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Victoria A. IVASHKINA

Zhiguli State Reserve, Samara Region, Zhigulyovsk, Bahilova Polyana, 445362 Russia, e-mail: ivavika@rambler.ru

ABUNDANCE AND ACTIVITY OF THE EDIBLE DORMOUSE (*GLIS GLIS* L.) IN THE ZHIGULI MOUNTAINS (RUSSIA, MIDDLE VOLGA REGION)

ABSTRACT: The object of study was the most eastern population of the edible dormouse (*Glis glis* L.), inhabiting the Zhiguli Mts. (Russia). Numbers of the edible dormouse in different sites, factors relating to its distribution, seasonal population dynamics, postnatal development and activity were studied. Live-trapping was the main study method. The dormice were also studied under laboratory conditions. The most preferred type of forest was lime-oak forest. Dense undergrowth played an important role in distribution of dormice. Number of dormice in studied region was relatively high and stable.

KEY WORDS: activity, *Glis glis*, habitat, population dynamics, postnatal development

1. INTRODUCTION

The edible dormouse (*Glis glis* L.) is a widespread inhabitant of broad-leaved forests. However, in Russia it remains a little known species. Its distribution is limited by the availability of suitable biotopes that have not been subjected to prolonged anthropogenic influence. Dormouse hunting took place mainly before the 19th century. The edible dormouse had some importance as a fur-bearing animal in the Caucasus at the beginning of the last century. The area formerly inhabited by the dormouse was considerably reduced as a result of the old forests clearing, and its present-day distribution within the boundaries of Russia is fragmentary (Likhachev 1972).

Within Russia, the edible dormouse is the most numerous in two separate districts – Volga's and Caucasian. The Caucasus is the most southern region of the distribution of this dormouse, where the edible dormouse reaches a high population density. In the West of Russia its area adjoins Latvia and Lithuania, while the northern boundary extends through the Pskov Region. The eastern boundary follows the Volga (Ognev 1947, Airapetianz 1983, Rossolimo 2001).

Previously, much information about the biology of the edible dormouse in various regions of Russia was accumulated, but these data were mainly obtained incidental to the study of murine rodents (which have much more practical importance) and mostly using trap-lines and trap grids (Kuznecov 1932, Kadackyi 1964, Alania 1971, Volkov 1978). However, ground-based studies give basic data on the occurrence, but do not reflect accurately the numbers of edible dormice, which inhabits tree layer in the forest. In the Volga region the species was studied

by Popov (1960), and directly in the Zhiguli Mountains by Snigirevskaya (1954).

Much data concerning *Glis* ecology in Russia are contradictory. It may be caused by the differences in ecological conditions over the very large area, intrapopulation variation, and improper methods.

Over most of Russia, the edible dormouse is considered a scarce species and is listed in the regional Red Books, but its apparent scarcity may be explained by the shortage of studies. The aim of study was to assess numbers of edible dormice and factors affecting their distribution in order to determine the ecological status of the species in different sites.

2. STUDY AREA

The object of study was the most eastern population of the edible dormouse, inhabiting the Samarskaya Luka peninsula, formed by a bend of the Volga in its middle reach (53′25°N, 49′42°E). The Zhiguli Mountains are located in the northern part of Samarskaya Luka. It is a barrier, which makes the old broad-leaved forests still intact here, although the majority of woods were exposed to logging operations in the past. Most of the Samarskaya Luka peninsula is protected territory. The Zhiguli State Reserve, one of the oldest in Russia, is situated in the mountainous part of Samarskaya Luka. This reserve is notable for its high landscape and biological diversity.

