
Poster Session 1 – Rodent Behaviour

9 Reproductive behaviour of mothers facing infanticide risk

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The threat of losing offspring to infanticidal conspecifics is widespread in the animal kingdom. If infanticide occurs, this poses enormous fitness costs to parents, in terms of losing out on reproductive investment. Therefore, the level of infanticide risk that a parent perceives should affect its behavioural strategy, for instance, in terms of offspring protection. Using the bank vole, *Myodes glareolus*, as a model species we experimentally investigated how infanticide risk affects behaviour. Bank voles have rapid reproductive cycles, producing a new litter every few weeks, and infanticide has been shown to occur, especially by conspecific males that are unrelated to the offspring. Females show post-partum estrus, i.e. are receptive immediately after giving birth. Therefore, they need to encounter a mate to fertilize them while also providing parental care and protection to their existing litter. This makes rodent females especially prone to the trade-off between current and future reproduction, and ideal to study the existence of behavioural reproductive strategies in response to the level of infanticide risk. Females were mated indoors with known males and, shortly after parturition they were released (non-pregnant) with their litter in a nest box in outdoor enclosures. By spreading either the familiar scent of her litter's sire or the scent of a male unfamiliar to the female (stranger) in the enclosure, we simulated low and high infanticide risk respectively. Using automated radio telemetry and RFID reading stations, we studied the effects of scent treatment on female spatial behaviour, including her presence/absence at the nest, activity level and movement pattern. We discuss findings of how infanticide risk posed by a potential mate partner affects female behaviour indicative of her investment in future reproduction (e.g. time away from the nest to find the mate) versus current reproduction (e.g. time at the nest to guard her litter).

Poster Session 1 – Rodent Behaviour

10 Social Contact Network loggers – an open source, high resolution approach for monitoring interactions between small rodents

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Behavioural ecology is often a matter of interactions; understanding the processes underpinning behaviour such as competition, predation, sociality, sexuality or disease transmission therefore often requires the ability to monitor interactions between individuals. Until recently, such detailed knowledge of individual behaviour has been restricted to either captive, large or easily visible species. However, by exploiting recent advances in embedded software, chip miniaturisation and battery development, we have developed small (<2g) loggers which record when individuals come within a predetermined distance of each other, the id of the individuals and the time period over which the interaction occurs. Our SCoNe loggers, developed in collaboration with the Department of Engineering and the Department of Product Design at Universiteit Antwerpen, are small enough to be attached to animals over 40g in weight (ensuring the logger is <5% of the animal body weight), are rechargeable, and can be remotely programmed to adjust logger settings. Here, we present initial results from developing and calibrating our loggers using *Mastomys natalensis*, the multimammate mouse, in Antwerp and Tanzania. Loggers were initially tested on captive, colony bred *Mastomys natalensis* to trial different attachment techniques and ensure no harm or discomfort was caused by attachment. Field realistic trials were carried out in mesocosms in Tanzania using wild caught *Mastomys natalensis*. We present the initial results in the anticipation that these SCoNe loggers will have a wide appeal to ecologists working on a range of species.

