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BROOD HABITS AND GROWTH OF 'BLUE GROUSE'¹

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THE 'blue grouse' (*Dendragapus fuliginosus* and *Dendragapus obscurus*), the West's premier game birds, inhabit mountain forests from Alaska to New Mexico. They are associated with the coniferous forests and have been called aptly the "coniferous counterpart of the Ruffed Grouse."

The principal work of this study was concentrated in the general area accessible from Conconully, Okanogan County, Washington, on

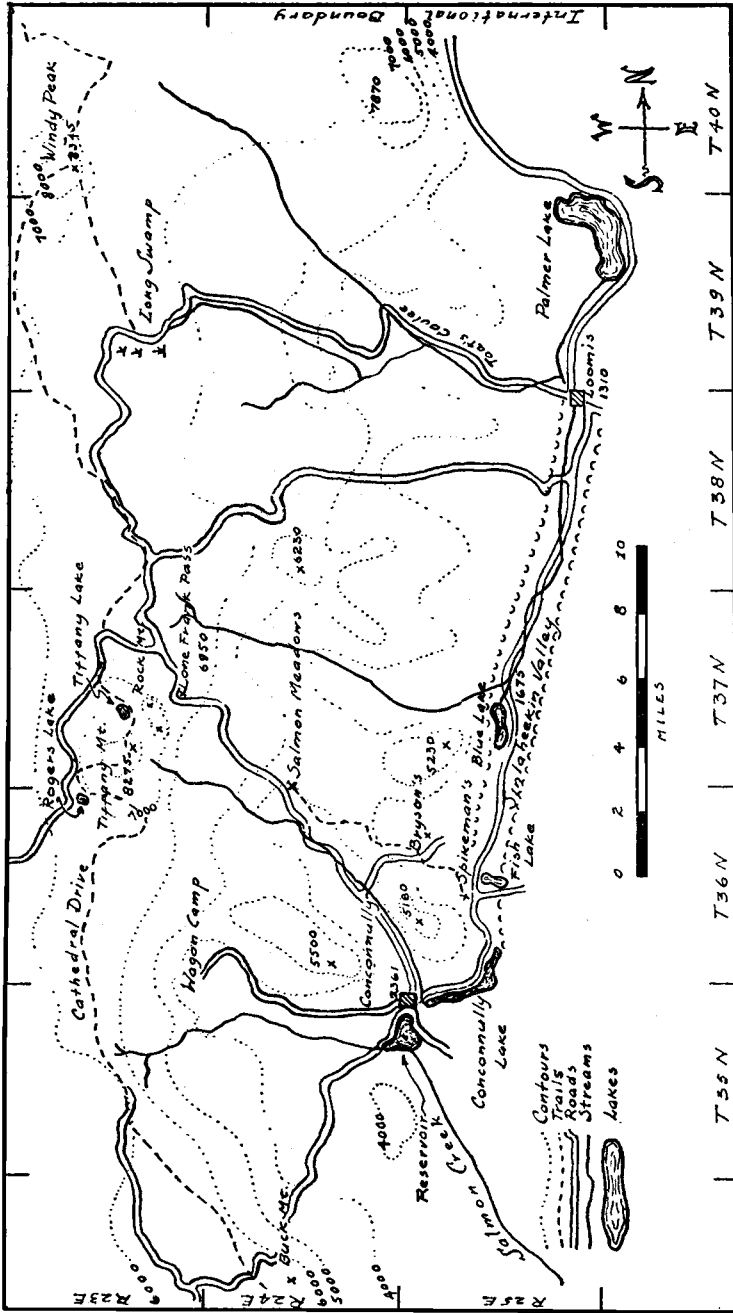
¹A coöperative study between the State College of Washington and the Washington Game Department. The birds of this study are Richardson's Grouse, *Dendragapus obscurus richardsoni*. See page 503.

the east side of the Cascades, in the summer of 1940. The areas of main attention were the Sinlaheekin Valley, Funk Mountain, Mineral Hill, valleys of the North and South Forks of Salmon Creek, the Lone Frank Pass region, the area between Lone Frank Pass and Long Swamp, and Toat's Coulee (Text-figure 1).

