longspur prior to the beginning of each new nesting cycle, regardless of whether or not the previous attempt had been successful, was very likely closely associated with enlargement of the gonads in preparation for another mating.

### HATCHING OF EGGS

On July 5, 1938, at 6:30 a. m., after flushing the female from nest 9, I found that her eggs were in the process of hatching. One young bird had already emerged from the shell; its down was still wet and clinging to the body. There was a large hole in the side of a second egg, through which could be seen the bill and part of the head of its occupant. A small, circular, cracked area, not yet broken through, was observed in the side of a third egg. Sounds and faint tappings could be detected coming from a fourth egg. When I visited the nest the following morning, all four had successfully hatched.

### DESCRIPTION OF YOUNG

The young were hatched blind but not entirely naked, for the dorsal feather tracts were covered with long, buffy down. The skin appeared dark where it was stretched over the body, yellowish where it lay in loose folds. The light, tan-colored egg-tooth was very prominent on the grayish bill. The egg-tooth was shed by the fifth day. The lining of the mouth was bright pink. The feet and legs were pale yellow.

The nestlings were blind for two days. Occasionally on the third day they momentarily opened their tiny, slit-like eyes. By the fourth day they could keep their eyes open for several minutes, although, if undisturbed, they rested quietly in the bottom of the nest with eyes closed. On the fifth day they appeared much more alert, for even though they sat quietly in the nest, they peered over the rim with bright, beady eyes.

When eight days old, the nestlings were no longer content to sit quietly in the nest, but moved about considerably, preening, stretching their necks, raising themselves up and fluttering their wings. By the ninth day, fear instinct was evident. Before this they had not been much disturbed at the weighing process but now they either crouched on the scale with neck drawn down between the scapulars, or fluttered about trying to escape, cheeping constantly. At this the adults became quite alarmed and circled low over the box containing the scales, uttering sharp alarm notes.

The flight of an eleven-day-old bird was very weak, but in another day it could fly thirty feet or more. Tinbergen (15) stated that young Snow Buntings were not able to fly when they left the nest, but walked about with amazing rapidity.

## GROWTH OF NESTLINGS

### *Weight*

Nestlings from thirteen nests were weighed daily, from the time of hatching until they left the nests. The following table shows the average daily increase in weight of these birds:

TABLE 2

AVERAGE DAILY INCREASE IN WEIGHT OF YOUNG FROM HATCHING UNTIL FLEDGING

| *Days* | *Number of birds weighed* | *Weight in grams* | *% of increase from time of hatching* |
|---|---|---|---|
| 0 | 13 | 2.03 | |
| 1 | 39 | 2.68 | 32 |
| 2 | 37 | 4.17 | 105 |
| 3 | 39 | 6.31 | 210 |
| 4 | 34 | 8.45 | 316 |
| 5 | 40 | 10.63 | 426 |
| 6 | 40 | 13.05 | 542 |
| 7 | 34 | 14.91 | 634 |
| 8 | 29 | 16.83 | 729 |
| 9 | 33 | 18.13 | 793 |
| 10 | 16 | 18.36 | 804 |

The weight at hatching varied from 1.6 to 2.9 grams. The nestling lightest in weight (1.6 g.) hatched from one of the small eggs in nest 9 (2 x 1.45 cm.), while the heaviest nestling (2.9 g.) hatched from one of the large eggs in nest 20 (2.25 x 1.6 cm.). An average nestling weighed 2.03 grams shortly after hatching and gained on an average of 1.6 grams a day during the time spent in the nest. The weights of sixteen fledglings varied from 15.5 to 23.0 grams, a difference of 7.5 grams. When the difference in weight at the time of hatching is taken into consideration, and two birds from two nests are compared as to the amount of weight gained during the nestling period, there seems to be a correlation between the growth of the bird and the amount of food supplied by the parent birds.

