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SEASONAL PATTERNS OF COMMON BUZZARD (*BUTEO BUTEO*) RELATIVE ABUNDANCE AND BEHAVIOR IN POLLINO NATIONAL PARK, ITALY

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KEY WORDS: *Common Buzzard;* Buteo buteo; *relative abundance; roadside surveys.*

Nest-site selection and habitat use have been described in the Common Buzzard (*Buteo buteo*) by several authors (e.g., Penteriani and Faivre 1997, Krüger 2002, Lõhmus 2003, Bustamante and Seoane 2004, Sergio et al. 2005), but few studies have documented annual variations in the abundance and habitat associations of this species (Meunier et al. 2000).

We conducted monthly roadside surveys of Common Buzzards in a mountainous area of southern Italy. Although roadside surveys have well-known limitations (e.g., Andersen et al. 1985, Fuller and Mosher 1987, Millsap and LeFranc 1988, Viñuela 1997), they remain a useful technique for monitoring local abundance and distribution of raptors (Fuller and Mosher 1987, Ellis et al. 1990). Because roadside surveys are easy to conduct, they can be carried out at frequent intervals. Here, we present results from monthly roadside surveys of Common Buzzards. Using these data, we examine habitat associations, describe seasonal patterns of Common Buzzard behavior and abundance and, in particular, discuss the effectiveness of roadside surveys to monitor changes in abundance.

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METHODS

The Common Buzzard (hereafter buzzard) surveys were conducted from October 2000–September 2001 in Pollino

