Diet and microhabitat use of the woodland dormouse *Graphiurus murinus* at the Great Fish River Reserve, Eastern Cape, South Africa

by

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A dissertation submitted in fulfilment of the requirements for the degree of MASTER OF SCIENCE (ZOOLOGY) in the Faculty of Science and Agriculture at the University of Fort Hare

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DECLARATION

I **Siviwe Lamani**, student number **200604535** hereby declare that this dissertation titled **"Diet and microhabitat use of the woodland dormouse *Graphiurus murinus* at the Great Fish River Reserve, Eastern Cape, South Africa"** submitted for the award of the Master of Science degree in Zoology at the University of Fort Hare, is my own work that has never been submitted for any other degree at this university or any other university.

Signature:

I **Siviwe Lamani**, student number **200604535** hereby declare that I am fully aware of the University of Fort Hare policy on plagiarism and I have taken every precaution on complying with the regulations.

Signature:

I **Siviwe Lamani**, student number **200604535** hereby declare that I am fully aware of the University of Fort Hare policy on research ethics and have taken every precaution to comply with the regulations. The data presented in this dissertation were obtained in the framework of another project that was approved by the University Ethics committee on 31 May 2013 and is covered by the ethical clearance certificate # SAN05 1SGB02.

Signature:

SUPERVISOR'S FOREWORD

The format of this Master's dissertation (abstract, general introduction and two independent papers) has been chosen with two purposes in mind: first, to train the MSc candidate to the writing of scientific papers, and second, to secure and allow for a quicker dissemination of the scientific knowledge. Consequently, the present work does not include extensive reviews on the study species or on the main field techniques used, as is sometimes the case in MSc dissertations. However, some additional information on dietary analyses has been provided in Chapter 3. In order to avoid repetitions, information on the study area has been placed in a separate chapter (Chapter 2).

For Chapter 4, Ms Lamani obtained significant assistance in the field from two other Master's students, as well as from her co-supervisor and myself. This is because this set of data was collected as part of a larger project investigating niche differentiation in a community of rodents living in a riverine *Combretum* forest. Overall, Ms Lamani spent nearly 80 days in the field to collect data. This, together with the entering and analysis of all the data presented in this dissertation, therefore constitutes a more than satisfactory effort for a Master's level research project.

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I am especially greatly thankful to my family, especially my parents and friends, for all their patience, support and understanding throughout my studies.

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ABSTRACT

The diet of the woodland dormouse *Graphiurus murinus* was studied in a riverine *Combretum* forest at the Great Fish River Reserve (Eastern Cape, South Africa). Food remains were collected seasonally from a maximum of 45 different nest boxes between December 2010 and November 2011. An overall mean of 1.32 ± 0.51 food categories (range 1–4) were identified in each nest box used as "larder" during the year. Dietary diversity and standardized diet breadth were low to intermediate, with a peak in summer and a nadir in winter. In terms of percentage occurrence, arthropods were dominant (99%) in all seasons, followed by molluscs (16%) and fruits (14%). When relative percentage occurrence and percentage weight were considered, arthropods were still dominant, but a slight decrease was observed in summer. Besides spiders (order Araneae), nine arthropod families were found in the diet of the woodland dormouse; Tenebrionidae (40%), Spirostreptidae (30%), Carabidae (15%) and Blattidae (14%) were the most dominant families in terms of percentage weight. *Grewia robusta* and *Ziziphus mucronata* were the only fruit species present in the diet. Pianka's diet overlap indices were very high (>0.93), indicating that the diet of the woodland dormouse was similar between pairs of seasons. This study also investigated whether woodland dormice *Graphiurus murinus* positively select or avoid specific microhabitat types or structures, and whether a set of predictor variables related to microhabitat characteristics can explain the presence and rates of visits to specific trapping stations. Trapping was conducted seasonally, over 5 days, between June 2011 and April 2012. A grid of 96 stations (16 rows × 6 lines) was established. Trap stations were set at 10-m intervals. At each station two Sherman traps were placed. The 192 traps were distributed relatively equitably among four height categories (0–0.5 m, 0.51–1 m, 1.01–1.5 m, and 1.51–2.5 m). On average, trapping success was 4.70 ± 4.17 dormice per 100 traps. Dormice were trapped at an average height of 136 ± 64 cm, which was significantly higher than the average height at which traps were set (99 ± 75 cm). Bonferroni Z tests indicated that dormice positively selected areas with high canopy cover and connectivity, possibly to decrease predation risk. Generalized Linear Models showed that trap use and numbers of visits and different animals caught were positively associated with a high arboreal connectivity, hence supporting the hypothesis that woodland dormice may depend on wooden "corridors" for their movements.

Key words: woodland dormouse, *Graphiurus murinus*, diet, food remains, arthropods, insectivorous, microhabitat selection, trapping success, canopy cover, arboreal connectivity.

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Chapter 1

The woodland dormouse *Graphiurus murinus*

1.1 Taxonomy and status

The woodland dormouse *Graphiurus murinus* is a small rodent belonging to the Gliridae family (order Rodentia). There are 14 species in the genus *Graphiurus* and all of these species are endemic to Africa (Skinner & Chimimba 2005). Five species of the genus *Graphiurus* occur in the southern African region; these include, besides the woodland dormouse, the small-eared dormouse *G. microtis* (Happold 2013), the lesser savanna dormouse *G. kelleni*, the spectacled dormouse *G. ocularis*, and the rock dormouse *G. platyops* (Skinner & Chimimba 2005). In 2008 the woodland dormouse was listed in the category Least Concern (LC) by the International Union for Conservation of Nature (Baxter 2008).

1.2 Description

Adult woodland dormice generally weigh between 24 and 34 g. The head–body length is about 78 to 113 mm and the tail measures 58 to 94 mm. The colour of the upper parts of the body is grey or buffy grey (Skinner & Chimimba 2005). The under parts are buffy white and the tail is bushy and faintly browner than the body colour (Fig. 1.1).

1.3 Geographic distribution

The woodland dormouse is widely distributed throughout the north-eastern to southern parts of the African continent (Baxter 2008). Countries in the north-eastern subregion include Ethiopia, Kenya, Uganda, Democratic Republic of Congo, Rwanda, Burundi, Tanzania, Malawi and Zambia. In the southern subregion the distribution includes Mozambique (only in the southeast), Zimbabwe, Swaziland, Lesotho, and South Africa (Baxter 2008) (Fig. 1.2). In the latter country, the species is located in provinces such as the Western Cape, the Eastern Cape, the Free State, KwaZulu-Natal, Mpumalanga and Limpopo. In Lesotho, according to Skinner & Chimimba (2005), the woodland dormouse is found solely in a narrow belt along the KwaZulu-Natal border, but is considered rare, as it is in Swaziland.

Figure 1.1. The woodland dormouse *Graphiurus murinus* (Photo: Emmanuel Do Linh San).

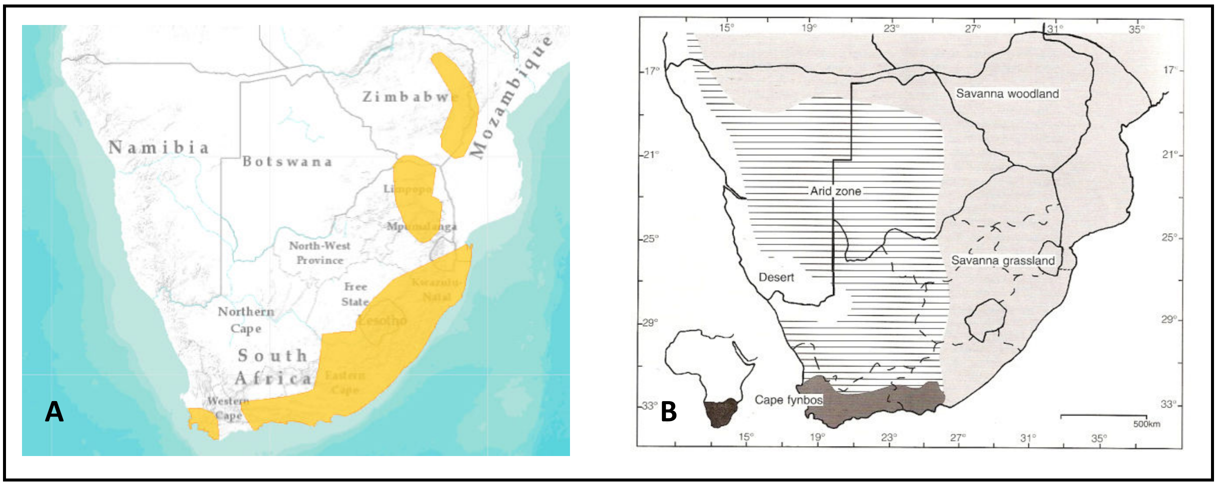

Figure 1.2. A. Distribution of *Graphiurus murinus* in the southern African subregion (from http://maps.iucnredlist.org). **B.** Map of the southern African subregion showing the major biotic divisions (after Stuart & Stuart 2001). The inspection of both maps indicate that the woodland dormouse essentially occupies wooded habitats (savanna woodland, savanna grassland and Cape fynbos).

1.4 Habitat preference

As its name implies, the woodland dormouse prefers woodlands or riverine forests where it uses tree holes as resting sites. In the Eastern Cape, woodland dormice were notably found in hollow Cape bushwillow *Combretum caffrum* trees (Madikiza *et al.* 2010a, Lamani 2011). Other appropriate resting sites are rock crevices and *Acacia* spp. trees (Skinner & Chimimba 2005). In KwaZulu-Natal the species has been recorded in grasslands with trees grouped around rocks and in the rocky drainages in the escarpment. In Lesotho woodland dormice have been found in rocky habitats such as large boulders and on rocky summits or slopes situated in montane grasslands without shrubs and trees (Lynch 1994). They are also found in human habitats such as house roofs, switch boxes and water pumps. They have also been taken in piles of rubbish debris caused by floods near seasonal rivers (Taylor 1998).

1.5 Reproduction

Little is known about the reproduction of the woodland dormouse. Normal litter size is probably 3–5 young, though up to 6 foetuses have been found (Lynch 1989). In the southern African region it was reported that the breeding season begins as early as October and lasts throughout the summer till February (De Graff 1981, Madikiza 2010). Kingdon (1974) estimated the gestation length in *G. murinus* to be around 24 days, and found body weight, head–body length and tail length of two neonates to be 3.5 g, 40 mm and 18 mm respectively.

1.6 Activity and socio-spatial behaviour

Graphiurus murinus is nocturnal (Lombard 2014) and generally arboreal, but sometimes can be terrestrial (Skinner & Chimimba 2005). It was reported as a solitary species by Ansell (1960), however, Kingdon (1974) found as many as 11 woodland dormice in the same nest. In the Great Fish River Reserve (Eastern Cape, South Africa), individual woodland dormice were found resting in groups in artificial nest boxes (Madikiza 2010); it was also noted that male woodland dormice had a home range size that was twice as large as that of females. Intrasexual home-range overlap was observed, and males displayed a larger overlap than females during the mating period (Madikiza *et al*. 2011).

1.7 Feeding behaviour and diet

Woodland dormice forage solitarily in trees in search for food, such as insects and fruits (Skinner & Chimimba 2005), millipedes, beetles (Baxter *et al.* 2005), and tiny lizards (Stuart & Stuart 1992). However, detailed information on the diet, including seasonal variation, is lacking.

1.8 Torpor and hibernation

Woodland dormice use daily torpor spontaneously to save energy when faced with unfavourable conditions like scarcity of food and low temperatures (Webb & Skinner 1995). The longest torpor bout that dormice can undergo without arousal is about 8 days (Mzilikazi *et al.* 2012). A recent study by Mzilikazi *et al.* (2012) conducted in a natural population indicated that torpid dormice can drop their body temperature to a minimum of 1 °C. In the laboratory, dormice entered hibernation when temperatures were between 10–15 °C (Ellison & Skinner 1991).

Chapter 2

Study area

2.1 The Great Fish River Reserve

The study was conducted in the Great Fish River Reserve complex (GFRR; Fig. 2.1), which is situated about 30 km north-east of Grahamstown and 50 km southeast of Fort Beaufort (Eastern Cape, South Africa). The GFRR is located between 33°04′ and 33°09′ S and 26°37′ and 26°49′ E. The conservation area is composed of three nature reserves: the Andries Vosloo Kudu Nature Reserve (65 km^2), the Sam Knott Nature Reserve (155 km^2) and the Double Drift Game Reserve (235 km^2). Therefore, the combined total size is approximately 445 km^2.

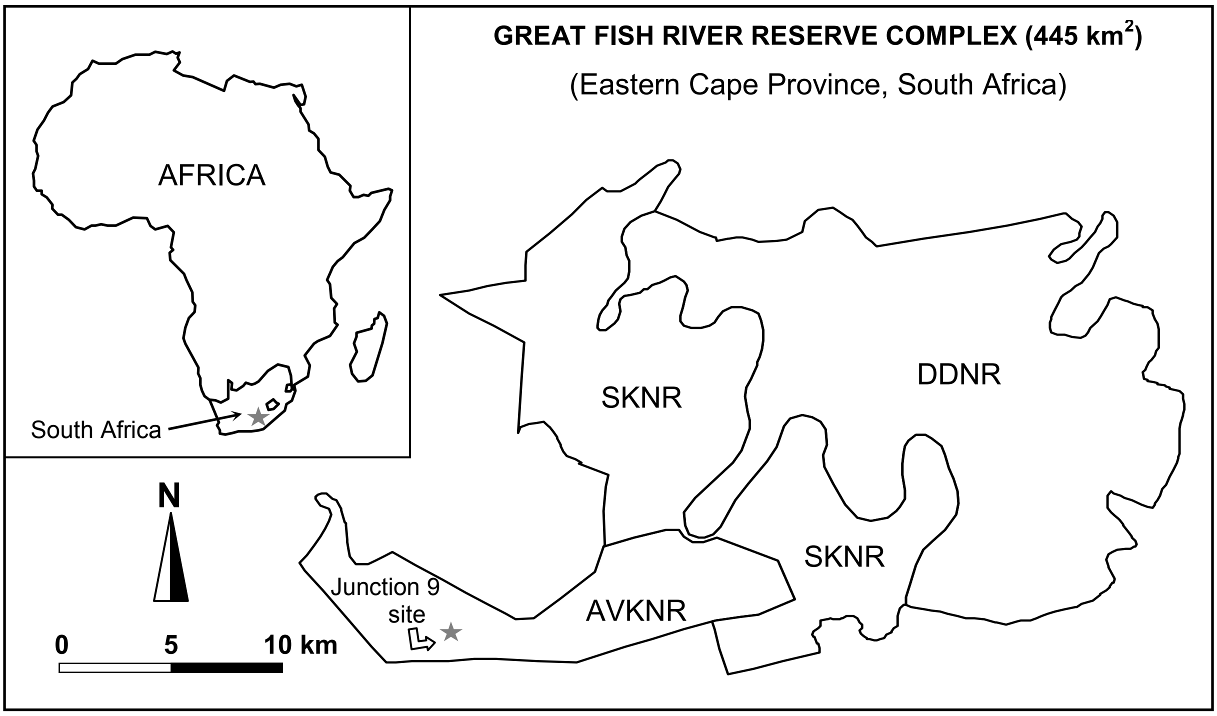

Figure 2.1. Map showing the location and the structure of the Great Fish River Reserve Complex. The "Junction 9" study site is indicated by a grey-shaded star. AVKNR: Andries Vosloo Kudu Nature Reserve; SKNR: Sam Knott Nature Reserve; DDGR: Double Drift Game Reserve.

2.2 Geology, climate and vegetation

The geological composition at the GFRR is predominately grey/red mudstone and sandstone of the Middleton formation (Birch 2000). The elevation ranges from 170 m a.s.l. at the level of the Great Fish River, to over 600 m a.s.l. at the ridges (Birch *et al.* 1999). The Reserve experiences an annual rainfall of 250–650 mm. Temperatures are mild to subtropical (the average for Grahamstown is 16.4 °C), with a mean minimum of 10.0 °C and a mean maximum of 22.9 °C. The absolute minimum is –3 °C during the winter months.

Dense thickets and clumps of thorny and succulent shrubs are major features of the reserve. The area falls within the Albany Thicket Biome. The main vegetation types have been classified as “Great Fish Noorsveld”, “Bisho Thornveld” and “Great Fish Thicket”, with the latter being the dominant one throughout the GFRR complex (Hoare *et al.* 2006). The western half of the reserve, the Andries Vosloo Kudu Nature Reserve, where the study site is located, is covered by *Euphorbia bothae* scrub. Numerically dominant species in this community are *E. bothae* and *Portulacaria afra*, while *Schotia afra*, *Grewia* spp., *Euclea undulata*, *Crassula* spp., *Ptaeroxylon obliquum*, *Phyllanthus verrucosa*, *Maytenus polyacantha* and *Pappae capensis* are also common. Bushclumps are interspersed with grasses including *Eragrostis obtusa*, *Sporobolus nitens*, *Arista* spp. and *Digitaria eriantha*.

The present study was conducted in a stretch of “Riverine *Combretum* Forest” (Fig. 2.2) dominated by *Combretum caffrum* stands (Fig. 2.3). This species is prone to rotting from the inside, resulting in numerous holes and hollows, and this in almost every *Combretum* tree present. The riverine forest supports several other tree species: *Maytenus heterophylla, Olea europaea* ssp. *africana, Rhus* spp., *Acacia* spp., *Ziziphus mucronata* and *Schotia afra*. Beneath these trees, *Azima tetracantha, Scutia myrtina, Ehretia regida, Acalypha glabrata* and *Carrisa bispinosa* ssp. *bispinosa* often form dense undergrowth. On both sides of the riverbed, the study area is bordered by relatively large expanses of “Bushclump Karroid Thicket”, a semi-open habitat composed of *Rhus* spp. and *Scutia myrtina* bushclump and a karroid herbaceous layer.

Figure 2.2. Overview of the "Junction 9" study site. The "Riverine *Combretum* Forest" can be seen in the middle part of the picture (Photo: Emmanuel Do Linh San).

Figure 2.3. Detailed view of the interior of the "Riverine *Combretum* Forest" dominated by stands of Cape bushwillow *Combretum caffrum* trees (Photo: Emmanuel Do Linh San).

2.3 Other small mammals at the study site

Within the rodent community, the four-striped mouse *Rhabdomys dilectus*, the Namaqua rock mouse *Micaelamys namaquensis*, the vlei rat *Otomys irroratus*, the bush Karoo rat *Otomys unisulcatus*, the pouched mouse *Saccostomus campestris*, the multimammate mouse *Mastomys* sp., the grey climbing mouse *Dendromus melanotis*, the African pygmy mouse *Mus minutoides*, and the Mozambique thicket rat *Grammomys cometes* have been captured at this site (Kryštufek *et al.* 2008, Arnolds 2009, Madikiza 2010, Gebe 2014) and elsewhere in the reserve (Kryštufek *et al.* 2008). The last mentioned species, together with an undetermined shrew species, possibly the least dwarf shrew *Suncus infinitesimus*, have been found in nest boxes (Madikiza 2010, Madikiza *et al*. 2010a).

Chapter 3

Diet of the woodland dormouse

3.1 Introduction

Studying the diet of animals is crucial in understanding relationships between species and between an animal species or an individual and its environment. These relationships may determine community structure, species diversity, relative abundance and resource portioning among species and individuals (Bar *et al.* 1984, Kronfeld & Dayan 1998). Composition of diets in animals varies within the year and depends on food availability and feeding preferences of a given species (Nowakowski & Godlewska 2006).

Rodents (order Rodentia) exhibit a broad range of foraging strategies and dietary preferences, including granivory (e.g. *Desmodillus*), herbivory (e.g. Otomyinae), insectivory (e.g. *Onychomys*), frugivory (e.g. Sciuridae), as well as omnivorous feeding patterns (e.g. Gerbillinae, Murinae) (Kerley & Whitford 1994). We refer to the terms "granivore", "insectivore" and "herbivore" as to those animals whose diet contains over 50% of seeds, insects (or arthropods in a general sense), and green plant parts (leaves, stems) respectively, whereas "omnivore" refers to those species in whose diets no particular category prevails. However, simply generalising and classifying rodents into such categories would not be adequate as information on the type or details of the food eaten, the food preferences, requirements, and the seasonal variations of these food types tend to be overlooked.

Within the family Gliridae, some species are considered to be omnivorous, while others are rather granivorous (Franco 1990, Nowakowski *et al.* 2006, Juškaitis 2008). Dormice characteristically lack a caecum (Ognev 1947, Storch 1978). This suggests that dormice may be less well adapted to digest cellulose than other small mammals (Juškaitis 2007). This may impose an important trophic limitation on these animals. Omnivorous species potentially exhibit a high dietary plasticity, which should provide them with advantages in seasonal habitats.

Studies of dormice feeding ecology are fairly common, although some controversy exists in relation to the diet composition and predatory behaviour in some species. For example, dormice are overall considered insectivorous and plant feeders (Bright & Morris 1993, Gil-Delgado *et al.* 2010, Juškaitis 2007). However, the diet of dormice species seems to be diverse geographically and within genera. In Europe, a number of studies have been conducted on the diet of dormice. The forest dormouse *Dryomys nitedula* has been reported to feed mainly on arthropods, snails and animal eggs (Nowakowski *et al.* 2006), while the edible dormouse *Glis glis* is mainly herbivorous (Sailer & Fietz 2009). The diet of the latter species is composed of buds, fruits and seeds of trees, bark, twigs, and arthropods (Franco 1990, Nowakowski & Godlewska 2006, Sailer & Fietz 2009). In a Bohemia forest (Czech Republic) the arthropod diet of the edible dormouse was almost exclusively composed of spiders (Mikeš *et al.* 2010). Both the edible dormouse and the garden dormouse feed on bilberries (Mikeš *et al.* 2010). The common dormouse *Muscardinus avellanarius* is reported as a selective feeder, consuming flowers, fruits and insects (Bright & Morris 1993), whereas Juškaitis (2007) indicated that this species has a varied diet, which depends upon latitude and nutritional plant species available and follows a strongly seasonal pattern. In a study on the garden dormouse *Eliomys quercinus*, where a combination of faecal analysis and analysis of food remains was used, Gil-Delgado *et al.* (2010) found that arthropods were the dominantly consumed invertebrates and were mostly preyed on from spring to autumn. Plant matter and gastropods appeared throughout the year. Garden dormice also predated on bird nests containing eggs and nestlings and captured adults as well (Gil-Delgado *et al.* 2010).

In the southern African region a number of studies have been conducted on three (see below) out of five species of dormice that occur in the region. No information is available on the diet of the last two species, the lesser savanna dormouse *Graphiurus kelleni* and the small-eared *dormouse G. microtis*. Channing (1984) reported that the diet of the spectacled dormouse *G. ocularis* is composed of vertebrates like lizards and birds, insects and other arthropods. In captivity, the spectacled dormouse consumes eggs. Channing (1984) also conducted a field experiment where *G. ocularis* consumed eggs, bees and honey. The diet of the rock dormouse *G. platyops* is composed of seeds, green vegetable matter, moths and other insects (Skinner & Chimimba 2005).

Previous research on the diet of the woodland dormouse *Graphiurus murinus* (Desmaret 1822) revealed that it is an omnivorous species, which mostly prefers arthropods, fruits and seeds; however, fruits and seeds were considered a secondary/supplementary food component (Ajrapetjanc 1983, Stuart & Stuart 1992, Wirminghaus & Perrin 1992, Baxter *et al.* 2005, Skinner & Chimimba 2005, Nowakowski *et al.* 2006). Arthropod species reported to be eaten by the woodland dormouse include large moths, rose beetles, termites, and the large millipede *Doratogonius flavifilis* (Pienaar *et al.* 1980, Webb & Skinner 1995). Furthermore in captivity the woodland dormouse consumes dead mice and birds (Kingdon 1974, Webb & Skinner 1995) and other green parts of plants (Ajrapetjanc 1983, Stuart & Stuart 1992, Nowakowski *et al.* 2006).

3.2 Techniques used to study the diet of rodents

Many techniques have been used to study the diet of rodents. These techniques include direct observations of the foods eaten by animals, and indirect observations such as faecal analysis, stomach content analysis, stomach pumping and collection of food remains (Channing 1984, Rowe-Rowe 1986, Monadjem 1997, Kronfeld & Dayan 1998). However, due to the cryptic nature of rodents, and the nocturnal habits of a majority of species, direct observations of foraging in rodents are difficult, and only a few researchers (Bright & Morris 1993) managed to use this method successfully.

3.2.1 Faecal analysis technique

Faecal analysis is useful in compiling a list of fruits (when seeds are swallowed) and insects (when their body is composed of chitin) eaten by rodents and other mammal species, and is an important method to determine seasonal diet changes in species that are difficult to follow (Atsalis 1999). However, it has been found to be inaccurate because of the discrepancies in the digestion; easily digestible matter like soft-bodied insects such as flies, caterpillars and larvae will therefore not be observed (Kronfeld & Dayan 1998, Atsalis 1999). The advantage of faecal analysis is that there is no sacrificing of animals. Faecal analysis technique has been used on various small mammals such as the spectacled dormouse (Channing 1984), the edible dormouse (Sailer & Fietz 2009), the round-eared sengi *Macroscelides proboscideus* (Kerley 1992), the Siskiyou chipmunk *Tamias siskiyou* (McIntire & Carey 1989), the golden mantled ground squirrel *Spermophilus lateralis* (McIntire & Carey 1989), and the brown mouse lemur *Microcebus rufus* (Atsalis 1999).

3.2.2 Stomach content analysis technique

Stomach content analysis is a widely used method in the studies of diet in various small mammal taxa such as Macroscelidae (Monadjem 1997), Murinae (Monadjem 1997, Wirminghaus & Perrin 1992), and Graphiurinae (Rowe-Rowe 1986) in the southern African subregion. It has been reported to be a more accurate technique than faecal analysis (Kronfeld & Dayan 1998, Atsalis 1999). This is mainly due to the fact that food items in the stomach are not yet fully digested; thus soft food items that may not be present in the faeces, can still be detected in the stomach. The disadvantage of using stomach analysis is that it requires the sacrifice of a large number of animals, and therefore cannot be used for some species because of conservation considerations (Kronfeld & Dayan 1998).

3.2.3 Food remains collection technique

Analysis of food remains collected in nesting sites, including artificial nest boxes, is another method used to determine the diet of rodents. This method was used by Baxter *et al.* (2005) on the woodland dormouse and by Gil-Delgado *et al.* (2010) on the garden dormouse (*Eliomys quercinus*). I will be using this method to determine the diet of the woodland dormouse.

3.2.4 Alternative techniques to study the diet of rodents

Alternative methods that are used in diet studies are stomach pumping and feeding tests. The first method has been used by Kronfeld & Dayan (1998) on the common spiny mouse *Acomys cahirinus*. The advantage of stomach pumping is that it will provide similar results to stomach content analysis without any animals being sacrificed (Kronsfeld & Dayan 1998). Diets of the edible, forest and woodland dormice were investigated using feeding tests on captive animals (Nowakowski *et al.* 2006). Feeding tests may be biased because the food provided in the test may differ to that available in the wild or may not be present in the same quantity.

3.3 Aim, objectives and predictions

The broad aim of this study was to describe the types of foods consumed by the woodland dormouse in a riverine *Combretum* forest during a yearly cycle.

Objectives:

1. To determine which families of arthropods will dominate the diet of the woodland dormouse.
2. To investigate whether there are seasonal variations in the consumption of arthropods and fruit seeds.
3. To evaluate whether food consumption corresponds to food availability. The latter will be determined through the use of pitfall traps for ground-dwelling insects and other arthropods, because preliminary observations suggested that a large quantity of remains found in nest boxes were that of terrestrial beetles (Baxter *et al.* 2005, Z.J.K. Madikiza, pers. comm.).

Predictions:

1. Based on the findings of previous dietary studies on *G. murinus* and other dormouse species, it was predicted that the diet of the woodland dormouse would mainly consists of insects, especially beetles (order Coleoptera), and fruits.
2. There will be seasonal variations in the diet of dormice; this may be caused by differences in food availability due to variations of weather conditions during the seasons, and possibly due to different energetic requirements during the mating and breeding season.

3.4 Materials and methods

3.4.1 Sampling of food remains

The north-western side of the study site, called "Junction 9" (altitude: 320 m; Fig. 3.1), contains 88 wooden nest boxes that were erected sequentially from 2003 onwards. These were installed in order to study the population biology and dynamics of woodland dormice, as well as nest box use as such (Madikiza 2010, Madikiza *et al.* 2010a). In contrast, the south-eastern side of the forest has been used as a control site, notably for a study on dormice resting site ecology (Fig. 3.1; Lamani 2011). Both sides possess similar vegetation composition and structure, and therefore offer the same habitat to dormice.

Nest boxes with entrance hole diameter of 3 cm and removable lids were made out of wood, approximately 2 cm thick, with internal dimensions of 11.5 × 13 × 12 cm (breadth × length × height). Nails were fixed on trees and nest boxes were hanged on nails by a wire sling, with the entrance hole facing the tree trunk, so as to be more accessible to small mammals climbing the tree or branch. This design is also intended to deter birds from entering by obstructing their direct line of flight to the entrance hole (Morris *et al.* 1990). Two transverse spacing bars, above and below the entrance hole, held the box about 2.5 cm clear of the tree to which it was attached, allowing dormice to access the nest boxes easily (Fig. 3.2A).

Nest boxes were located in a 2.5-ha (breadth × length: 100 × 250 m) area and were set randomly and spaced irregularly in the forest. Nest boxes were placed at variable heights, from 1.20 to 2.35 m above the ground (mean: 1.77 ± 0.23 m), in trees with trunk or branch circumference at nest box height of 96 ± 42 cm (range: 20–211 cm).

At the end of November 2010, food remains were collected from seven main feeding stations (Fig. 3.2B), or removed from all other nest boxes, in preparation for the collection of new food remains that would be left by dormice during the study period. The food remains collected in November 2010 (= "YEAR 2010") were later compared to food remains collected during the study period, from December 2010 to November 2011 (= "YEAR 2011"). Data for the year 2011 correspond to the pooling instead of the averaging of seasonal data. This approach was chosen in order to be able to compare 2010 and 2011 data, as the former likely corresponded to the pooling of multiple-year seasonal data. Collection of data for the year 2011 was then conducted at the end of each season: summer (December–February), autumn (March–May), winter (June–August), and spring (September–November). Contents from each nest box were stored in Ziploc® plastic bags, marked with the nest box number and date. The contents of each nest box was later weighed, categorised, counted, and identified to family level (for arthropods) in the laboratory. Arthropod exoskeleton remains were identified with the help of a key (Scholtz & Holm 2008).

