Interspecific variation in wildlife hazards to aircraft: Implications for airport wildlife management

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Background

- 70% of all wildlife strikes with aircraft occur at <500 ft, where management at the airport can be effective.
- At least 415 bird and 35 terrestrial mammal species were struck by aircraft from 1990-2009.
- Overall, 14% of all strikes with birds and 61% of all strikes with mammals caused some damage.
  - But, the severity and probability of damage is species-specific.
- To better prioritize management (e.g., habitat management, land-use planning, non-lethal dispersal), an improved understanding of which species are most hazardous is needed.

Research questions

- Which species are most hazardous?
  - That is, which species are most likely to cause some type of damage to the aircraft when struck?
- How do body mass, body density, and flocking behavior contribute to hazard level?

Building on previous research

- Dolbeer, R.A., S.E. Wright, and E.C. Cleary. 2000. Ranking the hazard level of wildlife species to aviation. *Wildlife Society Bulletin* **28**:372-378.
  - ~18,000 records in the database
  - 21 wildlife species/groups considered
- Dolbeer, R.A., and S.E. Wright. 2009. Safety management systems: How useful will the FAA National Wildlife Strike Database be? *Human-Wildlife Conflicts* **3**:167-178.
  - Did not use a composite hazard score
- Zakrajsek, E.J., and J.A. Bissonette. 2005. Ranking the risk of wildlife species hazardous to military aircraft. *Wildlife Society Bulletin* **33**:258-264.
  - Used the number of damaging strikes and cost as criteria

Methods

- Used FAA National Wildlife Strike Database records: 1990-2009
  - 99,411 total strikes
- Summarized strikes for **77** species or groups with **≥20 records**
- Only used strikes ≤500 ft AGL (in the airport environment)
  - Reduced sample size to 23,503 reports
- Variables used in ranking
  - % of strikes with damage
  - % of strikes with substantial damage
  - % of strikes with effect on flight (EOF)
- Species were ranked and a relative hazard score was calculated
- For birds, we assessed effects of body mass, body density, and group size on relative hazard scores

Top 10 most hazardous birds and mammals

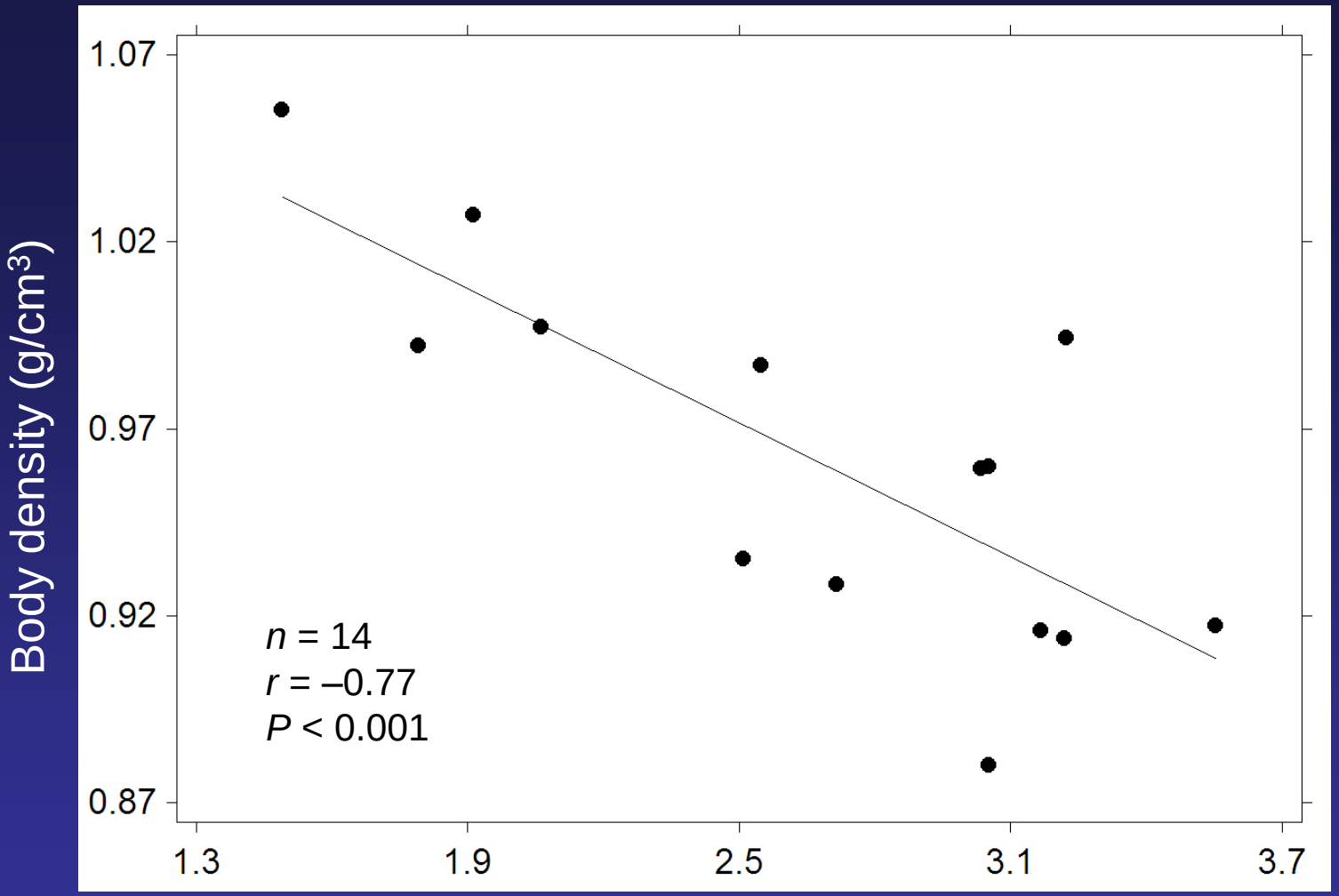
Species	Total strikes reported	% with damage	% with substantial damage	% with EOF	Composite rank	Relative hazard score
Mule deer	47	96	38	83	1	100
White-tailed deer	814	87	36	68	2	88
Domestic dog	21	53	26	75	3	71
Other geese*	20	68	32	32	4	61
Canada goose	776	51	16	34	5	46
Turkey vulture	159	46	16	34	5	44
Other ducks*	77	49	24	30	7	48
Great horned owl	29	52	16	27	8	44
Double-crested cormorant	24	52	13	29	8	43
Brown pelican	31	35	13	38	10	40

