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The impact of some spatial factors on disturbance and reaction distances on nest occupation by the near threatened Cinereous Vulture (*Aegypius monachus*)

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Abstract. Scavenging has been threatened with the declines of vultures. The Cinereous Vulture *Aegypius monachus* is predicted to be decline with mainly anthropogenic activities in Turkey, having the second largest population of the species in Europe. Earlier studies urgently recommended constituting a buffer zone in a spatial and temporal context for breeding areas of the species. For an effective buffer zone, land managers mostly used both the empirically revealed flight and stress distances between human activity and breeding individuals. Furthermore, various spatial and temporal factors could influence the disturbance level and reaction distances to human activity. Furthermore, reaction distances could affect the nesting strategies of the species as a disturbance indicator. Therefore, the main aim of this study is to determine the reaction distances as well as the significant spatial factors that influence those distances and to demonstrate the relationship between reaction distances and nest occupation. The study was carried out with the population of Cinereous Vultures in the Middle Sakarya Region in Northwest of Turkey. Based on 61 field observations, the average flight distance was 281.35 m, and stress distance was 467.53 m. The results also indicated that highly accessible and visible slopes located opposite the nest and concentrated in and/or around pathways/roads influenced the reaction distances of the breeding individuals significantly. Moreover, the reaction distances and roads are the primary factors for the decision of nest occupation in the study area. According to the study, 1084 m could be used as a radius for the inner buffer zone and the buffer zone was estimated as 369 ha. If it is not acceptable for economic reasons, at least 870 m should be used as a radius for the critical buffer zone. In conclusion, this study supports that the sensitivity of the Cinereous Vulture increases with the increase in accessibility/visibility of nest sites and those sensitivity levels may have affected the nest occupation of the species.

Key words: Cinereous Vulture, disturbance, reaction distance, buffer zone, spatial factors, nest occupation.

Introduction

Vultures are the most successful scavengers contributing to ecosystem dynamics with some important ecological services such as rapidly eliminating carrions (Moleón et al. 2014). In spite of that, most of vulture species are classified in various threat categories like other large raptor species, generally caused by anthropogenic pressure on wildlife (Thiollay 2006, Margalida et al. 2010, Ogada 2012a, Campell 2015). Declines in vultures are mainly a cause of the contamination of carcasses with veterinary drugs (Oaks et al. 2004, Green et al. 2006, Chaudhary et al. 2011), illegal poisoning (Virani et al. 2011, Margalida 2012), food limitation (Margalida et al. 2010), and electrocution (Ogada 2012a, Saran and Purohit 2012). As a result of the decline in vultures, opportunist species such as feral dogs acting as a replacement for primary scavengers can lead to some bacterial and virulent diseases (anthrax, rabies, etc.) as recently occurred in the Indian Subcontinent (Şekercioğlu et al. 2004, Markandya et al. 2008, Ogada 2012b). Thus, scavenging is likely to become one of the most threatened ecological services (Şekercioğlu et al. 2004). Therefore, necessary precautions for the decline of vulture populations should be taken to prevent the catastrophic impacts on the ecological system (Ogada et al. 2012a, Moleón et al. 2014). In this context four vulture species (Cinereous Vulture *Aegypius monachus*, Eagyptian Vulture *Neophron percnopterus*, Griffon Vulture *Gyps fulvus*, Bearded Vulture *Gypaetus barbatus*) breed in Turkey and all are thought to be in decline (Barov & Derhé 2011, BirdLife International 2004a,b,c,d).

