



universität
wien

MASTERARBEIT

Titel der Masterarbeit

Nest Site Selection of Tawny Owls
Strix aluco in Relation to Habitat Structure
and Food Abundance in the Biosphere
Reserve Wienerwald

Verfasserin

Julia Gstir BSc

angestrebter akademischer Grad

Master of Science (MSc)

Wien, 2012

Studienkennzahl lt. Studienblatt

A 066 831

Studienrichtung lt. Studienblatt

Masterstudium Zoologie

Betreuerin

Privat-Doz. Dr. Anita Gamauf

Table of contents

I	Figures	3
II	Tables	6
III	Danksagung	8
IV	Zusammenfassung.....	9
V	Abstract	10
1	Introduction.....	11
2	Material and methods.....	12
2.1	Study area.....	12
2.1.1	Biosphere Reserve Wienerwald (“Biosphärenpark Wienerwald”).....	13
2.2	Artificial nesting boxes	14
2.2.1	Condition of young	15
2.3	Habitat.....	16
2.3.1	Nest sites	16
2.3.2	Random plots	20
2.4	Prey abundance.....	21
2.4.1	Rodents.....	22
2.4.2	Birds.....	23
2.4.3	Prey remains.....	24
2.5	Statistics	25
2.5.1	Descriptive analyses	25
2.5.2	Further analyses	25
3	Results	27
3.1	Breeding period and breeding success of Tawny Owls in the study area.....	27
3.2	Habitat.....	27
3.2.1	Habitat differences between occupied and not occupied nest sites.....	30
3.2.2	Habitat differences between nest sites and random plots	41
3.3	Prey abundance.....	49
3.3.1	Rodents.....	49
3.3.2	Birds.....	52
3.3.3	Prey remains.....	57
4	Discussion.....	61
4.1	Breeding period and breeding success.....	61
4.2	Habitat differences between occupied and not occupied nest sites.....	61

4.3	Habitat differences between nest sites and random plots	63
4.4	Relationship between prey abundance and prey choice	63
5	References.....	65
6	Appendix.....	69
6.1	Habitat variables not significant in the analyses.....	69
6.1.1	Comparisons between occupied and not occupied nest sites	69
6.1.2	Comparisons between nest sites and random plots	75
6.2	PCA of habitat variables of occupied and not occupied nest sites and random plots (not normally distributed variables excluded).....	79
6.3	PCA of habitat variables of occupied and not occupied nest sites	80
6.4	Numbers and biomass of trapped rodents and mapped birds	81
6.4.1	Numbers and biomass of trapped rodents	81
6.4.2	Numbers and biomass of mapped birds	82
7	Lebenslauf	85

