SPATIAL SEPARATION OF SEXES IN ROCK AND WILLOW PTARMIGAN IN WINTER

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THIS paper reports information on spatial separation of the sexes in both Rock Ptarmigan (*Lagopus mutus*) and Willow Ptarmigan (*L. lagopus*) in winter in Alaska. The data include observations of the autumnal movement of female Rock Ptarmigan from alpine breeding areas to wintering ranges below timberline, observations of the reverse movement in spring, and results of examinations of specimens taken in winter. I first noticed segregation of sexes in ptarmigan in 1959 while collecting winter specimens incidental to research for the Alaska Department of Fish and Game. Most data were obtained in central Alaska from 1959 through 1963.

METHODS AND MATERIALS

As many specimens were examined as possible. Information was obtained on sex, age (when possible), location and date of collection, habitat type, and size and composition of the flock from which each bird was taken. In all, 181 Rock Ptarmigan and 381 Willow Ptarmigan were examined from collections made from mid-October to early April in central Alaska from 1959 through 1963. Of the Willow Ptarmigan, 133 were collected by the staff of the Laboratory of Zoophysiology, University of Alaska, College, Alaska; 9 others, collected at Stony Rapids, Saskatchewan, in the winter of 1957–1958, were made available by Ernst Kuyt of the Canadian Wildlife Service. Six Willow Ptarmigan collected at Huslia, Alaska, in November, 1956, were sent to me by Samuel Harbo, and Howard Kantner donated 22 from Dry Creek, Alaska.

I spent the period from 4 March through 17 May 1962, at Eagle Creek, in central Alaska (145°30′ W; 65°30′ N), observing the spring migration and the early part of the nesting period of Rock Ptarmigan. In 1963 I visited Eagle Creek from 14 to 19 October to determine whether the autumnal movement had occurred.

The sex of Rock Ptarmigan could be determined in fall, winter, and spring by the presence of a black loral stripe in males. This stripe, extending from the bill to a point 10 to 15 mm behind the eye, was present in all of 115 Rock Ptarmigan in winter plumage which were determined by internal examination to be males. The stripe can be seen at distances up to 100 m with 7 × 35 binoculars. It is present in cocks from late September to mid-June in interior Alaska. Females in this area usually lack loral stripes and very rarely have conspicuous ones. Of 71 Rock Ptarmigan in winter plumage determined internally to be females, 55 had no visible stripe. Partial loral stripes were present in 15 hens, and 1 had a complete, dark stripe.

ROCK PTARMIGAN

Evidence of segregation of sexes in winter.—Near Fairbanks, 38 Rock Ptarmigan were collected from shrubby openings in the boreal forest, a habitat used only in winter by ptarmigan. Only 5 of the birds (13 per cent) were males; 3 of the cocks had a bursa of Fabricius, indicating that they were young of the year; 2 had no bursa, but were taken in late winter

TABLE 1

SIZE AND COMPOSITION OF GROUPS OF ROCK PTARMIGAN IN CENTRAL ALASKA, MARCH–MAY, 1962

Period[1]	*Kind of Group*[2]									
	Males only			*Females only*			*Both sexes*			
	Per cent	*N*	*Mean*	*Per cent*	*N*	*Mean*	*Per cent*	*N*	*Mean*	*Per cent males*
1	72	34	6.1	0	0	0	28	13	16.4	89
2	62	39	2.5	5	3	9.7	33	21	9.2	65
3	65	56	1.2	6	5	4.6	29	25	12.6	29
4	45	53	1.5	8	9	1.8	47	55 (53)[3]	4.2 (2.5)	38 (44)
5	21	11	1.0	3	1	2.0	76	39	2.1	48

[1] See text for dates and explanation.
[2] Under each subheading percentages mean the per cent of all groups seen in the period, N = the number of groups, Mean = average number of birds per group.
[3] Values in parentheses are those obtained by excluding two large flocks (26 and 70 birds) composed largely of hens. Most observations in this period were of much smaller groups.

when the bursa begins to disappear in ptarmigan. Of the females, 23 had a bursa, and 8 hens taken early in the winter lacked the bursa and possessed an ovary typical of adults. The age of the other 2 females could not be determined.

