Aviation Stakeholder Management of Bird Strike Risks -

Enhancing Communication Processes To Pilots and Air Traffic Controllers for Information Derived from Avian Radar

Mr. Gerry Key
Accipiter Radar Technologies Inc.
gkey@accipiterradar.com

Dr. Tim J. Nohara
Accipiter Radar Technologies Inc.
tnohara@accipiterradar.com

Capt Richard J. Sowden
Avian Aviation Consultants
richard.sowden@sympatico.ca

Capt Robert Perkins
rperkins@niagara.com

Dr. Robert C. Beason
Accipiter Radar Corporation
bbeason@accipiterradar.com

Purpose

- Need to develop additional safety layers
  - Excellent efforts have been made by airports and wildlife biologists to make their aerodromes less attractive to hazardous bird species.
  - Hazardous bird populations continue to increase.
  - Damaging bird strikes continue on-airport and off-airport.
  - We must be vigilant by developing additional bird strike risk mitigation layers integrated across the aviation enterprise.
- White paper is available as a tangible starting point
  - New avian radar-derived tools with corresponding tactical and strategic bird strike threat awareness information are proposed.
  - An aviation enterprise system model is proposed for integrating this information into the airport operating environment following risk management principles and respecting culture and constraints.
  - Our hope is to engage aviation industry stakeholders into action.
  - http://www.accipiterradar.com/file/490

Acknowledgements

- Result of small working group of stakeholders:
  - Two pilots (co-authors Sowden & Perkins)
  - Mr. Claude Fortier, Manager,
    ATC Operational Support, NAV CANADA
  - Avian radar developer (co-author Nohara)
  - Ornithologist / certified airport wildlife biologist (co-author Beason)
  - Mr. Gerry Key (biologist)
- Captains Sowden & Eschenfelder (2009)
  - Proposed a practical risk mitigation framework for developing new safety layers for bird strike risk mitigation.
  - This paper builds on that framework by considering the actors across the aviation enterprise involved in environmental hazard (e.g., severe weather) risk management, examining their processes, and adapting them to avian hazards.

Outline

- The aviation enterprise
- Approach to improved management of bird strike risk
- Available avian radar information
- Integration of avian radar into the aviation enterprise
- Summary and next steps

This presentation briefly touches on the results of the working group, describing the approach we took. Please consult the paper for details:
http://www.accipiterradar.com/file/490

The aviation enterprise

Use all actors who can help

•Key actors in airport operational environment are arranged in a convenient model.

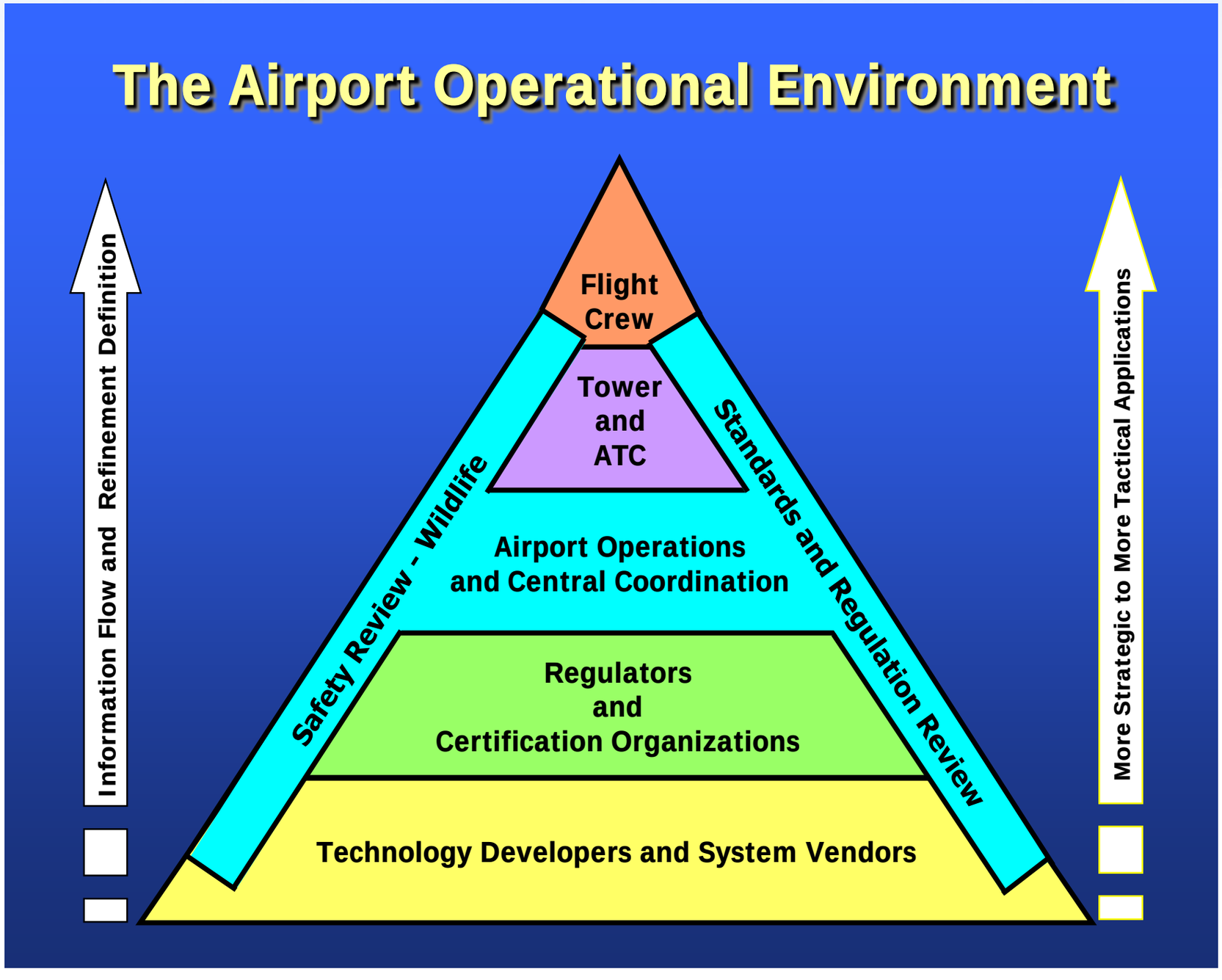
•Each actor plays an important role in bird strike risk mitigation.