The Cinereous Vulture *Aegypius monachus* L. is globally classified as near-threatened (BirdLife International 2015), assessed as rare status throughout Europe (BirdLife International 2004a), and regarded as critically endangered in Turkey (KAD 2005). Several studies indicated that human-induced disturbance is one of the main limiting and threatening factor on the species (Donázar et al. 2002, Poirazidis et al. 2004, Moran-López et al. 2006a,b, Kirazlı & Yamaç 2013). Disturbances occurred in the home range of the species not only for recreational concerns, but also for economic concerns (Margalida et al. 2011). Thus, anthropic activities can have negative impacts provoking the nest abandonment temporarily and affecting the breeding process and the use of the nest site in the future (Donázar et al. 2002, Morán-López et al. 2006a, Zuberogoitia et al. 2008, Margalida et al. 2011, Moreno-Opo et al. 2012). Recently, scientific studies about the Cinereous Vulture population of Turkey revealed that the human-induced disturbance possibly led to a major threat due to forestry, mining, and recreational activities especially hunting, which decreased the habitat quality and damaged the microhabitat of the species (Yamaç 2004, Kirazlı & Yamaç 2013). Therefore, the researchers recommended the urgent creation of conservation programs in a spatial and temporal context for the Cinereous Vulture population of Turkey, which is the second largest population in the Western Palearctic (Yamaç 2004, Kirazlı & Yamaç 2013). The latter recommendation is also indicated in the action plan for the Cinereous Vulture population of Turkey (KAD 2004). However, due to the low quality data and insufficient studies on the Cinereous Vulture population of Turkey, conservation measures and necessary implementations will be required (Barov & Derhé 2011).

Various conservation programs have been evaluated and applied, such as the creation of a buffer zone, food supply, improvements in spatial and temporal land management, and the development of effective legislation to prevent the damaging conflict between human-induced disturbances and sensitive large raptors like the Cinereous Vulture (Gavashelishvili et al. 2006, Oro et al. 2008, Skartsi et al. 2008, Barov & Derhé 2011). Although the establishment of a buffer zone is a traditional method, it has been becoming an important step for the conservation of sensitive large raptors by restricting the human activities completely or organizing those activities according to the focal species (Richardson & Miller 1997). Generally, the distance between disturbance activities and breeding individual reactions such as being alert behaviour (stress distance) or flying away (flight distance) is considered for the determination of the buffer zone, and the two measures more commonly used (Fernández-Juricic et al. 2005, González et al. 2006). Managers and conservationists generally estimate the minimum approach distance (minimum safe distance to the disturbing activities) by using stress and flight distances, and then the minimum approach distance is used as a radius for the inner buffer zone, where wildlife is isolated from anthropogenic pressure (Fernández-Juricic et al. 2005). As known, those distances indicated by experimentally designed studies, constitute more effective and useful buffer zones for the sensitive species (Richardson & Miller 1997, Blumstein et al. 2003, Beale & Monaghan 2004, González et al. 2006), especially species breeding in colonies (Fernández-Juricic et al. 2005). Furthermore, the results of experimentally designed field studies are considerably important in order to provide suggestions that could decrease the conflicts between economic activities, sustainable land management, and conservation (Margalida et al. 2011).

The current studies on the disturbance effect and the reaction distance of the Cinereous Vulture breeding in semi-colonies are insufficient to determine the buffer zone and effective management strategies. In this respect, in the first European action plan for the Cinereous Vulture, the minimum approach distances listed as ranging between 1 and 2.5 km according to various human activities and breeding season of the species (Heredia 1996), and it has not been updated (see Barov & Derhé 2011). Furthermore, it is known that breeding individuals can desert their nests for a long time if any activities with an average or higher noise level within 500 m of active nests are present (Margalida et al. 2011). Thus, various spatial and temporal variables can be discussed as likely influences on the reaction distances of sensitive large raptors (González et al. 2006, Martínez-Abraín et al. 2010). Especially orographic variables, accessibility to nest sites, and visibility of nests are among the potential factors influencing nest occupation, breeding success, and disturbance level of the sensitive large raptors (Donázar et al. 2002, González et al. 2006, Moreno-Opo et al. 2013). Hence, the importance of the above mentioned factors and the investment strategies of the Cinereous Vulture which has special habitat requirements (see review in Moreno-Opo et al. 2012), should be considered in together for effective land management of the species. However, buffer zones were not established with experimental studies, and also spatial variables and nesting strategies were not taken into account for land management of Cinereous Vulture colonies in the only protected area for the species in Turkey: the Soğuksu National Park. Therefore, the main aim of this study is to determine the reaction distances of the breeding individuals to disturbance activities and to indicate which factors influence those distances, especially in the context of some spatial variables. Here also, the effects of reaction distances on nest occupation and buffer zone measures for the nest sites of the species are presented. Finally, compatible alternative recommendations for the conservation of the species are suggested.

