Palacký University in Olomouc
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The influence of handling on the edible dormouse (*Glis glis*) denning activity

Master´s thesis

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Zoology

Supervisor: **Mgr. Peter Adamík, Ph.D.**

Olomouc 2011

Univerzita Palackého v Olomouci

Přírodovědecká fakulta

Katedra zoologie a ornitologická laboratoř

Vliv manipulace na úkrytovou aktivitu plcha velkého (*Glis glis*)

DIPLOMOMOVÁ PRÁCE

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Olomouc 2011

Declaration

I declare, that I have elaborated this master´s thesis on my own under the supervision of Mgr. Peter Adamík, Ph. D. and only with the usage of sources listed in the References section.

Olomouc, 25th April 2011 Signature: ....

Prohlášení

Prohlašuji, že jsem tuto diplomovou práci vypracovala samostatně pod vedením Mgr. Petera Adamíka, Ph. D. a jen s použitím uvedené literatury.

V Olomouci, dne 25. 4. 2011 Podpis.............................

Acknowledgements

I am especially grateful to my thesis supervisor Peter Adamík for a professional guidance, his great deal on statistical analyses elaborating, providing me a lot of scientific literature dealing with the subject matter and devoting much time and patience to consultations and valuable pieces of advice. I thank a lot the "Dormouse researchers´ team" – Anežka Gazárková, Lucie Škvařilová and Marcela Veselá for their help with difficult field work - this work would not be possible without their contribution. I would like to express my regards also to all people who supported and encouraged me or offered me any help - in particular my great thanks belong to my family and my mate.

Poděkování

V prvé řadě velice děkuji svému vedoucímu práce Peterovi Adamíkovi za odborné vedení, velký podíl na provedení statistických analýz, poskytnutí mi množství odborné literatury týkající se tématu a věnování spousty času a trpělivosti konzultacím a cenným radám. Velmi děkuji „týmu plchařů“ – Anežce Gazárkové, Lucii Škvařilové a Marcele Veselé za vyčerpávající sběr dat, jelikož by tato práce nebyla možná bez jejich přispění. Ráda bych také vyjádřila vděčnost všem lidem, kteří mě podporovali a povzbuzovali nebo mi poskytli jakoukoli pomoc – mé díky patří především mé rodině a mému příteli.

Bibliographical identification

Author´s first name and surname: Monika Kukalová

Title: The influence of handling on the edible dormouse (*Glis glis*) denning activity

Type of thesis: Master´s thesis

Supervisor: Mgr. Peter Adamík, Ph.D.

Place of work: Department of Zoology and Laboratory of Ornithology, Faculty of Science, Palacký University in Olomouc

The year of presentation: 2011

Extent and language: 23 p., 1 appendix, in English

Abstract: It is critically important to know how animals respond to investigators´ disturbance through standard practice including their catching, measuring or marking. The main reasons are animal welfare as well as assessment of presence of any form of bias in routinely used protocols. We have chosen the edible dormouse as a model species to evaluate whether routinely practiced field handling protocols do affect their behavioural responses. We periodically caught and manipulated with dormice resting during the daytime in nest boxes equipped with automatic transponder reading devices. The automatic reading devices enabled to asses how the animals responded to our manipulation. We focused on the nest box occupancy patterns and the variability in the initiation of nocturnal activity with controlling for the effects of manipulation, season, age, sex and sexual activity of the animals. We detected that after our disturbance females, sexually active and not manipulated animals spent the following day in the nest boxes with higher probability than males, sexually quiescent animals and those manipulated. Neither manipulation, nor the other tested factors had a significant effect on the initiation of nocturnal activity. Our study suggests that disturbance by investigators may modify certain aspects of animal behaviour but this effect is likely to have a short-term basis and does not seem to impair the reliability of routinely practiced field protocol for small mammals.

