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## NESTING BEHAVIOR OF THE AMERICAN DIPPER IN COLORADO

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Early naturalists and pioneers in western North America were attracted by the peculiar behavior of the American Dipper (*Cinclus mexicanus*), its aquatic feeding habits, melodious singing, and custom of nesting by swift mountain streams. Many writers have described various phases of its behavior, but none has made consecutive observations that in any sense approach a life history study.

While at the Rocky Mountain Biological Laboratory at Gothic, Colorado, in the summer of 1947, I became acquainted with the American Dipper and spent considerable time observing a nest and the parents and young after the young had left the nest. In the following summer, I arrived at Gothic on June 8 and remained until August 6, spending most of that time studying the dipper. Although June 8 seems like late in the spring season at low altitudes, this was by no means true at Gothic. The last few miles of road to the Laboratory had just been cleared of a remaining snow bank and two mud slides only the day before I arrived, and I was the first person to reach the station for the summer. The weather for a week after I arrived was pleasant, with the temperature going down to about freezing at night and up to 60° or 70°F. in the course of the day; then several days of cold rain and light snow followed before the summer weather returned to stay. Snow banks remained during the summer at a few hundred feet higher altitude.

The laboratory is situated at an elevation of 9,500 feet, about 700 feet higher than Crested Butte, Gunnison County, the nearest town and post office, nine miles away. The chief streams where dippers were found are: East River, from 10 to 60 feet wide, usually about 30 feet; Copper Creek, a slightly smaller stream joining East River at Gothic; and Cement Creek, a still smaller tributary, 7 to 20 feet wide, emptying into East River about 16 miles below, to the southeast. All the streams are very rapid, at least where the dippers are found, and have numerous falls and cascades; their beds are filled with large numbers of rocks of various sizes.

The altitude of the nests studied ranged from about 9,000 to 10,000 feet, thus lying within the Canadian Life-zone, which extends from about 8,000 to 10,500 feet. The chief forest growth of this zone consists of Engelmann spruce, Douglas fir, aspen, and willow, which cover only a limited portion of the surface, the remaining areas, where enough soil is present, being covered with innumerable herbaceous plants, mosses, and fungi (for further description of the area see Knox, 1944).

In making a study of the dipper I soon met limiting factors of time, distance, and inaccessibility. It might take half a day to reach one nest and return. Moreover, the problem of getting to the nests was a vital one. I had to observe two of the best nests with glasses only because they were out of reach without extra manpower and more or less perilous climbing. Most of the time was spent on three nests within a radius of one mile from the laboratory, as it seemed better to visit a few nests regularly than to divide my time among more nests at greater distances. Nevertheless, I did spend considerable time trying to locate other nests, traveling on foot and by car.

## NESTS

*Nest 47-1.* (Observed from distances of 50 to 60 feet. Figure 14.) The first dipper's nest of the study was one which was situated by the falls in East River about 400 yards upstream from the Laboratory in the summer of 1947. On one side of the river is a wall of stratified rock about 30 feet high, and the nest was in a niche half way up the wall. The stream here was about 30 feet wide, and a huge rock which formed an island served as a stopping place for the birds going to and from the nest. Dippers had nested in this same general location in previous years (Knox, 1944:29), and perhaps for ages. On June 30, the parent dippers were feeding young birds in the nest, and the young were reported to have left the nest July 14 or 15. Calculation showed that incubation began about June 4, and hatching occurred about June 20. At least two young birds left the nest, and these were observed frequently from July 20 to 28.

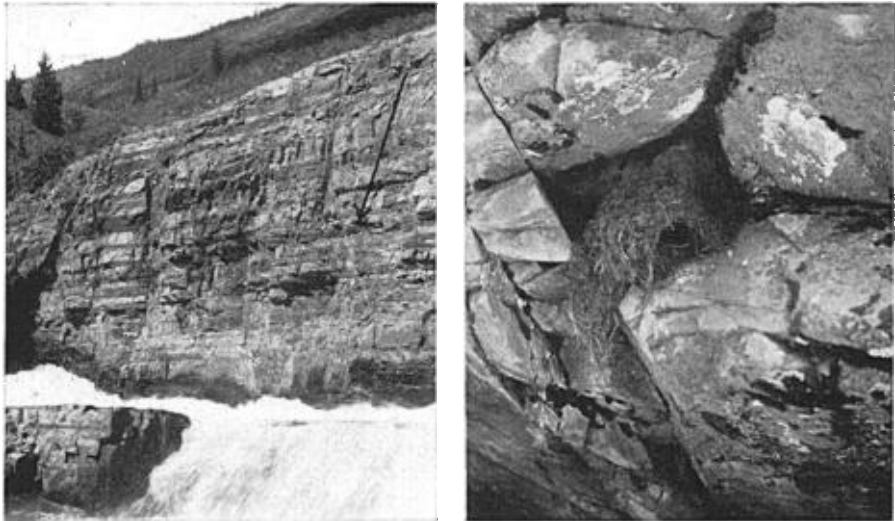


Fig. 14. Left, wall of stratified rock 30 feet high above falls of East River, Gothic area, Colorado. Arrow points to American Dipper nest site, number 48-1, July 2, 1948.

