SEASONAL CHANGES IN BURROWING OF THE COMMON HAMSTER (*CRICETUS CRICETUS* L., 1758) (RODENTIA: CRICETIDAE) IN THE CITY

Elena A. Katzman, Elena A. Zaytseva, Natalia Yu. Feoktistova, Nikolay N. Tovpinetz, Pavel L. Bogomolov, Ekaterina V. Potashnikova, and Alexey V. Surov

A. N. Severtsov Institute of Ecology and Evolution, Russian Academy of Sciences
33 Leninsky Prosp., Moscow 119071, Russia
E-mail: feoktistovanyu@gmail.com

Received 14 April 2018, revised 17 May 2018, accepted 23 August 2018

Katzman E. A., Zaytseva E. A., Feoktistova N. Yu., Tovpinetz N. N., Bogomolov P. L., Potashnikova E. V., Surov A. V. Seasonal Changes in Burrowing of the Common Hamster (*Cricetus cricetus* L., 1758) (Rodentia: Cricetidae) in the City. *Povolzhskiy Journal of Ecology*, 2018, no. 3, pp. 251–258 (in Russian). DOI: https://doi.org/10.18500/1684-7318-2018-3-251-258

The Common hamster (*Cricetus cricetus*) has been intensively colonizing cities during the last decades. Changes in the burrow numbers and their distribution over an area might be important indicators of the population status for the Common hamster in an urban environment. In this study, we consider the character of the burrow distribution on the experimental plot (2.2 ha) situated in the park of Simferopol City, Russian Federation. The brushwood and tree vegetation on this plot had been previously mapped in detail. Hamster burrows were put on the map once a quarter during a year. The peak of burrowing activity is shown to be in November. Interestingly, the ground activity of hamsters continued even in the coldest month (January) of the year but the number of used burrows was very low. The squares where both trees and burrows were present (by average annual indicators) was met significantly more frequently than burrows in the tree-free squares ($P = 0.02$; $\chi^2 = 5.2$) but this was not the case for the winter and spring seasons. We assume that the connection of burrows with arboreous vegetation facilitates digging, ensures better protection from predators and is a food source. All these factors ensure favorable conditions for the high abundance of the Common hamster in the urban environment.

Key words: Common hamster, burrow, urban population, vegetation.

DOI: https://doi.org/10.18500/1684-7318-2018-3-251-258

INTRODUCTION

During the last decades, urbanization on the global scale is constantly progressing and the urban human population is expected to increase by 2.5 billion in the next 30 years (World urbanization prospects…, 2014). This process represents an unintentional worldwide experiment that can provide insights into how animals will respond to future changes of environmental and anthropogenic parameters (Lahr et al., 2018). New human settlements initiate the process of degradation of natural habitats which are substituted by new ones with unusual niches, settled by variable animal species.

The Common hamster (*Cricetus cricetus*) is a species intensively colonizing urban landscapes for several decades in Western Europe and in some Russian cities, such as

Vladimir, Nalchik, Kislovodsk, Omsk, etc. (Feoktistova et al., 2013, 2016; Surov et al., 2016). In Simferopol (the capital of Republic of Crimea) the Common hamster was known since 1907 (Ognev, 1924) but an abundant urban population was firstly registered since the 70th of XX century (Tovpinets et al., 2006).

Burrows are essential for the species as a daytime residence; they are used as forage storehouses, as refugees to avoid danger, as breeding places and hibernacula. Hamster burrows may be up to 2 meters deep and usually are strongly branched. Main factors for burrowing are a depth of soil layer and level of subterranean water. Usually, one animal occupies a burrow except for females with their litter (Górecki, 1977). The hamster has both winter burrows (more deep and branched) and simpler summer ones (Grulich, 1981; Nechay, 2000). Burrows have two types of entrances, through the inclined and vertical channels. As a rule, there is no excavated material around the entrance of a vertical channel because soil and debris are removed through the inclined channel.

