



HABITAT SELECTION OF *Marmosops incanus* (LUND, 1841) (DIDELPHIMORPHIA, DIDELPHIDAE) IN THE SERRA DOS ÓRGÃOS NATIONAL PARK, ATLANTIC FOREST, SOUTHEAST BRAZIL

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Abstract: Habitat selection is one of the mechanisms responsible for allowing species coexistence and, therefore, local richness of communities. This study investigates microhabitat selection by the opossum, *Marmosops incanus*, in a forested area in the Brazilian Atlantic Forest. We measured microhabitat variables related to vegetation structure and inferred *M. incanus* abundance as a measure of habitat use. Eight microhabitat variables were measured in each trap station: litter, herbaceous and woody stems, rock outcropping, canopy cover, foliar vertical obstruction at three heights (FOV), and number of fallen trunks. Based on a correlation matrix, we selected four microhabitat variables (litter, rock outcropping cover, FOV, and number of fallen trunks) and performed a Poisson regression using the selected variables and *M. incanus* abundance. Litter and rock outcropping cover were positively related to abundance, thus representing the habitat characteristics selected by the species. We infer that litter represents a source of food items, since it can support an abundant fauna of macroinvertebrates, especially arthropods. Rock outcroppings can be used as shelter and protection against predators. Other studies have recorded *M. incanus* using habitat in a unique way, either by changing the frequency of ground/understory use, or habitats with high/few herbaceous and litter cover, as the habitat varied from restinga to fragmented forests. Different habitat selection patterns were observed in areas where *M. incanus* and *M. paulensis* are sympatric, or *Gracilinanus microtarsus*, both of which have comparable size and ecology. We suppose the selection patterns recorded in this study are a result of the absence of a congener species in the study area. It may allow *M. incanus* to use more frequently areas where near-ground strata are clear and highly covered with litter. It remains to be evaluated if habitat simplification leads to behavior homogenization.

Keywords: habitat use; mark-recapture; montane forest; small mammals; scansorial.

INTRODUCTION

Brazil is known as a megadiverse country (Mittermeier *et al.* 2005) and the Brazilian Atlantic Forest harbors great mammalian diversity and endemism (Paglia *et al.* 2012). Marsupials and small rodents are the most diverse ecological group of mammals in the Brazilian Atlantic Forest (Figueiredo *et al.* 2021). These species display wide

body size range (~5 g – 2 kg; Paglia *et al.* 2012), as well as locomotor (*e.g.*, terrestrial, arboreal and scansorial; Cunha & Vieira 2002, Paglia *et al.* 2012) and food habits (*e.g.*, omnivorous, frugivorous and insectivorous; Astúa *et al.* 2003, Lessa & Geise 2010). Overall, small mammals are considered a good study model because of its relatively small body size, short generation time, high fecundity, easy capturability, high relative abundance, and species diversity

(Gentile & Kajin 2015). In the group, it is common to find sympatric species with a high degree of morphological and behavior specialization (Dalloz *et al.* 2012), and others with high physiological and morphological convergences (McNab 1966, Schmitt & Lemelin 2002). The scale of space use and habitat selection allow their study to be well-succeeded with small-scale effort (space and time) in comparison with the study of medium to large-sized mammals. Yet, it is required great field effort to reach a minimum number of captured/monitored individuals, because capture success is low (Loretto e Vieira 2023, but also see Bovendorp *et al.* 2017). If the results described for these small mammals are widespread at broader scales, among populations and communities, we can repeat experiments and describe generalities for species at different study scales.