I collected 45 Rock Ptarmigan at or above timberline in the winters of 1959 through 1963; 37 of these birds (82 per cent) were males. The collections were made at several points in the Tanana Hills and in the Alaska Range near Summit Lake, Isabell Pass (145°30′ W; 63°10′ N). In February and March, 1963, I examined 98 Rock Ptarmigan shot by hunters in the Summit Lake area. The sexes of these birds were as follows: 16 and 17 February, 16 males and 8 females; 22 to 24 February, 29 males and 5 females; 2 and 3 March, 33 males and 7 females.

I think these data reflect a real preponderance of males among birds remaining on or near the breeding areas in winter, since there seems to be little likelihood of selective hunting for males.

Spring movements.—If some ptarmigan spend the winter away from breeding areas, it should be possible to detect a movement of birds back to their breeding grounds. Data obtained at Eagle Creek, 4 March through 17 May 1962, demonstrate the influx of female Rock Ptarmigan quite clearly (Table 1). When daily records of the numbers seen of birds with and without eyestripes were examined, it was possible to divide the span of time into five distinctive periods, within each of which the social structure of the population was relatively constant. The five periods may be characterized as follows:

1. March 4–25. There were far more males than females on the area. The males were in flocks of 2 to 17; lone males were uncommon. There were no single hens or hens in flocks by themselves. The few hens present always associated with a larger number of males.

TABLE 2

SEX RATIOS AND FLOCK SIZE OF ROCK PTARMIGAN AT EAGLE CREEK, ALASKA, 14–19 OCTOBER 1963

	Number of observations	*Flocks with more males than females*	*Flock size*	
			Range	*Mean*
Single birds	11	11	—	—
Flocks of one sex	9	7	2–7	3
Flocks with two-thirds or more of one sex	24	14	3–100	17
Flocks of both sexes in nearly equal numbers	8	—	2–50	16

2. March 26–April 9. The first migrant females arrived. Some large flocks found were composed entirely or largely of hens. The males tended to scatter, forming loose display groups.

3. April 10–20. The first pairs, perhaps temporary ones, were noted. Cocks were almost all alone and territorial, or in small, loose flocks. Many hens arrived, often remaining apart from the territorial cocks.

4. April 21–May 12. Nearly all males became territorial. Most hens were paired with cocks, but some migrant flocks of females were still arriving. Previously territorial birds sometimes joined into flocks in cold or snowy weather.

5. May 13–17 (and throughout the breeding season). The entire population consisted of pairs, rare trios, and unmated, territorial cocks.

Autumnal movements and separation of sexes.—The Alaska Department of Fish and Game receives numerous reports yearly of the occurrence of ptarmigan, near Fairbanks, in open areas below timberline. From the pattern of verbal reports, and from my own observations, it appears that Rock and Willow ptarmigan first reach the vicinity of Fairbanks, a minimum of 10–20 miles (16–32 km) from the nearest alpine breeding areas, in October. The first authentic reports of Rock Ptarmigan (verified by specimens in three years) were obtained 19 October 1959, 1 October 1960, 1 October 1961, 21 October 1962, and 9 October 1963. The first observations usually were of lone birds or small flocks. The build-up of populations below timberline seems to occur in late October and November and is followed by a long period of relative stability in numbers, but no quantitative data bearing on this matter are available.

In October, 1963, I watched the behavior of Rock Ptarmigan at Eagle Creek. Ptarmigan were observed daily 14 through 19 October; information was recorded on flock size and composition as to sex (Table 2). Flocks composed entirely or mostly of one sex were more common than flocks in which males and females were present in nearly equal numbers. Single cocks were common, but single hens were not seen. The population as a

whole contained about 58 per cent males (262 males and 191 females were identified).

Segregation of sexes in relation to annual cycle.—As the annual cycle of Rock Ptarmigan is not widely known, it seems worthwhile to review the broad features of the life of these birds, placing the matter of segregation of sexes in perspective. Although the timing of various events changes from place to place throughout the circumpolar range of the species, the events themselves and their sequence probably are similar. Watson ("The annual cycle of Rock Ptarmigan." Unpubl. thesis, University of Aberdeen, Scotland, 1956) gives a more detailed treatment of the life history of the Rock Ptarmigan.