Material and Methods

Study area

The study was carried out in the Middle Sakarya Region located between Ankara and Eskişehir provinces in the northwest of Anatolia (39°93′N, 31°18′E). In this region, the Cinereous Vulture population was monitored in the Sündiken Mountains (Fig. 1) covering an area of 218,068 ha and containing 46 pairs of the species (Kirazlı & Yamaç 2013). The pine vegetation mostly European Black Pine (*Pinus nigra*) and shrub vegetation mostly oak species (*Quercus cerris*, *Q. pubescens, Q. pedunculiflora* and *Q. dschorochensis*) are widespread at altitudes ranging between 190 and 1818 m. The Sündiken Mountains dominated by rough slopes and deep valleys. Besides the semi-arid open grasslands, the landscape is composed by arable areas. In the region timber production, mining, stock-raising and agriculture are the main economic activities. Mountaineering, hiking, hunting and some other recreational activities are mostly observed in the area as leisure activities. The study area is an important natural area where the sensitive large raptors such as Cinereous Vulture, Eastern Imperial Eagle (*Aquila heliaca*), Booted Eagle (*Hieraaetus pennatus*), Egyptian Vulture, and Bearded Vulture are bred in (Eken et al. 2006, pers. obs.).

Field study and definitions

The data were gathered on totally 31 Cinereous Vulture nests between late June to September in the years 2011 and 2012. The observations and experiments were carried out in a similar proportion for each spatial case among those nests to preventing the effect of personalities. Dehydration and cold stress are the main problems for chick mortality at an early stage of offspring (Margalida et al. 2011), so the experiment was not performed in rainy, very cold and very hot days, and if the chicks were under approx. 40 days old. Age determination was applied according to De la Puente and Gamonal (2006). Approaching to the scope-location, which formerly was appointed, and observing nest was defined as human-induced disturbance. Approaching, observing and leaving away from there were achieved as soon as possible according to the orographic structure. Margalida et al. (2011) indicated that the nest abandonment was not significantly related to the number of people in the area. Therefore, the disturbance activities were mostly performed by two researchers. Breeding individuals showed two general reaction type against disturbance: *Flight reaction*, adult left the nest temporarily; *Stress reaction*, adult displayed some alert movements (standing up, outstretching its head, flapping its wings slowly) on the nest. When the reaction was started by an adult then, the disturbance activities were stopped (breeding individuals displayed *no reaction* during all test-time rarely) and with those reaction types, the geographic coordinates, and some spatial features of that geographic point were recorded: a. *Adult reaction type* (flight reaction, stress reaction or no reaction), b. *Scope situation* (adult reaction was recorded during approaching to the scope-location or observing with binocular/telescope), c. *Location of investigators* (investigators located under the nest area or over the nest area), d. *Slope type* (investigators located at the same slope or opposite slope of the nest), e. *Vegetation type* (Location of investigators is dominated by pine vegetation or shrub vegetation/no vegetation), f. *Road situation* (disturbance activity was occurred on any pathway/forest roads or steep slopes), and g. *Period* (the study time was divided into two periods, first period from late June to August and second period from August to late September). In each case, the geographic coordinates of the closest rural road from the test location was also noted. The distance between investigators and nest (flight/stress distance), also investigators and rural road (closest rural road distance) were calculated with "haversine" formula using computer programs (Sinnott 1984). A total of 61 field observations (43 flight reaction, 18 stress reaction) were recorded. Observations were performed with 8x42 binocular and 30x telescope. One datum was recorded from each nest for each spatial variable.

Table 1. Results of the pairwise analyses with Mann-Whitney U test.

