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Breeding Biology and Feeding of the Lesser Spotted Eagle *Aquila pomarina* in Dadia Forest, North-Eastern Greece

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INTRODUCTION

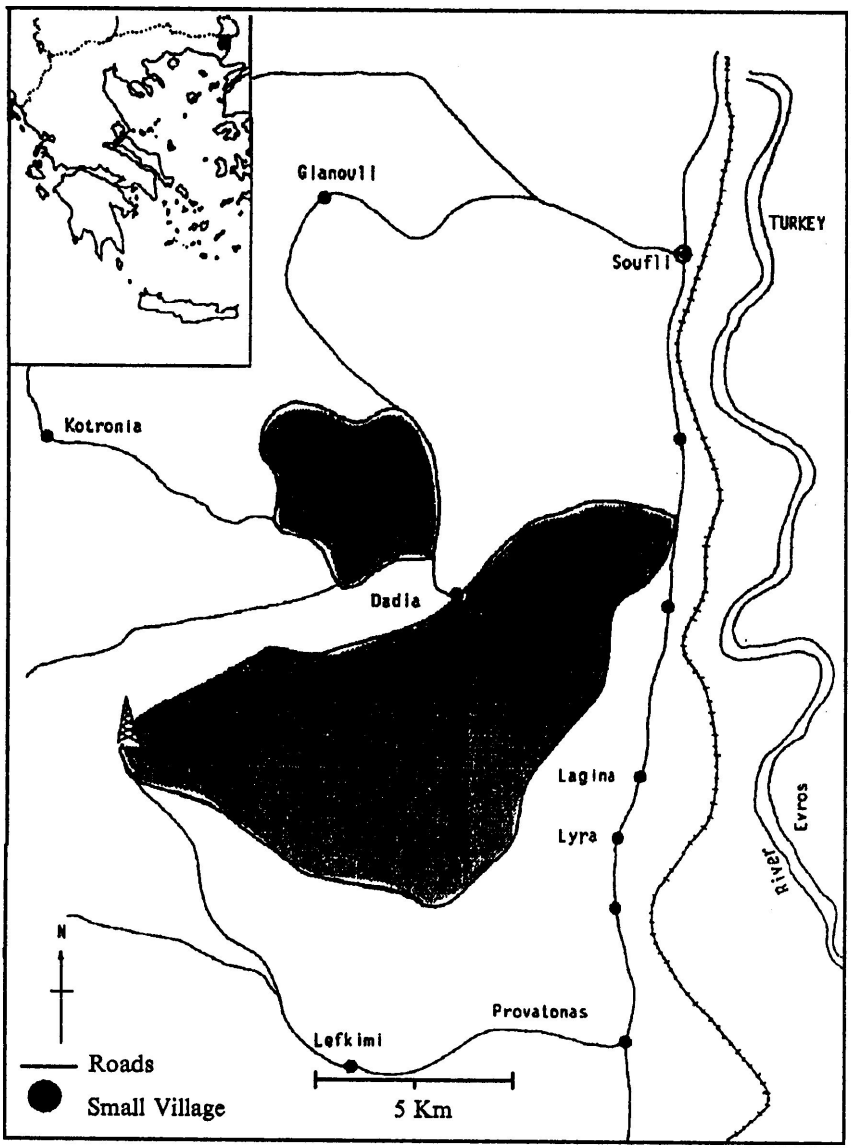
Northern Greece is the southern limit of the breeding range of the Lesser Spotted Eagle *Aquila pomarina* in Europe (Glutz 1971). However, accounts of its breeding biology and feeding habits have not so far been published. Hallman (1979) in a preliminary report described the importance of the Evros area, and especially Dadia forest, for wildlife conservation and gave some information about the Lesser Spotted Eagles breeding numbers.

During recent decades, major changes in the landscape of the Evros area have occurred, due to new agricultural practices, intensive exploitation of the forests and reduction of livestock. These alterations had significant effects on the birds of prey and their protection was seriously threatened. In order to propose a sound and realistic management plan for the conservation of the raptor populations in the area, our laboratory, in co-operation with the Greek Forest Service, initiated a long-term research programme in 1985.