•2010 FAA Advisory Circular 150/5220-25 Airport Avian Radar guidance (WHMP supplement) – provides safety layers for wildlife specialists.

•We propose additional safety layers that involve these actors as well as airlines.

•Consistent threat information is needed across the enterprise. Avian radar can provide this.

Model used by FAA CEAT in relation to civil airport avian radar tool development work



The aviation enterprise

Exploit and adapt existing transfer mechanisms to communicate threats to pilots

•Define 3 examples of bird threat situations:

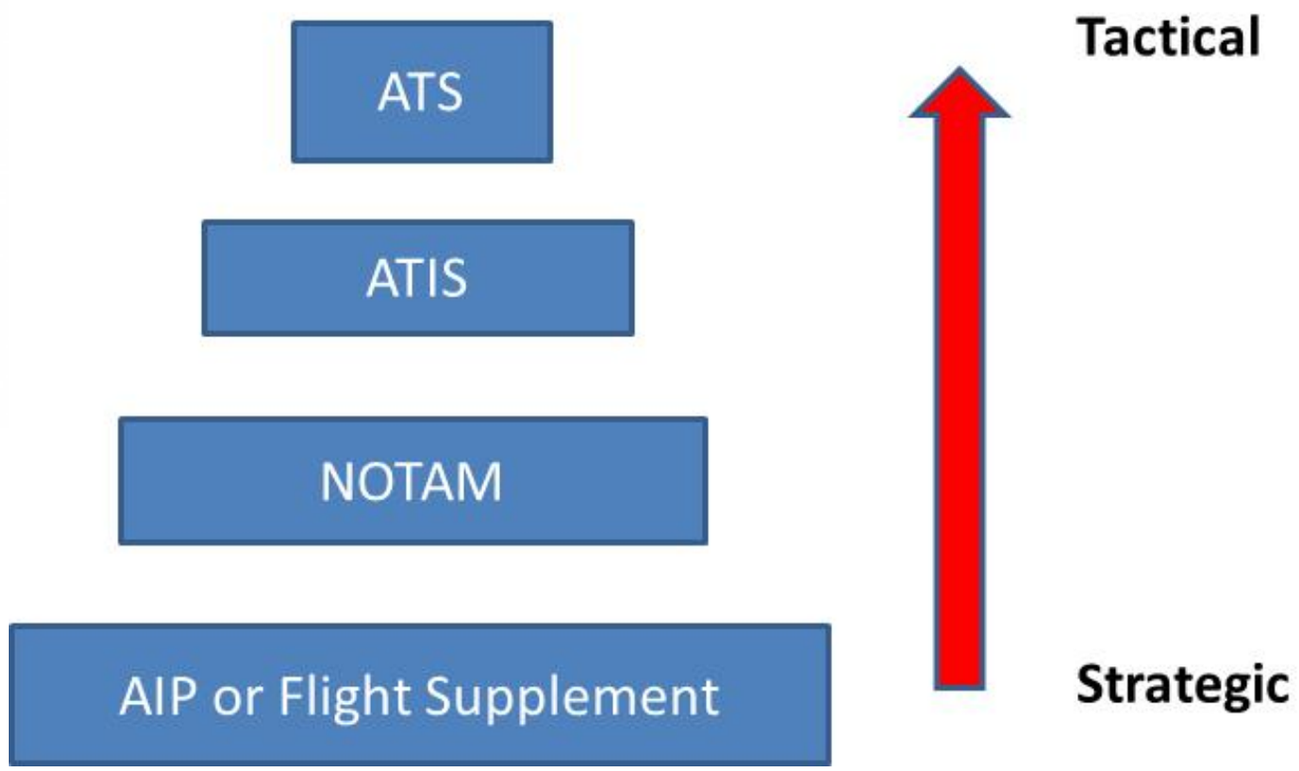
1. **Migration events**
(i.e., seasonal, fall and spring);
2. **Regular recurring events**
(e.g., daily commutes between night-time roosts and daytime foraging and loafing sites); and
3. **Irregular, unanticipated events**
(e.g., starlings invading airfield to feed on sudden increase in grasshoppers).

