Triggering bird strike events “falling through the cracks” in Part 139.337 regulations

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Findings and recommendations expressed in this presentation do not necessarily represent the position of the U.S. FAA or an endorsement of any company or technology.

Dolbeer, R. A., and M. J. Begier. 2025. Bird strikes during approach and climb: a need for innovative management strategies.

Human Wildlife Interactions 19: In press

Science versus Engineering

- Science is what we come to know.
- Engineering is about what we can build.

- Scientists discover the world as it is.
- Engineers build the world as we want it to be.

- As a scientist, I am going to present the world of bird strikes as what we have come to know.
- And what we know is: there is a major deficiency in mitigation efforts at Part 139 airports.
- My co-presenters and I ask the engineers in the audience to build the systems that will mitigate this risk!

CFR Part 139.337

CFR Part 139.337 presents required actions of certificated airports in the USA to mitigate the risk of wildlife strikes.

A Wildlife Hazard Management Plan (WHMP) must be developed when 1 or more of 3 strike-related triggering events occur to an air carrier aircraft "on or near" the airport:

1) multiple wildlife strikes,

2) substantial damage from striking wildlife,

3) engine ingestion of wildlife.

CFR Part 139.337

Importantly, the regulations require review and evaluation of existing WHMPs following triggering events:

(i) The plan's effectiveness in dealing with known wildlife hazards on and in the airport's vicinity.

(ii) Aspects of the wildlife hazards described in the wildlife hazard assessment that should be reevaluated.

CFR Part 139.337

Unfortunately, CFR Part 139.337 does not define "near the airport" although Advisory Circular 150/5200-33C instructs airports to work with surrounding landowners to reduce wildlife attractants within 5 miles of approach and departure airspace.

"There may be circumstances where two or more different land uses would not, by themselves, be considered hazardous wildlife attractants or are located outside of the separations identified in Paragraphs 1.2 through 1.4 but collectively may create a wildlife corridor directly through the airport and/or surrounding airspace."

CFR Part 139.337

The challenge is that WHMPs typically do not address threats posed by birds moving through aircraft climb and approach paths unrelated to nearby bird-attractant habitats such as landfills.

Thus, when triggering events occur in these off-airport environments not specifically tied to a manageable bird attractant, the airport does not review the WHMP or if it does, makes no changes because the strike could not be mitigated by the airport (e.g., the Miracle on the Hudson).

Miracle on the Hudson

CFR Part 139.337

Therefore, these off-airport "Triggering" events typically "fall between the cracks" related to tangible actions to prevent future, similar events.

This is a serious concern as I will now demonstrate with data from the NWSD.

Examples of 121 non-mitigated engine-damage strikes involving multiple large birds, USA	
Dates	Jan 2009 – Mar 2025
Aircraft	Commercial transport
Airports	Part 139-certificated
Phase of flight	Approach or climb
Height AGL	≥500 feet AGL
Size of birds	≥1.8.kg (4.0 lbs)
Number of birds	Multiple
Damage to engine	Yes

- Red = 2 engines damaged
- Yellow = engine plus other component damaged
- Red-yellow = 2 engines plus other component damaged

Multiple large-bird strikes outside P139 airport boundaries with engine damage (2009 - 2025; strikes 1-20 of 121)

	Date	Airport	Aircraft	Phase of flight	Height (ft AGL)	Distance (nm)	Negative effect on flight	Bird species
1	1/15/2009	KLGA	A-320	Climb	2820	4	P/EL	Canada geese
2	3/10/2009	KFSD	C-510	Climb	500		P/EL	Snow geese
3	3/21/2009	KEWR	B-737-800	Climb	1300		ES, P/EL	Canada geese
4	3/21/2009	KPHL	CRJ100/200	Climb	5000		P/EL	Waterfowl
5	4/15/2009	KDFW	B-757-200	Approach	1000	2	ES	DC cormorants
6	10/19/2009	KBOS	A-319	Climb	1000		None	Canada geese
7	10/29/2009	KMIA	B-767-300	Approach	1200		None	Turkey vultures
8	11/7/2009	KSMF	B-737-900	Approach	550		None	GWF geese
9	11/14/2009	KMCI	A-319	Climb	4260	4	ES, P/EL	Snow geese
10	12/22/2009	KBWI	B-717-200	Climb	4000	3	P/EL	Snow geese
11	3/9/2010	KIAD	MD-88	Approach	1700		None	Large birds
12	3/11/2010	KROC	A-319	Climb	2000		P/EL	Canada geese
13	3/23/2010	KPBI	A-320	Climb	500		P/EL	Turkey vultures
14	11/2/2010	KCRP	EMB-145	Approach	1500	3		Sandhill cranes
15	11/11/2010	KPHL	A-320	Climb	1500	3	P/EL	Canada geese
16	11/15/2010	KMSP	EMB-170	Climb	4000	10	P/EL	Snow geese
17	11/26/2010	KSMF	B-737-300	Approach	600	2	None	Snow geese
18	12/8/2010	KFLL	B-737-400	Climb	1200	2	P/EL	Turkey vultures
19	1/6/2011	KSMF	B-737-700	Approach	2000	10	None	GWF geese
20	1/7/2011	KSMF	DC-10-30	Climb	2000		P/EL	GWF geese

