CHANGE IN PTARMIGAN NUMBERS IN YAKUTIA

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ABSTRACT.—Counts of Willow Ptarmigan (*Lagopus lagopus*) and Rock Ptarmigan (*L. muta*) have been conducted for as long as 25 years in some areas of the Russian Republic of Yakutia in tundra, taiga, and along the ecotone of these landscapes. The largest counts of Willow Ptarmigan occur in the tundra and forest-tundra. Willow Ptarmigan numbers fluctuate, and the length of the "cycles" vary among areas in Yakutia. Fluctuations in ptarmigan numbers are greater in the tundra and forest-tundra than in the northern taiga. Rock Ptarmigan are common in the mountain areas and tundra of Yakutia, and their numbers also fluctuate. Factors affecting ptarmigan populations are weather shifts in early spring and unfavorable weather during hatching. A decrease in the number of Willow Ptarmigan in the taiga belt of Yakutia is most likely explained by a greater anthropogenic load. Current Willow and Rock Ptarmigan populations in Yakutia appear stable, except for central and southern areas. *Received 1 February 2011, accepted 31 May 2011*.

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Key words: Willow Ptarmigan, Rock Ptarmigan, Yakutia, Russia, count changes.

SINCE THE MIDDLE OF THE 20TH CENTURY the reduction in numbers of Tetraonidae birds has been reported everywhere, though the mechanisms have not been clear. In many ways, the change in numbers in some areas depends on human influences affecting the birds and their habitats, on weather conditions, and on food abundance (Hoglund 1955, Gullion 1970, Potapov 1985). To describe changes in counts of ptarmigan from 1984 to 2010 in regions of Yakutia, I used results of bird counts conducted for many years, materials in the literature, and questionnaire information. Four key sites were surveyed on a field station-basis during each of four years or more. Bird counts at the temporary camps lasting for one month or longer were made at 10 sites (Figure 1). Information from the winter route counts reported by inspectors working for the Ministry of Nature Protection, Sakha Republic, and by regular and non-professional hunters also were used in the work.

Yakutia territory occupies 3.1 million km^2 in northeast Siberia. Over 40% of Yakutia is north of the Arctic Circle. The territory of Yakutia encompasses four biological zones: taiga forests, tundra, forest-tundra and arctic desert (Figure1). Yakutia is distinguished by a sharply-continental climate with long, dry, and very cold winters, and short summer seasons. The maximum range from January temperatures, the coldest month, to July, the warmest month, is 100°C. Considering the absolute value that the

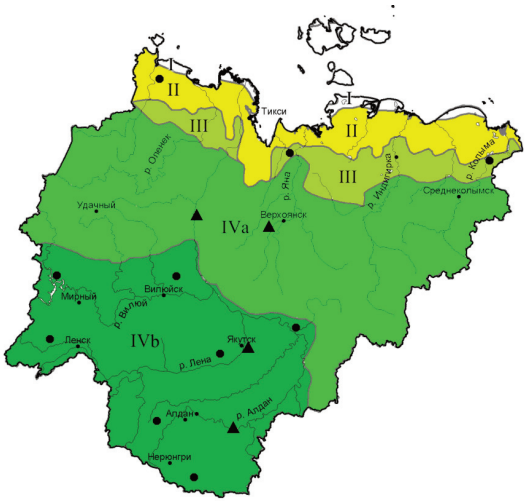

Figure 1. Geographical zones and areas of field studies in Yakutia, Russia (Andreev et al., 1988). Boundaries: I – arctic desert, II – tundra, III - forest-tundra, IV – taiga forests (IVa – north-taiga and IVb – mid-taiga): ▲- field stations, ● – temporary camps.