Variable	N	Z	P
Scope Situation	43	-1.81	0.069
Location of Investigators	43	-2.04	**0.041***
Slope Type	43	-4.01	**0.00005***
Vegetation Type	43	-1.07	0.284
Road Situation	43	-2.30	**0.021***
Period	43	-2.06	**0.038***
Year	43	0,91	0,358

* Bold value showed the significance variable which further used for GLM

Statistical analyses

All statistical analyses were performed by using Statistica 8.0 (StatSoft Inc. 2007). The normality of the data was analysed with Shapiro-Wilks test and some data (flight distances) did not satisfy the assumptions of normality. As a result of this, pair wise analyses including nonparametric tests were applied to reveal which variables have to include the General Linear Model (GLM) for analysing whether some spatial and temporal factors influenced the Cinereous Vulture reactions. In this context the effects of Year, Period, Scope Situation, Location of Investigators, Slope Type, Vegetation Type, and Road Type on flight reaction were determined using Mann-Whitney U Test (Table 1). Here, set of variables was divided into two groups

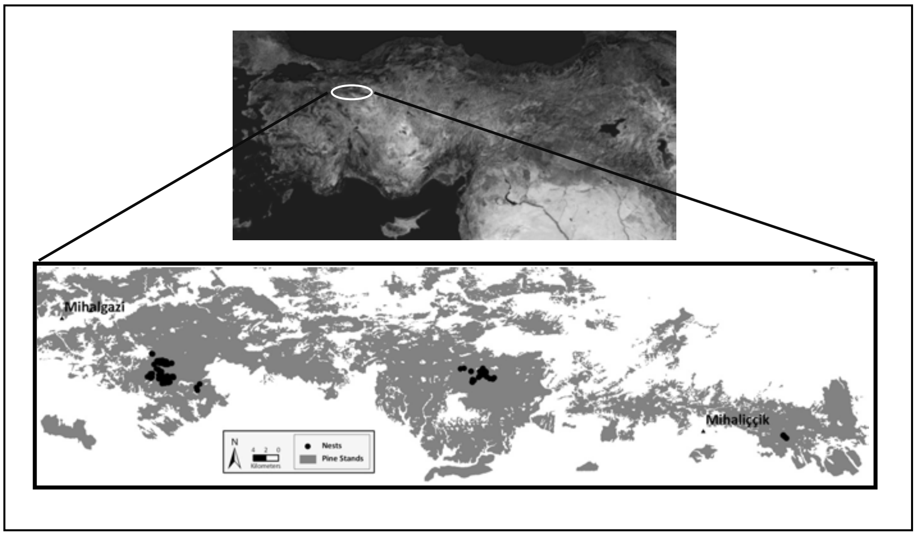

Figure 1. Sündiken Mountains and breeding areas (prepared by Ayşe S. Turak).

(for group definition see Field study and definition), and the flight distance cases were compared among those groups of each variable using Mann-Whitney U Test (Table 1). Spearman rank correlation test was also performed to determine the correlation between flight distance and closest rural road distance. GLM with significant variables based on the results of pairwise analyses (Mann-Whitney U test and Spearman rank correlation test) was used, and the flight distance (log-transformed to fit a normal distribution) was included as a dependent variable, closest rural road distance as a covariate and period, location of investigators, slope type and road type as categorical predictors. Furthermore, the frequency of flight reactions of breeding individuals was computed according to the distance. In addition, General Regression Model (GRM) was used to show how reaction distances (flight and stress distances in together) effect to nest occupation of the next breeding season, hereunder included the nest occupation in the year 2012 as a dependent variable, breeding success in the year 2011 as a categorical predictor, and reaction distance and closest rural road distance as continuous predictors. Also, Boosted Tree Classification Analyses was constructed using mentioned predictors in GRM to find out the influence level of the predictor variables (breeding success in the year 2011 as a categorical predictor, and reaction distance and closest rural road distance as continuous predictors) on nest occupation (it was classified as with occupied nest coded as 1 and not-occupied nest coded as 0). Those boosting models can produce a further accurate classification (Ridgeway 1999). The accuracy prediction (the overall percentage correctly classified: CC) was computed on the test set sample between predicted occupied and not occupied nests with actual occupied and not-occupied nests. The results were considered as significant at $p \leq 0.05$. The flight and stress distances were presented as a mean ± standard deviation. Buffer area was estimated with the most sensitive and conservative methods according to Fernandez-Juricic et al. (2005):

Minimum Approach Distance (MAD; used as Radius for Buffer Area)=(FD^{mean} +1.6495SD)+AD^{mean} , where the FD is the flight distance, SD is the standard deviation of FD^{mean} and AD is the stress distance, and Buffer Area=π*MAD^2.

