



DHI SOLUTION

# AEROECOLOGY – ECOLOGICAL SERVICES FOR THE AEROSPHERE

## Mitigating the impacts of wind turbines on migratory birds

### IMPACT OF HUMAN ACTIVITY ON BIRD AEROECOLOGY

Conventionally, the entire atmosphere surrounding the earth is referred to as the aerosphere. In recent times, a new discipline of study – aeroecology – has emerged, which pertains to this highly fluid environment. Aeroecology integrates a wide range of sciences in a unified concept that focuses on the myriad airborne life forms which rely on the support of the lower atmosphere.

In contrast to terrestrial and aquatic organisms, the effects of anthropogenic activity are almost instantaneous on creatures that use the aerosphere. Skyscrapers, lighted cities and aircrafts have a profound influence on the dispersal, foraging and migratory behaviour of insects, birds and bats. More recently the emergence of wind farms – both on and off shore – poses a greater threat to such organisms. This is specifically applicable to migratory birds and collisions & barrier effects between such birds and wind turbines are an increasing concern.



*Raptors constitute the group of birds for which collisions with wind farms may possess the highest risk — here a white-tailed eagle passes above the rotors of the Rødsand 2 wind farm, southern Denmark*

### HELPING YOU MITIGATE THE IMPACTS OF WIND FARMS ON BIRD MIGRATION

Since 2007, we have developed and applied a range of radar applications to Environmental Impact Assessments (EIAs) related to wind turbine and other infrastructure projects. One of the major challenges in understanding daily and seasonal movements of birds is to assess the flight altitude and direction of birds

### SUMMARY

#### CLIENT

Wind turbine operators

#### CHALLENGE

- Increasing number of wind turbines being established worldwide
- Collisions between migratory birds and wind turbines
- Wind farms introducing barriers to bird movements
- Dearth of specific knowledge of bird migration behaviour and response to wind farms

#### SOLUTION

Pre- and post-construction studies on bird movements and assessment of collision risks & barrier effects of wind turbines

#### VALUE

- Accurate assessment of collisions and barrier effects between bird migration and wind turbines
- Ability to take informed decisions to alleviate the impact of wind turbines on bird migration
- Improve ecological credibility of wind industry by reducing impacts on threatened or endangered species
- Decreased ecological footprint of wind turbines

during different weather and landscape conditions. We have developed techniques to circumvent these issues. We can now integrate 2D and 3D tracking of birds based on radar recordings with our extensive modelling capacity to make accurate predictions about the behaviour of migrating birds.

In fact, we have used such altitude models for the environmental monitoring of a Danish offshore wind farm. In so doing, we have estimated the numbers of collisions between birds and turbines and identify potentially critical periods, to decrease these instances.

Is the Marsh Harrier more prone to collide with your turbine or the White-tailed Eagle? Does the Rough-legged Buzzard reach rotor height of your turbine or the Sparrowhawk? When would Red Kites and Peregrine Falcons be most likely to fly in the direction of your turbine in large numbers? Is poor visibility the main factor in collision risks or do head wind, increasing humidity and peak migration periods play an equally important role? By answering these questions and more, we can help you accurately determine the impact of offshore wind farms on bird migration. We also enable you to decrease your ecological footprint in the process.

### WHAT OUR STUDIES INVOLVE

Our overall strategy involves targeted investigations of bird movements by the use of radar equipment, supplemented with our visual observations. We assess collision risks at the species level since general evaluations are inappropriate, owing to large differences in the size of affected populations. Combined radar, rangefinder and visual observations enable detailed statistics of the birds approaching and passing the wind farms. Generalisations can then be made and the number of collisions estimated using the species-specific collision models. Similarly, species-specific models of the barrier effect of a wind farm on bird movements can be developed.

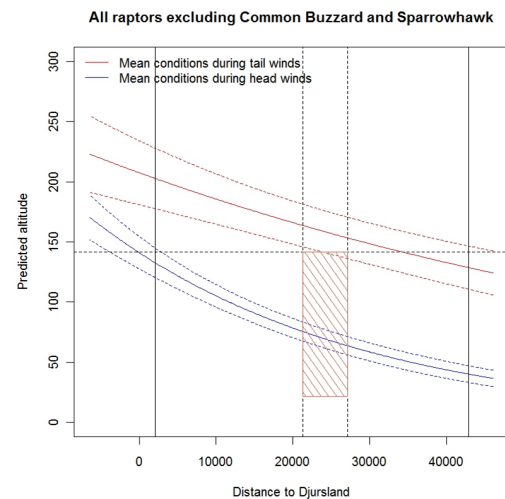


Red Kites passing wind farm

Laser rangefinders (Vectronix 21 Aero®) are used to collect species-specific data on the altitude of migrating birds. Thus operated at known geographical positions and elevations, the rangefinders are used to obtain 3D data on the birds. Parallel

to tracking by rangefinder the individual species are also tracked by horizontal radar to obtain data on the responsive movements to the wind farm at larger distances (> 2 km).. This has a dedicated software program called 'Bird Tracker', which makes it possible to follow several tracks of individual birds or flocks.

The species-specific collision rates and barrier effects are estimated by multivariate statistical models. These models describe the influence of weather conditions, landscape components and the wind farm on the migratory behaviour of birds. Modelled data on winds, precipitation and visibility are used to derive generic spatial data on the distribution of weather conditions at the altitude where the birds are migrating. The deployment of the migration models can then be generalised for typical weather scenarios, providing the basis for estimating the number of casualties and strength of the barrier effect.



*Model of altitude of migrating raptors in relation to the planned Anholt wind farm, Denmark.*

- Average predicted altitude is shown in relation to distance from the coast for raptors (excluding Common Buzzard and Sparrowhawk) during tail winds and head winds.
- The dashed lines indicate standard errors.
- The black vertical lines indicate the range of the observations.
- The models are based on data from "left of the left line" and from "right of the right line".
- The rectangle with shading red lines and the dashed vertical and horizontal lines indicates the rotor swept area.

Finally, the estimated annual number of dead birds can be compared with thresholds for sustainable mortality for the different species. These comparisons then serve as guidelines for the assessment and requirements for mitigation measures.

Contact: [GMAC - marketing@dhigroup.com](mailto:GMAC-marketing@dhigroup.com)  
For more information visit: [www.dhigroup.com](http://www.dhigroup.com)