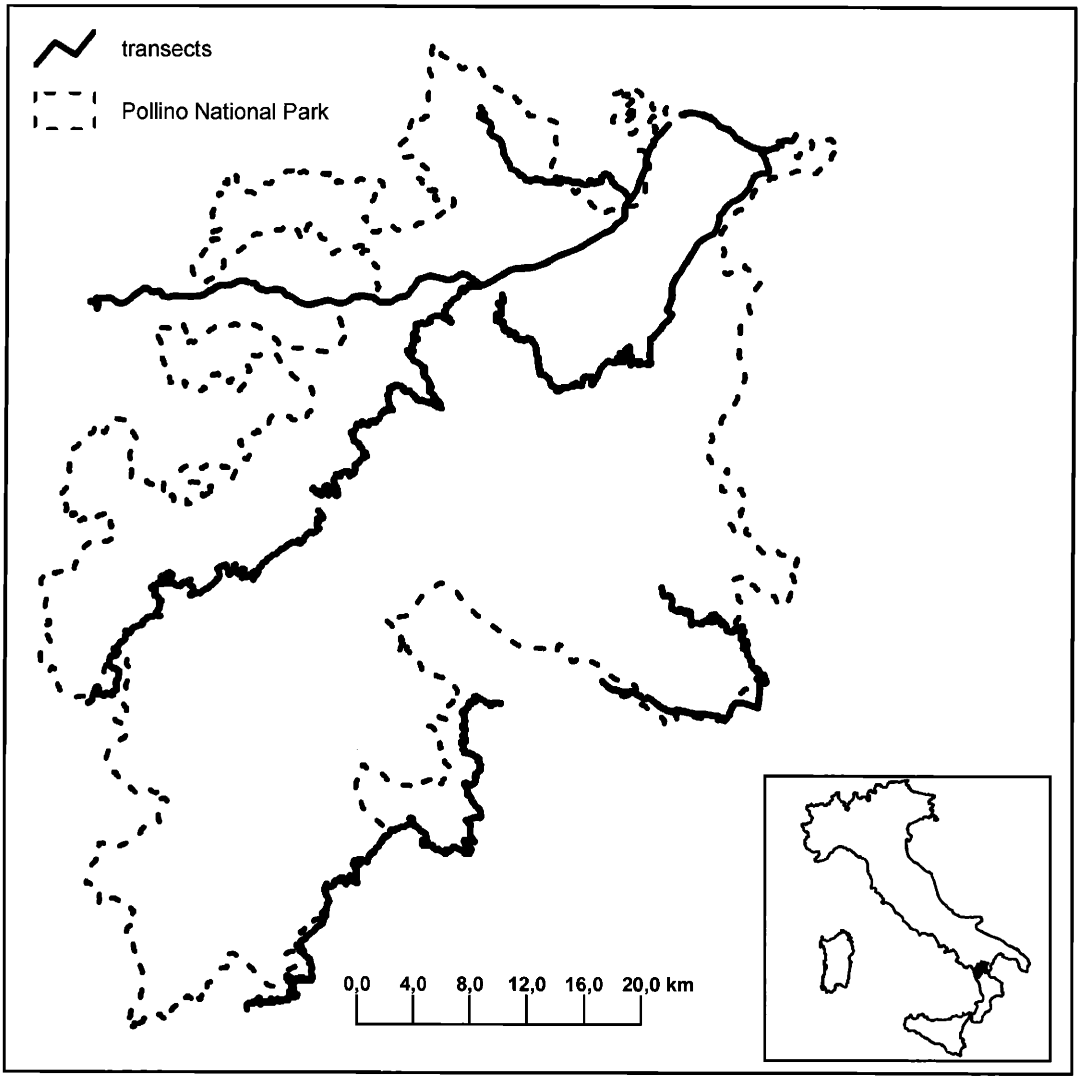

Figure 1. Locations of seven routes (thick dark lines) used for roadside surveys in Pollino National Park, southern Italy, in 2000–01 (thin lines indicate the boundaries).

National Park (39°58′N, 16°08′E), a 1821 km^2 area located in the southern Italian Apennines (Fig. 1). The elevation ranges from 170–2266 m. The land uses include farmlands and oak woods (*Quercus ilex, Q. pubescens, Q. cerris*) in the northern section of the park and grassland and beech woods (*Fagus sylvatica*) in the southern portion. Over the study period, the mean monthly temperature was 14.5°C, with a mean of 28.8°C during July–September and 9.7°C during October–February. The annual rainfall in the 12 mo of the survey was 841 mm.

We surveyed buzzards along seven paved roads (Fig. 1) selected randomly with restrictions (Caughley and Sinclair 1994). Specifically, we rejected routes adjoining those roads previously chosen. Each road was surveyed once each mo, during the third or fourth wk of the mo and only on calm and clear days. We did not sample on days with snow, rain, fog, or strong winds. Each month, the routes were surveyed over 4 d by means of two cars, each one with a driver and two observers. All surveys were conducted in the morning (0900–1200 H), typically the best time to count raptors (Robbins 1981). We drove at a speed of 40–45 km/hr and stopped the car to confirm each sighting. For each buzzard detected, we recorded if it was flying or perched and if it was alone or with other buzzards. Also, we discounted any buzzard that may have represented a re-sighted bird.

We calculated the relative abundance as the number of buzzards seen per 100 km sampled. For abundance computations we excluded the stretches of roads lined by trees within tunnels, forests, or villages. Therefore, al-

Table 1. Number of Common Buzzards recorded along seven routes in Pollino National Park (southern Italy, 2000–01). For computation of relative abundance, we used the survey length obtained discounting the stretches of roads lined by trees or passing through tunnels, forests, or villages.

Routes	Length (km) of Routes	Survey Length (km) of Routes	Monthly Mean ±SD of Relative Abundance
1	57.8	40.4	11.2 ± 1.8
2	18.3	18.3	10.2 ± 2.0
3	44.4	28.9	6.7 ± 2.0
4	47.3	34.0	12.7 ± 2.7
5	38.5	38.3	7.7 ± 1.6
6	43.8	24.2	20.1 ± 5.7
7	65.1	53.6	9.3 ± 1.2

though the total road length was 315.2 km, we considered for analysis only 237.6 km (survey km in Table 1).

For the analysis of buzzard habitat associations, we reported the sightings as presence/absence in a 1 × 1 km UTM grid. We created a 1 km buffer on both sides of each route and we considered only buzzards observed inside this buffer. We analyzed the habitat associations within this buffer using the Corine Land Cover 1:100 000 digital map (Legend level 3, Ministero dell'Ambiente e del Territorio—Ente Parco), identifying 10 land cover types which we then pooled into four general vegetation cover types: (1) arable land (cultivated areas regularly plowed and generally under a rotation system), (2) heterogeneous agricultural areas (areas principally occupied by agriculture, interspersed with natural areas), (3) forests, and (4) shrub or herbaceous vegetation (Table 2). In each 1 × 1 km grid cells or portions of a cell included inside the buffer, we calculated the surface of each cover type by means of a Geographical Information System (GIS) analysis (Geomedia Professional 2002). Buzzard habitat associations were analyzed in four periods: February–April (courtship), May–July (incubation and nesting), August–September (post-fledging), and October–January (winter). Although observers recorded the number of individual buzzards sighted, we only considered their presence/absence in each grid cell.