This study was carried out from April 1985 to September 1987 in Dadia forest with the following objectives:

a) to estimate the number and distribution of Lesser Spotted Eagle breeding pairs.
b) to determine the characteristics of its nest trees and nest sites.
c) to determine its breeding cycle and success.
d) to determine its food habits.

Figure 1. Study area.



STUDY AREA

Dadia Forest is located in the north-eastern part of the Prefecture of Evros (Fig. 1) and has been declared a wildlife reserve since 1980.

The unique feature of the area is that 20 different species of birds of prey breed here, which makes the reserve not only of national but of international importance (Table 1).

Table 1. Nesting pairs of raptors in Dadia forest during 1987.

Species	Number of pairs
Aquila pomarina	18-20
Circaetus gallicus	13-16
Aquila chrysaetos	4-5
Aquila heliaca	1
Haliaeetus albicilla	1
Neophron percnopterus	20-25
Aegypius monachus	12-15
Gyps fulvus	8-10
Pernis apivorus	2-4
Accipiter gentilis	10-15
Accipiter nisus	5-10
Hieraaetus pennatus	8-10
Falco biarmicus	1
Milvus migrans	?
Falco subbuteo	?
Falco peregrinus	?
Falco naumanni	?
Falco tinnunculus	?
Buteo rufinus	5-10
Buteo buteo	15-20

? Breeding pairs unknown.

The reserve covers an area of about 7,000ha and is part of a large forest complex of about 40,000ha. Its elevation starts at 50m, rising to 800m.

The climate is maritime with a dry summer and cold winter. Available data indicate that during the study period (1985-1987) the mean monthly temperature from March to August (breeding period) was 18.7°C with minimum and maximum of 3.8°C (March) and 25.6°C (August). The mean monthly precipitation during the above period was 39.5mm, with minimum

and maximum of 0 mm (August 1986) and 106.9mm (June 1985) respectively.

The main plant species are: *Pinus brutia, P. nigra, Quercus conferta, Q. pubescens, Q. sessiliflora* and *Q. cerris*. Other species present are *Erica arborea, Philirea media, Arbutus andrachne, Juniperus oxycedrus*, etc.

Apart from the raptors, the area supports a large number of different species of birds (100), mammals (20) and reptiles (21). The most important are: *Ciconia nigra, Merops apiaster, Dendrocopus syriacus, Canis lupus, Felis sylvestris, Lutra lutra, Citellus spermofilus, Martes foina, Vipera ammodytes, Vipera xanthina, Podarcis erhardii* and *Lacerta trilineata*. The surrounding area includes: a) low ground of moderate to high fertility with mixed farms, scattered woods and villages and b) high ground with open grassland grazed by sheep and mixed forest of conifers and oaks.

METHODS

Search for nest trees was conducted on foot by direct observation throughout the study area. From each nest tree the height, age, diameter at breast height (d.b.h.) and height of the nest were recorded. The eagle's breeding habitat requirements were determined by analysis of the vegetation surrounding each nest tree within 30m and 1km respectively.

The population density of the reptiles and turtles was estimated, using the transect method in six different biotopes (area of non-intensive agriculture, shrubland within strips of cultivated pasture, closed and open pine forest, and degraded oak (forest).

The eagle's diet was determined by collecting prey remains and pellets from the nests. The pellets were analysed in the laboratory. Prey items were identified by reference to museum collections.

