TERRITORIALITY, MOVEMENTS, AND POPULATION DENSITY OF THE DIPPER IN MONTANA

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The main objective of this report is to record quantitative data on territoriality, movements, and population density of the Dipper (*Cinclus mexicanus*) in western Montana. Life history observations have already been published (Bakus, 1959).

I wish to thank Dr. Robert S. Hoffmann for valuable assistance during this study and for generous advice in the preparation of this paper. I am grateful to Dr. Ludvig G. Browman for information on the topography of the Rattlesnake drainage. The efforts of Harold Knapp in assisting me with field work and in giving added advice are appreciated. My sincere appreciation goes to my wife, Grace, who has given freely of her time in the preparation of this material.

DESCRIPTION OF THE STUDY AREA

The study area was located on Rattlesnake Creek, Missoula County, Montana, and extended from its outlet into the Clark Fork River to the upper end of the canyon road, a distance of 13 miles by road. The width of Rattlesnake Creek varies from 10 to about 50 feet. The first half-mile upstream from the Clark Fork River, in an urban area, is intermittently frozen over during the cold winter months and Dippers are not often found there. Above this area, the stream passes successively through a riparian deciduous forest community dominated by cottonwoods (*Populus trichocarpa*), a transitional zone with yellow pine (*Pinus ponderosa*), and a coniferous forest of Douglas fir (*Pseudotsuga menziesii*). Work in the area extended from January, 1956, to August, 1957.

The tributaries that lead into Rattlesnake Creek are usually quite small, brushy, and devoid of Dippers. Even the East Fork of Rattlesnake Creek, which empties into the larger West Fork at an elevation of about 4000 feet (fig. 1) and is 10 to 15 feet wide with a year-round water flow, does not harbor any Dippers so far as is known.

Above the end of the study area the West Fork courses through a steep region of cascading rapids and then flows beneath wind-felled trees. Farther up is a series of brushy areas alternating with several rocky chasms, in which five nests were found. One main tributary supplied by the Rattlesnake Lakes empties into the West Fork in this area. Above this point the streambanks are clothed in dense brush. Wrangle Creek, another main tributary of the West Fork, drains Little and Glacier lakes and must serve as a passageway by a few birds in traveling to these lakes (fig. 1).

Rattlesnake Creek is used by Missoula as a source of some of its water. The Rattlesnake Lakes constitute the primary headwaters of the stream and the levels of many of them are artificially controlled. As the water level of the stream drops during the summer, water is released periodically from some of the lakes.

METHODS AND MATERIALS

Mapping.—A winter study area, representing the lowest 1.7 miles of Rattlesnake Creek, was measured in yards in order to determine accurately individual winter territories. Landmarks at intervals of 50 to 275 yards, such as houses, bridges, trees, and stream bifurcations were used in mapping. For the remainder of the study area the length of road, which follows within 0.25 miles of the stream, was utilized to obtain a total road-stream length by an automobile odometer (fig. 1). Over a period of time certain stream landmarks were recorded and paired with adjacent road landmarks. A map was then drawn to scale representing the 13 miles of stream.

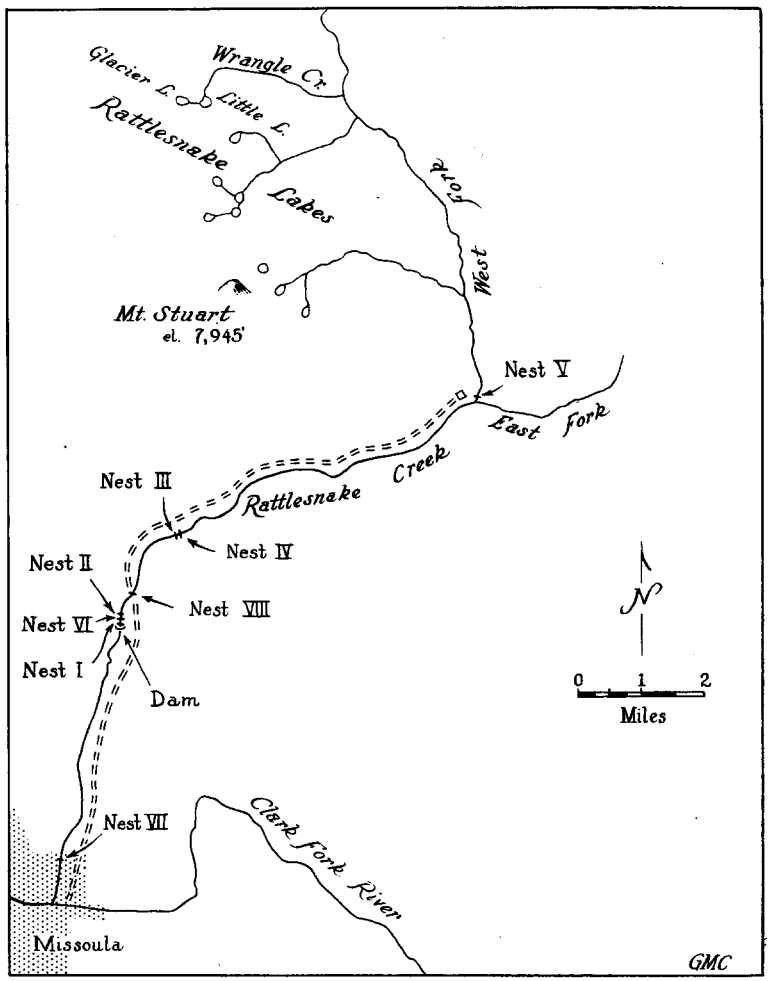

Fig. 1. Map of the Rattlesnake Creek drainage.

Trapping and banding.—Trapping was done with a number 5 Japanese mist net which was 38 feet long and 7 feet high when fully extended and had mesh openings of one square inch. The net, mounted between two poles, was placed across the stream in the vicinity of a Dipper. The observer then attempted to chase the bird into the net. The success of the procedure and the time it required varied with the topography and weather. During the winter, when the net threads froze together as they came in contact with the water, more than an hour was sometimes needed to effect a capture. Correct tension on the net was also important (see Low, 1957). After practice, however, the technique proved to be at least 75 per cent effective.