The basis for species richness distribution patterns is partially explained by processes that lead to species coexistence (Ødegaard 2000, Ellwood & Foster 2004). Several studies on Neotropical mammals have emphasized that habitat complexity (Cunha & Vieira 2002, Mena & Medellín 2017) and habitat heterogeneity (Carmignotto *et al.* 2022), as well as morphology, diet, and foraging behavior (Corbalán 2006) could explain species richness in local and regional scales (Figure 1). Habitat selection, the process by which

individuals of a species use certain patches of habitat on a non-random basis (Oatway & Morris 2007), may also enable species coexistence in local scale (Rosenzweig 1981, Sponchiado *et al.* 2012). Character displacement and, eventually, species diversification are frequently mediated by habitat and its selection process (Morris 2003), through different mechanisms, such as disruptive selection or ideal free distribution (Rosenzweig 1985). Thus, habitat selection influences spatial distribution of populations, reducing the effects of interspecific interactions, through differential habitat use (Morris 2003, Melo *et al.* 2013), for example, density-dependent selection (Oatway & Morris 2007) and seasonal habitat shifts (Hodara *et al.* 2000), by the selection of sub-optimal habitats. Such selection encompasses all the processes leading to biased differential habitat use, not only between species, but also individuals and phenotypes (Morris 2003). These processes lead individuals to maximize their fitness (Fretwell & Lucas 1969) and it can be named as use, choice, or preference, among other names found in literature (*e.g.*, Hall *et al.* 1997, Garshelis 2000, Frid 2001, Ferreira 2009).

Habitat use patterns can be influenced by study's scale and mobility of species (Leiner *et al.* 2010, Schweiger *et al.* 2021). In this study, we defined only microhabitat scale, which is the immediate habitat to an organism, *i.e.* habitat features in a small

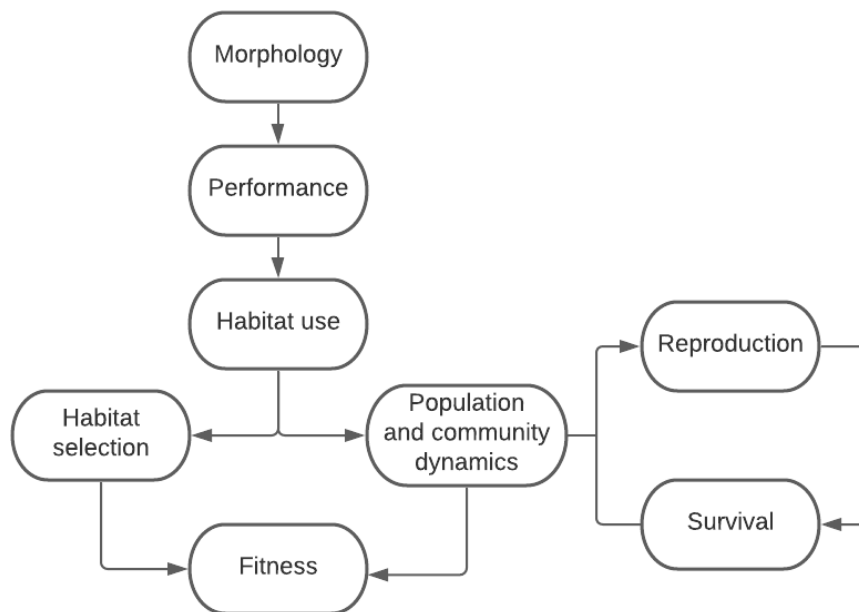


Figure 1. Relations between morphology and ecology, including habitat use and selection and its relations with population and community dynamics and individual fitness (adapted from Delciellos *et al.* 2006; and Ricklefs & Donald, 1994).

spatial scale, inside its home range (Jorgensen 2004). However, this term has a relevant temporal component, since the structures quantified can change in a brief time scale, even between trapping sessions. Moura *et al.* (2005) argue that the most appropriate scale for the assessment of habitat selection depends on body size and behavior. Jorgensen & Demar (1999) found that selection of small mammals occurs at larger scales, suggesting that the partitioning of microhabitats is limited by little known factors that act in the macrohabitat scale.

