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Small Mammal Population Fauna and Structure as an Indicator of Ecosystem State in the Area of Critically Endangered *Leucogeranus leucogeranus* Reintroduction

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Abstract. This article presents a research into fauna and communities structure of small mammals inhabiting the Kunovat River area, the Kunovat Sanctuary (northern taiga subzone, Yamal-Nenets Autonomous District, Russia), the range of critically endangered *Leucogeranus leucogeranus*. The animals were trapped in trap lines of 25-100 steel spring traps, and in a pitfall trap with 6 cylinders. We performed taxonomic, ecological, and faunal and genetic analyses of species. Performed quantitative assessment of species distribution across biotopes. During 1,250 trap days, 174 cylinder days, 6 small mammal species Insectivora and Rodentia were trapped. The biotope distribution of certain species complies with the latter's ecological and biological features. Certain species abundance indices are comparable with those of northern taiga ecosystems of the north-western European Russia flatland, Siberia and Western Siberia north-west, and Kamchatka Peninsula forest tundra. There are two pairs of species (*Cl. rutilus – M. schisticolor and S. caecutiens – S. araneus*) whose abundance dynamics shows inverse correlation over the season and in certain biotopes; this fact is indicative of a low resource capacity of the studied habitats. The micromammal fauna composition and structure of the area under investigation are completely in line with its zone and subzone characteristics, biotope composition and ratio, Western Siberia mammal complexes history, and showing the structure of natural complexes typical for the northern taiga subzone.c.

Keywords: small mammals, fauna, abundance, Kunovatsky Reserve, Yamal-Nenets Autonomous District.

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Introduction

The Siberian white crane, or the snow crane (*Leucogeranus leucogeranus* Pallas, 1773) is a stenotopic crane species, threatened with extinction (IUCN, CR), one of the few endemic species of the Russian subarctic territories [1]. Over the last four decades it is the subject of focused attention from scientists and nature conservation organizations [2-4]. In the Red Data Book of the Russian Federation, the West Siberian (Ob) population of the white crane falls into Category One [5], i.e. it "can become extinct in the near future", as its number reached the threshold of extinction [6-8].

Supported by the Department of International Relations of the Yamal-Nenets Autonomous District, Russia, and with its direct involvement, the Siberian White Crane Ob Population Recruitment project was launched in 2019. From the point of view of preserving biodiversity and achieving sustainable development, the project makes a difference not only regionally and nationally, but also internationally, and is geared to observe the UN Convention on Biological Diversity [9], and Russia's obligations under the Convention on the Conservation of Migratory Species of Wild Animals, or the Bonn Convention [10]. At the same time, the published materials and reports from the previous stages of the project show extremely little data on the existing white crane Ob population condition in its breeding grounds, including data on the population's interrelationships with other species of the ecosystem, and data on the ecosystems' condition in the area of white crane probable breeding, range and wild return. These data are indispensable for scientifically based planning of the project's future activities. From this perspective, the white crane population condition assessment as connected with general condition of the neighboring ecosystems takes a full-scale field study with the use of both special bird study methods and a complex of methods for investigating other living organisms' groups. As a result, the purpose of this study is to research the condition of terrestrial ecosystems in the probable white crane range and breeding grounds with the help of micromammal populations and communities' indicator characteristics.

Materials and Methods

The field study was held in the Northern taiga subzone around the Siberian White Crane scientific station (the Kunovat River flood-plain area, the Kunovat Sanctuary (Kunovatsky Zakaznik), Shuryshkarsky Region, the Yamal-Nenets Autonomous District, Russia; 55.75ºN, 35.61667ºE), from June 8 to June 20, 2021 and from August 17 to August 21, 2021 (Fig. 1).

Figure 1. The Study Area Plan

The landscape of the area under investigation includes small coniferous and mixed forests growing on upland patches in dwarf-birch-thicket dwarf-shrub sphagnum muskegs and extensive equisetum-sedge-grass bogs with a lot of deep watercourses (Fig. 2).

