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Assessing the impact of nine established wind farms on birds of prey in Thrace, Greece

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Climate change

- Greece must increase its percentage of RES participation in the overall energy end consumption from 6.9% in 2005 to 18% by 2020, which presupposes a RES participation in power production of at least 35%.
- Wind energy, both technologically and financially mature, is expected to make up the greatest part of the increased RES share in electricity production (by 2020 at least 6,000 to 9,000 MW).
- Given that the power currently produced by wind is less than 1,000 MW, there is an unambiguous and urgent need to increase the country's wind farms.

Response

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In 2007:

“Special Physical Planning and Sustainable Development Framework on Renewable Energy Sources” (RES land plan), (N. 2742/1999)»

↓

A large part of the region of Thrace has been selected as a Wind Priority Area (WPA 1), where a large scale wind farm development project of at least 960 MW is under development.

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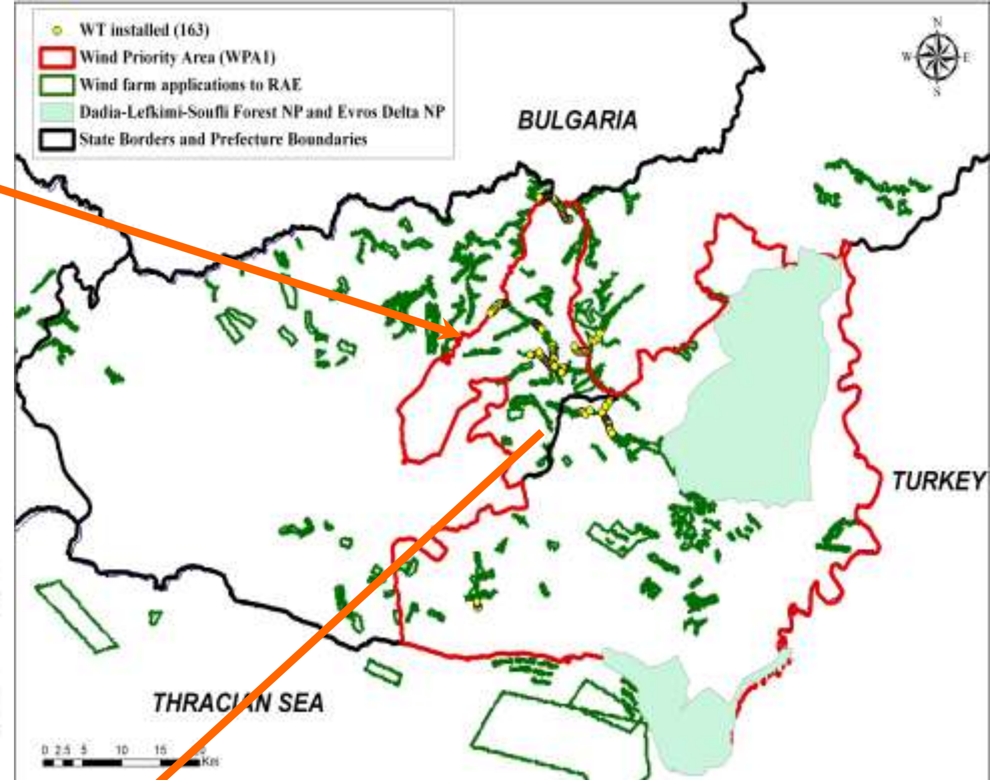
STUDY AREA