In Neotropical small mammals, the availability of resources may influence population abundance (Gentile *et al.* 2004) and affect patterns of habitat selection (Corrêa *et al.* 2018). Frugivory is frequently related to vertical stratification in didelphid marsupials: species that use the canopy are mostly frugivorous and as the movement habits become more terrestrial, species become carnivorous/insectivorous (Fowler 1981, Atramentowicz 1982, Cunha & Vieira 2002). In the continuum of diets, the marsupial *Marmosops incanus* is considered insectivore-omnivore (Astúa *et al.* 2003), thus, the species lies somewhere between both extremes (terrestrial-arboreal / frugivorous-carnivorous/insectivorous).

The study of habitat selection of didelphid marsupials is commonly related to local availability and food habits overlap among sympatric species (Freitas *et al.* 1997). Except for strictly terrestrial and strictly arboreal species, there is a *continuum* in the use of forest strata between sympatric species in the study area, and *M. incanus* is considered scansorial (Cunha & Vieira 2002). These authors emphasized that *M. incanus* “moved predominantly in the understory, occasionally on the ground, but never reached the canopy”. On the other hand, Loretto & Vieira (2008) found that ~70% of the species movements occurred on the ground and 30% in the understory, as observed by Passamani & Rosa (2015).

It is fair to state that when there is a correlation between habitat variables, resource and habitat use, and species occurrence, we can assume species preference, i.e., selection of a resource more than its relative frequency in nature (*e.g.*, Moura *et al.* 2005, Vieira *et al.* 2005). Thus, our objective was to investigate habitat selection at the microhabitat scale by the marsupial *Marmosops incanus* in the

Atlantic Forest of the Serra dos Órgãos National Park, Rio de Janeiro state, Brazil. We assumed that each microhabitat variable should (i) provide an structural measure of the environment known or suspected to influence the local distribution and abundance of small mammals, (ii) be measured in a quick, accurate and non-destructive manner, so it does not negatively influence the habitat itself, (iii) have smaller intraseasonal variation in relation to interseasonal variation and (iv) describe the environment in the immediate vicinity of the capture station (as defined by Dueser & Shugart Jr. 1978, Freitas *et al.* 2002). Considering the ecology and behavior of *M. incanus*, we expect (1) a high occurrence frequency in microhabitats with a higher presence of litterfall, and (2) high structural complexity of the understory, as suggested for the genus at other site in the Atlantic Forest (Leiner *et al.* 2010).

MATERIAL AND METHODS

Studied species

The slender mouse opossum, *Marmosops incanus* (Lund, 1840), is a small (72 g for males and 48 g for females; Macedo *et al.* 2007), nocturnal, insectivorous-omnivorous marsupial (Paglia *et al.* 2012). Its geographical distribution ranges from the state of Paraná to northern Bahia (Costa & Patton 2006), including few records in the biomes of Cerrado (*stricto sensu*) and Caatinga (Câmara *et al.* 2003). Therefore, its distribution covers evergreen forests, deciduous and semideciduous forests (Mustrangi & Patton 1997). *Marmosops incanus* and *M. paulensis* are sympatric and, in some sites, syntopic (Bezerra & Geise 2015), but the latter is mostly found above 800 m a.s.l. (Mustrangi & Patton 1997). In the study area *M. paulensis* is not present.

The species is scansorial, exploring the lowest forest stratum, the floor, and mostly the understory (Cunha & Vieira 2002, Loretto & Vieira 2008). There is evidence of territoriality in the *M. paulensis* (Leiner & Silva 2009) and it may also be a characteristic of *M. incanus*. Many species and genus of small didelphid marsupials are semelparous (Zangrandi & Vieira 2022), and that is the reason why individuals are not trapped within two subsequent breeding seasons, which occurred from October to February (Macedo 2007).

