Biodiv-Wind

# Fact Sheet

# Red Kite vs. Wind Turbine ?

**An analysis of Red Kite (Milvus milvus) collision risk as a function of Wind Turbine rotation speed**

**Based on detections made by SafeWind systems on 251 operating wind turbines from January 14, 2019 to January 14, 2023**

Lauréat du PASS FRENCH TECH

Biodiv-Wind

# DOES SHUTTING DOWN A WIND TURBINE REDUCE THE RISK OF BIRD COLLISION ?

The scientific literature suggests that the risk of bird collision on wind turbines depends on several factors[1,2] :

- The bird's own speed, their ability to anticipate movement and their ability to maneuver in flight.
- The frequency, abundance and phenology of species at the site.
- Weather conditions.
- The diameter and height of the rotors.
- **The rotor speed → this factor is the only one that can be controlled during the operation of the wind turbines.**

SafeWind is a video-based detection system installed on wind turbines which allows to study or reduce the risk of bird collision by deterrence and/or turbine regulation, depending on operators' requirements. From 2019 to 2023, theses systems have produced hundreds of thousands of Red Kite detections, and 30 collisions, lethal or not, have been recorded.

For each detection achieved, SafeWind records the rotation speed of the wind turbine. It thus becomes possible to study the influence of this speed on collision risk of and, ultimately, to assess the usefulness of stopping a wind turbine when a bird is in close vicinity during flight. This is the objective of this FactSheet, using the Red Kite (*Milvus milvus*) as an example.

The Red Kite can reach a flight speed of $21 m^{-1}$ or 76 km/h (*nb : 22 $m.s^{-1}$ or 79 km/h for the Black Kite*)[3].
This species should therefore be able to avoid other flying birds or moving objects within its natural speed range.

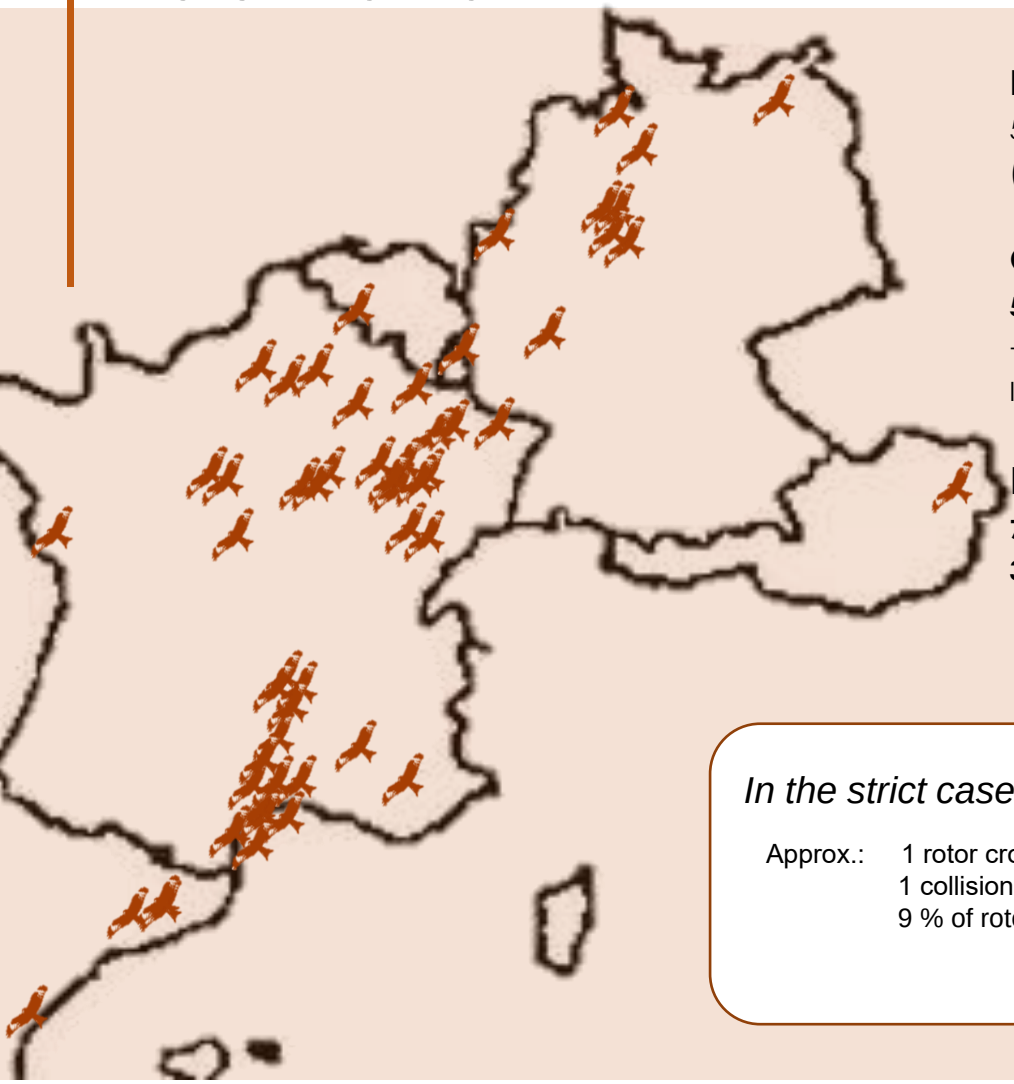
**As a consequence, Red Kite collisions should be more frequent when the linear speeds at the blade tip (BTS) are greater than 76 km/h.**

