



In a flap about bird strike

Australian bird strike reported to the ATSB
2002 to 2006



Australian Government

Australian Transport Safety Bureau

Thanks

- Interested Parties for constructive comments during draft
- Paul Halliday from the Bureau of Transport, Infrastructure and Regional Economics
- Leo Josephs CSIRO Division of Sustainable Ecosystems
- Aerodrome operators who responded to queries



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Take home

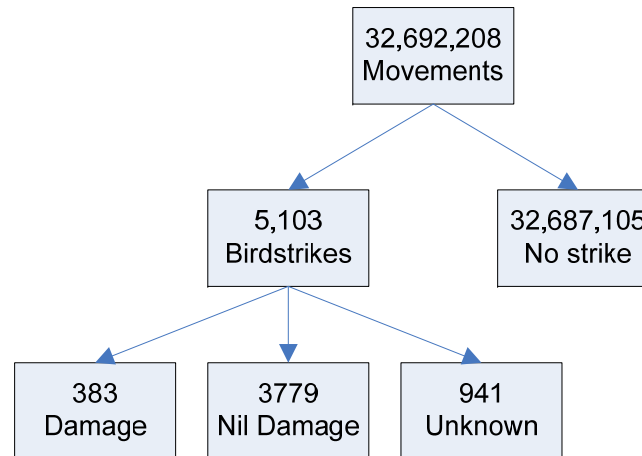
- Birdstrike rate has increased, reasons for the increase vary
- Injury some, death nil, damage still
- Rates of birdstrike at aerodromes differ, indicators of performance only
- Dual engine ingestion infrequent but real, consequences potentially surreal
- Strikes seasonal, species somewhat regional



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Summary



Assumptions

- measurable
- limits to incident data
 - initial incident data (incomplete)
 - real risk changes with big events
- association not necessarily causation
- frequency and consequence
- focus events with greatest potential damage
- breadth to see trends

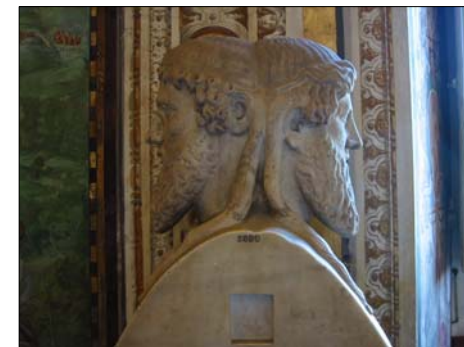


Photo from Wikipedia, 2008



Terms

- stratify
- association
- cross-sectional study
- bias
- confounding



Stage

- report driver AAWHG
- scope
 - annual report
 - species hazard ranking
 - temporal factors
 - inventory of all control measures
 - list all aerodromes with strike



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Process

- previous ATSB reports
- investigations
 - one final investigation report (2002 to 2006)
 - 767 Melbourne 2006 engine throttled back continued flight
- literature
- potential damage and public safety
- basic sense
- consultations



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Consult

- CSIRO
- AAHWG including CASA representative
- ATSB investigators (tech analysis)
- some airport operators
- BITRE
- Some airlines



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Beginning themes


- concern
- groups
 - ornithologist vs. pragmatists
- international vs. national scene



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Topic

- two-pronged problem
 - separate birds and aircraft
 - manufacture aircraft to withstand bird strike
- various players 
- control over all players difficult
- best way to assess harm
 - people
 - operations
 - equipment
 - processes



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Structure

- Central Science Lab UK by aerodrome
- BASI 1996 birdstrike report by damage
- US Dolbeer reports
- BHIU Annual Reports
- Serious potential consequence



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Script

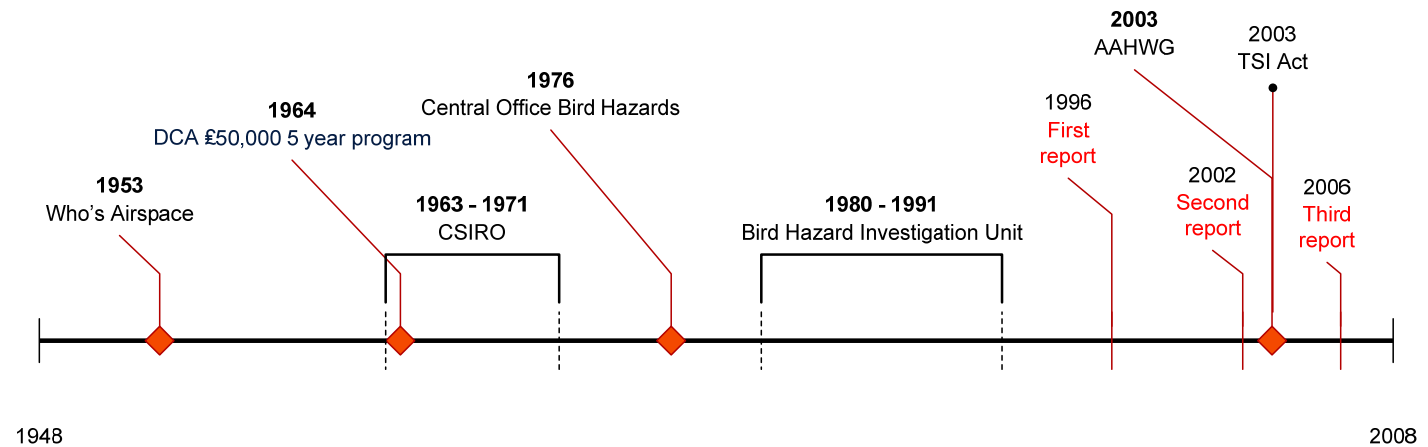
- big picture for Australia
- temporal factors
- damage
- location
 - major, GAAP, regional
 - at or near aerodrome and aerodrome alone
 - damage
 - species
- not performed
 - species hazard ranking
 - risk assessment models
- not a review control measure effectiveness