Results

The average flight distance of the breeding Cinereous Vultures was 281.35 ± 203.29 m (range 32.12-755.90 m, n = 43) and the average stress distance was 467.53 ± 218.45 m (range 104.40-870.60 m, n = 18). The flight reaction of the Cinereous Vulture significantly varied among slope type and the flight distances increased when the disturbance activity occurred on the opposite slope of the nest (Table 2, Fig. 2). Furthermore, there was a significant interaction between slope type and road type, also between slope type and closest rural road distance (Table 2, Figs 3-4). Additionally, the distance of flight reaction increased when the distance between the activity and the closest rural road decreased (n = 43, r = -0,50, p = 0,009) (Fig. 5), also the frequency of flight reaction increased when the distance between the nest and the disturbance activity decreased (Fig. 6).

According to GRM and Boosted Tree Analyses, the nest occupation was significantly influenced by reaction distances and closest rural road

Table 2. Results of the GLM analyses testing some spatial and temporal factors on flight distance of the Cinereous Vulture.

Variable	N	d.f.	F	P
Location of Investigators (LI)	43	1	0.721	0.403
Slope Type (ST)	43	1	13.130	**0.001**
Road Situation (RS)	43	1	4.099	0.052
Period (P)	43	1	0.279	0.601
Closest Rural Road Distance (CRD)	43	1	0.066	0.798
LI*ST	43	1	0.067	0.796
LI*RS	43	1	0.102	0.751
ST*RS	43	1	5.890	**0.022**
LI*P	43	1	0.142	0.709
ST*P	43	1	0.672	0.419
RS*P	43	1	1.908	0.178
LI*CRD	43	1	2.585	0.119
ST*CRD	43	1	10.170	**0.003**
RS*CRD	43	1	0.510	0.481
P*CRD	43	1	0.095	0.759

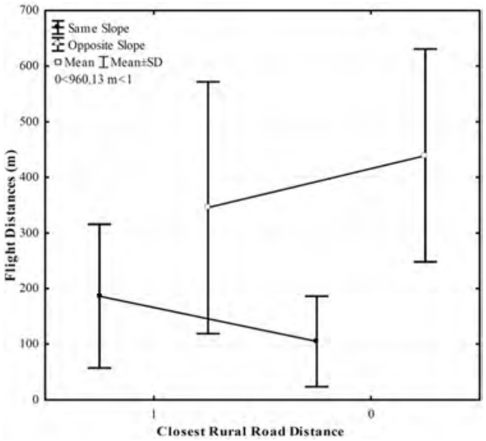

Figure 3. Combine effects of slope type and closest rural road distance on flight distances of the cinereous vulture (960,13 m is the mean of the closest rural road distances).

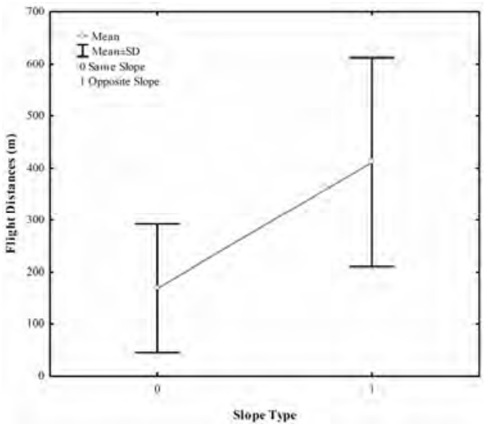

Figure 2. Effects of Slope Type on flight distances of the Cinereous Vulture.