This is the hypothesis we will test in this study.

[1] *Chamberlain, D. E. et al. (2006). The effect of avoidance rates on bird mortality predictions made by wind turbine collision risk models. Ibis, 148, 198-202.*
[2] *Barrios, L., & Rodriguez, A. (2004). Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. Journal of applied ecology, 41(1), 72-81*
[3] *Bruderer, B., & Boldt, A. (2001). Flight characteristics of birds: I. Radar measurements of speeds. Ibis, 143(2), 178-204*

# STUDY SITES



## Description of equipped wind farms

56 operating windfarms from January 14, 2019 and January 14, 2023
(= 251 wind turbines with presence of Red Kite)

## General data

**596'517 detection videos:** with 306'202 Red Kite videos
+ 290'315 Milvus sp. videos.
Including 404'745 videos with recorded rotor speed

## Results

**734 rotor crossings** with 237 Red Kite and 497 Milvus sp.
**30 collisions** including 22 Red Kites and 8 Milvus sp.

*In the strict case of Red Kite :*

Approx.: 1 rotor crossing for 1'000 detection videos
1 collision for 15'000 detection videos
9 % of rotor crossings result in a collision (22 / 237)*

*4 % with Red Kite + Milvus sp.

Biodiv-Wind

# COLLISIONS IN DESCENDING ORDER OF ROTATION SPEED (1/2)

| Date | Hour | Species | Country | Blade tip speed (SCADA logging , km/h) | rpm (SCADA logging) | Mortality |
|---|---|---|---|---|---|---|
| 29/02/2020 | *15:40:39* | *Milvus milvus* | Germany | 294 | 11,91 | YES |
| 21/03/2021 | *11:56:14* | *Milvus milvus* | France | 274 | 14,54 | YES |
| 01/06/2021 | *10:18:52* | *Milvus milvus* | France | 274 | 16,71 | NO, blown away |
| 05/06/2020 | *12:06:33* | *Milvus sp.* | France | 268 | 16,34 | YES |
| 28/10/2020 | *14:34:44* | *Milvus milvus* | France | 251 | 13,32 | YES |
| 28/05/2022 | 16:25:25 | *Milvus sp.* | France | 241 | 11,62 | YES |
| 05/09/2019 | *13:24:48* | *Milvus milvus* | France | 224 | 13,66 | YES |
| 25/11/2020 | *08:34:10* | *Milvus milvus* | France | 214 | 13,05 | YES |
| 26/11/2020 | *14:24:19* | *Milvus milvus* | France | 208 | 11,03 | NO, blown away |
| 11/11/2022 | *15:47:16* | *Milvus milvus* | Spain | 183 | 7,47 | YES |
| 23/01/2022 | *15:24:31* | *Milvus milvus* | Spain | 182 | 7,43 | YES |
| 02/02/2021 | *17:04:53* | *Milvus milvus* | Spain | 182 | 7,43 | YES |
| 25/04/2022 | *10:57:37* | *Milvus sp.* | France | 178* | 8,57* | YES |
| 22/07/2022 | *09:49:24* | *Milvus milvus* | France | 174* | 12,00* | YES |
| 23/07/2022 | *15:14:23* | *Milvus sp.* | France | 174 | 7,89 | YES |

* = Estimated speed (Estimate from videos when the SCADA was unavailable )

