Die Vogelwarte 39, 1998: 176–182

Reproduction and behaviour of the Long-legged Buzzard (*Buteo rufinus*) in North-eastern Greece

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Abstract: ALIVIZATOS, H., V. GOUTNER & M. G. KARANDINOS (1998): Reproduction and behaviour of the Long-legged Buzzard (*Buteo rufinus*) in North-eastern Greece. Vogelwarte 39: 176–182.

The breeding biology of the Long-legged Buzzard (*Buteo rufinus*) was studied in the Evros area, north-eastern Greece in 1989, 1990, 1992 and 1993. The mean number of young fledged per pair per year was similar between years with an overall average of 0.93 (1.58 per successful pair). Of ten home range variables examined, the number of alternative nest sites and the extent of forest free areas in home ranges were significant predictors of nestling productivity. Aggressive interactions were observed with 18 bird species (of which 12 were raptors), most commonly with the Buzzard (*Buteo buteo*). Such interactions declined during the course of the season. Prey provisioning to nestlings was greatest in the morning and late in the afternoon declining in the intermediate period.

Key words: *Buteo rufinus*, reproduction, behaviour, Greece.

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1. Introduction

The Long-legged Buzzard (*Buteo rufinus*) is a little known raptor of Europe. Published information (PETROV 1964, CRAMP & SIMMONS 1980, MICHEV et al. 1984, FRUMKIN 1986, VATEV 1987, DUDAS & SANDOR 1993) is generally limited and descriptive and quantification of behavioural aspects is lacking. It is a medium-sized raptor with the female being slightly heavier than male (means 1035 g vs. 1314 g), with strong plumage variation (CRAMP & SIMMONS 1980). The breeding distribution of the nominate race *rufinus* extends from the Balkans through Turkey to Russia. This species favours open uncultivated areas with bushes and trees and also cliffs in proximity to open foraging sites. Food includes small mammals, reptiles, birds and large insects (TUCKER & HEATH 1994). The breeding population of Greece consists of about 150–250 pairs (HALLMANN, pers. comm.), of which about 10% occur at its north-eastern border, the Evros Province. This area supports unique populations of raptors constituting an internationally important area for their conservation. Therefore, there has been an increasing interest for its appropriate conservation and management. Objectives of this study were a) to acquire information on the breeding biology of the Long-legged Buzzard in Evros and b) to investigate the relationships of its nestling productivity to home range characteristics.

2. Study area and methods

The study area was in the Evros Province area (40°44' - 41°15' N and 40°53' - 26°8' E) in north-eastern Greece with a relief varying from 10 to 800 m above sea level. It is made up of lowlands more prominent in the far eastern portion of the area, in the valley of the river Evros. Lowlands include extensive cultivations, woodland, scrub and open uncultivated areas. Hilly country, covered by extensive pine and oak forests and scrub interspersed with openings and many streams, lies in the western-central part of the province. Woodland included plants such as *Pinus brutia, P. nigra, Quercus conferta, Q. pubescens, Q. cerris, Erica arborea, Phillyrea media, Arbutus andrachne* and *Juniperus oxycedrus.* A part of this area, known as „Dadia forest", including two core areas totaling about 7300 ha has been declared a wildlife reserve. In Evros the breeding raptor populations, in addition to the Long-legged Buzzard, include Black Vulture (*Aegypius monachus*), Griffon Vulture (*Gyps fulvus*), Egyptian Vulture (*Neophron percnopterus*), Golden Eagle (*Aquila chrysaetos*), Lesser Spotted Eagle (*A. pomarina*), Short-toed Eagle (*Circaetus gallicus*) and others.

