Aeroecology meets aviation safety:

Early warning systems prevent collisions between birds and aircraft

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Introduction

Bird migration and military flying

- Summary of a synthesis paper for Ecography

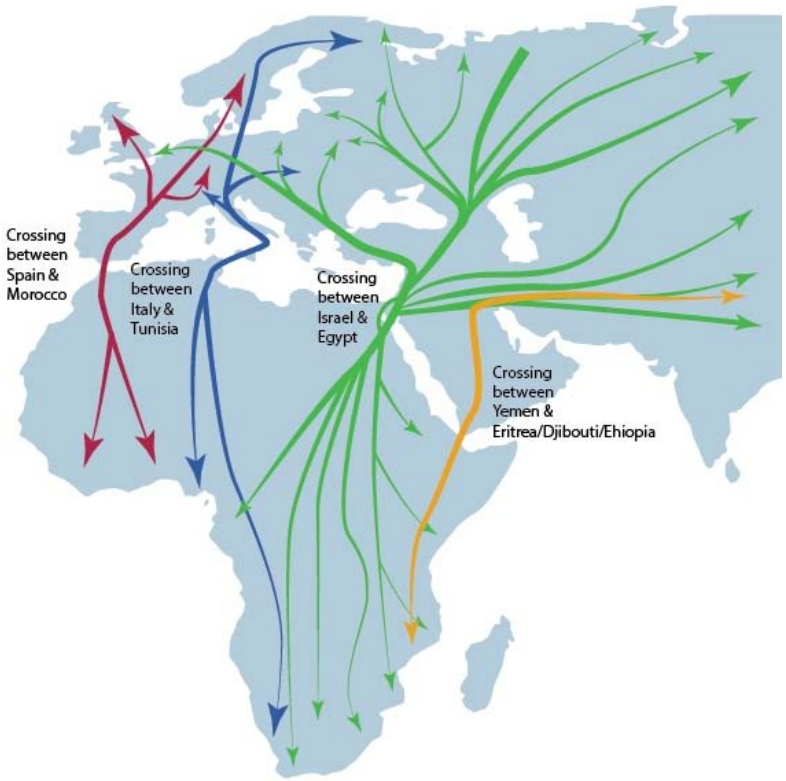
Overview of bird monitoring and warning systems (Germany, the Netherlands, Belgium, Poland and Israel)

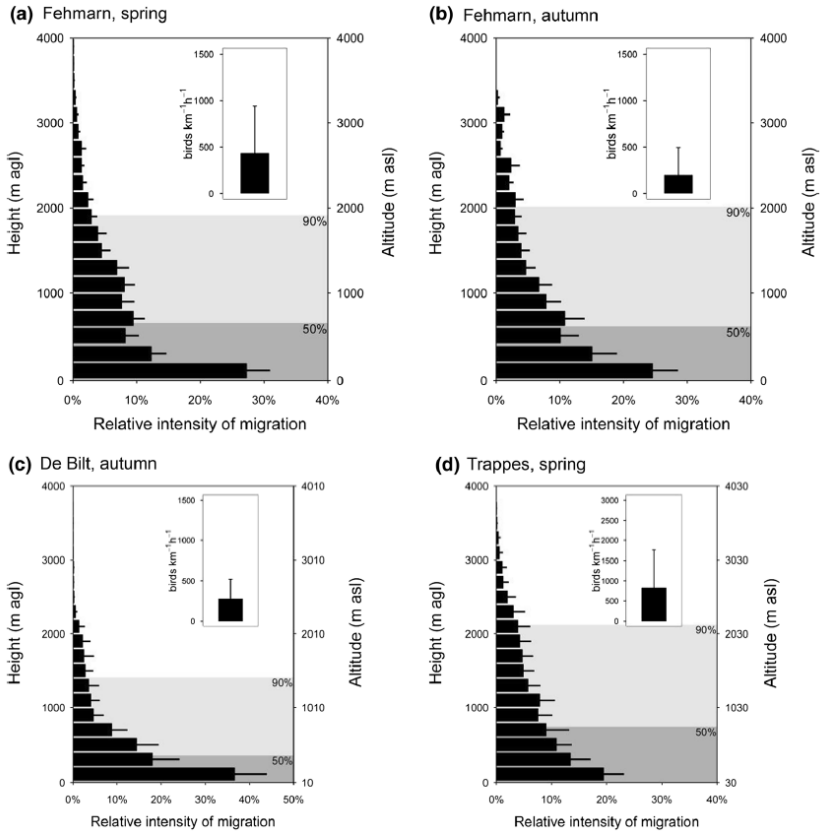
The impact of bird strikes on military aviation

