Detection offers best protection to birds

Bioseco Bird Protection System in Tenerife: a simple answer to the growing need to protect birds against collisions on onshore wind farms

Over a year ago, an article about the Polish Bird Protection System (BPS) was published in PES Wind. Throughout this time, Bioseco has been improving its system, testing its effectiveness and expanding operations in Europe, working with global players. Now in 2022, the company offers upgraded versions of BPS, a system that reduces bird mortality and makes the wind industry not only green, but ensures biodiversity is maintained while fulfilling environmental obligations.

Protecting birds against collision: is it really so important?

One of the most threatening aspects of biodiversity in the operation of wind farms are bird collisions. Blade tips can spin at speeds of over 400 kph and are hardly visible to birds. Depending on the location and rotor size, a single power plant might kill several birds each year.

According to scientist calculations, the susceptibility of birds of prey to collisions (Accipitriformes) is 0.07 individuals per turbine per year (Thaxter et al. 2017). With 100,000 onshore wind installations currently in Europe, annual bird death rates can be estimated at 7,000 birds of prey in Europe alone.

Yet it is not only the total number of fatal collisions that might cause concern in the future with the rapid increase of wind energy capacity. It is also the regional impact on certain species like Eagles, Vultures or Kites, which are the most common birds colliding with turbine blades.

Due to population and ecosystem stability, the most harmful outcome would be the loss of large predators, which are at the top of the food chain. Apex predators play a leading role in the balance of populations of their prey and the whole chain.

These birds are the prime focus of Bioseco's Bird Protection System.

Why automated vision systems?

Automated systems, using deep learning algorithms, are increasingly the answer for the grey area of the data gap. They are applied after a wind farm is built, mainly to reduce bird mortality, in particular of rare birds of prey.

A system of day cameras with AI-based software is mounted on the turbine. These cameras cover an area of 360 degrees around the turbine, and a distance of up to 600m depending on bird size. The system follows the detected birds and activates deterrents or stops the turbine when the bird approaches the distance at which it is at risk of collision.

This distance is programmed for every power plant individually, compliant to requirements. The turbine is turned on or the deterrents turned off when the threat of bird collision passes.

Reaction modules can also be installed, designed to scare away birds based on light and audio signals. The BPS firstly activates the scaring modules when the bird is detected, shutting the turbine down if the bird continues to fly towards the turbine and enters the risk collision zone of 200m or 300m.

Are two cameras better than one? The advantages of stereovision

Most similar visual bird detecting systems, like DTBird, SafeWind, BirdVision and Airelectronics, are based on a monoscopic approach. This is sufficient for detecting flying objects around the turbine, but only the application of a stereoscopic setup, with a pair of cameras observing the sky, enables the bird size and distance from the turbine to be estimated.

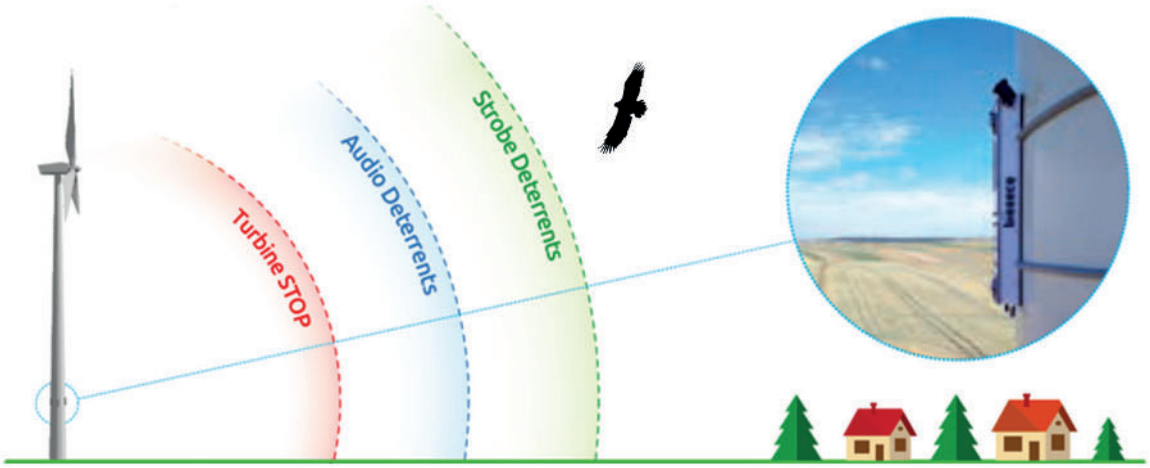
The more data about bird size and location the better for applying a mitigation strategy, which is the foundation of a reliable and effective collision avoidance system. Stereovision also helps to reduce false detections that cause an unnecessary loss of energy generation.

