Assessing the impact on birds of prey of seven established wind farms in Thrace

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Introduction – Why a wind farm monitoring?

The prefectures of Rodopi and Evros in Thrace are internationally acknowledged as of high ornithological interest, hosting habitats of European importance mainly for large birds of prey and aquatic birds. A large part of them has been declared as a Wind Priority Area (WPA 1) by the Greek state. 50% of the WPA 1 is covered by seven Natura 2000 sites, five of which constitute SPA and two of them National Parks. Since 2003, 9 wind farms (WFs) with 163 wind turbines (WTs) have been installed and are currently in operation. This number is expected to increase drastically in order to fulfil the objective of 480 typical WTs (930 MWe) set by the Greek state. Thus a big concern has been raised about the possible impacts of this overdevelopment on the avifauna of the area. In 2008 we started a monitoring in order to assess them.

In this paper we display the part of the monitoring that had as main objectives: a) to determine the degree of raptor mortality resulting from collision or interaction with the already existing wind turbines; b) to assess the influence of biases which affect the ability to detect raptor mortality and c) to come up with instructions and recommendations for the implementation of effective future post-construction monitoring studies in the area.

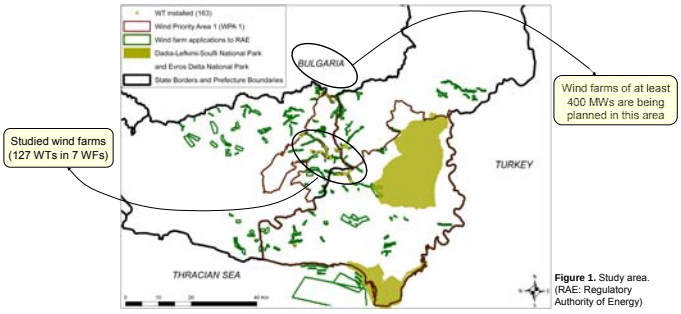


Figure 1. Study area. (RAE: Regulatory Authority of Energy)

Methods – What have we done?

During 2008-09, 127 turbines of seven out of the nine wind farms were systematically searched for carcasses for more than one year. A circular sample plot of 50 m radius centred on each one of the turbines was the minimum area to be searched. Searches took place two days per week, so that every turbine was searched within a 14 days interval. Every wind farm was searched in total 24 to 27 times.

Two of the main factors that may affect the detected raptor mortality – underestimating it – are the searchers' detection ability and the scavengers' removal activity. Trials were conducted at sites representative of the wind farms (and close to them) in terms of topography, vegetation and degree of difficulty, in order to assess their influence.

The standard errors (SE) and 90% confidence intervals (CI) of the average time a carcass remained before being removed (t) and the observer efficiency (p) were calculated by bootstrapping using 5,000 bootstrap iterations.

Results – What have we found?

*__Actual found mortality: evidence of four collided *Gyps fulvus* (one of them out of the searching area), one *Hieraaetus pennatus*, an *Aythya nyroca*, an *Alectoris chukar*, 9 other birds of 7 species and 8 bat individuals was found.__

*__The influence of the biases__

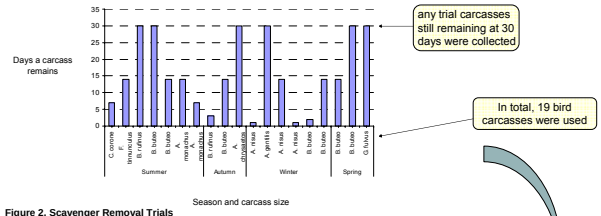


Figure 2. Scavenger Removal Trials

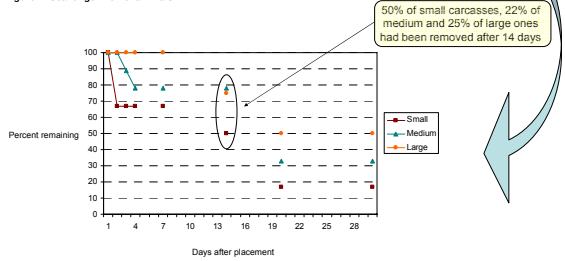


Figure 3. Observed mean proportion of bird carcasses available for detection over a 30-day interval

The average length of time a carcass remained in the trial area before it was removed was 23 days, SE(t) = 3.71 and CI 90%: 18.15-30.38. However, both season (H(3) = 14198, p<0.001) and carcass size (H(2) = 11350, p<0.001) had a highly significant effect on the removal day.

We placed a total of 120 carcasses for observer detection trials, distributed in the same four seasons. Searcher efficiency, expressed the proportion of found carcasses, was p = 0.66, SE(p) = 0.027 and CI 90%: 0.61-0.70.

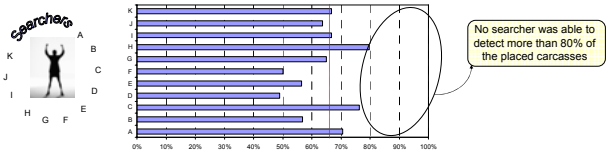


Figure 4. Percentage of carcasses found by searchers

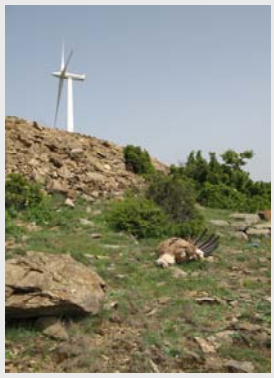
Although season had overall a significant effect on searcher efficiency (F_{BF} (3,17) = 4.39, p < .05, ω = 0.35), this was not pronounced in the post hoc tests.

***The estimated mortality**

Mortality (m) for the study period could then be calculated for both birds of prey in general and vultures specifically. Here we present the results of one model (Erickson *et al.* (2000)):

Birds of prey: m = 3.69, SE(m) = 0.61 and CI 90%:2.67-4.71
Vultures: m = 1.57, SE(m) = 0.40 and CI 90%:0.90-2.24

The mortality rate consequently was 0.029 birds of prey/turbine/year and 0.012 vultures/turbine/year



Conclusions and Recommendations

- Endangered and vulnerable bird and bat species were found dead due to collision.
- Although the average time a carcass remains was found to be 23 days, we still should be aware that keeping our searching interval time (14 days) may lead to an important underestimation of the real number of collision incidents (Fig.2).
- During the execution of the scavenger removal trials, carcasses of various sizes should be used in order to have reliable estimations of the removal rates.
- Scavenger removal trials should be conducted across all seasons of the year.
- Searcher efficiency trials should also be conducted across all seasons. The effect of the season in our results could be attributed to changes in the vegetation.
- If possible, the same searchers should be used across all seasons, to reduce the variance.
- The estimated mortality has to be evaluated per species in combination with population viability analyses.
- The estimated vultures mortality appeared to be smaller than the actual found mortality and this should always be taken into consideration.
- This kind of post-construction studies have to be carried out in every investment by independent researchers having access to unbiased field data, following sound ornithological studies.
- The accumulative effect of every new wind farm proposal should be evaluated before their authorization.
- If the establishment of new wind farms in the area continues as planned, then the impact of the already established wind farms should be evaluated again.

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