The topography is rough and consists of sharp slopes terminating in peaks and ridges whose altitudes are strikingly uniform. They vary from 6,000 to 8,350 feet, and when viewed from higher peaks, the horizon appears relatively uniform because so many sharp peaks and crests rise to the same general height. Most of the peaks and ridges have resulted from water dissection combined with subsequent glacial erosion. Glacial cirques are common in the higher altitudes where they form mountain meadows. The valleys which separate the ridges are rather deep and steep-sided; some of them are 2,500 to 3,500 feet deep. The altitude at both Conconully and the floor of the upper Sinlaheekin Valley is about 2,300 feet.

The principal ridges and valleys trend in a general north-south direction, but spurs and secondary ridges locally upset the trend. Because the main axis of the Cascade Range is north and south, a rain shadow forms on the eastern slope, and though the climate is therefore very dry, particularly in the summer-time (no rain fell at Conconully during the summer of 1940), many gulches are occupied by springs that flow all summer or cease flowing above ground yet indicate the presence of water by damp soil.

There are many park-like openings which are covered with grass or sagebrush (*Artemisia*) in the lower altitudes and on south-facing slopes. The ridges themselves are rather poorly covered with timber and form mountain meadows above timberline (about 7,000 feet). The slopes below 3,000 feet, depending upon the aspect, are covered with grass and a mixture of grass and timber, the latter chiefly ponderosa pine (*Pinus ponderosa*) except in moist sites where it gives way to some Douglas fir (*Pseudotsuga douglasi*). Ponderosa pine predominates between three and four thousand feet, and Douglas fir again occupies the damp sites. Ponderosa pine drops out rapidly above 4,000 feet and is replaced by lodgepole pine (*Pinus contorta*), Douglas fir, Englemann spruce (*Picea engelmanni*), and larch (*Larix occidentalis*). Lodgepole pine is common above 5,000 feet and persists to timberline where it frequently becomes dwarfed and gnarled. Douglas fir is found almost to timberline, yet not in any great quantity higher than 5,000 feet. On the higher slopes, the Douglas fir is confined to the south side of the ridges immediately below their tops.



TEXT-FIGURE 1.—Map of the brood area studied. The position of the area in the northern Cascades can be oriented by the right side of the map which is the boundary between the United States and Canada.

The white-bark pine (*Pinus albicaulis*) is common above 5,000 feet, especially at timberline.

The moister conditions of the north slope result in a richer and more luxuriant vegetation. Spruce predominates; it also reaches lower altitudes there. Mountain meadows are more common on the north slopes where they are found in damp situations and along most streams. Many south-facing exposures are partially bare and covered with sagebrush, which extends up to 7,000 feet on suitable sites.

The temperature exceeded 90° F. several times during the middle of the day at Conconully, but it cooled off at night. Our minimum thermometer recorded night temperature as low as 43° F. Night temperatures in the low 50's and high 40's were common. Several recordings were made near Lone Frank Pass at 7,000 feet; the highest in the shade was 68° F. We do not know what the minimum there may have been, but it was below freezing temperature.

Brood Territory.—There appears to be little territorialism in the 'blue grouse'; probably the brood territory should be classified as a home range. The brood range in the Okanogan region consisted, for the most part, of the lower slopes composed of open, park-like areas, dry but watered by a few springs, streams, or water holes. Although vegetation covered the ground, it was bunched so that bare space was present in varying proportions. The draws and gulches of the lower slopes sometimes contain water and are generally lined with relatively dense stands of brush; otherwise the ground, for the most part, is rather bare. Measurements taken August 13, 1940, of ten quadrats, each a meter square, averaged 73.8% bare ground. We also measured the trees in the pine stands which were occasionally used by broods of larger young during the day for resting cover and regularly at night for roosting cover. Two samples gave: (a) 150 stems to the acre, 2–9 inches DBH; height from 5 to 40 feet; and (b) 310 stems to the acre, 1½ to 12 inches DBH; height from 6 to 40 feet.