Multiple large-bird strikes outside P139 airport boundaries with engine damage (2009 - 2025; strikes 21-40 of 121)

	Date	Airport	Aircraft	Phase of flight	Height (ft AGL)	Distance (nm)	Negative effect on flight	Bird species
21	1/27/2011	KPHL	B-737-300	Climb	800		P/EL	Canada geese
22	2/28/2011	KDCA	B-737-800	Climb	1200		P/EL	Canada geese
23	3/15/2011	KMSP	DC-9-50	Climb	1000		None	Canada geese
24	4/1/2011	KLIT	CRJ100	Approach	5000	20	ES	A. white pelicans
25	8/30/2011	KBNA	BE-200	Approach	2400		None	Large birds
26	9/10/2011	KATL	B-767-300	Climb	1500		P/EL	Black vultures
27	9/22/2011	KLGA	A-319	Climb	1000		P/EL	DC cormorants
28	12/28/2011	KFLL	B-757-200	Climb	800	1	P/EL	Turkey vultures
29	12/28/2011	KSMF	A-319	Approach	3000	12		GWF geese
30	1/21/2012	KSMF	B-737-800	Climb	1200		P/EL	GWF geese
31	3/1/2012	KMEM	MD-11	Climb	8500	15	Other, P/EL	Snow geese
32	4/19/2012	KJFK	B-757-200	Climb	800		ES, P/EL	DC cormorants
33	8/10/2012	KMCO	B-767-300	Approach	500			Large birds
34	9/25/2012	KSFO	B-757-200	Climb	800		P/EL	Brt's cormorants
35	10/12/2012	KPHL	EMB-190	Approach	7000	15	ES	Canada geese
36	10/25/2012	KLAS	B-757	Approach	6500		None	Geese
37	10/25/2012	KBOI	B-757	Climb	12000	50	P/EL	Snow geese
38	1/3/2013	KSMF	B-737	Approach	1500	5	None	GWF geese
39	1/24/2013	KSMF	B-737-700	Climb	1500	3	P/EL	Snow geese
40	6/16/2013	KSAT	B-757	Approach	600		None	Black vulture

Multiple large-bird strikes outside P139 airport boundaries with engine damage (2009 - 2025; strikes 41-60 of 121)

	Date	Airport	Aircraft	Phase of flight	Height (ft AGL)	Distance (nm)	Negative effect on flight	Bird species
41	10/31/2013	KSMF	B-767-300	Approach	1800	15	None	GWF geese
42	12/20/2013	KAPF	CL-300	Climb	1800	1	P/EL	Turkey vultures
43	1/19/2014	KLFT	EMB-135	Approach	1500	5	ES	Snow geese
44	4/25/2014	KPHL	Hawker 800	Climb	700	1	ES, P/EL	DC cormorants
45	11/12/2014	KMCI	B-737-700	Climb	9000		P/EL	Snow geese
46	11/22/2014	KSMF	A-320	Approach	1100		ES	Snow geese
47	12/12/2014	KSMF	B-737-700	Approach	3000	5	Other	GWF geese
48	12/12/2014	KBWI	B-737	Approach	3800	20	Other	Canada geese
49	1/7/2015	KRST	Hawker 800	Climb	600		ES, P/EL	Canada geese
50	1/9/2015	KSMF	B-737-800	Climb	700		ES, P/EL	Tundra swan
51	3/6/2015	KDFW	B-737-800	Climb	5000	12	P/EL	Snow geese
52	10/30/2015	KRDU	B-737-300	Climb	1200	1	P/EL	Large birds
53	11/6/2015	KMCI	B-737-700	Approach	3500	5	None	GWF geese
54	11/20/2015	KDEN	B-737-300	Climb	2000		P/EL	Canada geese
55	11/25/2015	KSMF	A-320 2	Climb	5000	14	P/EL	Snow geese
56	1/9/2016	KSMF	B-737-700	Climb	1000	1	P/EL	Geese
57	2/18/2016	KFMN	BE-200 2	Approach	1000	1		Canada geese
58	7/21/2016	KSGF	A-319 2	Descent	10000	40	None	Canada geese
59	9/19/2016	KPDX	B-737	Approach	5000	15	Other	GWF geese
60	11/10/2016	KMIA	B-767-200	Climb	2300	4	ES, P/EL	Turkey vulture

