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BANDING AND MARKING METHODS IN STUDYING SEASONAL MOVEMENTS OF THE SHARP-TAILED GROUSE IN MORTON COUNTY, NORTH DAKOTA

by

Albert T. Klett

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Wildlife Management

UTAH STATE AGRICULTURAL COLLEGE
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INTRODUCTION

Importance and scope

The Great Plains variety of the sharp-tailed grouse Pediocetes phasianellus jamesi Lincoln was the predominant upland game bird during the exploratory and early settlement period in North Dakota (Coues 1874 and 1878, Larson 1928, and Williams 1926). Since then its status has diminished as the prairie grassland gradually was converted to intensively used pastures and cropland. Although the sharptail is still abundant enough in its remaining habitat to provide for liberal annual harvests, further demand on these lands by a growing human population will make it necessary to apply game management measures other than hunting regulations if the sharptail is to be retained as an important game bird in the state.

A knowledge of the motility and survival of the sharp-tailed grouse is of importance in the planning of habitat development projects, hunting regulations, and research concerned with population problems. In 1954, the game management division of the North Dakota Game and Fish Department initiated a sharp-tailed grouse movement and survival study. This paper presents an evaluation of the techniques used in the study of sharptail movements during the first 2 years of this project and a preliminary analysis of the seasonal movements of banded or marked sharp-tailed grouse that were recovered or observed to November 4, 1956.

The scientific names of the gallinaceous birds used in this paper were taken from Ridgeway and Friedmann (1946); The American Ornithologists Union Check List of North American Birds, 1931, was followed for

all other birds mentioned. The terminology of Bailey (1926) is followed for mammals and that of Stevens (1950) for plants.

Review of literature

The seasonal movement of sharptails from the open grasslands used during the breeding season to wooded wintering areas and the formation of late fall and winter flocks were recognized by some of the early naturalists such as Coues (1874), but it was not until comparatively recent times that detailed studies were made. Marshal and Jensen (1937), with the help of student labor, studied the seasonal movements of the Columbian sharptail var. Columbianus in Utah through observational and flushing work in 1936 and 1937. Baumgartner (1939) reviewed the results of movement studies carried on in Michigan but did not elaborate on the methods used.

The application of banding techniques to sharp-tailed grouse movement studies began about 1930. Until recently, most of the banding was done on the wintering areas, and recoveries were made chiefly through retrapping and hunter band returns. The results of some of these studies are available for Wisconsin (Hamerstrom and Hamerstrom 1951), North Dakota (Aldous 1943: Hammond 1957, unpublished), South Dakota (Janson 1951), and Michigan (Peterle 1956).

Winter banding increased knowledge on the longer movements of sharptails which could only be surmised by earlier observational work. The use of the cannon-net trap to capture sharptails on the spring dancing grounds by Peterle (1956) made it possible to follow dispersion from the spring as well as the winter range.

Outside of the realm of seasonal movements, Hamerstrom and Hamerstrom (1951) and Snyder (1935) have reviewed the subject of migrations

noted in the northern varieties of sharp-tailed grouse. Cade and Buckley (1953) described an emigration from the Tanana Valley in Alaska in 1934. The Hamerstroms (1951) have also reviewed range extensions, while Baumgartner (1939) has described the extension of the range of the sharptail into Michigan.

For an exhaustive review of the subject of sharp-tailed grouse movements, reference is made to Hamerstrom and Hamerstrom (1951).

Although banding has been the standard method of following bird movements, many workers have searched for methods to mark wild birds so that they could be identified in the field without recapturing or killing them. Various types of colored leg bands (Tanner and Beck 1941; Balham and Elder 1953; Hamerstrom and Hamerstrom as reported by Balham and Elder 1953), artificially attached colored feathers (Low 1945; Leopold, Lee and Anderson 1938; Edminster 1938), and several types of neck markers (Taber 1949; Gullion 1951; Helm 1955; Trippensee 1941) have been used to mark game birds.

Sowls (1950) used airplane dope to mark the plumage of ducks. Dyes have had wide usage in marking the plumage of birds (Nordberg 1942; Moffit 1942; Butts 1930). Wadkins (1948) experimented with a number of dyes for marking pheasants, and his recommendations have been followed by other workers for marking pheasants (Jones 1950, and Harris 1951) and waterfowl (Winston 1955). Cottam (1956) has presented a review of the various methods of marking birds.

DESCRIPTION OF AREA

Location

Most of the trapping stations were scattered in the St. Anthony-Huff area of southern Morton County about 15 miles south of Mandan on State Highway 6 (figure 1). Trap sites 1 and 2, located about 10 miles west of St. Anthony are not shown in figure 1. Trapping site 13 was located east of the Missouri River in Burleigh County.

Geology

The topography and drainage of the trapping area is typical of most of the sharptail range in eastern Morton County. The landscape consists of steep hills interspersed with undulating and rolling lands. A well-developed drainage system is afforded by the southeast branch of the Little Heart River, Rice Creek, and the north branch of the Cantepeta Creek.

The exposed substrata are made up of the three lower formations of the Fort Union Group: the Tongue River, the Cannonball, and the Ludlow Formations (Laird and Mitchell 1942). A thin deposit of glacial till, chiefly boulders, is widely scattered through the area.

Soils

The soils of the trapping area have developed in a semiarid climate, under a combination of short and tall grass cover, from the sandstones, shales, and clays of the Tongue River and the Cannonball Formations. Morton County soils have the characteristics of the chesnut soil group except where local extremes of relief or poor drainage have interfered with their development. Variations in parent material have