It was previously noted that incubation might start before the clutch was complete. This resulted in one bird hatching out a day later than

its nest mates. A nestling never overcame such a handicap; in fact, it often did not make normal daily gains in either weight or length. A comparison of the following table and charts will illustrate this point:

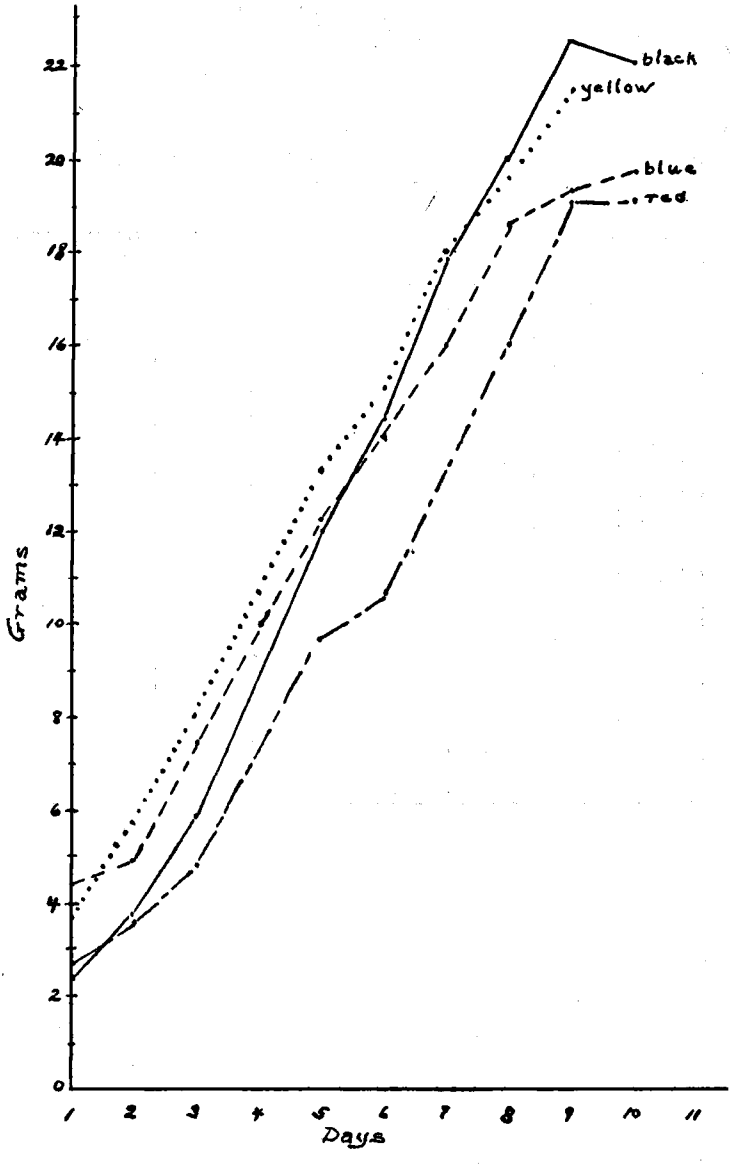
TABLE 3

A COMPARISON OF THE DAILY WEIGHTS OF THE YOUNG IN A NEST WHERE INCUBATION STARTED WHEN THE CLUTCH WAS COMPLETE (NEST 10) WITH ONE IN WHICH INCUBATION STARTED BEFORE THE LAST EGG OF THE SET HAD BEEN LAID (NEST 3)

