Evaluation of the application of warning and discouraging sounds automatically emitted from wind turbines on bird collision risk. Case studies in Sweden and Switzerland.

Presenter: **Agustín Riopérez. DTBird®**; Co-authors: **Marcos Puente & Javier Díaz. DTBird®;** Contact: **mpuente@dtbird.com**

Introduction

Wind energy is expanding worldwide, and there is an increasing demand to reduce the collision risk of birds with wind turbines (WTG). Methods commonly proposed include:

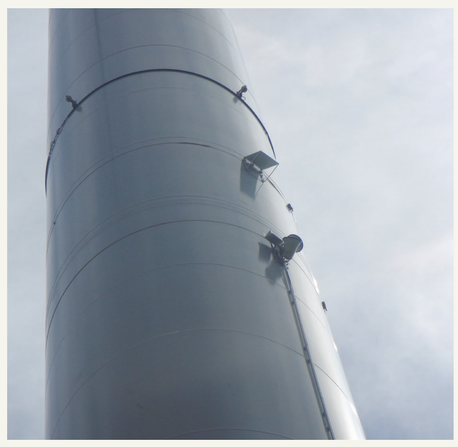
- "Deter" birds flying in the proximity of WTG.
- Stop the WTG before birds fly across the Rotor Swept Area.

Useful technologies applying these methods should be able to efficiently detect bird flights in real-time, and to take the proposed actions on time to reduce the collision risk.

The aim of this research is to evaluate the effect of warning and discouraging sounds, emitted automatically from WTGs, on bird collision risk.

General view of DTBird® *System* installed in Sweden.

Detailed view of DTBird® *System* installed in Sweden.



Detailed view of DTBird® *System* installed in Switzerland.

Methods

The evaluation has been performed in 2 WTGs equipped with DTBird® *System* for bird monitoring and collision risk reduction through sound emission.

Features of the 2WTGs selected for the evaluation and the evaluation periods are presented in **Table 1**.

DTBird® *System* Modules installed in every WTG are presented in **Table 2**, and phorographs 1, 2 and 3. DTBird® *System* features are available online in www.dtbird.com

The research has been focused on bird flights detected at the Rotor Swept Area height (RSA height), <100 m to the blades, and with the rotor running. Flights detected at <1 blade length to the RSA have been considered High Collision Risk flights (HCRF).

The evaluation methodology consisted of the activation/deactivation of sound emission on a weekly basis (experimental treatments), and the comparison of variables indicative of collision risk, determined from the flight video records:

- Nº High Collision Risk flights (HCRF).
- HCRF duration.
- % HCRF pattern changes(1).
- % Collision Avoidance flight(2).
- Nº RSA crosses.
- Nº Collisions.

A decrease in the value of a variable of collision risk has been considered indicative of collision risk reduction.

(1) Visible changes within 5 s from Warning/Discouraging Sound trigger (virtual or actual) in any of the following flight features: flight direction (at least 15° turn), flight speed or pattern of wing beat.

(2) Flights in the route to cross the RSA at any moment along the recorded flight (Collision flight), that change to a route without RSA cross within 5 s to a Sounds Trigger (virtual or actual), and later does not take again a route toward the RSA.

TABLE 1. FEATURES OF THE 2 WTGS SELECTED FOR THE EVALUATION

WTG LOCATION	WTG MODEL	TOWER HEIGHT	ROTOR DIAMETER	EVALUATION PERIOD
Switzerland	Vestas 3MW	119 m	112 m	Autumn 2014
Sweden	Vestas 850 KW	74 m	52 m	Summer 2015

TABLE 2. DTBIRD® SYSTEM MODULES INSTALLED IN EVERY WTG

DTBird® System	
Detection Module	Survey the airspace around WTGs detecting bird flights in real-time.
Collision Avoidance Module	Emits warning and discouraging sounds from the WTG to birds flying in collision risk.
Collision Control Module	Records bird flights in collision risk and potential collisions.
Data Analysis Platform	Stores online video and sound records of every detected flight, and allows to analyze and report flight features.

Results

Bird activity and flight composition registered by DTBird® *Detection Module* in the WTGs located in Switzerland and Sweden are presented in **Tables 3** and **4**.

The comparison in variables indicative of collision risk with sound emission activated and deactivated are presentend in **Table 5**.

TABLE 3. BIRD ACTIVITY REGISTERED BY DTBIRD® DETECTION MODULE

WTG LOCATION	TOTAL Nº FLIGHTS	TOTAL Nº BIRDS	FLIGHTS/DAY
Switzerland	274	423	4.2
Sweden	285	604	5.8

TABLE 4. FLIGHT COMPOSITION REGISTERED BY DTBIRD® DETECTION MODULE

FLIGHTS COMPOSITION	SWITZERLAND	SWEDEN
Raptors	3 %	10 %
Corvids	15 %	19 %
Geese	0 %	4 %
Seabirds	0 %	27 %
Cranes	0 %	4 %
Medium size birds	61 %	23 %
Others	21 %	13 %

TABLE 5. VALUES OF COLLISION RISK VARIABLES WITH SOUND EMISSION ACTIVATED AND DEACTIVATED, AND INDICATION OF COLLISION RISK REDUCTION

VARIABLES INDICATIVE OF COLLISION RISK	SWITZERLAND		SWEDEN		Collision risk reduction by Sound emission
	SOUNDS				
	Activated	Deactivated	Activated	Deactivated	
High Collision Risk flights (HCRF)	0[3]	8[3]	15	23	√
HCRF duration (minutes)	42"	3'01"	4'05"	10'15"	√
HCRF pattern changes (%)	60% (8/13 flights)	0% (0/14 flights)	82% (9/11 flights)	44% (7/16 flights)	√
Collision Avoidance flights (%)	100% (2/2 flights)	0% (0/1 flight)	87% (13/15 flights)	33% (4/12 flights)	√
RSA cross (nº)	0	1	0	0	Not enough data
Collisions (nº)	0	0	0	0	Not enough data

[3] At 1/2 HCR: 25 m to the blades

Conclusions

The research points out that the automatic emission of warning and discouraging sounds from the operating WTG, linked to the detection in real-time of birds flying in their proximity, has reduced the bird collision risk.