On-Board Bird Strike Prevention

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REDUCE BIRD STRIKES

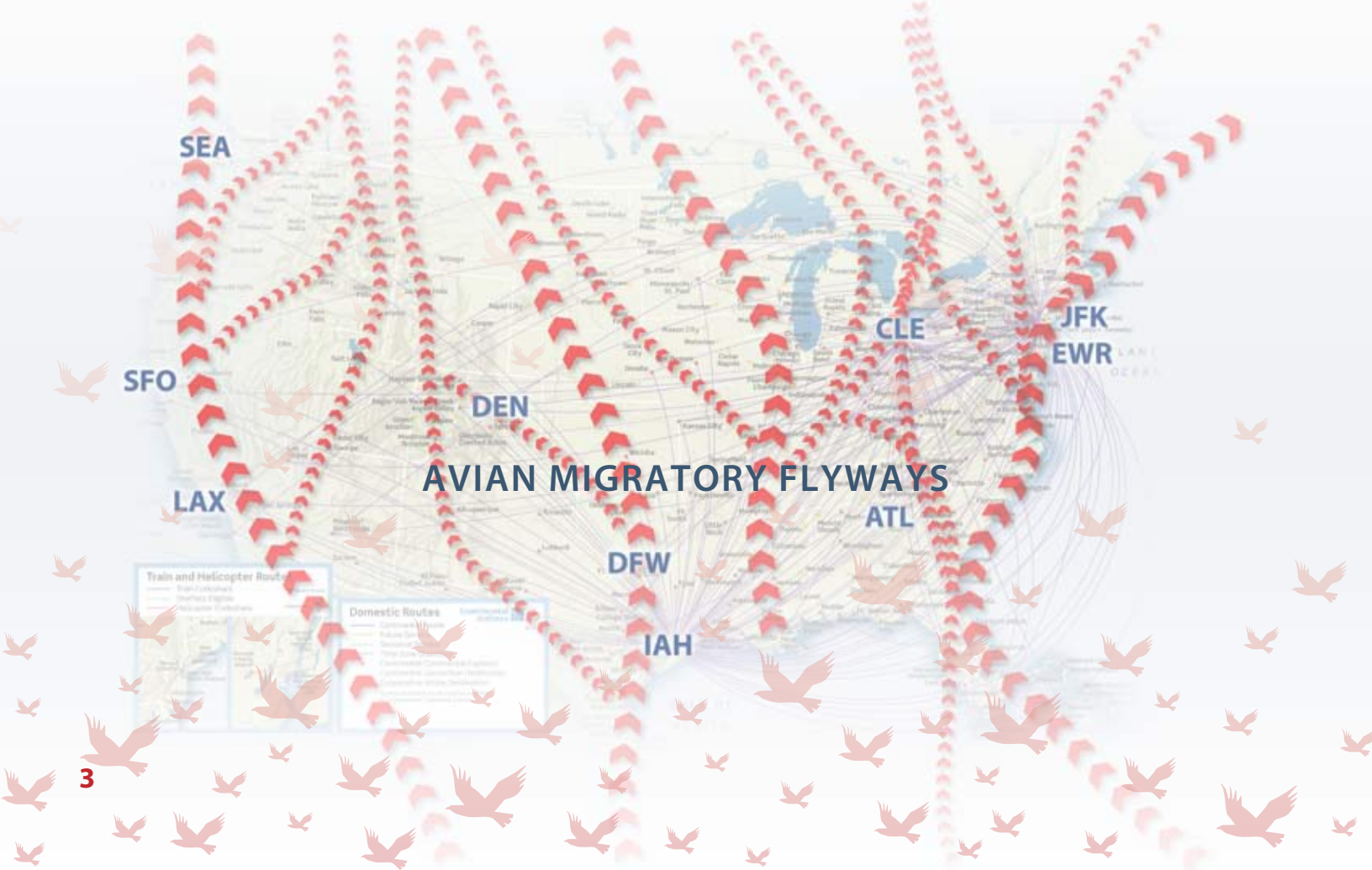
KNOWN RISKS

- 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 preceived.