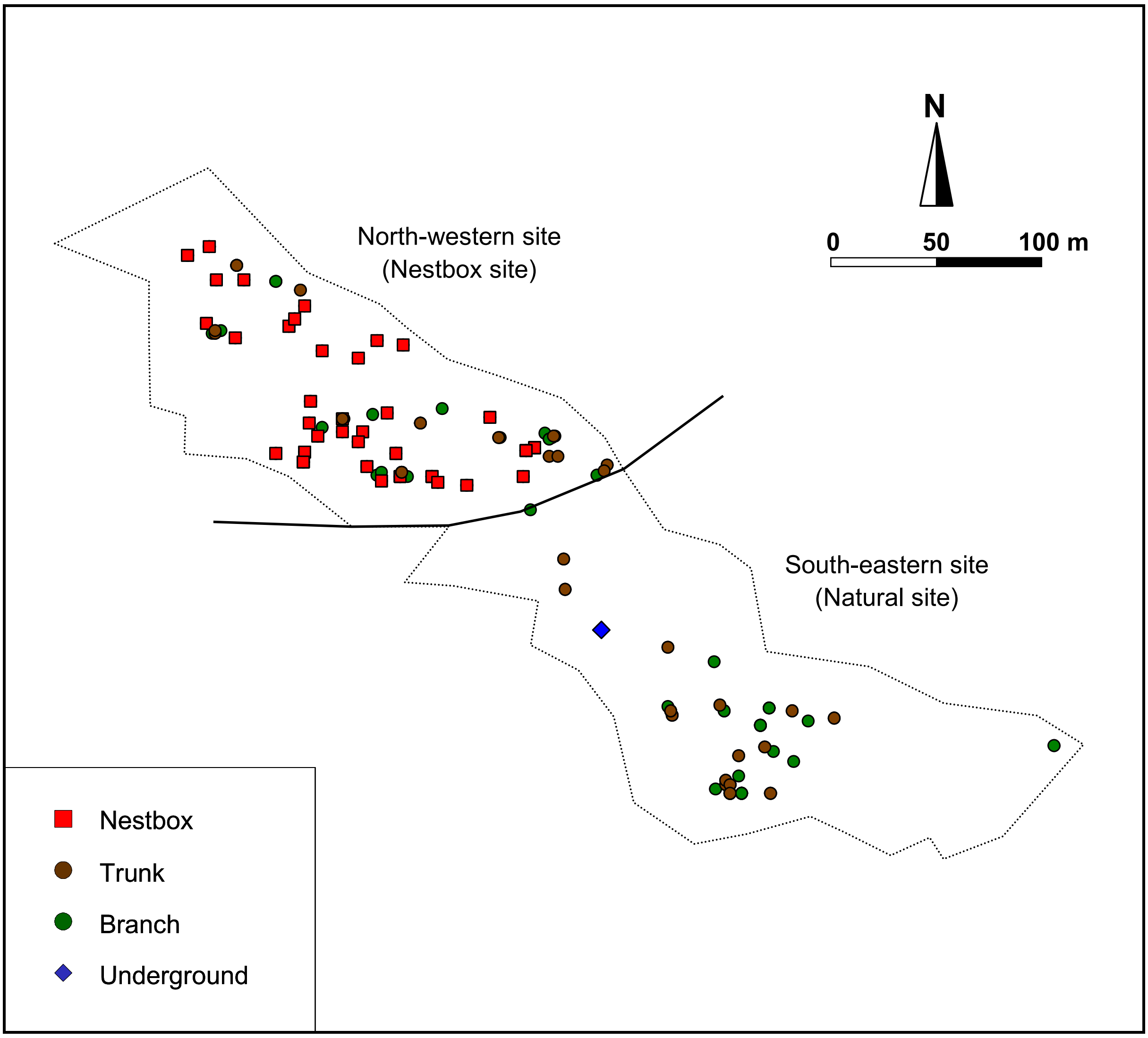

Figure 3.1. Map of the "Junction 9" study site. The dotted line indicates the border of the riverine forest and/or of the study area. The continuous line shows the gravel road separating the study site into a north-western (with nest boxes) and a south-eastern part (without nestboxes). The coloured dots, squares and diamond correspond to resting sites used by radio-tracked woodland dormice in winter and spring 2010 (for more details, see Lamani 2011).

Figure 3.2. A. Wooden nest box erected on a buffalo thorn *Ziziphus mucronata* tree. **B.** Nest box containing a variety of food remains (e.g. *Ziziphus* fruits and exoskeletons of tenebrionid beetles) and nest material (lichen and sloughed snake skin) (Photos: Emmanuel Do Linh San).

3.4.2 Assessment of terrestrial arthropod availability

Terrestrial arthropod diversity and relative abundance was evaluated seasonally during the study period. Sampling was conducted once every season. Fourteen plastic cups were used as pitfall traps and were set in two parallel transects 10 m apart inside the forest. Plastic cups were set at the same position during the study period. Only 14 traps were chosen, so as not to oversample the terrestrial food resources of the animals. The plastic cups were filled-up to 1/3 height with soapy water and set for a period of three nights in order to trap nocturnal insects. Traps were closed every morning using a parafilm to prevent the trapping of diurnal insects, and reopened late afternoons. After the period of three nights, all the pitfall traps were removed from the study site, and pitfall traps with trapped insects were taken to the laboratory where contents were washed and stored in 99% ethanol, until identified to family level using Scholtz & Holm (2008).

3.4.3 Expression of results and data analysis

The diet of the of the woodland dormouse was analysed as (1) percentage of occurrence (PO), i.e. the number of nest boxes in which a food item occurred / total number of nest boxes × 100, (2) relative percentage of occurrence (RPO), i.e. the number of occurrences of a food category / total number of occurrences of all food categories × 100, and 3) percentage weight (PW), i.e. the weight of a specific category / total weight of all food categories × 100, for each food category found in the nest boxes.

To examine similarity or potential variations in the diet of the woodland dormouse from different seasons of the year and between "years", the following broad food categories were recognized: 1) arthropods, 2) fruits, 3) molluscs and 4) unidentified. Potential seasonal and yearly differences in the overall diet were tested with a χ^2-test on a four × four contingency table, referring to the absolute occurrences of the diverse food categories. Comparison of occurrence of each food category (vs. remaining categories) between different seasons was done by performing a χ^2-test on a two × four contingency table. The χ^2-tests were performed in Excel 2007 (Microsoft Inc.).

Further comparative analyses were done using the relative frequency of occurrence (RFO = RPO/100) and the relative weight (RW = PW/100) for each food category in calculating (1) Shannon–Wiener diversity index (H'; range 0–2 for four food categories), (2) the evenness measure of representation (J'; range 0–1), (3) Levin's standardised diet breadth (B_A; range 0–1) and (4) Pianka's dietary overlap (α; range: 0–1) between pairs of seasons, and between the years 2010 and 2011. Related formulas are provided and explained in Krebs (1999).

3.5 Results

The diet of the woodland dormouse was analysed based on food remains collected in a total of 45 different nest boxes. In the year 2011, an overall mean of 1.32 ± 0.51 food categories (range 1–4) were present in the nest boxes that were used as feeding stations at least at one occasion (Table 3.1). The number of food categories consumed varied significantly during the year (Kruskal–Wallis test, $H = 10.329$, $df = 3$, $p = 0.02$).

Dietary diversity was low to intermediate (Table 3.1), with a peak in summer and a nadir in winter. Standardized diet breadth was low throughout the year, although dormouse's diet was slightly broader in summer and narrower in winter. The diversity index ($H' = 1.12$), evenness of representation ($J' = 0.56$) and standardized diet breadth ($B_A = 0.22$), were also intermediate and low respectively, when considering the year.

Table 3.1. Seasonal dietary parameters (mean ± SD) of food remains of the woodland dormouse *Graphiurus murinus* collected in nest boxes at the Great Fish River Reserve (GFRR). RFO = Relative Frequency of Occurrence, RW = Relative Weight.

	YEAR 2010	SUMMER 2010–2011	AUTUMN 2011	WINTER 2011	SPRING 2011	YEAR 2011
Number of nest boxes	7	23	33	19	13	88
Mean number of food categories/nest box	2.86 ± 1.07	1.61 ± 0.78	1.18 ± 0.39	1.11 ± 0.46	1.39 ± 0.17	1.32 ± 0.51
Shannon–Wiener Diversity Index (H')						
With RFO	1.926	1.457	0.935	0.569	1.065	1.120
With RW	0.801	0.588	0.313	0.009	0.176	0.335
Evenness of representation (J')						
With RFO	0.963	0.729	0.467	0.284	0.533	0.560
With RW	0.400	0.294	0.156	0.004	0.088	0.167
Standardised diet breadth (B_A)						
With RFO	0.879	0.402	0.153	0.076	0.251	0.215
With RW	0.180	0.098	0.031	0.0004	0.015	0.035

Food categories dominating the diet were firstly assessed using the percentage of occurrence (PO; Fig. 3.3, Table A2). Arthropods were the dominant food item throughout the year; other food items that were consumed were molluscs and fruits. Arthropods had a yearly average PO of 99.24%. Molluscs peaked in spring and summer, while fruits peaked in summer and were absent in winter; seasonal differences approached statistical significance at the 5% level (Table 3.2).

Percentages of occurrence were also calculated and compared for two years, 2010 and 2011 (Fig. 3.4, Table A1). Arthropods were dominant in both years, with a PO of 100% in 2010 and 97% in 2011. There were more fruits, molluscs and unidentified food in 2010 as compared to 2011. Statistically significant differences were found for the overall diet and for arthropods (Table 3.3).

Data were also analysed using the relative percentage of occurrence (RPO; Fig. 3.5, Table A2). Arthropods peaked in autumn and winter, fruits peaked in summer, whilst molluscs peaked in spring.

Annual comparisons of the relative percentage of occurrence (RPO; Fig. 3.6) indicated that there were more arthropods in the year 2011 than in 2010, whereas there were more fruits in 2010 as compared to 2011.

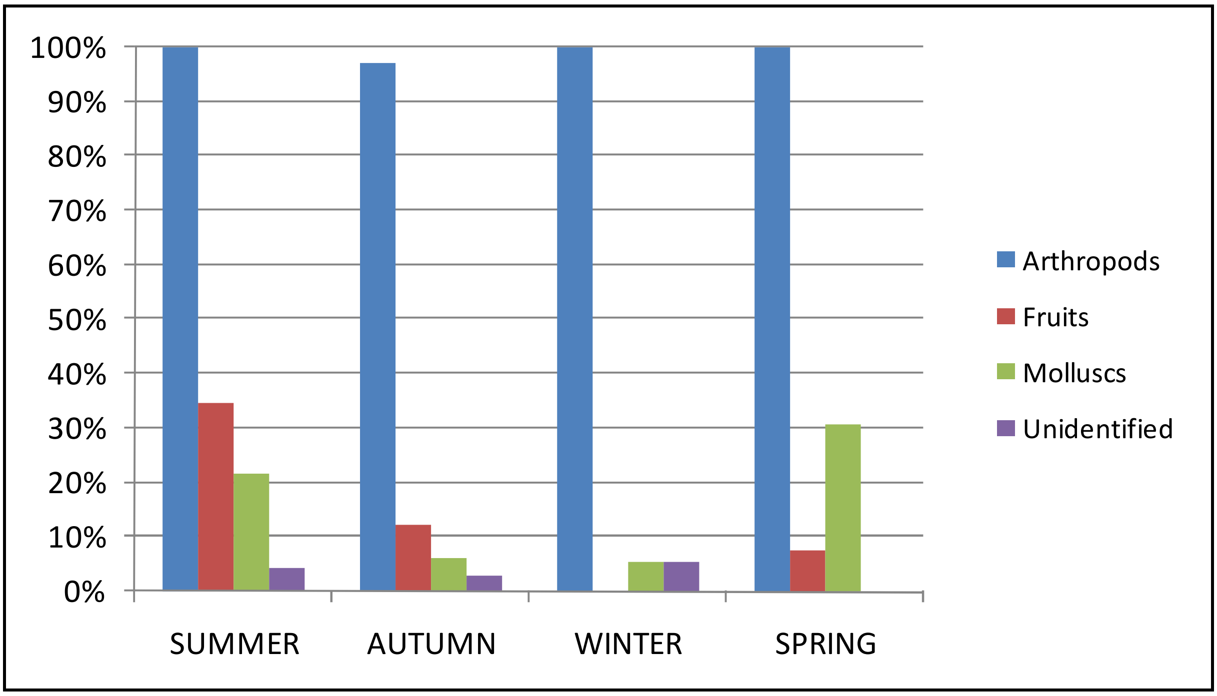

Figure 3.3. Seasonal percentages of occurrence (PO) of the main food categories in the diet of the woodland dormouse *Graphiurus murinus* at the Great Fish River Reserve (GFRR).

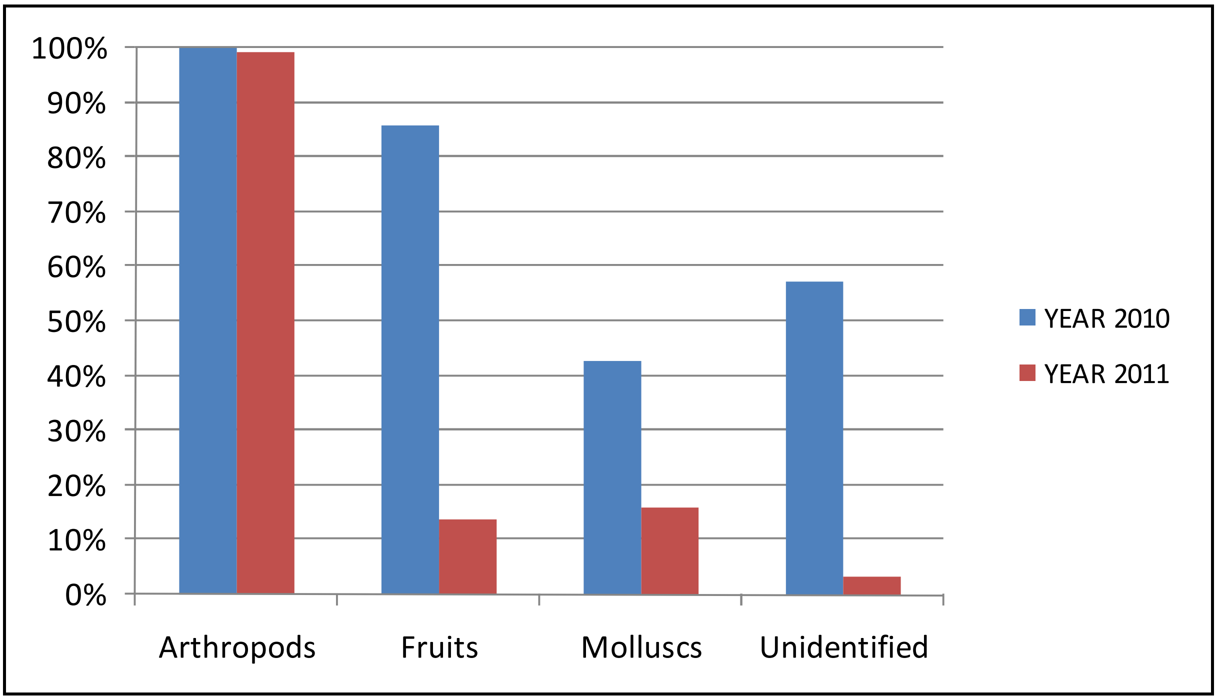

Figure 3.4. Annual percentages of occurrence (PO) of food categories in the diet of the woodland dormouse during the years 2010 and 2011 in GFRR.

Table 3.2. Results of the χ^2-tests performed to test for potential seasonal variations in the composition of the diet of the woodland dormouse in GFRR.

Test	χ^2	*df*	*p*
Overall diet	13.44	9	0.143745
Arthropods	7.14	3	0.067483
Fruits	7.24	3	0.064612

Table 3.3. Results of the χ^2-tests performed to test for potential annual variations (2010 vs 2011) in the composition of the diet of the woodland dormouse in GFRR. Statistically significant differences ($p < 0.05$) are highlighted in grey.

Test	χ^2	*df*	*p*
Overall diet	10.32	3	0.01606
Arthropods	7.18	1	0.00737
Fruits	2.82	1	0.09264

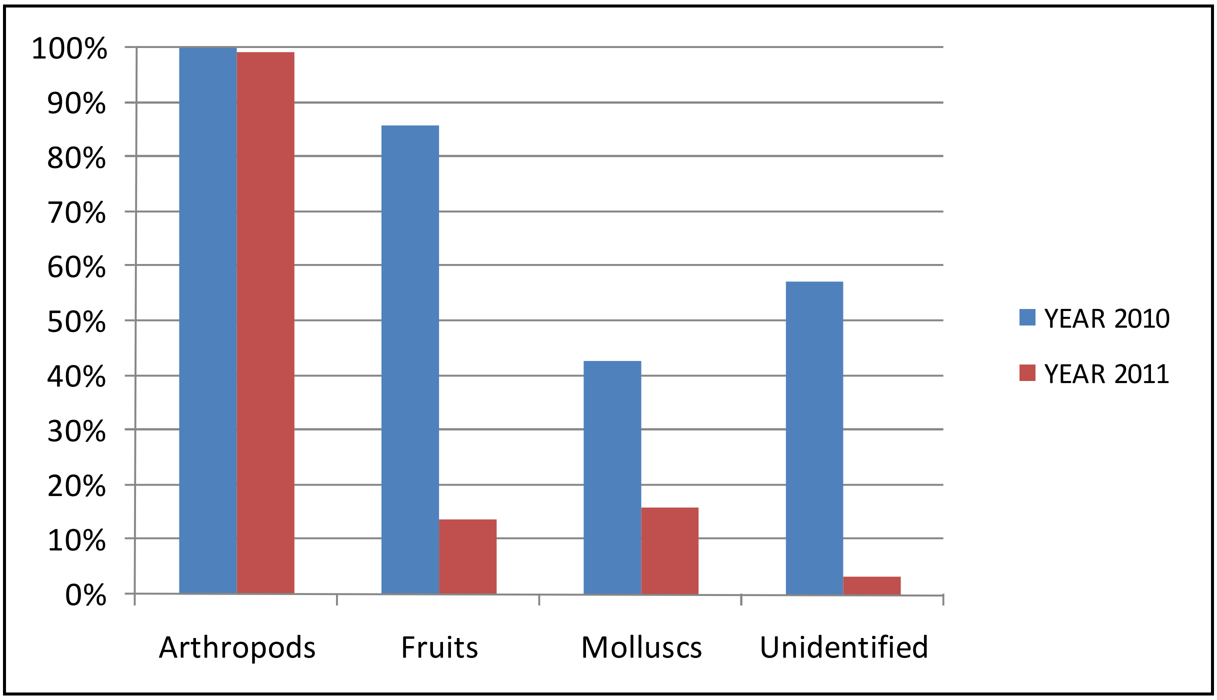

Figure 3.5. Seasonal relative percentages of occurrence (RPO) of food categories in the diet of the woodland dormouse in GFRR.

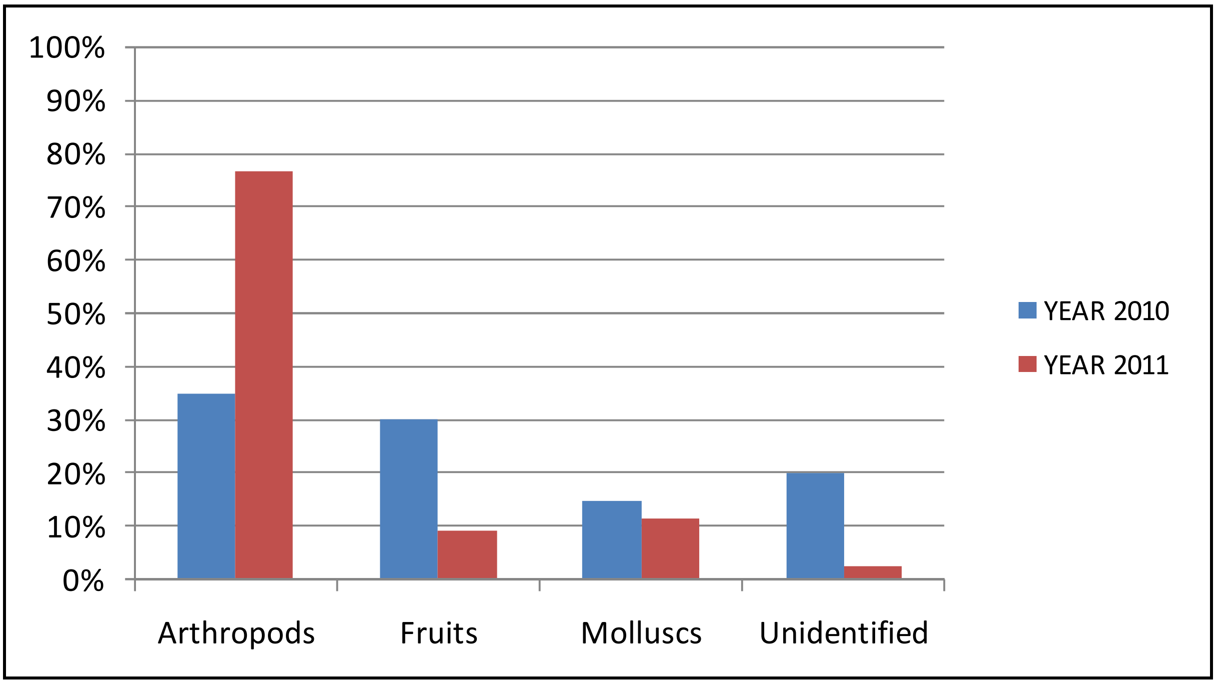

Figure 3.6. Annual relative percentages of occurrence (RPO) of food categories in the diet of the woodland dormouse during the years 2010 and 2011 in GFRR.

Data were also analysed in terms of percentage weight (PW). The average percentage weights are shown in Table 3.4. Arthropods were dominant through the year but fruits peaked in summer and molluscs were mostly present during spring. Statistical analysis showed that the importance of arthropods (Kruskal–Wallis test, $H = 9.654$, $df = 3$, $p = 0.022$) and fruits ($H = 11.748$, $df = 3$, $p = 0.008$) differed significantly through the seasons. No change was observed for molluscs ($H = 7.223$, $df = 3$, $p = 0.065$) and unidentified food remains ($H = 0.695$, $df = 3$, $p = 0.874$).

Table 3.4. Percentage weight of various food categories of food remains collected in nest boxes used by the woodland dormouse in GFRR.

Category	Summer	Autumn	Winter	Spring
Arthropods	87.04	95.55	99.94	97.78
Fruits	12.53	1.15	0.00	1.06
Molluscs	0.22	0.27	0.04	1.16
Unidentified	0.21	3.03	0.03	0.00

When comparing the percentage weight of food remains between 2010 (Fig. 3.7) and 2011 (Fig. 3.8), the results were that arthropods were consumed more in 2011 than in 2010, whereas fruits were consumed more in 2010 than in 2011.

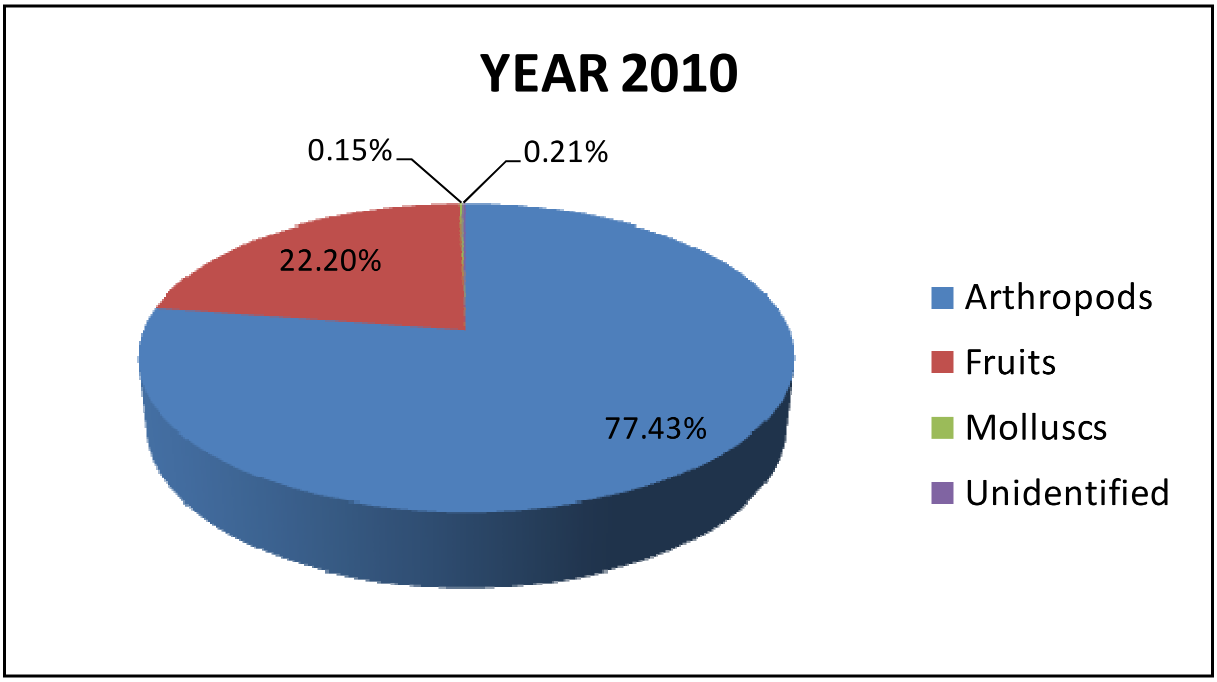

Figure 3.7. Percentage weight of food categories in the diet of the woodland dormouse in GFRR during the year 2010.

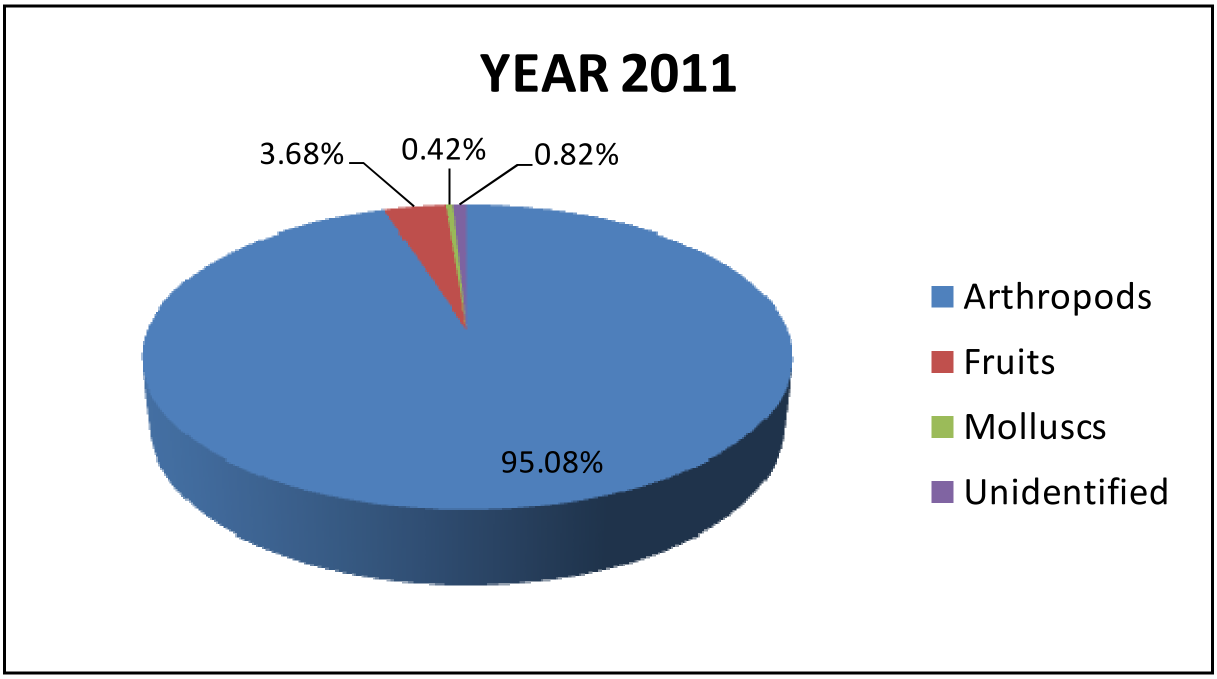

Figure 3.8. Percentage weight of food categories in the diet of the woodland dormouse in GFRR during the year 2011.

Arthropods remains were identified to family level (Table 3.5; Figs 3.9, 3.10 and 3.12), with exception of spiders which were only identified to ordinal level. Two "categories" of arthropod remains could not be determined and were pooled and classified as "Unidentified". Out of ten identified taxa, two distinctive families were dominant in all seasons. Tenebrionidae (Fig. 3.12) was the most dominant family in terms of percentage weight in summer (47%), autumn (47%) and in spring (45%). This included a large quantity of remains of two terrestrial beetle species belonging to the genus *Psammodes* (toktokkies; Fig. 3.12). Spirostreptidae (millipedes; Fig. 3.12) was the second dominant family, being the most consumed category in winter (35%). Carabidae and Blattidae (Fig. 3.12) also appeared to be important families in the diet of the woodland dormouse.

Table 3.5. Percentage weight of arthropods families (with exception of order Araneae) consumed by the woodland dormouse during the year 2011.

Family	Summer	Autumn	Winter	Spring
Araneae	0.09	0.00	0.29	0.00
Blattidae	13.20	12.16	17.49	11.88
Bostrichidae	1.41	0.11	0.29	0.82
Buprestidae	0.00	0.07	0.20	0.05
Carabidae	13.95	16.13	24.89	4.02
Chrysomelidae	0.00	0.12	0.00	0.00
Elateridae	0.08	0.00	0.00	0.00
Scarabaeidae	0.46	0.61	0.39	0.96
Spirostreptidae	23.67	24.20	35.52	36.55
Tenebrionidae	46.64	46.60	20.73	45.00
Unidentided	0.49	0.00	0.20	0.73
TOTAL	**100.00**	**100.00**	**100.00**	**100.00**

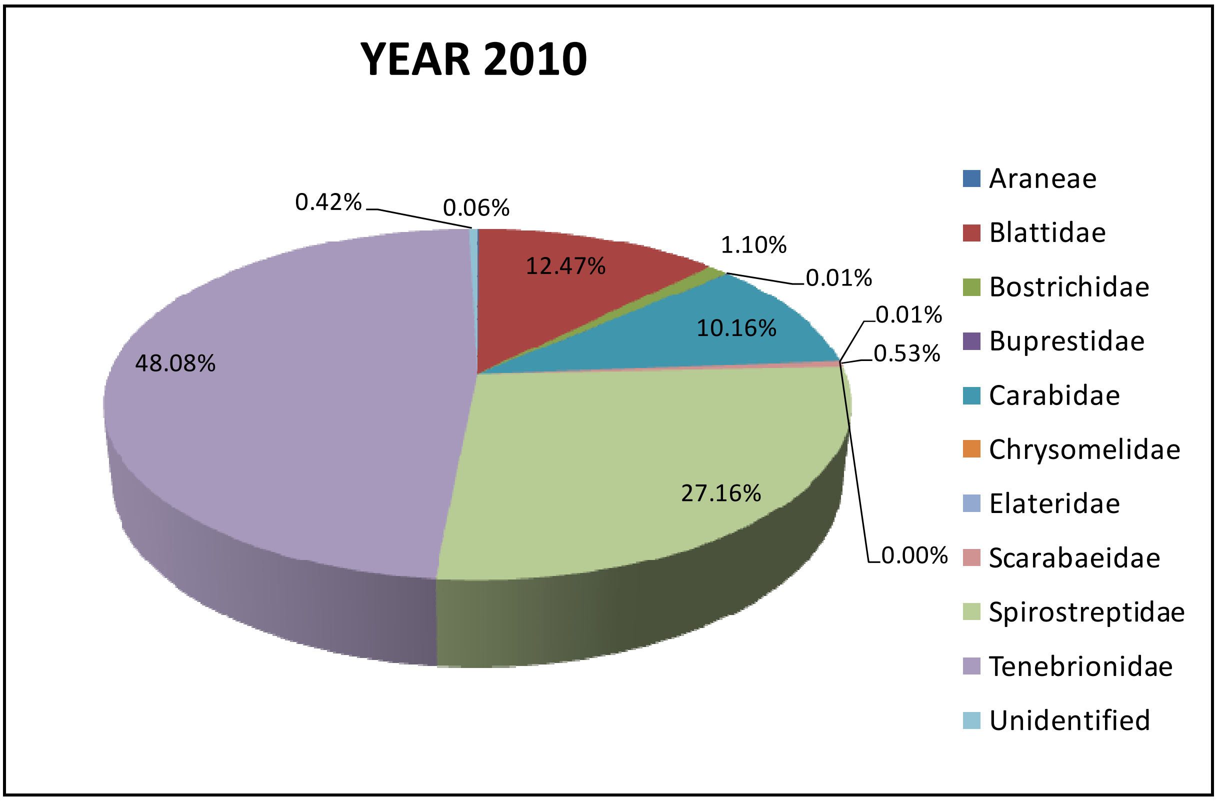

Figure 3.9. Percentage weight of arthropod families (with exception of order Araneae) during the year 2010.