We used the Friedman repeated measures analysis of variance (F_r) to detect any difference in the relative abundance among months and among periods. Using the same test, we evaluated if the number of flying or perched buzzards varied among months or periods. We used the Kruskal-Wallis test to detect any difference in the relative abundance among routes and the Mann-Whitney U test to ascertain whether flying buzzards were observed more frequently than perched buzzards. We used the arcsin-transformation to convert the proportion of sightings composed of buzzard groups. The Kolmogorov-Smirnov one-sample test (Z) was used to examine if the distribution of relative frequencies was uniform. Finally, we used a stepwise logistic regression to deter-

Table 2. Summary of logistic regression models exploring relationships between habitat types and Common Buzzard presence during four periods (Pollino National Park, southern Italy, 2000–01).

	Courtship		Incubation and Nesting		Post-fledging		Winter	
	P[a]	Exp (B)[b]	P	Exp (B)	P	Exp (B)	P	Exp (B)
Arable land	0.46	0.52	0.82	1.25	0.36	3.01	0.89	1.11
Heterogeneous agricultural areas	0.87	1.10	0.74	1.29	0.46	2.21	0.70	1.29
Forests	0.66	1.29	0.80	1.19	0.34	0.31	0.57	0.69
Shrub or herbaceous vegetation	0.83	1.14	0.53	1.60	0.20	3.79	0.80	0.84

[a] P = statistical significance of the Wald statistic, a chi-square distribution used to ascertain if a variable is a significant predictor of the outcome (presence or absence of buzzards; Field 2000).

[b] Exp (B) = indicator of the change in odds (probability of an event occurring divided by the probability of that event not occurring) resulting from a unit change in the predictor (Field 2000).

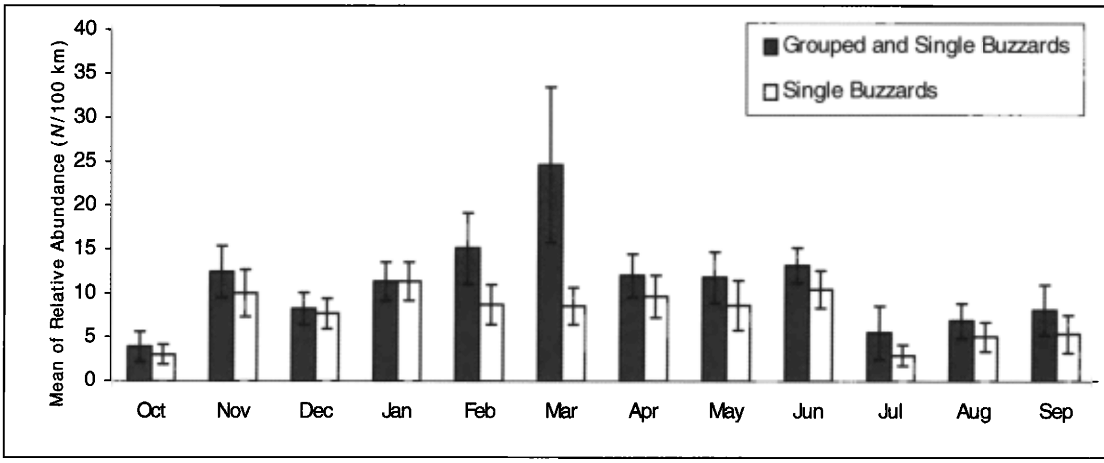

Figure 2. Monthly mean ±SD of the relative abundance of Common Buzzards recorded along seven routes in Pollino National Park, southern Italy (2000–01). The dark columns show the relative abundance calculated considering both grouped and single individuals; the white columns are the relative abundance calculated based on single individuals only.

mine whether the probability of detecting buzzards varied among the four cover types in each of the periods. Means are presented ±SD. The nonparametric tests were from Siegel and Castellan (1988), and the logistic regression analysis followed Field (2000). All of the statistical tests were performed with SPSS 10.0 (SPSS 2000).

