

Occurrence of the Common Buzzard (*Buteo buteo*) in Mediterranean coastal woodlands: Wood size and vegetation affect patch occupation

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Zusammenfassung

Der Mäusebussard (*Buteo buteo*) besetzt geschlossene und aufgelichtete Wälder sowie bewaldete Hochlagen mit den höchsten Brutdichten in Mitteleuropa. Geringe Dichten in Küstengebieten Südeuropas resultieren aus Mangel an geeignetem Habitat und begrenzter Zahl von Horstplätzen. In Zentralitalien sind Bussarde häufiger in hügeligem Waldland als im Tiefland und den Küsteneichenwäldern. Hier wird ein vorläufiger Überblick des Bussardvorkommens in Eichenwäldern des küstennahen Teils von Latium gegeben, mit Einschätzungen zum Einfluss von Waldgröße, Bedeckungsgrad und Vegetation in 15 Waldstücken unterschiedlicher Größe (Durchschnitt und Standardabweichung = 201 ± 241 ha, Einzelflächen von 25-890 ha), einschließlich Kiefern-, wärmeliebender Eichen- (besonders Stecheiche), Korkeichen- und gemischter Eichenwälder (besonders *Q. cerris* und *Q. frainetto*).

In 6 (40 %) der Waldstücke hatte der Bussard mindestens ein Brutrevier. Eine schrittweise Diskriminanzanalyse zeigt, dass allein mit den beiden unabhängigen Variablen Fläche und Anteil an mesophiler Eichenbedeckung alle 15 Waldinseln richtig den Gruppen "besetzt" und "unbesetzt" zugeordnet werden können. Eine logarithmische Regression zeigt eine klare Abhängigkeit des Vorkommens von Bussarden mit der Fläche der Waldinseln. Flächen von mehr als 2,5 km² waren immer mit Bussarden besetzt. Bussarde neigen zur Vermeidung von thermophilen Waldungen und besetzen nur solche mit mesophilen Eichen. Mesophile Eichen schaffen offenere Wälder mit hohen Bäumen und höherreichender Laubschicht und daher wohl optimalen Nistmöglichkeiten für größere Greife. Die Beziehung zwischen Bussarddichte (aus Literaturangaben) und Meereshöhe der Probestellen in Zentralitalien scheint diese Hypothese zu bestätigen mit höchsten Dichten in Wäldern zwischen 500 und 700 m, wo Zerreiche und Edelkastanie die dominante Vegetation stellen.

Introduction

Forest raptors are generally sensitive to wood fragmentation, as they defend large territories during the breeding season (e.g. BOSAKOWSKI & SMITH 1997, PENTERIANI 1997, PENTERIANI & FAIVRE 1997, SANCHEZ-ZAPATA & CALVO 1999). Common Buzzard (*Buteo buteo*) occupies extended forests, fragmented woodlands, and forested uplands (TUBBS 1974, MELDE 1983). Although widespread throughout the Palearctic, relative occurrence and breeding density

show the highest values in central Europe. Low densities in coastal areas of southern Europe arise primarily through lack of suitable habitat or limited availability of nesting sites (BIJLSMA 1997). Few studies have attempted to determine quantitatively the ecology of the Buzzard in the Mediterranean basin. In dry landscapes of southern Spain, SANCHEZ-ZAPATA & CALVO (1999) stated that the number of breeding pairs increases in relation to forest cov-

er. In central Italy, PENTERIANI & FAIVRE (1997) found that breeding densities increase from mountain areas of the Apennines to piedmont woodlands, with mesophilous forests dominated by oaks (e.g. *Quercus cerris*) probably being optimal habitats for nesting (PETRETTI & PETRETTI 1981,

DE GIACOMO et al. 1994, CERASOLI 1995). In this paper, we provide a preliminary survey of common Buzzards in dry oak woods of coastal Latium, assessing the influence of wood size, forest cover, and tree species composition on the distribution of this raptor in forest fragments.