Right, dipper nest, number 48-7, in a wall seven feet above edge of Cement Creek, July 19, 1948.

*Nest 47-2.* On July 3, 1947, dippers were seen flying in behind Judd Falls in Copper Creek about a mile from the Laboratory. This falls is about 75 feet high and 20 feet wide and is down in a gorge which is about 300 feet deep to the bottom of the falls. The birds flew in at the side of the falls, but they had to pass through a portion of the spray. Judging from the known habits of the birds, there must have been a nest behind the falls, but the location was quite inaccessible.

*Nest 48-1.* (Observed from distances of 50 to 60 feet. Figure 14.) This nest, the first of 1948, apparently was the same nest as 47-1 of the previous year. The location, as nearly as I could tell, was the same, and the nest had the appearance of an old one. The top seemed to be covered with a little soil; some grass was growing from the top; and a small plant, perhaps a *Sedum*, was growing on the back side. The nest was occupied by an incubating bird on June 8, the day of my arrival for the second season. Later calculation showed that the eggs had been laid from about May 30 to June 2 and that incubation had started about June 2. The first apparent feeding of the young was noted on June 18, but hatching, or a part of it, may have taken place on the previous day. The first young bird left the nest at 7:05 on the morning of July 12; two more were out at 6:30 a.m. on July 13; and the fourth left at 7:20 a.m. on July 13. Further observations were made on the parents and young until August 3.

*Nest 48-2.* (Observed from distances of 30 to 75 feet.) On June 10, 1948, two dippers were found along East River about a mile down the valley from the Laboratory, and soon one bird went to a

nest on the opposite bank from me. The nest was about three feet above the water, which was too deep and swift to wade, and above the nest the bank sloped upward some 200 feet at an angle too steep to descend without a rope. The nest was placed beneath a small spray of rootlets which grew out of the bank, and some grass of the inner portion of the nest was exposed in front. On the morning of June 13, two birds were present, but it soon was evident that all was not going well. One bird, presumably the female, entered the nest; and the other began to peck at the lower portion of the nest and later to pull grass from it. On June 16, a dipper was seen approaching the nest, but it left at once, and no birds were seen at the nest after that. The male seemed to be the dissenter, and his lack of cooperation may have been due to the nearness of another pair of dippers nesting about 400 yards upstream.

*Nest 48-3.* This nest was found on June 11, by seeing the birds around the nesting site and by seeing a bird entering and leaving the nest. The nest at this time was just being finished. It was beneath the base of a 24-inch Engelmann spruce tree, which stood on the edge of the bank of Copper Creek about one-half mile from the Laboratory. The bank here was about eight feet high, a vertical wall of stratified rock, and the nest was on a sloping root in a crevice of the wall just beneath the body of the tree. The creek at this place formed a cascade 20 feet wide, with about a 35-foot drop in 200 feet of stream. In the middle of the stream just opposite the nest was a large rock almost hidden by water but which caused the water to splash about eight feet high. I reached the nest by climbing down the wall while holding to a rope attached to a tree above. I could not see into the nest, but could reach into it with my hand. I also watched the birds from the opposite bank at a distance of 25 feet, and late in the season when the water was lower, I watched from the exposed rock 12 feet from the nest.

There was no activity around the nest for several days after I examined it on June 12, the day after its discovery, but on June 19, when I had almost concluded that I had caused them to desert the nest, I found two eggs in it. Another egg was added on June 20, and a fourth on June 21. On the evening of July 7, there were two young birds in the nest, and another hatched later, apparently on the following day. One egg which had a dent three millimeters in diameter in the shell failed to hatch and remained in the nest. On July 16, I banded the young birds with a metal band on the left leg of each, and a colored celluloid band on the right. All three of the young birds left the nest on August 1 between 7:09 a.m. and 4:00 p.m. Two were found on a narrow ledge of rock below the nest; and the third, 100 feet down stream. All three banded birds were seen on August 2, 3, and 4; and two, on August 5, the last day of observation.

*Nest 48-4.* (Observed from a distance of 25 feet.) This nest was found on June 28, 1948, and was first seen at a distance of about 200 yards as a brown spot on the side of a gray shale wall. It was situated at the edge of East River about 400 yards upstream from nest 48-2. The wall was about 40 feet high at this place, and the nest was in a niche, 10 feet above the edge of the water. A hundred feet up stream was a waterfall six feet high, and about the same distance below was another fall somewhat smaller. The parent dippers, when the nest was found, were feeding young, which later calculation showed were four or five days old. Only three young birds were seen in the nest at one time until July 10, when a fourth was noted. The female was not seen after July 14, but the male kept up the feeding of the brood. On July 18 at 7:05 a.m. the first young bird climbed out of the nest and fluttered down to the rocky ledge at the edge of the water. Two more left in the course of the day or early the next morning, and the last left on July 19. Young of the brood were seen at various times up to July 31, when a young bird believed to belong to this brood was last seen a mile away in another nesting territory.