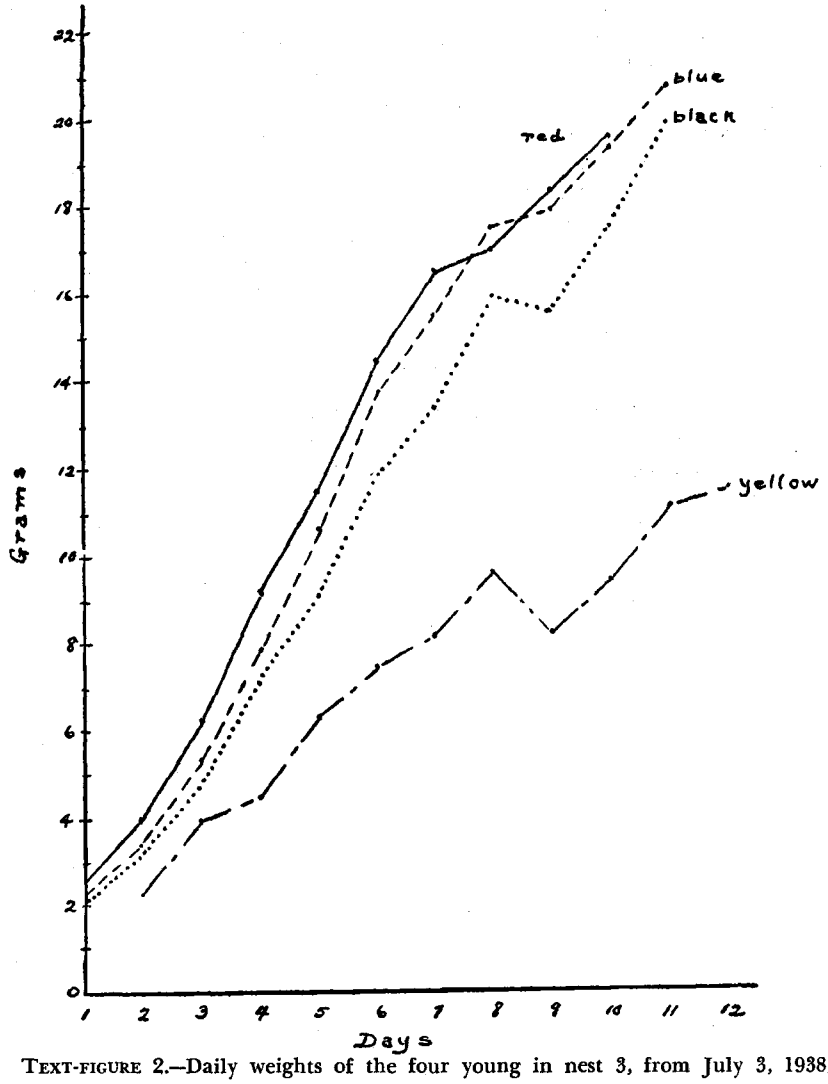
| | *Nest 3* | | | | *Nest 10* | | | |
|---|---|---|---|---|---|---|---|---|
| *Days* | *red* | *blue* | *black* | *yellow* | *red* | *blue* | *black* | *yellow* |
| 1 | 2.65 | 2.27 | 2.10 | | 2.50 | 4.20 | 2.40 | 3.90 |
| 2 | 4.00 | 3.30 | 3.20 | 2.40 | 3.45 | 4.90 | 3.60 | 5.70 |
| 3 | 6.40 | 5.10 | 4.70 | 4.00 | 4.70 | 7.30 | 5.80 | 8.00 |
| 4 | 9.30 | 7.95 | 7.30 | 4.50 | | (not weighed) | | |
| 5 | 11.50 | 10.60 | 9.00 | 6.40 | 9.70 | 12.20 | 12.00 | 13.30 |
| 6 | 14.50 | 13.75 | 11.90 | 7.50 | 10.50 | 14.00 | 14.20 | 15.00 |
| 7 | 16.50 | 15.50 | 13.30 | 8.20 | 13.20 | 16.00 | 17.70 | 18.00 |
| 8 | 17.00 | 17.50 | 16.00 | 9.70 | 16.00 | 18.30 | 20.00 | 19.60 |
| 9 | 18.10 | 17.90 | 15.70 | 8.20 | 19.00 | 19.30 | 22.50 | 21.50 |
| 10 | 19.50 | 19.30 | 17.40 | 9.50 | 19.00 | 19.50 | 22.00 | (left before being weighed) |
| 11 | (left) | 20.90 | 20.00 | 11.20 | | | | |
| 12 | | (left) | (left) | 11.50 | | | | |
| 13 | | | | (dead outside nest) | | | | |

The chances for the survival of these underlings were closely associated with the amount of food that they received. In cases where the adults did not respond readily to their weaker food calls, they died either before leaving the nest (as in nests 24 and 28), or shortly afterward (as the one from nest 3, which was found dead six inches from the nest). Those which were well fed by their parents fledged successfully a day later than the rest of the brood (as at nests 4, 11 and 28). At nest 5, the youngest bird left the nest the same morning as its nest mates, probably because this bird weighed only 2.8 grams less than the other two young in the nest.

