

AGE, MOLT AND WEIGHT CHARACTERISTICS OF BLUE GROUSE

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In the course of a study of the population dynamics of Blue Grouse (*Dendragapus obscurus*) at Quinsam Lake, Vancouver Island, British Columbia, data were obtained on age groups in this species. A quantitative method was developed for aging both yearling and adult grouse. In the young, feather and weight development can be used as an estimate of age from time of hatching in June to the first fall plumage of October. Observations on molt and weight of all age classes fit naturally into the present discussion.

According to Bent (1932) the juvenal plumage rapidly replaces the natal down. The juvenal flight feathers are molted during July and August and the body molt into the first winter plumage is continuous from August to October. The postjuvenal molt is complete except that the outer two pairs of primaries are retained a full year. Swarth (*in* Bent, 1932) noted that the first postnuptial or annual molt begins about the middle of July of the second year and lasts until about the middle of September.

The data on molt and weight presented here are based on the examination of 350 grouse on the breeding range at Quinsam Lake. Of this total 195 were chicks. The chicks were aged by dating the time when they were collected from the third week of June, the time of the peak in hatching. At least five birds were examined in each week between April and August in the years from 1950 to 1952. In September of 1950 and 1951 I examined for molt pattern and weight several hundred grouse taken by hunters.

MOLT IN CHICKS AND JUVENILES

The bird in natal or chick plumage is covered with a soft down and juvenal primary feathers are visible at the edges of the wings. By two weeks of age, seven pairs of primaries and at least twelve pairs of secondaries are present in each wing and in active growth. Juvenal contour feathers develop on the sides of the chest and juvenal rectrices appear on the tail. Flight is possible at this stage in plumage development.

At four weeks of age the seven juvenal primaries are almost completely grown and replacement from the wrist laterad is begun. Two more juvenal primaries appear distal to the original seven. By this time the twelve juvenal secondaries mature. Juvenal contour feathers sheath the top of the head, body, legs and wings. The sides and back of the head and upper neck are still in natal down. The juvenal rectrices are approximately one-half grown and the bird, except for the head, is in full juvenal plumage.

By six weeks of age the proximal or 1st juvenal primary is fully replaced while juvenal primaries 2, 3 and 4, in that order, are shed or being replaced. Juvenal primaries 8 and 9 are still in growth and juvenal primary 10 is visible. At this time, molt of the juvenal secondaries begins, usually mediad from the wrist. This molt pattern is irregular compared to that of the primaries. The juvenal rectrices are now approximately fully grown and replacement feathers are visible among them.

By eight weeks of age, juvenal primaries 5 and 6 are replaced by new feathers. Juvenal primary 8 is fully grown, 9 and 10 are one-half to fully grown. At this time replacement of the juvenal contour feathers begins on the shoulders and sides of the chest. The new rectrices are approximately one-half grown and extend beyond the juvenal rectrices still present.

By ten to twelve weeks of age juvenal primaries 7 and 8 are shed and the replacements are growing. The few remaining natal down feathers along with the juvenal contour feathers are, by now, almost fully replaced. By mid-September, or the age of 14

weeks, the new primaries (except the 8th), the secondaries, contour feathers and rectrices are approximately fully grown. It seems likely that all flight and contour feather development for the year is completed by October. This first fall plumage is carried until completion of a second fall molt and is called the yearling plumage. The yearling plumage results from a complete molt and replacement of chick and juvenal feathers with the exception of the two most lateral pairs of juvenal primaries, which are retained a full year.

In September, several differences may be noted between yearling and adult plumage (the plumage of birds going into at least their second fall season). At this time, the yearling plumage is lighter in color and more speckled with white. Yearling primaries 9 and 10 show this color difference as well as being more pointed than those of the adult bird. However, the most obvious difference between the two plumages is the shorter and narrower yearling rectrices. These are of characteristic size after all growth has ceased. Thus they can be used as an age criterion to separate yearlings from adults, which have the larger and wider rectrices gained in their second or later fall molt.

MOLT IN YEARLINGS AND ADULTS

The yearlings and adults begin in early summer what Swarth (*loc. cit.*) called the postnuptial molt. This molt is usually considered a complete replacement of plumage. The birds of two years and older are refeathered with apparently identical plumage while the yearlings assume the plumage of adult birds. There is some variation in this basic pattern.