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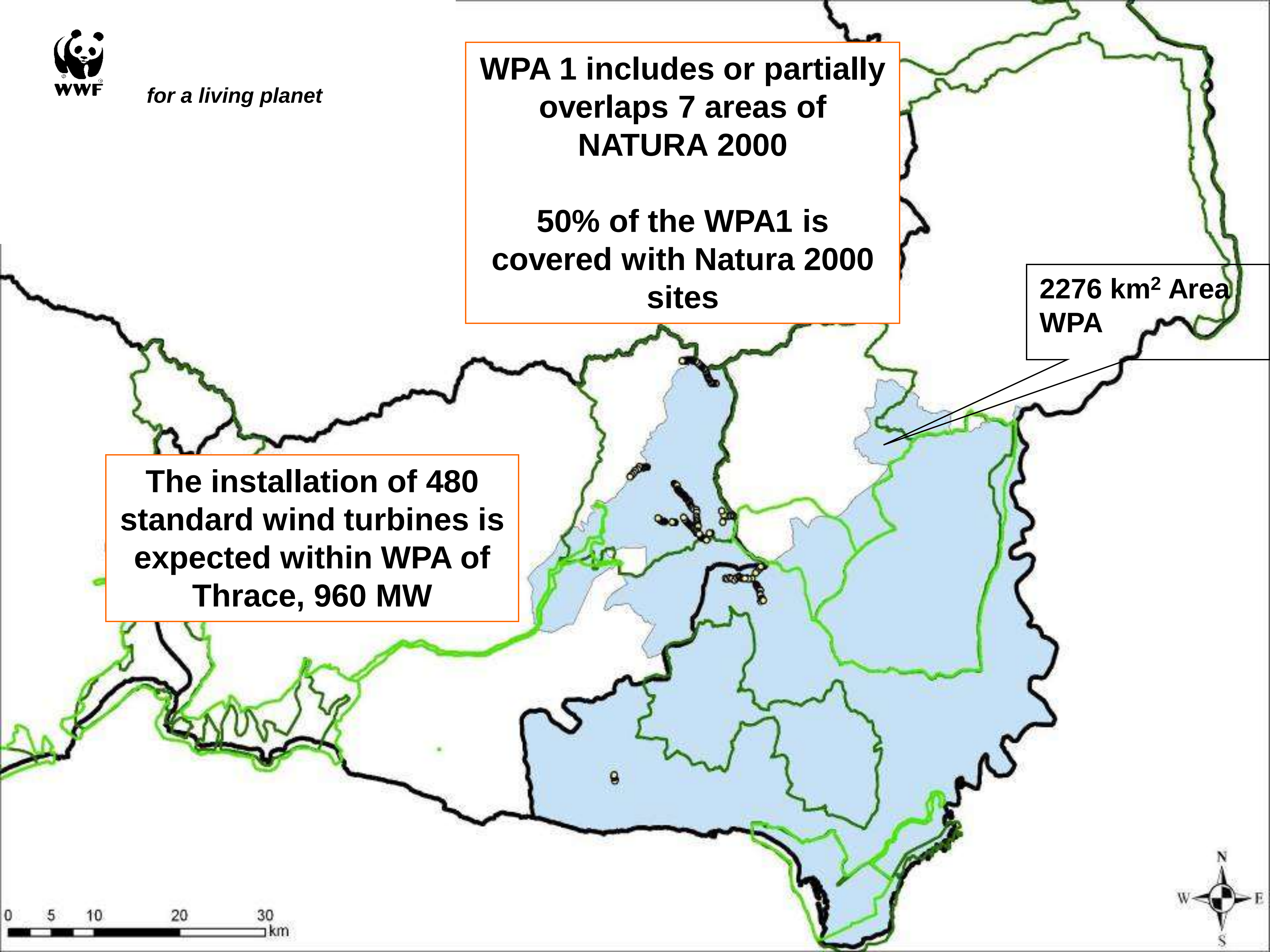
WPA 1 includes or partially overlaps 7 areas of NATURA 2000

50% of the WPA1 is covered with Natura 2000 sites

2276 km^2 Area WPA

The installation of 480 standard wind turbines is expected within WPA of Thrace, 960 MW



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Black vulture *Aegypius monachus*

BIRDS OF PREY OF THE REGION


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Griffon vulture *Gyps fulvus*
BIRDS OF PREY OF THE REGION
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Egyptian vulture *Neophron percnopterus*

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BIRDS OF PREY OF THE REGION


Golden eagle *Aquila chrysaetos*
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BIRDS OF PREY OF THE REGION
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Wind farm monitoring

1. **WWF Greece monitored the impact of wind farms on birds in Thrace for the first time in 2004 - 2005**

2. **A second monitoring was implemented from June 2008 to July 2009**

3. **A third monitoring comprised only carcass searches survey (on daily basis) and was implemented from August 2009 to August 2010**

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Second monitoring period

Surveys of space use by birds

Carcass searches on the ground of wind turbines (127 WTs from 163 WTs)

Observers’ detection trials

Scavenger removal trials

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Surveys of space use by birds

- Two indices of space use by birds:

•the crossing densities index-CDI (number of birds crossing the space between turbines per 100 meters and 100 hours)

•the bird use index- BUI (the number of hours a species was flying in the wind farm area per hours of monitoring).