Methods

Populations of Common Buzzards were studied from spring 1998 to spring 2000 in a coastal area near Rome (Latium, central Italy). The study involved 15 forest fragments of different size (mean \pm SD = 201 \pm 241 ha, range 25-890 ha), including pine (*Pinus pinea*) and oak (especially *Q. ilex*) mixed woods (Castelfusano, Procoio, Acquerosse, Focene, and Fregene pine woods), cork oak (*Q. suber*) woods (Vallerano, Antica Lavinium, Torretta Massimi, and Pineto woods), as well as mixed oak (especially *Q. cerris* and *Q. frainetto*) woods (Macchia di Capocotta, Macchiagrande di Trigoria, Castel di Guido, Acquatraversa, Infernaccio, and Monte Mario woods). For a detailed account of vegetation features of some of these woods see DINELLI & GUARRERA (1988), BLASI et al. (1999), and references therein.

The occurrence of breeding Buzzards

was assessed during spring and early summer by systematic searches and observing from elevated spots nuptial displays and adults carrying nesting materials, as well as by listening to alarm calls of adults, and searching for pellets and prey remains under trees (see CERASOLI 1991, CERASOLI & PENTERIANI 1996, PENTERIANI & FAIVRE 1997, VORISEK 2000 for details).

Description of wood features was obtained using the parameters given in Table 1.

We used the logistic regression analysis (LRA) to generate a predictive model for the occurrence of breeding Buzzards in Mediterranean forest fragments with wood size as independent variable. For each wood, the species was scored as 0 or 1 to represent the dependent variable (i.e. presence or absence). The incidence function (i.e. the relationship between the probabil-

Table 1: Sample means and standard deviations of habitat variables measured in woods occupied by the Common Buzzard and in control plots. – Biotopvariablen (Waldgröße, Bedeckungsgrad, Abstand zum nächsten Wald > 1 km², Anteile von Stech- und Korkeiche sowie von Zerreiche + *Q. frainetto* in %) mit Durchschnitt und Standardabweichung von Wäldern mit und ohne Bussardbesetzung.

	Buzzard breeding (n=6)	Buzzard absent (n=9)	U-test (p-level)
Wood size (km ²)	3.8 \pm 3.0	0.8 \pm 0.5	0.009
Wood cover (%)	84.7 \pm 14.2	69.7 \pm 25.2	0.125
Distance from nearest wood > 1 km ²	4.3 \pm 4.0	2.4 \pm 1.5	0.768
<i>Q. ilex</i> cover (%)	14.2 \pm 29.9	31.1 \pm 28.0	0.175
<i>Q. suber</i> cover (%)	5.0 \pm 3.2	40.0 \pm 46.3	0.814
<i>Q. cerris</i> + <i>Q. frainetto</i> cover (%)	73.3 \pm 31.2	5.6 \pm 9.8	0.003

ity of a given species breeding and woodland area) was then constructed from the logistic equation. LRA permits both the prediction of binary attributes such as presence/absence, and the treatment of data in which the distribution is highly skewed and includes many zeroes (e.g. TOBALSKE & TOBALSKE 1999). Landscape characteristics of woods with Buzzards breeding or absent were compared by non-parametric Mann-Whitney U test. To reduce the number of variables that accounted for a discrimination between occupied and control plots,

we performed a stepwise discriminant analysis (DFA) with the 15 woods sampled during the study. This procedure allows to determine the importance of the variables that are meaningful in discriminate among groups subjected to the analysis. To achieve normally distributed data sets we performed the logarithmic transformation. Arcsin root square transformation was applied on percentages. Statistical analysis was performed by STATISTICA (Statsoft Inc., 1993) software. Results are presented as mean \pm SD.

Results

Out of a total of 15 woods sampled, only 6 (40%) were occupied by at least one Buzzard breeding territory. Mann-Whitney U-test showed significant differences between occupied ($n=6$) and unoccupied ($n=9$) woodlands only for wood size and mesophilous oak (i.e. *Q. cerris* + *Q. frainetto*) cover (Table 1). The DFA confirms such findings, indicating that the best discrimination between occupied and control plots

was achieved with variables wood size and mesophilous oak cover (Table 2). We obtained correct classification for all plots. Based on presence/absence data, the frequency of plot occupation rapidly increased for woods ranging in size from 0.5 km² to 5.0 km². The LRA showed that the predicted area of wood for which the probability of occupation reaches one is higher than 2,5 km² (Fig. 1).