Study area and data collection

The monitoring study was conducted from February 1998 to December 2007 (11 years) in the Serra dos Órgãos National Park, municipality of Guapimirim, state of Rio de Janeiro, southern Brazil, in a mountainside locality known as Garrafão (22°28'28" S, 42°59'86" W; ca. 650 m a.s.l.). The terrain is steep, and the study area is in the Iconha river valley (Rocha 2007). The vegetation is classified as dense evergreen montane forest ("*Floresta Ombrófila Densa Montana*"; IBGE 2012). The canopy is not dense, due to the frequent absence of tree crowns caused by the terrain slope. Lianas, vines, palms, epiphytes (especially bromeliads) and ferns are common. Part of grid B (see details below) are also dominated by bamboos. Currently, the area is surrounded by vacation homes which can have some influence on the structure and composition of the forest (Macedo *et al.* 2007).

The weather is mesothermic (Nimer 1989), super-humid from October to March (average 254.5 ± 115.3 mm) and humid otherwise. June, July, and August were the less humid months (37.4 ± 33.7 mm), and periods of real hydric deficit, as defined by Walter (1986), are unlikely. During the study, the minimum and maximum mean monthly temperature were 15.7 and 24.9 °C, respectively, and monthly rainfall varied from 0.2 to 508 mm (INMET, Teresópolis, RJ). Graphic details on climatic data can be found in Loretto & Vieira (2005).

Small mammals sampling

Trapping data are part of a long-term capture-recapture study on small mammals populations started in 1997 (see details in Gentile *et al.* 2004). Sampling grids were established based on the random arrangement of sampling stations (Price & Kramer 1984), and trapping campaigns occurred simultaneously at three sampling grids named A, B and C (748 m, 652 m, and 522 m a.s.l., respectively). Each grid had 25 trap stations, 20 m apart, set in a 5 x 5 design, totaling 0.64 ha each. Spatial details on the sampling grids can be found elsewhere (Macedo *et al.* 2007).

At each trap station, two live traps were placed on the forest floor: a Sherman (model XLK, 7.64 x 9.53 x 30.48 cm; H.B. Sherman Traps, Tallahassee, Florida) and a Tomahawk (model 201, 40.64 x 12.70 x 12.70 cm; Tomahawk Live Trap Co., Tomahawk,

Wisconsin). Both traps were baited with a mixture of mashed bananas, peanut butter, oatmeal and bacon and Tomahawks were baited with additional slices of meat and bacon. Trapping sessions were performed bimonthly for five consecutive nights, during which each trap was daily checked and rebaited. Captured individuals received two ear tags (model 1005-1, National Band and Tag Co., Newport, Kentucky), one in each ear, for individual identification. Sex, trap station and model, head-body and tail length, presence of ectoparasites, reproductive condition, tooth eruption sequence (following Macedo *et al.* 2006) and general observations were recorded. Individuals were released in the same trap station they were captured.

Microhabitat measurements

Microhabitat measurements were registered in each trap station during trapping sessions (Murúa *et al.* 1996), following a quantitative method developed in the study area (Cerqueira & Freitas 1999, Freitas *et al.* 2002). We measured eight microhabitat variables to describe habitat structure (mostly related to vegetation): litter cover (LIT), herbaceous and woody stem cover (HWS), rock outcropping cover (ROC), canopy cover (CAN), foliar vertical obstruction (leaves and branches) in three heights – from 0 to 0.5 m (FVO1), 0.5-1 m (FVO2) and 1-1.5 m (FVO3) – and number of fallen trunks (TRU). Variables were described as percentages, except TRU, which is a numeric score.

Each trap station had four lateral visual marks (vertices of a square) established 3 m away from its center, each one aligned with the cardinal points. We used a 0.25 m² square wooden frame (0.50 x 0.50 m) to take each of the measures (Freitas *et al.* 2002). The observer measured LIT, ROC, and CAN at each of the four visual marks of each trap station and the center by holding the frame parallel to the ground near his knees. LIT and ROC are complementary variables, their sum must equal 100% after bare ground are included. CAN was measured holding the frame horizontally above the observer's head. FVO1, 2 and 3 were measured with the frame held vertically at three heights, pointing from the center of the trap station to each visual mark (Freitas *et al.* 2002). Therefore, we

obtained five values for LIT, HLC, ROC and CAN per trap station, and four values for FVO1, FVO2 and FVO3.