I Figures

Figure 1: Location of the study area in the Austrian federal states Vienna and Lower Austria. Boundaries of the study area are drawn in red. Main villages of the region are marked. Scale: 1:150,000. © NASA Zulu.....	12
Figure 2: Location of nesting boxes within study area. n. b. = nesting boxes; red line = boundaries of study area; red dots = nesting boxes occupied by Tawny Owls (n = 24); green dots = nesting boxes not occupied by Tawny Owls (n = 36). Some dots overlap because coordinates of nesting boxes were entered to only 2 decimal places. Scale: 1:150,000. © NASA Zulu.....	14
Figure 3: Nesting box used in this study attached to a beech tree. Scene shown in the photograph: climber approaching nesting box from the ground for investigation of young Tawny Owls in May. © 2011 Julia Gstir.....	15
Figure 4: Weighing of a Tawny Owl nestling during control of nine nesting boxes in the Biosphere Reserve Wienerwald in May 2011.	16
Figure 5: Beech forest at a nest site (NB 13, not occupied) in the study area in May 2011.	17
Figure 6: Location of random plots within study area. Red line = boundaries of study area; blue dots = random plots (n = 30). Scale: 1:150,000. © NASA Zulu.	21
Figure 7: Rodent trapping locations within study area. Red line = boundaries of study area; blue dots = rodent trapping locations (n = 6). Scale 1:150,000. © NASA Zulu.	22
Figure 8: Weighing of a rodent in the course of determining body parameters in the Biosphere Reserve Wienerwald in March 2011.	23
Figure 9: Bird mapping locations within study area. Red line = boundaries of study area; blue dots = bird mapping locations (n = 6). Scale: 1:150,000. © NASA Zulu.	24
Figure 10: Breeding period of Tawny Owls in the Vienna Woods, based on nine examined broods...	27
Figure 11: Frequency of the three occupation classes (nest sites occupied by Tawny Owls, nest sites not occupied by Tawny Owls, and random plots).....	30
Figure 12: Comparison of nest sites occupied by Tawny Owls and not occupied nest sites in relation to position on the slope. Frequency given as percentage of occupied / not occupied nest sites located at each position. 1 = hilltop; 2 = uphill; 3 = downhill; 4 = foot of the slope. Red = occupied nest sites; green = not occupied nest sites.....	33
Figure 13: Comparison of the frequency of the three nest tree species recorded in the two categories nest sites occupied by Tawny Owls (red) and not occupied nest sites (green). 1 = European Beech <i>Fagus sylvatica</i> ; 2 = Oak <i>Quercus</i> spp.; 3 = Maple <i>Acer</i> spp.....	33
Figure 14: Boxplots of six habitat variables showing significant differences between nest sites occupied by Tawny Owls (n = 24) and not occupied nest sites (n = 36) using Student's t-tests and/or Mann-Whitney-Wilcoxon-tests and/or separate/ assembled logistic regressions (see text). * = p < 0.05; ** = p < 0.01; *** = p < 0.001. 0 = not occupied nest sites; 1 = occupied nest sites; [m] = metres. Bold line = median; lower/ upper whisker = minimum/ maximum, circles = outliers.	36

Figure 15: Bar chart illustrating how much variance (in %) is explained by each PC (principal component) in the PCA (principal component analysis) comparing habitat variables between nest sites occupied by Tawny Owls (n = 24), not occupied nest sites (n = 36) and random plots (n = 30). Each bar represents one PC; PCs are numbered consecutively from left (PC1) to right (PC40) on the x-axis.....	37
Figure 16: Plot of PC1 (x-axis) against PC2 (y-axis) showing group separation of nest sites occupied by Tawny Owls (red; n = 24), not occupied nest sites (green; n = 36) and random plots (blue; n = 30). ..	39
Figure 17: Plot of LD1 (x-axis) against LD2 (y-axis), showing a discernible group separation of sites (n = 90) classified as occupied by Tawny Owls (red; n = 24), as not occupied nest sites (green; n = 36), and as random plots (blue; n = 30). Green dot = group mean of not occupied nest sites; red square = group mean of occupied nest sites; blue triangle = group mean of random plots.....	39
Figure 18: Comparison of the frequency of the four position classes hilltop (1), uphill (2), downhill (3) and foot of the slope (4) recorded in the two categories potential nest sites of Tawny Owls (yellow) and random plots (blue).....	42
Figure 19: Comparison of the frequency of the ten tree species recorded in the two categories potential nest sites of Tawny Owls (yellow) and random plots (blue). 1 = European Beech <i>Fagus sylvatica</i> ; 2 = Oak <i>Quercus</i> spp.; 3 = Maple <i>Acer</i> spp.; 4 = European Hornbeam <i>Carpinus betulus</i> ; 5 = Norway Spruce <i>Picea abies</i> ; 6 = European Ash <i>Fraxinus excelsior</i> ; 7 = Douglas-Fir <i>Pseudotsuga menziesii</i> ; 8 = Wild Cherry <i>Prunus avium</i> ; 9 = European Larch <i>Larix decidua</i> ; 10 = Elm <i>Ulmus</i> spp.	43
Figure 20: Boxplots of habitat variables showing significant differences between potential nest sites of Tawny Owls (n = 60) and random plots (n = 30) in Student's t-tests and/or Mann-Whitney-Wilcoxon-tests and/or separate/ assembled logistic regressions. * = p < 0.05; ** = p < 0.01; *** = p < 0.001. 0 = random plots; 1 = nest sites; [cm] = centimetres; [m] = metres. Bold line = median; lower/ upper whisker = minimum/ maximum, circles = outliers.....	46
Figure 21: Boxplots of habitat variables showing significant differences between potential nest sites of Tawny Owls (n = 60) and random plots (n = 30) in Student's t-tests and/or Mann-Whitney-Wilcoxon-tests and/or separate/ assembled logistic regressions. * = p < 0.05; ** = p < 0.01; *** = p < 0.001. 0 = random plots; 1 = nest sites; [%] = per cent; [m] = metres. Bold line = median; lower/ upper whisker = minimum/ maximum, circles = outliers.	47
Figure 22: Boxplots of habitat variables showing significant differences between potential nest sites of Tawny Owls (n = 60) and random plots (n = 30) in Student's t-tests and/or Mann-Whitney-Wilcoxon-tests and/or separate/ assembled logistic regressions. * = p < 0.05; ** = p < 0.01; *** = p < 0.001. 0 = random plots; 1 = nest sites; [m] = metres. Bold line = median; lower/ upper whisker = minimum/ maximum, circles = outliers.....	48
Figure 23: Total number of rodents trapped each month ($r_s = 1$; $P < 0.3$).	50
Figure 24: Overview of the number of rodents trapped each month at each trapping location (M1-M6) per 100 trapping units.	50
Figure 25: Biomass of rodents trapped each month at all six trapping locations. [g] = grams. Bold line = median; lower/ upper whisker = minimum/ maximum; circle = outlier.....	51