The principal vegetation of Samarskaya Luka is lime (*Tilia cordata* Mill.)-oak (*Quercus robur* L.) forest with some maple (*Acer platanoides* L.) and elm (*Ulmus glabra* Huds.). Pine (*Pinus silvestris* L.) and mixed broad-leaved-coniferous (*Pinus silvestris* L., *Quercus robur* L., *Tilia cordata* Mill., *Coryllus avellana* L.) forests occur in small patches on the slopes and crests of the mountains. Also aspen (*Populus tremula* L.) and birch (*Betula pendula* Roth.) forests of secondary origin with different admixtures grow on Samarskaya Luka. The main type of undergrowth is hazel (*Corylus avellana* L.), sometimes hazel and maple.

Table 1. Description of the sites for lines of traps.

Line	Year		
	2003	2004	2005
1. Lime-oak forest with admixture of maple and elm; sparse hazel-maple undergrowth, sparse grass cover	+	+	+
2. Old birch forest with admixture of maple, elm and oak; very dense hazel undergrowth and grass cover	+	+	+
3. The edge of old birch-lime forest with admixture of maple and elm; undergrowth and grass cover of medium density	+	+	+
4. Old lime-oak forest with dense hazel-maple undergrowth and sparse grass cover		+	+
5. Middle-aged lime-oak forest with admixture of maple; dense undergrowth and high dense grass cover		+	+
6. Birch-lime forest with admixture of maple; sparse undergrowth and very dense grass cover		+	+
7. Middle-aged lime-maple forest with admixture of aspen; sparse hazel-maple undergrowth and grass cover		+	+
8. Birch-lime forest with admixture of oak; dense hazel undergrowth and grass cover			+
9. Mixed pine-lime-oak forest with dense hazel undergrowth and sparse grass cover			+
10. Dense aspen forest with sparse grass cover			+

Note: lines, where no dormouse was trapped, are not included.
+ – year of the line using

3. METHODS

Our research were based on live-capture of rodents using metal traps. These traps were fixed in lines on trees at a height of 1.5 m, approximately 10 m from each other. In September 2005 sampling by live traps was carried out only on the ground level, using all 20 traps, because of parallel research of murine rodents. Each line, of 20 traps, operated for no less than 5 days. Bread fried in sunflower oil was used as bait and changed daily to enhance trap effectiveness. Traps were checked daily during the first half of the day. Sampling of rodents was carried out at 14 lines in various sites (Table 1). One trapping session (June–July) for each line was applied. In lines No. 4 and No. 5 two additional trapping sessions were carried out in 2005 in order to study the dormouse seasonal population dynamics in this year. Sites differed by tree and herb species, and also by the density of undergrowth and herb layer, determined visually. It was divided into three categories: dense, sparse and of medium density. We accepted 25 m distance as a width of forest edges. Some trap points were divided by country roads (from 3 to 12 m wide).

The age of dormice was determined by fur coloration and body mass of the animals. They were divided into three groups: adults (after two hibernations), yearlings (after one hibernation) and juveniles (born in a year of study).

The number of animals caught per 100 trap-nights was used as an index of abundance – it is the standard method for expressing the rodent number. This allows a comparison of numbers of the edible dormouse and murine rodents. In years 2003–2004 all captured dormice were brought to laboratory. In 2005 all dormice were marked by ear tattooing and released at trap site. Other rodents were marked by triarylmethane brilliant green dye (alcohol solution).

At the same time a study of the edible dormouse under laboratory conditions was conducted. These researches were conducted not far from the trap-lines. Dormice were kept in small aviaries under daylight with a volume of approximately 0.5 m^3, with food permanently available. Cardboard boxes were provided as an analogue of natural nest cavities. Bedding in the form of paper and leaves of trees was changed periodically.

4. RESULTS

During 2003–2005, 5040 trap-nights were recorded. A total of 603 animals of 6 species were trapped: yellow-necked mouse (*Apodemus flavicollis* Melch.), field mice (*Apodemus agrarius* Pall. and *A. uralensis* Pall.), bank vole (*Clethrionomys glareolus* Schreb.), edible dormouse (*Glis glis* L.) and forest dormouse (*Dryomys nitedula* Pall.). These included 96 individuals of edible dormice. Their number comprised 16% of the total number of rodents captured. Seventy-one dormice were marked. Another 25 dormice were brought to the laboratory. We recorded age and sex of 85 dormice.