Data on the breeding biology of 16 Long-legged Buzzard pairs were collected from March to July in 1989, 1990, 1992 and 1993. Observations were made using binoculars and a telescope from distances of 100–300 m from the nest sites. A total of 378 hours was spent to quantify aspects of breeding behaviour such as territorial and interspecific interactions, nest building, activities during incubation and prey provisioning to nestlings. The home ranges of individual pairs were plotted and measured on maps, based on extensive observations of activities and interactions of neighbouring pairs. These areas were used successively over the course of the study by the same pairs whose members were identified by plumage characteristics. Fourteen variables were measured in the home ranges studied (Table 1). All habitat variables were taken from 1:5000 topographical maps. In order to identify a probable dependence of nestling productivity on home range variables, ten of them, namely NNESTS (number of nests in a home range), EXT (area of home range), EH (area of human habitations), LAR (total length of paved roads), LSR (total length of dirt roads), DSR (mean nest distance from nearest dirt road), FFA (forest free areas), AR (maximum altitudinal difference in home ranges), RA (rocky areas) and UA (uncultivated open areas), were used as independent variables in a stepwise multiple regression with the mean nestling productivity (mean number of nestlings fledged per home range during the study) as the dependent variable. A correlation matrix of the above mentioned log-transformed independent variables indicated high correlations occurred between EXT and LAR and also between them and other variables, so these were excluded from this analysis (ZAR 1984). The independent variables were standardised by subtracting the mean and dividing by the standard deviation, but the dependent variable was log(x+1) transformed as standardisation of depended variables is not recommended (FRY 1993). The mean nestling productivity was compared among years using the analysis of variance on log(x+1) transformed data.

Particular thanks to the wardens of the Dadia reserve P. BABAKAS and K. PISTOLAS for aid in the field and to K. SAITANIS for helping with the data computation.

3. Results and discussion

3.1. Habitat and breeding output

Long-legged Buzzards' home ranges were found in varying altitudes, included cliffs, forest free and uncultivated areas (Table 1). All had dirt roads, nine had parts of paved roads and five included human habitations of very limited extent. The mean distance of nests to dirt roads was considerably

Table 1: Habitat variables measured in Long-legged Buzzard home ranges (N = 16) in North-eastern Greece.
Tab. 1: Variabilität einiger Habitat-Merkmale in den Aufenthaltsgebieten von 16 Adlerbussarden im nordöstlichen Griechenland.

Variable	Mean ± SD	Range
Number of nests in home range (NNESTS)	1.8 ± 1.1	1 – 4
Area of home range (EXT) (km²)	6.9 ± 3.5	3.0 – 14.0
Forest free areas (FFA) (km²)	3.72 ± 2.58	0.80 – 9.00
Uncultivated open areas (UA) (km²)	1.84 ± 1.15	0.50 – 4.00
Maximum altitudinal difference in home ranges (AR) (m)	144 ± 61	20 – 262
Rocky areas (RA) (km²)	0.13 ± 0.13	0.02 – 0.50
Area of human habitations (EH) (km²)	0.03 ± 0.06	0.00 – 0.20
Mean nest distance from nearest habitations (DNH) (km)	0.712 ± 0.261	0 – 0.800
Total length of dirt roads (LSR) (km)	1.4 ± 1.0	0.5 – 4.0
Mean nest distance from nearest dirt road (DSR) (m)	234 ± 187	90 – 800
Total length of paved roads (LAR) (km)	0.4 ± 0.5	0.0 – 2.0
Mean nest distance from nearest paved road (DAR) (km)	0.90 ± 0.64	0.30 – 2.05
Mean nest distance from nearest stream (DNS)* (m)	327 ± 236	60 – 1950
Mean nest distance from nearest European Suslik colony (DNSp)** (km)	1.03 ± 0.40	0.40 – 1.55

* Streams occurred in 13 home ranges; ** European Suslik colonies occurred in 10 home ranges.

shorter to that from paved roads. The occurrence of roads and human habitations in this species' home ranges may in part suggest an adaptability to the human activities of the area, supported by the fact that such features may be lacking from territories of other raptors in the area (ADAMAKOPOULOS et al. 1995). Thirteen home ranges included waterbodies and ten European Suslik (*Spermophilus citellus*) colonies, a small mammal, being the most important prey of Long-legged Buzzards in Evros (49% of the total biomass taken, ALIVIZATOS & GOUTNER in press).

In 44 nesting attempts observed during the four study years 26 (59%) were successful. Highest success of nesting attempts took place in 1992 and lowest in 1993. The mean production of young per successful pair was 1.58 and there was no significant difference among study years (ANOVA, $F = 0.266$, ns, data log-transformed). The mean overall production per pair was 0.93 without significant differences among years (ANOVA, $F = 1.868$, ns, data log-transformed) (Table 2).

The main cause of breeding failure, in the 18 unsuccessful nesting attempts, was predation of nestlings (72%) and, to a lesser extent, disturbance (17%) due to wood cutting (two cases) and rubbish dumping (one case) in the vicinity of nests. Predation was probably due in part to the Eagle Owl (*Bubo bubo*) which has been reported to eat Common Buzzards (*Buteo buteo*) and other raptors in the study area (PAPAGEORGIOU et al. 1993). Some pairs (11%) were observed at the onset of breeding at nests but finally did not breed.