Figure 26: Total number of birds recorded each month ($r_s = -1$; $P < 0.3$). 52

Figure 27: Number of bird species ($n = 39$) in weight categories 1-15. 1 = 1-19g; 2 = 20-39g; 3 = 40-59g; 4 = 60-79g; 5 = 80-99g; 6 = 100-119g; 7 = 120-139g; 8 = 140-159g; 9 = 160-179g; 10 = 180-199g; 11 = 200-219g; 12 = 220-239g; 13 = 240-259g; 14 = 260-279g; 15 = 280-300g. g = grams. 54

Figure 28: Number of bird individuals ($n = 1,568$) in weight categories 1-15. 1 = 1-19g; 2 = 20-39g; 3 = 40-59g; 4 = 60-79g; 5 = 80-99g; 6 = 100-119g; 7 = 120-139g; 8 = 140-159g; 9 = 160-179g; 10 = 180-199g; 11 = 200-219g; 12 = 220-239g; 13 = 240-259g; 14 = 260-279g; 15 = 280-300g. g = grams. 55

Figure 29: Total number of birds recorded each month at all six mapping locations. Bold line = median; lower/ upper whisker = minimum/ maximum. 56

Figure 30: Biomass of birds recorded each month at all six mapping locations. [g] = grams. Bold line = median; lower/ upper whisker = minimum/ maximum. 57

Figure 31: Number of identified prey individuals ($n = 67$) in weight categories 1-10. 1 = 1-30g; 2 = 31-60 g; 3 = 61-90 g; 4 = 91-120 g; 5 = 121-150 g; 6 = 151-180 g; 7 = 181-210 g; 8 = 211-240 g; 9 = 241-270 g; 10 = 271-300g. g = grams. 59

Figure 32: Two Eurasian Jay nestlings found in a nesting box occupied by Tawny Owls. They were returned after nest control (18 May 2011). © 2011 Julia Gstyr. 60

