On-Board Bird Strike Prevention
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Migratory bird populations are increasing.

**Most U.S. hubs are located in bird migratory paths.**

Numerous flights operate to regional airports with minimal wildlife management plans.

Bird strike rates increase when flights move into dusk or night hours.

Above 500 ft. AGL Spring and Fall seasons are highest risk.

**NOTE: Due to low light and increased avian activity**

Flights on approach phase, below 3500 ft. at night are at the highest risk.

### BIOLOGICALLY SPEAKING

**BIRD BEHAVIOR**

Birds have a high visual capability and respond to visual stimulus.

Visual stimulus is most effective in low light.

Birds will initiate avoidance when a threat is perceived.
REDUCE BIRD STRIKES

Wildlife plans cost millions yet have minimal impact outside the airport property

AIRPORT BASED BIRD STRIKE MITIGATION

NON-LETHAL TECHNIQUES
- Relocation
- Nest Destruction
- Animal Behavior Modification

Physical Exclusion Devices
Auditory Scaring Devices
Repellents
Visual Scare Devices
Immobilization
Non-lethal Traps
Animal Use

LETHAL TECHNIQUES
- Egg Addling/Destruction
- Shooting
- Toxicants
- Traps
- Euthanasia

WILDLIFE PATROL

RADAR EVALUATION OF HABITS AND PATTERNS

Radar implementation may give valuable insight on long-term bird patterns in the airport zone.

ON DEPARTURE

Below 3500 ft. for 2 Miles
Above 500 ft. departing aircraft have a much lower risk of a bird strike. Spending less time in the bird zone.

AIRPORT
ON-BOARD SYSTEM ZONE
Above 500 ft.

AIRPORT ZONE
Below 500 ft.

ON APPROACH
Below 3500 ft. up to 13 Miles spending most of that time outside Airport Management Area.

NIGHT AND LOW-LIGHT CONDITIONS
are 7 times more hazardous as birds ability to detect oncoming aircraft diminishes.

AIRCRAFT BASED BIRD STRIKE REDUCTION
On-board systems that address the Bird Strike risk outside the airport property through alerting birds to an aircraft is key to their avoidance behavior during migratory seasons.

WILDLIFE PATROL
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AIRCRAFT ZONE
Below 500 ft.

ON-BOARD SYSTEM ZONE
Above 500 ft.

REDUCE BIRD STRIKES
AIRCRAFT
Biologists at the National Wildlife Research Center Sandusky, OH, field station have developed an experimental procedure to test the effectiveness of aircraft-mounted light as a potential technique to reduce bird strikes. Test groups of birds were exposed to the approach of a vehicle fitted with 2 aircraft landing lights spaced at 12 feet apart on top of the vehicle. The vehicle was driven at a consistent speed of 75 miles/hour toward a light cage immediately next to the road. Flock responses behaviors of brown-headed cowbirds, Canada geese, European starlings, herring gulls, and mourning doves were recorded by a video camera and then quantified. Birds were exposed to various, no lights, pulsing lights, and steady lights. The biologists were able to show that birds exhibit earlier and more cohesive avoidance reactions to approaching vehicles in response to light and other external stimuli. Responses to the vehicle differed markedly among species. Further, because of the effects of varying ambient light conditions on bird response to the approaching vehicle, the biologists suspect that contrast to background lighting is likely important to increasing avian awareness of approaching aircraft.

The results indicate that bird strikes may be reduced in the future by enhancing the visibility of aircraft. Additional research has been planned involving varying pulse frequencies and specific light wavelengths. The studies found that 91 to 99 percent of birds “exhibited alert behavior” when exposed to incandescent pulsing lights. The tests also showed that the pulsing lights were most effective in low-light conditions, such as cloudy days, nighttime, dusk and dawn.

FLOAT PLANES - NOTICED THEY QUIT HITTING BIRDS

In the early 1990’s float plane operators in the Pacific Northwest, British Columbia and Alaska began reporting that along with the improved recognition and increased lamp life, bird strikes were dramatically reduced by pulsing their landing and taxi lights.

Commercial float plane operate in waterfowl habitat where there are no wildlife mitigation methods employed. Bird strikes are mitigated by having the aircraft more apparent.

Float planes fly in the most hazardous bird strike environment.
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REDUCE BIRD STRIKES

Sunstate/Qantaslink Pulsed or Modulated Aircraft Lighting Trials 2002-2003
5 DHC 8-300 aircraft

**WILDLIFE STRIKE REDUCTION**

The use of the Pulsing lights in accordance with company standard operating procedure on the DHC8-300 fleet resulted in a reduction of wildlife strikes by approximately 50%.