•the CDI were correlated with several wind farm characteristics (Spearman correlation).

•the CDI and the BUI were also calculated in the first monitoring period, making comparisons of the values from both periods possible.

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Carcass searches surveys

9 wind farms

127 wind turbines searched with a 14 day interval

A circular sample plot of at least 50 m radius was searched around each turbine

Mortality estimation based on carcass surveys:

N-estimated= Na*Cz*Cp*Ce, ***(Everaert and Stienen 2007)***

where *Na* -the number of collision fatalities, *Cz* -the correction factor for search area, *Cp*- the correction factor for scavenging, *Ce*- the correction factor for search efficiency)

Observers' detection trials

Three sites outside but near the wind farms were selected for trials

A specific number of dead birds, bird parts (e.g. one wing) or remains (e.g. feathers) was placed at random in each plot

The ability of observers to detect dead birds (ε) was calculated:

ε =Number of carcasses detected / Number of carcasses placed

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Scavenger removal trials

Scavenger removal rate was quantified using a known number of carcasses placed at the study area for one month and checked on particular dates

“Real” birds of prey carcasses were used

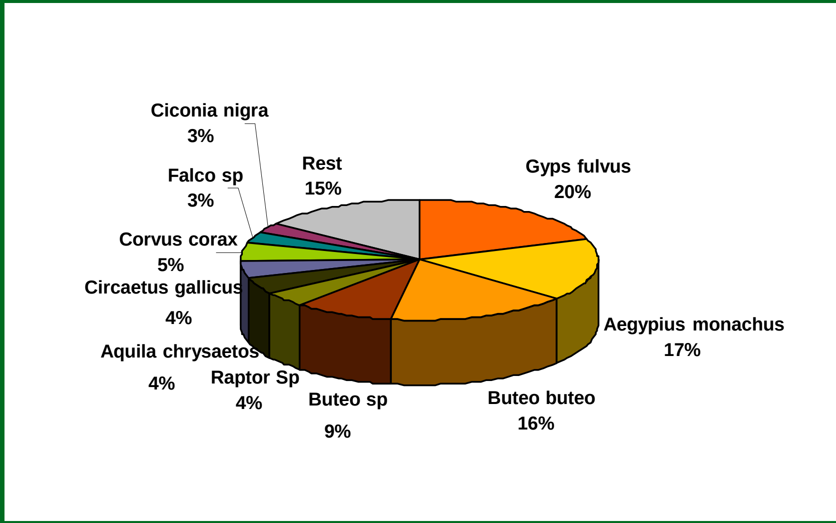
Mean carcass removal time was calculated as the average length of time a carcass remained at the site before it was removed :

$$\bar{t} = \frac{\sum_{i-1}^{s} t_i}{s - s_c},$$

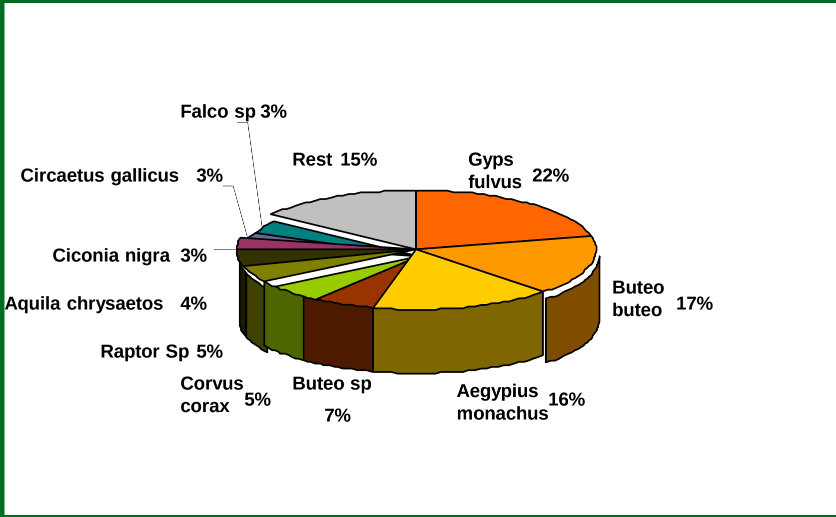
(Erickson et al. 2003)