The stepwise multiple regression analysis with eight independent variables indicated that the mean nestling productivity of the Long-legged Buzzard was statistically only related to the number of nests in the home ranges (NNESTS) and the forest free areas (FFA) (breeding success = 0.229 + 0.099 * (NNESTS) + 0.084 * (FFA), $R^2 = 0.646$, $F = 11.88$, $P < 0.002$, $df = 15$). Taken alone, these two variables explained 41.9% and 22.7% of the variance, respectively.

Multiple nest sites in raptors' territories may provide advantages of breeding alternatives to these birds. For example, as a response to disturbance to a nesting site, the Ferruginous Hawk (*Buteo regalis*) may move their nests to alternative sites in subsequent seasons (FYFE & OLENDORFF 1976). In part of our study area, the territories of Lesser-spotted Eagle (*Aquila pomarina*) had up to four alternative nest sites, 300–500 m distant. If breeding failed in one year, the eagles used an alternative nest site in the next (VLACHOS 1989). In the Peregrine Falcon (*Falco peregrinus*) studied in the south-eastern highlands of temperate Australia, the occupancy of territories by pairs was negatively affected by flooding of nests by rainfall, so that territories with alternative nest sites had a longer egg laying period resulting in a higher nestling productivity (OLSEN & OLSEN 1989).

The effect of plant cover on the suitability of buzzards' foraging sites seems to be quite important. Cultivated fields with high vegetation cover present in the home ranges of Swainson' s Hawk (*B. swainsoni*) though supporting large amounts of prey, were not hunted until harvested (BECHARD 1982). Forest openings and roads occur in territories of the Red-tailed Hawk (*B. jamaikensis*) used as hunting areas (SPEISER & BOSAKOWSKI 1988). Common Buzzard nests made in wooded areas are

Table 2: Breeding output of the Long-legged Buzzard in Evros.
Tab. 2: Bruterfolg des Adlerbussards in der Evros-Provinz.

	1989	1990	1992	1993	Totals	Mean ± sd
Nesting attempts	5	12	13	14	44	11 ± 4
% successful nesting attempts	40.0	66.7	84.6	35.7	59.1	56.7 ± 23.1
No of young fledged	4	13	16	8	41	10 ± 5
Mean no of young fledged per successful attempt	2.0	1.6	1.4	1.6	1.58	1.6 ± 0.2
Mean no of young fledged per nesting attempt overall	0.8	1.1	1.2	0.6	0.93	0.9 ± 0.2

preferably placed near forest openings a fact partly attributed to the use of such openings as foraging areas (JĘDRZEJEWSKI et al. 1988, HUBERT 1993). Use of open foraging habitats is reflected in of Long-legged Buzzard' s diet both in our study area (ALIVIZATOS & GOUTNER in press) and other areas (PETROV 1964, VARSHAVSKY 1973, FRUMKIN 1986). The important contribution of the forest-free (open) areas to breeding success of Long-legged Buzzards can be attributed to the fact that these birds exclusively used such habitats for foraging.

As a cliff nester, the Long legged Buzzard is dependent on the occurrence of rocky cliffs in its breeding territories. The relative importance of rocky areas in cliff nesting raptors varies: for example, this may not be a limiting factor in the Golden Eagle (*Aquila chrysaetos*) (TJERNBERG 1985) but may well be in the Egyptian Vulture (*Neophron percnopterus*) (CEBALLOS & DONÁZAR 1989). Independence of breeding success of Long-legged Buzzard from the extent of rocky areas may mean that rocky areas *per se* cannot be considered as an important determinant of breeding productivity without taking into account other factors such as exposure which may determine the suitability of the site (SPEISER & BOSAKOWSKI 1988, BECHARD et al. 1990). Exposure of Long-legged Buzzard nests was not random (ALIVIZATOS unpubl.) which means that microhabitat characteristics may have also determined the suitability and quality of nest sites and home ranges in general.

The size of the population in the study area is similar to that in the past 15–20 years (HALLMANN pers. comm.). The dynamics of the breeding population of the Long-legged Buzzard needs further long-term study but population stability may be due to that cliffs, their main nesting habitat, are not subjected to considerable changes through years and to that human interference in the environment of the Evros Province has been generally low.