After the young birds left the nest they did not continue to gain weight at the same rate as during the nestling period. One immature bird (band number 138-2830) was captured two days after leaving the nest. At this time the bird weighed 20.1 grams, a gain of but 1.5 grams in the two days.




TEXT-FIGURE 1.—Daily weights of the four young in nest 10, from July 13, 1938, through July 22, 1938.




TEXT-FIGURE 2.—Daily weights of the four young in nest 3, from July 3, 1938, through July 13, 1938.

## SIZE

One nestling, measured before its down was entirely dry, was one and one-fourth inches long. The young in nest 20, which were above average in weight, were also above average in length. These three birds, shortly after hatching, measured 1.75, 1.63 and 1.50 inches, respectively, whereas an average length of thirteen day-old birds was

but 1.54 inches. At the time of fledging, young longspurs measured from 3.5 to 4.0 inches in length, the average of five being 3.75. The daily growth in length was approximately 0.25 of an inch.

The wing (measured from the bend to the tip of the primary) of one newly hatched young measured 0.25 of an inch. Average measurements of eight young showed that the wing grew to a length of 2.03 inches before the birds left the nest.

The legs of seven birds were measured. At two days the tibia measured 0.5 of an inch in length; at ten days it measured one inch. The tarsus and toes together measured 0.63 of an inch at two days; 1.56 inches at ten days.

TABLE 4

AVERAGE BODY MEASUREMENTS OF NESTLINGS

| *Days* | *Number of birds measured* | *Length of body in inches* | *Length of wing in inches* | *Length of tibia in inches* | *Length of the tarsus and toes in inches* |
|---|---|---|---|---|---|
| 0 | 1 | 1.25 | 0.25 | | |
| 1 | 18 | 1.54 | | | |
| 2 | 17 | 1.81 | 0.43 | 0.50 | 0.625 |
| 3 | 21 | 2.06 | 0.52 | 0.625 | 0.875 |
| 4 | 16 | 2.38 | 0.63 | 0.75 | 0.94 |
| 5 | 13 | 2.51 | 0.82 | 0.75 | 1.13 |
| 6 | 17 | 2.79 | 1.22 | 0.875 | 1.19 |
| 7 | 10 | 3.10 | 1.32 | 0.875 | 1.25 |
| 8 | 12 | 3.26 | 1.64 | 1.0 | 1.365 |
| 9 | 13 | 3.46 | 1.94 | | 1.5 |
| 10 | 5 | 3.75 | 2.03 | 1.0 | 1.562 |

## FEATHER GROWTH

At the time of hatching all of the dorsal feather tracts of the nestlings were covered with a pale, buffy down ranging from three-eighths of an inch to one-half an inch in length. On the third day, tiny points of the sheaths of the developing quill feathers became visible under the skin. These became more prominent on the fourth day, especially on the dorsal, femoral, ventral and humeral tracts. In a few cases tiny feather tips were noted breaking from the sheaths of the nuchal, humeral and femoral tracts. By the sixth day, feather tips had broken from all sheaths except those on the capital tract. Another day was needed for the head feathers to emerge, otherwise, on the seventh day the bird appeared well feathered. Down still clung to the head and occasionally to some of the back feathers on the eighth day. The

feathers on the ventral tract were not yet long enough to cover completely all ventral apteria, but did so by the tenth day.

The wing feathers developed at a slightly different rate from those on the body proper. The developing flight feathers, enclosed in their sheaths, appeared on the wings on the second day. These sheaths grew from one-sixteenth of an inch on the third day to one-fourth of an inch by the fifth day. On the sixth day, feather tips had broken from the sheaths on the primary coverts and on the inner margins of the secondaries. On the following day, these feather tips extended from one-eighth to one-fourth of an inch beyond the sheath, which was now one-half an inch long; the primary feathers had grown one-sixteenth of an inch beyond the sheath. By the time the bird was ready to leave the nest, the feathers of the secondaries protruded one-half an inch beyond the end of the sheaths and those of the primaries one-fourth of an inch. The primary feathers of a bird captured when eighteen days old measured two inches in length.

