Blue grouse production, movements and population, in the Bridger Mountains, Montana
by Thomas W Mussehl

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management
Montana State University
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Abstract:
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by

THOMAS W. MUSSEHL

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Submitted to the Graduate Faculty

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ABSTRACT

A study of blue grouse (Dendragapus obscurus) was conducted in the Bridger mountains of southwest Montana. Field work, on a full or part time basis, was carried on from April 14, 1957 to October 6, 1958. A total of 256 grouse, captured on the summer range, provided a nucleus of data on seasonal movements, development of young, population characteristics, and other life history information. Grouse observations were made throughout the course of the study and hunting season information was obtained by contacting hunters.

INTRODUCTION

Various aspects of the life history and ecology of blue grouse, Dendragapus obscurus (AOU-1957) have been reported. These include, in Washington, food habit studies by Beer (1943), breeding age analysis by Buss and Schotelius (1954), brood habits and growth by Wing, Beer, and Tidyman (1944); and life history studies by Bendell (1954) in British Columbia, Caswell (1954) in Idaho, and others. The seasonal, altitudinal migration has been described by a number of workers, including Marshall (1946) in Idaho, Wing (1947) in Washington, and Bendell (1955) in British Columbia. During winter, blue grouse are reported to be present at the higher elevations of their mountain habitat. In spring, a movement to lower elevations takes place. Broods are raised in the foothill areas and move to higher elevations in late summer. The present study was on marked blue grouse from the Bridger mountains in Gallatin county, Montana. Information was secured on the chronology and extent of seasonal, altitudinal migrations; brood movements; development of young; population characteristics and general life history. During the summer months of 1957 and 1958, 256 blue grouse were captured, and of these 236 marked. Periodic observations of marked and unmarked grouse were made during other months of the year from April 14, 1957 to Oct. 5, 1958.

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DESCRIPTION OF THE AREA

The study area (Fig. 1), consisting of approximately 10 square miles on the western slope of the Bridger Mountains, in southwestern Montana, is located 20 miles north of Bozeman. The main part of the Bridger range extends in a somewhat north-south direction, with numerous ridges and canyons extending in an east-west direction. The slopes are generally steep (Fig. 2). Elevations on the study area range from 5,200 to 8,840 feet.

Three of four vegetative types described by Wilkins (1957) were included on the study area.

The montane forest (Figs. 1, 2, 3), consisting mainly of Douglas fir (Psuedotsuga menziesii) extends from approximately 6,000 to 8,600 feet. Limber pine (Pinus flexilis) and white bark pine (Pinus albicaulis) are prevalent on the tops of the higher ridges with some alpine fir (Abies lasiocarpa) on the north slopes. Most of this vegetative type is included in the Gallatin National Forest.

The bunchgrass prairie (Figs. 1, 2) extends outward from the base of the mountain. Bluebunch wheatgrass (Agrypyron spicatum) and Idaho fescue

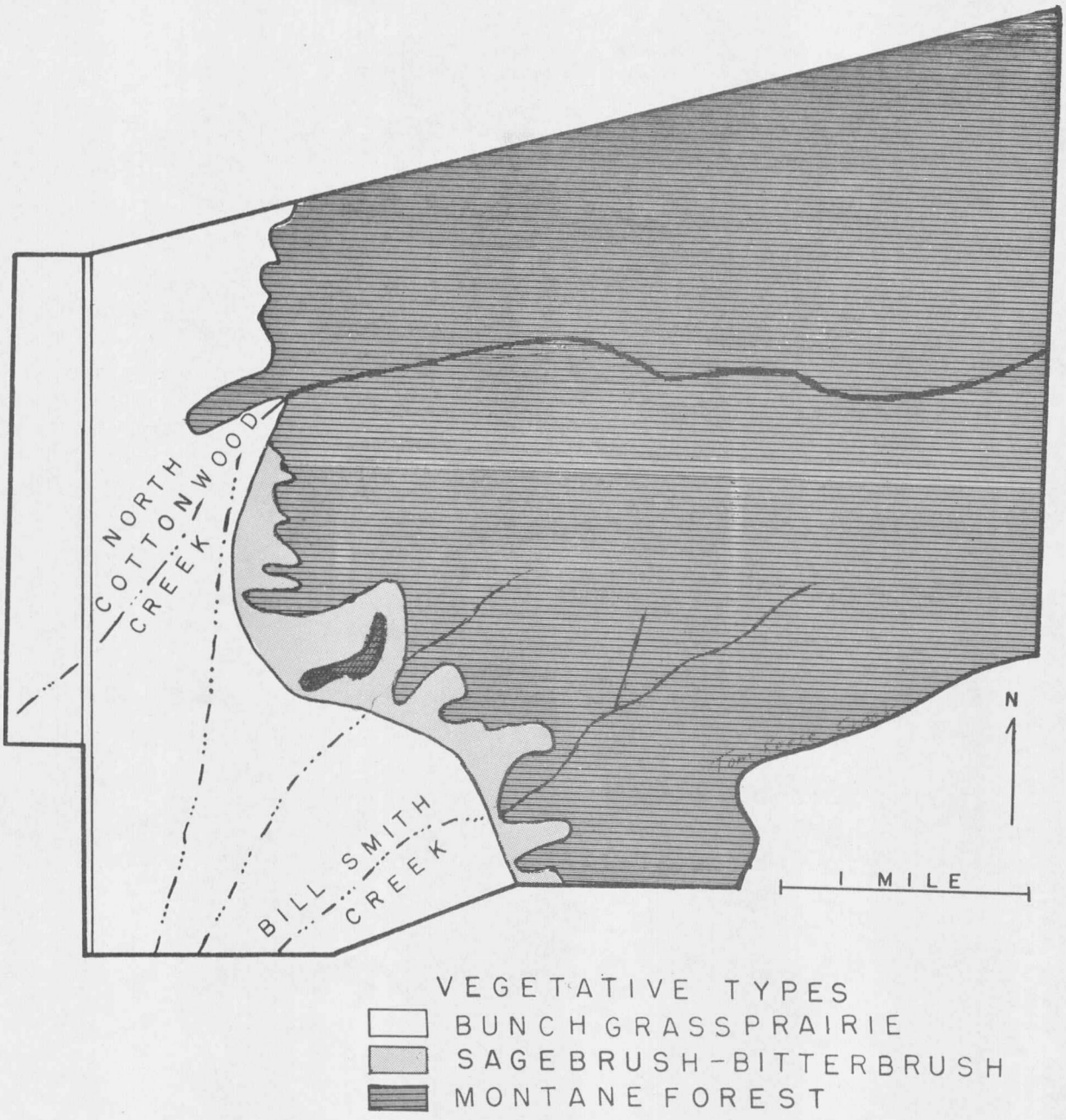


Fig. 1. Map of the study area.