*Nest 48-5.* On July 1, 1948, an empty dipper's nest was found along Copper Creek about one and one-half miles from the Laboratory. It obviously was built during the early part of the season, but for some reason was deserted. A pair of dippers whose nest could not be found at the time was seen about 200 yards down stream from here on June 12. It is probable that the nest belonged to this pair and that they were forced to abandon it by another pair (48-6) which nested a half mile or so upstream. The nest was built in a niche in a shale wall six feet above the water.

*Nest 48-6.* On July 11, 1948, two dippers were seen feeding in a beaver pond about two miles up Copper Creek from the Laboratory; and on July 14, further investigation revealed a nest near-by with three young birds nearly ready to leave. The nest was built in the bottom of a large uprooted tree which had stood at the edge of the creek on low ground and had fallen away from the creek at a

right angle. The nest was six feet above the water and was overhung by a large spray of rootlets. I watched the feeding from a distance of 25 feet, and on July 15 I waded the creek with the aid of a pole and examined the nest more closely. On July 23 the nest was empty and one young bird accompanied by an adult was near the nest.

*Nest 48-7.* On July 16, 1948, Dr. B. R. Coonfield reported finding two dipper's nests (48-8 and 48-9) along Cement Creek, 23 miles from the Laboratory. On July 19, I visited these nests and found a third one (48-7). I observed the nests again on July 20; Dr. Coonfield visited them on July 24; and I made a final trip to them on August 2. Nest 48-7 was located in the "First Gorge" of Cement Creek where the stream was narrow and swift, making a drop of about 20 feet in 250 feet of length. The stream was bordered and somewhat overhung by a wall of igneous rock about 25 feet high, and the nest was in a niche seven feet above the water (figure 15). The nest was empty when found, but had been used earlier in the season as shown by droppings on the rocks and by the presence of a young dipper a short distance up stream.

*Nest 48-8.* This nest was by Cement Creek in the "Second Gorge," which was about three miles up stream from the "First Gorge." The nest was placed in a small niche beneath a ledge of rock that projected out over the edge of the creek. The water was shallow at the edge, and the nest, which was only five feet above the water, was easily approached. On July 16, there were two eggs in the nest, and on the 19th there were five, indicating that the last had been laid that morning. The eggs, however, never were incubated and were still present on August 2, when both nest and eggs were collected. My removal of the eggs for photographing on July 19 may have contributed to the desertion, but more likely the lateness of the season found the female so depleted in breeding impulse that she could not continue with the duty of incubation. The presence of a nesting pair (48-9) 400 yards down stream may have been a hindering factor also.

*Nest 48-9.* Unlike the other nests, this one was situated by a stream small enough in places to step across, a tributary of Cement Creek which flowed down a steep mountain side over numerous ledges. The nest was completely hidden beneath a wet bank of moss, roots and soil, about 100 feet from the mouth of the stream. On July 16, 19, and 20, the parents were busily feeding the young, going under the bank a little down stream from the nest, and emerging a few moments later three feet farther up stream. On July 24, the young had left the nest, and one was being fed near by. On August 2, I dug away the outer bank with a shovel and found the nest nicely placed in a second bank within. The water was only two inches below the bottom of the nest at that time and must have been higher early in the season.

#### NESTING BEHAVIOR

*Territory.*—The area occupied by a pair of dippers in the Gothic region during the nesting season consists of a stretch of stream and its banks a half-mile or so in length and sometimes near-by tributary streams and beaver dams. Occasionally dippers fly overland, but nearly always in flying they follow the stream closely and rise only a few feet above the water. Feeding and the securing of food for the young may occur anywhere from the immediate vicinity of the nest to 300 or 400 yards up and down stream. That disputes over territory may occur was indicated by the desertion of three different nests (48-2, 48-5, and 48-8), at least two of which probably were abandoned on account of adjacent nesting pairs of dippers. Young birds may leave the home territory with a parent within a few days after leaving the nest, or they may remain until they become independent. Parents appear to go up and down stream regardless of territory after they no longer are obliged to care for young.

*The nesting site.*—Two characteristics common to all of the dipper nests observed were their location over, or nearly over, the edge of a stream, and their high degree of inaccessibility. The water beneath in most instances was swift and deep, thus forming a barrier to approach; and the usual location of the nest in a niche in a wall completed the protection. Since the wall closely bordered one side of the stream, the observer nearly always found himself on the opposite side of the stream from the nest. A person does not usually have much trouble in finding a nest after once locating the pair of birds,

for the parents will reveal the location by going to it if the nest is not in plain sight. Some of the nests were located where the spray kept them moist, but this was not universally true and apparently had nothing to do with the success of the nest.

A summary of the nest sites is as follows: 7 in niches in vertical walls, over, or nearly over, the edge of rapidly flowing water, the height above the water being 3 to 15 feet; 1 behind a large waterfall; 1 beneath the base of a large spruce tree which stood at the edge of a cascade; 1 in the bottom of an uprooted tree over the edge of swift water; 1 beneath the bank of a small rapidly flowing stream, about two inches above the water.

