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THE BREEDING BEHAVIOR OF THE PAINTED BUNTING IN SOUTHERN OKLAHOMA

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The Painted Bunting (*Passerina ciris*) is so intimately a part of the avifauna of southeastern United States that many ornithologists are surprised to find it as common in more western parts of its range [The A. O. U. Check-List (1957: 554) states that it breeds as far west as New Mexico, Texas, and parts of Mexico]. In south-central Oklahoma it is among the very commonest of passerine birds. Its great abundance in Marshall County near the north shore of Lake Texoma has been well known to investigators working at the University of Oklahoma Biological Station since its establishment there in 1950. This study deals chiefly with the population of Painted Buntings on or near the station from June 15 to August 9, 1957.

The original plan was to determine whether the subadult male of the species bred. In 1957, the number of subadult males in the population observed was very small. The number of fully adult males, on the other hand, was unexpectedly high. Consequently, the project changed to one concerned with the breeding behavior of adult buntings, particularly with the role played by each sex at the nest and in care of young.

The project started too late in the season to include spring arrival of the buntings. Records (Baumgartner and Howell, 1947: 58; Nice, 1931: 176; Norman, unpubl. notes; Sutton, unpubl. notes) show that the species arrives at Oklahoma in late April. The earliest known arrival date of April 17 is for Custer County, located west-centrally in the state (Nice, *ibid.*). The earliest arrival date for Marshall County is April 19; but apparently the species does not arrive there in force until the very last of April and the first of May (Sutton, *ibid.*).

It is not certain which sex arrives first, or if the sexes arrive simultaneously. Many April records are of singing males. The earliest known arrival date of a female is April 30 (Sutton, *ibid.*), this having been recorded for Cleveland County in the central part of the state. Earlier arrival dates may have been of either females or subadult males in female-like plumage. Territorial disputes occurred as early as May 5 in Cleveland County (Sutton, *ibid.*), and a full clutch of eggs was found as early as May 23 in Muskogee County in northeast Oklahoma (Norman, *ibid.*). In South Carolina, male Painted Buntings "always come first, followed in about a week by the females" (Sprunt and Chamberlain, 1949: 515).

In 1957, nesting of the Painted Bunting in Marshall County was well under way by mid-June. However, some early phases of the breeding cycle, e.g., courtship and nest construction, were continued

even into July. This repetition was due in part to excessive predation caused by flood waters which concentrated predators, and in part to double-broodedness. We never did see, or interpret as such, the actual establishment of a nest territory—the nesting area defended by the male against other males of the species. Those that had been established early in the season apparently were maintained until the end of nesting. The first egg of a clutch was found June 9 on the station grounds (by D. H. Baeppler). A juvenile estimated to be 23 days old was collected several miles northwest of the station on June 24, indicating that egg-laying started sometime in mid-May. Except for a female seen leaving an inaccessible nest that possibly had eggs or young during May 26-28 (Sutton, *ibid.*), there are no earlier dates of egg-laying for any year in Marshall County, so far as known.

We found the Painted Bunting common in scattered strips of woodland between open or partially overgrown fields, and along wooded, often very deep gullies that led to Lake Texoma. Thinly wooded fringe along county roads was also favored by the buntings. There male after male on territory sang from telephone wires and tree perches close to the road. Buntings were less numerous in the larger groves and forested areas where their numbers noticeably decreased from the forest ecotone to the dense interior. They thrived in primarily agricultural areas where some land was feral; in this respect recently abandoned farms provided optimal conditions. This was not always so. Two pairs of buntings even invaded the station grounds where large buildings and extensive kept lawns with exotic shrubs created a pronounced artificial environment. In all these habitats only the Mockingbird (*Mimus polyglottos*), Orchard Oriole (*Icterus spurius*), Brown-headed Cowbird (*Molothrus ater*), Cardinal (*Richmondena cardinalis*), and Lark Sparrow (*Chondestes grammacus*) appeared to be as common as the bunting.

Nest territories invariably had several things in common, namely: (1) enough vegetation, though it be but a single tree or small bush, to support and conceal the nest; (2) several singing perches for the male; (3) a feeding ground, usually a grassy field with scattered shrubs (see Fig. 1). We determined territorial boundaries by plotting points where skirmishes between males took place, and by employing dummy males which were attacked unhesitatingly by defending males on territory. One carefully studied territory was 75 by 180 yards, somewhat rectangular in shape. Several other territories studied were about this size. They also appeared rectangular in shape, perhaps a result of the artificial sectioning of the land by roads, groves, fields, etc.

At no time were trespassing males tolerated. Disputes were common, and there was much chasing by males; but displays closely resembling courtship displays also took place. Males approached within inches of each other, and sometimes one of them assumed a peculiar, very stiff stance, thrusting his head up and back and his tail up and forward. Then he fluttered his wings, at times violently; often he kept his bill wide open. Above ground this posture was maintained even vertically—with front end down. Holding fast to his perch, he leaned far forward, parrot-like, toward his adversary, followed by vicious attacks. At times two birds faced each other with open bills, and suddenly they

spiraled straight up from the ground for several feet, dealing blows the whole while. No cripples resulted from the skirmishes we witnessed; but there can be no doubt that real animosity existed. Many times the dummy was struck hard by irate males. Having first knocked the dummy from its perch, some males even followed it to the ground and attacked again. One dummy was thus literally defeathered and picked apart.