Discussion

The Common Buzzard showed a restricted distribution in dry coastal woods of Latium, with a marked preference for larger forest fragments (size > 2,5 km²). Al-

though Buzzards commonly use open spaces for foraging, their breeding distribution is generally affected by size, cover, and quality of woodlands (JEDRZEJEWSKI,

Table 2: Results of the Stepwise Discriminant Analysis (DFA) on the habitat variables measured in woods occupied by the Common Buzzard and in control plots. – Ergebnisse der stufenweisen Diskriminationsanalyse der Habitatvariablen in Wäldern mit und ohne Bussardbesetzung.

Wilks' Lambda = 0.18, $F_{2,12} = 27.1$, $p < 0.001$				
Variable	Wilks' Lambda	Partial Lambda	F to remove	p-level
<i>Q. cerris</i> + <i>Q. frainetto</i> cover	0.49	0.37	20.63	< 0.001
Wood size	0.25	0.71	4.82	0.048

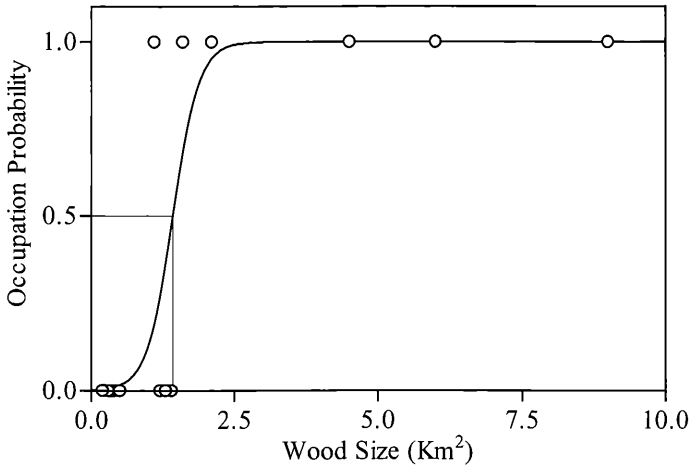


Fig. 1: Relationship between wood size and occupation probability from the logistic equation $y = \exp(-6.28 + 4.41x) / (1 + \exp(-6.28 + 4.41x))$. The loss function was maximum likelihood ($\chi^2 = 13.11$, $df = 1$, $p = 0.0003$). – Abb. 1: Beziehung zwischen Waldgröße und Wahrscheinlichkeit der Besetzung durch den Bussard.

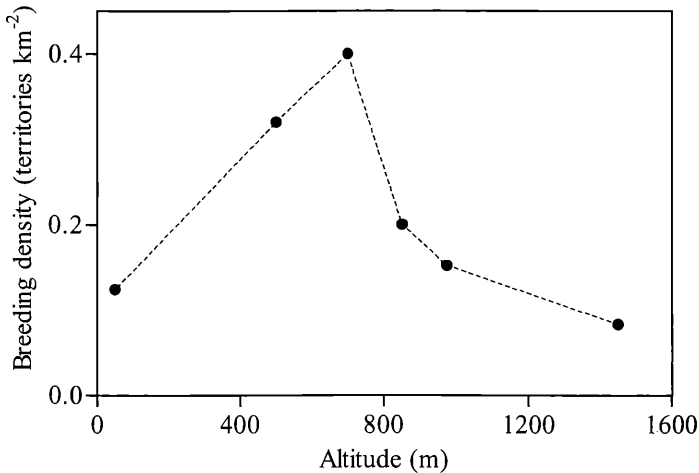


Fig. 2: Relationship between altitude and breeding density of Common Buzzard in 6 census plots of central Italy (data from: MANZI & PELLEGRINI 1989, CERASOLI 1991, MANZI et al. 1991, DE GIACOMO et al. 1994, BRUNI et al. 1995, PENTERIANI & FAIVRE 1997). – Abb. 2: Beziehung zwischen Meereshöhe und Dichte der Brutterritorien des Bussards in 6 Untersuchungsflächen (lit. cit. s.o.) Zentralitaliens.

