

A photograph of the National Museum of Natural History building, showing its classical architecture with columns and a large arched window. The sky is blue with some clouds.

NATIONAL MUSEUM *of* NATURAL HISTORY

☀ Smithsonian

SNARGE AT THE HEART OF IT ALL

Birdstrike Identification as the Foundation of Science, Policy and Practice

OVERVIEW

- **Staff**
- **A Day in the Life of the Feather Lab**
- **Foundations:**
 - **Science – trusted techniques**
 - **Policy Decisions – dependence on wildlife identification**
 - **Stability – what happens when foundation falters**
 - **Future – expanding our foundations**





Feather Lab Staff



Smithsonian Institution



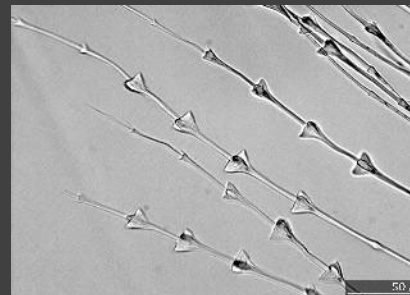
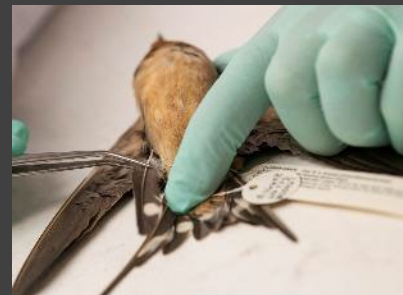
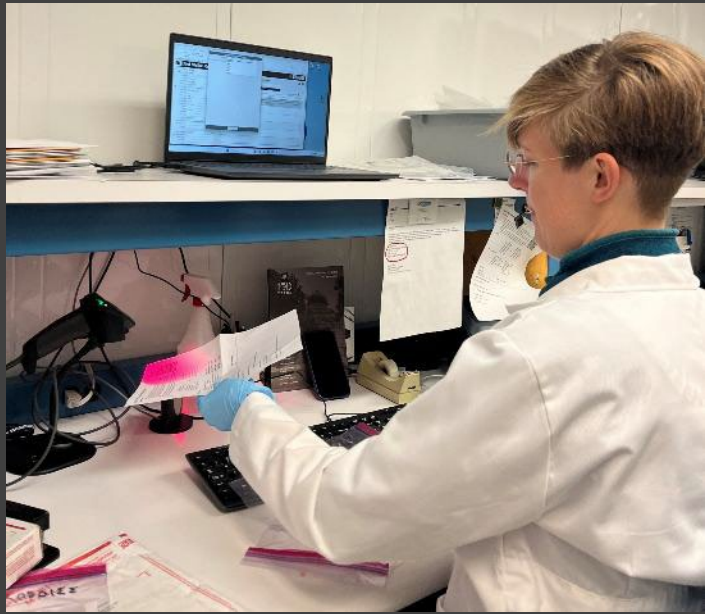


- **14,000 identifications FY25**
- **56 per working day (average)**
- **93% to species level**
- **3 business days (median)**

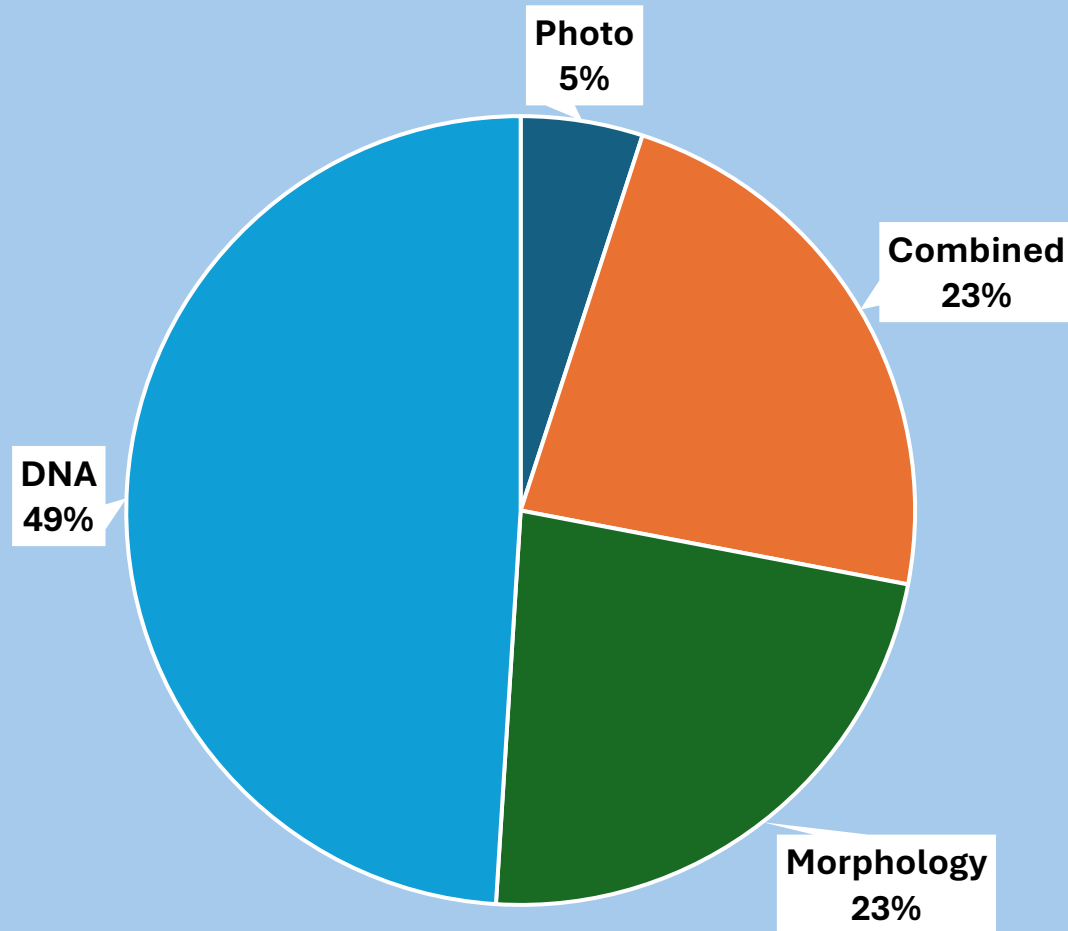


Identification Toolbox



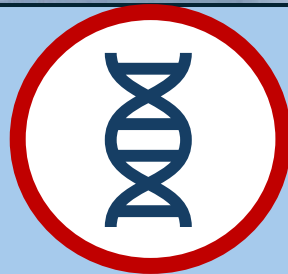


Feather Lab Methods Applied to Samples (%)



- **Percent samples exclusively identified using each method.**
- **All samples are subjected to verification based on location, date, and circumstantial information associated with the sample.**
- **Together we achieve 94% species level identifications and remaining samples to higher level (Genus, Family, Order).**

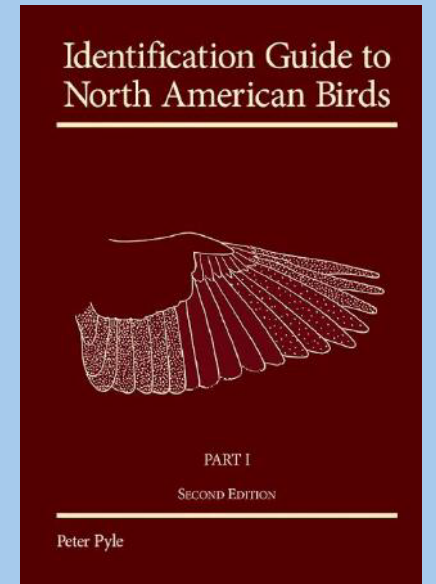
Foundational Science



"Whole Feather" – ID by Specimen Comparison

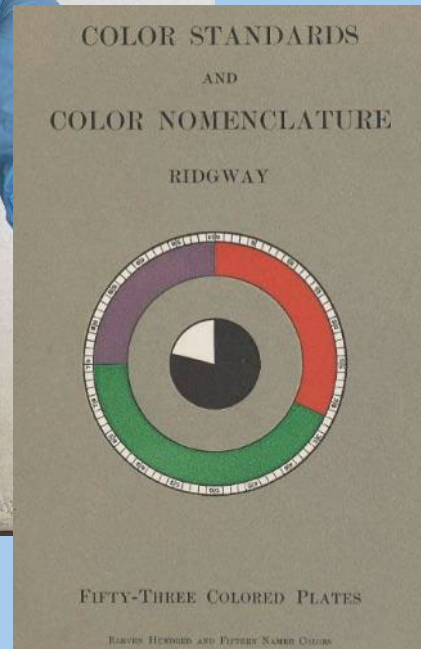
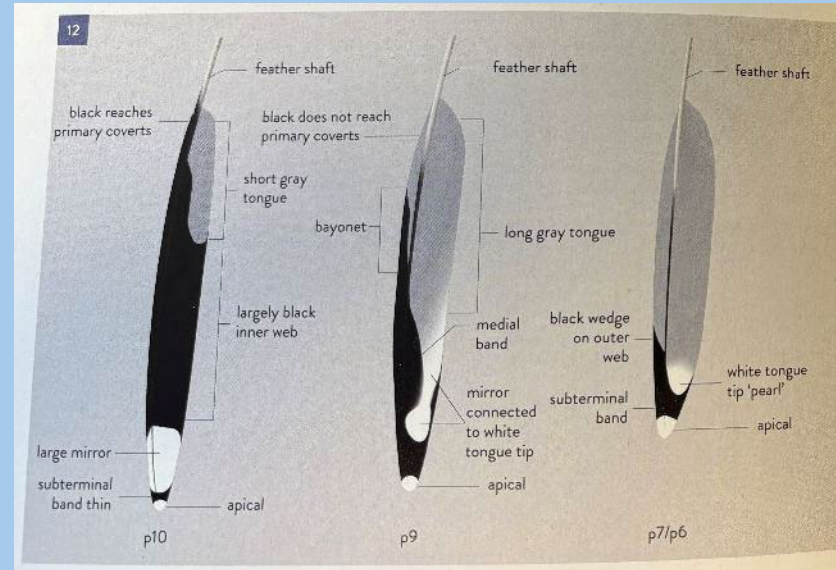


