

Reduction of Risk: A Flight Crew Guide

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2006 Joint Meeting

Birdstrike Committee USA/Canada

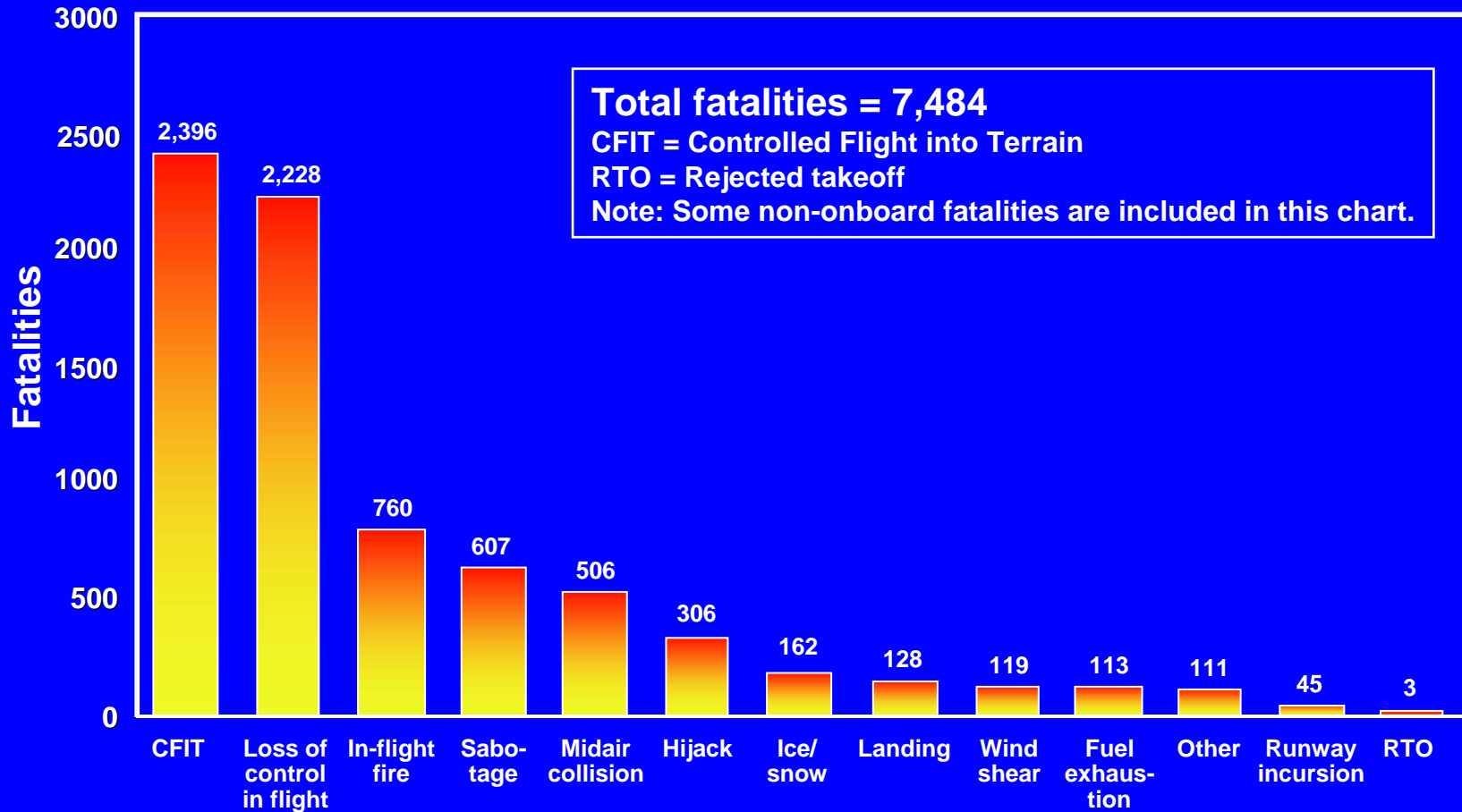
St. Louis, MO.

August 22, 2006

Costs of Wildlife Strikes

- US\$1-2 billion/year worldwide (similar to lost luggage cost)
- Over 190 people killed by collisions between their aircraft and wildlife since 1988

Types of Aircraft Accidents



The problem that safety officers face when trying to convince airlines that birds are a real and constant threat to aviation, a threat and hazard that can result in expensive repair cost to airframes and engines is, when reviewing the top ten reasons for recent aircraft accidents, bird strikes do not figure, so it appears to be a weak or inconclusive argument –

