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UDC 599.322/.324 (571.12)

BIOLOGY OF THE FLYING SQUIRREL IN THE SOUTH OF TYUMEN REGION

ABSTRACT. We have carried out a pioneer investigation on the assessment of the population of the Siberian flying squirrel in Tyumen region in 2007-2010 by recording its waste. The habitat area of the flying squirrel in Tyumen region stretches from the northern taiga (inclusive) to its southern borders in the forest-steppe zone. The maximum density of the flying squirrel population is registered in the southern taiga subzone. 44 sites have been studied in total. 31,8% of all the observed sites are inhabited by the Siberian flying squirrel. All habitats are connected with the transfer zone from the plain land to the river lowland and marsh. As a rule this transfer zone is significantly clean-boled. The flying squirrel adheres to such tree breeds as a birch, pine cedar, fir-tree, aspen and linden. The species has been seen in the forest park of Tyumen city. The morpho-physiological parameters testify to internal stability of the squirrel population found in favorable ecological conditions.

KEYWORDS. Flying squirrel, Tyumen region, habitats, excrements, morphology.

Introduction. The flying squirrel (*Pteromys volans volans* L., 1758) or pal'-aur (Komi) or tovlyn lenyn (Mansi) is an understudied rodent species of the flying squirrel family (Pteromyidae) both in Russia and in the world. There are only some works on it in Karelia [1] and European part of Russia [2]. There are also some fragmentary data on Kuznetskiy Alatau and Altay [3]. In the West Siberian region our works are of pioneering nature.

Pleistocene fossils of the flying squirrel in Tyumen region are not known [4]. Nowadays, the species is widely spread in the whole forest zone of the region. The northernmost places of the findings are in settlement Sidorovsk on the river Taz and the Synya river basin. Yet, however, it might also inhabit the more northern forested areas along the rivers. To the south it reaches as far as the southern border of the subtaiga. We have come across it near village Antipino, in Uspenskiy Bor (pine wood), and along the Tavda river. In Yalutorovskiy district it was noted along the river Yurga in Shatrovskiy district of Kurgan region [5]. "The catalog of mammals of the USSR" [6] mentions a subspecies P. v. gubari Ognev, 1934 inhabiting the forest-steppe zones of Western Siberia and Northern Kazakhstan and also in the forested areas to the south of Tyumen region. It is rare in the region; though in some places (basin of the river Sabun) the local populations can be quite numerous [7]. Hunters observed the flying squirrel in Ust'-Ishimskiy, Tevrizskiy, Znamenskiy and Tarskiy districts of the neighboring Omsk region [8].

Material and methods.

We carried out works on the assessment of the population of the Siberian flying squirrel in the middle and southern taiga and sub-taiga of Tyumen region [10] in 2007-2010 by recording its waste [9]. In 2012 we worked in the forest-steppe zone of the region. We recorded data on the presence or absence of the species, described the phytocenosis structure and noted the species of the trees which the flying squirrel frequents and the recurrence of its waste.

Besides, in the period from November 2012 to February 2013 we trapped 41 flying squirrels in the area of settlement Turtas (basins of the rivers Vyya and Manguya) – southern taiga. 26 of the caught squirrels were subjected to a complex morphophysiological analysis. According to the method of morphophysiological indicators by S.S. Shwartz we calculated the indices of the liver, heart, kidneys, adrenal capsule, spleen, lungs and thymus with the formula: m (of an organ), mg/m (of the body), g = d [11]. In order to analyze the health condition of the animals in the populations we analyzed the ratio of the body weight to its length expressed in g/mm [12] and the hepato-suprarenal coefficient which is equal to the ratio of the liver index to the adrenal capsule index [13].

Findings of the research and discussion.

In 2007-2010 we examined 44 areas on the territory of Tyumen region (9 in the middle taiga; 8 in the southern taiga and 27 in sub-taiga). Besides, in June 2012 we inspected 6 more areas (3 in sub-taiga and 3 in the forest-steppe zone). At that we noted the southernmost places of the species traces of life (winter excrements) on the territory of Tyumen region: one place is located in sub-taiga in the south of Tyumen district near settlement Levashy where the flying squirrel was seen on the edge of the spruce forest leading to swampland; the second finding occurred in the middle forest-steppe zone in the south of Isetskiy district in the valley of the river Yuzya at the south-eastern border of Rafailovskiy nature reserve where the flying squirrel was registered in the alder swamp [14].