Key words: edible dormouse, nocturnal activity, manipulation, handling, behaviour, stress, human-caused disturbance

Bibliografická identifikace

Jméno a příjmení autora: Monika Kukalová

Název práce: Vliv manipulace na úkrytovou aktivitu plcha velkého (*Glis glis*)

Typ práce: Diplomová práce

Vedoucí práce: Mgr. Peter Adamík, Ph.D.

Pracoviště: Katedra zoologie a ornitologická laboratoř, Přírodovědecká fakulta, Univerzita Palackého v Olomouci

Rok obhajoby práce: 2011

Rozsah a jazyk práce: 23 s., 1 příloha, anglicky

Abstrakt: Je velmi důležité vědět, jak živočichové reagují na disturbanci způsobenou standardními postupy výzkumníků zahrnující jejich odchyt, měření a značkování. Hlavními důvody jsou animal welfare a stanovení případné vzorkovací chyby v běžně používaných postupech výzkumu. Zvolili jsme si plcha velkého jako modelový druh pro zhodnocení, zda běžně používané terénní postupy manipulace ovlivňují behaviorální odpovědi zvířat. Pravidelně jsme odchytávali a manipulovali s plchy, kteří přes den přespávali v hnízdních budkách vybavených čtecími zařízeními čipových kódů. Čtecí zařízení čipových kódů nám umožnily zhodnotit, jak zvířata reagovala na manipulaci. Soustředili jsme se na pattern obsazenosti budek a variabilitu v započetí noční aktivity, přičemž jsme hodnotili vliv efektů manipulace, období sezóny, věku, pohlaví a pohlavní aktivity zvířat. Zjistili jsme, že po naší disturbanci v téže budce s vyšší pravděpodobností přespaly samice, pohlavně aktivní zvířata a zvířata, která nebyla manipulována. Manipulace ani další testované faktory neměly signifikantní vliv na započetí noční aktivity. Naše práce naznačuje, že vědecká disturbance může modifikovat některé aspekty chování zvířat, ale tento efekt je pravděpodobně krátkodobý a zdá se, že nenarušuje spolehlivost běžně používaných terénních postupů pro malé savce.

Klíčová slova: plch velký, noční aktivita, manipulace, chování, stres, disturbance způsobená člověkem

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Note: This thesis is presented as a manuscript for a peer-reviewed journal.

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Abstract

It is critically important to know how animals respond to investigators´ disturbance through standard practice including their catching, measuring or marking. The main reasons are animal welfare as well as assessment of presence of any form of bias in routinely used protocols. We have chosen the edible dormouse as a model species to evaluate whether routinely practiced field handling protocols do affect their behavioural responses. We periodically caught and manipulated with dormice resting during the daytime in nest boxes equipped with automatic transponder reading devices. The automatic reading devices enabled to asses how the animals responded to our manipulation. We focused on the nest box occupancy patterns and the variability in the initiation of nocturnal activity with controlling for the effects of manipulation, season, age, sex and sexual activity of the animals. We detected that after our disturbance females, sexually active and not manipulated animals spent the following day in the nest boxes with higher probability than males, sexually quiescent animals and those manipulated. Neither manipulation, nor the other tested factors had a significant effect on the initiation of nocturnal activity. Our study suggests that disturbance by investigators may modify certain aspects of animal behaviour but this effect is likely to have a short-term basis and does not seem to impair the reliability of routinely practiced field protocol for small mammals.

Keywords

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Introduction

Researchers usually have to repeatedly catch and manipulate with animals owing to the nature of their studies. This always imposes concern about animal welfare and a careful consideration of potential biases in data collected from the handled animals (Sikes et al. 2011). It is also relevant to provide objective data to the regulatory authorities, which control compliance of performed research with national laws and regulations.

Is the caused stress biologically relevant for the animals and are the ecology and behaviour of the animals affected in consequence of it? Does the experienced stress have a short-term or long-term impact on studied animals? How much bias in measured variables is introduced with stressed animals? Answering these questions is highly relevant not only from the ethical point of view, but also for the sake of reliability in gathered data.