Effectiveness of migration monitoring systems in bird strike avoidance

Conclusion and future role of weather radars

Bird migration





Military flying

Minimum flight altitude for jet aircraft, e.g.

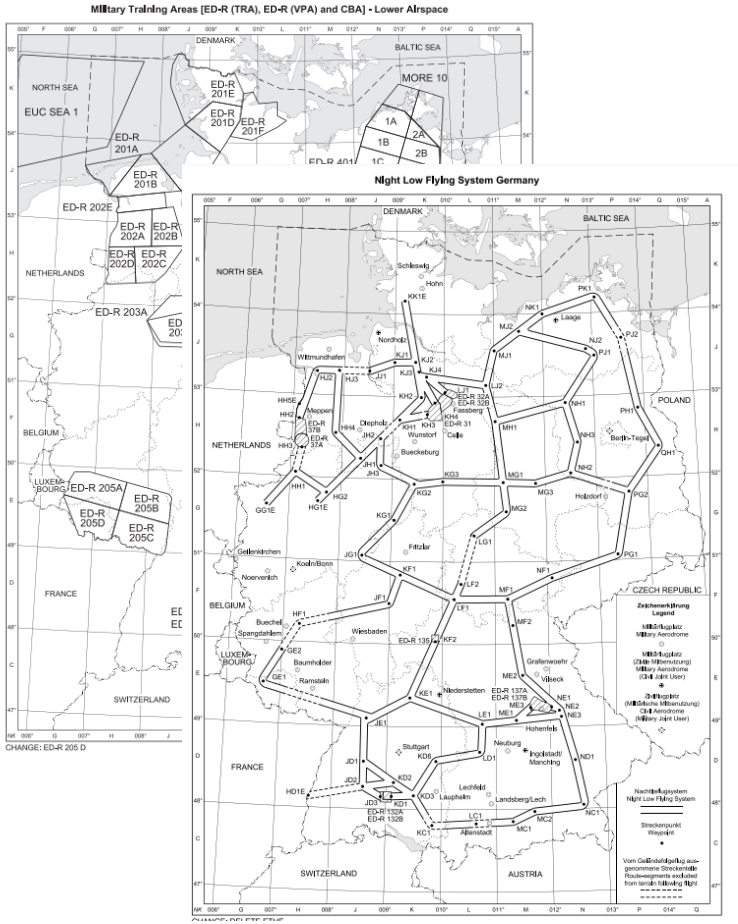
- Germany 1500ft
- The Netherlands 1200ft
- Belgium 1000ft

