Topic: Analysis of FAA Wildlife Strikes Data

Introduction:

The harmonious coexistence of birds and human activities is crucial for maintaining ecological balance and preserving the environment's beauty. However, this delicate balance is disrupted when birds come into conflict with aviation, resulting in wildlife strikes. These incidents, particularly collisions between aircraft and birds, have escalated in recent years, posing a growing threat to aviation safety. This report aims to analyze data from the National Wildlife Strike Database (NWSD) spanning a 33-year period from 1990 to 2022, shedding light on the patterns and factors contributing to wildlife strikes.

The increase in wildlife strikes is attributed to factors such as the rising populations of large birds and the surge in air traffic, particularly by quieter, turbofan-powered aircraft. Globally, the impact of wildlife strikes has been significant, leading to the loss of over 464 lives and the destruction of more than 305 aircraft from 1988 to 2022.

This report seeks to uncover insights into the complex dynamics of wildlife strikes, providing a foundation for further exploration and the development of strategies to mitigate this pressing issue in aviation safety.

Ambitiousness of the project:

The project embarked on the challenging job of examining 33 years of data from the National Wildlife Strike Database (NWSD) to fully understand the dynamics of wildlife strikes, particularly those involving birds and aircraft. This extensive dataset, spanning from years 1990 to 2022, contains a lot of information on the frequency, locations, and circumstances surrounding wildlife strikes, allowing for a thorough investigation of patterns and trends over time.

This method allows for a more nuanced understanding of recent incidents, which may lead to the discovery of emerging patterns and factors influencing wildlife strikes in the current aviation landscape.

Research Questions:

1) What airports in the United States have the most bird strikes?
2) What is the trend of airplane bird strikes over time?
3) What is the relationship between airline strike cost and distance from airport?

Methodology:

The primary data sources for this analysis are two datasets related to wildlife strikes provided by the Federal Aviation Administration (FAA). These datasets can be accessed on Kaggle and data.world:

1. Kaggle Dataset: https://www.kaggle.com/datasets/faa/wildlife-strikes
2. Data.World Dataset: https://data.world/faa/aircraft-wildlife-strike-data

The data dictionary for this dataset is as follows :

1. Kaggle Dataset

- INDEX_NR: Individual record number.
- OPID: Airline operator code.
- OPERATOR: A three-letter International Civil Aviation Organization code for aircraft operators (BUS = business, PVT = private aircraft other than business, GOV = government aircraft, MIL = military aircraft).
- ATYPE: Aircraft type.
- AMA: International Civil Aviation Organization code for Aircraft Make.
- AMO: International Civil Aviation Organization code for Aircraft Model.
- AC_CLASS: Type of aircraft.
- NUM_ENGS: Number of engines.
- TYPE_ENG: Type of power (A = reciprocating engine (piston), B = Turbojet, C = Turboprop, D = Turbofan, E = None (glider), F = Turboshaft (helicopter), Y = Other).
- REG: Aircraft registration.
- FLT: Flight number.
- REMAINS_COLLECTED: Indicates if bird or wildlife remains were found and collected.
- REMAINS_SENT: Indicates if remains were sent to the Smithsonian Institution for identification.
- INCIDENT_DATE: Date the strike occurred.
- INCIDENT_MONTH: Month the strike occurred.
- INCIDENT_YEAR: Year the strike occurred.
- TIME_OF_DAY: Light conditions.
- TIME: Hour and minute in local time.
- AIRPORT_ID: International Civil Aviation Organization airport identifier for the location of the strike (on or off airport).
- AIRPORT: Name of the airport.