Fig. 2. Blue grouse summer range; foreground, bunchgrass prairie; middle, sagebrush-bitterbrush; rear, lower montane forest.



Fig. 3. Blue grouse winter range: upper montane forest.

(Festuca idahoensis) are important grasses of this type. Balsamroot (Balsamorhiza sagittata) is an abundant forb. Big sagebrush (Artemesia tridentata) is scattered throughout. The portion of this type not grazed by livestock is devoted mainly to the growing of small grains and hay. Deciduous thickets are common along stream courses and at the mouths of draws near the base of the steep mountain slopes. The common shrubs and trees are black hawthorn (Crataegus douglasii), common choke-cherry (Prunus virginiana), Rocky Mountain maple (Acer glabrum), black poplar (Populus trichocarpa) and rose (Rosa acicularis).

A third vegetative type sagebrush-bitterbrush (Figs. 1, 2), occurs on the steep lower slopes of the mountains, extending from approximately 5,600 to 6,400 feet. This type is generally situated intermediate to the montane forest and bunchgrass prairie types. Common plants are big sagebrush, bitterbrush (Purshia tridentata), Rocky Mountain juniper (Juniperus scopulorum), cheatgrass (Bromus tectorum), bluebunch wheat-grass and balsamroot.

METHODS

In April, May and June of 1957 and 1958, portions of 41 days were spent cruising the study area on foot to locate breeding grouse. Hooting males could be heard at a maximum of about 75 yards, this distance being comparable to that estimated by others, including Caswell (1954) and Brooks (1926). In the spring of 1957, two mirror type traps similar to those described by Tanner and Bowers (1948) were used to capture territorial males. Christmas tree ornaments filled with automobile

lacquer were hurled at grouse that allowed approach to within thirty feet. Four were successfully marked. Bendell (1954) successfully used this method for marking blue grouse in British Columbia. In May and June of 1957 and 1958, portions of 57 days were spent in the field making grouse observations and looking for nests. A Labrador dog was used as an aid for the latter task during 1958.

From July to early August, broods were frequently found in the bunchgrass prairie and sagebrush-bitterbrush areas. During 1957 and 1958, portions of 44 days were spent cruising these areas with a jeep to locate broods. Early morning and late afternoon hours produced the best results. Broods often allowed a vehicle to approach them closely. Two men, equipped with hand nets (30 to 36 inch diameter hoops and 9 to 10 foot handles) would approach the brood from opposing directions. Grouse were netted on the ground or as they flushed. Several hens were captured as they flew at an observer in defense of their young. In late July and August, broods increased their usage of deciduous thickets. Grouse could then be captured with hand nets by two observers walking on opposite sides of the characteristically linear strips of brush. A cannon-fired net, mounted on the front of a jeep was tried. This was not very effective on the rough, brushy terrain. Several chicken wire traps using the principle of the modified shorebird trap (Liscinsky and Bailey, 1955) were used in brushy areas. These traps were generally baited with chokecherry and hawthorne fruit. There was a total of 92 trap days in 1957, and 90 in 1958.

In 1957, 105 grouse were captured as follows: 10 adult females and 89

juveniles by hand nets; 5 juveniles by baited wire traps; one adult (presumably a male) by a mirror trap. These included a female and 4 of her 6 young, 6 of 7 young of another female, and 2 to 3 members of 10 other broods, plus individuals that could not be assigned to a definite brood.

In 1958, 151 grouse were captured as follows: 19 adult females, 3 adult males, and 122 juveniles by hand nets, 4 juveniles and 2 adult females by baited wire traps, and 1 juvenile by a cannon net trap. Included were a female and 5 of her 7 young, and 2 to 4 members of 24 other broods, and unassigned individuals.

Grouse of 250 grams or less were weighed to the nearest 5 grams and those over 250 grams to the nearest 25 grams. Primary feather development and other plumage characteristics were noted. "Jiffy" wing bands from the National Band and Tag Company, Newport, Kentucky, were put in each patagium of the smaller chicks; aluminum leg bands were used on grouse of about five weeks of age and older. Combinations of plain and anodized aluminum bands, colored plastic spiral leg bands, and feathers painted with airplane dope were used to permit individual identification in the field. Identification of marked birds was aided by 8 x 30 binoculars. Back tags similar to those described by Blank and Ash (1956) and modified by Eng (1957), provided individual identification for grouse mature enough to wear them. Emphasis was placed on recatching banded birds in order to obtain data on development.

In 1957, nine recaptures involving eight juveniles were made with hand nets. Sixty-one observations (excluding recaptures) were made of

33 marked individuals, with a range of 1-7 observations per bird.

In 1958, 47 recaptures involving 27 juveniles were made with hand nets. One female juvenile was captured eight times. Sixty-nine observations (excluding recaptures) were made on 32 marked individuals.

From September 15 through 29, 1957 and from September 21 through October 5, 1958, hunters were contacted at checking stations and in the field. Grouse weights, sex, bursa depths, kill site elevations and band return locations were recorded, and the primary feathers and tails collected. Hunters were asked the number of hours they hunted in the lowland brush and mountain timber, and the number of grouse seen and shot in each of the two habitats.