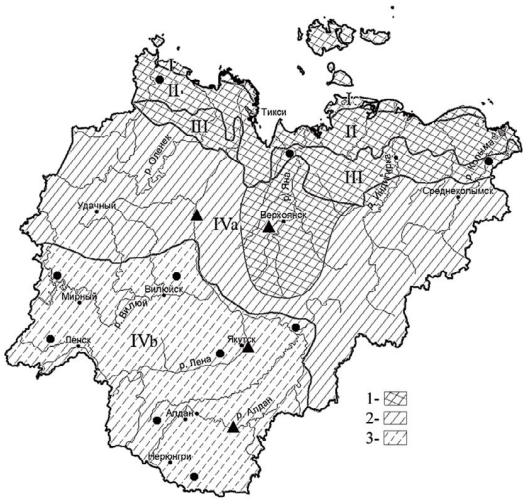

Figure 2. Distribution of Willow Ptarmigan in Yakutia (winter counts from 2000 through 2010). Population density: 1 = 5-16, 2 = 2-4, 3 = 0.1-1.0 individuals/km^2.

minimum temperature reaches –67.8°C in the Verkhoyansk depression, and the total period with negative temperatures is 6.5 to 9 months a year, Yakutia has no comparable region in the Northern Hemisphere.

Seven Tetraonidae species occur in Yakutia: Black-billed Capercaillie (*Tetrao parvirostris*), Western Capercaillie (*T. urogallus*), Willow Ptarmigan (*Lagopus lagopus*), Rock Ptarmigan (*L. muta*), Northern Black Grouse (*Tetrao tetrix)*, Hazel Grouse (*Tetrastes bonasia*), and Siberian Spruce Grouse (*Falcipennis falcipennis*). Among them, Willow Ptarmigan and Rock Ptarmigan are the most abundant. Willow Ptarmigan are widespread throughout Yakutia, but they are abundant only in the tundra and forest-tundra (Figure 2).

The first land counts in Yakutia of upland fowl, Willow Ptarmigan in particular, were conducted in the taiga zone in 1959 and in Chroma-Indigirka tundra in 1961-1962 (Perfiliev 1975). Since 1984 regular studies of bird stocks began in the lower reaches of the Lena River basin, since 1986 in the mountains of northeastern Yakutia (Isaev 1994, 2005), and since 2000, all over Yakutia territory (Isaev 2007).

Ptarmigan Numbers and Changes

According to the literature, the ptarmigan population density is 18 birds/km^2 in Chroma-Indigirka tundra. Ptarmigan nest almost everywhere there, but they often prefer tussock tundra growth with birch brushwood and dwarf willows. In other tundra areas, for example, in Alazeya and Lena-Khatanga, Willow Ptarmigan are much less numerous (Perfiliev 1975). In some years, Willow Ptarmigan density reaches 12 birds/km^2 in the forest-tundra of the lower Lena River basin, 10-15 birds/km^2 in the Kolyma, and 15 birds/km^2 in the river valleys of the northern macroslope of the Central Verkhoyansk Mountains (Perfiliev 1975, Isaev, 1994, 2005). Bird population size in the flat section of the forest zone is small, somes-

times scarce; more birds appear only during their seasonal movement. In summer, ptarmigan more often occur in swamp sites and marshes surrounded by thin larch trees, along floodplains of small creeks with wet open areas grown with grass or dwarf birch. In autumn, the main share of ptarmigan concentrate in the river valleys, near the edges of the floodplain terraces grown with dwarf birch, until permanent snow cover arrives. In late autumn and winter, they amass among river willows growing near the streams.

Willow Ptarmigan.—The results of winter counts (2009-2010) show that Willow Ptarmigan in Yakutia number about 2,000,000 birds (Table 1). Peak population size of Willow Ptarmigan occurs in the tundra and forest-tundra of Yakutia. Almost 1 million birds inhabit five Arctic zones. The total area of these zones is 19.2% of Yakutia. The bird population density in the tundra zones varies from 5.3 to 16.2 birds/km^2 in the tundra and 3.1 to 11.6 birds/km^2 in the forest-tundra, respectively. The northern taiga is poor in ptarmigan except in the mountains where ptarmigan reach 5.5 to 13.6 birds/km^2. The counts show that the bird population density was 10-15 birds/km^2 in the Kolyma forest-tundra in 1966 and 1967, 18 birds/km^2 in the Chroma-Indigirka tundra in 1961-1963, and 8 birds/km^2 in the taiga belt of Yakutia in 1959 (Perfiliev 1975). Our data indicate that ptarmigan numbers did not change much in the tundra, but there was a sharp decrease in the taiga of Yakutia as compared to the published data of counts made in the 1960s (Table 2). Within the area, the highest density of Willow Ptarmigan was recorded in Bolshaya Zemlya tundra, and Yakutia tundra is considered to be favorable habitat, noting that its comparatively high density there is regarded as above average (Table 3).

