Mitigating Bird Strikes in Aviation Project Part1&2

Mentor: Munna Pandey
Submitted by: Deepak Venkat Sairam

Introduction:

Mitigating Bird Strikes in Aviation

Bird strikes pose a significant risk to aviation safety, causing operational disruptions, financial losses, and potential harm to passengers and crew. As the Director of Safety, your mission is to address these challenges by leveraging a comprehensive dataset to:

- Identify patterns in bird strike incidents.
- Understand key risk factors such as aircraft type, flight phase, and wildlife species
- .Develop data-driven strategies to minimize the occurrence and impact of bird strikes.
- Identifying High-Risk Airports and Flight Phases
- Understanding the Role of Wildlife Species
- Analyzing the Impact of Weather Conditions
- Exploring the Importance of Pilot Awareness
- Implementing Effective Mitigation Strategies

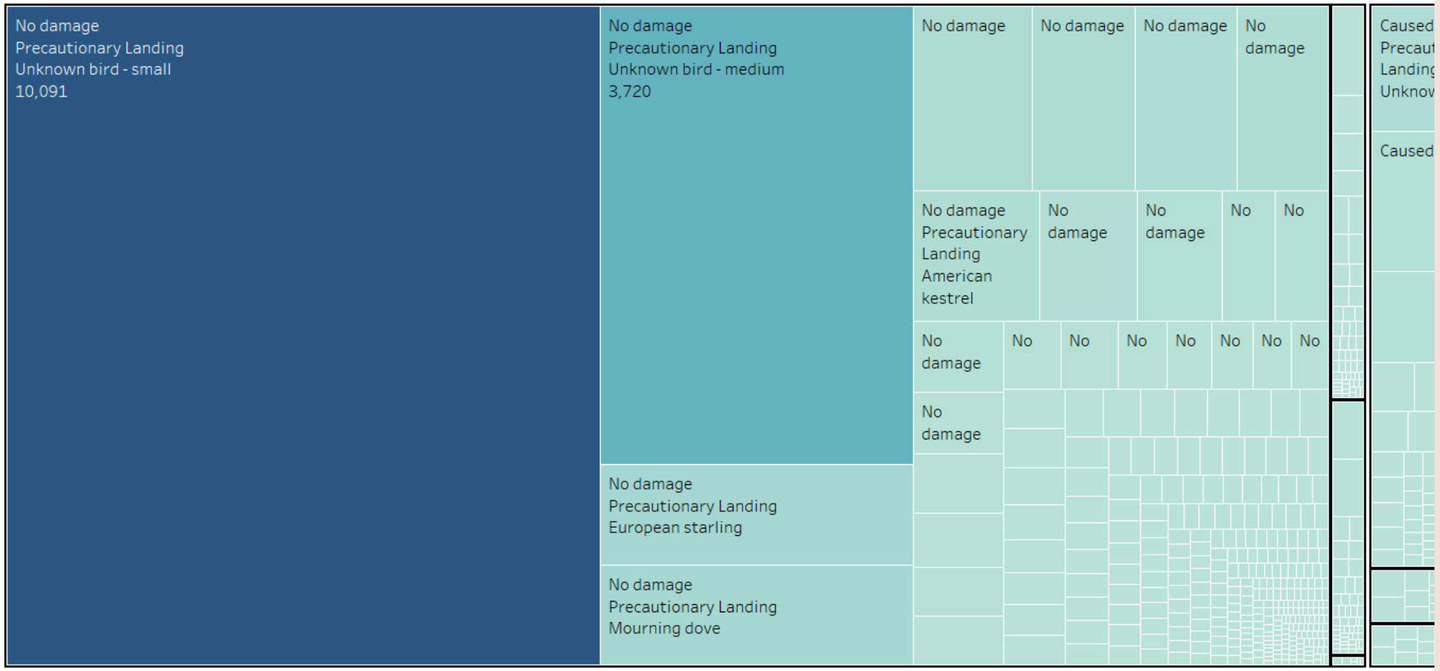
By the end of this presentation, you will gain valuable insights into the challenges posed by bird strikes and learn how to implement practical solutions to minimize their impact on the aviation industry.

Through this initiative, we aim to enhance aviation safety and improve management practices around airports. Together, let's unlock the insights hidden in the data and pave the way for safer skies.

Part1
Operational Efficiency

Task1(a)

Most Common Wildlife Species Involved in Bird Strikes and Their Impact on Flight Safety



Effect: Indicated Damage, Effect: Impact to flight, Wildlife: Species and count of Record ID. Color shows count of Record ID. Size shows count of Record ID. The marks are labeled by Effect: Indic
Damage, Effect: Impact to flight, Wildlife: Species and count of Record ID. The data is filtered on Flight Date Year and Wildlife: Size. The Flight Date Year filter keeps 12 of 12 members. The Wildl
filter keeps multiple members.

Interpretation:

- Key Insights:
- **Prevalence of Unknown Bird Strikes:**

A significant portion of bird strikes involve unidentified species, highlighting the need for improved bird identification and tracking methods.

- **Dominance of Minor Incidents:**

Most bird strikes result in minimal damage or precautionary landings, indicating a relatively low risk to aviation safety.