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

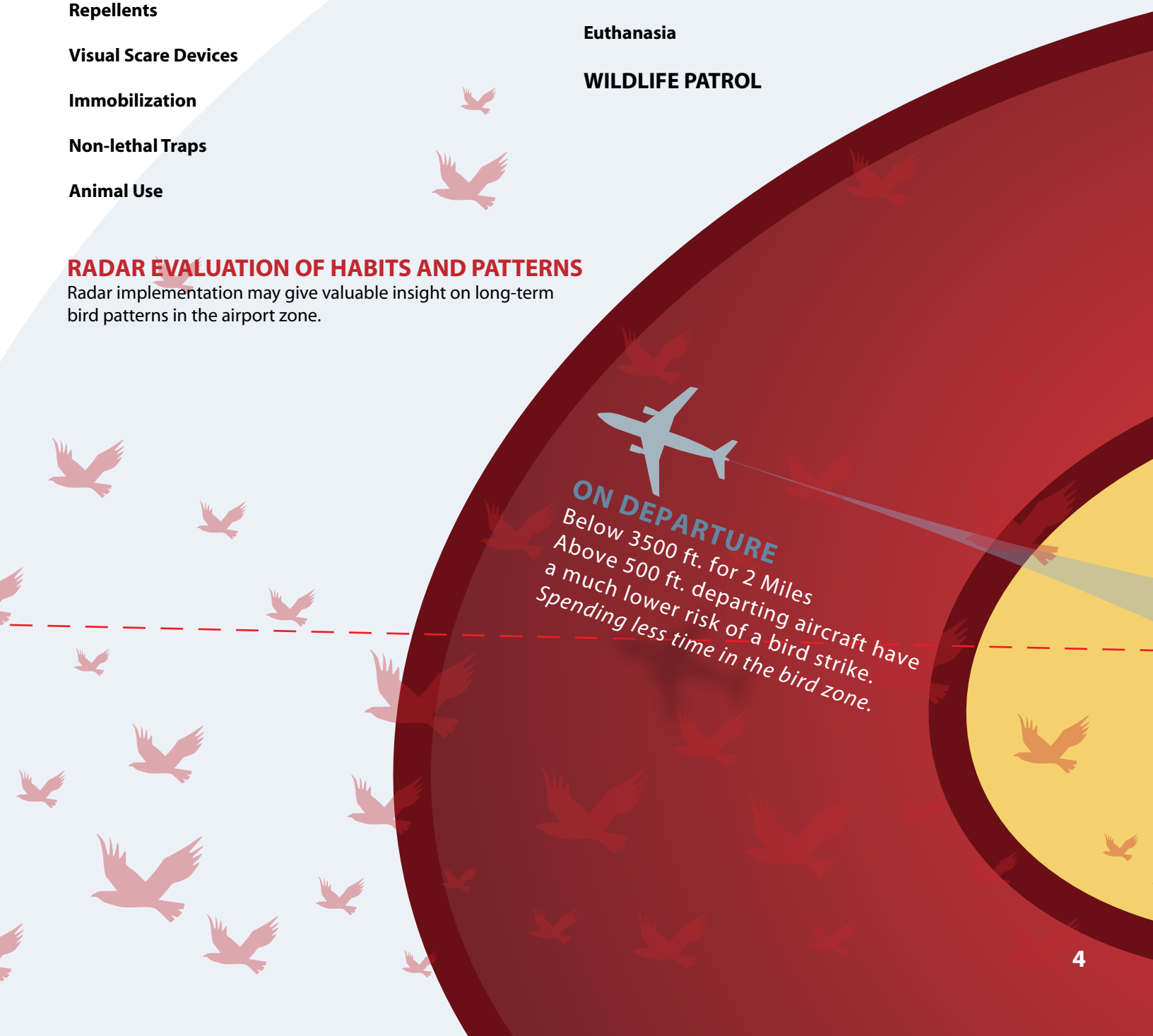
Traps

Euthanasia

WILDLIFE PATROL

RADAR EVALUATION OF HABITS AND PATTERNS

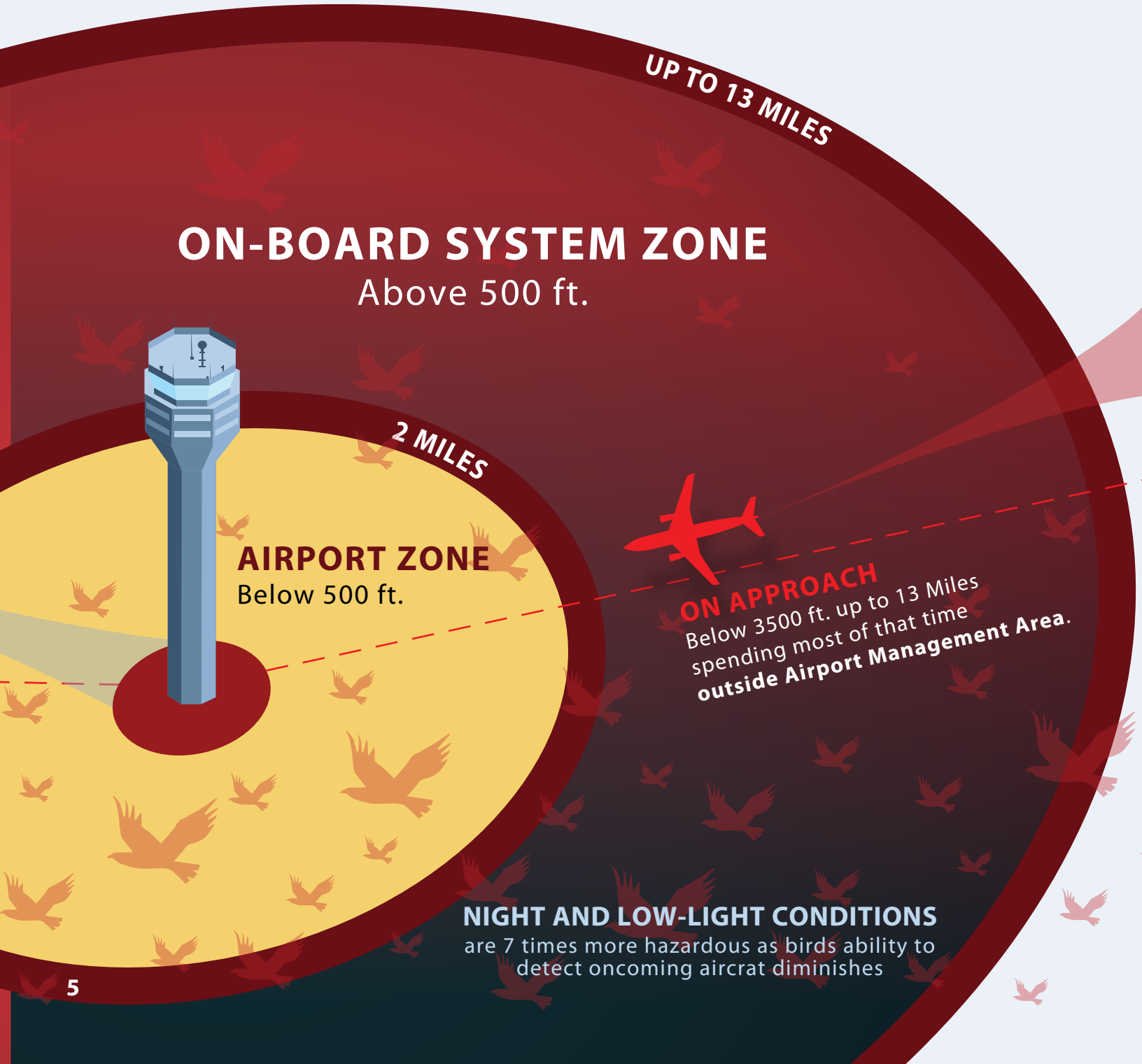
Radar implementation may give valuable insight on long-term bird patterns in the airport zone.



REDUCE BIRD STRIKES

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.



REDUCE BIRD STRIKES

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.

REDUCE BIRD STRIKES

US DEPT. OF AGRICULTURE - RESEARCH

Aircraft - Mounted Light Experimental Technique

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 birdstrikes.

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 75miles/hour toward a flight 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 birdstrikes 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.