*Nest structure.*—A dipper's nest consists of two parts, an outer spherical or dome-like shell and an inner bowl-shaped lining. The outer portion varies considerably in size, ranging from eight to twelve inches in diameter. It is composed chiefly of moss and a few stalks of grass, which may include the roots. The entrance hole is in the exposed side and measures about three inches in width by two inches in height. The inner chamber is globular and about five and one-half inches in diameter. Any projecting portions of the wall are not covered with the outer shell, but are bare within the nest. Also the outer covering is absent from the bottom of the nest. The inner bowl of the nest is about three inches in width and two inches in depth, inside measurements. It is composed of coarse grass which resists moisture, as opposed to the moss of the outside which absorbs it. Nests which are reached by the spray from the water thus remain moist and green without but are relatively dry inside. In nests which are located above the spray, the moss of the outside may be dry and brown.

*Egg-laying and eggs.*—At the only nest under observation before egg-laying (48-3), a period of six days elapsed from the last time the birds were seen around the nest until the first egg was laid. This, however, may be longer than the usual rest interval. Incomplete data at two nests indicated that the eggs were laid on successive days. One egg was laid between 7:11 a.m. and 10:38 a.m. (nest 48-3), although a bird had entered the nest at 6:31 a.m. and remained 12 minutes without laying. Four eggs constituted a clutch in one nest and five in another. The number of young in other nests were three, four, and four, but these numbers may not represent the full number of eggs laid. Nine eggs of two clutches averaged 26.2 millimeters by 19.1 millimeters. The eggs are white.

*Incubation and hatching.*—Incubation began at nest 48-3 between 4:03 p.m. of June 21, the day the fourth and last egg was laid, and the following day at 11:19 a.m. It is probable that it began in the evening. Two young birds were found hatched on the evening of July 7, and one hatched later. Thus the incubation period would be a scant 16 days for two of the birds and somewhat longer for the third, if incubating began on the evening of June 21. If it began on the morning of June 22, which seems less likely, the period would be 15 or 16 days. The incubation period may be taken then as 16 days  $\pm$  1 day. The approximate dates for the beginning of incubation in five nests with the dates of hatching and leaving the nest are given below. Those marked with an asterisk are only calculated.

Nest	Beginning of incubation	Hatching	Leaving the nest
48-1	June 2*	June 18	July 12-13
47-1	June 4*	June 20*	July 14-15
48-4	June 8*	June 24*	July 18-19
48-6	June 8*	June 24*	July 18-19
48-3	June 21	July 7	August 1

Incubating, as far as could be observed, was done entirely by the female. The male carries food to the female and was seen feeding her as many as seven times during one

period in the nest. The periods of incubating are long compared with those of many species, correlated with the fact that the female does not have to spend so much time searching for food. Periods of about one hour and 20 minutes at the nest, and 12 to 21 minutes away from the nest were observed.

*Development and care of young birds in the nest.*—Newly hatched dippers, like the young of practically all other passerine birds, are covered with a coat of down. Growth of the young birds is comparatively slow, perhaps an evolutionary result of their comparative safety in the nest and the large amount of work required by parents in securing food. This slow growth, coupled with the advanced stage of maturity at which the young leave the nest, makes the period in the nest one of the longest of any passerine bird of its size, namely 24 to 25 days. The male parent carries food to the young and may feed them while the female rises to let them poke their heads out. The proportions of feeding done by the male and female vary with the individual pairs. One male did only a small share of the feeding and for many days refused to feed at all when I was near the nest. Other males fed as much as the females, and one took care of the brood alone after the disappearance of the female three days before the first young bird left the nest. In spite of the work involved, feeding goes on at a fairly rapid rate, although the helpings are often small. Timing of the different pairs showed feeding every four or five minutes when the young birds were small, with an increase to every two or three minutes when they were larger. This rapid rate, however, is punctuated with intervals of rest which may last 15 or 20 minutes.

The delivery of food to the mouths of the young takes place quickly, and during the latter part of the period in the nest may require only a fraction of a second. At two nests where there were suitable approaches, the parents would alight a few feet below the nest and then complete the trip by hopping and running; but at another where there was no approach they alighted within reach of the nest. At one nest which had no adjacent room for perching, the parents clung to the lower edge of the nest while feeding. By the end of five or six days, the young birds are able to reach out for food at the opening of the nest. Only two or three can find room at the opening at one time, and the extra one, or ones, must remain in the back of the nest and await their turns. In delivering food, the parents make little attempt to distribute the food among the different young birds, but repeatedly feed the nearest one. This unequal feeding is augmented by the fact that any standing room for the parent is apt to be at one side of the nest opening rather than directly in front. A slow rotation of birds, however, as a result of change of places at defecation time, permits all of the young to get a share of the food. The young birds call loudly at feeding time, especially during the latter part of the period in the nest. The first calling was heard when the young were about four days old, but this was at a distance of 25 feet and amid the roar of water. When this calling was first heard, I thought it was done by the parent, but in light of the later calling, I concluded that it was done by the young.

Brooding by the female is kept up regularly for about one week after hatching, and it was observed up to the sixteenth day in the nest. At the later dates she entered the nest with much difficulty and remained but a short time. Periods of brooding observed were from 5 to 61 minutes, but usually did not last more than 25 minutes. Two brooding periods on the sixteenth day lasted only 6 minutes each. Periods away from the nest during the first few days were from 8 to 22 minutes in length. The male never was known to enter the nest.

