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NUMBER AND DISTRIBUTION OF AMUR REGION HUNTING BIRDS (TETRAONIDAE) USING GIS CARTOGRAPHIC VISUALIZATION METHODS

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Abstract

This article is based on long-standing data (2013–2017), which takes into account the number of birds during the winter route census (WRC) in the Amur region, where 5 hunting types of Galliformes occur (the black-billed capercaillie, black grouse, hazel grouse, willow ptarmigan, and the common pheasant). The collected data about their numbers and density were visualized using the ArcGIS 9.3.1 (2009) software with Spatial Analyst special analysis tools. The spatial distribution of birds in biotopes in places of our research is taken into account. The main limiting factors that cause fluctuations in the abundance of these bird species are identified. Such results of censuses of hunting birds and their analysis should be used by specialized hunting and nature protection organizations, which are obliged to regulate annually hunting of trade birds and animals in the region. In addition, data on the population and hunting ceiling for the hunting birds are the basis for the rational planning and opening of the hunting season, as well as establishing the maximum percentage of game production with no harm to the population. The study of ecological and biological features of bird species is of great importance for more successful and rational organization of hunting farms: biodiversity conservation, population monitoring, organization of reproduction, biotechnical and conservation measures, forecast of the number of hunting resources for long-term planning of the economy. Thus, such a generalized analysis of the state of populations of hunting's Tetraonidae birds in the Amur region will help ornithologists and any specialists in the field of protection and use of wild animal resources to assess the current state and adaptive features of local populations of Tetraonidae. Such research is a prerequisite for predicting the number of these birds and provides a solid foundation for the development of conservation measures.

Key words: population data of birds, spatial distribution, winter route census (WRC).

Introduction

Observation of the number and condition of forest and field bird populations used for game hunting is an important basis for their rational use, since it is based on data on the number of birds that can be discovered during the hunting season within the hunting ceilings with no harm to their regional population.

The importance of these studies can hardly be overestimated, since such an expert assessment of the resources of hunting birds makes it possible to obtain the maximum number of products while maintaining populations at the level of

maximum sustainable productivity.

In general, almost everywhere in the country there are two opposing processes, reflecting the status of hunting resources of the Galliformes. Thus, interest in the hunting of forest and field birds has gradually decreased due to the phased reduction in the number of professional hunters who experience difficulties in storing, transporting and selling products in modern economic conditions.

At the same time, according to Gavrin (1965) and Romanov (1988), since the 1960s, there has been a tendency to reduce the forest and field bird reserves throughout Russia. First of all, this is due to a noticeable reduction in the total amount of land suitable for their habitat (deforestation, intensive economic use of land, and many fires), an increase in the number of hunting enthusiasts and an increase in poaching.

In Russia, the monitoring of hunting bird populations and the study of their ecological and biological features are conducted in various regions on a regular basis. Masaytis (2018) investigated the status of the black grouse in the northwest of the European part of the taiga area of Russia. He proposed to use the classification of the state of leks according to their dislocation to assess the status of the black-billed capercaillie population in spring. This approach allows us to develop a set of security measures based on the category of dislocated leks of the black-billed capercaillie and the recommended percentage of seizures of birds in hunting farms. A huge amount of material (for over 75 years) about the distribution and ecology of the black-billed capercaillie was consolidated by Bugaev (2011) in the territory of the Mordovia Nature Reserve located in the forest-steppe zone of the European part of Russia.

Borchtchevski (2017) studied the problem of the influence of spring weather and climatic conditions on Tetraonidae (for example, the capercaillie) as main limiting factor in Central Russia. According to our observations, this is also characteristic of the Tetraonidae living in Siberia and the Far East.

Barbazyuk (2017) studied the long-term dynamics of the number of the capercaillie in the Orenburg Nature Reserve in the steppe zone of the Ural under the influence of fires. All these studies confirm the results of observations of Tetraonidae birds within their habitat. For example, the decrease in the number of the capercaillie in the post-fire period is due to a decrease in the feeding capacity of habitats, and the destruction of nesting biotopes.

In Siberia, many studies have been devoted to the distribution, biology and ecology of the Tetraonidae. Since 1996, the monitoring of the population status and the biology of the capercaillie of the Yeniseyevskaya Plain (Central Siberia) has been conducted by Savchenko and Savchenko (2001, 2002) and Savchenko (2000, 2004, 2005). Kotlov (2011) studied the species composition, population density of hunting birds, hunting methods and the volumes of prey in the Altai territory.

In Baikal Siberia, according to Dorzhiev (2016), up to 13 species of Tetraonidae are registered. In Southern Baikal Melnikov (2015) noted that the main change in the population density of 3 species of the Tetraonidae (the black-billed capercaillie, the black grouse, the hazel grouse) occurs in summer. At the same time, the main limiting factor is the influence of ground predators (sable to the greatest extent). Estimation of the general population status of the hunting species of birds has fragmentary information. Recently, interesting calrifications have emerged

about the distribution of the black-billed capercaillie in the Baikal region (Gagina 2015; Melnikov 2007, 2016), which indicate an expansion of its habitat range to the west along the south of Baikal and in the Upper Lena. According to Labutin and Pshennikov (1993), in the north of Siberia under the harsh Yakut winter, the distribution of the black-billed capercaillie is associated with the habitat of the Dahurian larch due to their trophic relations.

The population status of the Tetraonidae is also monitored in the Far East (Sandakova et al. 2015, Kharchenko 2013, Biserov and Medvedeva 2016). Some Tetraonidae species require special attention due to the ecological and biological features of the species. Biserov (2011) believes that the number of Siberian Tetraonidae is underestimated in the Khabarovsk region. He proposes to revise the census method of the Siberian grouse and it offers a census time (mid-August – mid-September) and a different choice of location for determining the route where the number is calculated (old roads). The research of Nechaeva and Nechaev (2012) reflects the role of birds in the distribution of wild berry plants in the south of the Far Eastern taiga area, especially during the period of nomadic movement and migration.

Foreign researchers also actively study the status of hunting birds, the ecological features of the Tetraonidae. Currently, the systematic position of many species of the Tetraonidae is being revised, and the recent changes are reflected in work of McGowan and Bonan (2018). Researchers of genetic variability of the hazel grouse *Bonasa bonasia* populations in Poland (Rutkowski et al. 2012) and Lithuania (Riauba and Butkauskas 2012) highlight significant differences between populations. The mosaic structure of habitats, the influence of the glacial period and the subsequent distribution of the species from refugia are the main causes of variability. Some experts recognize the genetic similarity of the Tetraonidae, which are represented by the same genus. For example, Ning et al. (2016) revealed family relationships between rare and poorly studied species – blood pheasant (*Ithaginis*), snow partridge (*Lerwa*) and long-billed partridge (*Rhizothera*).

In addition to monitoring bird populations in Europe, many studies are devoted to factors that cause fluctuations in the Tetrionidae population. In Central Europe and Fennoscandia, a decrease in the number of the capercaillie and the black grouse has been observed for 80 years. Jahren et al. (2016) identified a number of causes that affect the number of these species. These are natural limiting factors (weather and climatic conditions, fires, floods, etc.), habitat degradation (deforestation, extensive agricultural land) and the hunting press. A similar pattern develops over the entire area of the Tetrionidae distribution.

Huhta et al. (2017) also believe that the Tetraonidae population in Finland is gradually decreasing. In the northern forest-steppe and southern cultivated areas, the authors studied the success of nesting of the hazel grouse. This is due to the presence of old coniferous woods and mixed forests, which is associated with the abundance of the main feed (blueberries, insects, etc.). In open and semi-open landscapes, the proportion of death of broods due to predator attacks increased. Also Torfinn (2017) notes a decrease in the number of the capercaillie and the black grouse due to the influence of birds of prey and carnivorous mammals.

Researches of Scridel et al. (2017), Hofstettera et al. (2015) and Kervinen et al. (2016) indicate the importance of for-

est area for the population of the black grouse. Within 5 years, an increase in the black grouse population was observed, in cases where new forest lands accounted for about 30 %.

The Amur region, located in the Upper and Middle Amur River, is characterized by a sharply continental climate with some monsoons, as well as an ecotonic position between the taiga of Eastern Siberia and the coniferous and broadleaved woodlands of East Asia. Here, along with a long history of development, landscape and ecological heterogeneity, mosaic pattern of habitats, there is also a mixture of various elements in the plant and animal world with a predominance of Siberian species of fauna and flora. All this stipulates the specifics of this region.

However, even though in the Amur region there are quite few publications and studies on the state of populations of hunting bird species. Some of them have fragmentary population data from a short period of research or have only fragmentary character and do not reflect completely ecological and biological aspects of this question.

The aim is to comprehensively study and analyse the population size, dynamics, and population density of the game bird Galliformes; to determine their spatial distribution in the Amur region. We also identified ecological and biological features of birds and their factors affecting the current state of populations in the ecotonic zone (Siberian taiga, coniferous, and deciduous forests).

Materials and Methods

Studies of birds conducted in the winter period from 2013 to 2017 served as the basis for this work. We analysed the number of database about 5 game species of the fowl-like birds (*Galliformes*), living on the territory of the Amur region – the willow ptarmigan *Lagopus lagopus* (Linnaeus, 1758), the hazel grouse *Bonasa bonasia* (Linnaeus, 1758), the black grouse *Lyrurus tetrix* (Linnaeus, 1758), the black-billed capercaillie *Tetrao urogalloides* (Middendorf, 1853), the common pheasant *Phasianus colchicus pallasii* (Rothschild, 1903).

