

POPULATION INCREASES OF LARGE BIRDS, AIRWORTHINESS STANDARDS, & HIGH-SPEED FLIGHT: A PRECARIOUS COMBINATION



**RICHARD A. DOLBEER, PhD, U.S. Department of Agriculture,
Wildlife Services, Sandusky, Ohio USA.**

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Transport Canada

U.S. Air Force BASH Team



U.S. DEPARTMENT
OF TRANSPORTATION
FEDERAL AVIATION
ADMINISTRATION

WILDLIFE STRIKES TO CIVIL AIRCRAFT IN THE UNITED STATES 1990-2001



FEDERAL AVIATION ADMINISTRATION
NATIONAL WILDLIFE STRIKE DATABASE
SERIAL REPORT NUMBER 8

REPORT PREPARED BY
EDWARD C. CLEARY – RICHARD A. DOLBEER – SANDRA E. WRIGHT

REPORT OF THE ASSOCIATE ADMINISTRATOR OF AIRPORTS
OFFICE OF AIRPORT SAFETY AND STANDARDS
AIRPORT SAFETY & CERTIFICATION
WASHINGTON, DC

JUNE 2002

**The FAA Wildlife Strike Database
Contains about 43,000 Strike Reports
for Civil Aviation, 1990-2002.**

**Analysis of database indicates
wildlife strikes cost civil aviation
>\$400 million per year in USA.**

Problem:

Bird strikes are an increasing safety and economic concern to the civil aviation industry.

**Canada goose strike with A-300,
Dayton, Ohio, July 2001,
\$3.5 million**



Possible Solutions:

- 1. Enhance airworthiness standards for airframes and engines.**
- 2. Restrict airspeeds to 250 kts below 10,000 feet.**
- 3. Implement integrated management programs to detect, remove, & disperse hazardous birds from airport environments.**

What are the airworthiness standards for aircraft collisions with large birds?

Transport Aircraft –

- Standards for engines, airframes and windshields generally involve **a single 4-lb** bird test.
- Engine does **not have to keep running** to pass test...engine only has to be shut down safely and damage contained within cowling.

Commuter Aircraft

- Standards are much less stringent or non-existent.

Are these airworthiness standards adequate?

- A. How many bird species in North America have body masses >4 lbs and >8 lbs?**
- B. What are characteristics of these large-bird species?**
 - a) How many indicate increases in population numbers?
 - b) How many exhibit flocking behavior?
- C. What are strike characteristics with these large-bird species?**
 - a) How many strikes have occurred?
 - b) How many strikes involved multiple birds?
 - c) How many strikes caused damage?

CRC HANDBOOK OF
AVIAN BODY MASSES



EDITED BY
JOHN B. DUNNING, JR.

DK
SMITHSONIAN
HANDBOOKS

BIRDS
OF NORTH AMERICA
EASTERN REGION



Fred J. Alsup III

Body Mass Statistics for Large Birds in North America

- Total bird species = ~700
- Total species w/ mean body mass >4 lbs = 36 (5%)
- Total species w/ mean body mass >8 lbs = 14 (2%)

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

Rank	Species	Mass (lbs)
1	Mute swan	26.0
2	Trumpeter swan	25.1
3	California condor	22.3
4	Wild turkey	16.3
5	Tundra swan	15.7
6	American white pelican	15.4
7	Whooping crane	12.8
8	Sandhill crane	12.8
9	Yellow-billed loon	12.1
10	Bald eagle	11.8
11	Golden eagle	10.8
12	Canada goose	9.2
13	Common loon	9.1
14	Brown pelican	8.2



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

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

(Species ranked
15-28)

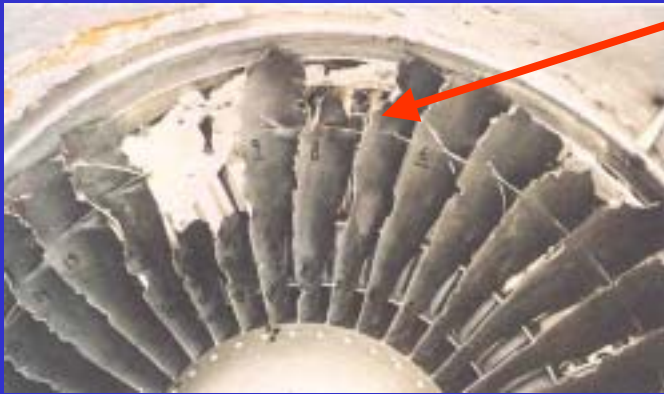


**Snow goose penetration
into cockpit, B-727,
Memphis, Nov 2001**

Rank	Common Name	Mass (lbs)
15	Greater flamingo	7.8
16	Snow goose	7.6
17	Arctic loon	7.4
18	Laysan albatross	7.1
19	Greater sage grouse	7.0
20	Black-footed albatross	6.9
21	Northern gannet	6.8
22	Emperor goose	6.1
23	Greater white-fronted goose	6.0
24	Wood stork	6.0
25	Great blue heron	5.7
26	Red-faced cormorant	5.6
27	Double-crested cormorant	5.2
28	Great cormorant	5.0

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

(Species ranked
29-36)



**Eider vs. B-737
engine, Maine 1995**

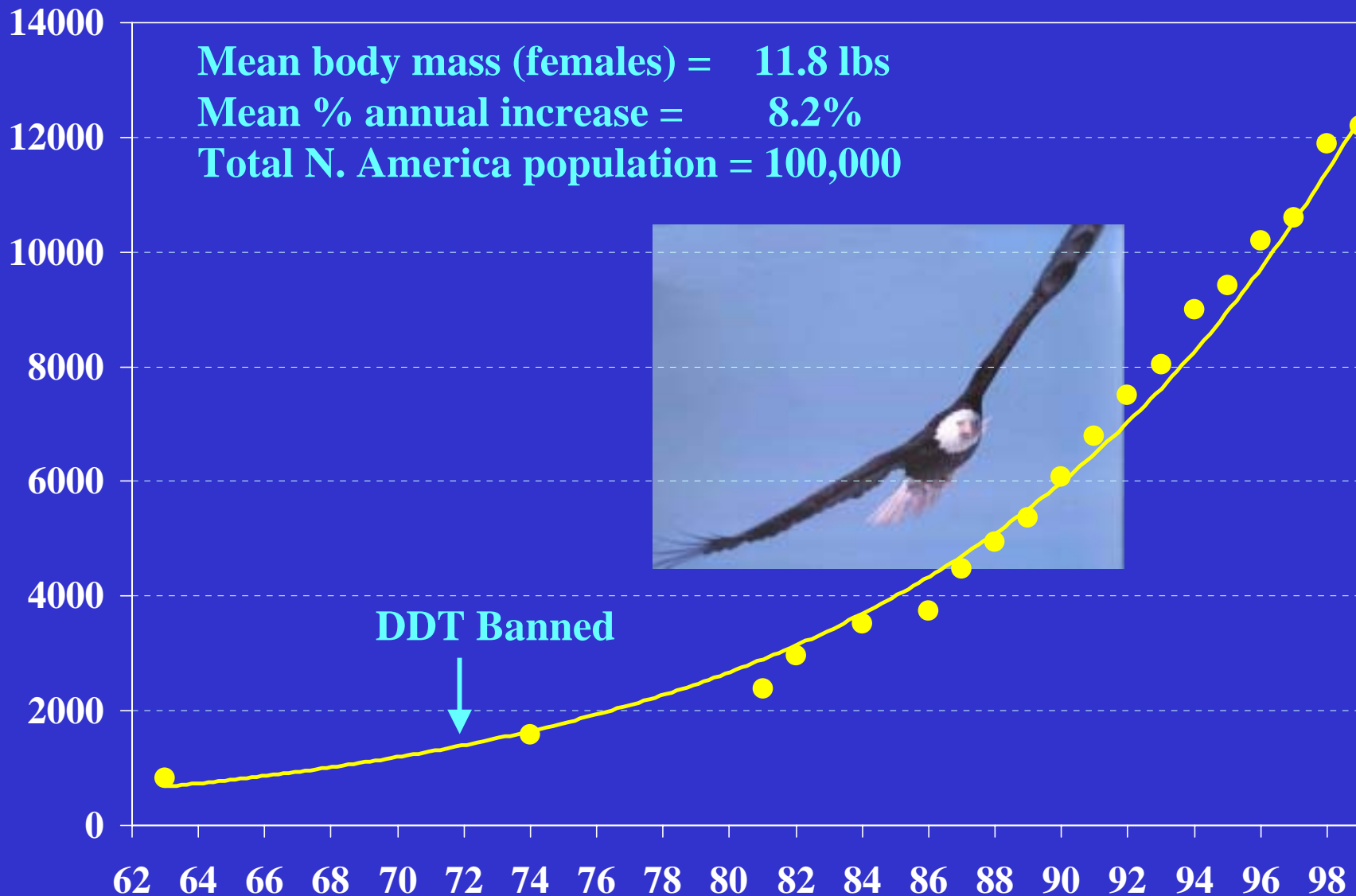
Rank	Common Name	Mass (lbs)
29	Snowy owl	5.0
30	Common eider	4.9
31	Black vulture	4.8
32	Brandt's cormorant	4.6
33	Masked booby	4.6
34	Pelagic cormorant	4.5
35	Turkey vulture	4.2
36	Great black-backed gull	4.0

Population Status of the 14 Bird Species in N. America with Mean Body Masses >8 lbs (3.6 kg)