• Categories 1 and 2 can use strategic mechanisms (AIP and Flight Supplements), as well as tactical (NOTAM, ATIS and ATS).

• Category 3 can use tactical NOTAMs, ATIS messages and ATS communications.

• **We adapt these transfer mechanisms for flight planning (AIP/NOTAMs), as well as near-term tactical (ATIS) and real-time tactical (ATS) bird threat situations**.

Existing aviation industry information transfer mechanisms that convey hazardous environmental conditions to pilots.



Approach to improved management of bird strike risk

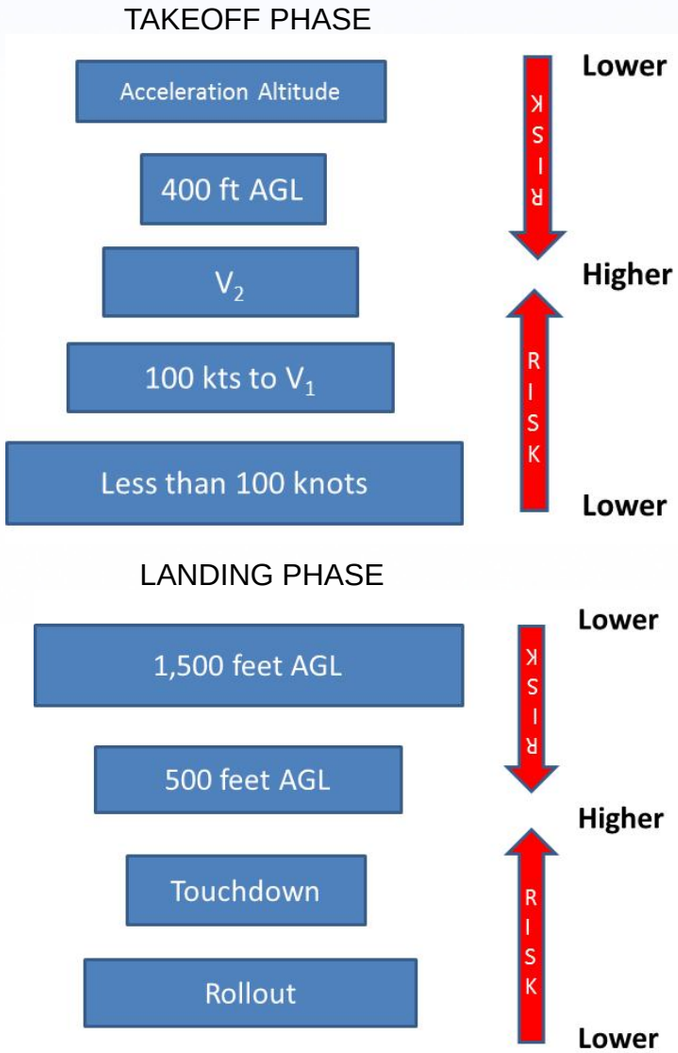
Processes not involving aircraft directly

- Three risk mitigation processes designed to remove bird presence from the aerodrome and aerosphere:
  - Wildlife hazard management plan
  - Habitat management
  - Bird control program
- These require special consideration for off-airport hazards as well as on airport
- These can benefit tremendously from avian-radar-derived threat information

Approach to improved management of bird strike risk

Processes involving aircraft directly

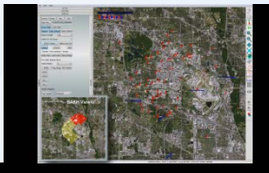
Bird strike reporting -> supports WHMP and understanding of hazardous species
Flight planning -> **recommended departure / arrival flight profiles**
Take-off and initial climb -> **pilot may consider flight profile adjustment balancing other risks**
Approach and landing -> **pilot may consider flight profile adjustment balancing other risks**