- **We identify birds by matching gross morphological characters against the Natural History Museum's collection of over 600,000 specimens.**
- **Lots of specimens help us tackle the problem of individual variation: with birds of both sexes and every age class from the entirety of a species' range, we can make the right match.**
- **Published references used in conjunction with specimens help us separate species using measurements.**





Pattern, Size, & Shape



Color



Immediate Impacts: Caspian Terns at Paine Field



**May 2026 engine
ingestion**



**Caspian Terns
observed at airport**

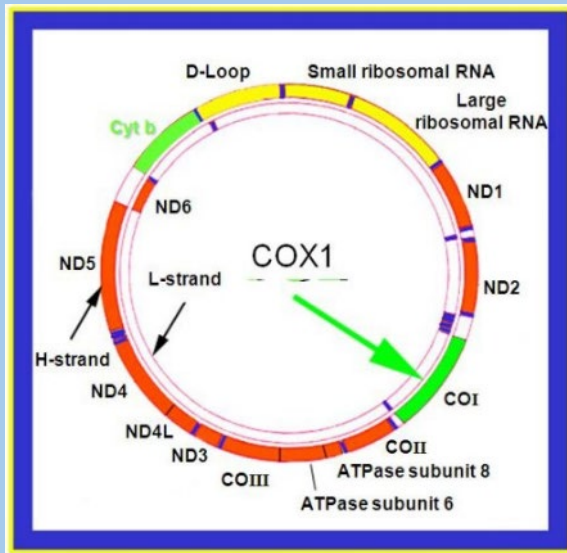


**Feathers confirmed that
terns, not gulls, were
interacting with aircraft**



Molecular methods for IDs

1. PRIMER



Cytochrome C Oxidase
Subunit I or CO1

Mitochondrial DNA

650 base pairs, ACTG

2. DATABASE/LIBRARY



BoLD: Barcode of Life

21 million animal sequences
40% birds – 95% of avian Order

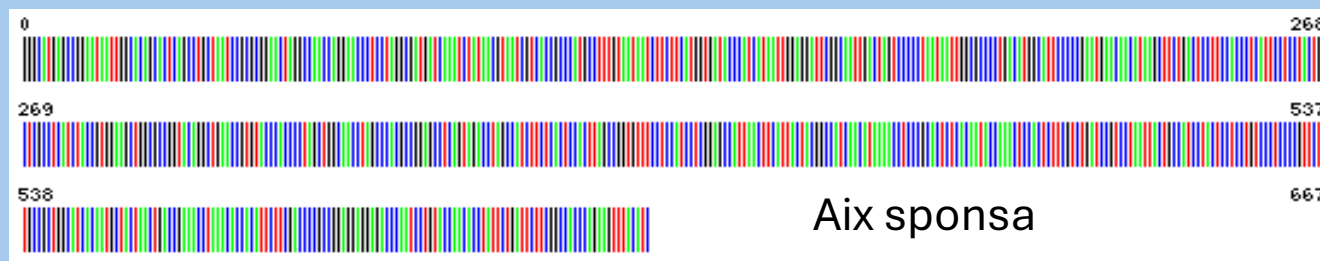
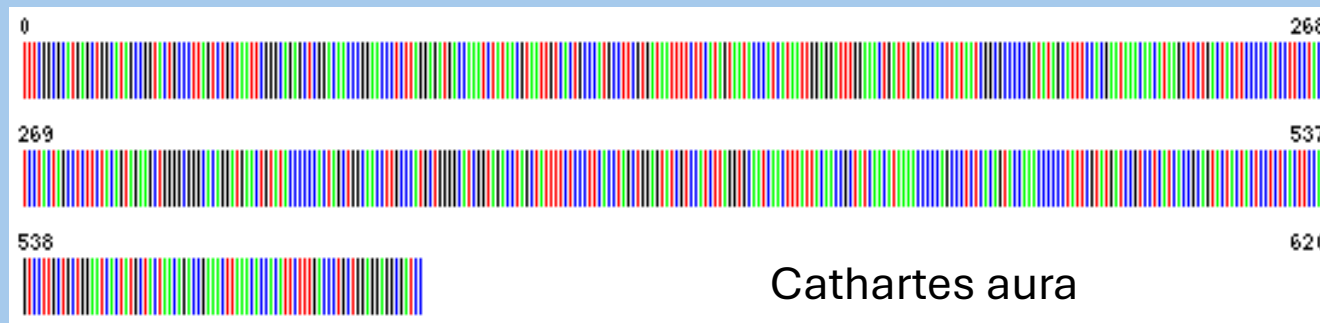
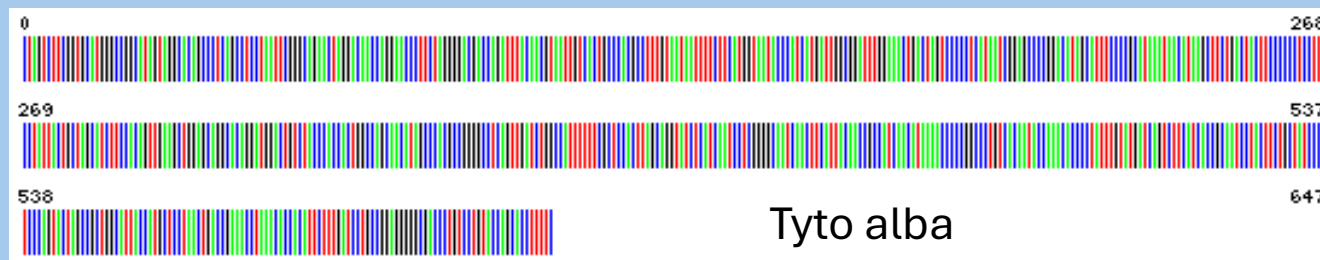
GenBank

47 million animal sequences
30% birds- 97% of avian Order



Molecular methods for IDs

The variation in the read of these sequences is the key to differentiate most organism to species level.





Molecular identification

3.

**Snarge - No visible feather
Damaging cases - Another line of evidence**

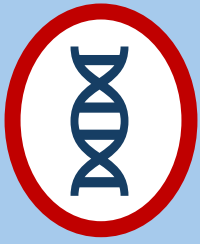


93.63% identification to species



Molecular identification





Osprey story

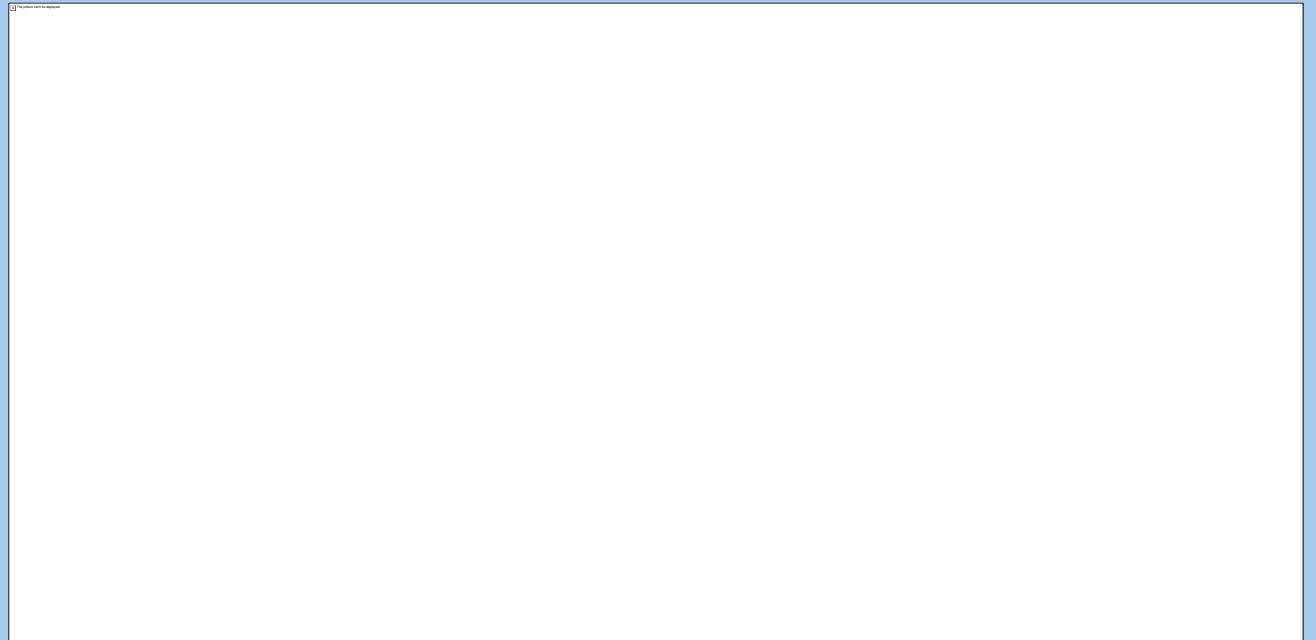
Birdstrike JFK

February 2026 (flight from Singapore)
July 2026 (flight from France)