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History



History

- 1977 van Tets aerodrome hazards
- 1980 to 1985 BHIU Annual Reports
- 1996 Birdstrike Report (BASI)
- 2002 Hazards posed to aircraft (ATSB)
- 2006 Forensic identification (DNA)





Methods

- Population
 - all accidents and incidents reported to the ATSB between 2002 and 2006
- Sample
 - bird or bat strikes in Australia
- Exclusions
 - possible strikes
 - near hit or dangerous occurrence
- Filter mechanisms
 - Combine word text analysis with coding to filter occurrences

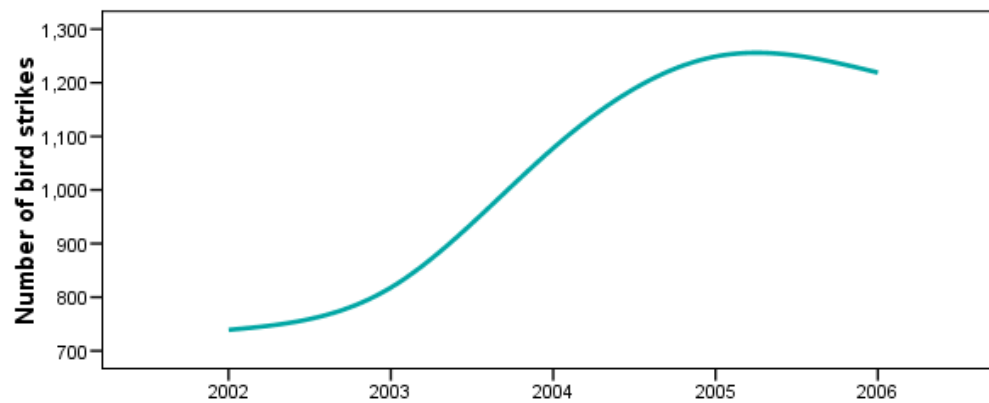
Definition

- Aircraft damage
 - is where an aircraft sustains either a scratch, crack, dent, bent, broken or non-functioning component or system
 - where a responsible person states it was damaged, even in the absence of a description of the part damaged, or damage severity
- Aerodrome and near aerodrome
 - wanted to use height and distance (too many missing variables)
 - phase of flight
 - near – circuit, final approach, aborted approach, or traffic pattern
 - aerodrome – take-off, landing, taxiing, stationary
 - non-aerodrome – descending, initial approach, intermediate approach, long straight in, climb to cruise, en route, normal cruise, normal descent and manoeuvring

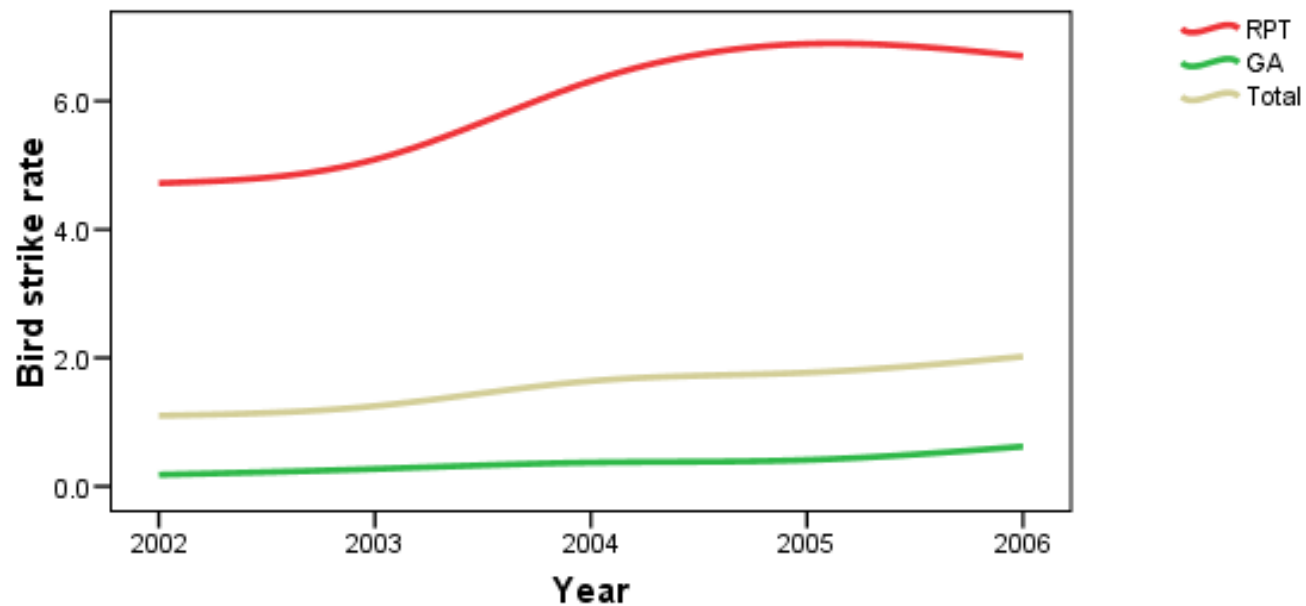
Total number

Table 1: Birdstrikes as a proportion of all occurrences, 2002 to 2006

	2002	2003	2004	2005	2006	Total
Birdstrikes	739	818	1,078	1,249	1,219	5,103
All occurrences ¹¹	6,014	5,017	5,315	6,873	7,608	30,827
% birdstrikes	12.3	16.3	20.3	18.1	16.0	16.6