The fleet was averaging approximately 3.65 strikes/aircraft/year prior to the evaluation and approximately 1.83 strikes/aircraft/year while using pulsing lights. The results were so impressive that QantasLink moved to a fleetwide introduction of a pulsed or modulated landing light system.

In response to the successful trial at QantasLink,

*Qantas Airways initiated a 737 Modulated Light Trial in 2005.*
REDUCE BIRD STRIKES

Qantas 737 Pulsed or Modulated Aircraft Lighting Trials 2005-2007
5 B737-400 and 5 B737-800 aircraft

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QANTAS SUCCESS STORIES

B737-400 group
Achieved a 54% (day and night) bird strike reduction rate per 1,000 departures, compared to a non-pulsed light equipped B737-400 group.

Daylight only bird strike reduction rate was 30%.

B737-800 group
Achieved a 66% (day and night) bird strike reduction rate per 1,000 departures, compared to a non-pulsed light equipped B737-800 group.

Daylight only bird strike reduction rate was 49%.

An averaged B737 reduction rate between approximately -10% and -35% per 1,000 departures with a pulsed or modulated light system operational has the ongoing potential to save a 100 aircraft Airlines approximately $2.5 to $8.9 million per year respectively.

(Pulsed light system B737 Operational Evaluation by Qantas Airlines)

ALASKA AIR GROUP SUCCESS STORY

Alaska Air Group is committed to the Pulselite system to decrease the incidence of bird strikes and to increase air-to-air conspicuity for other aircraft and ATC.

Alaska Airlines
Alaska commenced a fleet-wide fitment of Pulselite on their Boeing 737 series aircraft in 2010. The system was endorsed by their safety, maintenance & engineering groups, and the senior pilot corps. The cost analysis they performed exceeded their internal criteria warranting fleet-wide implementation. With a business case based on known operating/damage costs and a conservative 25 - 30% bird strike reduction proved by Qantas, Horizon, and USDA research, they successfully demonstrated to management the justification (a less than a 2 year ROI) for installing the system.

Horizon Air
Horizon initiated a fleet-wide fitment program on their Bombardier Q400 aircraft in 2008.
ENHANCE AIRCRAFT VISIBILITY WITH ON-BOARD SYSTEMS

Visual systems supported by research and field trials

THE RESULTS ARE AS DIFFERENT AS NIGHT & DAY

QANTASLINK-SUNSTATE
- Achieved 35% bird strike reductions.

QANTAS
- Achieved 30% bird strike reductions.

As a direct result of the successful trials at Qantas the following airlines are now using on-board bird strike mitigation systems.

ALASKA AIRLINES
HORIZON AIRLINES (ALASKA AIR GROUP)
AIR NELSON (AIR NEW ZEALAND)
AIR PACIFIC
AIR VANUATU
JETCONNECT (QANTAS NEW ZEALAND)

These airlines above are using Pulselite® to actively reduce the risk of bird strikes outside and inside of the airport zones (above 500 ft.).

<table>
<thead>
<tr>
<th></th>
<th>DAY</th>
<th>NIGHT</th>
</tr>
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<tbody>
<tr>
<td><strong>ON-BOARD ZONE</strong></td>
<td>371 Birdstrikes</td>
<td>2,315 Birdstrikes</td>
</tr>
<tr>
<td></td>
<td>12 (3.23%) Causing</td>
<td>73 (3.15%) Causing</td>
</tr>
<tr>
<td></td>
<td>substantial damage</td>
<td>substantial damage</td>
</tr>
<tr>
<td><strong>AIRPORT ZONE</strong></td>
<td>1,031 Birdstrikes</td>
<td>6,438 Birdstrikes</td>
</tr>
<tr>
<td></td>
<td>8 (.78%) Causing</td>
<td>386 (6%) Causing</td>
</tr>
<tr>
<td></td>
<td>substantial damage</td>
<td>substantial damage</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>13,970 Birdstrikes</td>
<td>14,334 Birdstrikes</td>
</tr>
<tr>
<td></td>
<td>495 (3.55%) Causing</td>
<td>508 (3.55%) Causing</td>
</tr>
<tr>
<td></td>
<td>substantial damage</td>
<td>substantial damage</td>
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</tbody>
</table>


NOTE: A strike outside airport countermeasures like the US Air flight 1549 was 48 times more likely to happen at night. Captain Sullenberger’s ability to get a visual judgement of the surface of the Hudson river would have been impossible.
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OTHER WILDLIFE APPLICATIONS - DEER VEHICLE COLLISIONS
This Test program was used to identify the question. Could this technology be applied to other wildlife species? Results of this test indicated that specific pulse frequencies and intense light stimulation can improve wildlife awareness and or elicit evasive action by deer. This research led to a conclusion that a high intensity discharge lights and Tungsten Halogen lights in combination at constant illumination can elicit an evasive action on the deer at a far greater distance.

