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A RAPTOR ROADSIDE SURVEY IN WESTERN TURKEY AND EASTERN GREECE

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ABSTRACT.—Roadside surveys were conducted in western Turkey and eastern Greece in April–May 1993 to determine the relative abundance of observed raptors. Ten diurnal species, as well as unidentified buzzards and unidentified harriers, and one nocturnal species were observed during 177 hr 30 min of observation over 4395 km travelled. Lesser kestrels (*Falco naumanni*), common kestrels (*F. tinnunculus*), common buzzards (*Buteo* spp.) and harriers (*Circus* spp.) were the most frequently observed species. More individuals ($N = 145$) and species ($N = 8$) were observed in agricultural lands than other habitat types. Indices of relative abundance were calculated for each species based on the number of individuals observed per kilometer travelled.

KEY WORDS: *Greece; raptor roadside survey; relative abundance; Turkey.*

Observación de rapaces en rutas del oeste de Turquía y el este de Grecia

RESUMEN.—Un estudio de ruta fue hecho en el oeste de Turquía y en el este de Grecia entre abril y mayo de 1993, para determinar la abundancia relativa de rapaces observados. Se observaron diez especies diurnas, incluyendo *Buteo* spp. y *Circus* spp. no identificados, y una especie nocturna, en un recorrido de 4395 km realizado en 177 hr 30 min. *Falco naumanni, F. tinnunculus, Buteo* spp. y *Circus* spp. fueron las especies observadas con mayor frecuencia. Se observaron más individuos ($N = 145$) y especies ($N = 8$) en tierras de uso agrícola que en otros tipos de hábitat. Se calcularon índices relativos para cada especie basados en el número de individuos observados por kilómetro recorrido.

[Traducción de Ivan Lazo]

Raptor population densities in Turkey and Greece, particularly Turkey, are poorly documented. Belkis et al. (1977) and Beaman and Porter (1985) summarized the status of 37 diurnal raptors known to winter or breed in Turkey. Vagliano (1977) reported on the status of 36 diurnal species in Greece and summarized their occurrence by habitat types. Cosson (1985) recorded six diurnal and two nocturnal species breeding on Rhodes and estimated relative abundance indices for the long-legged buzzard (*Buteo rufinus*). Additionally, the number of breeding pairs and population trends for the four vultures in Greece were estimated by Handrinos (1985), while Vagliano (1985) reported on little owl (*Athene noctua*) populations on Crete. Hallmann (1985) reported that 26 diurnal species breed in Greece, but provided no discussion of methods used to derive this population estimate. Handrinos and Demetropoulos (1983) estimated breeding pairs of 36 diurnal and eight nocturnal species in Greece, and Gensbol (1987) for 27 diurnal species in Greece and 28 diurnal species in Turkey, but again, no discussion of methods used to develop these population estimates were provided by the authors.

Relative abundance estimates have been widely used in raptor inventories and monitoring studies for investigating population dynamics, monitoring status, and evaluating responses to changes in the environment (Fuller and Mosher 1987). Relative abundance generally refers to the contribution a species makes to the total abundance of that wildlife community (Jones 1986). There are several ways to estimate relative abundance, including the number of raptors seen per hr of observation or per linear distance, and the number of owl calls heard per hr (Kochert 1986). In this study I used numbers of individuals observed per kilometer travelled for a roadside survey of raptors in western Turkey and eastern Greece. These results represent perhaps the first and most comprehensively reported indices of observed relative abundance collected by such method for raptor populations in this part of the world.