Tunnels are directed to the nest chamber, locating at a depth of 50 – 70 cm (Karaseva et al., 1999). In late July – August, hamsters leave summer burrows to arrange the winter retreats. This transition period usually lasts from late July until October (Karaseva, 1962). K. L. Novikov (1932) also mentioned the annual seasonal migrations of hamsters for modest distances connected with the arrangement of winter burrows. These burrows are situated usually not far from the summer ones within a distance of 5 – 10 m. The structure of burrows may vary greatly depending on soil and type of surrounding vegetation. In addition, it also depends on sex, age and abundance and changed during the year (Nechay, 2000).

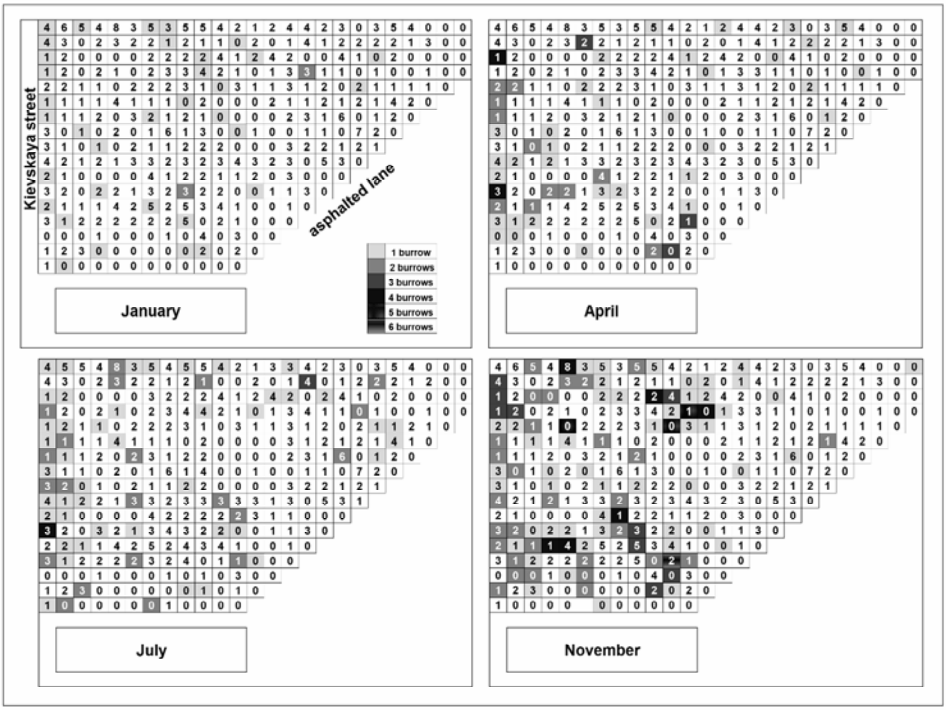
Therefore, changes in burrow abundance and their distribution over the area might be important indicators of the population condition for the Common hamster in an urban environment.

The present paper describes seasonal changes in burrowing activity of the Common hamster at the experimental plot in the Simferopol city park.

MATERIAL AND METHODS

Description of the experimental plot. The test plot was set up in 2015. It covered an area of 2.2 ha and was situated in Simferopol city in the park named after Yury Gagarin (34.1 N, 44.9 E). The vegetation here includes grass, brushwood and trees. In 2016 – 2017 a record of all trees and shrubs with their taxonomic identification was performed (Table 1). Location of each tree was mapped using laser range finder and GPS navigation with sitting over the spatial grid of 10x10 m. Special tags reflecting their location within particular grid cell were put on trees. From one side the plot is bordered by a large city road – Kievskaya street, from the other side – by an asphalted lane, illuminated during night hours, with fast-food stalls and refuse containers. Third and fourth sides border with variable park amusements with appropriate lights and music (Figure).

Regular tree plantings were realized 50 – 60 years ago and are represented by alleys of Lombardy poplar, Honey locust and some other. The central part of the plot was occupied by dominant tree species: ash-tree, maple, European walnut. They are scattered irregularly, due to their natural colonization. Shrubs are represented by such species as hazel, cherry-plum, bramble and a dog-rose. Shrubs are regularly thinned out as a part of fire-prevention measures and with the intention to reduce the number of ticks, supposed vectors of infectious diseases. The park staff regularly eliminates old dead trees, grasses are cut periodically. So the landscape of the plot constantly changes. In all, 635 trees and shrubs of 25 species are registered on the plot (Table 1). Besides that, there are several concrete sculptures like the horse, camel, the hen with chickens dispersed on the plot.



