# FLIGHT HEIGHT AND RANGE USE OF THE EURASIAN BLACK VULTURE (*Aegypius monachus*) IN THRACE, GREECE:

## IMPLICATIONS FOR WILDLIFE MANAGEMENT AND PROPOSED WIND FARMS


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**Introduction.** The Eurasian black vulture (*Aegypius monachus*) is globally nearthreatened. Greece is the only Balkan country holding a breeding population, located in the Dadia-Lefkimi-Soufli National Park (Dadia NP) (Skartsi et al. 2008). The number of breeding pairs for the years 2000-2003 ranged from 19-22 and the total population was estimated to be 90-100 (Skartsi et al. 2008). The viability of the population in the area remains critical, as mortality factors such as poison baits continue to negatively affect the population and new potential threats have appeared following the recent establishment of wind farms (habitat degradation, possibility of collision) (Ruiz et al. 2004, Vasilakis et al. 2008).

On December 2008 the Greek state issued the Special Physical Planning and Sustainable Development Framework on Renewable Energy Sources (RES land plan) that sets new standards on wind farm site selection and installation, having defined three Wind Priority Areas (WPAs). The first of these areas is the Region of E. Macedonia and Thrace in the Prefectures of Evros and Rodopi (fig. 1). The carrying capacity is set at 480 typical wind turbines (WTs) (960 MW indicatively). But the cumulative effects from multiple wind farms in a region densely used by rare and protected resident and migratory raptorial birds prone to collision, is a serious threat (Barrios and Rodriguez 2004, de Lucas et al. 2008), and some poorly-sited wind farms have had high collision mortality (Barrios and Rodríguez 2004, 2007, Smallwood and Thelander 2008).

For these reasons,in this paper we a) investigate horizontal and vertical space use o f the Eurasian black vulture population in Dadia NP and its surrounding areas, and b) evaluate the consequences of the proposed wind farm development for the endangered raptors.

**Study area.** Dadia NP (NE Greece) has an extent of about 430 km², including two strictly protected core areas that cover 73.5 km² (fig. 1). The mountainous area (altitudes ranging from 20 to 645 m above see level) is covered by extensive pine (*Pinus brutia, P. nigra*) and oak (*Quercus frainetto, Q. cerris, Q. pubescens*) forest, but it includes also a variety of other habitats such as pastures, fields (cultivations), torrents and stony hills (Schindler et al. 2008). Dadia NP is an essential refuge for breeding populations of a unique assemblage of raptors (Poirazidis et al. 2009), contains the only remaining Black Vulture breeding colony in the Balkan Peninsula (Poirazidis et al. 2004, Skartsi et al. 2008, Vasilakis et al. 2008), and a high diversity for several taxa of plants and animals (Kati et al. 2004).

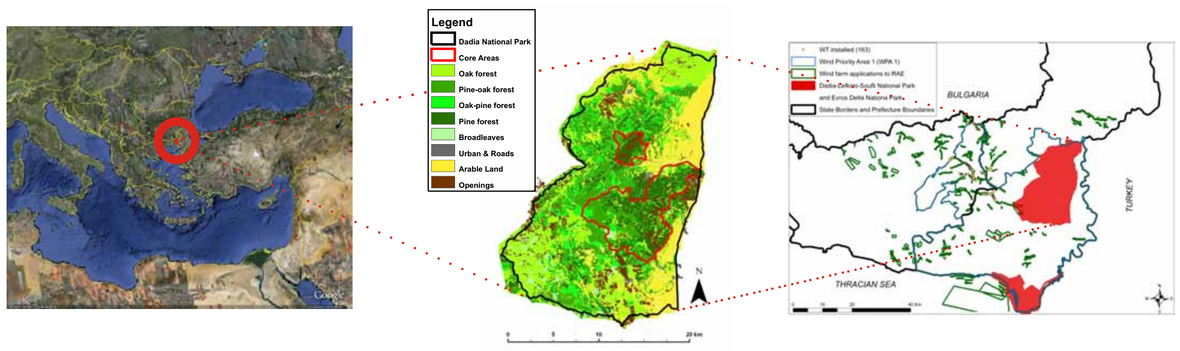


**Figure 1.** Dadia National Park, located in north-eastern Geece and the surrounding areas (including the proposed windpark priority areas and the already established turbines).

**Methods.**

- We VHF-radio tracked 10, 8 and 5 vultures during the years 2004, 2005, 2006. We included in the analysis all individuals for which the home range per season was stabilized. We merged first the individual home ranges per year and then the resulting annual ranges to the overall utilization distribution map (fig. 2).
- 741 GPS fixes from 3 Black Vultures were included in the analysis regarding the flight hights.
- We tested for differences among individuals regarding flight height (FH), flight altitude (FA), ground altitude (GA) and distance to an artificial feeding site, and analyzed the distribution of flight heights.
- We also hypothesized that the aforementioned variables are mutually exclusive.
- For the correlations between the variables the non-parametric coefficient Kendall's tau was used.
- We used the non-parametric Kruskal-Wallis Test for comparison of multiple independent samples.