Sanitation at the nest is executed with a fair degree of efficiency. Parents carry away the fecal capsules at first as they are extruded; but later the young birds, from the time they are a week old, turn around and extrude the capsules over the edge of the nest.

These may lodge on the outside of the nest, or on projecting rocks below, or may fall into the water. Capsules found on the side of the nest or on rocks are carried away by parents on following trips and deposited in the edge of the stream. Carrying away the extruded capsules, however, does not ordinarily prevent a soiled appearance of the rock wall below the nest, or even of the nest itself. One puzzling feature in connection with sanitation was the dribbling of fecal capsules onto rocks below before the young were old enough to back out over the edge of the nest. The solution was found when a brooding female was seen taking a capsule from a young bird beneath her and dropping it over the edge of the nest.

As time to leave the nest approaches, the young birds become very alert, watching eagerly for food and taking in all the landscape with their dark beady eyes. One young bird was seen turning its head around through about  $135^\circ$  to see something above. One brood showed extreme fear as I approached the nest when they were about 20 days old. They flattened out in the bottom of the nest and occupied only a small portion of the cavity that they seemed to fill so completely a few minutes before.

*Young birds out of the nest.*—When the young dippers leave the nest they appear to be nearly as large as their parents. They are a little lighter in color, especially on the throat and the outer borders of the wing feathers, and are faintly streaked and mottled below. The tail does not have its full growth.

The young birds may creep out of the nest and cling to the rocky wall, then reenter the nest before leaving permanently. At final leaving they flutter down from the nest, or from a perch near by, to a suitable landing place. In the three instances observed, all the young of a brood alighted on the same side of the stream, the side which seemed from the observer's point of view to be the better one. In two instances this was on the same side of the stream as the nest, and in the other, on the opposite side. At two of the nests, 24 hours or more elapsed between the time the first and last young left.

It seems to be the habit of the parents, or a parent, to remove the lining of the nest soon after the young leave. At one nest the last young bird had not yet fluttered down from the wall near the nest when one of the parents went to the nest and began pulling out the grass lining, making six or eight trips. At another nest, grass from the lining was found on a rock below the nest on the day after the young had left, and two nests which were collected some time after the young left had no lining left in them. One nest which was deserted as soon as the eggs were laid was left with the lining intact. The significance of tearing out the lining is not clear. Three possible reasons might be: (1) the prevention of further use of the nest by the young; (2) a preparation of the shell for use during another year; or (3) a carryover from a time when parts of the lining were removed on account of being soiled by excreta.

As soon as the young birds land outside the nest, they begin to move about, taking a few quick steps at a time and dipping at the rate of about once each second. They do not hop at first as do most passerine birds that run or walk at a later stage. Within a few minutes they enter the edge of the water if it is shallow and bathe by fluttering their wings; or they may swim if the water is too deep for wading; or they may poke their heads under as if searching for food. Such trips into the water do not usually last long, however, and the young spend most of their time ashore on rocks or logs or in slowly exploring the rough banks. During the first day out of the nest the young are apt to remain within a dozen yards of the nest if left undisturbed. They are not averse to creeping into crevices, if such are at hand, or to climbing along a steep bank near rapidly flowing water. A person may expect at such times to see them slip into the torrent, but this does not occur, at least ordinarily. The young birds, as well as the adults, are able to cling to very slippery surfaces, and if they slip, they resort to the use of their wings

and perhaps to swimming to regain their footing. For an hour or so after the young emerge from the nest they are rather active, but they finally tire and spend much of the time standing still or picking at themselves. They are difficult to see when quiet, for their color harmonizes with that of the rocks, especially with the shale of the Gothic region. Parents feed the young at intervals, and at feeding time the young call loudly and flutter their wings vigorously. Young birds usually are able to distinguish their parents from their brothers and sisters, as indicated by their calling for food only when seeing their parents. The young birds begin to peck at objects before they leave the nest, and this is continued with gradual increase when they are out. At first the pecking seems to net them little, but within a few days it is furnishing them with no small part of their subsistence.



Fig. 15. Juvenal dipper on board at edge of East River on the day it left nest 48-1, July 12, 1948.

Young birds ordinarily may be found within the nesting territory during the first two or three days; then some may move to a greater distance. Three color-banded young which left nest 48-3 on August 1 were found on August 2 at separate places within 150 yards of the nest; on August 3 they were within 200 yards of the nest; and on August 4, within 350 yards. On August 5, one was found one-fourth of a mile away; another was being fed by a parent one-half mile from the nest; and the third was not found. I did not follow them longer because of my departure from the area.

At nest 48-4 where the female was missing, only three out of four young were seen after they left the nest. A week later two of these were found 500 yards down stream where they were busily feeding, and no parent was seen in an hour and 25 minutes of watching. Four days later a young bird believed to belong to this brood, and probably one of these two, was found a mile away in territory 48-3, begging for food from the adult birds as they gathered food for their nestlings. It was fed at least three times, but on the following day when it begged for food, one of the adults apparently made an unfriendly gesture, for the young bird, quite frightened, flew up on the bank and alighted within six feet of me. It was not seen begging again, but it remained in the area and gathered its own food. It is very doubtful whether this young bird or its fellow received any food from its parent after it was a week out of the nest.