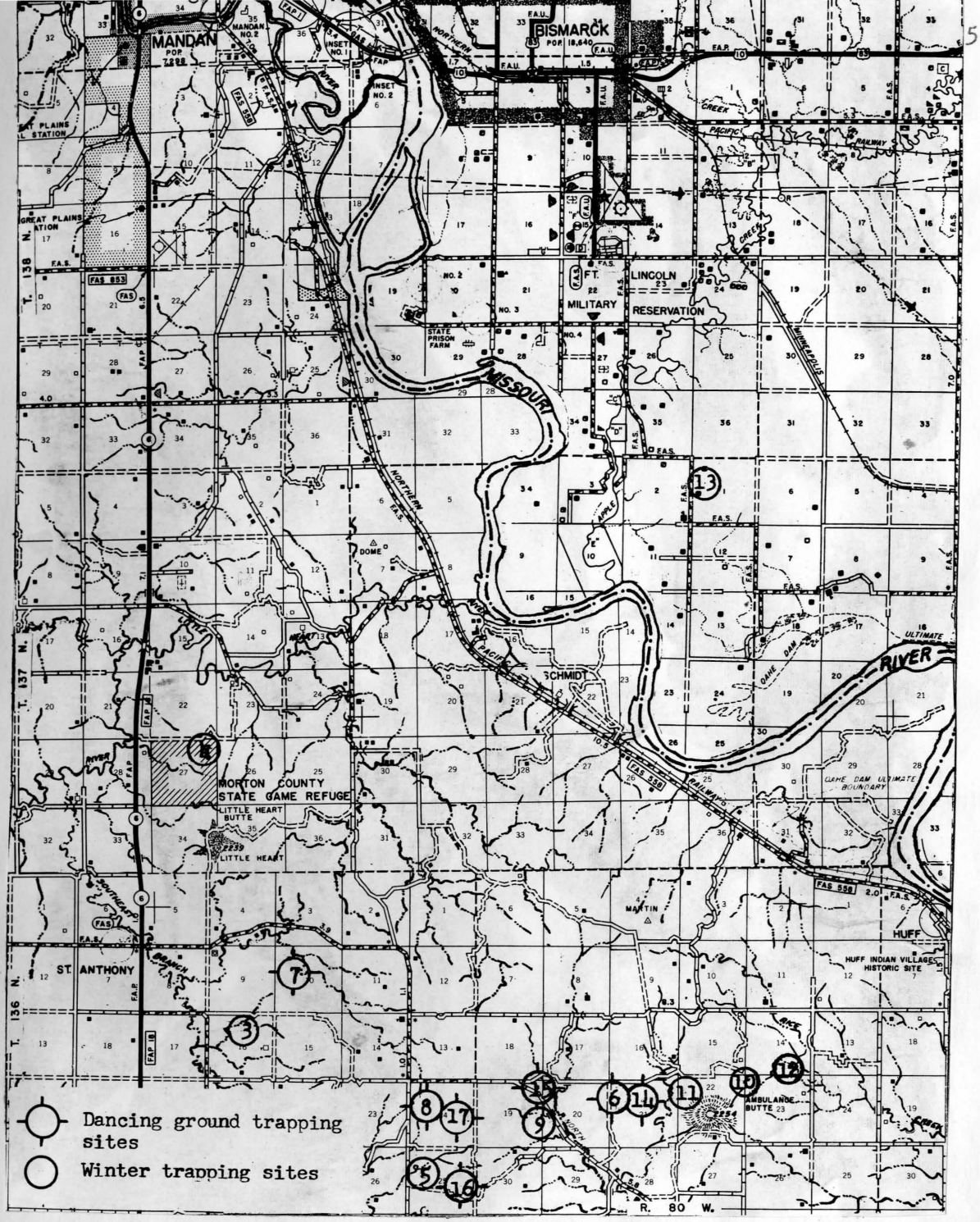

Figure 1. Location of trapping sites for sharp-tailed grouse[1]

1. Map from portions of General Highway maps of Morton and Burleigh Counties, prepared by North Dakota Department of State Highways.

provided a wide range of soil textures (Laird and Mitchell 1942; Edwards and Ableiter 1951).

Climate

The climate of Morton County is semiarid and continental. The annual precipitation averages slightly above 16 inches at Bismarck, which is about 12 miles north of the trapping area. About 75 percent of the precipitation falls between the first of April and the end of September; about 50 percent of it falls during the months of June, July, and August. Most summer precipitation falls during late afternoon and evening as thundershowers. Snowfall is light; the statewide average is 32.2 inches per year.

The range of daily and seasonal temperatures is large. Temperatures over 100 degrees are recorded on the average of once each year. Days when the maximum temperature is below zero occur about 7 days each year. The average growing season is 135 days (May 10 to September 22).

Wind velocity averages 10.9 miles per hour. The prevailing direction is from the northwest in all months, but south and east winds are more common in summer than during the winter (Anon. 1953).

Land use

Mixed farming is the principle type of agriculture carried on in the vicinity of the trapping area. Because of the steep topography most of the tillable areas are small and irregularly interspersed among the steeper grasslands. A land-use survey of a township in the vicinity of the trapping sites indicated that about 27 percent of the area was cultivated for the production of grain and forage crops. Of the remainder, about 70 percent is grassland. Much of the grassland is heavily used for grazing or wild hay production, but there are extensive areas

of unused native grasslands that are too steep or rocky for haying and subject only to light grazing because of the interspersed unfenced cropland.

The chief cash crops are wheat and flax. Barley and oats are the most important grain feed crops. Some corn is grown for both grain and forage. Of the hay crops, wild hay is the most important, but alfalfa and small grain hay is used to a lesser extent.

Most of the cattle in the sharp-tailed grouse trapping area are raised for beef, but some of the farms have small dairy herds. Most farms also raise some poultry and hogs.

There are 20 occupied farm dwellings on the township where most of the trapping was conducted. In general, the road system is well enough developed so that most areas can be reached by automobile except after heavy rains. During the winter months, the roads and trails are often blocked by drifting snow.

Vegetation

Dominants from both the mixed and true prairie associations are common in the native grasslands of Morton County. Needle grasses (Stipa comata Trin. and Rupr., Stipa spartea Trin., and Stipa viridula Trin.); june grass Koeleria cristata (L.) Pers., little bluestem Andropogon scoparius Michx., blue grama Bouteloua gracilis (HBK) Lag., and side-oats grama Bouteloua curtipendula (Michx.) Torr. are common grasses of the better upland sharptail ranges. The short grass, blue grama, predominates in the more heavily grazed areas which support few sharp-tailed grouse.

Brush and trees other than wolfberry Symphoricarpos occidentalis Hook. occupy about 1 percent of the area in the vicinity of the

trapping sites. Wolfberry clumps are widely spread throughout the grassland area. Other woody species are confined to farm plantings, ravines, and creek bottoms. The important woody species found in the trapping area are juneberry Amelanchier alnifolia Nutt., wild plum Prunus americana Marsh., choke cherry P. virginiana L., wolfberry, silverberry Elaeagnus argentea Pursh., wild rose Rosa sp., green ash Fraxinus pennsylvanica var. lanceolata (Borkh.) Sarg., bur oak Quercus macrocarpa Michx., willow Salix sp., cottonwood Populus deltoides Marsh., and buffalo berry Shepherdia argentea Nutt.

Wildlife

During the spring, sharptails are well distributed throughout the trapping area. A population of about 20 sharptails per section was estimated from a dancing ground survey made in 1955 on a 26-square-mile area surrounding the trapping sites. A population of 17 sharptails per section was estimated from a similar survey in 1956. Winter aerial and ground counts in 1955 and 1956 indicated a minimum wintering population of 15 to 20 birds per square mile in the same general area.

The pheasant Phasianus colchicus torquatus Gmelin and the Hungarian partridge Perdix perdix perdix (Linnaeus) were both common in the trapping areas. One prairie chicken Tympanuchus cupido pinnatus (Brewster) was trapped at site 12 in the winter of 1955-56, but no other observations of this species were made.

White-tailed deer Odocoileus virginianus macrourus (Rafinesque), cottontail rabbits Sylvilagus floridanus similis Nelson, white-tailed jackrabbits Lepus townsendii campanius Hollister, and yellow-haired porcupines Erethizon e. epixanthum Brandt were attracted by the bait piles at the trapping sites. The rodents often opened holes in the

trap netting to get at the bait.

The common predators on the area that were at least a potential threat to trapped sharptails were the coyote Canis latrans nebracensis Merriam, red fox Vulpes fulva regalis Merriam, American rough-legged hawk Buteo lagopus s. johannis (Gmelin), golden eagle Aquila chrysaetos canadensis (Linnaeus), and horned owl Bubo virginianus occidentalis Stone.