TAKEOFF PHASE	POSSIBLE MITIGATIONS	LANDING PHASE	POSSIBLE MITIGATIONS
Ready for takeoff	Delay takeoff	10,000’ down to 1500’ AGL	Profile adjustment (vertical / lateral / runway change) Monitor situation
Less than 100 knots	Reject takeoff	1,500’ down to 500’ AGL	Missed approach Continuing as per AFM
100 knots to V_1	Reject takeoff	500’ AGL down to touchdown	Missed approach Continuing as per AFM
Less than 400’ AGL	Profile adjustment (vertical / lateral)	Touchdown / Rollout	Idle reverse thrust
Greater than 400’ AGL	Profile adjustment (vertical / lateral)		
Acceleration Altitude	Profile adjustment (vertical / lateral)		

Available avian radar information:

3D trajectories with location, speed, heading and size - automatically

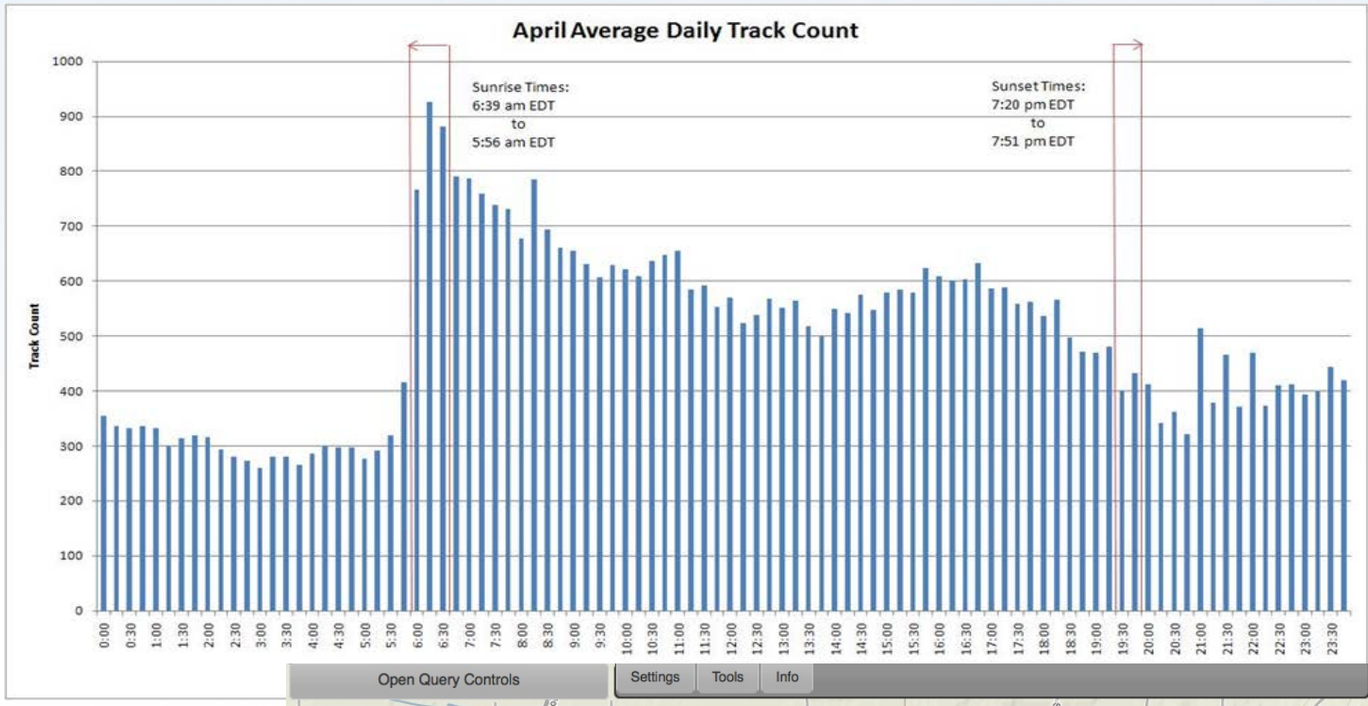


Date	Track ID	Start Time	Duration (s)	Number of Upd...	Start Latitude	Start Longitude	Start Speed (...	Start Heading (...	Start Height (m)	Start RCS (dBs
01/29/10	788	16:44:08.888	280.00	108	39.9222	-104.6814	16.7	340.6	709.4	-5.79
01/29/10	79	16:35:43.125	237.50	93	39.8991	-104.8495	23.8	353.3	1409.4	3.43
01/29/10	296	16:31:40.203	232.50	91	39.9282	-104.8502	35.4	180.4	1532.9	4.03
01/29/10	620	16:33:38.16	225.00	87	39.8794	-104.6218	10.6	56.4	474.3	-9.68
01/29/10	893	16:35:13.00	205.00	78	39.9386	-104.7091	4.3	316.0	908.1	-2.43
01/29/10	636	16:46:55.159	182.50	71	39.9188	-104.7737	8.0	293.4	1014.4	3.87