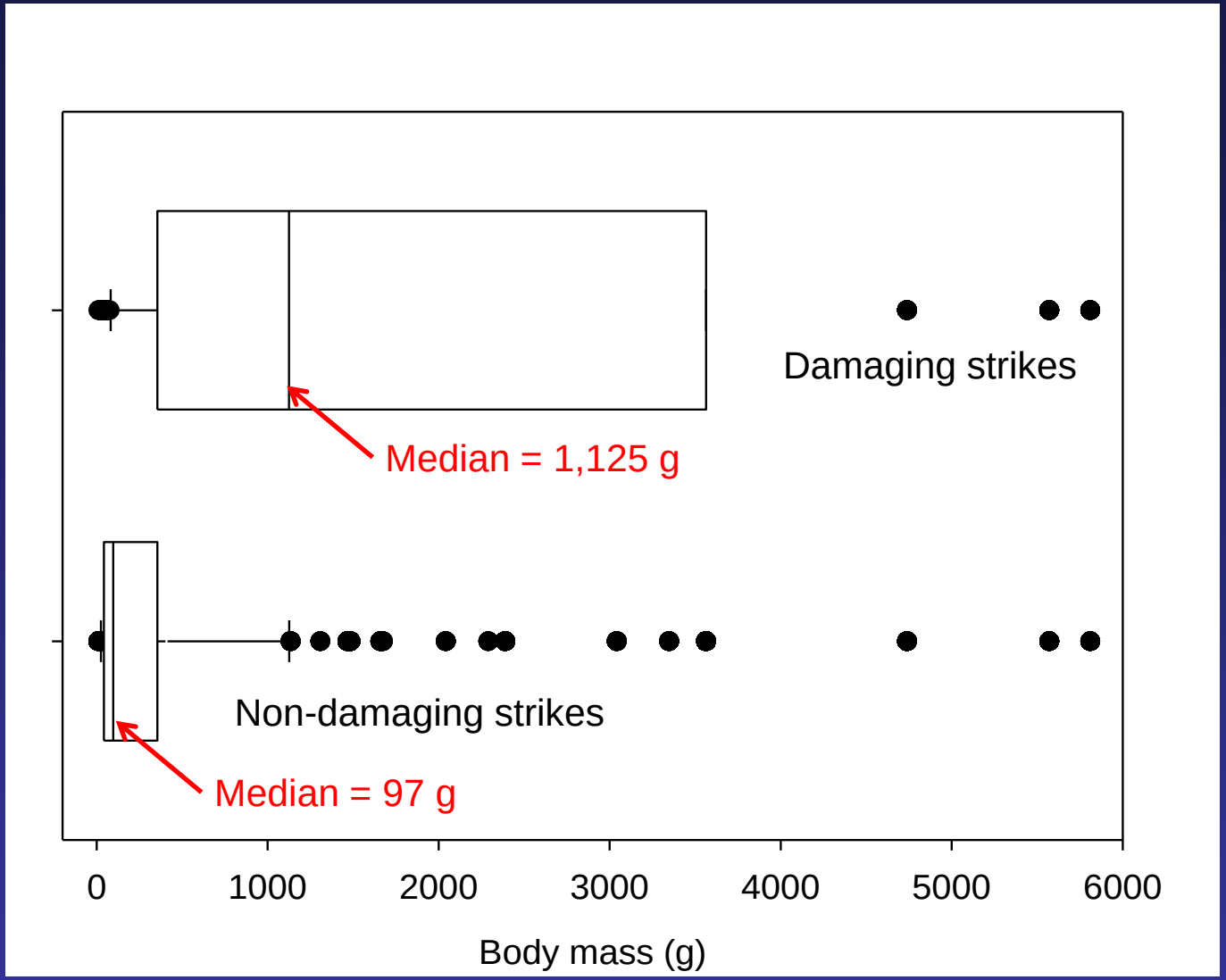
Top 15 most hazardous birds

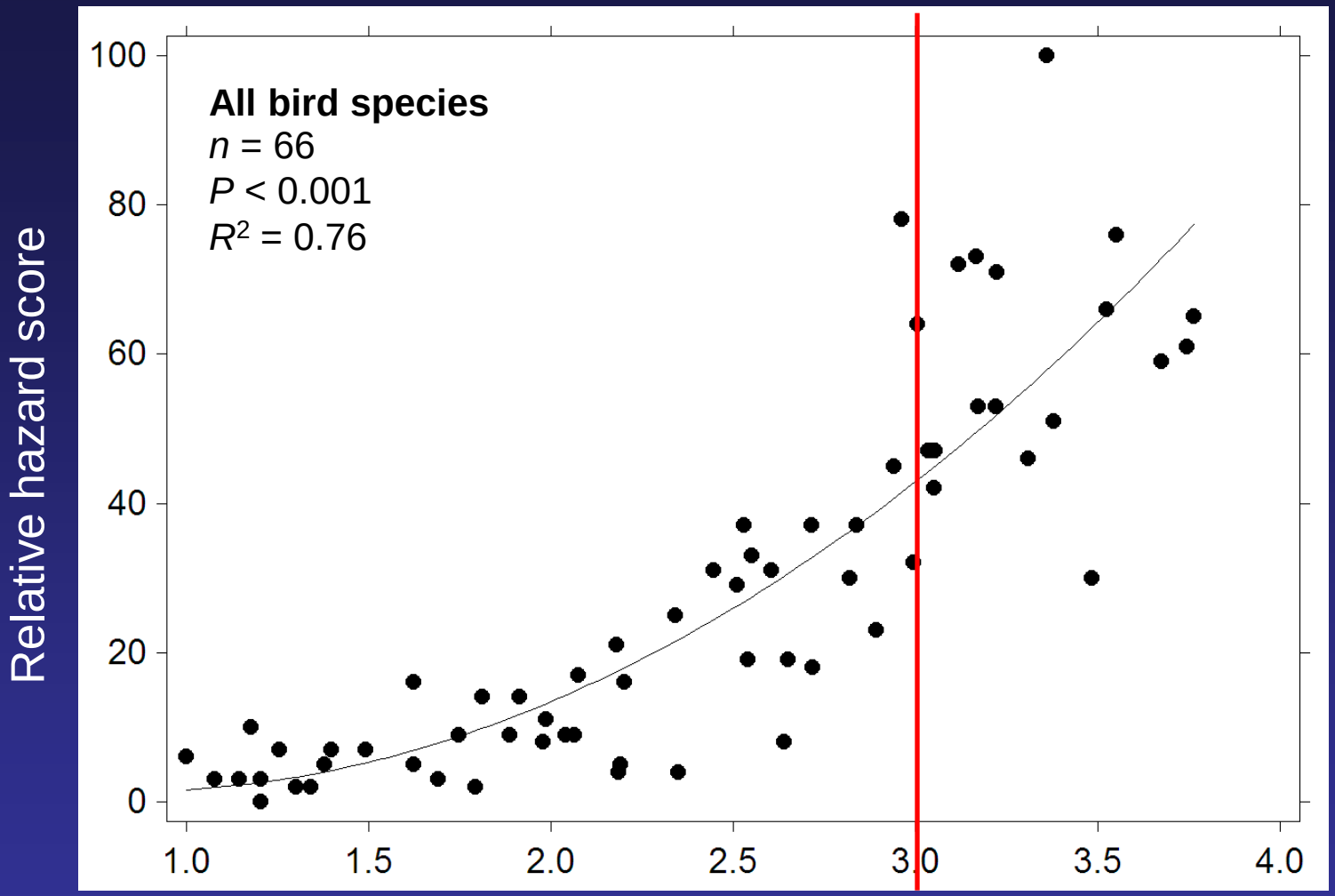
Species	Total strikes reported	Composite rank	Relative hazard score	Body mass (g)	% of strikes with mult. birds
Other geese*	20	1	100	2290	**60.0**
Canada goose	776	2	76	3564	**47.9**
Other ducks*	77	2	78	916	**46.8**
Turkey vulture	159	2	73	1467	9.0
Double-crested cormorant	24	5	71	1674	16.7
Great horned owl	29	5	72	1309	3.4
Brown pelican	31	7	66	3348	9.7
Sandhill crane	66	8	61	5571	44.6
Glaucous-winged gull	27	9	64	1010	25.9
Wild turkey	38	9	65	5811	23.7
Bald eagle	74	11	59	4740	12.2
Great black-backed gull	20	12	53	1659	15.0
Osprey	77	13	53	1485	2.6
Great blue heron	132	14	51	2390	2.3
Ring-necked pheasant	45	15	47	1135	8.9