The animals were captured in the forest patches with steel spring traps arranged in trapping lines of 25-75 traps, one trapping line per homogeneous habitat (biotope) [11-12]. The habitats were described in terms of plant association dominants of each layer [13-14]. In these descriptions, the dominant species of a layer are hyphenated, while layers are space-separated. In formulae representing Latin species names of such descriptions, the former are listed through a plus sign, and the first species of a new layer is listed after a minus sign.

In June, 25 cylinders (half-liter plastic cups) spaced 5 m apart were set along the border of a dwarf-birch-thicket dwarf-shrub sphagnum muskeg and a birch-spruce-Siberian-pine dwarf-shrub white-and-green-moss forest. In August, 2021 in the birch-spruce-Siberian-pine dwarf-shrub green-moss forest, a pitfall trap with 6 cylinders was set. The steel spring traps were baited with pieces of bread soaked in crude sunflower oil. The traps were checked daily and relocated to a new habitat every 2-4 days. In some cases, the traps were removed the next day after being mounted. The pitfall trap was checked daily.

Figure 2. The Kunovat Landscape. Photograph by R. Ilyasov

In total, there were 1,250 trap days and 174 cylinder days. The trap and cylinder days split across biotopes is as follows:

- 275 trap days, 24 cylinder days in the spruce-birch-Siberian-pine dwarf-shrub green-moss forest (*Pínus sibírica + Betula sp. + Pícea obováta – Lédum palústre + Vaccínium vítis-idaéa + Vaccinium uliginosum – Pleurozium schreberi + Ptílium crísta-castrénsis* (Ps+B+Po–Lp+Vv+Vu–Ps+Pc), study plot one (SP_1));
- 300 trap days in the birch-Siberian-pine dwarf-shrub green-moss forest (*Pínus sibírica + Betula sp. – Vaccínium vítis-idaéa + Lédum palústre – Pleurozium schreberi + Ptílium crísta-castrénsis* (Ps+B–Vv+Lp–Ps+Pc), study plot two (SP_2));
- 400 trap days in the spruce-birch-Siberian-pine dwarf-shrub-and-white-and-green-moss forest (*Pínus sibírica + Pícea obováta + Betula sp. – Vaccínium vítis-idaéa + Rubus chamaemorus + Lédum palústre – Sphágnum sp. + Pleurozium schreberi + Ptílium crísta-castrénsis* (Ps+Po+B–Vv+Rc+Lp–S+Ps+Pc), study plot three (SP_3));
- 100 trap days in the birch-Siberian-pine dwarf-shrub-white-moss-and-lichen open forest (*Pínus sibírica + Betula sp. – Betula nana – Lédum palústre + Vaccínium vítis-idaéa – Sphágnum sp. + Cladonia sp.* (Ps+B–Bn–Lp+Vv–S+C), study plot four (SP_4));
- 25 trap days in the birch-spruce-Siberian-pine equisetum-and-quackgrass forest (*Pínus sibírica + Betula sp. + Pícea obováta – Elytrígia sp. + Equisétum sp.* (Ps+B+Po–E+E), study plot five (SP_5));

- 75 trap days, 150 cylinder days on the dwarf-birch-thicket dwarf-shrub sphagnum muskeg (*Bétula nána* + *Betula sp.* – *Vaccinium oxycoccos* + *Vaccinium uliginosum* – *Sphágnum sp.* (Bn+B–Vo+Vu–S));
- 75 trap days on the birch-equisetum-and-buckbean bog (*Betula sp.* + *Bétula nána* – *Menyanthes trifoliáta* + *Equisétum fluviatil*e (B+Bn–Mt+Ef)).

In the traps and cylinders, no living animals were found and no retraps were made.

The small mammal abundance (relative abundance) was calculated in specimens per 100 trap days or 100 cylinder days (hereinafter "sp./100 tr.days" and "sp./100 cyl.days", respectively). In order to compare our research results with other available data, the abundance in specimens per 100 trap days was converted into specimens per 100 cylinder days. For that end, the specimen number per 100 trap days was multiplied by a conversion factor of 400, normalized to 1 km^2, and divided to be converted to 100 cylinder days (dry cylinders) – by 246.5 for rodents, and by 195 for insectivores [15-16].