RESULTS AND DISCUSSION

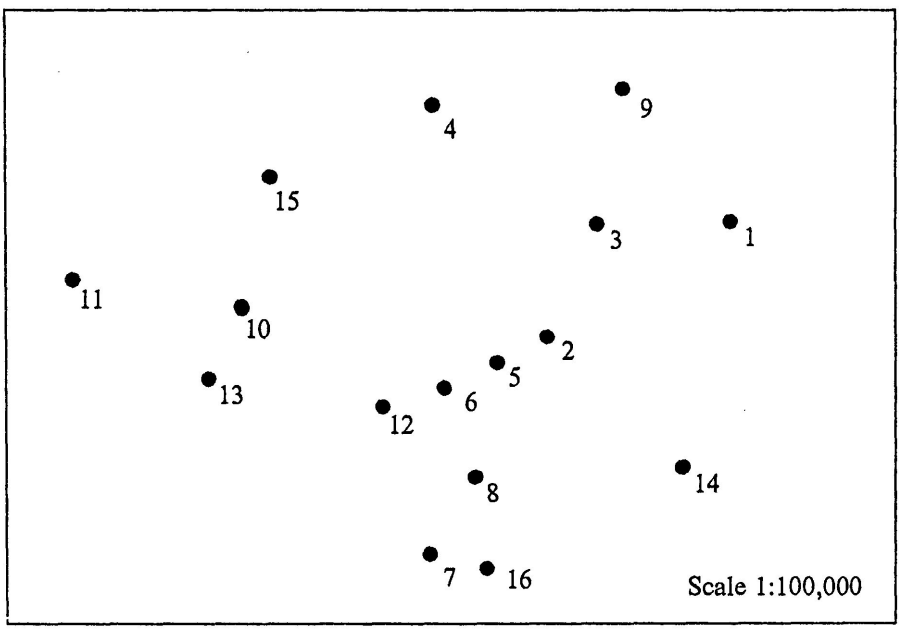
Breeding biology

In the surveyed area (12,000ha) 16 Lesser Spotted Eagle pairs were found in all (1 pair/750ha). The nests were located at elevations ranging from 100-300m. The minimum distance between active nests ranged from 1.3 to 4.3km and their mean distance apart was 2.6km (Fig. 2). As is shown in Table 2, the species prefers for nesting old pines (*Pinus brutia* 75% and *P. nigra* 25%) with a mean height of 13.5 ± 3.9m, d.b.h. 41.6 ± 9.3cm, and age 71 ± 16.6 years.

Table 2. Characteristics of nest trees.

Number of nest	Species	Height (m)	D.b.h. (cm)	Age	Nest height (m)
1	*Pinus brutia*	12.0	38.0	80	9.5
2	*P. nigra*	13.0	36.5	65	13.5
3	#	6.5	41.0	45	6.5
4	*P. brutia*	16.0	57.5	65	10.0
5	#	22.0	51.0	75	11.0
6	#	12.0	44.0	85	4.5
7	*P. nigra*	10.0	51.0	95	6.5
8	*P. brutia*	12.5	39.0	76	6.5
9	#	14.0	45.0	70	8.0
10	*P. nigra*	21.0	57.0	80	13.0
11	*P. brutia*	12.5	42.0	100	7.0
13	#	14.0	30.0	70	8.0
14	#	9.0	25.0	35	3.0
15	#	14.6	39.0	39	7.6
16	#	15.0	41.0	59	9.0
Average		13.5 + 3.9	41.66 + 9.29	71.25 + 16.6	8.29 + 2.78

Figure 2. Distribution of nests of Lesser Spotted Eagle in the study area.

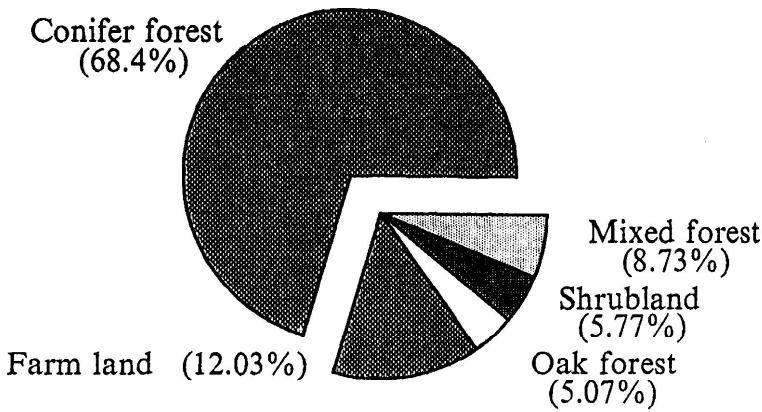


The nests were in small valleys and their mean distance from the edge of the wood was 3.5km. Only four nests (25%) were found near the edge (< 150m).

The number of alternative nests per nest site ranged from 1 to 4 with a distance of 300-500m between them.