Ptarmigan numbers fluctuate, and sometimes these rises and declines have the pattern of regular cycles lasting from 3 to 10 years. The Willow Ptarmigan has different periods between peaks in abundance in different parts of its

Table 1. Willow Ptarmigan numbers in the winter period of 2009–2010 in Yakutia.

Zone	Area, thousand km^2	Number of birds, thousands
Tundra and forest-tundra	593.9	990
Taiga	2,509.3	1,216
Total	3,103.2	2,206

Table 2. Comparison of count data made in 1959–1967 compared with counts in 1984–2010.

Zone	Year	Birds/km^2	1984-2010, Birds/km^2
Tundra	1961-1963	18	5-16
Forest-tundra	1966-1967	10-15	3-12
Taiga	1959	8	0.1-1.0

Table 3. Average and peak autumn-winter numbers of Willow Ptarmigan (according to: Potapov 1985).

Species	Number (Birds/1000 ha) Average	Peak	Place
Lagopus lagopus	33.9	64	Baraba
	39	200	Kola Peninsula
	180	—	Chroma-Indigirka tundra
	1159	2149	Bolshaya Zemlya tundra
	100-140	—	Northern Taimyr
	300-400	—	Southern Taimyr
	24.3	—	
	—	82.6	Karelia
	38	100	Finland
		49	Leningradskaya Oblast
Lagopus muta	40-60	400	Kamchatka
	25.8	—	NW Canada

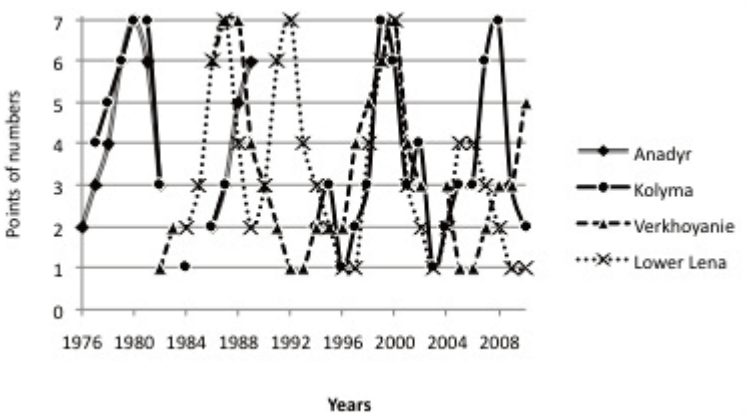

Figure 3. Fluctuation of Willow Ptarmigan numbers in different regions of NE Asia:
Row 1 - Anadyr (Krechmar, et al. 1991); Row 2 – Kolyma (Andreev 1988, our data); Row 3 – Verkhoyanie; Row 4 – Lower Lena (our data). Points of numbers: 1 – minimal, 2 – extremely low, 3 – low, 4 – average, 5 – above average, 6 – high, 7 – maximal (according to: Krechmar et al. 1991).