Rate per 10,000 total movements



Reports

Table 2: Number of birdstrikes by number of reports per occurrence, 2002-2006

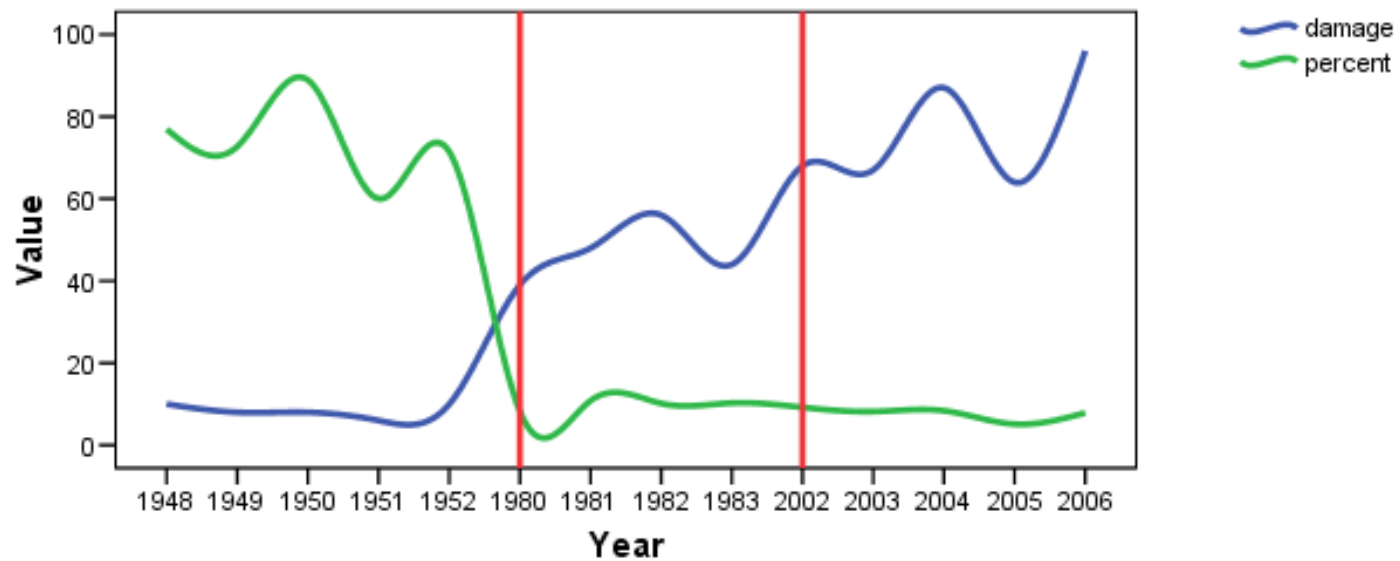
	2002	2003	2004	2005	2006	Total
One	592	631	808	938	761	3730
Two	127	155	220	230	295	1027
Three	19	30	46	80	162	337
Four	1	2	4	1	1	9
Total	739	818	1078	1249	1219	5103

Source

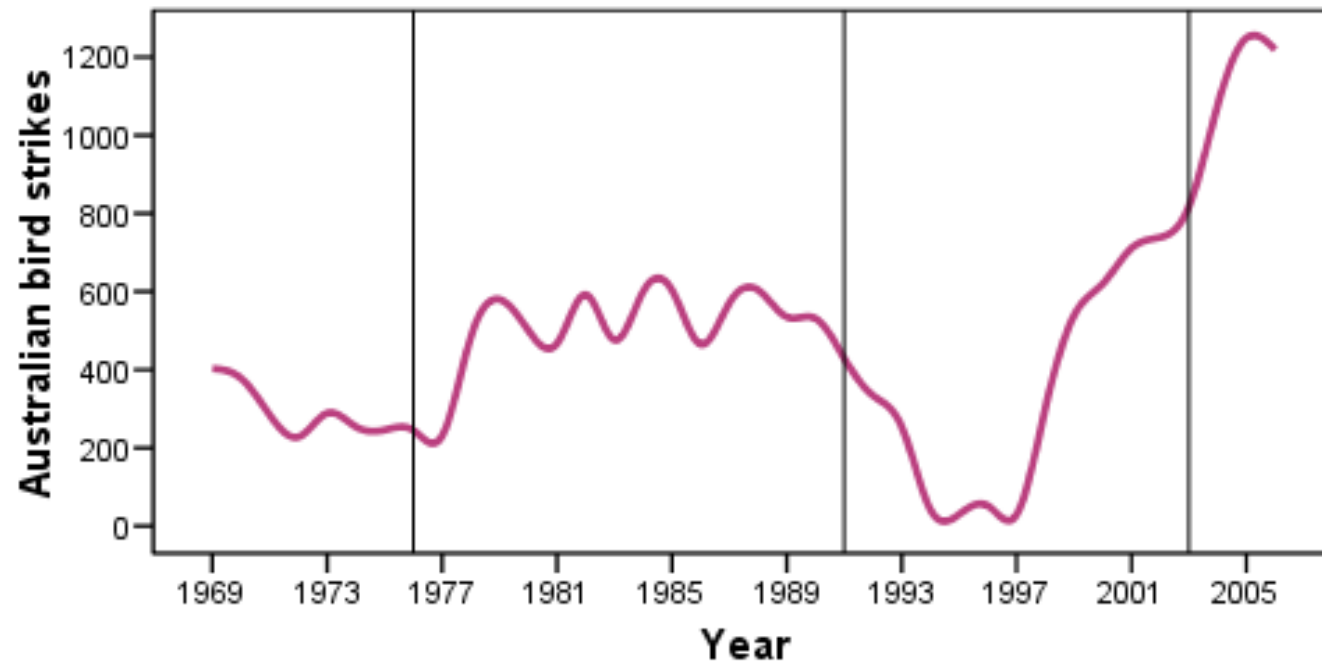
Table 3: Number of birdstrike reports by source, 2002 to 2006