Vegetation analysis around each nest tree showed that: a) within a radius of 30m the stands (including the nest tree) had an open canopy (< 70%), a density of 150 trees/ha, d.b.h. 35.8 ± 6.0cm and height 14.4 ± 2.8m; b) within a radius of 1km, the habitat consisted of conifer forest (68.4%), farmland (12.0%), shrubland (5.8%), mixed forest (8.7%) and oak forest (5.0%) (Fig. 3).

Figure 3. Vegetation analysis (%) within a radius 1 km around each.

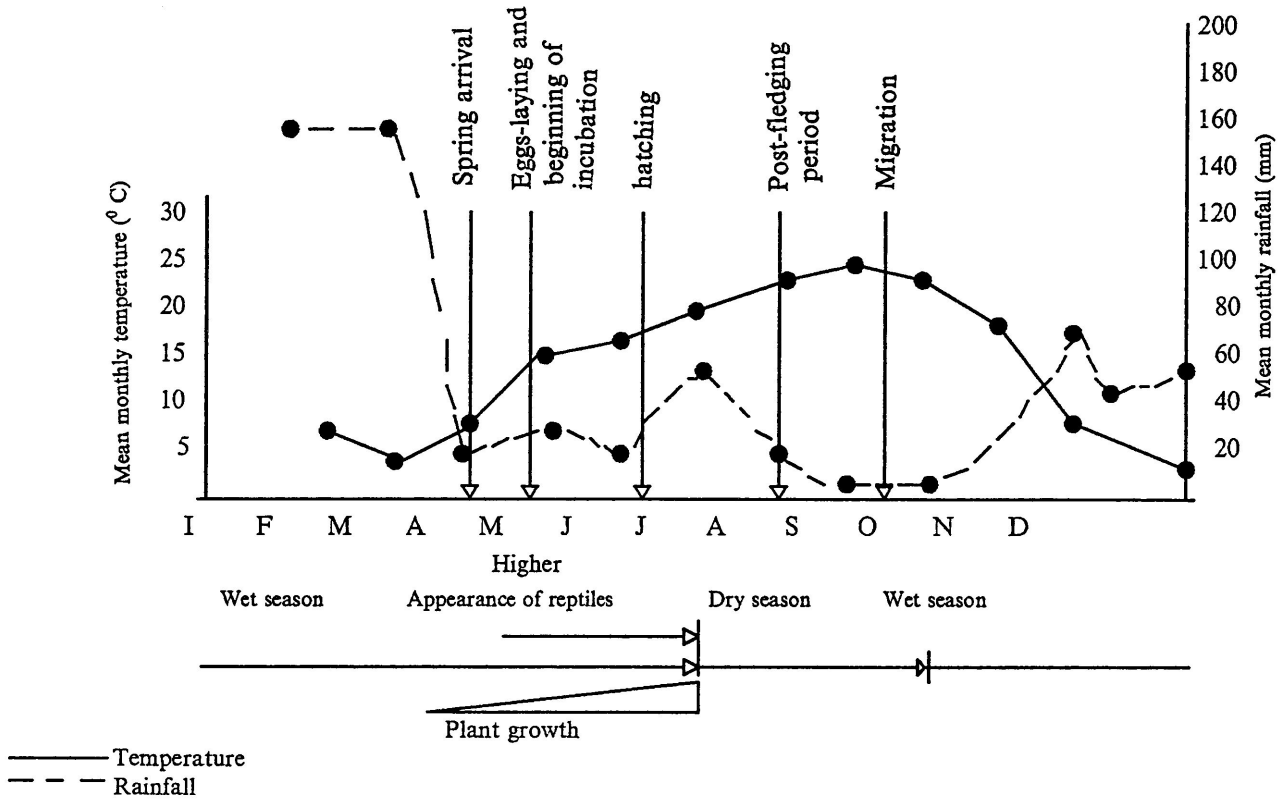


The data of the present study show that the breeding habitat of the Lesser Spotted Eagle in its southern range differs from that found in its northern and eastern ranges. A review of the literature shows that while the species breeds in eastern Europe (Germany, Poland and Russia) mainly in wet and low-lying forests and woodlands bordered by marshy meadows, in Dadia it prefers dry, semi-montane open pine forests and avoids stands of oak and beech.