The density of the hamster burrows and the number of trees on the test plot.
Note: a character in the cell indicates a number of trees, fill rate – a number of burrows

Dominating species are European ash – *Fraxinus excelsior* L (115 sp.), Norway maple – *Acer platanoides* L. (108 sp), and European walnut – *Juglans regia* L. (68 sp). Such trees as white birch – *Betula pendula* L. and white mulberry *Morus alba* L. are represented by single specimens. The average density of trees is about 3 per 100 m^2, but there are empty areas and areas with a higher coverage of trees.

The origin of all tree positions should be considered as complex one, because there are specially planted trees such as Lombardy poplar (*Populus pyramidalis*), Honey locust (*Gleditsia triacanthos*) and Eastern plane (*Platanus orientalis*), bordering alleys of the park, and at the same time the arrangement of dominating tree species – European ash (*Fraxinus excelsior*), Norway maple (*Acer platanoides*) and European walnut (*Juglans regia*) is coincidentally implying natural settlement. The presence of such trees as American arborvitae (*Thuja occidentalis*) and southern catalpa (*Catalpa bignonioides*) also may be explained by special planting by the park personnel.

Table 1

List of trees and shrubs on the plot

No.	Common name	Latin name	Number
1	Cherry-plum	*Prunus cerasifera*	12
2	White birch	*Betula pendula*	1
3	Euonymus	*Euonymus verrucosus*	2
4	Common willow	*Salix alba*	8
5	Honey locust	*Gleditsia triacanthos*	57
6	Common spruce	*Picea abies*	4
7	White spruce	*Picea glauca*	4
8	Southern catalpa	*Catalpa bignonioides*	4
9	Norway maple	*Acer platanoides*	108
10	Maple ash	*Acer negundo*	8
11	Horse-chestnut	*Aesculus hippocastanum*	12
12	European hazel	*Corylus avellana*	18
13	Small-leaved lime	*Tilia cordata*	11
14	European walnut	*Juglans regia*	68
15	Eastern plane	*Platanus orientalis*	51
16	Dogwood	*Cornus alba*	7
17	Garden plum	*Prunus domestica*	2
18	Scotch pine	*Pinus sylvestris*	26
19	Swiss mountain pine	*Pinus uncinata*	16
20	White poplar	*Populus alba*	27
21	Lombardy poplar	*Populus pyramidalis* (*Populus nigra*)	69
22	White mulberry	*Morus alba*	1
23	American arborvitae	*Thuja occidentalis*	3
24	Sweet moc-orange	*Philadelphus coronarius*	1
25	European ash	*Fraxinus excelsior*	115

Mapping of burrows on the plot. Mapping of hamster burrows on the test plot was implemented four times – in winter (January), in spring (April), in summer (July) and in autumn (November). For complete registration of all burrows, three persons searched the entire plot, walking five meters apart from each other. During mapping the burrows were identified as: a new burrow (presently used) (inlet opening 7 – 10 cm in diameter is free or surrounded by amount of excavated material or soil) and old burrow (unused) – the entrance is closed entirely or partly by the soil (Table 2).

Table 2

Seasonal change in burrowing activity and significance of association of presently used burrows with brushwood and tree vegetation

Month	Unused burrows	Used burrows	χ^2	*P*
April	40	70	2.3	0.127
July	52	93	15.8	0.001
November	84	174	7.7	0.006
January	17	36	0.6	0.449
$Mean_{seasons}$	48.3	93.3	5.2	0.023

During the whole study period, samples of the material excavated by animals in the autumn and spring were collected. This material contains vegetable leftovers permitting indirectly to draw conclusions of the composition of the diet. Five samples were studied, sorted out and vegetable remains found were listed in Table 3.

