Estimating wildlife-aircraft collision risk: next steps

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Annex 14, Volume 1, *Aerodrome Design and Operations*, ICAO (2004):

Safety Management Systems (SMS) for airports
*risk assessment, including strike risk, is emphasized,
but not defined.

International Civil Aviation Organization (ICAO). (2004). Convention on international civil aviation (Standards and recommended practices). Annex 14. Aerodromes. Volume I. Aerodrome design and operations. Fourth edition. International Civil Aviation Organization, Montreal, Quebec, Canada.

U.S. Federal Aviation Administration (FAA). 2010. Safety management systems for aviation service providers. U.S. Department of Transportation, Federal Aviation Administration. Advisory Circular AC 120/92A, Washington, D.C., USA.

Approach

- Purpose
- What is risk?
- What is NOT risk?
- Core model
- Recent efforts
- Next steps: necessary data & testing
- Summary

Purpose

Underscore the importance of estimating strike risk and focus efforts on development of new models.

Risk

The likelihood of threats to species, natural communities, or ecosystem processes.

Likelihood comprises factors that contribute to the event and, thus, is projected forward in time.

Frequency (e.g., no. heads per 10 coin tosses) looks back.

Accurately quantifying risk can inform effective management decisions.

Risk components include

- a spatiotemporal estimate of exposure to the problem sources and a quantification of potential effects and

- a conceptual understanding of the sources of the problem, realistic endpoints or potential events, and mechanisms by which the sources contribute to the defined endpoints.

Graham, R.L., Hunsaker, C.T., O'Neil, R.V., Jackson, B.L., 1991. Ecological risk assessment at the regional scale. Ecol. Appl. 1, 196–206.

Not Risk

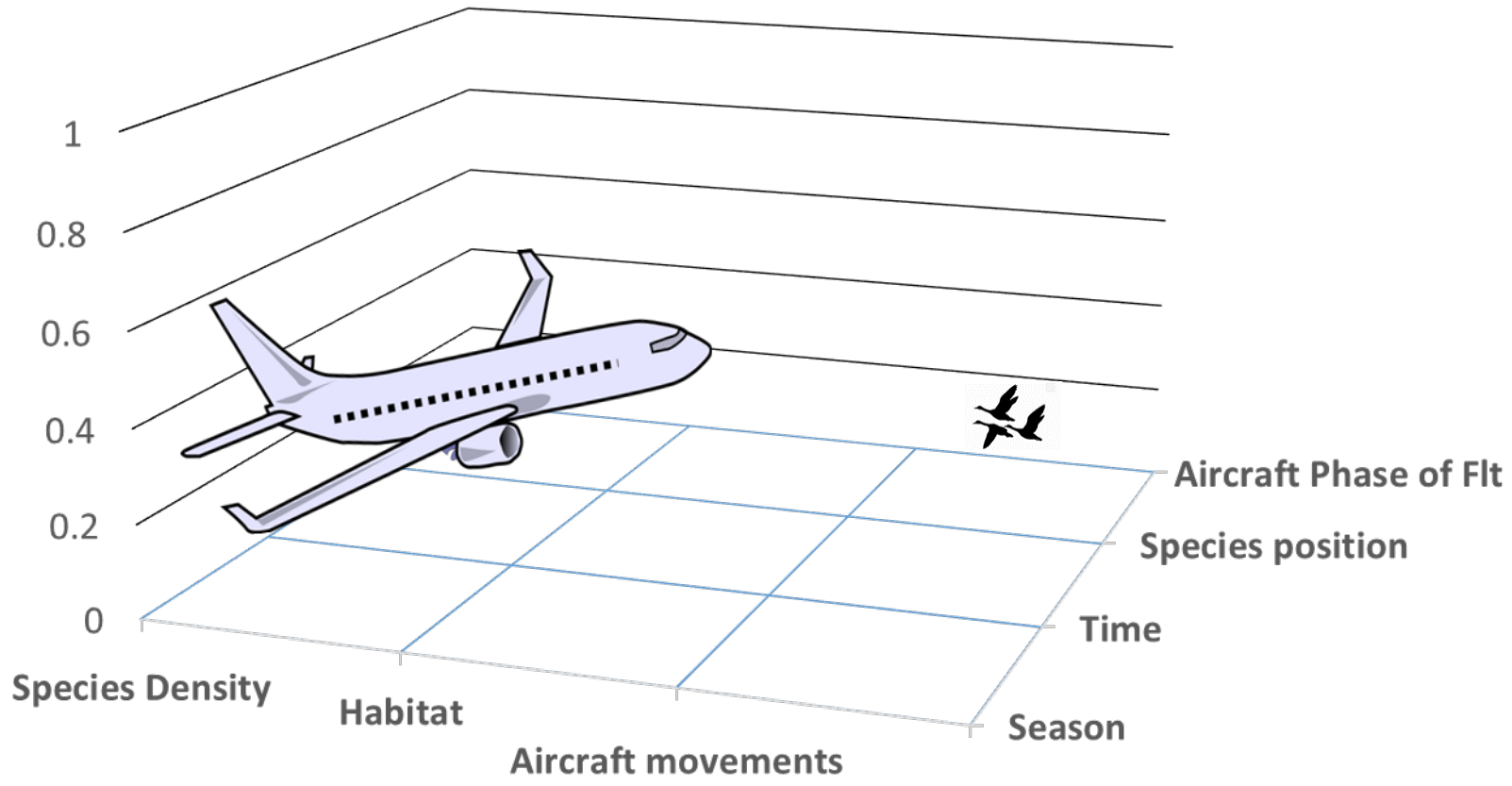
- Predation
- A natural disaster
- Wildlife strike
- Frequency of a negative event

