

Job Title: Federal Aid in Wildlife Restoration: Conduct pilot research to evaluate forest grouse management strategy

Period Covered: 1 January 1992 through 31 December 2009

Report Title: Progress Report: Harvest Management of Forest Grouse in Washington, with a focus in north-central Washington

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INTRODUCTION

Ruffed grouse (*Bonasa umbellus*), spruce grouse (*Falcapennis canadensis*), dusky grouse (*Dendragapus obscurus*), and sooty grouse (*D. fuliginosus*) are important wildlife resources in the forests of Washington. In addition to providing important hunting opportunities, forest-dwelling grouse are integral components of their respective ecosystems. In 1952 an aggregate bag limit of 3 was established for the ‘forest’ grouse. This bag limit remained in place until the hunting season of 2009 when it was increased to 4. Between 1950 and 1972 the season started on the first to the fourth Saturday of September (Fig. 1). Starting in 1973 the start of the hunting season was the first of September. The season ended at the end of December during the entire period.

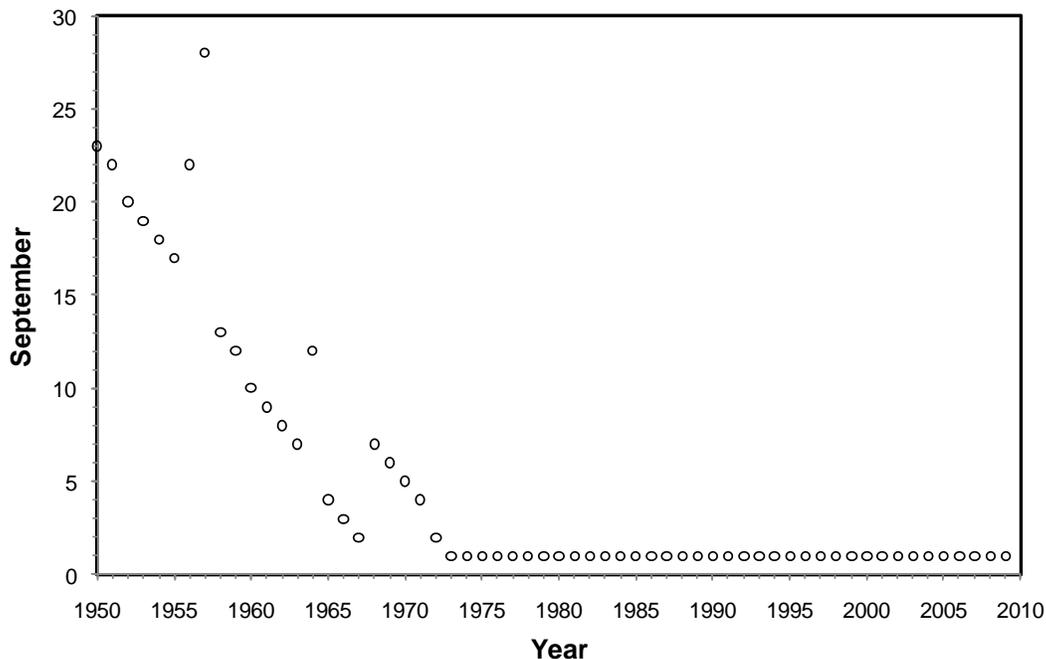


Fig. 1. Start of the forest grouse hunting season in Washington, 1950-2009.

In 1953 surveys were initiated to evaluate the overall demography of forest grouse populations and patterns of hunting pressure. Between 1953 and 2009 these surveys consisted of check stations, line transects, wing barrels, hunter questionnaires, and research on breeding populations. The subsequent analysis of these surveys and evaluation of the harvest management of forest grouse in Washington addresses numerous questions.

- 1) What is the distribution of grouse harvest with respect to species, sex, and age?
- 2) Does the distribution of harvest vary between area and year?
- 3) Does hunter success rate (hours/recovered grouse) vary between area and year?
- 4) Is the proportion of juveniles positively correlated with estimates of harvest?
- 5) How do the different survey techniques compare with regard to efficiency of data collection and quality of information?
- 6) How do Washington's harvest regulations compare with those in other states and provinces?

METHODS

Check Stations

Three check stations were operated in north-central Washington to obtain information on grouse harvest at various intervals between 1953 and 2000. The stations included Conconully (1953-1995, 1 km S Conconully), Chumstick (1953-1964, 2 km N Leavenworth), and Eight Mile Creek (1958-1962, 13 km N Winthrop). The check stations were eventually terminated because of the decline in the number of hunters in the respective areas and the inconsistent starting date of the hunting season. Check stations typically were conducted on the opening day and/or opening weekend of hunting season. In addition, surveys often were continued on the second, third, and fourth weekends of the hunting season. Check stations for species other than grouse were conducted during variable date periods.

Drivers and passengers of most vehicles were interviewed about their hunting results; most recovered grouse were examined. Data collected at check stations included: 1) number of hunters in each group; 2) number of hours hunted; 3) presence of a hunting dog; 4) county of origin for hunters; 5) specific area in which they hunted; and 6) number of birds recovered according to species, sex, and age (Table 1, Appendix A). Because blue grouse were recently split into 2 species, dusky grouse and sooty grouse (Banks et al. 2006), most of the data were recorded as only blue grouse. Despite this combination, the vast majority of blue grouse observations in this report refer to dusky grouse on the basis of appearance and location.

Table 1. Documentation of species, age, and sex for blue, spruce, and ruffed grouse.

Species	Age	Sex	Sex and age
General	Dwight 1900, Gower 1939, Petrides 1942, Wright and Hiatt 1943		Larson and Taber 1980
Blue (dusky and sooty) grouse	Van Rossem 1925, Bendell 1955, Smith and Buss 1963, Zwickel and Lance 1966, Schladweiler et al. 1970, Redfield and Zwickel 1976	Caswell 1954, Mussehl and Leik 1963, Zwickel and Dake 1977 ^a , Hoffman 1983, Zwickel et al. 1991	Boag 1965 ^a , Braun 1971, Bunnell et al. 1977, Hoffman 1985 ^a , Zwickel 1992
Spruce grouse	McCourt and Keppie 1975, McKinnon 1983, Szuba et al. 1987	Ellison 1968, Boag and Schroeder 1992	Lumsden and Weeden 1963, Zwickel and Martinsen 1967
Ruffed grouse	Dorney and Holzer 1957, Rodgers 1979	Roussel and Ouellet 1975	Dorney 1966, Hale et al. 1954, Davis 1969

^aMolt can be used to infer breeding success.

Line Transects

Line transects were surveyed between 1954 and 1974 and between 1996 and 2003 in order to monitor the abundance of forest grouse in north-central Washington (Table 2). Surveys of each transect were initiated at about sunrise during the last half of August and driven at a rate of about 15 km per hour. Information on observed grouse included species, sex (if known), age (if known), group size (particularly for broods), perpendicular distance to the center of the road, and location on the transect.

Table 2. Details of specific line transects in north-central Washington, 1954-2003.

General route of line transect	Distance	Survey interval ^a
Nahahum Canyon - Chiwawa River	67 km	1954-1974, 1996-2003
Lake Creek - Slide Ridge	68 km	1954-1974, 1996-2003
Salmon Creek - Boulder Creek	66 km	1954-1971, 1996-2003
Toats Coulee - Cecil Creek	85 km	1954-1971, 1996-2003
Cape LaBelle - Pontiac Ridge	77 km	1955-1971, 1996-2003
Gold Creek - South Navarre Road	86 km	1967-1971, 1974, 1996-2003
Eightmile Creek - Hart Pass	83 km	1997-2003

^aSome of the original data for 1954-1974 is missing and/or incomplete.

Wing Barrels

A survey with the aid of wing barrels (Hoffman 1981, Fig. 2) was conducted during 1993-1995, 1998-2005, and 2007-2008 (wing barrels not placed in 2006 due to forest fire) to obtain additional information on the harvest of forest grouse in north-central Washington. The locations of the 6 wing barrels included Conconully (1993-1995, 1998-2005, 2007-2008), Fish Lake (1993-1995), Loomis (1993-1995), Siwash Creek (1993), Havilla (1993), and Boulder Creek (1995, 1998-2005, 2007-2008). Wings usually were gathered at least once a week during September and October and once a month during November and December.

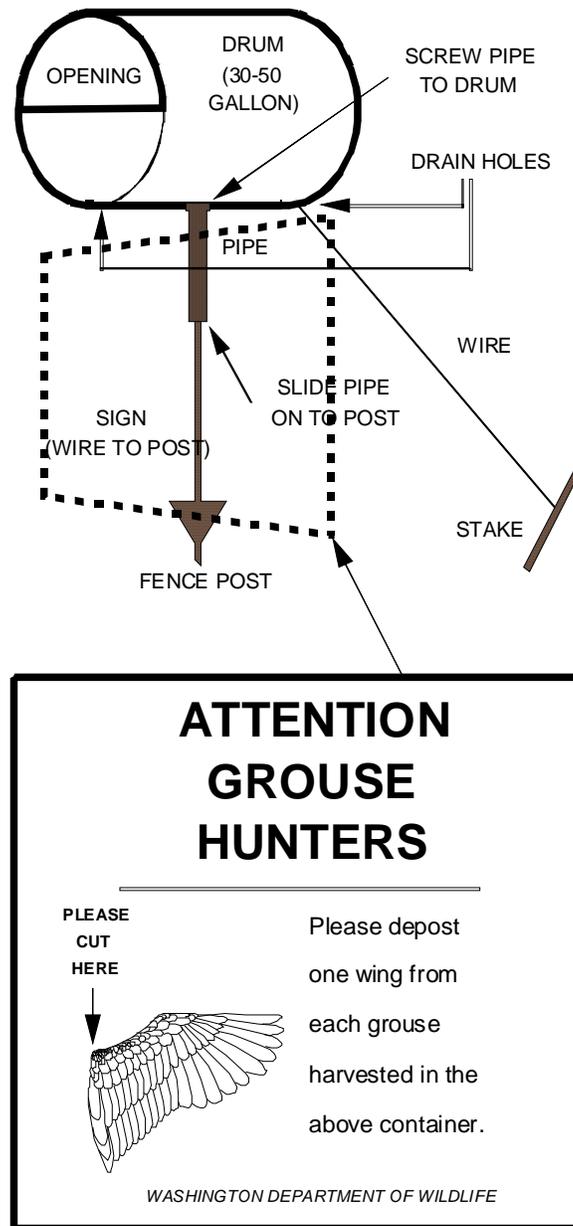


Fig. 2. Sample description of barrel and sign used for wing barrel survey in Washington, 1993-2008.

Questionnaires

Questionnaires were used to evaluate the statewide harvest between 1962 and the present, primarily for the purpose of examining long-term trend in harvest and harvest pressure. However, development of estimates is challenging because of a licensing structure that allows harvest with either a big game or small game license. Forest grouse harvest survey methods were modified in 1998 and 1999 because of 1) difficulty in separating effort among the grouse species, 2) inaccuracy in species identification by some hunters, and 3) changes in hunting license structure that impacted hunter sample stratification. Because of this change in survey technique, comparison of forest grouse harvest information before and after this time should be done with some caution. Data is only available through 2005 for this report.

Breeding Populations

Research on breeding populations of forest grouse have been largely pilot studies. The primary technique has been the identification and mapping of breeding territories for dusky and spruce grouse. In the case of dusky grouse, location of displaying males was determined by localization of their hooting behavior (Zwickel 1992). Dusky grouse territories were mapped on 2 areas in May 2007; 1) Frazer Creek on the Methow Wildlife Area about 10 km east of Twisp, Washington and 2) Chesaw Wildlife Area about 5 km west of Chesaw, Washington. The Frazer Creek area was a duplication of a similar effort in 1983 (Lewis 1985). A similar procedure was used between 1993 and 2007 for spruce grouse on the area around Tiffany Mountain (Okanogan National Forest northwest of Conconully and northeast of Winthrop, Washington). The primary difference with spruce grouse is that recordings of a female call were used to attract males (Schroeder and Boag 1989). Because spruce grouse are relatively easy to catch with noosing poles (Schroeder 1986), all territorial males were captured and banded with a unique combination of colored bands.

RESULTS

Check Stations

A total of 13,024 grouse was recovered from 48,411 hunters at all check stations combined (0.27 grouse/hunter). An additional 3,279 grouse were recovered from an unknown number of hunters. Blue grouse comprised about 65.7% of the harvest at all check stations combined. Grouse hunters recovered an average of 0.73 grouse/hunter and mule deer/mountain goat/ring-necked pheasant hunters recovered an average of 0.08 grouse/hunter. Results from check stations illustrated a significant decline in hunting pressure throughout the first month of the hunting season ($F = 42.01$, $P = 0.001$; Fig. 3). The average number of hours spent hunting also declined throughout the first month of the hunting season ($F = 18.85$, $P = 0.001$; Fig. 4). The average daily number of hunters declined annually at all check stations that were surveyed ($F = 61.00$, $P = 0.001$); this trend was particularly apparent at the Conconully check station (Fig. 5).

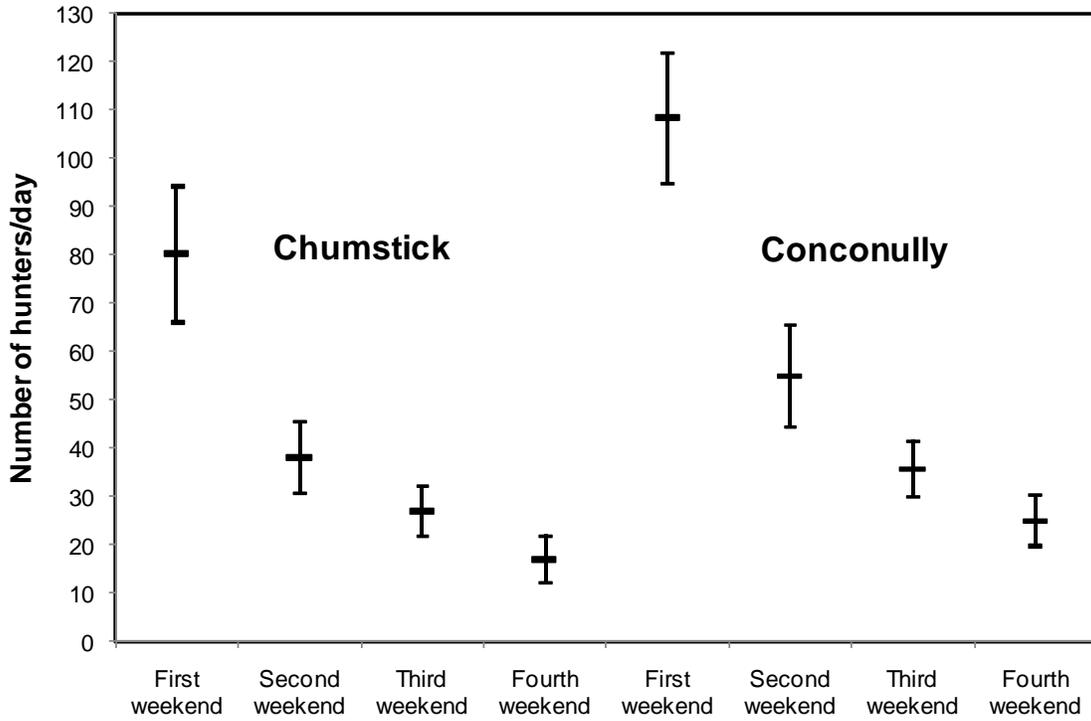


Fig. 3. Average number of hunters (middle horizontal bar) and 95% C.I. (end bars) recorded at two check stations throughout the first month of the hunting season in north-central Washington, 1953-1964.

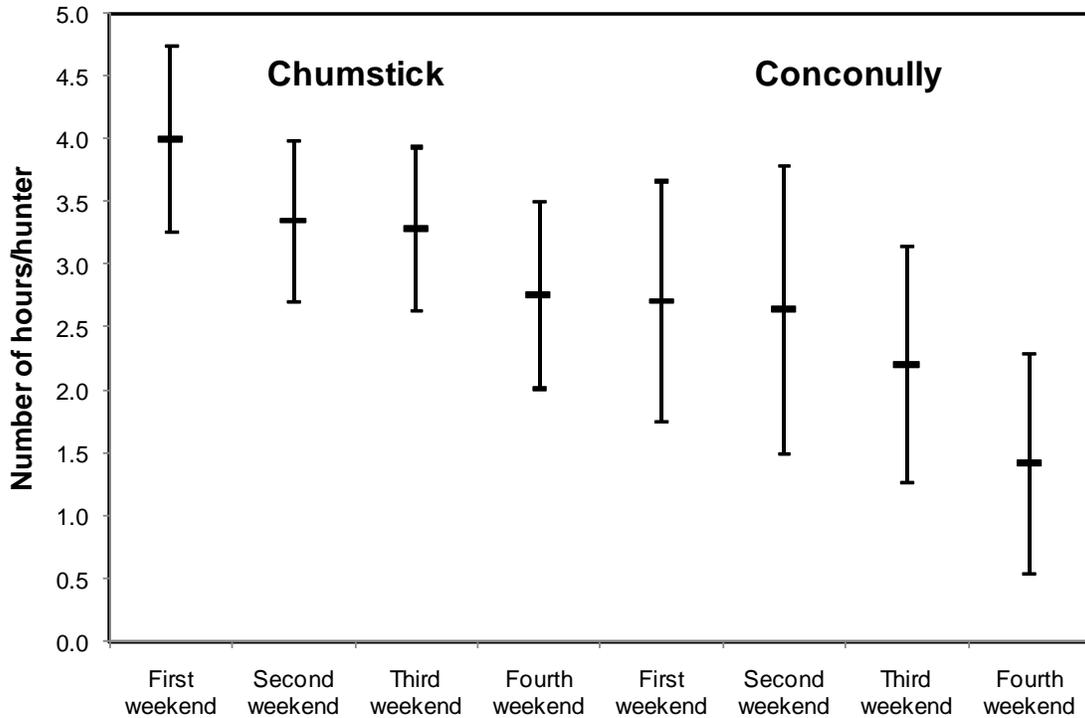


Fig. 4. Average number of hours per day each hunter spent hunting (middle horizontal bar) and 95% C.I. (end bars) recorded at two check stations throughout the first month of the hunting season in north-central Washington, 1953-1964.