The caudal feathers were the slowest of all to grow. The nestlings were six days old before the tail feathers could be measured. At that time the feathers had grown one-sixteenth of an inch beyond the sheath, which also measured one-sixteenth of an inch. Growth continued slowly: 0.125 of an inch on the seventh day, 0.189 on the eighth day, and 0.375 on the tenth day. The tail of an eighteen-day-old bird measured one inch in length. At this time the characteristic color pattern of the tail was clearly indicated.

## CARE OF THE YOUNG

Both parent birds cared for the young during the nestling period, and became increasingly more solicitous as the young developed. An incubating female would normally leave the nest and settle in the grass some distance from her nest during my visit to it. The brooding female would leave the nest if disturbed, but fed close by. By the time the nestlings were nine days old, both adults kept close to the nest during my visit, alternately feeding nearby and circling low over the nest, uttering sharp calls. On the day the young left the nest, both adults continually flew about me calling, *chip-pur-r-r-r, chip-pur-r.* They were just as excited at my intrusion on the following day, although later than this I did not notice any anxiety on the part of the adults, unless I accidentally flushed a young bird.

Normally the young left the nest on the tenth day. However, one brood (nest 3) remained in the nest until the eleventh day while two broods (nests 11 and 16) left on the eighth day. The young at eight

days were quite helpless, so it is possible that the adults were disturbed by my daily visits to their nests and coaxed the young birds out.

The female brooded most of the first two days after the young hatched, but she was relieved at intervals by the male. From the third day on, more time was spent by both adults gathering food for the young and less time brooding them. During showers the female brooded the nestlings even after they were well feathered. At nest 22, where the female had either deserted or been killed while away from the nest, the male fed the young, but apparently failed to brood them during a downpour, for the young were found wet and dead after the rain.

From an observation blind, F6 was seen to straddle the nest while brooding. She placed one foot on either side of the rim of the nest.

On the night of July 10, 1938, my husband and I visited the field at ten o'clock. We had previously marked the nests so that they could be found easily in the dark. When a nest was located, a flashlight was turned on it. The young birds in nest 9, which were five days old, were being brooded. The adult bird left the nest, but the young birds did not open their eyes. The seven-day-old nestlings in nest 3 were not being brooded. The adults were on the ground in the immediate vicinity. The male, evidently disturbed, sang a short snatch of song. From this night visit it seems that the young birds are brooded at night until they are well feathered, or until about six or seven days old.

### FEEDING THE YOUNG

The nestlings were fed insects from the first, never regurgitated food. Moths and grasshoppers furnished the bulk of the food, with the following kinds of grasshoppers predominating: *Arphia pseudonietans, Camnula pellucida, Melanoplus femur-rubrum,* and *Trimerotropis* sp. The young Snow Buntings were fed only animal food such as small Lepidoptera and Diptera (15).

Both male and female fed the young. The adults gave a call whenever they approached the nest with food. The young responded at once with a continuous twittering and stretched their gaping mouths toward the side of the nest from whence the adult's call had come.

Although both parents fed the young, they did not always assume an equal share of the task. The following observations, made from blinds set up before the nests, may not be entirely accurate from the feeding standpoint because in some of the birds the fear of the blind overcame the urge to feed the young.

During the three hours which I spent in a blind at nest 5 only the

male came to feed the young. He fed them alternately, giving each bird two portions. The female was in the vicinity with food in her bill, but she did not come to the nest.

The opposite situation occurred at nest 13. On July 26, this nest was observed for four hours from a blind. In this case it was the female which fed the young and brooded them during a light shower. The male guarded from his selected rock, but did not approach the nest while the blind was there. However, seven days after this brood fledged, one of the young was caught and placed inside a trap. This immature bird was crippled because of a leg injury. The male fed it several times before the trap was sprung, although when a nest trap had been placed over the nest only the female would enter it to feed the nestlings.