➡ component of risk

Strike Risk

The likelihood of species-specific strikes with aircraft and the associated negative effects.

Components of Strike Risk



What factors will inform the likelihood of an event?

- Season
- Resources…including airspace
- Time of day
- Current management
- Aircraft movements
- Species number

Core formulation of a risk metric

Risk = (likelihood of the event) • (likelihood/associated negative effects)

Specific mathematical relationship will likely vary by airport

Recent efforts-Application to wildlife management on airports

- Allan, J. R. 2006. A heuristic risk assessment technique for bird strike management at airports. Risk Analysis 26:723–729.

- Schafer, L. M., B. F. Blackwell, and M. A. Linnell. 2007. Quantifying risk associated with potential bird–aircraft collisions. Pages 56–63 *in* C. L. Irwin, D. Nelson, and K. P. McDermott, editors. Proceedings of the International Conference on Ecology and Transportation. Center for Transportation and the Environment, North Carolina State University, Raleigh, North Carolina, USA.

- Dolbeer, R. A., and S. E. Wright. 2009. Safety management systems: how useful will the FAA National Wildlife Strike Database be? Human-Wildlife Conflicts 3:167–178.

- Dolbeer, R. A., and M. J. Begier. 2012. Comparison of wildlife data among airports to improve aviation safety. Proceedings of the International Bird Strike Conference 30:25–29.

- DeFusco, R. P., E. T. Unangst, Jr., T. R. Cooley, and J. M. Landry. 2015. Applying an SMS approach to wildlife hazard management. Airport Cooperative Research Program Report 145, Transportation Research Board of The National Academies. Washington, D.C., USA.

- Soldatini, C., V. Georgalas, P. Torricelli, and Y. V. Albores-Barajas. 2010. An ecological approach to birdstrike risk analysis. European Journal of Wildlife Research 56:623–632.

- Soldatini, C., Y. V. Albores-Barajas, T. Lovato, A. Adriano, P. Torricelli, A. Montemaggiori, C. Corsa, and V. Georgalas. 2011. Wildlife strike risk assessment in several Italian airports: lessons from BRI and a new methodology implementation. PLoS ONE 6:e28920.