Steve Hull

British Airways

Past Accident Improvements

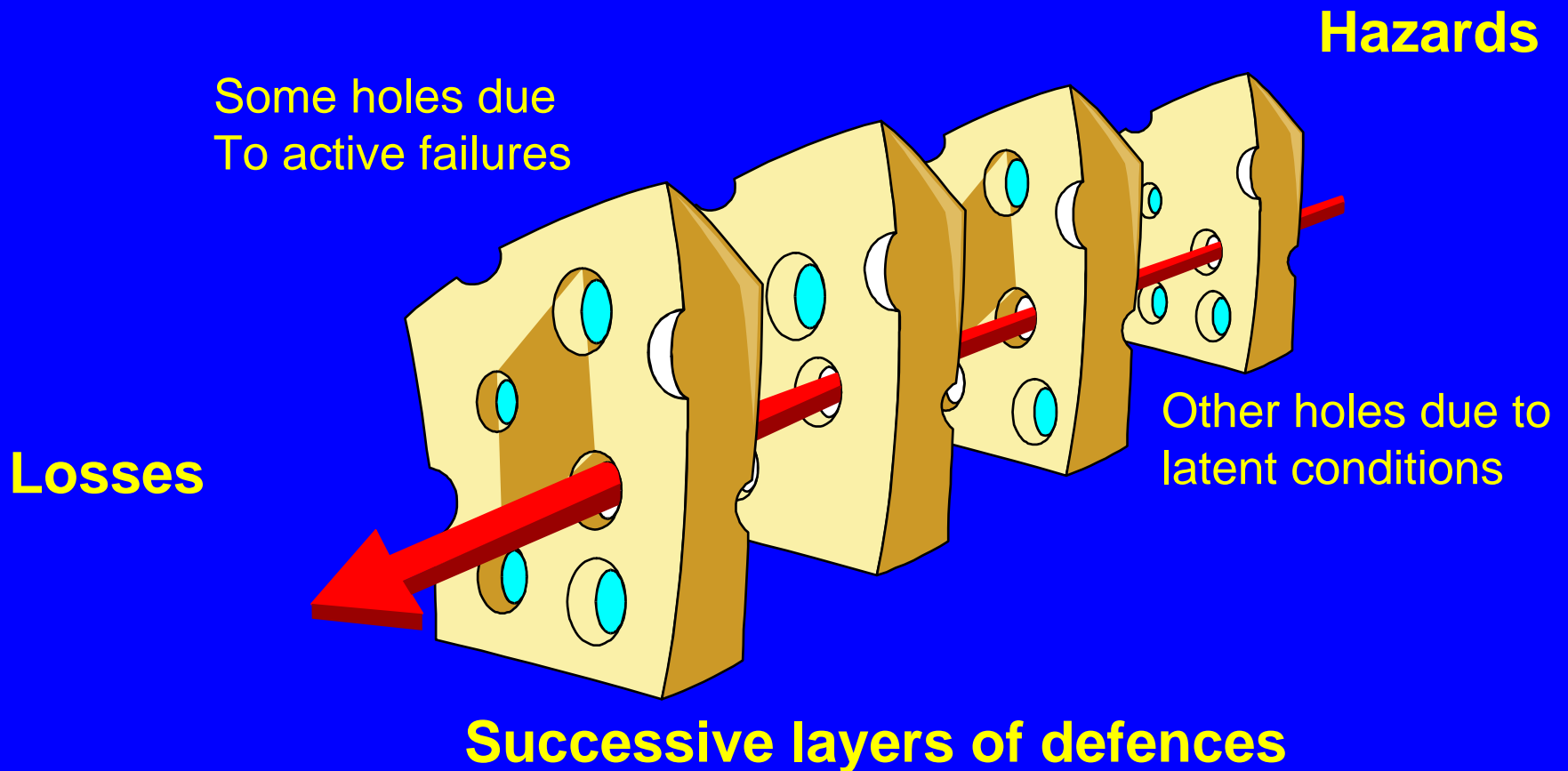


Future Accident Reduction

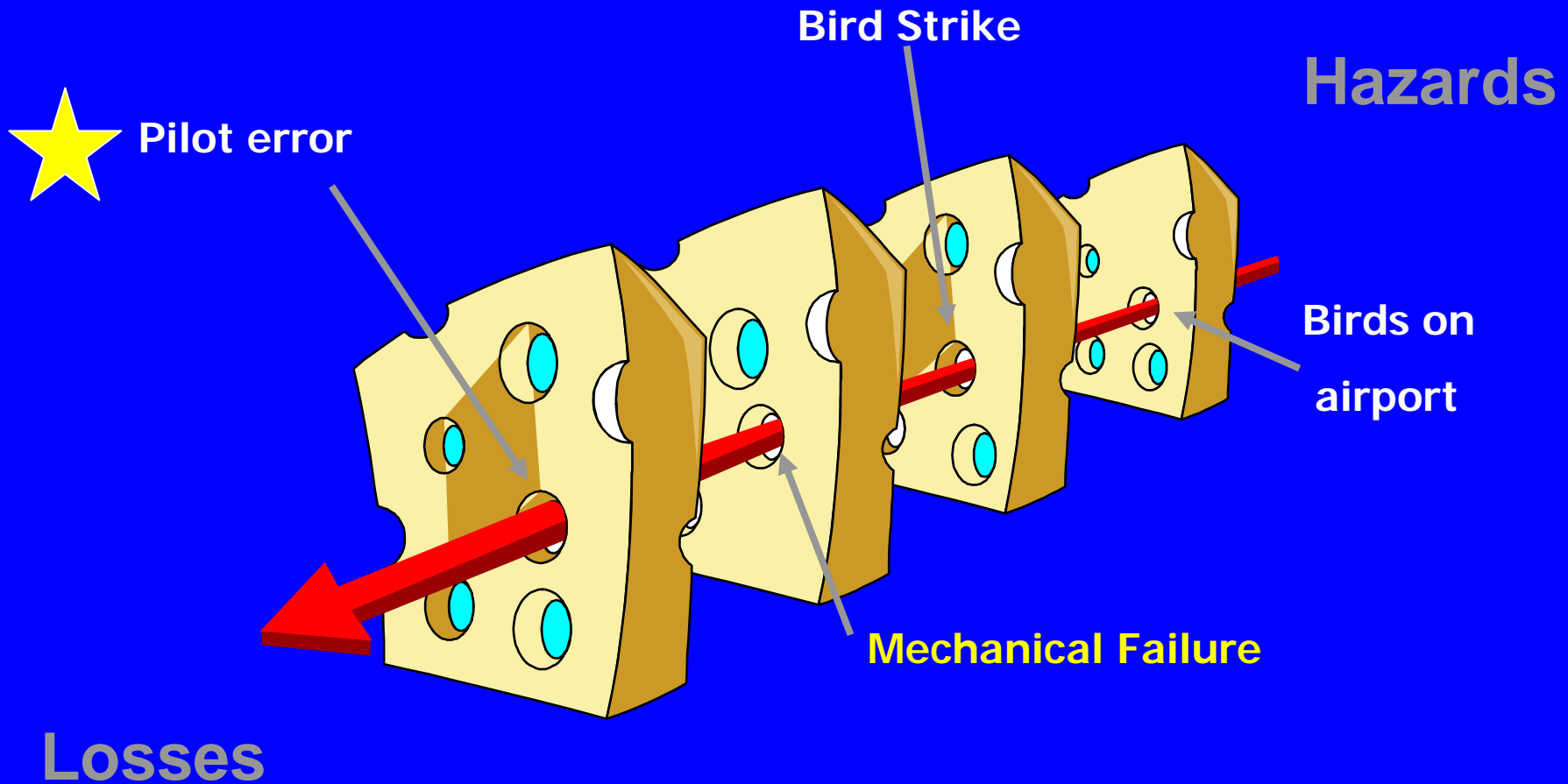
- In the future we must be **proactive**
- Must use **risk management** techniques to greater extent