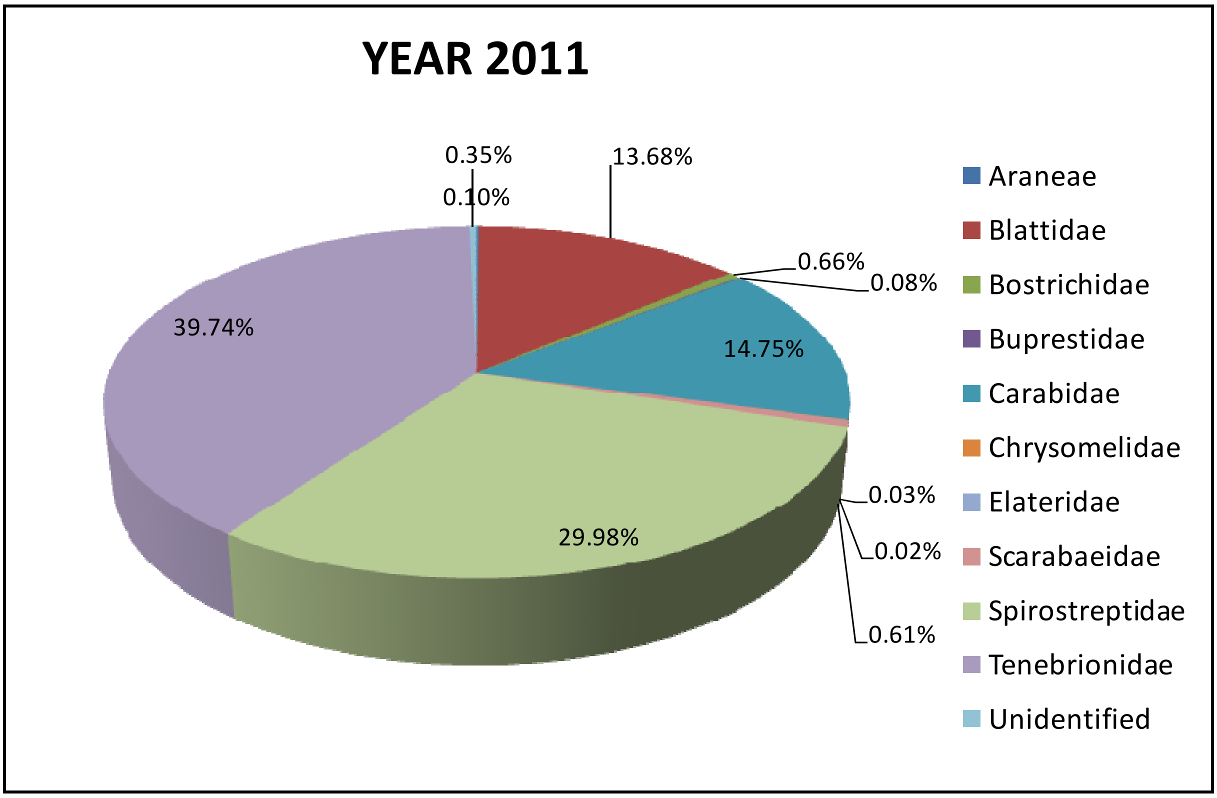

Figure 3.10. Percentage weight of arthropod families (with exception of order Araneae) during the year 2011.

Fruit remains were further identified to species level. Two types of food remains were found: seeds of cross-berry *Grewia robusta* and seeds of buffalo thorn *Ziziphus mucronata* (Fig. 3.13). Cross-berry seeds were mostly found in summer, while buffalo thorn seeds dominated in autumn and spring (Table 3.6).

Table 3.6. Seasonal weight percentage of fruit remains collected in nest boxes.

Name	Summer	Autumn	Winter	Spring
Cross-berry (*Grewia robusta*)	68.24	15.32	0	0
Buffalo thorn (*Ziziphus mucronata*)	31.76	84.68	0	100
Total	**100**	**100**	**0**	**100**

Comparison between the two years indicated that there were more *G. robusta* seeds in 2010 than in 2011, whereas *Z. mucronata* seeds were more abundant in 2011 than in 2010 (Fig. 3.11).

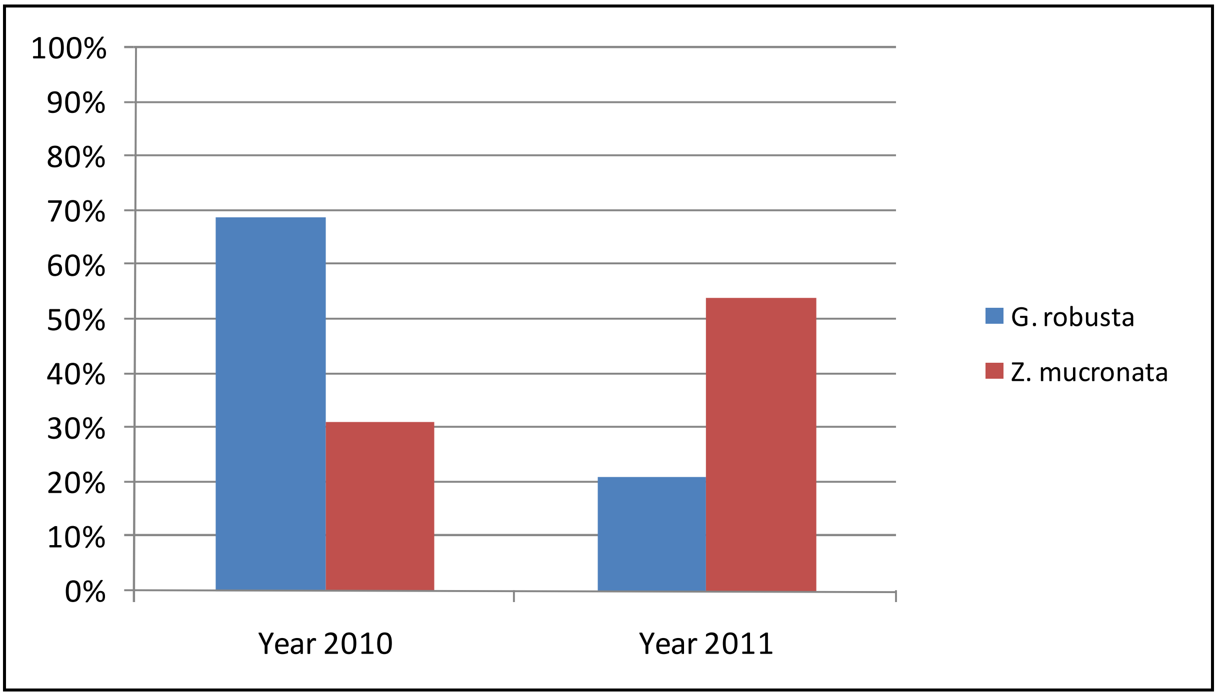

Figure 3.11. Percentage weight of fruit remains collected during the years 2010 and 2011.

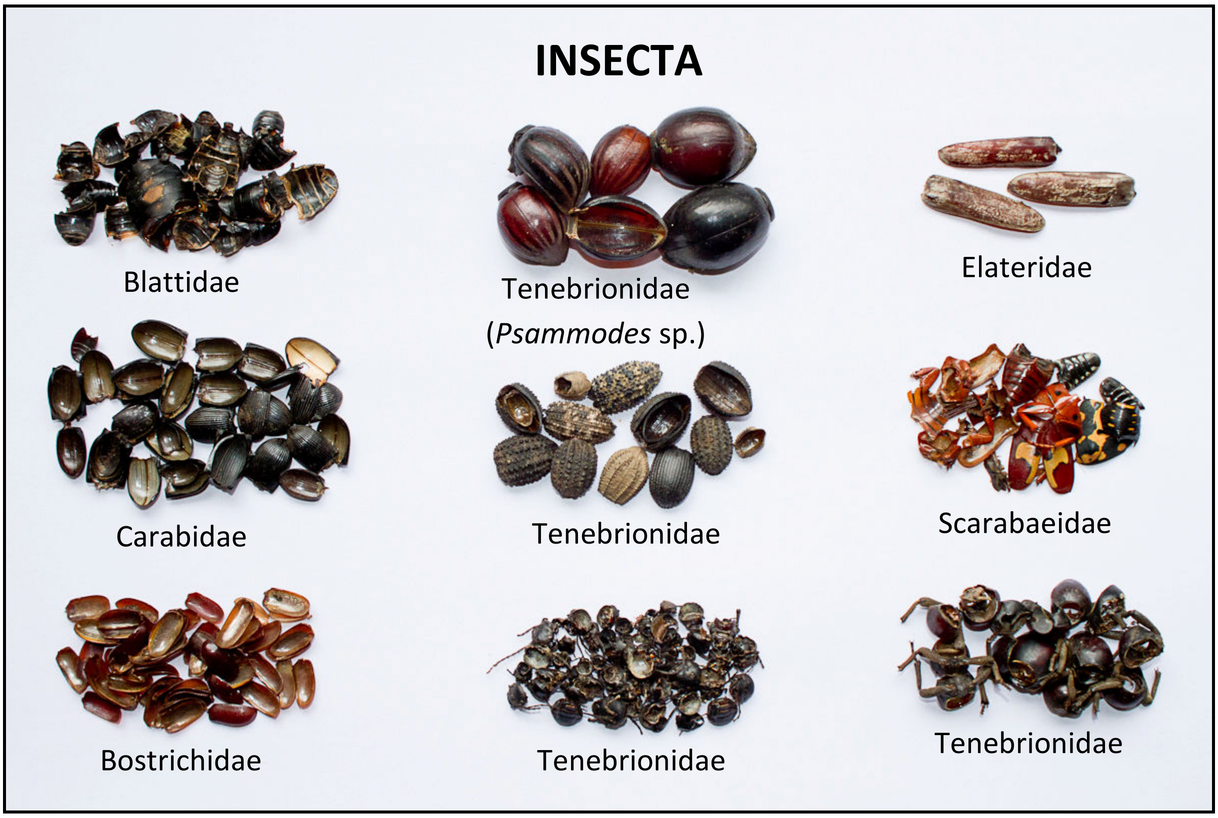

Figure 3.12. Examples of remains of the principal insect families eaten by the woodland dormouse (Photo: Emmanuel Do Linh San).

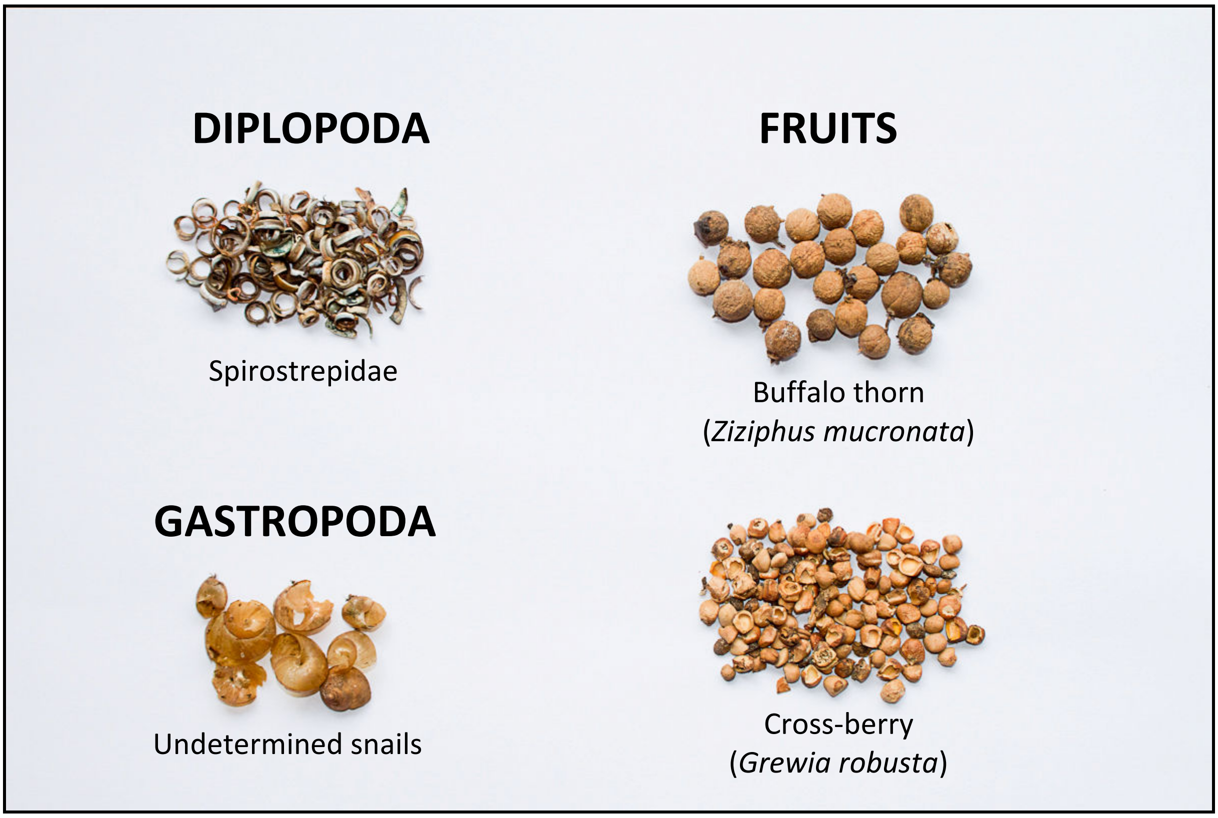

Figure 3.13. Millipede, gastropod and fruit remains found in nest boxes used as feeding stations by woodland dormice (Photo: Emmanuel Do Linh San).

The diet overlap indices were very high (0.932–0.999), indicating that the diet of the woodland dormouse was similar between pairs of seasons. Diet composition was also very similar between 2010 and 2011.

Table 3.7. Diet overlap (Pianka's α index) between pairs of seasons evaluated using relative frequency of occurrence (RFO) and relative weight (RW), and between two years (2010 and 2011). Su – Summer, Au – Autumn, Wi – Winter, Sp – Spring, Y – Year.

	Su vs Au	**Su vs Wi**	**Su vs Sp**	**Au vs Wi**	**Au vs Sp**	**Wi vs Sp**	**Y_{2010} vs Y_{2011}**
RFO	0.965	0.932	0.964	0.992	0.971	0.967	0.780
RW	0.991	0.990	0.991	0.999	0.999	0.999	0.971

Pitfall trapping showed that the family Formicidae was the most important family of terrestrial arthropods, followed by Staphylinidae, Carabidea and Bostrichidae. For exhaustive results, see Figures 3.14 and 3.15.

The percentage weight of arthropod families eaten by dormice during the year 2011 (use) and that of families indentified in the pitfall traps (availability) had a very low overlap value (Pianka's α index = 0.045).

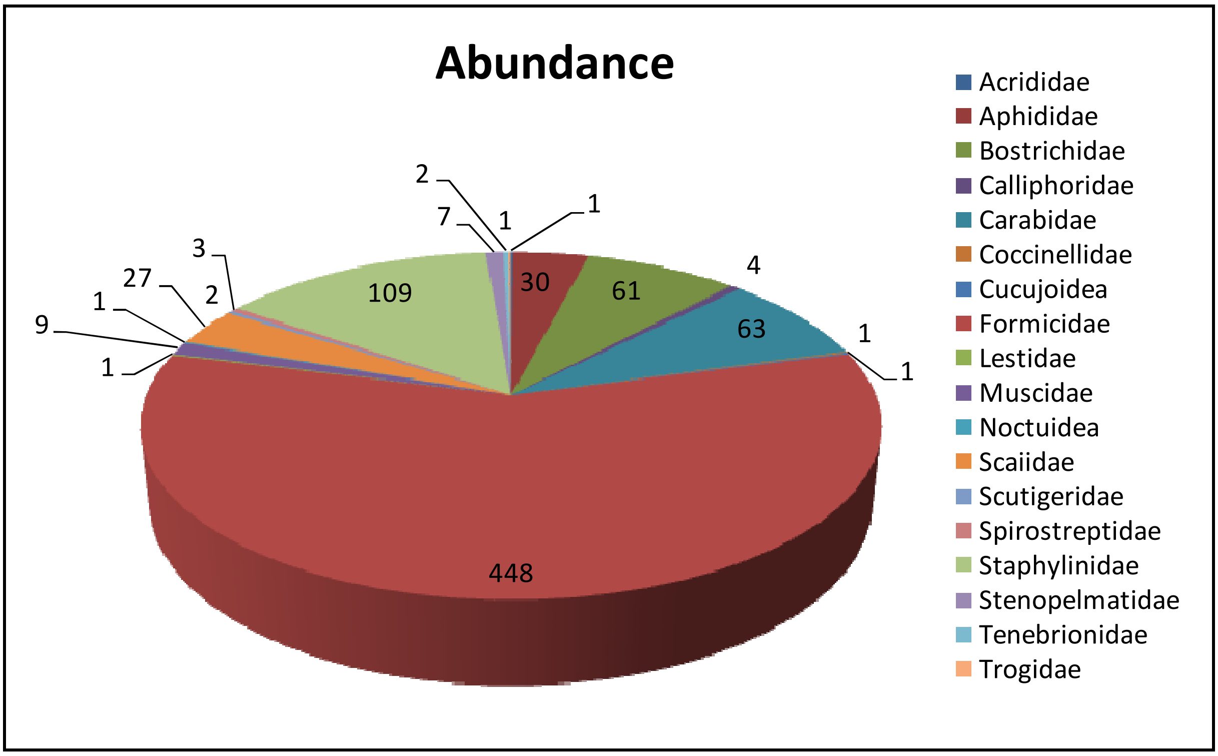

Figure 3.14. Abundance of all arthropod families collected collected throughout the year 2011 at the study site using pitfall traps.

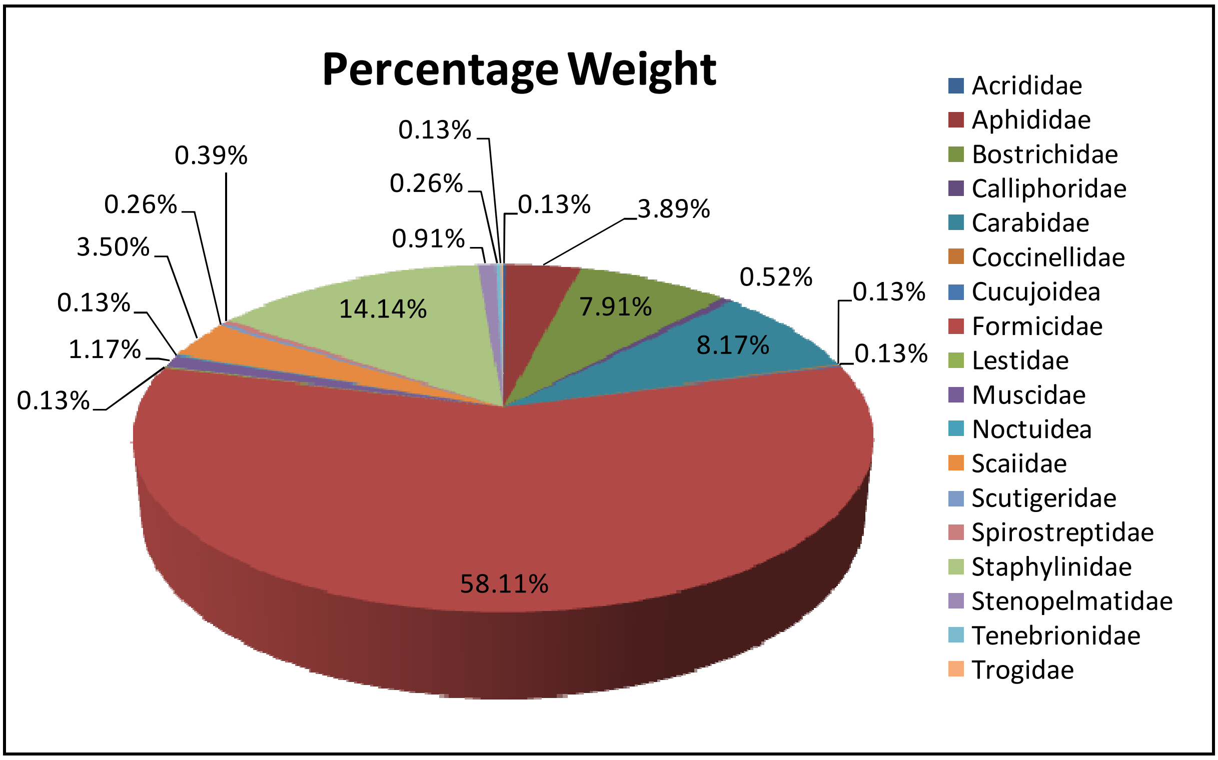

Figure 3.15. Percentage weight of all arthropod families collected throughout the year 2011 at the study site using pitfall traps.

3.6 Discussion

As predicted (Prediction 1) woodland dormice essentially fed on arthropods (and more specifically on insects) and fruits, although the former were clearly the dominant food category irrespective of the diet descriptor used. Similar results based on small samples or anecdotal evidence were described by Smithers (1971), Pienaar *et al.* (1980), Wirminghaus & Perrin (1992) and Baxter *et al.* (2005). In the UK, Richards *et al.* (1984) found that in early and mid-summer, insect remains dominated and comprised 70% of the common dormouse's diet. Other studies confirmed that arthropods also comprise an important part in the diets of some dormouse species, particularly *Eliomys quercinus* and *Dryomys nitedula* (Franco 1990, Nowakowski & Godlewska 2006, Gil-Delgado *et al.* 2010; see below for details).

Clear seasonal variations in the diet of dormice were observed (Prediction 2). The number of food categories consumed, as well as the diet diversity and diet breadth, were maximal in summer. Diet was the least diverse in winter, while data observed in autumn and spring were somewhat intermediate. However, despite these seasonal variations, arthropods were still the dominant food throughout the year. These can easily be understood for spring, summer and autumn, because these seasons are characterised by higher temperatures that favour the abundance of arthropods. In winter, temperatures are low, and arthropod abundance is expected to decrease. Yet arthropods had the highest relative percentage occurrence (90%) in winter compared to the other seasons. Since in winter no fruits were available, woodland dormice had to compensate by feeding more on arthropods than during the other seasons. However, winter is the hibernating period, and as indicated by the lower quantity of food remains collected during this period, dormice forage less. Woodland dormice can in fact partly rely on the fat reserves accumulated during autumn (Mzilikazi *et al.* 2012). In its native range, the common dormouse mostly feeds on hazelnuts, berries and fruits of bramble during autumn; feeding on arthropods was possible (due to their abundance), but was not recorded (Juškaitis 2007). In fact, *M. avellanarius* feeds on insects mainly in early summer, when suitable vegetable food is scarce (R. Juškaitis, pers. comm.).

Besides the order Araneae and a few undetermined remains, there were nine different families of arthropods found in the diet of the woodland dormouse. Out of these nine families, four (Blattidae, Carabidae, Spirostreptidae, Tenebrionidae) were dominant in all four seasons. Blattidae from the order Blattodea had a PW varying from 12–17% over the seasons. Representatives of this family of insects were commonly seen throughout the year at the study site, on trees and in the nest boxes. In the same study site, Baxter *et al.* (2005) found another family from the order Blattodea, namely Blaberidae. Blattidae were also reported to be part of the insects eaten by the spectacled dormouse in the Cederberg mountains, Western Cape (Channing 1984), as well as in the food remains found in nest boxes used as food stores by the garden dormouse (Gil-Delgado *et al.* 2010). Carabidae from the order Coleoptera had a PW varying from 4–25% throughout the year. Carabidae was also reported by Baxter *et al.* (2005) as one of the families consumed by woodland dormice. Spirostreptidae from the order Spirostreptida and class Diplopoda was one of the most consumed families by the woodland dormouse, with a PW of 24–37% at the seasonal level. Diplopoda were also found to be an important part in the diet of the forest dormouse (Nowakowski & Godlewska 2006). However, the most dominant family was Tenebrionidae from order Coleoptera, with PWs of 21–47% per season. Baxter *et al.* (2005) also found that dormouse largely depended on the family Tenebrionidae. Comparison of arthropod families consumed between the years 2010 and 2011 showed that the diet of woodland dormouse was the same in both years. There were no differences in the families consumed, and Blattidae, Carabidae, Spirostreptidae and Tenebrionidae were dominant in both years.

Other insect families, namely Bostrichidae, Buprestidae, Chrysomelidae, Elateridae, were not consumed as intensively as the four families discussed above. Seven out of the ten families found in the diet belonged to the order Coleoptera (beetles). Beetles also played an important role in the diet of other dormice species such as the spectacled dormouse, garden dormouse, and forest dormouse (Channing 1984, Nowakowski & Godlewska 2006, Gil-Delgado *et al.* 2010). Dietary studies of the edible dormouse mentioned the consumption of Coccinelidae and other families by this species, namely Lachinidae, and sawflies (Franco 1990). Additional arthropod families consumed by the garden dormouse are Acrididae, Apoidea, Blattidea, Cerambycidae and Scarabaeidae (Gil-Delgado *et al*. 2010).

At GFRR, molluscs (gastropods) played a slightly more important role than fruits when PO and RPO were considered, but the opposite was observed when PW was taken into account. At the seasonal scale, more molluscs than fruits were consumed in spring. Molluscs were also part of the diet of the garden dormouse but were less consumed than other categories (Gil-Delgado *et al.* 2010). In spring, the common dormouse eats plant food and nutritious parts of flowers, but no molluscs; it has also been recorded to eat adult insects and bird eggs (Richards 1984, Juškaitis 2007). In GFRR, fruits were consumed from spring to autumn, with a peak in summer. Two types of fruit remains were found: kernels of *Grewia robusta* and *Ziziphus* *mucronata*. The consumption of *Ziziphus* sp. and *Grewia* sp. fruits has also been documented by Smithers (1971) and Baxter *et al.* (2005). Fruit consumption has been reported in several dormouse species, and can be very seasonal. For example, in Spain, oranges have been found to be the dominant food type of the garden dormouse during autumn (Gil-Delgado *et al.* (2010), whereas in the common dormouse Juškaitis (2008) listed several fruit and seed species which are only eaten during relatively short time-spans between April and October.

The results from the pitfall trap study indicated that arthropod familial food diversity, abundance and percentage weight (biomass) did not correspond to those consumed by the dormice at the Great Fish River Reserve. This suggests that dormice are selective feeders, and in addition raises the question of where exactly dormice prey on arthropods. This could be on the forest floor, as suggested by the presence of large quantities of remains of terrestrial tenebrionid beetles (mostly *Psammodes* spp.) in nest boxes and natural feeding stations (E. Do Linh San, pers. comm.), but also inside or on tree trunks and branches. As indicated above, some of the arthropods consumed were observed on trees and in cavities. In addition, it is important to note that trapping success can be dependent on the sensitivity of the population density of an arthropod species, its locomotion and olfaction, and its habitat specificity (Perner & Schueler 2004; Niemela & Kotze 2009; Schirmel *et al.* 2010). Arthropod species also respond differently to the choice of liquid attractant and detergent, and the arrangement of traps (Schmidt *et al.* 2006; Niemela & Kotze 2009). Due to these complications, density estimation and community assemblage structures portrayed from pitfall trapping are often biased (Mommertz *et al.* 1996; Melis *et al.* 2010; Hummel *et al.* 2012).

To summarise, the results of this study are in agreement with preliminary findings from previous researchers that the woodland dormouse is predominantly insectivorous. Woodland dormice in the Great Fish River Reserve largely depended on four families of arthropods, namely Blattidea, Carabidae, Spirostreptidae and Tenebrionidae, with a higher consumption of the two latter families. Fruits of *G. robusta* and *Z. mucronata* were consumed as supplements to the arthropods diet, from spring to autumn. Molluscs (snails) and other unidentified food categories were probably consumed opportunistically. Further dietary studies based on faecal analyses would probably allow identifying and describing the vegetal components of the woodland dormouse’s diet, and would therefore provide a clearer picture of the diet of this arboreal rodent species. A radio-tracking study might also assist in identifying the main feeding areas and the associated resources, and whether dormice spend some significant time foraging on the ground.

Chapter 4

Microhabitat use and selection

4.1 Introduction

Bertolino (2007) defined a microhabitat as a "small habitat within a larger ecosystem that describes the small-scale requirements of a particular organism or a population during its daily activity". Cowan (1987) and Bertolino (2007) further noted that the use of specific habitats by animals is driven by the satisfaction of natural resources, survival and reproduction. Understanding habitat use by animals is therefore important if populations are to be conserved.

Many studies have been conducted on small mammal microhabitat use and selection across the world. For example, in the USA golden mice *Ochrotomys nuttalli* preferred habitats with thick vegetation which includes huge amounts of vines and woody vegetation (Wagner *et al.* 2000, Morzillo *et al.* 2003). In a central Brazil cerrado (savanna) a microhabitat study was conducted on three rodent species: the hairy-tailed bolo mouse *Necromys lasiurus*, the delicate vesper mouse *Calomys tener* and the hairy-eared cerrado mouse *Thalopomys lasiotis*. The hairy-tailed bolo mouse was associated with areas with a high tree density, grassy areas and murundus (earth mounds). The delicate vesper mouse preferred areas with termite mounds, while the hairy-eared cerrado mouse was mostly captured in areas with woody vegetation (Rocha *et al.* 2011). In India, the Malabar spiny dormouse *Platacanthomys lasiurus* (an endemic mouse species that resembles a dormouse because of the bushy tuft tip to the tail) preferred microhabitats with high canopy cover and areas which contained tall trees with branches for climbing (Mudappa *et al.* 2001). In South Africa, nests of the black-tailed tree rat *Thallomys nigricauda* were found in areas with large trees with cracks and crevices on the stems, and trees with nests were located near major food plants (Eccard *et al.* 2006). The above-mentioned studies indicate that small mammal species choose microhabitats (termite mounds, high canopy cover, thick vegetation, tree crevices, etc.) that may reduce the risk of predation.

In Europe a small number of studies have been carried out on habitat and microhabitat use by dormice (family Gliridae). For example, several authors reported that the physical characteristics of the microhabitat used by the garden dormouse *Eliomys quercinus* were high rock cover and thick shrub layer (Bertolino 2007, Bertolino & Currado 2001, Bertolino *et al.* 2003). Bertolino *et al*. (2003) reported that the garden dormouse spent most of its activity period on the ground under hazel bushes in search of food. The common dormouse *Muscardinus avellanarius* was also found in microhabitats with a well-developed dense understory and a network of branches that is used to travel from one tree to another (Bright & Morris 1992, Panchetti *et al.* 2007). In Latvia forest dormice *Dryomys nitedula* preferred mature forest stands with rich shrub layer, but were rarely found in pine forests with dense understory (Pilāts *et al.* 2012). It is also worth noting that nest boxes seem to play an important role in dormice habitat ecology, as in areas where these artificial features were available, dormice selected them as nesting/resting sites (Morris *et al.* 1990, Juškaitis 2006, Milazzo *et al.* 2003, Panchetti *et al.* 2004). The fat dormouse *Glis glis* preferred nest boxes placed in a vegetation structure made of dense understory and high trees (Milazzo *et al.* 2003).

Little is known about the microhabitat use of the African dormice. In a study conducted by Channing (1984), the spectacled dormouse *Graphiurus ocularis* exclusively selected rocky habitat and avoided sandy plains and isolated rocks. The rock dormouse *G. platyops* also prefers rocky habitats and live in rock crevices (Skinner & Chimimba 2005). The woodland dormouse *Graphiurus murinus* is commonly found in woodlands or riverine forests where it uses tree holes as resting sites, notably hollow Cape bushwillow *Combretum caffrum* trees in the Eastern Cape Province of South Africa (Madikiza *et al.* 2010a, Lamani 2011). It is also found in rock crevices and *Acacia* spp. trees (Skinner & Chimimba 2005). However, no information is available about the microhabitat requirements of this species during its activity period. As suggested by Bertolino (2007), a comparison of microhabitat characteristics recorded at trapping stations where animals are captured or not captured may assist in understanding which of the measured variables contribute to habitat use by a targeted species.