Biodiv-Wind

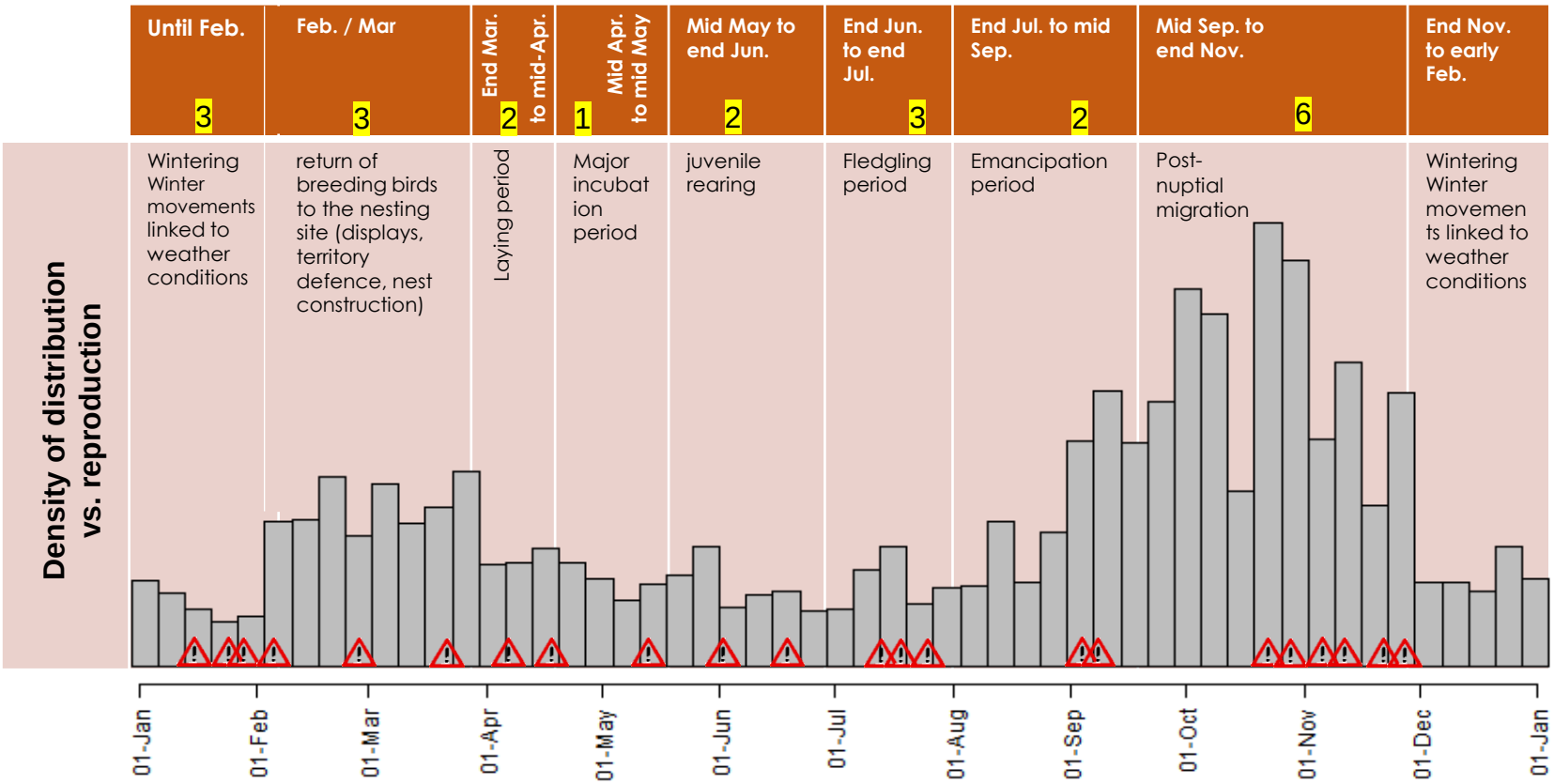
# COLLISIONS IN DESCENDING ORDER OF ROTATION SPEED (2/2)