Table 3

Vegetable remains in material excavated from the common hamster burrows

Sample no.	Species	Fragment's type	Number of fragments
1	Cherry-plum	Stone fragments	12
	Cherry	Stone	1
	Eastern plane	Intact nutlets	1
	European ash	Intact seeds	10
	European walnut	Shell fragments	13
	Grasses (Bluegrass, Rye-grass etc.)	Small intact seeds	>100
	Honey locust	Parts of a pod, (small, 4–5 mm long)	25
	Horse-chestnut	Whole fruit	1
	Horse-chestnut	Shell fragments	4
2	Apricot	Half of the fruit with intact stone	1
	Cherry-plum	Stone fragments	5
	European ash	Intact seeds	3
	European walnut	Shell fragments	21
	Grasses (Bluegrass, Rye-grass etc.)	Small intact seeds	>100
	Honey locust	Parts of a pod, (small, 4–5 mm long)	11
	Horse-chestnut	Whole fruits	2
	Norway maple	Samaras	2
3	European ash	Intact seeds	12
	European walnut	Shell fragments, half of a nut with kernel	9, 1
	Garlic mustard	Intact seeds	31
	Grasses (Bluegrass, Rye-grass etc.)	Small intact seeds	>100
	Honey locust	Parts of a pod, (large, 10–12 mm long)	18
	Norway maple	Samaras	1
4	Eastern plane	Intact nutlets	1
	European ash	Intact seeds	5
	European walnut	Shell fragments	9
	Grasses (Bluegrass, Rye-grass etc.)	Small intact seeds	>100
	Honey locust	Parts of a pod, (small, 4–5 mm long)	12
	Horse-chestnut	Intact chestnuts	2
	Horse-chestnut	Shell fragments	6
	Southern catalpa	Parts of a pod, 5–7 mm	6
5	Apple-tree	Fruitcase	1
	Cherry-plum	Shell fragments	3
	European ash	Intact seeds	3
	European walnut	Shell fragments	5
	Grasses (Bluegrass, Rye-grass etc.)	Small intact seeds	>100
	Horse-chestnut	Shell fragments	4
	Honey locust	Parts of a pod, 5–7 mm	7
	Maple ash	Samaras	8

Statistic methods. We ranged plot squares four category: with trees and burrows, with trees and without burrows, with burrows and without trees, without trees and burrows. These squares are calculated in accordance with the specified categories and statistically processed by the χ^2-test.

RESULTS AND DISCUSSION

Figure shows seasonal changes in the distribution of burrows in the test plot. Obviously, the largest number of burrows was registered in November (Table 2), when hamsters actively prepare new winter burrows and clear up the old ones. Note that in January, when the common hamster is usually hibernated, we also recorded the presently used burrows, but their number was five times less than in November.

Is the burrow distribution connected with the presence of trees in particular square? We tested this assumption using the annual and seasonal number of the burrows and presence of trees in particular grid cell. The number of hamster burrows associated with trees was significantly higher than the number of burrows not associated with trees if we took in account annual data (Table 2). However, seasonal distribution had some particular features. Therefore, in January and in April, these connections have not been statistically significant.

Another indirect factor to affect the position and distribution of burrows is managed cutting of trees and shrubs by the staff of the park, leading to notable changes of the landscape. In spring and summer, 2017, the central part of the plot was not densely populated because of cutting shrubs which led to a subsequent displacement of animals to the periphery with thick vegetation. Thus in different seasons hamsters are redistributed over the territory, occupying more convenient microhabitats. Certainly, the character of vegetation is directly associated with soil composition and in its turn defines digging capabilities for hamsters.

A deep trench and earth embankment go along the Kievskaya street (Figure) separating the park territory from the highway. A line of planted shrubs goes parallel to the trench in the park, and an alley of white poplars (*Populus alba*) was planted along the road. Dense vegetation represents good protection for numerous burrows registered in this place the whole year round. Earth embankment with soft soil is very convenient for digging being another factor favoring arrangement of burrows in this area. These factors may be regarded as crucial for the selection by hamsters a good place to dig a burrow.