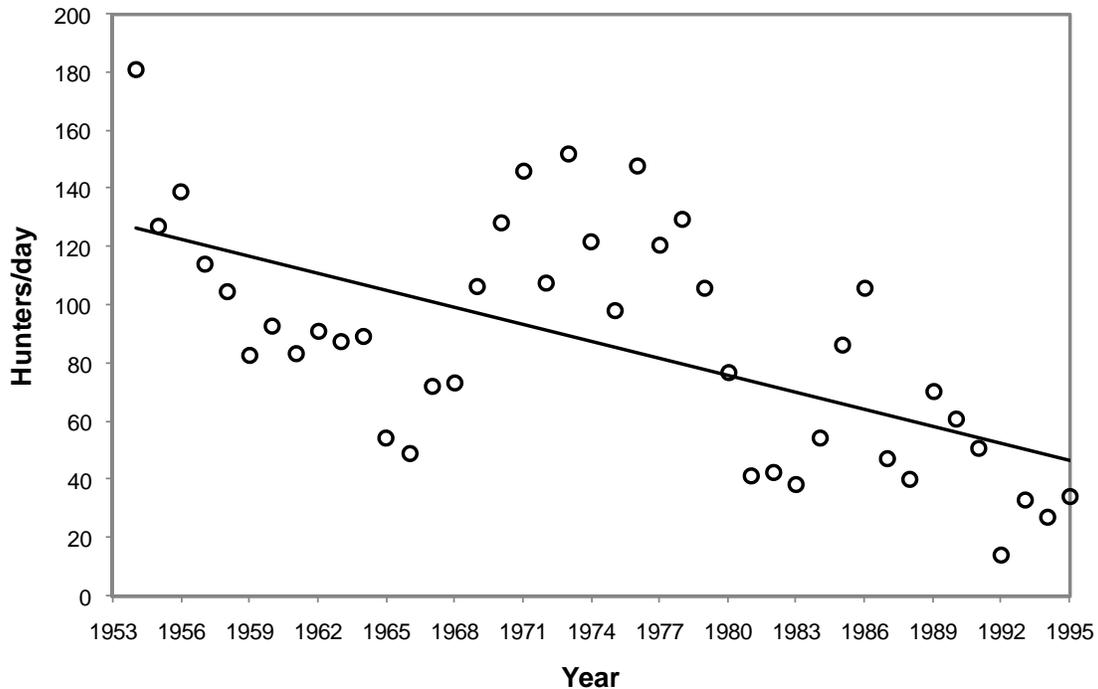


Fig. 5. Average daily number of hunters recorded during the opening week of the hunting season at the Conconully check station in north-central Washington, 1954-1995.

Declines in hunting pressure appeared to be reflected in annual numbers of recovered birds. Number of recovered birds appear to decline annually ($F = 11.21$, $P = 0.001$), even when differences between area ($F = 6.68$, $P = 0.002$) and weekend ($F = 16.93$, $P = 0.001$) were considered. Although it was clear that most of the decline in harvest was due to declining hunting pressure, some of the decline may have been due to declining numbers of grouse.

Check stations presumably are designed to provide more than basic information on proportions of species in the harvest and distribution of hunting pressure. Ideally, surveys should provide a methodology for monitoring the 'health' of populations. The average number of hours per recovered bird was considered as a technique for evaluating the population. Hours per bird varied by checking station ($F = 20.70$, $P = 0.001$) and weekend ($F = 5.24$, $P = 0.025$). Differences in hunting success were especially dramatic between the Chumstick and Conconully checking stations (Fig. 6). When 'hours per bird' was controlled for area and weekend, significant annual differences were detected ($F = 9.55$, $P = 0.004$); hours per bird appeared to increase slightly throughout the survey interval (Fig. 7).

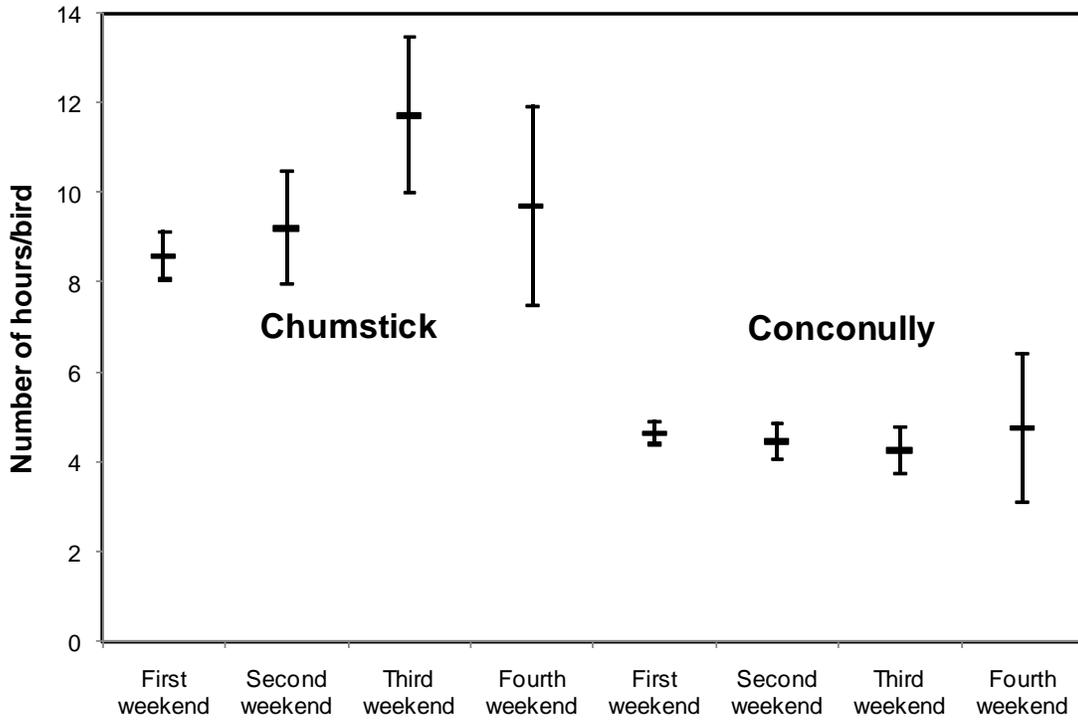


Fig. 6. Average number of hours for each recovered bird (middle horizontal bar) and 95% C.I. (end bars) recorded at Chumstick and Conconully check stations during the first month of the hunting season in north-central Washington, 1953-1964.

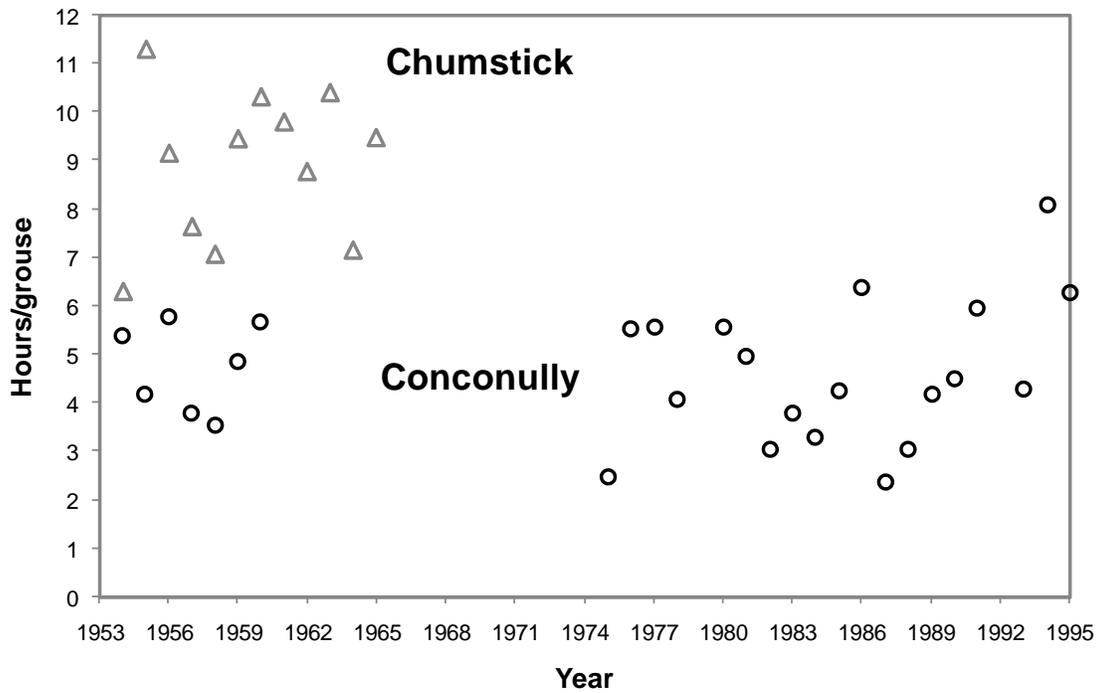


Fig. 7. Average number of hours for each recovered grouse recorded at the Chumstick and Conconully check stations in north-central Washington, 1953-1995.

The proportion of juveniles in the population was also considered as a technique for monitoring the health of the population. Presumably a declining proportion of juveniles would be consistent with a declining population. The proportion of juveniles examined at check stations appeared to fluctuate dramatically on an annual basis with no significant trends overall ($F = 1.18$, $P = 0.295$) (Fig. 8). Nevertheless, the proportion of juveniles in the harvest tended to be lower in recent years. There was no correlation in the proportion of juveniles examined at check stations with the total number of birds recovered ($F = 0.41$, $P = 0.684$) or the average number of hours for each recovered bird ($F = 0.49$, $P = 0.629$).

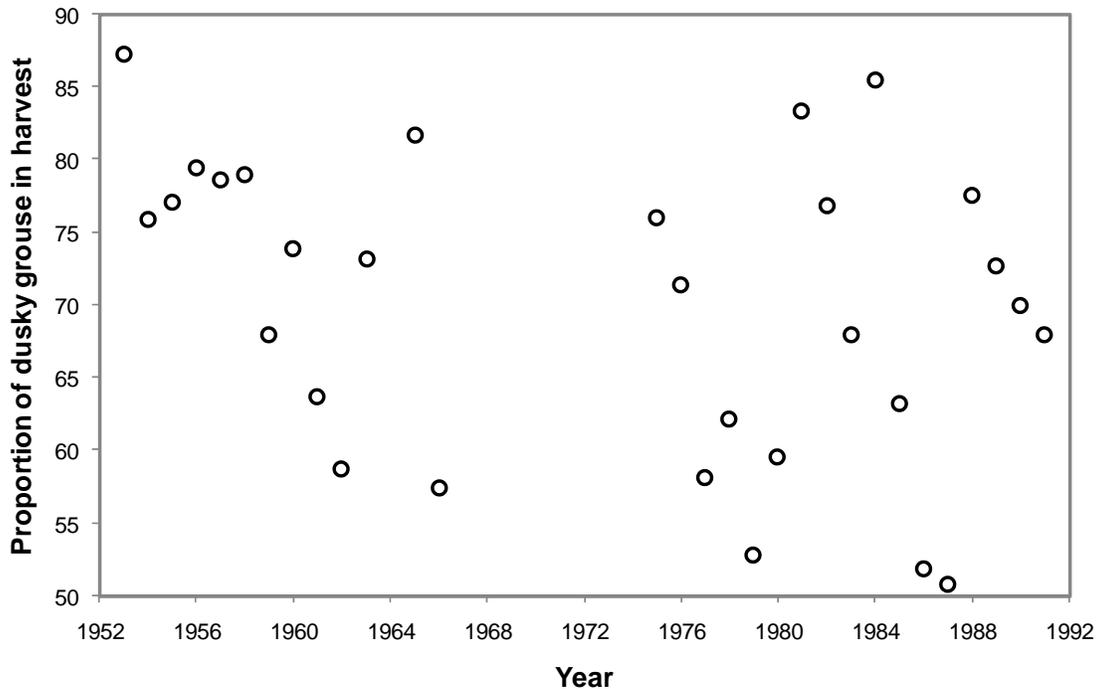


Fig. 8. The proportion of juvenile and adult blue grouse recorded at the Conconully check station in north-central Washington between 1953 and 1991.

Line Transects

A total of 740 grouse was observed on transects between 1954 and 2000 (excluding 1975-1995). Blue grouse comprised 73.5% of the observations on line transects. Spruce grouse were also common (16.5%), perhaps because most transects were placed on relatively high elevation roads. There was a substantial downward trend in number of grouse observed per km between 1954 and 2000 (Fig. 9). The lack of an appropriate line transect protocol made estimates of density impossible to obtain. There also appeared to be a slight increase in the relative number of blue grouse observed on the transects (Fig. 10); the difference appeared to be related to a decline in the number of spruce grouse observed.

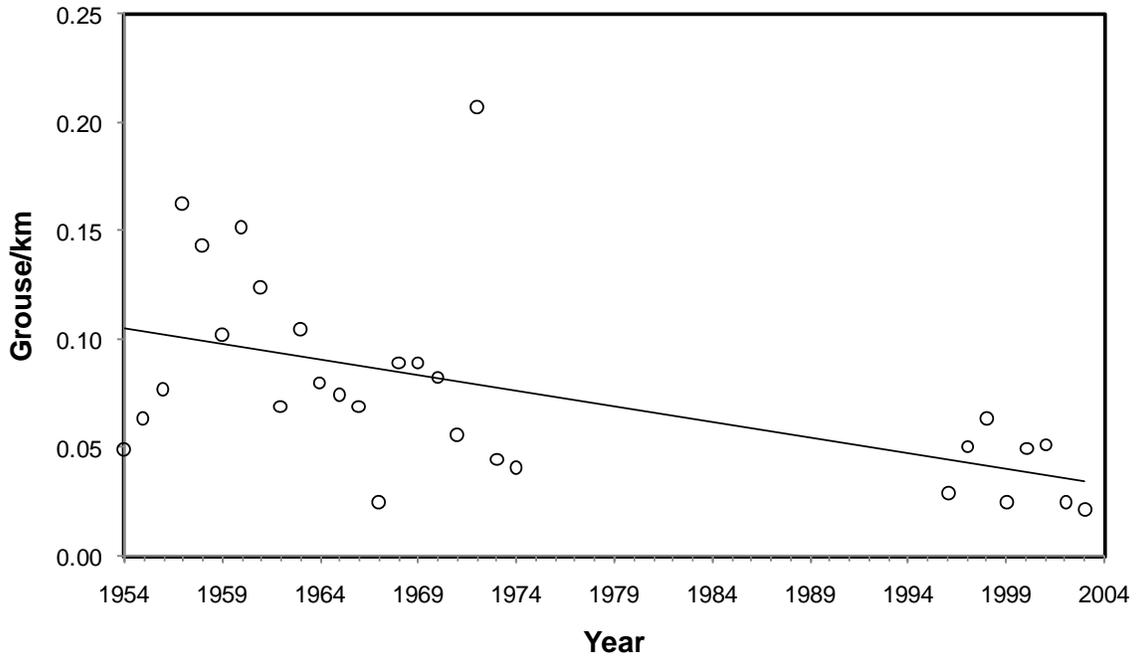


Fig. 9. The number of grouse (grouse/km) observed on transects in north-central Washington, 1954-2003.

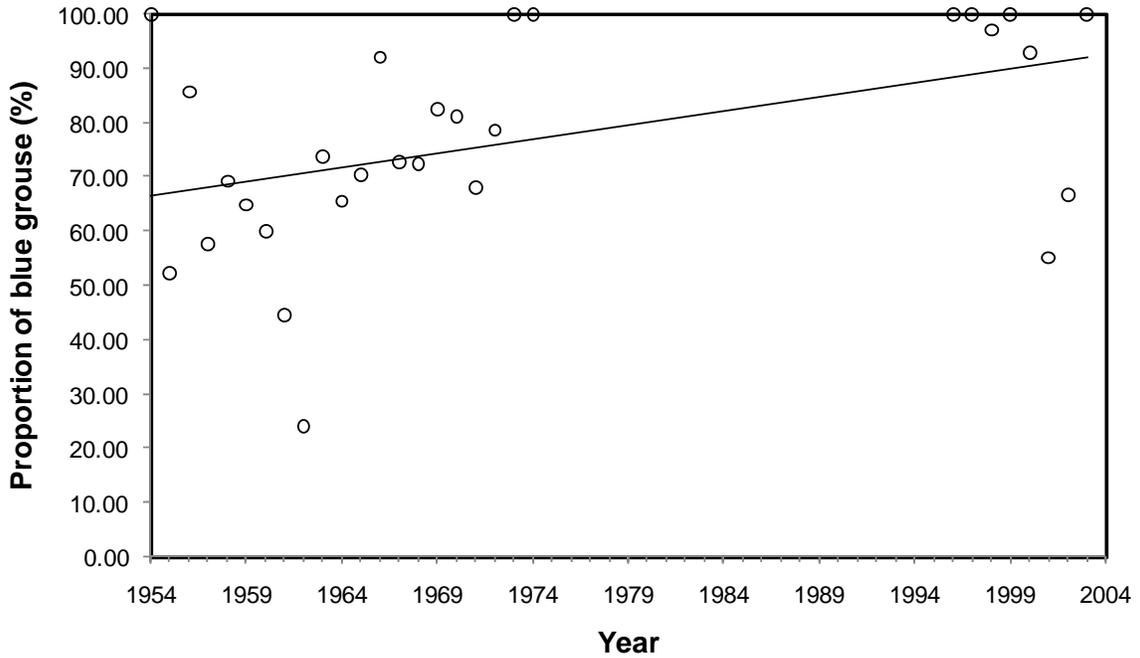


Fig. 10. Proportion of blue grouse (almost entirely dusky grouse) observed on transects in north-central Washington, 1954-2003.

Wing Barrels

A total of 6,225 grouse wings was examined from wing barrels from 1993 to 2008 (not counting 1996, 1997, and 2006 when barrels were not run). Declines in harvest throughout the hunting season were clear; 46.2% of wings were collected during the first half of September and only 6.8% of wings were collected during November and December combined. Consequently, wing barrels were not continued past October after 1994. When the wing barrel data was controlled for time of year and location, the long-term trend in harvest was clearly downward (Fig. 11).