| Date | Hour | Species | Country | Blade tip speed (SCADA logging , km/h) | rpm (SCADA logging) | Mortality |
|---|---|---|---|---|---|---|
| 04/07/2021 | *16:47:02* | *Milvus sp.* | France | 170* | 10,00* | NO, blown away |
| 06/11/2019 | 14:21:04 | *Milvus milvus* | France | 166 | 10,12 | YES |
| 02/06/2022 | *16:54:11* | *Milvus sp.* | France | 166 | 10,12 | YES |
| 04/04/2019 | *12:42:50* | *Milvus milvus* | France | 164 | 10,00 | YES |
| 16/07/2019 | *08:38:07* | *Milvus milvus* | France | 163 | 9,94 | YES |
| 24/10/2022 | *11:43:16* | *Milvus milvus* | Spain | 140 | 5,71 | YES |
| 18/04/2020 | *12:23:00* | *Milvus milvus* | France | 131 | 7,99 | YES |
| 12/08/2019 | *13:51:27* | *Milvus sp.* | France | 130 | 6,90 | YES |
| 07/05/2022 | *09:09:15* | *Milvus sp.* | France | 129 | 7,87 | YES |
| 26/01/2022 | *11:53:48* | *Milvus milvus* | Spain | 119 | 4,86 | YES |
| 12/05/2021 | *12:52:37* | *Milvus milvus* | France | 117 | 7,13 | wounded |
| 08/09/2022 | *11:24:53* | *Milvus milvus* | France | 112 | 6,83 | YES |
| 16/07/2022 | *09:28:01* | *Milvus milvus* | France | 90 | 5,82 | YES |
| 13/06/2022 | *11:35:04* | *Milvus milvus* | France | 32 | 1,95 | YES |
| 12/01/2023 | *13:59:00* | *Milvus milvus* | France | 32 | 1,70 | NO |

Biodiv-Wind

# SEASONAL DISTRIBUTION OF COLLISIONS

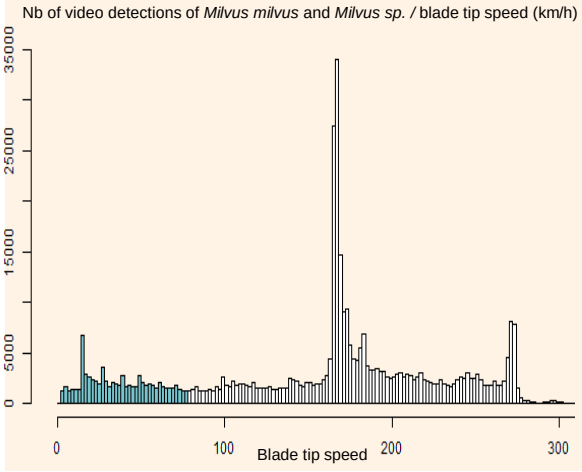
Seasonal distribution of detections and collisions of *Milvus milvus*, and bilogical cycle in France [4]
(n= 306,202 detections and 22 collisions of *Milvus milvus* ⚠)

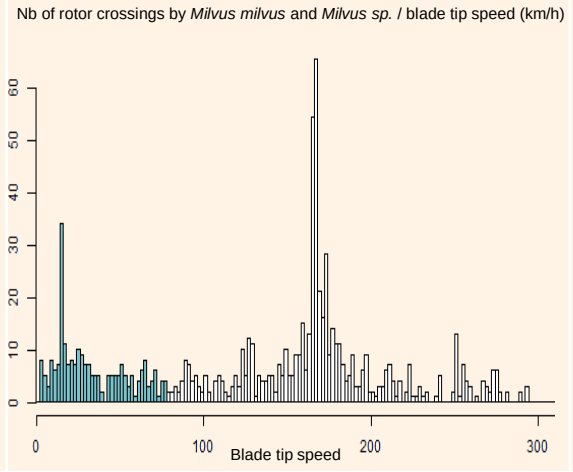


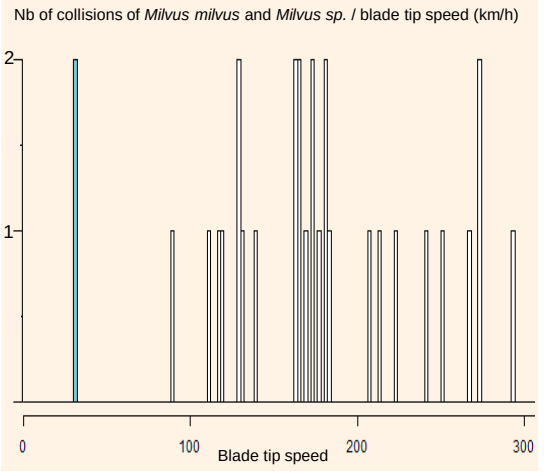

[4] PNA-Milan-Royal-2018-2027 - *French Ministry for Ecology, Sustainable Development and Energy* .