- Identify and eliminate adverse trends
- Stop accidents before they happen

The 'Swiss cheese' model of organisational accidents

Dr. James Reason

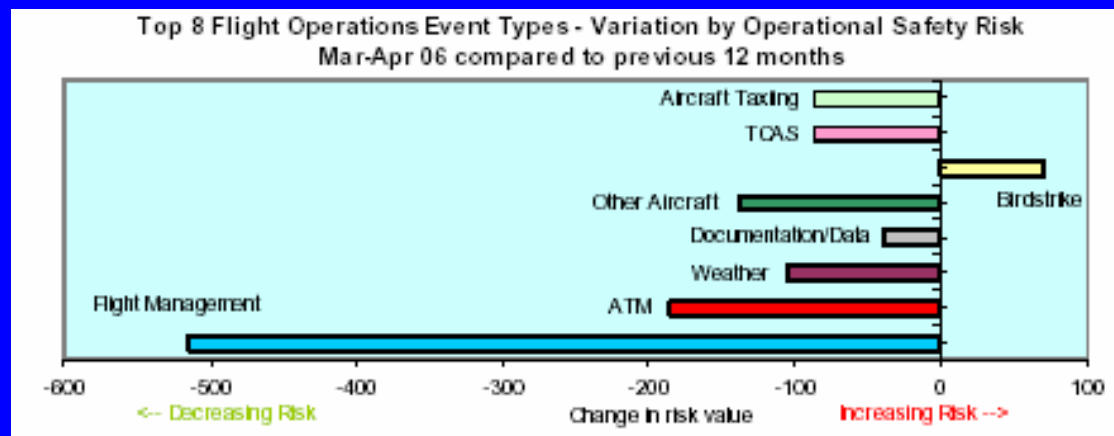
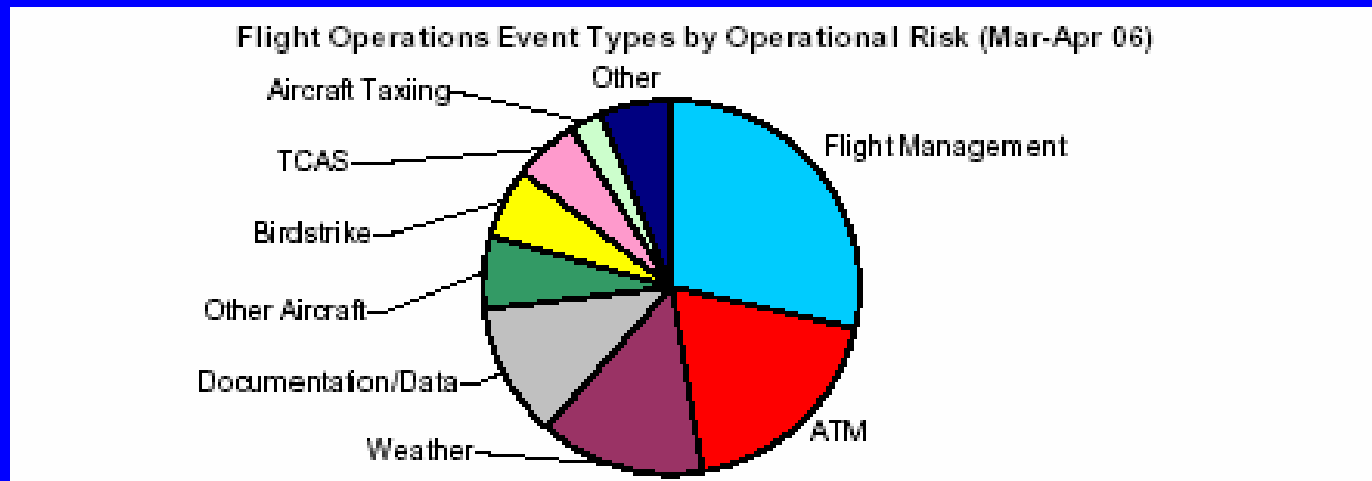