RESULTS

Surveys of space use by birds



Vulture individuals (Griffon and Black) represented more than one third of the total bird individuals



Griffon and Black Vulture observations in the risk area of 250m from turbines represented almost 70% of their total flight observations

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RESULTS

Crossing density indices by wind farm (WF)

Crossing density index (birds/100 m*100 h)				
Wind farm	***Aegypius monachus***	***Gyps fulvus***	**Rest**	**Total (all birds of prey)**
Sapka	0.179	0.268	0.982	1.429
Didimos Lofos	0.380	0.127	1.710	2.217
Geraki	0.301	0.137	1.025	1.462
Kerveros	0.869	0.382	1.251	2.503
Peltastis	0.092	0.138	0.644	0.874
Mati	0.285	0.000	0.569	0.854
Mytoula	0.234	0.979	0.788	2.001
Soros	0.600	1.851	1.151	3.602
Monastiri	0.094	0.141	0.422	0.656

A statistically significant difference was detected (U = 3439, p<0.05, r=-0.15) for the Griffon Vulture crossing density index with a higher crossing density in the second monitoring period.

Crossing density and wind farm attributes

The crossing density of **all birds** with **the eastness of the slope** (r=0.272, p<0.05)

The crossing density of **all birds** with **the northness of the slope** (r=-0.285, p<0.05)

The vultures' and the **Griffon Vultures'** crossing density with **the inclination of the slope** (r=0.289, p<0.05; r=0.421, p=0.001 respectively)

Crossing density and wind farm attributes

The Vultures' crossing density with **the northness of the slope** (r=-0.301, p<0.05)

The Griffon Vultures' crossing density with **the distance between turbines** (r=0.331, p<0.01)

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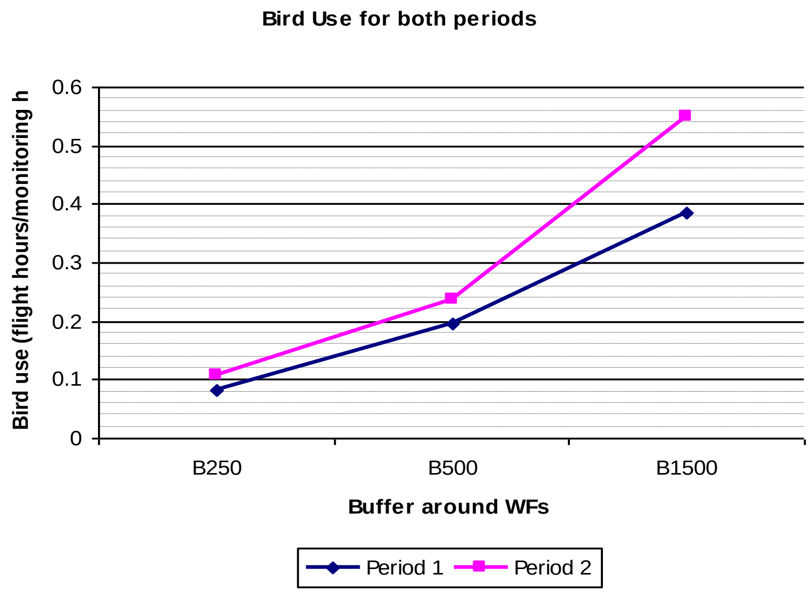
RESULTS

