Ascend XYZ

# Ascend Avian Radar Network

## AIRLINE BIRD STRIKE REDUCTION

**Historically measures to avoid bird strikes are limited to airport grounds:** It is estimated that more than 20.000 collisions between aircraft and birds are expected to happen in Europe in 2020[i]. While airports are responsible for mitigating the risk of bird strikes on the airport area, the airlines are actually the ones paying the heavy bills that reached €4,3 billion[ii] in 2017 globally. Since airports are legally responsible for mitigating the risk on the airport area, all solutions in the market are designed to match the airports' needs. Consequently, airlines and pilots have little or no value from existing solutions. This is what we are changing with the Ascend Avian Radar Network.

**The world's first airline-centric solution:** The novel Ascend Avian Radar Network (further–AARN) connects multiple radars in multiple airports to deliver airlines and their pilots real-time bird activity data, forecasts, and warnings of high-risk periods in all AARN airports[iii] that the airline chooses to include in its subscription. The solution includes an application for pilots and an airline planning application. Application for pilots allows them to check the bird activity and forecasts from anywhere in the pre-flight phase or in the air. Airline planning application facilitates management and route-planning units to view the risk analyses of the individual airports.

**Financial impact:**

*AARN = Flight safety + Profitability*

For an airline with 1 million annual movements the AARN will increase annual profitability by €4-€34 million and break-even at a strike reduction of 3-5%. One of the biggest threats to the profitability in the aviation industry are delays. United Airlines estimate that, on average, each delay when an aircraft is struck by a bird results in 4 secondary delays or cancellations to the subsequent flights.[iv] In the same study, that is based on 3,2 million[v] movements we can see that the average cost per strike is €51.850[vi], and the strike rate is 8,85 per movement (which is almost identical to the European bird strike rates[vii]). This means that the average cost of a bird strike (for United Airlines) is €45,88 per movement. If we include the added cost for mitigations, added taxi time, increased fuel burn, increased take-off power/engine ware (we only suggest mitigation in peak risk periods) plus an average AARN system cost, break-even point is obtained at a 3-5% reduction in bird strikes. In Aalborg airport (Denmark) we have so far obtained a strike reduction of 75% over a 3-year period, successfully combining airline and airport effort.

**In other words, airlines can increase flight safety and profitability by implementing the AARN solution.**

## THE PROBLEM IS GROWING

US Federal Aviation Authority (FAA) reported a 38% growth in bird strikes from 2009 to 2015[viii] and has noted that bird strike incidents have shown an alarming trend of significant growth.[ix]

Based on research in the field, we estimate that more than 20.000 bird strikes will happen in Europe in 2019, resulting in approx. €1 billion[x] in costs (see examples of bird strike damage to the aircraft in Figure 1).

Besides the direct maintenance costs (including replacement parts, inspection costs etc.), indirect costs of bird strikes are of concern as well. These costs arise in case of a precautionary return to airport, aborted take-off or engine shutdown and can include: re-routing passengers, crew and passenger accommodation, burned fuel replacement, contractual penalties, additional airport or air traffic control charges or loss of confidence and perceived damage to airline brand.[xi] Even though it is hard to identify the exact monetary value of delays due to bird strikes, the average cost of aircraft block (taxi plus airborne) for passenger airlines (USA) in 2017 was approx. €61 per minute (direct costs including labour, fuel, food, aircraft ownership, airport landing fees, insurance, utilities, interest)[xii]. Last, but not least, in case of delays passengers experience inconveniences, as well as direct and indirect costs, that might not be covered by airlines (to illustrate, average value of the passenger's time is assumed to be approx. €43 per hour[xii]).

*Figure 1 Bird strike damage to the aircraft*

Bird strikes can, in the worst cases, result in fatal crashes. An example of a fatal bird strike was the crash of a Sita Air Dornier Do 228 aircraft on 28th of September 2012 in Nepal. The aircraft was reported to have crashed shortly after taking off from Kathmandu airport. The pilot had told the air traffic controller that they had hit a vulture. The forced landing was unsuccessful, and all 16 passengers and 3 crewmembers died.[xiii] Furthermore, in a more recent accident from March 2019, where an Ethiopian Airlines 737 Max 8 crashed in Ethiopia resulting in 157 fatalities. US aviation authorities believe a bird collision may have set off the sequence of events that led to the crash and regard a collision with one or more birds as the most likely reason to the MCAS sensor failure[xiv].