Low flying areas

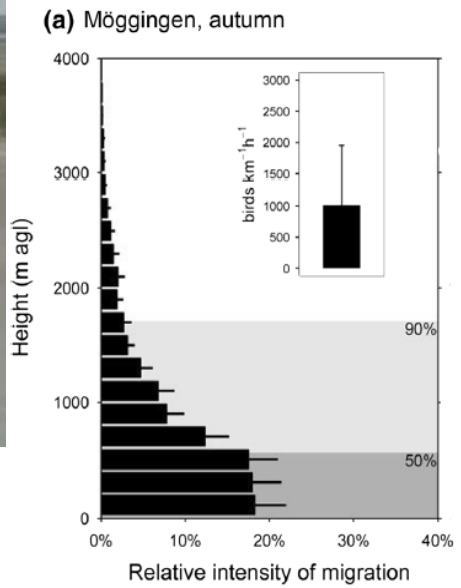
- e.g. Germany

Low flying routes

- Germany, the Netherlands, Belgium 250ft



Overlap in space and time

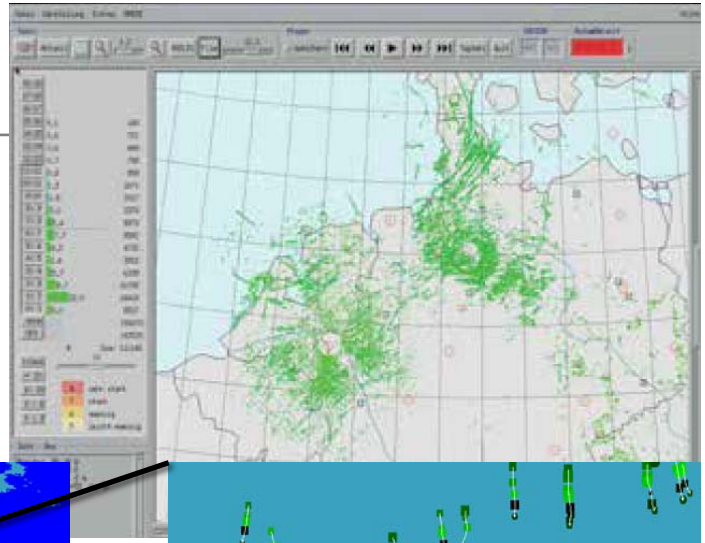


Low level route

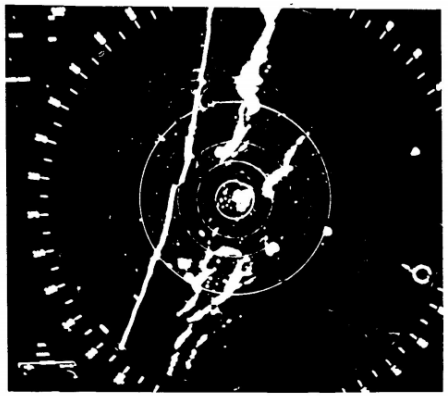
Minimum altitude

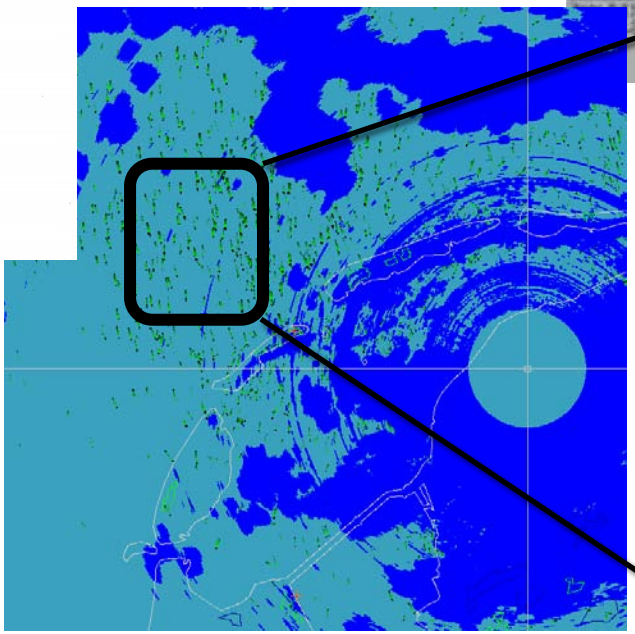
Bruderer, 2018

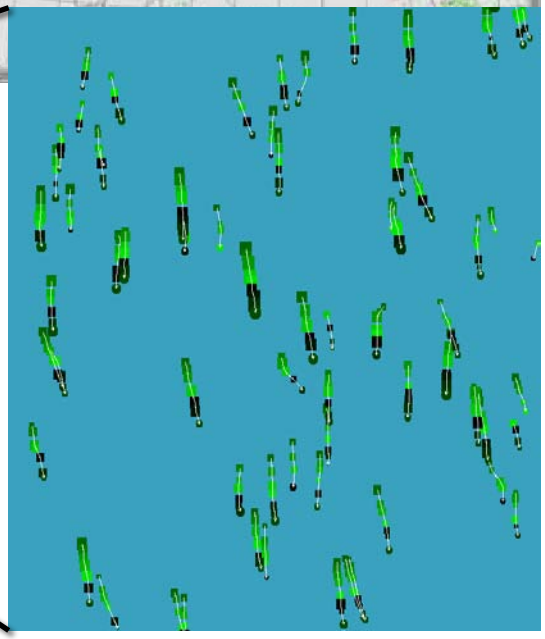
Bird monitoring and warning systems



Huge flocks of Lesser-spotted Eagles *(Aquila pomarina)* 28.9.86 - 1130 hrs. Ben Gurion Radar - length of line 82km