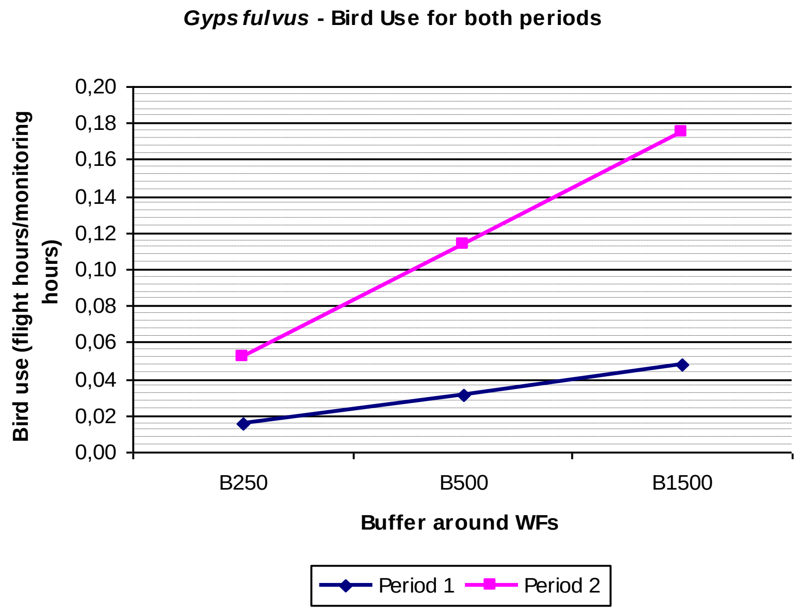
Crossing density and wind farm attributes

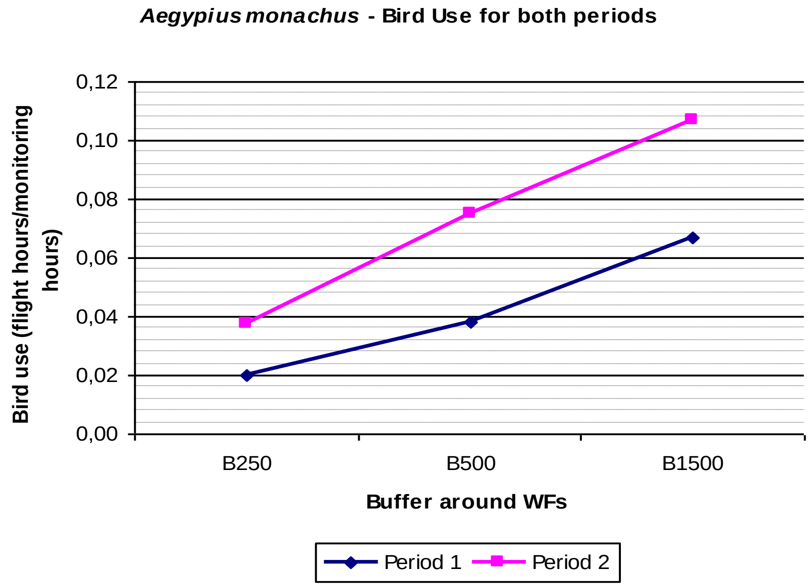
The Black Vultures' crossing density with **the eastness of the slope** (r=0.407, p=0.001)

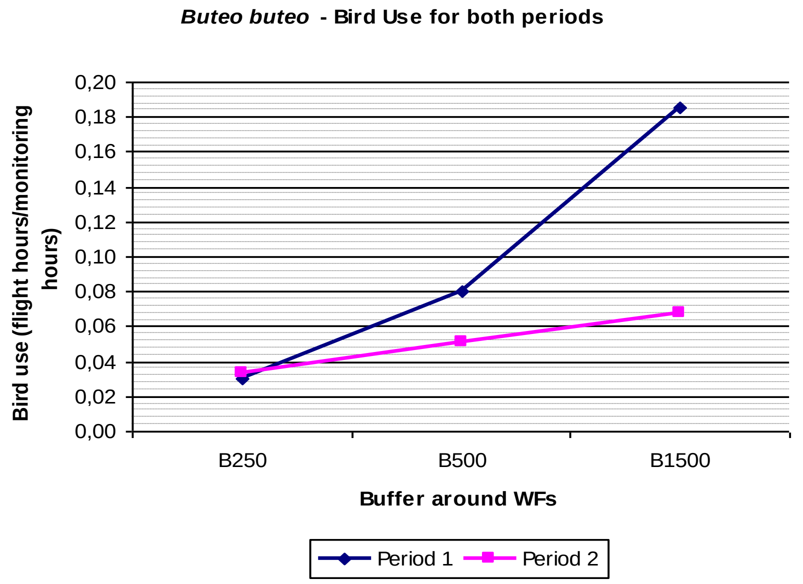
The Black Vultures' crossing density with **the northness of the slope** (r=-0.46, p<0.001)

