Roosting Tree Selection of Cinereous Vulture *Aegypius monachus* in Breeding Season in Turkey

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Abstract: In this study, the characteristics of roost trees selected by Cinereous Vulture *Aegypius monachus* were compared with those of the same number of paired, randomly selected trees on Turkmenbaba Mountain, north-western Turkey during September to October of 2003–2005 after the fledging period. All roost trees selected were Black Pine *Pinus nigra*. These trees were either dominant (65%) or intermediate (35%) in the canopy. Most roost trees were mature in terms of diameter at breast height (39.47 cm) and had flat canopies. The mean distances from the roost tree to the nearest occupied nest and unoccupied nest were 189±138.9 m and 83±74.4 m respectively. It was found that Cinereous Vultures selected roost trees that provided the best views to detect aerial predators at a distance and territorial intruders.

Keywords: Roosting, Tree Selection, Cinereous Vulture, *Aegypius monachus*, Breeding Season, Turkey

انتخاب درختان در فصل جوجه‌آوری کرکس سیاه (*Aegypius monachus*) در ترکیه

چکیده: در این پژوهش، ویژگی‌های درختان کاج سیاه انتخاب شده توسط کرکس سیاه (*Aegypius monachus*) با میانگین جامعه تصادفی آماری این درختان در کوه‌های ترکمن بابا، شمال غرب ترکیه طی سپتامبر تا اکتبر سال‌های ۲۰۰۳–۶ بعد از شروع پرواز جوجه‌های آشیانه‌ای مقایسه گردید. همه درختان انتخاب شده کاج سیاه (*Pinus nigra*) بودند که در تاج پوشش چیره (۶۵٪) یا زیرچیره (۳۵٪) داشتند. بیشتر درختان از نظر قطر برابر سینه بالغ بودند (۳۹،۴۷ سانتی‌متر) و تاج پوشش تخت داشتند. فاصله میانگین درخت تا نزدیکترین آشیانه فعال و غیرفعال به ترتیب ۱۳۸،۹±۱۸۹ و ۷۴،۴±۸۳ متر بود. نتایج بیانگر این بود که کرکس سیاه درختانی را انتخاب کرد که دارای دید مناسب برای کنترل شکارگران از هوا در یک مسافت مشخص و همچنین مزاحمان از سطح زمین باشند.

INTRODUCTION

Raptor conservation studies are mostly centred on the nest site selection to determine habitat requirements of the species. But no studies have attempted to describe roost tree characteristics that could provide valuable information for conservation management. Roosting is a characteristic behaviour observed throughout the gamut of bird species (*e.g.* Cramp & Simmons 1980, Ceballos & Donazar 1990, Whitaker & Stauffer 2003). Amongst social birds especially, immature and adult individuals concentrate in communal roosts (Donazar *et al.* 1994), an example being the highly gregarious vulture species. These birds roost together, soar together, and if the carcass is large enough, feed together. Even during the breeding season, birds will often nest in close proximity to a winter roost and will occasionally return to the roost for the night (Sibley *et al.* 1989).

One vulture that roosts near the nest tree to guard the young is the Cinereous Vulture *Aegypius monachus* (Cramp & Simmons 1980).