Main forage plants of the Common hamsters inhabiting the plot were determined using the results presented in Table 3. These are a honey locust, European walnut, cherry-plum, and two species of chestnut. It should be noted that foraging animals might travel outside the plot area to adjacent zones with planted fruit trees. That is why samples contain fragments of plants which are absent on the plot, such as apricot and cherry. Numerous fragments of cherry-plum' stones were found in samples though only 12 specimens of this plant grow on the plot. Some remains such as nutlets of plane, maple's samaras and seeds of ash seemingly are of no feeding value, because all of them were found intact.

The arrangement of young trees of walnut which frequently grow from old burrows of the common hamster, gives evidence of zoochoric spreading of this plant with the hamster as an agent.

Therefore, the arrangement of burrows, their number, and pattern of their use as well as foraging resources and other characteristics are evidence of favorable conditions for supporting a high abundance of the common hamster in urban environment as compared with the wild habitats.

Acknowledgments

The authors are grateful to Ulrich Weinhold, initiator of the International Common Hamster Workgroup, director of the Institut für Faunistik, Heiligkreuzsteinach, Germany, for valuable suggestions on improving the manuscript.

This work was supported by the Russian Foundation for Basic Research (project no. 17-04-01061) and by the Presidium of the Russian Academy of Sciences (project no. 41 "Biodiversity of natural systems and biological resources of Russia").

REFERENCES

Feoktistova N. Yu., Surov A. V., Tovpinetz N. N., Kropotkina M. V., Bogomolov P. L., Siutz C., Haberl W., Hoffman I. The Common hamster as a synurbist: a history of settlement in European cities. *Zoologica Poloniae*, 2013, vol. 58, iss. 3–4, pp. 113–126.

Feoktistova N. Yu., Meschersky I. G., Surov A. V., Bogomolov P. L., Tovpinetz N. N., Poplavskaia N. S. Genetic Structure of Urban Population of the Common Hamster (*Cricetus cricetus*). *Russian J. of Genetics*, 2016, vol. 52, iss. 2, pp. 194–203.

Górecki A. Consumption by and agricultural impact of the Common hamster *Cricetus cricetus* (L.) on cultivated fields. *Bull. OEPP*, 1977, vol. 7, pp. 423−429.

Grulich I. Die baue des Hamsters (*Cricetus cricetus*, Rodentia, Mammalia). *Folia Zoologica*, 1981, vol. 30, iss. 2, pp. 99–116.

Karaseva E. V. Izuchenie s pomoshyu mecheniya osobennostey ispolzovaniya territorii obyknovennogo khomyaka v Altayskom kraye [The study of the peculiarities of territory use by the hamster in Altay province carried out by capture-recapture method]. *Zoologicheskii zhurnal*, 1962, vol. 41, pp. 275−285 (in Russian).

Karaseva E. V., Telitsina A. Y., Samoilov B. L. *Mlekopitayushchie Moskvy v proshlom i nastoyaschem* [Mammals of Moscow in the past and in the present]. Moscow, Nauka Publ., 1999. 244 p. (in Russian).

Lahr E. C., Dunn R. R., Frank S. D. Getting ahead of the curve: cities as surrogates for global change. *Proceedings of the Royal Society B: Biological Sciences*, 2018, vol. 285, iss. 1882, p. 20180643. DOI: https://doi.org/10.1098/rspb.2018.0643

Nechay G. Status of hamsters *Cricetus cricetus*, *Cricetus migratorius*, *Mesocricetus newtoni* and other hamster species in Europe. *Nature and Environment series.* Strasbourg, Council Europe Publ., 2000, no. 106. 78 p.

Novikov K. L. *Khomyak obyknovenny* [The common hamster]. Moscow, Vneshtorgizdat, 1932. 28 p. (in Russian).

Ognev S. I. *Gryzuny Severnogo Kavkaza* [The rodents of the North Caucasus]. Rostov-na-Donu, Gosizdat Publ., 1924. 64 p. (in Russian).