Description of trapping sites

Table 1 presents a brief description of all the trap sites. Fall and spring trapping was done on the dancing grounds which were all located on high spots in the upland grassland. Most winter trapping was carried out in woody cover where the sharptails gathered to loaf or to feed on buds. In most cases some feeding was also noted in fields near the woody cover, but only one trapping site was set up in a field (site 12).

Table 1. Description of trapping sites for sharp-tailed grouse, Morton County, North Dakota

Site number	Location	Season and year trapped		Comments
1	NE Sec 3, T 136 N R 83 W	Fall Spring	1954 1956	Dancing ground Dancing ground
2	NE Sec 3, T 136 N R 83 W	Winter	1954-55	Small upland buffalo berry clump
3	NE Sec 16, T 136 N R 81 W	Winter Winter	1954-55 1955-56	Grove of trees at an abandoned farm site
4	NE Sec 27, T 137 N R 81 W	Winter Winter	1954-55 1955-56	Morton County State Game Refuge, woody planting
5	NW Sec 25, T 136 N R 81 W	Winter Winter	1954-55 1955-56	Small willow clump on intermittent drainage
6	NW Sec 21, T 136 N R 80 W	Spring Fall	1956 1955	Dancing ground Dancing ground
7	NW Sec 10, T 136 N R 81 W	Spring	1956	Dancing ground
8	NW Sec 24, T 136 N R 81 W	Fall Spring	1955 1956	Dancing ground Dancing ground
9	NW Sec 20, T 136 N R 80 W	Winter	1955-56	Wooded ravine
10	NE Sec 22, T 136 N R 80 W	Winter	1955-56	Wooded ravine
11	NE Sec 21, T 136 N R 80 W	Winter	1955-56	Grove of trees at an abandoned farm site
12	SE Sec 14, T 136 N R 80 W	Winter	1955-56	Shocked cornfield
13	NW Sec 1, T 137 N R 80 W	Winter	1955-56	Narrow shelterbelt near an occupied farm
14	NE Sec 21, T 136 N R 80 W	Spring	1956	Dancing ground
15	NE Sec 19, T 136 N R 80 W	Spring	1956	Dancing ground
16	SE Sec 25, T 136 N R 81 W	Spring	1956	Dancing ground
17	NE Sec 24, T 136 N R 81 W	Spring	1956	Dancing ground

PROCEDURE AND METHODS

General procedure

Sharp-tailed grouse were trapped at the wintering sites and on the spring and fall dancing grounds. All trapped grouse were banded and some were marked with colored dyes. The dispersal of the banded and marked birds from the seasonal ranges was traced through fall hunter band returns, retrapping, and by observation of marked birds. A few recoveries of banded dead birds were also used. Most of the marked bird observations were made personally, but some reliable observations were received from other sources.

Trapping

Winter trapping. During the winter, sharptails were easily captured with semi-portable funnel traps baited with ear corn (figure 2). The tops of the traps were covered with cotton netting and the sides with hardware cloth or wire screen. Later the sides were also covered with cotton netting to prevent injuries. Two or three ground level funnels were used on each trap.

Winter trapping could be started after the first heavy snowfall filled in the grain fields where the birds feed during late fall. Trapping sites which were usually located in woody plantings (figure 3), were prebaited for several days. The traps were set as soon as the sharptails in the vicinity were feeding at the corn piles regularly. Because rodents and deer were also attracted by the bait, it was necessary to replace it every 2 or 3 days.

Some of the trapping sites could be visited by car, but a snowmobile was essential for trapping after the first heavy snowfall. The

Figure 2. Semi-portable funnel trap used to trap sharptails during the winter

Figure 3. A typical sharp-tailed grouse wintering site (trapsite 14) located on the study area

traps were visited twice each day at mid-morning and late afternoon. Trapping efforts were continued at each site until unbanded birds were no longer entering the traps regularly. When the traps were operated continuously, most of the birds in the area could be trapped in less than 2 weeks. Intermittent trapping efforts at each site prolonged the trapping period.

Spring and fall trapping. Two sets of Dill's improved cannon-net assemblies were used to trap sharptails on the dancing grounds during the spring and fall (figures 4 and 5). The two 75-x 25-foot nets were laid out parallel and were fired simultaneously toward each other. Three guns were used on each net. This arrangement made it possible for one man to get a larger catch with each firing.

The largest catches were made when the net was fired before sunrise. During this period there was greater activity on the dancing grounds, and more birds were usually inside the trapping area.

Banding

All trapped sharptails were banded with numbered, butt-end type aluminum bands. A record of all banded sharptails was kept on a banding schedule. A history of banding and recovery data for each band recovery was tabulated on a card and filed in the office.

All hunters who reported shooting banded grouse were interviewed to determine the exact location of the recovery.

The following terminology was adopted for use during this study:

repeat: a bird that was retrapped at a site where it was trapped earlier during the same season.

recovery: a general term that includes any banded bird or band obtained from any source at any time with the exception of repeats.

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Figure 4. Dill's improved cannon net assembly used to capture sharp-tailed grouse on the spring and fall dancing grounds

Figure 5. A pair of Dill's cannon net assemblies set to fire simultaneously. After firing, the area between the cannons is completly covered by the net

direct recovery: a recovery made at any time between the date of release during a specific season and the beginning of the same season the following year.

indirect recovery: a bird banded in a specific season and recovered during or after that same season the following year.

recapture: a recovery of a live bird through retrapping at a different station during the same season or at any station during subsequent seasons. This term implies that the bird was again released.

return: the recovery of a dead bird or the band from a dead bird.

Marking

Birds to be dyed were crated at the trapping site and transported to a heated building for dyeing. The two dyes used were auramine concentrate (yellow) and rhodamine B extra (red), obtained from the E. I. DuPont De Nemours and Company. These dyes have been used with favorable results by other workers (Wadkins 1948, Jones 1950, and Harris 1951).

Dyes were applied by dipping the bird or by brushing the dye on the feathers with a firm bristled scrub brush. Because it was considered important that the birds dry quickly, especially in the winter, only alcohol was used in the dye solution.

The dyes were applied in combinations or singly to certain parts of the birds so that particular combinations indicated the sex and release site.

The movement of marked sharptails was traced by personal observation and reports from people who saw marked birds. Dancing grounds in eastern Morton County were checked for the presence of marked grouse.

Twenty-nine grounds were checked in the spring of 1955, and 42 in the spring of 1956. Observations of dyed sharptails were also made while other studies were being carried out in the area.

Several reports of marked birds were volunteered by farmers and other observers. To increase the data from this source, a form letter requesting information on marked sharptail observations was sent out in July of 1956 to 411 rural box holders living within 20 to 25 miles of the trapping sites. An addressed postpaid card was enclosed with each letter to encourage the return of observations.

Sexing and ageing

The age and sex of sharptails was determined by examining the wear on the outer wing primaries and by the pattern on the tail feathers as described by Ammann (1944) and Manweiler (1939). The characteristics of the eyebrow were also used as an indication of sex when the pattern of the tail feathers was indistinct. All trapped sharptails were sexed and aged by these methods except for those birds trapped on the spring dancing grounds; because of the worn condition of the outer primaries of the adults, only the sex of the spring trapped birds was recorded.