In general, in Russia, the winter route census (WRC) is a method of complex census, which helps to determine the number of hunting species and animals in their natural habitat (elk, roe deer, lynx, wolf, fox, corsac fox, sable, marten, chorea, wolverine, ermine, column, squirrel, hare, wild boar, red and spotted deer), and at the same time can determine the number of hunting birds (hazel grouse, black-billed capercaillie, black grouse, common and stone grouse, Siberian grouse, willow ptarmigan, gray, rock ptarmigan, bearded (Daurian) partridges, as well as the common pheasant). The WRC is the main and mandatory type of animal resource census, which is carried out on the territory of hunting grounds and protected areas (PAs) (with the exception of federal PAs) throughout the territory of the Russian Federation. Annual census of game animals and birds is carried out by the WRC method (Mirutenko et al. 2009), which allows to simultaneously receive the most complete and reliable picture of the number of animals and birds on fairly large areas.

The WRC is carried out on special routes from 15 January to 25 March in the presence of snow cover. The location of the ground route is one of the driving factors that affects the objectivity and completeness of the data collected during the WRC. Due to this, the organizers follow

strict rules governing the selection and collection of data.

According to the method of conducting the WRC, routes are laid in all categories of land: forest, field, and swamp. It must be at least 5 km long but not more than 15 km long. There should be at least 7 route censuses in the study area. Routes can be unidirectional or non-unidirectional, as well as closed (length of at least 10 km). If the route census is not unidirectional, then the change of the vector (direction) of the route census must be planned at an angle of not more than 90° to the previous vector (direction) of the route census segment.

Routes should not intersect between each other and should be located at least 200 m from feeding stations, mineral licks (salt licks), and residential buildings.

In the forest, the route censuses or part of it should not run through linear objects with a width of more than 5 m (for example, glades, roads and railways, power lines, watercourses, and ravines), as well as along them at a distance closer than 100 m. In mountainous areas, the route censuses are lay along watercourses, slopes of valleys and water gaps.

The length of all route censuses within each category of lands (forest, field, and swamp) have to be proportional to their areas, but not less than the extent determined by the following formulas:

$$DL_{forest} = \frac{DL \times S_{forest}}{S},$$

$$DL_{field} = \frac{DL \times S_{field}}{S},$$

$$DL_{swamp} = \frac{DL \times S_{swamp}}{S},$$

where:

DL_{forest} – the length of all route censuses for the group of category of lands 'forest', km;

DL_{field} – the length of all route censuses for the group of category of lands 'field', km;

DL_{swamp} – the length of all route censuses for the group of category of lands 'swamp', km;

S_{forest} – an area of the group of category of lands 'forest', ×1000 ha;

S_{field} – an area of the group of category of lands 'forest', ×1000 ha;

S_{swamp} – an area of the group of category of lands 'forest', ×1000 ha.

In general, the location of the route on the ground is one of the important factors that affects the objectivity and completeness of the data about the number of birds as a result of the winter route census. However, there are some drawbacks during the winter route census. The extreme winter conditions, like deep snow, low temperatures, and strong wind, which are especially harsh at the end of winter, force the birds and animals to stay in one specific location, such as glades, overnight locations, places of feeding, and otherwise, and to have short daily activity. Therefore, some birds are not encountered by the registering devices on the route due to the inaccessibility and remoteness of such areas of their concentration from the WRC routes.

The conditions and methods of the winter route census. Registration of animals is carried out on each route censuses over the course of two days. During the WRC, the route and population data are recorded using electronic tracking on a GPS device.

On the first day of the census, the animal trace recorder goes on the planned route and marks the land category boundaries on the GPS. Also the animal trace recorder removes old traces of animals on the snow, so that on the second day of the

census he would be able to register the traces that appear on this route and the number of animals that cross it.

During the passage of the route, the recorder registers each sighting of birds (bird species, number of birds, the distance from the recorder to the centre of a group of birds or a single bird, and the land category of where the birds were found). At the same time, the birds that have flown up from behind the recorder and have been seen flying are not recorded.

Rules on how to conduct the WRC's forbid doing the census in the dark, snowstorms, snowfall, in hard or dense snow (as animals do not leave tracks or tracks left by the animal cannot be identified).

If the weather changes and worsens during the census, then the census is finished. Only after the weather conditions improve, the census can restart from the beginning.

Counting and determining the number of animals and birds. The registered number of each bird species in the corresponding land categories in the study area is calculated by the following formula:

$$Z_{ru} = P_{ru} \times Q_{ru},$$

where:

Z_{ru} – is the number of individual birds of each species in the corresponding land group in the study area;

P_{ru} – is the population density of each bird species in the respective land group in the study area, birds/1000 ha;

Q_{ru} – is the area of each of the land categories in the study area, divided by 1000 ha.

Thus, to calculate the number of birds, two primary criteria are used – the number of bird encounters on the route and the conversion factor for each bird species by land category (Ravkin and Chelintsev 1990, Chelintsev 2000).

The population density of each bird species in the corresponding land category in the study area is calculated by the following formula:

$$P_{ru} = F_{ru} \times k_u,$$

where:

F_{ru} – is the index of census of each bird species in the corresponding land category in the study area;

k_u – is the conversion factor for each bird species in the corresponding land category (calculated for an individual subject of the Russian Federation).

$$F_{ru} = \frac{\sum_j^{M_r} Y_{ruj}}{E_{ru}} \times 10,$$

$$E_{ru} = \sum_j^{M_r} E_{ruj},$$

where:

Y_{ruj} – is number of individual birds registered on the part of the census route, passing in the corresponding land in the study area;

E_{ru} – is the overall index of the lengths of all routes in the census in the study area passing in its land category in kilometres;

E_{ruj} – is the doubled length of the portion of the route passing in the corresponding group of land categories in the study area in kilometres.

Conversion factor for each bird species in the corresponding group of land categories (calculated for an individual subject of the Russian Federation) by the following formulas:

$$k_u = \frac{500}{B_u}, \quad B_u = \frac{G_u}{\sum_i^{Tu} \frac{G_{ui}}{R_{ui}}}, \quad G_u = \sum_i^{T_u} G_{ui},$$

where:

B_u – the average distance from the recorder to the centre of a group of birds or a single bird in the corresponding land category of an individual subject of the

Russian Federation in meters;

i – is the number of sightings of the bird species;

R_{ui} – a distance from the counter to the centre of a group of birds or a single bird for each sighting in the corresponding land category in meters;

G_{ui} – the number of birds found in the for each sighting in the corresponding land category;

G_u – the total number of birds found in the corresponding land category of an individual subject of the Russian Federation;

T_u – the total number of sightings of the bird species in the corresponding land categories of an individual subject of the Russian Federation.

To calculate the accounting index (F_{ru}) of each animal and bird species, the actual length of the route census should be used. The index is the length of each part of the route in the group of land categories which is based on the GPS device's data.

In addition, we used 2 criteria of population density – the average and ecological density. Thus, the average density is the number of a species relative to a unit of the entire space of the area under research. Ecological density is the number of a species relative to a unit of habitable space of accessible area on a suitable land, which may be occupied by the population in reality.

The visualization of the spatial distribution of hunting birds was carried out by the cartographic method using GIS technologies. Thus, the data on the number of birds were obtained on the basis of the processed GPS tracks and primary registration data (the number of encounters of hunting bird species on census routes) recorded by people performing the work. Computer processing of the census data and mapping of routes on which the surveys were carried out was made with ArcGIS 9.3.1 software with the Spatial Analyst spatial analysis tools (ArcGIS 9.3.1 2009).

Based on the route population data, the density is estimated and the geo-analysis is required to build a map for the visualization of the population density of hunting birds (figs 1–3). Density criteria (high, medium, low) are displayed on the map with intensity of colouring of conventional colour variances.

A large amount of registration data is accumulated in the form of tables and is constantly accompanied by mathematical processing for their analysis. At the same time, cartographic visualization significantly improves the perception of the processed material and visually displays the registration data. This is necessary for the rational regulation of territories since it permits or prohibits the hunt for birds, and also determines the size of the hunting ceilings for specific places. Such cartograms help to reveal the hidden features of the dynamics of the spatial distribution of animal resources and their annual reproduction.

Study area. The Amur region total area is 363,700 km^2. It is part of the natural geographic area of the Upper and Middle Priamurye, which has an ecotonic position between two large geographic zones – Siberian taiga with sharp continental climate and coniferous and deciduous forests of East Asia with humid monsoonal climate.

The study area is located south of the Stanovoy Range to the Amur River. The eastern border runs from the ranges of the Small Khingan and Turan and reaches the headwaters of the Nyukzha River in the west. The main part of the Amur region is occupied by the basins of the left confluents of the Amur River – Oldoy, Zeya,

Selemdzha, Arkhara and the lower part of the Burei River.

From the point of view of orography, the field of study has a mountain character. The mountains are mostly of medium height and are located along the northern and eastern perimeters of the region. The Stanovoy Range (the average absolute height is about 1500 m, the maximum height is up to 2414 m) is an extensive mountain system in the north of the Amur region, which has steep southern slopes within the region. The main ridge of mountains consists of crystalline schists, gneisses and granites and has a smooth surface destroyed and dissected by geological processes that took place on the ridge during long geological eras and a series of ancient glaciations. Many mountain peaks are treeless, with sharp peaks, with alpine meadows at the upper boundary of the forest and littered with small rivers feeding on water from melting snow. The Dzhukdyr Ridge (up to 2107 m) is located to the east of the Stanovoy Range, it is similar in geology, its peaks and slopes are even more treeless.

From west to east in the middle part of the Amur region, for 1,200 km stretches the system of medium-altitude ridges called Yankan-Tukuringra-Soktakhan-Dzhagdy. On the eastern border of the region, the Turan Ridge and the Yam-Alin Ridge, connected by the wide Aesop Ridge, are meridional. In the western part of the region there are many small ridges of medium height.