Rank	Species	Mass (lbs)	Years covered	Population trend	MAPC*	Current population
1	Mute swan	26.0	1966-2000	Increase	+13.9	>7,000
2	Trumpeter swan	25.1	1968-2000	Increase	+5.9	24,000
3	California condor	22.3	1987-2002	Increase	+	74
4	Wild turkey	16.3	1959-1994	Increase	+6.1	4,000,000
5	Tundra swan	15.7	1970-2001	Increase	+1.7	189,000
6	Am. white pelican	15.4	1980-2000	Increase	+2.9	120,000
7	Whooping crane	12.8	1966-2002	Increase	+5.4	274
8	Sandhill crane	12.8	1966-2000	Increase	+6.9	650,000
9	Yellow-billed loon	12.1	2001	Unknown		>3,000
10	Bald eagle	11.8	1966-2000	Increase	+8.0	70,000
11	Golden eagle	10.8	1980-2000	Increase	+4.8	
12	Canada goose	9.2	1966-2002	Increase	+10.5	5,500,000
13	Common loon	9.1	1966-2000	Increase	+2.9	>250,000
14	Brown pelican	8.2	1980-2000	Increase	+2.1	93,000

*Mean annual percent change in population

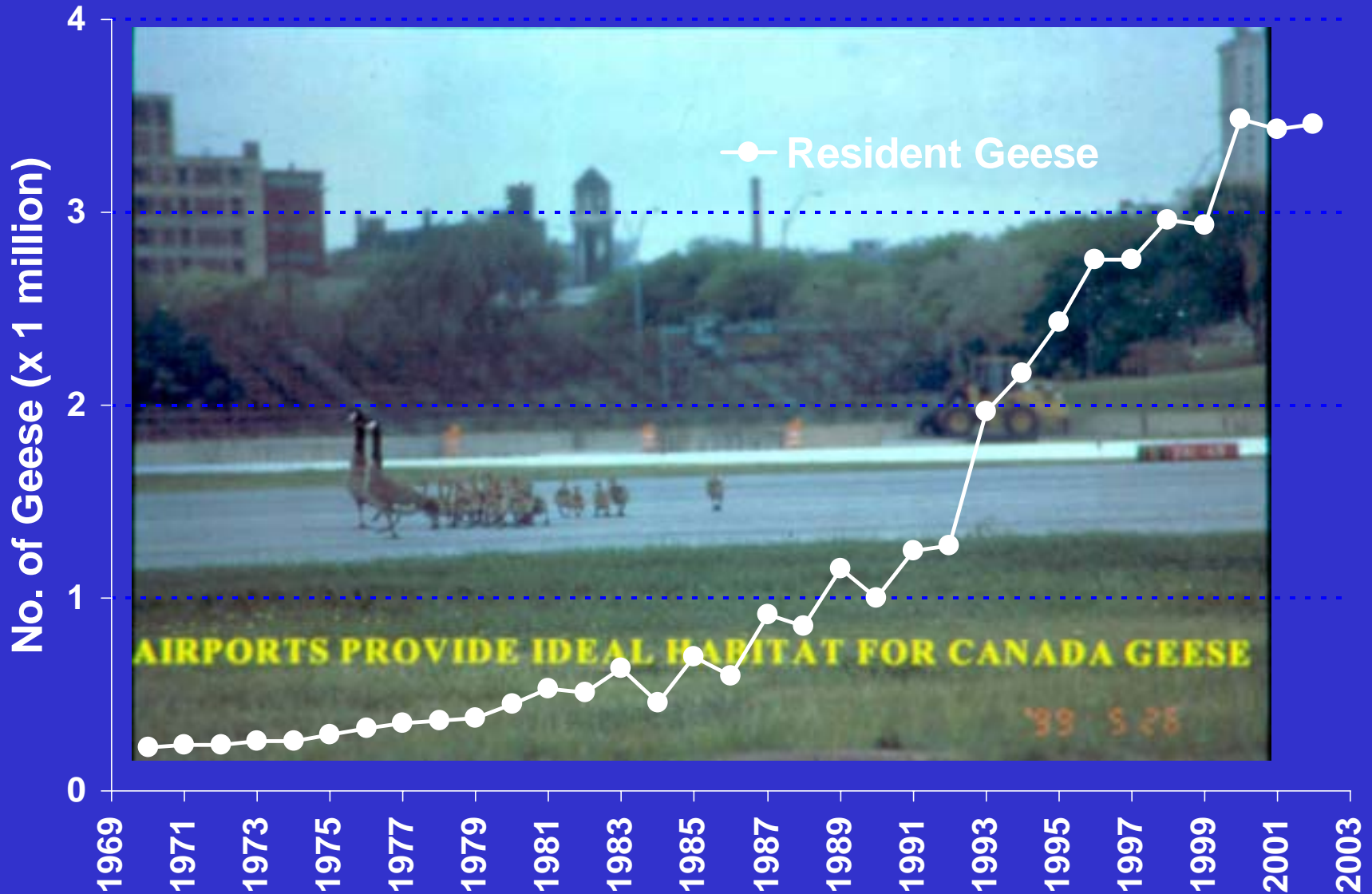
Nesting Bald Eagle Population in Contiguous USA (1963-1999)



Bald Eagle (12 lbs) through leading edge of wing on C-130, Sep 2000

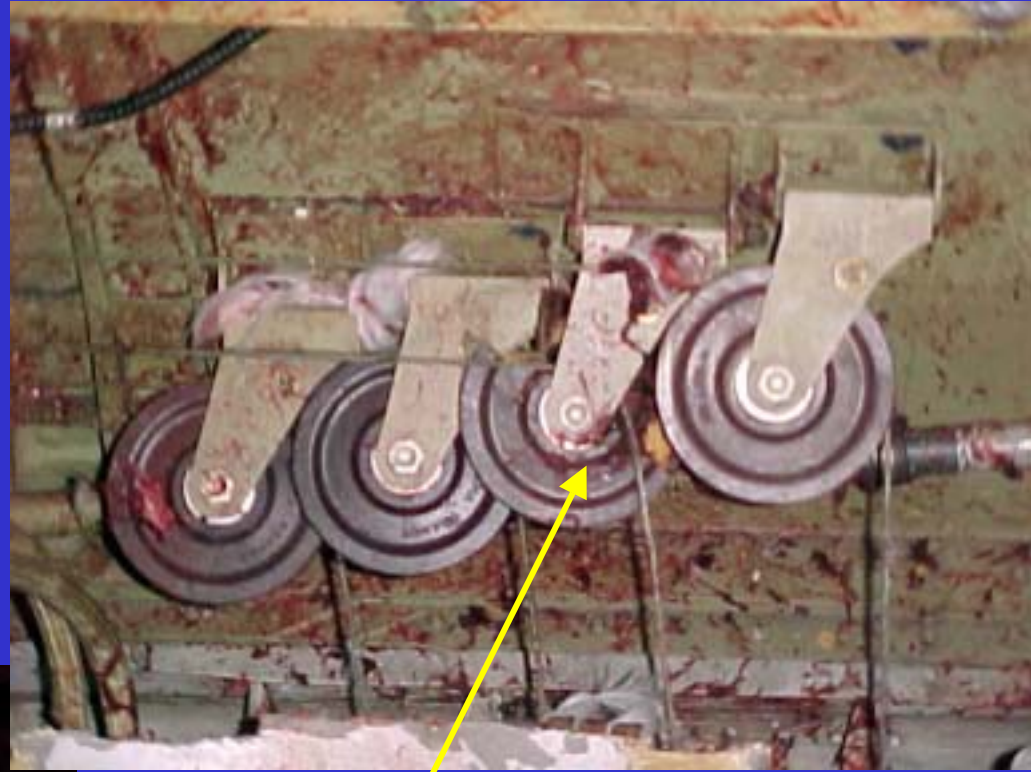


RESIDENT (NON-MIGRATORY) CANADA GOOSE POPULATION IN NORTH AMERICA INCREASED FROM 1 MILLION IN 1990 TO 3.5 MILLION IN 2002.



(Source U.S. Fish and Wildlife Service)

Collision of Canada goose (9 lbs) with ATR 42 (Commuter Turboprop) at 5,000 feet AGL in Pennsylvania, October 2001