Poster Session 1 – Rodent Behaviour

11 Comparative analysis of isolation-induced pup ultrasonic calls of five gerbil species

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Gerbils (*Gerbillinae*), inhabiting arid areas of Asia and Africa, display different ecological specializations and sociality. Adults primarily use ultrasound but some species produce also audible vocalizations. Pup vocal behaviour is poorly known. For five species (*Gerbillus campestris*, *Gerbillus perpallidus*, *Meriones unguiculatus*, *Meriones vinogradovi*, *Sekeetamys calurus*), we compared ultrasonic isolation calls of captive 6-10-day pups (each from a different litter; 5 pups per species, 25 in total). Each pup was recorded for 2 min at 22 °C using a recorder Pettersson D1000X (384 kHz, 16 bit), weighed and measured for body variables. Calls (5 per pup, 125 in total) were examined using Avisoft SASLab Pro software for duration and fundamental frequency variables and contour shape. Flat contours were common in *Gerbillus perpallidus* (60% of calls), chevron contours in *Gerbillus campestris* (52% of calls) and *Sekeetamys calurus* (56% of calls), ascending contours in *Meriones unguiculatus* (76% of calls), wavelike contours in *Meriones vinogradovi* (all calls). All the four contour variants occurred only in *Gerbillus campestris*. Most short calls were produced by *Gerbillus campestris* (85±52 ms) and *Gerbillus perpallidus* (89±32 ms) and the longest calls were produced by *Meriones vinogradovi* (184±37 ms). The maximum fundamental frequency was the highest in *Gerbillus campestris* (77.5±6.34 kHz) and ranged of 47.9-53.2 kHz in other species. Depth of frequency modulation varied from 8.2±4.0 kHz in *Gerbillus campestris* and 5.0±3.7 kHz in *Gerbillus perpallidus* to 11.7-16.0 kHz in other species. Pups of *Gerbillus campestris* were the smallest in body weight and size. The differences in fundamental frequency were higher between pups of *Gerbillus campestris* and *Gerbillus perpallidus* than between pups of species from different genus. Probably, such large differences were related to the differences in body size between these species, but further investigation is necessary to confirm this. Supported by the RSF grant 14-14-00237.

Poster Session 1 – Rodent Behaviour

12 Co-existence leads to diet shift of bank voles by competition with grey-sided voles?

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Grey-sided voles (*Myodes rufocanus*) and bank voles (*Myodes glareolus*) co-exist in boreal forests in northern Scandinavia. Previous studies suggest that the two species engage in interspecific interactions, with the grey-sided vole being the dominant species. We took muscle samples from voles in patches of old forest occupied by only bank voles and patches of old forest occupied by both grey-sided voles and bank voles. We found that (1) stable isotope ratios of bank voles differed in areas with and without grey-sided voles and that (2) the stable isotope ratios of bank voles were more similar to those of grey-sided voles in areas where grey-sided voles were absent. Our data suggests that grey-sided voles forced bank voles to change their diet due to interspecific competition.

Poster Session 1 – Rodent Behaviour

13 Sexual differences in home ranges of *Apodemus peninsulae* in Korea

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The spatial distribution of a species may imply their mating system strategies. In order to investigate home range characteristics of *Apodemus peninsulae*, we used capture-mark-recapture method from total 18,000 trap nights through 5 study sites in Korea. Home ranges were estimated with Minimum Convex Polygon method from individual data captured at least 3 different trap locations. Whether social ranks were related to home range patterns, generalized linear mixed models were employed with a Poisson error distribution and log link function. Fixed factors were weights (social ranks) and numbers of captures of each individual and random factors were study sites and years in study sites. Home ranges of 41 males and 26 females were estimated. Home ranges of males often overlapped with both males (23 in 41 males) and females (16 in 41 males) (Chi-square 1.723, df=1, p=0.189). However, home ranges of females overlapped more with those of males (19 in 26 females) than females (7 in 19 females) (Chi-square 9.308, df=1, p=0.002). Home range sizes increased with male weights but decreased with female weights. Home range sizes of both sexes increased with numbers of captures. Numbers of captures and weights in each sex were not correlated. Our results show two sexes of *Apodemus peninsulae* have different spatial distribution patterns. These patterns may imply that males of the species have a promiscuous mating strategy (polygynous mating) but females secure their territories in related to resource competition in order to maximize reproductive success of each sex.

Poster Session 1 – Rodent Behaviour

14 Find the needle in the haystack: tracing the dispersal of small palatable tree seeds in European beech forests

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Zoochory is of substantial importance for dispersal of palatable tree seeds. Besides primary dispersal, tree seeds might be detected by seed hoarding animals. Thereby, seeds might be either consumed or hoarded for later consumption. We analysed hoarding behaviour of small mammals in two different study areas in beech (*Fagus sylvatica*) dominated forests in Austria. Ground vegetation, terrain and predator guilds were comparable at both sites. Considering the relatively small dimensions of beechnuts we tested three different seed tagging methods: (1) wire threads with plastic flags fixed with solvent-free glue, (2) wire threads with plastic flags twisted around a beechnut, (3) and radio-transmitters fixed with solvent-free glue. We offered tagged as well as untagged seeds on experimental dishes to analyse seed removal rates. We did not find any difference in seed removal between different tags or untagged beechnuts. Nearly all seeds were removed within 25-35 days after exposure. However, transport distances differed between study areas and radio-tagged seeds generally experienced larger dispersal kernels with a maximum range of 60 m. Furthermore, seeds tagged with radio-transmitters were cached more frequently compared to flag-tagged seeds. In one study area, a higher quota of radio-tagged seeds could be recovered compared to flag-tagged seeds. We suggest to simultaneously use flag-tagged and radio-tagged seeds to obtain a realistic picture of dispersal kernels in situations with dense ground vegetation or irregular terrain.