4.2 Aim, objectives and predictions

The aim of the study was to describe microhabitat use and determine microhabitat selection by the woodland dormouse during its nocturnal activity (movement) period, based on trapping locations. Microhabitat selected for breeding and resting were not investigated.

Objectives:

1. To determine trapping success, and test whether trapping success varies throughout the year, and between night-time and day-time.

2. To describe the characteristics of the microhabitats used by the woodland dormouse by measuring variables such as height, circumference of trunk or branch used for nocturnal movements, tree species "used", understory or canopy cover, and check whether the location where an animal has been captured is connected to other trees (arboreal connectivity).

3. To determine whether woodland dormice positively select or avoid specific microhabitat types or structures, and whether a set of predictor variables related to microhabitat characteristics can explain their use of, and rates of visits to, specific trapping stations.

Predictions:

1. Trapping success will be lower during the day and in winter, considering that the species has been described as nocturnal (Skinner & Chimimba 2005, Lombard 2014) and hibernating during the cold season (Mzilikazi *et al.* 2012).

2. Woodland dormice will select microhabitats high above the ground, which have a high vegetation cover and a dense network of arboreal connections because these factors probably reduce predation risk by hiding the animals' presence and movements, and facilitate escape (Kotler 1993, Wagner *et al.* 2000, Ebensperger & Hurtado 2005).

3. Woodland dormice will likely be caught on the ground on a certain number of occasions, as their diet has been found to include a large quantity of terrestrial tenebrionid beetles (see Chapter 3 in this dissertation).

4. Woodland dormice will positively select areas with Cape bushwillows, as the trunks and branches of this tree species are predominantly used to build nests (Lamani 2011).

4.3 Materials and methods

4.3.1 Trapping

Trapping was conducted seasonally over 5 days between June 2011 and April 2012. A grid of 96 stations (16 rows × 6 lines) was established. Trap stations were placed at 10-m intervals. Two Sherman traps (H. B. Sherman Traps, Tallahassee, Florida, USA; breadth × height × length: 8 × 9 × 23 cm) were placed at each station. The 192 traps (96 stations × 2 traps) were distributed relatively equitably among four height categories: 0–0.5 m (n = 60), 0.51–1 m (n = 32), 1.01–1.5 m (n = 46), and 1.51–2.5 m (n = 54). The two height categories chosen per trap station were partly dependent on the microhabitat structures present at each station, hence explaining the slight variation in the total number of traps per height category. Traps were baited with a mixture of rolled oats and sunflower oil. Traps were checked twice daily, in the morning and late afternoon–early evening. Caught dormice were removed from the traps, inserted into a pre-weighed Ziploc plastic bag and weighed to the nearest gram using a 60-g or 100-g spring balance (Pesola, Baar, Switzerland). Each animal was anaesthetized with diethyl ether, marked by perforating the ears with single digit spikes attached to forceps and the holes were rubbed with a permanent tattoo-ink. Individuals were sexed and reproductive status was recorded both in males (scrotal vs. non-scrotal) and females (vaginal orifice open or sealed, size of nipples) before animals were released. Dormice were considered as adults when they were first caught as fully grown animals between winter and summer. Most of these animals had already been marked between January and May 2011, or even prior to that. Only unmarked males from neighbouring areas were first caught as adults during the mating season (from October to January). All dormice caught as juveniles in spring and summer were still considered as such in autumn, despite the fact that in some instances their weight was similar to that of adults, especially for males. All above-mentioned manipulations were conducted in the framework of a concurrent project using the same techniques, and approved by the Ethics Committee of the University of Fort Hare (Ethical clearance Nr SAN05 1SGEB02) (for more details, see Gebe 2014).

4.3.2 Assessment of microhabitat use and selection

In order to determine the use and selection of microhabitat by dormice, several variables (Table 4.1) were recorded, sometimes seasonally, for each trap. Measurements were made with a 5-m tape measure. The vegetation cover and the intensity of arboreal connectivity (vegetative connections leading from the trap to surrounding vegetation) was estimated visually within a 10 × 10 m quadrat centred on each trap. Due to the impossibility of being accurate enough, percentage cover and connections were allocated to four simple categories (0–25%, 2 = 26–50%, 3 = 51–75%, 4 = 76–100%; Table 4.2).

Table 4.1. Microhabitat variables (predictors) that were measured for each trap (*n* = 192). For possible categories within each variable, see Table 4.2.

Microhabitat variables	Description [units]
Canopy cover	Cover of bushes and trees >150 cm in height
Understory cover	Cover of plants <10 cm, 10–50 cm and 50–150 cm in height
Height	Height [cm] at which the trap was placed
Position	Position of the trap (ground, log, near trunk or canopy)
Vegetation	Type of vegetation on which the trap was placed (shrub, log, bush, woody interlace or tree)
Species	Tree or bush species on which the trap was placed
Circumference	Circumference [cm] of branch or tree trunk on which the trap was placed
Connections	Intensity of connectivity with the surrounding vegetation

4.3.3 Expression of results and data analysis

Trapping data were entered into, and analysed using Excel 2007 (Microsoft Inc.). Both the number of different woodland dormice caught (and marked) and the number of captures per season and over the year were calculated. The male:female and adult:juvenile ratios were also calculated. Trapping success was expressed as the percentage of traps (*n* = 192) containing a dormouse during each trapping session. Trapping success was also calculated for both the day- and night-trapping sessions. The mean and standard deviations for the nocturnal, diurnal and seasonal trapping success were also calculated. The following seasons were defined: winter (June–August), spring (September–November), summer (December–February), and autumn (March–May).

All statistical analyses were conducted with the software IBM SPSS Statistics 20.0 (SPSS Inc.) and with Excel 2007. Because data were non-normal (Kolmogorov-Smirnov tests, $p < 0.05$), possible differences in continuous variables between all trapping sites (i.e. availability) and those where dormice were trapped (i.e. use) were evaluated with non-parametric Mann–Whitney *U* tests. Chi-square tests were used to compare availability and use for all categorical (nominal and ordinal) variables, whereas selection or avoidance of specific categories was investigated with Bonferroni Z tests (Neu *et al.* 1974, Alldredge & Ratti 1986).

Generalized Linear Models (GzLMs) were used to assess the potential influence of the selected predictor (independent) variables (see Table 4.2) on four different response (dependent) variables: the use of traps (USE), the frequency of visits to traps by woodland dormice (ABSFREQ), the number of dormice (NODORM) and the number marked individuals (NODDORM) that were caught in a specific trap. GzLMs allow for the dependent variables to have a non-normal distribution (Norušis, 2008), as can be expected for the binary and count data used in this study. Because independent variables are treated as fixed known values in the GzLM procedure, there was no concern as to their distribution. A binomial distribution and logit link function were chosen for the binary dependent variable (USE), while negative binomial distributions and log link functions were used for the count variables (ABSFREQ, NODORM, and NODDORM). The potential influence of the predictor variables was evaluated with a Type III test, which does not depend on the entry order of variables (Norušis, 2008). Two criteria were chosen to select the best fitting model: 1) $\Delta AIC_c \leq 2$ (Burnham & Anderson 2002) and 2) $0.75 \leq$ deviance/df ≤ 1.25. To meet the second condition, the dispersion parameter *k* for the negative binomial distributions had to be adjusted until the ratio of the deviance to its degree of freedom was close to 1, therefore indicating that the variability in observed data was similar to the one predicted by the underlying distributions used for the models. The dispersion parameter *k* was set at 0.3 (ABSFREQ) and 0.5 (NODORM, NODDORM), respectively. No model weighing and averaging was carried out, as in most cases several "competing" models were over- or underdispersed.

GzLMs presented here were performed with all trapping data collected over the year, as trap use and the number of captures were not high enough to allow for multivariate statistical procedures to be carried out with seasonal data. For this reason, seasonal scores for vegetation cover and arboreal connectivity were averaged and assigned to the nearest matching category (e.g. an average bush cover of 2.4 would be assigned to category 2). Even though arboreal connectivity did not vary conspicuously over the year, this averaging method may inconveniently include information on vegetation cover from particular trap stations and seasons where no animals were caught. However, despite potential biases introduced for the yearly analyses, GzLMs inappropriately carried out with seasonal data yielded similar results (not presented here).

Table 4.2. List of the variables used in the Generalized Linear Models (GzLMs) to evaluate the potential influence of predictors on the use and rate of visits to traps by woodland dormice.

Variables	Type	Definition
USE[a]	Dependent, binary	Use of traps
ABSFREQ[b]	Dependent, count	Absolute frequency of trap use
NODORM	Dependent, count	Total number of dormice found in each trap
NODDORM	Dependent, count	Total number of different dormice found in each trap
Cover <10 cm[c]	Independent, ordinal	Cover of vegetation <10 cm in height
Cover 10–50 cm[c]	Independent, ordinal	Cover of vegetation 10–50 cm in height
Cover 50–50 cm[c]	Independent, ordinal	Cover of vegetation 50–150 cm in height
Cover >150 cm[c]	Independent, ordinal	Cover of vegetation >150 cm in height
Connections[c]	Independent, ordinal	Connectivity with the surrounding vegetation
Type & Position[d]	Independent, nominal	Vegetation type and position where the trap was placed
Height	Independent, continuous	Trap height above ground
Circumference	Independent, continuous	Tree trunk/branch circumference at trap height
Tree/bush species[e]	Independent, nominal	Tree/bush species on which the trap was placed

[a]Categories considered were: 0 = trap never "visited", 1 = trap "visited" at least once during the study period
[b]Minimum was 0, potential maximum was 20 per season and 80 for the whole study period.
[c]Categories considered were: 1 = 0–25%, 2 = 26–50%, 3 = 51–75%, 4 = 76–100%.
[d]Categories considered were: 1 = bush, 2 = ground–cover, 3 = ground–open, 4 = log, 5 = tree canopy, 6 = tree trunk, 7 = woody interlace.
[e]Categories considered were: 1 = *Acacia karoo*, 2 = *Combretum caffrum*, 3 = *Maytenus heterophylla, 4 = Olivea europaea,* 5 = *Ziziphus mucronata*, 6 = *Rhus* spp., 7 = others.

4.4 Results

From June 2011 to April 2012, a total of 116 captures of 33 individual woodland dormice were made. Eighteen male dormice, 13 females and two animals with undetermined sex were caught, of which 21 were adults and 12 were juveniles (Table 4.3). Trapping success averaged 1.51 ± 1.58% over the year (Table 4.4). Mean seasonal trapping success was lowest in winter and increased from spring onward to reach a peak in summer and autumn (Table 4.4). Trapping success was significantly higher during night-time than during day-time (Mann–Whitney test, $U = 17.5$, $p < 0.001$; Table 4.4). Nocturnal trapping success was significantly higher in summer and autumn than during the remaining seasons (Kruskall-Wallis test, $H = 16.064$, $df = 3$, $p = 0.001$). In contrast, no seasonal variation was recorded for diurnal trapping success ($H = 4.098$, $df = 3$, $p = 0.251$).

Table 4.3. Number of dormouse captures made at each season during the study period (from June 2011 to April 2012). The number of individual dormice trapped is given in parentheses.

Season	Number of dormice	Males	Females	Unsexed	Adults	Juveniles
Winter	5 (2)	1 (1)	4 (1)	0	5 (2)	0 (0)
Spring	23 (8)	7 (2)	16 (6)	0	23 (8)	0 (0)
Summer	47 (24)	27 (14)	18 (8)	2 (2)	28 (14)	19 (10)
Autumn	41 (14)	15 (7)	26 (7)	0	18 (6)	23 (8)
Total	116 (33)	50 (18)	64 (13)	2 (2)	74 (21)	42 (12)

Woodland dormice were trapped at an average height of 136 ± 64 cm, which was significantly higher than the average height at which traps were set (99 ± 75 cm). In contrast, no difference was recorded for the circumference of branches and trunks on which traps were placed (Table 4.5).

Woodland dormice were caught on traps placed on a large variety of tree and bush species, including *Combretum caffrum* (25%), *Rhus* spp. (19%), *Maytenus heterophylla* (16%), *Olea europaea* (13%) and *Ziziphus mucronata* (11%). Most traps where dormice were caught were set on tree trunks (43%), tree canopy (26%) and woody lace (16%), although 10% were situated on the ground (Table 4.6). In addition, almost 93% of these traps were "protected" by at least 50% of canopy cover (vegetation >150 cm in height) and 78% of them were located in areas with arboreal connections in at least 50% of the directions.

Table 4.4. Diurnal and nocturnal trapping success (%) of woodland dormice during the study period, June 2011 to April 2012, at the Great Fish River Reserve.

	Winter	Spring	Summer	Autumn	Year
Night 1	0.00	1.04	3.13	4.68	2.21
Day 1	0.50	0.00	0.00	0.00	0.13
Night 2	0.50	3.13	6.25	5.21	3.77
Day 2	0.00	0.00	0.00	0.00	0.00
Night 3	0.50	2.08	5.21	3.13	2.73
Day 3	0.00	0.50	0.00	0.00	0.13
Night 4	0.50	2.08	3.65	3.65	2.47
Day 4	0.00	0.00	0.00	0.00	0.00
Night 5	0.50	2.60	6.25	4.68	3.51
Day 5	0.00	0.50	0.00	0.00	0.13
NIGHT Average ± SD	0.40 ± 0.22	2.19 ± 0.77	4.90 ± 1.45	4.27 ± 0.85	2.94 ± 0.67
DAY Average ± SD	0.10 ± 0.22	0.20 ± 0.27	0.00 ± 0.00	0.00 ± 0.00	0.08 ± 0.07
TOTAL Average ± SD	0.25 ± 0.26	1.19 ± 1.183	2.45 ± 2.76	2.14 ± 2.32	1.51 ± 1.58

Table 4.5. Mean, standard deviation, minimum and maximum values of continuous variables measured for all the trapping sites and the sites with captures. Mann–Whitney *U* test indicated that the height used by dormice was significantly different from the height that was available.

Variables (cm)		**All traps**	**Traps with captures**	**Statistics**	***p***
Height	Mean	99.33	135.77	$U = 8581.00$	$p < 0.001$
	SD	75.21	64.12		
	Min	0	0		
	Max	236	225		
	N	192	70		
Circumference	Mean	46.13	56.64	$U = 1682.50$	$p = 0.488$
	SD	38.40	40.29		
	Min	7	9		
	Max	188	168		
	N	80	39		

Chi-square tests run to investigate microhabitat selection showed that five variables exhibited significant differences between availability and use data: these were vegetation cover lower than 10 cm, vegetation cover from 10–50 cm, vegetation cover higher than 150 cm, intensity of arboreal connections, and the type of surface and position of the trap (Tables 4.6 and 4.7). Bonferroni Z tests pointed out that woodland dormice actively avoided trap stations with more than 75% "grass" cover (vegetation cover <10 cm) and with a "canopy" cover (vegetation cover >150 cm) lower than 50%, areas that had arboreal connections in less than 25% of the directions, as well as bushes (Table 4.7). In contrast, dormice positively selected areas that had arboreal connections in 51–75% of the directions (Table 4.7).

The results of GzLMs on yearly (overall) trapping data confirmed that there is a strong association between the vegetation cover surrounding the traps and height of the traps and the four independent (output) variables. The "most fitting models" (with $\Delta AIC_c < 20$) are listed in Tables 4.8, 4.10, 4.12 and 4.14, with the best fitting models highlighted in grey. These best (chosen) models had a better explanatory power than the intercept only models (Omnibus test; USE: $\chi^2 = 54.699$, $df = 5$, $p < 0.001$; ABSFREQ: $\chi^2 = 83.453$, $df = 8$, $p < 0.001$; NODORM: $\chi^2 = 65.362$, $df = 4$, $p < 0.001$; NODDORM: $\chi^2 = 61.085$, $df = 4$, $p < 0.001$). The effects of the predictor variables are detailed in Tables 4.9, 4.11, 4.12 and 4.13, whereas the corresponding parameter estimates are provides in the Appendix (Tables A13–A14).

Out of the eight predictor variables, only connections and height had a significant positive effect on the use of traps (USE), whereas connections and cover <10 cm significantly affected the variables ABSFREQ, NOGRAM and NODGRAM during the study period. The other independent variable, including tree trunk/branch circumference at trap height, vegetation type and position in which the traps were placed, and tree species, did not have any significant effects.

Table 4.6. List of Chi-square tests carried out to test for potential differences between the available and used traps with regard to the measured ordinal and nominal variables. 1 = 0–25%, 2 = 26–50%, 3 = 51–75% and 4 = 76–100%.

Variable	All traps (%) *n* = 192	Used traps (%) *n* = 70	χ^2	*p*
Cover <10 cm	1 = 5.7	1 = 10.0	11.92	0.008
	2 = 18.2	2 = 30.0		
	3 = 35.9	3 = 35.7		
	4 = 40.1	4 = 24.3		
Cover 10–50 cm	0 = 3.6	1 = 5.7	8.11	0.044
	1 = 16.7	2 = 27.1		
	2 = 27.1	3 = 28.6		
	3 = 52.6	4 = 38. 6		
Cover 50–150 cm	1 = 3.1	1 = 2.9	1.24	0.743
	2 = 30.2	2 = 24.3		
	3 = 57.8	3 = 62.9		
	4 = 8.9	4 = 10.0		
Cover >150 cm	1 = 5.7	1 = 0.0	14.77	0.002
	2 = 19.8	2 = 7.1		
	3 = 34.4	3 = 35.7		
	4 = 40.1	4 = 57.1		
Connections	1 = 23.4	0 = 2.9	28.51	<0.001
	2 = 28.1	1 = 18.6		
	3 = 33.3	2 = 51.4		
	4 = 15.1	3 = 27.1		
Type & Position	Bush = 18.8	Bush = 2.9	18.09	0.006
	Ground–cover = 3.6	Ground–cover = 2.9		
	Ground–open = 13.5	Ground–open = 7.1		
	Log = 3.1	Log = 2.9		
	Tree canopy = 19.3	Tree canopy = 25.7		
	Tree trunk = 31.3	Tree trunk = 42.9		
	Woody interlace = 10.4	Woody interlace = 15.7		
Tree/bush species	*Acacia karoo* = 11.0	*Acacia karoo* = 7.9	8.83	0.183
	Combretum caffrum = 20.7	*Combretum caffrum* = 25.4		
	Maytenus heterophylla = 20.0	*Maytenus heterophylla* = 15.9		
	Olea europaea = 11.7	*Olea europaea* = 12.7		
	Rhus spp. = 12.4	*Rhus* spp. = 19.0		
	Ziziphus mucronata = 6.9	*Ziziphus mucronata* = 11.1		
	Others = 17.2	Others = 7.9		

Table 4.7. Selection of microhabitat variables tested using Bonferroni Z test, where n = number of traps, P_e = expected proportion, P_o = observed proportion, (=) category is used proportionally to its availability, (–) category is negatively selected, (+) category is positively selected.

Microhabitat variables available and/or used by dormice	P_e	P_o	**Bonferroni Confidence interval for P_o**	
Vegetation Cover <10 cm				
(n = 70, df = 3, p = 0.008)				
0–25%	0.06	0.10	$0.00 \leq P_o \leq 0.20$	=
26–50%	0.18	0.30	$0.14 \leq P_o \leq 0.46$	=
51–75%	0.36	0.36	$0.19 \leq P_o \leq 0.52$	=
76–100%	0.40	0.24	$0.09 \leq P_o \leq 0.39$	–
Vegetation cover 10–50 cm				
(n = 70, df = 3, p = 0.044)				
0–25%	0.04	0.06	$-0.02 \leq P_o \leq 0.14$	=
26–50%	0.17	0.27	$0.12 \leq P_o \leq 0.43$	=
51–75%	0.27	0.29	$0.13 \leq P_o \leq 0.44$	=
76–100%	0.53	0.39	$0.22 \leq P_o \leq 0.55$	=
Vegetation Cover >150 cm				
(n = 70, df = 3, p = 0.002)				
0–25%	0.06	0.00	$0.00 \leq Po \leq 0.00$	–
26–50%	0.20	0.07	$-0.02 \leq Po \leq 0.16$	–
51–75%	0.34	0.36	$0.19 \leq Po \leq 0.52$	=
76–100%	0.40	0.57	$0.40 \leq Po \leq 0.74$	=
Connections				
(n = 70, df = 3, p < 0.001)				
0–25%	0.23	0.03	$-0.03 \leq P_o \leq 0.09$	–
26–50%	0.28	0.19	$0.05 \leq P_o \leq 0.32$	=
51–75%	0.33	0.51	$0.34 \leq P_o \leq 0.69$	+
76–100%	0.15	0.27	$0.12 \leq P_o \leq 0.43$	=
Type & Position				
(n = 70, df = 6, p = 0.006)				
Bush	0.19	0.03	$-0.03 \leq P_o \leq 0.09$	–
Ground–cover	0.04	0.03	$-0.03 \leq P_o \leq 0.09$	=
Ground–open	0.14	0.07	$-0.02 \leq P_o \leq 0.17$	=
Log	0.03	0.03	$-0.03 \leq P_o \leq 0.09$	=
Tree canopy	0.19	0.26	$0.09 \leq P_o \leq 0.42$	=
Tree trunk	0.31	0.43	$0.24 \leq P_o \leq 0.61$	=
Woody interlace	0.10	0.16	$0.02 \leq P_o \leq 0.29$	=

Table 4.8. List of alternate fitted models for which a subset of independent variables better explained (Omnibus test) the values of the dependent variable USE than intercept-only models. The best model is highlighted in grey.

Variables	LR χ^2	*df*	*p*	AICc	ΔAICc
Cover <10 cm, Connections, & Height	62.798	9	**<0.001**	188.751	18.319
Connections & Height	54.699	5	**<0.001**	170.432	0.000

Table 4.9. Effects of arboreal connections and height on the usage of traps (USE) by woodland dormice according to the results of a GzLM procedure (Type III test).

Parameters	χ^2	*df*	*p*
(Intercept)	<0.001	1	0.999
Connections	15.749	4	**0.003**
Height	1.249	1	0.264

Table 4.10. List of alternate fitted models for which a subset of independent variables better explained (Omnibus test) the values of the dependent variable ABSFREQ than intercept-only models. The best model is highlighted in grey.

Variables	LR χ^2	*df*	*p*	AICc	ΔAICc
Connections & Cover <10 cm, Height	64.086	9	**<0.001**	398.687	5.84
Connections & Cover <10 cm (scale = 1)	63.630	8	**<0.001**	396.917	4.07
Connections & Cover <10 cm (scale = 0.3)	83.453	8	**<0.001**	392.847	0.000
Connections & Cover <10 cm (scale = 0.15)	89.956	8	**<0.001**	394.499	1.652

Table 4.11. Effects of arboreal connections and "grass" cover (cover <10 cm) on how frequently (ABSFREQ) traps were used by woodland dormice according to the results of a GzLM procedure (Type III test).

Parameters	χ^2	*df*	*p*
Intercept	4.068	1	0.044
Connections	23.693	3	**<0.001**
Cover <10 cm	10.981	4	**0.027**

Table 4.12. List of alternate fitted models for which a subset of independent variables better explained (Omnibus test) the values of the dependent variable NODORM than intercept-only models. The best model is highlighted in grey.

Variables	LR χ^2	*df*	*p*	AICc	ΔAICc
Connections, Tree/bush species & Height	61.978	14	**<0.001**	410.525	16.873
Connections & Height	54.739	5	**<0.001**	397.490	3.838
Connections & Tree/bush species	54.722	4	**<0.001**	395.376	1.724
Connections (scale = 1)	65.362	4	**<0.001**	393.652	0.000
Connections (scale = 0.3)	68.117	4	**<0.001**	394.238	0.586
Connections (scale = 0.15)	72.815	4	**<0.001**	396.244	2.592

Table 4.13. Effect of arboreal connections on the total number of dormice (NODORM) trapped according to the results of a GzLM procedure (Type III test).

Parameters	χ^2	*df*	*p*
Intercept	15.184	1	**<0.001**
Connections	29.637	3	**<0.001**

Table 4.14. List of alternate fitted models for which a subset of independent variables better explained (Omnibus test) the values of the dependent variable NODDORM than intercept-only models. The best model is highlighted in grey.

Variables	LR χ^2	*df*	*p*	AICc	ΔAICc
Connections & Height	51.616	5	**<0.001**	386.026	6.003
Connections (scale = 1)	51.514	4	**<0.001**	383.996	3.973
Connections (scale = 0.5)	61.085	4	**<0.001**	380.023	0.000
Connections (scale = 0.3)	66.239	4	**<0.001**	380.162	0.139
Connections (scale = 0.15)	70.852	4	**<0.001**	381.684	1.661

Table 4.15. Effect of arboreal connections on the number of different individuals of woodland dormice (NODDORM) trapped according to the results of a GzLM procedure (Type III test).

Parameters	χ^2	*df*	*p*
Intercept	17.217	1	**<0.001**
Connections	27.644	3	**<0.001**

4.5 Discussion

In this study trapping with Sherman traps was used as a method to investigate the microhabitat use and selection of the African woodland dormouse. Trapping is a method widely used by researchers (e.g. Kaplan 1995, Mudappa 2001, Bertolino 2007, Juškaitis 2007, Rocha *et al.* 2011) to investigate many aspects of rodent ecology, including population dynamics and microhabitat selection.

A total of 116 captures of 33 different dormice was recorded during the study period, with an overall average trapping success of about 2.9% during the night, and a maximum seasonal average of 4.9%. These values are very low as compared to the 13.3% (range 3.0–33.3%) obtained by Madikiza *et al.* (2010b) at the same study site over a yearly period. The discrepancy recorded between both studies seems to be explained by the fact that Madikiza *et al.* (2010b) used a trapping design that was aimed at optimizing the trapping of dormice based on prior knowledge of the animals' use of the forest. In contrast, the grid used in the current study included every type of microhabitat found in the forest, even if *a priori* not favourable for dormice. In a study conducted at the Thomas Baines Nature Reserve Kaplan (1995) reported a trapping success of 9.1%. Channing (1984) made 119 captures of 30 different spectacled dormice, confirming that dormice are generally easily caught when traps are set appropriately. As an additional explanation, it is also possible that the presence of other rodent species like the arboreal Mozambique thicket rat *Grammomys cometes* at the study site might have played a role in partly hindering woodland dormice from entering traps, as these two species live in syntopy and use similar micro-habitats, thus preventing a higher average trapping success. At the same study site Gebe (2014) found an average nocturnal trapping success of about 2.2% during the same seasonal trapping sessions. Obviously, these kinds of "negative" effects cannot be avoided if a study is to be conducted under natural conditions.

As predicted (Prediction 1), the winter season yielded the lowest trapping success, with only five captures of two dormice during the five days and nights of trapping. Winter is the coldest season, with daily temperatures ranging from –3 °C to 18 °C at the study site. Dormice use torpor when the minimum monthly temperature is lower than 4°C (Madikiza 2010), with torpor bouts of up to eight days (Mzilikazi *et al.* 2012). In a nest box study at the same site, on average 63% of dormice were found torpid in nest boxes during winter (Madikiza 2010). Therefore, the fact that dormice are torpid in winter likely explains the low numbers of captures during that season. Madikiza *et al.* (2010b) reported a trapping success about three to four times lower in winter (5.1%) as compared to summer (19.0%) and autumn (16.7%). In the current study, summer also yielded the highest trapping success, closely followed by autumn. At this study site the mating season begins in October (mid-spring) and ends in January (mid-summer). Therefore, the high trapping success in summer might be explained by the fact that during the mating season males increase their movements in search for female partners. This also seems to be confirmed by the fact that a much higher number of different males were caught during the summer season compared to females, with a ratio of 1 female to 1.75 males. In addition, in spring and summer females also increase their movements in search for suitable nesting areas and food for production of milk for litters (Madikiza *et al.* 2010b). Mzilikazi *et al.* (2012) reported that in autumn there was an increase in body mass, suggesting that woodland dormice might amplify their movements to forage. Similarly Juškaitis (2001) stated that autumn is a period for common dormice to prepare for hibernation by accumulating fat reserves. These findings might possibly explain why trapping success was still high in autumn. Another possible explanation could be that juveniles become part of the trappable population around mi-summer, with a peak of captures in autumn (Madikiza *et al.* 2010b), as was also the case in this study.

Out of a total of 116 captures, dormice were only trapped on a few occasions during daytime, once in winter and twice in spring. With an average diurnal trapping success of only 0.08% throughout the year, these results confirm that woodland dormice are essentially nocturnal (Prediction 1; Skinner & Chimimba 2005). These results were also corroborated by a recent preliminary radio-tracking study conducted by Lombard (2014) at the study site.

Woodland dormice were caught at a significantly higher height than expected, which corroborates their arboreal nature. Lamani (2011) found that even resting sites are located well off the ground, at an average height of 210 cm, with a maximum of 700 cm. In addition, as predicted (Prediction 2), dormice systematically used areas with a high canopy cover and a dense network of arboreal connections. They also significantly avoided areas that had arboreal connections in less than 25% of the directions. From the eight microhabitat variables that were measured and assumed to potentially influence microhabitat selection in woodland dormice, "arboreal connections" was the only variable that consistently had a significant effect in the GzLM procedures. There is obviously a partial link between canopy cover and arboreal connections in the sense that trees with a dense canopy cover will offer potential connections in several directions. However, because connections were measured in a 10 × 10 m quadrat, isolated trees would be assessed as devoid of arboreal connections despite an important canopy cover. Hence, our results suggest that for dormice both canopy cover and arboreal connections are important because they likely offer shelter from predators and also provide runways which facilitate movements for travelling from one tree to another. Kaplan (1995) observed that dormice used high densities of arboreal runways to forage effectively. As an arboreal species the woodland dormouse probably avoids isolated trees, and Madikiza *et al.* (2010a) advocated that the colonization of this species is dependent on wooded corridors. Wagner *et al.* (2000) reported that golden mice build nests located in microhabitats with climbing vines, suggesting that vines may serve as escapes from predators. It is possible that dense arboreal connections are also used as escape routes by dormice in case arboreal predators like genets (*Genetta* spp.) are detected.

In contrast to findings that dormice were not caught on the ground at the study site (Madikiza *et al.* 2010b), in the current study 10% of the traps were dormice were caught were located on the ground. This was expected (Prediction 3), as woodland dormice feed to a large extent on ground-dwelling arthropods such as beetles and millipedes (Baxter *et al.* 2005, see Chapter 3 of this dissertation). Hence, although dormice are arboreal, they sometimes venture down to the ground, probably to look for food. This is in line with observations made at the study site of radio-tracked dormice feeding on jointed cactus *Opuntia aurantiaca* fruits at ground level, outside the riverine forest (Z. J. K. Madikiza & E. Do Linh San, pers. comm.). "Grass" cover was found to be negatively correlated with the rates of visits to traps, and dormice avoided areas with a dense grass cover. However, this result was related to the fact that areas with high canopy cover selected by dormice were generally associated to a low grass cover because sunlight does not reach the ground. The few traps located on the ground where dormice were caught were in fact surrounded by important grass and bush cover, and were not situated too far from the nearest trunk. In a forest remnant of Thomas Baines Nature Reserve, Kaplan (1995) also successfully trapped dormice on the ground. Bright & Morris (1991, 1992) reported that in UK common dormice are not likely to travel far on the ground; dormice forage nearby a nest site and are reluctant to cross open areas on the ground. However, in Saxony Büchner (2008) reported that common dormice travelled more than 250 m on the ground. In general the possibility for small mammals to move through their home range using ground cover, holes and other refuges is recognized as an important means of avoiding avian predators (King 1985). Several authors obtained supportive results regarding the importance of a well-developed understory as a source of protection to animals (e.g. Morzillo *et al.* 2003, Bertolino 2007, Rocha *et al.* 2011).