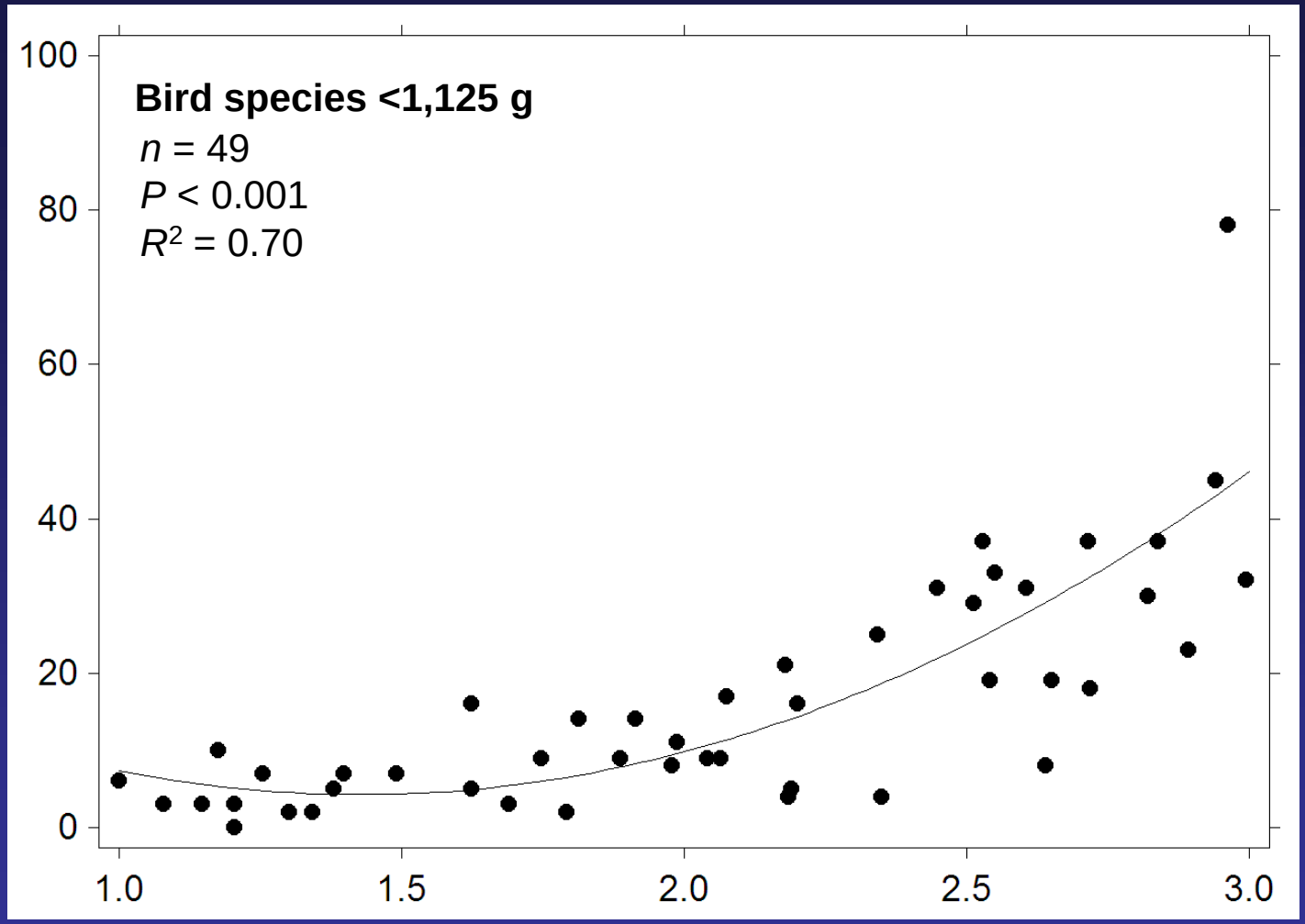
What contributes to hazard level?