Multiple large-bird strikes outside P139 airport boundaries with engine damage (2009 - 2025; strikes 61-80 of 121)

	Date	Airport	Aircraft	Phase of flight	Height (ft AGL)	Distance (nm)	Negative effect on flight	Bird species
61	11/23/2016	KSMF	A-320	Climb	2600	5	P/EL	GWF geese
62	12/4/2016	KMEM	B-737-700	Climb	2500	20	P/EL	Snow geese
63	12/15/2016	KRFD	A-320 2	Climb	500		ES, P/EL	Canada geese
64	12/15/2016	KATL	B-737-700	Climb	1200	1	ES	Sandhill cranes
65	12/15/2016	KMDW	B-737-800	Climb	3000		P/EL	Canada geese
66	2/6/2017	KEWR	B-737-800	Approach	2500	5	None	Canada geese
67	4/8/2017	KMKE	A-300	Climb	500		P/EL	DC cormorant
68	4/30/2017	KBNA	B-737-700	Climb	1200		P/EL	Large birds
69	11/5/2017	KDSM	CRJ900	Approach	3000	6	P/EL	Canada geese
70	11/19/2017	KSMF	B-737-700	Climb	2800	5		Large birds
71	12/4/2017	KSMF	A-320	Climb	1000		P/EL	Snow geese
72	12/6/2017	KMEM	DC-10-10	Approach	1800	4	None	Snow geese
73	12/13/2017	KHPN	A-320	Climb	1600	1	P/EL	Snow geese
74	9/1/2018	KSMF	B-737-700	Local	2000	3	None	Large birds
75	11/7/2018	KSLC	CRJ100	Approach		1	None	Snow geese
76	11/30/2018	KOAK	B-737-700	Approach	1500	5	None	Large birds
77	1/8/2019	KMIA	A-319	Climb	3000	5	P/EL	Turkey vultures
78	1/27/2019	KICT	A-319	Approach	4000	11	None	Canada geese
79	3/8/2019	KDEN	B-737-700	Approach	4000	17	Other	Canada geese
80	3/23/2019	KTPA	A-319	Climb	2000			Turkey vultures

Multiple large-bird strikes outside P139 airport boundaries with engine damage (2009 - 2025; strikes 81-100 of 121)

	Date	Airport	Aircraft	Phase of flight	Height (ft AGL)	Distance (nm)	Negative effect on flight	Bird species
81	10/27/2019	KMCI	A-320	Approach		4	None	GWF geese
82	11/7/2019	KMDW	B-737-700	Climb	4000	15	P/EL	Sandhill cranes
83	11/7/2019	KMCI	MD-11	Climb	7000	5	P/EL	Snow geese
84	11/11/2019	KMCO	B-737-700	Climb	1000	1	P/EL	Turkey vultures
85	11/11/2019	KOMA	BE-99	Approach	2800	10	None	Canada geese
86	11/12/2019	KACY	A-320	Approach	1200	3	None	Snow geese
87	11/12/2019	KDCA	CRJ100	Approach	4000	10	None	Canada geese
88	12/2/2019	KAUS	A-321	Descent	9000		None	Snow geese
89	1/16/2020	KSMF	B-737-700	Climb	900	2	P/EL	Snow geese
90	1/23/2020	KSMF	B-737-700	Approach	2200	6	None	Snow geese
91	3/2/2020	KTEB	CL-600	Climb	1300	<1	P/EL	Canada geese
92	3/8/2020	KXNA	A-319	Climb	4000	5	P/EL	Geese
93	3/8/2021	KORD	A-319	Climb	1500		P/EL	Canada geese
94	3/26/2021	KRSW	B-737-800	Climb	1500	4		Large birds
95	3/30/2021	KSLC	B-757-200	Climb	4000	3	P/EL	A. white pelicans
96	11/15/2021	KSMF	B-737-800	Climb	3000	6	Other, P/EL	GWF geese
97	12/18/2021	KSMF	B-767-300	Approach	1800	7	None	Snow geese
98	1/26/2022	KPIT	A-320	Approach	500	2	None	Snow geese
99	9/26/2022	KMSP	A-321	Approach	500	<1	None	DC cormorant
100	10/16/2022	KAUS	B-737-800	Approach	500	1	None	Black vultures