Statistical Analysis

Microhabitat data were arcsine transformed (Sokal & Rohlf 2011). We calculated the average microhabitat value to each trap station, except for TRU, which is a numeric score. For each microhabitat variable, we generated an annual mean value (*i.e.*, the average of six trapping sessions) to evaluate interannual shifts per trap station. Autocorrelation between microhabitat variables was evaluated using a correlation matrix with a mean value per trap station with data obtained for 11 years. We chose significant uncorrelated variables to avoid the situation in which a particular period observation (t1) influences the observation measured later (t2).

The total number of captures in each trapping session, a measure of abundance, were used as the dependent variable. *Marmosops incanus* abundance were counted for each trap station, including all records for each individual, excluding individuals who missed ear tags or had noting record errors. We analyzed data from the three trapping grids together once the distance between them is not big enough to sample different populations or sub-populations.

Microhabitat measurements were set as the independent variables. The correlation between these variables and species abundance indicates

species preference. We used Poisson regression to fit microhabitat variable decade means and the sum of captures for each trap station, according to the following equation:

$$Y = e^{\beta_0} e^{\beta_1 x_1 + \beta_2 x_2 + \dots + \beta_p x_p}$$

where β_0 is a constant, and $\beta_1, \beta_2 \dots \beta_p$ are the independent variables coefficients named $X_1, X_2 \dots X_p$ (Hosmer *et al.* 2000). We performed all analyses in Statistica 7.0 Stat Soft (2001) and assumed significance level as $p < 0.05$. The dataset used to perform Poisson regression is detailed in Appendix.

RESULTS

We recorded 223 individuals of *Marmosops incanus* in 604 captures (105 females and 117 males, in 302 captures for each sex). Most of the captures occurred in Sherman traps (73.55%; N = 445) and 99.1% on the ground. Herbaceous and woody stem cover (HWS) and canopy cover (CAN) were highly correlated with almost all variables ($p < 0.05$; Table 1). The three FVOs values were also correlated to each other, thus we chose FVO1, since *M. incanus* is predominantly terrestrial. Therefore, we used the four remaining microhabitat variables: LIT, ROC, FVO1 e TRU. The abundance of *M. incanus* was positively related with litter (Wald Test = 14.41, $p < 0.05$) and rock outcropping cover (Wald Test = 13.27, $p < 0.05$; Table 2).

Table 1. Collinear matrix among eight microhabitat variables quantified in the Serra dos Órgãos National Park, RJ. Litter cover (LIT), herbaceous and woody stem cover (HWS), rock outcropping cover (ROC), canopy cover (CAN), foliar vertical obstruction (leaves and branches) in three heights – from 0 to 0.5 m (FVO1), 0.5-1 m (FVO2) and 1-1.5 m (FVO3) – and number of fallen trunks (TRU). Bold values are statistically significant ($p < 0.05$).

	HWS	LIT	ROC	CAN	FVO1	FVO2	FVO3	TRU
HWS	1							
LIT	-0.36	1						
ROC	-0.28	-0.42	1					
CAN	-0.56	0.38	0.02	1				
FVO1	0.48	-0.18	-0.10	-0.50	1			
FVO2	0.54	-0.22	-0.17	-0.48	0.79	1		
FVO3	0.37	-0.11	-0.20	-0.34	0.61	0.87	1	
TRU	0.24	-0.15	0.12	-0.45	0.34	0.31	0.17	1

Table 2. Poisson regression results between *Marmosops incanus* abundance and four microhabitat variables quantified in the Serra dos Órgãos National Park, RJ. Litter cover (LIT), rock outcropping cover (ROC), foliar vertical obstruction (leaves and branches) in three heights – from 0 to 0.5 m (FVO1), and number of fallen trunks (TRU). Bold values are statistically significant ($p < 0.05$).