Plains (about 55 %) stretch to the southeast (Zeya-Bureya plain) and central regions. (Amur-Zeya and Upper Zeya plains). The Zeya-Bureya plain (total area is about 4 million hectares) is located east of the Zeya and Selemdzha rivers at an altitude of 200–300 m above sea level in combination with lowlands (less than 200 m). The plain consists of horizontally deposited layers of sand and loam, and there is a significant increase in its surface from southwest to northeast. The wide valleys of the rivers carve the plain, carrying water into the basin of the Zeya and Amur rivers.

At present, the surface of the Zeya-Bureya plain is highly susceptible to anthropogenic impact, which has contributed to the emergence of vast forests (only about 2 % of the forest area) and agricultural land. This contributes to an increase in the number of ravines and soil erosion. In some areas of opencast brown coal mining, barren sand hills and heaps appeared.

The Amur-Zeya plain (total area is about 4.5 million hectares) stretched 400 km north of the Zeya-Bureya plain to the Tukuringa – Soktakhan ridge, its length from the east (from the Zeya and Selemdzha river valleys) to the west to the low-hill terrain in the basin Urkana River is about 300 km.

The surface of the Amur-Zeya plain has a high (absolute altitude – 300–400 m) and hilly nature. In the lowlands of the plains there are numerous boggy areas. In the west and south of the plain a dense network of ravines is developed. Agricultural fields and some forests are located mainly in the south.

The upper part of the Zeya plain (total area is about 1 million hectares) is located in the intermountain subsidence in the upper part of the Zeya river valley. Currently, up to 240 thousand hectares of plain are occupied by the reservoir of the Zeya hydroelectric station, and the rest of the territory is covered with numerous boggy areas and residual hills.

In the Amur region there are many swamps (total area is 13 million hectares) and marshes, which are concentrated in

lowland and mountainous areas. They are formed due to the abundance of summer precipitation and low average annual temperatures. Thus, moss bogs dominate in the upper part of the Zeya plain and sedge swamps – on the Zeya-Bureya plain (between the Bureya and Arkhara rivers), in the foothills of the Lesser Khingan, in the middle part of the Zeya River and Upper Amur.

The territory of the Amur region combines contrasting climatic, orographic, and hydrographic features that determine the specific characteristics of the flora and fauna of the region.

Results and Discussion

On the territory of the Amur region, there are only 7 representatives of the fowl-like birds (Galliformes, Temminck, 1820). Of these, 2 species (*Falcipennis falcipennis*, Linnaeus, 1758 and *Perdix dauurica suschkini*, Poliakov, 1915) are listed in the Red Book. The remaining 5 types of fowl-like birds are game species – 4 species of forest birds (*Lagopos lagopus*, Linnaeus, 1758; *Bonasa bonasia*, Linnaeus, 1758; *Lyrurus tetrix*, Linnaeus, 1758; *Tetrao urogalloides*) and 1 species of field wild fowl – the common pheasant *Phasianus colchicus pallasii,* Rotschild 1903.

1. The black-billed capercaillie (*Tetrao parvirostris*, Bonaparte, 1856) – a common nesting nonmigratory species.

Distribution. The black-billed capercaillie is common in the forest zone of Eastern Siberia and the Far East. Within the Amur region, the species occupies one of the extreme southern regions of its habitat (Stepanyan 1990), which coincides with the distribution area of the Dahurian larch (*Larix gmelinii* (Rupr.) Rupr.), mixed forests with a predominance of coniferous species (the Dahurian larch, the Scots pine (*Pinus sylvestris* L.), the Siberian pine (*Pinus sibirica* Du Tour), the creeping pine (*Pinus pumila* (Pall.) Regel), the Siberian spruce (*Picea obovata* Ledeb.).

Forests of the northern (Tynda, Zeya and Skovorodino districts) and central (Magdagachy, Shimanovsky, Selemdzhinsky, Mazanovsky, Romny districts) areas of the region have the greatest importance in the Amur region for the black-billed capercaillie – larch, pine, small-leaved mixed forests, where most of the species lives. Here, the main limiting factors for the spread of capercaillie are the presence of dark coniferous taiga (spruce and fir forests) and forests that make formations along the slopes of the highlands.

As we move to the south of the Amur region, the population of the capercaillie becomes much smaller, the species is specifically absent in the south-west of the region (Fig. 1). As one moves from the south of the Amur-Zeya Plain to the forest-steppe zone of the Zeya-Bureya Plain, the black-billed capercaillie becomes a rare sporadic species. This is due to the fact that it avoids huge open spaces, and the flat territory is greatly transformed by agricultural activities. The remaining small, untouched areas do not have favourable conditions – these are islets of the forest in the fields or broad-leaved forests, which it does not inhabit.

The best forage and nest places for the black-billed capercailie are various types of forests with larch, as well as with pine, which provide an abundance of vegetable and animal feed, especially in winter. The most important are mixed larch forests interspersed with marshes with crowberry and places where young larch grows in combination with blueberries and lingonberries.

In the Amur region, the main part of the population of the black-billed capercaillie is concentrated in 4 districts located in the coniferous forest zone – from the north of the region to the east-central districts – these are Tynda, Zeya, Selemdzhinsky and Mazanovsky districts. A rather high number of the black-billed capercaillie is concentrated on good land with coniferous deciduous forest (larch forests), mixed forest with a predominance of coniferous species, as well as alluvial areas with a predominance of forest.

Population. During the winter route census, data on the number and distribution of the capercaillie are rather relative (due to an accidental underestimation or overestimation of their number). This is due to the fact that in winter, the black-billed capercaillie distributes in groups, which creates the effect of uneven settlement throughout the habitat, and the census routes often lie aloof from the main foci of the black-billed capercaillie, which either do not get into the census tables or, otherwise, are found in large groups.

In general, in the Amur region, the average number of the black-billed capercaillie for 5 years (according to the 2013–2017 survey data) was 85,499, and the area of land occupied by the species was 13,349.61 thousand hectares (Table 1).

Table 1. The average number and relative density of the population of the black-billed capercaillie (*Tetrao parvirostris*), and its spatial distribution by administrative areas of the Amur region (2013–2017).

Administrative distric	Arkhara	Belogorsky	Blagoveshchensky	Bureya	Zavitinsky	Zeya	Ivanovsky	Konstantinovsky	Magdagachy	Mazanovsky	Mikhailovsky	Oktyabrsky	Romny	Svobodny	Selemdzhinsky	Seryshevo	Skovorodino	Tambov	Tynda	Shimanovsky	Total in the region
The area of district, 10^3 ha	1,440	260	310	710	330	8,750	270	180	1,480	2,830	300	340	1,010	730	4,670	380	2,050	250	8,330	1,460	**36,190**
The area of land suitable for habitat, 10^3 ha	106.76	-	-	197.18	21.06	4,695.32	-	-	262.70	1,189.72	-	-	359.38	-	2,158.35	-	281.22	-	4,031.74	46.18	**13,349.61**
The average number by administrative areas, individuals	2,810	-	90	335	13	16,229	-	-	2 ,599	10,045	-	-	2,141	-	12,917	7	4,302	-	33,493	516	**85,499**
The relative density of the population of the species from S land suitable for habitat, individuals, 10^3 ha	26.32	-	-	1.70	0.61	3.46	-	-	9.90	8.44	-	-	5.96	-	5.98	-	15.30	-	8.31	11.17	**6.40**
The relative density of the species population from S district, individuals, 10^3 ha	1.95	-	-	0.47	0.04	1.85	-	-	1.76	3.55	-	-	2.12	-	2.77	-	2.10	-	4.02	0.35	**2.36**

On the whole territory of the Amur region the number of the black-billed capercaillie amounts to 2.36 per 1000 hectares, and the ecological density of the species from the area of suitable land is 6.40 per 1000 hectares.

The largest part of the black-billed population in the region is concentrated in 4 districts (72,684, which is 85 % of the population) – these are Tynda (33,493 individuals), Zeya (16,229 individuals), Selemdzhinsky (12,917 individuals) and Mazanovsky (10,045) (Table 1). At the same time, the population density of the black-billed capercaillie here is not quite large. Although this is a huge area of the administrative district itself, there is almost no suitable land at all. For this reason, the ecological density of the black-billed capercaillie varies from 1.85 per 1000 hectares (Zeya district; 4,695.32 thousand ha of usable land) to 4.04 per 1000 hectares (Tynda district; 4,031.74 thousand ha of usable land) (Table 1).

Lower population density of the capercaillie is observed in areas with medium-quality lands with the presence of mixed forests with a predominance of small-leaved species and alluvial natural complexes with mixed and deciduous forests – in Bureya district (1.70 birds per 1000 ha), Zavitinsk (0.61), Romny (5.96), etc.

Limiting factors. The fluctuations in the number of the black-billed capercaillie are quite significant and the instability is associated with a number of unfavourable factors of weather, climate and nature in different seasons of the year.

In winter, the birds migrate in search of food, since the capercaillie-holding grounds are of a mosaic nature. Young birds become very vulnerable when it is cold in autumn and winter, especially birds infected with worms, which make up a significant proportion of dead birds. Epizootics can lead to a catastrophic state of the capercaillie. In addition, heavy snowfalls in winter a have a negative effect on birds; they hide available food, reducing the feeding capacity of habitats. Periodically during the winter, food and stomach stones hide under a snow crust (ice crust) and become completely inaccessible to birds.

To a large extent, the reduction in the number of the black-billed capercaillie occurs during the breeding season in spring. The appearance and development of young individuals during prolonged rains, when it is damp and the air temperature drops sharply, night frosts and repeated cold snaps during the day. During this period, insects that are few during the cold spring are particularly important food for nestlings. Different abiotic factors often negatively affect birds that have not yet reached puberty (the ability to reproduce occurs in males from the 3rd year of life, and in females from the 2nd year).