	2002	2003	2004	2005	2006	Total
Ground staff	185	288	422	553	614	2,062
ATS	239	257	329	424	439	1,688
Operator	102	219	334	372	519	1,546
Flight crew	364	265	297	269	258	1,453
Military	1	2	1	2	6	12
Government	0	1	0	0	0	1
Public	0	0	0	0	1	1
Not known	16	7	19	22	4	68
Total	907	1,039	1402	1,642	1,839	6,831

Reports and damage



Historically



Phase of flight

Table 8: Number of birdstrikes by phase of flight, 2002 to 2006

	2002	2003	2004	2005	2006	Total
Standing	1	2	1	0	2	6
Taxiing	9	8	9	7	14	47
Takeoff	248	237	331	373	371	1,560
En route	24	19	20	28	17	108
Manoeuvring	4	4	9	6	5	28
Approach	131	115	156	174	158	734
Landing	237	317	393	449	466	1,862
Not known	85	116	159	212	186	758
Total	739	818	1,078	1,249	1,219	5,103

Effect on flight

Table 10: Number of birdstrikes by effect on flight, 2002 to 2006

	2002	2003	2004	2005	2006	Total
Precautionary landing	27	36	43	47	46	199
Rejected takeoff	22	21	22	21	38	124
Engine shutdown	0	4	2	1	1	8
Loss of control	0	0	0	2	0	2
Other ²³	1	0	0	1	1	3
None	629	672	918	1,057	1,048	4,324
Not known	60	85	93	120	85	443
Total	739	818	1,078	1,249	1,219	5,103

Engine ingestion

Table 14: Number of engine ingestions by damage, 2002 to 2006

	2002	2003	2004	2005	2006	Total
Damage	8	15	27	13	19	82
Nil damage	30	27	38	45	38	178
Not known	3	4	5	9	15	36
Total	41	46	70	67	72	296

Number of engines ingested

Table 15: Engine ingestion by number of engines, 2002 to 2006

Number of engines	2002	2003	2004	2005	2006	Total
1	40	45	68	66	69	288
2	1	1	2	1	3	8
Total	41	46	70	67	72	296

Twin engine ingestion

Table 18: Two-engine bird ingestions details, 2002 to 2006

Year	Damage	Location	Month	Model	Birds	Species
2002	No	Leinster	March	BAe 146	5	Galah
2003	Not known	Sydney	July	Boeing 737	3	Gull
2004	Yes	Adelaide	January	Boeing 737	2	Galah
2004	Yes	Burketown	November	Fairchild SA227	2	Not known
2005	No	Perth	February	Airbus A330	2	Not known
2006	No	Gold Coast	March	Airbus A320	3	Martin
2006	Yes	Adelaide	September	Boeing 737	4	Galah
2006	Yes	Melbourne	October	Boeing 767	8	Corella

Crew injuries

- *Occurrence 1*
 - During cattle mustering operations, the Schweizer 300 CBI helicopter tail rotor struck an eagle. The pilot lost control and the helicopter crashed into a heavily wooded area, receiving minor injuries. The helicopter was destroyed.
- *Occurrence 2*
 - During the climb phase, a Robinson R-22 helicopter struck a bush turkey that impacted the perspex bubble. The bubble was smashed and the front of the helicopter was damaged. The main rotor was damaged by debris and the pilot received facial injuries from shards of perspex.
- *Occurrence 3*
 - On final, the pilot of a Rockwell Aero Commander (<5,700 kg) reported to ATC that his aircraft struck a bird when 2 nautical miles from touchdown at a major Australian airport. The aircraft sustained a broken windscreen in the collision. The pilot was slightly injured, however, the aircraft landed without further incident. The type of bird and bird size is not known.

Bird size

Table 23: Number of birdstrikes by size, 2002 to 2006

	2002	2003	2004	2005	2006	Total
Very large	6	7	6	11	8	38
Large	145	193	259	282	286	1,165
Medium	171	192	241	262	318	1,184
Small	61	116	126	149	142	594
Very small	4	11	12	15	17	59
Not known	355	301	438	535	452	2,081
Total	742	820	1,082	1,254	1,223	5,121³⁰