At nest 20, the male came immediately to feed the young after a trap had been placed over the nest. In this case it was the female that would not enter the trap. Later on this male either deserted or was killed and left the female alone to feed the brood during the last four days of the nestling period. Desertion might be explained as due to molting; for when M13 was banded on August 8, molting of the primaries was already in progress.

At nest 24, both the male and female were seen feeding the brood two days after the young had left the nest. At this time I did not notice any partitioning of the brood between the adults, such as Tinbergen (15) noted with Snow Buntings. Both adults fed the young which were scattered about. Later on—in the case of immature birds which had been out of the nest for about a week—only one adult made its appearance when a young bird was flushed.

The food call of the young longspurs changed from the continuous chippering of the nestling to the shriller, intermittent call of the fledgling. Similarly young Horned Larks and Snow Buntings were reported developing a particular food call, prior to leaving the nest, which varied considerably from the call used during the preceding time spent in the nest (15).

### NEST SANITATION

Excrement was removed from the nest by the parent birds. The nests were kept quite clean until the last two days of nest life. By this time the young so filled the nest cavity that an occasional excrement sac was often overlooked. After the young fledged, the membranous sac no longer enclosed the feces. Tinbergen (15) stated that a change in the constitution of the feces, *viz.*, the loss of the membrane, occurred the day before young Snow Buntings left the nest cavity.

Ants were omnipresent. From the observation blind at nest 13, the female was seen picking them from the young and out of the nest.

## NESTING SUCCESS AND FAILURE

Of the three years, 1938 proved to be a more successful one for the longspurs than did either 1939 or 1940. Climatic conditions in 1938 were favorable during the whole of the breeding season; temperature and amount of precipitation were only slightly above normal when compared to averages for the past fifty years. In 1939, the hot, dry weather coming early in July probably caused a shortening of the nesting season, as no new nests were found after July 8. In 1940, while the preceding winter and spring were close to normal, June turned very warm, dropped below freezing on the 9th, and then turned hot. The latter part of June and the month of July, 1940, were the hottest and wettest on record. August turned abruptly cool. No new nests were found after July 7. In addition to the early hot weather, a badger and a weasel spent some time in the field. This

TABLE 5

A COMPARISON OF THE SUCCESSFUL, PARTIALLY SUCCESSFUL, AND UNSUCCESSFUL NESTS DURING 1938, 1939 AND 1940

| | *Number of nests* | *Per-centage* | *Number of eggs laid* | *Number of eggs hatched* | *Number of young fledged* | *Average number of young fledged* |
|---|---|---|---|---|---|---|
| *Completely successful nests* | | | | | | |
| 1938 | 6 | 24 | 23 | 23 | 23 | 3.83 |
| 1939 | 2 | 28.5 | 7 | 7 | 7 | 3.50 |
| 1940 | 3 | 23 | 9 | 9 | 9 | 3.00 |
| *Partially successful nests* | | | | | | |
| 1938 | 8 | 32 | 30 | 27 | 22 | 2.75 |
| 1939 | 3 | 42.9 | 9 | 7 | 7 | 2.33 |
| 1940 | 5 | 38.5 | 15 | 7 | 3 | 0.60 |
| *Unsuccessful nests* | | | | | | |
| 1938 | 11 | 44 | 39 | 12 | 0 | 0 |
| 1939 | 2 | 28.5 | 5 | 0 | 0 | 0 |
| 1940 | 5 | 38.5 | 16 | 0 | 0 | 0 |
| *Total* | | | | | | |
| 1938 | 25 | 100 | 92 | 62 | 45 | 1.8 |
| 1939 | 7 | 100 | 21 | 14 | 14 | 2.0 |
| 1940 | 13 | 100 | 35 | 16 | 12 | 0.92 |
| *Grand total* | 45 | | 153 | 92 | 71 | 1.58 |

combination of circumstances probably explains the large number of nesting failures and the lack of late nests in 1940.

A total of 153 eggs were deposited in 45 nests, averaging 3.4 eggs per nest. Of these 92, or 60 per cent of the total number laid, were hatched; 71 birds, representing 46.4 per cent of the eggs laid, were fledged, giving an average of 1.58 birds per total nest, or 3.5 birds per successful nest. This information is compiled in Table 5.