Engine power-control cables disabled

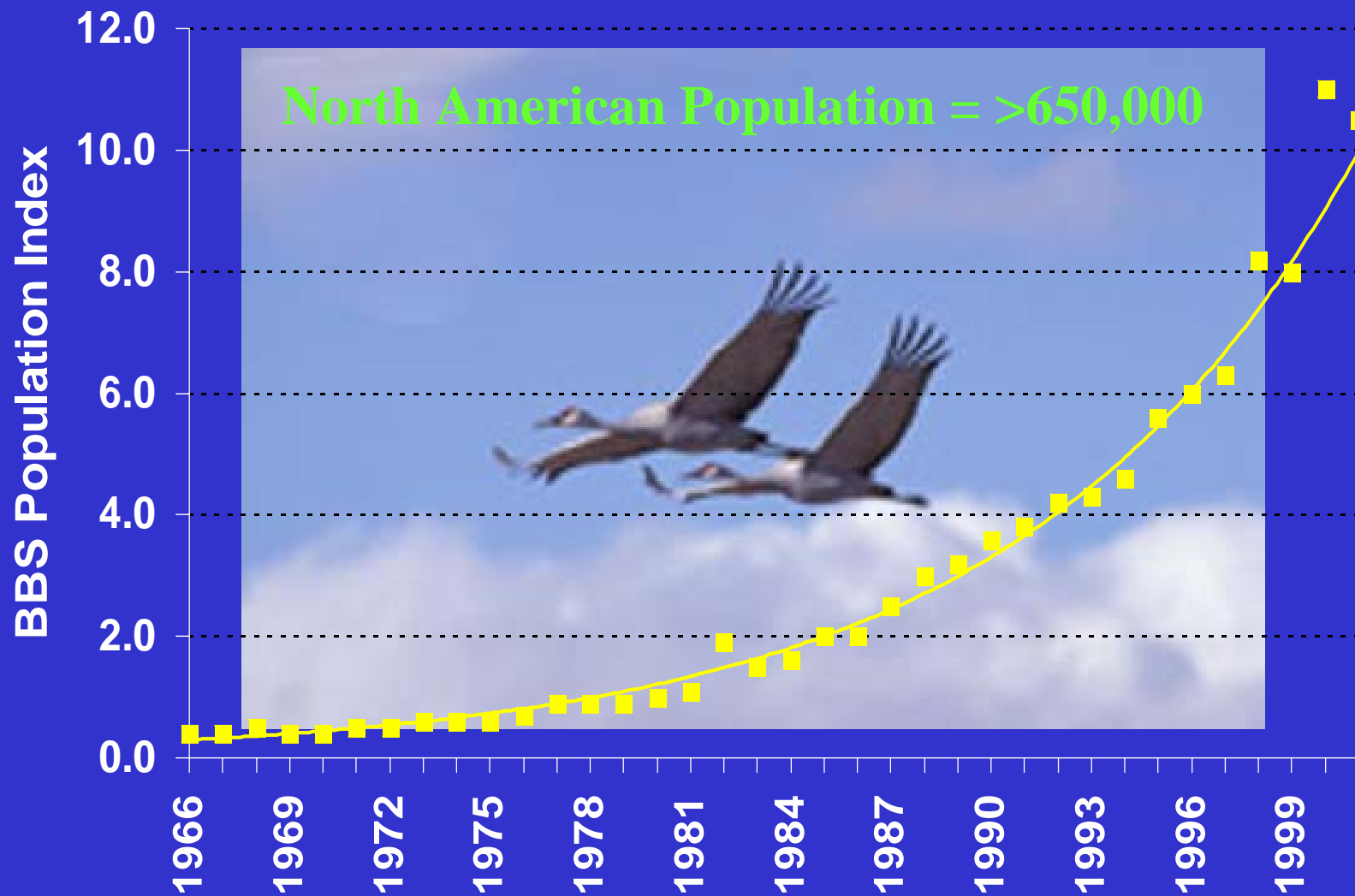


CANADA GOOSE INGESTION INTO #1 ENGINE, B-727 ON DEPARTURE AT KANSAS CITY INTERNATIONAL AIRPORT, APRIL 2000



Engine destroyed, 7 flights cancelled, aircraft out of service for 36 hours

GROWTH OF BREEDING POPULATION OF SANDHILL CRANES IN WISCONSIN, 1966-2001

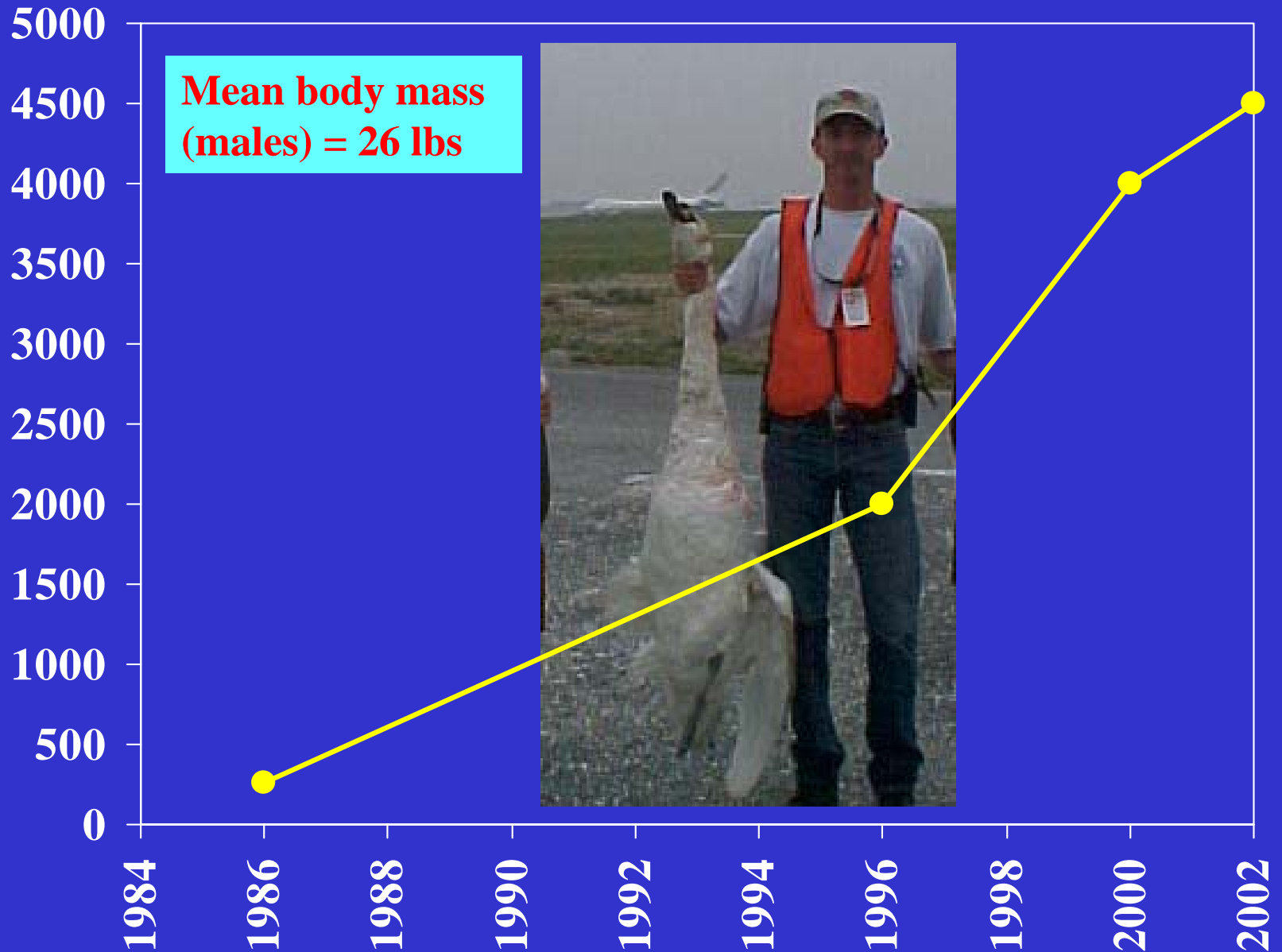




**Sandhill crane (12 lbs)
through radome of
B-727 at Tampa, FL**

Dec 1994

Maryland Wild Mute Swan Population (1986-2002)

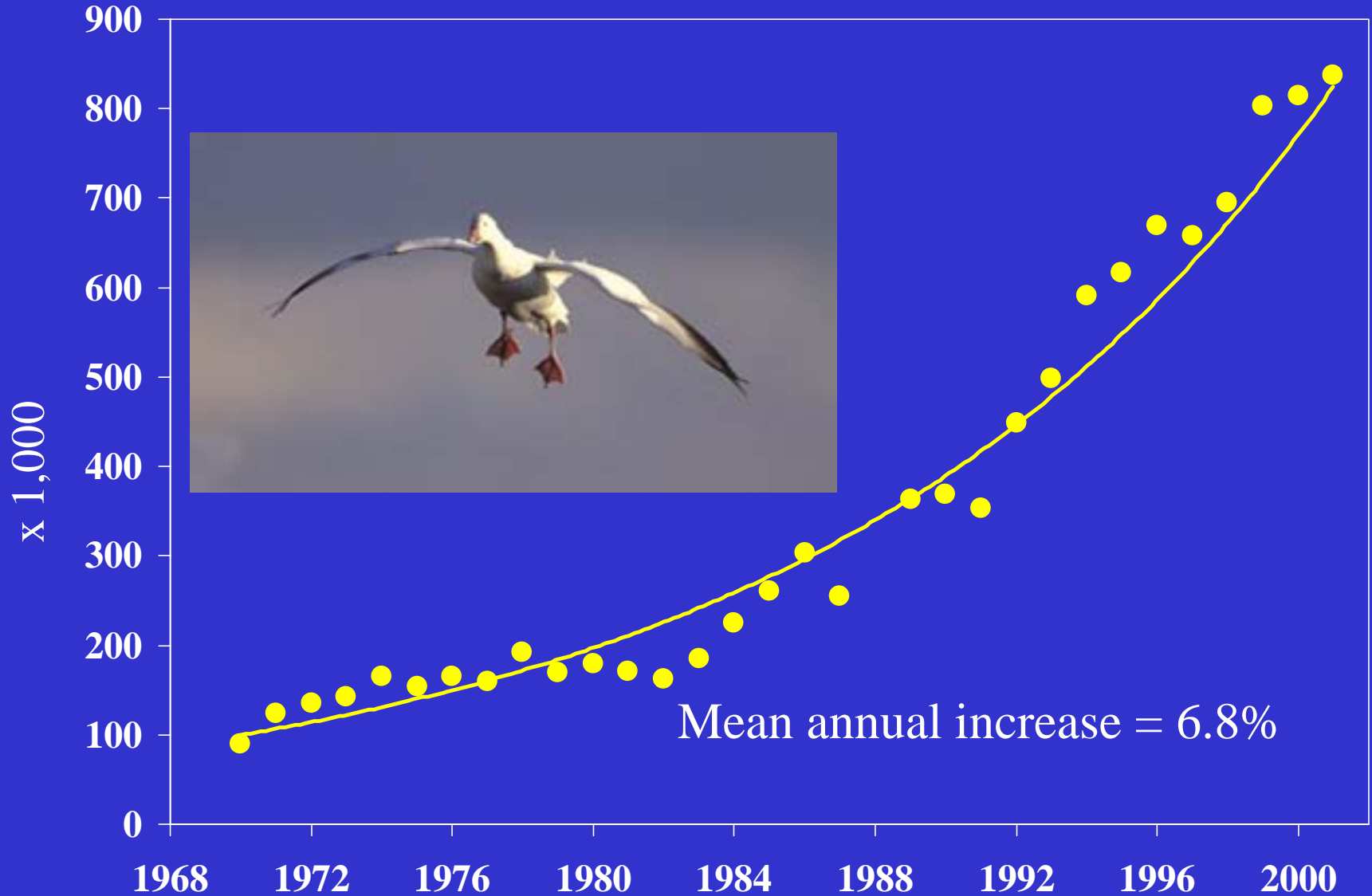


Wild turkey population in USA (1959-2000)



Greater Snow Goose Population (1970-2001)

(Winters from New Jersey to North Carolina)





On 8 Nov 2000, a Mesaba Airlines Saab 340 landing at Aberdeen SD flew through a flock of 20 snow geese at 600 ft AGL. One goose hit the windshield, causing minor damage by dislodging the wiper arm.

