Russian Journal of Ecology, Vol. 35, No. 5, 2004, pp. 337–342. Translated from Ekologiya, No. 5, 2004, pp. 380–385.

Ecological Characteristics of Small Rodents Living in Collective Gardens

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Received June 16, 2003

Abstract—The small-rodent populations of five collective gardens have been studied. The example of one of the populations has been used to monitor the annual cycle of population size. The species composition and animal number depends on the biotope, climatic conditions, and the anthropogenic load. The ratios between species in the gardens and neighboring biotopes differ from each other, with different species being dominant. It is assumed that small mammals use garden plots as refugia.

Key words: small mammals, species composition, species diversity, numbers, garden plots.

The anthropogenic transformation of the biosphere has been one of the strongest global processes in the past few decades. Changes in the land use pattern substantially affect the natural environment. The privatization of lands in many regions of Russia has caused a rapid increase in the number of garden plots, mainly due to the allotment of new areas. Many cities and towns are currently surrounded by dozens of collective gardens, in which specific ecosystems are being formed. These ecosystems possess the main properties of natural habitats, on the one hand, and alteration by human activities, on the other. Small mammals (mostly rodents) are a permanent and important component of these ecosystems. As these animals are widespread and reproduce at a high rate, they cause considerable damage to plantations and are prospective carriers of some infections hazardous to humans. However, the small-mammal communities of collective gardens had not been the subject of special research before our study. All previous observations (Inozemtsev, 1997, 1998; Polushina, 1987; Ponomarev *et al.*, 1994; Tikhonov *et al.*, 1992; Ksents, 1988) were fragmentary. Therefore, an integrated analysis of the species composition, population dynamics, and the entire spectrum of the parameters characterizing the small-mammal populations of garden plots is important in terms of both fundamental faunistic research and applied regional ecological problems.

Chelyabinsk oblast is a region stretching for almost 500 km in the north–south direction (from 56°18′ to 52° N), within which taiga landscapes on the plains are replaced by the landscapes of true steppes (Kolesnikov, 1969). The differences in relief determine the differences in climate. In turn, climatic variation is responsible for a variegated plant cover, which largely affects the species composition of the mammal population. Seventy-six mammalian species belonging to six orders live in the Chelyabinsk oblast (Latyushin and Shapkin, 1992).

MATERIALS AND METHODS

The studies were performed in garden plots located within and beyond the Chelyabinsk city limits.

The Traktorosad no. 4 collective garden, founded in 1984, is located by a lake at the eastern boundary of the city. It is surrounded by railways and protective forest strips. The greater part of the garden is marshy. Small pastures lie around the garden. About half the lake shoreline is overgrown with reeds. Two villages are located near the garden. Animals for comparative analysis were trapped in pastures, forest strips, and reed thickets.

The Metallurg garden was established in 1953. It is located at the northern city boundary and is divided in two by a road. It is almost entirely surrounded by the Kashtak Park Forest and borders on the Chelyabinsk Combined Metallurgical Plant and the Kashtak village on one side. Although it is located near an industrial enterprise, the garden is relatively clean, because northwesterly winds prevail there. The terrain is elevated and dry. Animals for comparison with the garden population were trapped in the birch part of the park forest and in pine and oak–maple forest stands.

The Traktorosad no. 1 garden was established in 1948 and is a part of an expanse of gardens. It borders on a lake (the shore is relatively high and open) and other gardens on one side and the city on the other side. These gardens are regarded as the most polluted in the city because of the neighboring thermoelectric power plant and constant winds carrying pollutants from

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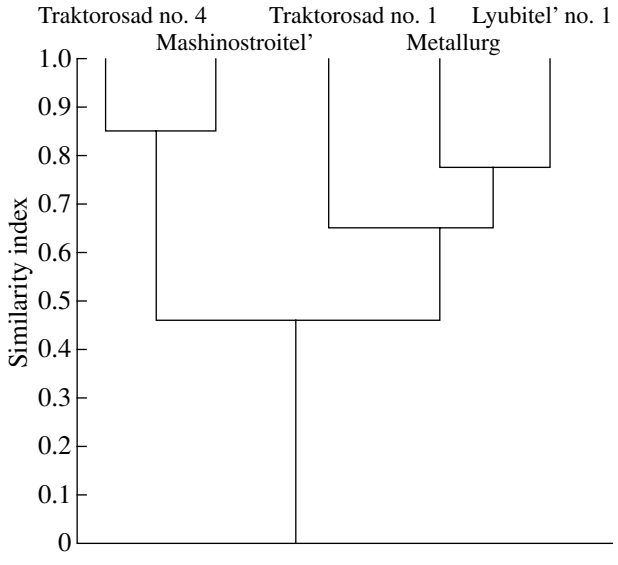

Fig. 1. Dendrogram of similarity between small-mammal communities based on the Czekanowski–Sørensen similarity index.

industrial enterprises. There are no natural or artificial forest stands near the gardens.