Comparing numbers of the edible dormouse in different years, some oscillations are evident (Fig. 1). These data were obtained with captures in three trap lines (Table 1), performed in 2003–2005. However, it is necessary to note that population density in these lines was low in comparison with trap lines set in subsequent years. In the other trap lines (No. 4–7) numbers of edible dormice in 2005 were 2–4 times greater than in 2004 (Fig. 2).

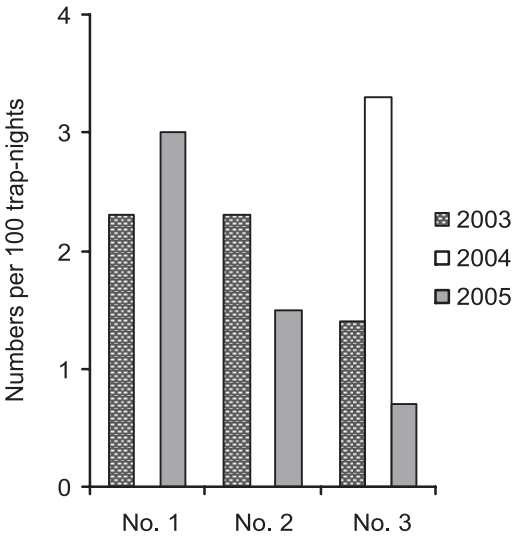

Fig. 1. Comparison of the edible dormouse numbers in the trap-lines No. 1–3 in 2003–2005 (see Table 1).

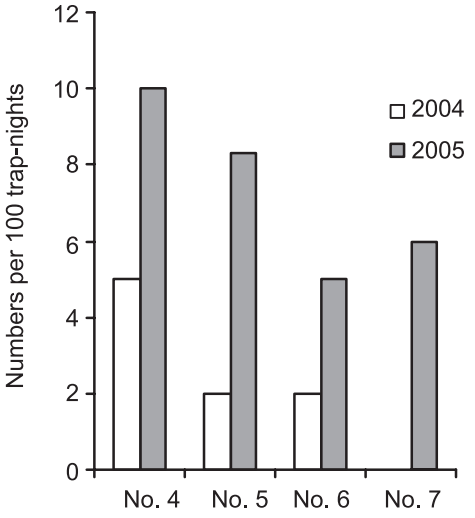

Fig. 2. Comparison of the edible dormouse numbers in the trap-lines No. 4–7 in 2004–2005 (see Table 1).

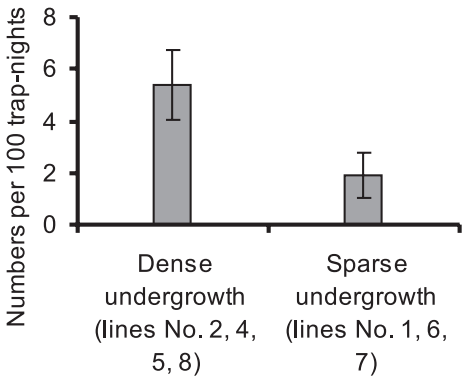

Fig. 3. Numbers of the edible dormouse in forest sites with different density of undergrowth in 2003–2005 (lines No. 1, 2, 4–8).

Site preferences of dormice in June–July, (before the birth of juveniles) can be assessed from Figs 1 and 2 and Table 1. The most preferred forest was an old lime-oak forest (trap-line No. 4), after it mixed pine-lime-oak forest (trap-line No. 9) and birch-lime forest (trap-lines No. 3, 6, 8). In aspen forest only one dormouse was caught in four trap lines, and in pine forest no dormice were trapped. Dependence of edible dormouse distribution upon development of undergrowth was also revealed (Fig. 3).