The animals were identified to species by the peculiarities of their built, their teeth and skull characteristics [17-19]. The relative age was determined by thymus gland presence/absence, dental wear, cranial crest sizes. The current work uses the genus name *Clethrionomys* although it was considered a junior synonym to *Myodes* in the last decade, but a recent article by B. Kryštufek et.al [20] advocated the use of the former as it is the oldest valid unambiguous name for red-backed voles.

Species composition and relative abundance of micromammal species served as indicators of the ecosystem's condition.

For quantitative assessment of species distribution across biotopes, the biotopic allocation index was calculated (F_{ij}) [21]:

$$F_{ij} = \frac{n_{ij}\,N - n_i\,N_j}{n_{ij}\,N + n_i\,N_j - 2n_{ij}N_j},$$

where n_{ij} – number of individuals of *i*th species in *j*th sample of size N_j; n_i – the number if its individuals in all samples of size *N*. Values of F_{ij} run from -1, when a species is not registered in a given biotope, to +1, when a species is registered only in a given biotope ($-1 \leqslant F_{ij} \leqslant +1$). And at $F_i=0$, a species is indifferent to a given biotope; with $F_{ij}<0$ a species avoids a given biotope; with $F_{ij}>0$ a species prefers a given biotope. If a species is registered only in one habitat ($F_{ij}=+1$) or prefers it ($F_{ij}>+0.7$) with negative or tending to zero values of the index for other biotopes, then it is a stenotopic species. With $F_{ij}=0\pm0.3$ a species should be considered eurytopic. Species with a wide ecological valence (plasticity) are on the borderline [22].

The study results were processed with the help of univariate statistical analysis methods [23].

Results

During the research we trapped 112 individuals around the White Crane scientific station. These small mammals come from two orders: Insectivora (22 individuals of *Sorex caecutiens* Laxmann, 1788, 8 individuals of *Sorex araneus* L., 1758) and Rodentia (53 individuals of *Clethrionomys rutilus* Pallas, 1779, 17 individuals of *Microtus oeconomus* Pallas, 1776, 10 individuals of *Microtus agrestis* L., 1761, 2 individuals of *Myopus schisticolor* Lilljeborg, 1844). A muskrat (*Ondatra zibethicus* L., 1766) lodge and canals were found on a quaking bog. On the studied sites of dwarf-birch-thicket dwarf-shrub sphagnum muskeg and birch equisetum-buckbean bog, a lot of small mammals' nest holes and runways were registered, but no individuals were trapped (Fig. 3, 4).

(a)

(b)

Figure 3. Small mammal nest holes **(a)** and runways **(b)** on dwarf-birch-thicket dwarf-shrub sphagnum muskeg. Picture by: A. Levykh

On the studied territory, the small mammals total abundance more than doubled (from 6.67 sp./100 tr.days to 14 sp./100 tr.days) from June to August, which is indicative of normal reproduction processes (Table 1).

The maximum total abundance of small mammals (16.0 sp./100 tr.days) with an equal share of many species was registered in August in birch-Siberian-cedar dwarf-shrub green-moss forest (Ps+B–Vv+Lp–Ps+Pc), on all sides bordering quaking bogs and dwarf-birch-thicket dwarf-shrub sphagnum muskegs. Steel spring trap catches both in June and August show that rodents (Rodentia) predominate. The share of insectivores (Insectivora) was under a third for the whole season albeit almost doubled from June to August (Table 2). August pitfall trap data show that *S. caecutiens* is the absolute dominant, which contributed to more than threefold dominance of Insectivora (Tables 1, 2).

The differences between Rodentia and Insectivora abundance numbers may be accounted for by trapping selectiveness [12]. However steel spring trap and pitfall trap censuses show that both main small mammal groups – Rodentia and Insectivora – are represented on the territory under investigation in certain ratios. Their proportion may significantly vary year on year depending on the climatic conditions of the year (season) and certain species population cycles.