- STATE: State.
- FAAREGION: FAA Region where the airport is located.
- ENROUTE: Location if the strike did not occur on approach, climb, landing roll, taxi, or take-off; indicates if the aircraft was enroute.
- RUNWAY: Runway.
- LOCATION: Various information about aircraft location if enroute or airport where strike evidence was found.
- HEIGHT: Feet Above Ground Level.
- SPEED: Knots (indicated airspeed).
- DISTANCE: Miles from the airport.
- PHASE_OF_FLT: Phase of flight during which the strike occurred.
- STR_RAD: Struck radome.
- DAM_RAD: Damaged radome.
- STR_WINDSHLD: Struck windshield.
- DAM_WINDSHLD: Damaged windshield.
- INGESTED: Engine ingested the bird/animal.
- STR_OTHER: Struck other than parts shown above.
- EFFECT: Effect on flight.
- EFFECT_OTHER: Effect on flight other than those listed on the form.
- SKY: Type of cloud cover, if any.
- PRECIP: Precipitation.
- SPECIES_ID: International Civil Aviation Organization code for the type of bird or other wildlife.
- SPECIES: Common name for bird or other wildlife.
- BIRDS_SEEN: Number of birds/wildlife seen by the pilot.
- BIRDS_STRUCK: Number of birds/wildlife struck.
- SIZE: Size of the bird as reported by the pilot, a relative scale.
- WARNED: Pilot warned of birds/wildlife.
- AOS: Time aircraft was out of service in hours. If unknown, it is blank.
- COST_REPAIRS: Estimated cost of repairs or replacement in dollars (USD).
- COST_OTHER: Estimated other costs, other than those in the previous field, in dollars (USD). May include the loss of revenue, hotel expenses due to flight cancellation, costs of fuel dumped, etc.
- COST_REPAIRS_INFL_ADJ: Costs adjusted for inflation.
- COST_OTHER_INFL_ADJ: Other costs adjusted for inflation.
- REPORTED_NAME: Name(s) of person(s) filing the report.
- REPORTED_TITLE: Title(s) of person(s) filing the report.
- REPORTED_DATE: Date the report was written.

- SOURCE: Type of report. Note: for multiple types of reports, this will be indicated as Multiple. See "Comments" field for details.
- PERSON: Only one selection allowed. For multiple reports, see the field "Reported Title".