The wiper arm hit the prop, causing more serious damage



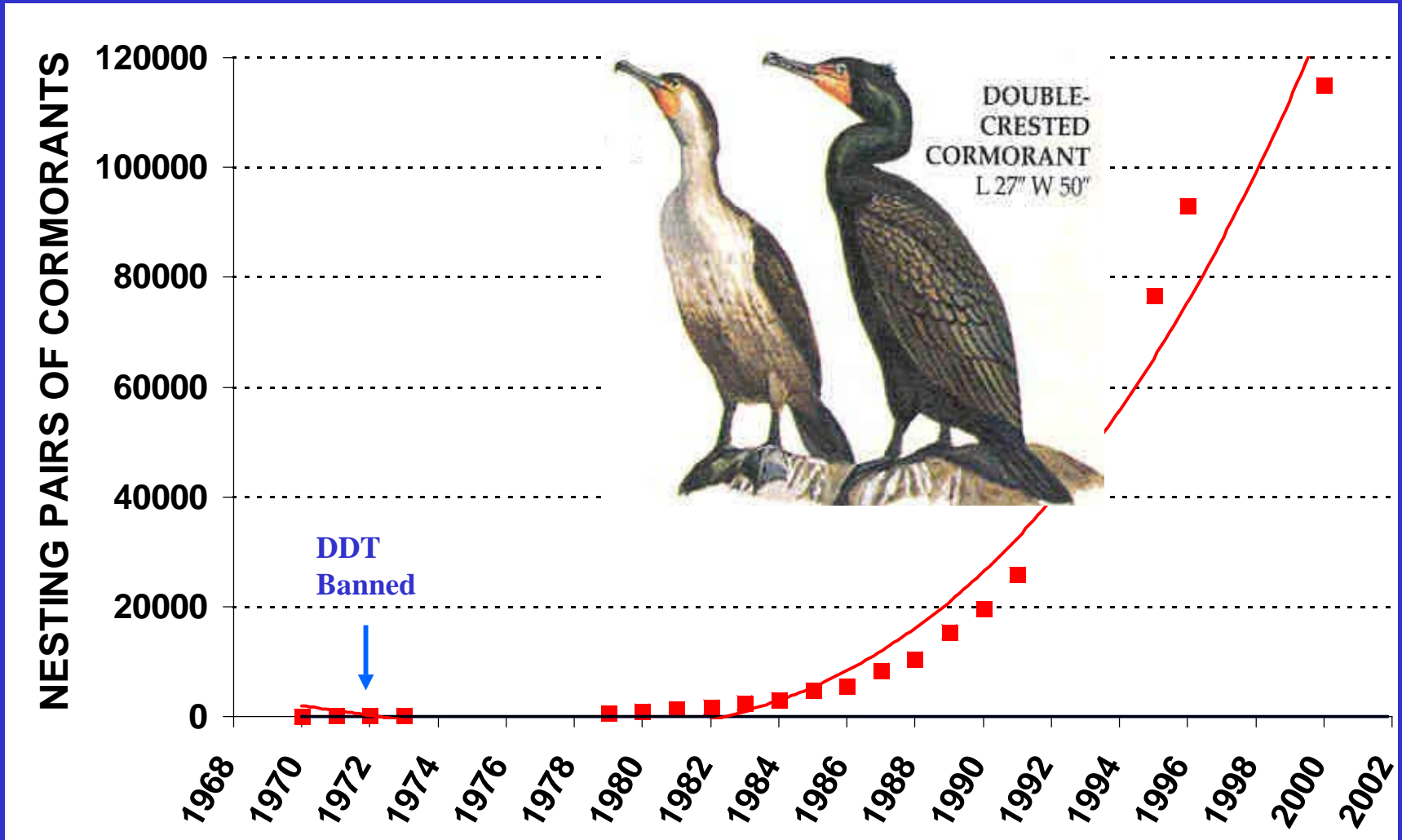


The propeller threw the wiper parts through the fuselage in at least 3 places, causing even more serious damage!

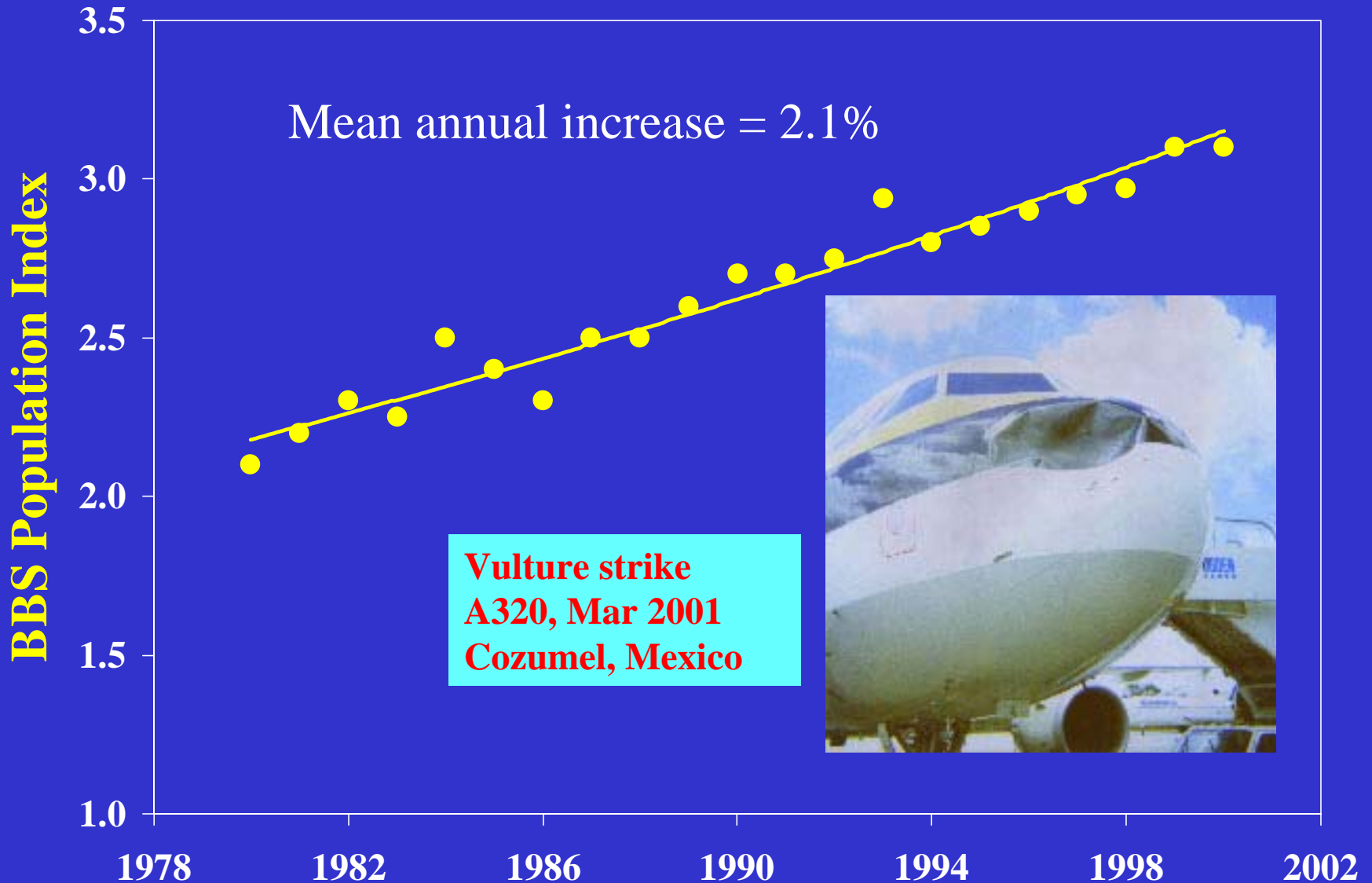
A piece of the wiper embedded into the thigh of a passenger, causing increasingly more serious damage (especially if the passenger knows a good lawyer)!