Poster Session 1 – Rodent Behaviour

15 Low correlation between parameters from different behavioral tests in the common vole

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Several different tests or at least one under different conditions are often used for animal personality trait determination, especially in rodents. Then all the obtained data are extracted by the principal component analysis (PCA). In this study, we do not report on usual results of the indicated procedure – the personality traits of the tested animals, but we have focused on the similarity (correlation) of the same parameters and behavioural elements in different tests. We have tested 47 individuals of the common vole (*Microtus arvalis*) in three different apparatuses: in the classical "Open Field" test (OFT), in the Elevated plus maze (EPM) and in the closed space box "Phenotyper" (PT, Noldus). We got data on 21 behavioural elements and parameters in total. As a natural baseline of locomotor activity, we considered the distance covered in the PT box where the animals spent 72 hours. We found very low insignificant correlations with the distance covered in EPM ($r = 0.05$) and OFT ($r = 0.14$). In a similar way the correlation between the EPM pathway and the OFT pathway was very low ($r = 0.21$) and insignificant. The parameters obtained in the PT box did not correlate with any other parameters or behavioural elements of the OFT or EPM tests. A more pronounced significant correlation was found only between the total distance covered in the OFT and the time spent in observation on the open arm of the EPM ($r = 0.64$). Significant correlation between the same parameters was found in one case only – between the total time of rearing in the OFT and the rearing in the closed EPM arm ($r = 0.54$). The prevailing absence of significant correlations between individual tests reflects a complexity of the tests and leads to caution in the interpretation of obtained data.

Poster Session 1 – Rodent Behaviour

16 Relationship of breathing frequency to personality trait in the common vole (*Microtus arvalis*)

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Intraspecific variation of breathing frequency and its relation to personality traits were studied in the common vole (*Microtus arvalis*). This relationship is important for verification of behavioural determination of the personality traits through physiological parameter values. In general, the increase in the respiratory rate is associated with increased energy expenditure in physical and mental stress. Thus, in the study, we worked on the assumption that individuals determined in behavioural tests as shy will exhibit steadily higher respiratory rates than the bold ones. Individual respiratory rates were measured using a device consisting of a respirometric (RM) chamber coupled to a pressure sensor and an oscilloscope. Stress breathing frequency (SBF) was measured after an individual was put into the RM chamber and an audible alarm was produced causing a startle reflex. After about 5-10 min resting breathing frequency (RBF) was recorded. This procedure was repeated after 24 hours and then again after 30 days. Based on these repetitions, the Intraclass Correlation Coefficient (ICC) was calculated to show repeatability of the reaction. The stress and rest values were used for calculation of absolute and relative differences. Personality traits of the tested animals were obtained from a classic Open Field (OF) test and were represented by the length of the exploratory trajectory. It has been found that the common vole shows consistent inter-individual differences in breathing frequencies. ICC values ranged from 56 to 74%. The results also showed a very close negative dependence between SBF and the personality trait ($p = 0.031$) and between the relative difference of SBF-RBF and personality traits ($p = 0.001$). The higher the respiratory rate or increase during stress, the shorter the exploratory trajectory. RBF values indicated a weak relationship to personality traits.