The broods immediately take to the open slopes upon hatching; as the young become larger, they work back into the tree-covered areas during late afternoon, probably for night roosting. Broods of young not able to fly apparently spend the night in the open. The characteristic plant of the open slopes used by broods is *Balsamorhiza*, and the brood association with it appears to be very close.

Broods were often found around springs and water holes, but we do not have enough data to determine whether or not they visit water regularly. It is probable that *Ribes* and *Amelanchier* berries provide water as well as food. In the North Fork Valley, however, we gen-

erally found them moving down the slopes to the creeks in the early morning and moving up from the creeks by the middle of the morning. They also visited the irrigation canal immediately above the town as well as Conconully Lake. Twice we observed birds drinking at springs, once at Spikeman's and once north of Blue Lake. The act does not differ from that of the domestic fowl.

Brood Counts.—Considerable difficulty was experienced in obtaining complete brood counts. The actual process of following a brood is in itself easy because the broods show little fear. The young stay close to the hen when small but tend to range farther as they grow older; at times the older ones may wander a hundred yards from her. Because of this tendency, it is difficult to locate all the members of the brood, and it is difficult to determine to what brood young belong when two or more broods are feeding near each other.

Although we observed several hundred broods, not allowing for duplicates, it was possible to obtain good figures for but ninety-nine. Ninety-two of these were found with females and seven without. Although the broods were actually scattered over more than a thousand square miles, most were observed in the upper Sinlaheekin Valley around Spikeman's, and the valley of the North Fork of the Salmon within two miles of Conconully (Text-figure 1). Some figures were obtained in Toat's Coulee and the Cathedral Drive region, and late in the season we obtained a few from Rock Mountain, Lone Frank Pass, and Roger's Lake.

Several times we observed broods of blue grouse mixed with Ruffed Grouse. On August 10, 1940, we found such a mixture at the spring on the Bryson ranch. August 13, 1940, we saw one Ruffed Grouse mixed with a brood of six young and two adult female blue grouse. Occasionally we observed young Ruffed Grouse and young blue grouse wandering together without females. The greatest amount of such mixing was noticed near Spikeman's where the heaviest concentration of both occurred.

Late in July the brood-organization appears to break down to some extent and a shuffling of young to take place. The fact that many young are found alone or in small bands at this season raises a question whether these birds are wandering young or young ranging far from the female. We encountered several bands containing birds of two different sizes, which would bear out belief that the young are not all ranging far from the female but are true wandering bands. Frequently we were unable to find any females within a reasonable distance. Sometimes the nearest female was with a full complement

of young, so that it would be unlikely for the wandering young to be part of her brood. In many instances we found females roaming alone or even in bands of two or three after late July, which probably indicates a loss of young or a break-up in broods. On August 2 we saw three females together among some Douglas fir trees in Toat's Coulee, 10 miles west of Loomis. There were no young with these birds and their actions indicated that they were not brood females or at least not recently with young. We were not able to collect any of the broodless females, however, in order to determine by examination whether or not they were nonbreeding birds.

Our brood studies lead us to believe that the brood instinct is rather low in the female and perhaps non-existent in the male. The breakdown of the brood instinct, as revealed by breakdown of brood composition, occurs much earlier in the blue grouse than in other gallinaceous birds with which we are familiar. We had some opportunity to compare broods of blue and Ruffed Grouse in the same areas; it is clear that the brood breakdown occurs much earlier in the former than in the latter. The Ruffed Grouse broods gave little indication of splitting late in August, and the only positive evidence which we had that broods were not intact consisted of the appearance of young with the broods of blue grouse. These may have been young that lost their mothers or that wandered from their own broods and joined the broods of blue grouse.

Some blue grouse broods break up earlier than others, for both attended and unattended broods were found on the same dates. Some females ran with their broods when the young were the size of, or even larger than, the hen. For the most part, however, the females seem to abandon the young before they reach the winter grounds; the proportion of unattended broods was much higher in the higher altitudes. The disbanding of broods seems to be a progressive gaining of independence on the part of old and young rather than a sudden abandonment.