One difficulty encountered was the relationship of the territory of the bird to be trapped to the position of the net. Several times a Dipper was observed, the net was set in position, and an attempt was then made to chase the bird into the net. The bird would move only so far and then suddenly reverse its direction and fly away from the net. I believe, in these instances, that the net was actually outside of the individual's territory.

During the first few months of trapping five birds were marked only with combina-

tions of Fish and Wildlife Service aluminum bands, size 1-A. A red plastic neck band (Craighead and Stockstad, 1956) was placed around the neck of bird no. 2 on February 11, 1956. The Dipper was not seen after this and may have succumbed because of the band's ruffling of neck feathers which allowed water penetration. In early April, 1956, split celluloid rings of three separate colors, yellow, orange, and red were used in various color combinations along with the Fish and Wildlife Service bands. The particular colors chosen were satisfactory, but occasionally there was some difficulty in distinguishing red and orange if they were placed together on one leg. Nestlings were also banded using the same markers.

Observations and census techniques.—Observations were made with the aid of 7×50 binoculars. The colors of the celluloid markers could be identified with certainty only if the birds were within about 30 yards of the observer. On several occasions it took as long as 15 minutes to determine the color combinations because of the evasive behavior shown by the bird. During most of the year the stream could be followed by walking along the bank. However, many times during the summer I walked directly in the stream and during July and the first part of August I was able to float down parts of the stream on a rubber raft.

Dippers could usually be flushed as I walked along the shoreline. However, sometimes birds would stand motionless until I had passed and then fly, giving alarm calls. My censuses were thus made using a combination of sight and sound records. The greatest errors occurred during the high water season in April, May, and June because the noise of the turbulent water prevented the calls of a flushed bird from being heard. In the spring of 1956, much of the upper five miles of the study area was flooded by the stream rising above its banks and creating numerous channels. These inundated areas made it difficult to approach the main stream. Thus, portions of the main stream could not be reached and the birds were not counted in these areas at that time.

Additional censusing errors occurred during the winter on frozen portions of the stream. Batchelder (1885:236) noted Dippers swimming downstream under ice and

Table 1

Dippers (*Cinclus mexicanus*) Observed in the Winter of 1956–57

Date	No. birds known in winter study area	Number designations of birds in order found	Per cent observed
Dec. 20	7	21, 3, 18, 20, 17	71.5
Dec. 29	7	1, 3, 19, 20, 17	71.5
Jan. 11	6	1, 21, 19, 18, 20, 17	100.0
Jan. 16[2]	6	1, 21, 18, 17	66.7
Jan. 21	5	1, 19, 18, 20, 17	100.0
Jan. 28	5	1, 19, 18, 20	80.0
			Average observation efficiency 82 per cent
Feb. 6[3]	3	1, 19	66.6
Feb. 9	3	19	33.3
Feb. 16[4]	3	19, 18	66.6
Feb. 23	4	17, 1, 19	75.0
March 2	4	19	25.0
March 6	4	1, 19, 18, 17	100.0
			Average observation efficiency 61 per cent

[1] Bird no. 3 last seen on this date.
[2] Bird no. 21 last seen on this date.
[3] Bird no. 20 was observed upstream at the Montana Power Company dam.
[4] Bird no. 17 was observed upstream at the Montana Power Company dam.

Murie (1946:260) stated that many times during winter they disappeared under ice overhanging the water. Frequently during winter I failed to observe some previously marked birds on a frozen stretch of stream, presumably because of their "under-ice" activities. On January 14, 1956, a Dipper when chased upstream about 200 yards flew under an ice ledge. An attempt to locate the bird was unsuccessful until it suddenly appeared five minutes later. On January 16, 1957, a Dipper flew into a small opening in an icy stretch and remained there until I walked over to the opening and flushed the bird out. In the winter of 1955–56, this type of census error was thought to be roughly 20 per cent. However, this was based on a relatively small number of birds and days of observation (fig. 3). The winter of 1956–57 was belated but very severe. During February many parts of the winter study area were frozen over. Under normal conditions an average of 82 per cent of the birds known to be on the winter study area were observed on any one day, but in February only 61 per cent were seen on any single observation day (table 1). The greatest accuracy in censusing was achieved from July to November when the observer walked or floated down the middle of the stream and more birds could be flushed and counted.

TERRITORIALITY

The Dipper is one of the few North American birds which exhibits a strong winter territorial defense. Individuals defend territories confined to the watercourse and its banks, and the limits of the territory constitute a strong psychological barrier which is seldom trespassed.

Territorial behavior.—Intraspecific territorial defense was seen many times on the winter study area. Observed behavior is nearly the same whether a bird was chased by the observer into another's territory or flew into its neighbor's territory of its own volition. If bird A, for example, comes near bird B in the latter's territory, both will take a territorial defense position. This consists of stretching the neck out with the head high in the air. If on the same rock, they then may walk around in a circular fashion, with wings raised, facing each other directly. An alarm call, a song, or a combination of the two may be given. Many times they cease their territorial display and begin foraging. This is perhaps displacement behavior. If the territorial strife is severe, they may quickly peck one another, with accompanying body and wing motions. This usually results in B chasing A well back into A's territory and then returning to its own territory.

If A, instead of gradually approaching, flies rapidly past B, B will usually pursue A and fighting may occur in flight. In most instances, a bird that invades another's territory is driven back. Sometimes A may fly completely over and beyond B's territory with B giving up the chase. If B sees the observer chasing A, both A and B may fly away together. On several occasions during the year I have pursued groups of as many as three birds in this manner.

The occurrence of interspecific defense behavior was occasionally observed. On January 28, 1958, a Dipper was seen approaching a Robin (*Turdus migratorius*) which was drinking from the stream. The Dipper assumed a territorial defense posture but no fight occurred. It may be that the Dipper mistook the Robin for another Dipper until it approached near enough to recognize that it was another species. On May 20, 1956, around nest III, a Spotted Sandpiper (*Actitis macularia*) was actively pursued by a Dipper, presumably the male of nest III (fig. 1). This was the only observed case which even suggested defense of the breeding territory or nest.