The over-all shape of the species, the various postures it assumes while perching, and its movements in general probably evoke little or no response, other than to call attention, in males on territory. The dummies were flat, shapeless, simply cotton filled skins. Regardless of how placed, even upside down, they were attacked unhesitatingly. Moreover, the dummies were motionless. Colors, more likely combinations of colors, probably elicited the responses, but we failed to isolate which colors were indispensable. The buntings did not attack cards of a single color or combinations of colored cards, and for this reason some depth or shape, within limits, seemed important. Very noticeable were the bright eye-rings of the males when they displayed before either sex. At such times these feathers appeared elevated. We did not, however, experiment specifically with the eye-ring. The dummies were invariably attacked by defending males, and usually repeatedly. Sometimes the dummies went unseen by the males for



Fig. 1. Painted Bunting habitat in southern Oklahoma. Adult buntings on territory commonly gather insects for their young in feral fields such as shown in this picture. Photographed August 9, 1957, by Donald H. Baepler.

considerable periods. This was especially true, interestingly enough, when the dummy was placed within a few feet of the nest.

Only once did we see a female attack an adult male, dummy or otherwise. This happened when a dummy was placed near her nest with large young. Both she and her mate together repeatedly attacked the dummy above and on the ground. When the dummy was replaced with a subadult male dummy, the male parent was much interested, approached it closely from the side, above, and below, but did not fly at and strike it. The female likewise looked it over carefully, then suddenly stiffened, fluttered her wings, and struck with full fury. Only then did the male join the attack.

We succeeded in trapping adult males only by baiting a live trap with other adult males, either genuine or dummy. On the other hand, we succeeded in trapping females only by baiting with a fledgling. Our use of mist nets was not at all effective in catching buntings of either sex. Trapping activities and field observations, use of both live and dummy birds, convinced us that trespassing males were attacked by males, seldom by females, and that trespassing females were tolerated by both sexes, even in the nest-tree itself. Since we did not possess live subadult males, we did not reach any satisfactory conclusion concerning them.

Only once did we see a bunting chase another species of bird on or off territory. In this case, a male struck and drove off a Downy Woodpecker (*Dendrocopos pubescens*) that had alighted near the bunting's nest. Only once did we see another species—a Great Crested Flycatcher (*Myiarchus crinitus*)—chase a bunting. The Mourning Dove (*Zenaidura macroura*), Yellow-billed Cuckoo (*Coccyzus americanus*), Scissor-tailed Flycatcher (*Muscivora forficata*), Mockingbird, Brown Thrasher (*Toxostoma rufum*), Bell's Vireo (*Vireo bellii*), Orchard Oriole, Cardinal, Blue Grosbeak (*Guiraca caerulea*), Lark Sparrow, and Field Sparrow (*Spizella pusilla*), often nested close to the buntings. Indeed, many of these birds were tolerated in the nest-tree of buntings.

Courtship was not practiced daily by the buntings, and, consequently, we saw displays only infrequently. It occurred mainly, if not solely, during pair formation (or attempts at pair formation), during the period immediately preceding egg-laying, and during egg-laying. At these times the males chased females on and off territory. Several males frequently became involved in these chases, causing overlap of courtship and territorial defense. Courtship often took place on the ground in fields and frequently along roadsides or on the road itself, and not necessarily near the nest when one was present.

The usual, perhaps essential, display of the male was one of hopping about in a circling manner close to the female. With body held low on flexed legs, he stretched his neck, at times lifted his head up and back, and invariably fluttered his wings. One male, observed in Tulsa County (Norman, *ibid.*), circled a female counterclockwise, and while doing so, extended his right wing vertically high above his back, then, extended both wings horizontally. Continuing hopping, he again extended vertically his right wing, and, finally, resumed a fluttering wing display. Another display not seen by us took place in Marshall County in 1952. There a male fluttered in mid-air, "treading in absolutely

one spot," before a female (Sutton, *ibid.*). A most remarkable display was seen by us, but only once. As a female flew low over a field, a male suddenly darted in front of her, and, while flying forward, spread his tail, elevated his head, and manipulated his wings in such a manner that they appeared to be fluttering in flight. Very noticeable were the bright colors of the male's upperparts—kept in full view of the female following close behind. This flight display covered nearly 30 yards!

During the male's display, the female often assumed no special attitude, oftentimes ignoring the male by pecking at objects on the ground. When serious, she crouched with head tilted back and tail up and forward. This position invited copulation, the male mounting from above. Courtship was not always followed by copulation, which appeared not to be an essential part of the courtship display. According to our observations, copulation occurred just before and during egg-laying, and at no other time; but this is problematical.

One adult male displayed before a juvenile. This bird, high up on a telephone wire, suddenly stopped singing and stiffened, and stretching far forward, rapidly fluttered both wings. Dropping directly to the ground below, he displayed—as in courtship—before a juvenile that we believed to be his own. We never again saw an adult display before a juvenile of any age.