Adults and yearlings of both sexes begin molting by the last week of May. At this time the 1st or innermost primary is replaced. By the end of June, primaries 2, 3 and 4 are either fully replaced or in the process of growth. At this time body molt begins in the head and neck and extends over the back, sides and legs. The brood patch of incubating hens is refeathered by the middle of July. By the end of July the 5th and 6th primaries are shed and being replaced while the new primaries are fully grown. Body molt continues with shedding and replacement of feathers. It is most noticeable in the cocks which show a white and black mottled appearance about the neck region. Concomitantly, the neck tissues of the male, swollen and deep yellow during April and May, become thin and pale in color. The same change is noted in the caruncle.

The samples obtained in August and mid-September indicate that primaries 7 and 8 are shed and in new growth at this time; this is true also in birds-of-the-year. Body molt continues. The first rectrix is shed by mid-August or late August; rectrices are replaced from the outside mediad. By mid-September most of the cocks and hens have a completely new set of tail feathers. The molt of the upper and lower tail coverts occurs simultaneously with the molt of the rectrices. Molt and feather replacement, as in the young, is probably completed by the end of October.

An unusual feature in this molt pattern is the rarity of molt of wing covert and secondary feathers. Of the adults and yearlings examined only two showed molt of the secondary feathers and this was erratic with the 3rd, 4th and 5th (counting mediad from the wrist) of the 12 secondaries being replaced in one, and the 2nd, 5th, 7th and 12th in the other. Both of these molts were observed early in August. If all feathers are to be annually replaced, then the secondary feathers, wing coverts and the 9th and 10th primaries, not molted by mid-September, must be shed later. However, complete annual molt may not always occur.

Two free-living adult males were dyed with red printer's ink dissolved in naphtha gas in May, 1952. They were shot and examined in early June, 1953. Any feather re-

placement in this time would be indicated by ink-free parts of the plumage. In both birds, the head, neck, body, tail and legs were uncolored. But the 10th primary was colored, as were all the secondaries except two. Most of the under and upper coverts of the wing were unmarked, although the first row of under coverts of the secondaries was solidly dyed. This evidence shows that a complete annual molt of the wing coverts and some of the primaries and secondaries does not always occur. A complete annual molt does occur in the head, body, leg and tail regions. If this condition is generally true of yearling Blue Grouse then age criteria based on the outer pair of primaries should be regarded with caution. A yearling bird which does not develop adult primaries in its second fall will still be classed as a yearling on the basis of characteristics of the primary feathers.

AGE CRITERIA FOR ADULTS

Van Rossem (1925) observed that Blue Grouse between their first and second fall molts (yearlings) have shorter and narrower rectrices than birds between their second and later fall molts (adults). Petrides (1942) measured the width of the outer rectrices of several Blue Grouse at a point one-half inch below the tip. Rectrices of the yearlings were three-quarters to seven-eighths of an inch in width. Rectrices of the adults were one and one-quarter to one and one-half inches in width. The length of tail was usually less than 6 inches in the yearlings and usually greater than 7 inches in the adults. Length of tail was subject to greater variation than width.

In this study the average length of the outer pair of rectrices separated the age classes better than average width. Moreover, length of rectrix was more easily and accurately obtained than width.

To establish age criteria based on this measurement, the outer pair of tail feathers of all birds examined other than juveniles were collected and measured for total length. Fully developed rectrices were used in measurements. The average lengths for each sex were then plotted in frequency diagrams, figure 1.

Birds of known first fall or yearling plumage were obtained at a British Columbia Game Department Road Check held in September at Campbell River, Vancouver Island. In September there are several ways of accurately identifying a bird-of-the-year other than by length of tail. The yearlings usually retain until this time a few juvenal feathers, as in the axillae. In yearling males the skin of the neck is not as colored or thickened or rugose as in adult males. In yearlings of both sexes the posterior edge of the sternum is not completely ossified and can be easily bent. Most characteristically, the bursa of Fabricius is a deep pouch 1 to 2 cm. in length in the yearlings whereas in the adults it is reduced in size or is absent. The hatched parts of figure 1 represent the birds in yearling plumage.

In addition to the yearling birds examined at the September road check a sample of unknown age of male and females was obtained from the breeding range in spring and summer at Quinsam Lake. The frequency of occurrence of average length of outer tail feathers in these birds is represented by the open columns or open parts of columns in the histograms.

