

*I.V. Horobtsov, PhD student, L.M. Cherniak, PhD, M.M. Radomska, PhD
(National Aviation University, Ukraine)*

Comparative SWOT-analysis of the use of traditional bird census and radar technology for ornithological monitoring in airports

The analytical comparison of traditional bird censuses (via point counts and liner transect) and radar technologies in terms of their applicability and usefulness for ornithological monitoring, via the definition of their SWOT parameters is performed.

Despite certain advancements in the field, bird strikes remain one of the relevant and unresolved issues, and ornithological safety is currently a “work-in-progress” question in modern aviation for both human society and avifauna, with >229 dead people only between 1988-2000 in civil and military aviation, estimated annual worldwide damage of >1.2 US\$ and countless recorded and unnoticed bird fatalities. In light of this the drive to develop and propose the most effective solution is only natural, as both scientists and technicians around the world are continuously working on new methods and tools of monitoring, risk assessment, forecast and control.

In the ornithological management strategies, monitoring is of the utmost importance, as it essentially provides the data necessary for forecast of birds' activity and preemptive measures to prevent collision, fatalities and economical damage. So far, the most widely used approach to monitoring is also a traditional one – recruitment and involvement of professional ornithologists for the collection of much needed data on species diversity and population numbers via censuses as well as analysis of this data for conclusions on inherent habits and populational behavior, and decision making. Nevertheless, new options are being developed and implemented to facilitate and automate the monitoring procedures. One prominent example, which is receiving more use in western world is monitoring of bird activity with radar. While there are some clear advantages to this approach – it is not without its limitations, which is why we think it would be useful to compare it with the traditional census counts.

Conceptually, traditional censuses rely on the definition of species diversity and abundance (numbers of individuals in population), which procedurally go hand in hand. For abundance either point counts or line transect counts technique is used. During *point counts* a certain representative number of points with a fixed radius is selected on the map of the study area, randomly or according to a systematic grid. At each point, for a short period of time (3-5 minutes), all birds observed visually and audibly are recorded, together with related information (e.g. habitat conditions, season and time of the day, weather etc.). In case of *line transect*, a certain representative number of transect lines with a fixed width of observation (the length may vary) is laid on the map of the studied area randomly or according to a systematic grid (parallel lines). The observer moves along the lines data and captures all birds observed visually and audibly, while also recording the related data. After either of those procedures, the estimation comes down to mathematical extrapolation via formulas, which allow you to assess the abundance of the bigger territory. In both of these options it is possible and recommended to use additional visual and audio recording equipment. While

planning the counts it is also vital to keep in mind the previous findings regarding the peak times of bird activity in different seasons. As for diversity definition – it is performed visually and/or audibly by observer during the counts, and then, if necessary, indices of diversity are calculated.

In its turn, *radar technology* came to the aid of ornithological studies in airports very recently – in the early 2010s. It was adapted from marine and naval studies and adjusted for monitoring of birds’ activity and flocking in real time as well as perform ornithological hazard assessment based on this data. The principle of its work is relatively simple and well-known: radar transmits a radio signal and registers the reflected signal, and based on this the numbers of individuals as well as their sizes are recorded. For ornithological radars typical scanning rates revolve around 24 rpm (once every 2.5 seconds). Works and studies are still in progress, regarding the optimal horizontal and vertical distances of such scanning, with different options available at the market and differing efficiency of detection at various range. The radar applications are receiving more and more attention in US airports as of late. One of potentially highly useful and perspective developments is the detection and recording of bird collisions “near-miss events” (NME) with the help of radar. According to the source: “The principle is that, if radar can detect 100% of near miss events in a way which permits structured and automated analysis, then hazard mitigation performance measurement will in future be able to be proactive (the detection of risk), rather than reactive (the recording of actual strikes). Hazard management may thereby be informed in a timelier manner and with real safety benefit where bird hazard is high.”

To perform the comparison of advantages and drawbacks of both methods of ornithological monitoring, we decided to identify their features according SWOT approach in relation to the task of ornithological monitoring and risk assessment in airports (Table 1).

Table 1.

Comparison of ornithological monitoring options via SWOT parameters

Monitoring options	SWOT parameters			
	Strengths	Weaknesses	Opportunities	Threats
Traditional censuses	<ul style="list-style-type: none"> • Comparatively inexpensive; • Identification of species diversity; • Extrapolation for bigger area coverage; • Effective for long-term study and “green” strategies composition. 	<ul style="list-style-type: none"> • Regular and frequent procedure needed; • Efficiency and accuracy depend on human factor; • Primary focus is on environmental parameters assessment, flight safety is a derivative. 	<ul style="list-style-type: none"> • Collection of wider and more detailed data; • Ornithological features and patterns identification, collection and analysis; • Integration of progressive, ecologically-friendly practices. 	<ul style="list-style-type: none"> • Possible non-analyzed data mounting; • High probability of human-related errors.

Table 1 (cont.).

<p>Radar usage</p>	<ul style="list-style-type: none"> • Less human resources and personnel involved; • Less time requirement; • Real-time observation; • Effective for immediate safety decision-making. 	<ul style="list-style-type: none"> • Comparatively costly; • Small coverage, efficiency fades with distance; • Requires additional training and depends on maintenance and serviceability; • Primary focus is on human safety, no link to ecological one. 	<ul style="list-style-type: none"> • Proactive safety strategies; • Integration of additional technologies (e.g. 3D area coverage); • Potential further future improvement of the tech; • Integration with other airport management services. 	<ul style="list-style-type: none"> • Possible equipment failure; • Under-studied – e.g. efficiency of detection of single birds and flocks, or big horizontal/vertical distances efficiency.
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As we can see, both approaches have a wide variety of features and factors either promoting or limiting their use. While traditional census is a more thorough, multi-faceted and environmentally-directed approach, it also is noticeably difficult in terms of procedure, qualified personnel involvement and data processing, which often results in negligence and underperformance in ornithological management of airports. As for radar – it definitely is useful from safety perspective within airport borders, but this strict specialization also proves to be its main limitation, as it provides no long-term progressive solution suitable both for humans and environment (namely, avifauna). Together with the fact, that it is rather young, understudied and expensive option, it represents more an auxiliary tool, than an independent methodology. Thus, we deem the combination of these approaches to be the best way of monitoring – usage of radar technology as a safety mand decision-making and data collection assistance tool, where the bird pressure is the highest or where it is financially feasible, while sticking with the more traditional censuses for overall ornithological management.

References

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