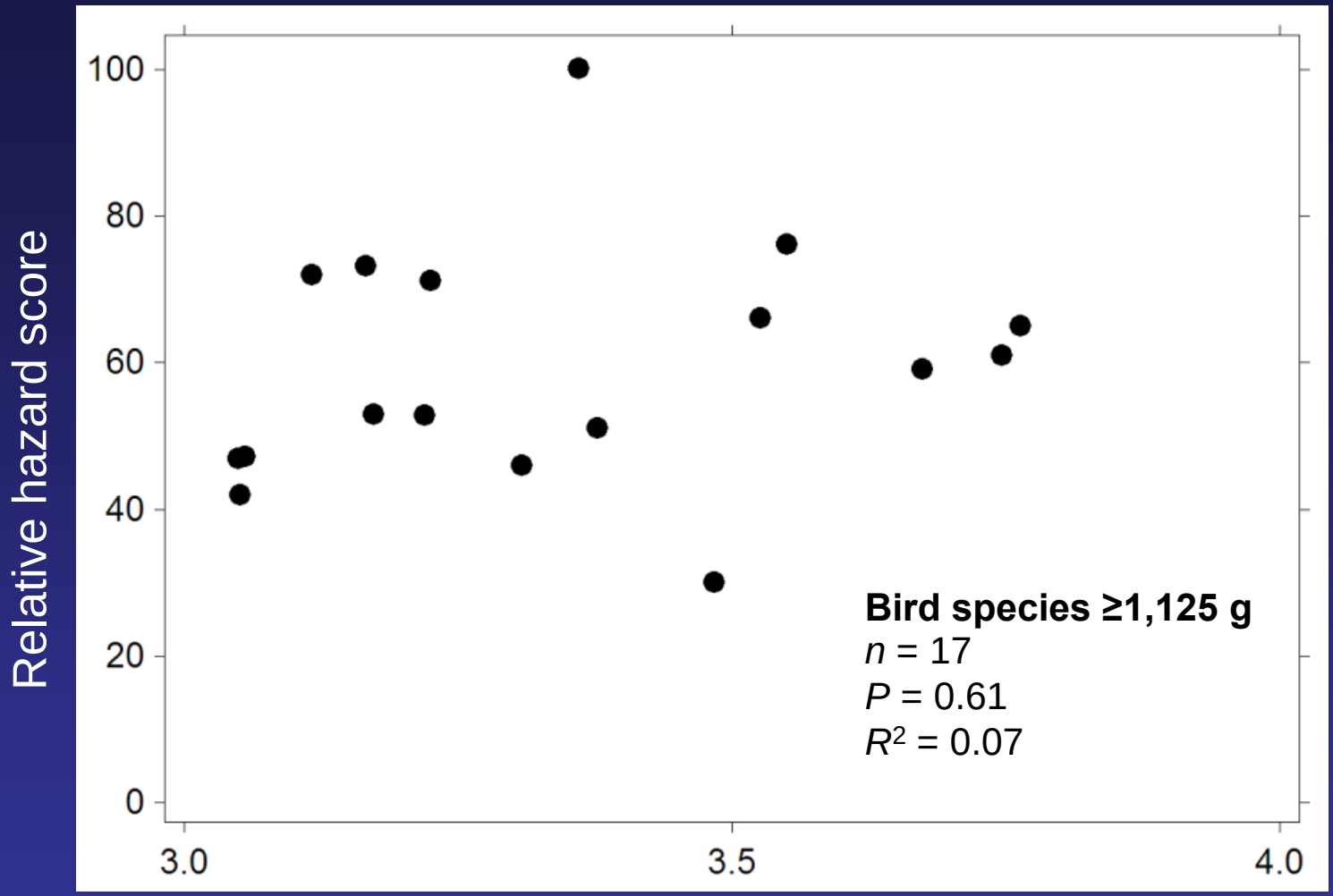
Double-crested Cormorant on nest

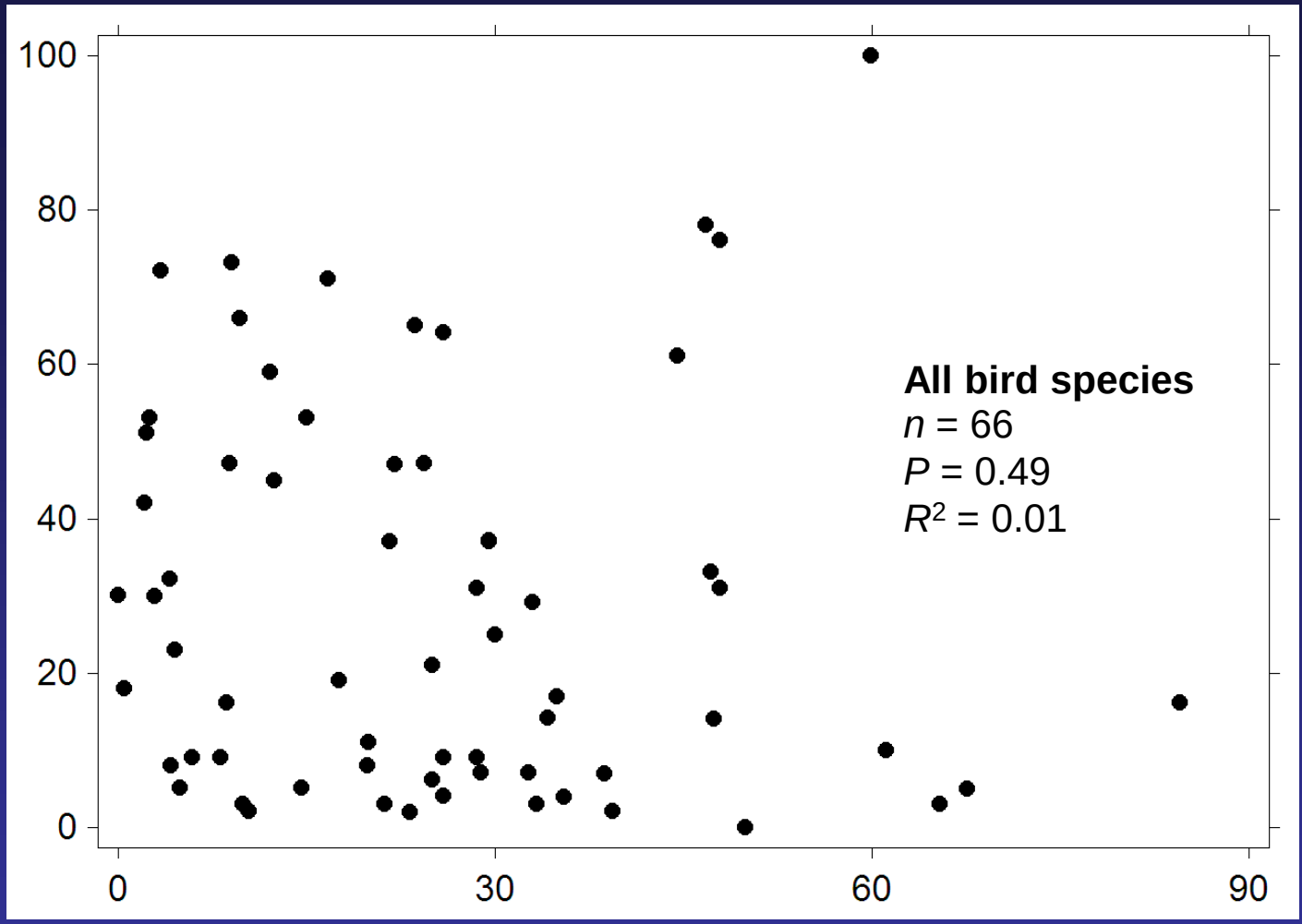

Body density (g/cm³)
1.07
1.02
0.97
0.92
0.87
1.3
1.9
2.5
3.1
3.7
n = 14
r = –0.77
P < 0.001
Log (body mass)