In addition, natural and anthropogenic fires have strong influence in the spring, worsening the food supply of birds. Especially, this is expressed in forests with pronounced pyrogenic dynamics. Fires lead to low yields of basic forage berries (blueberries, lingonberries, blackberries) and green and woody fodder. In addition, in spring (May-June) large-scale and long-lasting forest fires lead to a massive death of egg-layings and nestlings in a large area.

The main natural enemies of the black-billed capercaillie (for adult birds, young stock and egg-layings) are the northern goshawk, the Eurasian eagle-owl, the fox, the raccoon dog, small representatives of the Mustelidae – ermine, marten, and the Siberian weasel. A strong impact on the population of the capercaillie has

predation of the sable, because this bird becomes an important food for it in years when the numbers of rodents is low.

The main anthropogenic negative impact, which reduces the leks of the capercaillie and thereby worsens the biotope are logging, fires, and the destruction of the berries during the mass gathering leads to a decrease in forage reserves in the habitats of the capercaillie, etc.

Using. In the Amur region, the black-billed capercaillie procurement was ceased long ago. Hunting for the black-billed capecaillie is not very popular. In the northern areas, hunters traditionally prefer to hunt larger objects. In the central parts of the region, the hunt for the black-billed capercaillie becomes a difficult task for hunters due to the remoteness from the bird's habitats. The features of the biology of the bird itself also create difficulties for hunters (leks are difficult to access, large areas are privately owned, most leks are located on the ground, and the shortness of the song during spring mating games makes the hunt ineffective. Therefore, the black-billed capercaillie often becomes an additional prey, and amateur hunters use the black-billed capercaillie only for personal consumption. Commercial hunters often use the bird to catch sable.

2. The black grouse (*Lyrurus tetrix*, Linnaeus, 1758) – the common nesting nonmigratory species.

Distribution. The black grouse inhabits almost all of the northern Palearctic forest belt, in the south it flies deep into the forest-steppe zone, and into the steppe and even, as in the north of Kazakhstan, into semi-desert zones in some parts of its habitat (Stepanyan 1990).

The black grouse is a typical inhabitant of the taiga zone in the Amur region, where coniferous evergreen forests, mixed forests with a predominance of coniferous species and a forest with shrubs in the alluvial areas of the rivers have the greatest significance for the species. Such habitats of the black grouse are found on the territory of the northern districts of the region – Tynda, Skovorodino, Zeya – and central districts – Magdagachy, Mazanovsky (Fig. 1).

At the same time, the black grouse avoids dense areas of dark coniferous taiga (spruce and fir forest), high-altitude areas in the north and northeast of the region, and also larch forests along the slopes of mountain ranges. The distribution of the black grouse is sporadic due to large areas of larch marshes, which the bird avoids. Therefore, in areas where such places are frequent, the black grouse population density drops sharply, even if there are lands that are characteristic for the species and even places of better quality. Thus, in the Selemdzhinsky district (4,670 thousand hectares) a rather extensive territory is occupied by larch, which grows in marshy lands. The area of suitable habitats for the grouse is only 83.71 thousand hectares, and its population density is 72.35 thousand birds per 1000 hectares. The bird population density is presented in the form of clusters (Table 2). Most of the birds we found are in small deciduous forests with lingonberries, alternating with blueberries and bushy marshes.

Population. Over the past 5 years, in the Amur region, the average number of black grouses was 81,242 individuals, and the area of inhabited land – 9,571.4 thousand hectares (Table 2).

The main part of the black grouse population is concentrated in the forest zone of the central and northeastern part of the Amur region – these are 4 districts – Tynda (16,644 birds), Mazanovsky (13,148 birds), Zeya (9,191 birds) and Magdagachy (8,548 birds) (Table 2). They ac-

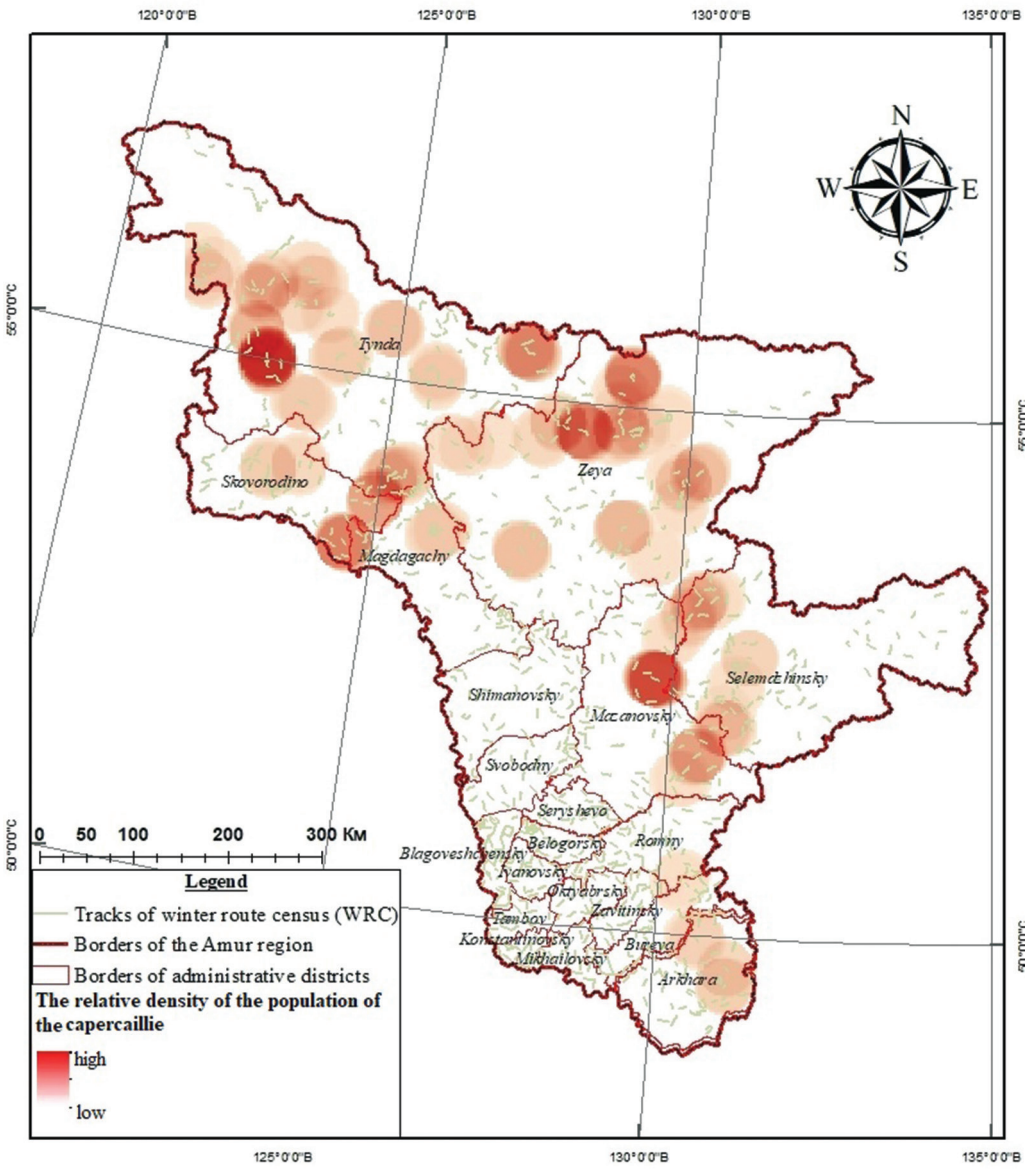

Fig. 1. The relative density of the population of the capercaillie by the number of encounters on the winter route recorded on the Amur region.

count for 47,531 black grouses (58.5 % of the total black grouses in the region). We want to note that in the Tynda district the grouse population is distributed sporadically, and the increase in the number of birds in some years is associated there with a general increase in the bird population, the activity of their migrations and mass arrivals from neighbouring regions, and this is a common pattern.

Table 2. The average number and relative density of the population of the black grouse (*Lyrurus tetrix*), and its spatial distribution by administrative regions of the Amur region (2013–2017).

Administrative district	Arkhara	Belogorsky	Blagoveshchensky	Bureya	Zavitinsky	Zeya	Ivanovsky	Konstantinovsky	Magdagachy	Mazanovsky	Mikhailovsky	Oktyabrsky	Romny	Svobodny	Selemdzhinsky	Seryshevo	Skovorodino	Tambov	Tynda	Shimanovsky	Total in the region
The area of district, 10^3 ha	1,440	260	310	710	330	8,750	270	180	1,480	2,830	300	340	1,010	730	4,670	380	2,050	250	8,330	1,460	**36,190**
The area of land suitable for habitat, 10^3 ha	402.93	80.19	235.38	381.98	292.51	494.10	-	-	1,583.32	1,329.62	241.86	196.17	419.93	705.16	83.71	249.11	1,538.08	-	-	1,337.39	**9,896.45**
The average number by administrative areas, individuals	2,375	1,502	1,386	569	422	9,191	-	-	8,548	13,148	-	-	9,466	2,359	6,056	321	1,959	-	16,644	7,295	**81,242**
The relative density of the population of the species from land suitable for habitat, individuals /10^3 ha	5.89	18.73	5.89	1.49	1.44	18.60	-	-	5.40	9.89	-	-	22.54	3.35	72.35	1.29	1.27	-	-	5.45	**8.21**
The relative density of the species population from S district, individuals /10^3 ha	1.65	5.78	4.47	0.8	1.28	1.05	-	-	5.8	4.65	-	-	9.37	3.13	1.30	0.84	0.96	-	2.00	5.00	**2.24**

For mixed and small-leaved forests in the Shimanovsk district, the black grouse numbers are 5.45 birds per 1000 hectares, but their population density decreases in areas to the west, and in the Shimanovsk district their number is already 1.27 birds per 1000 hectares.