The Lyubitel' no. 1 garden was established in 1949. It is entirely surrounded by residential areas; private cellars and a narrow belt of ash-leaved maple stands are located along a solid iron fence. The terrain is elevated and dry.

The Mashinostroitel' garden was established in 1991. It is located 50 km away from Chelyabinsk, between the Vanyushi and Chernyavskaya railroad stations in Krasnoarmeiskii raion of Chelyabinsk oblast. Near the garden, there is a lake with an adjacent marshy area overgrown with reeds and willows. For comparison, censuses were performed in birch–aspen groves, a wheat field, a hayfield, and the marshy area.

The Traktorosad no. 4 garden served as a stationary area in which animals were trapped nine times between January and November 2002 (Fig. 3). In other gardens, the animals were trapped in May, July, and September. The field work amounted to 10625 trap-days, with 1028 animals trapped.

We used crush traps with standard bait (bread and sunflower seed oil). In each garden and adjacent biotopes, we set four lines of 25 traps each and left them for four days. In winter, two lines were set. In gardens, the traps were arranged approximately 5 m apart in secluded places along the paths near fences. All animals were subjected to the standard zoological examination. The species status of the common vole was determined by Markova (2002) with the use of multivariate statistical analysis of odontological characters. The study area is inhabited by twin species: the common vole *Microtus arvalis* Pall. and the Eastern European vole *M. rossiaemeridionalis* Ognev, 1924.

RESULTS AND DISCUSSION

We found ten species of small mammals belonging to three families and two orders in the gardens studied and the adjacent biotopes. In addition, we found the suslik *Citellus major* Pall. and the hare *Lepus europeus* Pall. Norway rats mainly inhabited the watchmen's lodges. As seen from Table 1, the pygmy wood mouse *Apodemus uralensis*, species of the genus *Sorex*, the house mouse, and twin species of the common vole were the most prevalent. We divided the gardens into two groups according to the species composition of rodents and insectivores inhabiting them (Table 2). The first group comprised the collective gardens established 50 years ago or earlier; they were mostly located in dry biotopes (Lyubitel' no. 1, Traktorosad no. 1, and

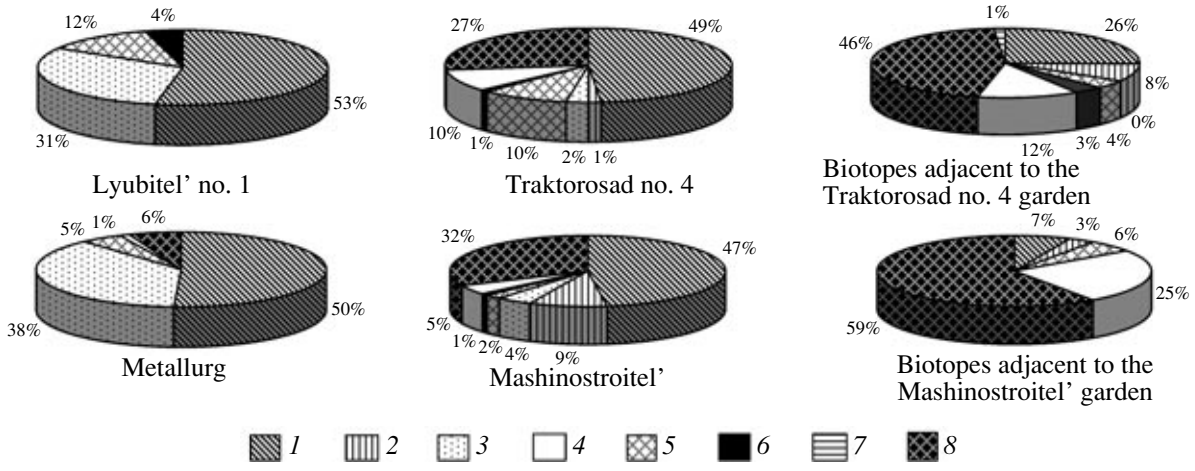

Fig. 2. Species ratios in the gardens and their vicinities: (*1*) *Apodemus uralensis*, (*2*) *A. agrarius*, (*3*) *Mus musculus*, (*4*) *Clethrionomys rutilus*, (*5*) *Microtus arvalis* and *M. rossiaemeridionalis*, (*6*) *M. oeconomus*, (*7*) *Microtus gregalis*, and (*8*) *Sorex* sp.