Based on interviews with airline executives, we understand that the positive business impact the AARN will bring is a clear benefit. However, avoiding a bird strike with a catastrophic outcome is the most important part of the AARN solution in their perspective. Originally, the airports are considered the main users of the avian radar data. However, in Ascend Avian Radar development process, we identified that airlines would have significant benefits from the data. Even though the airports are responsible for mitigating the risk, airlines are carrying the risk and cost. Airlines are expressing a significant need for the solution, where real-time data and historical analysis leads to the identification and prediction of peak bird activity periods.

Today airports are managing the bird strike risk within the airport area by taking mitigating actions to remove birds. Airports are tasked with "*monitoring the airport surroundings for landscape changes that could impact wildlife behaviour"*[xv], however there is no real active mitigation performed outside the airport. In reality the airports have little possibility to perform mitigation in this area, since it is owned by a 3rd party. The AARN solution will make it possible for airlines to mitigate risk in the airline mitigation areas (see Figure 2), and drastically reduce the probability and effect of a bird strike.

Currently no other solutions exist on the market that support airlines in management and mitigation of the bird strike risk. Today airport bird control units might warn pilots over the Automatic Terminal Information Service (ATIS) if bird activity is assessed to be high in the airport area. However, the data tends to be inconsistent, since it depends on the local conditions and intuition of the staff on duty. Airport staff are comparing the bird activity to their local knowledge. Pilots know this, and therefore they often do not respond to the warning at all, since it has no meaning and cannot be quantified. The lack of a solution for airlines to actively mitigate the risk of bird strikes hinders the fight against this industry wide challenge.

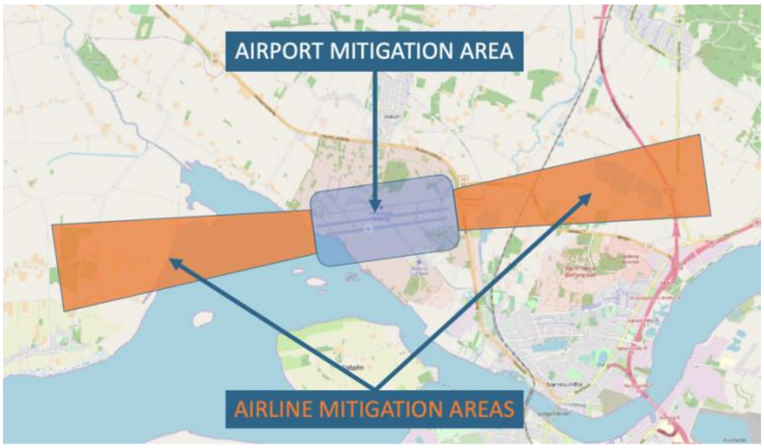


*Figure 2 Mitigation areas*

## THE PILOTS WILL KNOW WHEN, WHERE AND HOW TO MITIGATE THE RISK

When the AARN identifies a peak bird activity period, it will send a notification to the pilot application (as an integration into existing EFB solutions), allowing pilots to make the best possible decisions. Based on that information pilots then can:

- Use this information to prepare for the event of a strike, via approach and departure briefings;
- Use full runway for take-off (no intersection take-offs);
- Increasing rate of climb to reduce time spent in a high-risk area;
- Increase climb gradient to outclimb the risk area – if the area is close in, this also means traveling a shorter distance in a high-risk area;
- Consider take-off or approach in opposite direction if risk is lower at one runway end (see Figure 3).
- Reduce speed on approach to reduce the impact energy in case of a strike.