Multiple large-bird strikes outside P139 airport boundaries with engine damage (2009 - 2025; strikes 101-121 of 121)

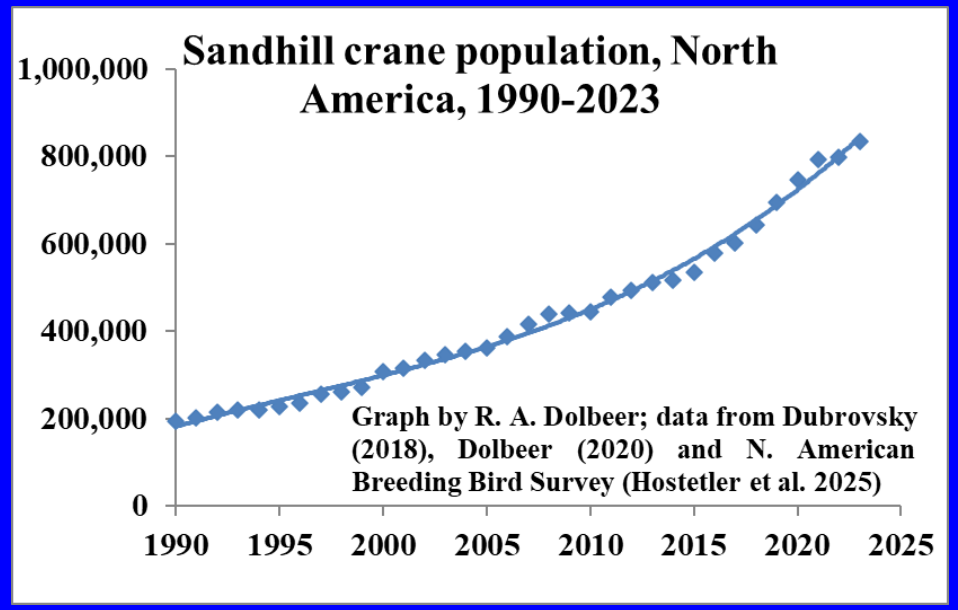
	Date	Airport	Aircraft	Phase of flight	Height (ft AGL)	Distance (nm)	Negative effect on flight	Bird species
101	12/18/2022	KMDW	Learjet-60	Climb	1500		P/EL	Sandhill cranes
102	1/10/2023	KSMF	B-737-7	Climb	700	3	P/EL	Snow geese
103	2/3/2023	KMEM	MD-11	Climb	2000	3	P/EL	Snow geese
104	2/5/2023	KSTL	B-737-800	Climb	1000		P/EL	Snow geese
105	2/12/2023	KPIA	A-320	Approach	2300	4	None	Snow geese
106	3/25/2023	KGRI	A-320	Climb	6000	20	Other, P/EL	Sandhill cranes
107	5/1/2023	KBOS	P2012	Approach	2500	5	Other	DC cormorants
108	8/19/2023	KJAX	B-737-8	Climb	460	1	None	Anhinga
109	11/25/2023	KMEM	A-300	Climb	900	5	None	Large birds
110	11/25/2023	KSGF	EMB-170	Climb	1500	4	None	Snow geese
111	11/29/2023	KEWR	B-737-900	Approach	3000		None	Canada geese
112	12/1/2023	KSMF	A-321	Climb	610	1	None	GWF geese
113	12/1/2023	KSMF	A-321	Climb	2000	1	None	GWF geese
114	1/15/2024	KICT	LJET-45	Climb	700		Other, P/EL	Canada goose
115	2/13/2024	KPDX	B-737-9	Climb	600	<1	P/EL	Cackling goose
116	6/26/2024	KCHS	DA-2000	Climb	1000		None	Anhinga
117	9/20/2024	KSAT	CL-300	Approach	2700	4	None	Black vulture
118	10/18/2024	KSFO	B-737-800	Climb	700	<1	None	Brown pelican
119	10/28/2024	KEWR	B-737-900	Approach	2500	3	None	Canada goose
120	11/10/2024	KMIA	B-737-800	Climb	1400	1	Other, P/EL	Turkey vulture
121	3/1/2025	KEWR	B-767-300	Climb	750	<1	P/EL	Canada goose