Poster Session 1 – Rodent Behaviour

17 Secondhand horror: effects of direct and indirect predator cues on behavior and reproduction of the bank vole

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In the evolutionary arms race between prey and predator, early risk recognition by the prey species is of paramount importance. Mammalian prey species are able to detect direct predator cues, like odors and to display appropriate defensive behaviors. Not much is known about indirect predation cues in mammals, i.e. the scent of scared individuals detectable by conspecifics, and how they affect recipient behavior. Current theories predict also cross-generational, maternally transferred, effects of increased predation risk or fear to their offspring. To escape predation now or in the next generation, predation risk is suggested to delay or suppress reproduction. However, in theory, enhancement of reproduction, bet-hedging or terminal investment, may be an adaptive strategy as well. Not much is known about cross-generational effects of predation risk on offspring behavior and fitness. We assessed how direct and indirect predation cues, in the form of predator odor or odor of scared conspecifics, alarm pheromones, affect bank vole (*Myodes glareolus*) reproduction and pup fitness. In our experiment, we exposed males and females either directly to least weasel (*Mustela nivalis*) odor, to indirect alarm pheromones from weasel-scared male voles, or to control odor. The treatments were started before mating and lasted until the pups were born. Contradictory to our expectations both predator odor and alarm pheromones enhanced reproduction compared to control. Alarm pheromone treated females had a significantly higher pregnancy rate and pups from predator-treated parents were significantly heavier at birth. Stress metabolite levels were similar in the predator odor and alarm pheromone treatment. Our study provides two novel results: compared to a signal of general danger, i.e. predator odor, the odor of a scared conspecific convey an immediate risk of attack and possible death. Both cues can work at the same time and trigger enhancement of reproduction in form of final investment.

Poster Session 1 – Rodent Behaviour

18 Fear or curiosity: does a shelter help to be courageous?

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Anxiety and exploration are common subjects in animal behavior research. While anxiety is mainly driven by fear, exploration can be motivated by curiosity. Despite these differences, tests for anxiety and exploration are often used interchangeably in behavioral research. Part of this confusion is due to the fact that the assessment of anxiety and exploratory ability of animals rely on the analysis of the same behavioral elements in an open field arena, i.e., distance moved, etc. Additional confusion arises from the introduction or removal of elements by researchers to the experimental setup (e.g., shelter). Given the ubiquitous use of this test in animal experimentation and the numerous conclusions drawn from it, it is especially important to clarify how certain elements, namely the presence of a shelter, have in the animals' state and how they affect its behavior. The aim of this project is to evaluate the role of a shelter in inducing exploratory behavior in an open field arena. Our hypothesis is that the presence of a shelter in an open field test decreases the anxiety level of mice and thus induces explorative behavior in opposition to an open field setting where no shelter is present. To evaluate this we are analyzing the behavior of two species of wild mice (*Mus musculus domesticus* and *Mus spretus*) in an open field setting with and without a shelter and we will correlate their behavior with their anxiety levels, which we assessed through blood cortisol levels directly after testing in each experimental setup. We predict the presence of a shelter will induce an increase of exploratory behaviors and lower anxiety levels in both species. The shelter should have a higher influence on motivational state on *Mus musculus domesticus*, as the latter is a commensal species and is used to human/artificial environments.

Poster Session 1 – Rodent Behaviour

19 Social networks and parasite transmission in wild guinea pigs (*Cavia aperea*) in outdoor enclosures

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Social network analysis (SNA) provides a description of social structure. Studies of the causes and consequences of individual variation in network position that arise as a consequence of an individual's phenotype or patterns of group-living. SNA provide a framework for representing the implications of networks for dynamics of parasites; the contact between hosts that may allow the transmission of parasites. Contacts were assumed that individuals are scaled according to their parasite load. Alternatively, parasites were distributed randomly among node social networks. We used SNA to shed light on the importance of different aspects of sociality on parasitism in a caviomorph rodent, wild guinea pig (*Cavia aperea*). This study implied different stage of intensive research: animals caught from the wild, cavies remained free of infection, enclosures acclimatization, capture-recapture, direct behavioural observations, and compare networks over time. Social interaction was recorded on at least two days each week for 5 months. Sampling for social network formation matched the chronic nature of parasites in *Cavia aperea*. We used daily subgroup composition records to construct space-sharing weighted networks with centrality measures. Preliminary results indicate relative consistency and stability of social networks over different months. Networks with a clear partition of nodes into groups according nest distribution and animal density. Additionally, asymmetry networks show minimized edge crossing and uniform edge length. High clustering indicates that, on average, focal individuals became more likely to interact locally with a subset of others rather trying to maintain group-wide interactions. Physical contact patterns were heterogeneous. The parasite load of highly connected individuals was note necessarily greater than that of less connected individuals in the networks. We suggest that the wild guinea pig may be an important model species for better understanding the transmission of infectious disease in an ecologically valid context.