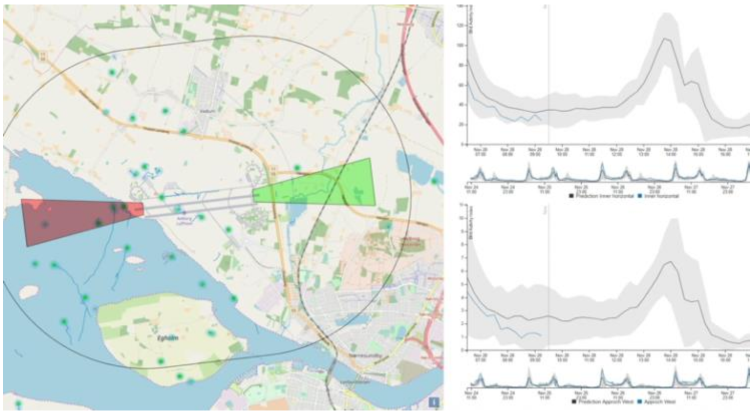

*Figure 3 Take-off or approach in opposite direction if risk is lower at one runway end and weather and traffic permits. Source: Ascend*

To illustrate, if a passenger aircraft hits a 2 kg duck at 300 knots, the impact energy will be equal to the weight of 10 elephants, but if you hit the same duck at 100 knots, the impact energy will be equal to 1 elephant. In other words, reducing speed reduces the impact energy and brings the aircraft within the design criteria. When looking at aircraft design criteria (FAR 25, see Figure 4) and impact speed[xvi], it becomes evident that a mere 15% reduction in speed could bring the aircraft within the design impact criteria – even in case of a collision with an avian heavyweight like a Canada goose

| Aicraft category | Airframe Component | Bird Impact Requirements |
|---|---|---|
| Transport Category Aircraft (FAR 25) | Entire airplane | Able to safely complete a flight after striking a **4-pound (1,81 kg)** bird at design cruise speed (Vc). |
| | Empennage (Tail) | Able to safely complete a flight after striking an **8-pound (3,63 kg)** bird at design cruise speed (Vc). |
| | Windshield | Able to withstand impact of a **4-pound (1,81 kg)** bird, without penetration, at design cruise speed |
| | Airspeed indicator system | The pilot tubes must be far enough to avoid damage to both in a collision with a single bird. |

*Figure 4 Airframe Bird Strike Airworthiness Requirements. Based on: Transport Canada (2004)*

(see Figure 5, where cells marked red indicate the impact force that is exceeding the FAR 25 design criteria, green – impact within design criteria).

| | | Aircraft Speed (Knots) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Bird Species | Weight lbs.(kg) | 100 | 150 | 200 | 250 | 280 | 300 | 350 | 400 | 450 |
| Starling | 0.187 lbs. (0,084 kg) | 995 | 2,238 | 3,978 | 6,216 | 7,798 | 8,951 | 12,184 | 15,913 | 20,140 |
| Ring-billed Gull | 1.5 lbs. (0,680 kg) | 2,775 | 6,244 | 11,100 | 17,343 | 21,756 | 24,974 | 33,993 | 44,399 | 56,193 |
| Duck | 4.0 lbs. (1,81 kg) | 6,078 | 13,676 | 24,314 | 37,990 | 47,655 | 54,706 | 74,461 | 97,255 | 123,088 |
| Canada Goose | 15.0 lbs. (6,80 kg) | 9,118 | 20,515 | 36,471 | 56,985 | 71,482 | 82,059 | 111,691 | 145,883 | 184,633 |

*Figure 5 Approximate Bird-impact Forces (lbs.) for Airbus 321. Based on: Transport Canada (2004).*

In many cases, a speed reduction is possible, although, that speed reduction would also lead to a slightly prolonged airborne time. However, we are talking about 1-2 minutes of the flight, and only when a radar detected high bird activity message is given.

These points are essential to keep in mind, considering the risk to the engines or, especially, the windshield in case of a bird strike. Not only are these areas among the most critical, but also where the majority of bird strikes actually happen[xvi]. If a collision with a bird occurs with a force above/outside the aircraft design criteria, there is a risk that the bird might shatter or penetrate the windshield, causing serious harm to the crew with a potentially fatal outcome.