Observations were made in wintering areas by snowshoeing and walking the high ridges. In 1957, trips were made on November 7 and 21, December 28 and 31. In 1958, they were on January 2, February 15, and March 4, 18, 21, 24, 27, 28 and 31. Twenty trips were made to wintering areas between July 16 and September 29, 1957 and August 16 and October 4, 1958.

RESULTS

Breeding

Observations on April 14 and 21, 1957 did not reveal any displaying males. On April 28, hooting was heard at several locations and a displaying male was located at 6,700 feet on a southwest slope covered by scattered Douglas fir and bunch grass. A male was displaying within an area of approximately 30 by 75 yards during late afternoon and/or early morning observations on May 7, 9, 10, 14, 18 and 19. None were seen at

that location on May 11, 12, and 15. A second displaying male was seen within 100 yards of the former one on April 28 and May 7. On May 14, a female was present for 15 minutes on the "territory" of the first male mentioned. The male kept up a continual display similar to that described by Brooks (1926), and by circling her, kept her within an area of about 30 by 50 yards. The display note, a loud single "Ooop", was given six times. Two mirror traps were placed on this territory on May 9 for 28 trap days. On May 22, the remains of a dead male was found in one trap. Visits on May 25, 27, 29, 30 and June 4, revealed no breeding males in the area.

Less hooting was heard on the study area after the second week of May. The last displaying male was seen on August 2, 1957. Hooting was detected at various elevations from 5,400 to 6,600 feet. Several displaying males were seen in the bunchgrass prairie type one-half to one mile from the montane forest.

From March 31 to June 25, 1958, 18 visits were made to a timbered draw, of approximately 17 acres, at an elevation of 5,600 to 6,500 feet. Tracks of four grouse were seen in the snow at this location on March 31. Four displaying males were observed there on April 19, which probably represents some of the earlier displaying, because trips to other areas on April 5, 8, and 12 had revealed no displaying birds.

Three breeding males and one female were marked with "paint bombs" in the 17 acre area described above. The female was marked on May 3, near where a male had been seen displaying. This female was not identified again. A male was marked on May 10, and observed displaying within

25 yards of where he was marked on May 11, 17, and 25. A second male was marked on May 10, and was seen displaying May 11 and 24 at points up to 150 yards apart. A non-displaying, un-marked male was seen on this "territory" May 17. A third male was marked May 11. On June 25, he was seen 40 yards from the marking location but was not displaying. The territories of four other males were evident, thus making a minimum of seven males that were present in this 17 acre area. Bendell's (1955) observations of five males during April and May showed that each male's positions never fell outside a territory of from one to two acres.

Less hooting seemed apparent after the second week of May. Occasional displaying males were seen in the bunchgrass prairie type. The last displaying male was observed July 30, 1958 at 5,900 feet.

Nests

In the summer of 1958, three nests, with remains of hatched eggs, were found in the bunchgrass prairie type at distances of 200 yards to over one mile from the montane forest. The first was located between large rocks adjacent to a clump of chokecherry brush. The second was found under sparse cover of bunch grass and rose, 20 yards from a chokecherry clump and the third was hidden under a clump of juniper. Numerous "clocker" type droppings in the vicinity led to its discovery. "Clockers" are mentioned as being indicative of nesting blue grouse, sage grouse, and wild turkey hens by Bendell (1954), Patterson (1952) and Rose (1956), respectively. "Clockers" were found on the study area at 7,400 feet. In June of 1958, two recently hatched broods were found in the montane forest

at 6,200 feet. Heebner (1956) in reviewing various studies, stated that nests have been found from timberline down through the open sage plains.

Hatch

According to Caswell (1954), the progression of wing feather development of juvenile blue grouse is similar to that described by Bump et al (1947) for ruffed grouse (Bonasa umbellus). One chick banded in the present study, at less than one week of age, and two chicks, banded at the initial flying age (Bendell, 1955) of two weeks, were recaptured six to seven weeks after banding. These birds were aged by Bump's primary wing feather method for ruffed grouse. Ages by this method were one week more for each bird than the ages indicated by the banding records. Thirty-two additional juveniles of various ages were captured two to six times each and aged by the Bump method. Hatching dates were calculated from each date on which a bird was recaptured. Recaptures of eight of the thirty-two birds occurred before nine weeks of age. In seven of these eight, the different hatching dates assigned to each bird did not vary over one week. Greater variance was apparent with older juveniles. Bump's method was used through the eighth week of age to approximate hatching dates. In 1957 and 1958, hatching dates ranged between May 25 and July 14 (Fig. 4). In 1957, 39 of 49 broods (80 per cent) hatched between June 9 and July 6. In 1958, 66 of 71 broods (93 per cent) hatched between June 8 and 29th. The peak hatch occurred the third week of June in both years.