The trap line No. 4 located on the slope in the old lime-oak forest was the most preferred (Fig. 2, Table 1). The undergrowth was dense, consisting of hazel, and the herb cover was sparse (mostly goutweed (*Aegopodium podagraria* L.) and sedge (*Carex* sp.); sometimes with lily-of-the-valley (*Convallaria majalis* L.), water avens (*Geum rivale* L.), asarabacca (*Asarum* sp.), low blackberry bushes (*Rubus caesius* L.), starweed (*Stellaria holostea* L.), violet (*Viola tricolor* L.), Solomon's seal (*Polygonatum odoratum* (Mill.) Druce), hound's tongue (*Cynoglossum officinale* L.) and nettle (*Urtica dioica* L.). On the other site of the same forest type, with sparse undergrowth, the number of animals caught amounted only to 2.1 individuals per 100 trap nights. The difference in dormouse numbers in the sites with sparse and dense undergrowth was considerable (Fig. 3). The numbers were different within one forest type and lower in the forest edge (Fig. 4). Marking animals also revealed that dormice did not use open spaces (roads and clearings). We didn't record any crossings of the roads.

Seasonal dynamics of numbers of edible dormice was partially followed in 2005 from June until September. In June male high activity in visiting traps was observed. Only one of 16 trapped animals was a female, the rest were male yearlings not ready to reproduce (testes were not extended). In July, adults as well as yearlings of both sexes were found, and the first male ready to reproduce was trapped on July 15. The first lactating female was caught on July 28. In August, animals of both sexes and different ages were also trapped. At this time juveniles dispersal from nests was observed, and 19 trapped individuals were juveniles of the current year. A predominance of males or females in the captures was not noted. In September a number of dormice was the highest (up to 25 dormice caught on the ground per 100 trap-nights). In October traps located on trees caught only juveniles and the last one was captured on October 14 (Fig. 5).

The ratio of males to females among all dormice captured was approximately 1:1 (45:40). A total of 12 adults, 54 yearlings and 19 juveniles were trapped. Thus, capture by live traps, placed both in branches of trees and on the ground, allows successful capture

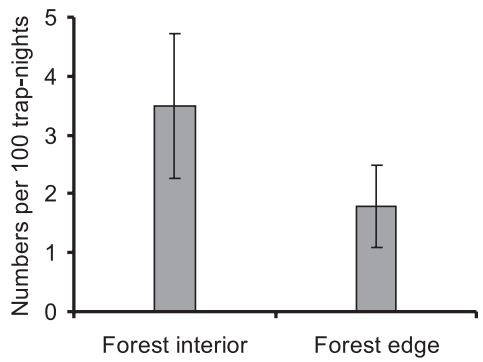

Fig. 4. The edible dormouse numbers in two forest sites in 2004–2005 (number of traps in the forest interior =10 and in the forest edge = 37).

of dormice, mostly young animals – both yearlings and juveniles.

In August 2005 observations of postnatal development of the edible dormouse under laboratory conditions were carried out. Development of 7 individuals (5 males and 2 females) born on July 27, was studied. The juveniles were born blind and naked. Their ears opened on the 19th day and eyes on the 22nd. On the 23rd day small dormice began to leave their cardboard nest box. The young began to move actively and independently on the 26th day, and on the 30th day they begun to eat also other food except milk. At this time their mother had ceased to feed them with milk.

Under laboratory conditions the daily activity of dormice was studied from July 2 to July 12. The activity (all time except for sleeping) of the focal animals was estimated by the duration of active period per 60 minutes during a day. In total, 60 individual daily actinograms for 7 individuals were obtained. The activity of the edible dormouse had a discontinuous character, and the alternation of phases of activity and rest was variable and could change even in one animal. Long breaks in daytime sleep were registered. According to our observations, the animal was active on average 202 minutes per 24 h, varying from 92 to 344 minutes per 24 h (Fig. 6).