3.2. Breeding behaviour

In total, 16 pairs of the Long-legged Buzzard were found in the study area. Breeders arrived in their territories in early April. At least some of the breeding pairs were present in their territories by late March. The first displays, copulations and branch carrying for nest building were observed at 21 March. Nests were made mainly on rocky cliffs. Territories had one to four nests with an average of 1.8 (Table 1). Multiple nests for Long-legged Buzzards are only known from DUDAS & SANDOR (1993). The start of the breeding activities and duration of the laying period (late March to mid-April) was similar to these known for other areas (DEMENT'EV & GLADKOV 1966, MICHEV et al. 1984, FRUMKIN 1986, CRAMP & SIMMONS 1980). Six cases of carrying of material for nest repair were to-

Table 3: Occurence of interactions (N = 47) of breeding Long-legged Buzzard with other birds.
Tab. 3: Beobachtete Interaktionen (n = 47) zwischen Adlerbussard und anderen Vogelarten während der Brutzeit.

Species	Number of interactions*
Buzzard (*Buteo buteo*)	10
Jay (*Garrulus glandarius*)	7
Kestrel (*Falco tinnunculus*)	5
Raven (*Corvus corax*)	5
Hooded Crow (*Corvus cornix*)	4
Black Kite (*Milvus migrans*)	3
Magpie (*Pica pica*)	2

* Interactions with the following species occurred only once: Sea Eagle (*Haliaeetus albicilla*), Egyptian Vulture (*Neophron percnopterus*), Black Vulture (*Aegypius monachus*), Short-toed Eagle (*Circaetus gallicus*), Marsh Harrier (*Circus aeruginosus*), Levant Sparrowhawk (*Accipiter brevipes*), Lesser Spotted Eagle (*Aquila pomarina*), Booted Eagle (*Hieraeetus pennatus*), Eleonora' s Falcon (*Falco eleonorae*), Woodchat Shrike (*Lanius senator*), Red-backed Shrike (*L. collurio*).

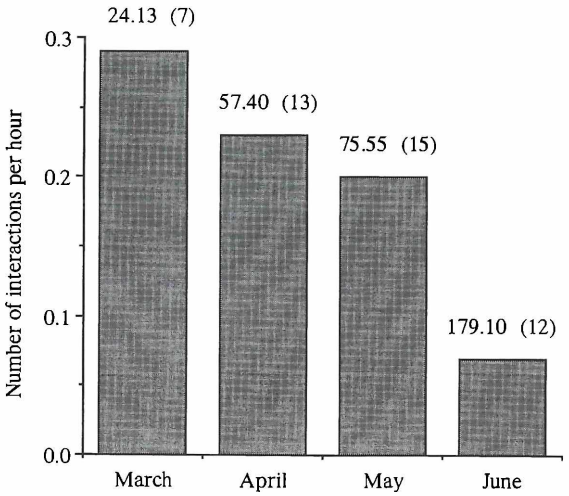

Fig. 1: Interactions per hour of the Long-legged Buzzard during the breeding season in Evros. Numbers above columns: decimal is the number of hours of observation; number in parenthesis is the number of interactions recorded. Data from all study years, compiled.

Abb. 1: Anzahl beobachteter Interaktionen im Verlauf der Brutzeit beim Adlerbussard in der Evros-Provinz. Dezimalzahl über den Säulen = Anzahl der Beobachtungsstunden, Zahl in Klammern = Anzahl erfaßter Interaktionen (Daten aller Jahre zusammengefaßt).

tally observed in the morning hours (09.00–10.00) (East-European Summer-Time) before egg-laying. No nest material was carried to nests earlier (06.00–09.00) or later (10.00–20.00). During the nestling period some females occasionally carried small, leafy branches to the nest. Pairs with more than one nest in their territory, carried nesting material to more than one (up to 3) nests before using one of them. The diameter of seven nests averaged 71 ± 4 (SD) cm (range 65–75 cm), height 13 ± 8 cm (5–25 cm) and depth 3 ± 1 cm (2–5 cm). The range of nest height measured was distinctly lower than that mentioned elsewhere (35–50 in DEMENT'EV & GLADKOV 1966; 20–46 in VATEV 1987) most likely because these nests were relatively new so there was not accumulation of nest material as occurs in old raptors' nests. In five pairs occasional meeting of the occupants occurred. In such circumstances, the pairs generally behaved non-aggressively and, in only one case of two pairs nesting about 1 km apart (the closest in the area), there were aggressive interactions (N = 4). Aggressive interactions with 18 other bird species were observed (of which 12 raptors) on 47 occasi-