Molecular id: *Pandion haliaetus*

**It is possible to tell the location
of the birdstrikes**



Osprey range

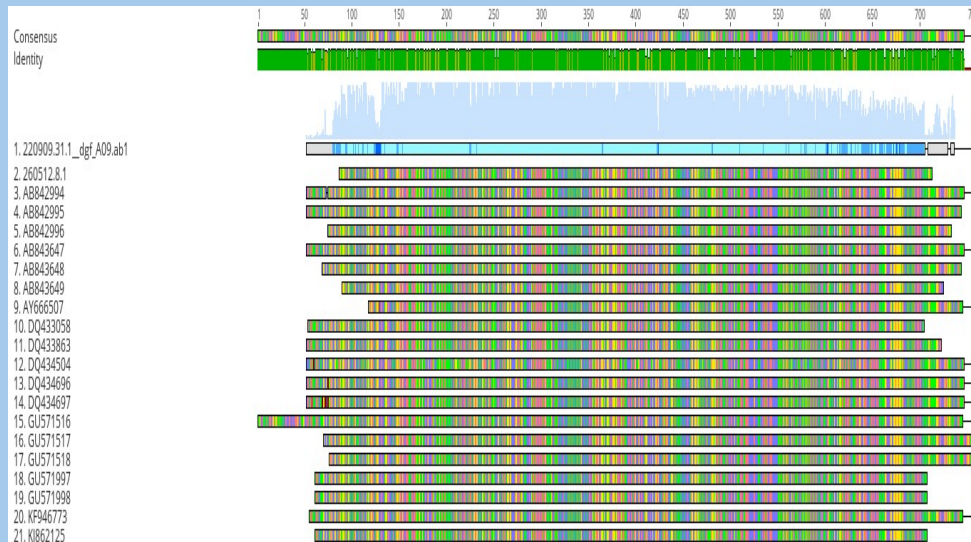
Detective work

Singapore, France or USA?

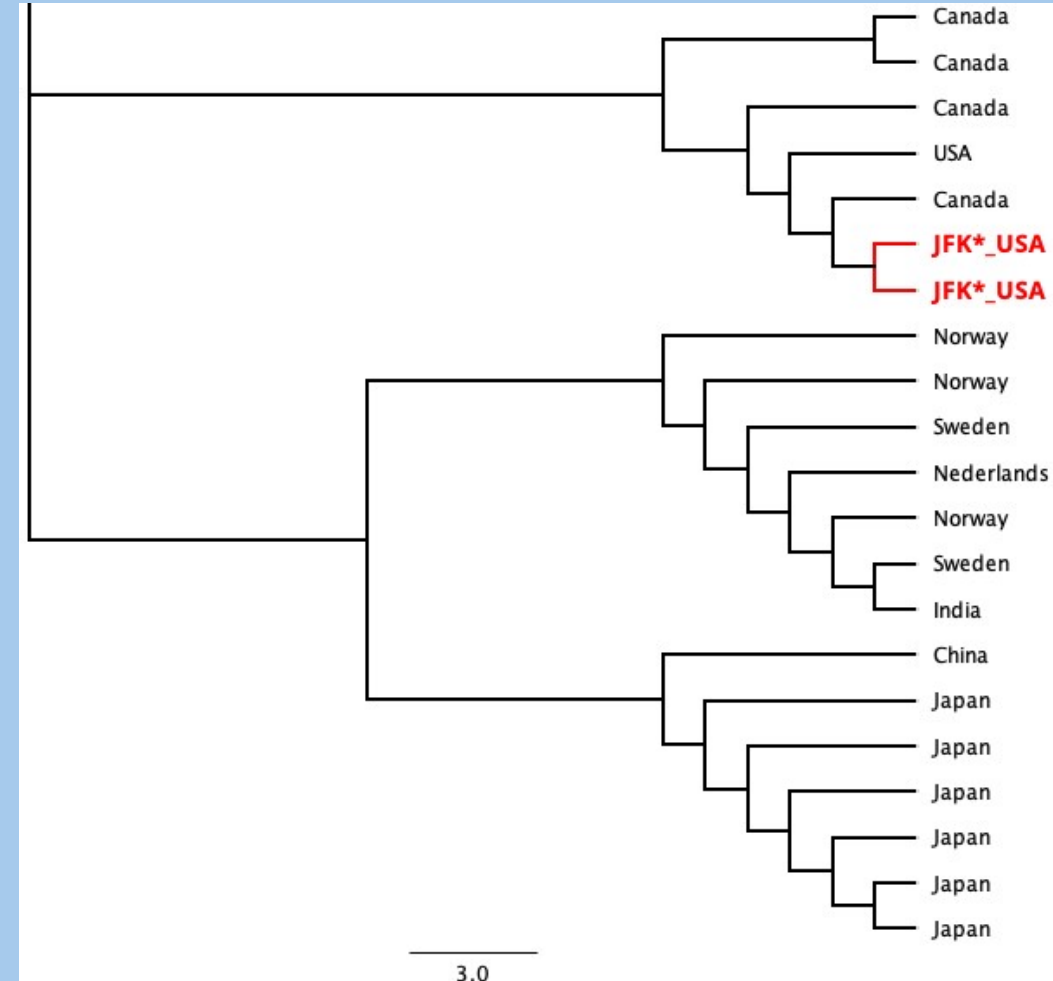
GenBank: Download sequences
from vouchered specimens

Align

Phylogenetic tree



Phylogenetic tree with locations



Both birdstrikes occurred at JFK



Policy Becomes Practice

Streaked Horned Lark

In 2013, the streaked horned lark (*Eremophila alpestris strigata*) was listed as a threatened subspecies under the Endangered Species Act.

US Fish and Wildlife
Services requirement to
report any SHL strikes

CO1:

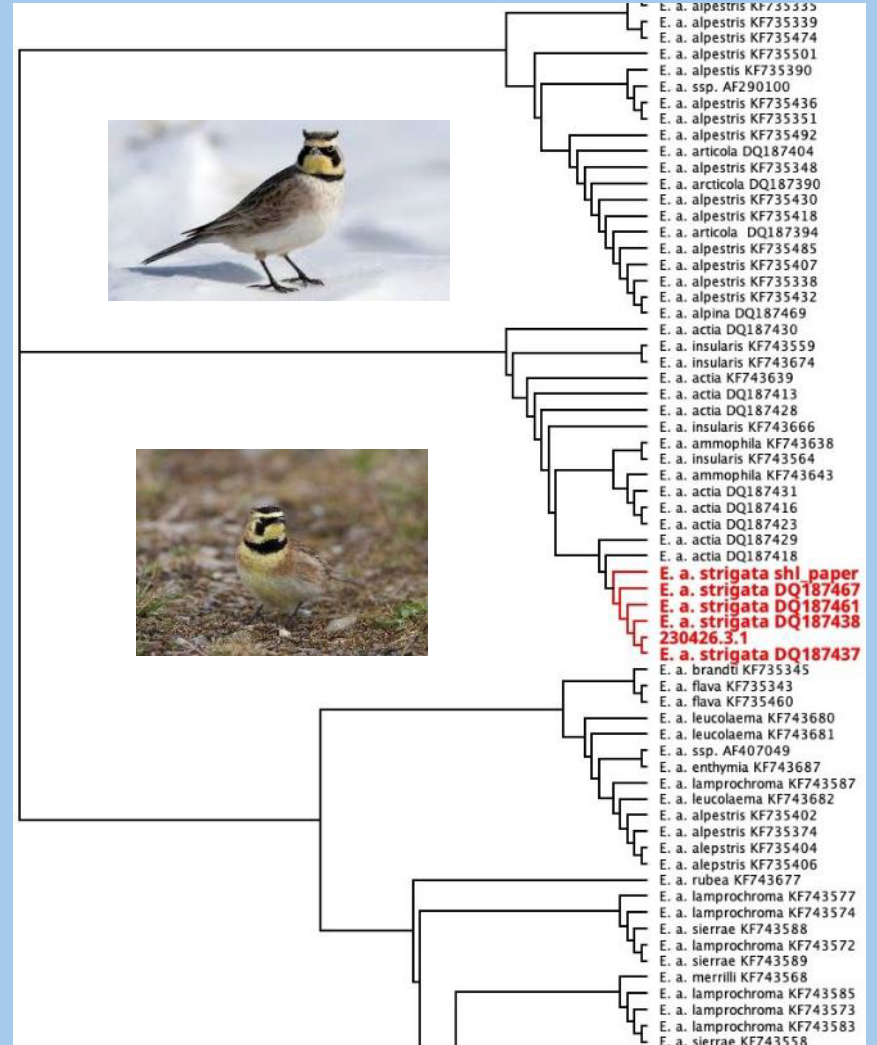
ID on BOLD/GenBank to
a mix Horned Lark/
Streaked Horned Lark

ND2:

GenBank: Download sequences
from vouchered specimens

Align

Phylogenetic tree



134 tested; 87 are Streaked Horned Lark



Policy Becomes Practice

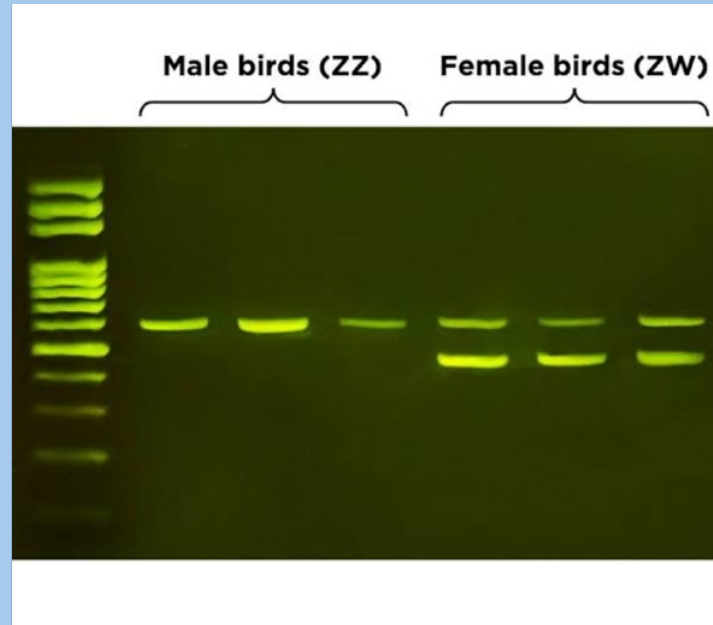
An extra step adopted upon requests from engine manufacturers, airports and investigators is to determine the sex of the bird. The weight of the bird has a direct effect on the amount of damage incurred during a birdstrike. Sometimes the female of the same species weighs more than the male. Weight data are compiled in the CRC Handbook of Avian Body Masses

Different primer sets

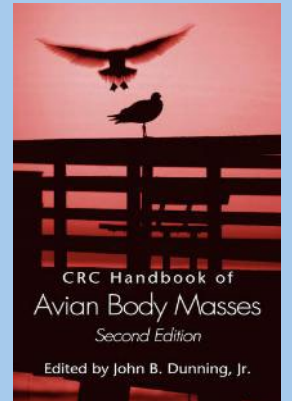
CHD1F CHD1R
2602F 2669R
2550F/2718R
P2/P8

PCR → gel

Gel photo: run with known male and female of the species. Or with a molecular ladder. Female has 2 sex chromosome ZW, male ZZ. Different birds can display the bands at different molecular weights.

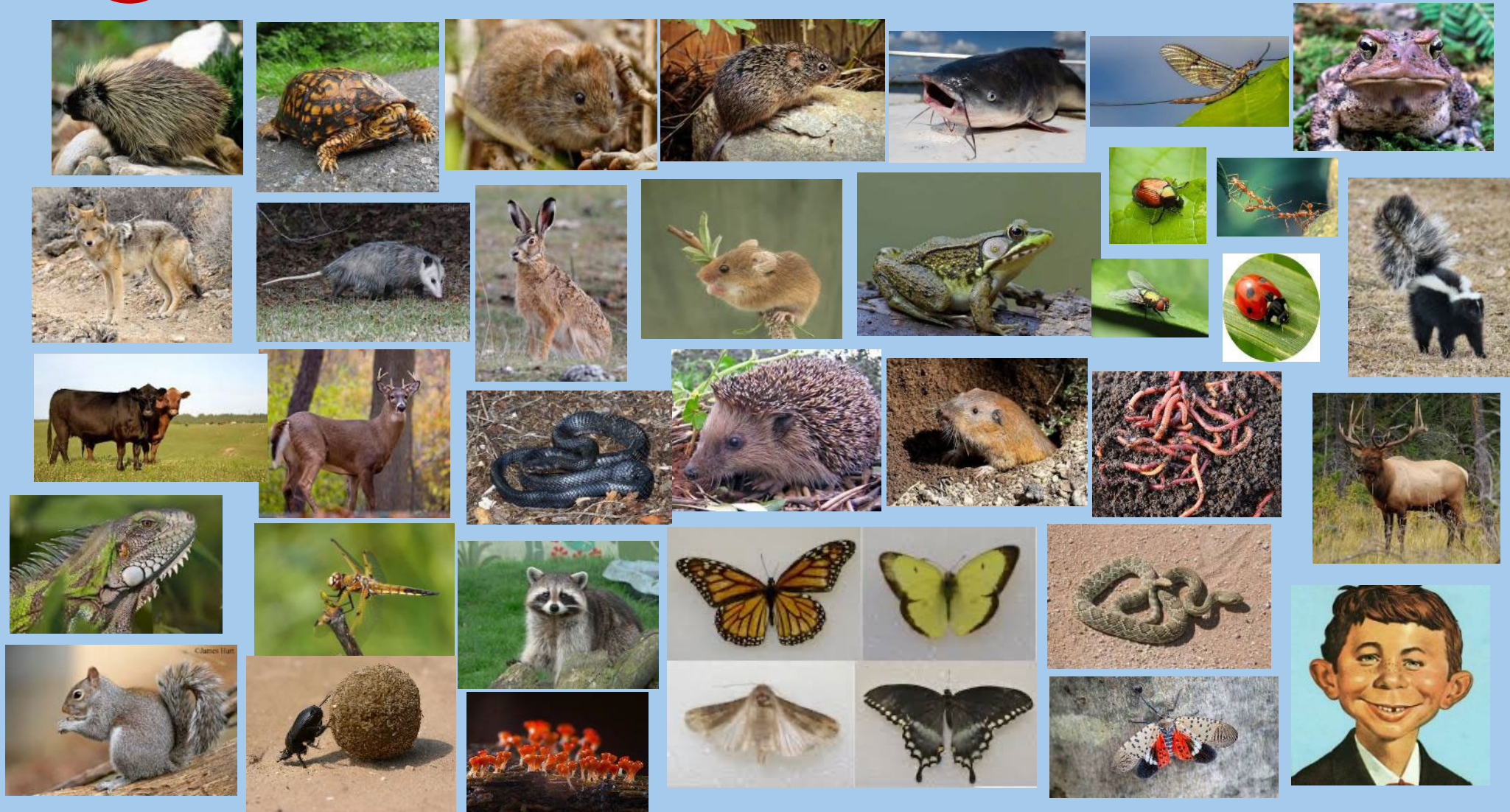


Molecular sexing





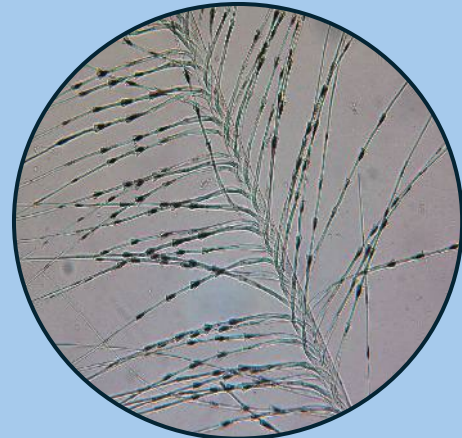
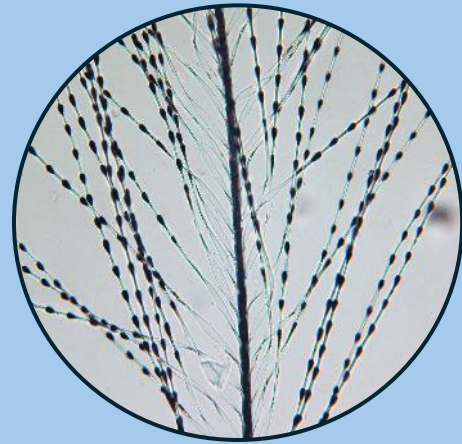
Not bird, then?



Microscopy



- **Microscopic evidence supports whole feather & DNA IDs, or serves as a primary ID method for degraded and/or miniscule samples.**
- **Diagnostic characters of downy feather barbs can be used to identify birds to order (or in some cases lower taxonomic levels.)**
- **Diagnostic characters were first described by Asa Chandler in 1916. Over the last century microscopic feather ID was elaborated by Roxie Laybourne & Carla Dove.**



Foundational Decisions



Accident Investigators



Airport Biologists & Operations



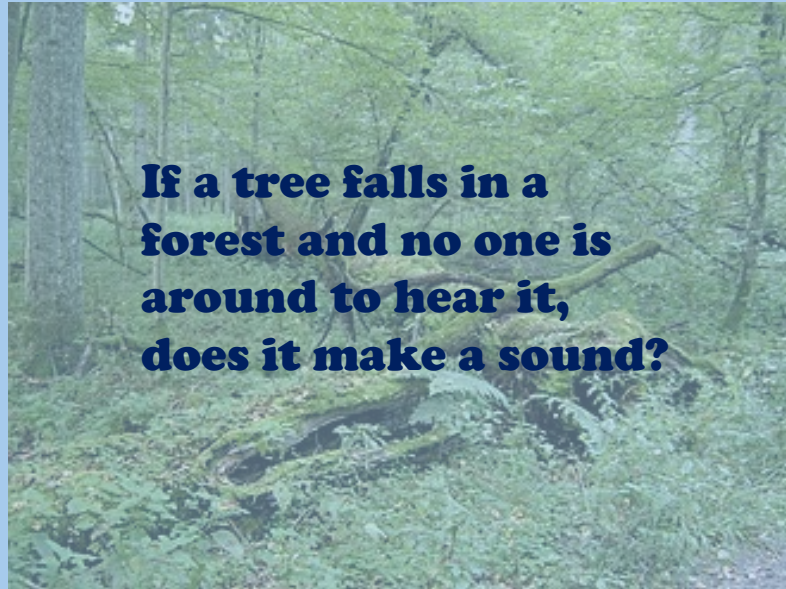
Military BASH



Aerospace Engineers



What Happens when the foundation falters



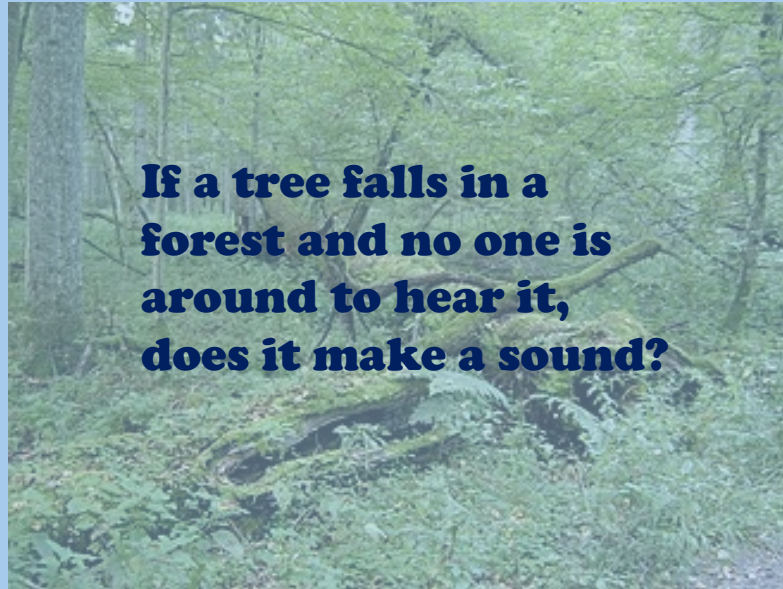
**1 October
2025:
Government
shutdown**

**12 November
2025:
Government
shutdown ends**



**Fiscal
Year
2026**

What Happens when the foundation falters



If a tree falls in a forest and no one is around to hear it, does it make a sound?