Species struck top ten

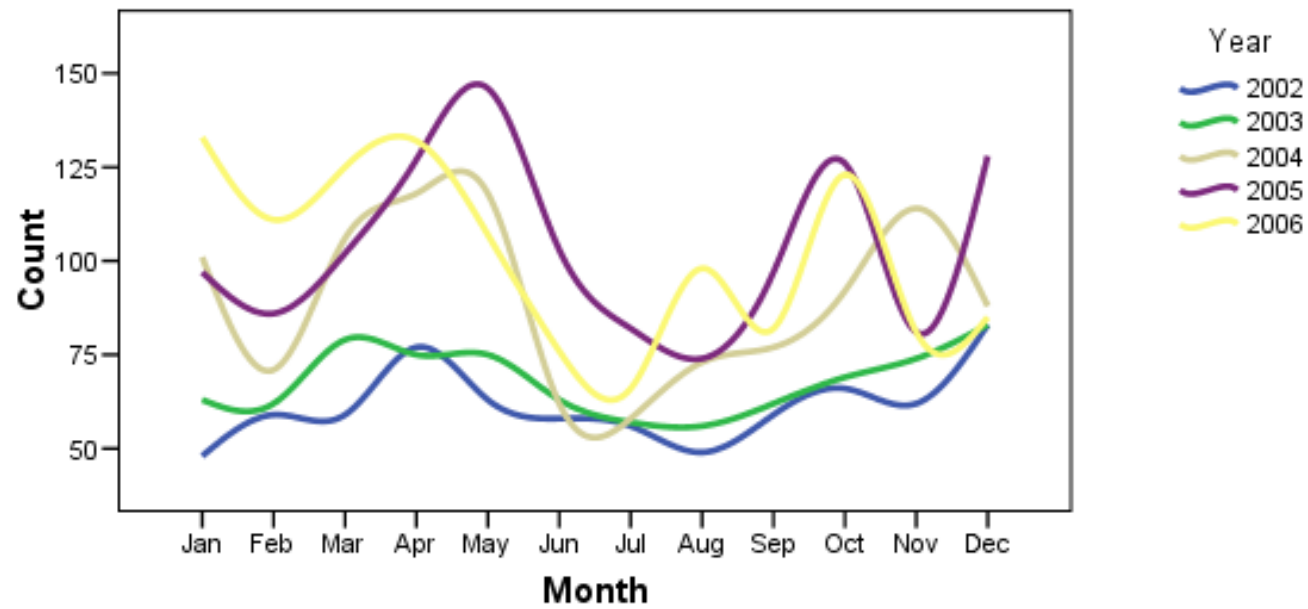
Bird	2002	2003	2004	2005	2006	Total
Galah	34	46	58	63	85	286
Flying-Fox	36	77	56	52	56	277
Plover	50	33	59	52	76	270
Black Kite	25	37	32	48	75	217
Australian Magpie	26	31	66	41	46	210
Nankeen Kestrel	30	33	37	29	58	187
Silver Gull	16	30	31	41	25	143
Hawk	26	19	25	37	34	141
Swallow	10	18	25	26	35	114
Magpie-lark	7	10	26	51	18	112

Missing species

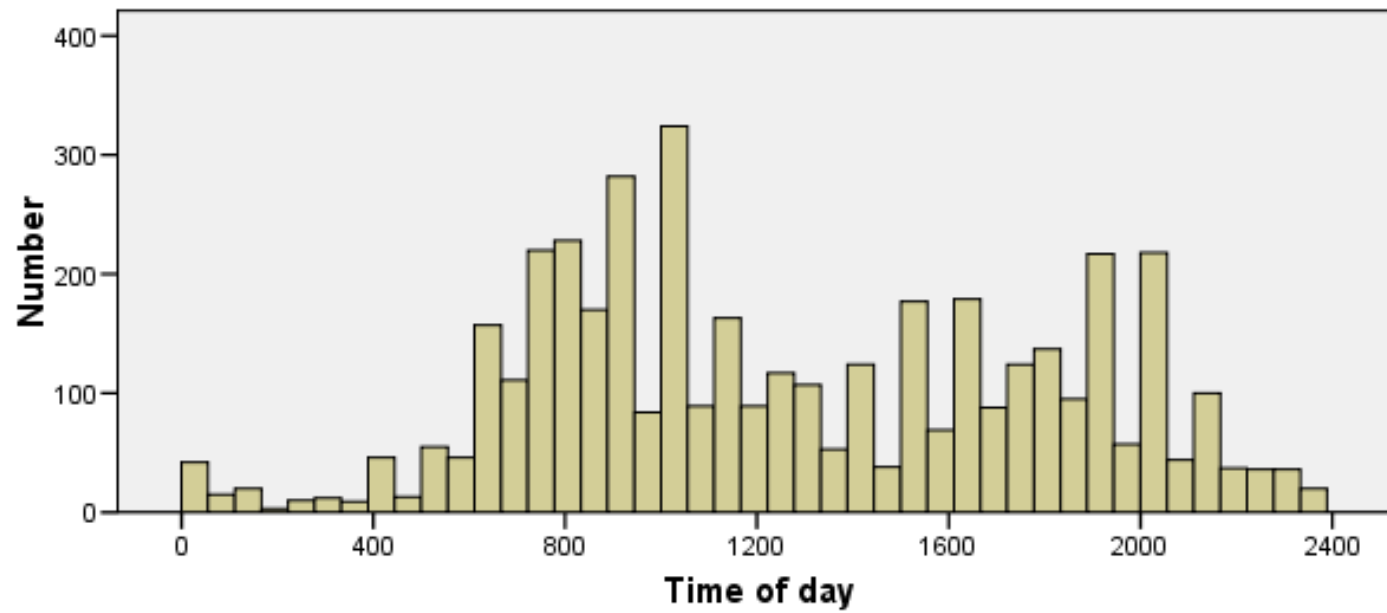
Table 24: Number of birdstrike occurrences with bird species reported, 2002 to 2006

	2002	2003	2004	2005	2006	Total
Species reported	389	523	647	721	774	3,054
Species not reported	353	297	435	533	449	2,067
Total	742	820	1,082	1,254	1,223	5,121

Month



Time of day



Location

Table 19: Location of birdstrikes, 2002 to 2006

	2002	2003	2004	2005	2006	Total
Aerodrome	567	668	867	1,020	1,010	4,132
Near aerodrome	125	106	147	166	154	698
En route	34	32	38	42	26	172
Not known	13	12	26	21	29	101
Total	739	818	1,039	1,249	1,219	5,103