- NR_INJURIES: Number of people injured.
- NR_FATALITIES: Number of human fatalities.
- LUPDATE: Last time the record was updated.
- TRANSFER: Unused field at this time.
- INDICATED_DAMAGE: Indicates whether or not the aircraft was damaged.

2. Data.gov data :

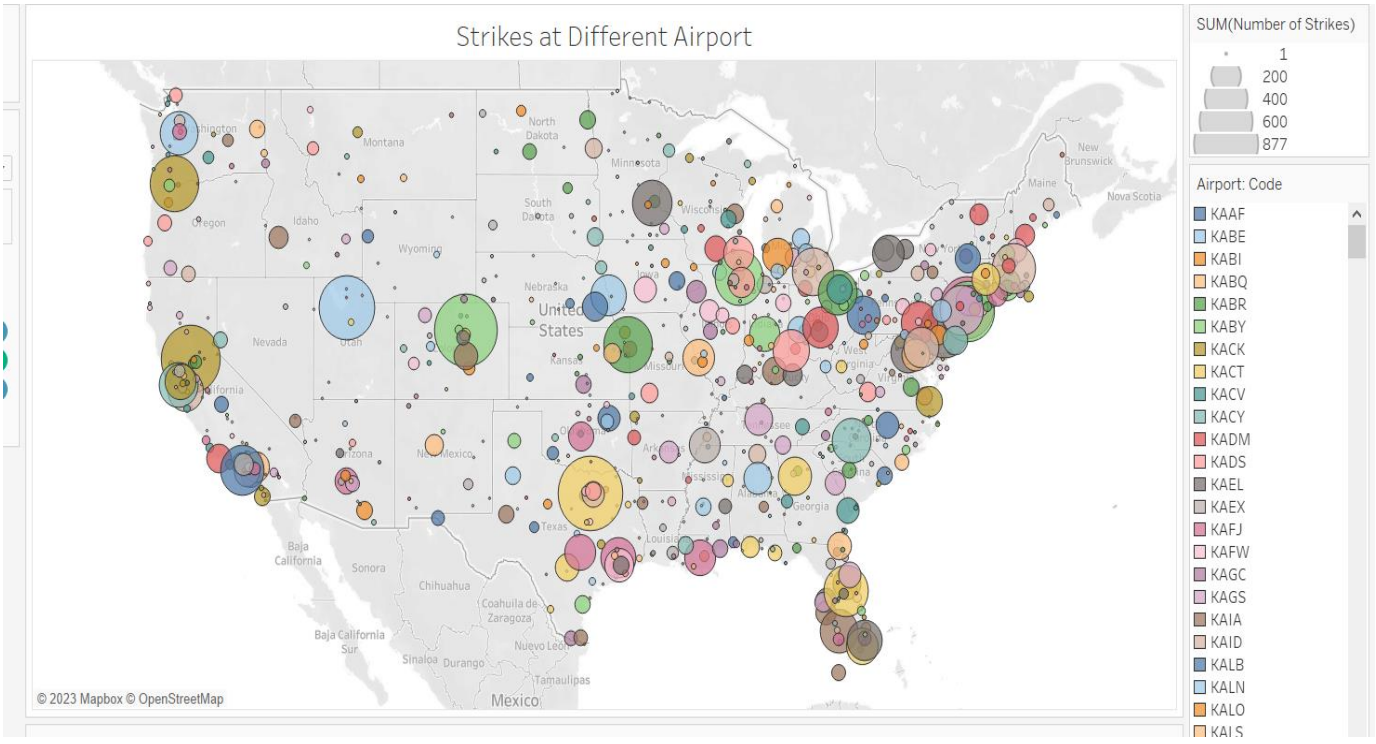
- record_number: A unique identifier for each wildlife strike incident record.
- incident_date: The date when the wildlife strike incident occurred.
- incident_month: The month in which the wildlife strike incident occurred.
- incident_year: The year in which the wildlife strike incident occurred.
- incident_yearmonth: A combination of the incident year and month.
- incident_time: The time at which the wildlife strike incident occurred.
- time_of_day: The categorization of the incident time into periods of the day (e.g., morning, afternoon, evening).
- airport_id: The identifier for the airport where the wildlife strike incident occurred.
- airport_name: The name of the airport where the wildlife strike incident occurred.
- latitude: The latitude coordinates of the incident location.
- longitude: The longitude coordinates of the incident location.
- location: A description or name of the location where the wildlife strike incident occurred.
- state_name: The name of the state where the wildlife strike incident occurred.
- state: The abbreviation or code for the state where the wildlife strike incident occurred.
- faa_region: The FAA (Federal Aviation Administration) region associated with the incident location.
- aircraft_mass: The mass or weight of the aircraft involved in the wildlife strike incident.
- engine_type: The type of engine(s) installed on the aircraft.
- number_of_engines: The count of engines on the aircraft involved in the wildlife strike incident.
- phase_of_flight: The phase of flight during which the wildlife strike incident occurred (e.g., takeoff, landing, cruise).
- height: The altitude or height of the aircraft during the wildlife strike incident.
- speed: The speed of the aircraft during the wildlife strike incident.