RESULTS

During the study period, we recorded 328 buzzard sightings. The mean relative abundance per roadside survey was 11.1 ± 4.4 ($N = 84$) buzzards/100 km (Table 1). Buzzard abundance varied among months ($F_r = 23.1$; df $= 11$; $P < 0.05$; Fig. 2) and, marginally, among periods ($F_r = 7.6$; df $= 3$, $P = 0.054$). In particular, a post-hoc multiple comparisons test showed that the abundance was greater during the courtship period than in the other three periods and in the incubation-nesting period than in the winter ($P < 0.05$ for all comparisons). However, the relative abundance estimates showed a high variation for all periods (17.2 ± 11.9 for courtship, 10.2 ± 5.0 for incubation and nesting, 7.2 ± 4.3 for post-fledging, and 9.0 ± 2.4 for winter).

We found no difference ($\chi^2 = 10.3$; df $= 6$; $P = 0.11$) in abundance among routes, although the survey routes crossed different land cover types. We detected more buzzards flying (87.2%) than perched (12.8%; $U = 1.5$; $N = 24$; $P < 0.0001$). The number of perched buzzards did not vary among months ($F_r = 15.6$; df $= 11$; $P > 0.05$), whereas the number of flying buzzards did ($F_r = 21.0$; df $= 11$; $P < 0.05$) (Fig. 3). In addition, the number of flying buzzards varied among periods ($F_r = 10.8$; df $= 3$; $P < 0.05$); during courtship, flying buzzards were more numerous than in all other periods (Multiple Comparison test $P < 0.05$).

Most buzzards detected (67.4%, $N = 221$) were alone, while 23.2% ($N = 76$) were paired and 9.4% ($N = 31$) were in larger groups, with a mean group size of 3.9 ± 0.6 individuals. The proportion of sightings composed of a group of buzzards showed a uniform distribution throughout the year, ranging from 0.4 in July to 0.0 in January ($Z = 1.5$; $N = 12$; $P > 0.05$).

No land cover variable entered the stepwise logistic regression discriminating between grid cells with or without buzzards, in any of the four periods of the year (Table 2).

DISCUSSION

The relative abundance of the study population was relatively stable throughout the year, apart from a peak during the courtship period (February–April). A possible explanation is that during the courtship period, many young buzzards return to their natal area. A high tendency for philopatric movements among dispersers has been recorded both in Common Buzzards (Walls and Kenward 1998) and other raptors (e.g., Ferrer 1993, Newton et al. 1994, Carter 2001). A second explanation for the observed increase in relative abundance may be linked more to buzzard behavior and detectability than to variations in actual population density. During courtship, buzzards participate in more aerial displays than in other periods, and are thus more detectable. This explanation is supported by the higher proportion of flying buzzards recorded during the courtship period, particularly in March, when all the detected individuals were flying (Fig. 3).

The decrease in relative abundance during the incubation and nesting periods is probably related to the fact