Note in the figure for males that there is a clear break between birds with yearling rectrices and another class representing birds with adult rectrices. From the histogram it may be seen that yearling males have an average length of outer tail feathers ranging between 13.2 and 15.2 cm. Adult males have an average length of outer tail feathers ranging between 16.2 and 19.4 cm. In the females the break between age classes is not as clear cut; however, the two groups are evident. Hens can be classed as yearlings if

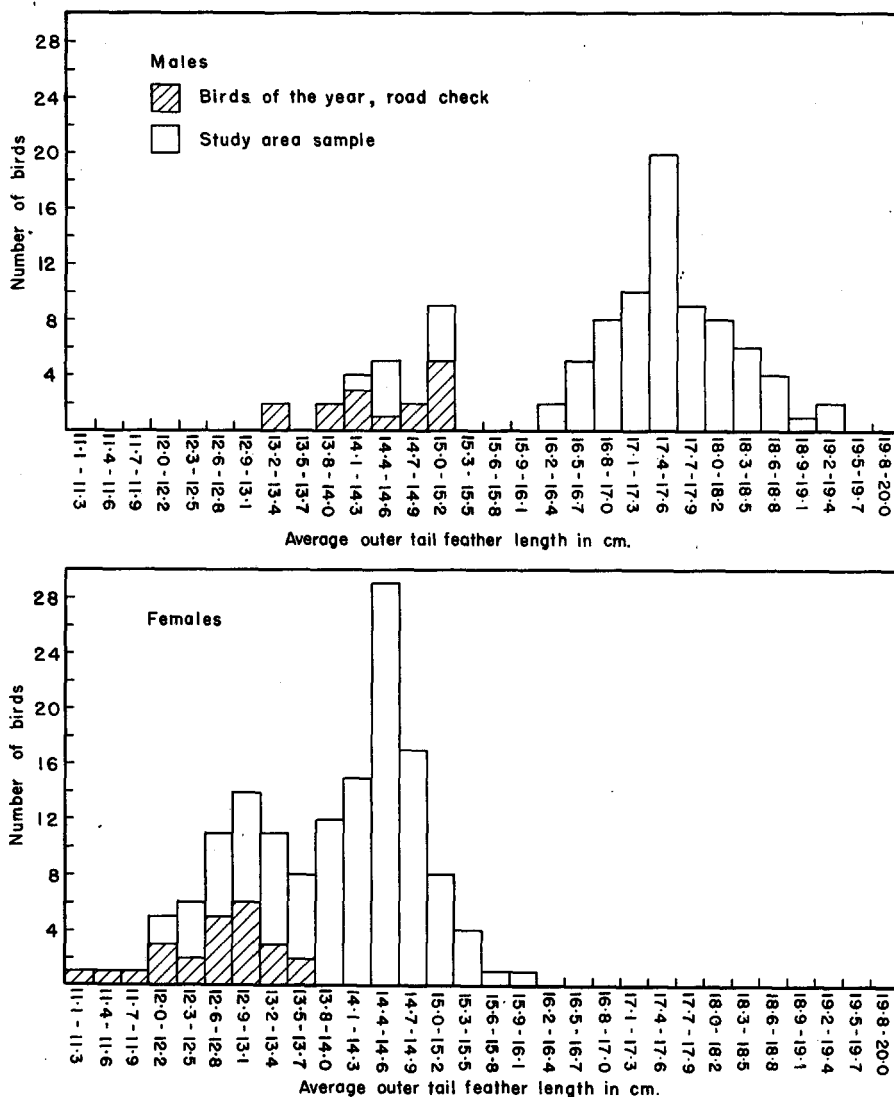


Fig. 1. Average lengths of outer tail feathers of yearling and adult Blue Grouse.

their average length of outer tail feathers falls between 11.1 cm. and 13.4 cm. and as adult hens if this length falls between 13.8 and 16.1 cm.

The bursa of Fabricius is an acknowledged indicator of age in many birds (Gower, 1939; Hochbaum, 1942; Kirkpatrick, 1944). Generally the bursa is resorbed within a year after hatching and is absent from most breeding birds. Buss and Schottelius (1954) recorded bursae of 1.8 cm. to 2.8 cm. in four Blue Grouse in adult plumage in October. They concluded that the birds were approximately one and one-half years of age and had not bred; it seems likely that the four birds were in their first adult plumage.

In this study, adult and yearling grouse of both sexes were examined on the breeding range for bursal depth. At this time the birds in yearling plumage are approximately

one year of age and the birds in adult plumage are at least two years of age. Territorial behavior was taken as an indication of a breeding male. In females the presence of a brood patch, well developed ova, or shed follicles were used as criteria for a breeding bird. Five yearling males had a modal bursal depth of 0.5 cm. with a range between 0.1 and 1 cm. None of the yearlings was a breeding bird. Twenty adult males had a modal bursal depth of 0.2 cm. with a range between 0 and 0.5 cm. Several males banded in previous years were examined. One was three years old, three were four or more years old, and one was five or more years of age. The three-year old male had a bursal depth of 0.2 cm., the rest were without bursae. All the adult males were breeding birds.