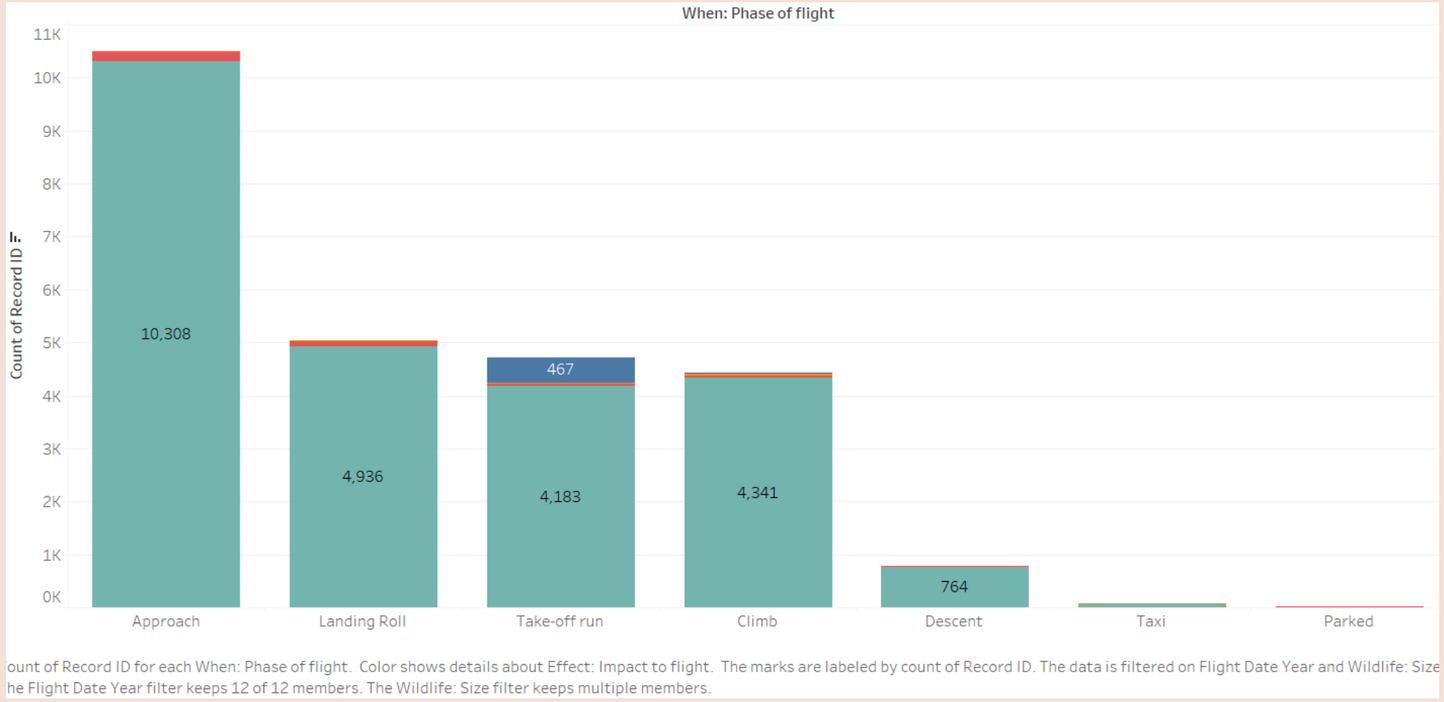
- **Identifying High-Risk Species:**

While unknown birds pose the highest risk due to frequency, specific identified species may warrant targeted mitigation strategies to reduce the likelihood and severity of strikes.

Part1
Operational Efficiency

Task1(b)

Phases of Flight that Wildlife Strikes Most Likely to Occur.



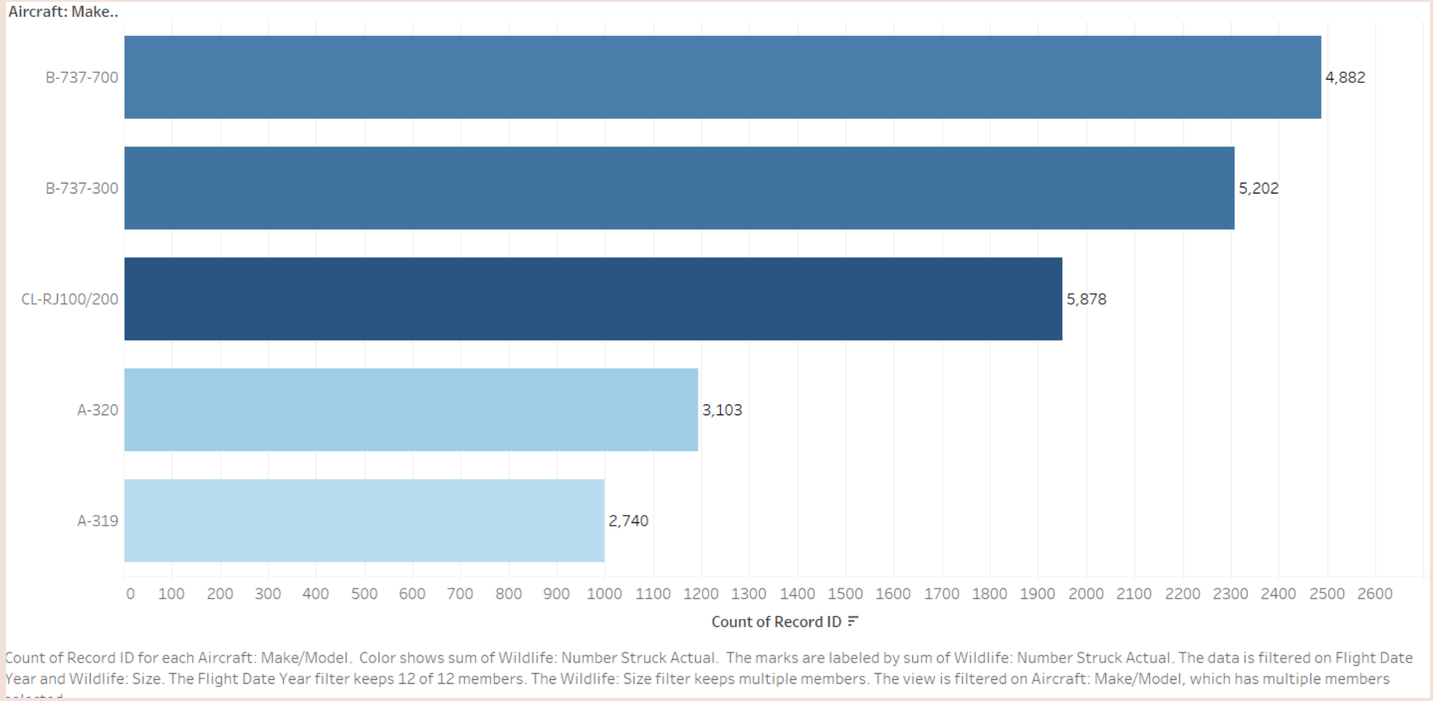
Interpretation:

Key Points:

- **Approach Phase:** This phase of flight has the highest likelihood of wildlife strikes, with a count of 10,308 incidents.
- **Landing Roll and Take-off Run:** These phases follow closely behind the approach phase in terms of strike frequency.
- **Impact on Flights:** While most strikes cause no damage, a significant number result in precautionary landings or engine shutdowns.

Part1
Operational Efficiency

Task1(C)
Aircraft Models or Types More Prone to Wildlife Strikes.