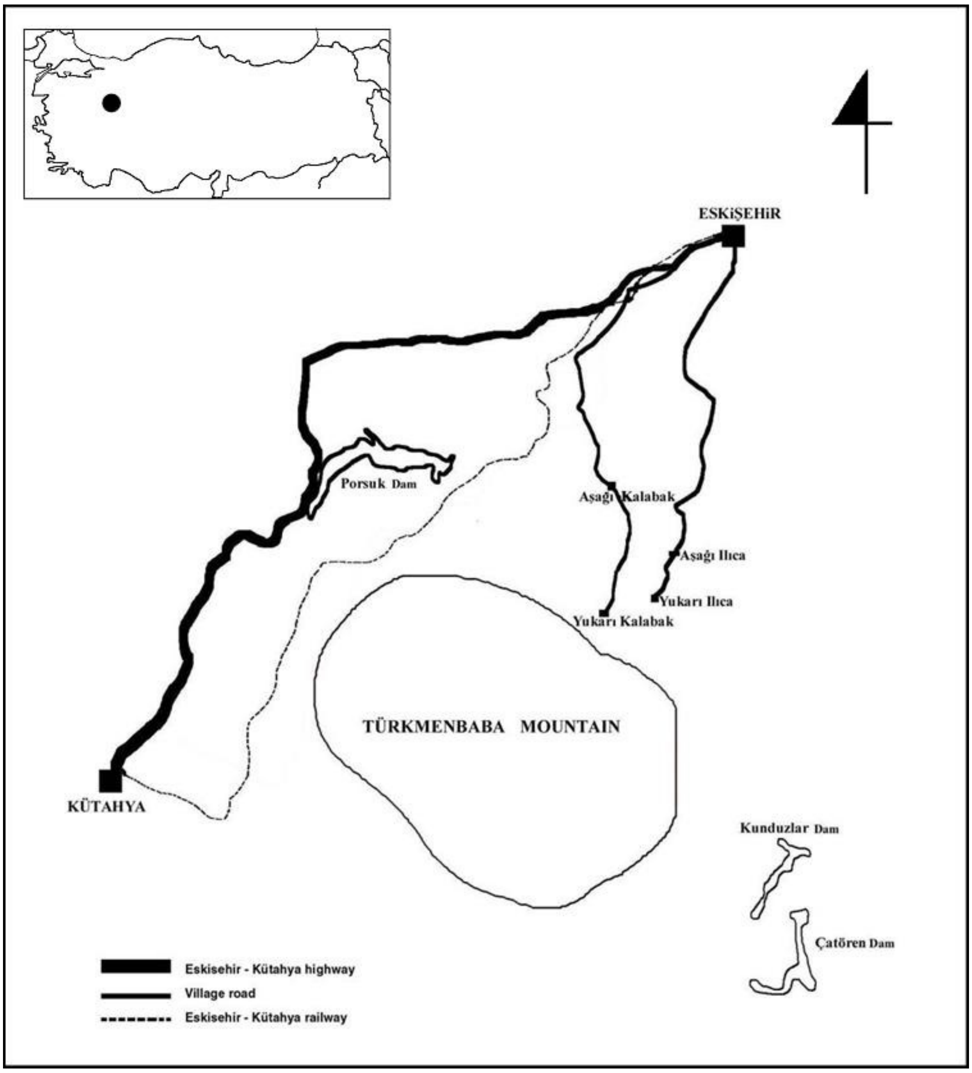


Figure 1. Study area in Turkey, © H. Kostekci.

The species is classified globally as "near threatened" according to criteria in the Conservation of Nature Red List (IUCN 2000) and is rare in Europe. It is included in Annex I of the European Union Bird Directive and in Appendix II of the Bern, Bonn and CITES Conventions (BirdLife International 2005).

This species may breed in loose colonies or solitarily (Cramp & Simmons 1980, Heredia 1996, Moràn-López *et al.* 2006a), building at the top of a tree a huge nest where it lays one egg (Heredia 1996). Incubation is by both adults and last 50–54 days (Cramp & Simmons 1980, Heredia 1996, Harrison & Castell 2002). The chick usually spends more than 100 days in the nest and remains with the adults 2–3 months after fledging before moving (Heredia 1996).

It is known that one member of pair will be present at nest from egg-laying until the chick is two months old, and that its mate will either roost at the nest or in a nearby tree (Bernis 1966). Information concerning roosting tree selection is important if forest managers are to be enabled to determine efficient ways of harvesting timber without harming Cinereous Vulture populations. The aim of this study was therefore to describe the characteristics of roost trees selected by Cinereous Vulture by comparing actual roost trees to randomly-selected trees. To the best of our knowledge, this is the first report on the characteristics of roost trees selected by Cinereous Vulture in Turkey.

STUDY AREA

The study was conducted on Turkmenbaba Mountain, between Eskisehir and Kütahya in northwest Turkey (39°24'N, 30°18'E). The survey was carried out in a 9500 ha area which includes Cinereous Vulture nests (Fig. 1), the whole region comprising 175 km^2. The highest point in the study site is 1826 m above mean sea level (asl), the mean monthly temperatures range from 21.6°C in July to –1.1°C in December, and the mean annual precipitation is 373.8 mm.

Steppe and forest are the two main habitat types of the study area. The lower limit of forest vegetation is at 1000–1100 m asl. The commonest tree species is Black Pine *Pinus nigra pallasiana*. Turkish Oak *Quercus cerris cerris* occurs at lower elevations and Scots Pine *P. sylvestris* and Oriental Beech *Fagus orientalis* in more humid sites (Ekim 1978).