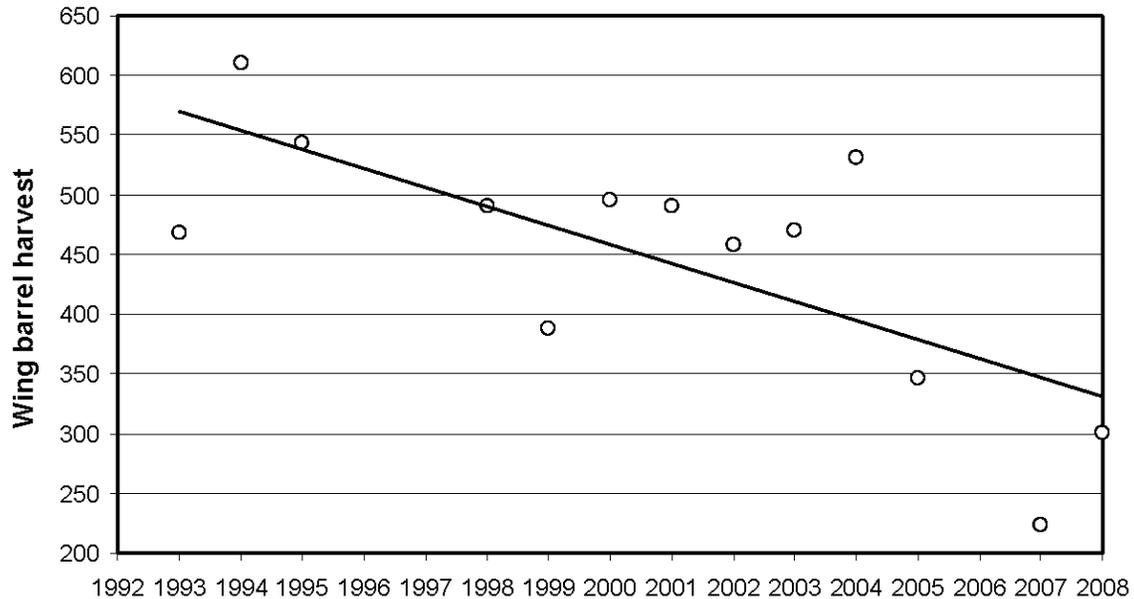


Fig. 11. Number of grouse wings in the Conconully and Boulder Creek wing barrels in north-central Washington during September and October, 1993-2008.

Blue grouse (mostly dusky grouse) comprised 63.0% of the wings at all wing barrels; the proportion of blue grouse in the harvest apparently declined throughout the hunting season and between 1993 and 2008 (Fig. 12). The majority (66.1%) of harvested grouse were juveniles. Most (58.2% for blue grouse and 58.0% for spruce grouse) of the remaining breeding-aged birds were females (sex could not be determined for ruffed grouse wings). Among breeding-aged blue grouse, the sex ratio is 1.76 females:male during the first half of September and 1.04 females:male during the rest of the season. Among breeding-age spruce grouse, the sex ratio is 2.01 females:male during the first half of September and 0.80 females:male during the rest of the season. This early harvest is clearly resulting in the selection of females over males, and likely in the selection of successful females over unsuccessful females. The reason for this selectivity is that females with broods are the latest to move to typical autumn and winter habitat and that they are particularly vulnerable when they are with chicks.

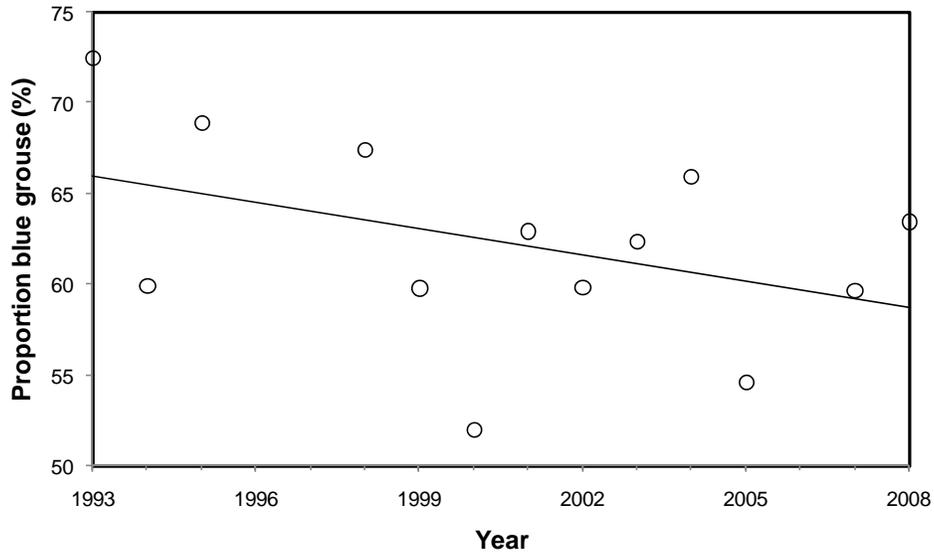


Fig. 12. Proportion of blue grouse (mostly dusky grouse, but also sooty grouse) deposited in wing barrels in north-central Washington, 1993-2008.

The ratio of juveniles to adults was also examined for wings collected at wing barrels (Fig 13). This was attempted because the proportion of juveniles in the harvest can provide an indicator of productivity. There was clearly annual and species-specific variability in the juvenile:adult ratios for dusky, spruce, and ruffed grouse.

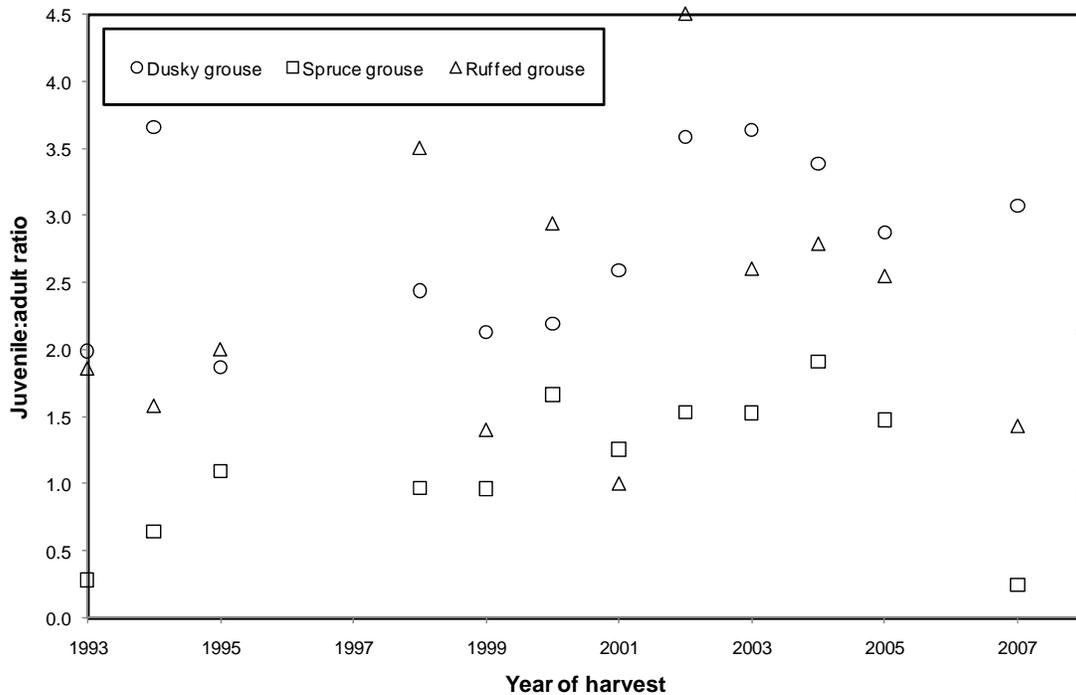


Fig. 13. Ratio of juvenile to breeding-aged dusky grouse (also a few sooty grouse), spruce grouse, and ruffed grouse deposited in wing barrels during the first half of September in north-central Washington, 1993-2008.

The juvenile:adult ratio is higher during the first half of September than it is during the remainder of the hunting season. The juvenile:adult ratio for dusky grouse was highest and the juvenile:adult ratio for spruce grouse was lowest. One possible explanation for this difference is that there is variation in natural history. The typical clutch size for a spruce grouse in Washington is 5 eggs, whereas the typical clutch size for dusky grouse ranges between 6 and 9. Ruffed grouse lay the largest clutches, often with more than 10 eggs.

Table 3. Juvenile:adult ratio for dusky grouse (including a few sooty grouse), spruce grouse, and ruffed grouse wings collected at wing barrels in Okanogan County, Washington, 1993-2008.

Time during collection period	Dusky grouse	Spruce grouse	Ruffed grouse
First half of September	2.54 (2327)	1.24 (666)	2.03 (557)
After first half of September	1.98 (1584)	1.14 (416)	1.73 (661)

Patterns of molt were used to evaluate breeding success among female blue grouse (successful females molt later than unsuccessful females). Estimated breeding success for harvested females was 62.1%. An attempt was made to examine breeding success (% of females producing a brood) in relation to the subsequent year’s wing barrel numbers (Fig 14).

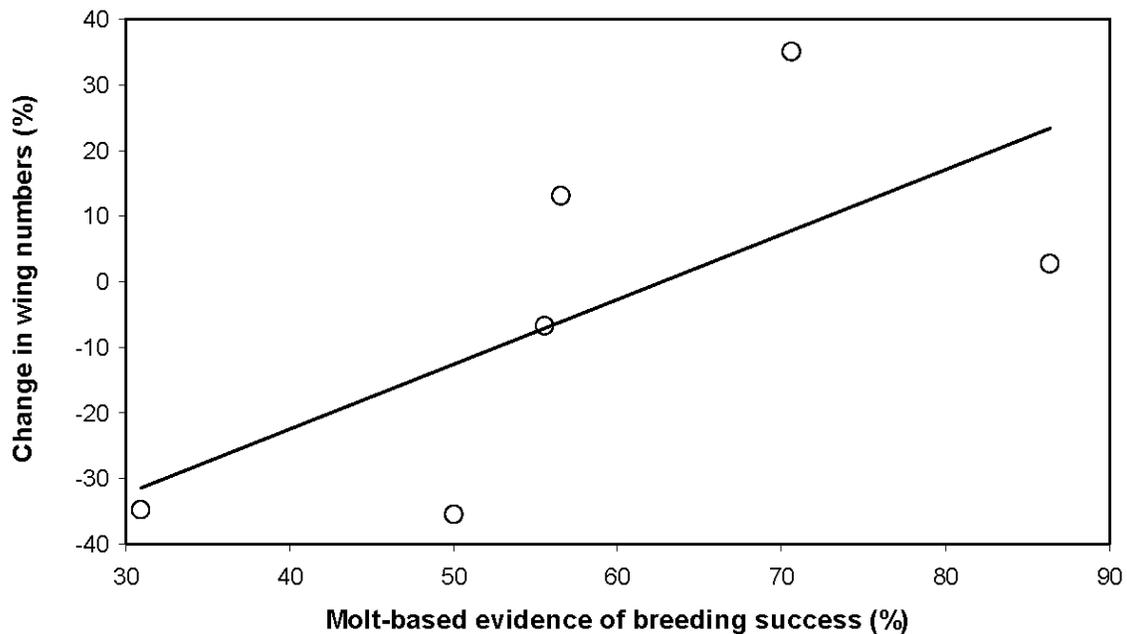


Fig. 14. Breeding success in relation to the subsequent year’s wing barrel numbers for blue grouse (mostly dusky grouse) in north-central Washington, 1993-2008.

Questionnaires

Questionnaires were used to evaluate grouse harvest and harvest pressure in Washington between 1962 and 2005. The number of grouse hunters declined dramatically during the period, particularly after 1979 (Fig. 15). Similarly, the number of grouse harvested also declined in a similar pattern (Fig. 16).

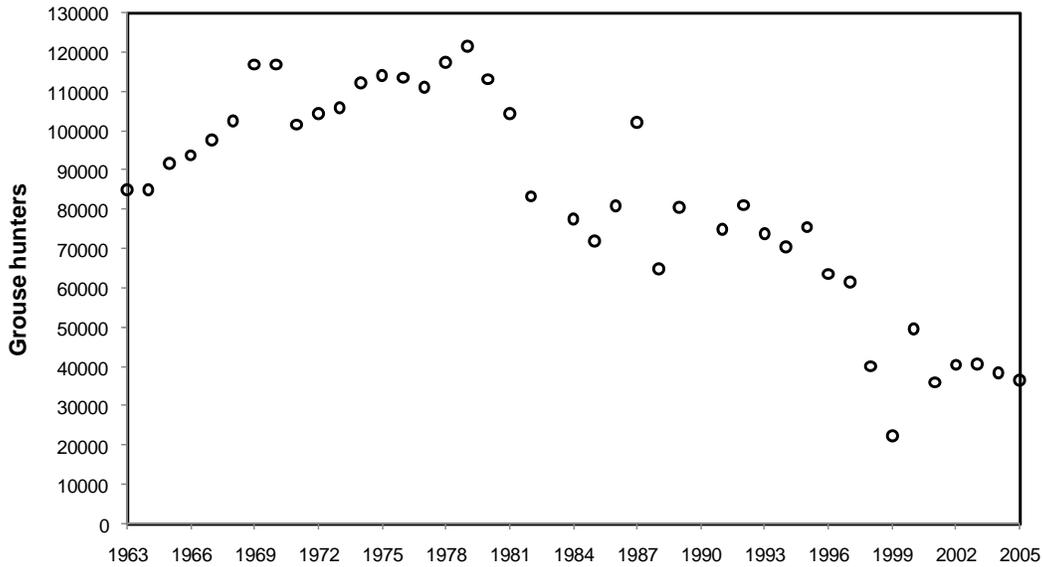


Fig. 15. Estimated number of grouse hunters in Washington, 1963-2005, based on questionnaires.

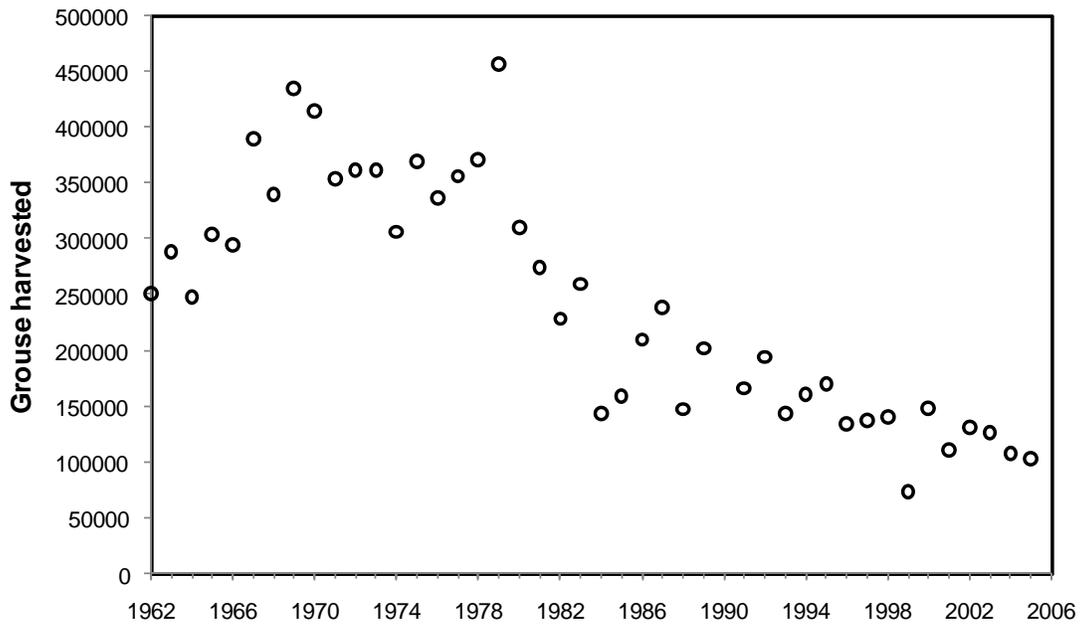


Fig. 16. Estimated number of grouse harvested in Washington, 1962-2005, based on questionnaires.

Although the number of grouse harvested per hunter may have declined between 1963 and 1997 (Fig. 17), there were differences in questionnaire method at various points during the 1963-2005 period (e.g., 1998).

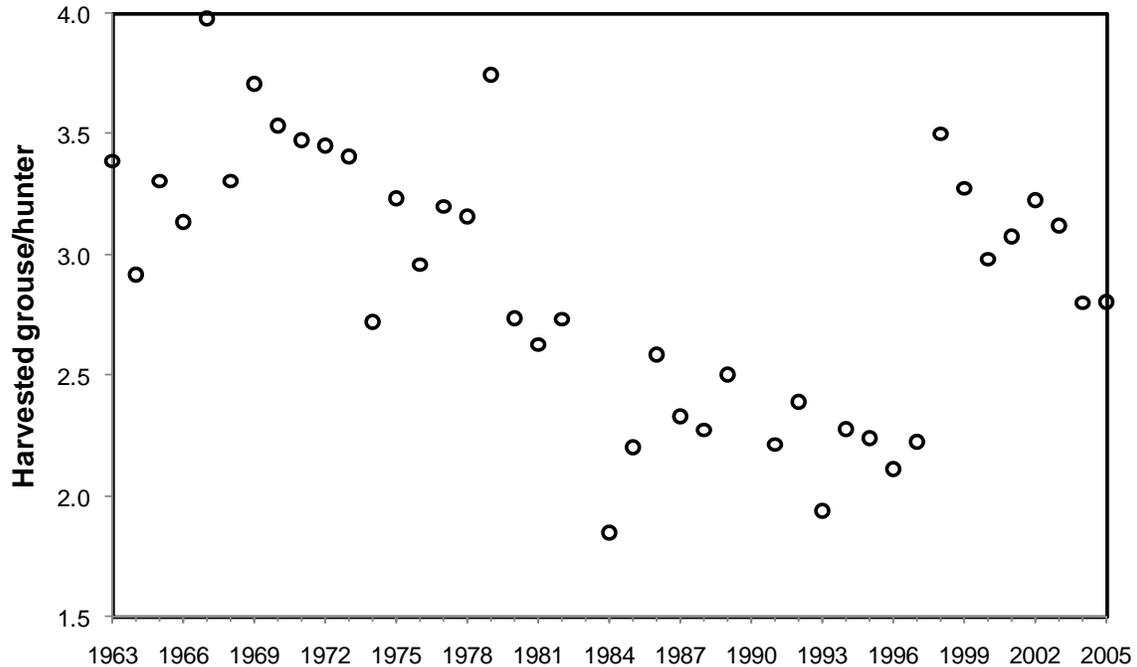


Fig. 17. Estimated number of grouse harvested/hunter in Washington, 1962-2005, based on questionnaires.