Growth Rates

Twenty juveniles (11 males and 9 females) provided information on

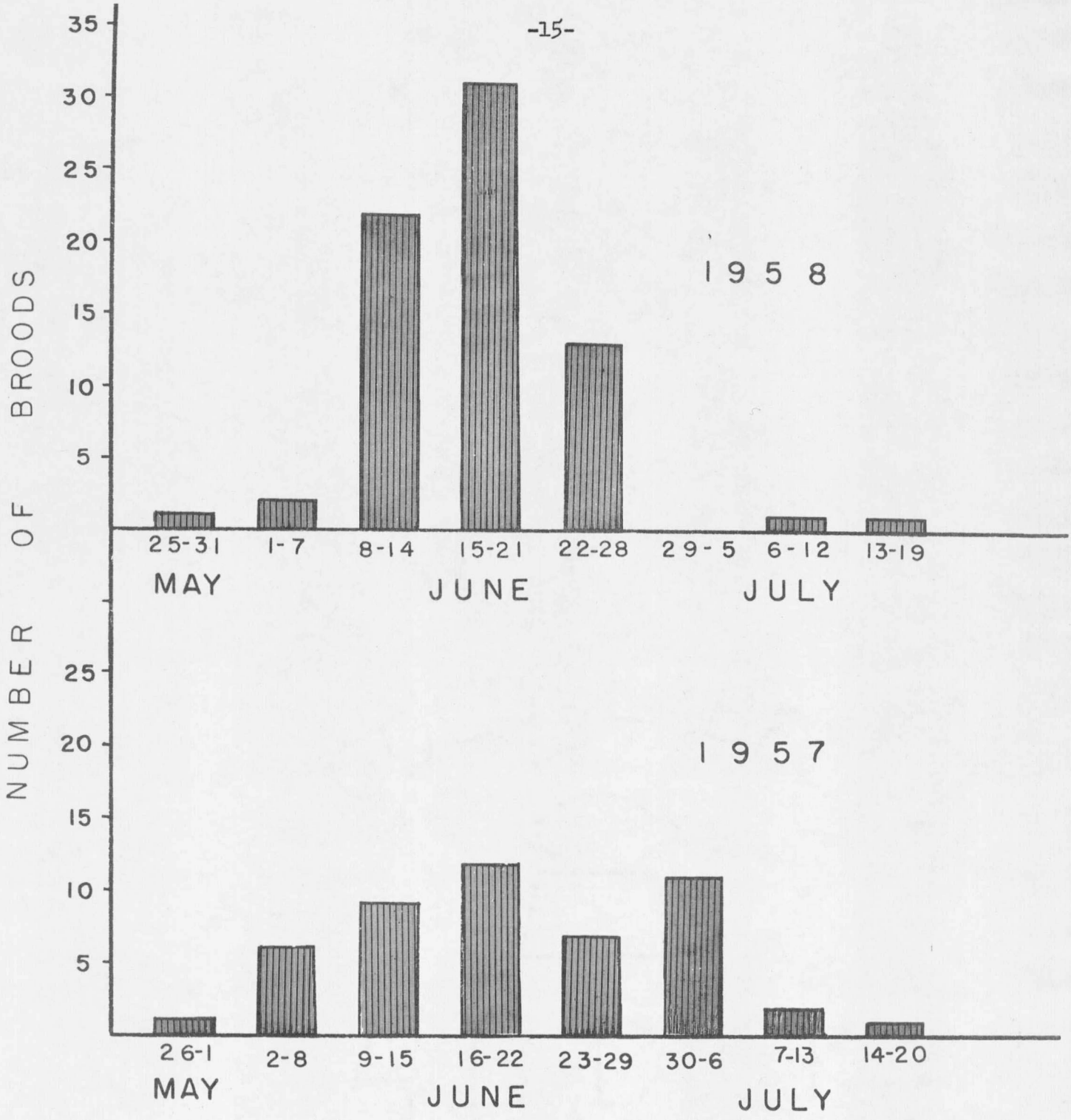


Fig. 4. The distribution of hatch by weekly periods as determined from aged juveniles.

growth rates. These were weighed from two to seven times each (Table I). All were initially captured at eight weeks of age or less and aged by the method previously discussed. Juvenile males of 10-11 weeks weighed more than 1,000 grams, while those of 9 weeks weighed less than 1,000 grams. Juvenile females ranged between 650 and 875 grams at 10 and 11 weeks of age. Three chicks, only a few days old, each weighed 25 grams or less. Average growth rates of approximately 90 grams a week occurred for males during the first 11 weeks. Female growth rates were between approximately 60 and 80 grams a week for the same period. For the initial 15 weeks of growth, Bendell (1955) in British Columbia, calculated rates of approximately 60 and 50 grams per week for males and females, respectively, and stated they were similar to values found by Wing et al (1944). In those studies variations in hatching dates were ignored and crop content weights were excluded.

The average weights of 34 juveniles from the 1957 hunting season, at ages of about 10-15 weeks were: 983 (775-1,175) grams for 17 males and 797 (600 to 975) grams for 17 females. Average weights for juveniles from the 1958 hunting season, at ages of about 11 to 16 weeks, were 1,008 (850 to 1,175) grams for 50 males and 821 (625 to 1,000) grams for 61 females. Two yearling males captured in June and July of 1958 weighed 1,125 and 1,225 grams, respectively. Weights of five yearling females in July and August ranged between 775 and 925 grams. During the first 11 weeks of growth, over 80 per cent of the first year's weight is attained. Bendell (1955), in British Columbia, recorded average weights of males and females

Table I. Weights in grams of blue grouse juveniles at various weekly intervals.

Bird No.	Weeks of Age 1	2	3	4	5	6	7	8	9	10	11	12	13	14
						Males								
1	-	-	150	-	-	-	-	-	-	1075	-	-	-	-
2	-	-	-	-	-	400	-	-	-	-	1050	-	-	-
3	-	-	-	-	325	425	-	-	800	-	-	-	-	-
4	-	-	-	-	375	-	-	725	-	-	-	-	-	-
5	-	90	-	-	-	-	-	-	-	-	-	-	1150	-
6	-	100	-	-	-	500	-	-	925	-	-	1050	-	-
7	-	-	-	-	350	-	-	-	775	-	-	-	-	-
8	-	-	150	-	-	-	650	-	-	-	-	1075	-	-
9	-	-	-	-	-	450	-	-	-	-	-	1075	-	-
10	-	-	-	-	-	-	-	575	-	-	-	-	1025	-
11	-	**	-	-	-	-	-	-	775	-	-	-	-	-
						Females								
12	-	-	140	-	-	-	-	-	750	-	-	-	-	-
13	-	-	140	190	-	400	500	650	775	875	-	-	-	
14	-	-	-	-	300	375	-	-	-	775	-	-	-	
15	-	-	-	210	-	-	-	-	625	-	-	-	-	
16	-	-	-	-	275	-	-	-	700	-	-	-	-	
17	-	-	-	-	300	375	-	600	675	-	-	-	-	
18	-	-	-	-	-	-	-	475	-	650	-	-	-	
19	-	-	-	-	-	-	-	450	-	-	-	-	-	850
20	-	-	-	-	-	375	-	-	-	-	800	-	-	-

** Not weighed

without crops (at approximately 15 weeks of age) as 885 (±50) grams and 725 (±35) grams respectively, and average yearling weights in May, June and July as 1,110(±40) for males and 790(±10) grams for females.