Bird use


Bird Use for both periods
Bird use (flight hours/monitoring h
0.6
0.5
0.4
0.3
0.2
0.1
0
B250
B500
B1500
Buffer around WFs
Period 1
Period 2


Gyps fulvus - Bird Use for both periods
Bird use (flight hours/monitoring hours)
0,20
0,18
0,16
0,14
0,12
0,10
0,08
0,06
0,04
0,02
0,00
B250
B500
B1500
Buffer around WFs
Period 1
Period 2


Aegypius monachus - Bird Use for both periods
Bird use (flight hours/monitoring hours)
0,12
0,10
0,08
0,06
0,04
0,02
0,00
B250
B500
B1500
Buffer around WFs
Period 1
Period 2


Buteo buteo - Bird Use for both periods
Bird use (flight hours/monitoring hours)
0,20
0,18
0,16
0,14
0,12
0,10
0,08
0,06
0,04
0,02
0,00
B250
B500
B1500
Buffer around WFs
Period 1
Period 2

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Carcass searches surveys

5 birds of prey (4 Griffon Vultures and 1 Booted Eagle)

11 others birds (swallows, thrushes etc.)

8 bats

Following Everaert and Stienen (2007), the mortality was:

Birds of prey: N = 19.27
Vultures: N = 9,12

The adjusted mortality rate consequently was: 0.152 birds of prey/turbine/year
0.072 vultures/turbine/year


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Daily carcass searches surveys (2009-2010)

9 birds of prey (1 Black Vulture, 2 Short-toed eagles, 3 Common Buzzards, 2 Sparrowhawks, 1 Marsh Harrier)

73 others birds (swallows, thrushes etc.)

186 bats

Following Everaert and Stienen (2007), the mortality was:

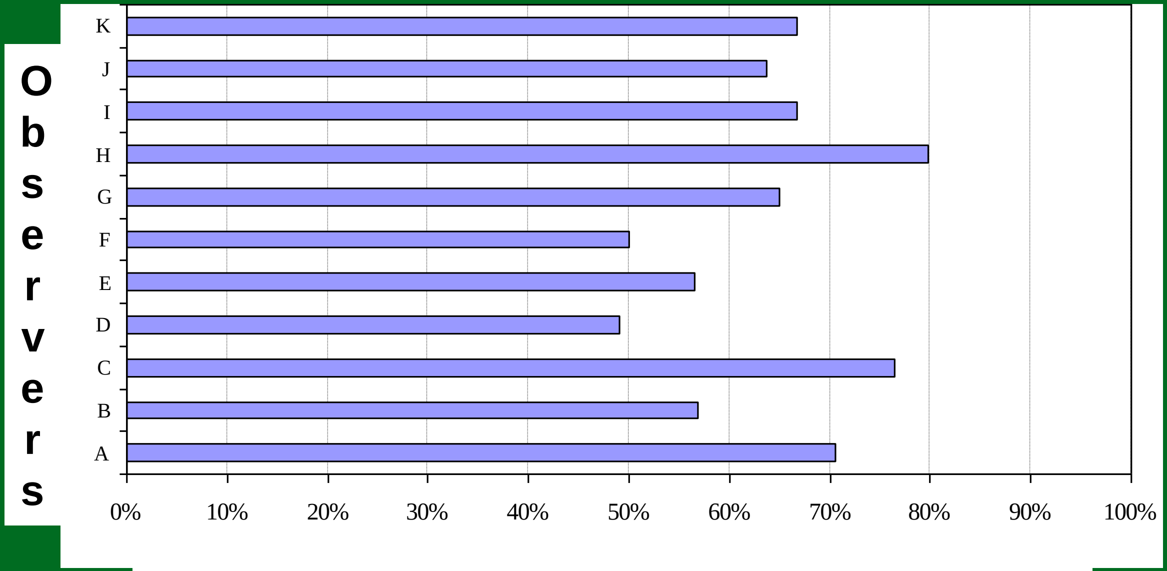
Birds of prey: N = 15.26
Black Vulture: N = 1.67