BREEDING POPULATION OF CORMORANTS INCREASED 1000-FOLD ON THE GREAT LAKES, 1972-2000



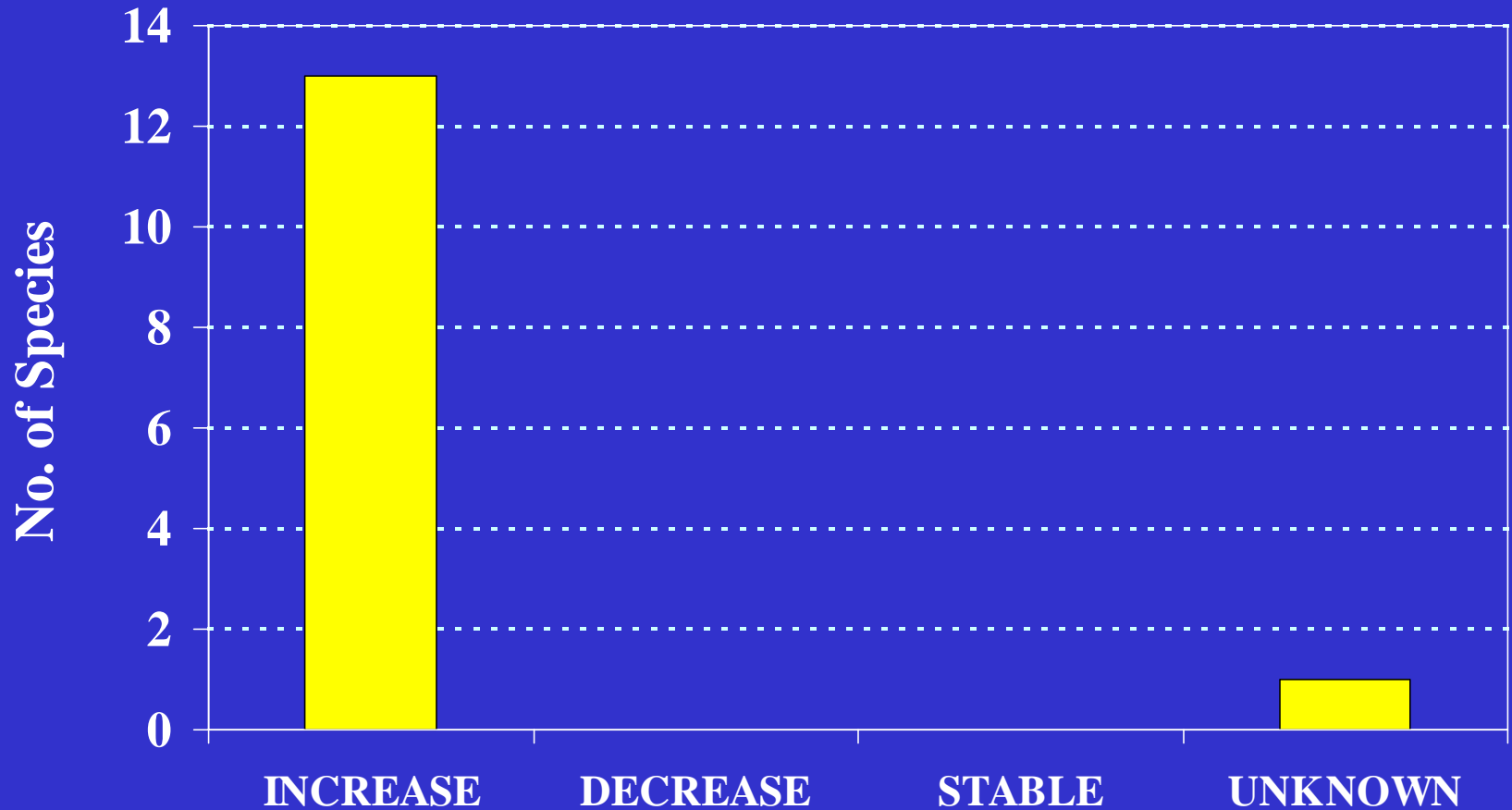
Turkey vulture population increase in N. America, 1980-2000



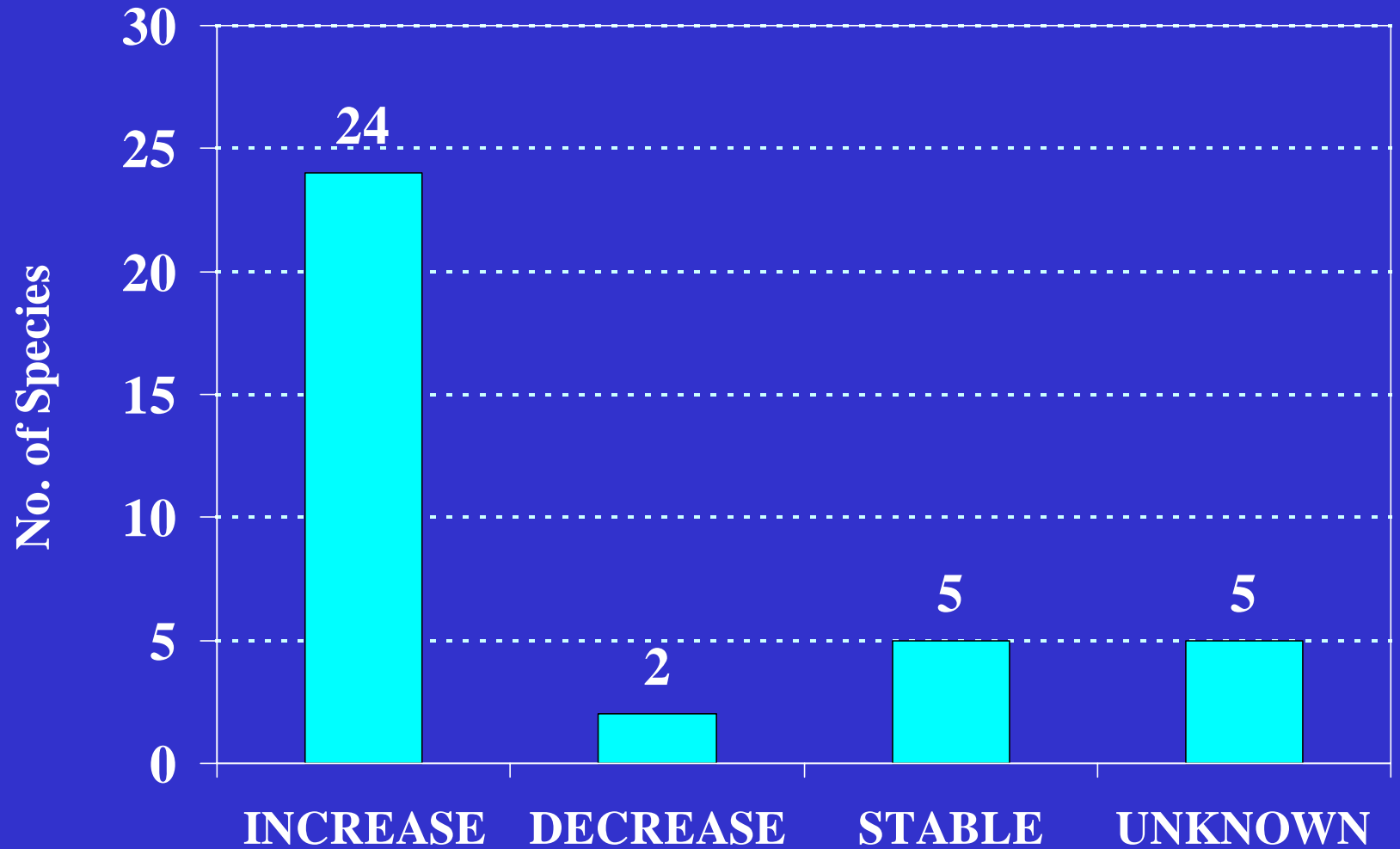


Several thousand black vultures at landfill in Mexico, 2001

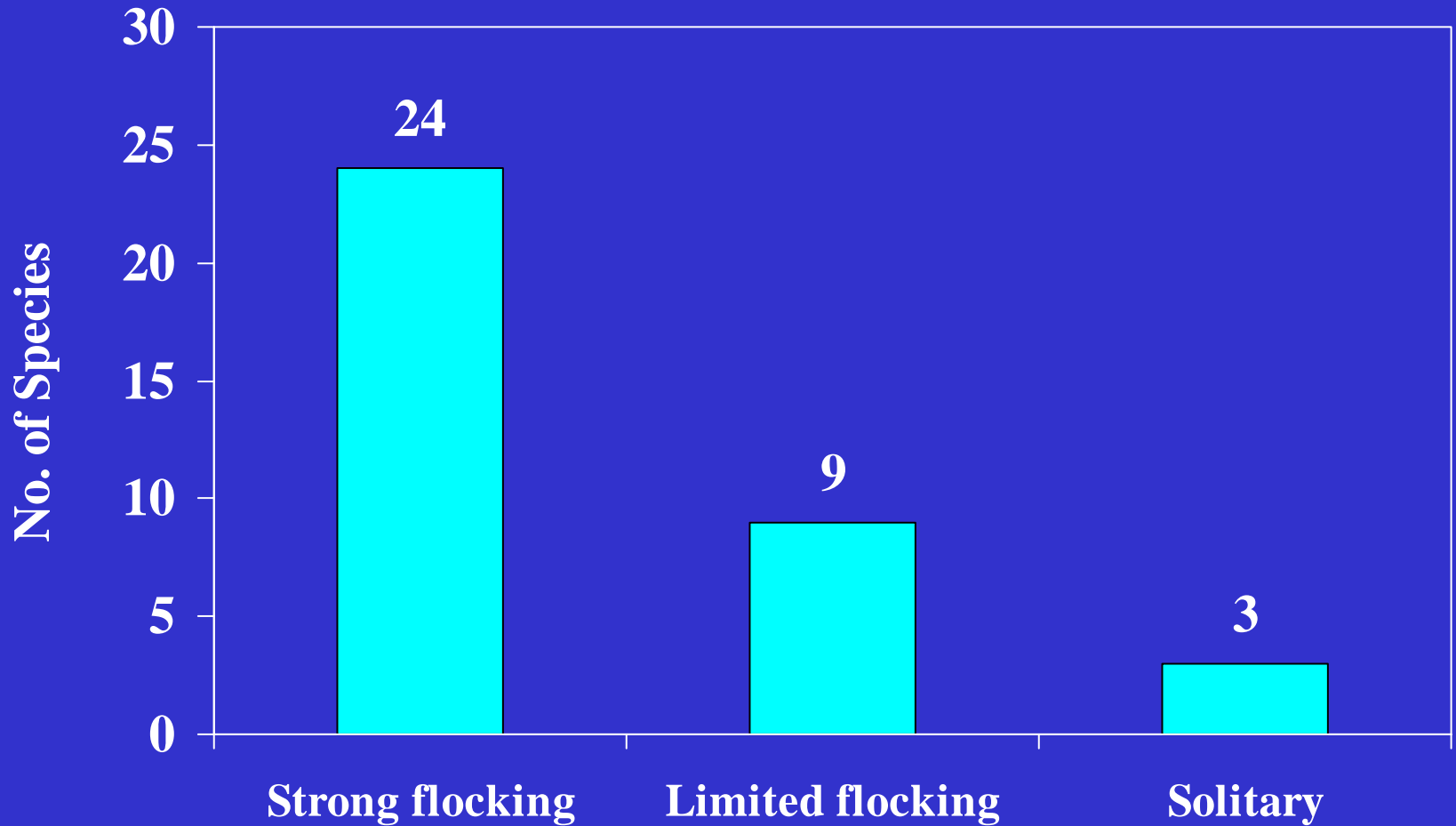
Population Trend Status of the 14 Largest Species of Birds (>8 lbs) in North America, 2002



Population Trend Status of the 36 Species of Large (>4 lbs) Birds in North America



Flocking Status of the 36 Species of Large (>4 lbs) Birds in North America



Number of reported strikes with civil aircraft for species with mean body mass >4 lbs, USA, 1990-2001

Species	Reported strikes*			
	Total	With damage	With substantial damage	No. (%) involving >1 bird
Total (all species >4 lbs)	1,568	789	261	473 (31)
Total (all species >8 lbs)	1,062	549	167	417 (40)

*Over 22,000 strikes were reported in which species of bird was not identified.