Cover Used By Broods

One hundred and fifty-four and 217 brood observations were made during the summers of 1957 and 1958, respectively, mainly between 5,200 and 6,200 feet. Brood location by cover types is shown in Table II but these figures probably do not reflect exact preference because field time was not proportionately divided between the different cover types. Emphasis was placed on capturing grouse and more time was spent in areas where grouse were most abundant. Chronological trends of cover usage by broods were apparent. In early summer, broods were often observed in grass-forb areas where balsamroot was a dominant aspect. This association of broods with balsamroot was also reported by Heebner (1956) in Idaho, and Schottelius (1951) and Wing et al (1944) in Washington. Usage of grass-forb areas was less in August than July in both 1957 and 1958. By the fourth week of July of both years desiccation of plants of the bunchgrass prairie, particularly forbs, was apparent. Increased usage of deciduous thickets during late July and August was apparent both years.

Return to Former Summer Range

Bendell (1954) reported that breeding males return to the same locality of the summer range each year, and discussed the possibility of young returning to the region of their birth. In the present study, a

Table II. Location by cover type of 351 brood observations.

Vegetation Types	July 1-15	July 16-31	Aug. 1-15	Aug. 16-31
Montane forest				
1957	0	3	3	0
1958	1	3	8	8
Sage-bitter-brush				
1957	1	6	9	3
1958	3	5	14	0
Deciduous thickets				
1957	0	19	31	29
1958	13	40	41	42
Grass-forbs				
1957	10	27	5	2
1958	13	8	4	0

banded male was recaptured on July 21, 1958 at a point slightly more than one-fourth mile from where he was banded as a chick on July 24, 1957. Female 5752 and two of her brood were captured on July 23, 1958 at the exact clump of brush where she had last been observed as a banded chick on August 22, 1957 (Fig. 5).

Summer Brood Movements

Numerous observations of marked individuals of various broods were recorded during the two summers. Observations of members of eight broods were sufficient to indicate the extent of summer movements.

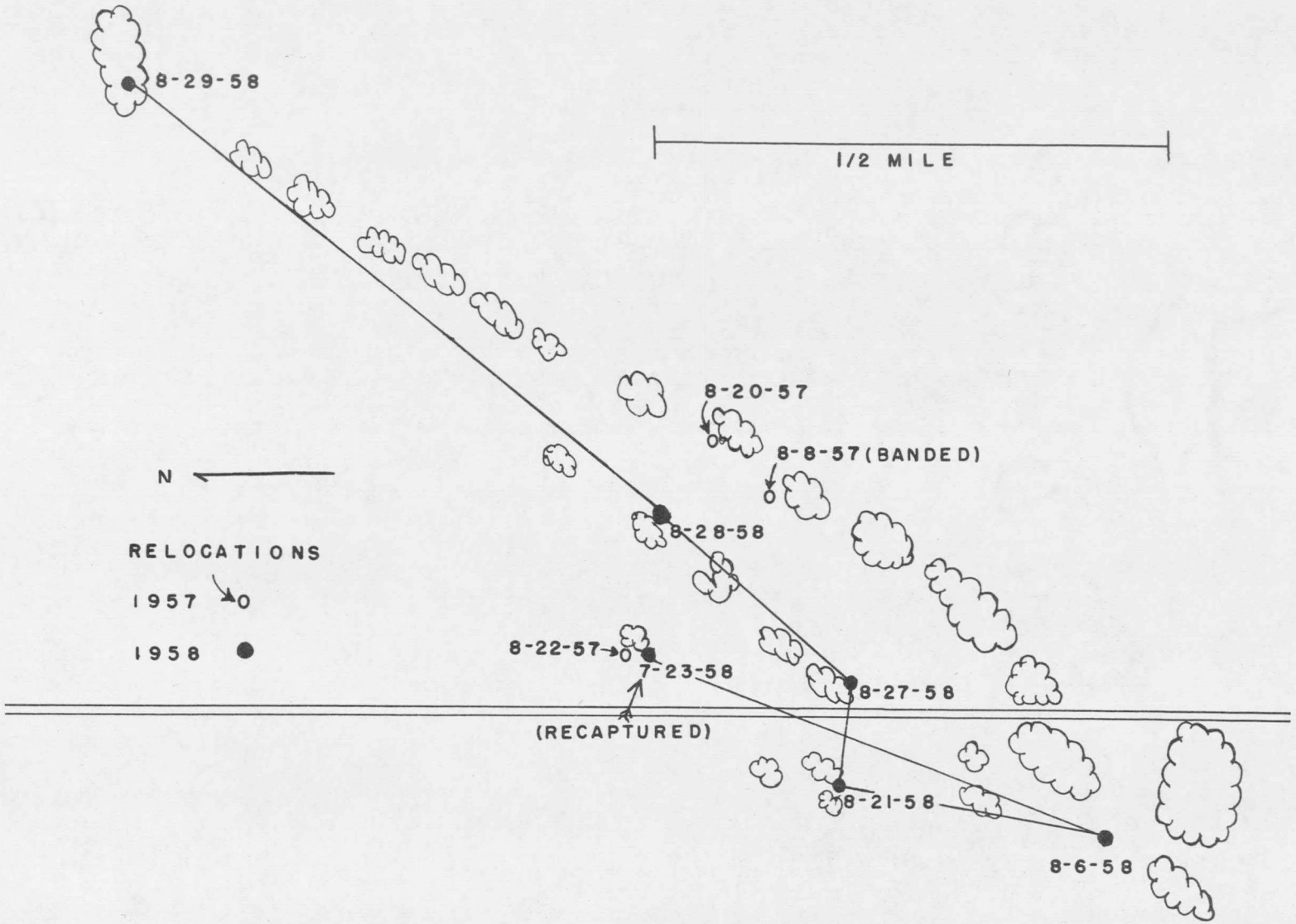


Fig. 5. Movements of female 5752 and brood on the summer brood range during 1957 and 1958.