PRESENTATION AND ANALYSIS OF DATA

Evaluation of techniques

Trapping success. Winter trapping with the semi-portable funnel trap was highly successful. Five hundred and six sharptails (unbanded birds and recoveries) were trapped during the winters of 1954-55 and 1955-56 (table 2). The average catch per site day was about 7.5 sharptails in 1955-56 (usually two traps were set side by side at each site). The range in the daily catch at each trapping site was from 0 to 39 sharptails. The large catches were nearly always made on a day early in the trapping period; the number of unbanded grouse caught per day usually declined steadily after the first large catch.

Trapping on the dancing grounds was less successful than the winter trapping because the catch per site was lower, and the trapper could visit only one site each day. In the spring of 1956 an average of 4.6 sharptails was captured each morning that the cannon-net trap was checked. As many as 16 grouse were captured at one time.

Fall trapping was even less successful than spring trapping. During the fall the sharptails were less active on the dancing grounds and were much wilder. There was also a considerable variation in the activity on the grounds which often made it necessary to visit the trap several mornings before firing. An average of 3.5 sharptails (0 to 9) was captured each time the trap was visited in the fall. Table 2 presents the number of sharp-tailed grouse, other than repeats, trapped during the period of the study.

Trapping mortality. Deaths from trapping were negligible with the use of the semi-portable funnel trap. Approximately 700 sharptails

Table 2. Number of sharp-tailed grouse banded and marked during each season, Morton County, North Dakota

Trapping season	Year	Number of sites trapped	Number banded	Number recaptured from previous banding	Number marked with dye
Winter	1954-55	4	208	4	112
	1955-56	8	244	50	62
Spring	1956	8	46	28	15
Fall	1954	1	9	0	9
	1955	2	13	3	16
Totals		17	523	85	214

(including recoveries and repeats) were handled in these traps with a loss of less than 1 percent. With the exception of a farm dog that entered a trap and killed a grouse, none of the traps was molested by predators. All the other losses were apparently due to injuries sustained by flying into the wire sides of the trap.

Injuries to the scalp, mandibles, and wings were commonly incurred when the sides of the trap were covered with hardware cloth or wire screen. Such injuries were considerably reduced, and deaths were eliminated when the sides of the trap were covered with cotton netting. The disadvantage in the use of cotton netting was that rabbits and porcupines commonly chewed their way through it to get at the bait inside.

Casualties from trapping were considerably higher with the cannon-projected net trap used on the spring and fall dancing grounds. During the spring of 1956, 76 sharptails were captured with the cannon net. Of these, two were killed and four were seriously injured (broken or dislocated legs or wings). Injuries were caused by the birds becoming entangled in the large mesh of the net (2-inch diameter). A smaller meshed net would perhaps reduce such casualties.

Trap selectivity. No evidence of trap selectivity was noted during the winter trapping period. Because the composition of the various wintering flocks differed, it is unlikely that the composition of the trapped birds would be representative of those populations using the area during the breeding season (table 5).

Trapping during the spring and fall was highly selective because of the preponderance of male sharptails on the dancing grounds. A peak of female attendance on the spring dancing grounds has been noted during late April. As many as 10 females have been captured at one

time during this period by firing the cannon-nets before sunrise. Very few females are captured later in the morning, as they spread out and start leaving the dancing ground by sunrise. The fall dancing grounds probably are not attended regularly by females as none was captured during that season.

Both adult and juvenile male sharptails were present on the fall dancing grounds. Again, trapping was selective, as the territorial adult males apparently drove the juveniles to the edges of the dancing area out of range of the cannon-net. However, the juveniles were found on the center of the dancing ground for a short time after their arrival, and it was possible to trap them if the cannon-nets were fired during this period.

Marking procedure. Auramine and rhodamine were successfully used to dye sharptails. Both dyes proved to be durable, and marked birds were very conspicuous in the field. Birds dyed red or yellow in the fall of 1955, although much faded, were still recognizable 8 months later on the spring and summer range. Winter marked grouse remained conspicuous until they started to molt in late summer. One sharptail marked in the fall of 1954 still carried an unmolted yellow secondary feather when it was recaptured in the spring of 1956, over 20 months later.

Attempts to mark individual birds with combinations of red and yellow dyes were found to be undesirable because the colors tended to run together during drying and also to spread to undyed areas. During the winter of 1954-55, most of the grouse were marked combinations to represent sex, age, and release site. It was found that most combinations were hard to recognize in the field, especially when several marked birds were flushed at one time. In addition, there was a

tendency for other observers to overlook the yellow in the combination and report every bird as a red one.

Mortality and behavior of marked sharptails. Because of their conspicuous coloration, losses among dyed birds might be excessive. During the winter of 1954-55, 107 dyed and 88 undyed sharptails were banded and released on sites 3, 4, and 5. Hunter band returns and recaptures made after the dyed birds had molted their colored feathers indicated that the survival of dyed birds was similar to that of the naturally colored birds (table 3). Although a greater number of undyed sharptails were recovered, no significant difference in the number of recoveries was detected between the dyed and undyed groups when the X^2 test was used.

Observations of marked birds in the field indicated that they behave normally. Dyed sharptails were observed in flocks of unmarked birds and on dancing grounds. The nests of four marked females were located, and at least one hen successfully raised a brood of six young.

Tracing the movement of marked sharptails. Records of marked sharptails were received from personal observation, voluntary reports from other observers, and reports returned on a questionnaire mailed out for that purpose. Personal observation at dancing grounds and other areas consisted entirely of birds that remained in the vicinity of the trapping sites and does not supply any information on wider dispersal. Such records are of value chiefly in determining the extent of local seasonal movements and are comparable to local retrapping recoveries of banded birds.

Voluntary reports of the conspicuously marked grouse were expected to fill in the longer movements, but only three reports were received

Table 3. Recovery data from dyed and undyed sharp-tailed grouse trapped during the winter of 1954-55 at sites 3, 4, and 5, Morton County, North Dakota

Color	Sex	Number released	Recovered after molting	
			Number	Percent
Dyed	Male	59	18	30.5
Undyed	Male	44	16	36.4
Dyed	Female	48	13	27.1
Undyed	Female	44	14	31.8
Dyed	Total	107	31	29.0
Undyed	Total	88	30	34.1

The difference between the recovery of dyed and undyed sharptails (both sexes) was not significant by the chi square test. $X^2 = 0.4139$; $.70 > P > .50$.

following the release of 121 colored birds during the fall of 1954 and the winter of 1954-55. A questionnaire requesting records of marked grouse was distributed to farmers within 25 miles of the release sites, following the winter marking program of 1955-56. Twelve reports (only seven were considered reliable) were received. Personal interviews showed that some of the farmers within the trapping area failed to report the marked grouse they had seen. These people were acquainted with the work and no longer had their curiosity aroused as did the people away from the area. The use of both interviews and questionnaires for tracing movements of dyed sharptails should be considered in future work.