In forest habitats, most species seem to be affected by tree species composition (Berg & Berg 1998). However, contrarily to what was predicted (Prediction 4) woodland dormice were trapped on a large variety of trees, with no selection observed. This contrasts with the results of a previous study focusing on the resting site ecology which indicated that dormice essentially use *Combretum caffrum* trees to build their nests (Lamani 2011). This difference seems to be explained by the fact that resting and movement ecology are affected by at least partly different factors, namely predation risk and thermoregulation for the former, and distribution of resources and predation risk for the latter. Chapter 3 of this dissertation indicated that dormice feed on fruits of *Ziziphus mucronata* trees and *Grewia robusta* bushes, and will therefore probably "use" any tree or bush species with sufficient cover that connect their resting sites to their foraging areas.

To summarize, this study has shown that woodland dormice positively select areas with high canopy cover and connectivity, possibly to decrease predation risk and facilitate movement. Trap use and numbers of visits and different animals caught were positively associated with a high arboreal connectivity, hence supporting the hypothesis that dormice may depend on wooden "corridors" for their movements (e.g. foraging, escaping from predators, finding mating partners and dispersal). A radio-tracking study would certainly assist in providing more detailed information on microhabitat use and selection by *Graphiurus murinus* during the nocturnal, activity period.

CONCLUSION

In this dissertation, I first described the diet of the woodland dormouse *Graphiurus murinus* in a riverine *Combretum* forest at the Great River Reserve (Eastern Cape, South Africa). Data were collected over the whole year and diet was determined based on food remains found in nest boxes used as food stations by dormice.

At the beginning of the study, I formulated two predictions and the following was found:

1. The diet of the woodland dormouse mainly consisted of arthropods, especially beetles (order Coleoptera) and millipedes (family Spirostrepidae only), and fruits (**prediction met**). This corroborates the findings of preliminary studies and anecdotal reports on the diet of this species.
2. Seasonal variation in the diet of the woodland dormouse was observed, with the consumption of fruits peaking in summer and molluscs being mostly eaten during spring. However, arthropods were still the dominant food throughout the year. Diet was the least diverse in winter, when temperatures are low and when dormice may go into hibernation (**prediction partially met**).

The second aim of the study was to describe microhabitat use and to determine microhabitat selection by the woodland dormouse during its nocturnal activity (movement) period, based on trapping locations.

I made four specific predictions and found the following:

1. Trapping success was higher during the night than during the day, supporting reports that this species is essentially nocturnal. Trapping success was lower in winter compared to other seasons; this result was due to the fact that woodland dormice are known to hibernate during winter (**prediction met**).
2. Woodland dormice were caught at a significantly higher height than expected, which corroborates their arboreal nature. In addition, dormice systematically used areas with a high canopy cover and a dense network of arboreal connections (**prediction met**). These habitat characteristics may be selected to reduce predation risk by hiding the animals' presence and movements, and facilitate escape from potential predators (snakes, arboreal small carnivores and nocturnal birds of prey) present at GFRR.

3. Woodland dormice were caught 10% of the times on the ground. This was expected, as this species' diet comprises a large quantity of ground-dwelling arthropods such as beetles and millipedes (**prediction met**). However, the study design did not allow establishing whether such incursions on the ground are directly linked to foraging.

4. Although woodland dormice were predominantly caught in traps placed on Cape bushwillow trees, use of such trees did not differ from their availability in the forest (**prediction not met**). This contrasts with the findings of a previous study on the resting site ecology which indicated that dormice essentially use *Combretum caffrum* trees to build their nests. This difference seems to be explained by the fact that resting and movement ecology are affected by at least partly different factors, namely predation risk and thermoregulation for the former, and distribution of resources and predation risk for the latter.

Further dietary studies based on faecal analyses would probably allow identifying and describing the vegetal components of the woodland dormouse's diet, and would therefore provide a clearer picture of the diet of this arboreal rodent species. Further food availability assessments need to be conducted using different protocol and methods, both on the ground and in trees, in order to specify what types of foods (arthropods, fruits, etc.) are available for this species at the study site. A radio-tracking study might also assist in identifying the main feeding areas and the associated resources, and whether dormice spend some significant time foraging on the ground. It would also provide more detailed information on microhabitat use and selection by *Graphiurus murinus* during its nocturnal activity period.

REFERENCES

Alldredge, J.R. & Ratti, J.T. (1986). Comparison of some statistical techniques for richness analysis of resource selection. *The Journal of Wildlife Management*: 157–165.

Ajrapetjanc, A.E. (1983). Soni [Dormice]. Izd. Len. Univ., Leningrad (in Russian).

Ansell, W.F.H. (1960). *Mammals of Northern Rhodesia*. Government Printer, Lusaka.

Arnolds, L.J. (2009). *Vegetation sampling in correlation with small mammal abundance and richness in the Andries Vosloo Kudu Nature Reserve (Eastern Cape, South Africa)*. B.Sc. Honours thesis, University of Fort Hare, Alice, South Africa.

Atsalis, S. (1999). Diet of the Brown Mouse Lemur (*Microcebus rufus*) in Ranomafana National Park, Madagascar. *International Journal of Primatology* 20: 193–229.

Bar, Y., Abramsky, Z. & Gutterman, Y. (1984). Diet of gerbilline rodents in the Israeli desert. *Journal of Arid Environments* 7: 371–376.

Baxter, R. (2008). *Graphiurus murinus*. The IUCN Red List of Threatened Species. Version 2014.2. <www.iucnredlist.org>. Downloaded on 02 August 2014.

Baxter, R.M., Madikiza, Z.J.K. & Villet, M. (2005). *The diet of the woodland dormouse, Graphiurus murinus, in the Great Fish River Reserve, South Africa*. 6th International Conference on the Biology of Dormice (Gliridae), September, Siedlce, Poland.

Berg, L. & Berg, A. (1998). Nest site selection by the dormouse *Muscardinus avellanarius* in two different landscapes. *Annales Zoologici Fennici* 35: 115–122.

Bertolino, S. (2007). Microhabitat use by garden dormice during nocturnal activity. *Journal of Zoology* 272: 176–182.

Bertolino, S. & Currado, I. (2001). Ecology of the garden dormouse (*Eliomys quercinus*) in the Alpine habitat. *Trakya University Journal of Scientific Research, series B* 2: 75–78.

Bertolino, S., Cordero di Montezemolo, N. & Currado, I. (2003). Home ranges and habitat use of the garden dormouse (*Eliomys quercinus*) in a mountain habitat in summer. *Acta Zoologica Academiae Scientiarum Hungaricae* 49 (Suppl. 1): 11–18.

Birch, N.V. (2000). *The vegetation of rangelands in the mid-Fish River Valley, Eastern Cape, South Africa: Towards a suitable and acceptable management system*. Ph.D. dissertation, Rhodes University, Grahamstown, South Africa.

Birch, N.V., A.M. Avis and A.R. Palmer (1999). The effect of land-use on the vegetation communities along a topo-moisture gradient in the mid-Fish river valley, South Africa. *African Journal of Range & Forage Science* 16: 1–8.

Bright, P.W. & Morris, P.A. (1991). Ranging and nesting behaviour of the dormouse, *Muscardinus avellanarius*, in diverse low growing woodland. *Journal of Zoology* 224: 177–190.

Bright, P.W. & Morris, P.A. (1992). Ranging and nesting behaviour of the dormouse, *Muscardinus avellanarius*, in coppice-with standards woodland. *Journal of Zoology* 226: 589–600.

Bright, P.W. & Morris, P.A. (1993). Foraging behaviour of dormice *Muscardinus avellanarius* in two contrasting habitats. *Journal of Zoology* 230: 69–85.

Büchner, S. (2008). Dispersal of common dormice *Muscardinus avellanarius* in a mosaic habitat. *Acta Theriologica* 53: 259–262.

Channing, A. (1984). Ecology of the namtap *Graphiurus ocularis* (Rodentia: Gliridae) in the Cedarberg, South Africa. *South African Journal of Zoology* 19(3): 142–149.

Cowan, D.P. (1987). Group living in the European rabbit (*Oryctolagus cuniculus*): mutual benefit or resource localization? *Journal of Animal Ecology* 56: 779–795.

De Graaff, G. (1981). *The rodents of southern Africa*. Butterworths, Pretoria.

Ebensperger, L.A. & Hurtado, M.J. (2005). On the relationship between herbaceous cover and vigilance of degus (*Octodon degus*). *Ethology* 111: 593–608.

Eccard, J.A., Dean, W.R.J., Wichmann, M.C., Huttunen, S.M., Eskelinen, E., Moloney, K.A. & Jeltsch, F. (2006). Use of large Acacia trees by the cavity dwelling black-tailed tree rat in the southern Kalahari. *Journal of Arid Environments* 64: 604–615.

Ellison, G.T.H. & Skinner, J.D. (1991). Thermoregulation and torpor in African woodland dormice, *Graphiurus murinus*, following cold acclimation. *Zeitschrift für Säugetierkunde* 56: 41–47.

Franco, D. (1990). Feeding habits of a dormouse population (*Myoxus glis*) of the Asiago plateau (Venatian pealps). *Hystrix* 2: 11–22.

Gebe, Z. (2014). *Resting site ecology and microhabitat use by the Mozambique thicket rat (Grammomys cometes) in a riverine Combretum forest.* MSc thesis, University of Fort Hare, Alice, South Africa.

Gil-Delgado, J.A., Mira, O., Viñals, A., Gómez, J., Banyuls, N. & Vives-Ferrándiz, C. (2010). Diet of the garden dormouse (*Eliomys quercinus* Linnnaeus 1766) in orange groves: seasonal variation and use of available resources. *Mammalia* 74: 147–151.

Happold, D. (Ed.) (2013). *Mammals of Africa. Vol. III: Rodents, hares and rabbits*. Bloomsbury, London.

Hoare, D.B., Mucina, L., Rutherford, M.C., Vlok, J.H.J., Euston-Brown, I.W., Palmer, A.R., Powrie, L.W., Lecmere-Oertel, R.G., Proches, S.M., Dold, A.P & Ward, R.A. (2006). Albany Thicket Biome. In: *The vegetation of South Africa, Lesotho and Swaziland*: 541–567. Mucina, L. & Rutherford, M.C. (Eds). South African National Biodiversity Institute, Pretoria, South Africa.

Hummel, J.D., Dosdall, L.M., Clayton, G.W., Harker, K.N. & O'Donovan, J.T. (2012). Ground beetle (Coleoptera: Carabidae) diversity, activity density, and community structure in a diversified agroecosystem. *Environment Entomology* 41: 72–80.

Juškaitis, R. (2001). Weight changes of the common dormouse (*Muscardinus avellanarius*) during the year in Lithuania. *Trakya University Journal of Scientific Research, series B* 2: 79–83.

Juškaitis, R. (2006). Interactions between dormice (Gliridae) and hole-nesting birds in nest boxes. *Folia Zoologica* 55: 225–236

Juškaitis, R. (2007). Feeding by the common dormouse (*Muscardinus avellanarius*): a review. *Acta Zoologica Lituanica* 17: 151–159.

Juškaitis, R. (2008). *The common dormouse Muscardinus avellanarius: Ecology, population structure and dynamics*. Institute of Ecology of Vilnius University Publishers, Vilnius, Lithuania.

Kaplan, T.E. (1995). *The habitat and the ecology of small mammals in an Eastern Cape forest remnant*. B.Sc. Honours thesis, Rhodes University, Grahamstown, South Africa.

Kerley, G.I.H. (1992). Small mammal seed consumption in the Karoo, South Africa: further evidence for divergence in the desert biotic processes. *Oecologia* 89: 471–475.

Kerley, G.I.H. & Whitford, W.G. (1994). Desert-dwelling small mammals as granivores: intercontinental variations. *Austral Journal of Zoology* 42: 543–555.

King, C.M. (1985). Interactions between woodland rodents and their predators. *Symposia of the Zoological Society of London* 55: 219–247.

Kingdon, J. (1974). *East African mammals. An atlas of evolution in Africa.* Vol. II Part B (Hares and rodents). Academic Press, London.

Kotler, B.P., Brown, J.S. & Mitchell, W.A. (1993). Environmental factors affecting patch use in two species of Gerbilline rodents. *Journal of Mammalogy* 74: 614–620.

Krebs, C.J. (1999). *Ecological methodology*. Second edition. Benjamin/Cummings, Menlo Park, California.

Kronfeld, N. & Dayan, T. (1998). A new method of determining diets of rodents. *Journal of Mammalogy* 79: 1198–1202.

Kryštufek, B., Haberl, W. & Baxter, R. (2008). Rodent assemblage in a habitat mosaic within the Valley Thicket vegetation of the Eastern Cape Province, South Africa. *African Journal of Ecology* 46: 80–87.

Lamani, S.F. (2011). *Resting site ecology of the woodland dormouse Graphiurus murinus at the Great Fish River Reserve, Eastern Cape.* B.Sc. Honours thesis, University of Fort Hare, Alice, South Africa.

Lombard, M. (2014). *Activity patterns of the woodland dormouse Graphiurus murinus at the Great Fish River Reserve (Eastern Cape, South Africa): a pilot study.* B.Sc. Honours thesis, University of Fort Hare, Alice, South Africa.

Lynch, C.D. (1989). The mammals of the North-Eastern Cape. *Memoirs van die Nasionale Museum Bloemfontein* 25: 1–116.

Lynch, C.D. (1994). The mammals of Lesotho. *Navorsinge van die Nasionale Museum Bloemfontein* 10: 177–241.

Madikiza, Z.J.K. (2010). *Population biology and aspects of the socio-spatial organization of the Woodland dormouse, Graphiurus murinus (Desmarest, 1822) in the Great Fish River Reserve, South Africa*. M.Sc. dissertation, University of Fort Hare, Alice, South Africa.

Madikiza, Z.J.K., Bertolino, S., Baxter, R.M. & Do Linh San E. (2010a). Nest box use by woodland dormice (*Graphiurus murinus*): the influence of life cycle and nest box placement. *European Journal of Wildlife Research* 56: 735–743.

Madikiza, Z.J.K., Bertolino, S., Baxter, R.M. & Do Linh San, E. (2010b). Seasonal, sexual and age-related variations in the live-trapping success of woodland dormice (*Graphiurus murinus*). *Zoological Studies* 49: 797–805.

Madikiza, Z.J.K., Bertolino, S. & Do Linh San, E. (2011). Female in space or female in space and time? First data on the socio-spatial organization and mating system of the woodland dormouse (*Graphiurus murinus*). *Journal of Ethology* 29: 375–380.

McIntire, P.W. & Carey, A.B. (1989). *A microhistological technique for analysis of food habits of mycophagous rodents.* Research Paper PNW-RP-404. U.S. Dept. Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR. 16 p.

Melis, C., Olsen, C.B., Hyllvang, M., Gobbi, M., Stokke, B.G. & Roskaft, E. (2010). The effect of traffic intensity on ground beetle (Coleoptera: Carabidae) assemblages in central Sweden. *Journal of Insect Conservation* 14: 159–168.

Mikeš, V., Hedrich, J. & Sedláček, F. (2010). Syntopic occurrence of the Garden dormouse (*Eliomys quercinus*) and the Edible dormouse (*Glis glis*) in a montane climax spruce forest (Rodentia: Gliridae). *Lynx, nova series (Praha)* 41: 193–200.

Milazzo, A., Faletta, W. & Sarà, M. (2003). Habitat selection of fat dormouse (*Glis glis italicus*) in deciduous woodlands of Sicily. *Acta Zoologica Academiae Scientiarum Hungraricae* 49(Suppl. 1) 117–124.

Mommertz, S., Schauer, C., Kosters, N., Lang, A. & Filser, J. (1996). A comparison of D-Vac suction, fenced and unfenced pitfall trap sampling of epigeal arthropods in agroecosystems. *Annales Zoologici Fennici* 33: 117–124.

Monadjem, A. (1997). Stomach contents of 19 species of small mammals from Swaziland. *South African Journal of Zoology* 32: 23–26.

Morris, P.A., Bright, P.W. & Woods, D. (1990). Use of nest boxes by the dormouse *Muscardinus avellanarius*. *Biological Conservation* 51: 1–13.

Morzillo, A.T., Feldhamer, G.A. & Nicholson, M.C. (2003). Home range and nest use of the golden mouse (*Ochrotomys nuttali*) in southern Illinois. *Journal of Mammalogy* 84: 553–560.

Mudappa, D., Kumar, A. & Chellam, R. (2001). Abundance and habitat selection of the Malabar spiny dormouse in the rainforest of the southern Western Ghats, India. *Current Science* 80: 424–427.

Mzilikazi, K., Madikiza, Z., Oelkrug, R. & Baxter, R.M. (2012). Hibernation in free-ranging African woodland dormice, *Graphirus murinus*. In: *Living in a seasonal world: Thermoregulatory and metabolic adaptations*: 41–50. Ruf, T., Bieber, C., Arnold, W. & Millesi, E. (Eds). Springer, New York.

Neu, C.W., Byers, C.R. & Peek, J.M. (1974). A technique for analysis of utilization–availability data. *The Journal of Wildlife Management*: 541–545.

Niemela, J. & Kotze, D.J. (2009). Carabid beetle assemblages along urban to rural gradients: a review. *Landscape and Urban Planning* 92: 65–71.

Norušis, M.J. (2008). *SPSS 16.0 Advanced Statistical Procedures Companion*. Prentice Hall Publishers, Upper Saddle River.

Nowakowski, W.K. & Godlewska, M. (2006). The importance of animal food for *Dryomys nitedula* (Pallas) and *Glis glis* (L.) in Bialowieza forest (East Poland): analysis of faeces. *Polish journal of Ecology* 54: 359–367.

Nowakowski, W.K., Remisiewicz, M. & Kosowsa, J. (2006). Food preferences of *Glis glis* (L.), *Dryomys nitedula* (Pallas) and *Graphiurus murinus* (Smuts) kept in captivity. *Polish Journal of Ecology* 54: 369–378.

Ognev, S.I. 1947. *The mammals of the USSR and adjacent countries*. Vol. 5. Academy of Science of the USSR Press, Moscow–Leningrad.

Panchetti, F., Amori, G., Carpaneto, G. M., & Sorace, A. (2004). Activity patterns of the common dormouse (*Muscardinus avellanarius*) in different Mediterranean ecosystems. Journal of Zoology *262*(3): 289-294.

Panchetti, F., Sorace, A., Amori, G. & Carpaneto, G.M. (2007). Nest site preference of common dormouse (*Muscardinus avellanarius*) in two different habitat types of Central Italy. *Italian Journal of Zoology* 74: 363–369.

Perner, J. & Schueler, S. (2004). Estimating the density of ground-dwelling arthropods with pit fall traps using a nested-cross array. *Journal of Animal Ecology* 73: 469–477.

Pienaar, U. De V., Rautenbach, I.L. & De Graaf, G. (1980). The small mammals of the Kruger National. Parks Board of South Africa, Pretoria.

Pilāts, V., Pilāte, D., Ornicāns, A. & Kārkliņš, A. (2012). Microhabitat utilization by forest dormice (*Dryomys nitedula*) in boreo-nemoral forest – preliminary results. *Peckiana* 8: 77–85.

Richards, C.G.J., White, A.C., Hurrell, E. & Price, F.E.F. (1984). The food of the common dormouse, *Muscardinus avellanarius* in south Devon. *Mammal Review* 14: 19–28.

Rocha, C.R., Riberio, R., Takahashi, F.S.C. & Marinho-Filho, J. (2011). Microhabitat use by rodent species in a central Brazilian cerrado. *Mammalian Biology* 76: 651–653.

Rowe-Rowe, D.T. (1986). Stomach contents of small mammals from the Drakensberg, South Africa. *South African Journal of Wildlife Research* 16: 32–35.

Sailer, M.M. & Fietz, J. (2009). Seasonal differences in the feeding ecology and behaviour of male edible dormice (*Glis glis)*. *Mammalian Biology* 74: 113–124.

Schirmel, J., Lenze, S., Katzmann, D. & Buchholz, S. (2010). Capture efficiency of pitfall traps is highly affected by sampling interval. *Entomologia Experimentalis et Applicata* 136: 206–210.

Schmidt, M.H., Clough, Y., Schulz, W., Westphalen, A. & Tscharntke, T. (2006). Capture efficiency and preservation attributes of different fluids in pitfall traps. *Journal of Arachnology* 34: 159–162.

Scholtz, C.H. & Holm, E. (Eds) (2008). *Insects of Southern Africa*. Pretoria Book House, Pretoria.

Skinner, J.D. & Chimimba, C.T. (2005). *The mammals of the Southern African Subregion*. Third edition. Cambridge University Press, Cambridge.

Smithers, R.H.N. (1971). *The mammals of Botswana*. Museum Memoir No 4. Trustees of the National Museums and Monuments, Salisbury, Zimbabwe Rhodesia.

Storch, G. (1978). Familie Gliridae Thomas, 1897. Schläfer. In: *Handbuch der Säugetiere Europas*. Band 1, Rodentia I: 201–280. Niethammer, J. & Krapp, F. (Eds). Akademische Verlagsgesellschaft, Wiesbaden.

Stuart, C. & Stuart, T. (1992). *Mammals of Southern Africa*. Struik Publishers, Cape Town.

Stuart, C. & Stuart, T. (2001). *Field guide to mammals of Southern Africa*. Third edition. Struik Publishers, Cape Town.

Taylor, P. (1998). *The smaller mammals of KwaZulu-Natal*. University of Natal Press, Pietermaritzburg.

Wagner, D.M., Feldhamer, G.A. & Newman, J.A. (2000). Microhabitat selection by golden mice (*Ochrotomys nuttali*) at arboreal nest sites. *The American Midland Naturalist* 144: 220–225.

Webb, P.I. & Skinner, J.D. (1995). The dormice of southern Africa. *Hystrix* 6: 287–293.

Wirminghaus, J.O. & Perrin, M.R. (1992). Diets of small mammals in a southern African temperate forest. *Israel Journal of Zoology* 38: 353–361.

APPENDICES

Table A1. Percentage weight of various categories of food remains collected in nest boxes used by woodland dormice. AVG = average (mean), STDEV = standard deviation, MIN = minimum, MAX = maximum.

CATEGORY	DESC STATS	YEAR 2010	SUMMER 2010–2011	AUTUMN 2011	WINTER 2011	SPRING 2011
Arthropods	AVG	77.43	87.04	95.55	99.94	97.78
	STDEV	23.93	27.45	17.71	0.28	4.25
	MIN	30.04	14.21	0.00	98.78	86.21
	MAX	100.00	100.00	100.00	100.00	100.00
Fruits	AVG	22.20	12.53	1.15	0.00	1.06
	STDEV	23.93	27.02	4.29	0.00	3.83
	MIN	0.00	0.00	0.00	0.00	0.00
	MAX	69.69	85.54	19.96	0.00	13.79
Molluscs	AVG	0.15	0.22	0.27	0.04	1.16
	STDEV	0.31	0.59	1.29	0.16	2.48
	MIN	0.00	0.00	0.00	0.00	0.00
	MAX	0.83	2.38	7.29	0.70	7.76
Unidentified	AVG	0.21	0.21	3.03	0.03	0.00
	STDEV	0.33	1.01	17.41	0.12	0.00
	MIN	0.00	0.00	0.00	0.00	0.00
	MAX	0.92	4.85	100.00	0.52	0.00

Table A2. Seasonal percentages of occurrence (PO) of various categories of food remains collected in nest boxes used by woodland dormice.

CATEGORY	SUMMER 2010–2011	AUTUMN 2011	WINTER 2011	SPRING 2011
Arthropods	100	96.97	100	100.0
Fruits	34.78	12.12	0	7.7
Molluscs	21.74	6.06	5.3	30.8
Unidentified	4.35	3.03	5.26	0.0

Table A3. Seasonal relative percentages of occurrence (RPO) of various categories of food remains collected in nest boxes used by woodland dormouse.

CATEGORY	YEAR 2010	SUMMER 2010–2011	AUTUMN 2011	WINTER 2011	SPRING 2011
Arthropods	35.00	62.16	82.05	90.48	72.22
Fruits	30.00	21.62	10.26	0.00	5.56
Molluscs	15.00	13.51	5.13	4.76	22.22
Unidentified	20.00	2.70	2.56	4.76	0.00

Table A4. Weight percentages of spiders (order Araneae) and arthropod families collected each season.

FAMILY	YEAR 2010	SUMMER 2010–2011	AUTUMN 2011	WINTER 2011	SPRING 2011
Araneae	0.06	0.09	0.00	0.29	0.00
Blattidae	12.47	13.20	12.16	17.49	11.88
Bostrichidae	1.10	1.41	0.11	0.29	0.82
Buprestidae	0.01	0.00	0.07	0.20	0.05
Carabidae	10.16	13.95	16.13	24.89	4.02
Chrysomelidae	0.01	0.00	0.12	0.00	0.00
Elateridae	0.00	0.08	0.00	0.00	0.00
Scarabaeidae	0.53	0.46	0.61	0.39	0.96
Spirostreptidae	27.16	23.67	24.20	35.52	36.55
Tenebrionidae	48.08	46.64	46.60	20.73	45.00
Unidentified	0.42	0.49	0.00	0.20	0.73

Table A5. Weight percentages of fruit seeds collected during the study period.

PLANT SPECIES	YEAR 2010	SUMMER 2010–2011	AUTUMN 2011	WINTER 2011	SPRING 2011
G. robusta	68.70	68.24	15.32	0	0
Z. mucronata	31.30	31.76	84.68	0	100

Table A6. Number of individuals from different arthropod families caught by pitfall traps during the study period.

FAMILY	SUMMER 2010–2011	AUTUMN 2011	WINTER 2011	SPRING 2011
Acrididae	0	0	0	1
Aphididae	1	25	4	0
Bostrichidae	52	3	4	2
Calliphoridae	0	0	0	4
Carabidea	7	1	6	49
Coccinellidae	0	1	0	0
Cucujoidea	0	0	1	0
Formicidae	34	2	9	403
Lestidae	0	1	0	0
Muscidae	1	0	4	4
Noctuidea	0	0	0	1
Scaiidae	7	7	3	10
Scutigeridae	0	0	1	1
Spirostreptidae	1	0	1	1
Staphylinidae	59	17	23	10
Stenopelmatidae	3	0	1	3
Tenebrionidae	0	0	0	2
Trogidae	0	0	0	1
Sum	**165**	**57**	**57**	**492**

Table A7. Microhabitat variables measured during winter 2011.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
A1	1	2	2	2	0	2	2	3	3	ground open		ground	0
A101	0	0	0	0	194	2	2	2	3	tree canopy		*M. heterophylla*	2
A2	0	0	0	0	68	2	3	3	3	woody		other	1
A102	0	0	0	0	101	2	3	3	3	woody		other	1
A3	0	0	0	0	0	3	2	3	3	woody		ground	0
A103	1	1	1	1	126	3	2	3	3	woody	29	*Rhus sp*	1
A4	0	0	0	0	50	2	3	2	4	tree_log	54	*C. caffrum*	3
A104	0	0	0	0	202	2	3	3	4	tree trunk	46	*Rhus sp*	4
A5	0	0	0	0	0	3	3	3	3	woody ground		ground	0
A105	0	0	0	0	161	3	3	3	3	woody		*Z. mucronata*	3
A6	0	0	0	0	76	3	3	3	2	tree trunk	27	*Rhus sp*	1
A106	0	0	0	0	191	3	3	3	2	tree trunk	27	*Rhus sp*	1
B7	0	0	0	0	133	3	2	0	3	bush	18	other	1
B107	0	0	0	0	67	3	2	0	3	tree canopy	10	*C. caffrum*	1
B8	0	0	0	0	0	3	2	3	3	woody		ground	0
B108	0	0	0	0	200	3	2	3	3	tree trunk	39	*O. europaea*	2
B9	0	0	0	0	42	3	3	2	2	bush		other	1
B109	0	0	0	0	117	3	3	2	2	bush	7	other	1
B10	0	0	0	0	0	3	3	2	3	ground open		ground	0
B110	0	0	0	0	223	3	3	2	3	tree trunk	59	*O. europaea*	2
B11	0	0	0	0	112	1	1	2	3	bush		*Rhus sp*	2
B111	0	0	0	0	203	1	1	2	3	tree trunk		*Rhus sp*	2
B12	0	0	0	0	0	3	3	2	3	ground open		ground	0
B112	0	0	0	0	134	3	3	2	3	tree trunk	26	*O. europaea*	1
C13	0	0	0	0	75	4	2	2	2	bush		other	1
C113	0	0	0	0	154	4	2	2	2	tree trunk		*C. caffrum*	1
C14	0	0	0	0	0	4	2	1	1	bush		ground	0

Table A7. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
C114	0	0	0	0	97	4	2	1	1	bush		*A. karoo*	0
C15	0	0	0	0	0	3	2	2	1	ground open		ground	1
C115	0	0	0	0	195	3	2	2	1	tree canopy	15	*O. europaea*	0
C16	0	0	0	0	46	1	2	2	3	woody	13	other	2
C116	0	0	0	0	140	1	2	2	3	tree trunk		*Rhus sp*	2
C17	0	0	0	0	0	3	2	0	3	woody		ground	2
C117	1	1	1	1	187	3	2	0	3	woody		*Rhus sp*	2
C18	0	0	0	0	84	4	3	0	3	tree trunk	31	*A. karoo*	3
C118	0	0	0	0	132	4	3	0	3	tree trunk	41	*A. karoo*	3
D19	0	0	0	0	78	3	3	2	1	woody		other	0
D119	0	0	0	0	129	3	3	2	1	woody		other	0
D20	0	0	0	0	0	3	4	1	1	ground open		ground	0
D120	0	0	0	0	236	3	4	1	1	tree trunk	49	*C. caffrum*	0
D21	0	0	0	0	81	0	3	1	1	tree trunk	20	*Rhus sp*	0
D121	0	0	0	0	140	0	3	1	1	tree canopy		*Rhus sp*	0
D22	0	0	0	0	0	3	3	1	2	ground open		ground	1
D122	0	0	0	0	177	3	3	1	2	tree canopy	19	*O. europaea*	0
D23	0	0	0	0	185	1	1	0	4	tree canopy		*M. heterophylla*	3
D123	0	0	0	0	185	1	1	0	4	tree trunk	33	*M. heterophylla*	3
D24	0	0	0	0	0	2	3	3	1	bush		Ground	0
D124	0	0	0	0	89	2	3	3	1	bush	12	other	0
E25	0	0	0	0	133	3	3	2	2	tree trunk		other	2
E125	0	0	0	0	211	3	3	2	2	tree trunk	62	*O. europaea*	2
E26	0	0	0	0	97	3	3	1	1	bush		*M. heterophylla*	2
E126	0	0	0	0	144	3	3	1	1	bush		*M. heterophylla*	2
E27	0	0	0	0	0	3	3	0	3	ground open		ground	3
E127	0	0	0	0	189	3	3	0	3	tree canopy	19	*Rhus sp*	3