Variable	df	Wald	P
LIT	1	14.41198	0.000147
ROC	1	13.27272	0.000269
FVO1	1	1.4599	0.226947
TRU	1	1.67047	0.196195

DISCUSSION

One of our hypotheses was confirmed, and litter abundance was a good predictor of *M. incanus* abundance, as well as rock cover. Leaf obstruction near the ground was not a predictor of the species abundance. Our results were slightly different from other studies on *M. incanus* in other localities and habitats, a sign of species' plasticity in different conditions. Another study in the Atlantic Forest found that *M. incanus* preferred microhabitats with higher plant cover and vertical obstruction above the ground (Leiner *et al.* 2010). In a restinga area, *M. incanus* used the ground more frequently, mostly in places with complex understory (Calazans & Bocchiglieri 2019). In fragmented areas of the Atlantic Forest, the species preferred sites with closed canopy, relatively open understory, but with high horizontal complexity (Püttker *et al.* 2008). Although our study area was an advanced secondary stage forest located in a National Park (not suffering with fragmentation effects), the preferences recorded for *M. incanus* were similar, except for the absence of canopy cover effect. *Marmosops incanus* also preferred sites with open understory (immediate stratum – FVO1 – unobstructed) and dense litter cover. In Garrafão, the canopy cover is probably not heterogeneous enough to represent a relevant factor as in fragmented landscapes.

Usually the preference and association of habitat use by *M. incanus* with the ground strata is related to its feeding behavior, as the abundance of fruits and insects found in the litter is related to its depth (Pellens & Garay 1999). The study area has a high rate of litter production (7.74 ton/ha/

year; Freitas 1998). High litter production rates in the Atlantic Forest, along with its decomposition dynamics, correlates with the presence of a constant and rich arthropod fauna (Pellens & Garay 1999), also closely related to *M. incanus* diet (e.g., Astúa *et al.* 2003, Leiner 2005), which are part of the diet of *Marmosops* spp. (Julien-Laferrière & Atramentowicz 1990, Leiner & Silva 2007), a typical understory forager (Cunha & Vieira 2002, Calazans & Bocchiglieri 2019). In the same study area, Gentile *et al.* (2004) used litter production as a measure of food resources for didelphid marsupials and found a positive relation between *M. incanus* density and seasonal litter production, including fruits.

Marmosops incanus also builds its nests on the forest floor where fallen logs and rock outcropping can also provide protection (D. Loretto, personal communication, data in Loretto & Vieira 2008, 2011). Moura *et al.* (2005) also found in the study area that *Didelphis aurita* and *Philander quica* (formerly *P. frenatus*) selected rock outcropping cover in the mesohabitat scale. These authors correlated their results to food resources and shelter availability. Our results also showed a relationship between the abundance of *M. incanus* and rock outcropping cover, which can provide protection from predators offering shelter sites, as well as areas of dense vegetation, even if it means higher costs in other activities such as foraging (Cassini & Galante 1992).

Habitat selection theory often fails to consider interactions such as predation and competition (e.g., Morris 2009, Grenier-Potvin *et al.* 2021). Thus, an insight into the patterns of habitat selection can further take interactions among populations into consideration. There is evidence that local abundance of *M. incanus* is constrained by interspecific competition (Braz *et al.* 2020). Although the study area is close to the type locality of *M. paulensis* ("Therezopolis", Tate 1931; Voss *et al.* 2004), we have never confirmed the presence of this species in the sampling grids, which could lead to a more intense habitat segregation and diet specialization. Interspecific competition was recorded for *Gracilinanus agilis* and *G. microtarsus* in gallery forests in a Cerrado-Atlantic Forest transition area (Azevedo *et al.* 2022). Although we did not record *M. paulensis* in the study area, *G. microtarsus* was commonly recorded in sympatry,

and the vertical stratification in the use of space by both species was shown using the spool and line (Cunha & Vieira 2002, Loretto & Vieira 2008) and artificial nests (Loretto & Vieira 2011) methods. In both studies, *M. incanus* used mostly the ground, while *G. microtarsus* only the arboreal stratum. Vertical stratification between these two species was also recorded in a montane forest area in the state of Espírito Santo (Passamani & Rosa 2015), but not in the Serra do Mar State Park, on the northern coast of the state of São Paulo (Paste & Voltolini 2013).