In the north and northeast of the Amur region, the mountain ranges of the Zeya district limit the spread of the black grouse. The map with relative density of the population of the black grouse can be seen on Figure 2. The black grouse was found in the village of Fevralsk in the Selemdzhinsky district (72.35 birds per 1000 hectares), as well as from the village of Norsk to the river Byssa and along the valley of the river Selemdzha. In the basins of the Tashina and Gorbyl rivers in the Romny district it is 22.54 birds per 1000 hectares.

In the south of the Amur region the black grouse is found only in 8 districts (out of 13 administrative districts). This is due to the fact that the black grouse avoids the vast open spaces that in the south are present in the large Zeya-Bureya plain, which has been greatly transformed by agricultural activities.

In the southeast of the region, the black grouse avoids cedar broad-leaved forests and open spaces of the Amur-Zeya plain. Thus, the Selemdzhinsky district has the total suitable area of 83.71 thousand hectares, where there are up to 6,056 black

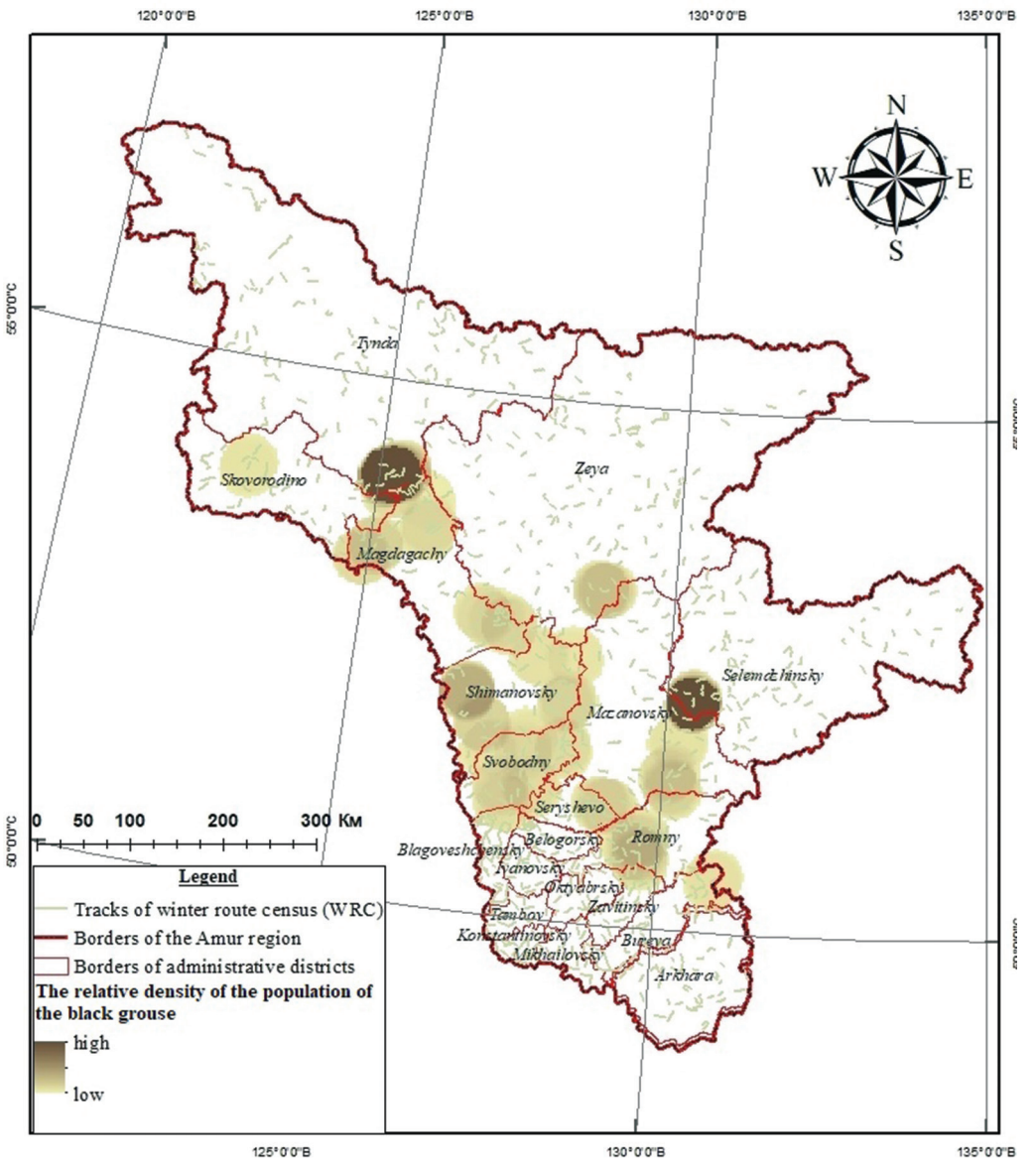

Fig. 2. The relative density of the population of the black grouse by the number of encounters on the winter route recorded on the Amur region.

grouses (72.35 birds per 1000 hectares). On the territory of Oktyabrsky, Zavitinsky, Bureisky and Seryshevo districts, the black grouse is distributed very unevenly.

To date, the number of the black grouse tends to decrease. At the same time, according to the data of the 50–60 years of the last century, it is known that the number of the black grouse was hundreds of times higher and since the beginning of the 60s numbers have declined sharply. The reasons for the reduction of the black

grouse population in the Amur region are unclear (possibly due to rare epizootics, Newcastle disease (chick fever) or the massive treatment of forests with DDT).

Limiting factors. All factors limiting the number of the black-billed capercaillie are also valid for the black grouse. Additionally, the increased number of the Northern goshawk, high floods in the bottom of the Amur River and extensive forest fires should be noted. In addition, the proximity of the black grouse habitats to settlements contributes to a high probability of the spread of Newcastle disease, which is registered with domestic pigeons. The number of birds hunted by the hunters does not affect the black grouse population because the impact is insignificant.

Using. The situation for the black grouse in the Amur region has a tendency common to the whole country. In the last century, hunting for the black grouse was popular (including lek hunting). During their autumn feeding in flocks, birds were shot from small-caliber rifles. They are hunted up close on snowmobiles and other vehicles with off-road capabilities. Now there was a very strong decline in the interest to the black grouse. As the statistics of previous years shows, when the black grouse hunting was popular in the northern and central regions of the Amur region, the reserves in the forests of birds were not exhausted. It was regulated only by abiotic and natural biotic factors. In the southern areas, the black grouse population was exterminated by hunters and the anthropogenic impact was significant. In general, more black grouses are hunted compared to those that are registered. But there are no data about the number of birds being hunted down due to restriction for hunting as the population of the black grouse declined everywhere.

3. The hazel grouse (*Tetrastes bonasia*, Linnaeus, 1758) **–** a common nesting nonmigratory species.

Distribution. In the Amur region this is the most numerous representative of upland fowl. The hazel grouse dwells in the region almost everywhere, with the exception of the Zeya-Bureya Plain, where the largest agricultural fields are located (in the Belogorsky, Ivanovsky, Konstantinovsky, Mikhailovsky, Oktyabrsky and Tambovsky districts).

The hazel grouse is distributed over all territories of the Amur region with forests, but its distribution is extremely uneven. In the southern part of the region, it is most numerous in cedar broad-leaved and broad-leaved forests. The hazel grouse in the central regions (mainly agricultural fields) is found (rarely or very rarely) in forests of various types that border on arable land and fields, as well as in fir forests between agricultural fields. And, especially, the species becomes rare in areas where oak forests are concentrated.

The highest population density is in the taiga zone of the northern parts of the Amur region. Here, the hazel grouse prefers to inhabit small-leaved forests, grassy and shrub larch forests and pine forests, of which it densely inhabits the cowberry and blueberry ones. The hazel grouse becomes common in forests with alder undergrowth. In the upper reaches of the river, it gives preference to the alluvial complex, where it concentrates on willow islands.

The hazel grouse avoids vast wetlands (marshes, swamps, flood plains) and, in general, any open areas, including treeless peaks of ridges.

Population. The total area of land in the region, suitable for the hazel grouse, is 21,416.3 thousand hectares. The map with relative density of the population of the hazel grouse can be seen on Figure 3.