Eight yearling females had a modal bursal depth of 0.5 cm. with a range between 0.1 and 0.5 cm. At least three of these hens were breeding. In 19 adult hens examined, 16 were without a bursa whereas three had a bursa of 0.1 cm. At least 17 of these birds were breeding. In two banded hens of three or more years of age, one had a bursa of 0.1 cm.; the other was without a bursa.

These observations suggest that both male and female Blue Grouse retain a bursa into their second or third year. The presence of a bursa in males in adult plumage indicates a bird two or three years of age. If the bursa is absent the male is likely four or more years of age.

In most of the hens the resorption of the bursa appears to be completed in the second year of life. If it is present in an adult hen, this would suggest that the bird is two or three years of age. The relatively rapid resorption of the bursa in the hens is possibly related to age of breeding. None of the yearling males was breeding; however, at least three of the yearling hens were breeding birds. Since each of these hens had a measurable bursa, the presence of a bursa in yearling Blue Grouse cannot be used as an infallible indicator of a non-breeding bird.

It is curious that Buss and Schottelius recorded bursae of 1.8 to 2.8 cm. in birds of one and one-half years of age. This is the depth we and they recorded in four- to five-month old birds in the fall. In our sample of yearling males of approximately one year of age the bursa was not deeper than 1 cm. These observations suggest that the measurement of bursal depth is more subjective than indicated by the foregoing data and requires more rigorous definition.

SEX RATIO AND WEIGHT DEVELOPMENT OF THE YOUNG

Of 138 young collected at random in the period from June 15 to August 15 in 1951 and 1952, 70 were males and 68 were females. This deviation from an equal sex ratio is not statistically significant and supports a sex ratio of 100:100 in the young.

The weights of 224 young were obtained in this period and at the road-check station in September of 1950, 1951 and 1952. Birds collected or captured were weighed for total weight (crop contents excluded) and these weights, classified as to sex, were averaged for each week from the date of peak of hatching. The sample obtained from hunters provided weights of birds approximately 14 and 15 weeks of age.

The average weights and their confidence limits at the 95 per cent level for each sex are plotted against week of age in figure 2. After 8 weeks of age few data were available from the study area until grouse of 14 and 15 weeks of age were obtained from hunters. Between these ages the averages are likely to be unreliable. The relatively large road-check sample of 68 birds provides a good estimate of weight of birds of 14 and 15 weeks of age. At 14 weeks of age the males are significantly heavier than the females (5 per cent level used throughout). At 15 weeks of age the males have attained 885 ± 50 grams while the females are 725 ± 35 grams. Both weights are lower than those recorded for yearling males and females on the study area in spring and summer (see below).

If a best straight line is drawn through the points, its slope represents an average rate of weekly growth. In the males this is approximately 60 grams per week and in the females approximately 50 grams per week. These values are similar to the growth rates calculated for Blue Grouse young in Washington by Wing, Beer, and Tidyman (1944). They found growth rates to be 66 grams per week in males and 59 grams per week in females.

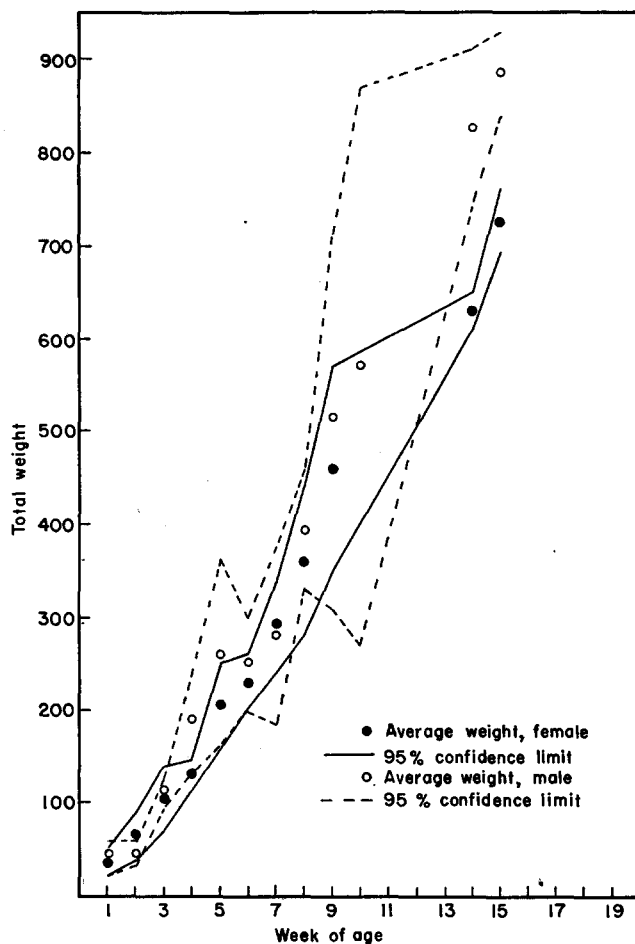


Fig. 2. Weight (grams) development of young Blue Grouse.