In territory 47-1, young birds were watched in 1947 from the end of the first week out of the nest until the end of the second. One parent was caring for a young bird



above the falls; and the other, for another below the falls. Parents did not ordinarily invade each other's portion of territory, and once when two adults were seen near each other, one expressed dissatisfaction by fluttering and scolding. Young birds were fed several times in succession and then were left alone for a half hour or more. The last feeding seen was when the young were about 11 days out of the nest. On the following day a young bird appeared to be calling for food but none was forthcoming.

In the same territory in 1948, only three out of four young birds were accounted for at one time after they left the nest. Four days after leaving, one parent was caring for one young bird and the other for two. When the young had been out of the nest 17 days, a parent and young bird were seen feeding near each other quite independently, and neither paid any attention to the other in the one hour and 50 minutes that I watched. Three days later two adults were seen some distance above the falls. One was believed to be from another area, but the other made no attempt to defend the territory; it only showed disapproval when the first bird came within two feet of it.

*Enemies and survival.*—No nests or their contents were disturbed by enemies during the study. One female dipper disappeared while the young were in the nest, but I found no indication of what happened to her. The most dangerous time for the species is just after the young leave the nest, when they are an easy prey for predators, or when they may be dashed to their death by the swift currents. Observations indicate that ordinarily not more than two young from each brood reach the independent stage.

#### DISCUSSION

Along with many undisputed details concerning the natural history of the American Dipper, there have been many conflicting and doubtful statements by various authors. Some of these will be discussed in connection with a series of topics to which they are related.

*Placing the nest where it is kept wet by spray.*—The first dipper nest that I have found recorded was discovered by Cooper (Cooper and Suckley, 1859:175) among the roots of an upturned arbor vitae floating in a millpond in the state of Washington; no mention was made of spray. Another recorded by Platt (Coues, 1874:11) was constantly wet by spray. Muir (1894:290) says that "usually" the nest is within reach of the spray and kept green "at least during the time of high water." Muir further states that the nest is far from being easily detected, and that "this is more especially the case where the nest is kept fresh by being well sprinkled." He thus implies that some nests are not kept fresh by sprinkling. Ridgway (1904:675) says that the nest "usually" is in contact with spray, and Sclater (1912:476) says that it "nearly always" is. Skinner (1922:21) speaks of a nest that "had a unique location in that there were no falls or rapids near, and consequently no spray to keep the moss green." Grinnell and Storer (1924:546) make the unqualified statement that "The American Dipper nests amid the surroundings which harbor it throughout the year, placing the structure on a rock close to or over rushing water where the surface of the nest will be kept wet by spray." In my own observations, seven out of eleven nests were located where they were dry and received little or no spray. One nest beneath a bank must have been quite moist all summer, as was one behind a large waterfall.

*Spraying the nest.*—Reports of a dipper spraying the nest appear to be based on observations made by J. Stevenson (Coues, 1874:13) near Berthoud Pass, Colorado. He says of the dipper, "One of the first things that attracted my attention was its manner of diving down into the water and then darting back and perching itself on the summit of its mound-like dwelling, where it would shake the water from its feathers and distribute it over the nest, apparently for the purpose of keeping the moss moist and in a growing condition, thereby increasing its strength and dimensions . . . . The operation

of sprinkling the nest was repeated daily." Assuming that Stevenson correctly recorded what he saw, I should like to inquire into the significance of this behavior. Muir (1894:287) tells of seeing an ouzel leave its singing perch on a snag, dive into the water for food, then return to the same snag where it showered the water-beads from its feathers and continued its singing. Perhaps Stevenson's bird was performing similarly, merely using its nest for a perch. Be that as it may, I know of no other case of a dipper even standing on its nest.

*Method of locomotion on land.*—Ehinger (1930:489) observed a dipper "running" up a steep bank, and Bent (1948:101) says the young "seem to know instinctively, as soon as they leave the nest, how to run, climb, dive and swim." Grinnell and Storer (1924:545) state, however, that "When hunting along the shore the bird moves by short hops." My own observations are that the birds ordinarily run, but may resort to hopping where the way is too rough or steep for running.

*Walking under water.*—Cordier (1927:173) says, "I could see the Ouzel wade on the bottom of the pool, where the water was two feet deep." Knowlton (1928:162) says, "the wings must be kept in action. The moment they cease, up comes the bird like a cork." Knowlton further infers that it cannot walk on the bottom because it is not a "walking" bird. Tucker (Witherby, *et al.*, 1938:222) says of the European Dipper (*Cinclus cinclus*) that the force required to keep the bird down is only slight, and there is no serious mechanical problem involved. Most observers, including myself, agree essentially with Grinnell and Storer (1924:545) when they say, "the dipper dives directly into the stream, usually against the current, and then seemingly walks along on the bottom, the wings assisting."