If a birdstrike happens in a funding pause, did it really happen?

**Fiscal
Year
2026**

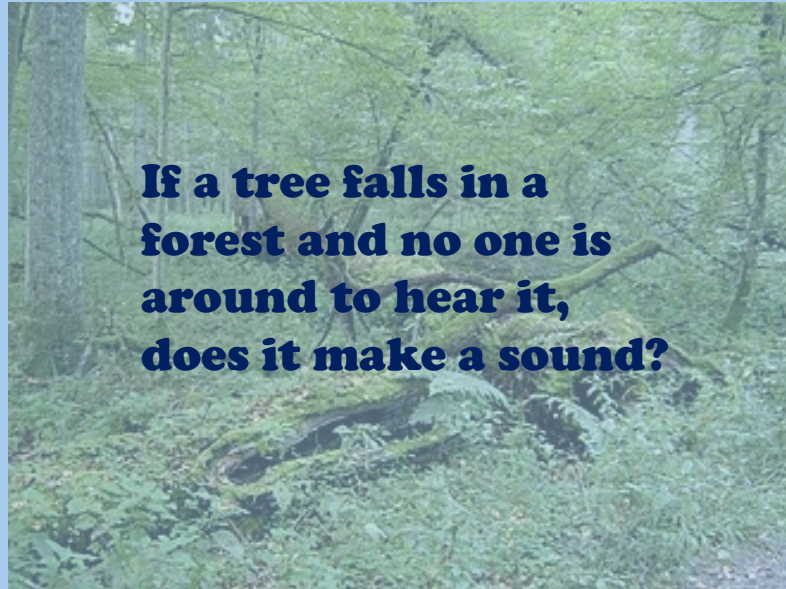
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Smithsonian**

**Smithsonian unable
to conduct any
work for USAF;
stores incoming
mail in freezer**

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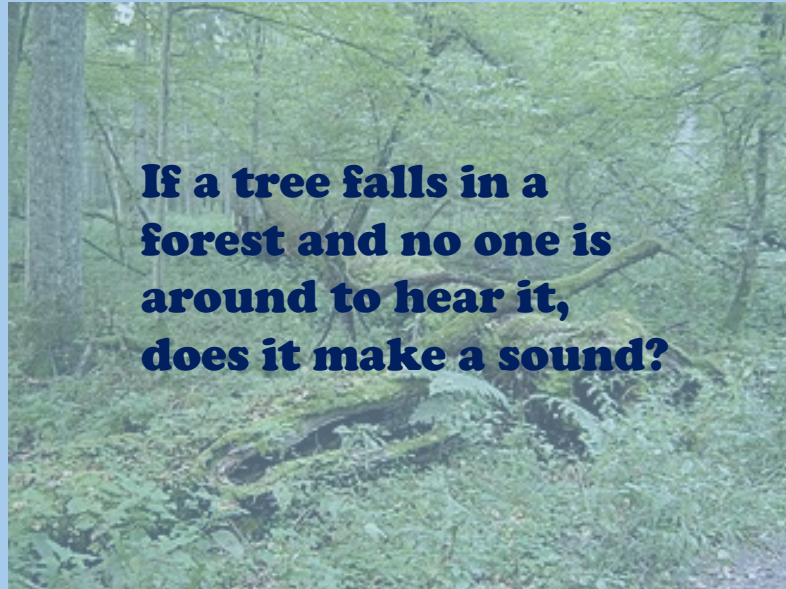
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**12 January
2026:
USAF paused
funding for
Smithsonian**

**20 April 2026:
USAF lifted
pause**

**24 April 2026:
1st batch of
backlog cases
arrives**

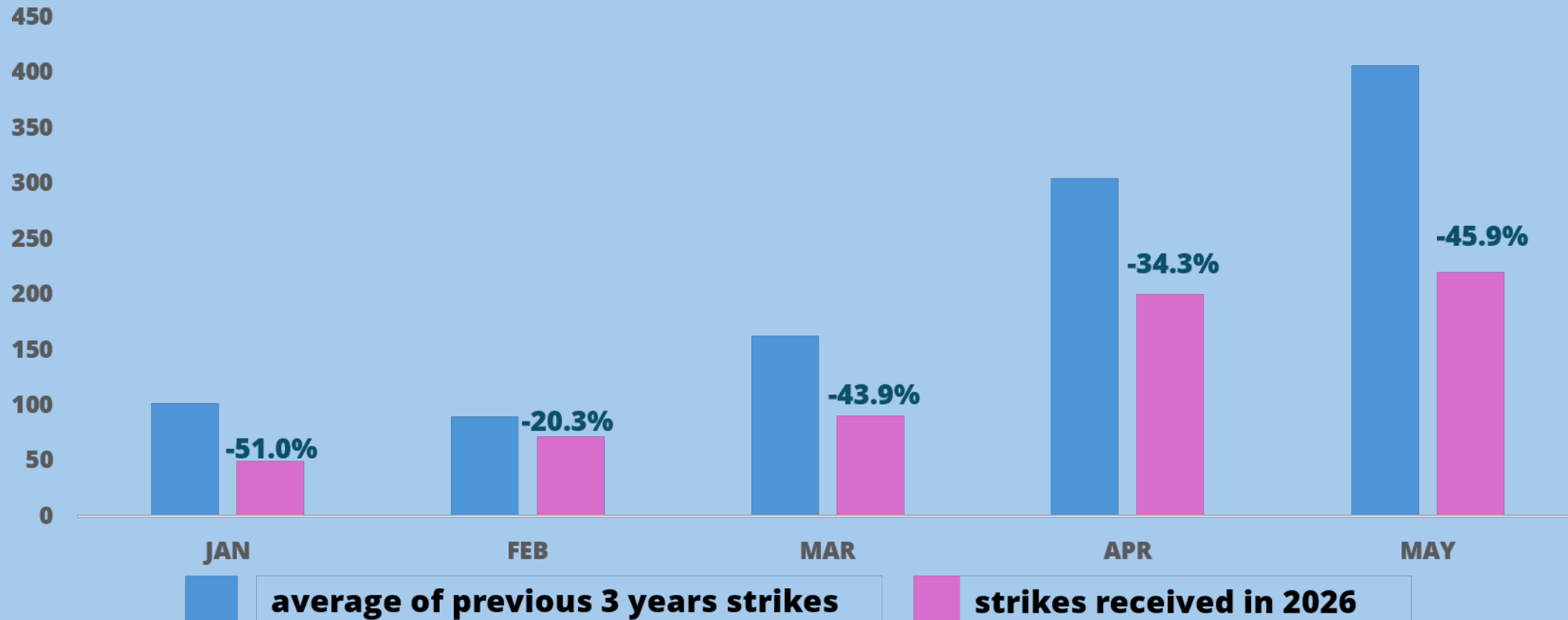
**Smithsonian unable
to conduct any
work for USAF;
stores incoming
mail in freezer**