The study area includes a very rich diversity of wildlife, such as Black Stork *Ciconia nigra,* Lammergeier *Gypaetus barbatus*, Egyptian Vulture *Neophron percnopterus*, Short-toed Eagle *Circaetus gallicus,* Common Buzzard *Buteo buteo,* Long-legged Buzzard *B. rufinus,* Booted Eagle *Hieraaetus pennatus*, Common Kestrel *Falco tinnunculus,* Cape hare *Lepus capensis,* Persian squirrel *Sciurus anomalus,* wolf *Canis lupus,* red deer *Cervus elaphus*, wild boar *Sus scrofa,* common fox *Vulpes vulpes* (Yarar & Magnin 1997, Yamac 2004).

The area's main economic activity is timber extraction. There is also some grazing (up to 7000 sheep) and certain restricted parts of the mountain are used for summer recreation.

MATERIAL AND METHODS

Roost trees were found by methodically searching the forest on foot in breeding season. Trees were designated as roost trees if an adult roosting Cinereous Vulture could be seen on them or droppings, feathers and pellets of the species could be found beneath or very near them (Ceballos & Donazar 1990). After determining the exact location of roost tree by GPS, all roost sites were plotted on a 1:25000 topographic map.

To avoid disturbing the vultures, data on roost tree characteristics were collected during

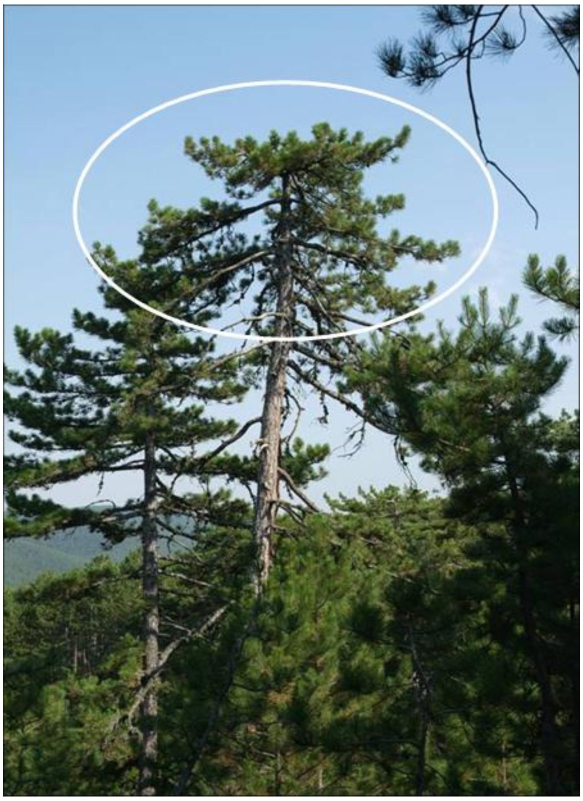


Figure 2. Roost tree on Turkmenbaba Mountain, © E. Yamac.

September to October of 2003–2005, after the fledging period. The following information was recorded to describe each roost tree: tree species, tree height, diameter at breast height (dbh), orientation of roost tree, crown class (dominant, intermediate or suppressed), roost tree branches and condition of roost tree. Besides, elevation of the site (asl), degree of slope, distances from the roost tree to the nearest occupied (NON) and unoccupied nests (NUN) were also recorded. The roost tree's direction to the associated nest was defined as roost tree orientation. The roost tree condition was taken as good or bad (evidence of fire or epiphytic growth). Roost tree branches were measured and classified according to their density (branches per vertical arc) I) <10, II) 10–20 and III) >20 (Bakaloudis *et al.* 2000). Mean elevation of the site above sea level and degree of slope were estimated by plotting the roost tree on 1:25000 scale topographic maps (Bakaloudis *et al.* 2001). Distances from the roost tree to the nearest occupied and unoccupied nests were measured by GPS. Occupied nests were those with an egg, with evidence that an egg had been laid (*i.e.* incubating adult or broken eggshells below nest) or containing a nestling. Unoccupied nests were those without an adult, egg, or nestling.

In order to compare roost tree characteristics within the same forest stand, the same number (17) of trees was randomly selected from the area located within a 200 m radius of each roost tree, (Bakaloudis *et al.* 2000). The area centred on the roost tree was divided into four quadrants (northeast, southeast, southwest and northwest). One quadrant was randomly selected. To calculate the distance of the random tree along the north-south and the east-west axes from the roost tree, two numbers between 0–200 were randomly selected. The intersection of lines extending from the roost tree defined the centred point. At this centred point, the nearest tree whose dbh was >10cm, was identified as the randomly-selected tree. As for the roost tree, randomly selected tree characteristics such as tree species, tree height, dbh, orientation of tree, crown class, tree branches and condition of tree, asl and degree of slope were measured.