## RELATION TO OTHER ANIMALS

The native mammals most commonly found in the field were the white-tailed jackrabbit, *Lepus townsendii townsendii,* the pale striped ground squirrel, *Citellus tridecemlineatus pallidus,* the Wyoming ground squirrel, *Citellus richardsonii elegans,* and the white-tailed prairie dog, *Cynomys leucurus.* Of these, the ground squirrels and prairie dogs could be classed as predators. The longspurs evidently recognized these rodents as marauders, for on several occasions the birds were seen hovering over a ground squirrel, chirping and darting at it in an effort to drive it away from the nest site. Predators which paid occasional visits were a cat, a badger, *Taxidea taxus taxus,* and a weasel, *Mustela arizonensis arizonensis.*

In regard to other birds, the longspurs nested in harmony with Desert Horned Larks, *Otocoris alpestris leucolaema,* Western Mourning Doves, *Zenaidura macroura marginella,* Howell's Nighthawks, *Chordeiles minor howelli* and Western Vesper Sparrows, *Pooecetes gramineus confinis.* In an adjoining field were Western Meadowlarks, *Sturnella neglecta* and a pair of Mountain Plovers, *Eupoda montana.* These birds undoubtedly competed with the longspurs for food, since they all fed mainly on insects during the breeding season; but no fighting between the different species was witnessed even when nests were fairly close together.

A pair of Swainson's Hawks, *Buteo swainsoni,* and a pair of Marsh Hawks, *Circus hudsonius,* were frequent visitors to this field. They swooped over the field in search of rodents, quite indifferent to the smaller birds. A Prairie Falcon, *Falco mexicanus,* occasionally visited the field, but did not seem to bother the longspurs. Sometimes the longspurs ignored the hawks, but oftener a group of birds would rise and twitter noisily as they flew around the hawk.

A pair of Western Crows, *Corvus brachyrhynchos hesperis,* also used this field as a hunting ground. Although I did not actually witness any depredations by the crows, it is my belief that they were responsible for the disappearance of some of the eggs and young of the

smaller birds. Two Mourning Dove nestlings were found decapitated, with the sides ripped open and the liver picked away. One fully fledged longspur was also found decapitated.

Insects were numerous. Some groups were neutral while others, namely moths and grasshoppers, furnished the bulk of the food supply for both young and adult longspurs. The following groups of insects were common in the field: ants, flies, robber flies, mosquitoes, short-horned grasshoppers (Acrididae), and among the beetles, Carabidae and Tenebrionidae.

## COMPARISON OF LONGSPURS AND SNOW BUNTINGS

When the behavior of McCown's Longspurs was compared with that of the closely related Snow Buntings, the two species were found to behave similarly in the following respects: The arrival of the males on the breeding grounds preceded that of the females. The male established the territory and, after mating, the female built the nest or nests within the territory. Territories were defended by the males against competing males of the species. Incubation was performed by the female. The male assisted in feeding the young. The young birds were fed insects. The food call of the nestlings varied from that of the fledglings. The following dissimilarities were noted: Longspurs usually remained on their territories, but the snow which covered the Snow Bunting territories at first forced them to return to neutral foraging areas each day. A newly mated Snow Bunting stopped singing, but sang again whenever his mate disappeared. The male longspur continued singing, but engaged in fewer flight-songs immediately after mating. The female longspur collected the nesting material from within the territory; in contrast the female Snow Bunting, accompanied by the male, wandered in search of the proper material. Longspurs nested in the open; Snow Buntings in rock crevices. The clutch of the single-brooded Snow Bunting contained five or six eggs; longspurs tended to raise more than one brood a year, and sets contained either three or four eggs. Song of the male Snow Bunting increased in intensity during the incubation period; song of the male longspur increased prior to each new nesting cycle. After young Snow Buntings left the nest, the brood was divided between the adult birds.

## SUMMARY

Male McCown's Longspurs arrived in southeastern Wyoming early in April and became common by the third week in April. At this time the resident males began to select territories.

Female longspurs arrived after the middle of April.

Longspurs were gregariously inclined even during the breeding season; thus territory became important in order to prevent overcrowding.