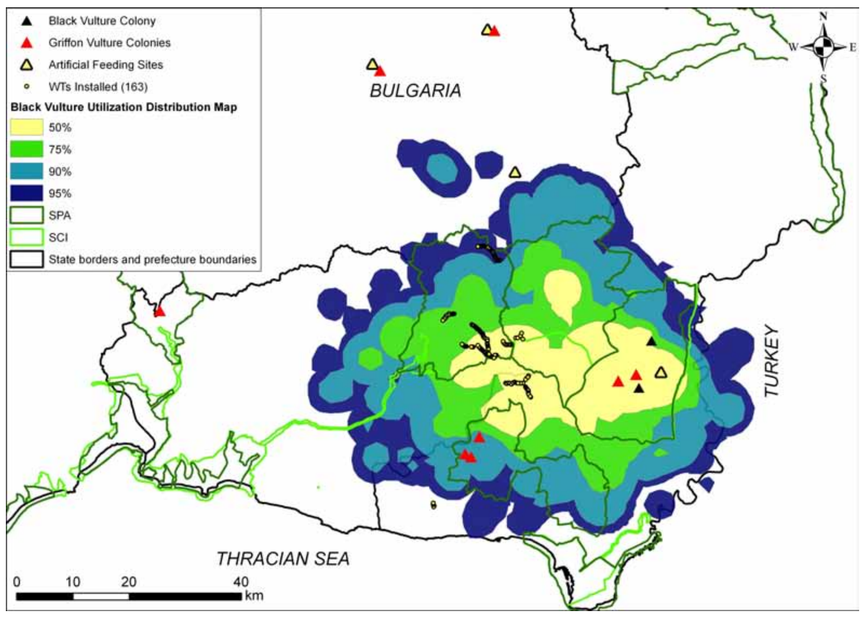


**Figure 2.** Black Vulture overall utilization distribution map. The vultures mainly use the area W and NW of the Dadia NP-breeding colony. This coincides with the main windfarm development in the area.

**Results.**

- Vultures prospect a much wider area (appr. 3500 km²) than Dadia NP (430 km²).
- The individual home ranges and the overall occupied area show a characteristic pattern around the colony, with a prevailing orientation towards W and NW, while the intensively cultivated lowland areas in the E and SE were avoided (fig. 2).
- No significant differences were detected among individuals regarding their flight height.
- **The median flight height was 68 m, with a 75 quartile of 183 m.**
- **In 68% of the records, vultures were flying at flight heights between 30 and 110 m - the range covered by the rotors of the wind turbines.**
- The vulture's flight height was not significantly affected by the ground altitude or the increment of distance to an artificial feeding site.
- In cases the vultures fly very high, they are usually far from the colony and over very low altitudes (fig. 3).

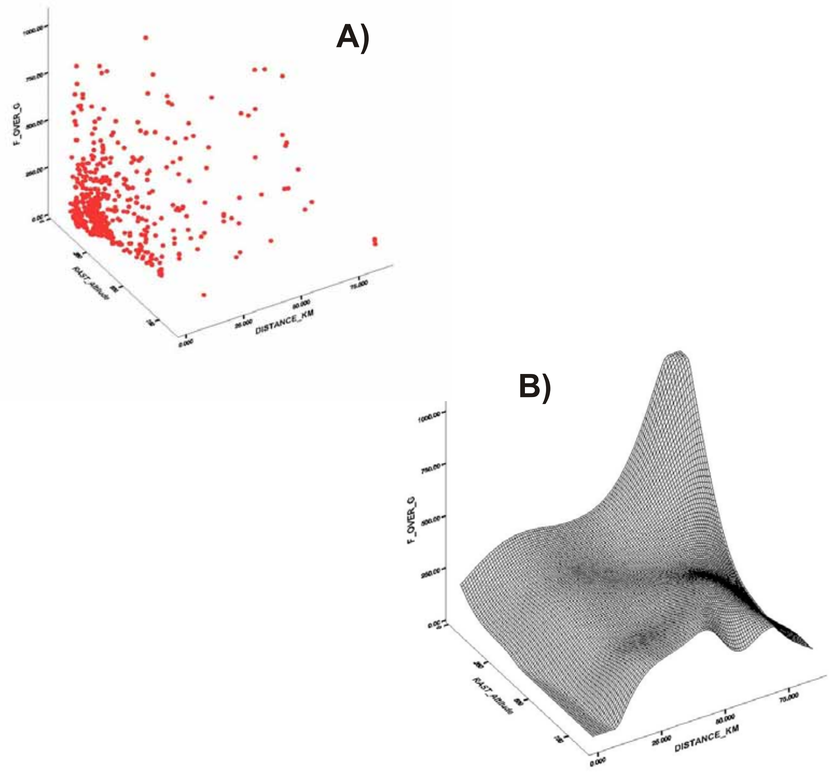


**Figure 3.** Distribution of flight heights in relation to ground altitude and distance to the articicial feeding site. A) GPS data, B) Modell

**Conclusions**

- Vultures include within their home ranges underpopulated areas where exploitation with traditional stock-raising practices is still common.
- Vultures flew at similar heights and mainly rather low.
- Apparently, vultures exploit the oreographic currents, which are the main sources of commercially used wind energy, too.
- BVs spend 68% of their flying time in the rotor risk zone, and a high collision mortality has to be expected at badly placed wind farms.
- The survival of this endangared population depends on the management of the areas outside of the National Park.

**Recommendations**

- No wind farms inside Dadia NP, nor in a buffer of 15 km around the colony, nor in further highly used areas (e.g. the 50% polygon, cf. fig. 2).
- Sensitive siting of the wind farms based on sound ornithological studies including a continous post construction monitoring.
- Implementation of a monitoring scheme for the continuous evaluation of the accumulative impact.


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