- DeVault, T. L., B. F. Blackwell, T. W. Seamans, M. J. Begier, J. D. Kougher, J. E. Washburn, P. R. Miller, and R. A. Dolbeer. 2018. Estimating interspecific economic risk of bird strikes with aircraft. Wildlife Society Bulletin 42:94–101.

- Nilsson et al. 2021. Bird strikes at commercial airports explained by citizen science and weather radar data. J Appl Ecol. 2021;58:2029–2039.

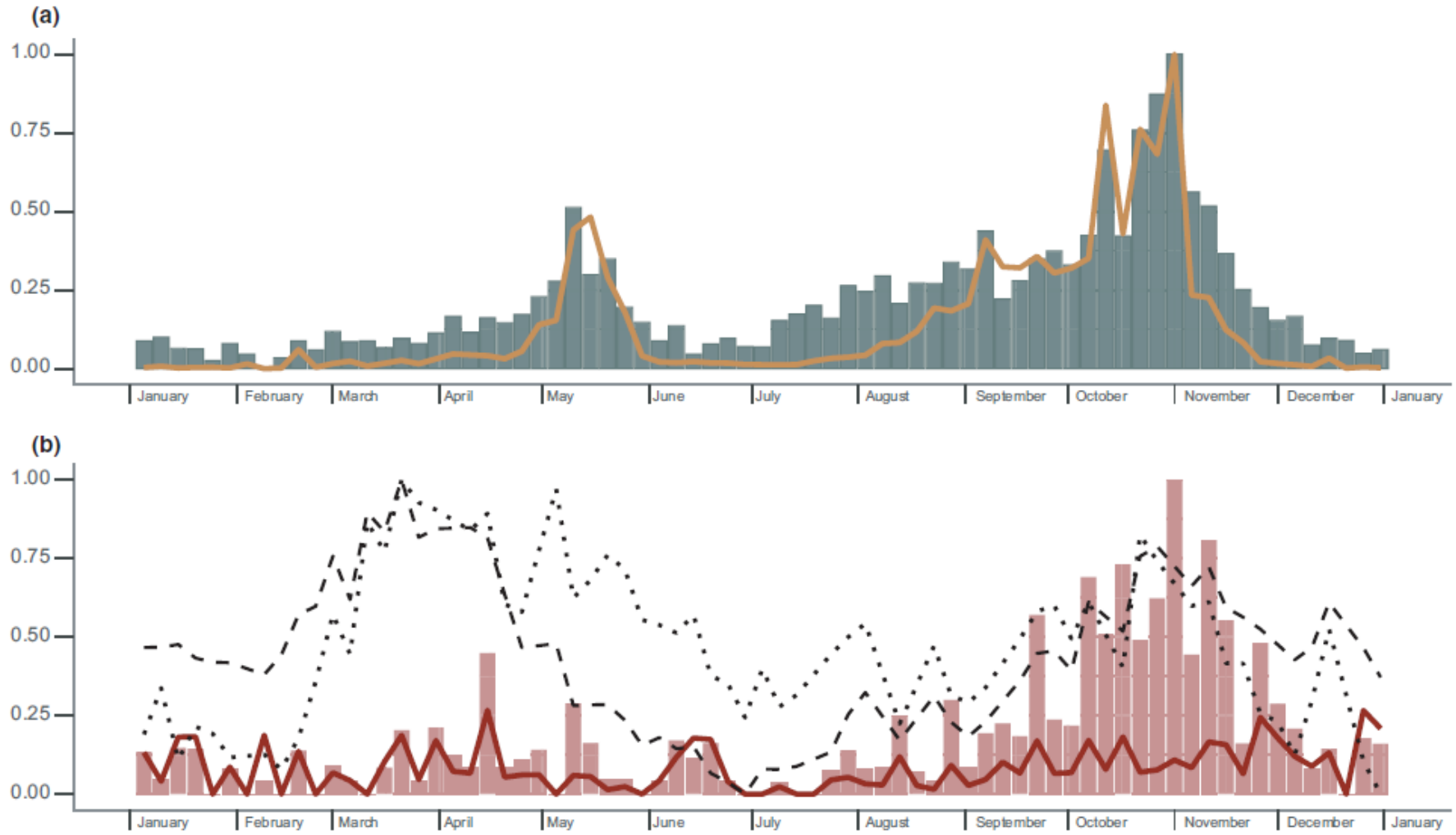


FIGURE 4 (a) Number of bird strikes per aircraft movement (bars) and amount of bird movements (line), averaged for each 5-day period for the years 2013–2018 combined at three NYC commercial airports standardized to the interval 0 to 1. (b) The number of damaging strikes per aircraft movement (bars) averaged for each 5-day period standardized to the interval 0 and 1. Also shown is BMHI (dashed line) and RHSI (dotted line) here standardized to the interval 0 and 1, and proportion of strikes that caused damage (full line) for each 5-day period

The combination of radar and eBird data can provide

1) correlative support for species observed on the airport and in the airspace,
2) relative abundances and local distributions,
3) indication of species that pose risk, but might not appear in surveys, and
4) independent data by which to assess strike risk likelihood models.