II Tables

Table 1: List and definition of all habitat variables recorded at occupied and not occupied Tawny Owl nesting habitats and random points, and their units and abbreviations. [m] = metres; [m. a. s. l.] = metres above sea level; [°] = degrees; [g] = grams.	17
Table 2: List of alterations made in recording habitat variables at random plots in contrast to Tawny Owl nesting habitats, and the units and abbreviations of these habitat variables. [m] = metres; [°] = degrees; [g] = grams.	21
Table 3: List of mean, standard deviation (SD), minimum and maximum of all habitat variables recorded at potential Tawny Owl nest sites as well as at random plots, calculated for not occupied nest sites, occupied nest sites, and random plots separately. Results are presented in each cell according to the following pattern: “mean ± SD (minimum – maximum)”.	27
Table 4: Comparison of standard deviation (SD) and mean absolute deviation (MAD) of habitat variables recorded at Tawny Owl nest sites as well as at random plots, calculated for not occupied nest sites (0), occupied nest sites (1) and random plots (2) separately.....	29
Table 5: Comparison of normally (Student’s t-test) and not normally (Mann-Whitney-Wilcoxon-test) distributed habitat variables of nest sites not occupied by Tawny Owls (0; n = 36), occupied nest sites (1; n = 24) and random points (2; n = 30). Value = t value or w value (Student’s t-test or Mann-Whitney-Wilcoxon-test). $P < =$ p value. - = data excluded from the tests. Significant results are marked in bold.....	31
Table 6: Results of the separate ANOVAs of the habitat variables Position and Species for nest sites occupied by Tawny Owls (n = 24) and not occupied nest sites (n = 36). $P < =$ p value.	32
Table 7: Results of the separate logistic regressions comparing habitat variables between nest sites occupied by Tawny Owls (n = 24) and not occupied nest sites (n = 36). A positive estimate value means that the concerned habitat variable is higher in the occupied class than in the not occupied class; if the estimate value is negative, it’s vice versa. $P < =$ p value. Significant results are marked in bold: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$	34
Table 8: Results of the assembled logistic regression comparing only those habitat variables showing significant results in the separate logistic regression between nest sites occupied by Tawny Owls (n = 24) and not occupied nest sites (n = 36). A positive estimate value means that the concerned habitat variable is higher in the occupied class than in the not occupied class; if the estimate value is negative, it’s vice versa. $P < =$ p value. Significant results are marked in bold: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$	35
Table 9: Rotation of habitat variables for principal components 1 (PC1) and 2 (PC2). A minus sign means that the concerned habitat variable is higher at nest sites than at random plots. Habitat variables exerting the strongest influence on PC1 or PC2 are marked in bold.....	38
Table 10: Discriminant scores of habitat variables for linear discriminants 1 (LD1) and 2 (LD2). A minus sign means that the concerned habitat variable is higher at random plots than at nest sites (LD1), or higher at not occupied nest sites than at occupied nest sites (LD2). Habitat variables exerting the strongest influence on LD1 or LD2 are marked in bold.	40

Table 11: Results of the separate ANOVAs of the habitat variables Position and Species for all potential nest sites of Tawny Owls (n = 60) and random plots (n = 30). $P < p$ value. 42

Table 12: Results of the separate logistic regressions comparing habitat variables between all potential nest sites of Tawny Owls (n = 60) and random plots (n = 30). A positive estimate value means that the concerned habitat variable is higher in the nest site class than in the random plot class; if the estimate value is negative, it's vice versa. $P < p$ value. Significant results are marked in bold: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$ 44

Table 13: Results of the first assembled logistic regression comparing only those habitat variables (except variable Dbh) showing significant results in the separate logistic regression between potential nest sites of Tawny Owls (n = 60) and random plots (n = 30). A positive estimate value means that the concerned habitat variable is higher in the nest site class than in the random plot class; if the estimate value is negative, it is vice versa. $P < p$ value. Significant results are in bold: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$ 45

Table 14: Results of the second assembled logistic regression comparing only those habitat variables (except variable Nrust5m) showing significant results in the separate logistic regression between potential nest sites of Tawny Owls (n = 60) and random plots (n = 30). A positive estimate value means that the concerned habitat variable is higher in the nest site class than in the random plot class; if the estimate value is negative, it is vice versa. $P < p$ value. Significant results are marked in bold: * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$ 45

Table 15: Numbers and morphological measurements of live-trapped rodents recorded during trapping sessions in 2011. Results are presented in each cell according to the following pattern: "mean \pm SD (minimum – maximum)". [g] = grams, [mm] = millimetres. 49

Table 16: Diversity, total number and percentage of birds recorded each month, as well as average body weight of each species (according to GLUTZ VON BLOTZHEIM ET AL. 1994) and resulting biomass. Species are sorted by " \sum numbers" (descending). \sum = sum; Ind. [%] = share of total number of individuals in %; % = per cent; Cum. = cumulative; [g] = grams. 53

Table 17: Prey items of Tawny Owls by number and biomass identified in nine nesting boxes (NB) in the Biosphere Reserve Wienerwald in the year 2011. Underlined numbers mark nestlings or young individuals. 58