Poster Session 1 – Rodent Behaviour

20 Habitat selection by small mammals in hemiboreal mosaic landscape

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Small mammals have an important role in the food chain and thus belong to keystones of the ecosystem. We analysed the abundance of small mammals and their habitat selection over six years in different landcover types. Species richness and abundance were highest in the ecotones. *Myodes glareolus* was mainly found in the forests where they preferred older stands, moreover, their abundance decreased towards ecotones. *Apodemus flavicollis* was opportunistic towards different habitats. Among open areas they preferred natural dry grasslands and among forest habitats they preferred middle-aged deciduous forests. *Apodemus agrarius* was found in grasslands ecotones. We continue doing our research to get more detailed results about different years and habitat selection among small mammals.

Poster Session 1 – Rodent Behaviour

21 Ultrasonic pulse bouts of a blind fast-climbing rodent (*Typhlomys chapensis*): similarities and differences with echolocation calls of bats

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Bouts of ultrasonic pulses produced by blind Vietnamese pygmy dormice (*Typhlomys chapensis*) are reminiscent of ultrasonic calls of echolocating bats, however they display some remarkable differences in the acoustics. Echolocation pulses of the dormouse are organized in bouts. We examined 1,481 bouts that consisted of 1-6 pulses per bout; 51.3% of bouts contain more than one pulse. The number of pulses per bout affected bout duration and inter-bout interval, whereas the period from start of a previous bout to start of the next bout was constant (80.0 ± 2.9 ms) in spite of the number of pulses per bout. Ultrasonic pulses (540 pulses measured in a subset of 234 bouts), represented short (0.68 ± 0.15 ms) convex sweeps with the fundamental frequency slope from 127.3 ± 6.3 kHz to 64.1 ± 4.6 kHz and peak frequency at 93.3 ± 7.4 kHz, emitted with a within-bout pulse period 13.03 ± 3.01 ms. Single pulses and start pulses of multi-pulse bouts were lower in frequency than other pulses of the bouts. In contrast, pulse duration was independent on pulse position within bout. Pulses were reminiscent of echolocation calls of *Murina* and *Myotis* bats, but were higher in frequency, much shorter, fainter, displayed a convex contour of frequency modulation and displayed only the fundamental frequency band without harmonics. At the same time, the organization of the ultrasonic pulses in bouts is not characteristic for bat echolocation. In contrast, hippopotamus (*Hippopotamus amphibius*) uses clicks organized in bouts for echo-ranging in muddy waters. Probably, the Vietnamese pygmy dormice can also use their ultrasonic pulses for echo-ranging during their locomotion and jumps among bush branches. Compared to bats, the speed of the dormice locomotion is not so high. Therefore, they do not need vary strongly the period between the ultrasonic pulses as in the echolocation series of bats. Supported by the RSF grant 14-14-00237.

Poster Session 1 – Rodent Behaviour

22 Age-class differences in the acoustic structure of ultrasonic calls of yellow steppe lemmings (*Eolagurus luteus*)

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A common pathway of the vocal ontogeny of mammalian audible calls displays a descent of fundamental frequency from pups to adults. A distinctive pathway (increase of fundamental frequency with age) found in rodents ultrasonic calls (rats and mice) might be related with a distinctive production mechanism (whistle). We investigated the ultrasonic isolation calls in captive yellow steppe lemmings *Eolagurus luteus* at five age-classes: Age1 (1-5 days), Age2 (10-16 days), Age3 (20-28 days), Age4 (35-42 days), Age5 (57 days-adults), 5 individuals per age-class, 25 individuals in total. Each individual was recorded for 2 min at 22°C using a recorder Pettersson D1000X (384 kHz, 16 bit), then weighed and measured for body variables. Calls (5 per individual, 125 in total) were examined using Avisoft SASLab Pro software for duration, fundamental frequency and power variables, contour shape and nonlinear phenomena. Animal body weight and body length increased from 6.47±2.62 g and 43.8±8.39 mm at Age1 to 78.90±22.36 g and 127.3±11.9 mm at Age5. Frequency contours were most variable at Age1. Chevron contour prevailed at Age1 (60% calls), whereas the ascending contour at Ages2-5 (56-92% calls). Non-linear phenomena included both frequency jumps (44% calls) and biphonations (32% calls) at Age1 and only frequency jumps at Ages2-5 (28-60% calls). Duration decreased from 77±24 ms at Age1 to 30-33 ms at Ages3-5. Maximum fundamental frequency and depth of frequency modulation were higher at Ages1-2 (49.6-51.5 and 19.7-19.8 kHz respectively) than at Ages3-5 (38.3-42.2 and 8.7-13.3 kHz). Minimum fundamental frequency was lower at Age5. Peak frequency and power quartiles decreased from Age1 to Age5. Against expectations based on potential whistle mechanism of vocal production, the fundamental frequency and duration of the lemming ultrasonic calls decreased with age and body growth, displaying the common ontogenetic pathway of mammalian audible calls. Supported by the RSF grant 14-14-00237.