- distance: The distance covered by the aircraft during the wildlife strike incident.
- sky: The sky condition or visibility during the wildlife strike incident.
- precipitation: The presence and type of precipitation during the wildlife strike incident.
- cost_repairs: The cost of repairs associated with the wildlife strike incident.
- cost_other: Other costs associated with the wildlife strike incident.
- cost_repairs_adj: Adjusted cost of repairs, considering inflation or other factors.
- cost_other_adj: Adjusted other costs, considering inflation or other factors.
- ingested: Indicates whether any wildlife was ingested by the aircraft during the incident.

Using the Airport ID column as a common identifier, we executed an LEFT join on both tables in Tableau to merge the datasets.

Analysis:

1. Strikes at Different Airport

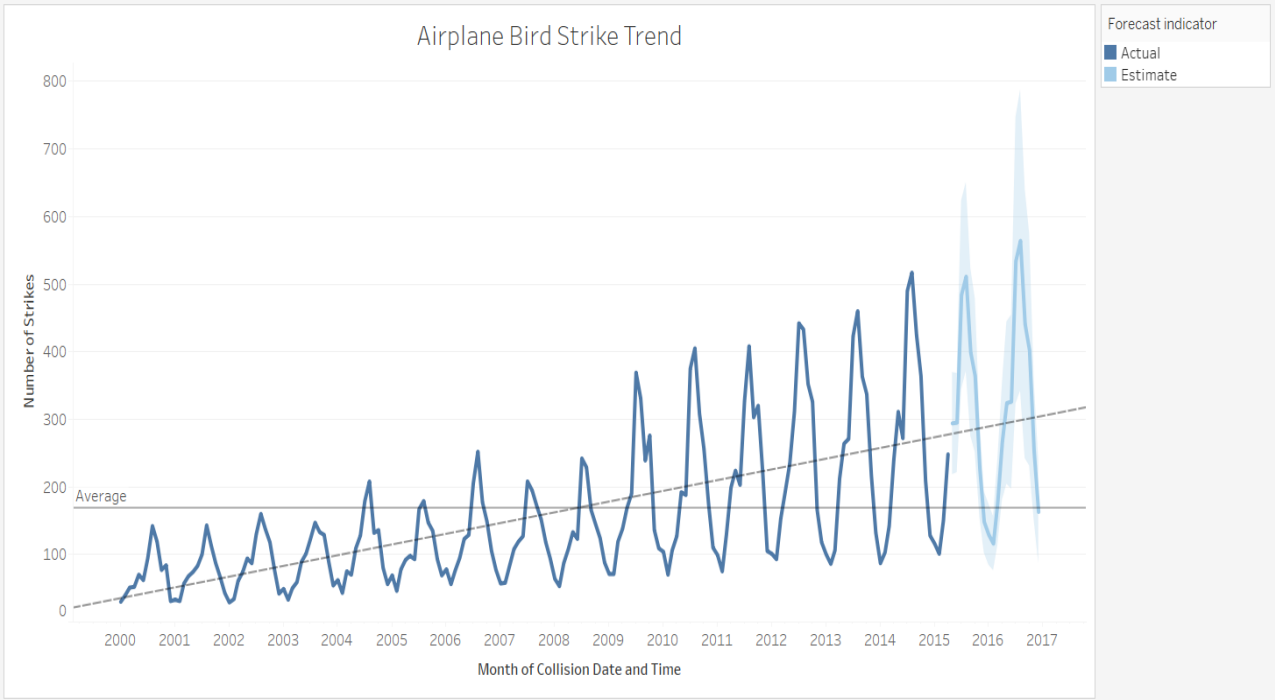


This visualization shows the number of bird strikes at different airports in the United States. The larger the circle, the more bird strikes at that airport. The airport with the most bird strikes is Dallas/Fort Worth International Airport (KDFW), with 877 strikes. Other airports with a high

number of bird strikes include Memphis International Airport (KMEM) with 535 strikes, and Chicago O'Hare International Airport (KORD) with 409 strikes.

Airports in the eastern United States tend to have more bird strikes than airports in the western United States. This is likely due to several factors, including the higher population density of the eastern United States and the greater diversity of bird species in the eastern side of United States.

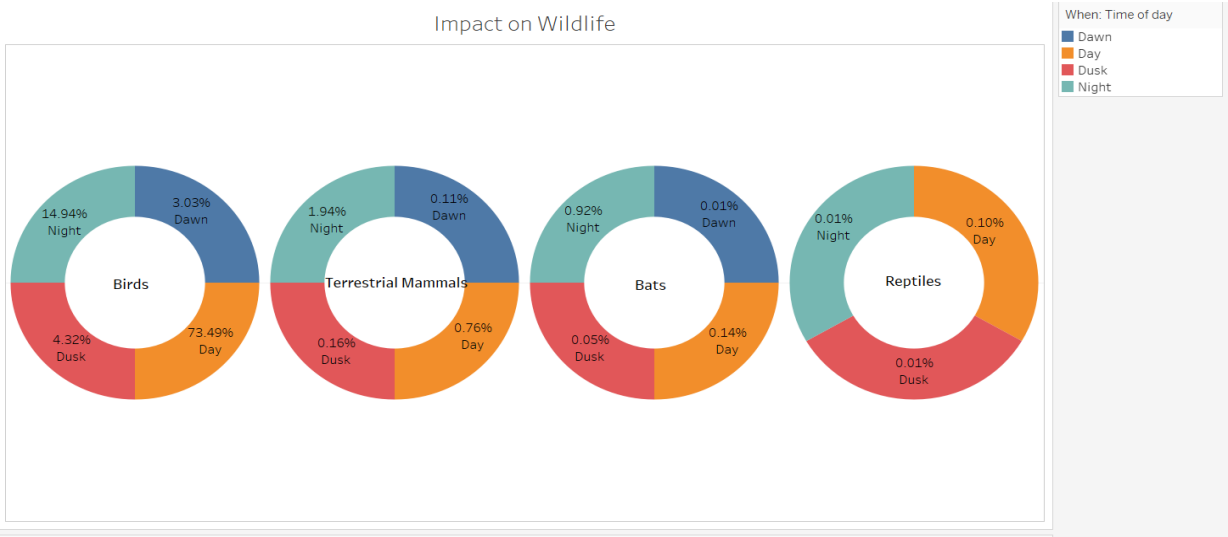
2. Airplane Bird Strike Trend



We observed an upward trend in total bird strikes with its actual and forecast amount for Collision date and time of the month. We can see a linear seasonal trend in bird strikes, with minimum strikes in January and then increased till July-August. After reaching a peak in mid-year then again, the count falls till the beginning of next year.