III Danksagung

Ich möchte meiner Betreuerin Anita Gamauf danken, die sich immer Zeit für mich genommen und mir viele Fragen beantwortet hat; Richard Zink und David Izquierdo, die mir ebenfalls theoretisch und praktisch zur Seite gestanden sind; Eva Schöll, die mich bei vielen Unternehmungen im Wald begleitet und unterstützt hat; meinem Bruder Martin, der sich auch die Zeit genommen hat, mir bei der Waldarbeit zu assistieren; Karoline, die mir mit einer Engelsgeduld die Statistik erklärt hat; Verena, die die Arbeit korrekturgelesen hat; meinem Partner Klemens, der mich sehr unterstützt, aber auch zu den notwendigen Pausen überredet hat; und meinen Eltern, die meine gesamte Studienzeit finanziert haben und immer Vertrauen in mich hatten und mich unterstützten.

Vielen Dank auch an die Österreichischen Bundesforste, die mir mit einer Fahrgenehmigung und einem Fahrtkostenzuschuss die vielen Fahrten in den Wienerwald ermöglicht haben.



An das Forschungsinstitut für Wildtierkunde und Ökologie der Veterinärmedizinischen Universität Wien, dessen Fahrzeuge ich benutzen durfte.



An die Universität Wien, die mit einem Förderungsstipendium die Kletterkosten übernommen hat.



Und an den Biosphärenpark Wienerwald, der für das Drucken & Binden der Arbeit aufgekomen ist.



IV Zusammenfassung

Die vorliegende Masterarbeit befasst sich mit dem Einfluss von Habitatstruktur und Nahrungsverfügbarkeit auf die Nistplatzwahl des Waldkauzes *Strix aluco* im Biosphärenpark Wienerwald (westlich von Wien, Österreich). Zwischen März und Mai 2011 wurden 60 Nistkästen auf Brutversuche untersucht, im Mai in neun besetzten Nistkästen der Bruterfolg erfasst, und zwischen Juni und August im Umkreis der 60 Nistkästen und 30 (auf bewaldete Flächen beschränkten) Zufallspunkte 46 Habitatvariablen erhoben. Davon wurden 34 Variablen innerhalb eines Radius von 20 m (Mikrohabitat) erhoben und 12 innerhalb eines Radius von 250 m (Makrohabitat). Die Verfügbarkeit der Hauptbeutetiere wurde zwischen März und Mai durch Fangen in Lebendfallen (1.080 Falleneinheiten; Nagetiere) bzw. Kartieren entlang von sechs Strecken zu je acht Punkten (Vögel) erfasst. Statistische Analysen wurden mit dem Programm „R“ durchgeführt und beinhalteten Zweistichproben-t-Test, Wilcoxon-Mann-Whitney-Test, ANOVA, logistische Regression, PCA und LDA.