Count of Record ID for each Aircraft: Make/Model. Color shows sum of Wildlife: Number Struck Actual. The marks are labeled by sum of Wildlife: Number Struck Actual. The data is filtered on Flight Date Year and Wildlife: Size. The Flight Date Year filter keeps 12 of 12 members. The Wildlife: Size filter keeps multiple members. The view is filtered on Aircraft: Make/Model, which has multiple members

Interpretation:

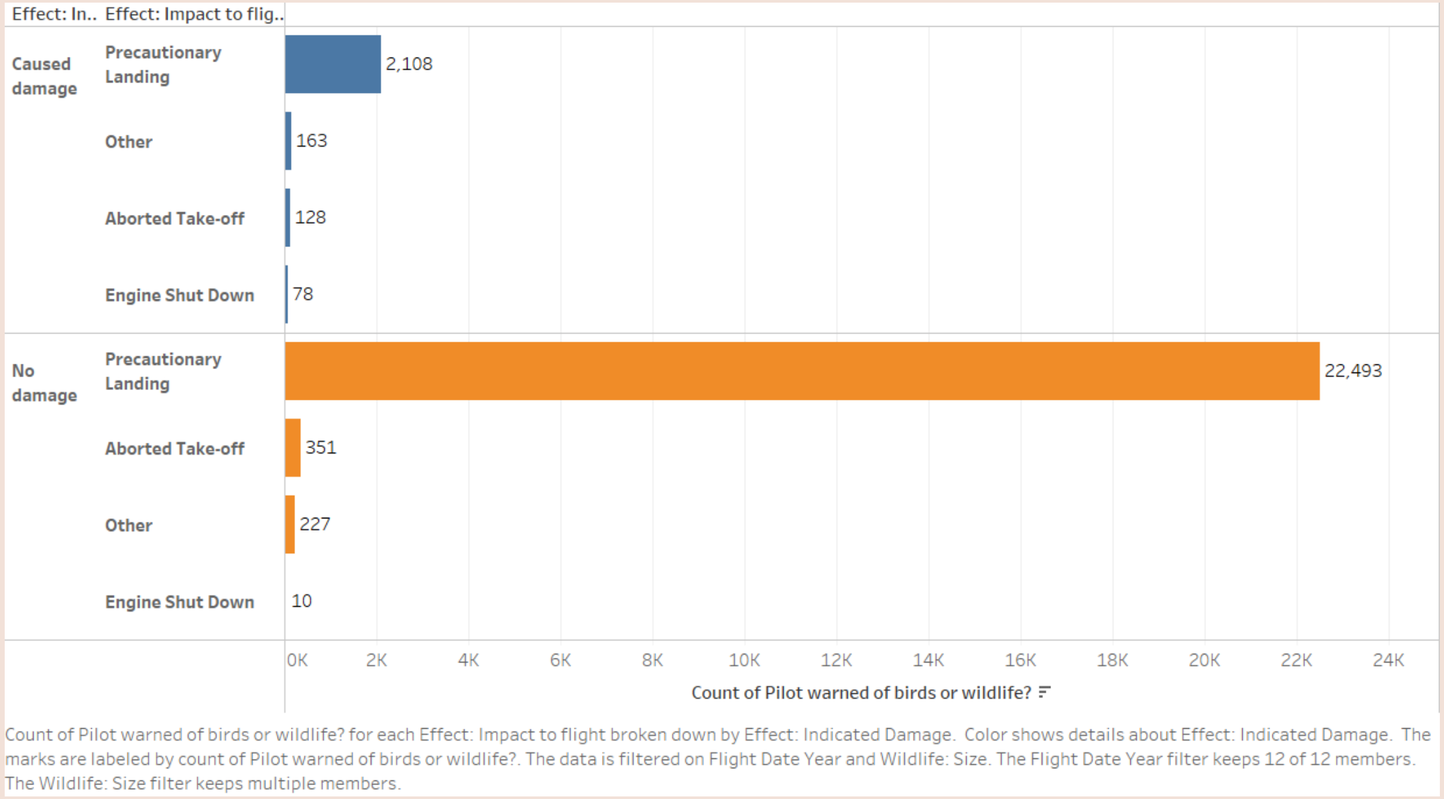
Key Insights

- **:B737-700 and B737-300:** These aircraft models have experienced a significantly higher number of bird strikes compared to the other models. This could be due to factors such as flight routes, operational frequency, or design characteristics.
- **CL-RJ100/200:** This model shows a moderate number of bird strikes, suggesting that it might be less susceptible to bird strikes or operates in regions with lower bird populations.
- **A320 and A319:** These Airbus models have the lowest number of recorded bird strikes, indicating that they might have better bird avoidance systems or operate in areas with fewer bird hazards.

Part1
Regulatory Compliance

Task2(a)

Bird strike incidents reported in compliance with aviation safety regulations



Count of Pilot warned of birds or wildlife? for each Effect: Impact to flight broken down by Effect: Indicated Damage. Color shows details about Effect: Indicated Damage. The marks are labeled by count of Pilot warned of birds or wildlife?. The data is filtered on Flight Date Year and Wildlife: Size. The Flight Date Year filter keeps 12 of 12 members. The Wildlife: Size filter keeps multiple members.

Interpretation:

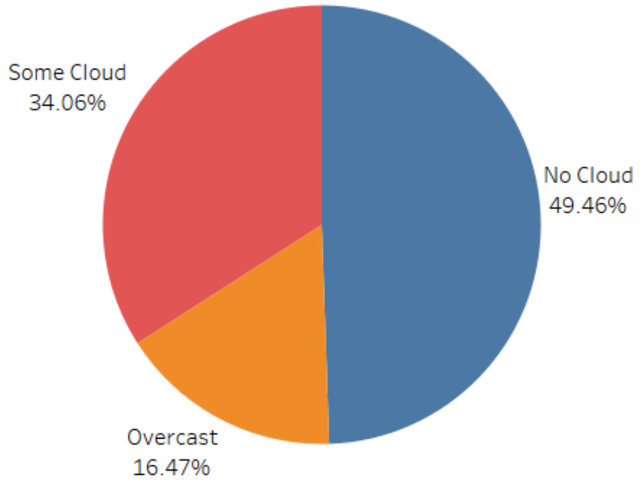
Key Points:

- **Majority of Incidents Cause No Damage:** The overwhelming majority of bird strike incidents (22,493) resulted in no damage to the aircraft.
- **Precautionary Landings:** A significant number of incidents (2,108) led to precautionary landings, likely due to potential damage or safety concerns.
- **Aborted Takeoffs and Engine Shutdowns**: A smaller number of incidents resulted in aborted takeoffs (128) or engine shutdowns (78), highlighting the potential severity of bird strikes.
- **Effect of Pilot Warnings:** The data suggests that pilot warnings about birds or wildlife may have helped mitigate the severity of some incidents, as evidenced by the higher number of precautionary landings in cases with warnings.