Behavior toward the observer.—Vogt (1944:38) discussing the Water Ouzel (*Cinclus cinclus*) designates four behavior patterns observable when the bird is approached by a human: perception, awareness, agitation, and flight, in that order. He states that

the perception distance of the bird and its reaction to the observer are unknown. The bird becomes aware of a person at about 45 yards and eyes the "intruder," sings, or resumes foraging. It becomes agitated at 35 yards and dips rapidly or may hop around and give an alarm call. At 30 yards the bird takes flight, usually giving an alarm call.

In the present study, there was a large variation in the observer-bird distance at which these behavior patterns were noted. Variation is due to season as well as to individual differences. At cold temperatures (usually below 10°F.), it is sometimes possible to approach within 10 feet of a bird before it shows signs of agitation. Usually, in warmer weather, birds were approached within 30 yards before they showed awareness, 20 yards before they displayed agitation, and 15 yards before they took flight. In some instances, however, it is impossible to approach within 50 yards of a bird without its taking flight. The awareness distance depends largely upon the position of the person in relation to the bird. Under favorable conditions, the Dipper is evidently aware of a person at a distance of at least 100 yards. This is substantiated by William Goodge (MS) who, in making an anatomical study of the Dipper, found that the bird had emmetropic or normal vision both in air and underwater.

Dippers frequently give an alarm call when approached, although during winter and spring, a mixture of song and alarm cry, or occasionally only the song, may be heard. Closer approach often elicits an alarm cry, followed by movement away and by hurried feeding, which may be a type of displacement behavior. If one walks rapidly or runs toward the Dipper, it flies off with an alarm call, and it may then be chased ahead for a short distance, for hundreds of yards, or it may even fly in the opposite direction from which it is being chased. It most commonly can be pursued for a distance of from 50 to 300 yards. It is very difficult to predict in what direction the bird will move. It seems to depend upon the position of the bird in relation to its territory and the position of its territorial neighbor at the time of the chase.

MOVEMENTS

Stream surveys.—During this study seven complete stream surveys were made in order to show exact distribution of the Dippers and to correlate data on movements of marked birds with movements of the total population. An explanation of these is presented in the section on population density (see p. 421). The data on movements of banded birds was corroborated by the stream censuses. The seven surveys are shown in linear form in figure 2.

Winter.—Winter territories of the Dipper were established in November, and territorial defense was strongest from November through February. A number of territorial fights was observed. Several of these were accompanied by loud singing, and singing was prevalent during this period. Territorial size varied considerably. A minimum of approximately 50 yards was observed on January 28, 1957, when four Dippers were occupying an open 233-yard stretch bounded by anchor ice at both ends. The maximum was nearly one-half mile, as in no. 17, which had a large open area with little, if any, territorial defense needed (fig. 4).

Many authors (Sclater, 1912; Skinner, 1922; Dawson, 1923; Ehinger, 1930; and others) have mentioned the territoriality of the Dipper. Vogt (1944:36) states that the winter territory of *Cinclus cinclus* in Switzerland varies between 200 and 500 meters in length, and that, in general, territorial limits are definite and rarely change. He adds that occasionally alien ouzels without a territory appear on the study area and are chased off by the resident birds.

In February of 1956, five birds were banded on the winter study area (numbers 1, 2, 3, 4, and 5). Bird no. 2 was also experimentally marked with a plastic neck band and