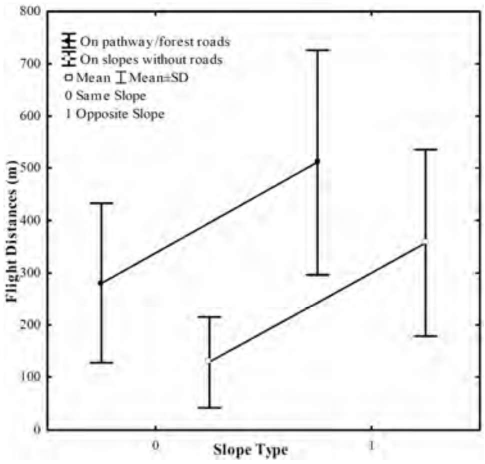

Figure 4. Combine effects of slope type and road situation on flight distances of the Cinereous Vulture.

Table 3. Results of the GRM analyses displaying the effects of reaction distances on nest occupation.

Variable	N	d.f.	F	P
Reaction Distance	39	1	11.439	**0.001**
Breeding Success	39	1	4.026	0.052
Closest Rural Road Distance	39	1	8.998	**0.004**

Table 4. Results of the Boosted Tree analyses ranking predictor variables according to importance for nest occupation (CC: 0.875, Number of Trees: 1201).

Variable	Variable Rank	Importance
Reaction Distance	100	1.000
Closest Rural Road Distance	95	0.941
Breeding Success	45	0.450

distances (Table 3-4). Nest occupation of the next breeding season is more likely to be in higher reaction and closest rural road distances (Fig. 7).

Minimum approach distance was calculated as 1084.2 m, and according to this distance Buffer Area was estimated as 369.1 ha for the Cinereous Vulture population in the Middle Sakarya Region. If the radius was too conservative and unfavourable for managers, at least the maximum stress distance of breeding individuals in the study area

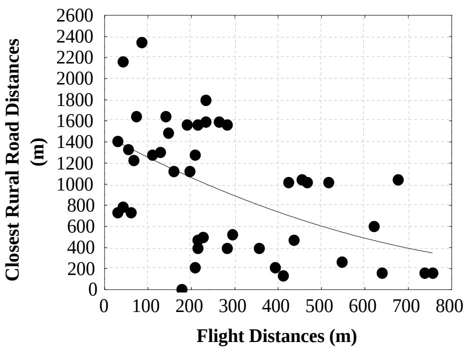

Figure 5. Relationship between the closest rural road distances and flight distances.

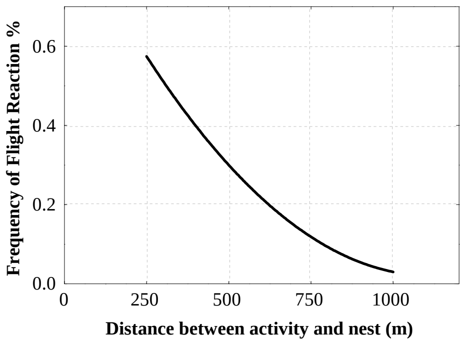

Figure 6. The frequency of flight reaction according to the distance between disturbance activity and nest.

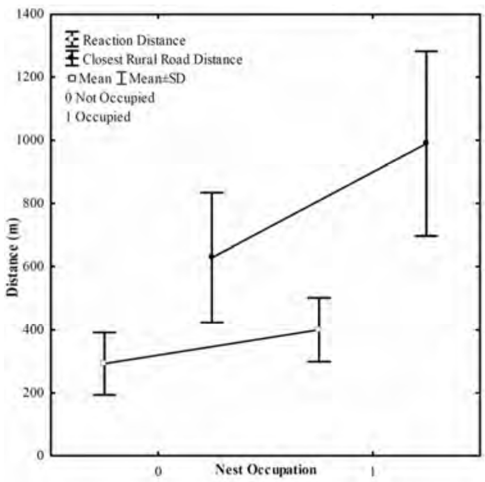

Figure 7. Effects of reaction distances and closest rural road distances on nest occupation.

(870.6 m) should be used for the estimation of the critical buffer zone.

Discussion

The average flight and stress distance of breeding individuals of the Cinereous Vulture in the Middle Sakarya Region were not different from the studies about the disturbance activities of some raptors from Spain. Nonetheless these results were slightly higher than those recorded in Spain population of Bearded Vulture, Cinereous Vulture, Egyptian Vulture, and Spanish Imperial Eagles (Arrroyo & Razin 1996, González et al. 2006, Zuberogoita et al. 2008, Margalida et al. 2011).