Nevertheless, there are records of *M. incanus* using the understory more frequently than the ground (Calazans & Bocchiglieri 2019) and this behavioral plasticity in habitat use can be observed in mammals both in spatial and temporal scales (Diete *et al.* 2017), as well as to biogenic characteristics, such as breeding season shifts (Loretto & Vieira 2005, Almeida *et al.* 2008). We suppose organisms with arboreal morphological adaptations or abilities may choose to use the ground if advantageous, either by an ease in locomotion to find food, or by the presence and/or interference of other species. Thus, it remains to be tested if habitat simplification leads to behavior homogenization, resulting in changes in the way individuals use the immediate habitat. In the opposite situation, we could expect a species, trophic guild or small mammal community inhabiting a primary forest, with complex vertical structure, to show a growing specialization of niches and behavior. As a conclusion, we expect other species of the genus *Marmosops* to behave similarly to what we presented here throughout their geographical ranges, shifting habitat use according to environment complexity variation and the number of interactions with species of similar ecology. These hypotheses could be evaluated in field experiments, using exclusion paired grids in changing physiognomy complexity habitats where other *Marmosops* species are known to be present.

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APPENDIX

Dataset used to elaborate the Poisson regression: captures of *Marmosops incanus* and means of microhabitat variables (litter and rock outcropping cover, and fallen trunks, in grids A, B and C) from February 1998 to December 2007. 'TotSta' – continuous numbering of the total 75 traps stations (25 per grid); 'cap+1' – data in the column 'captures' added in 1 (the Poisson regression does not allow values equal to zero in the cells of the dependent variable).

Grid	Trap station (TS)	TotSta	Captures	Captures +1	Litter	Rock	OFV1	Trunks
A	1	1	25	26	0.8715	0.0407	0.3531	1.2667
A	2	2	12	13	0.8747	0.0567	0.2410	1.7667
A	3	3	6	7	0.6522	0.0387	0.2913	1.9333
A	4	4	1	2	0.6680	0.0671	0.3150	0.9667
A	5	5	8	9	0.8661	0.0647	0.2710	0.8667
A	6	6	12	13	0.6519	0.0843	0.3402	1.5833
A	7	7	12	13	0.8300	0.0621	0.3352	1.2667
A	8	8	11	12	0.7810	0.1402	0.2642	1.2333
A	9	9	13	14	0.8722	0.0444	0.2006	3.3000
A	10	10	12	13	0.8724	0.0031	0.3873	2.4233
A	11	11	10	11	0.9223	0.0519	0.4224	1.2833
A	12	12	10	11	0.7397	0.0785	0.2217	1.1167
A	13	13	11	12	0.8317	0.0020	0.2323	0.4600
A	14	14	13	14	0.7094	0.1884	0.1855	0.7167
A	15	15	14	15	0.8489	0.0000	0.3255	2.6900
A	16	16	14	15	0.5804	0.3972	0.0691	1.1667
A	17	17	18	19	0.7637	0.0240	0.2625	1.4833
A	18	18	13	14	0.8941	0.0047	0.2564	1.0167
A	19	19	5	6	0.7610	0.1098	0.2674	1.4667
A	20	20	11	12	0.8332	0.0377	0.3022	1.7167
A	21	21	2	3	0.7035	0.2022	0.3523	2.0000
A	22	22	16	17	0.8902	0.0183	0.3986	1.3667
A	23	23	6	7	0.6135	0.0738	0.3233	1.5833
A	24	24	11	12	0.6947	0.1100	0.2583	0.9667
A	25	25	12	13	0.8546	0.0048	0.2519	1.7333
B	1	26	6	7	0.7184	0.0347	0.3573	0.6500
B	2	27	6	7	0.6679	0.1560	0.3679	2.4500
B	3	28	5	6	0.5350	0.1018	0.5314	2.4667
B	4	29	10	11	0.8024	0.0065	0.2104	0.2000
B	5	30	13	14	0.7855	0.0067	0.2573	1.0167
B	6	31	12	13	0.6010	0.0047	0.3857	1.6833
B	7	32	2	3	0.6179	0.0946	0.1709	0.8333
B	8	33	9	10	0.5379	0.0454	0.1786	1.8167
B	9	34	7	8	0.7428	0.0003	0.3124	0.9500
B	10	35	6	7	0.7446	0.0003	0.3875	1.0333
B	11	36	9	10	0.6367	0.0117	0.2848	2.0833