Out of the 44 examined plots 31.8% turned out to be inhabited. All in all this is much higher than the results of the similar surveys carried out in Finland in 2003-2005 (on average, 10.3% of the examined sites); in the Karelian Isthmus in 2004-2005 99.3%) [15] and in the Republic of Karelia in 2004-2007 (15.4%) [16] or in Sverdlovsk region – 14.3% [2]. This can be explained: in the north of Europe the flying squirrel exists (and has been studied!) only in the northern taiga areas; at the same time in Western Siberia it can be met in the whole forest zone including southern taiga, which from the ecological point of view is probably an optimal natural sub-zone for the species in question within Eurasia. The share of the inhabited sites in different natural zones of Tyumen region is 22.2% in middle taiga; 37.5% in southern taiga and 33% in sub-taiga. The decrease in the amount of the flying squirrel from the south to the north of taiga, where we recorded the maximum population density on the tested sites, can explain the lower density values in Finland and Karelia, where the surveys were carried out on the territory of the northern taiga sub-zone; though over 40% of the sites are inhabited there as well.

All the habitats where we found wastes of the flying squirrel are connected with an ecotone – transition from upland to lowland or swamp; as a rule a much opener space. It is necessary to note that other researchers have already mentioned swampy areas in connection with the habitats of flying squirrels. E.g. E. S. Zadiraka points out that in his research 90.6% of the medium swampy areas turned out to be inhabited in relation to the gross share of the inhabited sites [2].

Apart from the city of Petrozavodsk [17] we registered the species in the recreational forest of Tyumen city in the ripe standing forest of the holiday hotel "Olovyannikova" in 2008.

We found waste on the birch tree (52.2%), aspen and linden trees (both 17.4%). The linden trees grow only in sub-taiga. To the north more aspen trees than linden trees disappear. E.g. in Karelia 24% of aspen trees are inhabited by the flying squirrel [1]; 13% of all the findings occurred under spruce trees [10].

While steel-trapping in the subzone of southern taiga we found birch trees the most often inhabited (the flying squirrels were caught on all the trees supplied with traps); the second most inhabited tree was the cedar pine (48.1% of all the findings). 39% of the findings occurred on the fir trees; 10% on the aspen trees and 9.5% on the silver fir trees.

There were no flying squirrels on the common pine, dry trees and small trees (up to 15 cm in diameter) of various species.

In the inhabited areas which we observed continuously from 2007 to 2010 the flying squirrel was registered repeatedly in 50% of all the cases.

As for the gender structure of the flying squirrel population, we can so far refer only to the results of steel-trapping which indicate little male domination over females (sex ratio: males/females 1.36), which may be connected with the bigger activity and agility of the males.

The rutting period was noted to begin at the end of January 2013: 2 males and 2 females ready for breeding (increased seminal glands, thick uterine horns) were caught in January-February. Their share equaled 26.7% of all the caught animals in that period.

Autumn change of coat was registered in some animals till 13 November 2012 (paws, tail and wing membranes change their color).

We studied the anatomic and morphological properties of the flying squirrel in Western Siberia for the first time (table 1).

Analysis of table 1 lets us state confirmed bigger absolute dimensions of females as compared to males regarding the body and tail length. This might be explained by an older age of females. However, the thymus index shows the opposite (table 2). There is also a tendency towards a bigger body weight of the females although the relative dimensions of the animals expressed via their indices do not differ much (table 2). At that the females' tail index is a little bigger than the males' index.

Table 1

Indices	Males			Females			Student t-test
	N	Average ± error	Variation coefficient	n	Average ± error	Variation coefficient	
Body weight, g	14,00	124,82±1,251	3,75	9,00	129,28±2,72	6,31	-1,4867
Skin weight, g	14,00	22,36±0,93	15,64	9,00	22,37±1,19	16,02	-0,0066
Body length, cm	15,00	156,47±1,65**	4,09	9,00	161,89±1,37	2,54	-2,5273
Tail length, cm	12,00	144,25±1,98**	4,75	10,00	151,6±2,08	4,33	-2,5594
Foot length, mm	14,00	33,45±0,35	3,93	9,00	34,06±0,42	3,71	-0,1543
Ear length, mm	13,00	17,29±0,17	3,62	10,00	16,87±0,28	5,25	1,2822
Heart weight, g	15,00	0,7±0,02	11,46	11,00	0,74±0,025	11,28	-1,2494
Liver weight, g	15,00	4,63±0,19***	15,54	11,00	5,4±0,155	9,51	-3,1402
Kidney weight, g	15,00	0,62±0,017***	10,67	11,00	0,69±0,018	8,7	-2,8273
Adrenal capsule weight, g	15,00	0,025±0,002	29,74	11,00	0,025±0,002	27,01	0
Thymus weight, g	15,00	0,024±0,003	41,07	11,00	0,036±0,006	60,59	-1,7889
Spleen weight, g	14,00	0,26±0,03	39,19	11,00	0,31±0,05	49,65	-0,8575
Lungs weight, g	15,00	1,61±0,065*	15,64	11,00	1,79±0,06	11,37	-2,0348

Note: Validity of the difference between the sexes is * at $P<0.05$, *** at $P<0.01$.