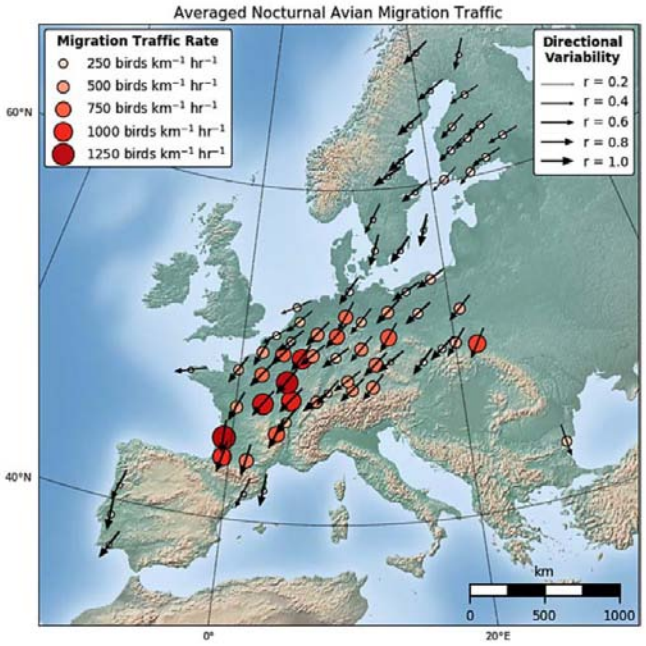




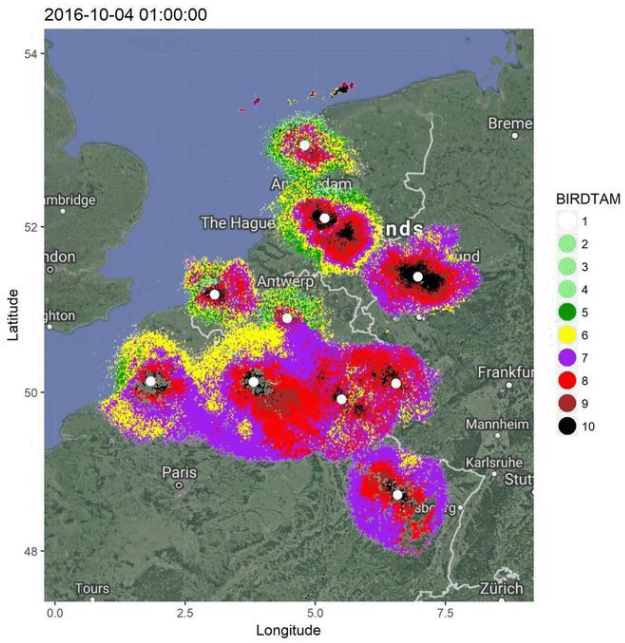
Military air-surveillance systems

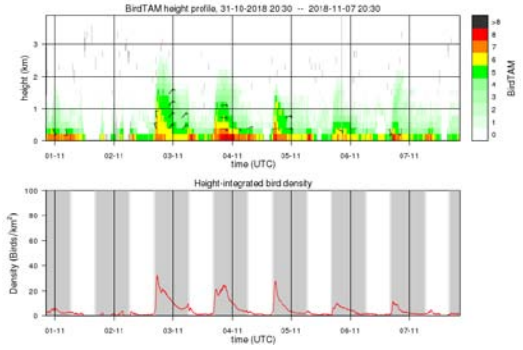
Bird monitoring and warning system (II)

weather radar network



Nilsson, 2018

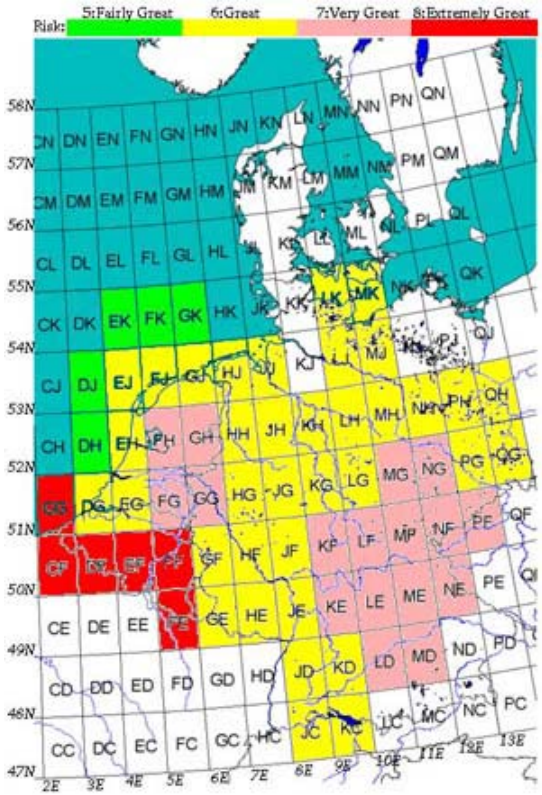




www.flysafe-birdtam.eu

En-route warning system

- Birds and pilots cannot avoid each other