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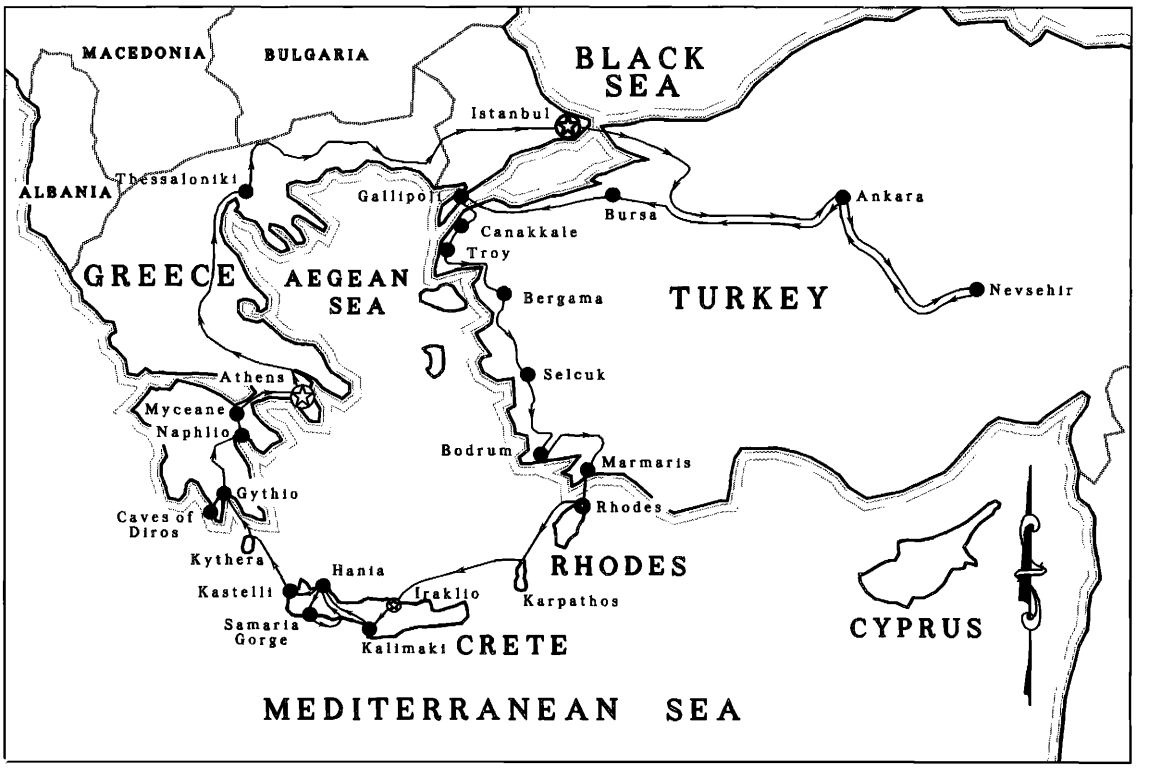

Figure 1. Raptor survey route in western Turkey and eastern Greece, including the islands of Rhodes and Crete, 9 April to 13 May 1993.

STUDY AREA AND METHODS

Western Turkey, which is part of Asia Minor, includes eastern Thrace from the city of Edirne to Istanbul, the peninsula of Gallipoli, the Sea of Marmara, the coastal region of the Aegean Sea, and central Anatolia including the region of Capadocia. On the southern shore of the Sea of Marmara are low hills used for grazing, farming and industry, and higher pine-forested mountains, such as Uludag (Mt. Olympus) near Bursa which reaches 2583 m (Fig. 1). The mean annual rainfall in this region is approximately 670 mm. The Aegean Sea coast is a region of plains and river valleys. Olive, fig and fruit orchards can be seen on hillsides, and tobacco and sunflower fields in valleys. Central Anatolia which embraces Capadocia is a vast plateau (rolling steppe) with a mean elevation of 1000 m where sheep grazing and wheat growing are primary land uses. The plateau is surrounded by mountain ranges with elevations to 2500 m, some being volcanoes with snow-capped peaks (Dubin and Lucas 1989, Brosnahan 1990).

In the month of March, the mean daily minimum and maximum temperatures in Istanbul are 3–30°C, in Ankara 0–11°C, in Bursa 4–13°C, and in Izmir (on the Aegean Sea coast) 6–16°C. In May, these temperatures are 12–21°C in Istanbul, 9–22°C in Ankara, 11–23°C in Bursa, and 14–26°C in Izmir (Brosnahan 1990).

Eastern Greece, the southernmost of the Balkan states, includes the Peloponnese from the Mani to Corinthia and Argolis (including Laconia and Arcadia), Thessaly, Macedonia, and western Thrace. Roadside counts on the island of Crete included the region near Iraklio to Kastelli on the western end of the island. Landscapes and land uses similar to those observed in Turkey were found on mainland Greece and Crete. These included mountains in the Mani peninsula, plains and mountains (Mt. Olympus, 2917 m) in Thessaly, black pine (*Pinus nigra*) forests in Macedonia, and the Evros River valley and Porto-Lagos wetlands in Thrace (Fig. 1).

On Crete, largest of the Greek islands, climatic and geographic conditions are similar to North Africa, although mountains such as Mt. Ida (2456 m), are snow-capped for several months of the year (Handrinos and Demetropoulos 1983). Lower mountain slopes and hills support low phrygana or maquis vegetation, Kermes oak (*Quercus coccifera*), locust (*Ceratonia siliqua*), and juniper (*Juniperus* spp.; Handrinos 1985; Fig. 1).

My study area is classified as two biomes. The region around the Aegean Sea included Crete, the Sea of Marmara, and Gallipoli was classified as evergreen sclero-

Table 1. Survey routes, mode of travel, and distance travelled for raptor surveys conducted in Turkey and Greece, April–May 1993.