Forty-five bunting nests were found by us in 1957. Not all were occupied when found, but all were nests of the year. All were above ground, from 12 to 90 inches up, the average height being 38.7 inches. Nests found late in the season were often at higher elevations than those found earlier. The reason for this was obvious. Much of the concealing undercover dried and thinned as the season advanced. Eleven nests were in Winged Elm (*Ulmus alata*), seven in Osage Orange (*Maclura pomifera*), four in Smilax (*Smilax bona-nox*), four in Post Oak (*Quercus stellata*), two in Chickasaw Plum (*Prunus angustifolia*), two in Persimmon (*Diospyros virginiana*), two in French Mulberry (*Callicarpa americana*), two in Buckbrush (*Symphoricarpos orbiculatus*), one in Red Cedar (*Juniperus virginiana*), one in Smooth Sumac (*Rhus glabra*), one in Poison Ivy (*Rhus toxicodendron*), one in Russian Olive (*Elaeagnus angustifolia*), one in Spindle Wood (*Euonymus japonica*). Several nests were supported by more than one plant: three in Smilax—Winged Elm, one in Smilax—Osage Orange, one in French Mulberry—Chittam Wood (*Bumelia lanuginosa*), one in Ragweed (*Ambrosia psilostachya*)—Wild Lettuce (*Lactuca*). The nests were close to the main axis of the plant, or out on branches, often at the very tip in a cluster of leaves that sometimes dipped low into a concealing understory of grasses and weeds. The nest-trees or -plants were in both dense and thin vegetative cover. One nest was situated in a tiny, isolated Winged Elm (18 inches high) out in an open, grassy field. Several nests were close to a well-travelled gravel road, the closest being only 11 feet from the edge of the gravel.

Many nests of previous years were found. All of these nests were situated like those above, the dominant nest-plants being Smilax, Winged Elm, and Osage Orange. In 1952, a nest was found 20 feet up and far out on the limb of a Winged Elm near the station (Sutton, *ibid.*). We consider such a site in that area rare.

Most of the 45 nests were completed or nearly completed when found and we did not observe nest-building from start to finish at any one nest. One had merely the bottom and part of a side when found June 19 at 10.50 a.m. By 4:15 p.m. the following day, all sides were built up and the lining of the cup started. The lining was finished June 21 and the first egg laid June 22. In one case, the lining was completed after the laying of the first egg. The female alone constructed the nest, gathering material on and above ground, close or far from the nest, on and off territory. Many flying females with nesting material eluded us completely. No males were ever seen with nesting material of any sort. Nest-construction often occurred shortly after sunrise and sunset. Nest-construction by double-brooded females attending young took, apparently, more time and continued, sporadically, throughout the day.

Egg-laying took place shortly after sunrise when the female returned from roosting. The time of laying was determined for 21 eggs (eight nests). All of these eggs were laid between 5:00 a.m. and 6:30 a.m. We did not record egg-laying at a later hour, and there is nothing in our data to indicate that it ever occurred much later in the day. The actual laying of an egg was noted at two rather exposed nests. In each of four occasions, the bird in the nest suddenly raised or elevated her body from a low to a very high setting position, spread her tail, puffed out her feathers, and while elevated, occasionally turned about. This lasted from one to seven minutes. Upon laying the egg, the bird again settled low in the nest, and on two occasions fell fast asleep. One bird, having just laid an egg, stood on the rim of the nest and peered down at the eggs before settling. Freshly laid eggs were sticky and difficult to mark.

When nest flushed, the female made no alarm cry. She simply slipped off the nest, usually obliquely to one's approach. Then she returned a moment later and chirped. We failed to note or identify injury-feigning by either sex.

Predation and cowbird parasitism made it impossible to determine accurately the clutch-size in most bunting nests. The clutch-size at 16 nests was three (nine nests) and four (seven nests). Both clutch-sizes occurred early and late in the season.

The female attended the eggs. During incubation the male only sporadically visited the nest-tree. But that he did so occasionally there is no doubt, for we trapped males within two feet of the nest. Sometimes the trap went unsprung for several days, indicating that males did not regularly go near the nest. Not once did we see one *alight* at a nest; nor did we ever see one sing from the nest-tree. Ten to 75 yards out from there they usually sang from favorite perches. Often they disappeared from the territory altogether but never for very long. They fed both on and off territory. During daylight hours females left the nest sometimes for more than a half hour to feed on or off territory. These females fed most often in mid-morning and late afternoon and during evening before sundown, but there was no precise feeding schedule, even for individuals of both sex, so far as we could tell. During darkness females remained on the nest and were not overly disturbed by flashlight and some were reluctant to flush when

touched. Once flushed they soon returned to the nest even on moonless nights. Where the males roosted throughout incubation and fledging remains a moot question.

The period of incubation, i.e., the time interval from laying to hatching of the last egg of the clutch, was 11 days and six hours at each of three nests under scrutiny. At a fourth nest, it fell somewhere between 11 days, 6 hours and 11 days, 9 hours. The period of hatching, i.e., the time interval between hatching of the first and last eggs, varied significantly. This was expected since incubation started before or after completion of the clutch. The hatching period of one three-egg clutch was at most only 4.5 hours, that of another three-egg clutch was at least 23 hours, and that of one four-egg clutch was at least 40 hours. Commonly, incubation began with the laying of the next to last egg of the clutch, the spread of hatching being about one day.

Chicks pipped their shells on the 10th day. A hole slightly larger than a millimeter in diameter usually appeared in the side of the shell within a few hours of hatching. The shell was not cut even half way around. It merely broke in two and the chick emerged rapidly. The female then carried the half-shells and dropped them on the ground sometimes as close as fifty feet away.

Newly hatched chicks weighed about two grams. They gained about one gram per day on the average until 10 to 11 grams were attained by fledging. Upon hatching they were naked and only scantily covered with light down; their eyes did not open wide until the third day. Development of the remiges proceeded rapidly, but the chicks remained mostly naked into the seventh day. Then the body feathers burst from their sheaths. Although an eight-day-old chick was capable of flying, it was not well feathered until the ninth day. Even then there were conspicuous "naked" areas.

