Demonstration of good practices to minimize impacts of wind farms on biodiversity in Greece

J. Fric[1], T. Dimalexis[1], V. Goritsas[1], M. Tzali[1] , E. Tzen[2], K. Rossis[2]

[1]Nature Conservation Consultants (NCC) Ltd., Chalandri, Greece, *e-mail: jakobfric@n2c.gr

[2]Center for Renewable Energy Sources & Saving

Introduction

In scope of European Union's 2020 objective to produce 20% of total energy production from renewable energy sources, a drastic development of wind farms in Greece is anticipated in the near future. This development is expected to cause increasing conflicts of energy production with wildlife and nature conservation. However:

• there is still lack of in-country knowledge, experience and know-how in planning of biodiversity compatible wind farm operation and in the application of modern mitigation technologies,

• the available mitigation methods and commercially available technologies have not yet been sufficiently tested for their applicability under Greek and Mediterranean environmental conditions

• there is still an insufficient planning framework on wind farm development i.e. there is not a single complete set of criteria and detailed guidelines, for competent authorities in Greece, concerning the appropriate use of mitigation measures in relation to biodiversity related impacts of wind farm, within or outside Natura 2000 sites.

In order to tackle these issues and with the overall objective to minimize the impacts of wind farms on wildlife and particularly on birds and bats, the **LIFE project "Demonstration of Good Practices to minimize impacts of Wind farms on Biodiversity in Greece" (LIFE12BIO/GR/000554,) aims to:**

demonstrate and promote state-of-the-art methods and approaches to improve the compatibility with the EU biodiversity conservation targets, and to develop prescriptions and guidelines that will enable Greek state authorities and wind farm developers to effectively plan, implement and regularly evaluate the performance of the mitigation technologies .

Methods

The main site for the demonstration of the modern technologies and methods of mitigating impacts of the wind farms on the aerial biodiversity, i.e. birds and bats, is the Park of Energy Awareness (PENA) of the Center for Renewable Energy Sources & Saving (CRES) in Keratea, Attika. The 3.01 MW demonstration wind farm at PENA consists of 5 wind turbines of different technologies, 2 prototypes and 3 commercial of nominal capacities from 500 kW to 750kW each.

Figure 1: View of the PENA demonstration wind farm at Keratea Attikis, Greece

The technologies which are being operated and tested include:

(A) an **ornithological radar**, based on a marine surveillance radar, operating as an early warning system in association with **visual observations by ornithologists**

(B) a commercial **High-Definition** (HD) **video system**, which acts as an early warning and bird dissuasion system, with the capacity to automatically control the operation wind turbines, in association with **visual observations for monitoring the efficiency**

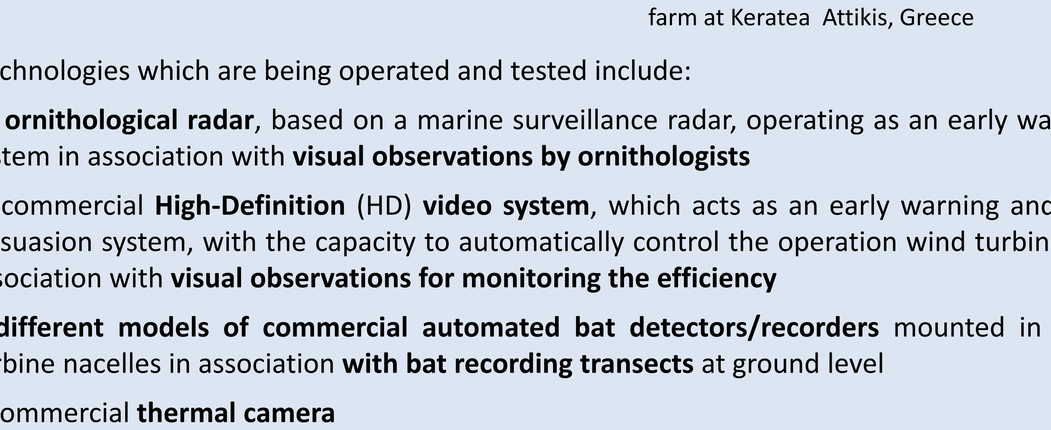
(C) 3 different models of commercial automated bat detectors/recorders mounted in wind turbine nacelles in association **with bat recording transects** at ground level