Appendix. Continues on next page...

Appendix. ...continued

Grid	Trap station (TS)	TotSta	Captures	Captures +1	Litter	Rock	OFV1	Trunks
B	12	37	11	12	0.7531	0.0452	0.2810	0.4833
B	13	38	8	9	0.7785	0.0497	0.3268	2.3500
B	14	39	11	12	0.9669	0.0061	0.2253	2.1333
B	15	40	8	9	0.6993	0.0000	0.2109	1.6833
B	16	41	7	8	0.7559	0.0848	0.3409	3.5167
B	17	42	11	12	0.8038	0.0201	0.3128	0.7933
B	18	43	13	14	0.8820	0.0355	0.3250	1.3833
B	19	44	12	13	0.6148	0.1977	0.3620	1.2667
B	20	45	10	11	1.0371	0.0063	0.1786	1.8167
B	21	46	11	12	0.6502	0.0033	0.4071	2.8333
B	22	47	14	15	0.9101	0.0609	0.3010	1.1333
B	23	48	5	6	0.6677	2.0132	0.2978	3.5933
B	24	49	5	6	0.9934	0.0037	0.3206	2.9500
B	25	50	7	8	0.9536	0.0218	0.2457	0.9167
C	1	51	3	4	0.8809	0.0285	0.3069	0.3000
C	2	52	1	2	0.7797	0.0384	0.2843	1.6500
C	3	53	7	8	0.7273	0.0060	0.2213	0.7333
C	4	54	7	8	0.8244	0.0000	0.2599	3.1500
C	5	55	6	7	0.8502	0.0020	0.2134	0.7000
C	6	56	1	7	0.6680	0.0000	0.2442	1.9500
C	7	57	4	5	0.8183	0.0003	0.2358	1.8000
C	8	58	1	7	0.5342	0.0000	0.4702	3.5500
C	9	59	9	10	0.9060	0.0000	0.2278	1.2500
C	10	60	8	9	0.9690	0.0000	0.1555	1.4333
C	11	61	2	3	0.8100	0.0000	0.3009	1.9333
C	12	62	4	5	0.8209	0.0054	0.2831	0.9167
C	13	63	3	4	0.8212	0.0007	0.3189	1.8333
C	14	64	4	5	0.8091	0.0000	0.2613	0.7667
C	15	65	4	5	0.8665	0.0000	0.2522	2.1500
C	16	66	1	2	0.8368	0.0000	0.2442	1.2333
C	17	67	0	1	0.7865	0.0000	0.2948	1.1833
C	18	68	5	6	0.7916	0.0000	0.3337	1.3667
C	19	69	4	5	0.7970	0.0000	0.2945	1.5833
C	20	70	2	3	0.8097	0.0020	0.1997	1.1000
C	21	71	6	7	0.6689	0.0277	0.3517	3.0000
C	22	72	7	8	0.9476	0.0047	0.2667	1.6167
C	23	73	6	7	0.7136	0.0013	0.2795	1.3333
C	24	74	4	5	0.7681	0.0037	0.3351	2.3500
C	25	75	10	11	0.8185	0.0434	0.3171	1.1333