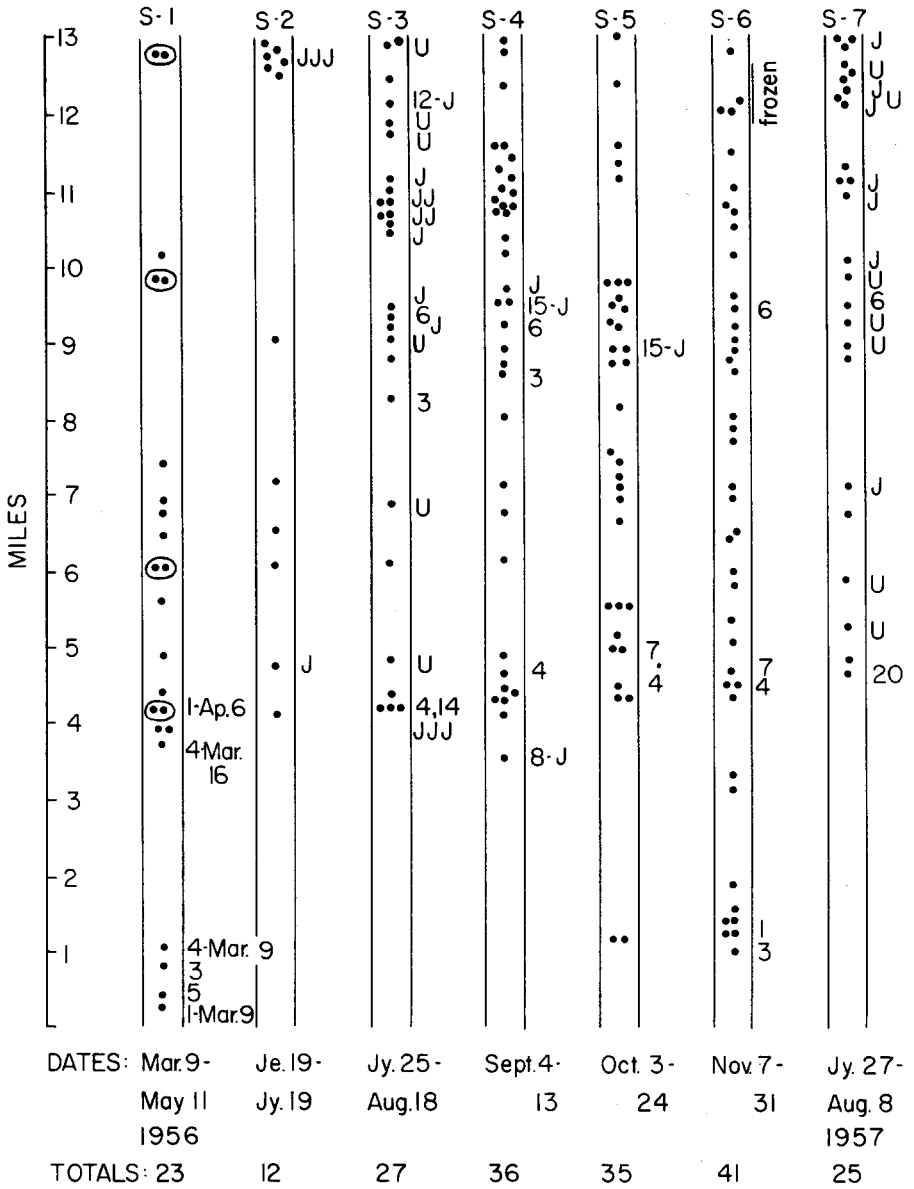

Fig. 2. Stream surveys taken during the study. Survey 7 was an additional check on the postbreeding population. Legend: S = survey; U = undetermined status; two circled dark spots = paired birds; J = juvenal bird.

was not observed again. The birds tended to remain in the following order, reading upstream: nos. 1, 5, 3, and 4. Number 3 was upstream from no. 4 when banded. On February 19, 1956, an unbanded bird was seen and remained upstream from no. 4 on all subsequent observations. On frequent occasions the birds were chased in order to determine how extensive their territories were by observing territorial fights. However, my pursuit many times resulted in two or sometimes three birds flying off in a group without

at first showing any territorial defense. Pursuit resulted in four position reversals of short duration; only once after banding did a shift in territorial position occur which was not the result of my chasing one bird into another's territory; no. 1 was found above no. 5 on February 25 (fig. 3). The reason for the shift is not known. There was some evidence of small daily movements in the total population. In two surveys, when the stream was checked twice in one day, it was found that the group of birds had moved downstream about 50 to 75 yards by afternoon but had maintained their original order.

On October 7, 1956, two unbanded birds were the first Dippers seen in the winter study area in the winter of 1956–57 (fig. 2). They had moved from the upper reaches of the stream. By November, 1956, nos. 1 and 3, and two additional unmarked birds had entered the winter study area (figs. 2 and 4). Six birds were banded in December (nos. 17, 18, 19, 20, 21, 22). However, no. 22 was marked 50 yards beyond the end of the area under observation. Both nos. 21 and 22 had difficulty in flying after being marked. This is attributed to wing injury received upon hitting the mist net. The order of the birds throughout the winter period was, beginning with the downstream position: nos. 1, 21, 3, 19, 18, 20, and 17. With the disappearance of no. 3 after December 29 and of no. 21 after January 16 the order of birds was: nos. 1, 19, 18, 20, 17 (fig. 4). After banding, the birds maintained their order of territorial possession even if upstream or downstream

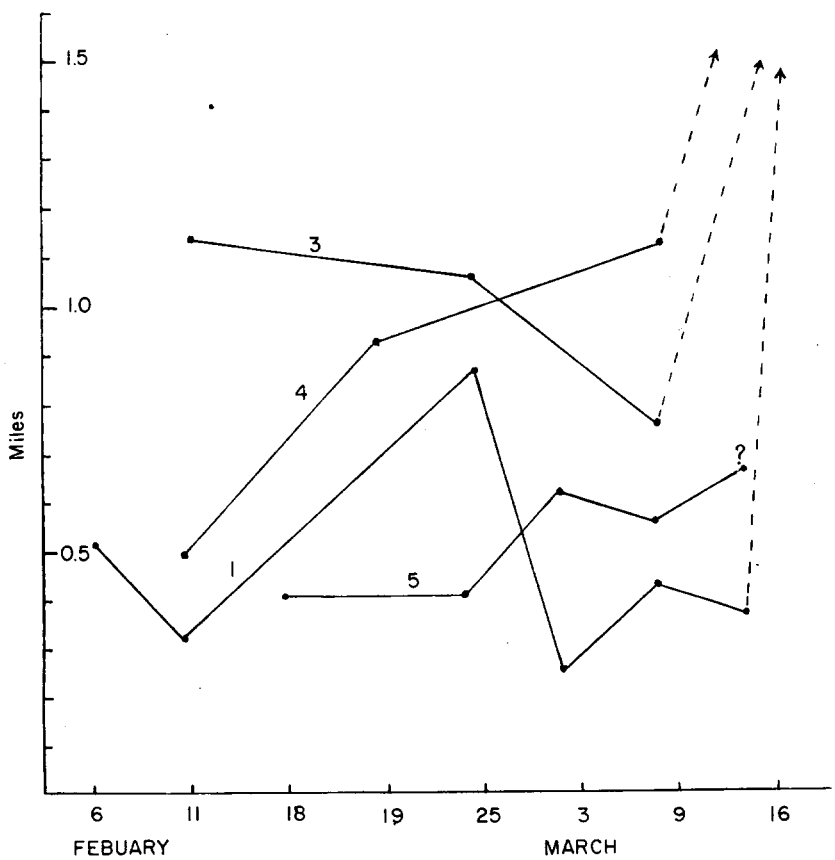

Fig. 3. Movements of banded Dippers in the winter study area in the winter of 1955–56. The arrows indicate that the birds were observed upstream at a later date.

movements of the whole population occurred. The only exception was no. 17, which was found below no. 1 on February 23, 1957 (fig. 4). This was attributed to a period of cold weather (see beyond). In contrast to the previous winter no pursuing of birds was done in order to compare the two different approaches in obtaining winter territorial data.