(D) a commercial **thermal camera**

The impacts of the PENA wind farm on the biodiversity is assessed by **carcass searches**. The **effects of the temporary wind turbine shut downs on the energy production** is evaluated based on the actual energy production of individual wind turbines.

The use of the above ornithological radar, bat detectors/recorders and thermal imagery is also **demonstrated at other commercial wind farms in Greece**, while an additional demonstration video early warning and dissuasion systems is planned to be installed at a commercial wind farm in the near future.

Additionally, a **Decision Support Tool** and a **Good Practice Guide,** aiming at assisting competent authorities, wind farm developers and nature conservation institutions in planning wind farms and in the implementation of mitigation measures, have been developed and are continuously updated based on the requirements of key stakeholder groups.



Figures 2: Good Practice Guide (left) and Google-Earth based Decision Support Tool (right)

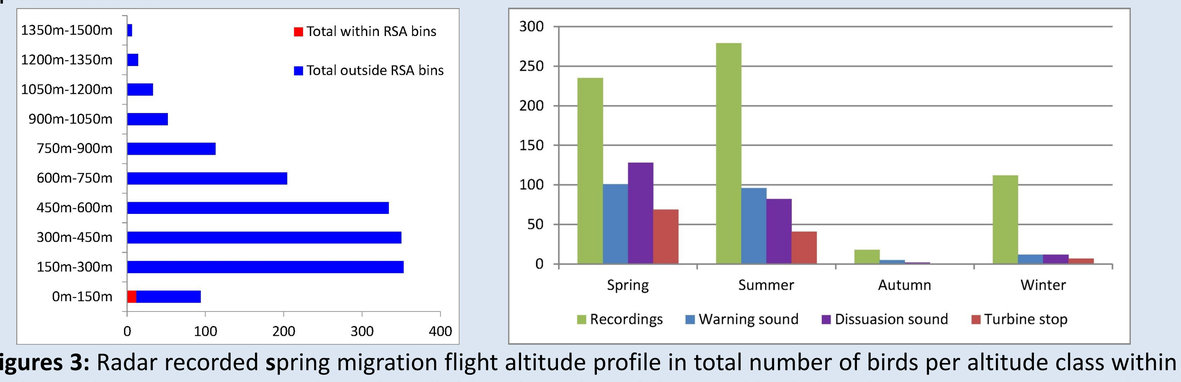
Finally, the mitigation technologies, approaches and tools are being promoted through **a series of training events, stakeholder meetings and workshops** which are taking place at PENA as well as other sites in Greece.

Results

The preliminary results of the operation and evaluation of the above systems are comparable with those acquired in other parts of the world:

(A) The **ornithological radar**, is an efficient early warning system with the detection range varying between few to several kilometers, depending on the size of the birds and bird flocks. However, the efficiency of the radar could be significantly affected by dense vegetation or rugged terrain. It is particularly useful in association with a network of observers for the monitoring of bird migration (diurnal and nocturnal).

(B) The **HD video early warning/dissuasion system** is a very powerful and cost-efficient tool for continuous monitoring of diurnal bird movements in the vicinity of wind turbines and for automatic acoustic dissuasion or turbine shutdown to prevent collisions. In a single year it recorded 2,500 birds at PENA. The false positives were within the manufacturer's specifications at 2 per day of all recording, however primarily due to aircraft passing by from the nearby Athens airport. The automated temporary (~90 second/shutdown) wind turbine shutdowns, if activated, would **reduce annual energy production for estimated 0.24%**. The detection range (e.g. 150m for buzzard-sized birds), evaluated by visual observations, was in accordance with the system's specifications.