Major strike rate

Table 20: Birdstrike rate per 10,000 total movements, major aerodromes

	2002	2003	2004	2005	2006	Total
Darwin	8.41	8.19	11.59	13.47	7.92	9.90
Hobart	7.98	5.62	3.26	8.56	9.16	6.93
Cairns	2.74	4.38	5.40	7.11	3.95	4.70
Adelaide	2.89	3.54	5.71	5.70	5.10	4.60
Brisbane	3.83	4.43	3.91	4.01	3.94	4.02
Perth	1.52	3.29	4.35	3.64	4.11	3.41
Melbourne	2.05	1.89	3.08	3.21	3.67	2.83
Gold Coast	2.07	3.54	1.70	3.73	3.53	2.80
Canberra	1.04	0.57	2.18	3.88	5.25	2.54
Sydney	1.54	2.32	2.92	2.73	2.50	2.43

GAAP strike rate

Table 21: Birdstrike rate per 10,000 total movements, GAAP aerodromes

	2002	2003	2004	2005	2006	Total
Parafield	1.18	1.09	1.37	1.35	0.71	1.12
Jandakot	0.73	0.46	0.66	0.40	0.68	0.59
Moorabbin	0.27	0.29	0.43	0.45	0.21	0.34
Bankstown	0.23	0.43	0.21	0.25	0.15	0.26
Archerfield	0.00	0.07	0.16	0.28	0.30	0.17
Camden	0.32	0.00	0.00	0.00	0.43	0.16

Regional strike rates

Table 22: Birdstrike rate per 10,000 total movements, regional aerodromes

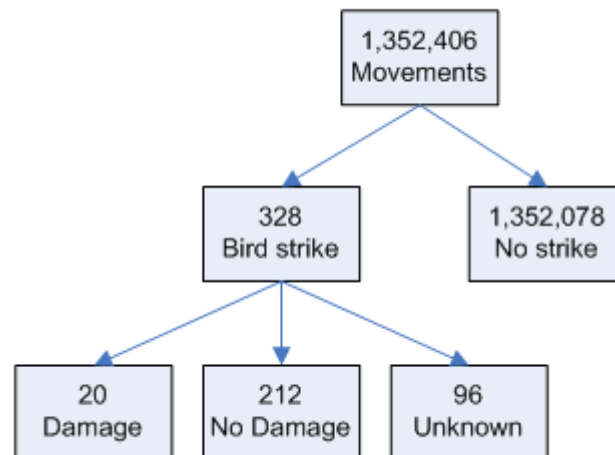
	2002	2003	2004	2005	2006	Total
Rockhampton	3.43	10.44	7.36	6.98	8.01	7.25
Alice Springs	8.96	3.84	4.49	5.22	5.55	5.65
Townsville	2.39	3.04	7.03	6.44	4.63	4.60
Mackay	2.95	2.11	7.08	4.32	3.12	3.99
Broome ²⁷	1.80	3.74	2.58	6.94	3.24	3.69
Hamilton Island	1.27	1.40	3.70	5.57	6.02	3.62
Williamstown ²⁸	1.79	1.83	0.88	2.00	9.68	3.60
Avalon ²⁹	1.19	1.00	0.89	7.79	3.22	3.31
Launceston	3.65	0.55	4.18	4.70	1.95	3.01
Coffs Harbour	0.27	2.29	1.51	3.87	4.23	2.28
Albury	1.01	0.32	2.83	3.32	3.04	2.10
Tamworth	1.27	2.15	1.08	0.88	1.66	1.39
Essendon	0.73	0.47	0.84	1.19	2.03	1.03



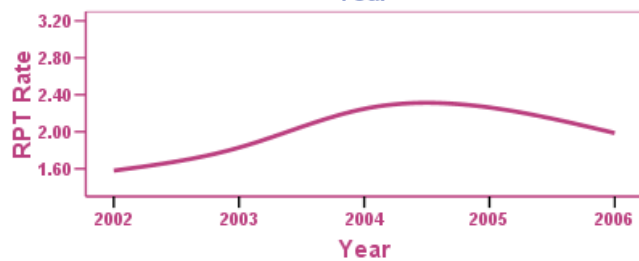
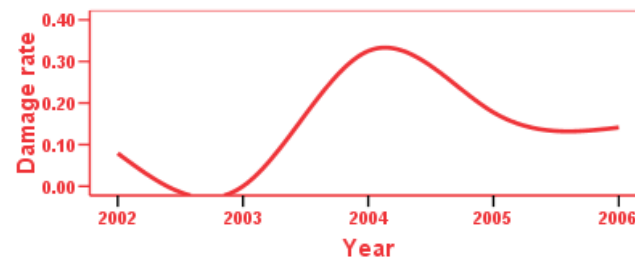
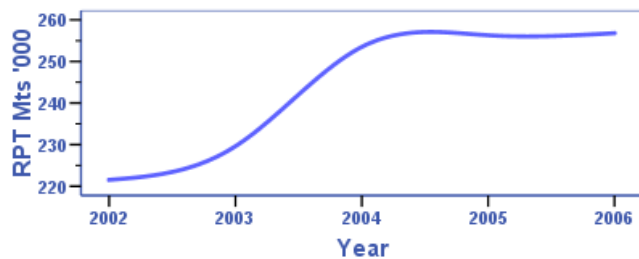
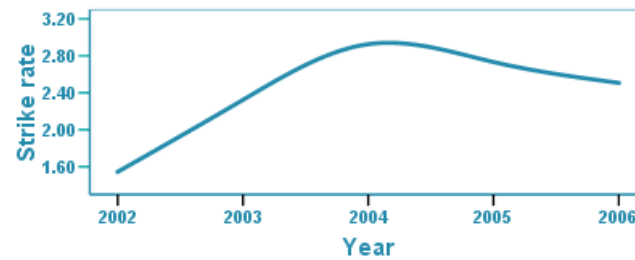
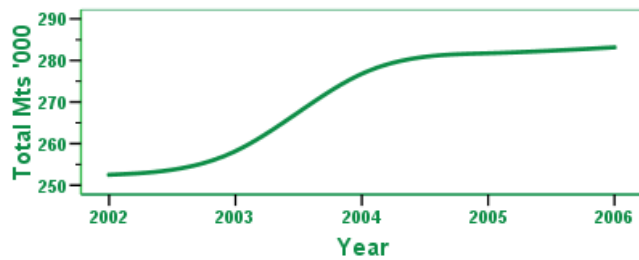
Detailed aerodrome