Obwohl der Waldkauz in seiner Habitatwahl sehr flexibel ist, konnten doch einige Besonderheiten festgestellt werden. Bei insgesamt sechs Habitatvariablen unterschieden sich besetzte und nicht besetzte Nistkästen signifikant. Die Waldkäuse schienen reine Hallenwälder weniger zu bevorzugen als etwas dichtere, strukturierte Waldabschnitte. Diese boten sowohl Deckung vor Mobbing durch Kleinvögel und Prädatoren, als auch Ansitzwarten für die Jagd. Im Vergleich zu Standorten mit mehr Nadelbäumen wurden 2011 in reinen Laubwäldern weniger Brutversuche unternommen. Möglicherweise ist die geringere Verfügbarkeit von Nagetieren im Jahr 2011, die in reinen Laubwäldern wahrscheinlich stärker ausgeprägt war, die Ursache dafür. Aufgrund der selektiven Montage von Nistkästen durch das Habichtskauz-Wiederansiedlungsprojekt-Team zeigten wie zu erwarten viele (18) Habitatvariablen signifikante Unterschiede zwischen Nistkästen und Zufallsflächen. Das Angebot an Kleinsäugetern, der üblichen Hauptbeute des Waldkauzes, war außerordentlich gering. Insgesamt wurden nur 25 Nagetiere aus drei Arten (Rötelmaus *Chletrionomys glareolus*, Gelbhalsmaus *Apodemus flavicollis*, und Waldmaus *Apodemus sylvaticus*) gefangen. Die Anzahl an gefangenen Individuen betrug lediglich 0,02 pro 100 Falleneinheiten (33 g / Monat). Der Grund für die niedrigen Werte dürften die aufeinanderfolgenden fast ausgebliebenen Buchenmasten in den Jahren 2009 und 2010 gewesen sein. Besser war es um die Vogeldichte bestellt. Die Anzahl der Vögel lag bei ca. 500 Individuen pro Monat (dem entsprechen ca. 2.000 g Biomasse). In Summe wurden 1.568 Individuen aus mindestens 39 Arten erfasst. Die meisten Individuen und Arten wogen weniger als 19 g. Aus den Nahrungsanalysen war ersichtlich, dass die Waldkäuse als opportunistische Prädatoren das niedrige Angebot an Nagetieren ausglich, indem sie auf Vögel als alternative Beute auswichen. Dass diese aufwändiger zu jagen sind ist möglicherweise die Ursache für die geringe Reproduktionsrate von 1,8 Jungen pro überprüfem erfolgreich brütenden Waldkauzpaar (n = 9 von 24). Die Nahrungszusammensetzung sah wie folgt aus: 20 Säugetiere (26,7 %), 45 Vögel (60,0 %), drei Reptilien (4,0 %), vier Amphibien (5,3 %), ein Fisch (1,3 %) und zwei Laufkäfer (2,7 %) (n = 75).

V Abstract

The thesis presented focuses on nest site selection of Tawny Owls *Strix aluco* in relation to habitat structure and food abundance in the Biosphere Reserve Wienerwald (to the west of Vienna, Austria). Breeding attempts in 60 nesting boxes were recorded from March to May 2011, breeding success in nine exemplary broods was controlled in May, and 46 habitat variables were measured at all of the 60 nest sites and at 30 random plots (located in forested areas only) from June to August. Of those 46 variables, 34 were recorded in the microhabitat with a radius of 20 m, and 12 were measured in the macrohabitat with a radius of 250 m. Abundance of main prey (rodents and birds) was recorded from March to May by trapping rodents with baited live traps (1,080 trapping units) and mapping birds at six locations with eight points each. Statistical analyses performed with the program "R" were Student's t-test, Mann-Whitney-Wilcoxon-test, ANOVA, logistic regression, PCA and LDA.

Although Tawny Owls are flexible in habitat choice, some distinctive features could be noted. Significant differences between occupied and not occupied nest sites were found in six habitat variables. Tawny Owls seemed to prefer forests that were not completely hall-like, but more densely structured and thus provided cover from mobbing and predators, and could be used for hunting as well. Presumably due to the low rodent abundance in 2011, which probably was more pronounced in deciduous forests, fewer breeding attempts occurred in purely deciduous forests in comparison to nest sites with a higher number of coniferous trees. Between nest sites and random plots, 18 significant differences were found. These differences were expected because they were caused by the selective installation of nesting boxes by the Ural Owl reintroduction project team. Rodent abundance was extremely low in the study period. In three months, only 25 individuals of three species (Bank Vole *Chletrionomys glareolus*, Yellow-necked Mouse *Apodemus flavicollis*, and Wood Mouse *Apodemus sylvaticus*) were trapped. Only 0.02 individuals per 100 trapping units were recorded (33 g / month). This was most likely due to the almost complete failure of beeches to bear seeds in two consecutive years (2009 and 2010). In contrast, bird density was much higher. A total of 1,568 bird individuals belonging to at least 39 species were recorded, most of them weighed less than 19 g. Bird biomass ranged around 2,000 g each month (corresponding to ca. 500 individuals). Prey analysis showed that Tawny Owls as opportunistic predators compensated the low rodent abundance by switching to birds as alternative prey. Nevertheless, the reproductive rate was relatively low (1.8 nestlings per inspected successful breeding pair, n = 9 of 24). Prey composition was as follows: 20 mammals (26.7 %), 45 birds (60.0 %), three reptiles (4.0 %), four amphibians (5.3 %), one fish (1.3 %) and two beetles (2.7 %) (n = 75).