- Prevention by avoiding high bird densities in the air in space and time
- Standard NATO-agreement defines risk
  - Regulations differ between countries
- BIRDTAM warning system in use by Germany, Belgium, Denmark and the Netherlands



Bird migration forecasts

(1) **Manually**

- Weather forecast model

(2) **Regression model:**

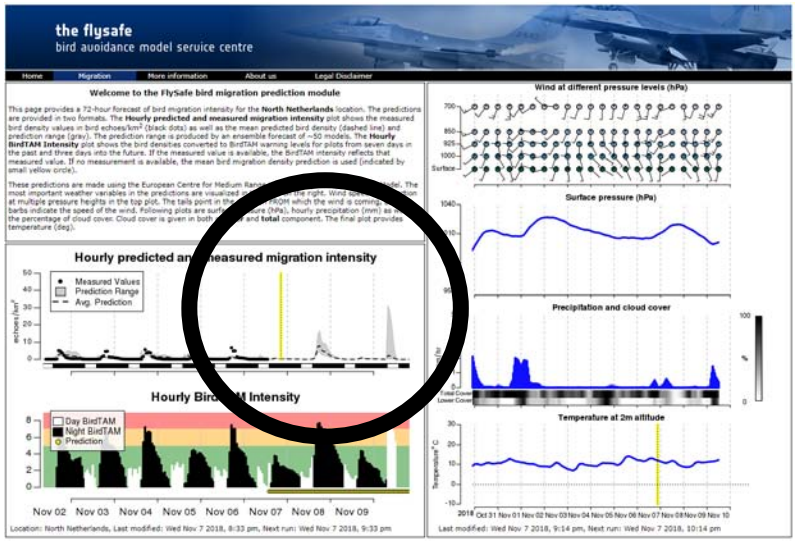
- migration intensities from air-surveillance radars
- meteorological data