Under laboratory conditions dormice ate tips of leaves and seedlings of maple, lime and oak and also insects.

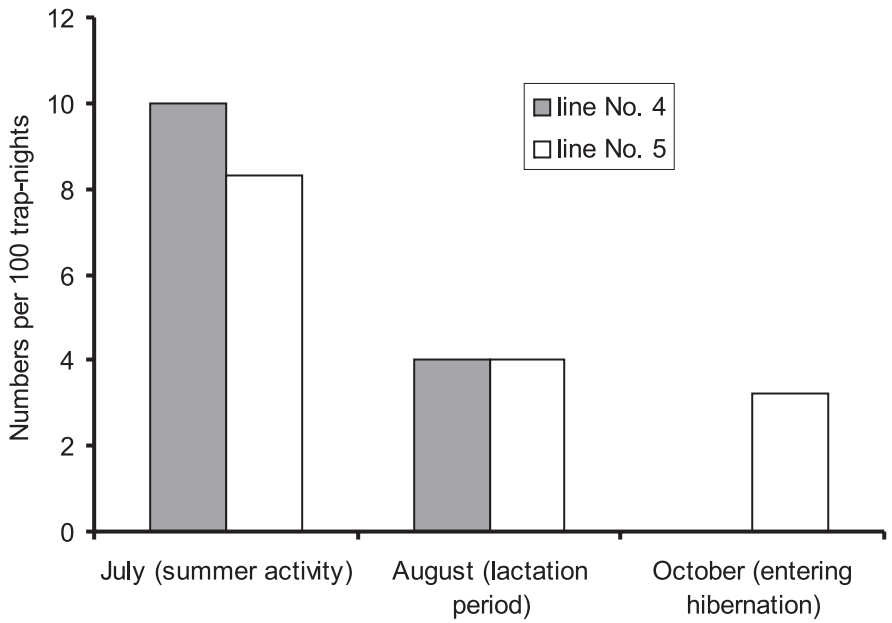

Fig. 5. Seasonal changes of the edible dormouse numbers on the sites with highest numbers of dormice (trap-lines No. 4 and No. 5 – see Table 1) in 2005.

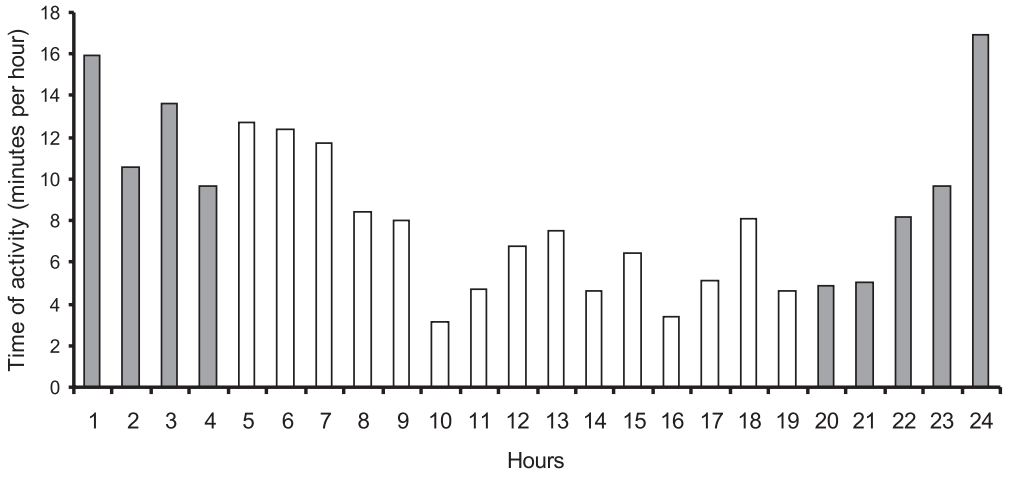

Fig. 6. The actinogram of the edible dormouse (7 individuals, 144 hours of observations). Shaded bars – night hours.