Band recoveries. The sources of band recoveries were recaptures and band returns. Hunter band returns should give the most representative distribution of dispersal, because hunting pressure was more evenly spread out over the possible area of recovery.

Unequal distribution of hunting pressure and mistakes in reporting the location of the kill would impair the accuracy of dispersal patterns based on hunter band returns. An aerial hunting pressure survey made during the first 3 days of the 1956 hunting season indicated that hunting pressure was greater (four times as great) in the vicinity of the trapping sites than in other parts of Morton County. However, because the area near the trap sites contained a greater percentage of sharptail habitat than the other areas checked, it is believed that hunting pressure per unit of sharptail range did not vary this much. Trapping site 4 was located on the Morton County State Game Refuge. No hunting was allowed on the refuge, and the adjacent areas were heavily posted. Only two bands from birds banded on site 4 were returned by

hunters.

Hunters who returned bands were interviewed personally or by telephone to further verify the location of recovery. Although this procedure eliminated much error, it was possible that some banded birds were not noticed until after they had become mixed with other sharptails that had been killed over a wide area.

Sexing and ageing techniques. Although no attempt was made to evaluate the accuracy of the sexing and ageing techniques used during this study, some error is known to exist. In describing the method of sexing sharp-tailed grouse, Manwieler (1939) mentioned that he correctly determined the sex of 85.7 percent of a group of 56 sharptails by the examination of the two central tail feathers. By the same method, L. L. Snyder (Manwieler 1939, correspondence) correctly aged 85.5 percent of 76 adult sharptails in a labeled collection.

No reference on the evaluation of the ageing techniques described by Ammann (1944) was located in the literature, but Reuel Janson (letter) reported that in South Dakota:

> Comparison of bursa age determinations and primary age determinations while making hunter bag checks showed a number of birds with deep bursas that had molted their outer primaries. Usually this had occurred in such a small number of birds that it was of little consequence as far as age determinations was concerned.

Errors in sexing and ageing techniques, although apparently minor, must be considered in the analysis of the differential movement of the four sex and age classes.

Seasonal movements of banded and marked sharp-tailed grouse

The fall and spring movements of sharp-tailed grouse between the grasslands used for breeding and the brushy or wooded wintering sites

have been described for all of the southern races of this species (Hamerstrom and Hamerstrom 1951). The banding studies of Aldous (1943), Janson (1951), Hamerstrom and Hamerstrom (1951), Hammond (1957, unpublished), and Peterle (1956) indicate that a part of the wintering population is sedentary, but that considerable dispersal can be expected from some of the wintering birds. Comparatively little is known of the time of the wider dispersion or which sex and age groups are most active in it; the sex and age composition and dispersal of the different types of wintering flocks; or the attachment of sharptails to specific dancing grounds and wintering sites, particularly the juveniles and adult females. More information is also needed on dispersion of sharp-tailed grouse from the spring and fall ranges.

Dispersal from wintering areas. Four hundred and fifty-two unbanded sharptails were trapped during the winters of 1954-55 and 1955-56 (table 2). Ten additional sharptails that had been banded during the fall were recovered at wintering sites. Of the 462 individual birds released at wintering sites, 44 were recovered in the second winter, 32 in the spring, and 35 in the fall. One hundred and seventy-four of the winter released sharptails were marked with dye. At least 64 (36.8 percent) of the marked grouse were observed or reported during the spring and summer following the winter in which they were released (table 4).

The sex and age composition of the sharptails trapped at different wintering sites varied considerably (table 5). On the basis of the sex and age of the grouse trapped and the estimated number wintering at each area, the wintering sites appeared to be of three types: (a) sites used by small flocks composed largely of males, (b) those used by large

Table 4. Summary of the seasonal recoveries and observations of sharp-tailed grouse banded and marked during the winter, Morton County, North Dakota

Winter	Number released	Season and number recovered							
		Same winter	1st spring and summer	1st fall	2nd winter	2nd spring	2nd fall	Total recoveries	Number birds recovered
Banded									
1954-55	212	0	5	15	44	9	5	78	68
1955-56	250[1]	1	18	15	-	-	-	34	30
Both	462	1	23	30	44	9	5	112	98
Marked									
1954-55	112		54						
1955-56	62		10						
Both	174		64						

1. Includes all recaptured birds except those released during the previous winter.

Table 5. Sex and age composition of sharp-tailed grouse trapped on wintering sites

Site	Year	Estimated number present	Number trapped	Percent			
				Adult male	Juvenile male	Adult female	Juvenile female
2	54-55	30	13	38.4	38.4	15.4	7.7
5	55-56	50	35	31.4	54.4	5.7	8.6
9	55-56	30	11	54.5	36.4	0.0	9.1
10 & 12	55-56	200	77	3.9	26.0	31.2	39.0
3	54-55	125	82	11.0	33.0	17.1	39.0
	55-56	50	35	11.4	37.2	37.2	14.3
4	54-55	100	52	25.0	27.0	11.5	36.5
	55-56	150	81	22.2	34.6	21.0	22.2
5	54-55	75	57	21.0	45.6	8.8	24.6
11	55-56	40	30	33.3	20.0	26.7	20.0

flocks of adult females and juveniles, and (c) an intermediate type in which both males and females were well represented.

The relationship of the wintering sites to dancing grounds was difficult to appraise because there were dancing grounds within 1.5 miles of all the wintering sites. The three sites on which males predominated (sites 2, 5, and 9) were all located within 0.5 mile of an established dancing ground. There is some indication that feeding conditions were below average at these sites. The only woody emergent cover at sites 2 and 5 consisted of a few clumps of buffalo berry and willow, respectively. During the mild winter of 1954-55, feeding conditions in the fields were better at site 5 than in 1955-56, and a greater number of females wintered there in the former year. However, site 9 was in a wooded ravine which provided a supply of buds, but only one female was captured.

A large flock of adult females and juveniles wintering near sites 10 and 12 had probably been attracted by the favorable feeding opportunity provided by an unharvested flax field and a large field of shocked corn within 0.5 mile of several heavily wooded ravines. During an aerial count, it was estimated that from 175 to 200 sharptails were using this area. About half of them were observed flying in one flock.

At the sites where both males and females were well represented among the trapped grouse, the degree of segregation of the sexes was unknown. Both males and females were removed from the same traps, but they may have arrived at the trapping sites in separate flocks. Although large flocks of grouse were observed at sites 3, 4, and 5, it is possible that the adult males were not represented in them. These sites may have been areas used jointly by flocks of males attached to

local dancing grounds and by larger groups of adult females and juveniles.

The large wintering flocks became less noticeable in March when the males began to attend the dancing grounds regularly. During early morning dancing ground counts in mid-March, flocks of 30 to 40 sharptails were observed in fields near active dancing grounds. Because these birds were apparently feeding and there was no sign of dancing activity, it was possible that some females remained in large flocks well into March. By mid-April the females became common on the dancing grounds and often arrived and departed singly.