Breeding Populations

Spruce grouse territories were mapped, but are not shown here due to the complex configuration of the areas. Between 1993 and 2007, approximately 47 territories were periodically monitored in the area around Tiffany Mountain. Although there was some variability, the number of territories was relatively consistent on an annual basis. Following clear-cuts and the large Tripod forest fire in 2006, the number of territories dramatically declined to 10. Only 2 of 35 territories remained within the perimeter of the Tripod fire (both in small remnant patches of forest). Logging removed another 4 territories in forest that was otherwise intact.

A breeding population of dusky grouse was monitored in the Frazer Creek area of the Methow Wildlife Area in 1983 (Lewis 1985) and again in 2007 (Fig. 18). The number of male territories was 35 in 1983 and 20 in 2006 (only those within the study area boundary were counted). Because of potential for annual variation, it is unclear if this represents a long-term decline. A similar effort on the Chesaw Wildlife area identified 40 territories (not counting 4 territories outside the study area, Fig. 19). This survey will be repeated on subsequent occasions.

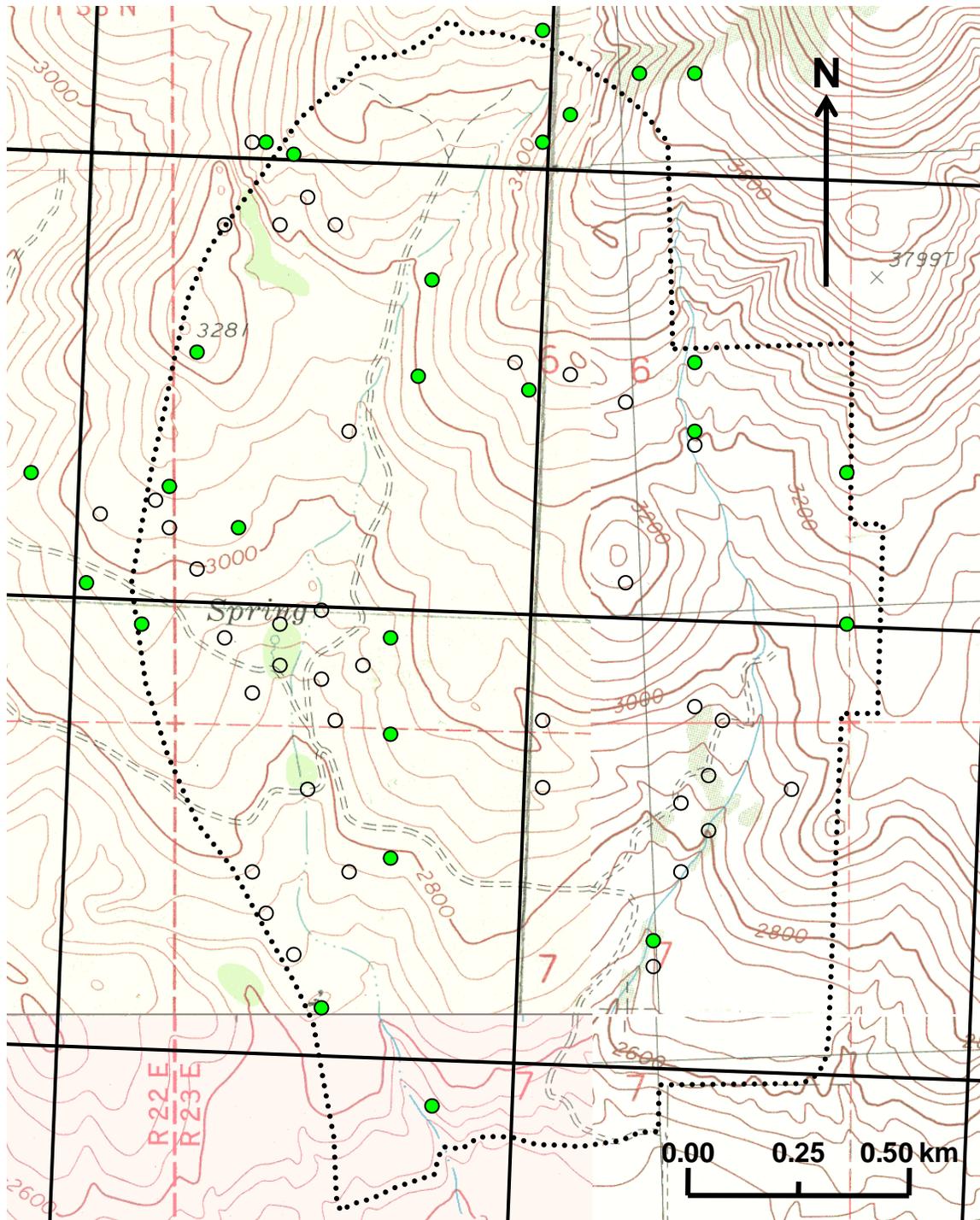


Fig. 18. Estimated locations of dusky grouse breeding territories on the Frazer Creek area of the Methow Wildlife Area, Washington. 1983 territories are open circles and 2007 territories are green circles. The approximate study area is outlined by a dotted line.

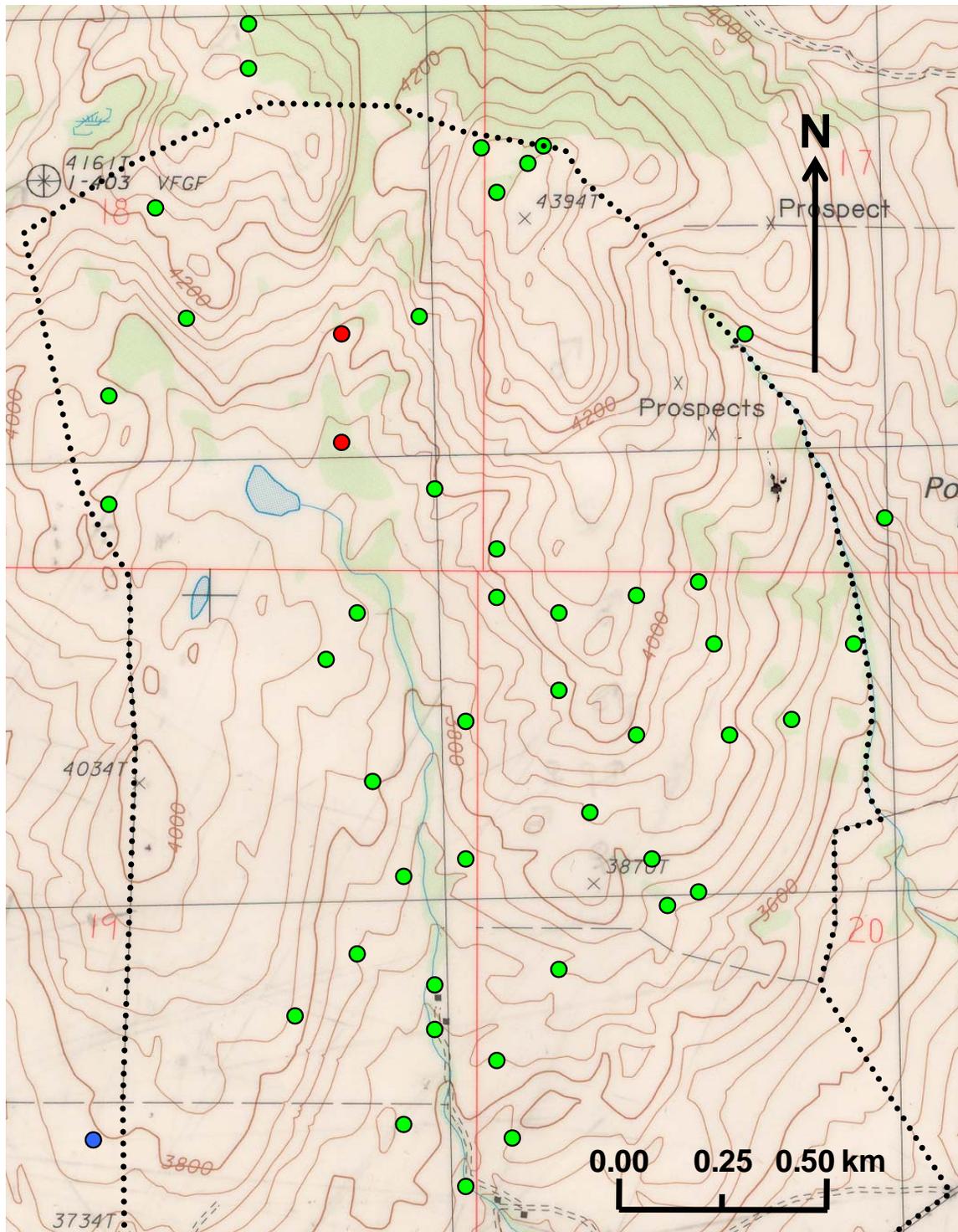


Fig. 19. Estimated locations of dusky grouse (green circle), ruffed grouse (red circle), and sharp-tailed grouse (*Tympanuchus phasianellus*; sharp-tailed grouse actually had a lek slightly off the edge of the study area) breeding territories on the Chesaw Wildlife Area, Washington. The study area boundary is a dotted line.

HARVEST REGULATIONS

Washington has had relatively consistent harvest regulations for forest grouse. An aggregate bag limit of three was in place from 1952 through 2009 when it was changed to four. The start of the season has been the first of September since 1973. In addition, there is no variation in the regulations by species or by area, except for specific areas (such as national parks) that are closed to hunting.

The Washington Department of Fish and Wildlife is “dedicated to preserving, protecting and perpetuating the state’s fish and wildlife resources. The department operates under a dual mandate from the Washington Legislature to:

- Protect and enhance fish and wildlife and their habitats.
- Provide sustainable, fish- and wildlife-related recreational and commercial opportunities.”

In an effort to address this mandate with regard to forest grouse, the current harvest regulations in Washington were compared with regulations in other states, provinces, and territories in North America. Grouse are native to every province and territory in Canada and to every state in the United States of America except Hawaii and Mississippi. As of 2009, grouse were legally harvested in 52 states, provinces, and territories (for simplicity, Nunavut Territory was grouped into the Northwest Territories). Season dates, bag limits, variation within administrative areas, and species-specific regulations (based on online evaluations of 2008-2009 or 2009-2010 harvest regulations) were examined.

There is little doubt that the Washington regulations for forest grouse are simple. Washington has a single season (1 September – 31 December) that does not vary by region within Washington or for any of the 4 species of grouse in the aggregate bag. In addition, the regulations are rarely changed for any reason with the exception that bag limit was increased from 3 to 4 in 2009. Washington’s closest neighbors, Oregon and Idaho, also have relatively simple regulations for forest grouse. Like Washington, both states start their forest grouse seasons on the first of September. Unlike Washington, Oregon has incorporated different seasons between the east and west sides of the state. Although Idaho’s forest grouse season is almost identical to Washington’s (aggregate possession limit of 8 in Idaho versus 12 in Washington), Idaho has incorporated a species-specific approach to harvest management with greater sage-grouse and sharp-tailed grouse, neither of which is hunted in Washington. In order to put Washington’s regulations into a broader context, regulations for each forest grouse species in North America were examined.

Dusky and Sooty Grouse

As a group dusky and sooty grouse are hunted in 15 states, provinces, and territories; 14 for dusky grouse and 6 for sooty grouse. Dusky and sooty grouse were formerly considered to be blue grouse (Barrowclough et al. 2004, Banks et al. 2006,

Schroeder et al. 2009). Some administrations have responded to this change in their hunting regulations (Montana, Alberta, Idaho, British Columbia, Colorado, California, and Northwest Territories), while others have not (Washington, Oregon, Utah, Yukon, Wyoming, Arizona, New Mexico, and Nevada).

The opening date for the start of the dusky grouse hunting season ranges from 1 September in several locations in North America to 1 October in western New Mexico. The closing date ranges from 15 October in northern New Mexico to 30 April in the Northwest Territories (Fig. 20). Season length ranges from 30 days in western New Mexico to 241 days in the Northwest Territories (average of 94 days). The opening date for the start of the sooty grouse hunting season ranges from 1 August in southeastern Alaska to 12 September in northern California. The closing date ranges from 12 October in northern California to 15 May in southeastern Alaska. Season length ranges from 30 days in California to 287 days in southeastern Alaska (average of 116 days).

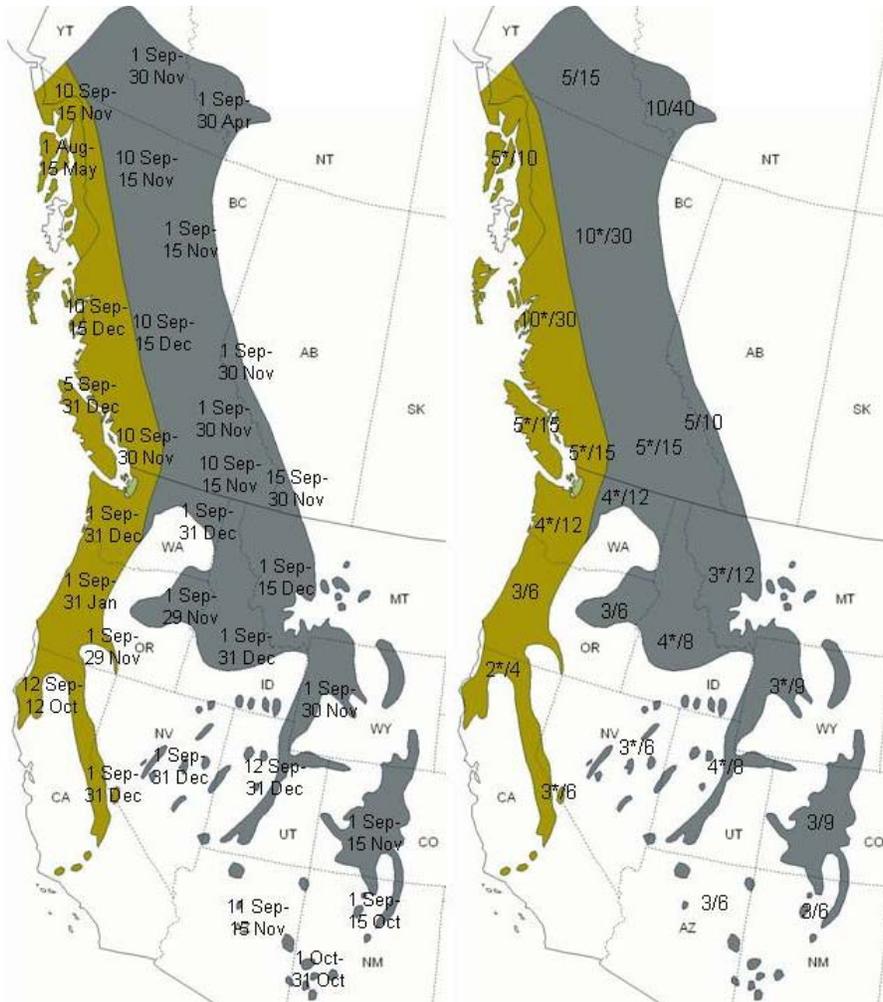


Fig. 20. Distribution of sooty grouse (light brown) and dusky grouse (gray) in western North America (compiled by MAS from a variety of sources). The left figure shows starting and ending dates for hunting seasons and the right figure shows the bag and possession limits (aggregate limits designated with asterisks).

There is no obvious pattern to the dusky and sooty grouse seasons except that they start relatively early when compared with other species of grouse. British Columbia has the most variation in seasons. The most unusual season for this group is the extended sooty grouse season in southeastern Alaska. Personal observations of this hunting season by MAS have shown that there is little hunting occurring in mid-winter in southeastern Alaska due to location of sooty grouse habitat high up on relatively steep slopes, and the difficult, if not dangerous, prospects for hunters reaching those birds. In addition, when hunters 'reach' the birds, they are often in conifers and difficult to find. Even in the spring, the few hunters that take advantage of the long season appear to be interested in obtaining an occasional male for taxidermy.

Bag limits for sooty and dusky grouse ranged from 2 in California to 10 in the Northwest Territories and portions of British Columbia (Fig. 20). Most of the bag limits are aggregated with other species of grouse, so it should not be assumed that the bag limits can be directly equated with the typical daily take for sooty or dusky grouse. In general the bag limits increase from south to north. It is also possible that these bag limits are correlated with population density; the largest bag limits are in areas where there are the fewest people.

Spruce Grouse

The spruce grouse is widely distributed across North America, but is only hunted in 15 states, provinces, and territories. Due to conservation concerns, the species is not legally hunted in Oregon, Wyoming, Minnesota, Michigan, New York, New Hampshire, Maine, and Nova Scotia; combined, this represents most of the southern tier of the original distribution. As with the sooty and dusky grouse, there are taxonomic considerations with spruce grouse. Peer-reviewed publications have recommended re-classification of the spruce grouse into 2 species; the Franklin's spruce grouse, which is found in Washington, Oregon, Idaho, Montana, southwestern Alberta, and southern British Columbia, and the Canada spruce grouse, which is found throughout the rest of the distribution (Gutierrez et al. 2000, Drovetski 2002). The American Ornithologists' Union has not made a decision on the classification of spruce grouse.