During the early part of the season, the males were frequently found close to the broods; on numerous occasions we found them 'hooting' when with, or at least in the neighborhood of, the broods. But we are not able to state definitely whether or not the males actually ran with the broods. Presumably the association of the male with the broods is a matter of choice of area rather than of an interest in them. In early summer it was usually possible to locate a male within a short distance of a brood, but the males were found less and less associated with broods as the intensity of hooting decreased.

On numerous occasions, much too frequent for chance, we found

two females attending a single brood. On several occasions we found single males associated with broods attended by two females. The two explanations which immediately come to mind to account for the two females are: (a) two females with one brood; and (b) two broods together, each with one female. Our average figures for the broods follow:

- 99 broods averaged 3.65 young;
- 92 broods with females averaged 3.67 young;
- 7 broods without females averaged 3.29 young;
- 83 broods with one female averaged 3.49 young;
- 9 broods with two females averaged 5.33 young.

The sample is small but the average of the broods with two females is 5.33, less than twice that for broods with one female. It would seem that the average should approximate twice that for broods with single females—or seven young—if these were double broods. The largest brood with two females presumably also should have been larger than the largest brood with one female. The largest brood with two females numbered six, whereas the largest brood with one female numbered eight. It proved more difficult, however, to obtain complete brood counts for those attended by two females than for those attended by one female because the former tended to scatter somewhat more widely. The nine two-female broods for which complete counts were obtained are:

<i>Date</i>	<i>Number of young</i>
June 12	5
June 21	6
June 29	6
July 1	6
July 1	4
July 3	5
July 3	5
July 3	5
August 13	6

One group found August 9 drinking from a spring in the orchard at Spikeman's was composed of two females and ten young. Their actions indicated that this band was composed of two broods arriving together rather than of one brood with two females.

Subsequent checks upon broods attended by two females indicated that the brood frequently broke up into two units. Sometimes the females and young would be together in a group; at times each female possessed half of the young; at other times the division would be unequal, so that one female possessed one young and the other the remainder.

In our computations of broods, we have considered all those with two females to be one brood rather than double broods. The evidence indicates that this is the correct procedure. All of the broods with two females were observed on the valley floor immediately north of Conconully and at Spikeman's, both of which were areas of brood concentration.

There appear to be four readily apparent explanations for the two females with one brood: (a) a female that lost a brood or whose nest had been broken up and subsequently attached herself to another brood, (b) nonbreeding females attending broods as 'nurse-maids,' (c) broods combined because of loss of young, and (d) broods combined because of the large number of broods in a small area.

There is no evidence to indicate that one female is dominated or resented by the other. There is likewise little indication that one female shows greater concern for the brood than the other, even though in a few instances one female flushed and showed the customary alarm and concern by cackling while the other bird flew silently to the trees. Single females with broods generally showed alarm, but sometimes they did not. The action of one or the other of two females attending a brood was not considered indicative of concern or of lack of concern for the brood. Presumably the maternal instinct is equally high in both.

Table 1 gives the size frequency of the ninety-four broods for which complete individual counts were obtained.

TABLE 1

<i>Number of young</i>	<i>Number of broods</i>	<i>Percentage</i>
1	13	13.83
2	12	12.77
3	13	13.83
4	29	30.85
5	15	15.96
6	9	9.57
7	1	1.06
8	2	2.13

The peak of frequency distribution is 4.00, slightly above the average brood size (3.67); there is a tendency for the curve to skew on the lower side.

The brood size has been averaged by five-day intervals (Table 2) and shows an uneven drop, probably because of the lack of sufficient data.

The brood size has been averaged also by ten-day intervals (Table 3), and, as in the five-day figures, the drop during late July still shows

TABLE 2

<i>Interval</i>	<i>Number of broods</i>	<i>Number of young</i>	<i>Average size</i>
June 19-23	17	62	3.65
June 24-28	1	4	4.00
June 29-July 3	12	50	4.25
July 4-8	—	—	—
July 9-13	11	50	4.55
July 14-18	8	41	5.12
July 19-23	18	58	3.22
July 24-28	1	3	3.00
July 29-Aug. 2	5	8	1.60
Aug. 3-7	4	8	2.00
Aug. 8-12	13	46	3.54
Aug. 13-17	3	11	3.67
Aug. 18-22	6	20	3.33
<i>Total</i>	99	361	3.65

TABLE 3

<i>Interval</i>	<i>Number of broods</i>	<i>Number of young</i>	<i>Average size</i>
June 19-28	18	66	3.67
June 29-July 8	12	50	4.25
July 9-18	19	91	4.80
July 19-28	19	61	3.21
July 29-Aug. 7	9	16	1.78
Aug. 8-17	16	57	3.56

itself. The August 22-26 interval included fifteen broods averaging 2.80; the July 22-31 interval, seventeen broods averaging 2.65.