The 'Swiss cheese' model of an accident (Crash of SA 227 in Scotland 2002)



British Airways – Operational Risk

March-April 06



Hypothetical Bird Strike

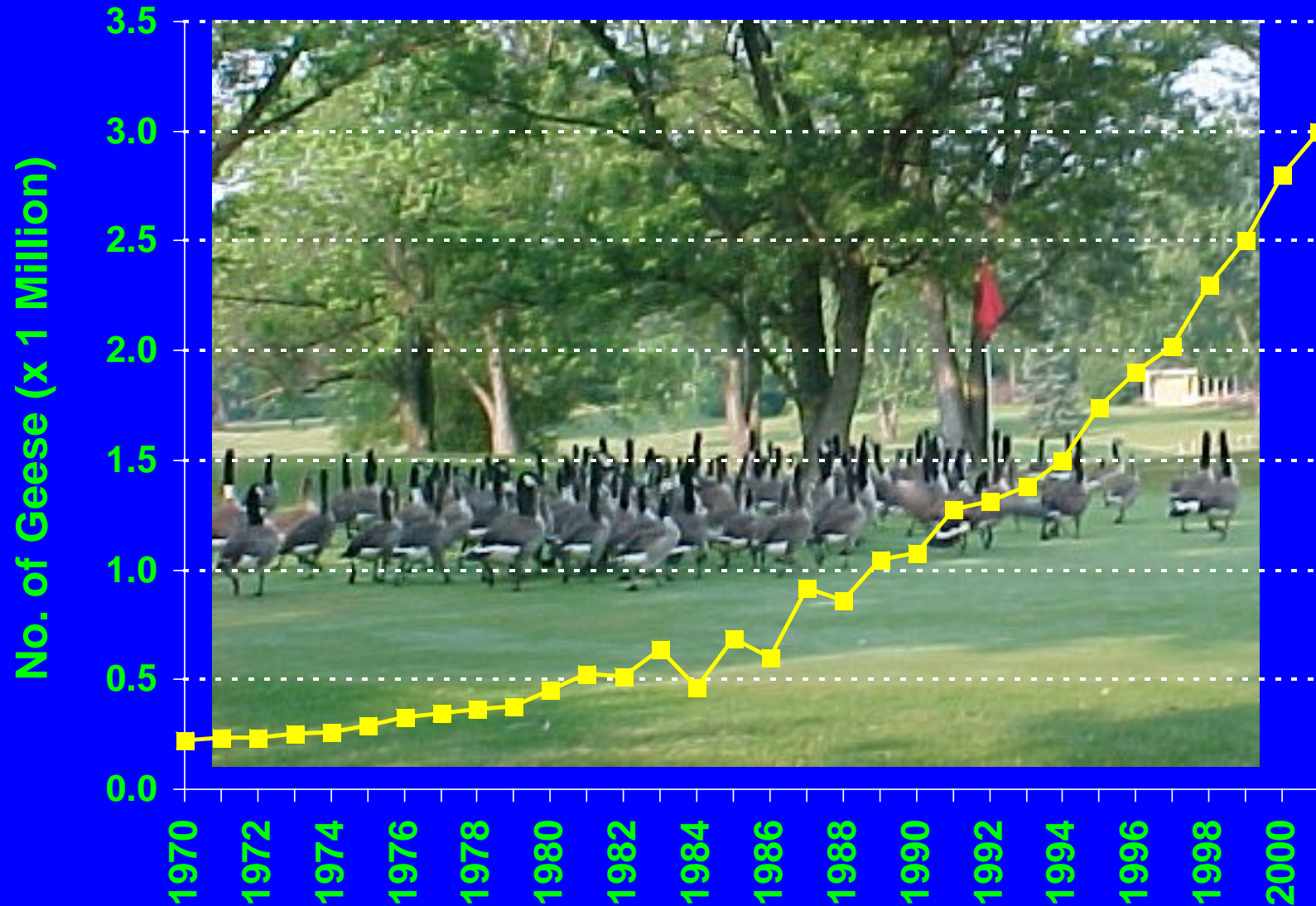


Risk Management - Severity high but probability can be mitigated

What's Needed?

- EDUCATION!
- CHANGE!
- Change in POLICY and/or REGULATION

RESIDENT (NON-MIGRATORY) CANADA GEESE IN NORTH AMERICA



Budgey-CSL-studies

A black and white photograph of a massive flock of birds, likely Canada geese, flying in a dense, coordinated pattern over a city skyline. The birds are in various stages of flight, with wings spread, creating a complex, overlapping pattern against the sky. The city buildings are visible in the background, partially obscured by the birds.

- Three dimensional flock structure - 100" engine:
- Canada geese - 3
- Mixed gulls - 4
- Starlings - 9



B-747 engine-vulture ingestion-Nairobi

NEW engine standards are being implemented by JAA/FAA-but only for NEW engines



B-767 gull ingestion-Tel Aviv



MD-11 gull ingestion-Portland,Ore.

The 36 Bird Species in N. America with Mean Body Masses >4 lbs



(Species ranked
1-14, mean body
mass >8 lbs)

Rank	Species	Mass (lbs)
1	Mute swan	26.01
2	Trumpeter swan	25.13
3	California condor	22.28
4	Wild turkey	16.31
5	Tundra swan	15.65
6	American white pelican	15.43
7	Whooping crane	12.84
8	Sandhill crane	12.78
9	Yellow-billed loon	12.13
10	Bald eagle	11.79
11	Golden eagle	10.83
12	Canada goose	9.22
13	Common loon	9.11
14	Brown pelican	8.16

Composite rotating blades

DH-8 composite props vs. Canada geese during landing at Toronto – both engines severely damaged



Aircraft Structures

- Design criteria is impact with *one* four pound bird at V_c
- Windshields are designed only to resist *one* four pound bird at V_c and not fail or spald
- Empennage is designed for *one* eight pound bird impact at V_c



**B-737 windshield destroyed by
goose impact over New York –
window spalled on impact
showering cockpit with glass**

B-767 encounter with flock of northern shovelers (17 hits including penetrations through wings, fuselage and radome) while climbing through 12,000 feet after departure from Paris to Miami, April 2001