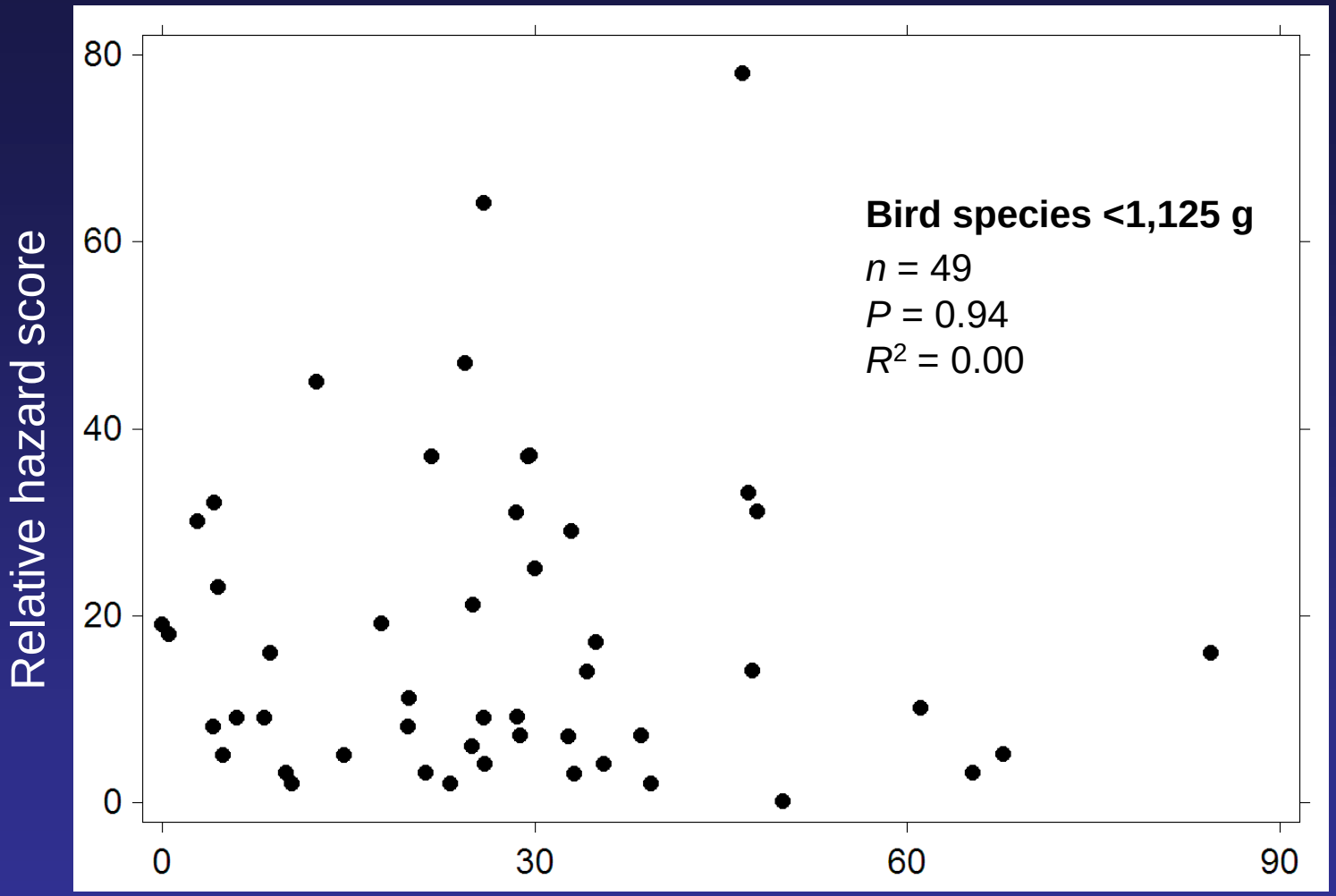

Damaging strikes
Median = 1,125 g
Non-damaging strikes
Median = 97 g
0
1000
2000
3000
4000
5000
6000
Body mass (g)