The opening date for the start of the spruce grouse hunting season ranges from 1 August in southeastern Alaska to 1 October in New Brunswick and Newfoundland (Fig. 21). The closing dates range from 15 November in portions of British Columbia to 15 May in southeastern Alaska, primarily on Prince of Wales Island. Season length ranges from 65 days in New Brunswick to 287 days in southeastern Alaska (average of 132 days). The primary pattern detected with hunting season dates is that Washington, Idaho, and Montana initiate the spruce grouse season earlier than most areas in southern Canada. Seasons starting on the first of September or earlier are usually in northern Canada or in Alaska. Bag limits for spruce grouse ranged from 3 in Montana to unlimited in Newfoundland (Fig. 22). As with sooty and dusky grouse, bag limits appear to increase with latitude and decrease with population density. Most spruce grouse bag limits are aggregated with other species, particularly ruffed grouse.

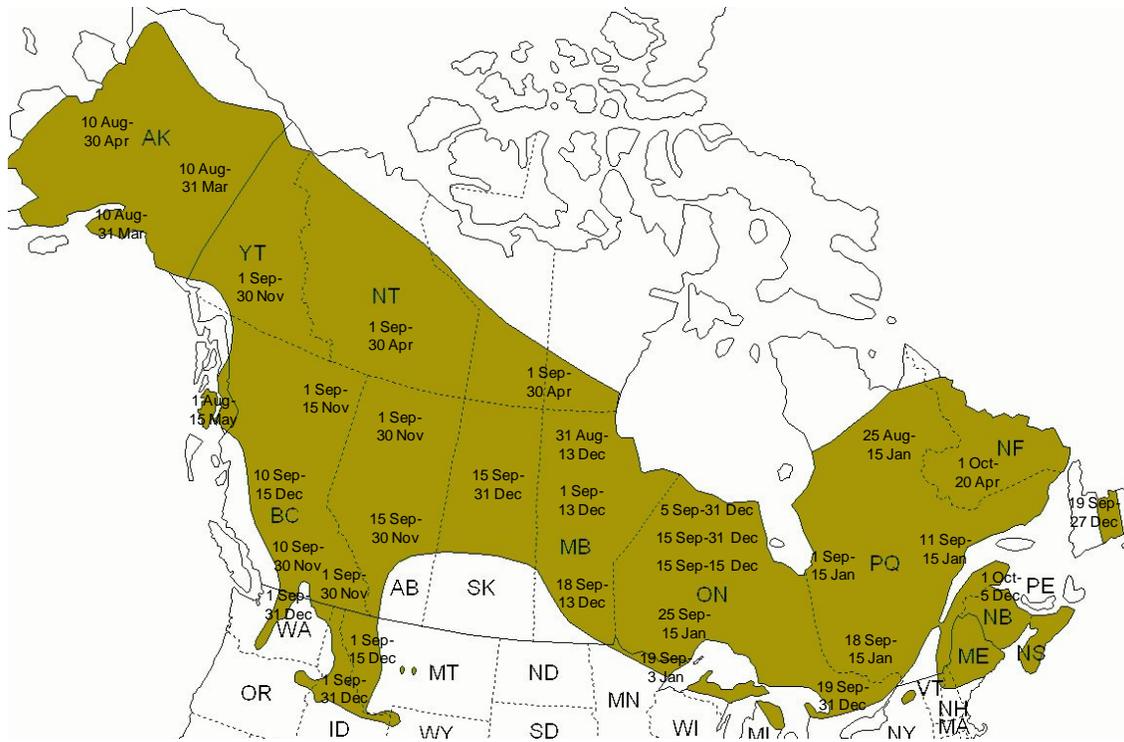


Fig. 21. Distribution of spruce grouse in relation to the starting and ending dates for hunting seasons. The range map was compiled by MAS from a variety of sources.

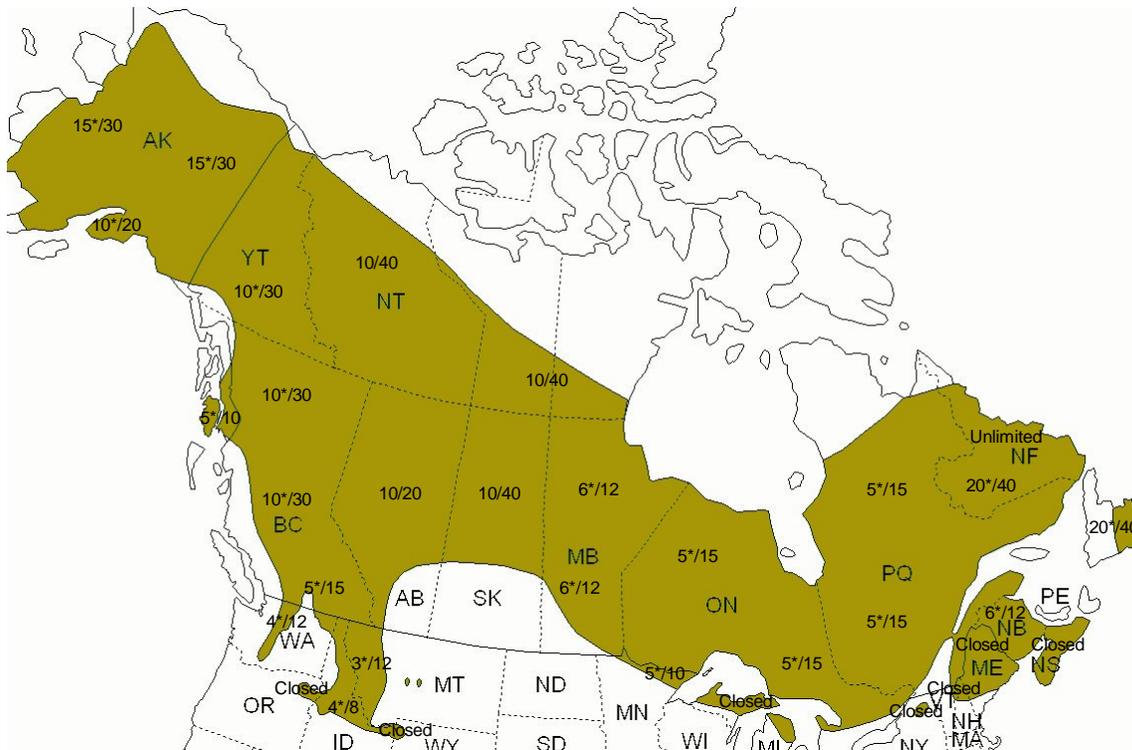


Fig. 22. Distribution of spruce grouse in relation to the bag and possession limits. Bag limits that are aggregated with other species of grouse are designated with asterisks. The range map was compiled by MAS from a variety of sources.

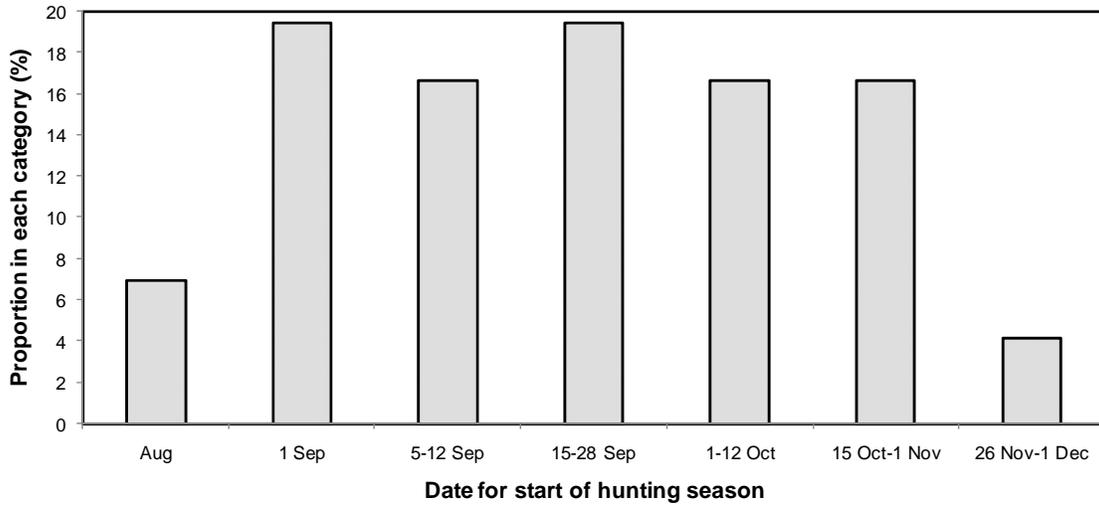


Fig. 24. Distribution of dates for the start of ruffed grouse hunting seasons in 45 states, provinces, and territories in North America. Washington's season starts on 1 September.

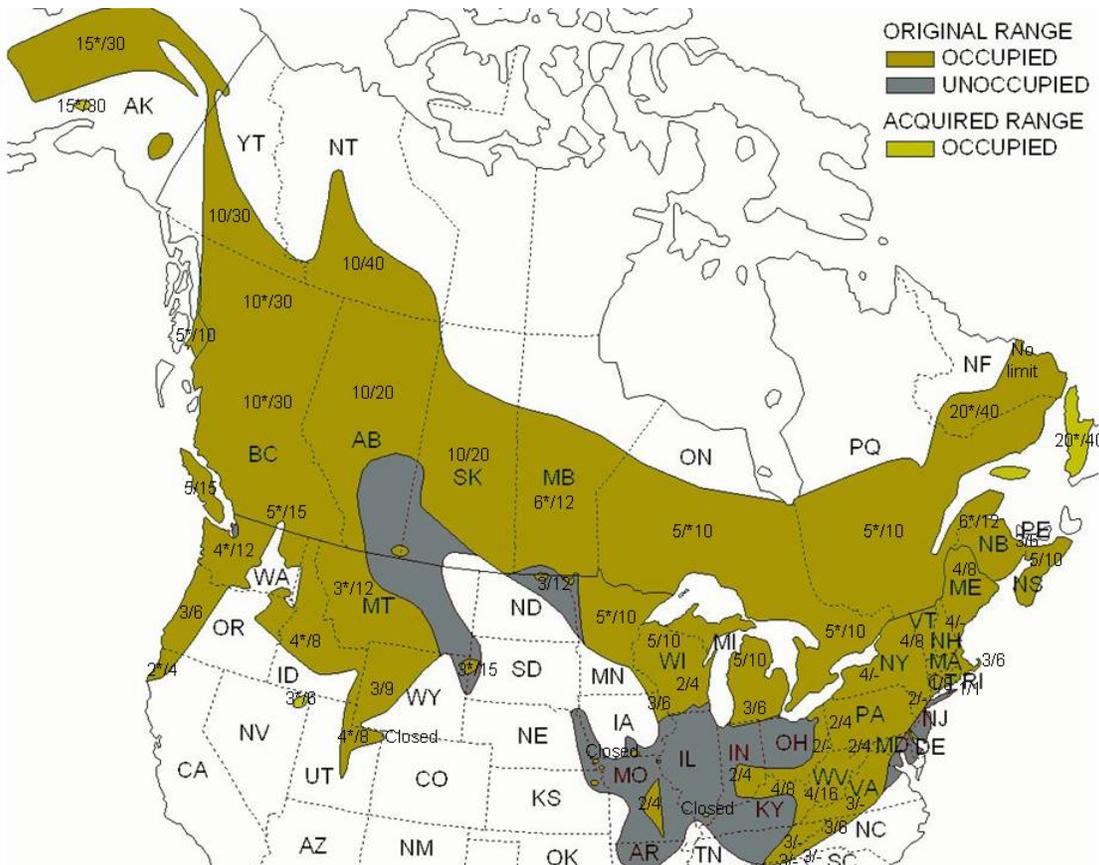


Fig. 25. Distribution of ruffed grouse in relation to the bag and possession limits. Bag limits that are aggregated with other species of grouse are designated with asterisks. The range map was compiled by MAS from a variety of sources.

Other Species of Grouse

There are three other non-forest species of grouse in the state of Washington. The greater sage-grouse and sharp-tailed grouse are listed within the state as ‘threatened’; consequently, neither is considered a game species at this time. Despite the conservation concerns for sage-grouse in other states besides Washington, it is still hunted in numerous areas (Fig. 26). Even so, the hunting seasons and bag limits for sage-grouse are generally conservative. The sharp-tailed grouse is also faced with numerous conservation concerns outside Washington, but due to its larger distribution in North America, it is hunted in many northern regions with fairly liberal seasons (Fig. 27) and bag limits (Fig. 28). The white-tailed ptarmigan is still considered a game species in Washington, but there is no designated season or bag limit (Fig. 29).

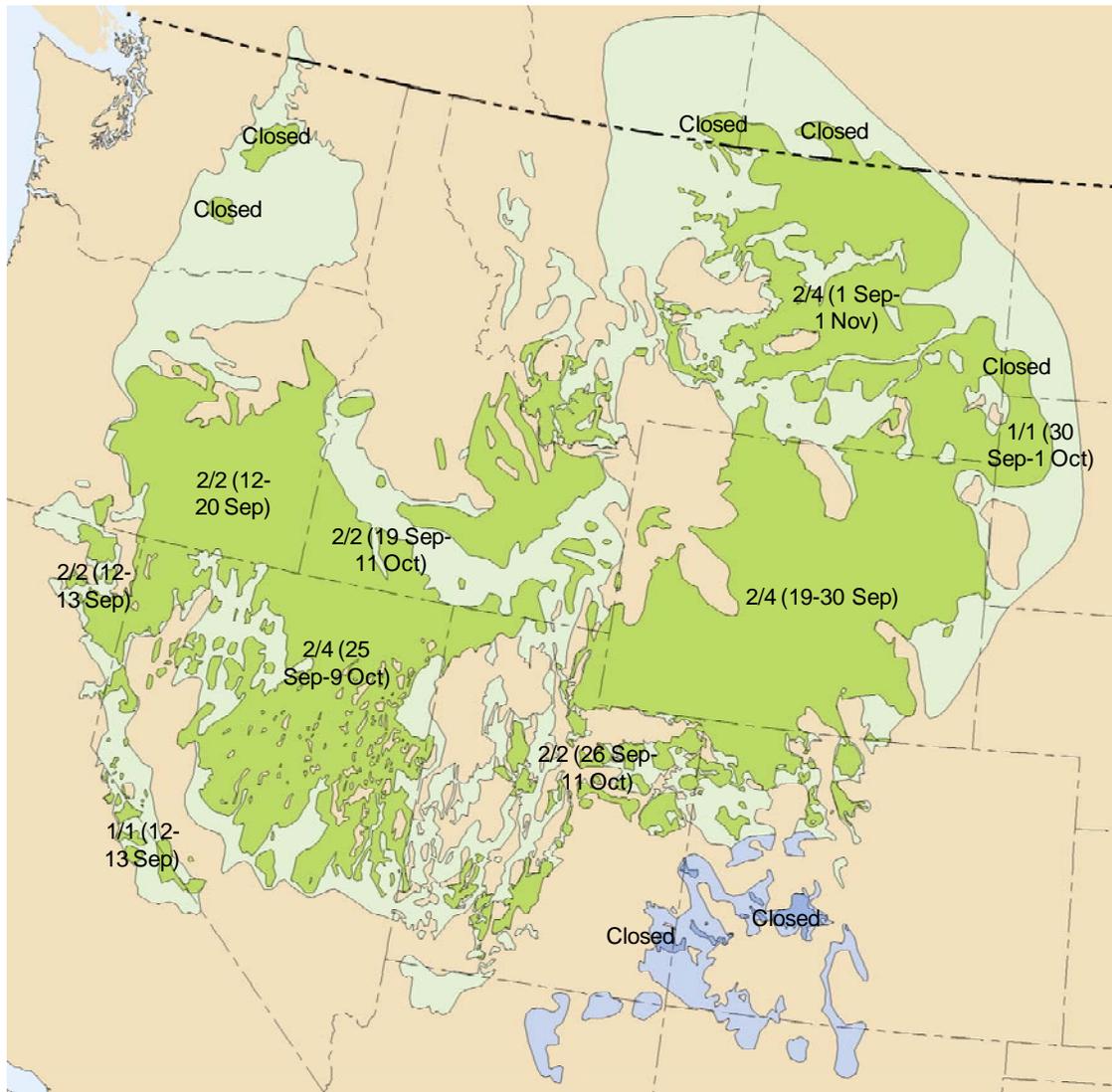


Fig. 26. Distribution of greater sage-grouse (green) and Gunnison sage-grouse (blue) in western North America (lighter colors represent areas of extirpation). The numbers reflect bag and possession limits and the numbers in parentheses are the dates for the hunting seasons. The range map is from Schroeder et al. (2004).