Airport Birds

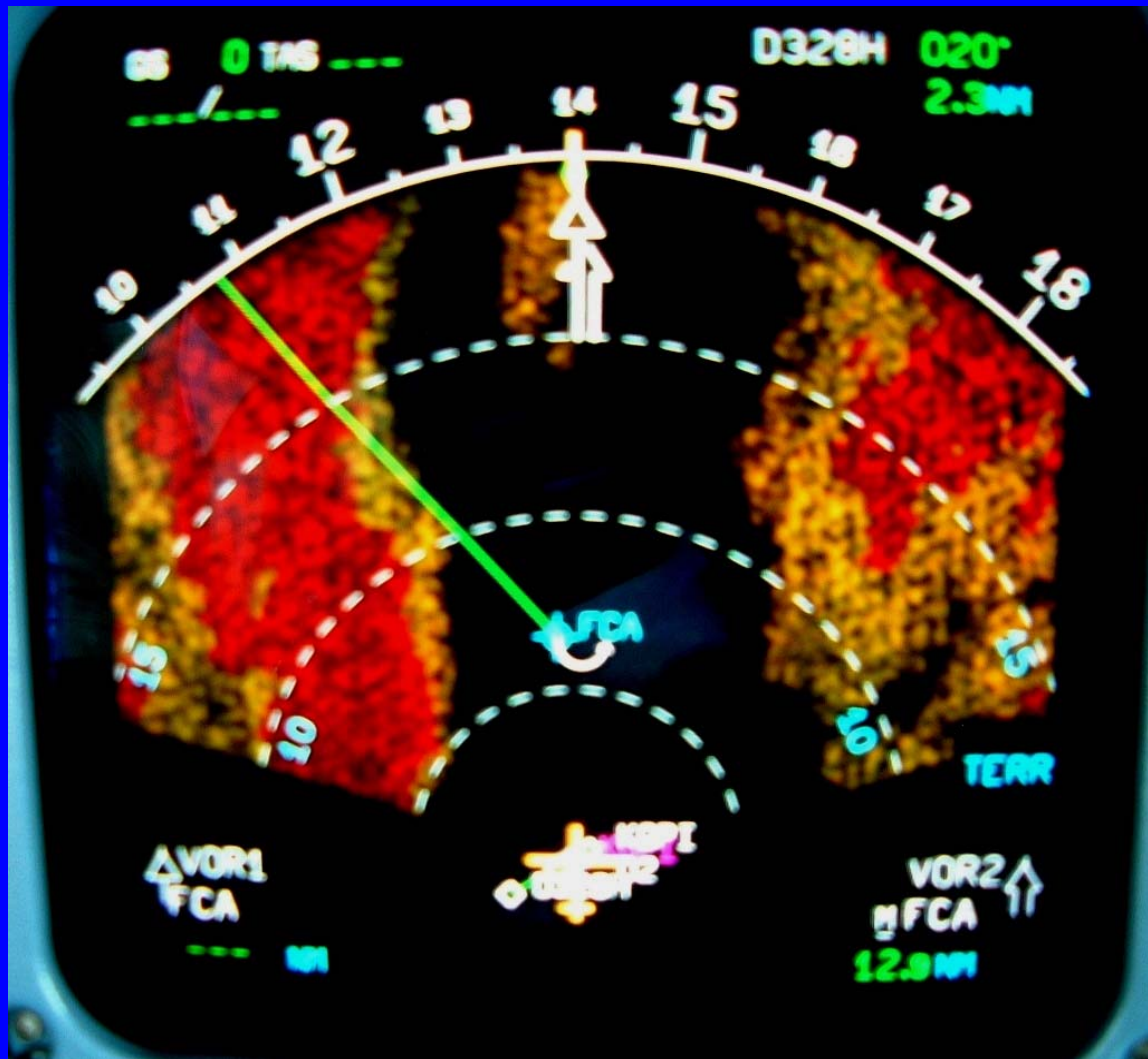
- Resident
- Non-Resident
- Fledgling
- How do we know?

Wildlife Hazards

- Part 139.337
REQUIRES Airport Operators to mitigate wildlife hazards
- ICAO SARPs updated to a *STANDARD* for wildlife mitigation