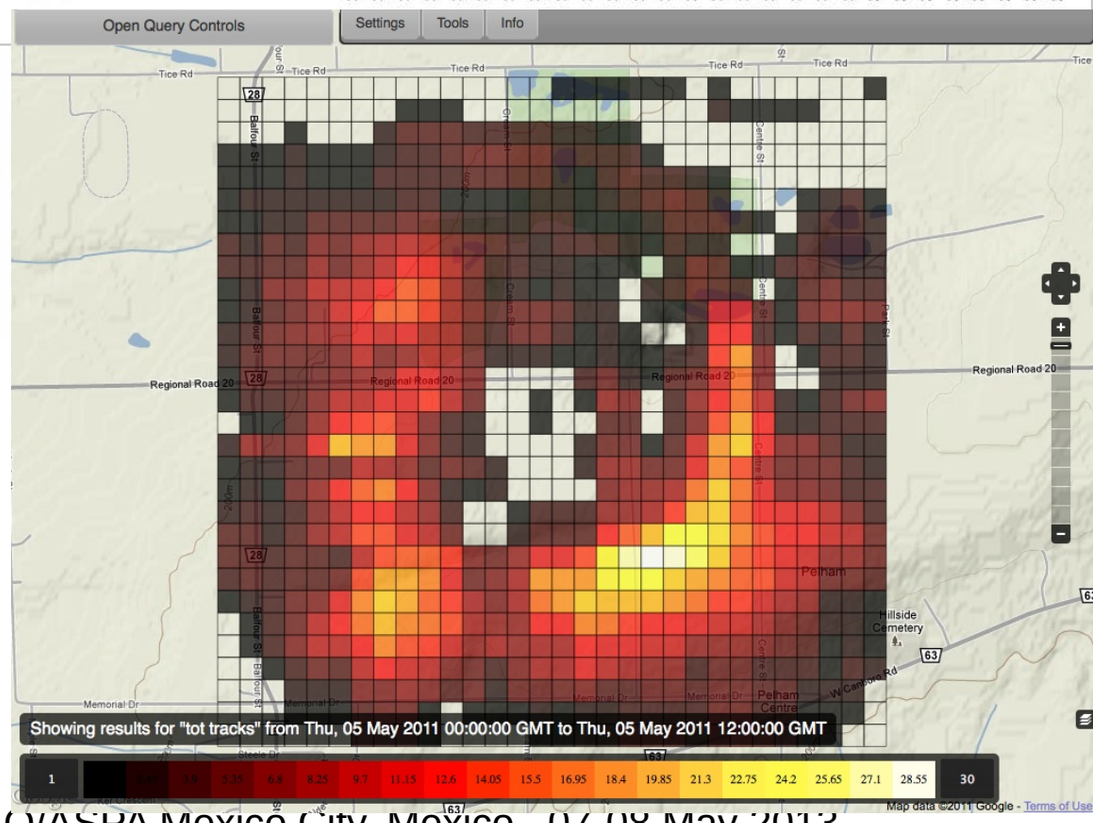
Tools generating tactical and strategic information