Table A7. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
E28	0	0	0	0	64	2	3	1	3	bush		*A. karoo*	3
E128	0	0	0	0	131	2	3	1	3	bush		*A. karoo*	3
E29	0	0	0	0	0	2	2	1	3	ground open		ground	0
E129	0	0	0	0	176	2	2	1	3	tree canopy		*O. europaea*	1
E30	0	0	0	0	0	4	3	1	0	bush		other	0
E130	0	0	0	0	67	4	3	1	0	bush		other	0
F31	0	0	0	0	96	3	3	2	3	tree trunk	49	*O. europaea*	2
F131	0	0	0	0	235	3	3	2	3	tree trunk	50	*O. europaea*	2
F32	0	0	0	0	0	4	4	2	2	ground open		ground	0
F132	0	0	0	0	115	4	4	2	2	tree trunk	36	*M. heterophylla*	0
F33	0	0	0	0	0	4	3	1	3	ground open		ground	0
F133	0	0	0	0	195	4	3	1	3	tree trunk	56	*O. europaea*	2
F34	0	0	0	0	0	3	2	2	2	bush		ground	2
F134	0	0	0	0	47	3	2	2	2	bush		other	2
F35	0	0	0	0	113	4	4	2	3	tree trunk	25	*O. europaea*	2
F135	0	0	0	0	194	4	4	2	3	tree canopy	18	*O. europaea*	2
F36	0	0	0	0	0	4	3	4	0	bush		ground	0
F136	0	0	0	0	60	4	3	4	0	bush		other	0
G37	0	0	0	0	119	2	3	1	3	tree trunk	141	*O. europaea*	3
G137	0	0	0	0	194	2	3	1	3	tree trunk	59	*O. europaea*	3
G38	0	0	0	0	134	4	4	3	3	tree canopy		ground	2
G138	0	0	0	0	0	4	4	3	3	ground open		*O. europaea*	0
G39	0	0	0	0	67	2	2	2	3	tree canopy	24	*O. europaea*	3
G139	0	0	0	0	206	2	2	2	3	tree canopy		*Z. mucronata*	3
G40	0	0	0	0	0	3	2	1	2	woody		ground	2
G140	0	0	0	0	167	3	2	1	2	tree trunk	135	*B. saligna*	1
G41	0	0	0	0	0	4	4	0	3	bush		ground	2

Table A7. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
G141	0	0	0	0	81	4	4	0	3	tree canopy		*A. karoo*	2
G42	0	0	0	0	106	3	3	2	3	bush		*M. heterophylla*	1
G142	0	0	0	0	113	3	3	2	3	bush		other	1
H43	0	0	0	0	27	4	4	1	4	tree trunk	23	*M. heterophylla*	2
H143	0	0	0	0	207	4	4	1	4	tree canopy		*M. heterophylla*	2
H44	0	0	0	0	0	3	2	3	3	ground open		ground	0
H144	0	0	0	0	38	3	2	3	3	log		other	0
H45	0	0	0	0	53	2	2	0	4	log	33	*M. heterophylla*	3
H145	0	0	0	0	179	2	2	0	4	tree trunk	34	*M. heterophylla*	3
H46	0	0	0	0	0	1	3	0	3	ground open		ground	4
H146	0	0	0	0	130	1	3	0	3	tree canopy		*A. karoo*	0
H47	0	0	0	0	126	0	2	2	3	bush		*M. heterophylla*	4
H147	0	0	0	0	179	0	2	2	3	tree trunk		*M. heterophylla*	4
H48	0	0	0	0	0	4	2	2	0	ground open		ground	0
H148	0	0	0	0	115	3	3	1	1	bush		other	0
I49	0	0	0	0	160	3	3	3	2	tree trunk	46	*A. karoo*	2
I149	0	0	0	0	192	3	3	3	2	tree canopy		*Rhus sp*	2
I50	0	0	0	0	0	3	3	3	2	bush		ground	0
I150	0	0	0	0	163	3	3	3	2	tree canopy		*C. caffrum*	1
I51	0	0	0	0	0	3	2	1	2	ground cover		ground	1
I151	0	0	0	0	94	3	2	1	2	log		*M. heterophylla*	1
I52	0	0	0	0	58	4	4	1	3	tree trunk		*A. karoo*	2
I152	0	0	0	0	108	4	4	1	3	bush		*A. karoo*	1
I53	0	0	0	0	138	2	2	2	2	tree trunk		*Rhus sp*	2
I153	0	0	0	0	165	2	2	1	3	tree trunk	53	*C. caffrum*	2
I54	0	0	0	0	0	4	2	1	1	bush		ground	0
I154	0	0	0	0	67	4	2	1	1	bush		*Acaccia karoo*	0

Table A7. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
J55	0	0	0	0	0	3	3	2	4	ground open		ground	0
J155	0	0	0	0	61	3	3	2	4	tree trunk	49	*Z. mucronata*	0
J56	0	0	0	0	0	4	4	2	3	ground open		ground	0
J156	0	0	0	0	185	4	4	2	3	tree canopy	10	*C. caffrum*	4
J57	0	0	0	0	50	4	4	3	3	bush		other	1
J157	0	0	0	0	218	4	4	3	3	tree trunk	51	*Z. mucronata*	0
J58	0	0	0	0	45	3	3	0	2	tree trunk	29	*C. caffrum*	1
J158	0	0	0	0	113	3	3	0	2	tree canopy	27	*C. caffrum*	1
J59	0	0	0	0	130	3	3	2	1	tree canopy		*M. heterophylla*	1
J159	0	0	0	0	188	3	3	2	1	tree trunk	13	*M. heterophylla*	1
J60	0	0	0	0	0	3	3	1	1	bush		ground	0
J160	0	0	0	0	134	3	3	1	1	bush		*M. heterophylla*	0
K61	0	0	0	0	0	4	4	3	3	ground open		ground	0
K161	0	0	0	0	214	4	4	3	3	tree trunk	67	*C. caffrum*	2
K62	0	0	0	0	167	3	3	2	4	tree canopy	13	*Z. mucronata*	3
K162	0	0	0	0	184	3	3	2	4	tree trunk	75	*C. caffrum*	3
K63	0	0	0	0	136	4	4	3	3	tree canopy	21	*C. caffrum*	3
K163	0	0	0	0	225	4	4	3	3	tree canopy	27	*C. caffrum*	3
K64	0	0	0	0	0	3	3	0	2	woody		ground	2
K164	0	0	0	0	64	3	3	0	2	woody		other	2
K65	0	0	0	0	102	4	4	3	2	tree canopy	12	*M. heterophylla*	1
K165	0	0	0	0	152	4	4	3	2	tree trunk	7	*M. heterophylla*	1
K66	0	0	0	0	0	4	4	0	2	bush		ground	0
K166	0	0	0	0	63	4	4	0	2	bush		*A. karoo*	0
L67	0	0	0	0	82	3	3	0	2	tree trunk	168	*C. caffrum*	2
L167	0	0	0	0	178	3	3	0	2	woody		*Rhus sp*	2
L68	0	0	0	0	0	4	4	3	2	woody		ground	3

Table A7. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
L168	0	0	0	0	148	4	4	3	2	tree canopy	13	*C. caffrum*	3
L69	0	0	0	0	62	4	4	2	3	tree canopy	39	*C. caffrum*	2
L169	0	0	0	0	149	4	4	2	3	tree canopy	18	*C. caffrum*	2
L70	0	0	0	0	0	4	4	1	4	ground open		*C. caffrum*	0
L170	0	0	0	0	203	4	4	1	4	tree trunk	111	*C. caffrum*	4
L71	0	0	0	0	50	4	4	2	4	tree trunk	33	*A. karoo*	1
L171	0	0	0	0	182	4	4	2	4	tree trunk	15	*A. karoo*	1
L72	0	0	0	0	0	3	3	2	3	bush		ground	1
L172	0	0	0	0	115	3	3	2	3	bush		*A. karoo*	2
M73	0	0	0	0	91	4	4	4	3	tree trunk	168	*C. caffrum*	4
M173	0	0	0	0	223	4	4	4	3	tree trunk	41	*C. caffrum*	4
M74	0	0	0	0	0	4	4	3	4	ground open		ground	0
M174	0	0	0	0	112	4	4	3	4	tree canopy	15	*Rhus sp*	2
M75	1	1	1	1	150	3	3	2	3	tree trunk	87	*C. caffrum*	3
M175	0	0	0	0	236	3	3	2	3	tree trunk	43	*M. heterophylla*	3
M76	0	0	0	0	0	4	4	2	3	ground open		ground	0
M176	0	0	0	0	95	4	4	2	3	tree trunk	72	*C. caffrum*	2
M77	0	0	0	0	132	3	3	1	3	tree canopy	23	*M. heterophylla*	2
M177	0	0	0	0	195	3	3	1	3	tree canopy	28	*M. heterophylla*	2
M78	0	0	0	0	0	2	3	2	2	bush ground		ground	1
M178	0	0	0	0	44	2	3	2	2	bush		other	1
N79	0	0	0	0	0	4	4	3	3	ground open		ground	3
N179	0	0	0	0	209	4	4	3	3	tree trunk	118	*C. caffrum*	3
N80	0	0	0	0	84	2	2	1	3	woody trunk		*Z. mucronata*	2
N180	0	0	0	0	128	2	2	1	3	woody		*Z. mucronata*	2
N81	0	0	0	0	73	1	1	1	2	woody		*Z. mucronata*	2
N181	0	0	0	0	215	2	2	1	2	tree trunk	47	*Z. mucronata*	2

Table A7. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
N82	0	0	0	0	0	0	0	1	2	woody ground		ground	2
N182	0	0	0	0	133	0	0	1	2	woody trunk		*Z. mucronata*	2
N83	0	0	0	0	101	2	2	1	4	tree canopy	9	other	4
N183	0	0	0	0	200	2	2	1	4	tree trunk	30	*A. karoo*	4
N84	0	0	0	0	0	3	3	1	3	bush ground		ground	2
N184	0	0	0	0	137	3	3	1	3	tree canopy		*M. heterophylla*	2
O85	0	0	0	0	167	3	3	2	3	tree trunk	29	*M. heterophylla*	1
O185	0	0	0	0	184	3	3	2	3	tree trunk		*M. heterophylla*	1
O86	0	0	0	0	0	3	3	2	4	ground open		ground	0
O186	0	0	0	0	167	3	3	2	4	tree trunk	66	*O. europaea*	3
O87	0	0	0	0	0	2	3	2	4	ground open		ground	0
O187	0	0	0	0	56	2	3	2	4	log	152	*C. caffrum*	2
O88	0	0	0	0	136	3	1	3	4	tree trunk	152	*C. caffrum*	4
O188	0	0	0	0	185	3	1	3	4	tree trunk	79	*C. caffrum*	4
O89	0	0	0	0	0	4	4	2	3	ground cover		ground	2
O189	0	0	0	0	74	4	4	2	3	log		other	2
O90	0	0	0	0	109	1	1	2	3	tree trunk	80	*Rhus sp*	2
O190	0	0	0	0	137	1	1	2	3	tree trunk	46	*Rhus sp*	2
P91	0	0	0	0	99	3	3	1	2	tree canopy		*M. heterophylla*	2
P191	0	0	0	0	152	3	3	1	2	tree trunk	25	*M. heterophylla*	2
P92	0	0	0	0	0	1	1	2	4	ground open		ground	0
P192	0	0	0	0	145	1	1	2	4	tree canopy		*Rhus sp*	2
P93	0	0	0	0	0	3	3	3	4	ground open		other	0
P193	0	0	0	0	190	3	3	3	4	tree canopy		*M. heterophylla*	2
P94	0	0	0	0	0	4	4	2	3	ground open		ground	0
P194	0	0	0	0	217	4	4	2	3	tree canopy	18	*C. caffrum*	2
P95	0	0	0	0	0	0	0	2	4	ground cover		ground	0

Table A7. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
P195	0	0	0	0	107	0	0	2	4	tree trunk		*M. heterophylla*	3
P96	0	0	0	0	143	0	0	2	4	tree trunk	84	*C. caffrum*	4
P196	0	0	0	0	183	0	0	2	4	tree canopy	42	*C. caffrum*	4

Table A8. Microhabitat variables measured during spring 2011.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
A1	1	1	1	1	0	2	2	2	3	ground open		ground	0
A101	0	0	0	0	194	2	2	2	3	tree canopy		*M. heterophylla*	3
A2	1	1	1	1	68	2	3	3	3	woody		other	2
A102	0	0	0	0	101	2	3	3	3	woody		other	2
A3	0	0	0	0	0	1	1	3	3	woody		ground	0
A103	0	0	0	0	126	1	1	3	3	woody	29	*Rhus sp*	3
A4	0	0	0	0	50	1	2	3	3	tree_log	54	*C. caffrum*	3
A104	0	0	0	0	202	1	2	3	3	tree trunk	46	*Rhus sp*	3
A5	0	0	0	0	0	4	4	3	3	woody ground		ground	0
A105	1	1	1	1	161	4	4	3	3	woody		*Z. mucronata*	4
A6	0	0	0	0	76	3	3	3	3	tree trunk	27	*Rhus sp*	2
A106	1	1	1	1	191	3	3	3	3	tree trunk	27	*Rhus sp*	2
B7	0	0	0	0	133	2	2	2	3	bush	18	other	1
B107	0	0	0	0	67	2	2	2	3	tree canopy	10	*C. caffrum*	1
B8	0	0	0	0	0	2	2	2	3	woody		ground	0
B108	0	0	0	0	200	2	2	2	3	tree trunk	39	*O. europaea*	3
B9	0	0	0	0	42	2	2	3	2	bush		other	2
B109	0	0	0	0	117	2	2	3	2	bush	7	other	2
B10	0	0	0	0	0	3	3	2	3	ground open		ground	0
B110	0	0	0	0	223	3	3	2	3	tree trunk	59	*O. europaea*	3
B11	0	0	0	0	112	2	2	2	3	bush		*Rhus sp*	2
B111	0	0	0	0	203	2	2	2	3	tree trunk		*Rhus sp*	2
B12	0	0	0	0	0	3	3	2	3	ground open		ground	3
B112	1	1	1	1	134	3	3	2	3	tree trunk	26	*O. europaea*	3
C13	0	0	0	0	75	4	3	3	2	bush		other	2
C113	0	0	0	0	154	4	3	3	2	tree trunk		*C. caffrum*	2
C14	0	0	0	0	0	4	2	1	1	bush		ground	0

Table A8. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
C114	0	0	0	0	97	4	2	1	1	bush		*A. karoo*	1
C15	0	0	0	0	0	3	3	2	1	ground open		ground	0
C115	0	0	0	0	195	3	3	2	1	tree canopy	15	*O. europaea*	1
C16	0	0	0	0	46	2	2	3	3	woody	13	other	2
C116	0	0	0	0	140	2	2	3	3	tree trunk		*Rhus sp*	2
C17	0	0	0	0	0	3	2	2	3	woody		ground	3
C117	0	0	0	0	187	3	2	2	3	woody		*Rhus sp*	3
C18	0	0	0	0	84	4	4	2	3	tree trunk	31	*A. karoo*	3
C118	0	0	0	0	132	4	4	2	3	tree trunk	41	*A. karoo*	3
D19	0	0	0	0	78	4	4	3	2	woody		other	2
D119	0	0	0	0	129	4	4	3	2	woody		other	2
D20	0	0	0	0	0	3	3	3	1	ground open		ground	0
D120	0	0	0	0	236	3	3	3	1	tree trunk	49	*C. caffrum*	1
D21	0	0	0	0	81	3	4	2	1	tree trunk	20	*Rhus sp*	1
D121	0	0	0	0	140	3	4	2	1	tree canopy		*Rhus sp*	0
D22	0	0	0	0	0	3	3	2	3	ground open		ground	0
D122	0	0	0	0	177	3	3	2	3	tree canopy	19	*O. europaea*	3
D23	0	0	0	0	185	1	1	1	4	tree canopy		*M. heterophylla*	4
D123	0	0	0	0	185	1	1	1	4	tree trunk	33	*M. heterophylla*	4
D24	0	0	0	0	0	3	3	3	1	bush		ground	0
D124	0	0	0	0	89	3	3	3	1	bush	12	other	0
E25	1	1	1	1	133	4	4	3	3	tree trunk		other	3
E125	0	0	0	0	211	4	4	3	3	tree trunk	62	*O. europaea*	3
E26	0	0	0	0	97	4	4	3	2	bush		*M. heterophylla*	2
E126	0	0	0	0	144	4	4	3	2	bush		*M. heterophylla*	2
E27	1	1	1	1	0	4	4	3	4	ground open		ground	3
E127	0	0	0	0	189	4	4	3	4	tree canopy	19	*Rhus sp*	3

Table A8. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
E28	0	0	0	0	64	3	3	3	3	bush		*A. karoo*	2
E128	0	0	0	0	131	3	3	3	3	bush		*A. karoo*	2
E29	0	0	0	0	0	2	2	1	4	ground open		ground	0
E129	0	0	0	0	176	2	2	1	4	tree canopy		*O. europaea*	3
E30	0	0	0	0	0	4	3	1	0	bush		other	0
E130	0	0	0	0	67	4	3	1	0	bush		other	0
F31	0	0	0	0	96	3	3	2	3	tree trunk	49	*O. europaea*	3
F131	0	0	0	0	235	3	3	2	3	tree trunk	50	*O. europaea*	3
F32	0	0	0	0	0	3	3	3	2	ground open		ground	0
F132	0	0	0	0	115	3	3	3	2	tree trunk	36	*M. heterophylla*	2
F33	0	0	0	0	0	4	4	3	3	ground open		ground	0
F133	0	0	0	0	195	4	4	3	3	tree trunk	56	*O. europaea*	2
F34	0	0	0	0	0	3	3	3	1	bush		ground	0
F134	0	0	0	0	47	3	3	3	1	bush		other	2
F35	0	0	0	0	113	4	4	3	3	tree trunk	25	*O. europaea*	3
F135	1	1	1	1	194	4	4	3	3	tree canopy	18	*O. europaea*	3
F36	0	0	0	0	0	4	4	3	1	bush		ground	0
F136	0	0	0	0	60	4	4	3	1	bush		other	1
G37	0	0	0	0	119	4	4	3	3	tree trunk	141	*O. europaea*	3
G137	0	0	0	0	194	4	4	3	3	tree trunk	59	*O. europaea*	3
G38	0	0	0	0	134	4	4	3	3	tree canopy		ground	0
G138	0	0	0	0	0	4	4	3	3	ground open		*O. europaea*	2
G39	0	0	0	0	67	3	3	3	3	tree canopy	24	*O. europaea*	3
G139	0	0	0	0	206	3	3	3	3	tree canopy		*Z. mucronata*	3
G40	0	0	0	0	0	4	4	2	2	woody		ground	2
G140	0	0	0	0	167	4	4	2	2	tree trunk	135	*B. saligna*	1
G41	0	0	0	0	0	4	4	1	3	bush		ground	3

Table A8. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
G141	0	0	0	0	81	4	4	1	3	tree canopy		*A. karoo*	3
G42	0	0	0	0	106	3	2	3	3	bush		*M. heterophylla*	1
G142	0	0	0	0	113	3	2	3	3	bush		other	1
H43	0	0	0	0	27	4	4	2	4	tree trunk	23	*M. heterophylla*	2
H143	0	0	0	0	207	4	4	2	4	tree canopy		*M. heterophylla*	2
H44	0	0	0	0	0	4	3	3	3	ground open		ground	0
H144	0	0	0	0	38	4	3	3	3	log		other	0
H45	0	0	0	0	53	2	2	1	4	log	33	*M. heterophylla*	4
H145	0	0	0	0	179	2	2	1	4	tree trunk	34	*M. heterophylla*	4
H46	0	0	0	0	0	4	4	2	3	ground open		ground	4
H146	0	0	0	0	130	4	4	2	3	tree canopy		*A. karoo*	4
H47	0	0	0	0	126	2	2	2	3	Bush		*M. heterophylla*	4
H147	0	0	0	0	179	2	2	2	3	tree trunk		*M. heterophylla*	4
H48	0	0	0	0	0	4	2	2	0	ground open		ground	0
H148	0	0	0	0	115	4	3	1	1	Bush		other	0
I49	0	0	0	0	160	3	3	10	3	tree trunk	46	*A. karoo*	2
I149	0	0	0	0	192	3	3	10	3	tree canopy		*Rhus sp*	2
I50	0	0	0	0	0	4	4	4	2	Bush		ground	0
I150	0	0	0	0	163	4	4	4	2	tree canopy		*C. caffrum*	1
I51	0	0	0	0	0	4	3	2	2	ground cover		ground	1
I151	0	0	0	0	94	4	3	2	2	Log		*M. heterophylla*	1
I52	0	0	0	0	58	4	4	1	3	tree trunk		*A. karoo*	3
I152	0	0	0	0	108	4	4	1	3	Bush		*A. karoo*	3
I53	0	0	0	0	138	3	3	3	3	tree trunk		*Rhus sp*	2
I153	0	0	0	0	165	3	3	3	3	tree trunk	53	*C. caffrum*	2
I54	0	0	0	0	0	4	3	1	1	bush		ground	0
I154	0	0	0	0	67	4	3	1	1	bush		*A. karoo*	0

Table A8. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
J55	0	0	0	0	0	4	4	3	3	ground open		ground	0
J155	0	0	0	0	61	4	4	3	3	tree trunk	49	*Z. mucronata*	2
J56	0	0	0	0	0	4	4	3	3	ground open		ground	0
J156	0	0	0	0	185	4	4	3	3	tree canopy	10	*C. caffrum*	3
J57	0	0	0	0	50	4	4	3	2	bush		other	0
J157	0	0	0	0	218	4	4	3	2	tree trunk	51	*Z. mucronata*	1
J58	0	0	0	0	45	4	4	2	2	tree trunk	29	*C. caffrum*	1
J158	0	0	0	0	113	4	4	2	2	tree canopy	27	*C. caffrum*	1
J59	0	0	0	0	130	3	3	3	2	tree canopy		*M. heterophylla*	1
J159	0	0	0	0	188	3	3	3	2	tree trunk	13	*M. heterophylla*	1
J60	0	0	0	0	0	3	3	1	1	bush		ground	0
J160	0	0	0	0	134	3	3	1	1	bush		*M. heterophylla*	0
K61	0	0	0	0	0	4	4	4	3	ground open		ground	0
K161	0	0	0	0	214	4	4	4	3	tree trunk	67	*C. caffrum*	3
K62	1	1	1	1	167	4	4	3	3	tree canopy	13	*Z. mucronata*	3
K162	1	2	2	2	184	4	4	3	3	tree trunk	75	*C. caffrum*	3
K63	0	0	0	0	136	4	4	2	3	tree canopy	21	*C. caffrum*	3
K163	1	2	2	2	225	4	4	2	3	tree canopy	27	*C. caffrum*	3
K64	0	0	0	0	0	4	4	0	2	woody		ground	2
K164	0	0	0	0	64	4	4	0	2	woody		other	2
K65	0	0	0	0	102	4	4	3	2	tree canopy	12	*M. heterophylla*	1
K165	0	0	0	0	152	4	4	3	2	tree trunk	7	*M. heterophylla*	1
K66	0	0	0	0	0	4	4	1	2	bush		ground	2
K166	0	0	0	0	63	4	4	1	2	bush		*A. karoo*	2
L67	0	0	0	0	82	4	4	2	2	tree trunk	168	*C. caffrum*	2
L167	1	1	1	1	178	4	4	2	2	woody		*Rhus sp*	2
L68	0	0	0	0	0	4	4	3	2	woody		Ground	3

Table A8. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
L168	0	0	0	0	148	4	4	3	2	tree canopy	13	*C. caffrum*	3
L69	0	0	0	0	62	4	4	3	3	tree canopy	39	*C. caffrum*	3
L169	0	0	0	0	149	4	4	3	3	tree canopy	18	*C. caffrum*	3
L70	0	0	0	0	0	4	4	2	4	ground open		*C. caffrum*	0
L170	0	0	0	0	203	4	4	2	4	tree trunk	111	*C. caffrum*	4
L71	0	0	0	0	50	4	4	3	4	tree trunk	33	*A. karoo*	1
L171	0	0	0	0	182	4	4	3	4	tree trunk	15	*A. karoo*	3
L72	0	0	0	0	0	4	4	2	3	bush		Ground	1
L172	0	0	0	0	115	4	4	2	3	bush		*A. karoo*	2
M73	0	0	0	0	91	4	4	4	3	tree trunk	168	*C. caffrum*	4
M173	0	0	0	0	223	4	4	4	3	tree trunk	41	*C. caffrum*	4
M74	0	0	0	0	0	4	4	3	4	ground open		Ground	0
M174	1	1	1	1	112	4	4	3	4	tree canopy	15	*Rhus sp*	2
M75	1	1	1	1	150	4	4	2	3	tree trunk	87	*C. caffrum*	3
M175	0	0	0	0	236	4	4	2	3	tree trunk	43	*M. heterophylla*	3
M76	0	0	0	0	0	4	4	3	3	ground open		Ground	0
M176	1	1	1	1	95	4	4	3	3	tree trunk	72	*C. caffrum*	2
M77	1	1	0	0	132	4	4	2	4	tree canopy	23	*M. heterophylla*	2
M177	0	0	0	0	195	4	4	2	4	tree canopy	28	*M. heterophylla*	2
M78	0	0	0	0	0	4	4	3	2	bush ground		Ground	1
M178	0	0	0	0	44	4	4	3	2	bush		other	1
N79	0	0	0	0	0	4	4	3	3	ground open		Ground	3
N179	0	0	0	0	209	4	4	3	3	tree trunk	118	*C. caffrum*	1
N80	0	0	0	0	84	3	3	2	3	woody trunk		*Z. mucronata*	2
N180	0	0	0	0	128	3	3	2	3	woody		*Z. mucronata*	2
N81	0	0	0	0	73	2	2	1	2	woody		*Z. mucronata*	2
N181	0	0	0	0	215	2	2	1	2	tree trunk	47	*Z. mucronata*	2

Table A8. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
N82	0	0	0	0	0	0	0	1	2	woody ground		Ground	2
N182	0	0	0	0	133	0	0	1	2	woody trunk		*Z. mucronata*	2
N83	1	1	1	1	101	2	2	4	4	tree canopy	9	other	4
N183	1	1	1	1	200	2	2	4	4	tree trunk	30	*A. karoo*	4
N84	0	0	0	0	0	4	4	2	3	bush ground		Ground	2
N184	0	0	0	0	137	4	4	2	3	tree canopy		*M. heterophylla*	2
O85	0	0	0	0	167	3	3	3	3	tree trunk	29	*M. heterophylla*	1
O185	0	0	0	0	184	3	3	3	3	tree trunk		*M. heterophylla*	0
O86	0	0	0	0	0	2	2	2	3	ground open		Ground	3
O186	0	0	0	0	167	2	2	2	3	tree trunk	66	*O. europaea*	0
O87	0	0	0	0	0	3	3	2	4	ground open		ground	2
O187	1	1	1	1	56	3	3	2	4	log	152	*C. caffrum*	4
O88	0	0	0	0	136	2	1	3	4	tree trunk	152	*C. caffrum*	4
O188	0	0	0	0	185	2	1	3	4	tree trunk	79	*C. caffrum*	2
O89	0	0	0	0	0	4	4	2	3	ground cover		ground	2
O189	0	0	0	0	74	4	4	2	3	log		other	2
O90	1	2	2	2	109	1	1	2	3	tree trunk	80	*Rhus sp*	2
O190	0	0	0	0	137	1	1	2	3	tree trunk	46	*Rhus sp*	4
P91	0	0	0	0	99	3	3	1	2	tree canopy		*M. heterophylla*	2
P191	0	0	0	0	152	3	3	1	2	tree trunk	25	*M. heterophylla*	2
P92	0	0	0	0	0	0	1	1	2	ground open		ground	2
P192	0	0	0	0	145	0	1	1	2	tree canopy		*Rhus sp*	2
P93	0	0	0	0	0	2	2	2	3	ground open		other	4
P193	0	0	0	0	190	2	2	2	3	tree canopy		*M. heterophylla*	0
P94	0	0	0	0	0	4	4	3	3	ground open		ground	2
P194	0	0	0	0	217	4	4	3	3	tree canopy	18	*C. caffrum*	0
P95	0	0	0	0	0	2	2	2	4	ground cover		ground	3

Table A8. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
P195	0	0	0	0	107	2	2	2	4	tree trunk		*M. heterophylla*	0
P96	0	0	0	0	143	3	3	2	4	tree trunk	84	*C. caffrum*	4
P196	0	0	0	0	183	3	3	2	4	tree canopy	42	*C. caffrum*	0

Table A9. Microhabitat variables measured during summer 2011–2012.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
A1	1	1	1	1	0	1	2	3	4	ground open		ground	3
A101	1	1	1	1	194	1	2	3	4	tree canopy		*M. heterophylla*	3
A2	0	0	0	0	68	1	1	3	2	woody		other	3
A102	0	0	0	0	101	1	1	3	2	woody		other	3
A3	0	0	0	0	0	0	0	3	4	woody		ground	0
A103	1	2	2	2	126	0	0	3	4	woody	29	*Rhus sp*	4
A4	0	0	0	0	50	1	1	2	4	tree_log	54	*C. caffrum*	3
A104	0	0	0	0	202	0	1	1	3	tree trunk	46	*Rhus sp*	3
A5	0	0	0	0	0	1	1	3	4	woody ground		ground	4
A105	0	0	0	0	161	1	1	3	4	woody		*Z. mucronata*	4
A6	0	0	0	0	76	4	3	4	4	tree trunk	27	*Rhus sp*	3
A106	0	0	0	0	191	4	3	4	4	tree trunk	27	*Rhus sp*	3
B7	0	0	0	0	133	3	2	1	1	bush	18	other	1
B107	1	2	2	2	67	3	3	2	2	tree canopy	10	*C. caffrum*	3
B8	0	0	0	0	0	0	1	2	3	woody		ground	0
B108	0	0	0	0	200	0	1	2	3	tree trunk	39	*O. europaea*	1
B9	0	0	0	0	42	3	3	2	0	bush		other	2
B109	0	0	0	0	117	3	3	2	1	bush	7	other	2
B10	0	0	0	0	0	2	2	2	3	ground open		ground	0
B110	1	1	1	1	223	2	2	2	3	tree trunk	59	*O. europaea*	4
B11	0	0	0	0	112	1	1	2	4	bush		*Rhus sp*	3
B111	1	1	1	1	203	1	1	2	4	tree trunk		*Rhus sp*	3
B12	0	0	0	0	0	3	4	3	3	ground open		ground	3
B112	0	0	0	0	134	3	4	3	3	tree trunk	26	*O. europaea*	3
C13	0	0	0	0	75	1	3	2	1	bush		other	3
C113	1	1	1	1	154	1	3	4	1	tree trunk		*C. caffrum*	3
C14	0	0	0	0	0	4	3	4	1	bush		ground	0

Table A9. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
C114	0	0	0	0	97	4	3	2	1	bush		*A. karoo*	0
C15	0	0	0	0	0	3	3	2	4	ground open		ground	0
C115	0	0	0	0	195	3	3	2	4	tree canopy	15	*O. europaea*	3
C16	0	0	0	0	46	0	1	2	4	woody	13	other	0
C116	0	0	0	0	140	0	2	2	4	tree trunk		*Rhus sp*	4
C17	0	0	0	0	0	0	2	3	4	woody		ground	1
C117	1	2	2	2	187	0	2	3	4	woody		*Rhus sp*	4
C18	0	0	0	0	84	4	4	4	3	tree trunk	31	*A. karoo*	3
C118	0	0	0	0	132	4	4	4	3	tree trunk	41	*A. karoo*	3
D19	0	0	0	0	78	4	4	3	2	woody		other	3
D119	0	0	0	0	129	4	4	3	2	woody		other	3
D20	0	0	0	0	0	4	4	3	2	ground open		ground	0
D120	0	0	0	0	236	4	4	3	2	tree trunk	49	*C. caffrum*	2
D21	0	0	0	0	81	4	4	2	2	tree trunk	20	*Rhus sp*	3
D121	0	0	0	0	140	4	4	2	2	tree canopy		*Rhus sp*	3
D22	0	0	0	0	0	4	3	3	3	ground open		ground	3
D122	1	1	1	1	177	4	3	3	3	tree canopy	19	*O. europaea*	3
D23	0	0	0	0	185	2	2	2	3	tree canopy		*M. heterophylla*	4
D123	0	0	0	0	185	2	2	2	3	tree trunk	33	*M. heterophylla*	4
D24	0	0	0	0	0	4	4	3	2	bush		ground	0
D124	0	0	0	0	89	4	4	3	2	bush	12	other	1
E25	1	2	2	2	133	4	4	4	3	tree trunk		other	4
E125	0	0	0	0	211	4	4	4	3	tree trunk	62	*O. europaea*	4
E26	0	0	0	0	97	4	3	2	3	bush		*M. heterophylla*	2
E126	0	0	0	0	144	4	3	2	3	bush		*M. heterophylla*	2
E27	0	0	0	0	0	4	4	3	2	ground open		ground	0
E127	1	1	1	1	189	4	4	3	2	tree canopy	19	*Rhus sp*	3