Surov A. V., Poplavskaya N. S., Bogomolov P. L., Kropotkina M. V., Tovpinetz N. N., Katzman E. A., Feoktistova N. Yu. Synurbization of the Common Hamster (*Cricetus cricetus* L., 1758). *Russian J. of Biological Invasions*, 2016, vol. 7, no. 1, pp. 69–76.

Tovpinetz N. N., Evstafiev I. L., Karaseva E. V. Sklonnost k sinantropii u obyknovennogo khomyaka (*Cricetus cricetus*) na osnove issledovaniy v Krymu [Tendency to synanthropy in the Common hamster (*Cricetus cricetus*) based on investigations in the Crimea]. In: I. Zagorodnyuk, ed. *Fauna in Anthropogenic Environments*. Uzhhorod, Pryvatna drukarnya Romana Povcha, 2006, pp. 136–145.

World urbanization prospects: the 2014 revision, Highlights. ST/ESA/ SER.A/352. New York, UN DESA, 2014.

УДК 599.323.42:574

СЕЗОННАЯ ДИНАМИКА В ИСПОЛЬЗОВАНИИ НОР У ОБЫКНОВЕННОГО ХОМЯКА (*CRICETUS CRICETUS* L., 1758) (RODENTIA: CRICETIDAE) В ГОРОДЕ

Е. А. Кацман, Е. А. Зайцева, Н. Ю. Феоктистова, Н. Н. Товпинец, П. Л. Богомолов, Е. В. Поташникова, А. В. Суров

Институт проблем экологии и эволюции им. А. Н. Северцова РАН
Россия, 117071, Москва, Ленинский просп., 33
E-mail: feoktistovanyu@gmail.com

Поступила в редакцию 14.04.2018 г., после доработки 17.05.2018 г., принята 23.08.2018 г.

Katzman E. A., Zaytseva E. A., Feoktistova N. Yu., Tovpinetz N. N., Bogomolov P. L., Potashnikova E. V., Surov A. V. Seasonal Changes in Burrowing of the Common Hamster (*Cricetus cricetus* L., 1758) (Rodentia: Cricetidae) in the City [*Кацман Е. А., Зайцева Е. А., Феоктистова Н. Ю., Товпинец Н. Н., Богомолов П. Л., Поташникова Е. В., Суров А. В.* Сезонная динамика в использовании нор у обыкновенного хомяка (*Cricetus cricetus* L., 1758) (Rodentia: Cricetidae) в городе] // Поволжский экологический журнал. 2018. № 3. С. 251 – 258. DOI: https://doi.org/10.18500/1684-7318-2018-3-251-258

Обыкновенный хомяк (*Cricetus cricetus*) в последние десятилетия интенсивно заселяет города. Изменения в количестве нор и их распределении по территории могут быть важными индикаторами популяционного статуса этого вида в городской среде. В данном исследовании рассматривается характер распределения нор на экспериментальной площадке (2.2 га), расположенной в городском парке г. Симферополь. Предварительно на площадке была детально закартирована древесно-кустарниковая растительность. Жилые норы хомяков наносились на эту карту один раз в квартал в течение года. Показано, что наибольшее количество активно используемых нор приходилось на ноябрь. Интересно, что наземная активность хомяков сохранялась даже в самый холодный месяц года (январь), но число используемых нор в это время было минимальным. Квадраты, в которых присутствовали и деревья и норы (по среднегодовым показателям), встречались достоверно чаще, чем норы в квадратах, лишенных деревьев (P = 0.02, χ^2 = 5.4), но это не относится к зимнему и весеннему сезонам. Мы предполагаем, что связь нор с кустарниковой и древесной растительностью облегчает норостроение, обеспечивает лучшую защиту от хищников и является источником корма. Все эти факторы обеспечивают условия для поддержания высокой численности обыкновенного хомяка в городской среде.

Ключевые слова: обыкновенный хомяк, норы, городская популяция, растительность.

DOI: https://doi.org/10.18500/1684-7318-2018-3-251-258

Благодарности. Работа выполнена при финансовой поддержке Российского фонда фундаментальных исследований (проект № 17-04-01061) и Программы Президиума РАН (проект № 41 «Биоразнообразие природных систем и биологических ресурсов России»).