Like many grouse, ptarmigan are essentially gregarious birds. The basic population unit, the flock, is fragmented temporarily by the territorial activities accompanying reproduction. In winter, Rock Ptarmigan are partially nomadic. Although little is known about the causes of their movements, such things as food supply, weather, roosting conditions, and predation may be involved. Winter flocks in central Alaska concentrate at timberline, at the lower limit of nesting range. Some males and a few hens live in breeding habitats all winter; more hens are found just below timberline and far out in shrubby openings of the boreal forest. Segregation of sexes, while not complete, results in the separation of a large proportion of males and females, not only by distance but by habitat.

The spring movement begins late in March. Males (and a few females) that spent the winter at the upper fringe of timber move higher up to alpine habitats, and females (and a few males) return from their wintering areas below timberline. There is no information on the extent of these movements. Many adult hens return to the nesting area of the previous year, but young birds seldom return to the natal area. (Of 191 adult hens banded at Eagle Creek, Alaska, from 1960 to 1962, 55 were recaptured on the study area in the later years. Only 7 of 138 adult males were recaptured, and only 25 of 329 banded chicks were caught again.) Some adult cocks occupy the same or adjacent territories for several seasons, but others shift locations of their territories considerably.

Rock Ptarmigan are monogamous, with occasional exceptions in which a hen mates with two or more cocks, or in which males have two mates. Hatching usually is concentrated between 20 and 30 June. Cocks leave territories, or cease to defend their territories, in mid-June. Groups of 3 to 10 molting males are common at the upper or lower limits of nesting habitat throughout July and early August. Unproductive hens often join these groups. Re-nesting seems very rare. Hens with broods wander erratically during July and early August, sometimes staying in a small area of a few acres, sometimes traveling up to 1.5 to 2 km from the nest.

Flocks composed of combined broods become common in August, and by late August some flocks containing adult cocks, family groups, and unproductive hens are present. Flocking reaches a peak in late September, although even then some single birds (mostly males) can be found. Bigger flocks break up in October, a partial sorting of the sexes occurs, and the fall emigration of females begins. Although males usually remain in breeding habitats through much of the winter, it is not known whether extensive movements within this habitat occur.

WILLOW PTARMIGAN

The only data available on segregation of sexes in Willow Ptarmigan are from examinations of carcasses, since it is not possible to distinguish the sexes in winter from external characteristics visible at a distance. I examined 65 Willow Ptarmigan taken in winter in boreal forest habitats (Fairbanks area, 147°50′ W, 64°50′ N; Huslia area, 156°30′ W, 65°45′ N); 60 of these were females. Samples were available from wintering populations in five timberline or tundra areas (Miller House, 145°15′ W, 65°30′ N; Summit Lake, 145°30′ W, 63°10′ N; Dry Creek, 147°30′ W, 63°55′ N; Anaktuvuk Pass, 151°20′ W, 68°00′ N; Nome, 165°45′ W, 64°30′ N). Of 316 Willow Ptarmigan collected from October to April in those areas, 232 (73 per cent) were males.

The likelihood of selective shooting of cocks among Willow Ptarmigan seems small. I think the samples reflect true local sex ratios, although they are subject to errors inherent in small samples.

Willow Ptarmigan generally appear near Fairbanks in October, although in three years the first specimens were shot in November. The first reliable sightings are 7 November 1960, 8 November 1961, 2 November 1962, and 8 October 1963.

OTHER RECORDS OF SEGREGATION OF SEXES OF PTARMIGAN

The few published records of winter segregation of ptarmigan suggest a wide occurrence of the phenomenon in the western hemisphere. Grinnell (1900: 35, 36) encountered large flocks composed mostly or entirely of male Rock Ptarmigan in February and March in western Alaska. Porsild (1943) said that Willow Ptarmigan flocked in groups of one sex in winter in the MacKenzie River Delta, Northwest Territories. On the Adelaide Peninsula, Northwest Territories, MacPherson and Manning (1959: 21) collected 17 Rock Ptarmigan in September, of which 15 were males. MacPherson and McLaren (1959) often saw migrating male Rock Ptarmigan in mid-May on Baffin Island, but saw no females until late May. Soper (1928: 105) also observed that male Rock Ptarmigan arrived at Takuirbing River, Baffin Island, earlier in May than females. Harper (1953) com-

mented that one migrating flock of Willow Ptarmigan in the Nueltin Lake area of the Northwest Territories in May contained 25 birds, all cocks. In Greenland, Salomonsen (1950: 178) noted that in 1949 all wintering Rock Ptarmigan in one area, and the first spring arrivals, were males.