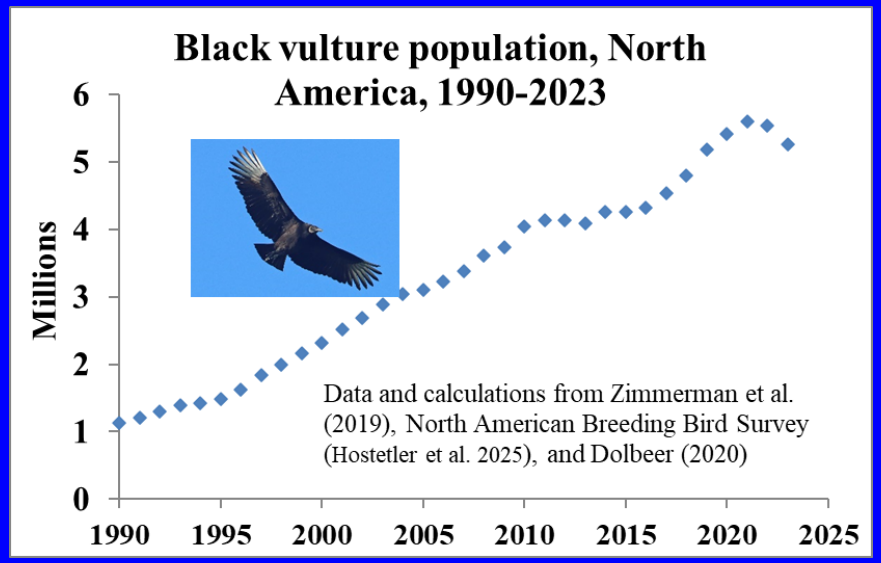
Dolbeer, R. A., and M. J. Begier. 2025. Bird strikes during approach and climb: a need for innovative management strategies. Human Wildlife Interactions 19: In press

We documented 2,299 strikes from 2009 to 2023 involving >2.5 lb-birds and transport civil aircraft during climb or approach at >500 feet AGL at Part 139-certificated airports, USA.

1,040 (45%) of these strikes caused damage.