Table 2

Morphophysiological indices	Males	Females
Relative body weight	0,08	0,08
Skin index	0,18	0,17
Tail index	0,92	0,94
Foot index	0,21	0,21
Ear index	0,11	0,10
Heart index, ‰	5,61	5,72
Liver index, ‰	37,09	41,77
Kidney index, ‰	4,97	5,34
Adrenal capsule index, ‰	0,20	0,19
Hepatosuprarenal coefficient	185,45	219,84
Thymus index, ‰	0,19	0,28
Spleen index, ‰	2,08	2,40
Lungs index, ‰	12,90	13,85

The variation coefficient of the exterior features of the flying squirrel found in Tyumen region, except for the skin weight, does not exceed 10% which can be an indicator of favorable environmental conditions ensuring morphological stability of the species.

As for the interior features, the absolute liver and kidney sizes are significantly bigger which can be traced in the organs' indices. This can be a sign of a balanced energy metabolism with a little increased metabolism of this group of the intra-population group ensuring its reproduction and further existence.

At that the females' bodies do not show any signs of stress: their adrenal capsule index is even slightly lower than the males'. Hepatosuprarenal coefficient of the males tends to be higher as well. The lungs weight of the females is higher as compared to the males, which increases their respiratory capacity. The same is confirmed by comparison of their relative dimensions.

Variability of the interior indices of the population of the flying squirrel in the south of Tyumen region is higher as compared to the exterior ones. The variation coefficient of the following features is especially high: thymus weight, spleen weight (that is a multifunctional organ reacting practically to anything) and adrenal capsule weight which is responsible for the activation of the mechanisms of adaptation under stressful conditions.

The low infestation with ecto- and endoparasites (3.8% invasion is registered for the former and none at all for the latter) is another proof of the generally favorable environment of the species.

Conclusion. We have determined that the habitation area of the flying squirrel in Tyumen region stretches from the northern taiga (inclusive) to the middle wooded steppe zone. The maximum population density was registered in the southern taiga subzone. Everywhere the flying squirrel prefers ecotones along the edge of the swamp

among such tree species as the birch, cedar pine, fir tree, aspen and linden. The morphophysiological parameters and intra-population variation value indicate a stable internal condition of the population of the flying squirrel in the southern taiga of Tyumen region which is located in the favorable ecological conditions.

REFERENCES

1. Kulebjakina E.V. *Populjacionnaja jekologija letjagi (Pteromys volans* L.*) v prirodnyh kompleksah vostochnoj Fennoskandii* (avtoref. diss. kand.) [Population Ecology of the Flying Squirrel (*Pteromys volans* L.) in the Natural Habitats of Eastern Fennoscandia (avtoref diss. kand.)]. Petrozavosk, 2010. 27 p. (in Russian).

2. Zadiraka E.S. *Territorial'noe raspredelenie i biologija letjagi obyknovennoj (Pteromys volans L.) v taezhnyh jekosistemah evropejskoj zony Rossii i Urala* (avtoref. diss. kand.) [Territorial Distribution and Biology of the Flying squirrel (*Pteromys volans* L.) in Taiga Ecosystems of the European Part of Russia and Urals (avtoref. diss. kand.)]. Petrozavosk, 2012. 23 p. (in Russian).

3. Baranov P.V. *Biologicheskie resursy Kemerovskoj oblasti* (Biological resources of Kemerovo Region) Available at: http://ineca.ru/?dr=bulletin/arhiv/0095/&pg=006 (accessed 27 March 2013) (in Russian).

4. Gashev S.N., Sorokina N.V., Hritan'ko O.A. *Katalog chetvertichnoj (plejstocen-golocenovoj) fauny mlekopitajushhih Tjumenskoj oblasti* [Catalog of the Quaternary (Pleistocene – Holocene) Fauna in Tyumen region]. Tyumen: Tjumenskij gosudarstvennyj universitet publ., 2006. 180 c. (in Russian).