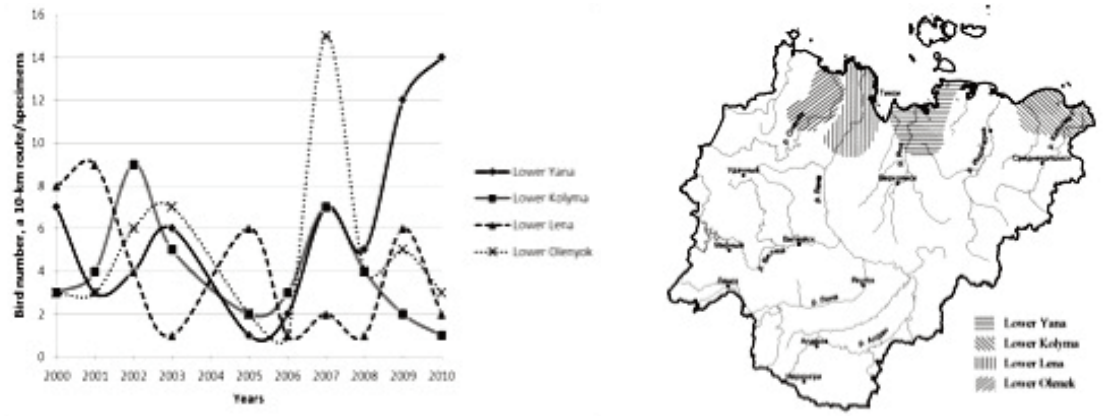

Figure 4. Fluctuations of Willow Ptarmigan numbers in the arctic regions of Yakutia tundra and forest-tundra (winter counts, 2000–2010).

Figure 5. Fluctuations of Willow Ptarmigan numbers in Yakutia northern taiga (winter counts, 2000-2010).

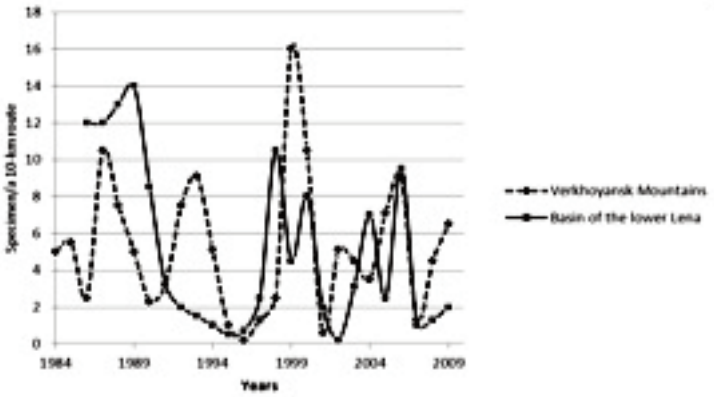

Figure 6. Fluctuations of Willow Ptarmigan numbers in permanent monitoring sites located in the northern taiga.

range: in Fennoscandia, peaks occur every 3-4 years (Myrberget 1974), in the British Isles and NE Europe 5-6 years (Moss 1969, Hudson 1986), in Newfoundland 6 years (Bergerud 1970), 10 years in NE Asia (Andreev 1988), and in Alaska 9-11 years (Irving 1960).

The ptarmigan population fluctuation during 34 years in the middle and lower reaches of the Kolyma River basin occurs every 9-10 years. It should be noted that a 10-year cycle for Willow Ptarmigan in the Lower Kolyma district was synchronous with the Anadyr basin in eastern Russia (Andreev 1988, Krechmar et al. 1991). The Willow Ptarmigan from the Verkhoyansk region is known for its 12-year cycle over the last 26 years. The increases in this species' numbers were observed every 4-7 years over the past 26 years in the basin of the lower Lena River (Figure 3). Declines in Willow Ptarmigan populations occurred in Kolyma in 7 and 10 years, Verkhoyansk in 8 and 10 years, and Lower Lena in 5 and 6 years, respectively. We can see that rises and declines reoccur at 7-12 years in the northeast of Yakutia (Kolyma and Verkhoyanie) and at 4-7 years in the Lower Lena.