In both winters movements of Dippers were frequently restricted in the winter study area during periods of cold weather. At these times the lowest 500 yards of the creek were frozen over almost completely and birds in the remaining open areas were somewhat isolated by intermittent frozen stretches of stream. The water level was low at this time; the rate of flow during December ordinarily varies between 30 and 75 cubic feet per second (personal communication, Montana Power Company). Beginning on January 16, 1957, the lowest 950 yards of Rattlesnake Creek were frozen over. This resulted in a clustering of four birds (nos. 1, 19, 18, 20) within a 253-yard stretch of stream (fig. 4, January 21). Following this there was a short period of intense cold with minimum temperatures of −25°F. on the 25th, −33°F. on the 26th, and −31°F. on the 27th of January. The maxima of January 28 and 29 were still well below zero. As a result, not one bird was seen on the first five miles of the stream when it was checked on January 30 (fig. 5). The stream was frozen solid except for three small openings along this five-mile length. It is known that temperatures were higher at greater elevations due to an inversion phenomenon and it is probable that the birds were forced upstream to open water, as no birds were observed on the Clark Fork River (fig. 1). This hypothesis is

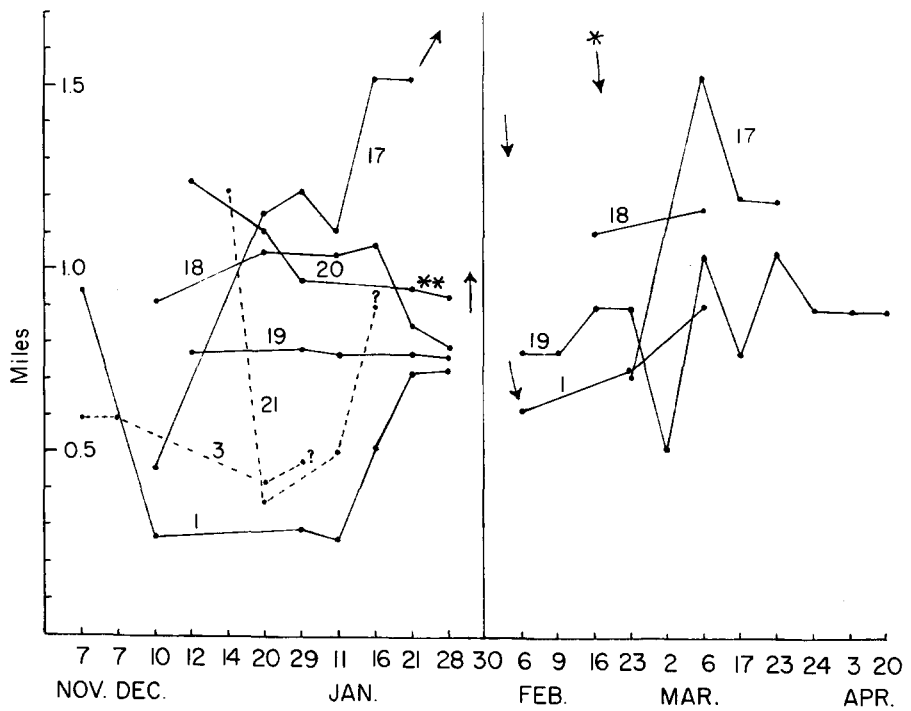

Fig. 4. Movements of banded Dippers in the winter study area in the winter of 1956–57. Intermittent lines represent birds that were observed for short periods of time. Arrows show probable movements during and after the freeze in late January. * Bird 17 (Feb. 16) observed 3 miles upstream from previous location. ** Bird 20 (Feb. 16) observed 3 miles upstream where it remained.

supported by the fact that nos. 17 and 20 were found three miles upstream, near the dam, during the thaw which followed the cold spell. A week later no. 17 had returned to the winter study area but no. 20 remained near the dam (fig. 5).

Spring.—Between March 10 and 16 in 1956 upstream movements began. Bird no. 4 had moved up 2.6 miles and was paired with another bird. Bird no. 1 had moved 3.2 miles upstream. By March 20, all birds had moved from the winter study area (fig. 5). Upstream, other unmarked paired birds were observed. However, solitary birds were observed upstream as late as April 21, 1956. Birds no. 6 and no. 7 were banded in April. On April 23, no. 6 was found in nest I, and it was mated to no. 4. Number 7 and an unbanded bird were feeding young in nest II. Nest III (unbanded parents) had nestlings

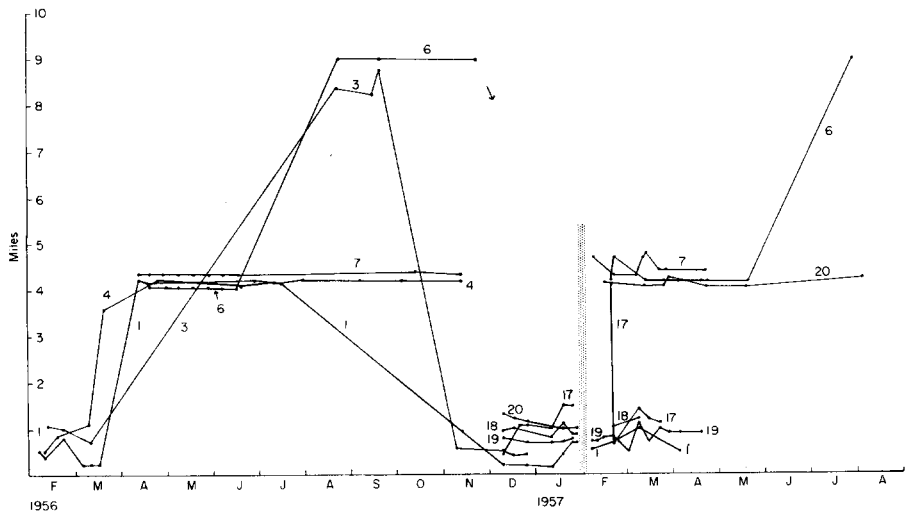

Fig. 5. Movements of banded Dippers that were frequently encountered within the study area. The stippled band (Jan. 30, 1957) indicates that at least 5 miles of stream were completely frozen.

and nest IV had a pair of unbanded birds (fig. 1). A pair of birds was seen copulating across from nest IV on May 23 and a female was found in the nest on June 6. However, on June 14, no parent was in the nest and no brood was raised. A bird was once found in nest V but apparently it raised no young.