5. *Krasnaja kniga Kurganskoj oblasti* [Red Data Book of Kurgan Region]. Kurgan: Kurganskij gosudarstvennyj universitet publ., 2012. 448 p. (in Russian).

6. *Katalog mlekopitajushhih SSSR (pliocen-sovremennost')* [Catalog of Mammals in USSR (Pliocene – Modern Times)]. Leningrad: Nauka, 1981. 456 p. (in Russian).

7. Gashev S.N. *Mlekopitajushhie Tjumenskoj oblasti. Spravochnik-opredelitel'* [Mammals of Tyumen region. Reference Book.]. Tyumen: Tjumenskij gosudarstvennyj universitet publ., 2008. 336 p. (in Russian).

8. *Krasnaja kniga Omskoj oblasti* / Otv. red. G.N. Sidorov, V.N. Rusakov. Omsk: Omskij gosudarstvennyj pedagogicheskij universitet publ., 2005. 460 p. (in Russian).

9. Hanski, I.K. Home ranges and habitat use in the declining flying squirrel, Pteromys volans, in managed forests. *Wildlife Biology*. 1998. 43. P. 33-46.

10. Gashev S.N., Sazonova N.A., Nizovcev D.S. Distribution of the Flying Squirrel (*Pteromys volans* L.) in Tyumen region. *Vestnik ohotovedenija — Herald of Game Management*. Vol. 7. № 2. 2010. Pp. 206-209 (in Russian).

11. Shvarc S.S., Smirnov V.S., Dobrinskij L.N. *Metod morfofiziologicheskih indikatorov v jekologii nazemnyh pozvonochnyh* [The Method of Morphophysiological Indicators in the Ecology of Terrestrial Vertebrates]. Sverdlovsk, 1968. 388 p. (in Russian).

12. Lidicer, W.Z. Regulation of numbers in an Island population of California Vole: a problem in Community Dynamics. *Ecological Monographs*. 1973. V. 43. № 3. P. 271–302.

13. Korneev G.A., Karpov A.A. Experience of Study of the Liver and Adrenal Indices as Indicators of the Energetic Potential of the Population of the Giant Day Jird. *Gryzuny — Rodents*. Moscow: Nauka, 1980. Pp. 213–214 (in Russian).

14. Gashev S.N., Nizovcev D.S., Parfenov A.D., Sorokina N.V., Sharafutdinov I.G. On the Problem of Discovering Rare and New Vertebrate Species in Tyumen Region [K voprosu o

nahodkah redkih i novyh vidov pozvonochnyh v Tjumenskoj oblasti]. *Tezisy dokladov III Mezhdunarodnoj konferencii «Okruzhajushhaja sreda i menedzhment prirodnyh resursov»* (Theses of the Reports of III International Conference "The Environment and Management of Natural Resources"). Tyumen, 2012. Pp.54-56 (in Russian).

15. Hanski, I. K., Kurhinen, J., Danilov, P., Belkin, V. Investigation of Flying Squirrel *Pteromys volans* abundance in Fennoscandia: experience in Finland and perspectives in NW Russia. *Proceeding of International Conference "Anthropogenic Transformation of Taiga Ecosystems in Europe: Environmental, Resource and Economic Implications"*. Petrozavodsk. 23-25 November 2004. P. 144-145.

16. Hanski I., Kurhinen Ju.P., Ivanter Je.V., Kulebjakina E.V., Zadiraka E.S. The Flying squirrel (*Pteromys volans* L.) in Taiga Ecosystems of Fennoscandia: Experience of International Research [Letjaga (*Pteromys volans* L.) v taezhnyh jekosistemah Fennoskandii: opyt mezhdunarodnyh issledovanij]. *Severnye territorii Rossii: problemy i perspektivy razvitija. Materialy Vserossijskoj konferencii* (Northern territories of Russia: Problems and Perspectives of Development. Materials of All-Russian Conference). Arkhangelsk: Institut jekologicheskih problem Severa UrO RAN, 2008. Pp. 1445-1448 (in Russian).

17. Kulebjakina E.V., Zadiraka E.S., Kurhinen Ju.P. Some Aspects of the Flying Squirrel's (*Pteromys volans* L.) Biology in the Anthropogenic Landscape of the west of the Taiga Zone of Russia. *Jekologija zhivotnyh i faunistika — Animal Ecology and Fauna Studies*. Issue 8. Tyumen: Tjumenskij gosudarstvennyj universitet publ., 2008. Pp. 43-49 (in Russian).