JEDREZEJEWSKA & KELLER 1988, DARE & BARRY 1990, HUBERT 1993, PENTERIANI & FAIVRE 1997, VORISEK 2000). Also vegetation types seem to be an important factor affecting forest fragment occupation. Buz-

zards tend to avoid thermophilous forest stands, such as *Q. ilex* and *Q. suber* woods, occupying only stands characterized by mesophilous oaks (e.g. *Q. cerris* and *Q. frainetto*). Probably, mesophilous oaks tend to

produce open forests, with higher trees and taller arbustive layer, providing optimal nesting sites for a large-sized raptor like the Buzzard (CERASOLI 1991, PENTERIANI & FAIVRE 1997, VORISEK 2000). Conversely, thermophilous oaks tend to produce close forest fragments, with taller trees and higher arbustive layer. The relationship between Buzzard breeding density obtained from literature data and altitude of census plots in central Italy may confirm this hypothesis (Fig. 2). As a matter of fact, the highest densities were observed in wooded census plots between 500 m and 700 m, while in lowland as well as in mountain plots breeding densities significantly decreased. The dominant vegetation type in hilly forests is represented by mesophilous oaks (e.g. *Q. cerris*) and Chestnuts (*Castanea sativa*) (BLASI et al. 1999), generally providing open woods with high prey productivity (SARROCCO & SORACE 1997, SALVATI 1998). Lower densities in mountain areas, with woods dominated by beeches (*Fagus sylvatica*), are likely attributable to low prey productivity and unfavourable weather conditions during spring (PENTERIANI 1997, PENTERIANI & FAIVRE 1997, SALVATI, MANGANARO & RANAZZI 2000). In coastal areas, where ter-

mophilous woods provide extremely high prey availability as well as optimal weather conditions during breeding (PENTERIANI 1997, MANGANARO, RANAZZI & SALVATI 2000, SALVATI, MANGANARO & RANAZZI 2000), wood structure seem to be sub-optimal for nesting. Competition with other predators with similar feeding habits may further support our hypothesis. In particular, the Tawny Owl seems to be a competitor of the Common Buzzard in central Italy, inhabiting different wood types with generally high densities (MANGANARO, PUCCI & SALVATI 1999, SALVATI, MANGANARO & RANAZZI 2000), and showing a trophic niche comparable to that of Buzzard (see MANZI & PELLEGRINI 1989, DE GIACOMO et al. 1994, BRUNI et al. 1995, BRUNI 1996, MANGANARO, RANAZZI & SALVATI 2000). As Tawny Owls reach in Latium the highest density figures in thermophilous oak woodlands (SALVATI, MANGANARO & RANAZZI 2000), the interference with the Buzzard could be consistent in such habitat. Competition between Tawny Owl and Buzzard in Mediterranean forests should be further investigated by providing comparative data on the ecology of these raptors in different wood types.

Summary

The Common Buzzard (*Buteo buteo*) occupies extended forests, fragmented woodlands, and forested uplands with the highest breeding density in central Europe. Low densities in coastal areas of southern Europe arise primarily through lack of suitable habitats or limited availability of nesting sites. In central Italy, Buzzards are generally more common in hilly woodlands than in lowland and coastal oak forests. Here, we provide a preliminary survey of Buzzards in dry oak woods of coastal Latium, assessing the influence of wood size, forest cover, and vegetation on the distribution of

this raptor in 15 forest fragments of different size (mean \pm SD = 201 \pm 241 ha, range 25-890), including pine (*Pinus pinea*) and thermophilous oak (especially *Quercus ilex*) woods, cork oak (*Q. suber*) woods, as well as mixed oak (especially *Q. cerris* and *Q. frainetto*) woods. Six (40 %) forest fragments were occupied by at least one Buzzard breeding territory. By using the stepwise discriminant analysis, occupied and unoccupied woodlands were all discriminated based on the two landscape variables wood size and proportion of mesophilous oak cover. Based on the logistic regression analysis

the predicted area of wood for which the probability of occupation reaches 100% is higher than 2,5 km². Buzzards tend to avoid thermophilous forest stands, occupying only stands with mesophilous oaks. Mesophilous oaks tend to produce open forests, with higher trees and taller arbustive layer, probably, providing optimal nesting sites for large-sized raptors. The relationship between Buzzard density obtained

from literature data and altitude of census plots in central Italy may confirm this hypothesis, with highest densities recorded in woods between 500 m and 700 m, where *Q. cerris* and *Castanea sativa* represent the dominant vegetation.

Key words: Common Buzzard, *Buteo buteo*, breeding, dry oak woods, wood size, central Italy.

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