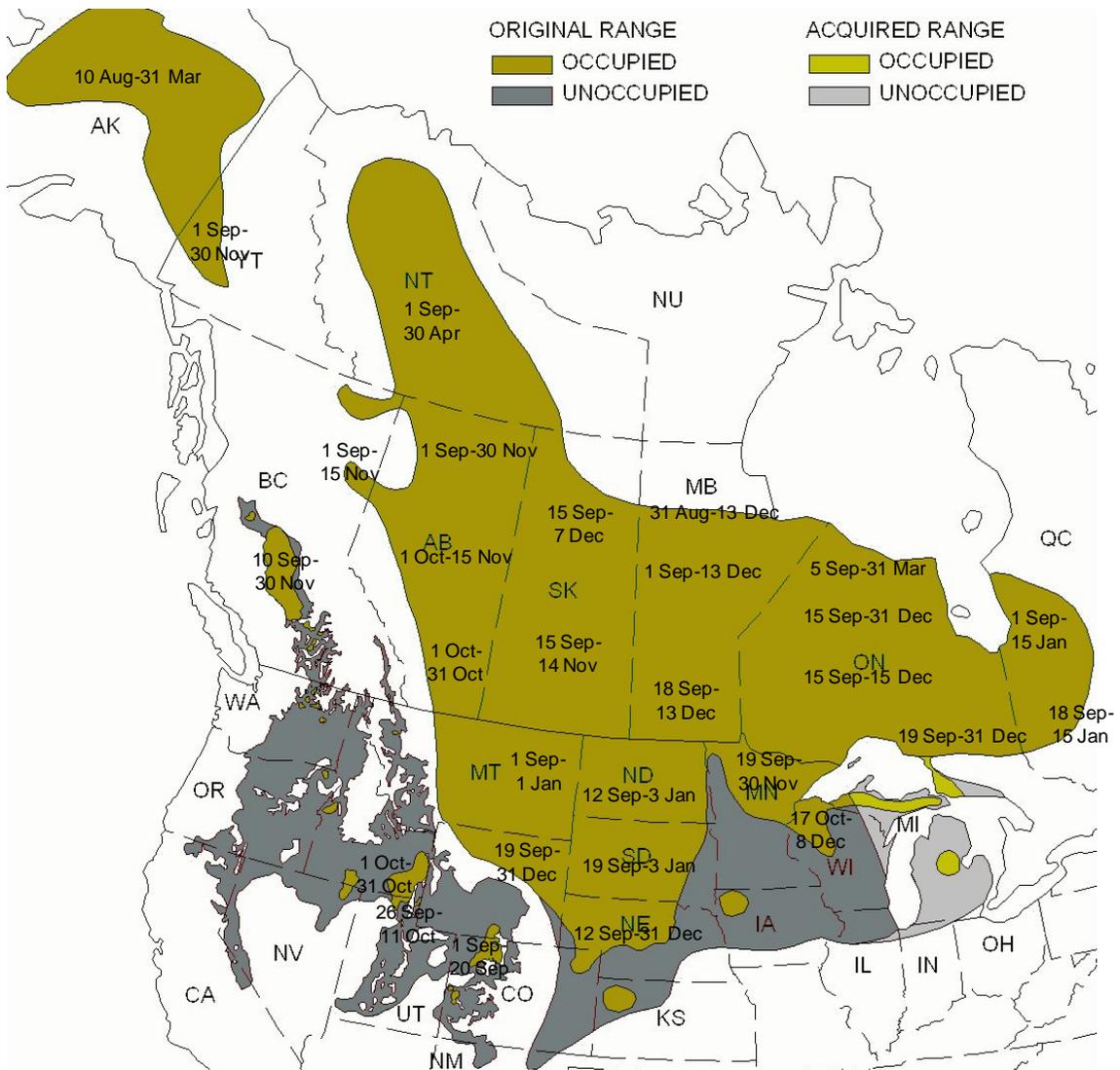


Fig. 27. Distribution of sharp-tailed grouse in North America. The numbers are the starting and ending dates for the hunting seasons. The range map was compiled by MAS from multiple sources.

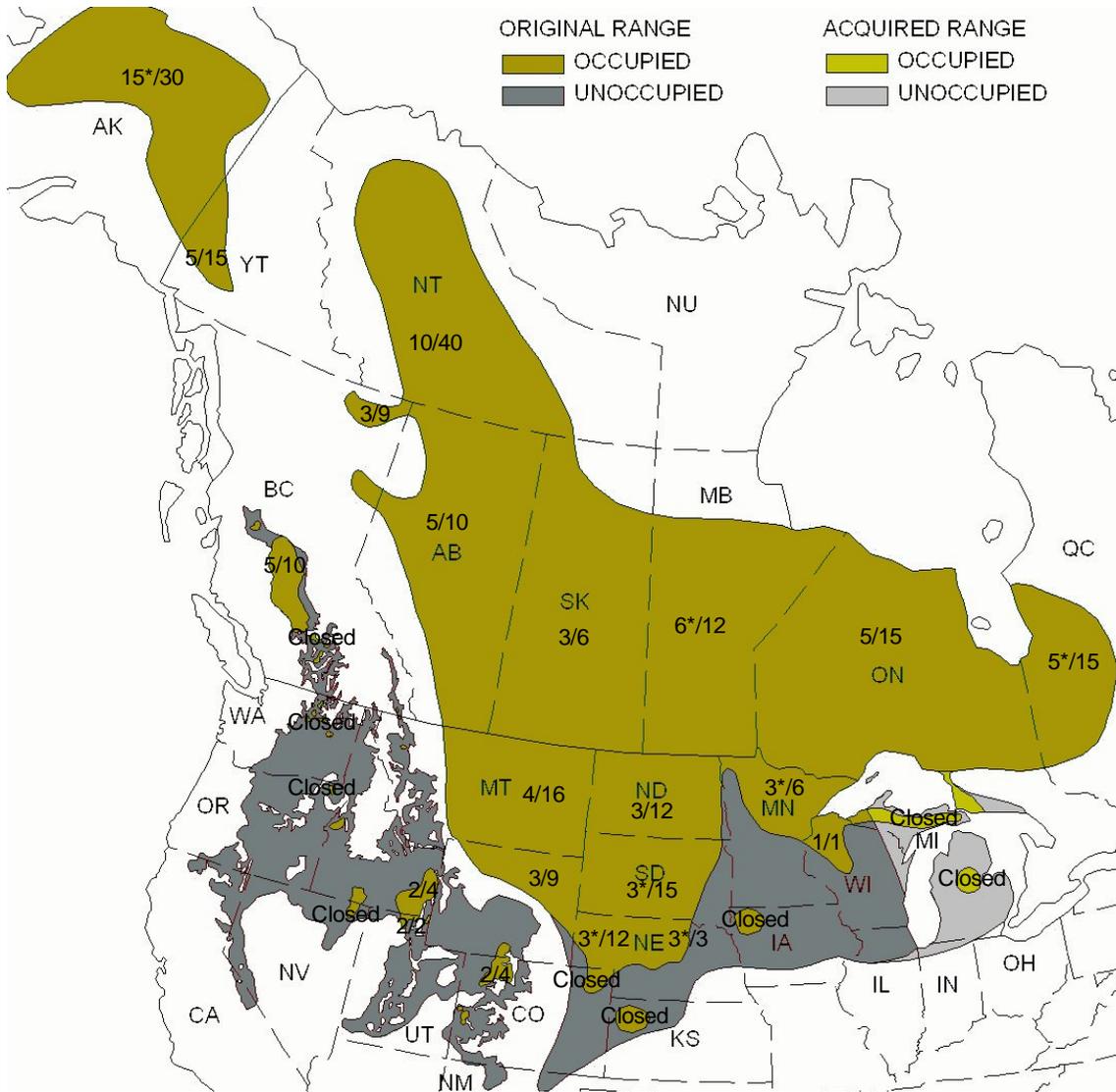


Fig. 28. Distribution of sharp-tailed grouse in North America in relation to the bag and possession limits. Bag limits that are aggregated with other species of grouse are designated with asterisks. The range map was compiled by MAS from multiple sources.

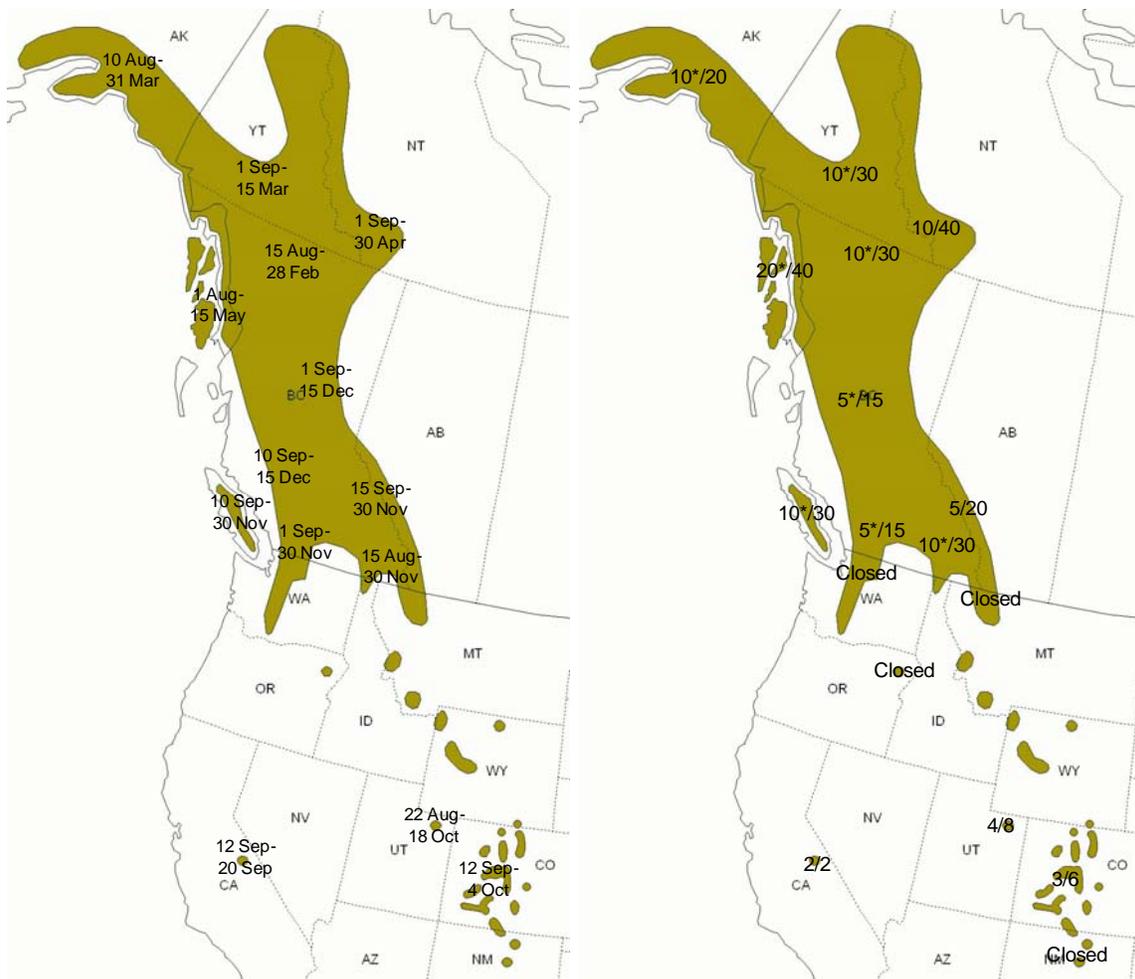


Fig. 29. Distribution of white-tailed ptarmigan in western North America. The left figure shows the starting and ending dates for hunting seasons and the right figure shows the bag and possession limits. Bag limits that are aggregated with other species of grouse are designated with asterisks. The range map was compiled by MAS from a variety of sources.

DISCUSSION

Check stations, line transects, wing barrels, hunter questionnaires, and breeding populations are relatively independent sources of data. The data is relatively clear with regard to declining number of hunters and harvest. Because the number of hunters and harvest are closely related, it is somewhat more complicated to evaluate long-term changes in grouse populations. One reason for this uncertainty is that many factors in addition to harvest influence grouse populations. This include development within breeding habitat, forest fires (particularly since 1994), and numerous other management issues such as grazing, timber harvest, roads, and population pressure (Fig. 30). There is no doubt that human population pressures in Washington are high, and getting higher every year. These pressures can be illustrated by housing developments in core dusky

grouse breeding areas of the Methow Valley in Okanogan County. Many regions in North America with heavy population pressures have responded to increased people by adjusting the bag limits and the timing of harvest for forest grouse; later starts to the season and/or smaller bag limits.

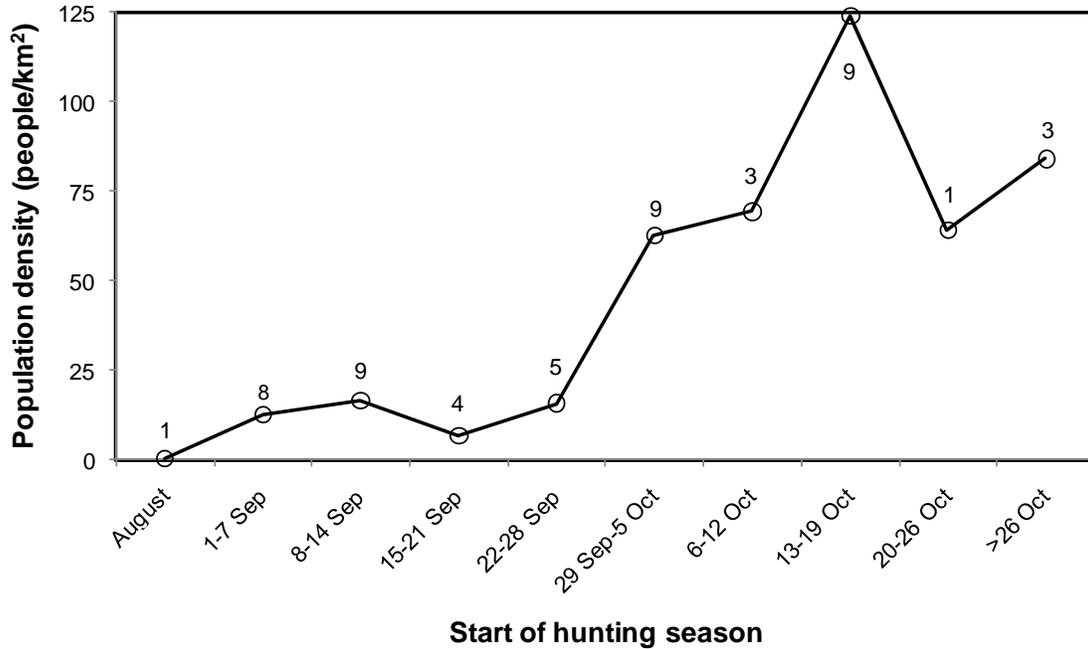


Fig. 30. Population density of 52 states, provinces, and territories, with a legal grouse harvest, in relation to the typical start date for their respective grouse seasons. Washington state is represented on the figure with a population density of 32 people/km² and a hunting season starting on 1 September.

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APPENDIX A: KEY FOR GROUSE WINGS

DETAILS

Wing measurements are taken from the folded bend in the wing to the tip of straightened, but not flattened, primaries. This measurement may not be useful if the longest primaries are not full length (primary 7 and 8 may be missing or growing). The lengths of specific primaries are measured with a ruler placed between adjacent primaries, with the target primary straightened on the outside. For example, the length of primary 9 (Fig. A1) is measured with the ruler placed between primary 8 and 9 and the end of the ruler gently pushed to the point of feather insertion in the wing. The tail is measured from the point of feather insertion to the length of the completely grown central tail feather.

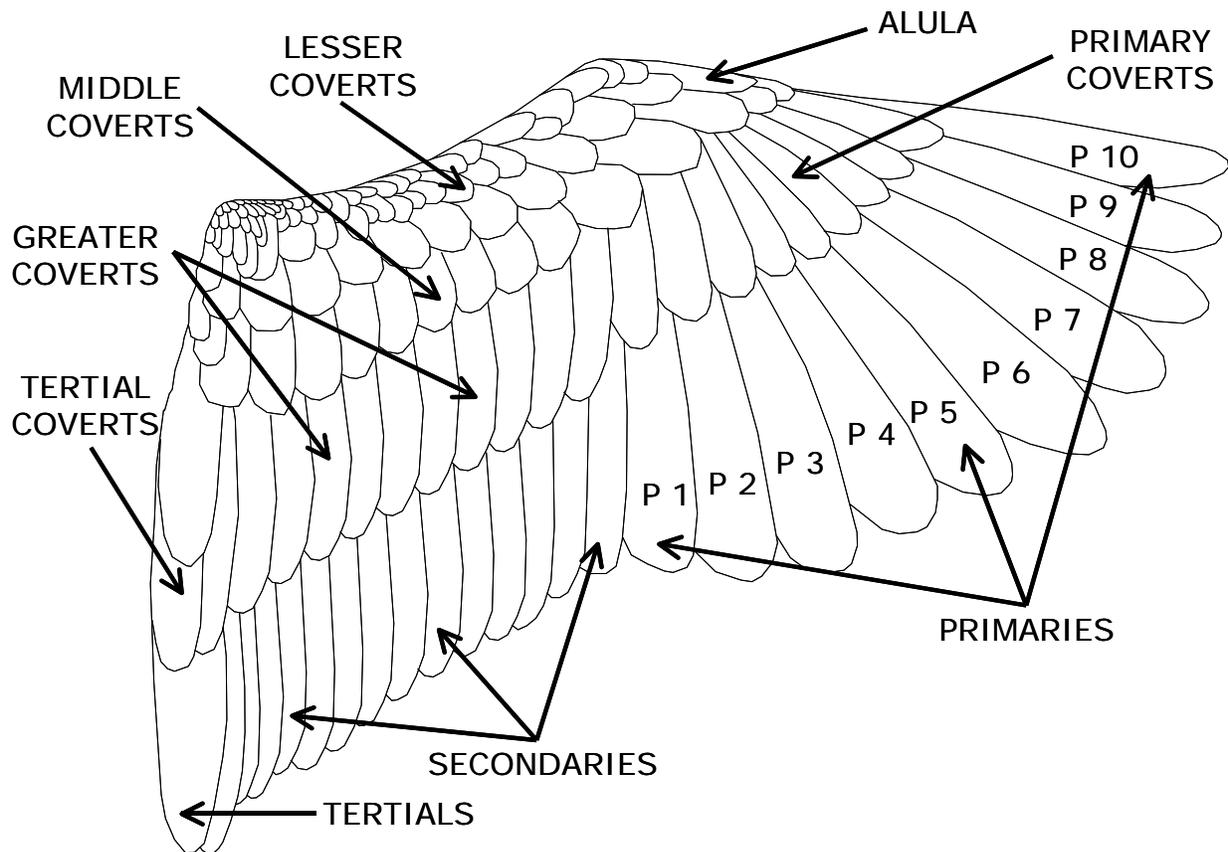


Fig. A1. Basic feather types on a typical wing; primaries are numbered from proximal to distal and secondaries are numbered from distal to proximal (primaries labeled on figure).

Wings can be differentiated by species, or in this case spruce grouse, ruffed grouse, and dusky and sooty grouse. Although there are differences between dusky and sooty grouse in wing characteristics, these differences are not clear enough to be certain unless the location of recovery is known. Wings can also be differentiated by sex for dusky grouse, sooty grouse, and usually for spruce grouse. Sex can rarely be determined for ruffed grouse wings, which is why a tails are needed to determine sex. General age categories can be determined for all wings: 1) juveniles are birds during their first year; 2) yearlings are birds during their second year; 3)

adults are birds after their second year; and 4) breeding-aged birds refers to both yearlings and adults combined. The breeding-aged category is used when the wing molt has progressed to the point that adults cannot be differentiated from yearlings.