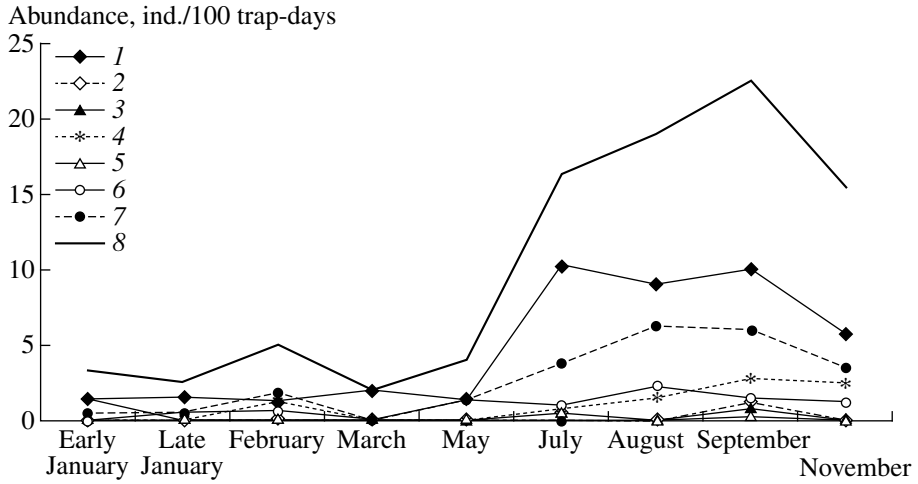

Fig. 3. Relative abundance of small mammal species in the Traktorosad no. 4 garden: (*1*) *Apodemus uralensis*, (*2*) *A. argarius*, (*3*) *Mus musculus*, (*4*) *Microtus arvalis* and *M. rossiaemeridionalis*, (*5*) *Microtus oeconomus*, (*6*) *Clethrionomys rutilus*, (*7*) *Sorex* sp., and (*8*) total.

Metallurg). The second groups comprised gardens set up later (12–19 years ago) located in moist biotopes (Traktorosad no. 4 and Mashinostroitel'). The groups of gardens differed in the species composition and numbers of small mammals. We caught 202 and 482 animals in the first and second groups, respectively. Cluster analysis using the Czekanowski–Sørensen similarity index confirmed the data obtained (Fig. 1).

Thus, in the series of gardens studied, the species composition and numbers of animals varied depending on anthropogenic load and biotope transformation. Figure 2 shows the relative numbers of animal species in the gardens and adjacent biotopes. The pygmy wood mouse *A. uralensis* was the main dominant in the first group of gardens; this species accounted for 116 out of 202 animals captured (57%). According to Kolcheva (1992), this species is subdominant and its proportion in a sample does not normally exceed 25%. The high activity and ability to migrate allow it to spread over large areas very rapidly (Evdokimov, 1980).

The house mouse *Mus musculus* was the second dominant species in the first group (55 animals or 27.2%). This is a synanthropic species closely connected with various buildings; only in the warm season, when shelters and food abound, can it move to open habitats, and its ecology under these conditions has not been studied in sufficient detail. Most gardens of the first group are located near city residential areas, which favors the spread and migration of *M. musculus.* In addition, people live in some garden houses year round, which is also favorable for house mice. However, we found virtually no animals in the biotopes adjacent to the Metallurg garden, where most *M. musculus* were caught. We trapped only one mouse in the birch part of the park forest.

Approximately 9% of all animals in catches belonged to the twin species of the common vole. They are widespread in Chelyabinsk oblast. In addition, we trapped two root voles (*Microtus oeconomus*), one northern red-backed vole (*Clethrionomys rutilus*), and six shrews in gardens of the first group. Four common hamsters (*Cricetus cricetus*) trapped with crush traps did not reflect the true numbers of this species. The gardeners sometimes catch seven to nine *C. cricetus* during summer using traps or by pouring water into burrows.