(3) **Ensemble model to improve predictions**

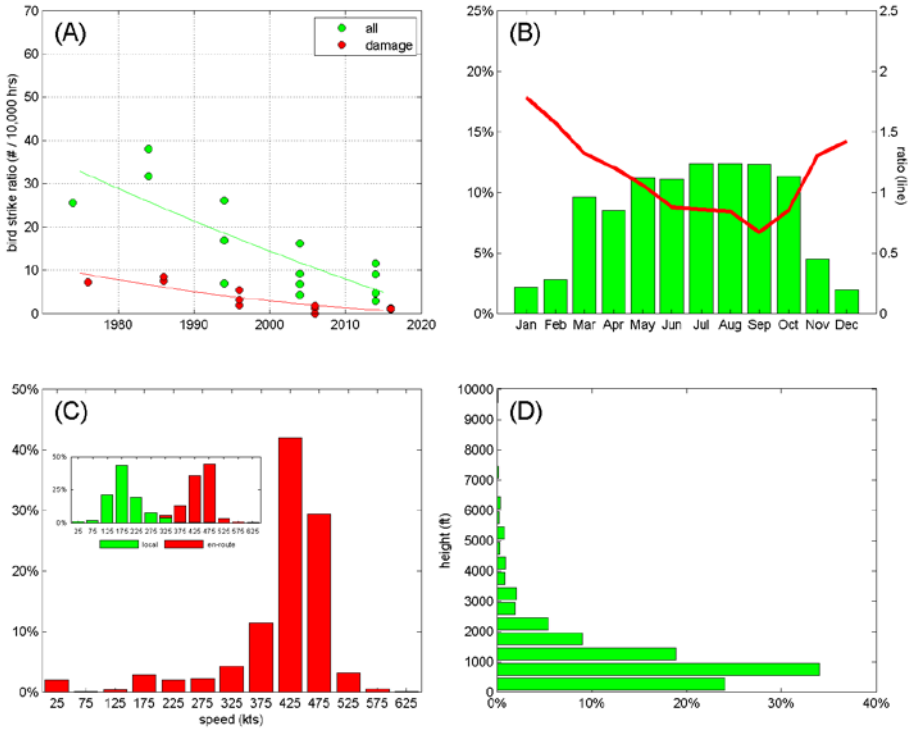
- set of regression models

(4) **Next steps**

- Switching to weather radar network
- Recalibrate forecast models on individual weather radars
- Develop robust models using spatial models and weather radar measurements, by combining international radar information



Impact of bird strikes on military aviation



En-route bird strikes
with fighter jets from Poland, Germany, Netherlands, Belgium and Israel

(A) Bird strike ratios

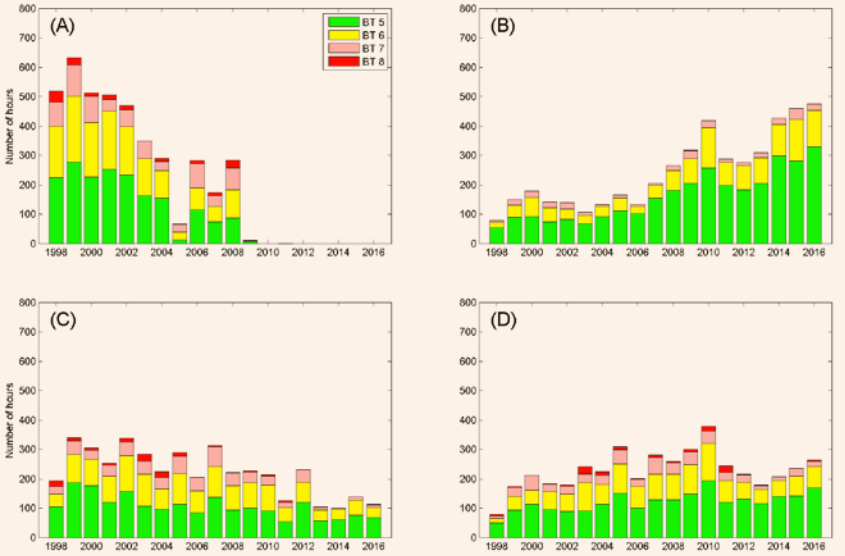
(B) Seasonal pattern and relative proportion of damage