The female attended the nestlings—the young in the nest. As during incubation, the male parent only sporadically visited the nest-tree. Not once did we see a male carry food to nestlings. The female gathered food both on and off territory, using no special entrances or exits at the nest-tree. Flights to and from the nest were rather conspicuous. Fecal sacs were dropped at various distances from the nest. When obviously disturbed by our presence the females lingered and chirped with food in bill not far from the nest. They went to the nest sooner when the male sang near by, for the song was an apparent releaser in this respect. Most females became accustomed to us within a short time, and some even fed nestlings while we sat fully exposed ten feet away. Conditioning of this sort had to be constantly reinforced. Food for the nestlings, so far as we determined, consisted entirely of insects—including caterpillars, grasshoppers, and small beetles.

Females frequently brooded between feedings, especially when the nestlings were small. They also brooded at night. One brooded three young constantly for eight nights and then abandoned them on the ninth—on the eve of fledging. Having roosted far from the nest-tree, she returned in dim light the following morning (5:25 a.m.) from across a wide cultivated field. Then she brooded for 11 minutes before fetching food.

Fledging occurred on the 8th or 9th day. The oldest chicks remained in the nest for nine days; but the youngest chick, often younger by a day, usually fledged about the same time as its older siblings. One eight-day-old chick actually left the nest several hours ahead of a nine-day-old sib, at a time when we were away. When put back in the nest it remained another 24 hours but would not stay put after that. This was the only case where an eight-day-old chick remained in the nest after it had fledged. All other eight- and nine-day-old chicks would not stay put. Since the eight-day-old chick flew fairly well, we considered it fledged when it left the nest.

Painted Buntings about to fledge did not suddenly bolt from the nest. Crowded, they nudged their way toward the female parent whenever she brought food. The drive to approach the parent was very strong even in nestlings, and this drive increased until, by fledging time, they climbed on one another, on the rim of the nest, and often on the supporting limb close by, settling back in the nest once the female left. When they left the nest finally, they gradually moved into the surrounding foliage. Some tumbled straight down to the ground. There they were fed by the female who readily located them by their loud food-chirps.

At first these fledglings, half walking, half fluttering, made their way laboriously through the ground vegetation, and in doing so became dispersed. Within a few hours they worked their way back to the upper foliage where they remained mostly still, calling when hungry, and occasionally flying from branch to branch or bush to bush. One nine-day-old chick that had remained on the ground for three hours after falling from the nest suddenly flew straight up and alighted on a limb six feet above the ground; another made its way up by successive short flights. Although fledglings occasionally flew down to the ground, we never saw one accidentally fall after it had once fallen from the nest. Considering their age, they were incredibly agile and strong of wing. Three fledglings, each nine days old and out of the nest less than two hours, flew 50 feet before alighting in upper foliage. When approached most nine-day-old chicks (Fig. 2) and some ten-day-old chicks remained still on a perch and were easily caught by hand. We failed to catch older chicks.

Certain pairs continued to nest after they had a successful fledging and were—in a true sense of the term—double-brooded. In full charge of the brood, the female alone constructed a new nest near her old one. The male dramatically took over the brood just before egg-laying, and thereafter the female had nothing to do with the brood, so far as known.

One female (57-81508) built her new nest 14.5 feet from the old one. Already large and substantial when discovered four days after her young had left the old nest, construction must have started soon after the fledging, perhaps before. Building continued between feedings of the young, all of which remained close by within the territory of the male. In a single breath she fed a chick, reached out and pulled nesting material from a branch near by, placed the material in her nest several feet away, and then flew off to gather more food. At times construction lagged, sometimes it was hurried along, but there was no regular building period. Now the male courted. Seven days after

the fledging and on the very eve of egg-laying he took charge of the brood. Between feedings he chased the female about the open fields on territory. Twice we saw him follow her into high grass where copulation probably took place. An egg was laid on each of three following days. The brood often visited the nest-tree and sometimes flew close to the incubating parent; but there was no visible sign of recognition or show of excitement between them.

This bunting's nest was wholly different from her old one. The old nest, small and compact, was 22 inches above the ground and attached to vertical stalks of Giant Ragweed and Wild Lettuce. The new one, large and bulky, was saddled 82 inches up on a horizontal limb of a large Persimmon. Bunting 57-81502 built a nest 15 inches above the ground in a smilax tangle; after the young fledged she built another 27 inches up in an Osage Orange, 32.5 feet away. Bunting 57-81507 built her nest 19 inches up in Smilax; after the fledging she built another 41 feet away in Smilax 88 inches above the ground. Bunting 57-81526 had a nest 54 inches up in a fairly large Winged Elm; after the fledging she built another 73 feet away and 44 inches up in a stunted Winged Elm overshadowed by Persimmon. These findings made clear that individuals do not necessarily select a similar nest-site each time, and that they do not necessarily attach and fashion each nest in the same manner.

Female bunting 57-81502 produced one bunting fledgling and one cowbird fledgling on June 24, i.e., the young fledged on that date.



Fig. 2. Nine-day-old Painted Bunting photographed shortly after leaving the nest. A bunting of this age flies strongly. Note bands on legs. From a kodachrome taken July 29, 1957, by David F. Parmelee.

This double-brooded female produced three more bunting fledglings on July 23—only 29 days after the first brood fledged. Bunting 57-81507 produced three bunting fledglings on June 26; on July 25 she produced one bunting fledgling and two cowbird fledglings—again 29 days between fledglings. Bunting 57-81508 produced three bunting fledglings on June 30; on July 29 she produced three more—again 29 days between fledglings. Bunting 57-81526 produced one bunting fledgling (one cowbird died prematurely) on July 18; on August 17-18 she produced three bunting fledglings—approximately 30 days between fledglings. Thus the time interval between fledglings was not only surprisingly short but remarkably constant.