Table 1. Species composition and numbers of animals trapped

Species	Number of animals					
	total		in gardens		in adjacent biotopes	
	ind.	%	ind.	%	ind.	%
Apodemus uralensis	428	41.6	355	52.0	73	21.2
Sorex sp.	307	29.9	141	20.6	166	48.1
Clethrionomys rutilus	93	9.0	37	5.4	56	16.2
Microtus arvalis (+*M. rossiaemeridionalis*)	71	6.9	55	8.1	16	4.6
Mus musculus	68	6.6	67	9.8	1	0.3
Apodemus agrarius	41	4.0	19	2.8	22	6.4
Microtus oeconomus	14	1.4	6	0.9	8	2.3
Microtus gregalis	3	0.3	0	0.0	3	0.9
Cricetus cricetus	3	0.3	3	0.4	0	0.0
Total	1028		683		345	

Table 2. Species composition of rodents in different collective gardens

Area	Total number trapped	Number of trap-days	*Apodemus uralensis*	*Apodemus agrarius*	*Mus musculus*	*Microtus arvalis*	*Microtus oeconomus*	*Microtus gregalis*	*Clethrionomys rutilus*	*Cricetus cricetus*	*Sorex* sp.
Traktorosad no. 4											
garden	333	2687	168	5	6	34	3	0	29	0	88
adjacent biotopes	228	2988	58	19	0	8	8	3	28	0	104
Mashinostroitel'											
garden	149	800	71	14	6	3	1	0	7	0	47
adjacent biotopes	104	800	7	3	0	6	0	0	26	0	62
Metallurg											
garden	75	950	34	0	31	4	0	0	1	0	5
adjacent biotopes	12	550	8	0	1	1	0	0	2	0	0
Traktorosad no. 1	78	1100	56	0	9	8	0	0	0	4	1
Lyubitel' no. 1	49	800	26	0	15	6	2	0	0	0	0
Total	1028	10675	428	41	68	70	14	3	93	4	307

As noted above, the gardens of the second group are located at the city outskirts or close to the city or other settlements. There are lakes with thickly overgrown shores near them, and the gardens are partly flooded in years when water is especially high. The most prevalent small-mammal species in the second group of gardens were the pygmy wood mouse *A. uralensis* (50%), shrews of the genus *Sorex* (28%), the northern red-backed vole (7.5%), and twin species of the common vole (7.5%). The striped field mouse (*A. agrarius*), root vole, and common hamster were almost absent.

The species ratio in the biotopes adjacent to the gardens was entirely different (Fig. 2). Species of the genus *Sorex* were dominant there (50%), with *A. uralensis* being the second dominant (about 20%). The proportion of northern red-backed vole in the small-animal population was 16%; the striped field mouse, root vole, and twin species of the common vole accounted for 13.5%; and neither house mice nor common hamsters were found.

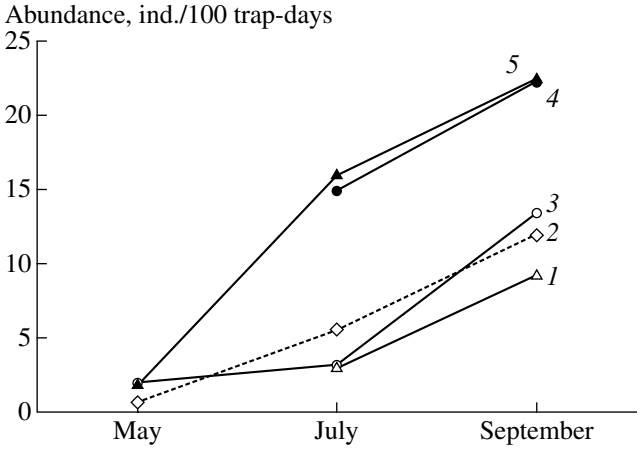

Fig. 4. Population dynamics of small mammals in (*1–3*) the first and (*4, 5*) the second groups of gardens: (*1*) Lyubitel' no. 1, (*2*) Traktorosad no. 1, (*3*) Metallurg, (*4*) Mashinostroitel', and (*5*) Traktorosad no. 4.

The communities studied were very similar to one another with respect to the rank distribution of species abundance. This distributions were close to lognormal, which is typical of natural communities (Magurran, 1988). There were more species (seven) in relatively young gardens (Traktorosad no. 4 and Mashinostroitel'); in other gardens, there were four to six species. We estimated the species abundance and alignment in the communities using Shannon's index. With respect to this parameter, the Traktorosad no. 4 garden differed from its vicinity (1.33 and 1.41, respectively) and the Mashinostroitel' garden (1.32) differed from the Traktorosad no. 1 and Lyubitel' no. 1 gardens, as well as from the vicinity of the Mashinostroitel' garden (0.99, 1.09, and 1.10, respectively). In each natural biotope separately, the number of species and species diversity were considerably lower than in the adjacent garden plots. In general, the gardens and surrounding natural biotopes were characterized by very low values of Shannon's index (i.e., low species diversity), compared to their normal range reported by different authors (1.5–4.5).