According to winter counts over the last 10 years, sharp rises in numbers were recorded in the tundra and forest-tundra of western Yakutia in 2007 and central one in 2010 (Figure 4). The questionnaire data indicate that there was an increase in bird numbers in the eastern tundra in 2007. During the count period, the greater share of birds were observed in the northern taiga (Figure 5), and owing to the fact that they occupied large areas, their rise in number is not obviously observed. Fluctuation in the ptarmigan number is much higher in the tundra and forest-tundra than in the northern taiga (Figure 4 and 5). For the periods of 24 and 26 years, two permanent monitoring sites located in the northern taiga in the east and west of Yakutia demonstrate that ptarmigan numbers rise in the Verkhoyansk area every 9 years; in Lower Lena, ptarmigan counts increase at 6, 7, and 8 years, and decline at the same sites in 5 and 7, and 5 and 6 years, respectively (Figure 6).

The analysis of all information indicates that Willow Ptarmigan increases are typical in 9–10 years for Kolyma, in 9–12 years for Verkhoyansk area, and in 5–7 years for Lower Lena area. In peak years, the species density is 16–17 birds/km^2, with bird occurrence up to 26 individuals per 10-km route in some sites.

Rock Ptarmigan.—Rock Ptarmigan were common in the mountain areas and tundra of Yakutia (Figure 7, Isaev and Borisov 2008). In the Verkhoyansk area, the average density of the nesting bird population was 1.3 birds/km^2; in some years it reached 10–12.3 birds/km^2. Rock Ptarmigan density changed 34-fold among years. Noticeable rises in their number were recorded in 1987–1988 and 2000–2001, an interval of 12–13 years. Rock Ptarmigan are

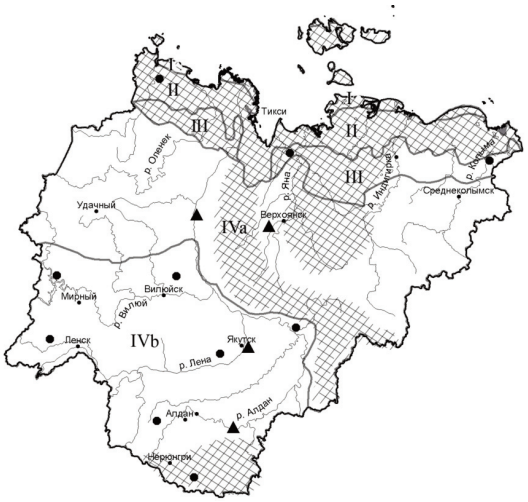

Figure 7. Distribution of Rock Ptarmigan in Yakutia.

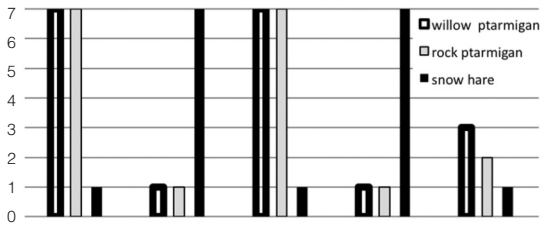

Figure 8. Fluctuations in Willow and Rock Ptarmigan numbers and Mountain Hare in the Verkhoyansk area. Horizontal lines indicate: 1 – minimal, 2 – extremely low, 3 – low, 4 – average, 5 – above average, 6 – high, 7 – maximal numbers of animals.

known for often moving from the northern to the central part of Yakutia, and from the Verkhoyansk Mountains to Aldan and Lena River valleys in the autumn-winter seasons, except for some years. Sometimes mass movements of birds over large distances are observed.

Discussion

Over 25 years we observed coincidence in the movement of Willow and Rock Ptarmigan numbers which is asynchronous to dynamics of Mountain Hare (*Lepus timidus*) numbers (Figure 8). Hare in the area were noted to have an 11-year cycle with a range of 2,500 times difference, unlike any other *Lepus* in the world (Solomonov 1975).

