ENVIRONMENTAL SCIENCE JOURNAL FOR TEENS
MAY 2017

How can vultures and wind farms co-exist?

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Abstract

Imagine how it would feel to fly through the sky on wings so wide, when you catch some rising warm air you soar for miles! This is how vultures fly as they look out for their next meal.

Unfortunately, places that are best for vultures can also be good locations for wind farms because there's lots of wind to turn their turbines and make electricity. When vultures fly close to these turbines, the moving blades can hit them, killing or severely wounding them.

We collected data on existing and proposed wind farms in south-eastern Europe, and compared them with data on the areas that cinereous vultures *(Aegypius monachus)* live in. We found that if the new wind farms go where planned, this population of vultures could be at serious risk of extinction.

We suggest an approach that would allow for Greece to exceed its wind power targets, while protecting these vultures.

Introduction

The European Union has set strict targets for all of its member countries to produce more of their energy from green sources like solar and wind. These targets are really important to help reduce the speed of global warming.

In Greece, wind power (capturing the energy in the movement of the wind) is a key part of their green energy strategy. They have targets to produce 20% of their energy from wind power by 2050. This means that there are plans to build lots of new wind farms.

Our study area is a priority area for bird conservation, and hosts the only breeding population of cinereous vultures in south-eastern Europe (Fig.1). But the government has marked large parts of it as a wind farm priority area.

Wind farms can be a serious threat to key species when developers don't properly follow environmental laws. Birds of prey such as vultures and eagles are at risk of colliding with the turning blades of the wind turbines, and scientists have found that the turbines also have negative impacts on bats.

We wanted to:

1. Look at the total effect of all of the existing and proposed wind farms on the cinereous vulture population – how many birds would die by colliding with turbines in these farms?

2. Create a solution for where to locate new wind farms, to meet wind energy targets at the lowest possible cost to the vulture population.

Figure 1:
The cinereous vulture, also known as the Eurasian black vulture, is endangered in Greece and globally near-threatened. (Photo credit: WWF Hellas/G.Mercier)

Methods

While studying how best to protect vultures, we have equipped some of them with personal tracking devices (e.g. portable GPS). We used long-term tracking data from nineteen of those birds to create a *sensitivity map* for the population (Fig. 2). The map shows the most important areas for the birds, and which areas they spent most time in. We also tracked their flight activity, which showed us the amount of time that the birds spent at wind turbine height.

We defined the following three zones:

- Core area of vital importance = where the tracked birds spent on average 70% of their time
- Non-core area = where they spent 25% of their time.
- Peripheral zone = where they spent less than 5% of their time.