Part1
Regulatory Compliance

Task2(b)

Sky conditions during hits



Interpretation:

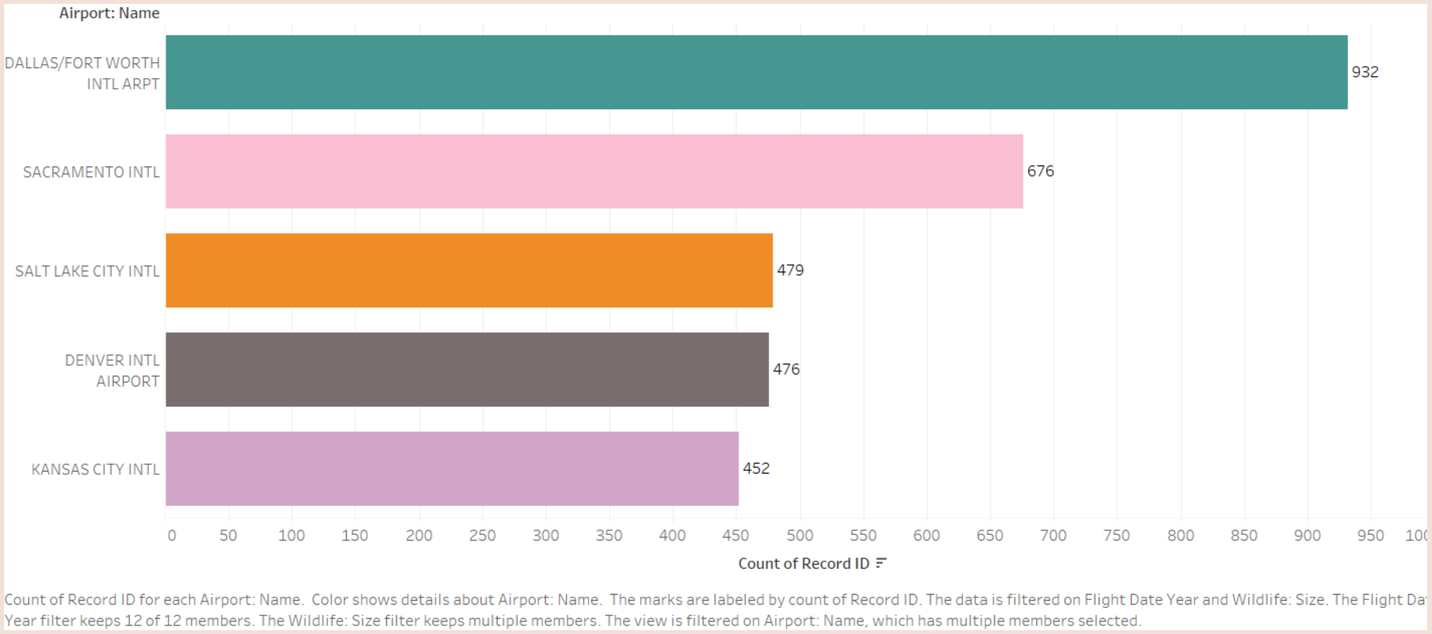
Key Points:

- **No Cloud:** The most common sky condition during bird strikes is "No Cloud," accounting for 49.46% of all incidents.
- **Some Cloud:** The second most common sky condition is "Some Cloud," accounting for 34.06% of all incidents.
- **Overcast:** The least common sky condition is "Overcast," accounting for 16.47% of all incidents.

Part1
Regulatory Compliance

Task2(c)

Airport with the Highest Number of Strikes



Interpretation:

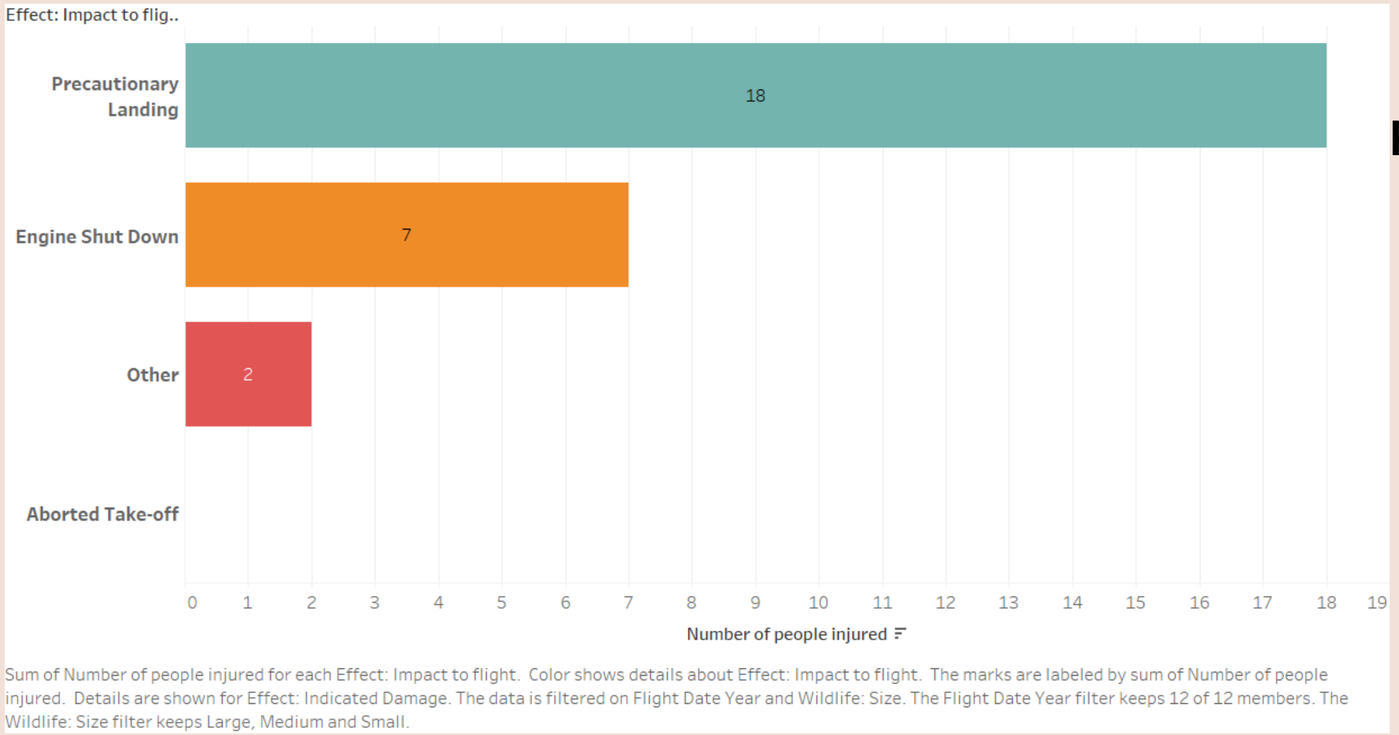
KeyPoints:

- **Dallas/Fort Worth International Airport** leads with the highest number of bird strike incidents, reporting 932 cases.
- **Denver International Airport** follows closely with 676 reported incidents.
- **Sacramento International Airport** ranks third with 479 incidents.
- **Salt Lake City International Airport** and Kansas City International Airport complete the top five with 476 and 452 incidents, respectively.