Furthermore, it is important to highlight the fact that the risk of a bird strike increases in connection with the proximity to the ground, thus with take-off and landings (75% bird strikes happen below 500 feet)[xvii]. The AARN solution gives a consistent quantifiable bird activity measurement and prediction data in real time below 500 feet. Consequently, pilots can start using the AARN on their routine as a live forecast of bird strike risk, just as they commonly do for other relevant parameters that can put the flight in danger, e.g. weather forecast.

Ascend can supply directional specific 3D systems. However, the added cost of the 3D systems cannot be justified with added value. Therefore, we have chosen to base the AARN on 2D radars. The 2D radars are measuring a 3D area (as shown in Figure 6). Radar data shows what is in the area (not the specific height birds are recorded at in that area). However, it means that Ascend Avian Radar is measuring the area with a high density of air traffic and where the risk of bird strikes is the highest (due to the mentioned proximity to the ground).

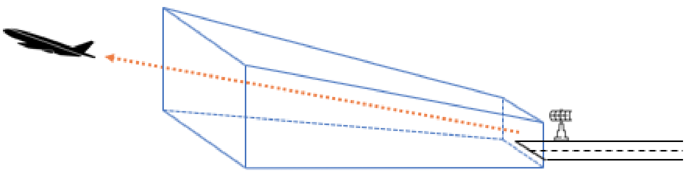

*Figure 6 Departure and approach measurement area*

## THE AARN SOLUTION

The AARN solution will enable pilots to easily access the reliable and valuable information at any time in the pre-flight phase or during flights either directly integrated into existing Electronic flight bag solutions (EFBs) or as part of crew briefing packages. The pilot workload has been increasing with an immense focus on operational efficiency and turnaround times. Thus, an easily accessible solution providing easy-to-understand and actionable information is paramount. The AARN delivers on this need by allowing pilots to access data about any airport that their airline has subscription for (and at any flight time) by just entering the Airport ICAO designator (also used in flight plans and related operational information).

Furthermore, airline safety management and route planning teams will have access to historical analysis of the data and will be able to extract radar risk assessment for individual analysis of existing or future destinations. By doing so, the airline could potentially aim to plan departures and arrivals at high-risk destinations at the times with the lowest predicted bird activity. This would typically be possible on transcontinental flights or operating at regional airports. In the busiest airports the aircraft will have to depart at assigned time slots and mitigate the risk from an operational perspective.

## CONCEPT

The AARN is a comprehensive solution consisting of radar software/hardware and cloud-based software, which makes it possible to perform complex radar configuration in a centralized manner remotely from Ascend HQ. Ascend takes care of uptime and maintenance - the users only have to apply the information. The radars are built into a rugged trailer solution and configured with onboard computers (see Figure 7). Immense amounts of radar data are processed using both onboard computers and the cloud, in this process Ascend algorithms condense the radar data, remove noise and ground clutter to identify and track birds.


*Figure 7 Ascend Avian Radar operating in Aalborg airport*

The AARN is a network of “plug and play” devices – all the airports have to do, is to provide power and internet. Afterwards, the radar configures itself by analysing ground clutter based on the first antenna rotations. Ascend’s algorithms identify and classify all signal responses, and relay the identified birds and bird tracks as geographical vector data to the Ascend Cloud service, which starts providing forecasts and alerts based on time series analysis. From the cloud service the data is distributed to pilots, airline planning units and safety teams, as well as the airports. Once the individual radars have been running for 7 days, they are able to predict patterns and bird activity peaks. Bird activity prediction algorithms use local radar data in combination with meteorological information. With the solution we can move from reactive to proactive use of the data, by using the predictive algorithms. The algorithms create a bird activity forecast, enabling pilots and airport staff to take action and mitigate the risk. See an example of the activity graph from Aalborg airport (Denmark) approach and departure sector west in Figure 8, where the black line indicates the actual bird activity and the purple line indicates activity forecast.