During fourteen days of our observation, we were able to obtain complete counts on three or more broods each day; these have been compiled separately (Table 4). Fourteen broods counted on July 23 averaged but 2.79 which is lower than for later brood-counts.

The data of Tables 2, 3, and 4 indicate that the brood size undergoes a general drop from the early part of summer to at least late August. In addition, a somewhat sudden drop begins in mid-July and reaches a low point about the first of August. The subsequent recovery is not great enough to restore the broods to the size of late June and early July. The shuffle of young and shift in brood habits are noticeable in the field, even though it is not possible to obtain complete evidence without recourse to banding and marking.

Some shuffling of broods and abandonment by females of lessened maternal instinct make their appearances between the middle and

TABLE 4
AVERAGES FOR DAYS WHEN THREE OR MORE BROODS
WITH FEMALES WERE CHECKED

Date	Number of broods	Average size
June 20	3	4.67
June 21	10	3.80
June 29	3	3.00
July 1	4	4.75
July 3	5	4.40
July 10	5	3.80
July 12	6	5.17
July 17	8	5.12
July 23	14	2.79
Aug. 2	3	1.67
Aug. 6	4	2.00
Aug. 9	5	4.00
Aug. 10	4	4.25
Aug. 18	3	3.33

end of July. Young birds may shift for themselves in bands or join other broods and thereby re-establish the size of the brood as indicated by subsequent counts. Some bands, with and without females, contained two distinct sizes of young. It may be that the figures for late July have included some partially broken-up broods.

The movement up the mountain slopes can be detected between mid-July and the first of August; it seems to be correlated with the break-up of broods. It may be that after the birds start up the mountains, many of the groups no longer constitute true broods but are bands composed of both adult females and young birds. Should the band be under the 'leadership' of the female, it could be considered a true brood; on the other hand, if the female has lost most if not all of the brood instinct, and is merely associated with the young, the group would be a band rather than a brood. It is possible that the brood abandonment of July results from low maternal instinct in first-year females. If this were true, the high average brood-size late in the season would result from greater brooding continuity in older females.

The mechanism of shuffling is not understood. On July 21, for example, some broods of young were showing indications of breaking up; we found a number of females and young feeding in a clump of *Amelanchier* and flushed twenty-one birds. There appeared to be no semblance of brood composition among the twenty-one birds, and every sign pointed to mingling.

Voice.—Small chicks peep somewhat like chicks of domestic fowls, but the half-grown young have a peculiar wailing cry which seems to be the call of lost birds. The female running with the brood has a low cluck very much like that of a domestic hen but pitched distinctly lower. Upon flushing during the early part of the season, the female usually flies to a nearby tree and gives a chicken-like cackle in flight, probably a warning to the young. At times she may cackle from her perch. Later, when the brood instinct begins to break down, the females generally flush noiselessly. Early in the season the females fly only short distances, but later they fly as much as a quarter or half mile before treeing.

Growth Rate.—Our data for growth-rate studies are not nearly sufficient; we have satisfactory records for the weights of but twenty-one young males and twenty-eight young females. It is unlikely that a good picture of growth rate will be available until weights for several hundred growing males and females are available. We believe, however, that theoretical and sketchy though they may be, the data are of some value in indicating trends in growth of the young blue grouse.