Measuring the flight distances is one of the best and easiest methods to quantify species-specific responses to human disturbance and also to shed light on human disturbance levels with in a local frame (Tarlow & Blumstein 2007). As is known, Cinereous Vultures avoid highly disturbed areas for nesting (Donázar et al. 2002, Kirazlı & Yamaç 2013). On the contrary, we are aware of its philopatric behaviour meaning that the species display strong connection with the traditional nesting territories (Poulakakis et al. 2008). Hence, if human pressure increases with economic (such as forestry, or mining) or leisure activities (such as hunting or camping) in traditional nest sites, the response of the species should be different from undisturbed nesting sites. Consequently, slightly high flight and stress distances in comparison with Spain population of Cinereous Vulture (Margalida et al. 2011) might be due to high disturbance levels, which have been considered as one of the main factors for low breeding success in the Middle Sakarya Region (see Kirazlı & Yamaç 2013). On the other hand, the type of disturbance activity might be responsible for this difference regarding disturbance distance as recorded in other raptors (Arrroyo & Razin 2006, González et al. 2006). Nevertheless, the data on breeding success (see Kirazlı & Yamaç 2013) and reaction distances to the disturbance emphasized that the current level of disturbance is high and anthropogenic pressure is one of the main problems for the population of the Middle Sakarya Region.

According to several recent studies, the probability of raptors being alarmed or abandoned depends highly on the distance between disturbance activity and nest (Arrroyo & Razin 2006, González et al. 2006, Zuberogoitia et al. 2008, Margalida et al. 2011). The results of this study are in agreement with those, but this investigation primarily focused on which factors have an impact on reaction distances, and how reaction distances influence the nest occupation of the breeding individuals. In this context, the results indicated that the flight reaction of the Cinereous Vulture was greatly affected by orographic characteristics displaying higher accessibility and visibility. Furthermore, the decision of the nest occupation of the species significantly depended on reaction distances and road factor. It is obvious that the Cinereous Vulture has high sensitivity to human-induced disturbance, and the disturbance level became stronger with the increase of roads around the nests of the Cinereous Vulture and high visibility of nest sites (Donázar et al. 2002, Martínez-Abraín et al. 2010). Additionally, tree-nesting big raptors are known to nest at a greater distance from roads and are more sensitive than cliff-nesting raptors to road-caused disturbance (Poirazidis et al. 2007, Martínez-Abraín et al. 2010). The results of this study supported this data and indicated that road factors influenced the response levels of breeding individuals of tree-nesting Cinereous Vultures to disturbance, which implies that the accessibility and visibility of nest sites are increased by any road type (pathway to rural roads) constructed or restored. Thus, roads increased the anthropogenic pressure in the breeding sites as recorded for European vultures (Donázar et al. 2002, Margalida et al. 2007, 2008, Zuberogoita et al. 2008). Therefore, in the Middle Sakarya Region, the flight distances of easily accessible territories were higher than others, difficult to access, similarly to situations reported earlier for other raptors (González et al. 2006, Martínez-Abraín et al. 2010). As is known, the disturbance, and as a result, reaction distances could negatively affect breeding outcomes of sensitive species (Zuberogoita et al. 2008, Margalida et al. 2011). In this case, the occupation patterns of the Cinereous Vulture were mostly determined by accessibility and visibility of the nest territories influencing the reaction distances of the breeding individuals against disturbance. According to the results, roads and herewith disturbance density seem to be among the main factors for increasing the level of sensitivity of the breeding individuals in the context of nest occupation. Therefore, subsequent studies must concentrate on the effects of reaction distances (using an indicator for disturbance level) on nesting strategies of the Cinereous Vultures.