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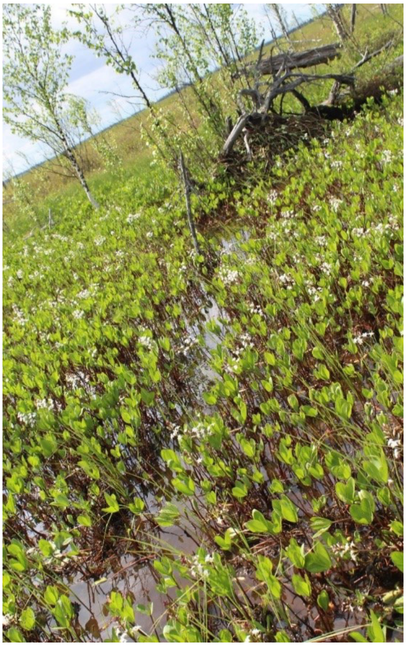

Figure 4. O. *zibethicus* lodge and canal. Picture by: A. Levykh

Table 1. Relative small mammal species abundance in various biotopes of the studied site of Kunovatsky State Nature Reserve

Species, share trapped (%) min-max abundance indices	Habitats									Mean abundance		
	SP_1		SP_2		SP_3		SP_4		SP_5	June	August	total
	Ps+B+Po–Lp+Vv+Vu–Ps+Pc		Ps+B–Vv+Lp–Ps+Pc		Ps+Po+B–Vv+Rc+Lp–S+Ps+Pc		Ps+B–Bn–Lp+Vv–S+C		Ps+B+Po–E+E			
	June	August	June	August	June	August	June	August	June			
Cl. rutilus	6.0 9.74	5.33 4.17*	5.0 8.11	4.0 6.49	3.67 5.96	3.0 4.87	4.0 6.49	5.33 8.65	12.0 19.47	6.13 ± 1.52	4.41 ± 0.57	5.37 ± 0.89
F_{ij} *Cl. rutilus*	0.08		-0.06		-0.03		-0.09		0.19			
M. oeconomus	-		1.0 1.62	5.0 8.11	0.33 0.54	6.0 9.74	4.0 6.49	2.67 4.33	-	1.78 ± 1.13	4.56 ± 0.99	3.17 ± 0.91
F_{ij} *M. oeconom*	-1.0		0.26		0.28		0.26		-1.0			
M. agrestis	-	4.0 6.49	-	2.0 3.25	0.67 1.09	-	-	4.0 6.49	-	-	3.33 ± 0.67	2.67 ± 0.82
F_{ij} *M. agrestis*	0.07		-0.25		-0.22		0.55		-1.0			
S. araneus	0.5 1.03	-	-	3.0 6.15	-	3.0 6.15	-	-	4.0 8.21	2.25 ± 1.75	3.0 ± 0	2.63 ± 0.75
F_{ij} *S. araneus*	0.45		0.18		0.21		-1.0		0.54			
S. caecutiens	2.0 4.10	4.0 41.67*	0.5 1.03	2.0 4.10	-	2.0 4.10	-	-	-	1.25 ± 0.75	2.67 ± 0.67	2.10 ± 0.56
F_{ij} *S. caecutiens*	0.51		0.04		-0.37		-1.0		-1.0			
M. schisticolor	-		-	-	-	-	-	-	-	-	-	-
Species number	3	3	3	5	3	4	2	3	2	5	6	6
Total abundance	8.5	13.33 54.17*	6.5	16.0	4.67	14.0	8.0	12.0	16.0	6.67	14.0 54.17*	9.0 54.17*

Note: the number above the line is abundance in specimen/ 100 trap days; below the line, in specimen/ 100 cylinder days; * — empirical abundance indices from pitfall trapping; without asterisk — abundance indices calculated with conversion factors from steel spring traping numbers; SP_i — study plot (the subscript is a plot number); F_{ij} — is biotopic allocation index.

Certain species abundance and their share in the total small mammal abundance vary from one biotope to another according to species-specific ecologic and biological peculiarities.

