Effects of wind turbine dimensions on the collision risk of raptors: a simulation approach based on flight height distributions

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Background

Informed selection of wind turbine dimensions could mitigate the collision risk of birds.

But: Effects of turbine dimensions still unknown for many species!

Methodological problem: Fatality data associated with strong biases

→ Alternative approach:
Simulations based on **flight height data** allowing to keep confounding factors constant (e.g. bird abundance and behaviour)

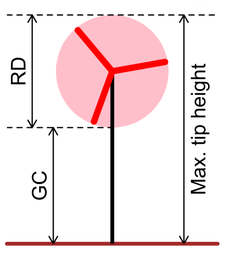


Figure 1: Illustration of the considered size parameters of wind turbines.
GC = ground clearance; RD = rotor diameter.

Methods

275 GPS-tagged individuals of **six raptor species** in 15 study areas in FR, BE, LU, NL, DE and SE

High-frequency GPS tracking to obtain accurate flight height data (6,126 h of HF flight tracks ↓)

Figure 2: Example of high-frequency flight track (GPS interval of 3 s).

Stochastic Band Collision Risk Model (sCRM) applied to range of wind turbine models using:

- Species-specific flight height distributions
- Rotation speed as a function of rotor diameter

Results (1): Flight height distributions

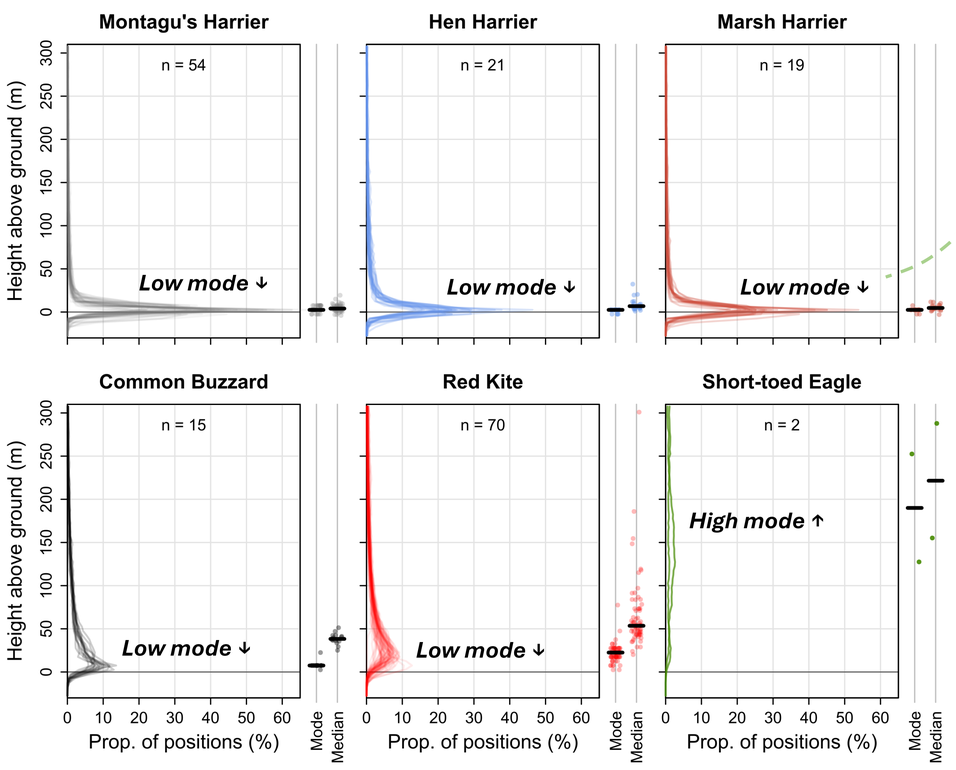


Figure 3: Flight height distributions per species in height bins of 5 m. Every line represents one individual bird; the mode and median per individual are indicated right of the panels (thick horizontal line: medians across individuals). Prop. = proportion.