We suspected other pairs of double-broodedness, but we failed to band and thus establish their identity beyond question.

Sprunt and Chamberlain (1949:515) state that in South Carolina the Painted Bunting "raises three broods, sometimes possibly four." Apparently this statement on triple-broodedness was based on dates for succeeding broods (June 11 and July 15), and on a late brood noted September 16.

We never saw a brood being fed by both parents at the same time. They were often seen together with the brood, but only one fed. This also happened when a pair and their chick were caged together. The female immediately took charge and fed the chick until it cared for itself. The male fed it but twice. Not only did he eat unhesitatingly while facing the begging chick, he even snatched food from its mouth. The female, on the other hand, invariably snatched insects from the male and gave them to the chick. So intent was she in her feedings, that she readily took insects from our fingers.

The male under normal circumstances fed young only when the female was involved in another nesting. Although we do not consider the matter final, there is nothing in our data to the contrary. The comings and goings of the bright males attending young were easily followed. Flights to and from the brood were mostly direct, and the favored hunting grounds were the open or semi-open fields on territory. Flying low over the field the male suddenly plunged into the grasses, the tops of which swayed as he made his way through the understory searching for insects. Flying out of the grasses, he often went to some tree limb to kill his prey. Then he flew back to the brood. Feedings were intense or casual. For the most part he kept the brood within his territory. Hard pressed as he often was during this period, he still sang from his perches and chased trespassing males.

Female huntings not involved in another nesting attended young until parent-offspring relations broke down. A female thus employed did not always keep the brood within the territory of the mate. Some even moved into adjacent territories and were tolerated. Movements of the females were more difficult to follow. Their flights to and from the brood were fairly direct, but the favored feeding places were less restricted.

The fledgling, like the nestling, was strongly attracted to the parent (of either sex) arriving with food. When the parent alighted near by, on or above the ground, the fledgling often flew directly to it and begged clamorously. With outstretched neck it fluttered its wings so

violently that it was conspicuous. Often the entire brood approached and begged together. As the young grew older they flew greater distances to the parent. This irresistible drive or compulsion to go to a parent for food must be part of the mechanism that keeps the brood within a given area.

The characteristic posture of the juvenile was one of begging, even when the adult was away. It kept its wings low, relaxed, almost droopy. In this it was strikingly unlike the adult with wings set high, tucked in. This peculiar juvenile posture was still pronounced in a 30-day-old captive chick.

An eight-day-old chick taken from the nest quickly responded to our approach and begged food from us. When placed with its captive parents two days later it begged equally often from both of them, even when they had no food. Parental sex made no difference. It is not surprising then that a brood suddenly accepts the male in cases of double-broodedness.

One bunting fledgling was placed with another brood of buntings that had just fledged about a mile away. The foster parent (female) raised it with her own brood of three.

The food-call of the juvenile was a loud, often persistent, single or double chirp, distinct from alarm notes of adults. We did not understand the significance of the single or double note. It appeared not to be a matter of age but of individual variation. A series of notes not recorded by us in the field was given repeatedly by the captive female attending her chick. These notes—usually *chew-chew-chew-cheee* oft repeated, sometimes *chew-cheee-chew-cheee-chew-cheee* oft repeated—were invariably given when this bird, with food in bill, tried to induce the chick to eat. At such times the chick, already stuffed with food, ignored her. These inducing notes were not clearly audible beyond five or six feet. They may have been similar to ones given by females attending small nestlings, but we never heard those notes clearly, and we did not understand them.

Grasshoppers of various kinds were readily accepted by the captive pair, but they had to be of a certain size, i.e., not too large. The larger ones taken were thoroughly crushed. Wings, legs, often the head, were nipped off and discarded or eaten. The thorax and abdomen were macerated but left in one piece. This was carefully thrust far back in the throat of the chick by the female. When not swallowed immediately, she took it away and then quickly repeated the performance. Food was retrieved when accidentally dropped by adult or chick. One non-captive female retrieved an insect that had dropped nearly 15 feet to the ground. Small insects were invariably killed but usually not picked apart. Spiders, damselflies, and walking sticks were readily taken by the captive birds, but dragonflies, true bugs, butterflies, and moths were not.

Young of two different broods, respectively 26 and 29 days old, captured and ate insects on their own. Young 32 days old ate grass seeds on their own. All of these young were still under parental care. Other field observations indicated that even younger juveniles were capable of feeding without parental help, and for this reason the feedings of the captive juvenile were closely watched. When 20 days

old the juvenile chased and attempted to kill and swallow grasshoppers, but it was not successful in this until the 23rd day. When 26 days old it cracked seeds for the first time—as expeditiously as the adults. Very noticeably it begged less often at 29 days, and the adult fed it but once during the following three days. When 33 days old it refused grasshoppers and fed thereafter exclusively on seeds and other vegetation. Non-captive birds, 38 days old and not under parental care, caught and ate insects, but this was not observed in older juveniles.

The captive juvenile drank water frequently after 27 days old, but we do not know when it took its first drink. Juveniles 32 days old, and older, often visited pools in the gully bottoms. There they splashed, thoroughly wetting the plumage. Then they perched high and preened in direct sunlight.