The available studies, which have evaluated the impact and bias induced by investigators´ activity, have brought mixed results, from negative to positive effects. In some studies harmful and stressing effects of scientific handling are discussed. Negative effects have been reported for bird behavioural responses (e.g. foraging activity) and body condition as well as increases of stress levels and predation risk (Kendall et al., 2009; Lynn and Porter, 2008; Müller et al., 2006; Sharpe et al., 2009). Associated with this, the extent of influences of human disturbance varies with different species, even concerning closely related species (Delehanty and Boonstra, 2009). On the other hand, others have brought evidence even for positive effects of disturbance, e.g. reduced nest predation patterns (Ibanez-Alamo and Soler, 2010; Weidinger, 2008). Studies referring to the impact of scientific handling on mammals under natural conditions are quite rare, though there is some evidence based on observing mammals that live trapping (including nest-box monitoring) and manipulation with the animals are invasive, induce stress and negatively influence the animals´ behaviour and condition (Delehanty and Boonstra, 2009; Fletcher and Boonstra, 2006; Kenagy and Place, 2000; Moore et al., 2010; Pearson et al., 2003). The need for a more comprehensive evaluation of animal responses is also evident from the new and massive advent of bio-logging techniques (Ropert-Coudert et al. 2009; Saraux et al. 2011). Also some innovative remote monitoring methods are recommended, e.g. using temperature dataloggers which provide remote monitoring of nest boxes occupancy with minimal disturbance (Moore et al., 2010). Nevertheless, not all surveys can rely on these non-invasive methods because also some physiological parameters of the animals must be measured and this is not possible without physical handling.

In this study we aim to asses how a routine and widely adopted handling protocol for studying small mammal species affects the short-term behavioural responses in den use in an arboreal rodent, the edible dormouse. We focused on two behavioural aspects: a) does handling with animals affect their subsequent timing of nocturnal emergence from their daytime denning sites? b) are animals more likely to abandon their daytime denning site after a handling procedure?

Material and Methods

Study species

The edible dormouse *Glis glis* is a nocturnal arboreal rodent which occupies mature deciduous woodlands. This species is an obligate hibernator that may also exhibit torpor during the active summer period (Fietz et al., 2004; Fietz et al., 2010). In central Europe, the edible dormice hibernate from mid-September – November until May – June (Kager and Fietz, 2009; Morris and Morris, 2010; Schlund et al., 2002). During the active summer season they use tree holes or nest boxes as daytime denning sites and they commonly raise offspring in them. The mating season follows after their arousal from hibernation, usually during early July (Kager and Fietz, 2009; Ruf et al., 2006). However in some years the dormice may skip reproduction (Bieber, 1998; Bieber and Ruf, 2009; Morris and Morris, 2010; Pilastro et al., 2003; Ruf et al., 2006). After 30 – 32 days of gestation (Ruf et al., 2006; Vietinghoff-Riesch, 1960) the young are born. In central Europe, the dormice have only one litter per year (Kager and Fietz, 2009; Ruf et al., 2006). Litter size varies from 1 to 13, most commonly 7. Communal breeding occurs occasionally (Pilastro et al., 1996). The offspring are weaned after 30 days (Ruf et al., 2006). The main source of food are acorns, beechnuts, hazelnuts, various fruits, buds and leaves but they can feed on bark, insects, fungi, carrion, eggs or nestlings too (Adamík and Král, 2008a,b; Bieber and Ruf, 2009; Fietz et al., 2005; Harris and Yalden, 2008; Ruf et al., 2006).