# BLADE TIP SPEED DISTRIBUTION *MILVUS MILVUS + MILVUS SP .*

| Videos detection | Rotor crossings | Collision events |
|---|---|---|
| **404'745 videos** | **851 video (734 events)** | **30 events (incl. 4 nonlethal)** |
| **18% below 76 km/h** | **27% below 76 km/h** | **< 7% below 76 km/h** |




→ **96% of lethal collisions are observed when blade tip speed (BTS) > 76 km/h**

**And 92% of lethal collisions when BTS > 110 km/h**

→ **The proportion of rotor crossings is statistically higher when BTS < 76 km/h**

nb of video are compared, McNemar's Chi-squared test - p-value <2.2e-16

**0.31% vs. 0.19% → Tendency to avoid rotor more when BTS > 76 km/h**

→ **The proportion of lethal collisions while crossing is statistically higher when BTS > 76 km/h**

nb of events are compared, McNemar's Chi-squared test - p-value <2.2e-16

**1/213 vs. 25/521 → Ten fold more risk of lethal collision if crossing with BTS > 76 km/h**

**2/273 vs. 24/461 → Seven fold more risk of lethal collision if crossing with BTS > 110 km/h**

# IN CONCLUSION

1. Red Kite mortalities on wind turbines are observed throughout its biological life cycle.
2. Lethal collisions occur at high rotational speeds but also at very low speed (32 km/h BTS), when the blades are in a feathered position, therefore already in functional shutdown, and do not produce electricity..
3. Non-lethal collisions are also observed at high rotation speeds (> 270 km/h BTS)

**4 %**
of rotor bushings (all speeds combined) lead to a collision

**7X _**
more risk of mortality when BTS > 110 km/h

**92%**
of lethal collisions occur when BTS > 110 km/h

→ **The risk of collision for Red Kite appears to be related to the rotation speed of the wind turbines**

Although this species demonstrates caution in avoiding rotor crossings when the BTS exceeds its maximum flight speed, it is less effective at avoiding collisions when the BTS surpasses this maximum flight speed

The individual factors (less cautious or less watchfull birds) or environmental factors explaining the rotor crossings at high rotation speed as well as the reduction in avoidance capacity must still be explained.

# DISCUSSION

## About bird protection

→ The data obtained by the SafeWind® systems allows for the first time to confirm the influence of the wind turbine rotation speed on the risk of collision for the Red Kite.

→ The principle of real-time detection of this species by automated systems in order to initiate a slowing down of the wind turbines therefore appears to be effective in significantly reducing the risk of collision.

→ However, this risk cannot be completely canceled by this method since collisions are also observed when the wind turbines are "feathered", therefore already in functional shutdown, and do not produce electricity [5] .

→ Reducing the risk of collision in the latter cases requires implementing means other than the wind turbine regulation.

## Concerning less accident-prone rotation speed thresholds

→ The significant reduction of collision risk does not require a complete shutdown of the wind turbines (i.e BTS = 0 km/h).

→ More than 90% of lethal collisions could be avoided by slowing the rotors down to a speed threshold of 110 km/h BTS, which is significantly higher than the maximum speed of the Red Kite in the wild.

→ However, this threshold must be refined by continuing to detect and record collision events. The detection systems should therefore provide means of verification including at least continuous video recording and a ex-post checks.

## To go further

→ Several models of contemporary wind turbines have a minimum production speed below the threshold of 110 km/h BTS. Considering for these turbines a minimum production of 6 rounds per minute, the BTS is thus 92 km/h for a 80 m rotor diameter and 80 km/h for a 70 m rotor diameter.

→ Rather than completely shutting down these turbines in case of a bird being detected, simply reducing their rotation speed down to the production threshold would theoretically make possible to address two major challenges for wind power production : the significant reduction of collision risk for birds and the reduction of intermittent power production.

→ Additionally, avoiding repeated stops and restarts of turbines and induced grid disconnections should also help to preserve their lifespan while facilitating the balance of grid at a larger scale**.**

*[5] . For information, we observed feathered turbines with BTS up to almost 70 km/h.*

Biodiv-Wind


## Authors:

A. BEAUDRY - PhD, Biodiversity Project Manager
H-P. ROCHE – MSc, CEO



**Website:** www.biodiv-wind.com

**Email:** contact@biodiv-wind.com