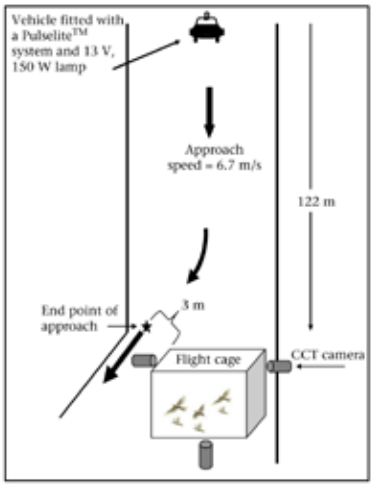


FIGURE 1

Figure 1. Schematic representation of the experimental site showing the relative trajectory of the vehicle in relation to the position of the cage. Experiments were conducted in Erie County, Ohio, U.S.A., from 12 June through 26 September 2006.

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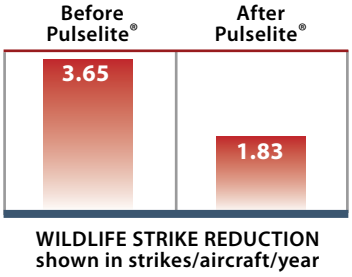
REDUCE BIRD STRIKES

SUNSTATE

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



WILDLIFE STRIKE REDUCTION
shown in strikes/aircraft/year

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.

(Prepared for Sunstate Airlines/QantasLink by Peter Reardon Enterprises Pty Limited)

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

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)

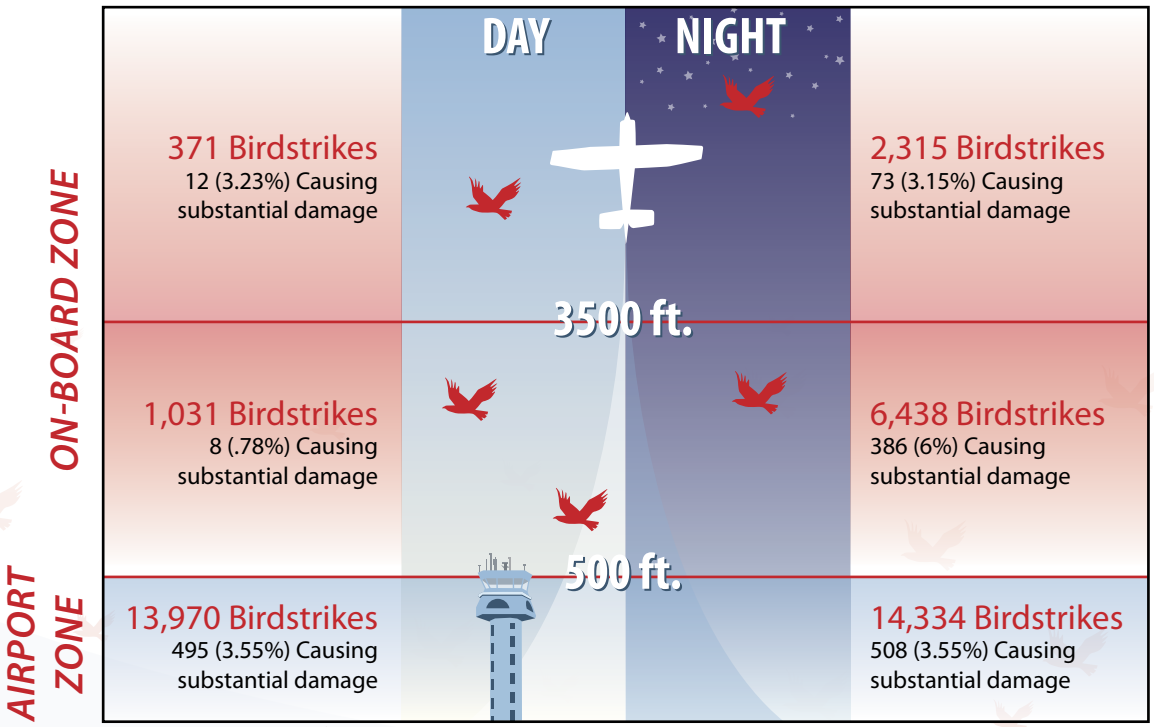
AIR NELSON (AIR NEW ZEALAND)

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.).