Study site

This study was conducted near Dlouhá Loučka, Czech Republic (49° 49´ N, 17° 12´ E, altitude 300 – 450 m a. s. l.), in a part of a large mixed deciduous woodland. The study site is dominated by sessile oak *Quercus petraea* and European beech *Fagus sylvatica*, with an admixture of Norway spruce *Picea abies*, European hornbeam *Carpinus betulus* and small-leaved lime *Tilia cordata*. The study site contains several hundreds of wooden nest boxes, with an entrance hole 32 mm in diameter, which have been provided primarily for ornithological studies since 1973 (Adamík and Král, 2008a). The boxes have been installed to tree trunks ca 1.5 – 2 m above the ground at a constant density of 6 nest boxes per hectare in several clusters. Data for this study were taken from the core area with approximately 200 nest boxes. There, 19 – 34 nest boxes were annually equipped with automatic transponder reading devices (number of nest boxes provided with devices - 2007: 19, 2008: 26, 2009: 34, 2010: 33). The reading device consisted of a circular antenna attached to the entrance hole of the nest box, an OEM decoder (LID 650, EID Aalten B.V., The Netherlands) and a 12V battery. Both the battery and the decoder were attached to the tree trunk ca 4–5 m high and they were connected with the antenna by a cable. The antenna was equipped with an infrared movement monitor. Any time a PIT-tagged animal entered or left the nest box its unique code, the day and time were recorded to the memory of the reader.

Field procedures

We checked the nest boxes for the presence of dormice on weekly basis approximately from the end of June till the end of October, 2007 – 2010. Prior to the end of June the nest boxes were checked more often in order to study the nesting birds. The dormice were captured manually with the aid of a leather glove. On the first encounter, each individual was marked (subcutaneously in the interscapular region) with a passive integrative transponder (Trovan Ltd., UK, type ID 162 FDX-B, diameter 2 mm, length 11.5 mm). The age was estimated according to experience based on size, fur colour and the length of tibia (Bieber, 1998; Schlund et al., 2002; Vietinghoff-Riesch, 1960). We recorded three age categories: juveniles – before first hibernation, yearlings – after first hibernation and adults – after their second hibernation. The condition of sexual organs was ascertained – we classified males with developed tangible or visible testes and females with visibly perforated vulva, signs of gestation or visible mammae as reproductively active. Each individual was put into a special cone-shaped cotton bag for easier handling - marking or controlling for being marked from previous years of study and taking measurements (weighing and measuring the tibia length). We tried to minimize handling to the shortest possible time and after taking the measurements, the animals were immediately returned into their nest box. On each control a subset of animals was remotely checked for their identity by hand-held portable PIT-tag reader. These animals were not disturbed by any means in their nest boxes. All field procedures were conducted during daytime hours. Afterwards, we observed the dormice activity based on the records from the automatic transponder reading devices attached to the nest boxes.

Data analyses

We assessed the potential disturbance effect of our field handling procedure on the dormice in two ways. First, we evaluated whether the procedure affected the decision of the animal to remain -in the nest box for another day. As explanatory factors we considered the effect of sexual activity (sexually active vs. quiescent), age (yearlings vs. adults; we do not consider juveniles in this study), sex, date of the year (as there is pronounced seasonal pattern in nest box occupancy, Fig. 1) and type of manipulation with the animals (the animal was either removed from the nest box and weighed etc. = manipulated, or it was only remotely checked with a portable transponder reader = not manipulated). The response variable was a binary datum (dormice that remained in the nest box next day after our visit vs. dormice which left the nest box). We used generalized linear mixed model (GLMM, binomial error, logit link function) with an animal identity as a random factor (n = 193 individuals).

Second, we evaluated whether the procedure affected the timing of the initiation of nocturnal activity. The response variable was the difference between the timing of the nocturnal activity on the day of nest box checks and the day prior the nest box checks. As explanatory factors we considered the effect of sexual activity, age, sex, date of the year and type of manipulation with the animals. A linear mixed model (LMM) with an animal identity as a random factor was used to analyse the variation in the timing of nocturnal emergence (n = 122 individuals). Non-significant terms were removed at $\alpha = 0.1$ from the model, stopping at the minimum adequate model.