Poster Session 1 – Rodent Behaviour

23 Hibernation performance in free-ranging common hamster (*Cricetus cricetus*)

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The most of hibernation studies carried out in artificial conditions with photoperiod and ambient temperature control. So, animals unlikely display in full such natural seasonal patterns as hoarding, burrow digging, nesting and temperature dynamics itself. The best decision is to follow hibernation in nature, although it is quite difficult and risky. On experimental plot in Central park of Simferopol city (Russia), 4 hamsters (3 males and 1 female) used as focal to study temperature patterns during 1 season each. Animals were implanted intraperitoneally by Petrovsky thermologgers (interval – 30 min) and by radiotransmitters to follow the location of the animal. The same number of individuals were either lost, early died or records were not full for analysis. All focal animals found hibernated, body temperature dropped up to +2.3 °C (in female) and +4.9 °C (in males). The total number of hypothermic episodes were 11 in female, 11, 12 and 13 in males. The maximum duration of hibernation episodes in males were noted at the end of December – beginning of January (5 days), in females – at the beginning of February (5 days). The longest normothermia period between hibernation episodes lasted for 19 days. The hamsters in the City park start hibernate quite late (early December), and finish not late as early March. Also we watched above the ground activity of some other animals on the plot any winter months. The short hibernation of the Common hamster in Simferopol compare to other known data on this species in labs may be explain by good food resources here (walnuts, Gleditschia, hazelnut). These fruits probably reached by polyunsaturated fatty acids (for instance, linoleic). As shown by C. Siutz et al. (2018) such diet forward shortening of hibernation. The study was supported by RFBR 17-04-01061.

Poster Session 1 – Rodent Behaviour

24 Hibernation patterns in free-ranging common hamsters (*Cricetus cricetus*)

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The aim of this study is studying winter activity and hibernation of the common hamster in the natural environment, but in the urban area. In Simferopol city (Crimea) lives one of the largest natural populations of the common hamster in Europe. In the Central City Park in 2015 we established an experimental plot of 2.2 ha. For the analysis of hibernation, 4 hamsters were chosen as focal animals. To record the body temperature, animals under anesthesia were implanted intraperitoneally by Petrovsky thermologgers (measurement interval - 30 min) and a radio transmitter to determine the location of the animal. Throughout the experiment (2015-2018), all animals lived in the park. The total number of hypothermic episodes in female is 11, in male is 11 and 12. All focal animals found hibernating, body temperature dropped up to +2.3 °C (for female) and +4.9 °C (for males). The maximum duration of hibernation episodes in male was noted at the end of December – beginning of January, in females – at the beginning of February. The maximum duration of a hypothermic episode in female and males is 5 days 15 hours. After restoring of the body temperature, the animal either remained in normothermia state for 19 days and 11 hours. The data obtained in Simferopol Park show that animals can start to hibernate quite late (at the end of December), but hibernation periods are finished very early (in late February - early March). The common hamsters from Simferopol have a short hibernation, which may be due to the presence of polyunsaturated fatty acids (PUFAs, particularly linoleic acid) in the diet (Siutz, et al., 2017). The RUFAs (LA) in large quantities are contained in walnuts. Walnuts are the main feed for common hamsters in the Simferopol park.