Is there a technical solution?



TCAS or Weather avoidance?



What doesn't work: Pilot Folklore

- Aircraft radar
- Jet engine noise
- Aircraft lights

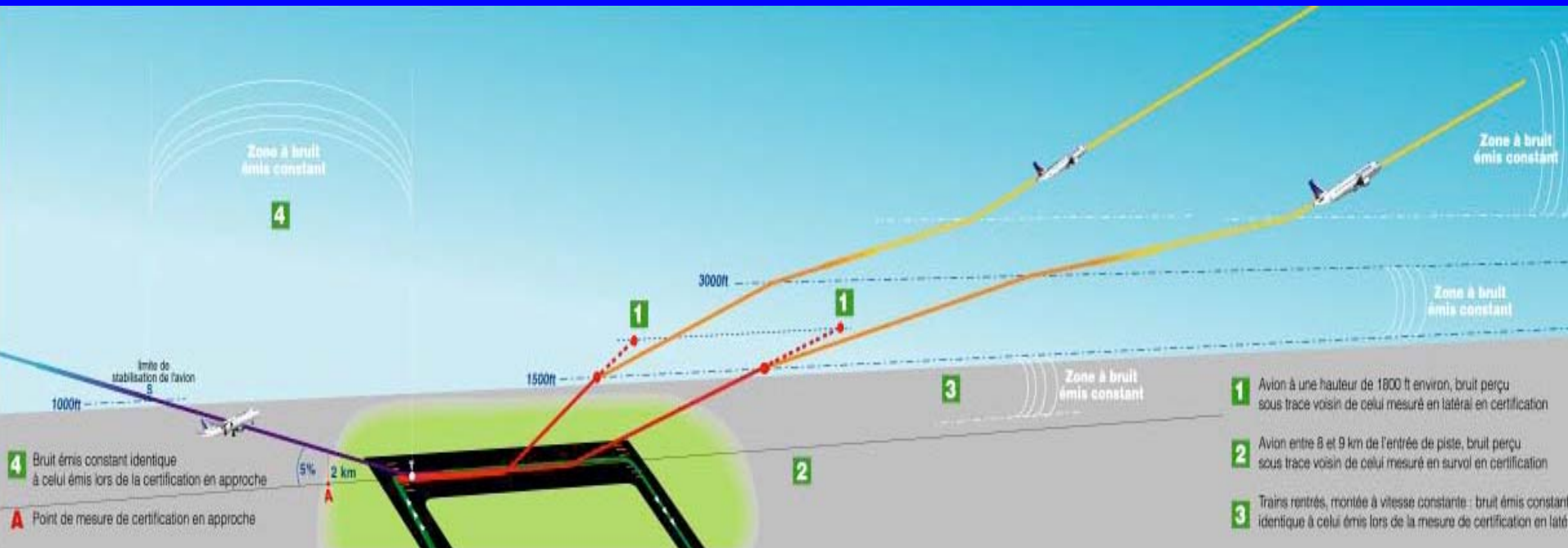
What does work?