The annual breeding cycle is given in Figure 4. The data show that the species arrives in the study area at the beginning of April and the laying period starts between 20 and 30 April. The hatching date, after an incubation period of 42-43 days, was estimated to be the beginning of May.

The research of 1985, 1986 and 1987 showed that the average size of 18

Figure 4. Breeding annual cycle of Lesser Spotted Eagle in Dadia forest.



clutches was 1.6, 1.8 and 1.5 respectively (Table 3), while nesting success was 70%, 76% and 56% respectively (Table 4). Similar figures were reported by Goloduschko (1961) and Meyburg (1970).

Table 3. Clutch size of Lesser Spotted Eagle in Dadia Forest (1985-1987)

Year	Number of breeding pairs	Number of nests with 1 egg	2 eggs	Average clutch
1985	10	4	6	1.6
1986	13	3	10	1.8
1987	*18	8	10	1.5

* Two nests were found outside the study area.

Table 4. Breeding success of Lesser Spotted Eagle in Dadia forest (1985-1987)

Year	No. of breeding pairs	No. of nests with 1 newly hatched young	2 newly hatched young	Fledglings	Mean number of young	breeding success %
1985	10	3	5	7	0.70	70
1986	13	3	9	10	0.76	76
1987	*18	6	8	10	0.56	56

*Two nests were found outside the study area.

The lower nesting success in 1987 (56%) was probably due to the bad weather conditions that prevailed during the rearing period of the young (<3 weeks). As a result, both parents were leaving their nests unattended for long periods, searching for food, mainly reptiles, which were inactive and temporarily unavailable. Furthermore, the young were more vulnerable to predators, which is believed to be the reason for five young found dead in their nests, probably killed by wild cats.

Food habits

A total of 101 pellets were collected throughout the 3-year study period.

The general food categories found in the examined pellets are listed in Figure 5. The data show that the eagle's staple diet was snakes (70.6%) followed by birds (57.6%), lizards (52.6%), insects (40.3%) and rodents (22.0%).

The principal prey by frequency of occurrence (Table 5) was the Grass Snake *Natrix natrix*, found in 42.3% of the pellets examined. Other major

species identified were lizards (*Lacerta* sp.) (24.9%), grasshoppers (24%), Montpelier Snake *Malpolon monspesulanus* (21%) and Leopard Snake *Elaphe situla* (10.4%).

Other species such as European Souslik *Spermofilus citellus*, Hedgehog *Erinaceus europaeus* and Wood Mouse *Apodemus sylvaticus* also comprised part of the diet.

Table 5. The most important prey items in the diet of the Lesser Spotted Eagle in Dadia Forest (1985-1987).

Species	1985*		1986**		1987***	
	No. of pellets in which given species found	Frequency of occurrence %				
	(A)	(B)	(A)	(B)	(A)	(B)
Natrix natrix	15	35.71	15	46.87	12	44.44
Malpolon monspesulanus	7	16.66	10	31.25	4	14.81
Lacerta sp.	6	14.28	9	28.12	5	18.51
Grasshoppers	11	26.19	7	21.87	-	-
Elaphe situla	2	4.76	5	15.62	3	11.11
Erinaeceus europeus	-	-	3	9.37	4	14.81
Apodemus sylvaticus	3	7.14	3	9.37	-	-
Lepus europeus	-		-	-	2	7.40
Spermofilus citelllus	2	4.76	-	-	2	7.40
Testudo sp.	2	4.76	1	3.12	2	7.40
Coluber sp.	2	4.76	1	3.12	-	-
Dryomys nitedula	-	-	-	-	2	7.40

* 42 pellets examined
** 32 pellets examined
*** 27 pellets examined

The high density of reptiles in the area (Fig. 6), making them an available and easy to capture food source, explains their frequency of occurrence in the eagle's diet. Herlmer and Scholte (1985) estimated the density of reptiles in the Evros area to be one of the highest in Europe.