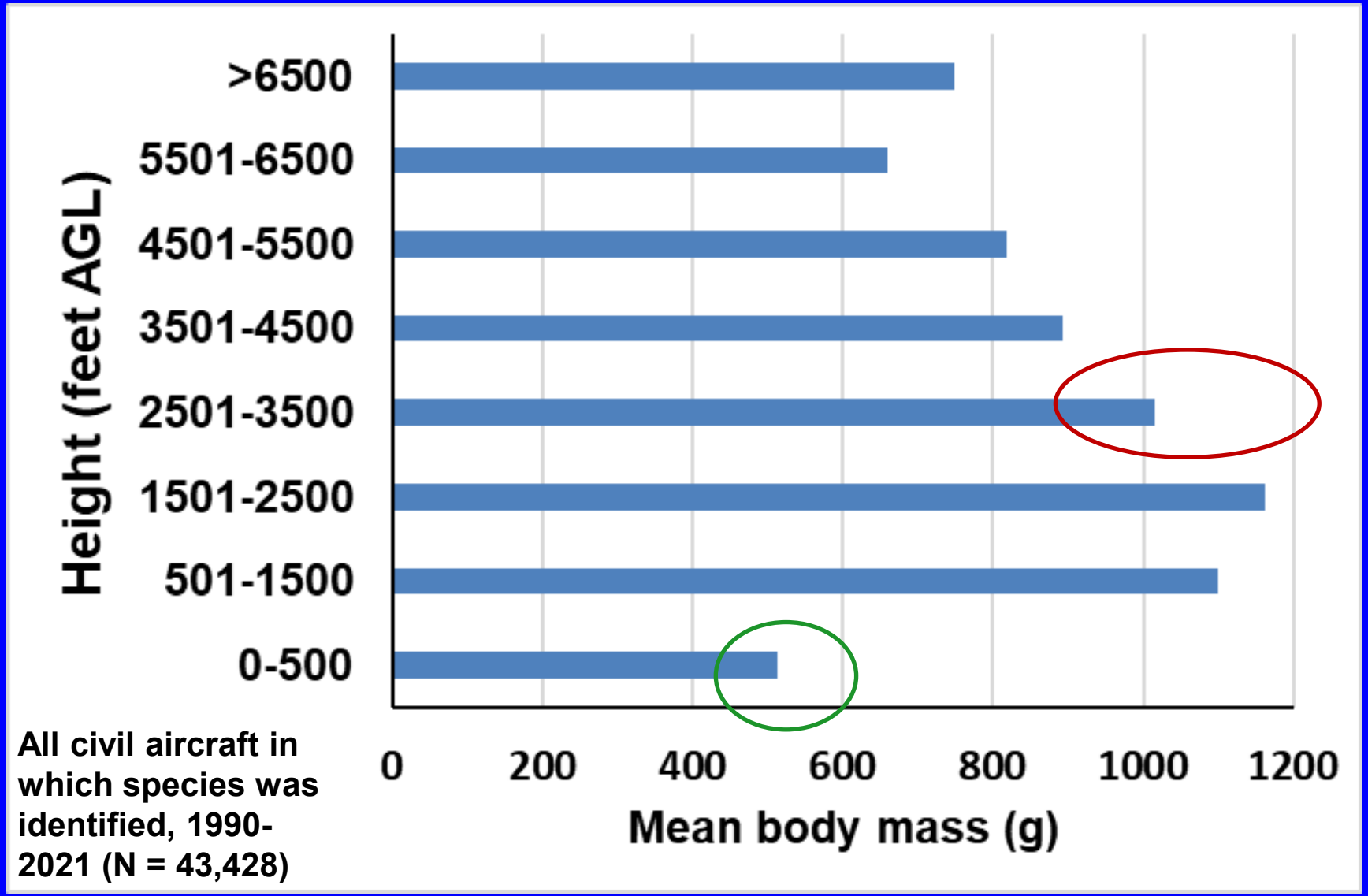
Almost all large bird species in North America have shown significant population increases since 1990.





Dolbeer, R. A. 2020. Population increases of large bird species in North America pose challenges for aviation safety. Human Wildlife Interactions 14 (3):345–357.

The mean body mass of birds struck at 501-3500 feet AGL is twice that of birds struck at ≤500 feet!



All civil aircraft in which species was identified, 1990-2021 (N = 43,428)

Probability of damage for bird strikes based on height AGL	
Dates	Jan 2009 – May 2023
Aircraft	Commercial transport at Part 139 airports
Phase of flight	Arrival or departure
Height AGL	≤500 feet AGL compared to >500 feet AGL

Height (feet AGL)	Total strikes	Strikes with damage	% with damage
0-500	48,968	1,773	3.6
>500	20,217	1,807	8.9