Striking multiple birds increases the probability of multiple engine ingestions!

**Increased populations of large
birds influence decisions
regarding high-speed (>250 kt)
flight below 10,000 ft**

Large-bird issues related to high-speed (>250 kt) departures below 10,000 ft AGL

- Most transport aircraft cannot accelerate and climb at the same time.
- $E = \frac{1}{2} MV^2$ (Increasing velocity of aircraft is more critical than increasing mass of bird)

Hitting 4 lb bird @250 kts = 38,000 ft-lbs.

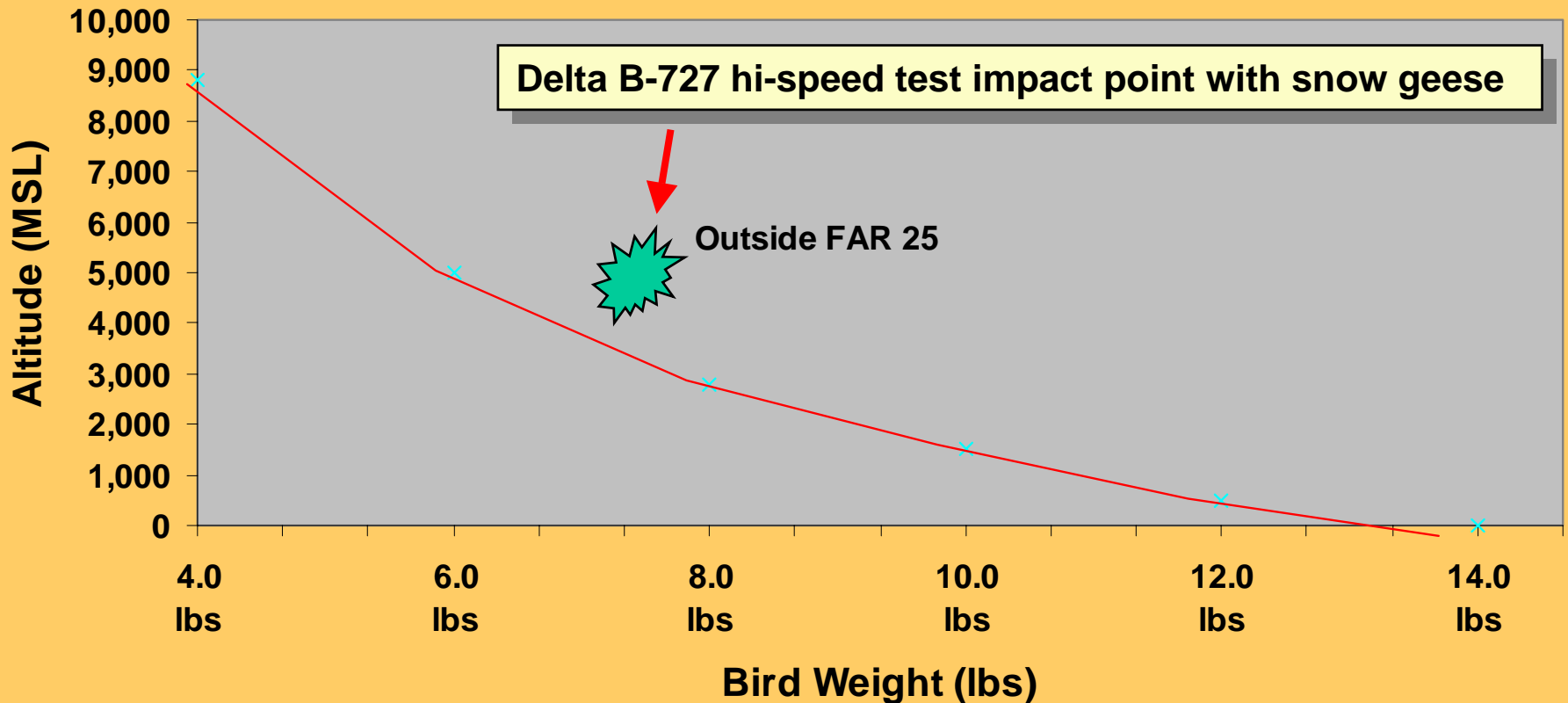
Hitting 4 lb bird @300 kts = 55,000 ft-lbs.

(20% increase in velocity = 44% increase in impact energy)