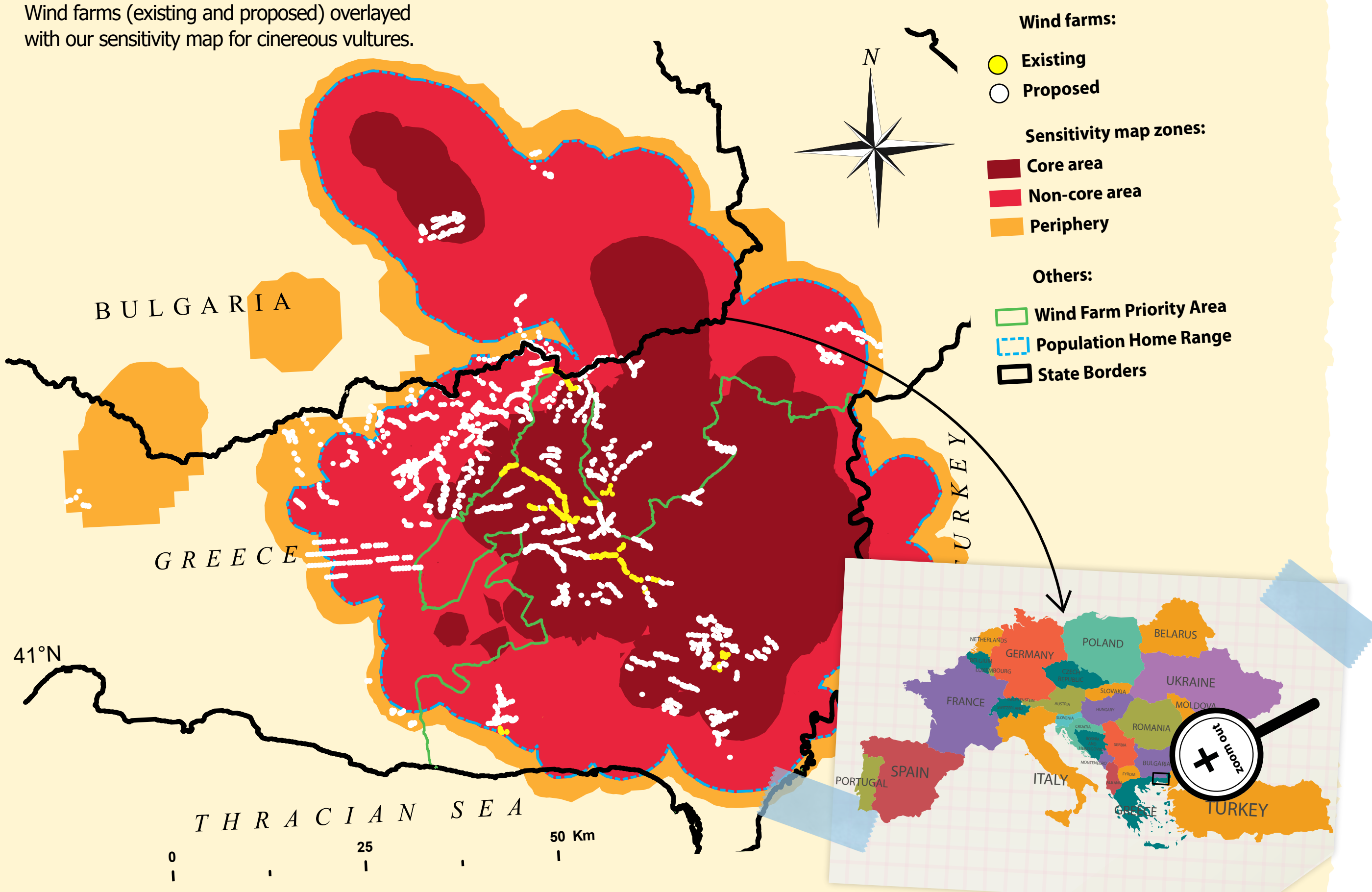
Then we charted the location and characteristics of the 13 existing, and 142 proposed wind farms in our study area.

We estimated the number of vultures that would die each year from collisions (annual collision mortality) for existing and proposed wind farms in each of the zones in our sensitivity map.

To work out the collision risk, we set a 99% avoidance rate. This means that 99 times in 100, we expect the birds to avoid the revolving blades of the turbines. We used this rate because it was the most appropriate when we compared the predicted deaths with results from daily carcass searches underneath the turbines, but it is still quite optimistic.

We calculated the cumulative collision mortality for all wind farms per zone, by removing the fraction of the population that had already collided in a previous zone, before calculating the collision mortality in the next zone.

Figure 2:
Wind farms (existing and proposed) overlayed with our sensitivity map for cinereous vultures.



Results

More than 90% of the current wind farm priority area is within the vulture population home range, and half of it is within the population's core area of vital importance (53%).

If all turbines that are in planning were to operate at the same time, we predict that 59% of the current population (103 individuals) would die from collisions each year.

A pattern emerged when we looked at the effect of the proposed wind farms:

- 11 times more vultures would die from collisions if all proposed wind farms are added to the operating ones
- More than 90% of expected deaths would occur in the population's core area (Table 1)

Fortunately, we found that Greece can meet the national target for wind energy by locating 576 wind turbines in the two outer zones of the sensitivity map (peripheral zone + part of the non-core area). This would mean that less than 1% of the standing population would die (but only as long as the wind turbines currently located in core areas are moved or stop operating during the day).