Artificial Intelligence and IoT in real-time detection and reaction

With the growing capability of computing power and the effectiveness of algorithms, solutions based on automated detection and convoluted neural networks (CNN) have become more commonly used for picture, sound and event detection and recognition. Implementing this in the IoT paradigm has tended to be the desirable approach recently.

Bioseco applies this path to provide the real-time operation and reaction that is necessary for bird protection. A stereoscopic

Protection area



acquisition with an embedded AI-based identification system consisting of six to eight vision modules continuously monitors the area around the power plant. From the object's contour it recognises birds from a range of at least 500m and classifies them into either small or large categories.

The decision-making system combines information from each module and the 3D localization algorithm computes its flight height, distance and trajectory. Depending on the environmental authorities, wind farm developments and requirements specified by them, when a bird is detected at a particular distance, the system emits pulsating lights. If the bird doesn't change its flight path, sound deterrents are launched, and when it continues its flight on a dangerous trajectory, the turbine can be stopped.

Validating effectiveness of the BPS

Ornithologists support the development of the BPS and validate its effectiveness. In 2019, the prototype of the system was covered by a field ornithological survey. Since then, all subsequent versions of the system have been tested. A detection efficiency evaluation study was carried out, comparing birds observed at the study site by the field expert with those detected by the BPS.

As a result of methodical surveys and analyses, the effectiveness of BPS in detecting birds at greater distances can be seen, as well as how the percentage share of false positive and false negative detections drops.

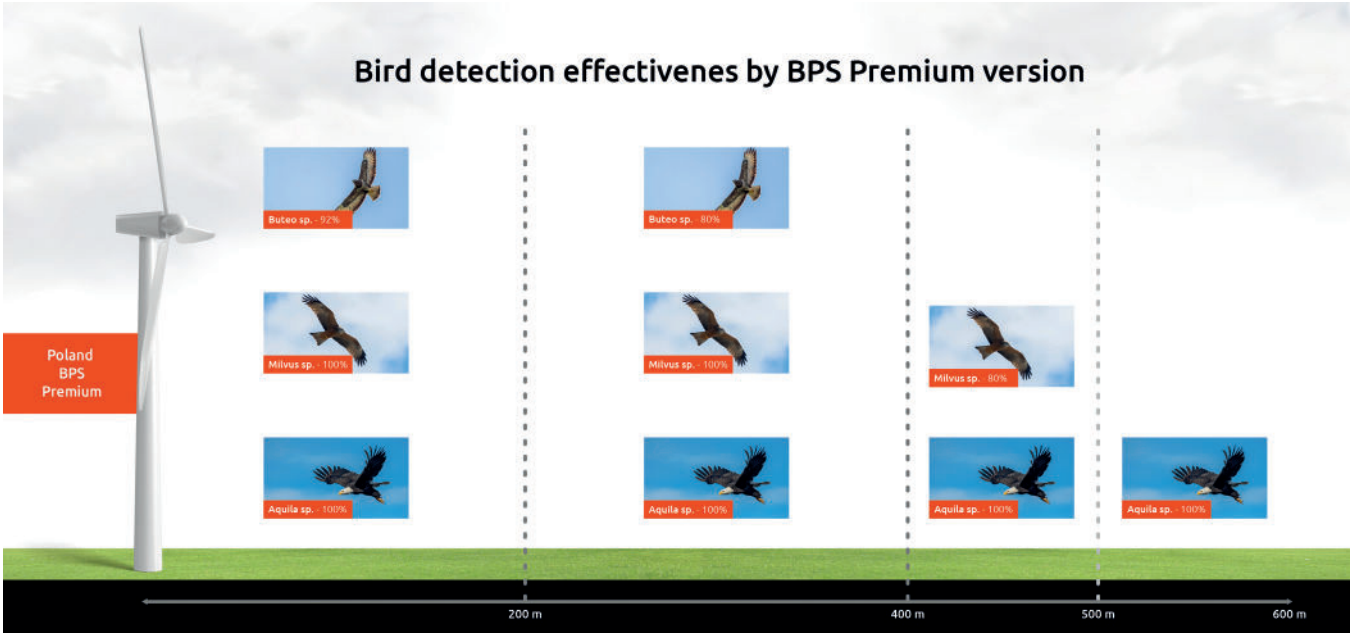
So far, the tests have been carried out on various wind farms in Poland, Germany and Spain. Ornithologists focused on testing the effectiveness of bird detection, detection distance, bird response to scare signals and the effectiveness of turbine shutdowns.