TABLE 5
WEIGHT AND GROWTH RATE OF YOUNG MALES

<i>Date</i>	<i>Net weight</i>	<i>Average daily growth*</i>
July 3	373.2	10.70
July 3	422.8	12.21**
July 3	291.1	8.21
July 3	292.1	8.25
July 21	576.0	10.90
July 25	573.4	10.06
Aug. 8	737.9	10.40
Aug. 9	628.2	8.69
Aug. 10	650.8	8.88
Aug. 10	772.2	10.59
Aug. 10	695.6	9.52
Aug. 10	850.8	11.70
Aug. 12	639.3	8.48
Aug. 13	557.0	7.26***
Aug. 13	711.9	9.35
Aug. 14	689.3	8.92
Aug. 16	828.2	10.42
Aug. 18	641.5	7.87
Aug. 18	615.6	7.54
Aug. 18	628.1	7.70

*Based upon June 1

**Fastest growth rate

***Slowest growth rate

No figures were obtained for the weight of newly hatched chicks, but by comparison with data from other sources, it would seem that twenty grams is a fairly representative figure. The date of hatching has been assumed as June 1 and all data computed from this 'zero' day. The net body-weight figures have been obtained by weighing the bird and subtracting the weight of the crop and gizzard contents. The daily growth rate has been computed on the basis of the number of days elapsing from June 1, after subtracting the assumed weight of the newly hatched chick from the body weight.

The weights and growth rates for the young males and females, respectively, are given in Tables 5 and 6.

A frequency table of the average daily growth rate has been compiled for the young males as well as the young females, using an in-

TABLE 6
WEIGHT AND GROWTH RATE OF YOUNG FEMALES

<i>Date</i>	<i>Net weight</i>	<i>Average daily growth*</i>
June 20	128.0	5.40***
June 23	241.6	9.63
June 23	213.7	8.42
June 23	251.1	10.05
July 3	394.8	11.36
July 3	317.0	9.00
July 3	300.3	8.49
July 3	403.8	11.63**
July 3	398.0	11.45
July 3	244.5	6.80
July 7	320.8	8.13
July 7	333.6	8.48
July 10	304.2	7.11
July 17	434.9	8.83
July 21	434.5	8.13
Aug. 10	591.6	8.05
Aug. 11	452.2	6.00
Aug. 16	516.5	6.45
Aug. 18	546.1	6.66
Aug. 18	773.8	9.54
Aug. 18	672.8	8.26
Aug. 18	535.1	6.52
Aug. 18	844.4	10.43
Aug. 18	507.2	6.17
Aug. 18	666.8	8.19

*Based upon June 1

**Fastest growth rate

***Slowest growth rate

interval of 1.50 grams (Table 7). The males averaged 9.38 grams a day and the females 8.37.

TABLE 7

Interval	Number	
	Female	Male
5.01-6.50	4	0
6.51-8.00	4	4
8.01-9.50	10	7
9.51-11.00	4	7
11.01-12.50	3	2

The maximum daily growth rate was 12.21 grams for the males and 11.63 grams for the females. The minimum daily growth rate was 7.26 grams for the males and 6.00 grams for the females. Four very low growth rates (2.87, 3.37, 3.49, and 3.61) were obtained but these were probably sick birds. Using the net weights for the average male and female, we find that the average growth rate of the male

TABLE 8

NUMBER OF DAYS TO REACH MATURITY, COMPUTED ON THE BASIS OF 20-GRAM WEIGHT AT PRESUMED HATCHING DATE (JUNE 1) AND STRAIGHT-LINE GROWTH

Sex	Type of growth rate	Growth rate	Type of adult weight	Weight	Computed number of days to maturity	Computed maturity date
Male	Average	9.38	Average	1112.2	119	Sept. 27
Female	Average	8.37	Average	839.8	100	Sept. 8
Male	Fastest	12.21	Average	—	91	Aug. 30
Female	Fastest	11.63	Average	—	72	Aug. 9
Male	Slowest	7.26	Average	—	153	Oct. 29
Female	Slowest	6.00	Average	—	140	Oct. 18
Male	Average	—	Heaviest	1206.1	129	Oct. 7
Female	Average	—	Heaviest	973.4	116	Sept. 24
Male	Fastest	—	Heaviest	—	99	Sept. 7
Female	Fastest	—	Heaviest	—	84	Aug. 23
Male	Slowest	—	Heaviest	—	166	Nov. 13
Female	Slowest	—	Heaviest	—	162	Nov. 10
Male	Average	—	Lightest	1002.3	107	Sept. 15
Female	Average	—	Lightest	711.0	85	Aug. 23
Male	Fastest	—	Lightest	—	82	Aug. 11
Female	Fastest	—	Lightest	—	61	July 31
Male	Slowest	—	Lightest	—	138	Oct. 16
Female	Slowest	—	Lightest	—	119	Sept. 29
				Average	112.4	Sept. 20*