"This research led to a peer review article in the Journal of Wildlife Management:

This research program also resulted in development of a new motorcycle headlamp which is validated to provide enhanced motorcycle conspicuity to other traffic, and a reduction in deer/motorcycle collisions.

REVISED VEHICULAR LIGHT TREATMENT EXPERIMENT - AVIAN WILDLIFE
This test program was a result of peer review of the Vehicular Mounted Aviation Light Experiment, described above. The peer review process raised the question, Can aircraft based lighting elicit an alert response in avian wildlife and does this response change with ambient lighting? Again, Precise Flight partnered with USDA/Sandusky on an experiment testing and supplied the lab equipment for light stimulation and the recording video equipment.

The research found that avian awareness is dependent upon background illumination and that relatively simple modification to an existing aircraft lighting system demonstrably improves the awareness of the aircraft by birds. The research has also led to further improvements in the effectiveness of the ground based lighting system in deterring birds from the airport environment.

This research led to a peer review article in Animal Behavior,


This research program initiated further product development and on the ground based Avian Harassment system. This developments found in this research improved the avian response to the ground based lighting system.
CONCLUSIONS AND RECOMMENDATIONS

On May 4th, 2010 the NTSB held a public board meeting concerning their investigation of the US Airways Flt 1549 ditching into the Hudson River following a bird strike on 15th January 2009. The NTSB’s probable cause report includes recommendations for innovative technologies like on-aircraft pulsing lights to reduce the ever increasing bird strike hazard.

Conclusions #s 27, 28 and 31, the NTSB noted the following:

This accident was not a typical bird-strike event; therefore, this accident demonstrates that a bird strike does not need to be typical to be hazardous.

The accident bird strike occurred at a distance and altitude beyond the range of LaGuardia Airport’s (LGA) wildlife hazard responsibilities and, therefore, would not have been mitigated by LGA’s wildlife management practices.

Research on the use of aircraft systems such as pulsating lights, lasers, and weather radar may lead to effective methods of deterring birds from entering aircraft flightpaths and, therefore, reduce the likelihood of a bird strike.

Recommendations # 15 to the Federal Aviation Administration:
Work with the U.S. Department of Agriculture to develop and implement innovative technologies that can be installed on aircraft that would reduce the likelihood of a bird strike.

Recommendations # 26 to the U.S. Department of Agriculture:
Develop and implement, in conjunction with the Federal Aviation Administration, innovative technologies that can be installed on aircraft that would reduce the likelihood of a bird strike.
PRESS LINKS

AVIATION INTERNATIONAL NEWS WEBSITE
*Firm moves bird avoidance from airport to airport*
By Jennifer Harrington

AIR TRANSPORT WORLD - JUNE 2009
*Aviation’s Bird Flu - Bird strikes are an ever-present danger*
By Geoffrey Thomas / Perth / Sydney
http://viewer.zmags.com/publication/f5659eab#/f5659eab/40

DISCOVERY CHANNEL WEBSITE
*The Wide Angle: Aircraft Lights Could Reduce Bird Hits*
By Bradley Blackwell, research wildlife biologist for the U.S. Department of Agriculture
http://dsc.discovery.com/technology/my-take/birdstrike-blackwell.html

WALL STREET JOURNAL WEBSITE
*New Focus Put on Avoiding Bird Strikes*
By Andy Pasztor and Susan Carey
http://online.wsj.com/article/SB123293125714114163.html

UNIVERSITY OF NEBRASKA - DIGITAL COMMONS
*2005 Bird Strike Committee Proceedings*
*Efficacy of Aircraft Mounted Lighting to Reduc Bird Strikes*
By Scott T. Philiben
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1012&context=birdstrike2005

UNIVERSITY OF NEBRASKA - DIGITAL COMMONS
*2006 Bird Strike Committee Proceedings*
*Response of Birds to Aircraft Lighting: Implications for Reducing Bird - Aircraft Collisions*
By Bradley F. Blackwell, Scott T. Philiben, Thomas W. Seamans
http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1021&context=birdstrike2006

NATIONAL GEOGRAPHIC NEWS WEBSITE
*Future Tech May Reduce Bird-Plane Collisions*
By John Roach