The male proclaimed his right to a territory by a conspicuous flight-song.

Song lasted from the time a definite territory had been selected until the young hatched, and was repeated for each new nesting cycle.

The male defended his territory by song in combination with threatening actions and aërial fighting.

Territorial defense was directed against other male longspurs who were competing for territory, but not against non-competing males, nor against males of other species frequenting the area.

Courtship by the male longspur consisted primarily of singing from perches within the territory, of raising the wing to display its white lining, and of bowing to the female.

Nests were built by the females, in shallow depressions in the ground, beside clumps of grass or low shrubs. Nests were commonly constructed of grasses collected by the female from the territory. An average weight of the material used was nine grams. Nests were not used a second time.

Nests were usually wider than deep. Average measurements of six nests were: 3.4 inches, outside diameter; 2.46 inches, inside diameter; and 2.08 inches, depth.

The complement of eggs was either three or four, occasionally five. First sets were found complete between May 9 and May 20. The latest date for a full set of eggs was August 6.

Eggs varied in ground color from white to pale olive, and were marked with various combinations of speckles, spots, lines or scrawls of lilac, rusty-brown, or mahogany. They were usually oval in shape and averaged 2.055 by 1.546 cm. in size.

The average weight of an egg in a 3-egg set was 2.4 grams; in a 4-egg set, 2.37 grams; and in a 5-egg set, 2.28 grams.

Eggs lost approximately 0.05 of a gram daily, or 20 per cent of their weight during incubation.

The incubation period was twelve days in length.

Incubation was performed by the female. During this time the male engaged in flight-song, defended the territory, and guarded the nest.

In some cases eggs were deposited at the rate of one a day and incubation began with the laying of the last egg; in other cases the eggs

were not deposited on successive days, nor did the female always wait for the completion of the clutch before starting to incubate.

Long, buffy down covered the dorsal feather tracts of the newly hatched young.

Nestlings were blind for two days. By the fifth day they could keep their eyes open.

During the first half of the nestling period the young sat quietly in the nest, but during the last half of the period much time was spent exercising.

Nestlings increased in weight from an average of 2.03 grams at the time of hatching to 18.36 grams at the time of fledging, a gain of 1.6 grams a day.

As to measurements: the body increased from a length of 1.25 inches at the time of hatching to 3.75 inches at the end of the ten-day nestling period; the wing, from 0.25 inches to 2.03 inches; the tibia, from 0.5 of an inch on the third day to 1.0 inch on the tenth; and the tarsus and toes together, from 0.6 of an inch on the second day to 1.5 inches on the tenth.

As to feather growth: feather sheaths became prominent on the body the fourth day. By the time the young were ready to leave the nest the feathers were long enough to cover all apteria. Capital feathers made their appearance a day later than the body feathers, the wing feathers a day earlier. By the tenth day the feathers of the wing had grown from one-fourth to one-half an inch beyond the sheaths. Caudal feathers were the slowest to grow. The tail was less than one-half inch long when the bird left the nest.

The young birds left the nest on the tenth day.

When incubation started prior to the completion of a clutch, it resulted in one bird hatching out a day later than the rest of the brood. Very often this bird did not grow as rapidly as the others and so could not always leave the nest successfully.

Both male and female fed and brooded the young. After the nestlings became well feathered they were still brooded during showers but not at night.

The young were fed mainly on insects.

The adults called whenever they came to the nest with food. The young answered with a continuous twitter. The food call of the young became shriller and was uttered intermittently after fledging.

Excrement was removed from the nest by the adults.

There were 153 eggs laid in 45 nests, 92 eggs hatched, and 71 young fledged, an average of 1.58 fledglings per nest. The birds were more suc-

cessful in 1938 than in 1939 or 1940, probably due to the less favorable climatic conditions during the latter years, and to the presence of more predators in 1940.

The relationship between the longspurs and the majority of the other birds and mammals found in the field was a neutral one. Crows, ground squirrels, and prairie dogs as well as the badger and the weasel were considered predators. Some of the insect groups were neutral; others furnished food for both young and adults.

The behavior of the longspurs and the closely related Snow Buntings was compared.

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