Figures 3: Radar recorded **s**pring migration flight altitude profile in total number of birds per altitude class within and outside Rotor-Swept-Area (RSA) bins (left) and number of big-sized birds (wind span > 75 cm) recorded and automated actions taken by the video early warning/dissuasion system per season (right).

(C) all **automated bat detectors/recorders** produced comparable results and recorded up to 178 recordings per night, with significant bat activities between March and November. In spring, 94% of the bat activity was at wind speeds less than 3m/s. In autumn, bats were active at higher wind speeds with 50%, 80% and 95% of bat activity been recorded at wind speeds of less than 3m/s, 4m/s and 5m/s, respectively.

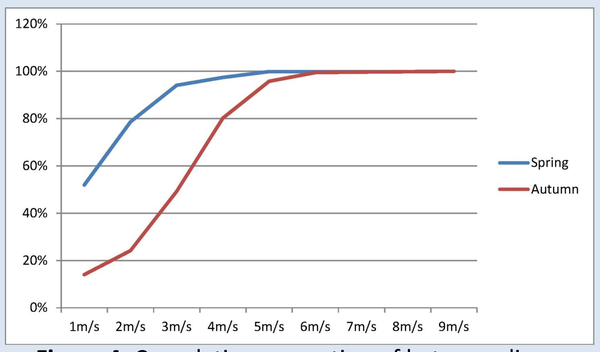


Figure 4: Cumulative proportion of bat recordings as a function of wind speed.

In general the majority of bat activity was recorded below the wind turbine cut-in speed. Nearly entire bat activity (> 99%) was recorded at an average daily temperature above 15°C. In total, 6 species or groups of species were recorded out of 34 bat species present in Greece.

(D) the **thermal camera** was capable of detecting bats and nocturnal passerines in the vicinity of the wind turbines, but was suitable primarily to provide supplementary data to other methods used i.e. to provide nocturnal passerine data in the near vicinity of the wind turbine which could not be assessed by the radar or to further assess the space use of bats which were detected by bat recorders.

Conclusions

The preliminary results of the demonstration operation have already highlighted the capabilities and limitation of applied technologies under different environmental conditions in Greece and if they are properly applied, they can significantly improve the amount and the quality of data during the wind farm planning stage, but also provide effective early warning and mitigation tools to reduce the collision risks of operational wind farms on birds and bats.

The results of the project are already being utilized by the competent authorities as well as wind farm developers to reduce impacts of particular wind farms on birds and bats, with special reference to mitigation of collision risks.

Based on the preliminary information and experience acquired by the project, the most cost-effective currently available technologies for the mitigation of collision impacts of wind farms include:

• automated **video early warning/dissuasion/SCADA system** for continuous mitigation of collision impacts in areas with sensitive medium-large sized bird species

• **marine-surveillance radar in association network of visual observers and manual wind turbine shutdown** for bird migration corridors and bottlenecks

• **automated bat detectors/recorders in association with meteorological data (i.e. wind speed and temperature)** in areas with significant bat presence to design optimal wind turbine operation protocols (e.g. cut-in speed adjustments).

All these methods, however, need to be accompanied by the conventional visual observation and carcass search surveys.

The active involvement of all key stakeholder groups in the project's Advisory Committee in association with the results of the demonstration operation and tools developed by the project are expected significantly to improve the capacity of competent authorities, wind farm developers and nature conservation institutions in finding optimal solutions for sustainable planning of wind farm development in collaboration with nature protection in Greece.

www.windfarms-wildlife.gr

The project LIFE Wind farms & Wildlife (LIFE12BIO/GR/000554) is implemented by the Centre for Renewable Energy Sources and Saving, in collaboration with the NCC Ltd, with the financial support of the European Union LIFE Instrument and the Hellenic Green Fund.