Table A9. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
E28	0	0	0	0	64	4	3	3	3	bush		*A. karoo*	3
E128	1	2	2	2	131	4	3	3	3	bush		*A. karoo*	3
E29	0	0	0	0	0	2	2	2	2	ground open		ground	0
E129	0	0	0	0	176	2	2	2	2	tree canopy		*O. europaea*	3
E30	0	0	0	0	0	4	4	1	2	bush		other	0
E130	0	0	0	0	67	4	4	1	2	bush		other	0
F31	1	1	1	1	96	4	4	3	4	tree trunk	49	*O. europaea*	3
F131	0	0	0	0	235	4	4	3	4	tree trunk	50	*O. europaea*	3
F32	0	0	0	0	0	4	4	2	3	ground open		ground	0
F132	0	0	0	0	115	4	4	2	3	tree trunk	36	*M. heterophylla*	3
F33	0	0	0	0	0	3	3	3	3	ground open		ground	0
F133	0	0	0	0	195	3	3	3	3	tree trunk	56	*O. europaea*	3
F34	0	0	0	0	0	4	4	2	2	bush		ground	0
F134	0	0	0	0	47	4	4	2	2	bush		other	1
F35	0	0	0	0	113	4	4	2	3	tree trunk	25	*O. europaea*	3
F135	1	1	1	1	194	4	4	2	3	tree canopy	18	*O. europaea*	3
F36	0	0	0	0	0	4	4	2	2	bush		ground	0
F136	0	0	0	0	60	4	4	2	2	bush		other	2
G37	0	0	0	0	119	4	4	3	3	tree trunk	141	*O. europaea*	4
G137	0	0	0	0	194	4	4	3	3	tree trunk	59	*O. europaea*	4
G38	0	0	0	0	134	4	4	3	3	tree canopy		ground	0
G138	0	0	0	0	0	4	4	3	3	ground open		*O. europaea*	3
G39	0	0	0	0	67	1	1	2	2	tree canopy	24	*O. europaea*	2
G139	0	0	0	0	206	1	1	2	2	tree canopy		*Z. mucronata*	2
G40	0	0	0	0	0	3	3	3	2	woody		ground	2
G140	0	0	0	0	167	3	3	3	2	tree trunk	135	*B. saligna*	2
G41	0	0	0	0	0	4	4	3	1	bush		ground	2

Table A9. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
G141	1	2	2	2	81	4	4	3	1	tree canopy		*A. karoo*	2
G42	0	0	0	0	106	3	2	3	3	bush		*M. heterophylla*	2
G142	0	0	0	0	113	3	2	3	3	bush		other	2
H43	0	0	0	0	27	1	4	4	2	tree trunk	23	*M. heterophylla*	3
H143	0	0	0	0	207	1	4	4	2	tree canopy		*M. heterophylla*	3
H44	0	0	0	0	0	3	3	2	2	ground open		ground	0
H144	0	0	0	0	38	3	3	2	2	log		other	0
H45	0	0	0	0	53	3	3	3	3	log	33	*M. heterophylla*	3
H145	0	0	0	0	179	3	3	3	3	tree trunk	34	*M. heterophylla*	3
H46	0	0	0	0	0	4	4	3	4	ground open		ground	0
H146	0	0	0	0	130	4	4	3	4	tree canopy		*A. karoo*	4
H47	0	0	0	0	126	4	4	2	4	bush		*M. heterophylla*	3
H147	0	0	0	0	179	4	4	2	4	tree trunk		*M. heterophylla*	3
H48	0	0	0	0	0	4	4	1	1	ground open		ground	0
H148	0	0	0	0	115	4	4	1	1	bush		other	0
I49	0	0	0	0	160	1	4	4	3	tree trunk	46	*A. karoo*	2
I149	1	1	1	1	192	1	4	4	3	tree canopy		*Rhus sp*	2
I50	0	0	0	0	0	4	4	4	1	bush		ground	0
I150	0	0	0	0	163	4	4	4	1	tree canopy		*C. caffrum*	1
I51	0	0	0	0	0	4	4	2	1	ground cover		ground	1
I151	0	0	0	0	94	4	4	2	1	log		*M. heterophylla*	1
I52	0	0	0	0	58	4	4	2	2	tree trunk		*A. karoo*	1
I152	0	0	0	0	108	4	4	2	2	bush		*A. karoo*	1
I53	0	0	0	0	138	3	3	2	3	tree trunk		*Rhus sp*	2
I153	1	2	2	2	165	3	3	2	3	tree trunk	53	*C. caffrum*	2
I54	0	0	0	0	0	4	4	2	0	bush		ground	0
I154	0	0	0	0	67	4	4	2	0	bush		*Acaccia karoo*	0

Table A9. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
J55	0	0	0	0	0	3	4	2	3	ground open		ground	0
J155	0	0	0	0	61	3	4	2	3	tree trunk	49	*Z. mucronata*	3
J56	0	0	0	0	0	3	4	3	3	ground open		ground	0
J156	0	0	0	0	185	3	4	3	3	tree canopy	10	*C. caffrum*	3
J57	0	0	0	0	50	4	4	3	2	bush		other	2
J157	0	0	0	0	218	4	4	3	2	tree trunk	51	*Z. mucronata*	2
J58	0	0	0	0	45	2	2	2	1	tree trunk	29	*C. caffrum*	1
J158	0	0	0	0	113	2	2	2	1	tree canopy	27	*C. caffrum*	2
J59	0	0	0	0	130	4	0	1	4	tree canopy		*M. heterophylla*	3
J159	0	0	0	0	188	4	0	1	4	tree trunk	13	*M. heterophylla*	3
J60	0	0	0	0	0	4	2	1	1	bush		ground	0
J160	0	0	0	0	134	4	2	1	1	bush		*M. heterophylla*	1
K61	0	0	0	0	0	4	4	3	3	ground open		ground	0
K161	0	0	0	0	214	4	4	3	3	tree trunk	67	*C. caffrum*	3
K62	1	1	1	1	167	3	3	3	3	tree canopy	13	*Z. mucronata*	4
K162	0	0	0	0	184	3	3	3	3	tree trunk	75	*C. caffrum*	4
K63	0	0	0	0	136	2	4	3	2	tree canopy	21	*C. caffrum*	3
K163	0	0	0	0	225	2	4	3	2	tree canopy	27	*C. caffrum*	3
K64	0	0	0	0	0	2	3	2	2	woody		ground	2
K164	0	0	0	0	64	2	3	2	2	woody		other	3
K65	0	0	0	0	102	4	4	3	2	tree canopy	12	*M. heterophylla*	2
K165	0	0	0	0	152	4	4	3	2	tree trunk	7	*M. heterophylla*	2
K66	0	0	0	0	0	4	4	3	1	bush		ground	0
K166	0	0	0	0	63	4	4	3	1	bush		*A. karoo*	1
L67	1	1	1	1	82	2	3	2	2	tree trunk	168	*C. caffrum*	2
L167	1	1	1	1	178	2	3	2	2	woody		*Rhus sp*	2
L68	0	0	0	0	0	4	4	3	3	woody		ground	3

Table A9. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
L168	0	0	0	0	148	4	4	3	3	tree canopy	13	*C. caffrum*	0
L69	0	0	0	0	62	4	4	3	2	tree canopy	39	*C. caffrum*	2
L169	0	0	0	0	149	4	4	3	3	tree canopy	18	*C. caffrum*	3
L70	0	0	0	0	0	4	4	3	0	ground open		*C. caffrum*	0
L170	0	0	0	0	203	4	4	3	3	tree trunk	111	*C. caffrum*	3
L71	0	0	0	0	50	4	4	3	4	tree trunk	33	*A. karoo*	1
L171	1	1	1	1	182	4	4	3	4	tree trunk	15	*A. karoo*	3
L72	0	0	0	0	0	3	3	2	3	bush		ground	1
L172	0	0	0	0	115	3	3	2	3	bush		*A. karoo*	2
M73	0	0	0	0	91	3	3	3	3	tree trunk	168	*C. caffrum*	2
M173	1	1	1	1	223	3	3	3	3	tree trunk	41	*C. caffrum*	2
M74	1	1	1	1	0	3	4	3	4	ground open		ground	0
M174	0	0	0	0	112	3	4	3	4	tree canopy	15	*Rhus sp*	3
M75	0	0	0	0	150	3	3	3	4	tree trunk	87	*C. caffrum*	4
M175	0	0	0	0	236	3	3	3	4	tree trunk	43	*M. heterophylla*	4
M76	0	0	0	0	0	4	4	2	4	ground open		ground	0
M176	1	1	1	1	95	4	4	2	4	tree trunk	72	*C. caffrum*	3
M77	1	1	1	1	132	4	2	3	4	tree canopy	23	*M. heterophylla*	3
M177	0	0	0	0	195	4	2	3	4	tree canopy	28	*M. heterophylla*	3
M78	0	0	0	0	0	4	2	1	1	bush ground		ground	2
M178	0	0	0	0	44	4	2	1	1	bush		other	2
N79	0	0	0	0	0	2	2	2	4	ground open		ground	2
N179	0	0	0	0	209	2	2	2	4	tree trunk	118	*C. caffrum*	2
N80	1	1	1	1	84	2	1	2	4	woody trunk		*Z. mucronata*	2
N180	0	0	0	0	128	2	1	2	4	woody		*Z. mucronata*	2
N81	0	0	0	0	73	1	1	2	4	woody		*Z. mucronata*	2
N181	0	0	0	0	215	1	1	2	4	tree trunk	47	*Z. mucronata*	3

Table A9. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
N82	1	2	2	2	0	0	0	1	4	woody ground		ground	2
N182	0	0	0	0	133	0	0	1	4	woody trunk		*Z. mucronata*	4
N83	0	0	0	0	101	1	1	2	4	tree canopy	9	other	4
N183	0	0	0	0	200	1	1	2	4	tree trunk	30	*A. karoo*	4
N84	0	0	0	0	0	4	2	3	3	bush ground		ground	0
N184	0	0	0	0	137	4	2	3	3	tree canopy		*M. heterophylla*	3
O85	1	2	2	2	167	4	4	3	4	tree trunk	29	*M. heterophylla*	3
O185	0	0	0	0	184	4	4	3	4	tree trunk		*M. heterophylla*	3
O86	0	0	0	0	0	4	4	3	4	ground open		ground	0
O186	0	0	0	0	167	4	4	3	4	tree trunk	66	*O. europaea*	3
O87	1	1	1	1	0	3	3	3	4	ground open		ground	0
O187	1	1	1	1	56	3	3	3	4	log	152	*C. caffrum*	1
O88	1	2	2	2	136	1	1	3	4	tree trunk	152	*C. caffrum*	3
O188	1	1	1	1	185	1	1	3	4	tree trunk	79	*C. caffrum*	3
O89	0	0	0	0	0	4	4	3	4	ground cover		ground	0
O189	0	0	0	0	74	4	4	3	4	log		other	2
O90	1	1	1	1	109	1	1	2	4	tree trunk	80	*Rhus sp*	4
O190	0	0	0	0	137	1	1	2	4	tree trunk	46	*Rhus sp*	4
P91	0	0	0	0	99	4	4	2	4	tree canopy		*M. heterophylla*	3
P191	0	0	0	0	152	4	4	2	4	tree trunk	25	*M. heterophylla*	3
P92	0	0	0	0	0	1	1	3	4	ground open		ground	0
P192	0	0	0	0	145	1	1	3	4	tree canopy		*Rhus sp*	4
P93	0	0	0	0	0	2	2	3	4	ground open		other	0
P193	0	0	0	0	190	2	2	3	4	tree canopy		*M. heterophylla*	4
P94	0	0	0	0	0	4	4	3	4	ground open		ground	3
P194	0	0	0	0	217	4	4	3	4	tree canopy	18	*C. caffrum*	3
P95	1	1	1	1	0	4	4	3	4	ground cover		ground	0

Table A9. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
P195	1	2	2	2	107	4	4	3	4	tree trunk		*M. heterophylla*	4
P96	1	1	1	1	143	3	3	3	4	tree trunk	84	*C. caffrum*	4
P196	0	0	0	0	183	3	3	3	4	tree canopy	42	*C. caffrum*	4

Table A10. Microhabitat variables measured during autumn 2012.

Trap Code	USE	ABSFREQ	NODORM	NODDORM	Height	Cover <10cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150cm	Type & Position	Circ.	Tree/bush species	Connections
A1	0	0	0	0	0	0	2	3	3	ground open		ground	3
A101	1	1	1	1	194	0	2	3	3	tree canopy		*M. heterophylla*	3
A2	0	0	0	0	68	0	1	1	2	woody		other	3
A102	1	1	1	1	101	0	1	1	2	woody		other	3
A3	0	0	0	0	0	0	0	1	4	woody		ground	4
A103	1	1	1	1	126	0	0	1	4	woody	29	*Rhus sp*	4
A4	0	0	0	0	50	0	0	3	3	tree_log	54	*C. caffrum*	4
A104	1	1	1	1	202	0	0	3	3	tree trunk	46	*Rhus sp*	4
A5	0	0	0	0	0	0	0	4	4	woody ground		ground	4
A105	0	0	0	0	161	0	0	4	4	woody		*Z. mucronata*	4
A6	0	0	0	0	76	4	4	4	3	tree trunk	27	*Rhus sp*	4
A106	0	0	0	0	191	4	4	4	3	tree trunk	27	*Rhus sp*	4
B7	0	0	0	0	133	3	3	3	1	bush	18	other	1
B107	0	0	0	0	67	3	3	3	2	tree canopy	10	*C. caffrum*	3
B8	0	0	0	0	0	0	1	1	2	woody		ground	3
B108	0	0	0	0	200	0	1	1	2	tree trunk	39	*O. europaea*	3
B9	0	0	0	0	42	4	4	3	1	bush		other	2
B109	0	0	0	0	117	4	4	3	1	bush	7	other	2
B10	0	0	0	0	0	3	3	2	3	ground open		ground	4
B110	1	1	1	1	223	3	3	2	3	tree trunk	59	*O. europaea*	4
B11	0	0	0	0	112	4	4	4	3	bush		*Rhus sp*	3
B111	1	1	1	1	203	4	4	4	3	tree trunk		*Rhus sp*	3
B12	0	0	0	0	0	4	4	3	4	ground open		ground	4
B112	1	2	2	2	134	4	4	3	4	tree trunk	26	*O. europaea*	4
C13	0	0	0	0	75	4	4	3	2	bush		other	2
C113	0	0	0	0	154	4	4	3	2	tree trunk		*C. caffrum*	2
C14	0	0	0	0	0	4	3	2	2	bush		ground	0

Table A10. Continued.

Trap Code	USE	ABSFREQ	NODORM	NODDORM	Height	Cover <10cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150cm	Type & Position	Circ.	Tree/bush species	Connections
C114	0	0	0	0	97	4	3	2	2	bush		*A. karoo*	0
C15	0	0	0	0	0	3	3	3	2	ground open		ground	0
C115	1	2	2	2	195	3	3	3	2	tree canopy	15	*O. europaea*	1
C16	0	0	0	0	46	2	3	3	4	woody	13	other	0
C116	0	0	0	0	140	2	3	3	4	tree trunk		*Rhus sp*	3
C17	0	0	0	0	0	3	3	3	4	woody		ground	0
C117	1	1	1	1	187	3	3	3	4	woody		*Rhus sp*	4
C18	0	0	0	0	84	4	4	3	4	tree trunk	31	*A. karoo*	3
C118	0	0	0	0	132	4	4	3	4	tree trunk	41	*A. karoo*	3
D19	0	0	0	0	78	4	4	2	2	woody		other	2
D119	1	1	1	1	129	4	4	2	2	woody		other	2
D20	0	0	0	0	0	4	4	3	1	ground open		ground	0
D120	0	0	0	0	236	4	4	3	1	tree trunk	49	*C. caffrum*	2
D21	0	0	0	0	81	3	3	1	1	tree trunk	20	*Rhus sp*	1
D121	0	0	0	0	140	3	3	1	1	tree canopy		*Rhus sp*	1
D22	0	0	0	0	0	4	4	2	3	ground open		ground	0
D122	0	0	0	0	177	4	4	2	3	tree canopy	19	*O. europaea*	3
D23	0	0	0	0	185	1	1	2	4	tree canopy		*M. heterophylla*	3
D123	1	2	2	2	185	1	1	2	4	tree trunk	33	*M. heterophylla*	3
D24	0	0	0	0	0	4	4	3	0	bush		ground	0
D124	0	0	0	0	89	4	4	3	0	bush	12	other	0
E25	0	0	0	0	133	2	2	4	3	tree trunk		other	4
E125	1	1	1	1	211	2	2	4	3	tree trunk	62	*O. europaea*	4
E26	1	1	1	1	97	2	2	3	1	bush		*M. heterophylla*	2
E126	0	0	0	0	144	2	2	3	1	bush		*M. heterophylla*	2
E27	0	0	0	0	0	2	2	3	4	ground open		ground	0
E127	0	0	0	0	189	2	2	3	4	tree canopy	19	*Rhus sp*	4

Table A10. Continued.

Trap Code	USE	ABSFREQ	NODORM	NODDORM	Height	Cover <10cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150cm	Type & Position	Circ.	Tree/bush species	Connections
E28	0	0	0	0	64	2	2	3	3	bush		*A. karoo*	3
E128	0	0	0	0	131	2	2	3	3	bush		*A. karoo*	3
E29	0	0	0	0	0	2	2	2	3	ground open		ground	0
E129	0	0	0	0	176	2	2	2	3	tree canopy		*O. europaea*	3
E30	0	0	0	0	0	4	4	1	0	bush		other	0
E130	0	0	0	0	67	4	4	1	0	bush		other	0
F31	0	0	0	0	96	0	2	4	4	tree trunk	49	*O. europaea*	3
F131	0	0	0	0	235	0	2	4	4	tree trunk	50	*O. europaea*	3
F32	0	0	0	0	0	0	4	3	3	ground open		ground	3
F132	0	0	0	0	115	0	4	3	3	tree trunk	36	*M. heterophylla*	3
F33	0	0	0	0	0	3	3	3	4	ground open		ground	0
F133	1	1	1	1	195	3	3	3	4	tree trunk	56	*O. europaea*	3
F34	0	0	0	0	0	0	4	3	2	bush		ground	0
F134	0	0	0	0	47	0	4	3	2	bush		other	2
F35	0	0	0	0	113	4	4	2	3	tree trunk	25	*O. europaea*	3
F135	0	0	0	0	194	4	4	2	3	tree canopy	18	*O. europaea*	3
F36	0	0	0	0	0	4	4	1	0	bush		ground	0
F136	0	0	0	0	60	4	4	1	0	bush		other	0
G37	0	0	0	0	119	0	4	3	4	tree trunk	141	*O. europaea*	4
G137	0	0	0	0	194	0	4	3	4	tree trunk	59	*O. europaea*	4
G38	0	0	0	0	134	0	4	3	4	tree canopy		ground	0
G138	0	0	0	0	0	0	4	3	4	ground open		*O. europaea*	3
G39	0	0	0	0	67	0	2	2	3	tree canopy	24	*O. europaea*	3
G139	1	1	1	1	206	0	2	2	3	tree canopy		*Z. mucronata*	3
G40	0	0	0	0	0	2	3	3	2	woody		ground	0
G140	0	0	0	0	167	2	3	3	2	tree trunk	135	*B. saligna*	2
G41	0	0	0	0	0	0	3	3	1	bush		ground	0

Table A10. Continued.

Trap Code	USE	ABSFREQ	NODORM	NODDORM	Height	Cover <10cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150cm	Type & Position	Circ.	Tree/bush species	Connections
G141	0	0	0	0	81	0	3	3	1	tree canopy		*A. karoo*	1
G42	0	0	0	0	106	2	3	3	1	bush		*M. heterophylla*	2
G142	0	0	0	0	113	2	3	3	1	bush		other	2
H43	0	0	0	0	27	0	4	2	3	tree trunk	23	*M. heterophylla*	3
H143	0	0	0	0	207	0	4	2	3	tree canopy		*M. heterophylla*	3
H44	0	0	0	0	0	1	2	2	2	ground open		ground	0
H144	0	0	0	0	38	1	2	2	2	log		other	0
H45	1	1	1	1	53	0	2	3	4	log	33	*M. heterophylla*	2
H145	0	0	0	0	179	0	2	3	4	tree trunk	34	*M. heterophylla*	4
H46	0	0	0	0	0	0	4	3	3	ground open		ground	0
H146	0	0	0	0	130	0	4	3	3	tree canopy		*A. karoo*	3
H47	0	0	0	0	126	0	0	3	4	bush		*M. heterophylla*	3
H147	1	1	1	1	179	0	0	3	4	tree trunk		*M. heterophylla*	3
H48	0	0	0	0	0	3	4	2	1	ground open		ground	0
H148	0	0	0	0	115	3	4	2	1	bush		other	0
I49	1	1	1	1	160	0	4	4	3	tree trunk	46	*A. karoo*	2
I149	0	0	0	0	192	0	4	4	3	tree canopy		*Rhus sp*	2
I50	0	0	0	0	0	1	3	3	2	bush		ground	0
I150	0	0	0	0	163	1	3	3	2	tree canopy		*C. caffrum*	2
I51	0	0	0	0	0	4	4	2	1	ground cover		ground	2
I151	0	0	0	0	94	4	4	2	1	log		*M. heterophylla*	2
I52	0	0	0	0	58	4	4	3	3	tree trunk		*A. karoo*	3
I152	0	0	0	0	108	4	4	3	3	bush		*A. karoo*	3
I53	1	1	1	1	138	1	4	4	4	tree trunk		*Rhus sp*	4
I153	0	0	0	0	165	1	4	3	3	tree trunk	53	*C. caffrum*	4
I54	0	0	0	0	0	4	1	1	0	bush		ground	0
I154	0	0	0	0	67	4	1	1	0	bush		*Acaccia karoo*	0

Table A10. Continued.

Trap Code	USE	ABSFREQ	NODORM	NODDORM	Height	Cover <10cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150cm	Type & Position	Circ.	Tree/bush species	Connections
J55	0	0	0	0	0	4	4	4	3	ground open		ground	0
J155	0	0	0	0	61	4	4	4	3	tree trunk	49	*Z. mucronata*	3
J56	0	0	0	0	0	4	4	2	3	ground open		ground	0
J156	0	0	0	0	185	4	4	2	3	tree canopy	10	*C. caffrum*	4
J57	0	0	0	0	50	4	4	4	3	bush		other	3
J157	0	0	0	0	218	4	4	3	3	tree trunk	51	*Z. mucronata*	2
J58	0	0	0	0	45	4	4	2	0	tree trunk	29	*C. caffrum*	1
J158	0	0	0	0	113	4	4	2	1	tree canopy	27	*C. caffrum*	1
J59	0	0	0	0	130	0	4	4	4	tree canopy		*M. heterophylla*	2
J159	0	0	0	0	188	0	4	4	4	tree trunk	13	*M. heterophylla*	2
J60	0	0	0	0	0	4	0	1	1	bush		ground	0
J160	0	0	0	0	134	4	0	1	1	bush		*M. heterophylla*	1
K61	0	0	0	0	0	0	4	4	3	ground open		ground	0
K161	0	0	0	0	214	0	4	4	3	tree trunk	67	*C. caffrum*	3
K62	0	0	0	0	167	0	4	2	3	tree canopy	13	*Z. mucronata*	3
K162	0	0	0	0	184	0	4	2	3	tree trunk	75	*C. caffrum*	3
K63	0	0	0	0	136	0	4	3	3	tree canopy	21	*C. caffrum*	3
K163	1	1	1	1	225	0	4	3	3	tree canopy	27	*C. caffrum*	3
K64	0	0	0	0	0	2	4	2	1	woody		ground	0
K164	0	0	0	0	64	2	4	2	1	woody		other	1
K65	0	0	0	0	102	4	4	4	2	tree canopy	12	*M. heterophylla*	2
K165	0	0	0	0	152	4	4	4	2	tree trunk	7	*M. heterophylla*	2
K66	0	0	0	0	0	4	4	2	0	bush		ground	0
K166	0	0	0	0	63	4	4	2	0	bush		*A. karoo*	0
L67	1	1	1	1	82	3	4	3	3	tree trunk	168	*C. caffrum*	3
L167	1	1	1	1	178	3	4	3	3	woody		*Rhus sp*	3
L68	0	0	0	0	0	4	4	2	3	woody		ground	0

Table A10. Continued.

Trap Code	USE	ABSFREQ	NODORM	NODDORM	Height	Cover <10cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150cm	Type & Position	Circ.	Tree/bush species	Connections
L168	0	0	0	0	148	4	4	2	3	tree canopy	13	*C. caffrum*	3
L69	0	0	0	0	62	4	4	4	3	tree canopy	39	*C. caffrum*	3
L169	0	0	0	0	149	4	4	4	3	tree canopy	18	*C. caffrum*	3
L70	0	0	0	0	0	3	4	4	3	ground open		*C. caffrum*	0
L170	0	0	0	0	203	3	4	4	3	tree trunk	111	*C. caffrum*	4
L71	0	0	0	0	50	4	4	4	4	tree trunk	33	*A. karoo*	1
L171	1	1	1	1	182	4	4	4	4	tree trunk	15	*A. karoo*	3
L72	0	0	0	0	0	4	4	2	2	bush		ground	0
L172	0	0	0	0	115	4	4	2	2	bush		*A. karoo*	2
M73	0	0	0	0	91	4	4	3	4	tree trunk	168	*C. caffrum*	4
M173	0	0	0	0	223	4	4	3	4	tree trunk	41	*C. caffrum*	4
M74	0	0	0	0	0	0	2	3	4	ground open		ground	4
M174	1	1	1	1	112	0	2	3	4	tree canopy	15	*Rhus sp*	4
M75	1	1	1	1	150	0	4	3	4	tree trunk	87	*C. caffrum*	3
M175	0	0	0	0	236	0	4	3	4	tree trunk	43	*M. heterophylla*	3
M76	0	0	0	0	0	3	4	4	3	ground open		ground	0
M176	0	0	0	0	95	3	4	4	3	tree trunk	72	*C. caffrum*	4
M77	0	0	0	0	132	0	0	2	4	tree canopy	23	*M. heterophylla*	4
M177	0	0	0	0	195	0	0	2	4	tree canopy	28	*M. heterophylla*	4
M78	0	0	0	0	0	4	2	2	0	bush ground		ground	2
M178	0	0	0	0	44	4	2	2	0	bush		other	2
N79	1	1	1	1	0	0	4	3	4	ground open		ground	0
N179	1	1	1	1	209	0	4	3	4	tree trunk	118	*C. caffrum*	4
N80	0	0	0	0	84	2	2	3	2	woody trunk		*Z. mucronata*	3
N180	1	1	1	1	128	2	2	3	2	woody		*Z. mucronata*	3
N81	1	3	3	3	73	0	0	2	4	woody		*Z. mucronata*	3
N181	0	0	0	0	215	2	2	3	2	tree trunk	47	*Z. mucronata*	3

Table A10. Continued.

Trap Code	USE	ABSFREQ	NODORM	NODDORM	Height	Cover <10cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150cm	Type & Position	Circ.	Tree/bush species	Connections
N82	1	1	1	1	0	0	0	1	4	woody ground		ground	4
N182	1	2	2	2	133	0	0	1	4	woody trunk		*Z. mucronata*	4
N83	0	0	0	0	101	0	2	3	4	tree canopy	9	other	4
N183	1	1	1	1	200	0	2	3	4	tree trunk	30	*A. karoo*	4
N84	0	0	0	0	0	4	4	3	3	bush ground		ground	0
N184	0	0	0	0	137	4	4	3	3	tree canopy		*M. heterophylla*	3
O85	1	2	2	2	167	0	4	2	4	tree trunk	29	*M. heterophylla*	4
O185	0	0	0	0	184	0	4	2	4	tree trunk		*M. heterophylla*	4
O86	0	0	0	0	0	0	3	2	4	ground open		ground	0
O186	0	0	0	0	167	0	3	2	4	tree trunk	66	*O. europaea*	4
O87	1	1	1	1	0	0	2	4	4	ground open		ground	0
O187	1	1	1	1	56	0	2	4	4	log	152	*C. caffrum*	2
O88	0	0	4	4	136	0	2	4	4	tree trunk	152	*C. caffrum*	4
O188	1	4	0	0	185	0	2	4	4	tree trunk	79	*C. caffrum*	4
O89	0	0	0	0	0	3	3	2	2	ground cover		ground	0
O189	0	0	0	0	74	3	3	2	2	log		other	2
O90	1	1	1	1	109	0	3	3	4	tree trunk	80	*Rhus sp*	4
O190	1	1	1	1	137	0	3	3	4	tree trunk	46	*Rhus sp*	4
P91	1	1	1	1	99	0	3	3	4	tree canopy		*M. heterophylla*	3
P191	0	0	0	0	152	0	3	3	4	tree trunk	25	*M. heterophylla*	3
P92	0	0	0	0	0	0	1	2	4	ground open		ground	0
P192	0	0	0	0	145	0	1	2	4	tree canopy		*Rhus sp*	2
P93	0	0	0	0	0	0	2	1	3	ground open		other	1
P193	1	2	2	2	190	0	2	1	3	tree canopy		*M. heterophylla*	4
P94	0	0	0	0	0	4	4	2	2	ground open		ground	0
P194	1	1	1	1	217	4	4	2	2	tree canopy	18	*C. caffrum*	3
P95	1	1	1	1	0	2	2	3	4	ground cover		ground	4

Table A10. Continued.

Trap Code	USE	ABSFREQ	NODORM	NODDORM	Height	Cover <10cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150cm	Type & Position	Circ.	Tree/bush species	Connections
P195	1	2	2	2	107	2	2	3	4	tree trunk		*M. heterophylla*	4
P96	1	1	1	1	143	4	4	4	4	tree trunk	84	*C. caffrum*	4
P196	1	3	3	3	183	4	4	4	4	tree canopy	42	*C. caffrum*	4

Table A11. Microhabitat variables measured during the year (winter 2011 to autumn 2012).