- SIMPLE
- EFFECTIVE
- CHEAP

Don't takeoff/land!

- Same technique for other aviation hazards: windshear, poor braking, conflicting traffic, deicing, etc.
- Is safety first?

ICAO Noise Abatement Profile 'A' (VNAP 'A')



SLOW DOWN!

- $KE = [1/2 \text{ mass}] \times \text{velocity (squared)}$, e.g., *31% more energy transfer with the same bird at 300 kias vs. 250 kias*
- *Same applies to engines*



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Learjet vs. deer - Alabama


Dallas Cowboys Football
Club Learjet



Enroute – PULL UP!

- Birds will attempt to avoid the aircraft – if seen
- Birds may turn, dive but *do not climb*
- *Pull up* to pass over the threat

Report Hazards

 BIRD/OTHER WILDLIFE STRIKE REPORT			
<small>U.S. Department of Transportation Federal Aviation Administration</small>			
1. Name of Operator	2. Aircraft make/model	3. Engine make/model	
4. Aircraft Registration	5. Date of Incident Month _____ Day _____ Year _____	6. Local time of incident <input type="checkbox"/> Dawn <input type="checkbox"/> Dusk _____ HR _____ AM <input type="checkbox"/> Day <input type="checkbox"/> Night <input type="checkbox"/> AM <input type="checkbox"/> PM	
7. Airport Name	8. Runway Used	9. Location of Str. Route (Chart, Coordinates & Desc)	
10. Height (AGL)	11. Speed (Kt)		
12. Phase of Flight <input type="checkbox"/> A. Takeoff <input type="checkbox"/> B. Climb <input type="checkbox"/> C. Cruise <input type="checkbox"/> D. Descent <input type="checkbox"/> E. Approach <input type="checkbox"/> F. Landing Roll	13. Part(s) of Aircraft Struck or Damaged		
	A. Airframe	<input type="checkbox"/> Struck <input type="checkbox"/> Damaged	H. Propeller
	B. Windshield	<input type="checkbox"/> <input type="checkbox"/>	I. Wing/Rotor
	C. Nose	<input type="checkbox"/> <input type="checkbox"/>	J. Fuselage
	D. Engine No. 1	<input type="checkbox"/> <input type="checkbox"/>	K. Landing Gear
	E. Engine No. 2	<input type="checkbox"/> <input type="checkbox"/>	L. Tail
	F. Engine No. 3	<input type="checkbox"/> <input type="checkbox"/>	M. Light
	G. Engine No. 4	<input type="checkbox"/> <input type="checkbox"/>	N. Other: <input type="checkbox"/>
	<small>(Specify if "N. Other" is checked)</small>		
14. Effect on Flight <input type="checkbox"/> None <input type="checkbox"/> Aborted Take-Off <input type="checkbox"/> Precautionary Landing <input type="checkbox"/> Engines Shut Down <input type="checkbox"/> Other (Specify)	15. Sky Condition <input type="checkbox"/> No Cloud <input type="checkbox"/> Some Cloud <input type="checkbox"/> Overcast	16. Precipitation <input type="checkbox"/> Fog <input type="checkbox"/> Rain <input type="checkbox"/> Snow <input type="checkbox"/> None	
17. Bird/Other Wildlife Species	18. Number of birds seen and/or struck		19. Size of Bird(s)
	Number of Birds	Seen	Struck
	1	<input type="checkbox"/>	<input type="checkbox"/>
	2-10	<input type="checkbox"/>	<input type="checkbox"/>
	11-100	<input type="checkbox"/>	<input type="checkbox"/>
	more than 100	<input type="checkbox"/>	<input type="checkbox"/>
20. Pilot Warned of Birds <input type="checkbox"/> Yes <input type="checkbox"/> No			
21. Remarks (Describe damage, injury and other pertinent information)			
DAMAGE / COST INFORMATION			
22. Aircraft time out of service: _____ hours	23. Estimated cost of repairs or replacement: \$ _____	24. Estimated other cost: \$ _____ <small>(i.e., loss of revenue, lost assets)</small>	
Reported by (Printed)	Title	Date	
<small> Paperwork Reduction Act Statement: The information collected on this form is necessary to allow the Federal Aviation Administration to assess the magnitude and severity of the wildlife-aircraft strike problem in the U.S. The information is used in determining the best management practices for reducing the hazard to aviation safety caused by wildlife-aircraft strikes. We estimate that it will take approximately 5 minutes to complete this form. If you wish to make any comments concerning the accuracy of this burden estimate and any suggestions for reducing this burden, send those comments to the Federal Aviation Administration, Management Staff, 600 15th Street, NW, Washington, DC 20561. The information collected is voluntary. Please note that an agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid OMB control number. The OMB control number assigned to this collection is 3120-0046. </small>			