Part1
Injury Prevention

Task3(a)

Types of incidents lead to injuries.



Interpretation:

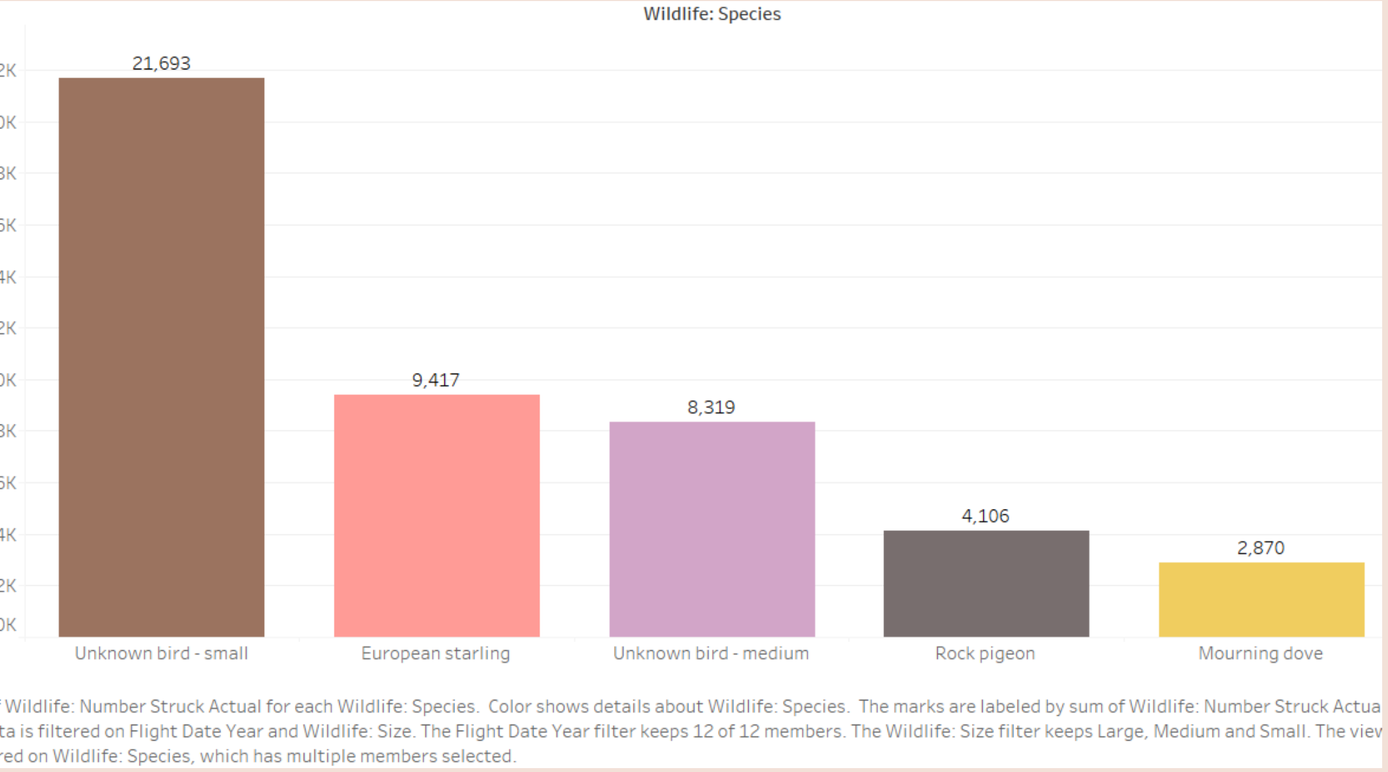
Key Points:

- **Precautionary Landings:** The most common type of incident leading to injuries is a precautionary landing, with a total of 18 injuries.
- **Engine Shutdowns:** The second most common type of incident is an engine shutdown, resulting in 7 injuries.
- **Other Incidents:** A smaller number of injuries (2) are attributed to other types of incidents.
- Aborted Take-offs: No injuries have been reported from aborted take-offs.

Part1
Wildlife Conservation

Task4(a)

Wildlife species that most frequently involved in strikes.



Interpretation:

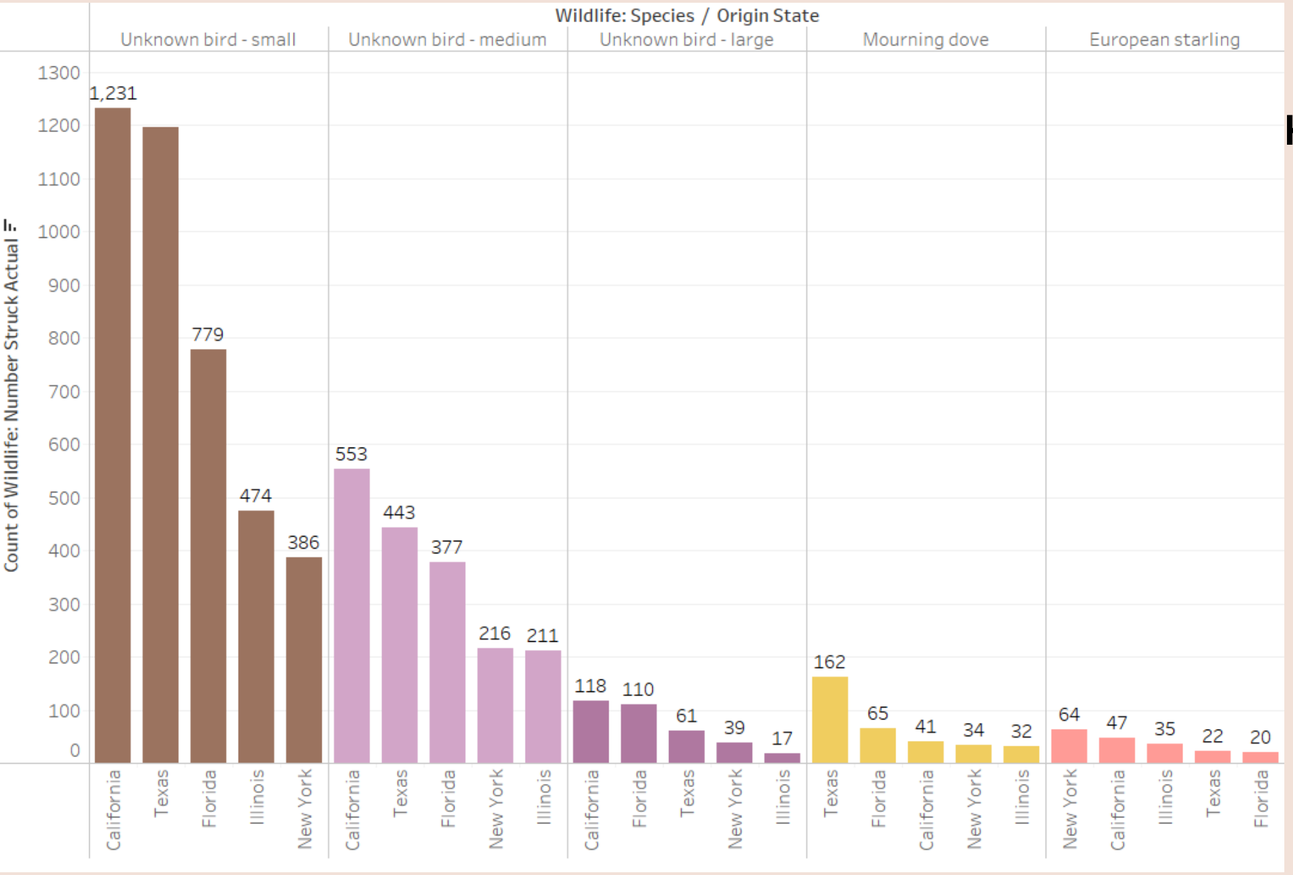
Key Points:

- **Unknown Bird (Small):** This category dominates with 21,693 strikes, highlighting the challenges in identifying smaller bird species.
- **European Starling:** This species ranks second with 9,417 strikes, emphasizing its significant impact on aviation safety.
- **Unknown Bird (Medium):** Another category with substantial impact, accounting for 8,319 strikes.
- Rock Pigeon: With 4,106 strikes, this species poses a notable threat to aircraft.
- **Mourning Dove:** While less frequent, mourning doves contribute to 2,870 strikes.

Part2
Operational Efficiency

Task1(2)

Routes or locations where the risk of bird strikes is higher



Interpretation:

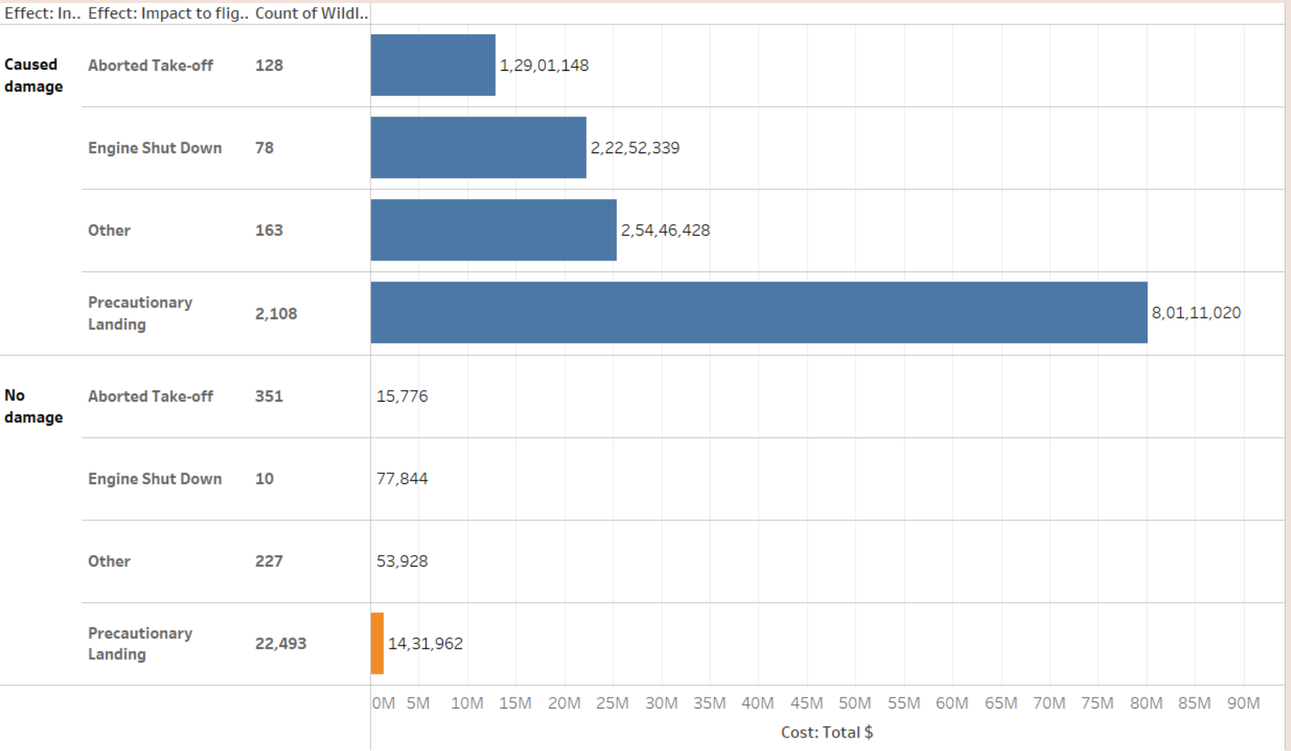
Key Points:

- **California:** This state emerges as a hotspot for bird strikes, particularly involving unknown bird species (small and medium).
- **Texas:** Another significant location with high bird strike occurrences, especially with European starlings and unknown bird species.
- **Florida:** While less prominent than California and Texas, Florida also experiences a notable number of bird strikes, primarily involving unknown bird species.
- **New York:** This state sees a relatively lower number of bird strikes compared to the others, with unknown bird species and mourning doves being the most common.
- **Illinois:** Similar to New York, Illinois has fewer bird strike incidents, with unknown bird species and mourning doves being the primary culprits.

Part2
Cost Reduction

Task2(1)

Total cost associated with wildlife strikes, damages and operational disruptions.



Sum of Cost: Total $ for each count of Wildlife: Number Struck Actual broken down by Effect: Indicated Damage and Effect: Impact to flight. Color shows details about Effect: Indicated Damage. The marks are labeled by sum of Cost: Total $. The data is filtered on Conditions: Sky, Airport: Name, Conditions: Precipitation, Aircraft: Airline/Operator and Flight Date Year. The Conditions: Sky filter keeps No Cloud, Overcast and Some Cloud. The Airport: Name filter keeps 1,109 of 1,109 members. The Conditions: Precipitation filter keeps 7 of 7 members. The Aircraft: Airline/Operator filter keeps 292 of 292 members. The Flight Date Year filter keeps 12 of 12 members. The view is filtered on Effect: Impact to flight and Effect: Indicated Damage. The Effect: Impact to flight filter keeps Aborted Take-off, Engine Shut Down, Other and Precautionary Landing. The Effect: Indicated Damage filter keeps Caused damage and No damage.