Table 2. Ratio of small mammal species abundance in the studied area of Kunovatsky State Nature Reserve

Species	Species share, %			
	min	max	x_{mean}	combined sample
June / August				
Rodentia				June /August / total
Cl. rutilus	50.0/21.4	78.6/44.4	70.2±5.2/ 32.7±5.6	74.0/30.6/53.5 7.7
M. oeconomus	7.1/22.2	50.0/42.9	24.2±13.1/ 32.1±6.0	8.0/26.5/17.2
M. agrestis	-/12.5	-/33.3	-/25.3±6.5	4.0/16.3/10.1 -
M. schisticolor	-	-	-	- /- 15.4
			Total Rodentia:	86.0/73.5/79.8 23.1

Continuation of Table 2

Species	Species share, %			
	min	max	x_{mean}	combined sample
June / August				
Insectivora				
S. araneus	5.9/18.8	25.0/21.4	15.4±9.6/ 20.1±1.3	4.0/12.2/8.1
S. caecutiens	7.7/12.5	23.5/30.0	15.6±7.9/ 18.9±5.6	10.0/14.3/12.1 / 76.9
			Total Insectivora:	14.0/26.5/20.2 / 76.9

Note: the number above the line is steel spring trap data; under the line, pitfal trap data.

Discussion

The trapped micromammal species have been reported to be registered in Northern Eurasia, the Northern and Polar Urals; in the northern taiga of the East European Plain, Western Siberia, the Yamal-Nenets Autonomous District [24-31].

Sorex (L., 1758), *Clethrionomys* (=*Myodes*) (Pallas, 1811), *Microtus* (Schrank, 1798) are Holarctic genera, and *Myopus* (Miller, 1910) genus is Palearctic. *Cl. rutilus* and *M. oeconomus* are transholarctic species, found in the Eurasian boreal zone and Western North America [32-40]. *Cl. rutilus* is of East Palearctic origin with the range optimum in Siberian taiga zone [28; 38; 41-43]. *M. schisticolor* is a typical Palearctic taiga species, whose range borders almost coincide with the Palearctic taiga borders, and the species range optimum is in the norther taiga subzone [44]. Within its whole species range, *M. schisticolor* is sporadically spread, as it is a stenobiontic species and is allocated to habitats with a well-developed moss cover. *S. caecutiens* – is a widely spread Transpalearctic species with the optimum in the southern taiga and northern forest steppe of the Southern Urals and Western Siberia [45]. *S. araneus* and *M. agrestis* are typical Western Palearctic species; their ranges form a southeastward tapering wedge. The area under investigation is the northernmost limit of *S. araneus*.

According to E.N. Matyushkin [46] faunal and genetic classification, *Cl. rutilus, M. oeconomus, M. schisticolor* are part of the East Sibereian complex or Arctic-Boreal fauna element, a "northern red-backed vole and elk" faunula. *S. caecutiens* belongs to the Far Eastern complex or "Laxmann's shrew and elk" faunula. E.A. Shvarts lists *M. agrestis* in the group of European forest species [31]. Some authors include *M. agrestis* along with *Cl. rutilus* and *S. caecutiens* in one and the same group of Transpalearctic boreal species in spite of their different origins [47-48].

All these species except for *M. schisticolor* were included in the Pleistocene mammal fauna of Tyumen Oblast, Russia, (when the southern boarders of the tundra mammal complex spread to the modern middle taiga latitude, 64º N, and to the South, there were tundra steppes and steppes there) [32; 49]. The trapped shrew species were found in Pleistocene depostits of the Middle Trans-Urals: *S. araneus* – in fauna complexes of forest flood-plains, *S. caecutiens* – in forest tundras. The trapped vole species were found in the Lower Irtysh River Pleistocene deposits: *Cl. rutilus* – in fauna complexes of forest habitats, *M. oeconomus* – in near-water habitats, *M. agrestis* – in moistened habitats. On the whole, this distribution of the species across stations corresponds to the modern biotope preferences of the above species [28; 31-32; 42]. *M. oeconomus, M. agrestis*, red-backed voles from the *Clethrionomys* genus and shrews from the *Sorex* genus were jointly described in the fauna complexes of Chembakchino (500-470 thousand years old, when the southern taiga spread to 60º S) and Yarsino (127-115 thousand years old, when the landscape zones should have moved 500-700 km northward) coming from the tundra-forest steppe Low Irtysh faunas of Western Siberia [49-51]. The fact that the vast northern Western Siberia Pleistocene fossil record does not have anything on a typical taiga species *M. schisticolor* may be due to either its very low number and sporadic range distribution (it is characteristic of the species at present), or its absence on the territory at the time and, consequently, absence of the contemporary taiga mammal complex here. L.I. Galkina [52-53] and N.G. Smirnov et al. [49] believe that the taiga-forest mammal complex was derived from tundra steppe and forest steppe ones, and took on the modern composition only in the second half of the Holocene (not earlier than 6 000 years ago).