Female 5702 was marked with a "paint bomb" on July 5, 1957 and she and two of her young were banded on July 11, 1957. Another juvenile with the brood was banded July 22, 1957. During a 30-day period the brood was identified six times within an area one-fourth mile long.

Six of seven young of Brood A were banded during 1957. The first was banded on July 23, the others during seven other encounters with this brood in the following 31 days. From July 23 to August 22, the relocations of this group were contained within a 660 yard linear strip of deciduous thicket. On August 23, an observation 660 yards away from the August 22 location was made. The brood was not identified again and this movement possibly initiated a dispersal from the summer brood range.

Juvenile 5748 was banded on August 7, 1957 while accompanying a hen and four other juveniles. One of these juveniles was No. 5718 which had been banded in the same vicinity on July 25, 1957. No. 5748 was identified with a brood seven more times in the next thirty days. The relocations indicated movement within a 770 yard strip of deciduous thicket.

Juvenile female 170 was banded July 17, 1958 and was captured eight times within the next forty-seven days. A hen with juvenile 170 was captured on August 11, 1958 and seen with juvenile 170 on August 12. Number 170 was seen with an unmarked hen and several juveniles, including No. 125, from another brood on August 22, 29, and September 2, 1958. The relocations of juvenile 170 indicated movements along the base of the mountain at points within 660 yards of each other.

Female 5717 and one of her approximately five young were banded

July 25, 1957. The brood was identified five times in the next 28 days. The relocations indicated movement within a 1320 yard long area at the base of the mountain.

Female 5752 and two of her six young were captured July 23, 1958 and this brood was identified five times during the next 38 days. Four of the relocations in 1958 indicated movements within a one-half mile area along linear strips of deciduous thicket. The fifth relocation (August 29, 1958) was interpreted as a dispersal movement; the brood having moved 1150 yards, in a maximum of 17 hours, from the previously frequented brood range. Movements of this brood are shown in Figure 5.

Female 5553 and five of her seven young were banded on July 23 and 25, 1958, and identified on 11 other occasions during the next 38 days. This brood's movements were also along linear strips of brush, within an area slightly more than one-half mile long.

Female 5549 and two of her five or six young were banded on August 11 and 14, 1958. The brood was identified five times in the next 19 days. Four of these identifications occurred within points one-half mile apart at the base of the mountain. The fifth identification was 1260 yards away from the base of the mountain and was interpreted as a dispersal movement. The hen was later shot (Table III, ref. 16).

Indications were that the broods of females 5553 and 5752 had nearly identical summer brood ranges. These broods were seen intermingled on several occasions. The broods of females 5717 and 5549 and the brood(s) juvenile 170 was associated with, all appeared to frequent the same

Table III. Summary of hunter band recoveries showing movements.

Ref. No.	Date last Observation	Date of Recovery	Distance (miles)	Elevation increase (feet)
1	8- 9-57	9-15-57	.7	400
2	8-26-57	9-17-57	.5	0
3	8- 2-57	9-20-57	.5	0
4	7-29-57	9-20-57	3.1	2800
5	7-18-57	9-22-57	.1	0
6	7-18-57	9-29-57	3.0	2600
7	8-27-58	9- 9-58*	1.1	1300
8	9- 4-58	9-11-58**	.3	0
9	8-29-58	9-21-58	1.8	600
10	8-21-58	9-21-58	3.4	1000
11	8-15-58	9-21-58	1.9	1400
12	8- 4-58	9-21-58	2.8	1600
13	8-18-58	9-21-58	2.6	400
14	8- 7-58	9-21-58	2.0	1600
15	8- 8-58	9-21-58	1.0	1600
16	8-29-58	9-21-58	1.1	1600
17	8-21-58	9-21-58	.7	0
18	8-21-58	9-21-58	.1	0
19	8-15-58	9-21-58	.0	0
20	8-21-58	9-22-58	.6	0
21	8-15-58	9-22-58	.5	0
22	8-13-58	9-22-58	.1	0
23	8-18-58	9-25-58	2.1	0
24	8-21-58	9-28-58	.6	0
25	8-29-58	10- 3-58	1.3	1400