*The part of the eye which does the winking.*—Olive Thorne Miller (1894:82) believed it was the "snowy white eyelids" which did the winking. Grinnell and Storer (1924:544), on the other hand, state that "The nictitating membrane or 'third eyelid' is whitish in the Dipper, and, when drawn backward across the eye, as it frequently is when the bird is above the water, can be seen at a considerable distance." This statement is incorrect, however, in saying that the lid so easily seen moves *backward* across the eye, since it moves down from above.

Townsend's article (1925) on the "Winking of the Water Ouzel" states clearly how the winking takes place. The upper lid, which is covered with short white feathers, merely moves downward exposing the whitish portion. This should have settled the matter, but Cordier (1927) replied with an astounding article describing how he had watched a nesting bird and its winking nictitating membrane from as near as eighteen inches and had taken moving pictures of the process. A careful reading of Cordier's description, however, reveals some discrepancies. He states (p. 177) that "the external layer of the upper lid is like any other part of the bird's naked skin surface." This is incorrect, for it is covered with white feathers. The nictitating membrane, he says, is "glistening, pearly-white," and these terms fit precisely the feathers of the upper eyelid. The time required for winking, as shown by the camera, was about one-third of a second, but, he says that "some of the winks are so quick that they may be compared to the rapid action of a focal-plane shutter of a graflex camera." I am convinced, after careful reading, that Cordier in the first case was looking at the winking upper lid, but that in the second, he was watching the actual nictitating membrane. This interpretation is in accordance with observations made by Ehinger (1930:490), who said, "being at very close range [he] noted particularly the winking of the white-edged eyelids and the flash of the third eyelid or nictitating membrane." Eggebrecht (1937:665) was unable to harmonize the accounts of Cordier and Townsend, but did not quite agree with me as to where the error was.

*The incubation period.*—Steiger (1940:13) states that the incubation period is 13 days, but does not tell how he arrived at that figure. Eggebrecht (1937:652) gives the incubation period of *Cinclus cinclus aquaticus* as 15 days, but since he did not observe the exact time of the beginning, it may have been 16 days. Jourdain (Witherby, *et al.*, 1938:220, 223) gives the incubation period of *C. c. cinclus* as 15 to 16 days and that of *C. c. gularis* as 15 to 17 days, usually 16 days. These figures for the European races of *Cinclus cinclus* closely correspond with my own for the American form, which was 16 days  $\pm$  1 day.

*The length of time the young remain in the nest.*—Steiger (1940:13) gives 18 days for the American Dipper; Eggebrecht (1937:675) says that *C. c. aquaticus* left on the twenty-fourth day; and Jourdain (Witherby, *et al.*, *loc. cit.*) gives 18 to 19 days for *C. c. cinclus*, and 19 to 24 or 25 days for *C. c. gularis*. My observed time for one nest was 24 and 25 days, and approximately the same for two other nests at which the time was less exactly determined. Since young birds will leave the nest before the normal time if frightened, it seems likely that any of the dippers mentioned may leave as early as 18 days under stress, but that they will remain for 24 or 25 days if unmolested.

*The number of broods per season.*—Cooper (Cooper and Suckley, 1859:175) and Cordier (1927:170) each state that a brood was reared earlier in the season before the one at that time under observation, but evidently both of these men were accepting the word of some other person. Bent (1948:101) thinks that probably two broods are raised under favorable circumstances. Gale (Henderson, 1908:3) did not think that more than one brood is reared in Colorado, and certainly that is true around Gothic at an elevation of 9,000 to 10,000 feet. The long period through which eggs have been found over the country as a whole—from the last of March until the middle of July (Bent, 1948, and my own data)—lends some support to the two brood theory, but no reliable record of two broods is available. Jourdain (*loc. cit.*) says that *C. c. gularis* is double-brooded as a rule, possibly three occasionally and that *C. c. hibernicus* of Ireland rears two broods; but Eggebrecht (1937), whose study of *C. c. aquaticus* lasted to the end of June, makes no mention of a second brood.

*Eggs in nests which have no lining.*—Bent (1948:100) quotes from A. A. Saunders, apparently in a personal letter, regarding dipper nests in Montana: "Some dipper nests, built on rocks, are without a bottom or lining, the eggs being deposited on the rocks, the nest being merely a roof, side walls and the usual front entrance, made of woven moss." In answer to this I will say that such nests appear to be the rule after the young have left. I have two collected ones of this kind in my possession. I also saw, however, a parent tearing the lining from a nest immediately after the last young bird had left, and at another nest portions of the grass lining were found on the rocks below on the day following the exit of the young. This evidence indicates that dippers regularly remove the lining of nests as soon as the young leave. Perhaps Saunders found some of these used nests and inferred that they never had possessed a lining.

*The natal down.*—Steiger (1940:13) says that "from the first, the young Ouzel has a complete coat of down." Bent (1948:102) apparently thought this was a plumage other than the usual natal down, for he said, on the evidence of Steiger's statement, "This down becomes a necessary protection by the time that the young bird takes its first plunge, at an early age, into the cold water." I have observed this down, and, though fairly heavy, it is the usual passerine natal down. When the young birds are about two weeks old, the down may be seen standing up like a pompadour on the heads of the young birds as they peer from the nest. It has disappeared, however, by the time the young leave the nest, leaving the bird in possession of the usual juvenal plumage.