All these facts evidence that the small mammal species trapped around the White Crane scientific station historically developed as a component of the associated faunal complexes and now are typical for the ecosystems of northern taiga subzone, the territory under study located here.

As per S.N. Gashev [32] classification, the trapped species fall into the following ecological groups in relation to man: synanthropes – *S.araneus*; anthropophils – *M. agrestis*; neutrals – *Cl. rutilus*, *M. oeconomus*, *S. caecutiens*, anthropophobes – *M. schisticolor*. The anthropophobic species *M. schisticolor*, has the lowest index of anthropogenic adaptation (8.0) of 31 Tyumen Oblast (Russia) small terrestrial rodent species, and its presence in the small mammal population may evidence that the studied territories are not affected by human economic activities [32].

Steel spring trap censuses show that *Cl. rutilus* dominates in most habitats with *M. oeconomus* or *M. agrestis* in rodents and *S. caecutiens* or *S. araneus* in insectivores subdominating in different biotopes. Such a composition of dominants and subdominants was reported by other researchers studying northern taiga systems [28; 42; 54]. As per the spatiotypological classification of terrestrial vertebrates of the West-Siberian Plane [54], the following species are most abundant in the following assemblage types: *Cl. rutilus, S. caecutiens*, *M. agrestis* in forest tundra–northern taiga swamp-forest communities; *M. oeconomus* – in forest tundra–subarctic swamp-tundra communities; *S. araneus*

– in forest tundra–steppe meso-europhic communities with oligotrphic bogs of the middle and southern taiga. Zoning of Northern Eurasia in terrestrial vertebrates fauna types showed that *S. araneus* and *S. caecutiens* are among the most abundant species of certain districts and provinces of forest transpalaearctic subregion of the forest region [55]. Thus, the investigated area small mammal fauna composition and structure are in line with the area's zonal and subzonal characteristics, its biotopes' composition and ratios. The composition of the fauna complex under investigation is consistent with its territoriality in zoogeographic zoning of Tyumen Oblast, and belongs to the flood-plain complex of Nadym-Pur province of the northern taiga subzone [56].

Cl. rutilus is the most euritopic species. Its biotopic allocation index deviates slightly from zero (Table 1). Maximum abundance of the species was registered in the most drained biotopes with the most dense leaf canopy (Ps+B+Po–Lp+Vv+Vu–Ps+Pc; Ps+B+Po–E+E), where F_{ij} values are positive (Tables 1, 2). As the forests get sparser (Ps+B–Bn–Lp+Vv–S+C) and moister (Ps+Po+B–Vv+Rc+Lp–S+Ps+Pc) *Cl. rutilus* abundance decreases. The inverse relation between *Cl. rutilus* abundance and forest stand sparseness or absence and habitat moistness was reported by other researchers [28; 42]. *Cl. rutilus* shows significantly higher values of mean abundance over the season when compared to the same of *M. agrestis* ($p<0.05$), *S. araneus* ($p<0.05$), *S. caecutiens* ($p<0.01$) and a significanlty lower coefficient of abundance variation across biotopes (CV=49.6%) as compared to the same of *M. oeconomus* (CV=70.7%; $p<0.001$), *M. agrestis* (CV=61.2%; $p<0.001$), *S. araneus* (CV=56.9%; $p<0.001$), *S. caecutiens* (CV=59.3%; $p<0.01$). The statistic comparison demonstrates the discussed species numerical dominance and its comparatively even distribution across biotopes (habitat versatility) in the study area.

M. oeconomus was trapped in biotopes where trap lines were mounted on the forest-bog or forest-muskeg edge (Bn+B–Vo+Vu–S; B+Bn–Mt+Ef). Maximum species abundance (5.0; 6.0 sp./100 tr.days) is characteristic of the moistest forest patches bordering on both the bog and the muskeg (Table 1). A burrow hole and runways detected on a dwarf-birch-thicket dwarf-shrub sphagnum muskeg are obviously the *M. oeconomus*' (Fig. 4).