All the field tests involved farms characterised by different terrain conditions and different structures of the use of airspace by individual species or groups of birds of prey.

One of the first system tests was carried out in Germany. Scientists from Schweizerische Vogelwarte Sempach focused on the effectiveness of Red Kite detection. The BPS Standard Plus version tested had a very high detection efficiency but over a short distance.

Since 2020, the effectiveness of a BPS Premium version has been tested on a farm owned by PGE EO, one of the largest wind operators in Poland. Ornithological surveys have shown significant progress in the detection of birds at much greater distances from the turbines.

The detection efficiency varied between different bird size categories and distance ranges, but is high for birds with a wingspan



A bird equipped with GPS during efficiency test on a wind farm in Poland

of over 1.5m at a distance up to 600m.

Experience with BPS efficiency in real applications

In 2021, during a short visit to a wind farm in Spain, we evaluated BPS effectiveness, focusing on problematic species locally, such as vultures. The surveys revealed that BPS Standard Plus version works quite well in the conditions of central Spain, detecting all birds with a wingspan over 1.5 m at a distance of up to 400m.

'Importantly, we noted that BPS effectively shutdowns the turbine and the birds can fly safely, even if the risk of collision is high and the turbine is working,' says Aleksandra Szurlej-Kielańska, an ornithologist from the consulting company Tactus, cooperating with Bioseco.

Since 2020, data from three BPS systems installed on this farm has been collected and analysed. Data from one year's worth of detections found that birds of prey account for just over 10% of all detections. Of these, about 40% did not meet the turbine shutdown criteria due to the distance of detection being in excess of 300m.

Around 30% of the detections that would cause the turbine to stop occurred at a wind speed below 2 m/s, which means that the turbine was not working anyway.

Finally, it can be concluded that on average during energy generation, turbines stopped only twice per day for a total of around 7 minutes, showing how stereovision helps reduce the number of turbine stops and limit energy loss.

'This year we are planning our next field trip in Spain, focusing on the maximum distance detection of vultures using the BPS Premium. This is a very important parameter for many wind operators in Western Europe,' continues Szurlej-Kielańska.

'We are also starting to test the reaction of birds of prey to audio and strobe scare signals. Having seen the system in action we are of the opinion that BPS is a good detection/reaction system and a very good alternative to periodical turbine shutdowns and an effective method to mitigate bird's collision risk at the windfarms.'

To ensure data accuracy of field testing, Bioseco is also using drones and trained birds with a GPS transmitter, to improve detection algorithms and test detection distances.

The future of Bioseco Bird Protection System

In 2021 we doubled the number of BPS in operation and are currently operating in four European countries: Poland, Germany, France and Spain.

In spring 2022 BPS will be installed on one of the wind farms in Poland, where part of the wind farm will be located in the NATURA 2000 area. The aim of this installation is to reduce the potential collision of Lesser Spotted Eagles and Storks.

'Further systems will also be installed on new wind projects in Spain owned by some global wind energy players, following the environmental obligations imposed by authorities,' says Adam Jaworski, CEO at Bioseco.

'We are seeing an increased interest for Bioseco from other EU markets like Italy and Greece, plus the UK, South Africa and Brazil. Despite Covid, the technological progress is still very rapid and we are testing new cameras and microchips that will enable the improvement of BPS capabilities.'

A new version called BPS Long-range, currently under testing, is expected to be launched by the third quarter of 2022. The aim of this version is to provide efficient Red Kite detection up to 700m and even 1 km for Eagles. 'We are ready for pilot projects with interested parties to confirm BPS capabilities in specific site conditions,' says CEO Adam Jaworski.

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New version of Bird Protection System: BPS Long-range

Ornithological observations during verification BPS operation on a wind farm in Spain