Grouse generally are molting feathers from June through September. The last secondary to molt is usually secondary 1 (furthest outside on the wing and next to P1, Fig. A1). Primaries generally molt from inside (P1) to outside (P10) in order (Fig. A1). The stage of molt refers to the newest feather, or in some cases the outermost feather that is missing (see figure below). If the molt is complete, primary 8 will generally be the newest primary in juveniles whereas primary 10 will be the newest primary in other age categories. Juveniles are unusual in that they grow 'juvenile' primaries 1 through 10 (in order), and primaries 1 through 8 are molted and replaced (in order), all during their first year. Because 'juvenile' primaries have a different appearance than the primaries that replace them, and because 'juvenile' primaries 9 and 10 are generally retained, the appearance of these feathers can be used to identify young birds. Younger juveniles may occasionally be molting at two different points in the wing; for example, 'juvenile' primary 10 may be growing at the same time as some of the inner primaries are molting. In this case, the inner feathers are used to identify the stage of the molt. The presence of natal coverts can also be used as a clear indication of age (Fig. A2).

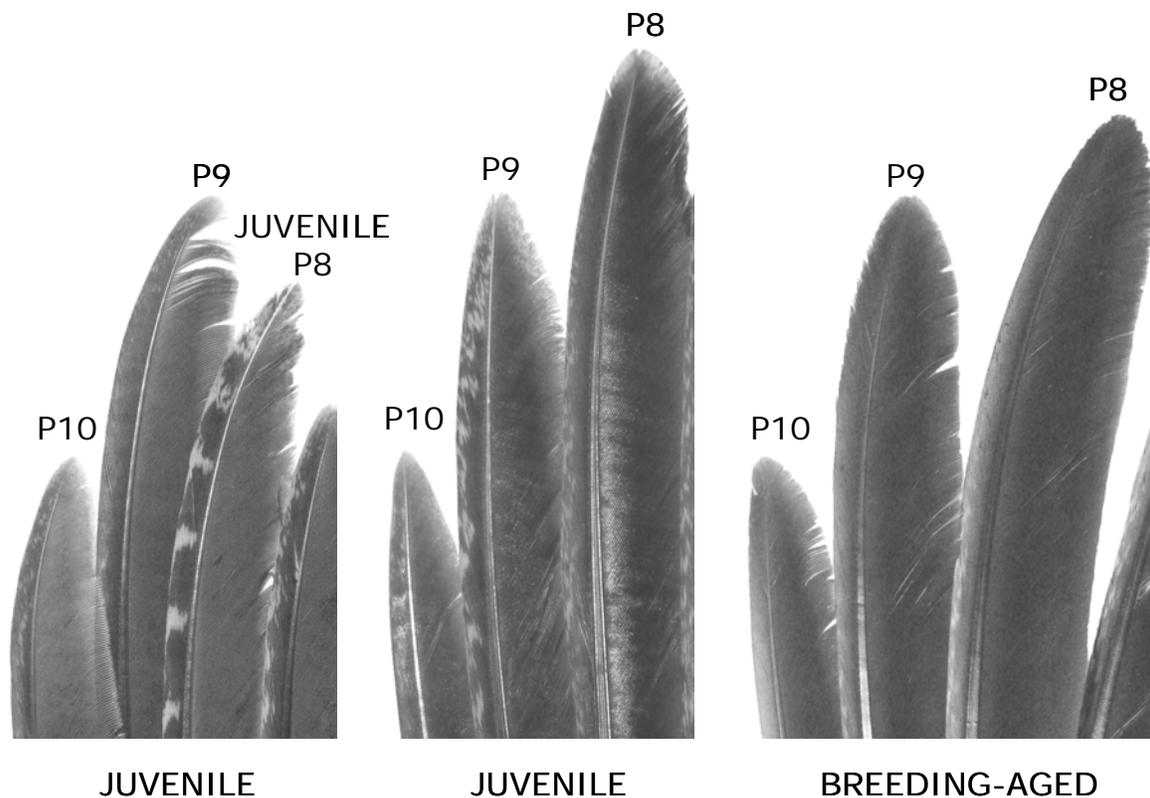


Fig. A2. Comparison of juvenile and breeding-aged female dusky grouse wings collected during the autumn harvest. In the juvenile wing on the left, the relatively short 'juvenile' P8 has not molted yet and P9 and P10 are relatively pointed (P8 is also shorter than P9). In the juvenile wing in the middle, P8 has been replaced and P9 and P10 are both relatively pointed. P9 and P10 in the breeding-aged wing on the right are relatively rounded.

KEY FOR SPECIES AND SEX

- 1a) Newly molted coverts have bold white on rachi, leading edges of primaries have horizontal white marks, and wings ≤ 200 mm in length (Fig. A3). Differentiation of sex by wings is not easy.

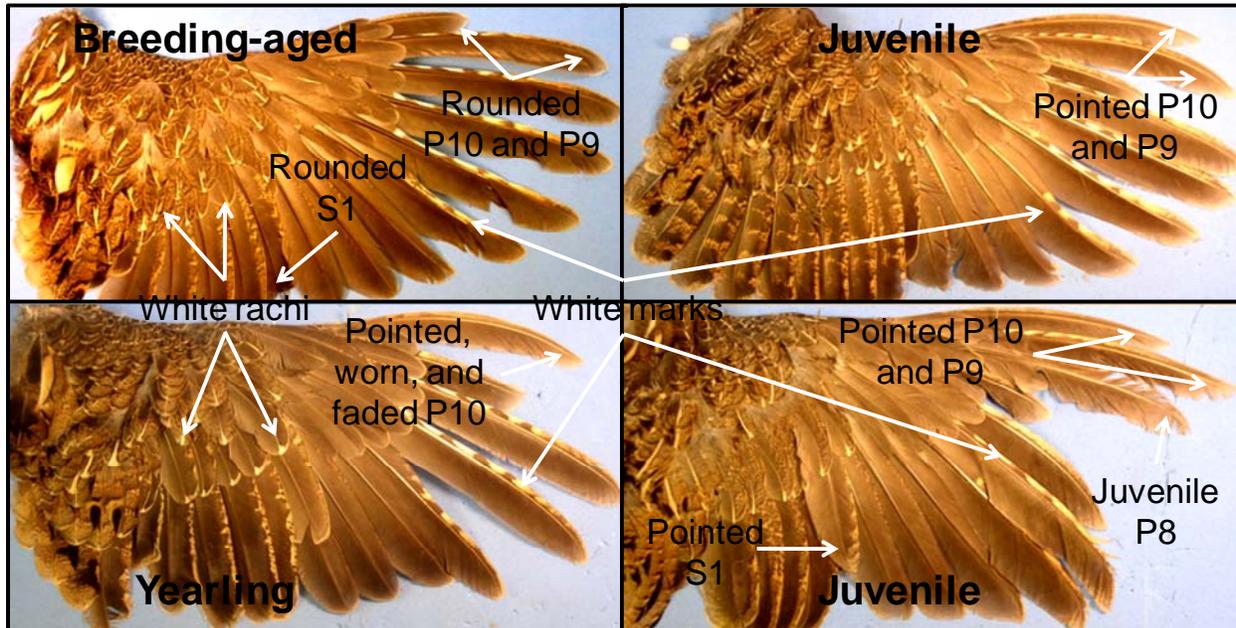
Ruffed grouse

Fig. A3. Ruffed grouse wings of different ages. Key features are referenced in text.

- 2a) If tail is available, its coverts have 2-3 white spots. Tail has solid sub-terminal band. Tail ≥ 140 mm in length. **Male ruffed grouse**
- 2b) If tail is available, its coverts have 1 white spot. Tail has broken sub-terminal band near central rectrices. Tail < 140 mm in length. **Female ruffed grouse**
- 1b) Bold white marks are absent on rachi of coverts unless feathers are natal and leading edges of primaries are not horizontally marked.
- 3a) Newly molted coverts are banded with black/dark brown and gray/light brown and wings ≤ 200 mm in length (Fig. A4). **Spruce grouse**
- 4a) Non-natal coverts are black, dark brown, and gray brown with little light brown. Horizontal bars on feathers tend to be in denser pattern (Fig. A5). **Male spruce grouse**
- 4b) Non-natal coverts are black, dark brown, and light brown. Horizontal bars on feathers tend to be in a relatively sparse and broken pattern (Fig. A5). **Female spruce grouse**
- 3b) Newly molted coverts may be solid or mottled, but not banded and wings ≥ 190 mm in length. **Dusky or sooty grouse**
- 5a) Non-natal coverts are relatively dark and unmottled; white is generally restricted to the edges of the feathers (Fig. A6). P5 generally ≥ 165 mm in length. Sooty grouse tend to be darker with less white than dusky grouse (Fig. A7). **Male dusky or sooty grouse**
- 5b) Non-natal coverts are relatively mottled with black, brown, and white (Fig. A6). P5 generally ≤ 163 mm in length. Sooty grouse tend to be brighter than dusky grouse (Fig. A7). **Female dusky or sooty grouse**

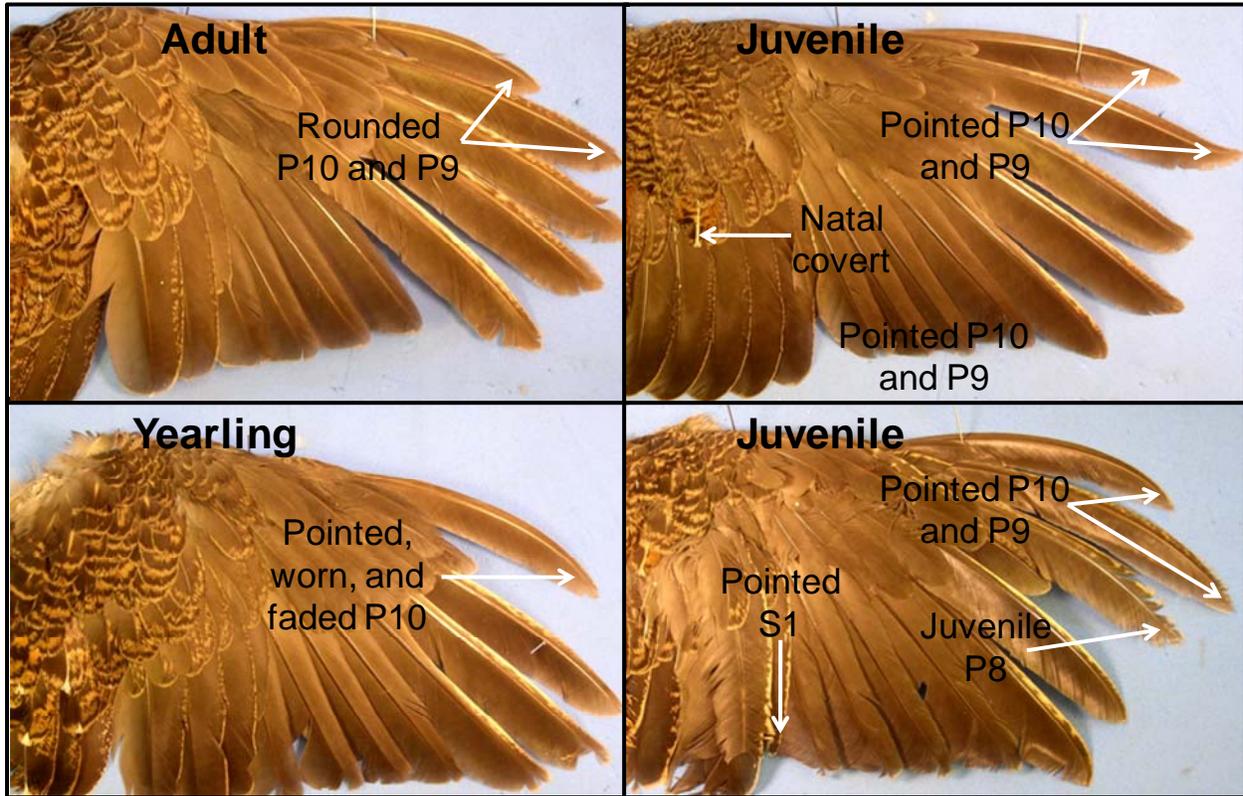


Fig. A4. Spruce grouse wings of different ages. Key features are referenced in text.



Fig. A5. Close-up of male and female spruce grouse wings.

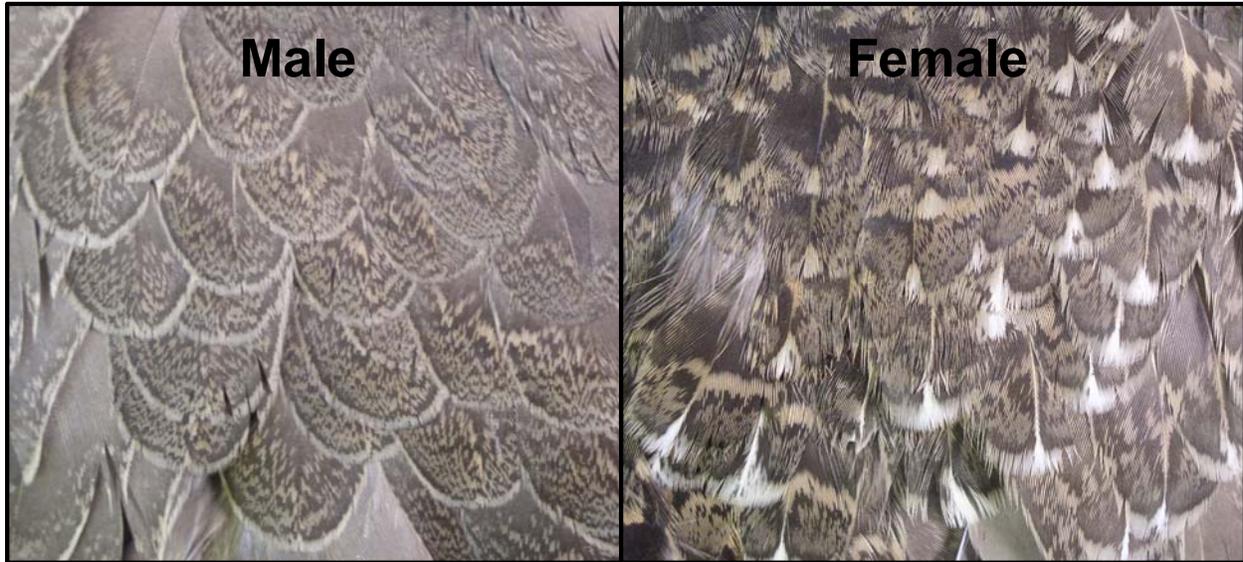


Fig. A6. Close-up of male and female dusky grouse wings.



Fig. A7. Close-up of male and female sooty and dusky grouse wings.

KEY FOR RUFFED GROUSE AGE (see Fig. A3)

- 1a) Molt complete
 - 2a) P9 and P10 are pointed, slightly worn, and faded when compared with P8 and P7 and the base of P9 immediately above insertion point is not as scaly as P8. **Juvenile ruffed grouse**
 - 2b) P9 and P10 are rounded, unworn, and unfaded similar to P8 and P7; the base of P9 immediately above insertion point is as scaly as P8. **Breeding-aged ruffed grouse**
 - 2c) Pointedness, wear, fading, and scaliness are unclear.
 - 3a) $P1 \leq 99$ mm and $P3 \leq 108$ mm. **Juvenile ruffed grouse**
 - 3b) $P1 \geq 108$ mm and $P3 \geq 113$ mm. **Breeding-aged ruffed grouse**
- 1b) Molt incomplete at P7 or earlier.
 - 4a) Length of P8 < P9 and if S1 is present, it will be pointed. **Juvenile ruffed grouse**
 - 4b) Length of P8 > P9 and if S1 is present, it will be rounded. **Breeding-aged ruffed grouse**
 - 5a) P9 and P10 are relatively pointed and/or speckled near the outer 2 cm when compared with P8 and P7. **Yearling ruffed grouse**
 - 5b) P9 and P10 are relatively rounded and unspeckled; similar to P8 and P7. **Adult ruffed grouse**
- 1c) Molt incomplete at P8.
 - 6a) $P8 \geq 60\%$ complete. **Juvenile ruffed grouse**
 - 6b) $P8 < 60\%$ complete.
 - 7a) P9 and P10 are pointed and unfaded when compared with P8 and P7 and if S1 has not molted yet, it will be pointed. **Juvenile ruffed grouse**
 - 7b) P9 and P10 are pointed or rounded; P9 and P10 are relatively worn or faded when compared with P8 and P7 and if S1 has not molted yet, it will be rounded. **Breeding-aged ruffed grouse**
 - 8a) P9 and P10 are pointed. **Yearling ruffed grouse**
 - 8b) P9 and P10 are rounded. **Adult ruffed grouse**
 - 7c) Wear, fading, S1 appearance, and coverts are unclear.
 - 9a) $P1 \leq 99$ mm and $P3 \leq 108$ mm. **Juvenile ruffed grouse**
 - 9b) $P1 \geq 108$ mm and $P3 \geq 113$ mm. **Breeding-aged ruffed grouse**
 - 10a) P9 and P10 are pointed. **Yearling ruffed grouse**
 - 10b) P9 and P10 are rounded. **Adult ruffed grouse**
- 1d) Molt incomplete at P9.
 - 11a) P10 is relatively pointed, worn, and faded when compared with P9, P8, and P7. **Yearling ruffed grouse**
 - 11b) P10 is relatively rounded, unworn, and unfaded when compared with P9, P8, and P7. **Adult ruffed grouse**
- 1e) Molt incomplete at P10. **Breeding-aged female spruce grouse**

KEY FOR MALE SPRUCE GROUSE AGE (see Fig. A4)