The extent of dispersal from the wintering sites was indicated by the distribution of marked grouse observations and hunter band recoveries (tables 6 and 7). About 74 percent of the band recoveries and 86 percent of the marked bird observations were made within 1.5 miles of the winter release sites. Although a large majority of the birds remained near the wintering sites, a part of the wintering population dispersed widely. Two marked grouse were observed about 30 miles from the general trapping area, and one banded sharptail released on site 11 was shot 16.5 miles away during the first hunting season. This same general distribution of band recoveries was noted by Aldous (1943), Hamerstrom and Hamerstrom (1951), and Peterle (1956).

The time at which the wider movements away from the wintering sites took place was not clear. The hunter band returns indicated that some dispersal had taken place by late fall (most of the hunter band returns were made in October). A small sample of fall returns of sharptails trapped on the spring dancing grounds showed that no dispersal took place in this group of recoveries (table 6). This indicated that

Table 6. Distribution of spring and summer marked bird observations and fall hunter band returns from sharp-tailed grouse released in Morton County, North Dakota

Season of release	Source of data	Number recovered	Distance in miles from the release site						
			0-1.5	1.5-5	5-10	10-15	15-20	20-25	25-30
Winter	Marked birds	64	55	3	1		2	1	2
Winter	Hunter band returns	32	23	3	3	1	2		
Spring	Hunter band returns	11	11						
Fall	Hunter band returns	1	1						

Table 7. Spring and summer movements of sharp-tailed grouse marked on the wintering sites

Winter released	Release site	Number marked	Number observed	Miles from release site	
				Average	Range
1954-55	All	121[1]	54	2.0	0.25 - 30.0
1955-56	All	62	10	7.0	0.5 - 22.0
1955-56	10 & 12[2]	52	7	9.8	1.5 - 22.0
1955-56	9	10	3	0.8	0.5 - 1.0
1954-55 & 1955-56	All	183	64	2.8	0.5 - 30.0

1. Includes nine marked birds that were released 0.25 mile from wintering site 2 on October 2, 1954, because at least six birds spent part of the winter on site 2.

2. Sites 10 and 12 were frequented by a large group of adult females and juveniles.

the dispersal from the wintering sites took place between the time of winter banding and the time at which the grouse became attached to the dancing grounds. Some of the wider dispersal may have taken place during the winter. One juvenile male banded at site 3 on December 10, 1955, was recaptured 10 miles away on site 13 on February 27, 1956. Hammond (1957, unpublished) reported a large amount of winter movement of less than 2 miles for sharptails on the Lower Souris Waterfowl Refuge in North Dakota but also cited three instances of movements of from 7.5 miles to 10 miles during this season. On the Morton County study area, no direct evidence was found of long movements during early spring before the sharp-tailed grouse began to gather on the dancing grounds. However, because the number of males found on dancing grounds within 2.25 miles of the wintering sites appeared to be less than the number on the wintering sites during late winter, it was assumed that some of the wider dispersal took place during late winter and early spring.

Some evidence of the dispersion of the various sex and age classes from the wintering sites was noted. Sixty-five percent of the male sharptails marked during the winter of 1954-55 were observed on spring dancing grounds within 2.25 miles of the winter trapping sites. The average distance of movement was 0.9 miles. Because not all of the dancing grounds were located, it was likely that a greater percentage of the males used dancing grounds near wintering sites.

A sample of winter-banded sharptails, that were recaptured on or found dead near dancing ground adjacent to wintering sites in the spring, indicated that both juvenile and adult males had a tendency to breed near the wintering sites (table 8). In addition, the

Table 8. Spring band recoveries of winter trapped sharp-tailed grouse released in Morton County, North Dakota[1]

Sex and age	Recoveries[2]	
	Direct	Indirect
Adult male	10	5
Juvenile male	10	4
Unaged male	1	0
Adult female	1	0
Unaged female	1	0

1. Six sharptails were found dead; the remainder were recaptured on dancing grounds.

2. All spring band recoveries were made within 1.25 miles of the winter release site.

distribution of fall band returns was similar for both adult and juvenile males. The average distance of recovery was 1.2 and 1.3 miles, respectively, (table 9).

Less evidence was available on the dispersion of female sharptails from the wintering sites. Only seven of the winter marked or banded females were noted during the spring and early summer, but all of these were within 1.5 miles of the winter release sites. One of the females was observed near a dancing ground, one was found dead, one was retrapped on a dancing ground, and the nests of four others (indicated by dyed feathers in the nest) were found. The distance at which banded females were shot from the winter sites was greater for females (especially juvenile females) than for males (table 9).

The sex and age composition of the birds recaptured the second winter at sites 3, 4, and 5 compares favorably with the composition at banding during the first winter (table 10). If it is assumed that the chances of grouse returning to the same wintering area the second winter diminish with the distance of dispersal, then the composition of the banded grouse retrapped during the second winter might be usable in evaluating differential dispersal. However, the presence of homing ability to wintering sites, trap selectivity, or differential mortality would alter the validity of this assumption.

The dispersal of the large flock of adult females and juveniles from sites 10 and 12 was traced through marked bird observations reported on a questionnaire (table 7). Although it is possible that the longer average movement of this flock (9.8 miles) was partly due to the different method employed in collecting observations, only two birds (males) were located on dancing grounds in the area of the

Table 9. Differential movements indicated by direct fall band returns from sharp-tailed grouse released during the winters of 1954-55 and 1955-56, in Morton County, North Dakota

Sex and age	Number recovered	Miles from release site	
		Average	Range
Adult male	9	1.2	0.50 - 4.25
Juvenile male	7	1.3	0.25 - 6.25
Adult female	8	1.6	0.25 - 7.00
Juvenile female	4	7.4	0.75 -16.50

Table 10. Recoveries of sharp-tailed grouse trapped during the winter of 1954-55 at the same site one year later on sites 3, 4, and 5

Sex and age when banded	Banded		Recovered		
	Number banded	Percent composition	Number[1]	Percent composition	Percent recovered
Adult male	34	17.8	8	18.2	23.5
Adult female	25	13.1	7	15.9	28.0
Juvenile male	67	35.0	13	29.5	19.4
Juvenile female	65	34.0	16	36.4	24.6

1. The difference between the composition of the recovered and released population was not significant by the chi square test. $X^2 = 0.69$; $.90 > P > .80$.

release site during the spring of 1956. Three direct fall band returns from grouse banded on site 12 were received in the fall of 1956. One adult male had been shot 4.25 miles away, and two adult females 0.5 and 7.0 miles away. Further banding and marking are needed to determine if any differential movement occurs between the sex and age groups from the various types of winter aggregations.

Other workers (Janson 1951; Baumgartner 1939; Hamerstrom and Hamerstrom 1951) have mentioned the different types of winter sharptail concentrations. Janson (1951) banded 148 sharptails (44 males and 104 females) on an island in the Missouri River near Mobridge, South Dakota. The average movement of 12 fall-recovered birds from this group was 10.4 miles. Although no mention was made of the age composition of the banded birds, it is likely that this concentration was similar to the one found near sites 10 and 12 because of the high proportion of females and the fact that this flock was wintering outside of the breeding range.