One brood was observed each day from fledging until the parent-offspring relationship broke down. All three young were nine days old when fledged. At first they remained with the female (double-brooded), but when 16 days old they became the charge of the male. The brood was remarkably compact, i.e., the young stayed together and did not scatter for any great length of time. As they developed they became less sedentary and followed the male about on territory, often one behind the other. They were seen off territory, briefly, when 30 days old, and thereafter were seen off territory more frequently and for longer periods. All three were last seen together when 32 days old. Two remained and still begged and received food from the male when 34 days old; but the relationship was dissolved a day later. The male parent mostly remained near the nest-tree of its mate which was then attending nestlings. By the 39th day only one of the original brood was seen. On the 41st day one was collected—only 83 feet from the nest in which it had hatched. In the meantime the new brood fledged. The female and brood left the territory which, until then, had been defended vigorously by the male. Then he, too, abandoned the area and followed. When last seen, four days after the fledging, all were together, off territory, some 300 yards from the original nest-site.

Just what initiated the breakdown between parent and offspring is not known. The break was not sudden. Young of the year flocked together, and this flocking or mixing of broods (some of which were banded) occurred even while part of the flock was still being fed by an adult. Thus it appeared to be a gradual breakdown, and even after it was final, the young occasionally returned, sometimes with other young, to the original territory.

Polygamy existed among the buntings, but just how widespread it was throughout the population is uncertain. Males on territory appeared to have a single mate. This could have been an erroneous assumption of ours, for once a nest was found further search in the same territory was mostly discontinued. Quite by accident we found two active nests (nos. 15 and 16) only 45.5 feet apart in an area occupied by a single male. The females with their broods were captured and marked, but the male was not captured until it was attending the brood of nest 15—at a time when the female from that nest was involved in another nesting. The female of nest 16 was not double-brooded. She took her brood

across a well-travelled road into an adjacent territory and raised them there. The male of that territory—captured and identified with still another female and nest—courted her for a week but in vain. Occasionally the female and brood briefly visited the original territory. Indeed, they and the brood of nest 15 were seen together in a nest-tree then occupied by the female from old nest 15. We did not discover which male fathered the brood of nest 16. The only times we saw a male with the female near that nest was on the day before and when the brood fledged. No males were marked then. In any event, here was a situation in which there were three employed females in two territories each defended by a male.

The roosting habits of the buntings baffled us. Although some 50 hours were spent searching for them at night in well-known territories, we never did find adult males or fledged young older than 12 days at roost, and only once did we find an adult female at roost aside from nesting. At dusk on July 30, a pair flushed from a small clump of mixed trees. A moment later the female (banded by us previously) returned alone to the identical spot, fluttered from perch to perch, and in a little opening finally alighted on a slender oak branch four feet above the ground. There she preened in near darkness before settling down. She remained on the same perch throughout the night, but her mate and 20-day-old young we did not find. The abandoned nest of these birds was about 125 yards away. We never found any of them roosting in or near the oak again.

Attempts to follow males to roost at dusk failed time and again. They simply escaped us. One flew a hundred yards from its territory in dim light and dropped down in a corn field. Whether it remained there throughout the night is questionable. For all we knew the buntings may have regularly roosted off territory.

In 1957 flood waters of Lake Texoma inundated much land about the station and temporarily destroyed habitats otherwise occupied by buntings and other animals. Many animals then concentrated in number on high land adjacent to the flooded areas. This probably was why the buntings among others appeared more abundant than usual near the station. Very conspicuous at that time were a variety of bird-eating snakes—the chief predators of hunting nests that year. Before the flood waters subsided very much these predators, especially the Coach-whip (*Masticophis flagellum*), were seen surprisingly often, every day. Alarm cries and frantic flutterings of adult buntings of both sex invariably led us to one of them. At one bunting nest, a Common Kingsnake (*Lampropeltis getulus*) had already grasped a fledgling before we intervened. At another, we finally shot a Racer (*Coluber constrictor*) that repeatedly tried to reach the nestlings that were about to fledge. The nestlings were then placed in a cage where the parent could feed them, but a Rat Snake (*Elaphe obsoleta*) entered through a narrow crack and ate them.

When the waters receded many animals reclaimed the lake shore habitat. Although mostly dead trees and practically no undercover except withered smilax tangles remained, some buntings nested there, indicating establishment of late territories. One nest was on a branch below the high water mark of a Winged Elm. Fewer and fewer snakes

were seen as the season advanced. Predation of birds in general fell off after mid-July.

Avian and mammalian predators of birds were scarce, and we found little evidence of their destroying buntings or their nests. Two nests contained bunting eggs that were crushed. Tiny ants (classification uncertain) destroyed one, possibly two, nests that we knew of. One we had watched critically since egg-laying. The ants moved up and down the nest-tree and crawled over the nest during incubation; but they did not cause the bunting to desert. During hatching the ants killed the first chick and also the second which had merely pipped its shell. This resulted in nest desertion. Another nest overrun with ants apparently was deserted before egg-laying. Ants also killed a young cowbird that left a bunting's nest prematurely; but its nest-mate, a bunting, survived by staying in the nest until able to fly.

Many cowbirds were shot near the station before and during the investigation. In spite of this, at least 13 of the bunting nests found were parasitised by them. All but four of these were deserted during egg-laying. We do not know why the buntings deserted one time and not the next, but our observations support a point of view that nest desertion by the species occurs when the nest is parasitised early in egg-laying, before the third or fourth host egg has been laid. If parasitised later, the bunting does not desert, even if the cowbird then destroys some of the host eggs. No more than two cowbird eggs or young were found in a bunting nest. No cowbird eggs were found buried in bunting nests. One cowbird egg was found broken on the ground directly beneath a nest that had three buntings only. Latest date of a fresh cowbird egg in a bunting nest: July 3; latest date of a cowbird young in a bunting nest: July 25. In a nest containing one bunting and one cowbird, the bunting fledged first. In one with two buntings and a cowbird, a bunting and the cowbird fledged (together) first. The female bunting fed cowbird juveniles out of the nest, but we were uncertain if the males ever did.