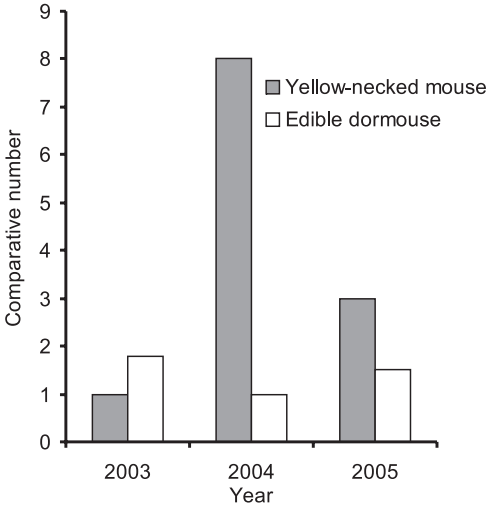

Fig. 7. Comparison of the average numbers of the edible dormouse and the yellow-necked mouse (taking the minimal numbers of both species as 1).

A weak negative relationship between numbers of edible dormice and the yellow-necked mice was observed (Fig. 7). In 2004 a sharp increase in numbers of the yellow-necked mouse (up to 31.6 individuals per 100 trap-nights) was observed, whereas numbers of edible dormice were minimal that year.

5. DISCUSSION

In Russia the different methods of estimating dormice numbers are applied. For example, in the Caucasus absolute counts of *Glis* numbers by their calls was used, while in the Zhiguli Mts. Snigirevskaya (1954) studied a population of this species by finding and

cutting down trees occupied by the edible dormouse. The technique, used by us allows to determine the comparative numbers of the dormice. We confirmed that edible dormice of the Zhiguli Mts. were confined to old broad-leaved and mixed broad-leaved forests, and its occurrence in aspen forests was rarely observed. Being an arboreal species, it avoids the open places and isolated trees, preferring closed, the most shaded forest. This can be explained by greater predation pressure from martens, foxes, polecats, raptors in open spaces. Popov (1960) suggested that in the Volga region dormice dominated in the food of the tawny owl (*Strix aluco* L.) in summer. Gromov (1955) analyzed its pellets collected from heights of the Zhiguli Mts. and found that the edible dormouse made up 50% of the total mammal prey. In less shady parts of woods, with dense herb layer, competition with yellow-necked mice may be very strong as mice reach the highest numbers in such places.

Monitoring the edible dormouse demonstrated high conservatism of this species in the choice of sites. Strong dependence of edible dormouse distribution upon development of undergrowth was revealed. The availability of old hollow trees can be insignificant in the presence of forage in the undergrowth layer. Also the composition of tree species has an important role.

Thus, preservation of continuous forests with undamaged undergrowth is necessary for the population of the edible dormouse. Population density is lower near forest edges. So, roads and pastures as well as the increase of the mid-forest cleared areas enhance the reduction of dormouse numbers.

It was found, that the active period of the edible dormouse in the Zhiguli Mts. was extended compared to the period given in the literature for this region. Research by Popov (1960) in Povolzie revealed, that *Glis* emerged from hibernation at the end of April, and entered hibernation at the second half of September. Similar data were obtained by Snigirevskaya (1954) (June 5–September 26). But in our study, numbers were already stable in June and the last individual was trapped in mid October. And high numbers were caught at the beginning of this month – 3.2 dormice per 100 trap-nights.

We also confirmed that only one litter is produced per year by the edible dormouse in the Middle Volga Region, although some researchers considered that this species has normally two litters per year (Beme 1925, Heptner 1932, Vinogradov 1953).

We conclude that the most eastern population of the edible dormouse is relatively stable. Broad-leaved forests of the Zhiguli Mts. serve as a natural reserve for the dormice, where it occurs in relatively high numbers.

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