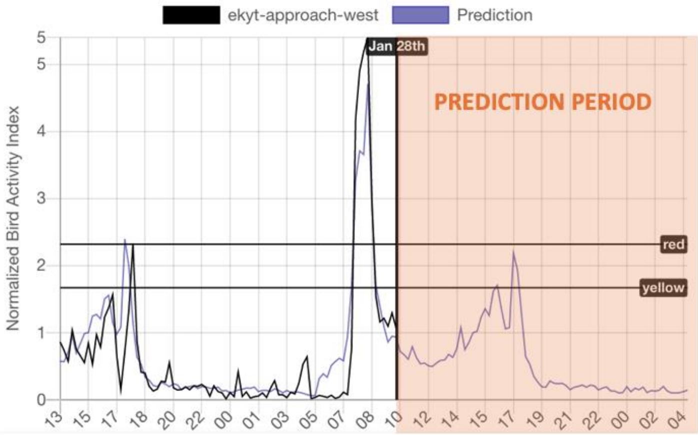



*Figure 8 Activity graph from Aalborg airport (approach and departure corridor west)*

For additional information, system integration or education contact info@ascendxyz.com. To view live radar data and bird activity forecasts click here (or contact info@ascendxyz.com if you are viewing a printed version).

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[i] ACI (2018), Media releases, *ACI World publishes annual World Airport Traffic Report.* Available at: https://aci.aero/news/2018/09/20/aci-world-publishes-annual-world-airport-traffic-report/

[ii] Allan, John R., "THE COSTS OF BIRD STRIKES AND BIRD STRIKE PREVENTION" (2000). Human Conflicts with Wildlife: Economic Considerations. 18. Available at: http://digitalcommons.unl.edu/nwrchumanconflicts/18

[iii] AARN airports – airports that are supplying data to the Ascend Avian Radar Network.

[iv] https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1001&context=birdstrike2001

[v] For comparison, the total number of movements in Europe in 2018 was 24.4 million.

[vi] The cost per bird strike was $ 37,983 in 1999/2000. Updated to todays (28.01.2020) price level this is equivalent to $ 56,975=€ 51,850 or €45 per movement. This is without the European compensation scheme for passenger delays.

[vii] In the UK CAA has reported a bird.strike rate of 8.3 per 10 000 movements.

[viii] P. Seidenman, D. Spanovich (2016), *How Bird Strikes Impact Engines*, in Maintenance, Repair & Overhaul, October 06, 2016, available at: https://www.mro-network.com/maintenance-repair-overhaul/how-bird-strikes-impact-engines

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[x] The calculation includes 2018 traffic information and inflation, and is based on Allan, John R., "THE COSTS OF BIRD STRIKES AND BIRD STRIKE PREVENTION" (2000). Human Conflicts with Wildlife: Economic Considerations. 18. Available at: http://digitalcommons.unl.edu/nwrchumanconflicts/18

[xi] http://worldbirdstrike.com/IBSC/Amsterdam/IBSC25%20WPSA8.pdf

[xii] Airlines for America, *U.S. Passenger Carrier Delay Costs*, available at: http://airlines.org/dataset/per-minute-cost-of-delays-to-u-s-airlines/

[xiii]BBC News (2012), "Nepal plane crash: UK dead remembered", available at: https://www.bbc.com/news/uk-19767823

[xiv] A.Sider and Pasztor, The Wall Street Journal, *Boeing Official Played Down Scenario That May Have Doomed Ethiopian Jet,* (May 21, 2019), Available at: https://www.wsj.com/articles/boeing-official-played-down-scenario-that-may-have-doomed-ethiopian-jet-11558439651?mod=hp_lead_pos3

[xv] Commission Regulation (EU) No 139/2014, available at: https://www.easa.europa.eu/document-library/regulations/commission-regulation-eu-no-1392014

[xvi] Transport Canada (2004), *Sharing the skies. An Aviation Industry Guide to the Management of Wildlife Hazards.* Publication, TP 13549, p. 203. Available at: http://www.tc.gc.ca/publications/en/tp13549/pdf/hr/tp13549e.pdf

[xvii] Federal Aviation Administration., 2016. Wildlife Strikes to Civil Aircraft in The United States 1990-2015, Available at: https://wildlife.faa.gov/downloads/Wildlife-Strike-Report-1990-2015.pdf