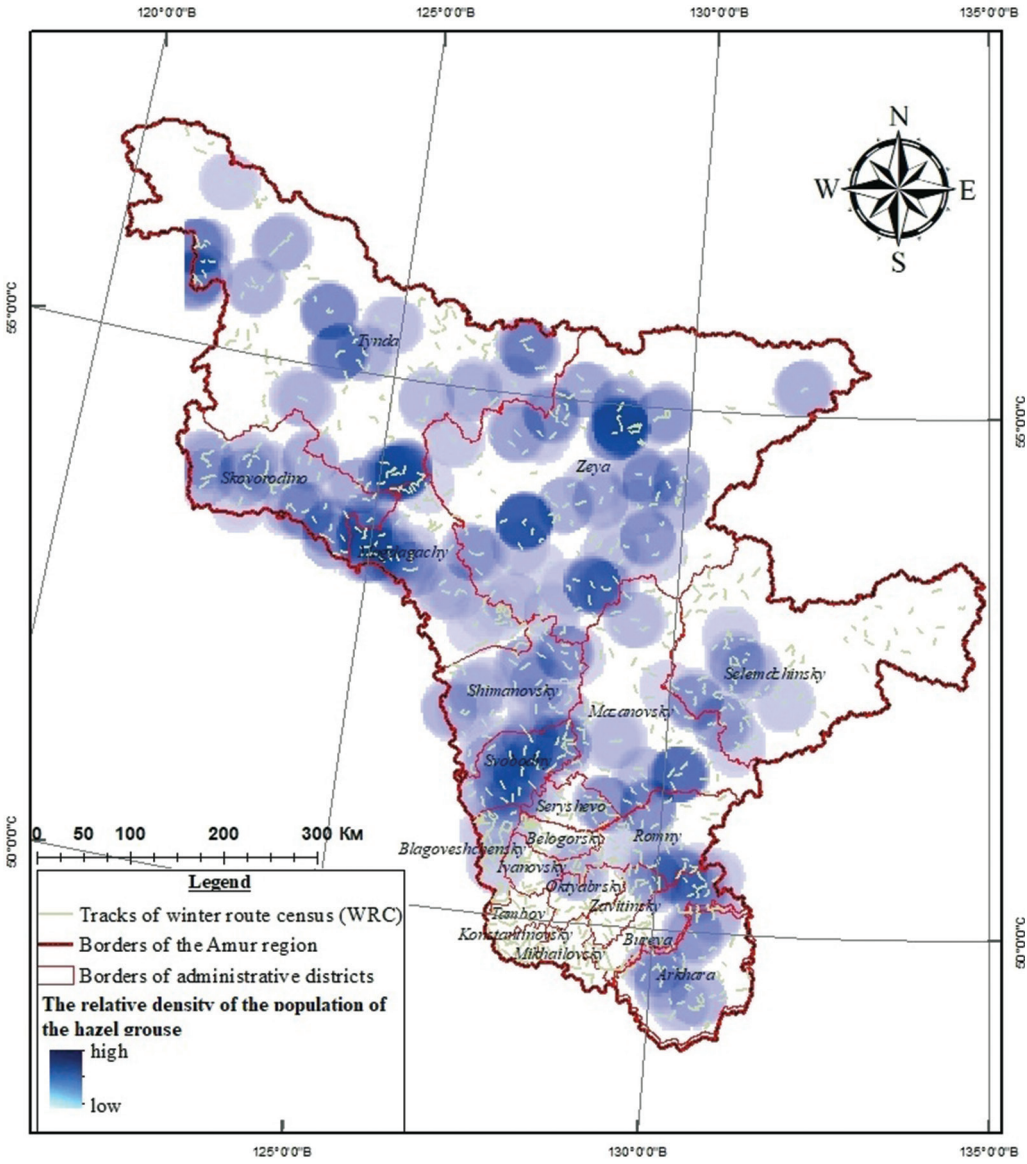

Fig. 3. The relative density of the population of the hazel grouse by the number of encounters on the WRC routes in the Amur region.

During the WRC of animals in the Amur region, the main census of the hazel grouse is carried out. Due to the ecological preferences of this species, significant errors may occur during the counting of the bird number. The hazel grouse in winter prefers to form concentrations along the floodplains of the rivers, and thus the contours of its distribution sites take on the ribbon-like character. This fact later leads

to frequent errors during the extrapolation of registration data obtained on routes or sites.

The number of the hazel grouse is a very dynamic phenomenon; it is determined by the natural conditions during the breeding season. In the Amur region, according to figures obtained from all regions annually, the number of grouse in the last decade amounts to 938 thousand birds, and in some years with favourable weather and climatic conditions, the number can be twice as high.

After analysing these data and comparing them with neighbouring regions, we came to the conclusion that in the Amur region the hazel grouse has a low population density of 13.85 birds per 1000 hectares, and the environmental density of the hazel grouse is 23.41 birds per 1000 hectares from the area inhabited in nature (Table 3).

Table 3. The average number and relative density of the hazel grouse (*Tetrastes bonasia*), and its spatial distribution by administrative regions of the Amur region (2013–2017).

Administrative district	Arkhara	Belogorsky	Blagoveshchensky	Bureya	Zavitinsky	Zeya	Ivanovsky	Konstantinovsky	Magdagachy	Mazanovsky	Mikhailovsky	Oktyabrsky	Romny	Svobodny	Selemdzhinsky	Seryshevo	Skovorodino	Tambov	Tynda	Shimanovsky	Total in the region
The area of district, 10^3 ha	1,440	260	310	710	330	8,750	270	180	1,480	2,830	300	340	1,010	730	4,670	380	2,050	250	8,330	1,460	**36,190**
The area of land suitable for habitat, 10^3 ha	783.11	0.58	155.52	383.97	110.88	5,841.56	-	-	1,273.61	1,288.76	2.07	31.34	482.40	459.24	3,204.71	39.84	868.11	-	5,530.12	960.52	**21,416.3**
The average number by administrative areas, individuals	18,980	-	4,151	8,888	1,584	122,038	-	-	34,303	44,762	-	-	8,865	29,637	37,807	469	22,998	-	142,893	23,964	**501,333**
The relative density of the population of the species from land suitable for habitat, individuals, 10^3 ha	24.24	-	26.69	23.15	14.29	20.90	-	-	26.93	34.73	-	-	18.38	64.53	11.80	11.77	26.49	-	25.84	24.95	**23.41**
The relative density of the species population from district, individuals, 10^3 ha	13.18	-	13.39	12.52	4.80	13.95	-	-	23.18	15.81	-	-	8.78	40.60	8.10	1.23	11.22	-	17.15	16.41	**13.85**

Most part of the hazel grouse population is 342,500 birds, representing 69.3 % of the total population in the region. It is concentrated in the northern and north-eastern parts – Zeya (122,038 birds), Tynda (142,893 birds), Mazanovsky (44,762 birds) and Selemdzhinsky (37,807 birds) administrative districts. Here we must take into account the fact that these northern districts have very large areas, therefore, by extrapolating the numbers obtained on the route, the hazel grouse density is

reduced. Thus, the ecological density of the grouse population ranges from 11.80 birds per 1000 hectares (Selemdzhinsky district, 3,204.71 thousand hectares of useful land) to 34.73 birds per 1000 hectares (Mazanovsky district, 1288.76 thousand hectares of suitable land) and 20.90 birds per 1000 ha (Zeya district, 5841.56 thousand hectares of suitable land). Here we need specific correction factors.

In agricultural areas without forests, located on the territory of the Zeya-Bureya plain, the hazel grouse is distributed sporadically (in the Bureya district – 23.15 birds per 1000 hectares, in Arkhara district – 24.24 birds per 1000 hectares). Probably, in some places there are narrow-local habitats (14.29 birds per 1000 hectares). There are a lot of such places in Zavitinsk district. The hazel grouse does not inhabit such areas as Belogorsky, Ivanovsky, Konstantinovsky, Mikhailovsky, Oktyabrsky, Romny and Tambov districts (Table 3, Fig. 3).

Limiting factors. All the factors that do not allow a high number of the Galliformes affect the grouse too. These are weather and climatic conditions during the breeding season. The most significant factor is the long and cold spring with high humidity. It leads to mass death of nestlings due to a lack of feed and an abundance of diseases.

Invasive and viral diseases, which often take on the character of epizootic diseases, are of particular negative significance for the hazel grouse. Also predators, especially sable, Siberian weasel, Northern goshawk, tawny owl, etc., cause significant damage to the grouse population.

Using. Currently, there is no mass hunting of the hazel grouse by professional hunters, and amateur hunters get birds for personal use (for culinary dishes, for use as bait for catching sable). Although in the 1950s and 1960s hunting for the hazel grouse was quite popular among commercial farms – the birds were received at special points and the planned target numbers for hunted birds were strictly controlled.

Nowadays, hunting for the hazel grouse is practically popular and is mainly conducted in the autumn with a whistle and on the roads. A more popular alternative in the autumn is waterfowl hunting.

4. The common pheasant (*Phasianus colchicus pallasi*, Rothschild, 1903) – the common nesting nonmigratory species.

Distribution. The common pheasant is a subspecies that lives on the northernmost border of the distribution range of the entire species. In the Amur region the pheasant occupies the valley of the Amur River and prefers open spaces like sparse forest, fields and meadows.

In the agricultural areas of the southern, southeastern and central parts of the Amur region there are lots of the common pheasant. This species is sporadically distributed from the central parts of the region to the north within the Amur-Zeya plain. It is absolutely absent in the very north of the region – these are the southern spurs of the Stanovoi Ridge. The northern harsh wintering conditions stop the common pheasant from settlement and expansion of its range. The common pheasant does not live in the 5 northern districts – Zeya, Magdagachi, Selemdzhinsky, Skovorodino, Tynda. Although, in some favourable years, rare birds were recorded in the south of the Zeya district (flocks of up to 190 birds) and Magdagachi district (up to 410 birds).

Thus, the northern and western borders have a pronounced pulsating character. It depends on the degree of anthropogenic transformation of landscapes,

the development of agriculture and the cyclical nature of favourable climatic conditions. In the central and northern regions of the pheasant, only isolated birds can be found in the river valleys in their southernmost part. There are cases of unsustainable expansion of the boundaries of the distribution of pheasant to the north after extensive flooding in the valley of the Amur and Zeya rivers (summer 2013) and a noticeable reduction in its habitat after wintering.

Typical habitats of pheasants are pastures with a well-marked mosaic pattern and the ecotone of the taiga and meadows. The pheasants are mostly common in mixed forests, in which there are open spaces (large glades, clear-cuts, forest edges, bare places), places near agricultural fields with crops of grain and soy. The common pheasant is found quite often in abandoned fields, in places with shrubs and small oak forests, along the edges of the forest near swamps and so on. Places of concentration are usually located near soybean fields. In the southeastern part of the study area the bird is almost evenly distributed.

Conditions suitable for nesting are in floodplain or piedmont tree and shrub thickets, in habitats with small ponds overgrown with tree and shrub vegetation. In such places there is a lot of food and there are protective conditions.

Population. The number of the common pheasant is subject to significant fluctuations; this is typical for the Galliformes, which depend on the survival of the young birds during the breeding period and the main mass of adult birds that survived in conditions of extreme cold in winter.