*If all possibilities are equally distributed.

indicates that the average male would reach maturity in 119 days, or September 27, and the average female in 100 days or September 8, were growth to continue in a straight line. The growth rate tapers off before maturity is reached, so that the date of maturity is undoubtedly later. The few figures we have indicate that the growth rate increases during the first thirty days of life and then drops off at the rate of 0.05 grams a day in the female and a little less in the male during the next six weeks; it probably doubles after that. We have used the respectively heaviest, lightest, and average growth-rate figures; together with the heaviest, lightest, and average weights of the adults to make up a table indicating the probable range of maturity on a straight-line trend (Table 8). On the basis of a tapering-off of the growth rate, the figures of the table probably indicate maturity two to three weeks earlier than is the actual case.

The young females apparently reach maturity earlier than the young males despite the faster growth rate of the males. Table 8 indicates strongly the probable extension of maturity from September to November. From all indications, it would appear that the majority of young blue grouse do not reach maturity until about October 1 or perhaps later. It would seem logical, therefore, that the hunting season should not open earlier than October 1.

The Upward Migration.—It appears from our field study that the males migrate to winter grounds in the high altitudes earlier than the females. The upward movement of the latter apparently coincides with the upward movement of the broods, perhaps because the first broods that move upward are with the females. On July 12, it was noted that males and an occasional lone female were moving up the north slope of Mineral Hill. These males were usually banded together in groups of three to six. No broods were moving with them although some movement of broods and old birds had been noted on Funk Mountain. As a nest of the 'blue grouse' had been found near the top of this mountain, it may be that the broods were resident. July 17, a hen with four young was found at 4,200 feet on Mineral Hill, a little below a nest found on the same hill. July 19, we observed a female and brood in the road immediately below the summit of Buck Mountain at 5,000 feet; it appeared that this brood was migrating. July 25, a hen with three young was found on the south slope of Rock Mountain at 7,500 feet in a high, narrow meadow which reached above timberline. This was the earliest brood found at so high an altitude.

Our impression from field studies is that the birds migrate up

Funk Mountain earlier on the dry western slope than on the moister eastern one. Open, park-like grassy areas extend to 4,500 feet on the western slope; on the east they extend not higher than 3,000 feet, and in some places the timber reaches to the floor of the Sinlaheekin Valley. It is logical that the birds should move more rapidly across the open parks of the western side and more slowly through the timber of the eastern side. On August 6, we found numbers migrating through Douglas fir on the eastern side at an altitude of 4,000 feet. The adult males were in bands of three to six, but the unattached females apparently were either alone or in groups of two or three. There were several broods composed of a female with half-grown young, as well as several bands of half-grown young without females.

The females accompanying the young paid little attention to them and apparently the brood composition had almost completely broken down, at least among the migrating birds. August 8, we found a band, evidently migrating, of two females and four young south of Lone Frank Pass at an elevation of 5,000 feet. August 12, we found a young male migrating on foot along the road south of Salmon Meadows. The same day a lone female was observed coming up the slope from the creek bottom and crossing the road to the ridge east of Salmon Meadows.

It would seem that the earliest upward movement, at least among the young birds, may begin shortly after the middle of July and that migration is well under way by mid-August. It is probable that the upward migration spreads over a period of two or two and one-half months. No doubt most grouse are on or near their winter grounds by the first of October, but some may linger in the valleys until November. The number of birds observed above timberline or in the stunted trees at timberline indicates that migrating birds sometimes move above timberline in late summer, probably to feed upon grasshoppers and *Vaccinium* berries, and down into the timber again for the winter.

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