All statistical analyses were performed using Statistica (version 4). Differences were considered significant where α=0.05. Since no variable was normally distributed, data were analyzed by the nonparametric Wilcoxon matched pair test. To compare nominal variables such as roost tree branches, conditions and crown class of the roost tree, the non-parametric Chi-square test was used. Orientation of the roost trees was analysed using Observed versus expected X^2 test.

RESULTS

Seventeen roost trees were recorded in the 2003–2005 period. All of the roost trees were associated with the related occupied nest trees. According to study, all roost trees were Black Pine *Pinus nigra* (Fig. 2). All of the randomly selected trees were Black Pine except two *Quercus* oaks. No difference was detected between roost trees and randomly selected trees in terms of their height (Table 1). Cinereous Vulture had a tendency to roost on older trees (mean dbh=39.47 cm) which were significantly different from randomly selected trees (p<0.001). The mean elevation of roost sites asl was 1234.5±78 m. The mean slope gradient of roost sites was 27.08±10.11°. Elevation of the actual roost site asl and of calculated slope were similar to the randomly-selected site values and showed no significant differences statistically (Table 1).

The orientation of the majority of the roost trees was towards the northeast, orientation to the west and southwest being completely avoided (Fig. 3). The distribution of orientation deviated significantly from random (p<0.05). The canopy crown classes of roost trees were either dominant (65%) or intermediate (35%), significantly different from the randomly selected trees (p<0.01) (Fig. 4). There were no differences between roost trees and randomly-selected trees in the roost tree branches or the condition of the trees (Figures 5-6). The mean distances from the roost tree to the nearest occupied nest (NON) and unoccupied nest (NUN) were 189±138.9 and 83±74.4 m, respectively (Table 2).

Table 1. Characteristics of Cinereous Vulture roost trees and randomly selected trees. P value indicates significance of difference between the pairs of means.

Variable	Roost tree				Random tree				*P* Value
	Mean	Min.	Max.	± SD	Mean	Min.	Max.	± SD	
Height (m)	9.25	5.04	17.33	3.27	7.94	3.5	15.8	3.27	ns
Dbh (cm)	39.47	28	56	7.23	18.23	11	34	6.17	***
Elevation (m)	1234.5	1101	1387	78	1210.5	1050	1360	92.31	ns
Slope (degree)	27.08	0	42.5	10.11	29.29	15.5	45	10.23	ns

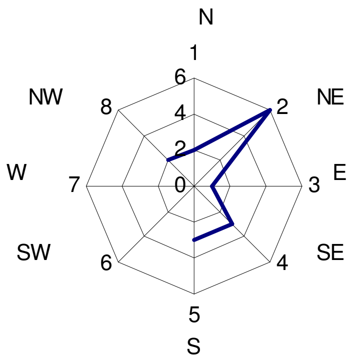
n=17, * = p<0.05, ** = p<0.01, *** = p<0.001, ns (non-significant) = p>0.05.

Table 2. Distances from the roost tree to the nearest occupied nest and unoccupied nest.

Variable	Mean	Min.	Max.	± SD
NON (m)	189.4	4	520	138.9
NUN (m)	83	4	220	74.4

n=17

a



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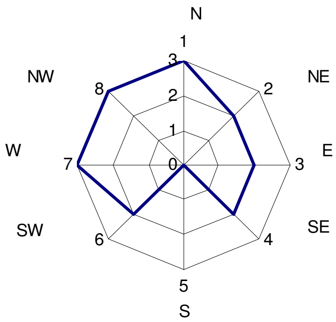

Figure 3. a. Orientation of Cinereous Vulture roost tree, and **b.** Orientation of randomly selected tree (*n*=17).

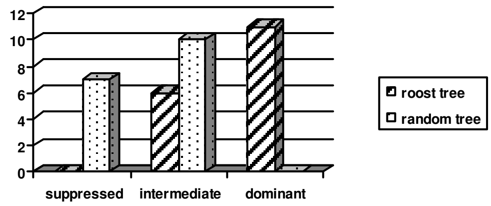

Figure 4. Crown classes of roost trees and randomly selected trees.

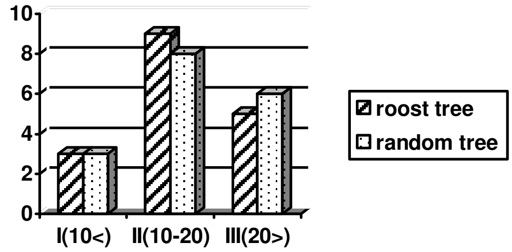

Figure 5. Roost and randomly selected tree branches

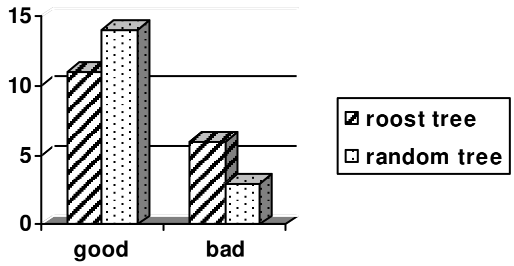

Figure 6. The condition of roost and randomly selected tree.