Cleary, E. C., R. A. Dolbeer, and S. E. Wright, 2003. Wildlife strikes to civil aircraft in the United States, 1990-2002.

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.

NOTED RESEARCH

VEHICULAR MOUNTED AVIATION LIGHT EXPERIMENT - 70MPH DRIVE BY

This test program was used to identify the question. Could aviation based lighting could elicit an avoidance response in a variety of bird species in daylight operation? Results were mixed but there was a key research result that was significant enough to initiated additional questions. This research led to a peer review article in the Journal Of Wildlife Management.

"Blackwell, B. F., & G. E. Bernhardt. 2004. Efficacy of aircraft landing lights in stimulating avoidance behavior in birds. Journal of Wildlife Management 68:725-732."

FIXED LED AND FILTERED LIGHTING EXPERIMENT

This Test program was used to identify the question. Could a biologically specific wavelength or pulse frequency enhance an awareness response in avian wildlife of known capability? Results of this test indicated that biologically specific pulse frequencies and wavelengths? could enhance avian awareness to light stimulation. This research also led to a conclusion that a specific light stimulation would be free from habituation.

This research led to establishment of a shared USDA – Precise Flight U. S. Patent (#6940424,Hazard Avoidance System).

FIXED LED AND FILTERED LIGHTING EXPERIMENT - AVIAN HARASSMENT SYSTEM

Additionally the above research led to development of a ground based Avian Harassment System, for use in the airport environment. We are coordinating with USDA/Sandusky on field trials of this product this spring.

This ground based device combines a collimated beam of high intensity and far reaching light. This light allows the selection of a specific emission or change in spectral emission, combined with the ability to pulse this light at a biologically significant or range of frequencies. This device avoids the issue of Laser use in the airport environment and the high intensity pulse component allows the light effect to reach avian wildlife as far as ¼ mile away.

"Blackwell, B. F., G. E. Bernhardt. Dolbeer R, Cepek J 2002 Lasers As Non-Lethal Avian Repellents: Potential Applications In The Airport Environment

NOTED RESEARCH (cont.)

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:
"Blackwell, B. F., & T. E. Seamans. 2008. Enhancing the Perceived Threat of Vehicle Approach to Deer" Journal of Wildlife Management 73:128-131."

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,

"Blackwell, B. F., Dolan, T, Seamans, T & Fernandez E, 2008. " Avian VISUAL System Configuration And Behavioral Response To Object Approach", Animal Behavior 77:673-684

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.

NTSB REPORT ON US AIRWAYS FLIGHT 1549

NTSB National Transportation Safety Board
Office of Aviation Safety
US Airways Flight 1549
Ditching on the Hudson River
January 15, 2009
Investigation

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. **27**

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. **28**

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 **31**

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. **15**

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. **26**

PRESS LINKS

AVIATION INTERNATIONAL NEWS WEBSITE
Firm moves bird avoidance from airport to airport
By Jennifer Harrington
http://www.ainonline.com/news/single-news-page/article/firm-moves-bird-avoidance-from-airport-to-airplane-20374/

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

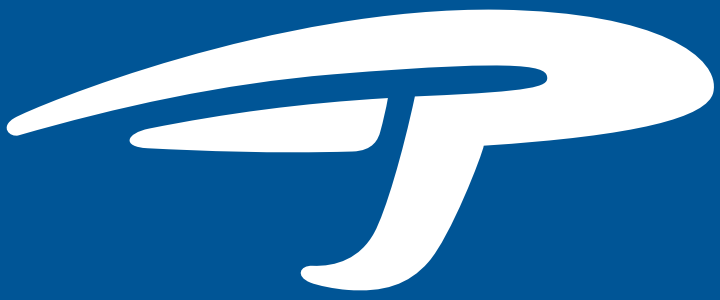
DISCOVERY CHANNEL WEBSITE
The Wide Angle: Aircraft Lights Could Reduce Bird Hits
By Bradley Blackwell, research wildlife biologist for the U.S. Department of Agriculture
http://dsc.discovery.com/technology/my-take/birdstrike-blackwell.html

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 Committe 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 Committe 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
http://news.nationalgeographic.com/news/2009/02/090206-birds-airplane-hudson-river.html



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