*Predator kill

**Dog kill

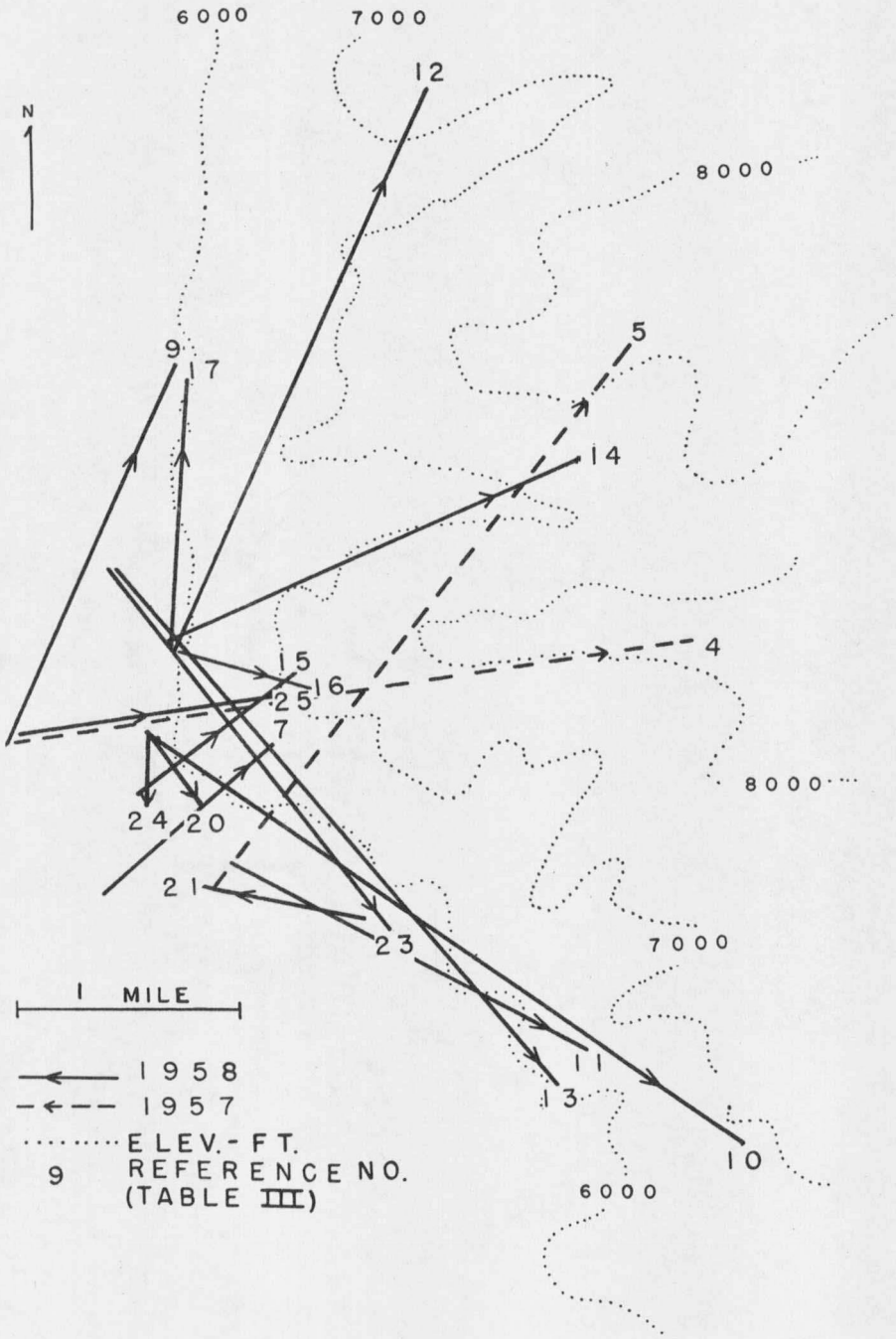


Fig. 6. Fall dispersal and altitudinal migration of banded blue grouse.

series of deciduous thickets. Other observations of miscellaneous marked and unmarked grouse indicated usage of these same areas by other broods. Banding data suggests that movements on the summer brood range are generally restricted to about one-half mile or less. Bendell (1954) made similar conclusions from banded blue grouse hens with broods.

Fall Dispersal

There was indication that adult males and brood-less females moved from summer ranges prior to fall dispersal of broods. The latest observation of an adult male on the summer range was August 2, 1957. Yearling male 5526 was banded on the bunchgrass prairie June 28, 1958, observed nearby July 1, and last seen July 22, 1958 within 25 yards of where banded. Yearling male 5713 was banded July 21, 1958 on the bunchgrass prairie, observed within 200 yards from the banding site on July 23 and 24, and last seen July 29, 1958 at the banding site. Numerous observers have stated that adult males initiate upward movement. An apparently brood-less hen was banded on the summer range July 21, 1958 and observed within 200 yards of the banding site on July 24 and 28, 1958.

Break-up of broods appeared to be concurrent with fall dispersal. An increasing number of singles and small groups of juveniles was observed during late August and September of both years. Of three banded brood mates last seen together August 21, one was shot September 21, 1958 over three miles from and 1,000 feet higher than the other two, which were shot 400 yards apart on September 22 and 28, 1958, respectively. Their movements are shown in Figure 6 and Table III; reference numbers 10, 20 and

24. Wing et al (1944) in Washington, and Bendell (1955) in British Columbia, stated that the earliest break-up in brood organization occurred in late July. During both years the number of brood observations on the summer brood range decreased the second week of August, and decreased sharply the fourth week of that month (Table IV). During late August and September, observations of marked grouse indicated increased abandonment of summer brood ranges (see previous section) and an increase in lateral movement. Dates on which 11 marked broods were last seen on summer brood ranges were August 9, 21, 22, and September 5, 1957, and August 4, 22, 22, 26, 29, 29, and September 2 of 1958. Only 8 of 23 banded birds shot during both years were on areas previously frequented as summer brood range. The latest date these were shot was September 22, for both 1957 and 1958. The extent of dispersal was suggested by hunter band returns (Fig. 6 and Table III); lateral movements up to 2.1 miles and altitudinal movements up to 3.4 miles were recorded.

A somewhat different distribution of grouse during the two hunting seasons was indicated. During 1957, the altitudinal migration seemed to have progressed further. Although broods appeared to have left summer brood ranges at about the same time each year, more grouse appeared to be present at intermediate elevations during 1958. This is also probably reflected in the improved hunter success of 1958. Beer (1943) in Washington, and Marshall (1946) in Idaho, concluded that the upward movement in fall was a response to the ripening of fruit at higher altitudes; Fowle (1944) in British Columbia, suggested that the coincidence of the

Table IV. Average number of brood observations per day by weekly periods, beginning with the fourth week of June.

		1957		1958	
Month	Week	No. days observing	Av. No. brood observations per day	No. days observing	Av. No. brood observations per day
June	4	2.5	.0	2.0	1.0
June-July	1	2.0	1.5	3.0	1.7
July	2	3.5	2.0	4.0	4.5
July	3	4.0	3.5	4.5	4.7
July	4	4.5	4.7	4.5	6.0
July-August	5	5.0	6.4	4.5	5.6
August	1	5.0	6.6	4.5	8.7
August	2	2.0	5.5	4.5	6.9
August	3	4.5	4.7	4.5	7.3
August	4	4.5	2.0	3.0	3.3
August-September	1	2.5	2.0	1.5	2.0
September	2	1.5	1.0	2.0	1.0

altitudinal movement and berry ripening may well have been accidental; Wing (1947) in Washington, attributed the movement as a response to a geotropism; Bendell (1955) in British Columbia, suggested desiccation of lower vegetation as a factor affecting upward migration; Heebner (1956) in Idaho, stated that there appeared to be more available food on the summer range at the time of the upward movement than there was at the higher elevations. In this study, the upward movement of broods and the unavailability of berries at low elevations appeared somewhat linked in 1957, but in 1958 heavy crops of chokecherries were evident on parts of the abandoned summer brood range. The abundance of such food as low red huckleberry (Vaccinium scoparium) at higher elevations may have had some effect on the distribution of grouse after altitudinal migration had begun.