When impact energy is beyond certification standards

Altitude at which bird impact energy exceeds FAR 25 Certification Standards

280 kts IAS

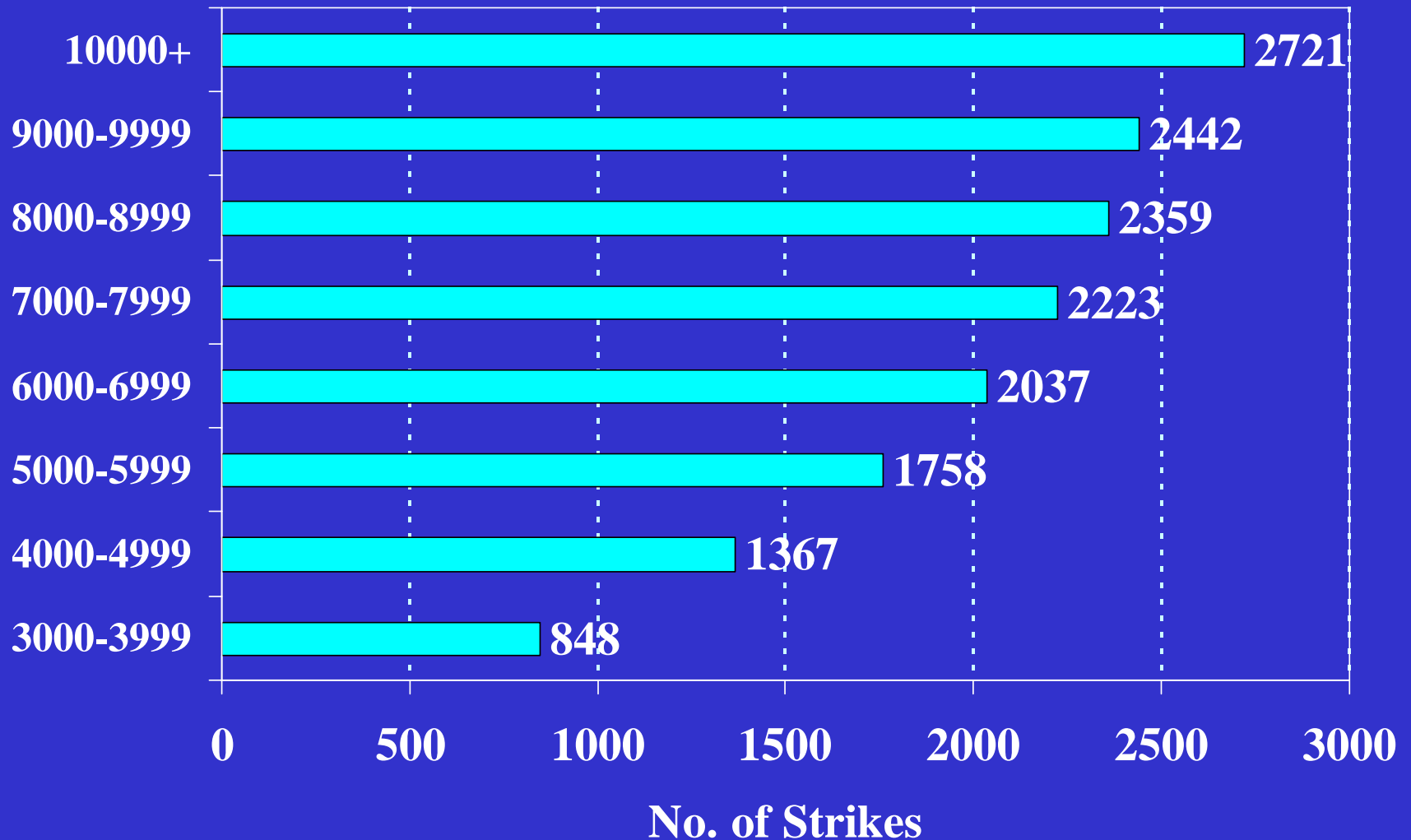


Delta B-727 IAH Accident

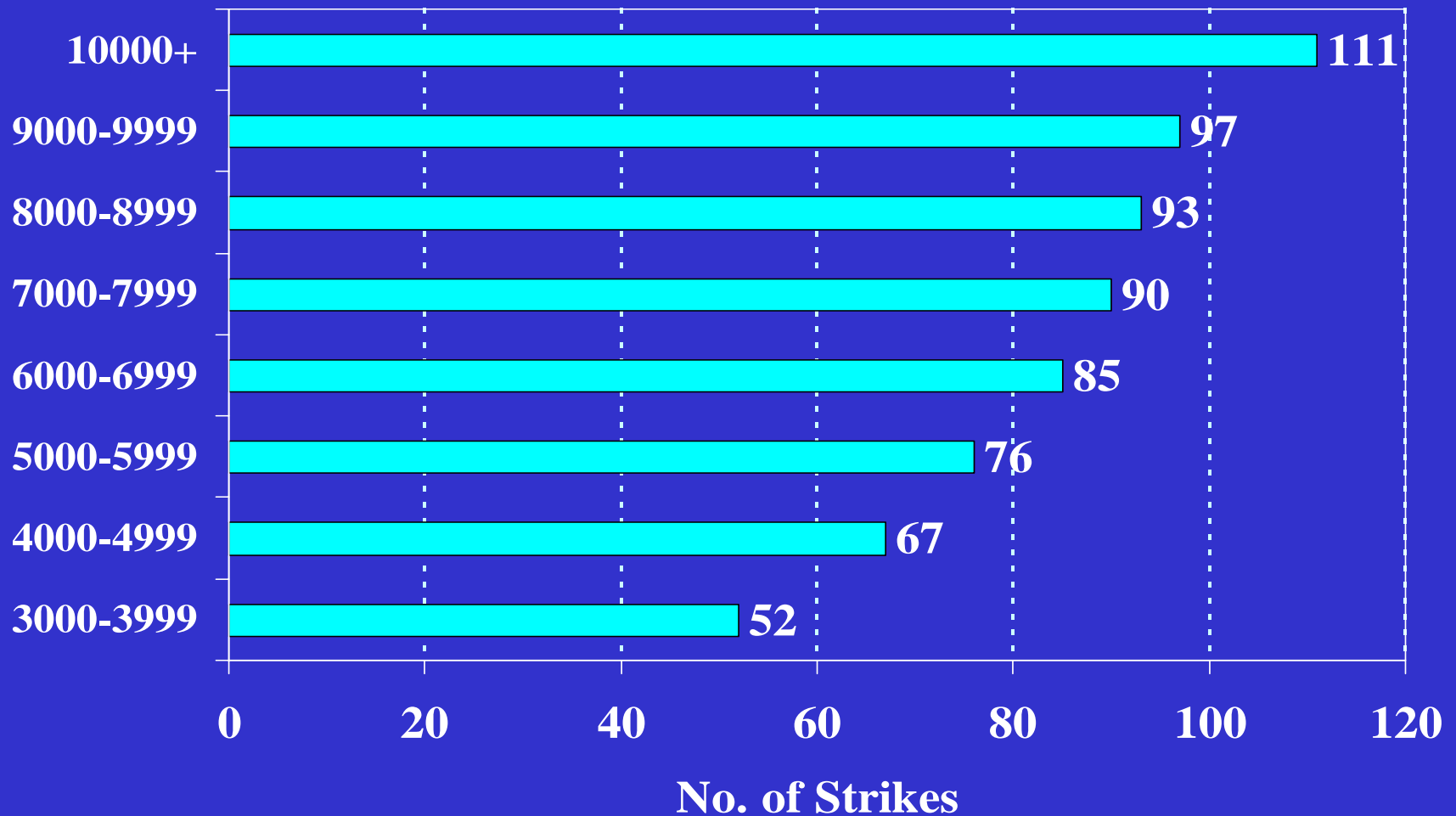


- **High-speed climb test: 280 kts at 6,000' on 8 Jan 1998.**
- **Aircraft encountered flock of snow geese (6-lb birds).**
- **All 3 engines destroyed or damaged.**
- **F/O's pitot tubes destroyed-F/O's instrument's lost.**
- **Radome & radar torn off aircraft.**
- **Leading edge flaps penetrated in 2 places.**

Cumulative number of reported bird strikes with civil aircraft above 3000 ft (AGL), USA, 1990-2002



Cumulative number of reported bird strikes with civil aircraft above 3000 ft (AGL) causing substantial damage, USA, 1990-2002



Conclusions

- 1. We have done outstanding job of wildlife conservation for large, flocking bird species in N. America over past 30 years.**
- 2. Aircraft and engines are not designed to withstand impacts by large (>4 lbs) birds, especially multiple strikes.**



Solutions

In light of:

- a). major increases in populations of large birds, and
- b). the frequency of multiple-bird strikes by these species.

The aviation industry must:

1. Reevaluate airworthiness standards.

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





**Three hits on tail - no damage
due to greater design strength**

Dash-8 on approach to Medford, OR

3 Jan 2003

Pilot received lacerations requiring 20 stitches



Bird species = Lesser Scaup (1.9 lbs)

Wednesday, September 27, 2000

Los Angeles Times

Sea Gull Blamed for Jet Engine Blast on Takeoff

LOS ANGELES – A sea gull was blamed Tuesday for an engine explosion that forced a KLM jumbo jet with 429 on board to return to Los Angeles International Airport last month for an emergency landing.

Several pieces of the engine plunged to earth near Dockweiler Beach, including a large slab of cowling that landed within 25 feet of beachgoers.

The pilot dumped 83 tons of fuel over the Pacific Ocean before landing.



EXHAUST CONE FROM KLM B-747, 27 AUG 2000

FAN BLADES FROM KLM B-747



FEATHER REMAINS FROM
ENGINE, IDENTIFIED BY
SMITHSONIAN BIOLOGIST

Western gull = 2.2 lbs



Herring gull ingestion causes uncontained engine failure on MD-11 during aborted takeoff run at west coast airport in USA, 2001



Herring gull= 2.2 lbs

Solutions

In light of:

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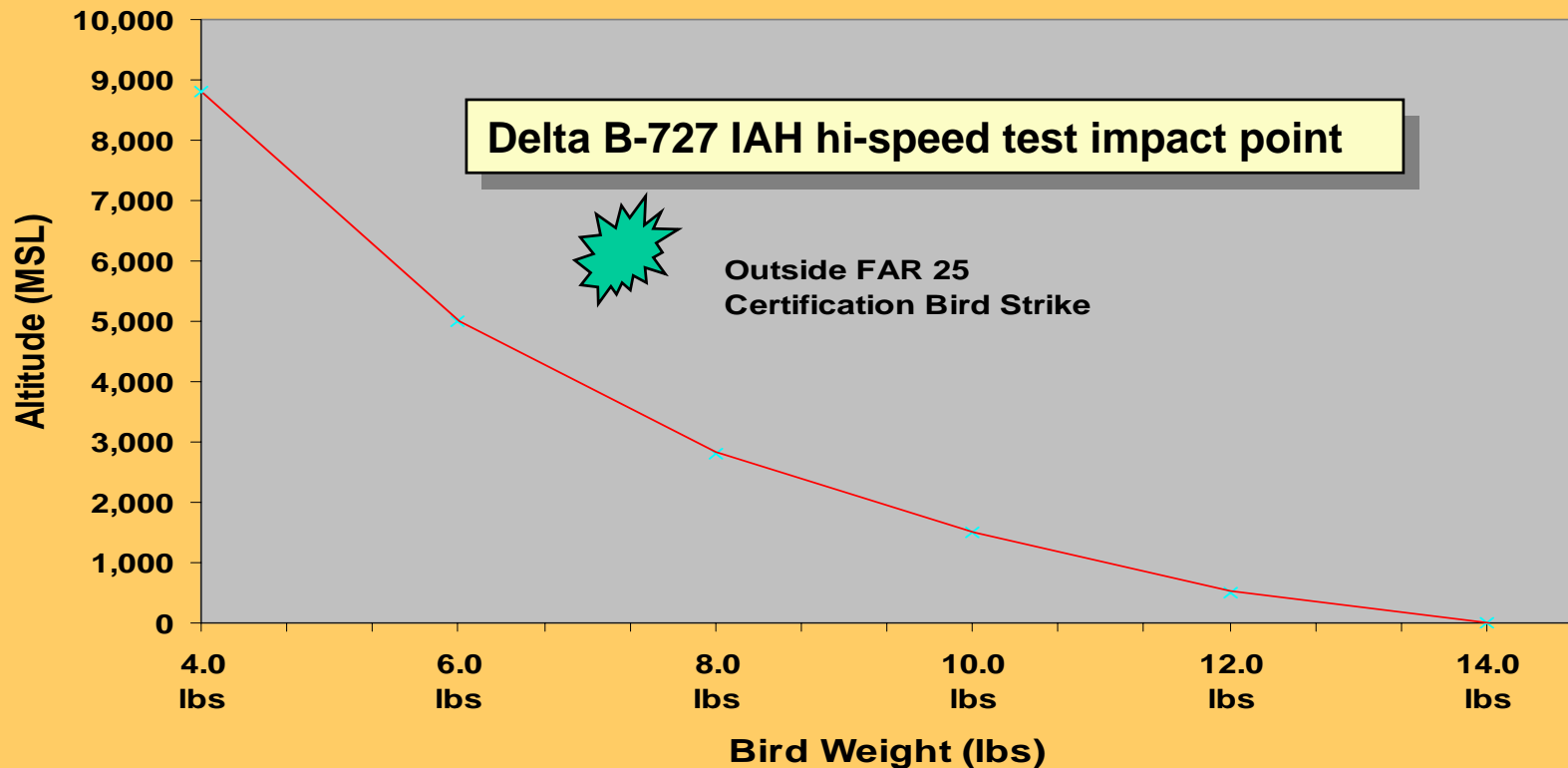
The aviation industry must:

- 1. Reevaluate airworthiness standards.**
- 2. Restrict airspeeds to 250 kts below 10,000 feet.**

When impact energy is beyond certification standards

280 kts IAS

Altitude at which bird impact energy exceeds FAR 25 Certification Standards



Solutions

In light of:

- a). major increases in populations of large birds, and
- b). the frequency of multiple-bird strikes by these species.