An important factor in breeding success of the species is nest durability. Small young at two nests fell to the ground when the nests tipped low on one side. Another nest fell all the way to the ground. To keep these young alive we stitched the nests firmly to their supports by needle and thread. One nest simply disintegrated in a light rain, spilling three small young nearly seven feet to the ground. Rain occurred but once during our stay; but persistent inclement weather during nesting would certainly ruin many active bunting nests in southern Oklahoma.

Several nests found were not well shaded from the sun. All embryos in four eggs at one nest apparently died from overheating. One bunting lined her nest with horse hair and frequently became entangled in it. When two of the three eggs were thrown out of the nest by such entanglements, we removed the lining. The third egg survived.

Loss of eggs resulting from predation and cowbird parasitism made it impossible to determine the total number of eggs laid in all 45 nests, and it is not feasible to state breeding success as percentages of young fledged to the total number of eggs laid, or young fledged to the number of eggs laid in the nests which did produce young. This much we

know: One of the 45 nests contained feather sheaths only, indicating successful fledging of an unknown number of young. Of the other 44 nests, only 19 produced young—48 in all. At least 53 eggs had been laid in the 19 nests, but this figure is too low. Thirty-seven young (from 15 of 19 nests with young) fledged. The remarkable fact is that 19 of the 37 fledglings were produced by only four double-brooded females. Three of the double-brooded females were parasitised by cowbirds which reduced the bunting clutch-size. The double-brooded female unmolested by cowbirds produced at least six fledglings (from seven eggs) in 1957.

Generally, it may be said that the nest of the Painted Bunting is highly vulnerable to destruction. Yet, it is obvious that the species is very successful in southern Oklahoma where it is so abundant. The species endures and overcomes high mortality of nests by virtue of its high breeding potential. There is little doubt in our minds that a few females favorably situated can produce enough young to maintain the population when the majority fails. Bumper crops can be expected when breeding conditions approach the ideal. Conceivably, some buntings may be triple-brooded, but we have no evidence that this is ever the case.

Why some females were "favorably situated" or just what constitutes a favorable situation is uncertain. The double-brooded females did not choose a particular kind of site each time; nor did their choice of sites differ, seemingly, from those of less successful females. A variety of nest types and nest locations produced young. However, nests placed in an upright crotch endured wear and the elements best; those saddled on a limb or situated in vines or in a loose cluster of leaves at the end of a branch were less durable. Well-shaded eggs or young had obvious advantages. Cowbirds parasitised a variety of nest types and locations. With respect to predation, the site of the territory seemed important. Certain predators were noted time and again in some territories, much less often in others.

Why some females were double-brooded and others not, is also uncertain. Age may be a factor, but there is no evidence of this for the species. The polygamous male bunting and his ability to care for a given number of young at one time may well be an important factor why some females do not proceed with another nesting, even when there is sufficient time. We do not know if female buntings ever mate with more than one male during one season. Seemingly, the whole question of polygamy has to be better understood before we fully understand double-broodedness in this species.

Not all buntings had stopped nesting by the time we departed. There were at least two active nests, one with eggs and one with 5-day-old young. Observations at these nests were continued by W. M. Pulich who later wrote that the eggs at the one nest hatched during August 9-10, and that the young of that nest fledged sometime during August 17-18. We know of no later bunting nesting for Oklahoma.

Adult buntings did not undergo extensive postnuptial molt up to the time of our departure. It seems unlikely that they ever do before migrating from Oklahoma. Males continued to sing into August, but frequency of song fell off after mid-July. We recorded the last full

song August 6. Apparently there are no late August or September records of adult males for the state, the latest one being our own (August 9, Marshall County). Latest recorded date for an adult female: August 18, Marshall County (Pulich, *in litt.*).

Flocks of juveniles were common by early August, and apparently they remain fairly common locally in the state into September (at least one specimen available). October dates for "female-like" Painted Buntings have been noted for Woods County in northern Oklahoma (Sutton, *ibid.*).

A number of banded juveniles of known age were collected by us in 1957. These include 9-, 15-, 19-, 21-, 25-, 31-, 35-, and 41-day-old birds. All of them were collected near their nests—good evidence that juveniles of these ages are not rangy. These specimens, including adults, will be reported on in a separate paper dealing principally with plumages and molts of the species.

The Indigo Bunting (*Passerina cyanea*) was both scarce and local, and we found no situation where it and *ciris* bred side by side, although conceivably they do just that in parts of Marshall County. When compared with this work previous studies on the Indigo Bunting (Forbush, 1929:118-121; Allen, 1933:227-235; Bradley, 1948:103-113) indicate that there are significant differences in the breeding behavior of the two species. Ideas differ on the role of male *cyanea* at the nest and in care of young. According to Bradley only the female incubates and "All parental care while the young Indigo Buntings are in the nest is given by the female"; but according to Forbush both sexes incubate and attend nestlings. Allen states that although the male Indigo Bunting does not brood, both sexes attend nestlings and further substantiates this belief with a photograph of a male feeding young at a nest. According to Allen both parents attend fledged young until the young feed themselves. He further states that *cyanea* is double-brooded, but that the interval between the start of the first nest (e.g., early June) and that of the second nest (e.g., late July or early August) is long. This certainly is not the case with *ciris*. The 12-day incubation period of *cyanea* by Forbush and Allen is nearly a day longer than that of *ciris*. Bradley states that eight- and nine-day-old *cyanea* fledge as very weak flyers and that they then remain on or close to the ground. According to Forbush and Allen, young *cyanea* remain in the nest 10 to 13 days. Eight-day-old *ciris* fledglings fly and the nine-day-old ones are strong of wing and mostly remain fairly high above the ground soon after fledging.