**Smithsonian
continues to
process FAA and
Navy cases**

**Smithsonian
immediately
processed cases
received during
pause**

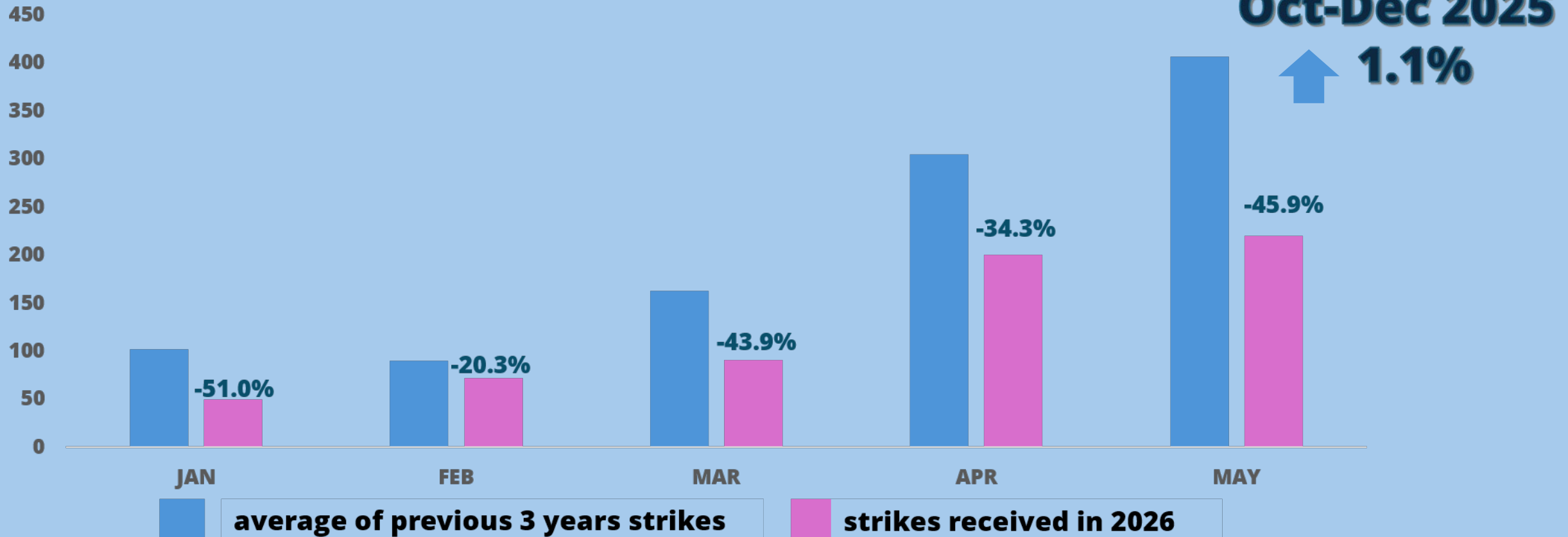
The collapse in USAF strike submission

USAF strikes per month by strike date submitted to the Smithsonian



The collapse in USAF strike submission

USAF strikes per month by strike date submitted to the Smithsonian



Effects of the collapse

- **Surprised to see that the recovery was not as robust**
 - Numbers still down for year
 - Remove funding, remove importance?
- **Loss of data for USAF**
 - Joint-use airfield data loss
- **Possible effects on mission readiness**
- **Time to receive strikes is 50% longer this year after pause was lifted**
- **Possible loss of SI staff**
 - Reducing capacity for staff to serve other interagency partners



Restarting a Routine

FAA Strikes submitted to Smithsonian with % change year over year

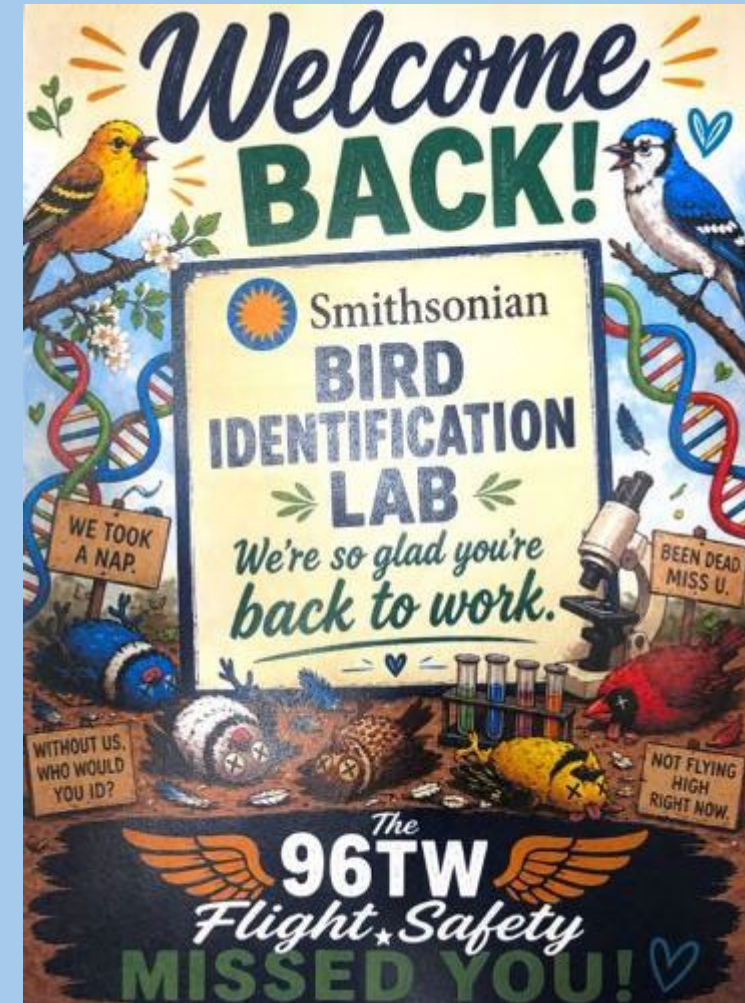


- Restarting a routine can be challenging
- While different reasons, the decrease in submitting remains for civil strikes due to covid was similar



Rebuilding the foundation

- Effects are still lingering, even months after the pause ended.
- Smithsonian long-term funding model not as stable
 - We currently are looking for outside funding sources/endowments
- USAF BASH team and Safety Center worked to restore funding for the next two years.
- Thanks to our colleagues for the support, especially from the Navy, FAA, and Smithsonian, who were scrambling to find funding to fill the gap.



Expanding our Foundations

Tools and technology continue to streamline reporting and data collection.

Can AI assist in identifications?



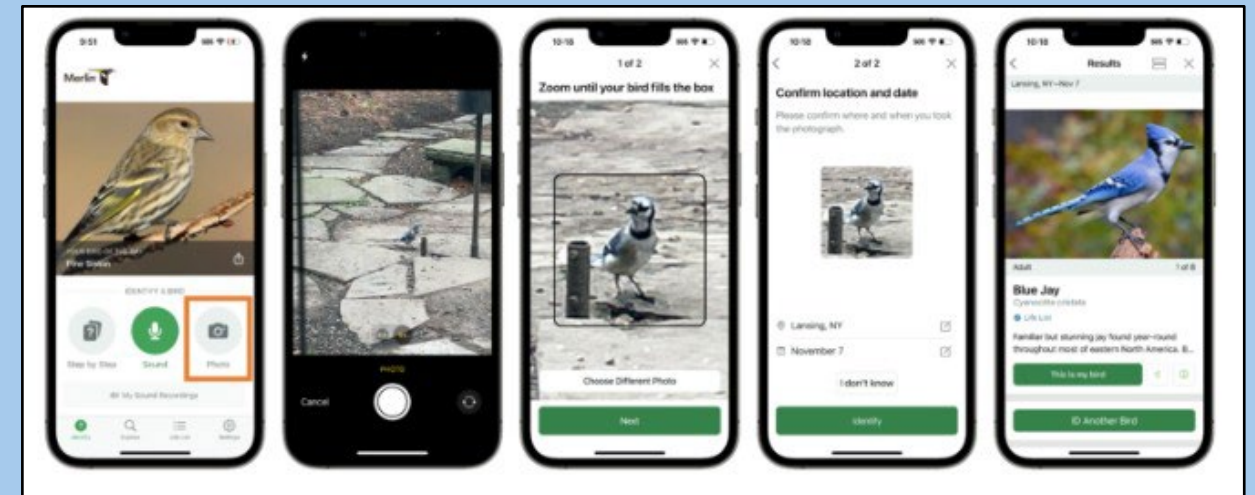
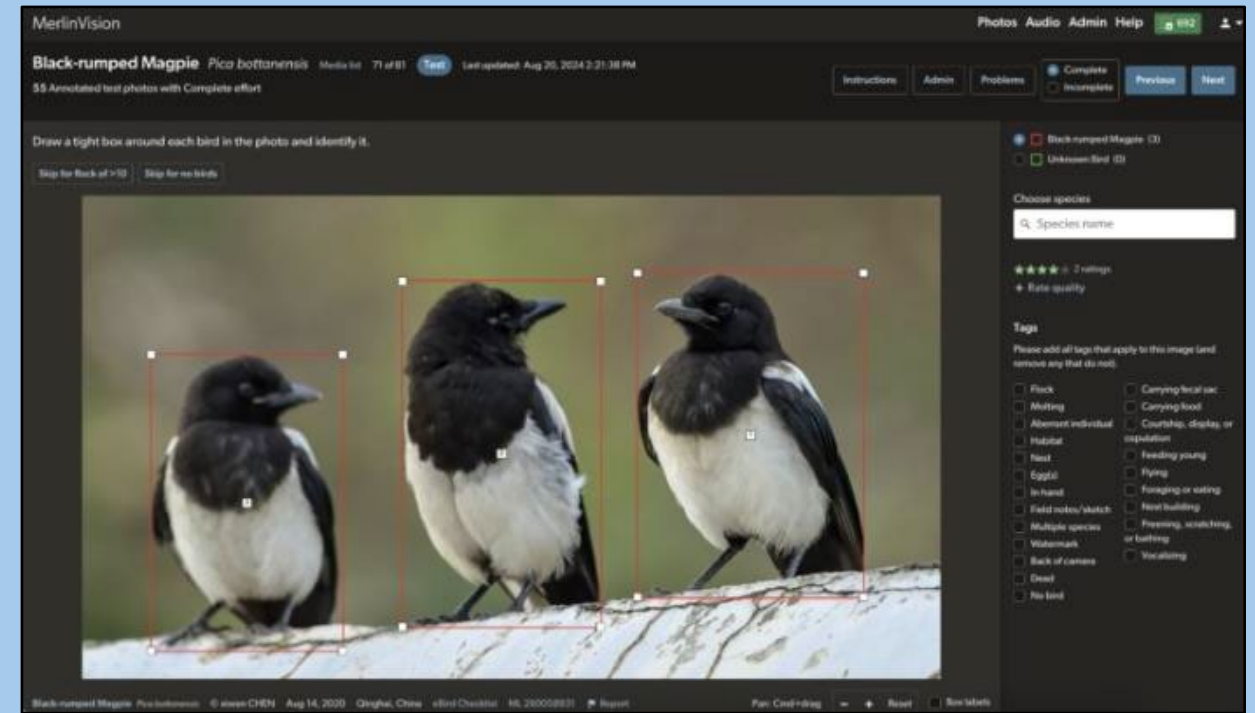
Unusual Field IDs