DISCUSSION

As in other parts of the Cinereous Vulture's breeding area, on Turkmenbaba Mountain, for example (Yamac 2004), the species preferred to roost near the nest tree in the breeding season to guard and defend the nest site. The Cinereous Vulture may build its nest on a tree other than Black Pine, for example on other pine *Pinus* spp., or on juniper *Juniperus* or oak *Quercus* spp. (Cramp & Simmons 1980, Esquivias *et al.* 1980, Fargallo *et al.* 1998, Suetens & Groenendael 1966). Yamac (2004) noted although that the Cinereous Vulture had used Black Pines as nesting and roosting trees in that particular study area, it may have been because this tree species was so abundant. However, in comparison with other tree species, mature Black Pine trees have many more and thicker branches and have relatively flatter canopies, and thus probably provide optimal roost sites for the vulture. My results here show that the roost trees were also mature, belonging to the high-diameter size classes having a mean dbh of 39.47 cm.

It is known that Cinereous Vultures employ low-energy take-off and landing techniques at roosts and nests (Cramp & Simmons 1980), and according to Donazar *et al.* (2002), Cinereous Vulture use the standing waves produced by the prevailing upslope winds in mountain areas. In the present study, the species tended to roost on slopes with a northeasterly aspect, similarly to the findings for nesting trees in Yamac (2004), which relates to the prevailing winds, which are northerly. It is likely that the species nests and roosts in this manner because the regular use of low-energy take-off and landing techniques utilises a favourable selection pressure in terms of breeding success. Likewise, warmth from the eastern exposure to the early-morning sun allows earlier initiation of thermals that enable the species to employ low-energy techniques over a longer daily period, again a favourable selection pressure.

Although there some reports refer to several vulture species selecting dead trees for roosting (Ceballos & Donazar 1990), this is not borne out in Yamac (2004) or in this study, where the Cinereous Vulture always chose trees in good condition (64.7%) that in the breeding season had more than 10 branches (82.3%).

Roost trees were either dominant or intermediate (Fig. 4) and were in steeply-sloping areas, according with the findings of Fargallo *et al.* (1998) and Hiraldo & Donazar (1989) for nesting Cinereous Vulture. It is suggested that steeply-sloping areas may allow better and earlier visibility of predators and minimise human disturbance (Donazar *et al.* 1993, Fargallo *et al.* 1998, Speiser & Bosakowski 1988). In this study, all roost trees were at higher elevations than the nearest nest trees (Table 3), a circumstance that gains three advantages: better nest protection and improved predator and competitor detection over a wide arc and long distance.

A frequent cause of breeding failure for many species is human activity, whether deliberate or accidental (Moràn-López *et al.* 2006a). The Cinereous Vulture is considered sensitive to such disturbance (Tewes 1996, Fargallo *et al.* 1998, Morán-López *et al.* 2006b, Poirazidis *et al.* 2004), the most serious threats for the species being loss and alteration of habitat (Blanco & Gonzalez 1992, Donazar 1993, Donazar *et al.* 2002). Because of this sensitivity, it is therefore very important to ascertain the territory of the species and of individual pairs to allow practical conservation and management strategies to be determined. In the present study, the mean distance from the roost tree to the nearest occupied nest were 189m, but the maximum distance was 520 m. My empirical conclusion from there data is that all forest management practices should be restricted within a 1000 m radius of any nest, otherwise human-induced nest disturbance will constitute a significant limiting factor in species' productivity (Morán-López *et al.* 2006b). Furthermore, Moràn-López *et al.* (2006a) indicated that an increase in human activity up to at least 500 m from the nests had a negative effect on breeding success – beyond this distance this effect decreased with distance.

In conclusion, the results of the present study allowed us to identify, for Cinereous Vulture the roost tree characteristics and the territory of the species in the breeding season, important information in planning habitat conservation. How best to preserve this microhabitat of roost and nest sites should be determined carefully. It is apparent that logging activities and other human-induced disturbance should be restricted during the breeding season. Suitable roost trees must be identified and preserved as a vital part of the long term conservation management of the area. This information should be made available to those monitoring other populations of Cinereous Vulture.

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