The adjusted mortality rate consequently was: 0.173 birds of prey/turbine/year
0.02 Black Vultures/turbine/year

Observers' detection trials

120 carcasses for observer detection trials

ε = 0.66 [SE(ε) = 0.027, CI 90%: 0.61-0.70]



Total detection ability by observer

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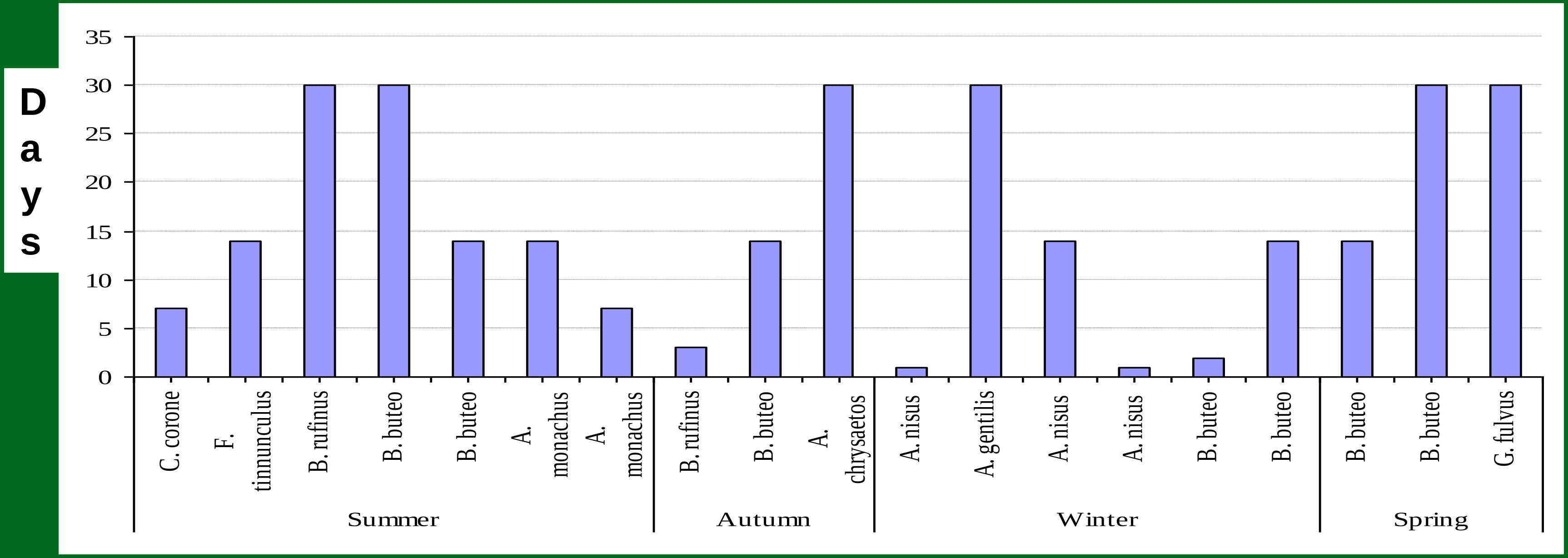
Scavenger removal trials

19 bird carcasses

t=23 days [SE(t) = 3.71 and CI 90%: 18.15-30.38]