- **Likely from a Field Guide**
 - **Yellow-throated Warbler (Horned Lark)**
 - **Great Kiskadee (Horned Lark)**
- **Extremely unlikely from a Field Guide**
 - **Yellow-throated Bush Sparrow (Horned Lark)**
 - **Tropical Mockingbird (Scissor-tailed Flycatcher)**
- **"Identification made using Merlin™ bird ID app"**



An Intro to Merlin™

- **Merlin™ is a mobile bird identification app from the Cornell Lab of Ornithology that includes photo recognition.**
- **Each species is trained by a minimum of 50 vouchered (LIVE) examples.**
- **It uses edge detection, color, body shape.**
- **It accounts for species abundance data from eBird (citizen science-based bird occurrence database).**



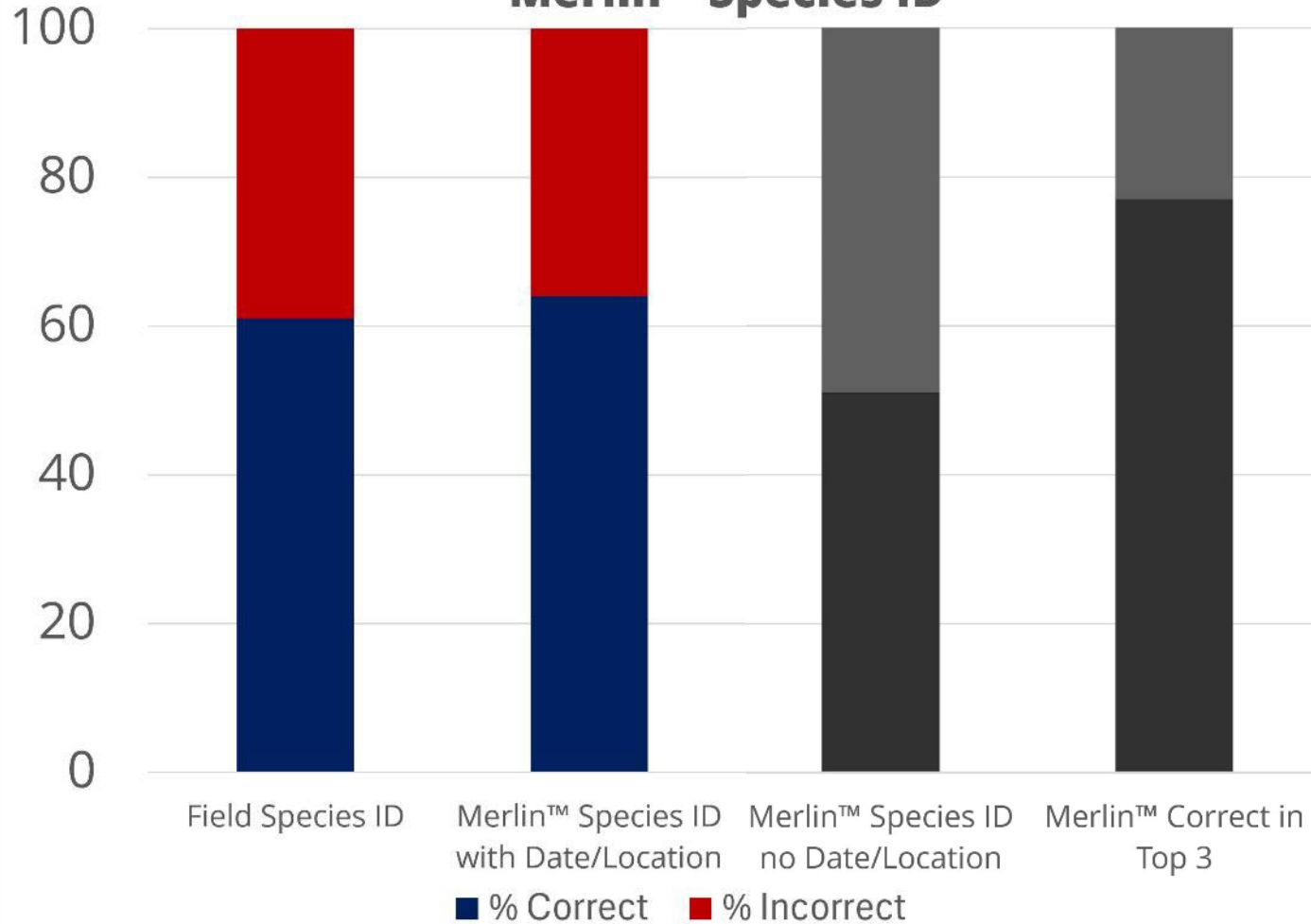
Study Design

- **320 Published, FAA Wildlife Strike Database photos used by FIL for photo identifications**
- **Categorized photos based on completeness of carcass**
- **Compared Merlin™ output and field ID (when provided) to FIL final identification**



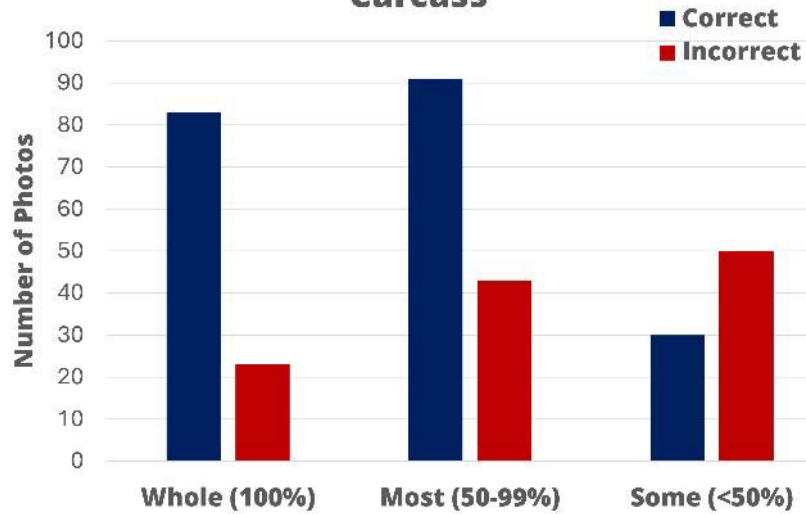
Results and Conclusions

Merlin™ Species ID



- Merlin™ is about as good as people in the field
 - Merlin™ is 64% accurate, field identifications of the same data (n=215) were 61% accurate.
- Date and location are important
 - Accuracy dropped to ~50% in a subset of samples tested without date and location.
- Merlin™ can be used as a starting point.
 - Merlin™ offered the correct species as one of the top 3 suggestions 77% of the time.
- For this dataset FIL was able to ID to species 98% of the time.

**Merlin Performs Best with >50% of
Carcass**



Results and Conclusions

- Having at least 50% of the bird in the photo is the biggest predictor that Merlin™ will successfully identify the carcass.