DATE	SURVEY ROUTE	TIME OF DAY	MODE OF TRANSPORTATION	DISTANCE (km)
9 April	Istanbul–Ankara	1030–1800	train	450
10 April	Nevsehir–Derinkuyu	0900–1600	bus/foot	60
11 April	Nevsehir–Goreme	1030–2000	bus/foot	20
12 April	Goreme–Cavusin–Zelve	0900–1730	foot	15
13 April	Goreme–Bursa	0700–1800	bus	695
14 April	Bursa–Uludag	0900–1700	car/foot	65
15 April	Bursa–Canakkale	1000–1430	bus	310
16 April	Gallipoli	1000–1600	bus/foot	50
17 April	Troy–Canakkale–Bergama	1000–2000	bus/foot	300
18 April	Bergama (Pergamum)	1000–1700	foot	10
19 April	Bergama–Selcuk	1200–1530	bus	180
20 April	Selcuk (Ephesus)	0800–1600	foot	15
21 April	Selcuk–Bodrum	1200–1500	bus	170
22 April	Bodrum	1000–1600	foot	5
23 April	Bodrum–Marmaris	1000–1330	bus	165
26 April	Iraklio–Knossos	1000–1600	bus/foot	15
27 April	Iraklio–Kalimaki	1130–1630	bus/foot	65
28 April	Kalimaki–Hania	0800–1700	bus/foot	150
29 April	Hania–Samaria–Kastelli	0730–2130	bus/foot	170
1 May	Gythio–Caves of Diros	1000–1400	bus	70
2 May	Gythio–Naphlio	0830–1630	bus	180
3 May	Naphlio–Myceane	1000–1400	bus	65
4 May	Naphlio	1030–1830	foot	10
5 May	Naphlio–Athens	1000–1430	bus	145
10 May	Athens–Thessaloniki	0700–1330	train	530
12 May	Thessaloniki–Komotini	1400–2030	train	415
13 May	Kabakca–Istanbul	0630–0730	train	70
Total distance				4395
Total observation time		177 hr 30 min		

phyllus forests, scrub or woodlands, and central Anatolia as cold winter (continental) desert and/or semi-desert (UNESCO 1987).

Roadside counts were conducted primarily by means of public bus, but some routes were surveyed by train, car, and on foot. All means of transportation provided excellent viewing opportunities, allowing two observers to focus on locating and identifying raptors on both sides of the road or railroad track. Unfortunately, driving speeds were variable and not always known, nor was it possible to stop the vehicle to identify distant birds or estimate the distance of the raptor from the survey vehicle. Visibility was comparable for buses and trains. Data recorded for each observation included date, time, location, species, age and sex (if possible), number, habitat type, activity, and perching substrate.

Surveys were conducted in western (Asian) Turkey from 9–23 April 1993, and in eastern Greece, including Crete, from 26 April to 12 May 1993. Additional data were collected in northwestern (European) Turkey (eastern Thrace) on 13 May 1993. Survey times ranged from 0630–2130 H. Weather conditions were variable during the survey period, but mostly without any precipitation.

I used the method developed by Woffinden and Murphy (1977) to calculate an index of observed relative abundance for each raptor species sighted:

$$\text{Index} = \frac{\text{Total number of a species observed}}{\text{Total kilometers travelled}} \times 1000$$

RESULTS AND DISCUSSION

Nearly 4400 km were travelled and approximately 177 hr of observation time logged (Table 1), yielding 1.05 individual raptors sighted per hour of observation time, or 23.7 km travelled per bird sighted (0.04 individual raptors sighted per kilometer).

Lesser kestrels (*Falco naumanni*) and common kestrels (*F. tinnunculus*) were the most commonly

observed raptor species, followed by unidentified *Buteo* species, long-legged buzzards, and unidentified *Circus* species (Table 2). Lesser and common kestrels accounted for 71% of individual raptors sighted, followed by *Buteo* species (16%; Table 2). The unidentified buteos ($N = 20$) were most likely long-legged buzzards and common buzzards (*B. buteo*) given the time of year and location of the survey route (Gensbol 1987 and C.G. Vlachos pers. commun.).

Most of the species observed are migratory over a portion of their range, but some are year-round residents in Turkey and Greece. During March through May, many of these species could be migrating through the region to more northern breeding grounds or returning to local nesting areas (Gensbol 1987). Species thought to be year-round residents in the region include the griffon vulture (*Gyps fulvus*), sparrowhawk (*Accipiter nisus*), and common and long-legged buzzards. Both harrier species (western marsh harrier [*C. aeruginosus*], and Montagu's harrier [*C. pygargus*]) that breed in Turkey and Greece generally return to nesting areas in April (Gensbol 1987). Three of the four falcons observed are long distance migrants and summer throughout Greece and Turkey. The lesser kestrel is often seen in small flocks on spring migration (Gensbol 1987), and in fact, 10 flocks of kestrels with as many as 19 individuals were observed during the survey. The common kestrel is a year-round resident.