*Other contentions.*—Steiger's popular article about the dipper (1940) contains a

number of doubtful and misleading statements in addition to the erroneous ones mentioned above regarding the periods of incubation and the remaining of the young in the nest. He says (p. 13) that "amidst raucous calling, the experimenting young follow the creek. Flying at short distances, the parents entice their charges from rock to rock, seeming to encourage them to greater and braver acts. The fledglings' first flights are comically clumsy. When attempting to perch, they frequently tumble into the creek . . . . On the first days out of the nest, the parents hide their young after they have been fed." My observations show that the young remain quiet near the nest for at least the first day, and when they do travel, they run or flutter along awkwardly but carefully, picking and choosing their own way, and occasionally creeping into crevices. Under usual conditions they are *not led* by the parents, though parents might try to lead them out of danger or induce them by warning calls to hide if they were crowded too much by threatened danger. I never have seen a young bird *tumble* into the water, but I can see how they might do so if caused to become too much excited.

Steiger (*loc. cit.*) states that "even after the brood is mature, the parents will fly to them with a choice larva that the fully grown beggars greedily accept." Eggebrecht (1937:675) also says of *C. c. aquaticus* that the young stayed with the parents and were fed by them for over a month after leaving the nest. I should like to have definite proof by means of banded birds before accepting these statements, which seem to imply, at least in the American species, that young birds beg and receive food from their parents after once becoming independent.

Steiger (p. 14) says, "On a single stream you may find several birds living separately as hermits . . . . In each of the cases I have noted, the solitary birds have been males whose mates, evidently, have died or perished during the hazardous nesting season. This circumstance suggests a monogamous mating pattern as a characteristic of the species. Young birds pair late in the summer, but do not become markedly attentive to one another until the coming of spring." Even if the mortality is higher in the female, and the birds ordinarily pair for life, both of which remain to be proved, this would not preclude the possibility of males left without mates from mating with young females of the first year. If, on the other hand, dippers change mates often, as many species do, there could scarcely be any regular pairing off of the young birds late in summer, but rather a mixed pairing of all ages at the mating season.

Steiger states (p. 14) that "the water snake, mink, marten, the skunk, weasel and other stream-frequenting animals continuously prey upon the mother and young." I see no objection to rating the above named animals as *potential predators*, but it would take long and careful observation to establish the facts regarding predation even in one locality. He states that "During the nesting period and while the young remain dependent, they give no body odor," and hence cannot be scented by predators. He does not tell, however, how he arrived at this conclusion, or whether the dippers are different from other birds in this respect.

#### SUMMARY

The American Dipper was studied in the Gothic region of Colorado at an altitude of 9,000 to 10,000 feet, in the summers of 1947 and 1948.

Eleven nests were observed, eight of which contained eggs or young.

Egg laying at five successful nests extended from about May 30 to June 21, and incubation, according to one record, lasted 16 days  $\pm$  1 day.

The young remained in one nest 24 and 25 days and in two other nests approximately the same time.

When leaving the nest the young flutter down and exercise considerable choice as to where they land.

The parents, or a parent, seem to have the habit of removing the lining of the nest soon after the young leave.

The young birds are fed in the vicinity of the nest by both parents at first, but within a few days may wander away, sometimes outside the home territory. Each parent then cares for a portion of the brood. Probably not more than two young out of a brood, as a rule, reach the independent stage.

Young birds begin picking up food from the time they leave the nest. They normally become independent of their parents in about two weeks, but apparently they can obtain all their own food by the end of one week after leaving the nest.

No nests or contents were disturbed by predators during the study; one female disappeared while the young were in the nest, and the brood was fed by the male alone.

The literature on dippers has been reviewed and the following conclusions reached regarding controversial and doubtful statements found therein:

1. Dipper nests are not always built where they receive spray.
2. Reports of a dipper spraying its nest to keep it moist are based on one record, which is open to doubt as to interpretation.
3. Dippers ordinarily travel on land by running, but may *hop* where the way is rough or steep.
4. When under swift water dippers apparently walk on the bottom, against the current, and receive some aid from their wings.
5. The slow winking accompanied by a flash of white is done by the white-feathered upper eyelid. A more rapid flash of the nictitating membrane apparently may be seen at very close range.
6. The incubation period of the American Dipper, as observed in the study, corresponds with records of the European species (*C. cinclus*) of 15 to 17 days; the young of the American and European species probably always remain in the nest about 24 or 25 days if undisturbed, but they may leave as early as 18 days if frightened.
7. There is no reliable record of the American Dipper raising more than one brood in a season. The European species has been reported to raise two or even three broods.
8. The statement that the dipper lays eggs in nests with no lining is contrary to observations made in this study.
9. The coat of down on newly hatched dippers is the normal passerine natal down.
10. Statements that the parents lead and hide the young which have left the nest, that the young frequently fall into the creek, that parents feed the young after they are fully grown, that solitary birds along the stream outside of the breeding season are males which have lost their mates, that young birds pair late in summer, and that young dippers give off no odor, all need qualification or are unproven.

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