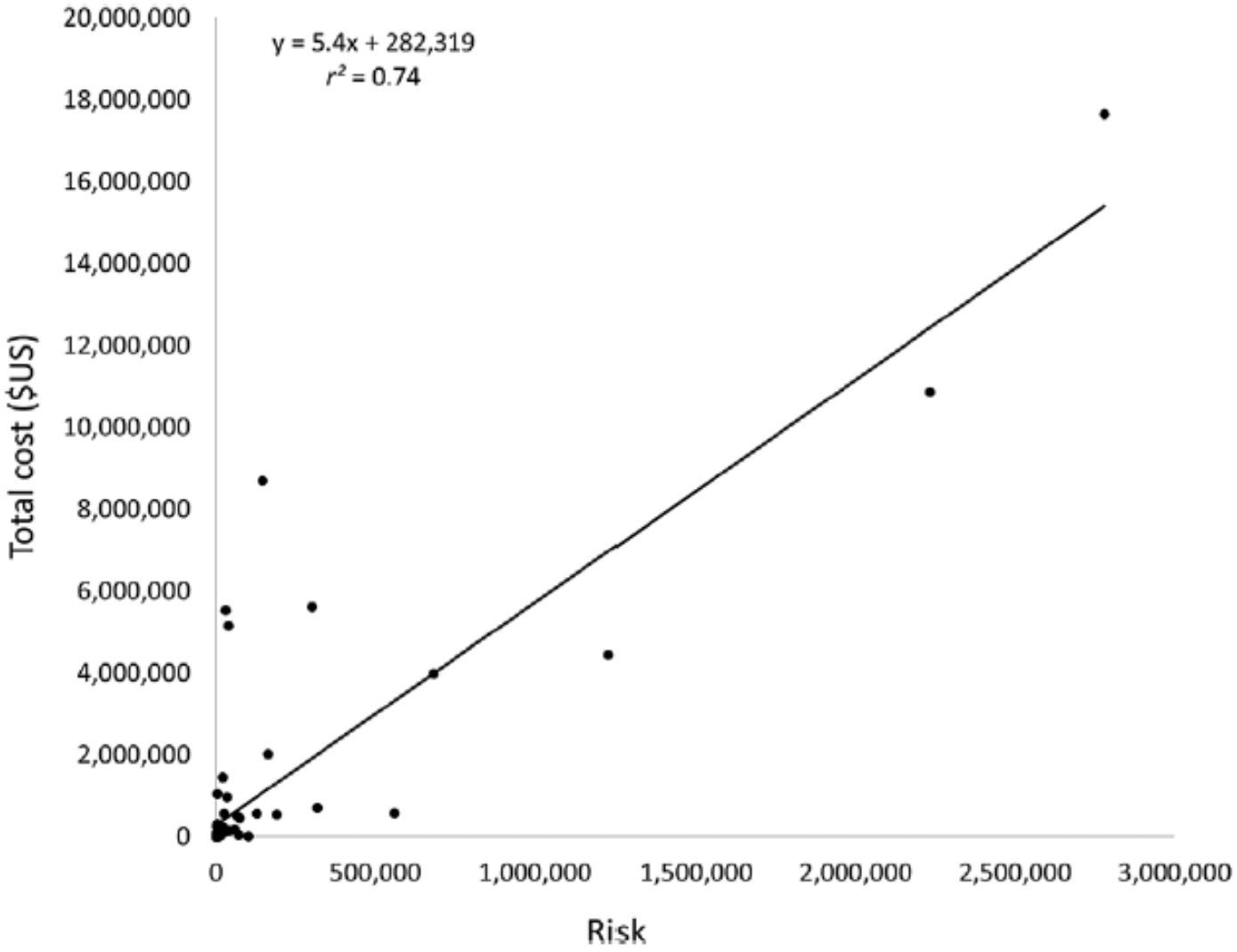
A recent in-use metric derivation

DeVault, T. L., B. F. Blackwell, T. W. Seamans, M. J. Begier, J. D. Kougher, J. E. Washburn, P. R. Miller, and R. A. Dolbeer. 2018. Estimating interspecific economic risk of bird strikes with aircraft. Wildlife Society Bulletin 42:94–101.

"Risk" = (Total strikes by species scaled to 100)^2 x severity^2

Not a true likelihood because 1) total aircraft movements are not included: strikes/total aircraft movements; and 2) there is no model examining contributing factors to strikes.

Not a true likelihood because the RHS is essentially a rank, not a likelihood of degree of damage, again necessitating a model populated by contributing factors.


y = 5.4x + 282,319
r^2 = 0.74
Total cost ($US)
20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
0
500,000
1,000,000
1,500,000
2,000,000
2,500,000
3,000,000
Risk

If a species is not struck, does it pose risk?

Standard bird survey methodology

- Can be used to complement wildlife strike database records to calculate frequency or relative abundances.
- These methods generally focus on airport-wide population estimation (i.e., averaged across hundreds or thousands of ha).
- Often ignore vital information contributing to strike likelihood, e.g., use of runway protection zones and other critical areas, and temporal and spatial overlap (in all three spatial dimensions) with departing or approaching aircraft.

Next steps

Per airport–species-specific strikes relative to aircraft movements (seasonal)

Species-specific strike likelihood:

species strikes/total aircraft movements with contributing factors

Challenge

- Understand cause & effect via modeling

  Species relative abundance ~ resource availability season
  disturbance/management

- Derive candidate risk models

  (Likelihood of strike relative to model components)

  (Likelihood of damage relative to model components)

- Likelihood of strike-related effects (per the FAA: damage, substantial damage, negative effect on flight)

Species-specific strike effects:

Strikes per “damage” category/total strikes for that species, but incorporating contributing factors

- Comparison of risk metric outputs to independent data (cost data or strikes in subsequent years)
- Refinements:
  - Likelihood of species use of particular airspace/altitude and land cover per unit time (survey data, telemetry, 3D space use modeling)
  - Likelihood of aircraft movement through the defined airspace and altitude per unit time

Wildlife Services NWRC, University of Georgia, and FAA collaboration, beginning spring 2023:

Assessment of birdstrike likelihood and development of strike risk models at southeastern US airports

The University of Georgia
Savannah River Ecology Laboratory

Ultimately, management decisions that are guided by data that inform the likelihood of management outcomes will reduce strike frequency and associated costs.

Questions?