- Basic description
- Capital, GAAP
- Movements
- Rates for RPT and total aircraft
- Damaging rate
- Species
- Aerodrome and near aerodrome strikes

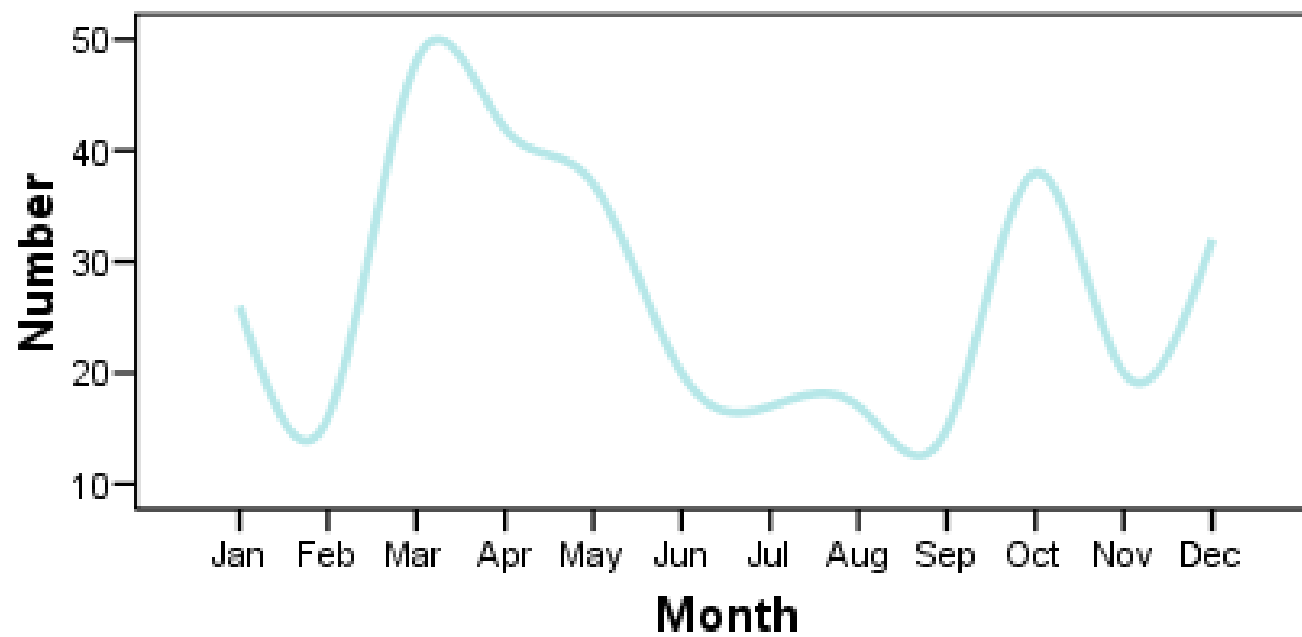
Aerodrome overview example



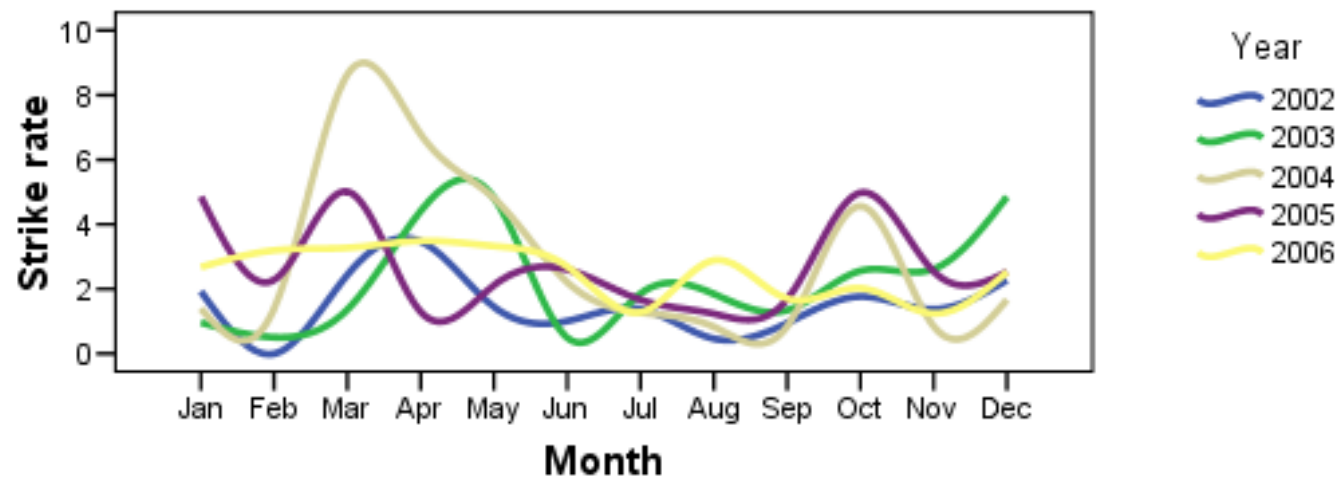
Example aerodrome rate



Example aerodrome by month



Example strike rate, aerodrome and month



Examples aerodrome species

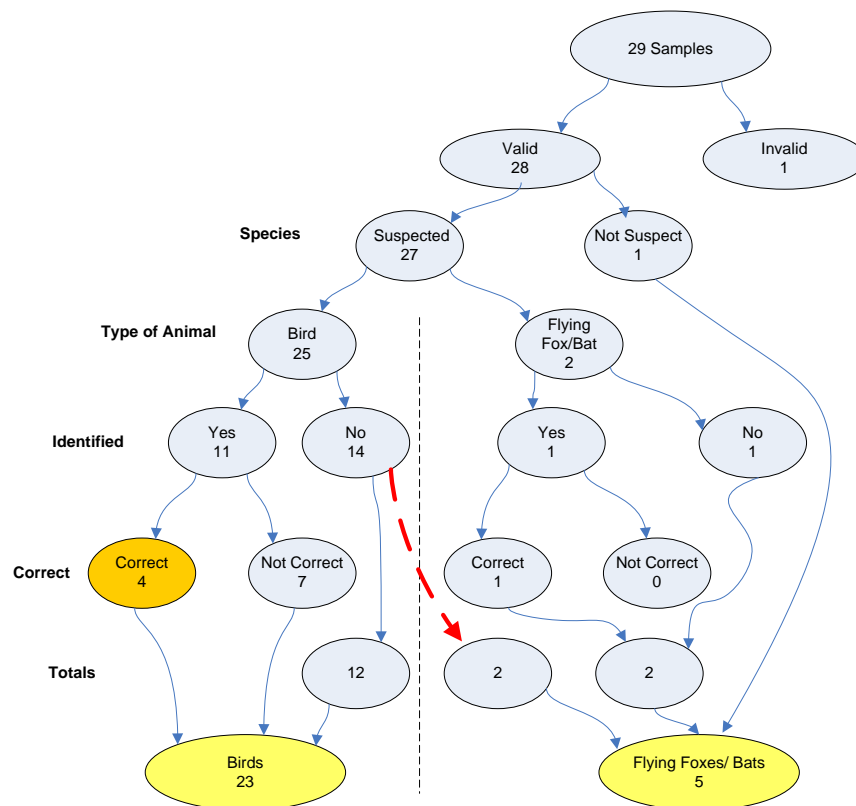
	2002	2003	2004	2005	2006	Total
Australian Magpie	0	0	3	0	0	3
Brown Falcon	0	0	0	1	0	1
Corella	0	0	0	0	1	1
Common Blackbird	0	0	0	0	1	1
Flying-Fox	0	0	1	0	0	1
Not known	1	0	5	2	0	8
Total	1	0	9	3	2	15



Data quality

- missing data
- incomplete data
- initial incident report

Species