Crucial factors affecting the ptarmigan populations are weather shifts in early spring and unfavorable weather conditions during hatching, and acquiring stable thermoregulation in nestlings. Figures 2 and 3 show a sharp decline of Willow Ptarmigan numbers in the Verkhoyansk area in 1989. The other half of that year was characterized with abnormally warm weather in the daytime and warming to positive temperatures in late March (+3ºC on March 28), while in April there were heavy frosts (-40ºC on April 9), which caused crusts of snow and icing on woody plants. In spring after snow melt, carcasses of dead birds were found everywhere within the river floodplains of the northern macroslope in the Verkhoyansk Mountains (117 dead birds/10-km route). High mortality of Willow Ptarmigan nestlings during hatching was recorded in the Verkhoyansk area in 1987 because of heavy snowfall (June 10) that melted in only 3 days, and in 1991 because of heavy rainfall from late June to early July. To know principal factors influencing the bird numbers in the other Yakutia regions we need further studies.

There is some impact of ptarmigan numbers on birds of prey. Among others, two species have close relationships with Willow Ptarmigan: Gyrfalcon (*Falco rusticolus*) and Goshawk (*Accipiter gentilis*). The Gyrfalcon is known for its feeding on Willow Ptarmigan, especially in the hatching and fledging period.

Climate change also occurs in Yakutia. The climate change in the Verkhoyansk region may illustrate this (Figure 9). The lowest air temperature for Eurasia, -67.8°C, was recorded in Verkhoyansk in 1881, giving this locality the name of the "cold pole." In the end of the 19th Century, almost all stations registered the lowest temperatures in winter, while in the 20th Century air temperatures in Verkhoyansk were mostly above long-term means. However, more significant increases in air temperature occurred in the 1970s and 1990s. Winter temperature in the late 20th Century (-44 °C) was 7.5°C higher than that in the end of the previous century (-51.5°C) and 24ºC higher than the 1881 record. In recent years, mean annual temperature has also been rising (Gavrilova 2007).

Dependence between dynamics in the Willow Ptarmigan number and climate warming, in our opinion, is not strongly expressed. The decrease in number of Willow Ptarmigan in the taiga belt of Yakutia may be most likely explained by a greater anthropogenic load. However, to clarify the climate warming and ptarmigan number interactions we need further investigation.

To summarize, in Yakutia, the peak population size of Willow Ptarmigan occurs in the tundra and forest-tundra zones. Our data indicate that ptarmigan numbers did not change much in the tundra belt, while there was a sharp decrease in the taiga belt of Yakutia as compared to the published data of counts made in the 1960s. The analysis of all information indicates that

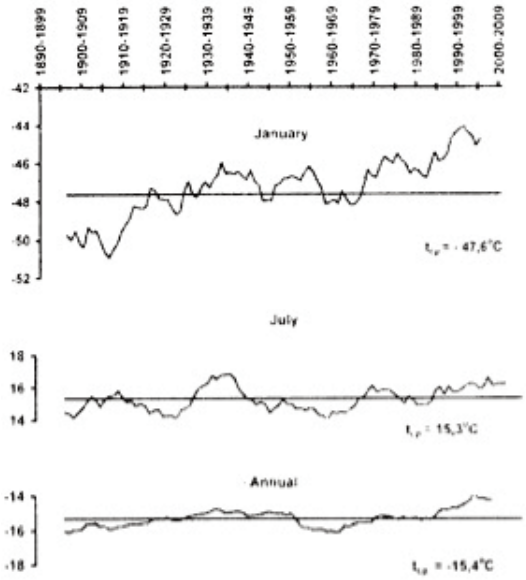

Figure 9. Sliding 10 - year average temperatures, °C, NE Yakutia (Gavrilova, 2007).

increases for Willow Ptarmigan are characteristic of the following cycles: Kolyma 9–10 yr, Verkhoyansk area 9–12 yr, and lower Lena River area 5–7 yr. In peak years, the bird density amounts to 16–17 birds/km^2 with bird occurrence up to 26 per 10-km route in some sites. Noticeable rises of Rock Ptarmigan numbers during 12–13 years were recorded in 1987-1988 and 2000-2001. In general, current Willow and Rock Ptarmigan populations in Yakutia give no reason for concern, except for central and southern areas. However, to clarify the dependence between climate warming and ptarmigan numbers we need further investigation.

Acknowledgments

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