Nestlings no. 8, 9, 10, 11, and 12 were banded from nest III on May 7 and nos. 13 and 14 were banded from nest I on May 19 (fig. 1). Four fledglings were seen on May 23 from nest III, four on June 6 from nest II, and two on June 14 from nest I. The fledglings were very gregarious, being observed in groups of two, three, or even four, on rare occasions.

In the spring of 1957 birds no. 23 and 24 were banded on March 9. On the same day, previous to the marking of these two, the first observed pairing of birds occurred between no. 7 and either no. 23 or 24. However, this was temporary as no. 7 was seen to be paired with an unbanded bird on March 28. This indicates that some birds may change mates during the early pairing period. Numbers 19 and 1 both were paired with unbanded mates within the winter study area in early April (fig. 5). This spring season differed from the previous one in that two pairs of birds remained in the winter study area, one pair (no. 19 and mate) constructing nest VII (fig. 1). The unbanded mates of nos. 1 and 19 had moved downstream into the winter study area as contrasted with unidirectional movement out of the winter study area in the spring of 1956. However, by May 6, 1957,

no birds were found within the winter study area, probably because they had moved upstream, and nest VII was deserted. Bird no. 6 (nest I) and no. 7 (nest II) both returned to their previous year's nesting site and initiated nesting activities (fig. 5). Nest III again had a pair of unbanded nesting birds. April 1 was the last date on which winter territorial defense was noticed. By April 5, all the birds observed in the lowest six miles of Rattlesnake Creek were paired but on May 5, about one mile above the upper limit of the study area, a solitary bird was seen. This observation plus other nesting data indicate that nesting activities, including pairing, commence later at higher elevations. No observations were carried out this season on the dispersal of fledglings and adults.

During the two spring seasons the water level remained low until April. Several erratic thaws then resulted in temporarily torrential waters. The stream reached its yearly peak around May 19, 1956. During an average year this amounts to a flow of about 2100 cubic feet per second (personal communication, Montana Power Company), but this figure does not include water consumed by Missoula or used for irrigation purposes along the lower Rattlesnake Creek drainage. The stream receded slightly on May 26, and by June 28, 1956, it could be crossed at many points. The spring of 1957 differed in having less water. It appears that the nesting of those birds observed was correlated with the high water period. This may perhaps give the nestlings and fledglings an additional margin of security against potential predators.

Only a few territorial defenses were recorded in March and April. The transition in 1957 from winter defense to pairing, with no observed defense, took a minimum of 12 days for bird no. 19, 19 days for no. 7, 22 days for nos. 6 and 20, and less than a month for no. 1. Number 6 showed slight indications of territorial defense against her mate (no. 20), when rapidly approached, even after the inner lining had been placed in the nest. During the nesting period no intraspecific strife was observed. This is attributed to the fact that most breeding pairs were widely separated from one another; also the breeding defense may be weak. Hann (1950:57) says that the parent Dipper does not ordinarily invade the territory of another. On one occasion he observed a parent expressing "dissatisfaction" toward an alien Dipper by fluttering and scolding. Another time there was only "disapproval."

Hann (*op. cit.*:52) mentions that food for the young is obtained as far as 400 yards downstream or upstream from the nest. Cordier (1927:173) has observed adult Dippers gathering food one-half mile down from the nest. My observations differ; no. 6 had the largest observed breeding territory and was found only as far as 150 yards upstream from nest I and as much as 200 yards downstream for a total of 350 yards.

Bent (1948:109) states that during the nesting season territories are extensive with nests being a mile or more apart. Grinnell and Miller (1944:328–329) note that along an especially favorable stream four breeding pairs have been found in one mile. Hann (*loc. cit.*) gives the size of nesting territories of the Dipper as about one-half mile in length. He relates two cases in which nests were abandoned and says that these may be due to the proximity of other pairs of Dippers 400 yards and one-half mile, respectively, from the nests. However, he apparently had no evidence from banded birds and the present study indicates that two functional nests may be found within 250 yards of each other. On Rattlesnake Creek three pairs of nests were located in which members of the pair were within 50 yards of one another. Three additional nests (nests I, VI, and II) were all placed within 250 yards of each other, and two of the three were occupied.

Summer.—By June 15, 1956, most of the fledglings and adults had dispersed from the breeding sites (fig. 5). Hann (1950:56) states that fledglings ordinarily were found within the nesting territory during the first three days. They rapidly dispersed up to a mile within a week. My observations show that the dispersal of Dippers took place

within the first two weeks. In 1956, no birds were observed within three-fourths of a mile of nest III in either direction six days after fledging, dispersal having begun after four days.

Some solitary adults, juveniles, and occasionally duos of juveniles were seen during June in the first 9 miles of the study area. In the last three miles, where nesting was not studied, several groups of adults with young were observed in July. This would suggest a later breeding upstream. Bird no. 15, a fledgling, was banded near the 12.6-mile point on July 18 and two other fledglings were also observed in the area. Three days later no. 16, another fledgling, was banded in the same area. Since no. 15 and several other fledglings could not be found on the uppermost three-fourths of a mile on July 21, it was thought that the birds might have moved downstream. During early August, no. 4 (adult) and no. 14 (juvenile) were observed below nest II (figs. 2 and 5). This signifies that some adults and juveniles remain near the nesting site.

Frequently groups of two or three birds were observed during July and August and a reduction in the number of Dippers on the first five miles was noticeable. There was an evident concentration of birds on the upper five miles of the study area (fig. 2). Number 12 (juvenile) was observed on August 17 about one mile below the upper end of the study area, having moved upstream about six miles. Number 6 had likewise moved upstream a total of five miles (fig. 5). Number 3 had not been observed after March 9, 1956, but it was now found almost eight miles upstream (fig. 5). A sizable upstream movement had thus taken place from the lower half of the study area.