Results (2): Effects of turbine dimensions

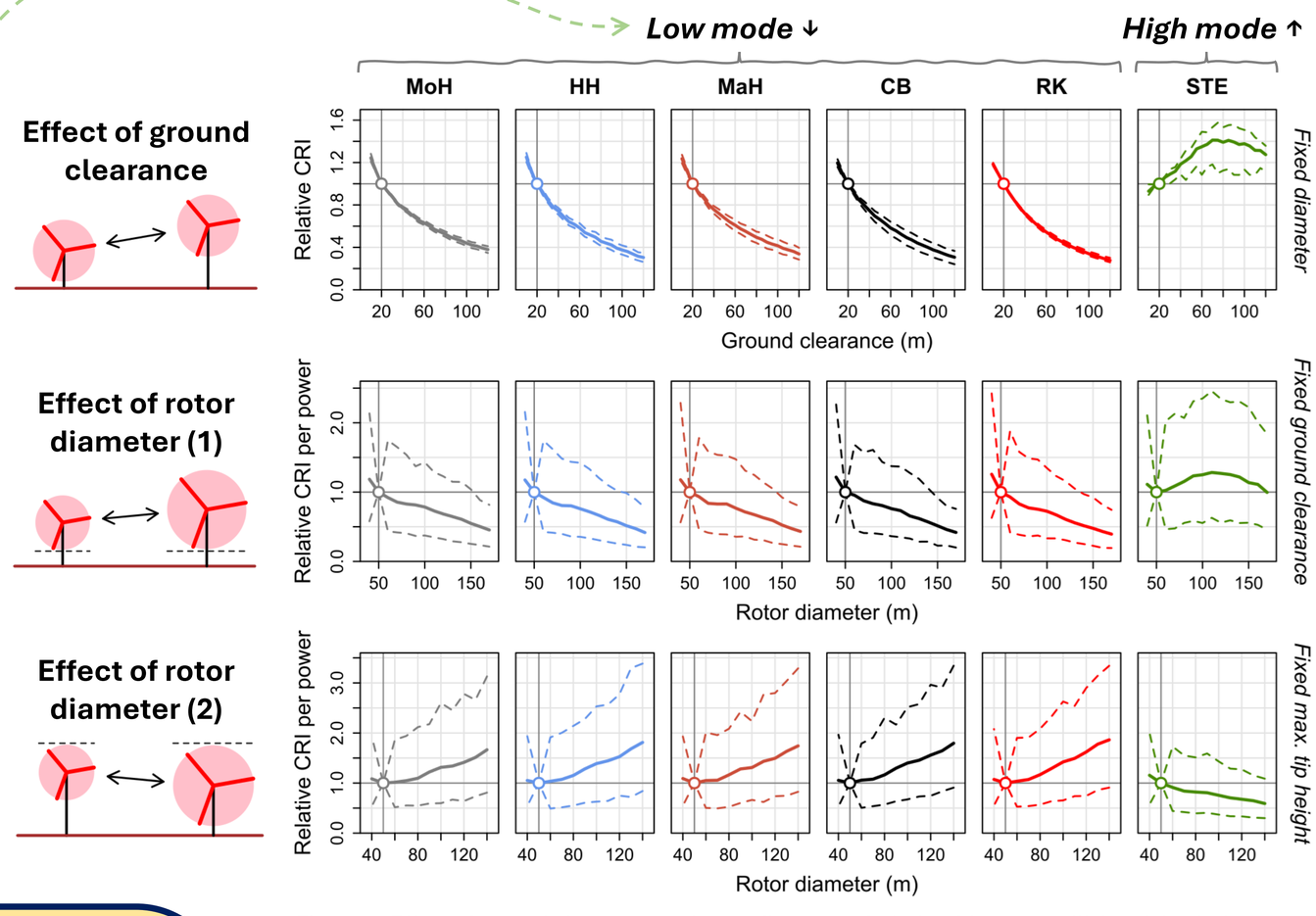


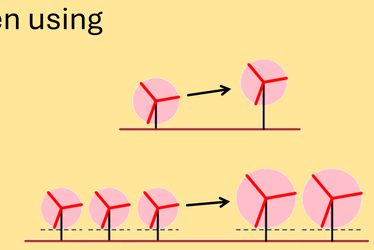
Figure 4: Effect of ground clearance and rotor diameter of wind turbines on collision risk relative to a reference level (thick vertical line). Panels show either collision risk index per turbine (first row) or per rated power (second and third row). Thick lines: means; dashed lines: 95% confidence intervals.

Conclusions:

Opposite effects of wind turbine dimensions on collision risk for different raptor species depending on the flight height distribution (low mode vs. high mode)

For **species with low mode**: Collision risk reduced when using

- turbines with **higher ground clearance**
- **less turbines with larger diameter** instead of more turbines with smaller diameter to achieve given total power (at fixed ground clearance)



Further reading:

Schaub et al. 2024 *Sci. Total Environ.*

PhD thesis Tonio Schaub

Up next:

Development of publicly available **online tool** allowing to apply approach to real-world wind energy projects

If you want to keep updated, feel free to send an email! ↓

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