Population

During 1957 and 1958, 255 grouse were captured on approximately three square miles of summer range. One square mile of this was subjected to more intensified field work. From July 11 through August 15, 1957, the hens of 6 broods plus 69 juveniles were captured on this one square mile. From July 1 through August 15, 1958, the hens of 14 broods plus 103 juveniles were banded there. Field observations indicated that in 1957 and 1958 approximate minimums of 27 and 34 broods, respectively, had all or part of their summer brood ranges on that one square mile. Few reliable brood size counts were obtained; the broods observed had from one to eight young. Schottelius (1951), in Washington, made 82 complete

counts and reported an average brood size of 3.77.

Of 104 grouse captured in 1957, 11 died during capture and 6 were discovered later as predator losses. All instances of predation detected (including 3 unbanded birds) occurred at a time when broods were concentrated in deciduous thickets and fall dispersal had begun. Predation evidence was found on August 8, 13, 16, 19, 20, 21 and September 4. Of the remaining 87 banded birds (9 adult females and 78 juveniles), 6 (7 per cent) were reported shot. All were juveniles. During 1958, two yearlings (banded in 1957) were recaptured, two grouse with 1957 bands were observed but not identified, and the 1957 bands of two grouse were found on the study area. The number of 1957-marked grouse observed in 1958 possibly was influenced by the habits of yearlings, especially males. Buss et al (1954) and Bendell (1955) reported that many yearlings probably do not return to the summer range the first year. No 1957 bands were returned during the 1958 hunting season.

Of 151 grouse captured in 1958, 10 died during capture and 2 were predator losses. These two losses as well as those of three unmarked birds apparently occurred at the time of fall dispersal. Predation evidence was found on August 5, 12, 14, and September 4. Of the remaining 139 banded birds (17 adult females, 3 adult males, 119 juveniles), 17 (12 per cent) were reported shot. Included were 15 juveniles and 2 adult females.

Evidence from banding data suggested concentration of broods on a relatively small summer range, subsequent dispersal to a large winter range, and a substantial turnover rate the first year of life. Bendell's

(1955) population study indicated heavy loss of blue grouse young (67 per cent mortality of chicks by August) and a relatively uniform death rate of adults (31 per cent yearly death rate of males). Numerous other studies, including those of Leopold (1943) on pheasants and Errington (1945) on bobwhite quail, have indicated a high turnover rate on other gallinaceous birds. The per cent of banded blue grouse shot (7 per cent in 1957 and 12 per cent in 1958) indicated the minor influence of hunting.

Indications are that hunting success could be substantially affected by the chronology of the hunting season. It was apparent that altitutinal migration was well under way during both the 1957 and 1958 hunting seasons. Further progression of the altitudinal migration in 1957 was interpreted as a factor influencing hunter success. In 1957, an average of 5.9 man hours per bird bagged were expended compared to 3.5 for 1958. This difference was interpreted as being more of a direct result of altitudinal migration than differences in grouse abundance between the two years. In 1957, of 38 grouse (for which the kill site elevation was available) 25 (66 per cent) were shot above 7,400 feet. In 1958, of 120 grouse, only 17 (14 per cent) were shot above 7,400 feet. This variation of grouse distribution between the two hunting seasons is also indicated by band returns (Table III). Information obtained from hunters indicated an increased vulnerability of grouse at lower elevations. In 1957, 63 of 289 (22 per cent) grouse reported flushed in mountain timber areas were bagged and 23 of 39 (59 per cent) flushed in lowland brush were bagged. In 1958, 108 of 404 (27 per cent) grouse reported flushed in

mountain timber were bagged and 51 of 122 (42 per cent) flushed in lowland brush were shot. Hartkorn (1957) reported that probably less than 10 per cent of blue grouse mountain habitat is ever covered by hunters.

Hatching data for 1957 and 1958 indicated that mid-September seasons harvested juvenile blue grouse mainly at the 12, 13, 14 and 15th week of age. Growth rate data indicate that only relatively small gains in weight would be lost by harvesting juveniles at the 10, 11, 12, and 13th week of age.

SUMMARY

During 1957 and 1958, a study of blue grouse was carried on in the Bridger mountains of southwest Montana. Information was obtained on the chronology and extent of seasonal movements, development of young, population characteristics and general life history. Two hundred and fifty-six grouse were captured, of which 236 were banded and released. Thirty-five juveniles were recaptured a total of 56 times. One hundred and thirty observations (excluding recaptures) of 65 individuals were made.

Observations during the breeding season indicated a minimum of 7 males present on a 17 acre area. The sites of three nests are described. During 1957 and 1958, hatching dates determined by aging juveniles, ranged between May 25 and July 14. The peak hatch occurred the third week of June for both years. Growth rate information from 20 juveniles, that were recaptured 2 to 7 times each, indicated weekly gains of 90 grams for males, and 60 to 80 grams for females during the first 11 weeks.

Numerous observations of marked broods indicated movements within

approximately a one-half mile area on the summer brood range. During both years dispersal from the summer brood range became evident in August and upward altitudinal migration was well under way by the opening of the hunting season in mid-September. Lateral movements up to 2.1 miles and altitudinal movements up to 3.4 miles were recorded. Seven and 12 per cent return of banded birds occurred during the hunting seasons of 1957 and 1958, respectively. No 1957 bands were returned in 1958, and hunting was interpreted as a minor influence in yearly population turnover. Indications were that hunter success could be substantially affected by the chronology of the hunting season. Data presented for 1957 and 1958 indicated that the progress of altitudinal migration had a pronounced effect on hunter success.

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