Seasonal variation in abundance is one of the most important and the least studied issues of the ecology of small mammals living in collective gardens. In the period of our study, the winter was unusual for this region: the daily average air temperatures from January

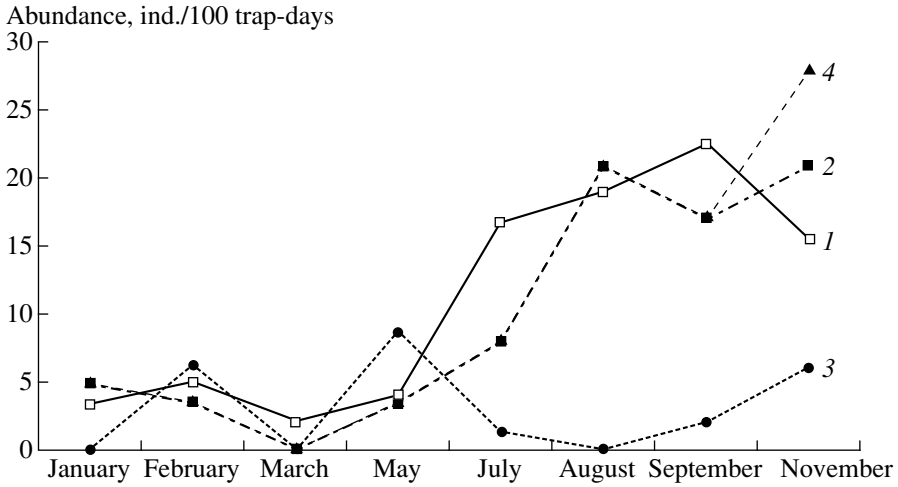

Fig. 5. Seasonal population dynamics of small mammals in natural biotopes adjacent to gardens: (*1*) Traktorosad no. 4, (*2*) forest strip, (*3*) pasture, and (*4*) reed thickets.

to March were 6–10 K higher than normal, the temperature was sometimes above zero (+2°C) even in January, and snow depth was less than usual. The relative abundance of small mammals in the Traktorosad no. 4 garden in January and February reached 2.9 and 4.9 animals per 100 trap-days, respectively (Fig. 3). Gardens proved to be the preferred habitats for small mammals, exceeding the surrounding natural biotopes in both the abundance and species composition of these animals. In the gardens, we trapped mammals of the following species: species of the genus *Sorex*, *A. uralensis, M. musculus, C. rutilus*, and twin species of the common vole. In the protective forest strips and pastures, we found only three and two species, respectively. Different parts of the same garden also differed from one another: the species composition was more diverse near permanently inhabited houses and buildings where fruits were stored.

In March, mammals disappeared from the forest strips and pastures because of the cold spring, multilayered snow crust, repeated snow melting, and, as a consequence, flooded burrows and the absence of shelter (Nurtdinova, 2002). In spring, the factors making gardens preferable for animals were a relatively deep snow (almost without crust), which didn't melt completely until late March (in contrast to the adjacent biotopes), numerous refuges, and additional food resources. The mild winter provided favorable conditions for rodents. We trapped (on March 1) pregnant, parous, and young root voles. We also observed an early growth of testes in *A. uralensis* (153 and 125 mg in February 2002 and March 2003, respectively).

The increase in the relative abundance of all animals followed different patterns. In the first group of gardens, this parameter increased slowly and exceeded the initial value by a factor of 4 only by September. In the second group, the relative abundance rapidly and exceeded the initial value by factors of 4 in July and 5.6 in September (Fig. 4).

In some biotopes adjacent to Traktorosad no. 4, including the thicket near the lake and the forest strips, the relative abundance of animals was the same as in the gardens; however, it increased in November, which was likely accounted for by the migration of shrews (Fig. 5). In open areas (pastures), there were almost no animals in summer, probably because of cattle grazing.

Thus, our studies demonstrated that both the numbers and species composition of small mammals in garden plots directly depended on the types of biotopes, climatic conditions, and anthropogenic load. The pygmy wood mouse *A. uralensis* was the main dominant species in all areas studied. The gardens could be divided into two groups according to species ratio, species diversity, and seasonal population dynamics. One group comprised of gardens older than 50 years located in dry biotopes within city residential areas. *Apodemus uralensis* and *M. musculus* were dominant species there. The other group comprised gardens established 12–19 years ago. They were located in moist biotopes; *A. uralensis* and species of the genus *Sorex* were their main dominant species. The gardens and adjacent biotopes differed from each other with respect to species ratio, with different species being dominant in them. It may be assumed that small mammals use the transformed areas of garden plots as refugia, which is evidenced by seasonal variations in numbers.

ACKNOWLEDGMENTS

This study was supported by the Russian Foundation for Basic Research, project no. 01-04-96406 "Species complexes of Terrestrial Animals in Natural and Technogenic Landscapes of the Urals."

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