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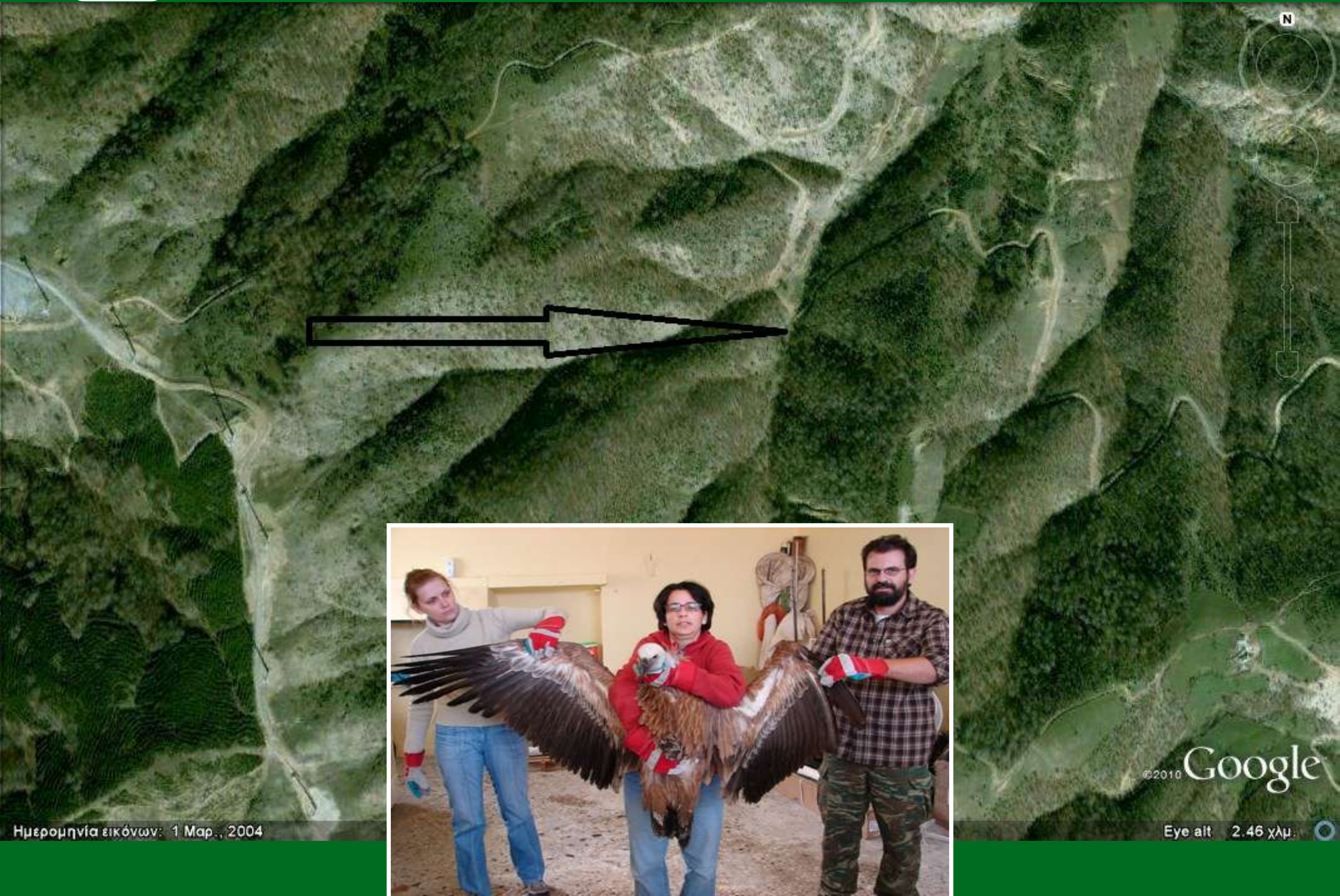

CONCLUSIONS

•Common and rare bird species were found dead due to collision with wind turbines.

•The comparison of crossing densities and bird use indices between the two study periods suggests that all raptors except the Common Buzzard used the broader wind farm area more intensively during the second period.

•Only a single year of post-construction monitoring may not be adequate to reveal the real impact of the wind farms on birds of prey.

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CONCLUSIONS

•Both scavenger removal and observer efficiency trials should be conducted across all seasons of the year. The same observers should be used across all seasons.

•Cumulative negative impacts of operating wind farms will certainly be more serious for the long-term survival of vulture populations in the area.

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Conservation implications and recommendations

- Pre-construction ornithological studies should incorporate data with regards to the steep slopes and exposure (aspect) of the slope in their evaluation of the proposed wind farm locations.

- The distance between adjacent wind turbines should be accounted for in the wind farm design.

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Conservation implications and recommendations

- Cumulative effects of every new wind farm proposal should be evaluated before getting final authorization.

- The impact of the already established wind farms should be evaluated again, as new wind turbines occupy the space around them and change the environment in which birds fly.

Acknowledgements

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Thank you for your attention