The main problem during the work on the pheasant census is to identify the habitat area inhabited by the bird and to characterize the biotopes by quality, as these are diverse and large areas. Fluctuations in the number of pheasants in a small area with a maximum concentration near the fields with crops of soybean or maize are especially well traced. In addition, pheasants, except for the breeding season, prefer the gregarious way of life and feed in small groups. They can unite into huge clusters in places with an abundance of food. In areas with significant agricultural fields there is a stable number and high concentration of birds.

For 5 years in the Tambov district (165.6 thousand hectares of farmland) there were registered up to 14,775 pheasants on 245.74 thousand hectares of suitable land. In the Mikhailovsky district (136.4 thousand hectares of farmland), the average number of pheasants is up to 17,452 birds (290.42 thousand hectares of usable land).

During the study period (2013–2017), the average number of pheasants was 271,866 birds, with a populated area of suitable land of 4,763.6 thousand hectares (Table 4). In recent years, there has been a tendency to a decrease in the number of pheasants in the regions throughout the world, with significant fluctuations from 188,979 (2013) to 336,227 birds (2015). At the same time, earlier in some years (2010–2013), up to 450 thousand individuals of the common pheasant were recorded in the Amur region.

Thus, every year the largest average number of pheasant (2013–2017) is observed in the agricultural areas of the south and southeast of the Amur region, located on the Zeya-Bureya Plain: Belogorsky (31,209 birds), Oktyabrsky (30,497 birds), Ivanovsky (28,420 birds), Zavitinsky (26,717 birds), Blagoveshchensky (25,101 birds) (Fig. 4).

Table 4. Average number and relative density of the population of the common pheasant (*Phasianus colchicus pallasi*) and its spatial distribution by administrative districts of the Amur region (2013-2017).

Administrative district	Arkhara	Belogorsky	Blagoveshchensky	Bureya	Zavitinsky	Zeya	Ivanovsky	Konstantinovsky	Magdagachy	Mazanovsky	Mikhailovsky	Oktyabrsky	Romny	Svobodny	Selemdzhinsky	Seryshevo	Skovorodino	Tambov	Tynda	Shimanovsky	Total in the region
The area of district, 10^3 ha	1,440	260	310	710	330	8,750	270	180	1,480	2,830	300	340	1,010	730	4,670	380	2,050	250	8,330	1,460	**36,190**
The area of land suitable for habitat, 10^3 ha	429.81	255.10	218.42	327.88	240.69	104.58	252.34	157.27	51.94	488.20	290.42	327.92	260.24	440.76	46.56	322.38	17.61	245.74	-	285.75	**4,763.60**
The area of agricultural land, 10^3 ha	38.6	105.1	51.6	34.6	43.9	3.1	114.2	108.7	3.0	27.6	136.4	109.9	63.6	33.4	0.2	104.3	1.3	165.6	0.2	7.1	**1,152.4**
The average number by administrative areas, individuals	13,484	31,209	25,101	12,043	26,717	-	28,420	15,042	-	13,938	17,452	30,497	12,488	7,442	-	20,383	-	14,775	-	2,755	**271,866**
The relative density of the population of the species from land suitable for habitat, individuals, 10^3 ha	31.37	122.34	114.92	36.73	111.00	-	112.63	95.64	-	28.55	60.09	93.00	47.98	16.88	-	63.23	-	60.12	-	9.64	**57.07**
The relative density of the species population from district, individuals, 10^3 ha	9.36	120.03	80.97	16.96	80.96	-	105.26	10.16	-	4.93	58.17	89.70	12.36	10.19	-	53.64	-	69.9	-	1.89	**7.51**

In the territory of the Amur region, the average population density of a pheasant is 7.51 birds per 1000 ha. The population density of pheasant from the area suitable for habitat is 57.07 birds per 1000 ha (ecological density).

Areas with high ecological population density of pheasant are Belogorsky (122.34 birds per 1000 hectares with 255.1 thousand hectares of suitable land), Ivanovsky (112.63 birds per 1000 hectares with 252.3 thousand hectares of suitable land), Zavitinsky (111.0 birds per 1000 hectares with 240.7 thousand hectares of suitable land), Konstantinovsky (95.64 birds per 1000 hectares with 157.3 thousand hectares of suitable land).

A fairly stable low density of pheasant ranges from 31.37 birds per 1000 hectares (Arkhara district; 429.81 thousand hectares of suitable land), 28.55 birds per 1000 hectares (Mazanovsky district;

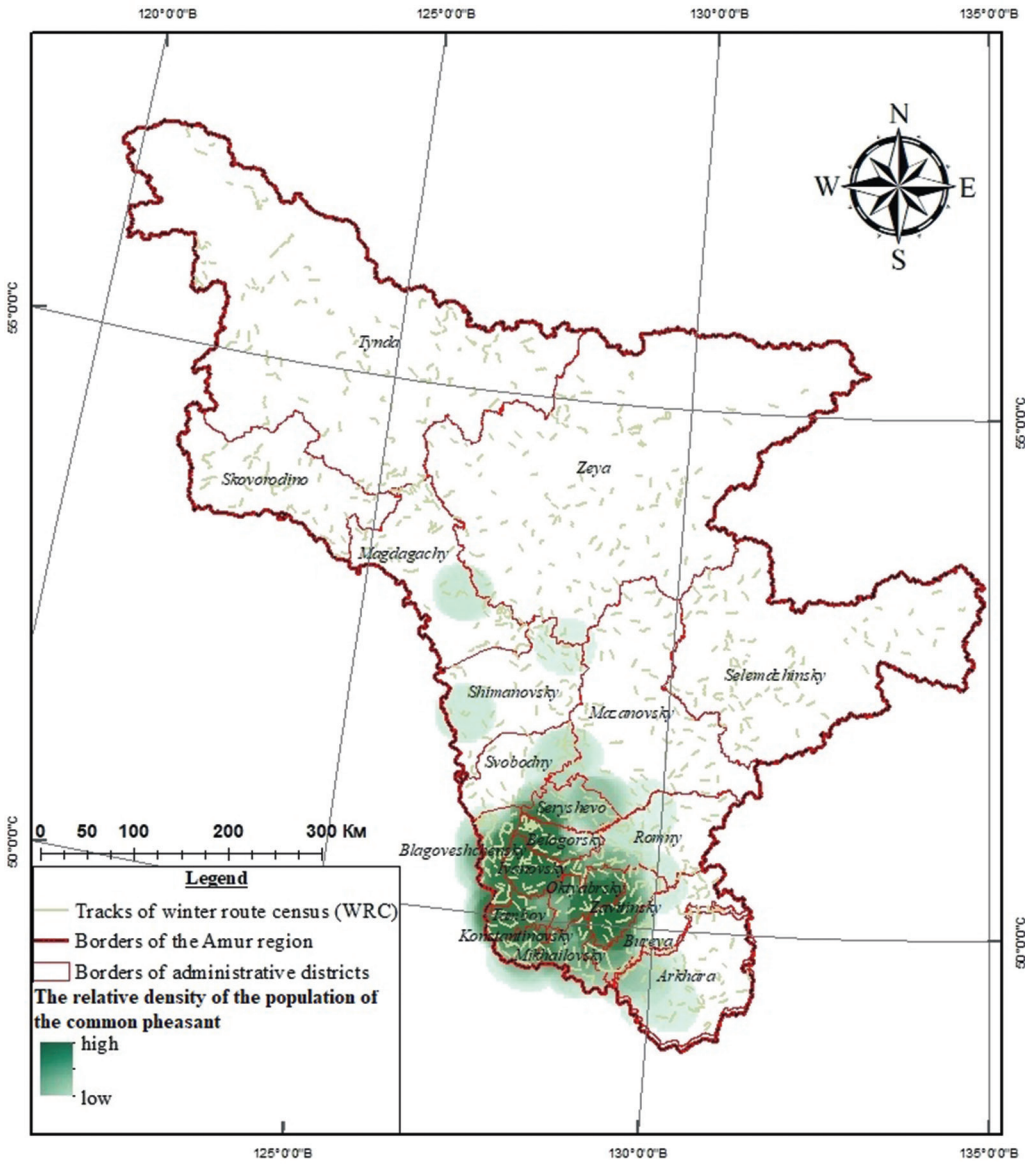

Fig. 4. Map of the relative population density of the common pheasant by the number of encounters at the routes of the WRC in the Amur region.

488.20 thousand hectares of suitable land), 16.88 birds per 1000 hectares (Svobodny district; 440.76 birds per 1000 hectares of suitable land).

Limiting factors. The number of the common pheasant mainly depends on the weather and climatic conditions of a particular year. Especially, the cold, lingering frost and wet spring have a detrimental effect on young birds. During the period of

incubation of eggs and hatching of nestlings, temperature drops, the presence and abundance of precipitation, wind, and predators (raccoon dog, goshawk, fox, etc.) have adverse impact. Pheasants are easily affected by Newcastle disease. Extreme natural factors (fires, spring grassland fires, floods, heavy snowfall in spring and moisture) also have a limiting effect on the common pheasant. A great deal of harm is caused by anthropogenic pressure, especially poaching (many pheasants are hunted illegally).

Using. Every year pheasant hunting is becoming increasingly popular. Thus, the legal production of the common pheasant in the Amur region varies from 3 to 12 thousand birds, which, despite the considerable illegal hunting, does not exhaust resources yet.

5. The willow partridge (*Lagopus lagopus*, Linnaeus, 1758) is a common nesting nonmigratory species.

Distribution. On the territory of the Amur region, the willow partridge dwells in sparsely endangered larch forests and along the slopes of the main ridges of the northern part of the Tynda and Zeya districts in the upper reaches of the Zeya, Giluy, in the Olekma basin with small forests. The willow partridge is rarely found in Skovorodino district. Two types of partridges are often found in the area of the origins of Selemdzha, in the Selitkan basin. Inside the area of distribution of the species, the ability to form places of concentration in well nourished, protected and nesting sites is well defined. Mostly, the willow partridge prefers moss marshes and moss and shrub tundra.