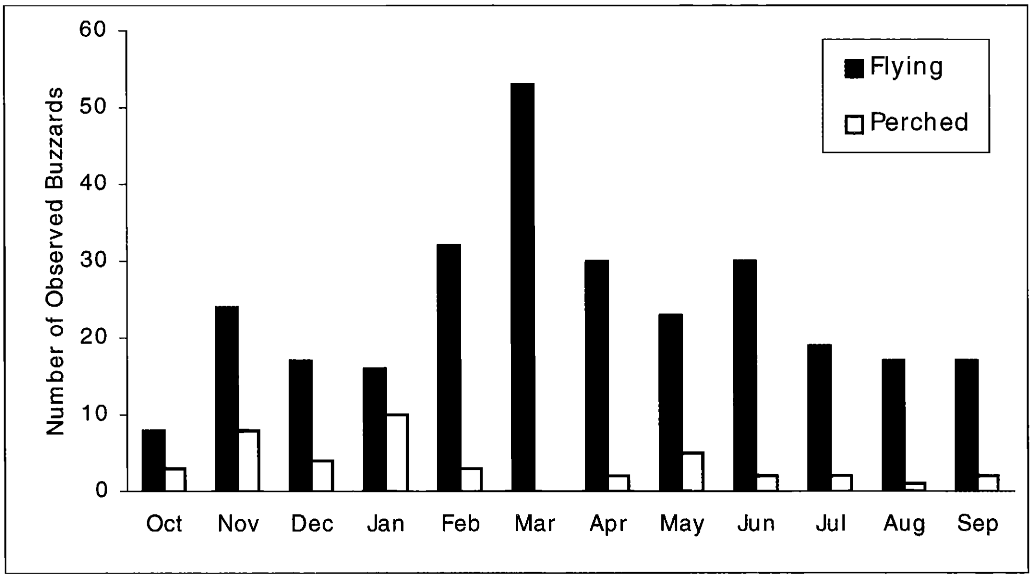

Figure 3. Total number of flying and perched Common Buzzards observed per month during vehicle surveys conducted at Pollino National Park, southern Italy in 2000–01.

that half of the breeding population were tending nests or were close to their nests most of the time. However, contrary to expectations, during the post-fledging period, when flying young join the adult population, the relative abundance was not higher than that estimated during the other periods. This could be caused by the relatively inconspicuous behavior of fledged buzzards that often are perched in the immediate neighborhood of the nest for several weeks after fledging (Tubbs 1974, Tyack et al. 1998). Moreover, because most natal dispersal usually occurs in the autumn (Picozzi and Weir 1976, Walls and Kenward 1998), it is possible that our survey methods underestimated fledged young during the post-fledging period.

In our study, buzzards did not show a preference for any land cover type during any periods of the year. This is supported by lack of variation among the seven roadside surveys, although these routes crossed different habitats. This lack of association with cover type may be due to the buzzard's high plasticity and varied diet (Cramp and Simmons 1979, Sergio et al. 2002). However, Sánchez-Zapata and Calvo (1999), Krüger (2002), and Sergio et al. (2005) found that buzzard breeding sites were linked to some landscape characteristics, particularly forest cover. There are three possible explanations for this discrepancy in results. First, the previous studies examined the relationship between habitat characteristics and nesting sites, while we examined the association of individual locations with land cover type. Second, we recorded buzzards when in flight or perched, whether they were hunting or involved in other activities. Finally, the disagreement could be related to the coarse scale of our landscape analysis. However, Sánchez-Zapata and Calvo (1999) found a linkage between buzzard nest sites and some landscape characteristics using a coarse-scale (1. 200 000) land use map.

In summary, our results showed that the relative abundance of a raptor population recorded by road counts may be sensitive to temporal behavioral changes, which ultimately affect detectability, thus biasing a potential assessment of seasonal variations in numbers. For this reason, roadside surveys would be a coarse method to monitor intra-annual population changes, or to compare the relative abundance recorded in different years, unless the data are collected in the same time period or season. On the other hand, we suggest further investigation into whether roadside surveys can be a useful tool for long-term monitoring of a population when comparing the same months in different years.

PATRONES ESTACIONALES EN LA ABUNDANCIA RELATIVA Y EL COMPARTAMIENTO DE *BUTEO BUTEO* EN EL PARQUE NACIONAL POLLINO, ITALIA

RESUMEN.—Se estudió la abundancia relativa de una población de *Buteo buteo* a lo largo de 12 meses en el Parque Nacional Pollino (sur de Italia) para comparar datos entre meses y para determinar las asociaciones de hábitat Realizamos censos mensuales en carreteras a lo largo de siete rutas (total = 315 km). La media anual de aves detectadas fue de 11.1 ± 4.4 individuos/100 km, aunque este valor varió significativamente entre meses. Esta varia-

ción probablemente reflejó la actividad de vuelo de *B. buteo* y no las fluctuaciones en el número de individuos durante el año, ya que la mayoría de los registros tuvieron lugar durante el período de cortejo. Con base en nuestros resultados, sugerimos que los censos realizados para esta especie a lo largo de carreteras son más efectivos durante el período reproductivo que en otras épocas, cuando los individuos realizan vuelos elevados con menor frecuencia. Finalmente, la presencia y la distribución de *B. buteo* dentro del parque no se asociaron con el tipo de cobertura del suelo.

[Traducción del equipo editorial]

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