- Hazard assessment
  - Abundance distributions …

Temporal Distributions



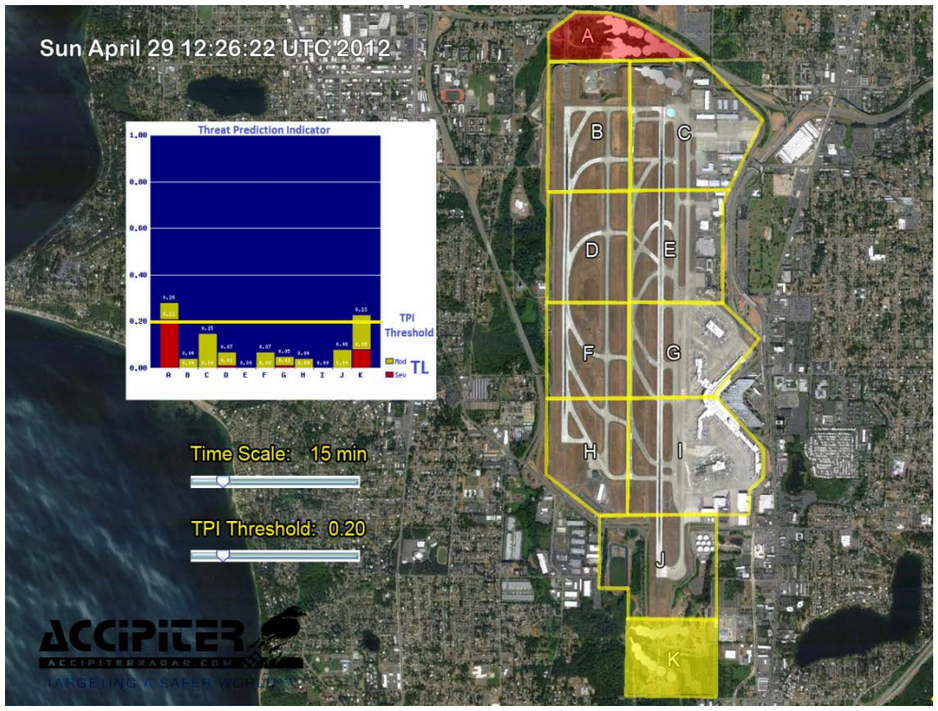
Spatial Distributions



Tools generating tactical and strategic information

- Threat prediction
  - Tactical threat alerts
  - Strategic airport avian threat advisory system