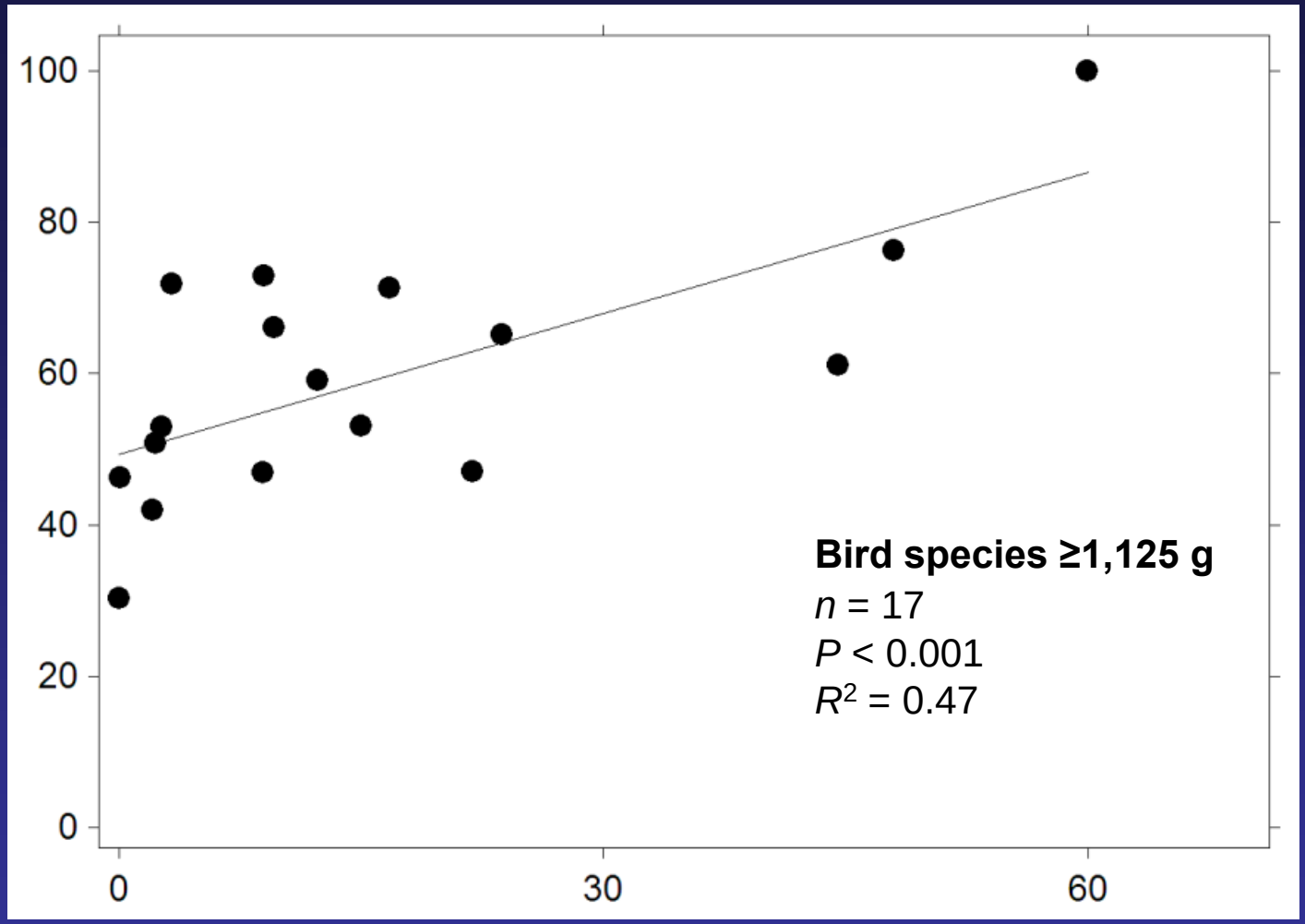

All bird species
n = 66
P < 0.001
R2 = 0.76
Relative hazard score
Log (body mass)
0
20
40
60
80
100
1.0
1.5
2.0
2.5
3.0
3.5
4.0


Bird species <1,125 g
n = 49
P < 0.001
R2 = 0.70
Relative hazard score
Log (body mass)
100
80
60
40
20
0
1.0
1.5
2.0
2.5
3.0


Relative hazard score
100
80
60
40
20
0
3.0
3.5
4.0
Log (body mass)
Bird species ≥1,125 g
n = 17
P = 0.61
R^2 = 0.07


Relative hazard score
100
80
60
40
20
0
0
30
60
90
All bird species
n = 66
P = 0.49
R2 = 0.01
% of strikes involving multiple birds


Relative hazard score
80
60
40
20
0
0
30
60
90
Bird species <1,125 g
n = 49
P = 0.94
R2 = 0.00
% of strikes involving multiple birds

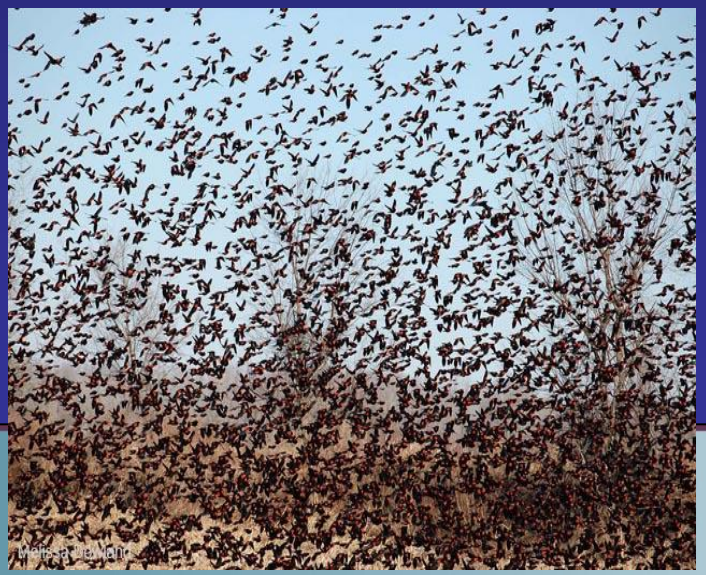

Relative hazard score
100
80
60
40
20
0
0
30
60
Bird species ≥1,125 g
n = 17
P < 0.001
R2 = 0.47
% of strikes involving multiple birds

Conclusions—confirmed

- Large mammals are extremely dangerous on airports
  - The top 3 most hazardous species are large mammals
- Overall, large (>1 kg) birds are most dangerous to aircraft
  - Median body mass for species in damaging strikes = **1,125 g**
  - Median body mass for species in non-damaging strikes = **97 g**
- Importance of proper management of stormwater retention ponds and other water bodies
  - 10 of 15 most hazardous birds were associated with water

Conclusions—new

- Avian body mass was strongly associated with relative hazard score, but not for species ≥1,125 g
- Relative hazard score increased when multiple birds involved in strike, but only for species ≥1,125 g
  - For small birds, are only very large flocks are especially dangerous?
- The effect of avian body density is swamped by body mass



Take-home messages

- Zero-tolerance for deer and other large mammals on the airfield
  - Fences!
- Geese and other waterbirds are often the most hazardous species at airports
- Prioritize habitat management for highest-hazard species/groups present at the airport

For further reading…

DeVault, T.L., J.L. Belant, B.F. Blackwell, and T.W. Seamans. Interspecific variation in wildlife hazards to aircraft: Implications for airport wildlife management. *Wildlife Society Bulletin*: In Press.

Biondi, K.M., J.L. Belant, J.A. Martin, T.L. DeVault, and G. Wang. White-tailed deer incidents with U.S. civil aircraft. *Wildlife Society Bulletin*: In Press.