Dispersal from the spring dancing grounds. Spring trapping and banding was carried out in 1956 to trace the movements of sharp-tailed grouse from the dancing ground areas to their fall and winter range. Seventy-four birds were trapped at eight sites (tables 1 and 2) located in the same general area as the winter trap sites (figure 1). The breast feathers of 10 females captured on site 7 were dyed red, and the wings or tails of five birds trapped at site 8 were also marked with dyes.

One male trapped on a dancing ground (site 6) on April 17, 1956, was recaptured on a different dancing ground (site 12) about 0.4 mile away on April 24, 1956. This was the only evidence of a shift between

dancing grounds by any of the male birds. Observations on dancing grounds showed a constant number of marked and unmarked males in attendance from morning to morning during the peak of dancing ground activity in April. Some shifting probably occurred between closely located grounds, but such shifting was negligible when the dancing grounds were located more than 1 mile apart.

Some sharptails of both sexes remained in the vicinity of the dancing grounds during the spring and early summer. A flock of males containing marked birds was commonly flushed in the vicinity of site 7 during a nesting study in the summer of 1955. The frequency of observations as well as the size of the flock declined considerably by the first of July. Apparently the flock split up during the molting season, and it is suspected that there might have been a movement off this upland area as well. Coues (1874) and Baumgartner (1939) have described a movement to moist brushy areas during mid-summer.

Five sight observations of red-dyed females were made between April 4 and August 21, 1956. The distance of these observations ranged from 0.5 to 0.75 miles to the south and west of site 7. It was possible that only one bird was seen. On June 21 a colored hen was observed with a week old brood. A colored hen was observed in the same area on August 21 with a brood of six nearly full-grown young. In 1955, 14 sharptail nests were located near trapping site 7 (dancing ground). Nine of the nests were found within 0.5 mile of the dancing ground. The success of locating nests diminished at distances past 0.5 mile to such an extent that attempts to locate nests over 1 mile from the grounds were discontinued.

No evidence of a dispersal of adult birds during the summer and

early fall was noted from the return of 11 direct hunter band returns of spring banded sharptails (table 6). All these birds (about 15 percent of the spring banded population) were shot within 0.75 mile of the respective release sites.

Very little was learned of the dispersal of the juvenile sharptails. Some of the broods were raised near the dancing ground sites, but no information was available on their movements after they became independent of the hen. During September small groups of grouse were flushed that probably represented broods. Juvenile male sharptails were in attendance on the fall dancing grounds in October, but whether or not these were locally-raised birds is questionable; there may have been a shuffle during this period.

Dispersal from fall range. Twenty-five male sharptails were banded and marked on the fall dancing grounds in 1954 and 1955 (table 2).

None of the fall banded grouse were killed during the hunting season in which they were banded. Sixteen of the 25 fall banded and dyed male sharptails that were trapped and marked on sites 1, 7, and 8 (dancing grounds) were recaptured or observed wintering on areas within 1.75 miles of the respective release sites (table 11). This is a minimum estimate of the number of fall banded birds that spent at least part of the winter adjacent to the fall dancing grounds.

By marking the male sharptails on the fall dancing grounds, it was possible to determine how many returned the following spring. Nine male sharptails (eight adults and one juvenile) were dyed yellow at site 1 during the fall of 1954. Because four male sharptails were also marked with yellow dye near this site (site 2, 0.25 mile north) during the winter, it was impossible to determine exactly how many of the fall

Table 11. Band recoveries and observations of 25 fall released sharp-tailed grouse

Source of data	Season of observation or recovery			
	1st Winter	1st Spring	2nd Fall	2nd Spring
Band recoveries	12	4	1	1
Marked grouse observations	13	12	-	-
Combined band recoveries and marked grouse observations[1]	16	12	1	1

1. After elimination of duplication.

marked birds returned to the same dancing ground in the spring. Ten marked male grouse were observed at site 1 in April 1955, so it is certain that at least six and possibly more of the fall marked birds returned to the same dancing ground.

During the fall of 1955, six all yellow adult males and 10 yellow juvenile males with red tails were released on sites 7 and 8 (dancing grounds). Colored celluloid leg bands were used to identify the release sites. Four of the adult males and two of the juvenile males returned in the spring. Four of these birds (three adults and one juvenile) were captured with a cannon-net trap. There was no evidence to show if the low return of juvenile birds was due to movement or mortality. Fall trapping and marking showed that juvenile males commonly attend the dancing grounds during their first fall, and at least some may become permanently attached at this time. Hamerstrom and Hamerstrom (1951) have noticed the presence of juvenile males on fall dancing grounds by observing the molting pattern on the wings of the dancing birds, and they also suspected that new grounds may have originated during this time of year.

None of the recoveries of marked or banded sharptails released in the fall (table 11) was made more than 1.75 miles from the release sites.

Home range vs. progressive dispersion. A review of the movements away from the seasonal trapping sites showed a trend toward short seasonal movements by the majority of the population with widespread dispersion up to 30 miles by the remainder. Janson (1951) reported that his banding studies indicated two types of movement, a regular seasonal movement between breeding and wintering areas, and a more or

less continuous dispersal. Most of the sharptails that Janson banded were from flocks wintering off the breeding range.

Some evidence against a continued outward dispersion from wintering sites was furnished by repeated recaptures of sharptails on wintering sites and local dancing grounds (table 12). Banding records showed that 16 sharptails were recovered two or more times during the course of this study (in some cases this included the final return if the bird were shot). All the multiple recoveries showed repeated short range movement between wintering and dancing ground sites where the trapping was carried out. None of the birds in this group was recovered at more than 1.25 miles from the wintering site or dancing ground site on which it had been trapped. None of 67 sharptails that were recaptured at least once have to date been shot or retrapped outside of the range to which they have apparently become attached. Some sharptails apparently became attached to a "home range" from which little dispersion takes place; it will be necessary to continue trapping over a period of years to determine the importance of continuous dispersal.

Females as well as males may become attached to a particular range as evidenced by the proportional return of females and males to the same wintering sites the second winter (table 10). In the case of males, the attachment of at least certain individuals to a particular dancing ground for more than one season has been demonstrated. It was also shown that this attachment may begin during the first fall for some juvenile males. The attachment of females was less clear chiefly because of the difficulty with which they were trapped on the dancing grounds. From the small sample (20) of females captured on the spring dancing grounds, only one was banded (5 percent), but approximately 49

Table 12. Movements of sharp-tailed grouse recovered more than once between October 1, 1954 and November 4, 1956[1]

Miles moved between band and seasonal recovery sites						
Fall	Winter	Spring	Fall	Winter	Spring	Fall
Banded	0.25				0.0	
Banded	1.25	0				
Banded		0	0.5			
Banded	1.0	0				
	Banded		1.25[2]	0		
	Banded		1.25[2]	0	1.25	
	Banded				1.25	1.25
	Banded			0	1.25	1.00
	Banded			0		0.25
	Banded			0	0.5	
	Banded			0	0.5	
	Banded			0	0.5	
	Banded	0.5	0.25			
	Banded	1.0	1.00			
	Banded	0.75	0.25			
	Banded	0.75	0.25			

1. The word banded appears under the season of the original capture; the distance of each recovery in miles from the original trapping site appears under the season of each subsequent recovery.