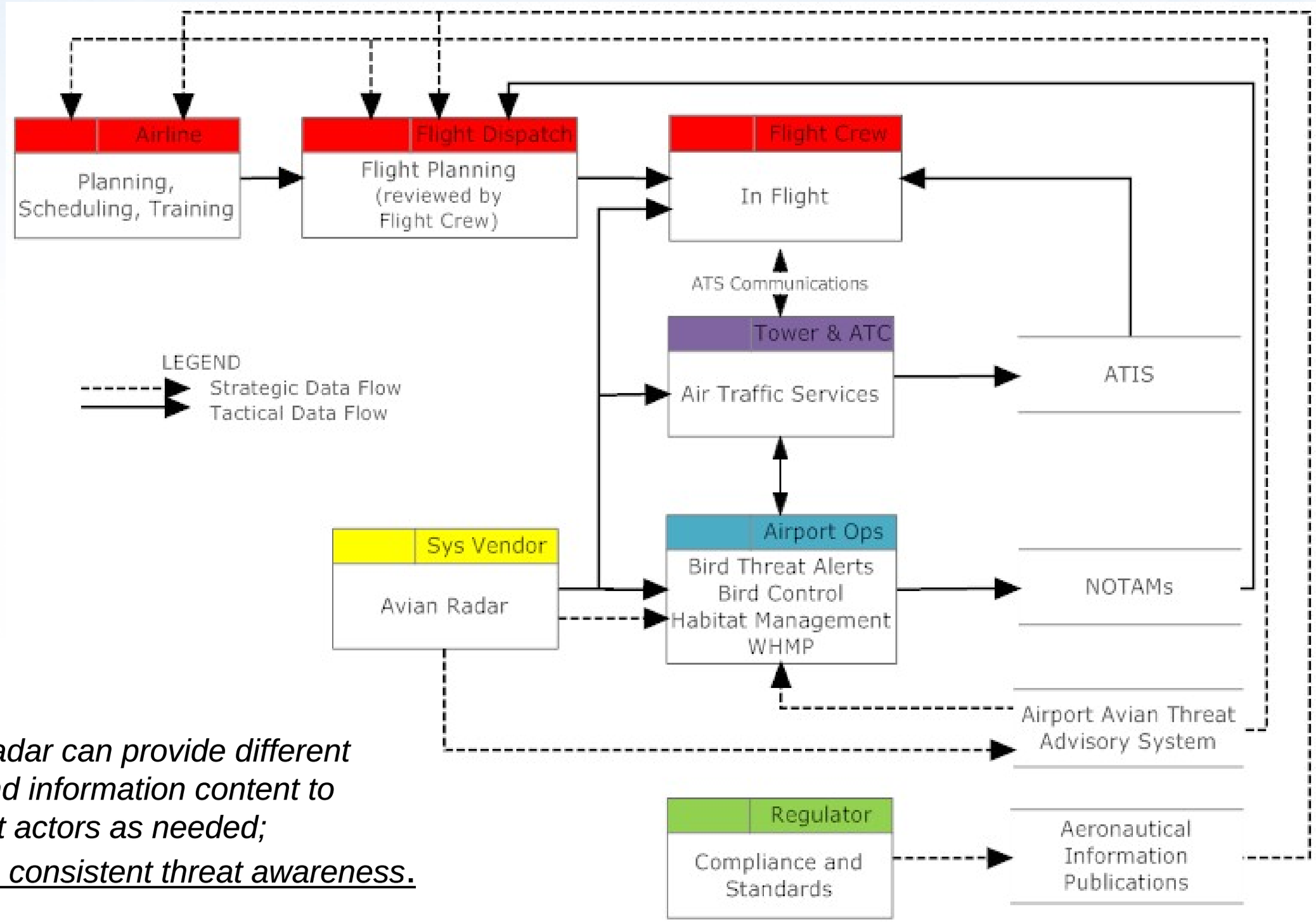
Tactical Threat Alerting System



Strategic Avian Threat Advisory System

Date (dd/mm/yyyy)	Alert Name	Hour (UTC)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		Hour (Local)	16	17	18	19	20	21	22	23	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
26/04/2012	A Severe		0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0	0
27/04/2012	A Severe		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28/04/2012	A Severe		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29/04/2012	A Severe		0	0	0	0	0	0	0	0	0	0	0	0	0.08	0	0	0	0	0	0	0	0	0	0	0
30/04/2012	A Severe		0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0
01/05/2012	A Severe		0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0
02/05/2012	A Severe		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26/04/2012	B Moderate		0	0	0.01	0	0	0	0	0	0	0	0	0	0.04	0	0.01	0	0	0.01	0	0.01	0	0	0.01	0.01
27/04/2012	B Moderate		0.01	0	0.03	0	0.04	0	0	0	0	0.01	0.01	0.01	0.03	0.02	0	0.01	0	0.01	0.01	0.01	0	0	0	0.01

Integration of avian radar into the aviation enterprise



Avian radar can provide different tools and information content to different actors as needed;

<u>but with consistent threat awareness</u>.

Integration of avian radar into the aviation enterprise

Threat alerts to pilots

- Industry must develop and standardize the messaging of bird threats, whether at the strategic or tactical level, whether for departures or arrivals. Consistent language is necessary for flight planning, and for NOTAMs, ATIS messages and ATS communications.

- Parameterizing the threat using a standardized probability and severity scale allows risk and standard operating procedures to be developed and applied for different aircraft.

Bird Hazard Information Report: sample data elements

SOURCE *Radar*	{FORECAST, RADAR, VISUAL}
THREAT TYPE *Migration*	{MIGRATION, SOARING, FLOCKING, ...}
ISSUED AT TIME 19 Aug 12, *1900*	{defines the date/time the report was made}
EXPECTED COMMENCEMENT 21 Aug 12, 1800	{DATE/TIME of threat}
EXPECTED DURATION 90 days	{TIME HOURS or DAYS}
PROBABILITY *high*	{low, medium, high}
SEVERITY *medium*	{low, medium, high}
REF-POINT *16R threshold*	{2D based on geographic reference point}
BEARING 67 *deg*	{degrees relative to REF-POINT}
DISTANCE 4 mi	{miles from REF-POINT}
ALTITUDE 1000 to 2000 feet	{feet min to max AGL}
HEADING *SE*	{N, NE, E, SE, S, SW, W, NW – direction birds are heading}
SPEED 20 knots	{GROUND SPEED of birds in knots}

Integration of avian radar into the aviation enterprise

Hypothetical example for regular recurring event at YYZ Pearson International

AIP / CFS

MANY SPECIES OF BIRDS EXHIBIT REGULAR, DAILY COMMUTES BETWEEN THEIR NIGHT-TIME ROOSTS AND DAYTIME FORAGING AND LOAFING SITES. GULLS, WATERFOWL, AND AQUATIC BIRDS SPEND THE NIGHTS ON LAKE ONTARIO AND MOVE ONTO SHORE SHORTLY AFTER DAWN. THESE FLIGHTS ARE TO PARKS, GOLF COURSES, AGRICULTURAL FIELDS, WASTE FACILITIES, AND PARKING LOTS AROUND YYZ. RETURN FLIGHTS TO THE LAKE TAKE PLACE ABOUT AN HOUR BEFORE SUNSET. THIS ACTIVITY IS HEAVIEST FROM LATE SUMMER THROUGH AUTUMN WHEN NEW JUVENILE BIRDS AND MIGRANTS AUGMENT LOCAL POPULATIONS. ALTITUDES ARE GENERALLY LESS THAN 1000’ AGL AND HAZARDOUS MOVEMENTS ARE ADVERTISED BY CLASS I NOTAM, ATIS MESSAGE AND ATS COMMUNICATION WHERE AVAILABLE.