Lesser and common kestrels accounted for over 75% of the raptors sighted in agricultural lands (Table 3). Agricultural lands supported the greatest number of species (61%) and individuals observed (78%). Harriers, long-legged buzzards, unidentified *Buteo* species, lesser kestrels, and common kestrels were sighted more frequently in agricultural lands than all other habitat types encountered (Table 3). Unidentified *Buteo* species were observed in six habitat types, while all other species were observed in three or fewer habitat types.

Road transects are often used to obtain indices to raptor abundance or density in order to assess or compare population structure, seasonal population changes, habitat use, distribution, yearly population trends, and to determine activity (Millsap and LeFranc 1988). However, road counts are affected by a number of biases. Perhaps the most significant inherent bias associated with road counts is species detectability, or the detectable distance of a raptor, which can vary by species, activity, habitat, and behavior (Fuller and Mosher 1987). Millsap and LeFranc (1988) believed several assumptions are violated in many raptor road transect studies, and suggested presenting results based on volume of habitat searched for more direct comparison of results between studies. However, their method requires additional time to measure vegetation variables necessary to calculate volume estimates. Kochert (1986) recommended recording all birds seen on road counts used as line transects, and measuring their perpendicular distances from the transect centerline regardless of their distance and analyzing these data with a line transect computer program.

The problem of species detectability was encountered during the roadside surveys in Turkey and Greece. Habitat types that provided the highest spe-

Table 2. Frequency of sightings and observed relative abundance indices of raptors sighted during surveys in Turkey and Greece, April–May 1993.

SPECIES	NUMBER OBSERVED	KM TRAVELLED PER INDIVIDUAL	INDEX OF RELATIVE ABUNDANCE[a]
Lesser kestrel (*Falco naumanni*)	75	58.6	17.1
Common kestrel (*Falco tinnunculus*)	57	77.1	13.0
Buteo spp.	20	219.7	4.5
Long-legged buzzard (*Buteo rufinus*)	10	439.5	2.3
Circus spp.	9	488.3	2.1
Eleonora's falcon (*Falco eleonorae*)	3	1465.0	0.7
Common buzzard (*Buteo buteo*)	3	1465.0	0.7
Black kite (*Milvus migrans*)	2	2197.5	0.5
European hobby (*Falco subbuteo*)	2	2197.5	0.5
Griffon vulture (*Gyps fulvus*)	1	4395.0	0.2
Sparrowhawk (*Accipiter nisus*)	1	4395.0	0.2
Booted eagle (*Hieraaetus pennatus*)	1	4395.0	0.2
Little owl (*Athene noctua*)	1	4395.0	0.2

[a] Analysis of relative abundance after Woffinden and Murphy (1977)

Table 3. Numbers of raptors observed in habitat types in Turkey and Greece, April–May 1993.

SPECIES	HABITAT TYPES[a]								
	W	A	F	S	U	C	O	R	L
Black kite	—	—	1	—	—	1	—	—	—
Griffon vulture	—	—	1	—	—	—	—	—	—
Circus spp.	1	8	—	—	—	—	—	—	—
Sparrowhawk	—	—	—	—	—	1	—	—	—
Common buzzard	—	1	—	—	—	—	—	1	1
Long-legged buzzard	—	9	—	—	—	1	—	—	—
Buteo spp.	1	14	1	1	1	2	—	—	—
Booted eagle	—	1	—	—	—	—	—	—	—
Lesser kestrel	—	57	—	—	15	3	—	—	—
Common kestrel	—	53	—	—	1	—	3	—	—
Eleonora's falcon	—	—	—	—	—	—	3	—	—
European hobby	—	2	—	—	—	—	—	—	—
Little owl	—	—	—	—	—	1	—	—	—
Total species	2	8	3	1	3	6	2	1	1
Total individuals	2	145	3	1	17	9	6	1	1

[a] Habitat types (W = wetland, A = agricultural land, F = pine forest, S = steppe, U = urban, C = chaparral/scrub-shrub, O = ocean/coast, R = riparian/riverine, L = lake shore.

cies detectability clearly included the vast, open agricultural lands of central Anatolia, Thessaly, Macedonia, and Thrace, as well as some urban areas near Ankara, Bursa, and Thessaloniki, and along the coast of the Aegean Sea. Species detectability was lowest in habitat types with greater plant species and structural diversity (e.g., black pine forest and riparian areas). Accordingly, species such as kestrels and buzzards that were more likely to be observed in open habitats were recorded in greater numbers. Substrates for perching, such as power and telephone poles, were also typically located along roads and railroad tracks.

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