Observed prey deliveries to the nest showed that frogs were a considerable part of the diet. However, their small representation in the pellets examined

Figure 5. The Percentage of occurrence of the most important groups of prey in the diet of Lesser Spotted Spotted Eagle in Dadia forest 1985-1987.

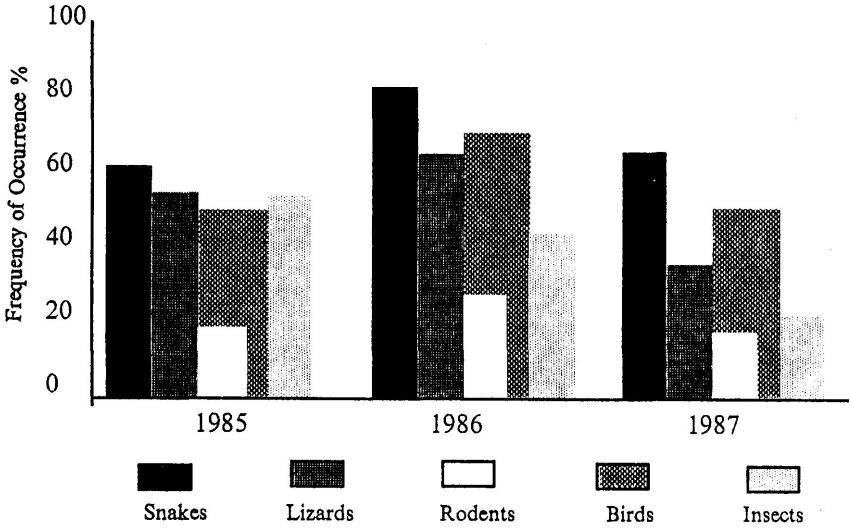
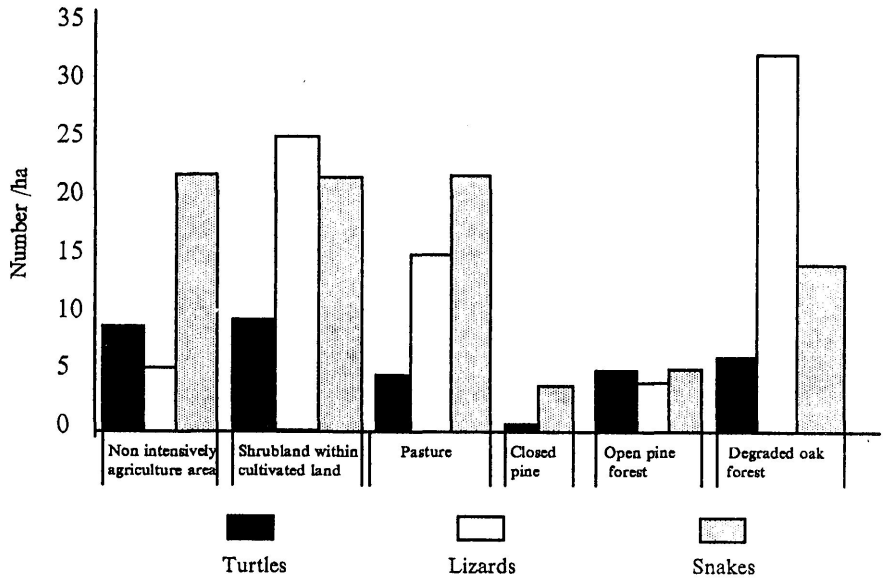


Figure 6. Density of reptiles in different biotopes in the study area.



was possibly due to their high digestibility.

Furthermore, the high proportion of insects found in the pellets may overestimate their significance as a food source, since a large part of them is thought to have been eaten by the reptiles.

Direct observations showed that the Lesser Spotted Eagle prefers for hunting non-intensively cultivated areas (52%) and shrubland (35%), followed by open forests (13%) - biotopes with a high density of reptiles.

CONCLUSION

The key for the future protection of the Lesser Spotted Eagle in Dadia forest, apart from sustaining a suitable number of nesting sites, must be habitat management, so as to continue to maintain a high density of reptiles, which form the main food source not only for the eagle but also for other birds of prey in the study area.

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