In early September there were at least as many birds on the upper three and one-half miles as in August (fig. 2). Number 4 (adult) remained near nest II. Number 3 (adult) was found in the same general upstream area as in August. Number 8 (juvenile) was observed on September 13 for the first time since fledging and was at the 3.3-mile point, which was below its birthplace (fig. 2). This may indicate that a few fledglings disperse downstream although most of the birds tended to move into the upper half of the study area. Number 15 (juvenile) was observed to have moved downstream about three miles since July 18 (fig. 2). This supports the hypothesis that some of the fledglings near the upper end of the study area moved downstream after fledglings on the lower area had moved upstream. These movements resulted in a concentration of young and adults between the 8- and 12-mile points (fig. 2).

During this summer period individual preference was exhibited toward a given area of stream. The extent of this area varied greatly, the maximum observed being about one-half mile. No territorial defense was noted, and no singing was heard from the time of fledgling dispersal until September 11, 1956. Dippers were commonly seen in groups of two or three or they were solitary, young birds tending to be especially gregarious. Bird no. 6, in 1957, returned to the same summer area in which it was found in 1956 (fig. 5).

Late summer observations on other areas.—A check on the West Fork of Rattlesnake Creek, beyond the upper boundary of the study area, was first made on August 24, 1956, in order to see if any banded birds had moved that far upstream (fig. 1). On that date two solitary Dippers were observed within the first mile above the end of the study area. On September 1 and 5, an additional seven miles of stream was covered. Twelve birds were seen, some solitary and some in groups of two. None was banded and no territorial defense was shown.

Seven of these birds appeared to be young juveniles. This, together with observations previously given, is interpreted to mean that nesting occurred later in this upper area; that is, nesting begins on the lower half of the study area and proceeds upstream as the season progresses.

Just preceding the autumn season Little Lake and Glacier Lake, two of the 20 or more Rattlesnake Lakes, were visited (fig. 1). On September 16, 1956, two Dippers were observed on Little Lake (elevation 6500 feet). One pursued the other around the shoreline for about one-fourth mile and sang loudly while in flight. On September 17, two Dippers were found on Glacier Lake (elevation 7000 feet). Each was chased about 250 yards before turning back but displayed no territorial defense. The birds found on the lake shores exhibited habitat preferences similar to those of a stream bird.

Fall.—On October 7, 1956, two unbanded birds were observed within the winter study area, and an abundance of birds was seen between the 5-mile and 9.5-mile points (fig. 2). Downstream movement was in progress. Number 15 had moved down about one mile since September 11 (fig. 2). Dippers were still found in pairs and groups of three, and also as solitary birds. However, the occurrence of one territorial fight and increase in the frequency of singing was evidence for the commencement of fall-winter territoriality. Bent (1948:105–106) mentions that Dippers are very rarely seen in groups. My studies, however, have shown that they are commonly gregarious during the summer post-breeding period and throughout the first half of the fall season.

By November 7, 1956, a total of six birds had moved downstream into the winter study area (fig. 2). Among these was no. 3, an adult from the previous winter, which had moved downstream 8.3 miles within two months and no. 1, another old adult, which had moved downstream three miles since July 12, 1956 (fig. 5). Number 4 was still near the dam, having remained in that area throughout the spring, summer, and fall, as did no. 7 in the region of nest II. Number 6 remained up near the 9-mile point for an undetermined period of time before returning to the dam (fig. 5). Dippers were fewer on the uppermost three and one-half miles, abundant on the next four and one-half miles, and showed a large increase over October on the lower five miles (fig. 2). Territorial defense again became widespread among the Dippers, and more songs were heard. The majority of birds observed were solitary and those near one another had territorial fights. A summary of the numbers of birds and their movements throughout the summer and fall of 1956 is given in table 2.

POPULATION DENSITY

Spring-summer, 1956 and 1957.—The first complete survey of the study area (No. 1) took place during the pre-nesting and nesting period from March 9 to May 11. A total of 23 presumably different adults was observed. Five pairs were seen; pairs appeared more commonly on the upper part of the study area because that region was observed at a later date (fig. 2). Because of two high-water periods which made some sections of the uppermost five miles of stream inaccessible, and because of the length of time involved, the total number of birds counted is unreliable as a census. Some birds were undoubtedly missed and others were probably counted twice.

A post-nesting survey (No. 2), June 19 to July 19, was made from about the 4- to the 13-mile points as no birds were present at that time below the 4-mile point. An increase in the total number of birds would be expected, but only eight adults and four juveniles were observed (fig. 2). The noise in mid-June from the rushing water still prevented birds from being heard, in some cases, even if accidently flushed.

Another survey (No. 3) was conducted from July 25 to August 18. A total of 27 Dippers, including 9 adults, 12 juveniles, and 6 birds of undetermined status, was observed (fig. 2). Water level was low at this time and the census was made by either walking or floating down midstream.

A comparable survey (No. 7) was carried on from July 27, 1957, to August 8, 1957. This was an additional check on the Dippers during the post-breeding season. A total of

25 birds was counted including 11 adults, 7 juveniles, and 7 birds of undetermined status (fig. 2).

Survey 4 from September 4 to September 13, 1956 (walking midstream) was considered to be more reliable. Three juveniles, two of which were banded, and 33 adult or adult-like birds were observed (fig. 2). The decrease in proportion of juveniles on this survey is attributable to the fact that most of them had acquired adult plumage.

Fall, 1956.—Survey 5 from October 3 to October 24 (walking midstream) resulted in 35 birds being observed (fig. 2). The duration of the survey was longer than the previous one but the total number of birds remained almost the same.

Table 2

Numbers and Movements of Dippers in 1956

Survey no.	Area (road mi.)	No. of birds	Per cent of total	Dates
3	1–5	5	18	July 25, 26, 28
	5–9½	8	30	June 25, 28; Aug. 17, 18
	9½–13	14	52	Aug. 17, 18
		Total 27		
4	1–5	8	22	Sept. 4, 13
	5–9½	8	22	Sept. 4, 7, 8, 11
	9½–13	20	56	Sept. 11
		Total 36		
5	1–5	8[1]	23	Oct. 3, 5, 7
	5–9½	19	54	Oct. 13, 17
	9½–13	8	23	Oct. 19, 24
		Total 35		
6	1–5	14[2]	34	Nov. 7, 9
	5–9½	17	42	Nov. 14, 21
	9½–13	10	24	Nov. 28, 31
		Total 41[3]		

[1] Two birds were seen in the winter study area at this time.
[2] Six birds were seen in the winter study area at this time.
[3] Total of survey 6 was greater than that of 4 and 5. This may have been due to an influx of birds from above the study area or duplications in counting as downstream movement was occurring at this time.