Results

We found out that those animals which were not manipulated, were more likely to spent a following day in the nest box than those who were manipulated (b = 0.7967 ± 0.3391, $t_{1, 189} = 2.35$, P = 0.0198). Furthermore, females were more likely to choose the same nest box for a subsequent day than males (b = 0.8055 ± 0.2158, $t_{1, 35.49} = 3.73$, P = 0.0007) and sexually active animals remained more often in the nest box than sexually quiescent individuals (b = 0.6943 ± 0.2149, $t_{1, 49.14} = 3.23$, P = 0.0022).

We found out that manipulation with dormice did not have a significant effect on the initiation of their nocturnal activity ($F_{1, 105.0} = 0.31$; P = 0.575). None of the considered factors (season, age, sex and sexual activity) had a detectable effect on the initiation of the nocturnal activity.

Discussion

Our study revealed that the dormouse decision whether to remain in a nest box for a subsequent day was influenced by the type of field procedure (manipulation having an adverse effect on nest box occupancy), sex and sexual activity. We found that females were more likely to choose the same nest box for a subsequent day in contrast to males and similarly sexually active individuals remained more often in the den than sexually quiescent animals. These results fit nicely into the available theory. Mammalian females are well known to be more territorial than males (Ims, 1987; Scinski and Borowski, 2008; Solomon and Keane, 2007; Waterman, 2007; Wolff, 1993). Hence, this territoriality imposes a limit for the female on the number of available cavities within her territory. This likely increases the willingness to risk and to defend a cavity in a given territory (Wolff, 1993). Moreover, some of the females are bounded to the nest boxes because they have to nurse their offspring in them.

Furthermore, we have found that sexually active animals, irrespective of their sex, were not affected by the manipulation and remained in the nest boxes more often than sexually quiescent individuals. This pattern is likely to be a consequence of the fact that sexually active animals are known to take higher risks (Waterman, 2007).

We have found that animals which were not manipulated (i.e. only remotely checked with a portable transponder reader) spent a following day in the nest box with higher probability than those who were manipulated. On the other hand, we have found that the timing of nocturnal activity was not affected, no matter whether the animals had been manipulated or not. Probably we can admit that the level of disturbance to the animals by investigators´ manipulation is similar to the threat the animals perceive when encounter natural predator. Available studies, performed in semi-natural settings, bring mixed results on this issue. For example, Abramsky et al., (1996) have found that gerbils exposed to barn owl flights and owl hunger calls have responded by reducing their activity, but this response disappeared shortly after removing the source of risk and within the same night the gerbils´ activity returned to its normal level. In contrast Kotler et al. (1992), have shown that normal levels of activity appeared not until 1 – 5 and more nights after the removal of predators. Nevertheless, it remains a question whether the disturbance created by investigators´ manipulation is perceived by animals similarly as they perceive the disturbance created by natural predators. Some studies support the opinion that animals perceive humans as potential predators and respond accordingly to this fact (Beale and Mohaghan, 2004; Frid and Dill, 2002). Thus, according to our study, it seems to some extent that the edible dormice perceive human manipulation as a predation attack and therefore they try to avoid the place where the manipulation was held. But this result seems to hold true only for a part of the population.

Our study suggests that the disturbance caused by investigators´ handling to the edible dormouse may stress the animal and modify its behaviour afterwards e.g. in a way of leaving a nest box as a den where it has stayed before the manipulation. But this effect is probably of no long-term character and does not involve the whole population. The data indicate that responses to handling differ between individuals within the population. Hence, we suppose that investigators´ handling may affect the animals but this effect is likely to be a state-dependent strategy (e.g. the value of the den in relation to reproductive cycle or timing within the activity season) and condition and perhaps other circumstances (e.g. food availability). Therefore we suggest that investigators should consider individual-specific effects of handling when designing field studies. Nevertheless, additional research aimed at handling-induced stress and evaluating the effects of handling on the animal behaviour is needed.

To sum up, our study indicates that the animal handling by investigators does not seem to impair the reliability of routinely practiced field protocols for small mammals; however the disturbance should be minimal as it may induce changes in the animal behaviour with respect to the current animals´ state.

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Figure legends

Figure 1. Nest box occupancy pattern by the edible dormouse during the summer season of 2009.