(C) Effect of aircraft speed

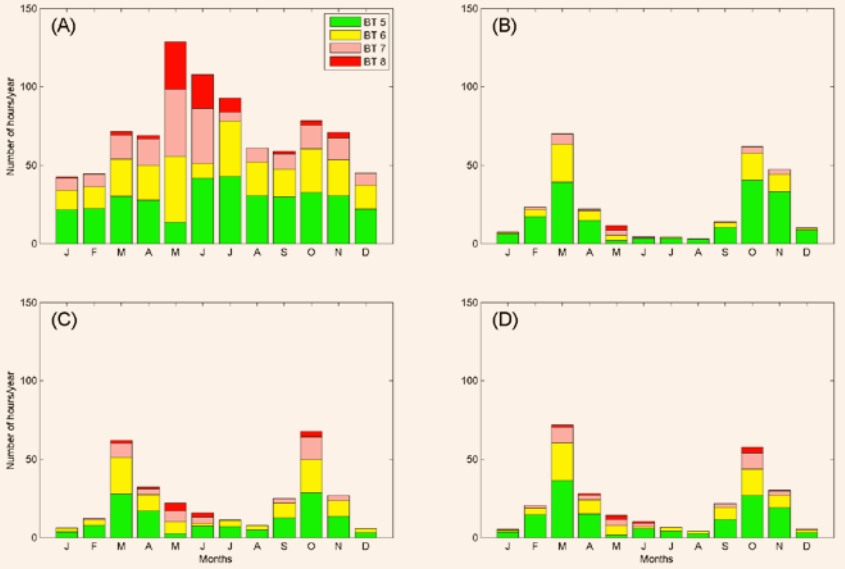
(D) Height distribution of bird strikes

Effectiveness of migration monitoring systems in bird strike avoidance (I)

OVER YEARS



OVER SEASON



Effectiveness of migration monitoring systems in bird strike avoidance (II)

Assuming the same effectiveness, France & UK could have saved M$4.5 – 5 US per year

Country	Warning system	Bird Strike Ratio	Cost estimate /10^3fl.hr	(in M$ US) /yr
France	absent	6.59	0.66	10.3
Great Britain	absent	8.34	0.83	11.3
Germany	present	4.84	0.48	4.1
Netherlands	present	3.35	0.33	0.9

~45% reduction damaging bird strike ratio

Data: Dekker & Van Gasteren, 2005 and this study

Financial costs related to bird strikes with damage in relation to presence or absence of warning system, to four NW-European air forces in 1991-2000. Based on a cost estimate of US$100.000 per damage case (Insinna, 2018).

Conclusion and future role weather radars

Warning systems have existed for decades, but:

- Only in a few countries
- Although agreement through NATO, harmonization in interpretation still lacking, because of different policies and different warning systems between countries
- Spatial and temporal differences exist between areas. Migration period is not the only period when the risk of low level bird strikes is high

Bird strike ratios are much lower in countries where warning systems are implemented

The utilization of OPERA weather radar network is still in its infancy, but has huge potential for improving flight safety.

Lets start working together!!

Thank you for your attention