Whole



FIL: Yellow-rumped-Warbler
Merlin: Yellow-rumped Warbler

Most



FIL: Mississippi Kite
Merlin: Mississippi Kite

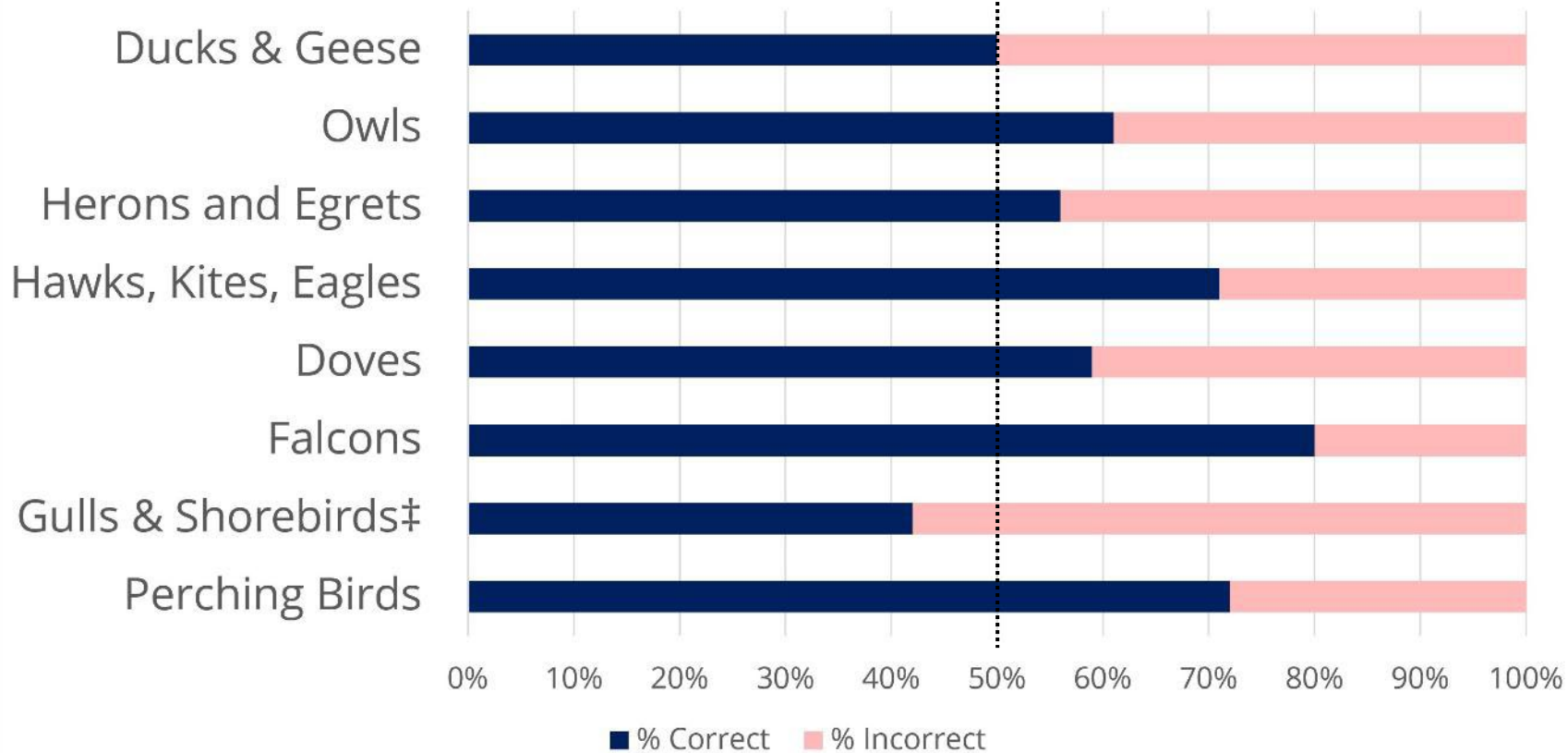
Some



FIL: Mourning Dove
Merlin: Eurasian Collared Dove

Results and Conclusions

Performance Varies by Taxonomic Group*



* **Only Order with >10 samples shown. 14 Orders in dataset.**

‡ **Only the Order including Gulls and Shorebirds significantly impacted Merlin™ accuracy.**

Other Challenges for AI

Merlin™ is trained on live bird images, so it struggles with:

obstructions,

**unusual body positions,
and blood.**



**Merlin: No likely bird
FIL: Ring-billed Gull**

Other Challenges for AI

Merlin™ is trained on live bird images, so it struggles with:

obstructions,

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and blood.



**Merlin: Ring-necked Pheasant
FIL: Barn Swallow**

Other Challenges for AI

Merlin™ is trained on live bird images, so it struggles with:

**obstructions,
unusual body positions,
and blood.**



**Merlin: Muscovy Duck
FIL: Killdeer**

Expanding Foundations: Photos, Yes... AI, proceed with caution

- **If using Merlin TM ...**
 - **Take the most complete, “natural” picture possible without obstructions.**
 - **Include date and locality.**
 - **Treat it as a starting point and check the ID, especially for Gulls and Shorebirds.**
- **Regardless of Merlin TM, use photos to document the strike.**
 - **Photos can refine or confirm field identifications to maintain integrity of the database. Photo submission to FIL is fast and easy!**
- **Come visit the poster, talk to us about your use of AI Natural History IDs**

SHARE THE KNOWLEDGE



**Haya AlDoseri,
Wildlife Manager Bahrain Airport Company**



**Marco Pavia,
University of Torino, Italy**

Are you better than Merlin?
A carcass competition



Guess That Bird



Merlin: No Likely Bird

Guess That Bird



Merlin: No Likely Bird

**FIL: Yellow-crowned
Night Heron**

Guess That Bird



Merlin: No Likely Bird

Guess That Bird



Merlin: No Likely Bird

FIL: Burrowing Owl

Guess That Bird



**Merlin: White-breasted
Nuthatch**

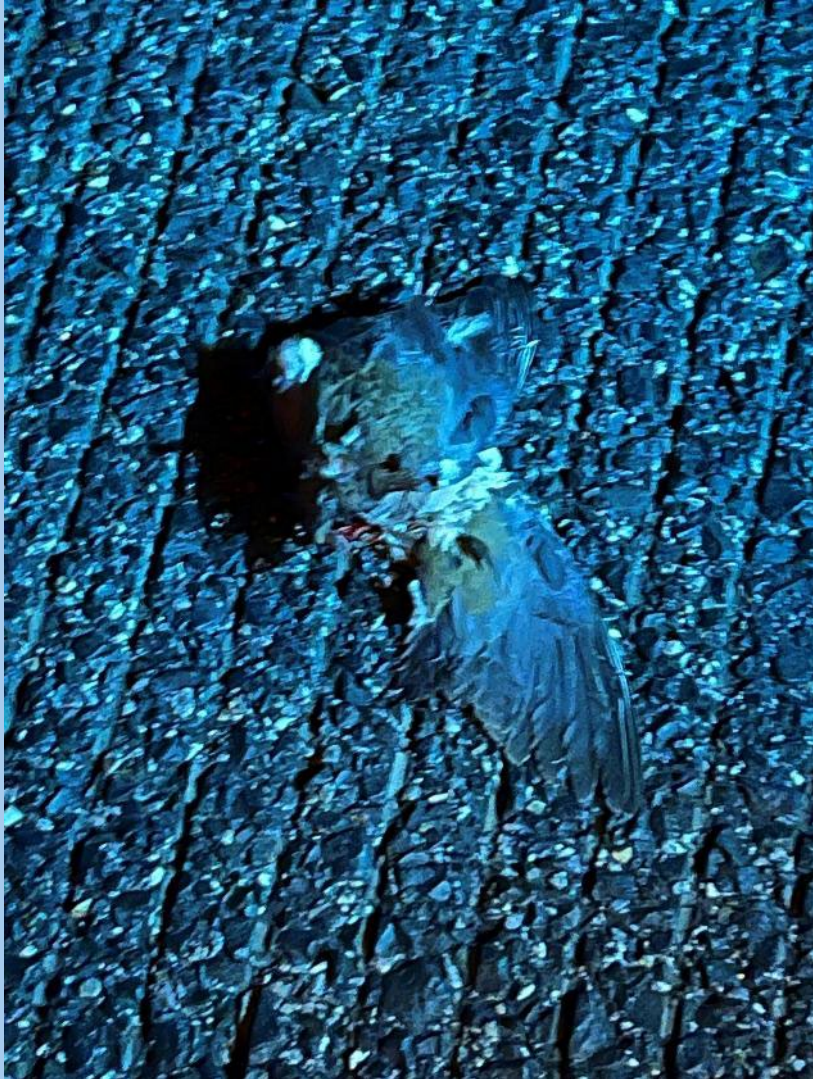
Guess That Bird



**Merlin: White-breasted
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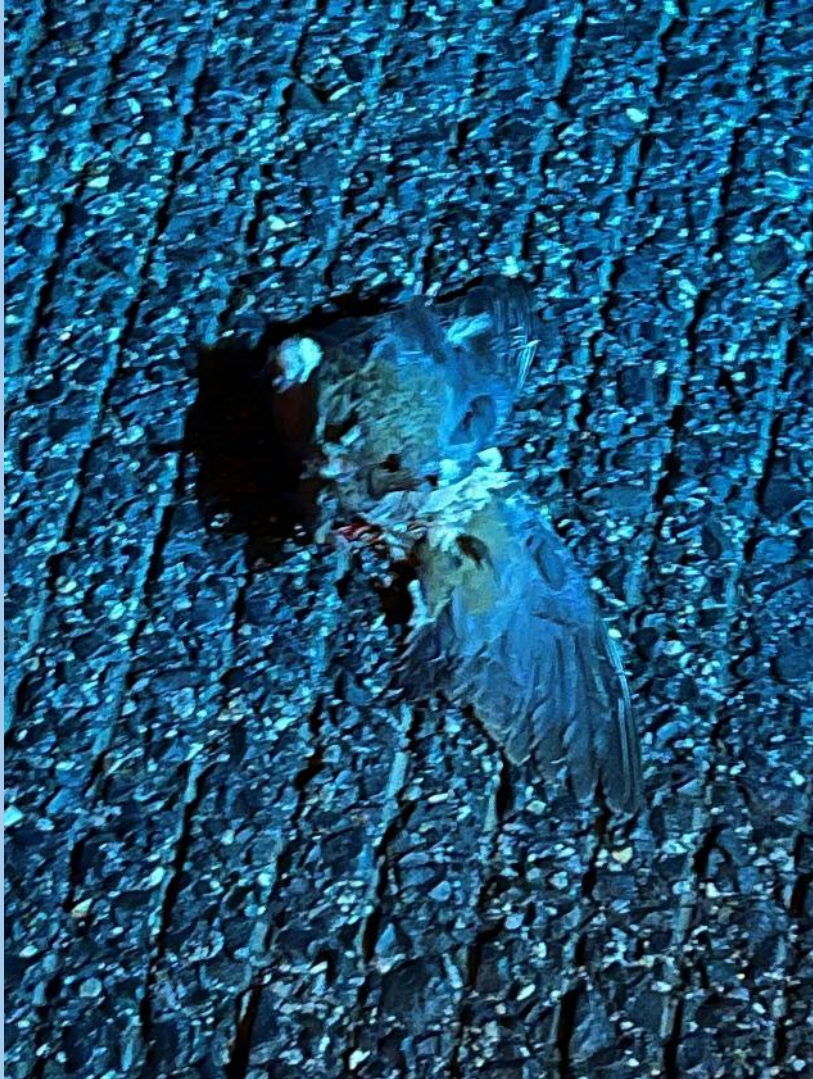
FIL: Ring-billed Gull

Guess That Bird



Merlin: Red Crossbill

Guess That Bird



Merlin: Red Crossbill

FIL: Mourning Dove