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
A1	1	4	4	3	0	2	2	3	4	ground open		ground	2
A101	1	2	2	2	194	2	2	3	4	tree canopy		*M. heterophylla*	3
A2	1	1	1	1	68	2	2	3	3	woody		other	3
A102	1	1	1	1	101	2	2	3	3	woody		other	3
A3	0	0	0	0	0	1	1	3	4	woody		ground	1
A103	1	4	4	4	126	1	1	3	4	woody	29	*Rhus sp*	3
A4	0	0	0	0	50	1	2	3	4	tree_log	54	*C. caffrum*	4
A104	1	1	1	1	202	1	2	3	4	tree trunk	46	*Rhus sp*	4
A5	0	0	0	0	0	2	2	4	4	woody ground		ground	2
A105	1	1	1	1	161	2	2	4	4	woody		*Z. mucronata*	4
A6	0	0	0	0	76	4	4	4	3	tree trunk	27	*Rhus sp*	3
A106	1	1	1	1	191	4	4	4	3	tree trunk	27	*Rhus sp*	3
B7	0	0	0	0	133	3	3	2	2	bush	18	other	1
B107	1	2	2	2	67	3	3	2	3	tree canopy	10	*C. caffrum*	2
B8	0	0	0	0	0	2	2	2	3	woody		ground	1
B108	0	0	0	0	200	2	2	2	3	tree trunk	39	*O. europaea*	3
B9	0	0	0	0	42	3	3	3	2	bush		other	2
B109	0	0	0	0	117	3	3	3	2	bush	7	other	2
B10	0	0	0	0	0	3	3	2	3	ground open		ground	1
B110	1	2	2	2	223	3	3	2	3	tree trunk	59	*O. europaea*	4
B11	0	0	0	0	112	2	2	3	4	bush		*Rhus sp*	3
B111	1	2	2	2	203	2	2	3	4	tree trunk		*Rhus sp*	3
B12	0	0	0	0	0	4	4	3	4	ground open		ground	3
B112	1	3	3	3	134	4	4	3	4	tree trunk	26	*O. europaea*	3
C13	0	0	0	0	75	4	3	3	2	bush		other	2
C113	1	1	1	1	154	4	3	3	2	tree trunk		*C. caffrum*	2
C14	0	0	0	0	0	4	3	2	2	bush		ground	0

Table A11. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
C114	0	0	0	0	97	4	3	2	2	bush		*A. karoo*	1
C15	0	0	0	0	0	3	3	3	2	ground open		ground	1
C115	1	2	2	2	195	3	3	3	2	tree canopy	15	*O. europaea*	2
C16	0	0	0	0	46	2	2	3	4	woody	13	other	2
C116	0	0	0	0	140	2	3	3	4	tree trunk		*Rhus sp*	3
C17	0	0	0	0	0	3	3	2	4	woody		ground	2
C117	1	4	4	4	187	3	3	2	4	woody		*Rhus sp*	4
C18	0	0	0	0	84	4	4	3	4	tree trunk	31	*A. karoo*	3
C118	0	0	0	0	132	4	4	3	4	tree trunk	41	*A. karoo*	3
D19	0	0	0	0	78	4	4	3	2	woody		other	2
D119	1	1	1	1	129	4	4	3	2	woody		other	2
D20	0	0	0	0	0	4	4	3	2	ground open		ground	0
D120	0	0	0	0	236	4	4	3	2	tree trunk	49	*C. caffrum*	2
D21	0	0	0	0	81	3	4	2	2	tree trunk	20	*Rhus sp*	2
D121	0	0	0	0	140	3	4	2	2	tree canopy		*Rhus sp*	1
D22	0	0	0	0	0	4	4	2	3	ground open		ground	1
D122	1	1	1	1	177	4	4	2	3	tree canopy	19	*O. europaea*	3
D23	0	0	0	0	185	2	3	2	4	tree canopy		*M. heterophylla*	4
D123	1	2	2	2	185	2	3	2	4	tree trunk	33	*M. heterophylla*	4
D24	0	0	0	0	0	4	4	3	1	bush		ground	0
D124	0	0	0	0	89	4	4	3	1	bush	12	other	1
E25	1	3	3	3	133	4	4	4	3	tree trunk		other	4
E125	1	1	1	1	211	4	4	4	3	tree trunk	62	*O. europaea*	4
E26	1	1	1	1	97	4	3	2	2	bush		*M. heterophylla*	2
E126	0	0	0	0	144	4	3	2	2	bush		*M. heterophylla*	2
E27	1	1	1	1	0	4	4	2	4	ground open		ground	2
E127	1	1	1	1	189	4	4	2	4	tree canopy	19	*Rhus sp*	4

Table A11. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
E28	0	0	0	0	64	3	3	3	3	bush		*A. karoo*	3
E128	1	2	2	2	131	3	3	3	3	bush		*A. karoo*	3
E29	0	0	0	0	0	2	2	2	3	ground open		ground	0
E129	0	0	0	0	176	2	2	2	3	tree canopy		*O. europaea*	3
E30	0	0	0	0	0	4	4	1	1	bush		other	0
E130	0	0	0	0	67	4	4	1	1	bush		other	0
F31	1	1	1	1	96	3	3	3	4	tree trunk	49	*O. europaea*	3
F131	0	0	0	0	235	3	3	3	4	tree trunk	50	*O. europaea*	3
F32	0	0	0	0	0	3	4	3	3	ground open		ground	1
F132	0	0	0	0	115	3	4	3	3	tree trunk	36	*M. heterophylla*	2
F33	0	0	0	0	0	4	4	3	4	ground open		ground	0
F133	1	1	1	1	195	4	4	3	4	tree trunk	56	*O. europaea*	3
F34	0	0	0	0	0	3	4	3	2	bush		ground	1
F134	0	0	0	0	47	3	4	3	2	bush		other	2
F35	0	0	0	0	113	4	4	3	3	tree trunk	25	*O. europaea*	3
F135	1	2	2	2	194	4	4	3	3	tree canopy	18	*O. europaea*	3
F36	0	0	0	0	0	4	4	3	1	bush		ground	0
F136	0	0	0	0	60	4	4	3	1	bush		other	1
G37	0	0	0	0	119	3	4	3	4	tree trunk	141	*O. europaea*	4
G137	0	0	0	0	194	3	4	3	4	tree trunk	59	*O. europaea*	4
G38	0	0	0	0	134	3	4	3	4	tree canopy		ground	1
G138	0	0	0	0	0	3	4	3	4	ground open		*O. europaea*	2
G39	0	0	0	0	67	2	2	3	3	tree canopy	24	*O. europaea*	3
G139	1	1	1	1	206	2	2	3	3	tree canopy		*Z. mucronata*	3
G40	0	0	0	0	0	3	3	3	2	woody		ground	2
G140	0	0	0	0	167	3	3	3	2	tree trunk	135	*B. saligna*	2
G41	0	0	0	0	0	3	4	2	2	bush		ground	2

Table A11. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
G141	1	2	2	2	81	3	4	2	2	tree canopy		*A. karoo*	2
G42	0	0	0	0	106	3	3	3	3	bush		*M. heterophylla*	2
G142	0	0	0	0	113	3	3	3	3	bush		other	2
H43	0	0	0	0	27	3	4	3	4	tree trunk	23	*M. heterophylla*	3
H143	0	0	0	0	207	3	4	3	4	tree canopy		*M. heterophylla*	3
H44	0	0	0	0	0	3	3	3	3	ground open		ground	0
H144	0	0	0	0	38	3	3	3	3	log		other	0
H45	1	1	1	1	53	2	3	2	4	log	33	*M. heterophylla*	3
H145	0	0	0	0	179	2	3	2	4	tree trunk	34	*M. heterophylla*	4
H46	0	0	0	0	0	3	4	2	4	ground open		ground	2
H146	0	0	0	0	130	3	4	2	4	tree canopy		*A. karoo*	3
H47	0	0	0	0	126	2	2	3	4	bush		*M. heterophylla*	4
H147	1	1	1	1	179	2	2	3	4	tree trunk		*M. heterophylla*	4
H48	0	0	0	0	0	4	3	2	1	ground open		ground	0
H148	0	0	0	0	115	4	4	2	2	bush		other	0
I49	1	1	1	1	160	2	4	3	3	tree trunk	46	*A. karoo*	2
I149	1	1	1	1	192	2	4	3	3	tree canopy		*Rhus sp*	2
I50	0	0	0	0	0	3	4	4	2	bush		ground	0
I150	0	0	0	0	163	3	4	4	2	tree canopy		*C. caffrum*	2
I51	0	0	0	0	0	4	4	2	2	ground cover		ground	2
I151	0	0	0	0	94	4	4	2	2	log		*M. heterophylla*	2
I52	0	0	0	0	58	4	4	2	3	tree trunk		*A. karoo*	3
I152	0	0	0	0	108	4	4	2	3	bush		*A. karoo*	2
I53	1	1	1	1	138	3	3	3	3	tree trunk		*Rhus sp*	3
I153	1	2	2	2	165	3	3	3	3	tree trunk	53	*C. caffrum*	3
I54	0	0	0	0	0	4	3	2	1	bush		ground	0
I154	0	0	0	0	67	4	3	2	1	bush		*Acaccia karoo*	0

Table A11. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
J55	0	0	0	0	0	4	4	3	4	ground open		ground	0
J155	0	0	0	0	61	4	4	3	4	tree trunk	49	*Z. mucronata*	2
J56	0	0	0	0	0	4	4	3	3	ground open		ground	0
J156	0	0	0	0	185	4	4	3	3	tree canopy	10	*C. caffrum*	4
J57	0	0	0	0	50	4	4	4	3	bush		other	2
J157	0	0	0	0	218	4	4	3	3	tree trunk	51	*Z. mucronata*	2
J58	0	0	0	0	45	4	4	2	2	tree trunk	29	*C. caffrum*	1
J158	0	0	0	0	113	4	4	2	2	tree canopy	27	*C. caffrum*	2
J59	0	0	0	0	130	3	3	3	3	tree canopy		*M. heterophylla*	2
J159	0	0	0	0	188	3	3	3	3	tree trunk	13	*M. heterophylla*	2
J60	0	0	0	0	0	4	2	2	1	bush		ground	0
J160	0	0	0	0	134	4	2	2	1	bush		*M. heterophylla*	1
K61	0	0	0	0	0	3	4	4	3	ground open		ground	0
K161	0	0	0	0	214	3	4	4	3	tree trunk	67	*C. caffrum*	3
K62	1	2	2	2	167	3	4	3	4	tree canopy	13	*Z. mucronata*	4
K162	1	2	2	1	184	3	4	3	4	tree trunk	75	*C. caffrum*	4
K63	0	0	0	0	136	3	4	3	3	tree canopy	21	*C. caffrum*	3
K163	1	3	3	3	225	3	4	3	3	tree canopy	27	*C. caffrum*	3
K64	0	0	0	0	0	3	4	1	2	woody		ground	2
K164	0	0	0	0	64	3	4	1	2	woody		other	2
K65	0	0	0	0	102	4	4	4	2	tree canopy	12	*M. heterophylla*	2
K165	0	0	0	0	152	4	4	4	2	tree trunk	7	*M. heterophylla*	2
K66	0	0	0	0	0	4	4	2	2	bush		ground	1
K166	0	0	0	0	63	4	4	2	2	bush		*A. karoo*	1
L67	1	2	2	2	82	3	4	2	3	tree trunk	168	*C. caffrum*	3
L167	1	3	3	3	178	3	4	2	3	woody		*Rhus sp*	3
L68	0	0	0	0	0	4	4	3	3	woody		ground	3

Table A11. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
L168	0	0	0	0	148	4	4	3	3	tree canopy	13	*C. caffrum*	3
L69	0	0	0	0	62	4	4	3	3	tree canopy	39	*C. caffrum*	3
L169	0	0	0	0	149	4	4	3	3	tree canopy	18	*C. caffrum*	3
L70	0	0	0	0	0	4	4	3	3	ground open		*C. caffrum*	0
L170	0	0	0	0	203	4	4	3	4	tree trunk	111	*C. caffrum*	4
L71	0	0	0	0	50	4	4	3	4	tree trunk	33	*A. karoo*	2
L171	1	2	2	2	182	4	4	3	4	tree trunk	15	*A. karoo*	3
L72	0	0	0	0	0	4	4	2	3	bush		ground	1
L172	0	0	0	0	115	4	4	2	3	bush		*A. karoo*	2
M73	0	0	0	0	91	4	4	4	4	tree trunk	168	*C. caffrum*	4
M173	1	1	1	1	223	4	4	4	4	tree trunk	41	*C. caffrum*	4
M74	1	1	1	1	0	4	4	3	4	ground open		ground	1
M174	1	2	2	2	112	3	4	3	4	tree canopy	15	*Rhus sp*	3
M75	1	3	3	2	150	3	4	3	4	tree trunk	87	*C. caffrum*	4
M175	0	0	0	0	236	3	4	3	4	tree trunk	43	*M. heterophylla*	4
M76	0	0	0	0	0	4	4	3	4	ground open		ground	0
M176	1	2	2	2	95	4	4	3	4	tree trunk	72	*C. caffrum*	3
M77	1	2	1	1	132	3	3	2	4	tree canopy	23	*M. heterophylla*	3
M177	0	0	0	0	195	3	3	2	4	tree canopy	28	*M. heterophylla*	3
M78	0	0	0	0	0	4	3	2	2	bush ground		ground	2
M178	0	0	0	0	44	4	3	2	2	bush		other	2
N79	1	1	1	1	0	3	3	3	4	ground open		ground	2
N179	1	1	1	1	209	3	3	3	4	tree trunk	118	*C. caffrum*	3
N80	1	1	1	1	84	3	2	2	3	woody trunk		*Z. mucronata*	3
N180	1	1	1	1	128	3	2	2	3	woody		*Z. mucronata*	3
N81	1	3	3	3	73	1	1	2	3	woody		*Z. mucronata*	3
N181	0	0	0	0	215	2	2	2	3	tree trunk	47	*Z. mucronata*	3

Table A11. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
N82	1	3	3	2	0	0	0	1	3	woody ground		ground	3
N182	1	2	2	2	133	0	0	1	3	woody trunk		*Z. mucronata*	3
N83	1	1	1	1	101	2	2	3	4	tree canopy	9	other	4
N183	1	2	2	2	200	2	2	3	4	tree trunk	30	*A. karoo*	4
N84	0	0	0	0	0	4	4	3	3	bush ground		ground	1
N184	0	0	0	0	137	4	4	3	3	tree canopy		*M. heterophylla*	3
O85	1	4	4	4	167	3	4	3	4	tree trunk	29	*M. heterophylla*	3
O185	0	0	0	0	184	3	4	3	4	tree trunk		*M. heterophylla*	2
O86	0	0	0	0	0	3	3	3	4	ground open		ground	1
O186	0	0	0	0	167	3	3	3	4	tree trunk	66	*O. europaea*	3
O87	1	2	2	2	0	2	3	3	4	ground open		ground	1
O187	1	3	3	2	56	2	3	3	4	log	152	*C. caffrum*	3
O88	1	2	6	5	136	2	2	4	4	tree trunk	152	*C. caffrum*	4
O188	1	5	1	1	185	2	2	4	4	tree trunk	79	*C. caffrum*	4
O89	0	0	0	0	0	4	4	3	3	ground cover		ground	1
O189	0	0	0	0	74	4	4	3	3	log		other	2
O90	1	4	4	3	109	1	2	3	4	tree trunk	80	*Rhus sp*	3
O190	1	1	1	1	137	1	2	3	4	tree trunk	46	*Rhus sp*	4
P91	1	1	1	1	99	3	4	2	3	tree canopy		*M. heterophylla*	3
P191	0	0	0	0	152	3	4	2	3	tree trunk	25	*M. heterophylla*	3
P92	0	0	0	0	0	1	1	2	4	ground open		ground	1
P192	0	0	0	0	145	1	1	2	4	tree canopy		*Rhus sp*	3
P93	0	0	0	0	0	2	3	3	4	ground open		other	2
P193	1	2	2	2	190	2	3	3	4	tree canopy		*M. heterophylla*	3
P94	0	0	0	0	0	4	4	3	3	ground open		ground	2
P194	1	1	1	1	217	4	4	3	3	tree canopy	18	*C. caffrum*	2
P95	1	2	2	2	0	2	2	3	4	ground cover		ground	2

Table A11. Continued.

Trap code	USE	ABSFREQ	NODORM	NODDORM	Height [cm]	Cover <10 cm	Cover 10–50 cm	Cover 50–150 cm	Cover >150 cm	Type & Position	Circ. [cm]	Tree/bush species	Connections
P195	1	4	4	3	107	2	2	3	4	tree trunk		*M. heterophylla*	3
P96	1	2	2	2	143	3	3	3	4	tree trunk	84	*C. caffrum*	4
P196	1	3	3	3	183	3	3	3	4	tree canopy	42	*C. caffrum*	3

Table A12. List of raw data for the trapping events of woodland dormice between June 2011 to April 2012. M= Male, F = Female, P = perforated, N-P = non-perforated, S = scrotal, N-S = non-scrotal, JUV = juvenile.

DATE	SEASON	ANIMAL	SEX	CONDITION	RETRAP	CODE	SOIL	WIND	WEATHER	TEMP	M/E	POINT/REMARK
19.06.11	Winter	W73	F	N-P	YES	A1	DRY		CLEAR		E	On the ground
20.06.11	Winter	W73	F	N-P	YES	A1	—	—	—	—	M	On the ground
21.06.11	Winter	W73	F	N-P	YES	C117	—	—	—	—	M	2 m
22.06.11	Winter	W73	F	N-P	YES	A103	—	—	—	—	M	1.5 m
23.06.11	Winter	W54	M	N-S	YES	M75	DRY	SLIGHT	—	12°C	M	—
15.09.11	Spring	B28	M	N-S	YES	K163	DRY	MEDIUM	C90	17°C	M	—
15.09.11	Spring	W45	F	N-P	YES	O90	DRY	MEDIUM	C90	17°C	M	—
16.09.11	Spring	W51	F	N-P	YES	A2	—	—	—	—	M	—
16.09.11	Spring	W73	F	N-P	YES	A105	—	—	—	—	M	—
16.09.11	Spring	W71	F	N-P	YES	E25	—	—	—	—	M	—
16.09.11	Spring	W43	F	N-P	YES	K163	—	—	—	—	M	—
16.09.11	Spring	W44	F	N-P	YES	M174	—	—	—	—	M	—
16.09.11	Spring	B28	M	N-S	YES	M176	—	—	—	—	M	—
17.09.11	Spring	W51	F	N-P	YES	A1	—	—	—	—	M	—
17.09.11	Spring	B28	M	N-S	YES	K162	—	—	—	—	M	—
17.09.11	Spring	W43	F	N-P	YES	N83	—	—	—	—	M	—
17.09.11	Spring	W44	F	N-P	YES	M75	—	—	—	—	M	—
17.09.11	Spring	W43	F	N-P	YES	N183	—	—	—	—	E	—
18.09.11	Spring	W73	F	N-P	YES	F135	DRY	MEDIUM	SUNNY	—	M	—
18.09.11	Spring	W43	F	N-P	YES	K62	—	—	—	—	M	—
18.09.11	Spring	B28	M	N-S	YES	K162	—	—	—	—	M	—
18.09.11	Spring	W44	F	N-P	YES	O187	—	—	—	—	M	—
19.09.11	Spring	W61	M	N-S	YES	B112	DRY	MEDIUM	C20	—	M	—
19.09.11	Spring	W71	F	N-P	YES	E27	DRY	MEDIUM	C20	—	M	—
19.09.11	Spring	W43	F	N-P	YES	L167	DRY	MEDIUM	C20	—	M	—
19.09.11	Spring	B28	M	N-S	YES	M77	DRY	MEDIUM	C20	—	M	—

Table A12. Continued

DATE	SEASON	ANIMAL	SEX	CONDITION	RETRAP	CODE	SOIL	WIND	WEATHER	TEMP	M/E	POINT/REMARK
19.09.11	Spring	W44	F	N-P	YES	O90	DRY	MEDIUM	C20	—	M	—
19.09.11	Spring	W61	M	N-S	YES	A106	DRY	MEDIUM	C20	—	E	—
26.01.12	Summer	G0	M	JUV	YES	C117	—	—	—	—	M	—
26.01.12	Summer	G1	M	N-S	NO	E25	—	—	—	—	M	Might be related to G5
26.01.12	Summer	G2	M	N-S	NO	M77	—	—	—	—	M	—
26.01.12	Summer	W44	F	N-P	YES	N80	—	—	—	—	M	—
26.01.12	Summer	B28	M	S	YES	M74	—	—	—	—	M	—
26.01.12	Summer	G3	M	N-S	NO	O187	—	—	—	—	M	—
27.01.12	Summer	W65	M		YES	B107	—	—	—	—	M	—
27.01.12	Summer	W51	M	S	YES	A101	—	—	—	—	M	—
27.01.12	Summer	G0	M	JUV	YES	A103	—	—	—	—	M	—
27.01.12	Summer	G4	M	JUV	NO	B111	—	—	—	—	M	—
27.01.12	Summer	G5	F	JUV	NO	E25	—	—	—	—	M	—
27.01.12	Summer	W65	M		YES	E127	—	—	—	—	M	—
27.01.12	Summer	G0	M	JUV	YES	E128	—	—	—	—	M	—
27.01.12	Summer	G6	M	N-S	NO	I153	—	—	—	—	M	—
27.01.12	Summer	G7	M	N-S	NO	I149	—	—	—	—	M	—
27.01.12	Summer	G2	M		YES	L171	—	—	—	—	M	Retrap from yday
27.01.12	Summer	W44	F	N-P	YES	P96	—	—	—	—	M	—
27.01.12	Summer	G3	M	JUV	YES	P95	—	—	—	—	M	Retrap from yday
28.01.12	Summer	G8	F		NO	A103	—	—	—	—	M	—
28.01.12	Summer	W65	M		YES	C117	—	—	—	—	M	—
28.01.12	Summer	W7	M	N-S	YES	E128	—	—	—	—	M	—
28.01.12	Summer	G5	F	N-P	YES	D122	—	—	—	—	M	—
28.01.12	Summer	G7	M	N-S	YES	I153	—	—	—	—	M	66 OR 67
28.01.12	Summer	G2	M	N-S	YES	L167	—	—	—	—	M	63 OR 62
28.01.12	Summer	W80	F	N-P	NO	O85	—	—	—	—	M	Tail very short

Table A12. Continued

DATE	SEASON	ANIMAL	SEX	CONDITION	RETRAP	CODE	SOIL	WIND	WEATHER	TEMP	M/E	POINT/REMARK
28.01.12	Summer	G3	M	JUV	YES	O90	—	—	—	—	M	—
28.01.12	Summer	W44	F	NIPPLES	YES	N82	—	—	—	—	M	—
28.01.12	Summer	Gx	M	N-S	YES	O88	—	—	—	—	M	—
29.01.12	Summer	G8	F		YES	C113	—	—	—	—	M	—
29.01.12	Summer	W51	M		YES	B110	—	—	—	—	M	—
29.01.12	Summer	W65	M		YES	F135	—	—	—	—	M	—
29.01.12	Summer	G5	F	N-P	YES	G141	—	—	—	—	M	Short tail green
29.01.12	Summer	B28	M	S	YES	O85	—	—	—	—	M	
29.01.12	Summer	W44	F	N-P	YES	P195	—	—	—	—	M	Tail just cut
29.01.12	Summer	W81	M	N-S	NO	O87	—	—	—	—	M	
30.01.12	Summer	G9	M		NO	A1	—	—	—	—	M	
30.01.12	Summer	Gx1			YES	B107	—	—	—	—	M	Short tail
30.01.12	Summer	Gx2	M	N-S	YES	F31	—	—	—	—	M	—
30.01.12	Summer	Gx3	M	S	YES	G141	—	—	—	—	M	—
30.01.12	Summer	Gx	M	N-S	YES	P195	—	—	—	—	M	—
30.01.12	Summer	B28	M	S	YES	O188	—	—	—	—	M	—
30.01.12	Summer	W44	F	N-P	YES	O88	—	—	—	—	M	—
30.01.12	Summer	G2	M		YES	N82	—	—	—	—	M	—
30.01.12	Summer	Gxx			YES	M176	—	—	—	—	M	—
30.01.12	Summer	G11	M	JUV	NO	M173	—	—	—	—	M	—
30.01.12	Summer	W65	M		YES	L67	—	—	—	—	M	—
30.01.12	Summer	B51	M		YES	K62	—	—	—	—	M	—
18.04.12	Autumn	G5	F	N-P	YES	A103	DRY	SLIGHT	OVERCAST	—	M	Short tail
18.04.12	Autumn	G1	M	N-S	YES	B110	DRY	SLIGHT	OVERCAST	—	M	—
18.04.12	Autumn	G0	F	N-P	YES	B111	DRY	SLIGHT	OVERCAST	—	M	—
18.04.12	Autumn	G8	F	N-P	YES	I53	DRY	SLIGHT	OVERCAST	—	M	—
18.04.12	Autumn	G11	F	N-P	YES	M174	DRY	SLIGHT	OVERCAST	—	M	—

Table A12. Continued

DATE	SEASON	ANIMAL	SEX	CONDITION	RETRAP	CODE	SOIL	WIND	WEATHER	TEMP	M/E	POINT/REMARK
18.04.12	Autumn	W44	F	N-P	YES	M75	DRY	SLIGHT	OVERCAST	—	M	Short tail
18.04.12	Autumn	G3	M	N-S	YES	P91	DRY	SLIGHT	OVERCAST	—	M	—
18.04.12	Autumn	W65	M	N-S	YES	P193	DRY	SLIGHT	OVERCAST	—	M	—
18.04.12	Autumn	G2	M	N-P	YES	O88	DRY	SLIGHT	OVERCAST	—	M	—
19.04.12	Autumn	G1	M	N-S	YES	C117	—	—	—	—	M	—
19.04.12	Autumn	G0	F	N-P	YES	B112	—	—	—	—	M	—
19.04.12	Autumn	G5	F	N-P	YES	E26	—	—	—	—	M	—
19.04.12	Autumn	G8	F	N-P	YES	G139	—	—	—	—	M	—
19.04.12	Autumn	G2	M	N-P	YES	N182	—	—	—	—	M	—
19.04.12	Autumn	W44	F	N-P	YES	P195	—	—	—	—	M	—
19.04.12	Autumn	W81/61	M	N-S	YES	N81	—	—	—	—	M	—
19.04.12	Autumn	G13	M	N-S	YES	O85	—	—	—	—	M	—
19.04.12	Autumn	G6	F	N-P	YES	O88	—	—	—	—	M	—
19.04.12	Autumn	G3	M	N-P	YES	P96	—	—	—	—	M	—
20.04.12	Autumn	G5	F	N-P	YES	A102	—	—	—	—	M	—
20.04.12	Autumn	G1	M	N-S	YES	B112	—	—	—	—	M	—
20.04.12	Autumn	G8	F	N-P	YES	H45	—	—	—	—	M	—
20.04.12	Autumn	G6	F	N-P	YES	L67	—	—	—	—	M	—
20.04.12	Autumn	W44	F	N-P	YES	N182	—	—	—	—	M	—
20.04.12	Autumn	W65	M	N-S	YES	P194	—	—	—	—	M	—
21.04.12	Autumn	G0	F	N-P	YES	A101	—	—	—	—	M	—
21.04.12	Autumn	G5	F	N-P	YES	D123	—	—	—	—	M	—
21.04.12	Autumn	G11	F	N-P	YES	N180	—	—	—	—	M	—
21.04.12	Autumn	G8	F	N-P	YES	N81	—	—	—	—	M	—
21.04.12	Autumn	W44	F	N-P	YES	O88	—	—	—	—	M	—
21.04.12	Autumn	G3	M	N-P	YES	O90	—	—	—	—	M	—
21.04.12	Autumn	G0	F	N-P	YES	A104	—	—	—	—	M	—

Table A12. Continued

DATE	SEASON	ANIMAL	SEX	CONDITION	RETRAP	CODE	SOIL	WIND	WEATHER	TEMP	M/E	POINT/REMARK
22.04.12	Autumn	G5	F	N-P	YES	D119	—	—	—	—	M	—
22.04.12	Autumn	G8	F	N-P	YES	I49	—	—	—	—	M	—
22.04.12	Autumn	G11	F	N-P	YES	N79	—	—	—	—	M	—
22.04.12	Autumn	G6	F	N-P	YES	N183	—	—	—	—	M	—
22.04.12	Autumn	W44	F	N-P	YES	O190	—	—	—	—	M	—
22.04.12	Autumn	G40	F	N-P	YES	P196	—	—	—	—	M	—
22.04.12	Autumn	G2	M	N-S	YES	P95	—	—	—	—	M	Ground
22.04.12	Autumn	G3	M	N-P	YES	P195	—	—	—	—	M	—
22.04.12	Autumn	W65	M	N-S	YES	O88	—	—	—	—	M	—

Table A.13. Parameter estimates of the GzLM procedure aiming at testing the effects of arboreal connections and height at which the trap was placed, on the use (dependent variable USE) of the traps by woodland dormice.

Parameters	**B**	**SE**	χ^2	***df***	***p***
(Intercept)	0.101	0.6207	0.026	1	0.871
$Connections_0$	–22.714	17314.7610	<0.001	1	0.999
$Connections_1$	–2.632	0.9072	8.419	1	**0.004**
$Connections_2$	–1.537	0.5486	7.850	1	**0.005**
$Connections_3$	–2.76	0.4772	0.334	1	0.563
$Connections_4$	0[a]	—	—	—	—
Height	0.003	1.249	1.249	1	0.264
(Scale)	1[b]				

Categories considered were: 0 = no connections, 1 = 1–25% connections, 2 = 26–50% connections, 3 = 51–75% connections, 4 = 76–100% connections.
[a]Hessian matrix singularity is caused by this parameter. The parameter estimates at the last iteration is displayed.
[b]Set to zero because this parameter is redundant.

Table A.14. Parameter estimates of the GzLM procedure aiming at testing the effects of arboreal connections and "grass" cover on how frequently (dependent variable ABSFREQ) woodland dormice used the traps.

Parameters	**B**	**SE**	χ^2	***df***	***p***
(Intercept)	–28.608	0.8479	1138.411	1	**<0.001**
$Connections_4$	29.611	0.6240	2254.027	1	**<0.001**
$Connections_3$	29.524	0.6074	2362.816	1	**<0.001**
$Connections_2$	28.561	0.6373	2008.688	1	**<0.001**
$Connections_1$	27.473[a]	—	—	—	—
$Connections_0$	0[b]	—	—	—	—
Cover <10 cm_4	–1.336	0.6405	4.353	1	**<0.001**
Cover <10 cm_3	–0.801	0.6200	1.669	1	**<0.001**
Cover <10 cm_2	–0.526	0.6290	0.669	1	**<0.001**
Cover <10 cm_1	–0.376	0.6881	0.298	1	**<0.001**
Cover <10 cm_0	0[b]	—	—	—	—
(Scale)	1[c]				
Negative Binomial	0.3[c]				

Categories considered were: 0 = no connections, 1 = 1–25% connections, 2 = 26–50% connections, 3 = 51–75% connections, 4 = 76–100% connections.
[a]Hessian matrix singularity is caused by this parameter. The parameter estimates at the last iteration is displayed.
[b]Set to zero because this parameter is redundant.
[c]Fixed at the displayed value.

Table A.15. Parameter estimates of the GzLM procedure aiming at testing the effects of arboreal connections on the number of woodland dormice (dependent variable NODORM) that used the traps.

Parameters	**B**	**SE**	χ^2	***df***	***p***
(Intercept)	–29.743	0.5951	2497.868	1	**<0.001**
$Connections_4$	29.987	0.6312	2256.863	1	**<0.001**
$Connections_3$	29.875	0.6129	2375.722	1	**<0.001**
$Connections_2$	28.750	0.6430	1999.302	1	**<0.001**
$Connections_1$	27.664	—	—	—	—
$Connections_0$	0[b]	—	—	—	—
(Scale)	1[c]				
Negative Binomial	0.5[c]				

Categories considered were: 0 = no connections, 1 = 1–25% connections, 2 = 26–50% connections, 3 = 51–75% connections, 4 = 76–100% connections.
[a]Hessian matrix singularity is caused by this parameter. The parameter estimates at the last iteration is displayed.
[b]Set to zero because this parameter is redundant.
[c]Fixed at the displayed value.

Table A.16. Parameter estimates of the GzLM procedure aiming at testing the effects of arboreal connections on the number of different woodland dormice (dependent variable (NODDORM) that used the traps.

Parameters	**B**	**SE**	χ^2	***df***	***P***
(Intercept)	–29.723	0.5951	2494.459	1	**<0.001**
$Connections_4$	29.882	0.6331	2227.772	1	**<0.001**
$Connections_3$	29.798	0.6136	2358.560	1	**<0.001**
$Connections_2$	28.678	0.6450	1976.773	1	**<0.001**
$Connections_1$	27.644	—	—	—	—
$Connections_0$	0[b]	—	—	—	—
(Scale)	1[c]				
Negative Binomial	0.5[c]				

Categories considered were: 0 = no connections, 1 = 1–25% connections, 2 = 26–50% connections, 3 = 51–75% connections, 4 = 76–100% connections.
[a]Hessian matrix singularity is caused by this parameter. The parameter estimates at the last iteration is displayed.
[b]Set to zero because this parameter is redundant.
[c]Fixed at the displayed value.