2. Trapped on fall dancing ground; other fall recoveries were shot.

percent of the spring trapped males was banded. Assuming no selectivity in the winter trapping, an equal proportion of each sex should have carried bands. Fall recoveries of winter trapped sharptails showed a wider dispersal of females than males (table 9). Additional trapping on both spring and wintering sites is needed to determine the extent of the attachment to a home range.

CONCLUSIONS

The trapping and marking techniques used during this study are considered effective for the study of sharp-tailed grouse movements under conditions present on the study area. In other areas it is likely that modifications would be necessary. Peterle (1956) in Michigan found that grains were unsatisfactory as bait, but he was successful in attracting sharptails with buds of the white birch Betula alba papyrifera. The selection of a winter trap will also depend on such factors as snow conditions and availability of the trapping sites.

Serious trapping injuries and mortality were insignificant with the funnel trap but approached 10 percent of the trapping catch when the cannon-net assembly was used. The degree of trapping selectivity was not determined during the winter but favored males over females on the spring dancing grounds and adult males over juvenile males on the fall dancing grounds. The composition of the catch varied with the time during the morning when the trap was fired.

The dyes auramine and rhodamine proved to be applicable in marking sharptails. Dyed grouse could be easily recognized for at least 3 months and for as long as 8 months in some instances. Combinations of dyes were avoided in later work because of the difficulty in applying and because of uncertainty in field recognition, especially by untrained observers.

Preliminary work on the mortality and behavior of marked grouse indicated that in spite of their conspicuous coloration, they behaved

normally, and losses were no higher than in an uncolored group banded in the same area. If these results are substantiated in future work, it would be a safe practice to combine survival studies with a marking program or use marked birds in other projects such as census studies.

No relationship was demonstrated between the distribution of marked grouse observations and the actual dispersal pattern of sharp-tailed grouse. Personal observation, because of time and space limitations, consists chiefly of birds seen around the release sites. Reliable reports from other observers were of value in determining the range of movement. This source of observations could perhaps be exploited more fully by applying questionnaire and random personal interview methods in the area surrounding the release sites. Extreme care must be exercised in accepting reports from untrained observers.

The distribution of fall band returns from hunters is perhaps the best indicator of sharptail dispersal, but unequal distribution of hunting pressure and occasional mistakes in locating the area where the kill was made may result in misleading conclusions. Band recoveries from trapped birds and the few found dead, like personal marked bird observations, tend to exaggerate the sedentary habits of the sharp-tailed grouse.

The preliminary results of this study show that the sharp-tailed grouse is a sedentary species in this area. The average annual cruising radius is estimated to be less than 2 miles, although a part of the wintering populations may disperse widely. Similar results were recognized in other banding studies by Aldous (1943); Hart, Lee, and Low (1950); Hamerstrom and Hamerstrom (1951); and Peterle (1956). Marshal and Jensen (1937) estimated that the annual cruising radius of

the sharp-tailed grouse was about 2 miles. Most of the widespread dispersion probably occurs between late fall and early spring, but more recoveries are needed from spring and fall banded sharptails before this conclusion can be accepted.

A larger sample of band recoveries and marked grouse observations from all sources is needed before the differential dispersion of the various sex and age classes can be evaluated. The preliminary results of this study indicate that the sex and age composition of the sharp-tailed grouse varies with the trapping sites. This may be due to the reluctance of adult males and some juvenile males to winter away from their dancing grounds even when feeding conditions are below optimum, while adult females and juveniles tend to move to areas that are better suited for feeding. When favorable wintering sites are located near dancing grounds, both males and females may be well represented among the wintering birds. The degree of segregation of the sexes at the latter type of wintering site is unknown. More information is also needed on the source and dispersion of the large flocks of adult females and juveniles.

The majority of the wintering males, both adult and juvenile, remained near the wintering sites to breed. Some females also selected breeding areas near the wintering sites, but there is some evidence of a wider average dispersal of females from wintering sites than of males. A lower percentage of winter banded females than males was retrapped on the spring dancing grounds. However, both sexes returned to the same wintering sites the second winter in proportional numbers.

After the sharptails have become attached to a dancing ground, apparently little dispersion occurs although there may be some shifting

between local dancing grounds. Most of the hens nested within 0.75 mile of the dancing grounds, and broods were commonly found in the same area during early summer. The tendency for sharptails to nest or rear broods near dancing grounds has been mentioned by Baumgartner (1939) and Hamerstrom (1939). The range used during late summer on the sharptailed grouse study area is unknown, but by October the grouse were found in the uplands near the dancing grounds. Fall band returns indicated that the same range was used in the fall and spring; no dispersion was noted from the spring range.

Juvenile dispersion during early autumn was not studied, but juvenile males do attend the fall dancing grounds and some may become permanently attached at this time. Most of the males marked on the fall dancing grounds wintered nearby, and many returned to the same dancing ground in the spring.

There is a possibility that a home range exists because of strong attachments to dancing grounds or wintering sites. Multiple recoveries of individual males within a restricted range and the return of sharptails to the same dancing grounds and wintering sites in later years were presented as evidence, but a definite conclusion cannot be drawn until further study is completed.

SUMMARY

1. A sharp-tailed grouse movement study was initiated by the North Dakota Game and Fish Department in the fall of 1954 on a study area in eastern Morton County, North Dakota. This paper presents an evaluation of the methods used and a preliminary analysis of data on seasonal movement to November 4, 1956.

2. Baited funnel traps were used effectively during the winter to trap sharptails. Two sets of Dill's improved cannon-net assemblies were used to trap grouse on the dancing grounds. The composition of the catch made with the cannon-net varied with the time of morning at which it was discharged. Trapping injuries were frequent when the cannon-net assembly was used but negligible with the use of the funnel trap.

3. The sharp-tailed grouse marked with auramine or rhodamine were recognizable in the wild for over 3 months. Some difficulty was experienced when both dyes were used on one bird. No difference in the mortality or behavior of the dyed and undyed sharptails was noted.

4. In total, 523 sharp-tailed grouse were banded at 17 sites located on wintering areas or on the spring and fall dancing grounds. Of the trapped sharptails, 214 were marked with dyes. Movement was traced through 128 band recoveries from 110 different sharptails and 284 recorded observations of dyed sharptails.

5. The sharp-tailed grouse on the trapping area were largely sedentary, but a small part of the wintering population dispersed widely.

The average annual cruising radius was estimated to be less than 2 miles.

6. The long movements of banded sharptails probably took place during the winter and early spring, as no dispersal was noted from the spring and fall dancing grounds.

7. The majority of adult and juvenile male sharptails used dancing grounds within 2 miles of the wintering sites on which they were released; females also used breeding areas near their wintering sites but to what extent was undetermined.

8. A large wintering flock of adult females and juveniles appeared to disperse more widely than flocks at sites where adult males were also present.

9. Some juvenile males became attached to a dancing ground during their first autumn and returned to the same ground the following spring.

10. Multiple recoveries of individual sharptails on the same dancing grounds and wintering areas suggested a strong attachment to a particular range.

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