NOTAM

120002 NOTAM CYYZ TORONTO INTERNATIONAL
CYYZ INCREASED LOCAL BIRD ACTIVITY FROM LAKE ONTARIO SHORE TO CENTENNIAL PARK GOLF COURSE (3NM SE THRESHOLD RWY 33R) ALTITUDES LESS THAN 500’ AGL
1207010000 TIL 1207312359

ATIS – I HR BEFORE DAWN

HAZARDOUS FLOCKING GULL ACTIVITY EXPECTED FROM LAKE ONTARIO TO CENTENNIAL PARK GOLF COURSE (2NM BRG 135 DEGREES FROM RWY 33R THRESHOLD) ALTITUDES LESS THAN 500’ MOVING NW AT 20 KTS

ATIS – I HR BEFORE SUNSET

HAZARDOUS FLOCKING GULL ACTIVITY EXPECTED FROM CENTENNIAL PARK GOLF COURSE (2NM BRG 135 DEGREES FROM RWY 33R THRESHOLD) TO LAKE ONTARIO ALTITUDES LESS THAN 500’ MOVING SE AT 20 KTS

ATS – REAL-TIME

BIRD HAZARD ADVISORY
RADAR OBSERVES FLOCKING GULL HAZARD THREAT LEVEL 2, SEVERITY 2 BEARING 135 DEGREES FROM RWY 33R THRESHOLD 2NM. FLOCK HEADING SE AT 20 KTS. MAX ALTITUDE OBSERVED 500’ AGL.

Example: Pilot alters flight profile at JFK

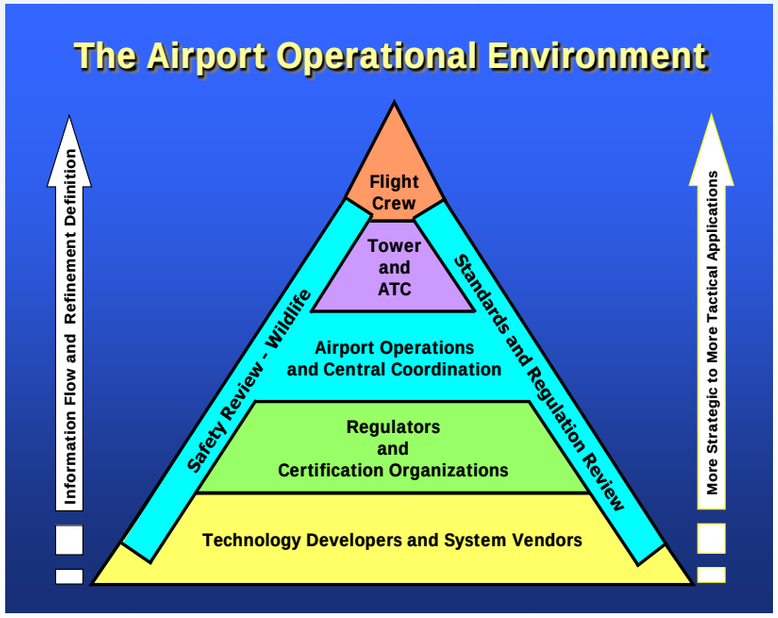
Response to ATIS to reduce exposure to broad scale geese migration after sunset

Summary & next steps

- Summary:
  - We have proposed new bird-strike risk mitigation layers that involve pilots, air traffic controllers, airlines, airport operations, avian-radar developers, and regulators.
  - These layers use existing aviation information transfer mechanisms and respect industry culture and constraints
  - We have shown how avian radar can integrate with the aviation enterprise to provide consistent hazard assessment and threat prediction tools and information to support improved bird-strike risk management and the proposed safety layers.
- Next steps:
  - Our desire is to receive constructive comments to improve the ideas presented in the paper making it a better, more tangible starting point
  - To engage the broader aviation community to establish an appropriate working group or committee to pick up this effort and move it forward for the benefit of improved aviation safety
  - http://www.accipiterradar.com/file/490

CURRENT ROLE OF AVIAN RADAR IN BIRD STRIKE MITIGATION

- Recall CONOPS at start of presentation →
- Current focus is on wildlife management
  - Avian radar is a force-multiplier
    - Continuous – 24/7/365
    - Detects 50X more birds than visual
      - Farther, higher, 3D, nighttime, etc.
      - On- and off-airport
      - Radar cannot identify species of birds or birds in vegetation
  - Real time and historical data
    - Tactical vs. strategic



A GOOD RETURN ON INVESTMENT FOR AVIATION

- Safety Management Systems (SMS) – due diligence for executives; save on litigation, improve safety
- Airlines save with fewer bird strikes
- Save on unnecessary habitat modifications
- More effective wildlife hazard assessments
- Monitor effectiveness of habitat management
- Automatic warning of developing hazards
- Use wildlife personnel resources more effectively (force multiplier)
- Provide information for use with off-site property owners and other stakeholders
- A tool to monitor, manage, alert and investigate
- Improve public relations