Population. In the Amur region, the willow partridge population is practically not used and information about the number of partridges is rather contradictory. The reason for this is that the conclusions on the number are made on the basis of expert sampling estimates without detailed specification of the characteristics of the populated areas for the selection of places and carrying out the census. Information on the number of willow partridges in the reports of hunters contains many gaps, therefore, the dynamics of the number of species in the area of our research usually do not reflect. Therefore, it is difficult to tell the dynamics over a period of more than 5 years.

The average number of a partridge over the last 5 years, according to the results of our census, is 18,725 birds, with significant variations in numbers by year. Thus, in 2014, the number of a partridge had a minimum value – 2,842 birds, and a maximum – 27,318 birds (2017) (Table 5, Fig. 5).

The willow partridge is concentrated in two districts – Tynda and Zeya. However, nomadic movements of long distances are typical for partridges. In winter, birds move to bushes and blueberries in the marshes, to areas of willow islets in the floodplains of rivers, and to alder thickets. Thus, in different years, the willow partridge can live in the Selemdzhinsky district (up to 5,656–10,272 birds), and goes far to the north-west to the Skovorodino district (up to 914 birds).

According to the winter route census, it is noted that the number of willow partridges is decreasing, which is confirmed by local experts who have done the census and local hunters. Birds of these species become rare in many areas of the region, and the range shifts to the north.

Table 5. The average population and relative density of the willow partridge (*Lagopus lagopus*) and its spatial distribution by administrative regions of the Amur region (2013–2017).

Administrative district	Arkhara	Belogorsky	Blagoveshchensky	Bureya	Zavitinsky	Zeya	Ivanovsky	Konstantinovsky	Magdagachy	Mazanovsky	Mikhailovsky	Oktyabrsky	Romny	Svobodny	Selemdzhinsky	Seryshevo	Skovorodino	Tambov	Tynda	Shimanovsky	Total in the region
The area of district, 10^3 ha	1,440	260	310	710	330	8,750	270	180	1,480	2,830	300	340	1,010	730	4,670	380	2,050	250	8,330	1,460	**36,190**
The average number by administrative areas, individuals	-	-	-	-	-	4,835	-	-	-	-	-	-	-	-	-	-	-	-	11,470	-	**18,725**
The relative density of the species population from S district, individuals, 10^3 ha	-	-	-	-	-	0.55	-	-	-	-	-	-	-	-	-	-	-	-	1.38		**0.52**

Limiting factors. The number of willow partridges is determined by the weather and climatic conditions (especially during the breeding season), mass diseases, the impact of predators, and forest fires.

Using. In the Amur region, hunting for willow partridges is virtually absent and they may be hunted down during random encounters. Probably the main reason for such poor use of the resources of the willow partridge population is that the partridge habitats are difficult to reach and are located far from amateur hunters.

The local population of the Zeiya, Tynda, Skovorodino districts do not consider the partridge as worthy prey, occasionally use it as bait for sable.

Conclusions

For the rational use of natural resources, it is important to track trends in the population status of 5 species of Galliformes birds, which inhabit the territory of the Amur region.

Ecological and biological features of Galliformes hunting species are due to specific conditions of distribution and habitat in the study area. The Amur region is a unique geographic area and has regional specificity of landscape and ecological conditions, habitat mosaic pattern, relief contrast, etc.

The south and central part of the region are occupied by two large plains. There are large agricultural fields, sown soybean, grain cereals – these are the favourite habitats of numerous field birds, for example, the common pheasant. In the north of the region dominated by taiga with inclusions of mixed and small-leaved forests, there are numerous black-billed capercaillie grouse, black grouse and hazel grouse populations. The pheasant does not live there at all. In the north of the Amur region there are areas of moss and shrub tundra and a sparse larch covering

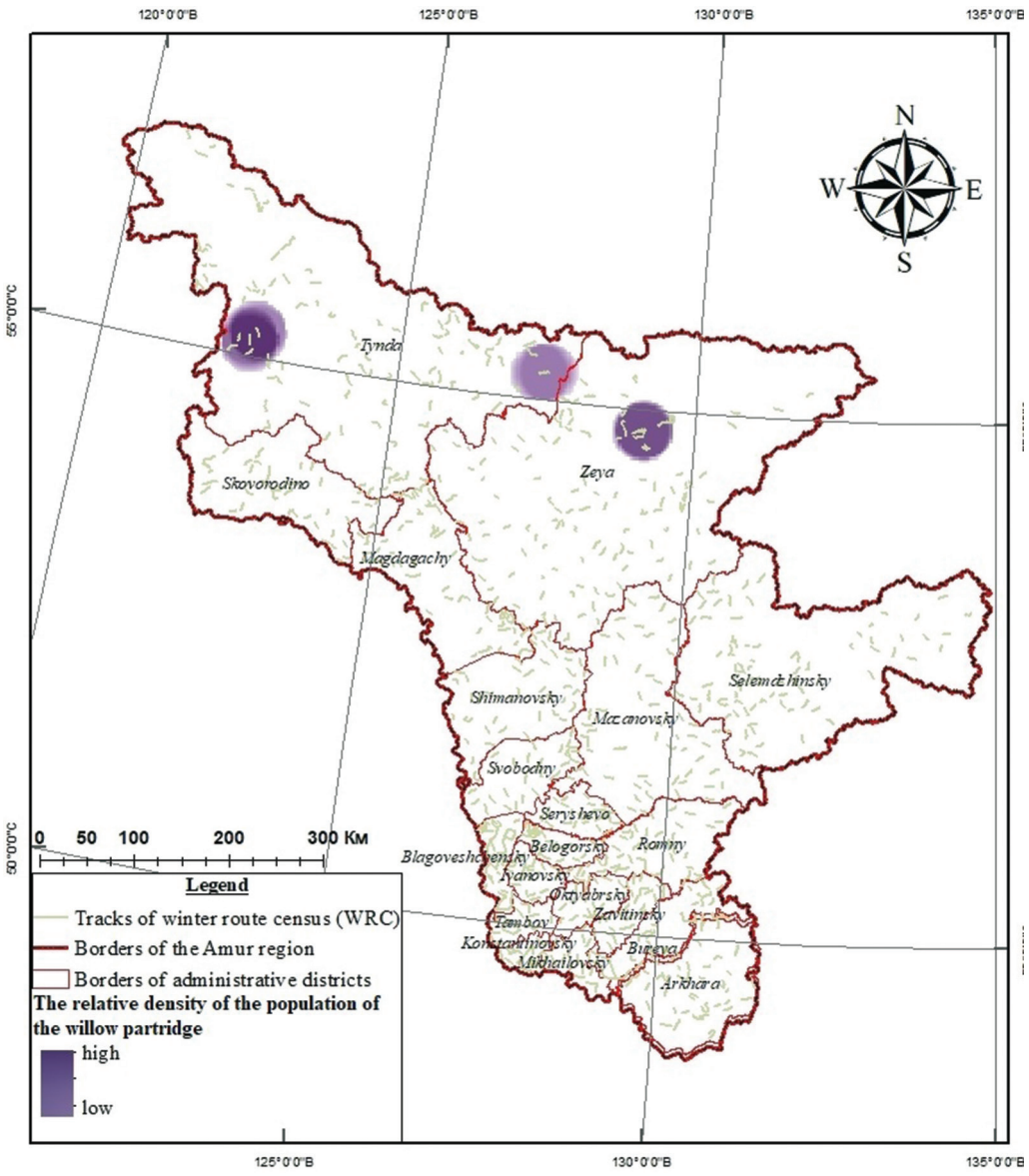

Fig. 5. The relative density of the population of the willow partridge by the number of encounters on the WRC routes in the Amur region.

the mountain ranges inhabited by the willow partridge.

The number of hunted fowl-like birds to the greatest extent is determined by the weather and climatic conditions during the breeding season, hatching of eggs and hatching of young birds, mass diseases and epizootics, the impact of predators, forest fires, anthropogenic pressure (poaching, fires, spring grassland fires, etc.).

Despite the fact that Tetraonidae birds experience significant fluctuations in numbers in some periods, they remain important as an object of sport hunting. The data we obtained were used in the practical work of the Department for Protection, Control and Regulation of the Use of Wildlife and their Habitats of Amur region. Together with data from other specially protected natural areas, an analysis was carried out and proposals were prepared to improve the protection and use of Tetraonidae birds.

The winter route census (WRC) used in Russia for hunting resources may be different in other countries. Therefore, the authors of this study believe that the data collected on the number of birds and the results of the analysis within this study should not be used for other regions to directly compare the data. In Russia the WRC is the main type of the state system of animal resource census, which is quite different from other methods of census used in foreign studies.

The cartograms obtained during geo-analysis show the patterns of the spatial distribution of birds in the winter season. All this unevenness is connected with 2 factors – the availability of food and its abundance in winter, as well as the depth of the snow. In the northern regions, it is deep snow that will determine the success of the winter overnights of birds, which die from low temperatures and winds, if they cannot find snow shelter or due to the ice crust formed on the ground. Thus, the high density of population in winter is expressed in greater intensity of colour of bird symbols in areas with the most favourable factors.

Building zoogeographic maps is a fairly convenient visual way to reflect reality and to track trends in the number and density of birds (and animals in general). It is also convenient to identify the boundaries of their distribution. In addition, it allows an objective assessment of the distribution of populations in the study area, to trace and clarify the ranges of animals. Thus, cartographic modelling helps to analyse various objects or processes in the animal world and to obtain qualitatively new information. The structure of the vector map helps to conveniently use geodata and operate information. Thus, the map database allows to easily store a large array of data, make requests for information on any area, and also carry out statistical processing of any sample population.

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