The greatest error in the calculation of growth rate and the description of plumage development results from the inability accurately to age the young other than from the date of peak of hatching. Thus, in pooling the weights of birds collected in any given week, variation in hatching date is ignored. This error contributes to the large fiducial interval observed in some samples. The use of weights obtained over three years of study is not considered a major source of error. A sample of 18 weights taken at the road check in 1951 was tested against a similar sample obtained on the same date in 1952. The difference between the two averages was not statistically significant. Moreover, assuming environmental effects were equal over the growth period of the two samples, this result would suggest little difference between 1951 and 1952 with respect to time of peak hatch.

WEIGHT OF YEARLINGS AND ADULTS

The average weights of adult males (crop contents excluded) captured or collected on the summer range in spring, summer and early fall are as follows:

Period weighed	Size of sample	Average weight and standard error of the mean
April, May	21	1285±30 gm.
June, July	34	1230±10 gm.
September	6	1245±50 gm.

The differences in the averages are not statistically significant.

The hens in late April and May are heavy with eggs and thus comparison with average summer weight is less meaningful. Of 24 recorded in this period the weights ranged between 850 grams and 1200 grams. A sample of 55 adult females obtained in June and July was 845±10 grams in average weight. A sample of 37 adult females taken in September was 850±10 grams in average weight. The difference between the two averages is not statistically significant.

These comparisons indicate no statistically significant change in the average weights of adult birds on the summer range. The samples from September give no indication of a weight gain prior or during migration to the winter range in the highlands. This, and the similarity of spring and early fall weights, would suggest conditions for weight development were comparable on the summer and winter ranges. Data on weight in the winter months and particularly in February and March, the time of spring migration, would be most instructive.

Eight yearling males weighed in May and June averaged 1110±40 grams. This is significantly lighter than the 1230±10 grams recorded for the adult cocks in June and July, and an indication that yearling males do not attain adult weight until after June in their second year.

Eleven yearling females weighed in June and July averaged 790±10 grams. This weight is significantly lighter than average weight of 845±10 grams recorded in the adult hens over the same period. It is likely that yearling hens do not attain adult weight until after July of their second year.

The use of pooled data from three years of study is not considered a major source of error in the calculation of average weight of adults. Where suitable samples were available in one year, these were tested in the same way as were the pooled data with similar results. The greatest error in the determination of adult weight results from the paucity of data. By pooling weights in one-month and two-month periods, short term fluctuations of weight are obscured, particularly when monthly samples are unequal in size.

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SUMMARY

Observations on age groups of Blue Grouse on Vancouver Island, British Columbia, are presented. By October, chicks of the first year are in plumage similar to the adults with the exception of shorter and narrower rectrices. The chick, postjuvinal and annual

molt follows a recognizable pattern of replacement of flight and contour feathers. There is evidence that the annual molt of flight feathers is not complete in adult birds.

Several criteria of age are defined. The average length of the outer pair of rectrices in yearlings (birds between their first and second falls) ranges between 13.2 and 15.2 cm. in males and probably between 11.1 and 13.4 cm. in females. The same measurement in adults (birds between their second and later falls) ranges between 16.2 and 19.4 cm. in males and probably between 13.8 and 16.1 cm. in females.

The presence of the bursa of Fabricius in a Blue Grouse in adult plumage indicates a bird of two to three years of age. Its absence from males in adult plumage indicates a bird of four years of age and older.

A sample of 138 young collected in the period from June 15 to August 15 in 1951 and 1952 was 100:100 in sex ratio.

Over the period from June 15 to September 23 (1 to 15 weeks of age) the average growth rate of young males and females is approximately 60 and 50 grams per week, respectively.

The average weights of adult birds on the summer range showed no statistically significant change between April and September. In June and July adult males averaged 1230 ± 10 grams; adult females, 845 ± 10 grams.

Eight yearling males and 11 yearling females weighed in May, June, and July averaged 1110 ± 40 grams and 790 ± 10 grams, respectively, an indication that yearlings do not attain adult weight until after June or July of their second year.

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