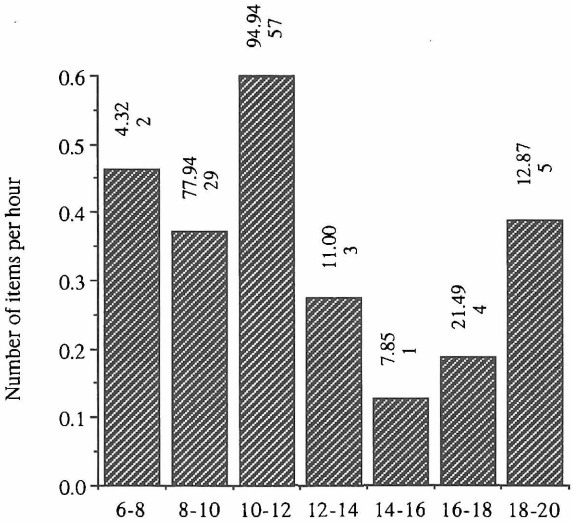

Fig. 2: Prey provisioning (prey items per hour) to Long-legged Buzzard nestlings in the course of the day in Evros. Numbers above columns: decimal is the number of hours of observation; integer is the number of items recorded. Data from all study years, compiled.

Abb. 2: Fütterung von Adlerbussard-Nestlingen (Anzahl der überbrachten Beuteobjekte pro Stunde) bezogen auf die Tageszeit in der Evros-Provinz. Dezimalzahl über den Säulen = Anzahl der Beobachtungsstunden, Zahl darunter = Anzahl erfaßter Beuteobjekte (Daten aller Jahre zusammengefaßt).

ons (Table 3), most frequently (21.3%) with the Common Buzzard. Interactions with species such as Magpies, Ravens, Kestrels and other raptors have also been observed in the Golden Eagle (COLLOPY & EDWARDS 1989). Interactions declined gradually as the breeding season progressed (Fig. 1) a fact probably related to hormonic reasons (CATHPOLE & SLATER 1995).

Incubation was carried out by both sexes. Males were seen to bring food to the incubating female on only two occasions. A ritual of prey offering by the male to the female, as the former took over incubation (VATEV 1987) was never observed in this study. During 230 hours of observations at six nests a total of 101 prey items were carried to nestlings giving an overall average of 0.44 items per hour. However, there were differences in the rate of prey provisioning at these nests during the course of the day: highest rates were observed in the morning (especially between 10.00 and 12.00 hrs) dropping between 12.00 and 18.00 hrs, giving a peak in the late afternoon (18.00–20.00 hrs) (Fig. 2). The peak of prey provisioning during certain periods, particularly in the morning, was probably due to an increased activity of prey species, particularly reptiles (HELMER & SCHOLTE 1985) given that the diet of Long-legged Buzzard in the study area constituted by 27% by reptiles, in terms of biomass (ALIVIZATOS & GOUTNER in press). An increased prey provisioning activity in morning hours has also been observed in the Short-toed Eagle (PETRETTI 1988), a reptile eater.

In conclusion, the breeding productivity of the Long-legged Buzzard appears to be affected by home range quality. In these areas hunting takes places mainly during the morning and late afternoon and conflicts occurring with several species (mainly with the Buzzard) declined as season progressed.

5. Zusammenfassung

In den Jahren 1989, 1990, 1992 und 1993 wurden in der Evros-Provinz im nördöstlichen Griechenland Beobachtungen zur Brutbiologie und zum Verhalten des Adlerbussards (*Buteo rufinus*) durchgeführt. Es wurden im Mittel aller Jahre 0,93 Jungvögel pro Paar bzw. 1,58 Nestlinge pro erfolgreichem Paar flügge. Der Bruterfolg zeigte einen signifikanten Bezug zur Anzahl vorhandener Nistplätze und zum Anteil waldfreier Fläche im jeweiligen Aufenthaltsgebiet. Streitigkeiten wurden zwischen Adlerbussarden und 18 anderen Vogelarten – darunter 12 Greifvogelarten – beobachtet, am häufigsten zwischen Adlerbussard und Mäusebussard. Die Aggressionsbereitschaft ließ im Verlauf der Brutsaison nach. Die Nestlinge wurden am häufigsten morgens und spät nachmittags mit Beute versorgt.

6. Literature

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