Interpretation:

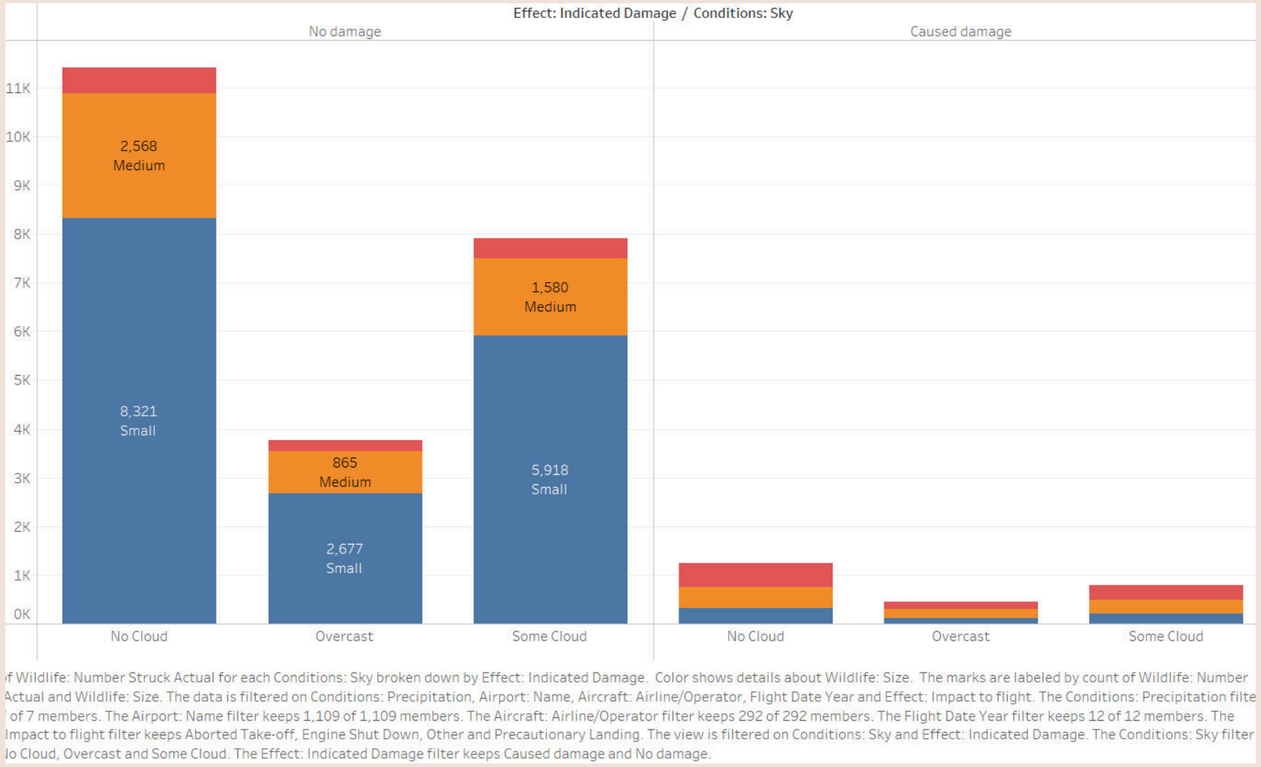
Key Points:

- **Caused Damage:** Incidents resulting in damage (aborted take-offs, engine shutdowns, other, precautionary landings) incur a significant cost of $80,111,020.
- **No Damage:** Incidents with no reported damage (aborted take-offs, engine shutdowns, other, precautionary landings) still result in substantial costs, totaling $14,319,621.
- **Breakdown:** The chart provides a breakdown of costs for each type of incident and damage category, allowing for a detailed analysis of cost drivers.

Part2
Risk Management

Task3(a)

The key Risk factors contributing to Wildlife Strikes



f Wildlife: Number Struck Actual for each Conditions: Sky broken down by Effect: Indicated Damage. Color shows details about Wildlife: Size. The marks are labeled by count of Wildlife: Number Actual and Wildlife: Size. The data is filtered on Conditions: Precipitation, Airport: Name, Aircraft: Airline/Operator, Flight Date Year and Effect: Impact to flight. The Conditions: Precipitation filte of 7 members. The Airport: Name filter keeps 1,109 of 1,109 members. The Aircraft: Airline/Operator filter keeps 292 of 292 members. The Flight Date Year filter keeps 12 of 12 members. The Impact to flight filter keeps Aborted Take-off, Engine Shut Down, Other and Precautionary Landing. The view is filtered on Conditions: Sky and Effect: Indicated Damage. The Conditions: Sky filter lo Cloud, Overcast and Some Cloud. The Effect: Indicated Damage filter keeps Caused damage and No damage.

Interpretation:

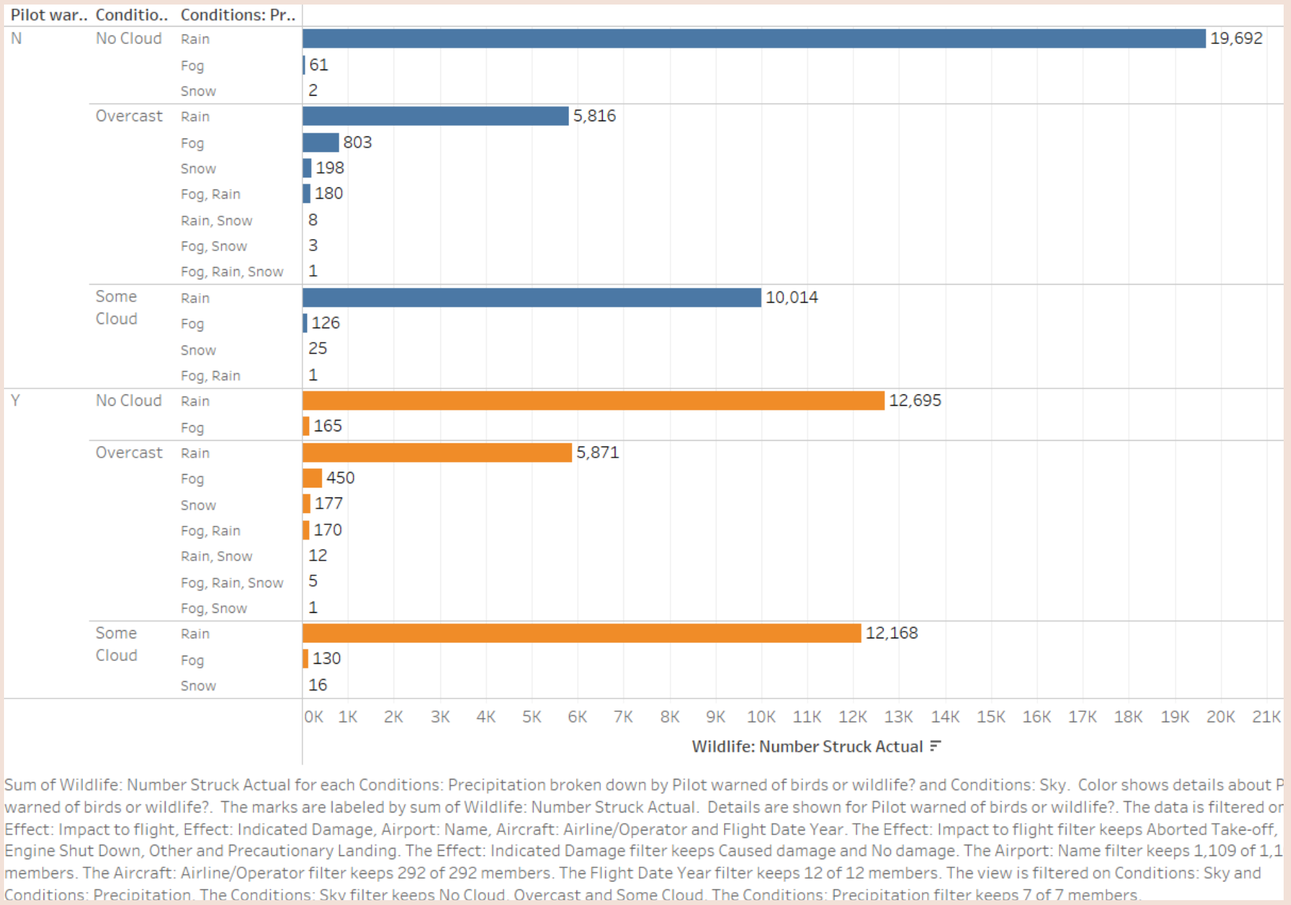
Key Points:

- **Sky Conditions:** No Cloud conditions have the highest number of wildlife strikes, particularly for small-sized birds.
- **Wildlife Size:** Small-sized birds dominate the number of strikes across all sky conditions, highlighting their significant impact on aviation safety.
- **Impact:** While both caused damage and no damage incidents occur across all sky conditions, the distribution varies. For instance, under No Cloud conditions, a higher proportion of strikes result in no damage.

Part2
Communication and Training

Task4(e)

Pilot awareness and responsiveness to bird strike risks



Sum of Wildlife: Number Struck Actual for each Conditions: Precipitation broken down by Pilot warned of birds or wildlife? and Conditions: Sky. Color shows details about P warned of birds or wildlife?. The marks are labeled by sum of Wildlife: Number Struck Actual. Details are shown for Pilot warned of birds or wildlife?. The data is filtered or Effect: Impact to flight, Effect: Indicated Damage, Airport: Name, Aircraft: Airline/Operator and Flight Date Year. The Effect: Impact to flight filter keeps Aborted Take-off, Engine Shut Down, Other and Precautionary Landing. The Effect: Indicated Damage filter keeps Caused damage and No damage. The Airport: Name filter keeps 1,109 of 1,1 members. The Aircraft: Airline/Operator filter keeps 292 of 292 members. The Flight Date Year filter keeps 12 of 12 members. The view is filtered on Conditions: Sky and Conditions: Precipitation. The Conditions: Sky filter keeps No Cloud, Overcast and Some Cloud. The Conditions: Precipitation filter keeps 7 of 7 members.

Interpretation:

Key Points:

- **Pilot Warnings:** When pilots are warned of birds or wildlife, there's a significant increase in the number of bird strikes, especially under No Cloud and Overcast conditions.
- **Sky Conditions:** No Cloud and Overcast conditions seem to be the most conducive for bird strikes, regardless of whether pilots were warned or not.
- **Precipitation:** The presence of precipitation (rain, snow, fog) generally reduces the number of bird strikes, possibly due to decreased visibility or reduced bird activity.

Conclusion:

Key Findings:

1)High-Risk Airports:
Dallas/Fort Worth International Airport and Denver International Airport consistently rank among the top airports with the highest number of bird strikes.
These airports should prioritize bird strike prevention and mitigation strategies.

2)Critical Flight Phases:
The approach and landing phases, as well as the takeoff run, are particularly vulnerable to bird strikes.
Increased vigilance and specific mitigation measures should be implemented during these phases.

3)Dominant Bird Species:
Unknown bird species (small and medium) pose the highest risk, highlighting the need for improved bird identification and monitoring techniques.
European starlings and rock pigeons are also significant contributors to bird strikes.

4)Impact of Sky Conditions and Precipitation:
No cloud and overcast conditions, especially in the absence of precipitation, are associated with a higher number of bird strikes.
Precipitation can reduce the risk by limiting visibility and affecting bird behavior.

5) Role of Pilot Awareness:
Pilot awareness and timely warnings can play a crucial role in mitigating bird strike risks, especially under adverse conditions.
However, increased awareness may also lead to more reported incidents.

Overall Recommendations:

1)Enhanced Airport Design:
Implement bird-friendly design principles, such as habitat modification and the use of bird-repellent materials.
Consider the placement of runways and taxiways to minimize bird activity in critical areas.

2)Effective Bird Control Measures:
Employ a combination of non-lethal techniques, including habitat management, bird scaring devices, and falconry.
Use lethal control measures only as a last resort and in accordance with regulations.

3)Improved Pilot Training and Awareness:
Provide comprehensive training on bird strike recognition, avoidance, and reporting.
Promote a culture of vigilance and timely reporting of bird sightings and strikes.

4)Advanced Detection Technologies:
Utilize radar systems, thermal imaging, and other advanced technologies to detect birds and alert pilots.
Develop real-time monitoring systems to track bird movements and migration patterns.

5)Data-Driven Decision Making:
Continuously collect and analyze data on bird strike incidents to identify trends, assess the effectiveness of mitigation measures, and inform future strategies.

By implementing these recommendations, airports can significantly reduce the risk of bird strikes, improve aviation safety, and minimize operational disruptions.

THANK YOU