Survey 6 was conducted from November 7 to November 31. Forty-one birds were observed (fig. 2). Since downstream movement was in progress the increased number of birds may have been due to an influx of Dippers from above the study area.

Winter, 1955–56 and 1956–57.—During the winter of 1955–56 in the winter study area, six birds were observed within a span of 2280 yards for a mean density of one bird per 380 yards or 0.216 mile. During February and March an average of 80 per cent of the birds was observed on any one day. Only on one occasion were all the birds seen. This indicates a considerable survey error. However, these percentages are based on eight censuses.

During the winter of 1956–57, seven birds were observed on the winter study area. They were found within a span of 2425 yards for a mean density of one bird per 346 yards or 0.197 mile. From December 14 through January 28 an average of 82 per cent

of the birds was observed on any one census. On January 30 the first five miles of stream were completely frozen over. From February 6 through March 6, with fewer birds on the winter study area, the average observed on any census was about 61 per cent (table 1). This increased error may be the result of the frozen condition of the stream in which the birds would stand unnoticed in small ice openings or under ice ledges.

Interpretation.—Under conditions of the winter study, it was found that about 82 per cent of the birds present on the study area were observed on any one day. Conditions for censusing from the 1.7- to the 13-mile points were not as favorable as that of the winter study area. However, if it is assumed that 82 per cent of the birds can be observed, and if this correction is applied to the pre-nesting survey (No. 1), then the total pre-nesting population in 1956 would be roughly about 27 birds for a mean density of one bird per 0.481 road-stream mile. Road and stream lengths are considered to be approximately the same since meanderings of the stream are compensated for by bends in the adjacent road. The first post-nesting survey (No. 2) is inadequate to show the population increase during the breeding season, but the remaining five surveys are more reliable. The corrected population for survey 3 is approximately 32 birds. This is a density of one bird per 0.406 road or stream mile. A similar adjustment of the post-nesting survey of 1957 (survey 7) results in a total of 30 Dippers on the study area, for a density of one bird per 0.433 road-stream mile.

The calculated pre- and post-nesting populations of the study area indicate a population increase of at least five birds during the 1956 breeding season. However, on the basis of observed marked and unmarked, fledged Dippers, the juvenile increment amounted to about 14 birds in 1956 and 11 birds in 1957. The difference might be attributed to the disappearance of about ten adult Dippers between pre- and post-breeding surveys. This interpretation is supported by a decline of this magnitude in the number of adult birds seen over this period. On the other hand, surveys 4 and 5 indicate a corrected population of 42 Dippers, or one bird per 0.310 road-stream mile. This value may more accurately represent the post-breeding population and indicates a spring to fall population increase of 15 during the 1956 breeding season. However, the figure may also include individuals which have recently entered the study area from above.

Other areas.—On September 1 and 5, 1956, a total of 14 birds was observed on eight trail-miles of stream beyond the end of the study area. This is a density of one bird per 0.571 trail-stream mile (fig. 1). It is believed that some of these upper areas freeze over more or less completely during the winter, forcing some of the birds down to lower regions.

It has been observed that Dippers tend to congregate about restricted open waters in winter (Warren, 1914; Dawson, 1923). Skinner (1922:20) compared the number of birds on the lower six miles of the Gardiner River in Yellowstone National Park, which supported a population of 75 in winter and about 10 during the summer. These reports and additional data from Rattlesnake Creek seem to indicate that increased density of Dippers on the lower parts of streams and rivers during winter occurs over much of their range.

SUMMARY

Territoriality, movements, and population density of Dippers (*Cinclus mexicanus*) were studied from January, 1956, through August, 1957, on Rattlesnake Creek, Missoula County, Montana. Nestlings, juveniles, and adults were color-banded or otherwise marked. Of 28 banded birds, 21 were seen at least once at a later date and 9 were observed for a considerable length of time.

The winter territories were established in November, and territorial defense was

strongest from November through February. Territories range from 50 yards to as much as one-half mile. The birds tend to maintain their respective positions on the stream. Shifts result from extremes in weather which result in stream-ice formation and thawing.

In March, a general movement of birds away from the lower reaches of the stream occurred. A two- to four-week transition from winter defense to pairing, with no territorial defense, took place. During the nesting period little, if any, territorial defense was shown, but most breeding pairs were well separated from one another. The maximum extent of the breeding territory was about 350 yards.

During June most birds tend to disperse, primarily upstream from the lower half of the study area. Dispersal downstream from the upper reaches of the study area occurred in July, as a later nesting season is typical of birds found at higher elevations. The effect of these movements was a marked concentration of birds above the 9½-mile point of the study area during August and September. Preference is then exhibited toward a chosen area of stream but without territorial defense.

General downstream movement occurred in October with the greatest number of birds observed between the 5- and 9½-mile points.

A concentration of Dippers on the lowest five miles of the study area was observed in November. The remainder of the stream showed relatively small change. This may indicate the possibility of an influx of birds from higher elevations as winter weather begins. Several birds returned to the site of their previous winter territory. Others remained for the duration of the winter in the area where they had previously nested.

Assuming a census error of about 18 per cent, the total pre-nesting population in 1956 was about 27 birds for a mean density of one bird per 0.481 road-stream mile. The post-nesting population in 1956 was approximately 32 for a mean density of one bird per 0.406 road-stream mile, and about 30 in 1957 for a mean density of one bird per 0.433 road-stream mile. However, on the basis of observed marked and unmarked, fledged Dippers, the population increase amounted to about 14 birds in 1956 and 11 birds in 1957. Winter density was one bird per 0.216 stream mile in 1955–56, and 0.197 stream mile in 1956–57, for the lowest 1.7 miles of Rattlesnake Creek.

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