Zone	a) Operating turbines		b) Total turbines (proposed and operating)	
	Annual collisions	Percentage of annual collisions (%)	Annual collisions	Percentage of annual collisions (%)
Core area	5.5	98.42	55.23	90.29
Non-core area	0.09	1.58	5.74	9.39
Periphery	0	0	0.2	0.33
Total	5.59	100	61.17	100

Table 1:
Predicted collision mortalities per year for the cinereous vulture population from:
a) existing wind farms
b) all existing and proposed wind farms.

According to the calculations, how many vultures per year are hit by the blade of an already existing wind turbine? What would this number become if all proposed wind turbines were built?

Discussion

In our study, we considered the collective effect of wind turbines on vultures across a large area and a long period of time. This method provides more accurate predictions of population effects than the usual approach of individual wind farm assessments.

The biggest problem we identified was that wind farms were located without properly considering environmental impacts, according to biodiversity conservation laws designed to protect *biodiversity*.

To minimize the number of vultures dying from collisions, we recommend only allowing new turbines in the two outer zones of our sensitivity map (the peripheral zone and part of the non-core area) to operate. The core area of the cinereous vulture should be officially named *a wind farm exclusion zone*.

This "win-win" approach would allow Greece to meet its wind power targets and the percentage of the population predicted to die from collisions would not results in the vultures' extinction.

Conclusion

Our study is an example of problem-solving in conservation biology. Our solution to the threat of wind farm development on the population of vultures is particularly effective because it is a "win-win". This means that both sides (investors who wish to build wind farms and the scientists trying to protect this important species) would benefit from it. That way society will have a double benefit: reducing air pollution by using green energy while protecting biodiversity.

When you are solving problems between two sides that have different priorities, try to find a "win-win" so that both sides are happy with the result! That's the best way to get them to agree to your solution.

Glossary of Key Terms

Biodiversity – the variety of animal and plant life in an area as well as the variety of their habitats and genes. *When developers build wind farms in areas of special biological importance, they risk reducing the biodiversity*.

Breeding – when animals mate and produce offspring. *The vultures in our study area are the only breeding population of cinereous vultures in south-eastern Europe.*

Endangered species – a species that soon would be extinct from an area if human don't stop acting negatively on it or its habitat. *When developers build wind farms in vultures' core area, this destroys the vital habitat of an endangered species*.

Green energy – a collective name for energy that is created from *renewable* sources, like the movement of wind or water, or the energy from the Sun. Green energies produce less carbon dioxide than other sources of energy, which is a gas that causes global warming. These are different to *non-renewable, or fossil fuels* like coal, oil and gas, which produce carbon dioxide when we burn them.

Sensitivity map – a map reflecting where a species typically spend the majority of its time.

Wind farm – a group of wind turbines used to generate electricity.

Wind farm exclusion zone – an area that the government has defined where it is illegal to build wind farms.

Wind turbine – a structure that captures the movement energy of the wind to generate electrical power. The wind turns huge blades around a rotor. This spins a generator to create electricity.

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Learn more about the Cinereous vulture
http://www.europeanraptors.org/raptors/cinereous_vulture.html

Check your understanding

1. In our study, we used four different vulture avoidance rates to estimate the collision risk. These were 99.5%, 99%, 98% and 95%. What effect do you think that these different rates would have had on the estimated population decrease from the wind farms?

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2. Between 2003 and 2013, 16% of proposed wind farm developments were declined because of technical considerations, but 0 wind farms were declined because of environmental concerns. Why does this suggest that the environmental assessments have not been well implemented?

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3. We put tracking devices on nineteen vultures to capture data on their flight behaviour, range, and the time that they spent in different parts of the study area. What considerations do you think we needed to make, to ensure that we didn't harm the birds when we did this?

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4. We calculated the cumulative collision mortality for all wind farms per zone, by removing the fraction of the population that had already collided in a previous zone, before calculating the collision mortality in the next zone. Why is this more accurate than extrapolating data on individual site-based deaths to the future or wider geographic scales?