M. agrestis was trapped in only one habitat (Ps+Po+B–Vv+Rc+Lp–S+Ps+Pc), where it dominates together with *Cl. rutilus*. In August, *M. agrestis* was trapped in three biotopes more, in two of which it is a co-dominant of *Cl. rutilus* (Table 1). Co-dominance of these two species in forest habitats is coherent with I.Ya. Polyakov's opinion that *M. agrestis* belongs to forest voles biological group [42; 57]. It is known that steel spring traps baited with bread perform poorly for *M. agrestis* and *M. oeconomus,* with except for the most optimal habitats with high species density [42]. This fact suggests that *M. agrestis* density around the White Crane scientific station is sufficiently high. F_{ij} values for meadow voles (*Microtus*) evidence that in the study area *M. agrestis* shows higher ecological plasticity than

M. oeconomus, preferring a more open biotope – birch-Siberian-pine dwarf-shrub-white-moss-and-lichen open forest (Ps+B–Bn–Lp+Vv–S+C) (Table 1). The latter fact is in line with a certain preference of this species for open or sparce forest stations in the northern end of its range [58-60]. At the same time, the share of *M. oeconomus* in the combined Micromammalia sample, both in each month separately and over the whole season is higher than that of *M. agrestis*. It may be accounted for by a wide spread of flood-plain biotopes in the study area, a considerable area of bogs and muskegs, and probably, a certain population cycle phase.

M. schisticolor was pitfall trapped only in August in spruce-birch-Siberian-pine dwarf-shrub green-moss forest (Ps+B+Po–Lp+Vv+Vu–Ps+Pc). This is in line with a very low steel spring traping rate of *M. schisticolor* reported by previous reseach [42]. The calculated abundance is consistent with maximum mean abundance (8.0 sp./100 cyl.days) reported as a result of long-term censuses in the Little Sosva (Malaya Sosva) Nature Reserve located in the subzone of middle taiga Siberian pine waterlogged forests (Kondo-Sosva middle taiga province of the Ob-Irtysh gepgraphical region) [42]. Y.L. Volpert and E.G. Shadrina [28] note that in the north-west of Siberia there is an asynchronous dynamics of *M. schisticolor* and *Cl. rutilus*. In the northern reaches of their range, these species compete for the scarce resources. This is coherent with the fact that *M. schisticolor* was trapped in August when *Cl. rutilus*. abundance declined. The harsh climate of the territory (a high precipitation ratio, a low heat supply, a short growing period, a slow biological cycle of matter, permafrost soils, etc.) and the small area of forest patches surrounded by bogs and muskegs induce a low resource capacity of the habitats under study, making it inappropriate for living through a harsh winter [61-63]. The following fact also evidences that the resource capacity is low: in June 2021, spruce-birch-Siberian-pine dwarf-shrub green-moss forest (Ps+B+Po–Lp+Vv+Vu–Ps+Pc) showed a comparatively high abundance of small mammals in the first three days of steel spring trapping (11.3 sp./100 r.days), while from the fourth day onwards no retraps were made, obviously for the reason that all the resident animals were trapped and no migrants from adjacent territories came there. Therefore, in the adjacent dwarf-birch-thicket dwarf-shrub sphagnum muskeg (Bn+B–Vo+Vu–S) there were no wintered animals.