SUMMARY

1. The breeding behavior of the Painted Bunting (*Passerina ciris*) was studied near the north shore of Lake Texoma in Marshall County, Oklahoma, from June 15 to August 9, 1957. Particular attention was given the fully adult birds with respect to the role played by each sex at the nest and in care of young.
2. Previous records indicate that the species arrives at Marshall County as early as mid-April, but not in force until late April or early May. The arrival of adult females is poorly known.
3. Egg-laying in Marshall County probably commences as early as mid-May. In 1957, nesting was well under way by mid-June, but early phases of the breeding cycle were repeated even into July.

4. The species was among the commonest of the passerine birds. It was most numerous in the thinly wooded places, in primarily agricultural areas where some land was feral.
5. Throughout nesting, the nest territories were vigorously defended by males against other males of the species. Trespassing females with or without broods were tolerated by both sexes on territory. Defensive displays resembling courtship displays occurred among males.
6. Ground displays and flight displays by courting males occurred during pair formation, during the period preceding egg-laying, and during egg-laying. One adult male displayed as in courtship before a juvenile.
7. All 45 nests found in 1957 were placed 12 to 90 inches (average 38.7 inches) above the ground in a variety of plants. The nest-trees or -plants were in both dense and thin vegetative cover.
8. The female alone constructed the nest. Nest-construction required as little as two days. Lining the nest was completed before or after laying of the first egg.
9. Egg-laying occurred shortly after sunrise when the female returned from roosting.
10. The clutch-size at 16 nests was three and four. Both clutch-sizes occurred early and late in the season.
11. The female alone incubated and left the nest to feed. The male only sporadically visited the nest-tree and rarely approached the nest. Males sang near but not in the nest-tree. Each male had several singing perches on territory.
12. Incubation started before or after completion of the clutch. Commonly, it began with the laying of the next to the last egg. The period of incubation in three known cases was exactly 11 days, six hours. The period of hatching varied from 4.5 hours to at least 40 hours.
13. The female alone attended the nestlings. She brooded between feedings and at night.
14. Fledging occurred on the 8th or 9th day. Eight-day-old young flew fairly strongly, nine-day-old young very strongly.
15. Some Painted Buntings were double-brooded. In full charge of the brood the female alone constructed a new nest near her old one. The new nest was not necessarily situated or fashioned like the old one. In one known case, egg-laying took place eight days after the young fledged.
16. The time interval between fledgings in four cases of double-broodedness was 29-30 days.
17. With respect to double-broodedness, the male took over the brood just before egg-laying. He then cared for the brood until parent-offspring relations dissolved. When not double-brooded, the female cared for the brood until parent-offspring relations dissolved.
18. The brood remained together and did not range far from the original nest-site.
19. A captive 23-day-old juvenile caught and ate insects. When 26 days old it cracked and ate seeds. It refused to take food from the parent when 33 days old. Non-captive juveniles, 26 days old, caught insects while still attended by the parent. Adults fed young until parent-offspring relations dissolved.
20. Juveniles of different broods flocked even while some individuals of the flock were still attended by adults.
21. Parent-offspring relations dissolved gradually. It ceased altogether when the young were 33-35 days old. Unattended juveniles often returned to the original territory.
22. Polygamy existed among the buntings.
23. Flood waters forced the Painted Bunting among other animals to concentrate in certain areas. When the waters receded the buntings among others reclaimed the shore habitat.
24. Bird-eating snakes were principal predators of the species during nesting. The species was commonly parasitised by cowbirds.
25. The nest of the species was highly vulnerable to predation. Nest durability was important in nest success.
26. Nineteen of 44 nests produced 48 young. Nineteen of the 37 young that

- fledged were produced by four double-brooded females. One double-brooded female produced at least six fledglings in 1957.
27. The species endures and overcomes high mortality of nests by virtue of its high breeding potential.
 28. Adult males sang full songs as late as August 6. Adults did not undergo postnuptial molt during nesting.
 29. Fledging occurred as late as August 17-18.
 30. Adults apparently migrate south from Oklahoma before molting. There are no September or later records of adults for the state. Juveniles have been recorded in September, female-like birds in October.
 31. Differences exist in the breeding behavior of the Indigo and Painted Buntings.

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THE BAL-CHATRI: A TRAP FOR THE BIRDS OF PREY

By DANIEL D. BERGER AND HELMUT C. MUELLER

In spite of the abundance and variety of traps left to us by many generations of falconers, the raptors remain among the most difficult birds to trap. The device presented below is the best all-purpose trap we have encountered in nearly a decade of experimenting with the various techniques for capturing hawks. It has the advantages of being small, having no moving parts, and can be thrown into the vicinity of a hawk from a moving vehicle. As with most trapping techniques, the device is an adaptation of an ancient idea. For many years the east Indian falconers have taken hawks in horsehair nooses affixed to the exterior