Roads have the strongest impact, together with slope features, that could increase the visibility of Cinereous Vulture nests. In the study area, approx. 3/4 of breeding individuals nested in the middle or higher sections of slopes (Kirazlı 2013), and this seems to provide space dominance for breeding individuals with respect to vigilance and using thermal winds. According to the results, the observing activity that occurred on the opposite slope of the nests created a high disturbance, because opposite slopes can provide high visibility for the vigilant behaviour of breeding individuals by increasing angle of sight. In addition, the road network in and around the slopes can also change the response level of breeding individuals to those disturbance activities by increasing the accessibility of nesting area. In conclusion, this study supports this knowledge directly, which suggested that the sensitivity of the Cinereous Vulture increases with the increase in accessibility/visibility, and the species concentrated in specific steep slopes (Donázar et al. 2002, Kirazlı & Yamaç 2013).

As is accepted, forestry activities have some negative impacts on the sensitive Cinereous Vulture, such as low nest occupation, breeding density, and breeding success (Margalida et al. 2011, Kirazlı & Yamaç 2013). In this study, the effect of approaching to the nest and observing directly with binoculars induced a strong reaction in breeding individuals of Cinereous Vultures as leisure activities. In various studies, the researchers elaborately indicated that pedestrians such as campers, mountaineers, hunters, and ecotourists, who remained in the breeding sites for a long time, have considerable negative effects on raptors nesting phenology, mainly thermoregulatory and nutrition stress of offspring may have occurred especially under unfavorable climatic conditions (Arrroyo & Razin 2006, Gonzalez et al. 2006, Zuberogoitia et al. 2008, Margalida et al. 2011). Later situation leads to an increase in chick mortality, decrease in breeding success (Donázar et al. 2002, Margalida et al. 2011), and may influence the decision of nest occupation. Even if habitat features are suitable for nesting, the disturbance level can influence the final decision of the Cinereous Vulture on whether to occupy a nest in consecutive years, as occurred for the Egyptian Vulture in the Northern Spain (Zuberogoitia et al. 2008). Therefore, the persons who participate in outdoor activities, especially wildlife researchers/observers and photographers, must behave sensitively, and should insist on ethical rules, and those activities should occur as soon as possible in conservation.

It is noteworthy to say that the impact of human-related disturbances on the natural environment should be evaluated and necessary precautions should be considered by local and international authorities. Especially the conservation program should be created according to the umbrella species like the Cinereous Vulture, which require large areas for breeding and feeding, and is highly sensitive to human-induced disturbances, habitat fragmentation, and change. This will enable the protection of other species belonging to low trophic levels and to maintain the value of biodiversity reserve in the ecosystem (Sergio et al. 2006, 2008, Carrate et al. 2009). Eventually, some priorities for the conservation of near-threatened Cinereous Vulture should be recommended as:

1. Wildlife managers could use the distance of 1084 m for the radius of the inner buffer zone, in which all human activities (economically or leisure) were restricted. If this buffer zone measures will not be compatible for economic concerns of managers, at least maximum stress distance determined by this study (870 m) should be used as a radius for the critical buffer zone.

2. The inner buffer zone should also be applied for the potential nesting areas of Cinereous Vultures as described by researchers.

3. To avoid the unnecessary restrictions within the inner buffer area (see Taylor & Knight 2003), activities such as ecotourism should be scheduled according to the breeding cycle of Cinereous Vulture. For example, authorities should let to this activity during the nonbreeding season of the species (from late August to late February) as recommended for some other raptors (Richardson & Miller 1997).

4. For the current case, the distance between 1084 and 2500 m should be used as vulnerable buffer zone, in which activities such as using vehicles, forestry implications, ecotourism and activities should be authorized according to the breeding period of Cinereous Vulture, as recommended in the first European Action Plan for the Cinereous Vulture (Heredia 1996).

5. Construction and use of dirty/rural roads and pathways should be restricted by wildlife managers and authorities according to the breeding periods of Cinereous Vultures within the buffer zone.

6. If the implementation of buffer zone is not possible for the economic reasons of government as mentioned by Margalida et al. (2011), the economic activities should be scheduled according to the nested slope, and activities should not be applied in the slopes that are appropriate for the nesting Cinereous Vultures. Leisure activities around the nesting place should also be scheduled according to the breeding period of the species, especially should not be carried out under nasty weather condition as well as during incubation and early nestling period of the species in order to prevent thermoregulatory stress of the offspring/chick.

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