Ernst Kuyt, Canadian Wildlife Service, collected a few Willow Ptarmigan near Stony Rapids, Saskatchewan, at least 200 km from the nearest known breeding place of the species. He collected 1 male and 7 females between 26 November and 11 December 1957, and 1 female on 30 March 1958. In a letter dated 29 August 1962, H. Lumsden (Ontario Department of Lands and Forests) said: "Two winters ago we had an irruption of Willow Ptarmigan in Ontario and I received 87 carcasses from Moosonee. Only five of these were males." Moosonee is at the extreme southern edge of the known breeding range of Willow Ptarmigan.

Little information is available on segregation of sexes in White-tailed Ptarmigan (*L. leucurus*). Choate (1963) mentions a slight tendency toward sexual segregation in flocks in Montana in late summer, but he had no information on winter flocks. Late in February, 1962, I examined 17 White-tailed Ptarmigan shot by a hunter from one flock near Summit Lake, Alaska Range; 14 were hens.

DISCUSSION

At present we have only a vague and general notion about segregation of sexes among ptarmigan. The fact that the sexes do live separately in winter has been demonstrated for Rock and Willow ptarmigan in a few areas. We know there is both a spatial separation and a difference in habitat preference by the sexes in some regions, and that the segregation of sexes is partial rather than absolute. Beyond this, very little is known. Not only are data scanty regarding the geographic occurrence of the behavior pattern, the mechanics and timing of the sorting process, and other descriptive aspects of the phenomenon, but it seems that another process, migration, must be studied in detail before segregation of sexes can be understood. The two patterns of action seem chronologically very closely related in Rock and Willow ptarmigan. If, as in Black Grouse (*Lyrurus tetrix*), the two sexes lived in separate flocks but occupied the same habitats all winter (see Koskimies, 1957: 14; Seiskari, 1962: 23), segregation of sexes could be studied apart from migration. Perhaps this situation occurs in the White-tailed Ptarmigan, a species thought to be much less migratory than the Rock or Willow ptarmigan. Investigations in the Aleutian Islands might be productive, too, since the Rock Ptarmigan found there may be very sedentary, judging from the morphological variation encountered from island to island.

Considering segregation of sexes and migration together, I think it is

likely that very real adaptive advantages must be inherent in these behavior patterns. The expenditure of energy on the part of the birds that move, and the likelihood of increased mortality during migrations, seem to be too great not to be offset by marked advantages to the species. But why do some members of a population leave breeding habitats while others stay? Why do females tend to move farthest and select forest, rather than tundra, environments as their winter homes? At least three possible answers call for study: the movement of some hens and a few males over large expanses of country and through a variety of habitats may be a mechanism for dispersal, ensuring that many suitable breeding localities will be occupied each year; movement of part of the autumn population may be necessary because of food shortages in winter in breeding habitats; or conditions (other than food supply) for winter survival in boreal forest habitats may be better than in tundra or tundra-fringe habitats, at least for females.

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SUMMARY

Studies were made of sexual segregation in Rock Ptarmigan (*Lagopus mutus*) and Willow Ptarmigan (*L. lagopus*) in Alaska from 1959 through 1963. Data were obtained from field observations in the fall and spring, and from birds collected in winter.

Among Rock Ptarmigan in central Alaska, a partial sorting of the sexes occurs in October and early November. At the same time, extensive movements occur. In winter nearly all Rock Ptarmigan on an alpine study area were males. Females returned in late March and April. Migrant Rock Ptarmigan were seen in boreal forest habitats in central Alaska beginning in October. Collections made in these habitats in October through March showed a preponderance of females. Populations wintering at or above timberline in the Alaska Range consisted mostly of males.

Examinations of Willow Ptarmigan collected in winter demonstrated a similar separation of the sexes. Only 5 of 65 Willow Ptarmigan shot in forested areas were males, whereas 232 male and 84 female birds were collected at or above timberline.

Published records, although scarce, suggest that segregation of the sexes occurs among ptarmigan in many parts of the western hemisphere. The phenomenon of sexual segregation and the chronologically related habit of

migration merit more study. More data are needed on descriptive aspects of these patterns of behavior before any but tentative hypotheses about the value of these actions can be formed.

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