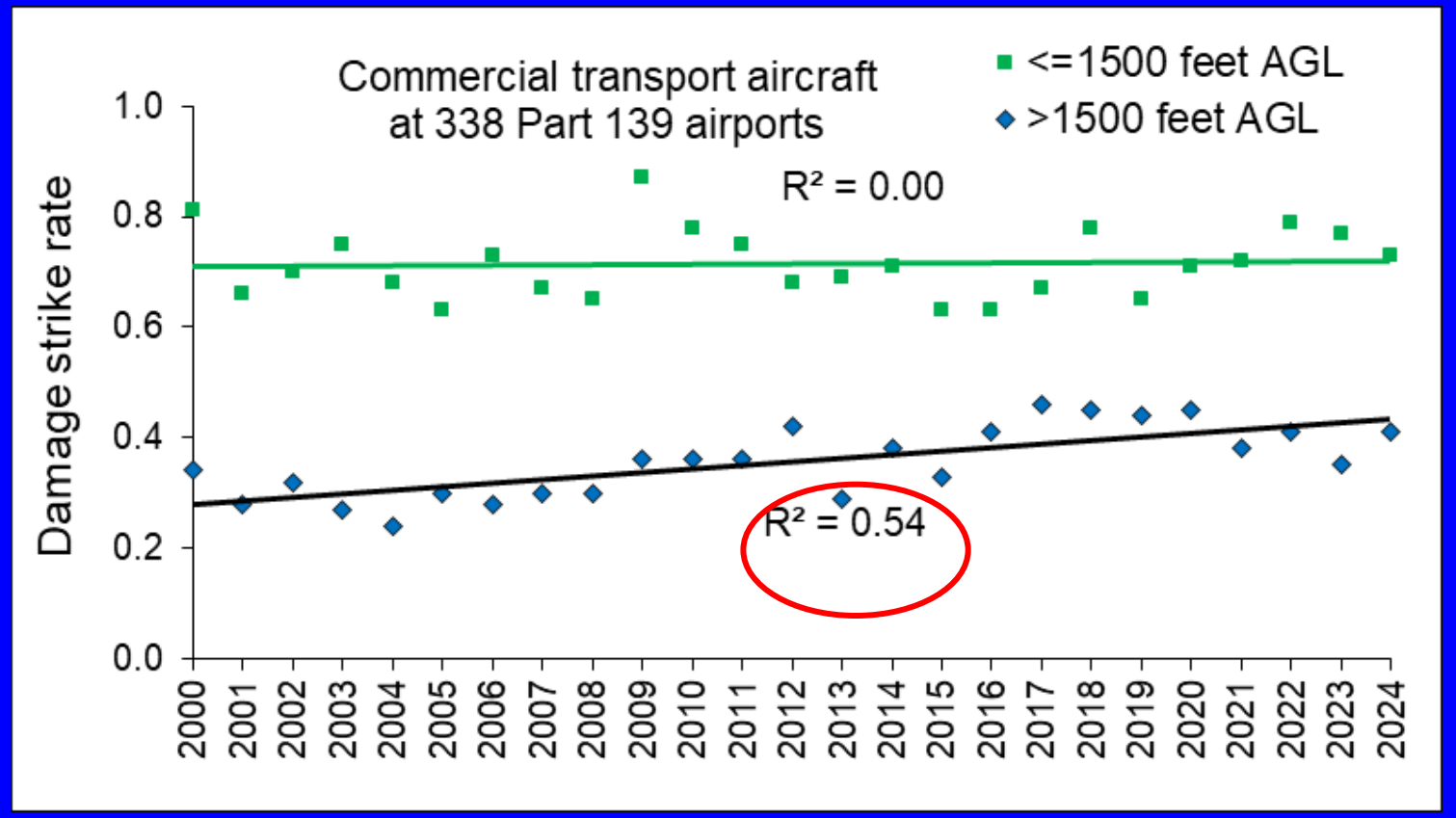
- Strikes at >500 feet have 2.5x greater probability of damage than strikes at <500 feet

- More damage strikes occurred at >500 feet (no mitigation measures) than damage strikes at <500 feet

Part 139 Airports:
Damage strikes/100,000 movements (2000-2024):

≤1500 feet AGL: Rate is stable

>1500 feet AGL: Rate increased (*P* <0.01)



Dolbeer, R. A. et al. 2025. Wildlife strikes to civil aircraft in the United States, 1990-2024. U.S. Department of Transportation, Federal Aviation Administration, Office of Airport Safety and Standards, Serial Report No. 31, Washington, DC., USA.

Bird strikes are comprised of two components:

- Our efforts have focused on managing the birds.
- To mitigate off-airport strikes on approach & departure, we must manage the aircraft (involve ATC & flight crews).

- **No mitigation measures are in place for the >2,300 strikes with medium and large birds since 2009 in approach/ departure airspace above 500 feet AGL at Part 139 airports in USA (121 with multiple large birds and engine damage).**
- **These strikes are not being addressed by WHMPs at certificated airports; they are "falling through the cracks."**
- **These strikes are triggering events; thus, if they cannot be mitigated by adjustments to the WHMP, this should be explicitly stated in a review of the WHMP with recommendations for possible solutions.**
- **These strikes are an airspace management problem that can be addressed by Radar for real-time warnings.**
- **The alternative is the status quo--a continuation of these presently non-mitigated "off-airport" strikes with large birds, some of which may not have "miraculous" endings.**

Parting words:

- Scientists understand but cannot control windshear on approach and departure routes at airports.
- But engineers designed radars to detect windshear and manage aircraft to avoid the windshear!

- Likewise, scientists cannot control transiting/migrating birds on approach and departure routes at airports.
- But engineers have developed radars to detect these birds, and we can develop procedures to manage aircraft to avoid them!


Let’s just do it!
•Safer skies for all who fly!
•Thank you.