S. araneus and *S. caecutiens* were steel spring trapped in all the studied habitats except for birch-Siberian-pine dwarf-shrub white-moss-and-lichen open forest (Ps+B–Bn–Lp+Vv–S+C) (F_{ij}=- 1 for both species). This is in line with previous data on *S. araneus* and *S. caecutiens* keeping away from lichen pine forests [42]. The highest values of abundance and biotopic allocation of *S. araneus* were registered in spruce-birch-Siberian-pine equisetum-quackgrass forest (Ps+B+Po–E+E), *S. caecutiens* – in spruce-birch-Siberian-pine dwarf-shrub green-moss forest (Ps+B+Po–Lp+Vv+Vu–Ps+Pc) (Table 1). On the whole, the space and biotope variability of incidence and abundance of *S. araneus* and *S. caecutiens* is in line with an idea that there is a close connection between *S. caecutiens* and taiga forest communities with mosses dominating ground vegetation [25; 64-65], and that *S. araneus* prefers grass stations of various kinds [42; 66-68]. Throughout the summer period the abundance of both species increased, but in one and the same biotope one of the species outnumbered the other, which shows their inverse correlation in their distribution across biotopes (Tables 1, 2). F_{ij}, values show the same trend in almost all the biotopes except for spruce-birch-Siberian-pine dwarf-shrub green-moss forest (Ps+B+Po–Lp+Vv+Vu–Ps+Pc) with a well developed dwarf shrub and moss cover, and, consequently, a relatively higher resource capacuty; it is also consistent with S.V. Puchkovsky's evidence [69]. Mean shares in both species catches are comparable, but in the combined spample for the season (without the pitfall trap data) *S. caecutiens* share is 1.5 times larger than that of *S. araneus* (Table 2). A decrease in the share of *S. araneus,* dominating among the shrews (*Sorex*), almost throughout its whole wide range is also registered by other scientists for northern taiga landscapes in the eastern part of this species range [31].

Our resulting abundance of certain species complies with long-term mean abundance calculated for the Tyumen Oblast [32; 70-71]: 5.0 sp./100 cyl.days. for *Cl. rutilus* , with a maximum (9.0 sp./100 cyl.days) in the middle taiga; 3.0 sp./100 cyl. days. *M. oeconomus* , with a maximum (9.0 sp./100 cyl.days) in the southern taiga; 1.0 sp./100 cyl.days. for *M. agrestis* , with a maximum (3.0 sp./100 cyl. days) in the subtaiga; 0.4 sp./100 cyl.days. for *M. schisticolor* , with a maximum (16.0 sp./100 cyl.days) in the middle taiga; 10.0 sp./100 cyl.days. for *S. araneus* , with a maximum (26.0 sp./100 cyl.days) in the southern taiga; 8.0 sp./100 cyl. days. for *S. caecutiens* , with a maximum in the middle (18.0 sp./100 cyl. days) and southern taiga (13.0 sp./100 cyl.days). Our pitfall trap abundance of *S. caecutiens* (41.67 sp./100 cyl.days) is close to the maximum abundance (50.0 sp./100 cyl. days), reported by S.N. Gashev [32] for a brook flood-plain near Numto village (the Khanty-Mansi Autonomous District, Russia, the northern taiga subzone).

Our abundance values for certain species are comparable with those of other researchers studying northern taiga ecosystems of the European Russia flatland's North-East [31; 42; 72-74], Siberia's North-East [28], as well as with our own data for the forest tundra zone of the Kamchatka Peninsula and Western Siberia northern taiga [75-76].

Conclusions

Within the framework of complex research of the ecosystems condition in the endangered species *Leucogeranus leucogeranus* Ob population range, six small mammal species were trapped in various biotopes of the northern taiga forest outliers bordering on dwarf-birch-thicket-and-shrub shpagnum muskegs and quaking bogs near the Kunovat River flood-plain in June and August, 2021.

These species come from two order: Rodentia (*Cl. rutilus*, *M. oeconomus*, *M. agrestis*, *M. schisticolor*) and Insectivora (*S. caecutiens*, *S. araneus*). We also found *O. zibethicus* lodge and canals on a quaking bog.

Certain species biotope distripution patterns correspond to their well-studied ecologic and biologic characteristics.

Certain species abundance indices are comparable with those of northern taiga ecosystems of the north-western European Russia flatland, Siberia and Western Siberia north-west, and Kamchatka Peninsula forest tundra.

From June to August, small mammals total abundance more than doubled (from 6.67 sp./100 tr.days to 14 sp./100 tr.days), exhibiting normal reproduction processes.

The fact that two pairs of species (*Cl.rutilus – M. schisticolor* and *S. caecutiens – S. araneus*) occupying similar ecological niches show inverse correlation of abundance across biotopes and over the whole season evidences a low resource capacity of the studied habitats.

This preliminary investigation of micromammal fauna and population shows that the ecosystems in the Siberian white crane reintroduction area have a structure typical for the northern taiga subzone. In order to confirm and extend the findings it is essential to continue investigation of small mammals and launch research of other ecosystem components (birds, vegetation, invertebrates).

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