Summary

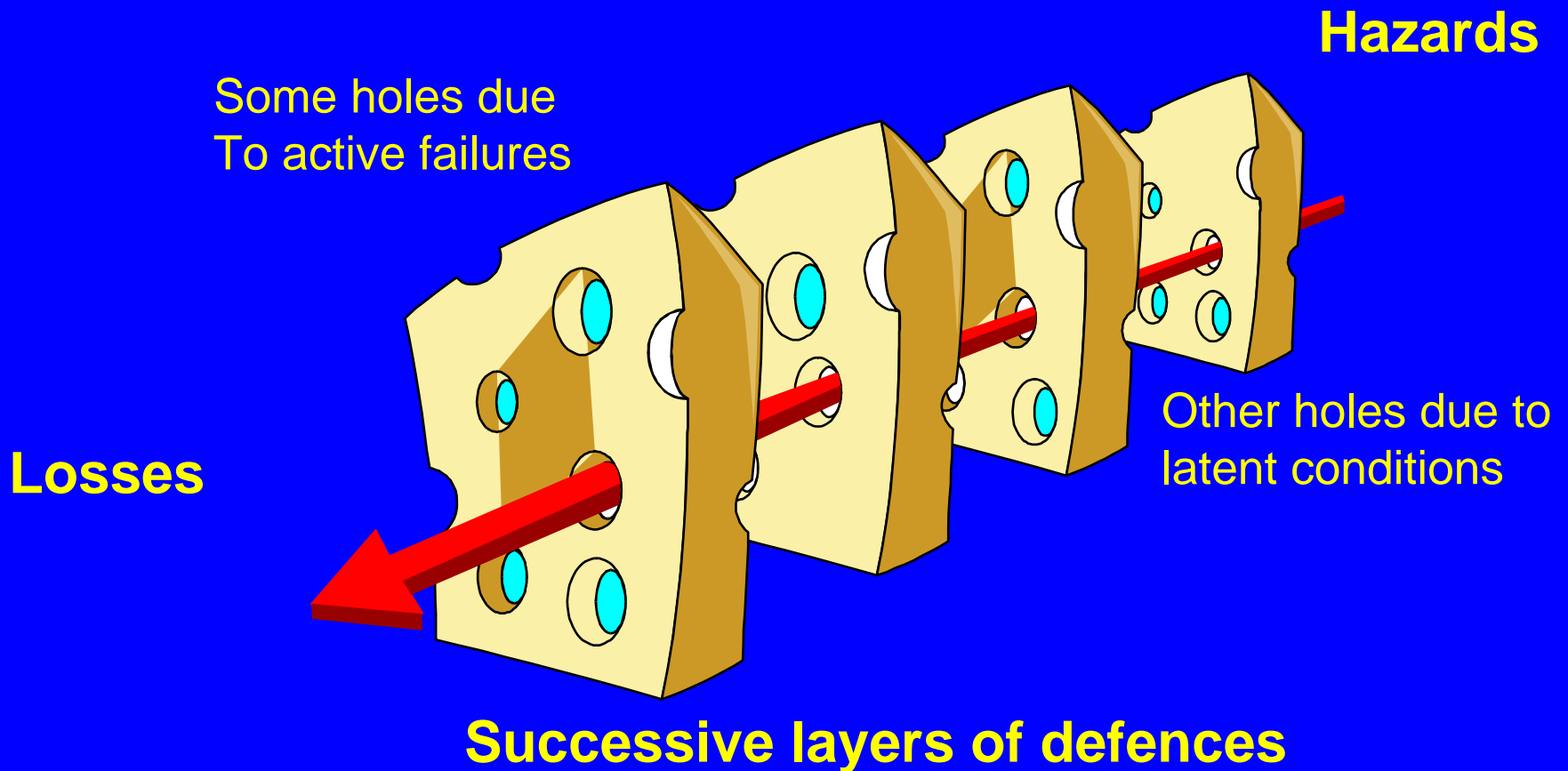
- Don't takeoff/land
- Pull up – enroute
- Climb above 3,000'
- No tolerance of large animals
- Slow down
- Report Hazards

Times change, Aviation Adapts

- Average strike cost = US \$244,000
- Pilots have a duty – but need the tools!
- Aviation safety is defense in depth

The 'Swiss cheese' model of organisational accidents

Dr. James Reason



Acknowledgements

- Bruce Mackinnon – Transport Canada
- Flight Safety Foundation
- Capt. Mack Moore - UAL, ret.
- USDA, FAA, TC

Questions?

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