- 1a) Molt complete
 - 2a) P9 and P10 are pointed, slightly worn, and faded when compared with P8 and P7 and the base of P9 immediately above insertion point is not as scaly as P8. **Juvenile male spruce grouse**
 - 2b) P9 and P10 are rounded, unworn, and unfaded similar to P8 and P7; the base of P9 immediately above insertion point is as scaly as P8. **Breeding-aged male spruce grouse**
 - 2c) Pointedness, wear, fading, and scaliness are unclear.
 - 3a) $P1 \leq 98$ mm and $P2 \leq 102$ mm. **Juvenile male spruce grouse**
 - 3b) $P1 \geq 100$ mm and $P2 \geq 103$ mm. **Breeding-aged male spruce grouse**
- 1b) Molt incomplete at P7 or earlier.
 - 4a) Length of $P8 < P9$; if S1 is present, it will be pointed; and natal coverts are likely present. **Juvenile male spruce grouse**
 - 4b) Length of $P8 > P9$; if S1 is present, it will be rounded; and natal coverts can never be present. **Breeding-aged male spruce grouse**
 - 5a) P9 and P10 are relatively pointed and possibly speckled near the outer 2 cm when compared with P8 and P7. P9 usually ≥ 100 mm in length. **Yearling male spruce grouse**
 - 5b) P9 and P10 are relatively rounded and unspeckled, similar to P8 and P7. P9 usually ≤ 99 mm in length. **Adult male spruce grouse**
- 1c) Molt incomplete at P8.
 - 6a) $P8 \geq 60\%$ complete. **Juvenile male spruce grouse**
 - 6b) $P8 < 60\%$ complete.
 - 7a) P9 and P10 are pointed and unfaded when compared with P8 and P7; if S1 has not molted yet, it will be pointed; and natal coverts may be present. **Juvenile male spruce grouse**
 - 7b) P9 and P10 are pointed or rounded; P9 and P10 are relatively worn or faded when compared with P8 and P7; if S1 has not molted yet, it will be rounded; and natal coverts will never be present. **Breeding-aged male spruce grouse**
 - 8a) P9 and P10 are pointed. **Yearling male spruce grouse**
 - 8b) P9 and P10 are rounded. **Adult male spruce grouse**
 - 7c) Wear, fading, S1 appearance, and coverts are unclear.
 - 9a) $P1 \leq 98$ mm and $P2 \leq 102$ mm. **Juvenile male spruce grouse**
 - 9b) $P1 \geq 100$ mm and $P2 \geq 103$ mm. **Breeding-aged male spruce grouse**
 - 10a) P9 and P10 are pointed. **Yearling male spruce grouse**
 - 10b) P9 and P10 are rounded. **Adult male spruce grouse**
- 1d) Molt incomplete at P9.
 - 11a) P10 is relatively pointed, worn, and faded when compared with P9, P8, and P7. **Yearling male spruce grouse**

11b) P10 is relatively rounded, unworn, and unfaded when compared with P9, P8, and P7. **Adult male spruce grouse**

1e) Molt incomplete at P10. **Breeding-aged male spruce grouse**

KEY FOR FEMALE SPRUCE GROUSE AGE (see Fig. A4)

1a) Molt complete

2a) P9 and P10 are pointed, slightly worn, and faded when compared with P8 and P7 and the base of P9 immediately above insertion point is not as scaly as P8. **Juvenile female spruce grouse**

2b) P9 and P10 are rounded, unworn, and unfaded similar to P8 and P7; the base of P9 immediately above insertion point is as scaly as P8. **Breeding-aged female spruce grouse**

2c) Pointedness, wear, fading, and scaliness are unclear.

3a) $P1 \leq 98$ mm and $P2 \leq 102$ mm. **Juvenile female spruce grouse**

3b) $P1 \geq 100$ mm and $P2 \geq 103$ mm. **Breeding-aged female spruce grouse**

1b) Molt incomplete at P7 or earlier.

4a) Length of P8 < P9; if S1 is present, it will be pointed; and natal coverts are likely present. **Juvenile female spruce grouse**

4b) Length of P8 > P9; if S1 is present, it will be rounded; and natal coverts can never be present. **Breeding-aged female spruce grouse**

5a) P9 and P10 are relatively pointed and possibly speckled near the outer 2 cm when compared with P8 and P7. P9 usually ≥ 100 mm in length. **Yearling female spruce grouse**

5b) P9 and P10 are relatively rounded and unspeckled, similar to P8 and P7. P9 usually ≤ 99 mm in length. **Adult female spruce grouse**

1c) Molt incomplete at P8.

6a) $P8 \geq 60\%$ complete. **Juvenile female spruce grouse**

6b) $P8 < 60\%$ complete.

7a) P9 and P10 are pointed and unfaded when compared with P8 and P7; if S1 has not molted yet, it will be pointed; and natal coverts may be present. **Juvenile female spruce grouse**

7b) P9 and P10 are pointed or rounded; P9 and P10 are relatively worn or faded when compared with P8 and P7; if S1 has not molted yet, it will be rounded; and natal coverts will never be present. **Breeding-aged female spruce grouse**

8a) P9 and P10 are pointed. **Yearling female spruce grouse**

8b) P9 and P10 are rounded. **Adult female spruce grouse**

7c) Wear, fading, S1 appearance, and coverts are unclear.

9a) $P1 \leq 98$ mm and $P2 \leq 102$ mm. **Juvenile female spruce grouse**

9b) $P1 \geq 100$ mm and $P2 \geq 103$ mm. **Breeding-aged female spruce grouse**

10a) P9 and P10 are pointed. **Yearling female spruce grouse**

- 10b) P9 and P10 are rounded. **Adult female spruce grouse**
- 1d) Molt incomplete at P9.
- 11a) P10 is relatively pointed, worn, and faded when compared with P9, P8, and P7. **Yearling female spruce grouse**
- 11b) P10 is relatively rounded, unworn, and unfaded when compared with P9, P8, and P7. **Adult female spruce grouse**
- 1e) Molt incomplete at P10. **Breeding-aged female spruce grouse**

KEY FOR MALE DUSKY AND SOOTY GROUSE AGE (see Fig. A8 and A9)

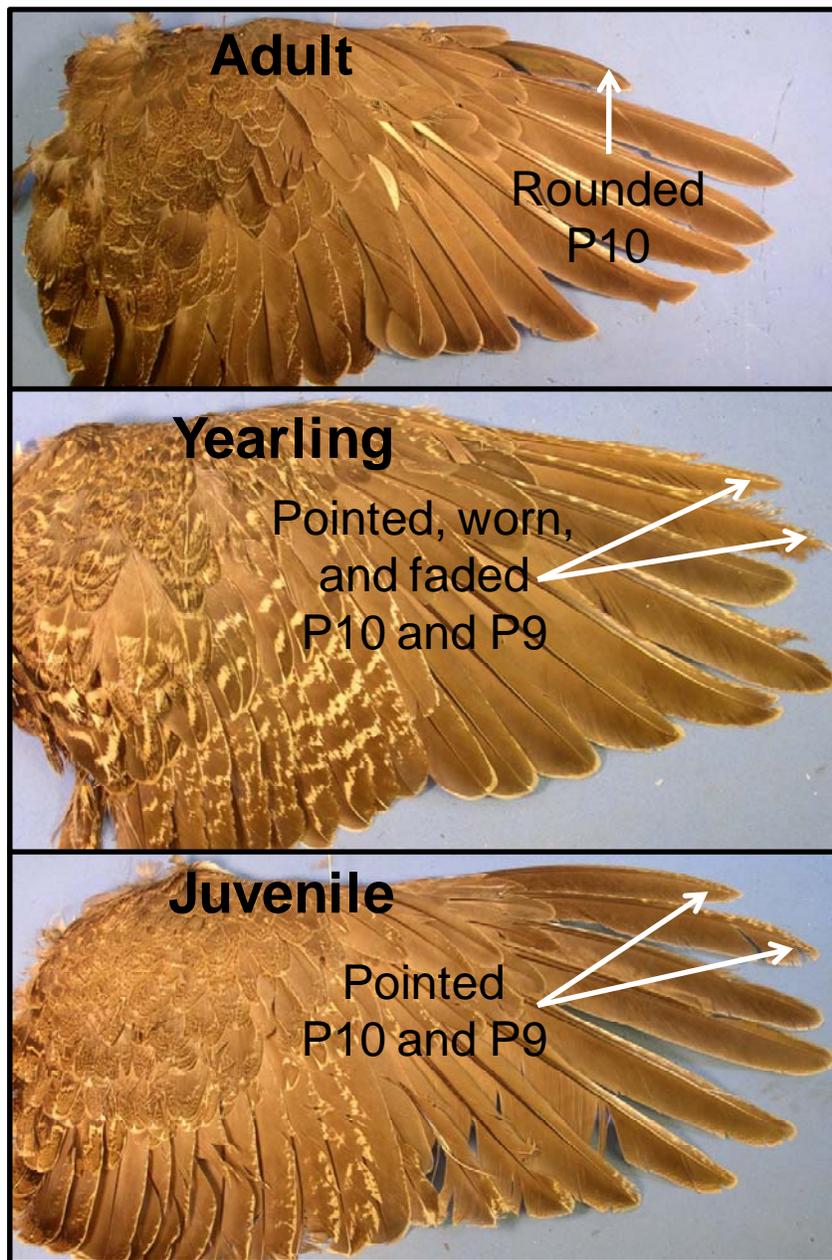


Fig. A8. Dusky grouse wings of different ages. Key features are referenced in text.

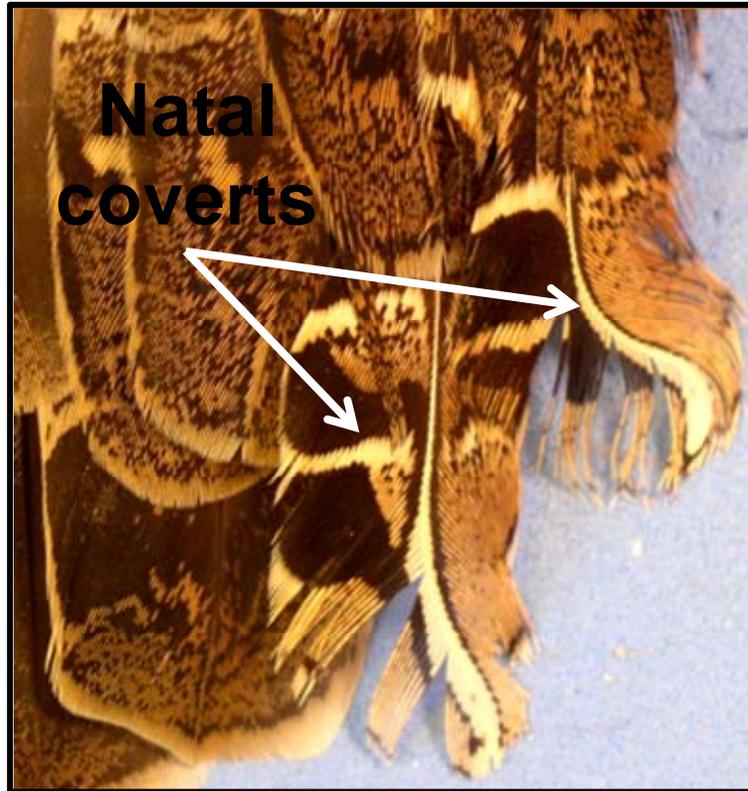


Fig. A9. Dusky grouse natal coverts.

- 1a) Molt complete
 - 2a) P9 and P10 are pointed, slightly worn, and faded when compared with P8 and P7 and the base of P9 immediately above insertion point is not as scaly as P8. **Juvenile male dusky or sooty grouse**
 - 2b) P9 and P10 are rounded, unworn, and unfaded similar to P8 and P7; the base of P9 immediately above insertion point is as scaly as P8. **Breeding-aged male dusky or sooty grouse**
 - 2c) Pointedness, wear, fading, and scaliness are unclear.
 - 3a) $P1 \leq 118$ mm and $P2 \leq 122$ mm. **Juvenile male dusky or sooty grouse**
 - 3b) $P1 \geq 120$ mm and $P2 \geq 132$ mm. **Breeding-aged male dusky or sooty grouse**
- 1b) Molt incomplete at P7 or earlier.
 - 4a) Length of P8 < P9; if S1 is present, it will be pointed; and natal coverts are likely present. **Juvenile male dusky or sooty grouse**
 - 4b) Length of P8 > P9; if S1 is present, it will be rounded; and natal coverts can never be present. **Breeding-aged male dusky or sooty grouse**
 - 5a) P9 and P10 are relatively pointed and possibly speckled near the outer 2 cm when compared with P8 and P7. **Yearling male dusky or sooty grouse**
 - 5b) P9 and P10 are relatively rounded and unspeckled, similar to P8 and P7. **Adult male dusky or sooty grouse**
- 1c) Molt incomplete at P8.

- 6a) $P8 \geq 60\%$ complete. **Juvenile male dusky or sooty grouse**
- 6b) $P8 < 60\%$ complete.
 - 7a) $P9$ and $P10$ are pointed and unfaded when compared with $P8$ and $P7$; if $S1$ has not molted yet, it will be pointed; and natal coverts may be present. **Juvenile male dusky or sooty grouse**
 - 7b) $P9$ and $P10$ are pointed or rounded; $P9$ and $P10$ are relatively worn or faded when compared with $P8$ and $P7$; if $S1$ has not molted yet, it will be rounded; and natal coverts will never be present. **Breeding-aged male dusky or sooty grouse**
 - 8a) $P9$ and $P10$ are pointed. **Yearling male dusky or sooty grouse**
 - 8b) $P9$ and $P10$ are rounded. **Adult male dusky or sooty grouse**
- 7c) Wear, fading, $S1$ appearance, and coverts are unclear.
 - 9a) $P1 \leq 118$ mm and $P2 \leq 122$ mm. **Juvenile male dusky or sooty grouse**
 - 9b) $P1 \geq 120$ mm and $P2 \geq 132$ mm. **Breeding-aged male dusky or sooty grouse**
 - 10a) $P9$ and $P10$ are pointed. **Yearling male dusky or sooty grouse**
 - 10b) $P9$ and $P10$ are rounded. **Adult male dusky or sooty grouse**
- 1d) Molt incomplete at $P9$.
 - 11a) $P10$ is relatively pointed when compared with $P9$, $P8$, and $P7$.
 - 12a) $P10$ is relatively faded and worn when compared with $P9$, $P8$, and $P7$. $P1$ usually ≥ 120 and $P2$ usually ≥ 132 mm in length. **Yearling male dusky or sooty grouse**
 - 12b) $P10$ is relatively unfaded and unworn when compared with $P9$, $P8$, and $P7$. $P1$ usually ≤ 118 and $P2$ usually ≤ 122 mm in length. Note: Approximately 10% of dusky grouse appear to molt $P9$ during their first year. **Juvenile male dusky or sooty grouse**
 - 11b) $P10$ is rounded when compared with $P9$, $P8$, and $P7$. **Adult male dusky or sooty grouse**
- 1e) Molt incomplete at $P10$. **Breeding-aged male dusky or sooty grouse**

KEY FOR FEMALE DUSKY AND SOOTY GROUSE AGE (see Fig. A8 and Fig. A9)

- 1a) Molt complete
 - 2a) $P9$ and $P10$ are pointed, slightly worn, and faded when compared with $P8$ and $P7$ and the base of $P9$ immediately above insertion point is not as scaly as $P8$. **Juvenile female dusky or sooty grouse**
 - 2b) $P9$ and $P10$ are rounded, unworn, and unfaded similar to $P8$ and $P7$; the base of $P9$ immediately above insertion point is as scaly as $P8$. **Breeding-aged female dusky or sooty grouse**
 - 2c) Pointedness, wear, fading, and scaliness are unclear.
 - 3a) $P1 \leq 111$ mm and $P2 \leq 117$ mm. **Juvenile female dusky or sooty grouse**
 - 3b) $P1 \geq 119$ mm and $P2 \geq 124$ mm. **Breeding-aged female dusky or sooty grouse**
- 1b) Molt incomplete at $P7$ or earlier.
 - 4a) Length of $P8 < P9$; if $S1$ is present, it will be pointed; and natal coverts are likely present. **Juvenile female dusky or sooty grouse**

- 4b) Length of P8 > P9; if S1 is present, it will be rounded; and natal coverts can never be present. **Breeding-aged female dusky or sooty grouse**
- 5a) P9 and P10 are relatively pointed and possibly speckled near the outer 2 cm when compared with P8 and P7. **Yearling female dusky or sooty grouse**
- 5b) P9 and P10 are relatively rounded and unspeckled, similar to P8 and P7. **Adult female dusky or sooty grouse**
- 1c) Molt incomplete at P8.
 - 6a) $P8 \geq 60\%$ complete. **Juvenile female dusky or sooty grouse**
 - 6b) $P8 < 60\%$ complete.
 - 7a) P9 and P10 are pointed and unfaded when compared with P8 and P7; if S1 has not molted yet, it will be pointed; and natal coverts may be present. **Juvenile female dusky or sooty grouse**
 - 7b) P9 and P10 are pointed or rounded; P9 and P10 are relatively worn or faded when compared with P8 and P7; if S1 has not molted yet, it will be rounded; and natal coverts will never be present. **Breeding-aged female dusky or sooty grouse**
 - 8a) P9 and P10 are pointed. **Yearling female dusky or sooty grouse**
 - 8b) P9 and P10 are rounded. **Adult female dusky or sooty grouse**
 - 7c) Wear, fading, S1 appearance, and coverts are unclear.
 - 9a) $P1 \leq 111$ mm and $P2 \leq 117$ mm. **Juvenile female dusky or sooty grouse**
 - 9b) $P1 \geq 119$ mm and $P2 \geq 124$ mm. **Breeding-aged female dusky or sooty grouse**
 - 10a) P9 and P10 are pointed. **Yearling female dusky or sooty grouse**
 - 10b) P9 and P10 are rounded. **Adult female dusky or sooty grouse**
- 1d) Molt incomplete at P9.
 - 11a) P10 is relatively pointed when compared with P9, P8, and P7.
 - 12a) P10 is relatively faded and worn when compared with P9, P8, and P7. P1 usually ≥ 119 and P2 usually ≥ 124 mm in length. **Yearling female dusky or sooty grouse**
 - 12b) P10 is relatively unfaded and unworn when compared with P9, P8, and P7. P1 usually ≤ 111 and P2 usually ≤ 117 mm in length. Note: Approximately 10% of dusky grouse appear to molt P9 during their first year. **Juvenile female dusky or sooty grouse**
 - 11b) P10 is rounded when compared with P9, P8, and P7. **Adult female dusky or sooty grouse**
- 1e) Molt incomplete at P10. **Breeding-aged female dusky or sooty grouse**