The aviation industry must:

- 1. Reevaluate airworthiness standards.**
- 2. Restrict airspeeds to 250 kts below 10,000 feet.**
- 3. Establish zero tolerance for hazardous bird species at airports.**

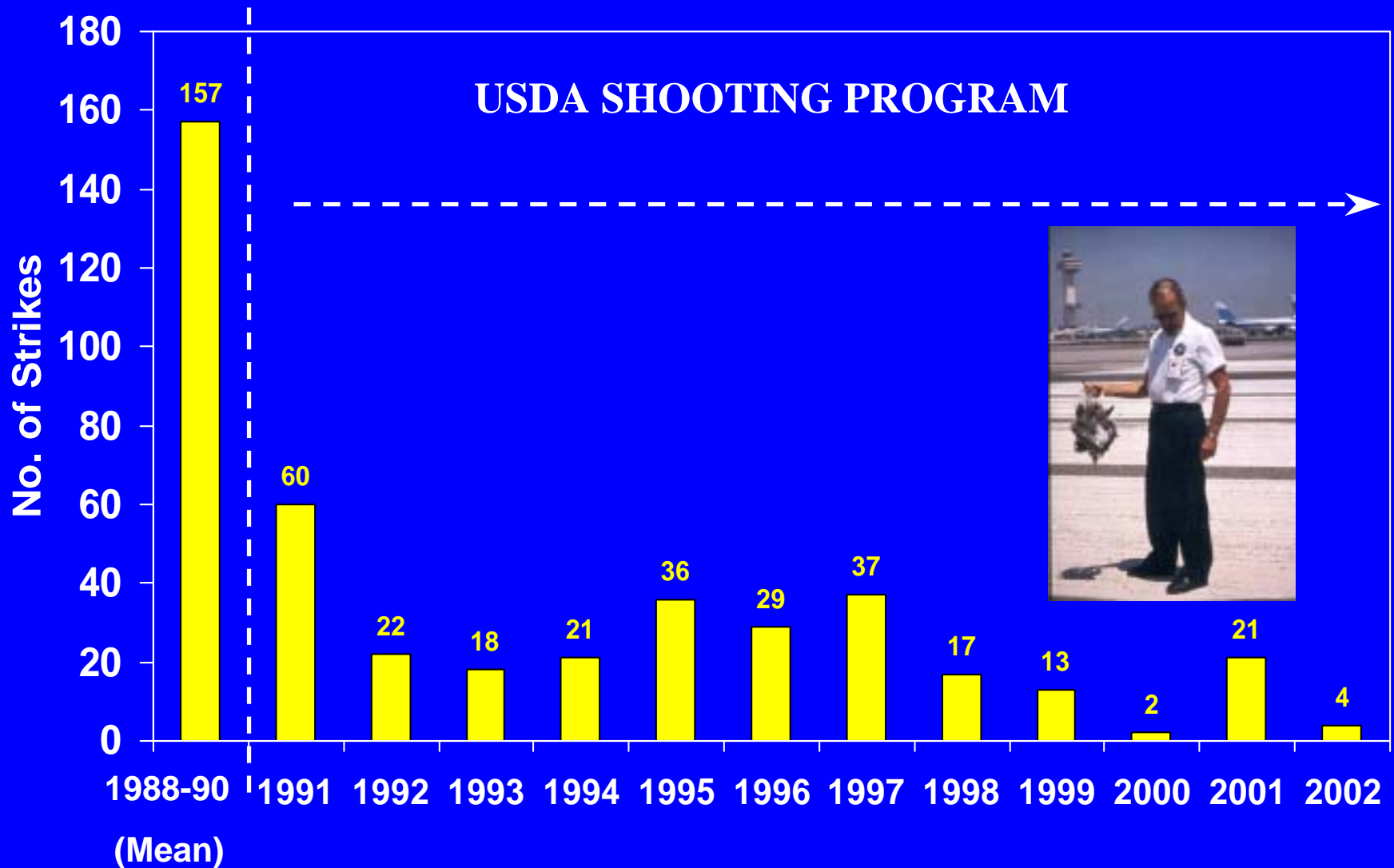
BIRDS

24 Airmen killed, \$190 million loss, Sept 1995

***Alaska crash raises the question:
How large a threat?***

The runway at Elmendorf Air Force Base
after the fatal September crash.

Number of Aircraft Striking Laughing Gulls, JFK International Airport, NY, 1988-2002



What can aviation industry do to minimize wildlife hazards at airports:

Pilots/air carriers

- Report all wildlife strikes and wildlife hazards on airports.
- Develop education/training programs regarding wildlife hazards.

Airport Operations

- Employ trained, qualified personnel (USDA/Wildlife Services) to assess and manage wildlife hazards at airports and surrounding areas.



**Sandra Wright, USDA,
Manager, FAA Wildlife Strike
Database for Civil Aviation**



**Carla Dove, Smithsonian: Provides
free bird identification via analysis
of feather remains**

**TO REPORT A STRIKE OR SEND
IN FEATHER REMAINS FOR
SPECIES ID:**

wildlife-mitigation.tc.faa.gov

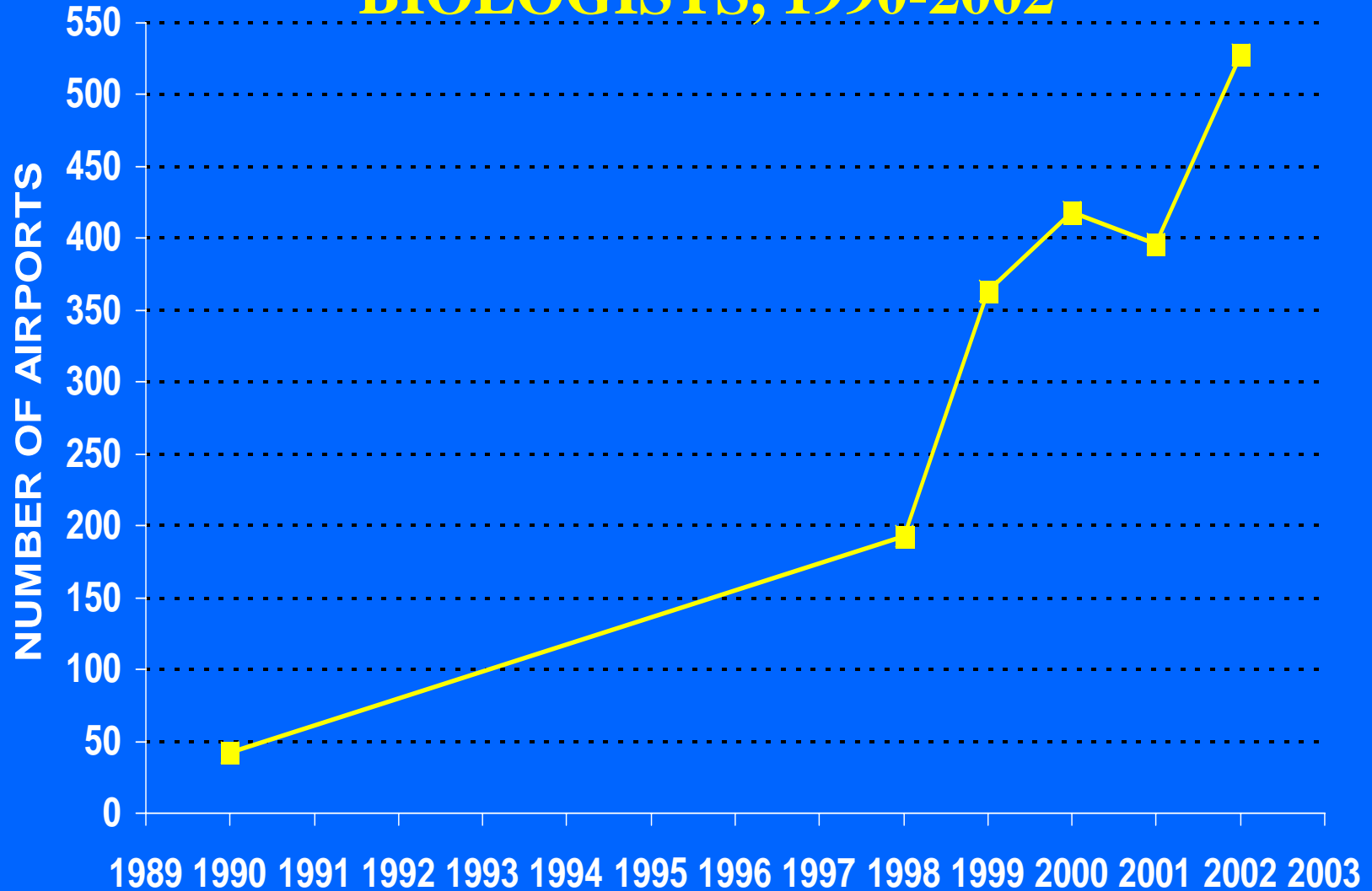
OR

www.birdstrike.org

MANAGING BIRD STRIKES IN THE AIRPORT ENVIRONMENT CREATES UNIQUE CHALLENGES REQUIRING USE OF PROFESSIONAL BIOLOGISTS

- 1. 90% of strikes are by native bird species federally protected by International Treaty (MBTA).**
- 2. Public is sensitive to killing of birds.**
- 3. However, birds rapidly habituate to most non-lethal frightening devices and techniques.**
- 4. Birds are dynamic, often flying ≥ 25 miles daily between nesting/roosting sites and feeding areas.**

U.S. AIRPORTS REQUESTING ASSISTANCE FROM USDA WILDLIFE SERVICES BIOLOGISTS, 1990-2002



**Safety is the absence of
precursors to a fatal
accident**

Our Goal:

Safer Skies for all who fly

Birds *and* People!



Thank You!