Bias and confounding

- aircraft movements
 - rpt vs. GA
 - estimates
 - risk adjustment (normalise)
- ingestion
 - probably underestimate
 - pitfalls of text analysis (struck, ingestion, injestion, hit)

Take home

- Birdstrike rate has increased, reasons for the increase vary
- Injury some, death nil, damage still
- Rates of birdstrike at aerodromes differ, indicators of performance only
- Dual engine ingestion infrequent but real, consequences potentially surreal
- Strikes seasonal, species somewhat regional

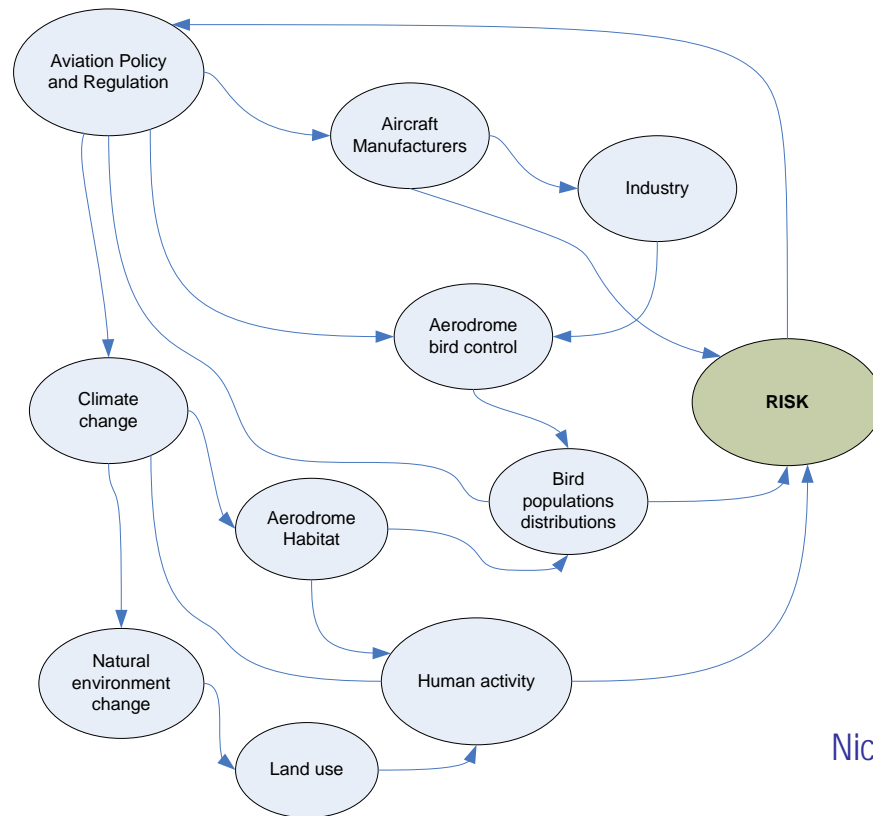


Quotable quote

I am a conscientious man, when I throw rocks at seabirds, I
leave no tern unstoned

Ogden Nash

Players



Nicholls and Bells, 2005