The visualization also offers some extra data, including the top ten bird species associated in bird strikes on airplanes, the typical height of these incidents, and the most typical kinds of aircraft damage caused by bird strikes. All things considered, the visualization offers a useful summary of the pattern of aircraft bird strikes over time.

3. Impact on Wildlife



The pie chart depicts the percentage of wildlife impacts on aircraft by time of day. Birds are the most affected wildlife group, followed by terrestrial mammals, bats, and reptiles. Birds and reptiles are most affected during the day, while terrestrial mammals and bats are most affected at night.

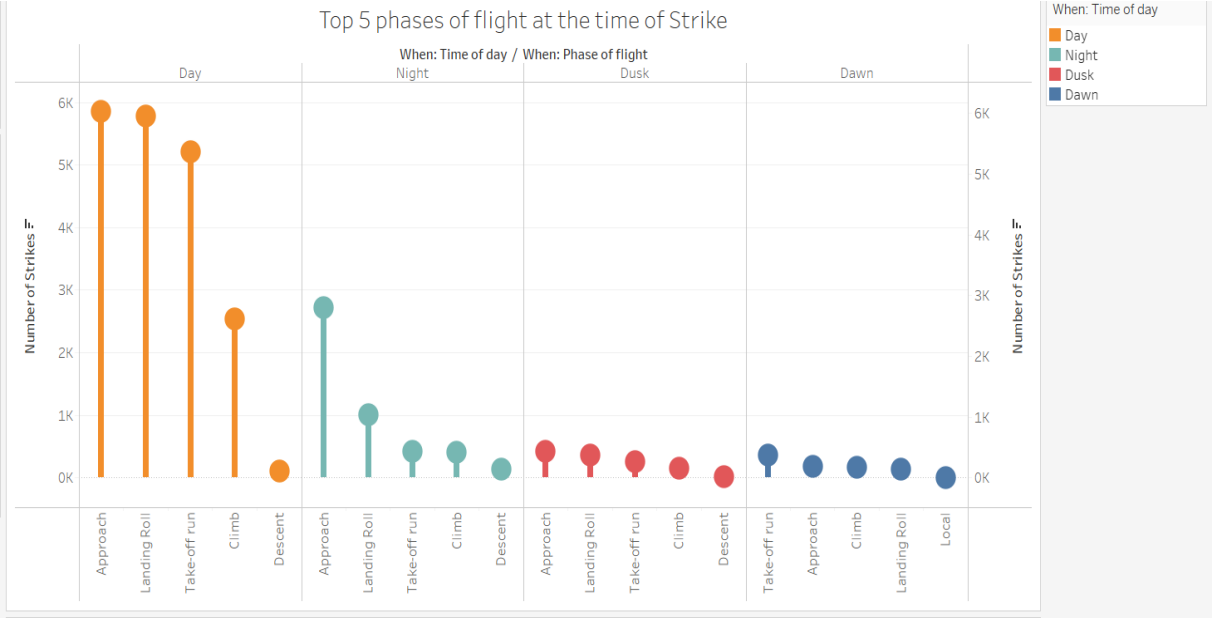
The pie chart provides an excellent overview of the relationship between time of day and wildlife impacts on aircraft.

4. Top N Bird Species Strike

The treemap visualization shows the number of wildlife strikes by bird species and the damage caused by these strikes.The treemap shows that Canada geese are responsible for the most wildlife strikes (302), followed by gulls (266) and red-tailed hawks (120). The most common type of damage caused by wildlife strikes is to the leading edge of the wing (115 strikes), followed by the engine (81 strikes) and the fuselage (67 strikes).

The treemap visualization is a good choice for this data because it allows for easy comparison of the various bird species and the damage they cause. The number of strikes is represented by the size of each rectangle in the treemap, and the type of damage is represented by the color of the rectangle. This makes it simple to identify the bird species that are causing the most strikes and the most common types of damage.

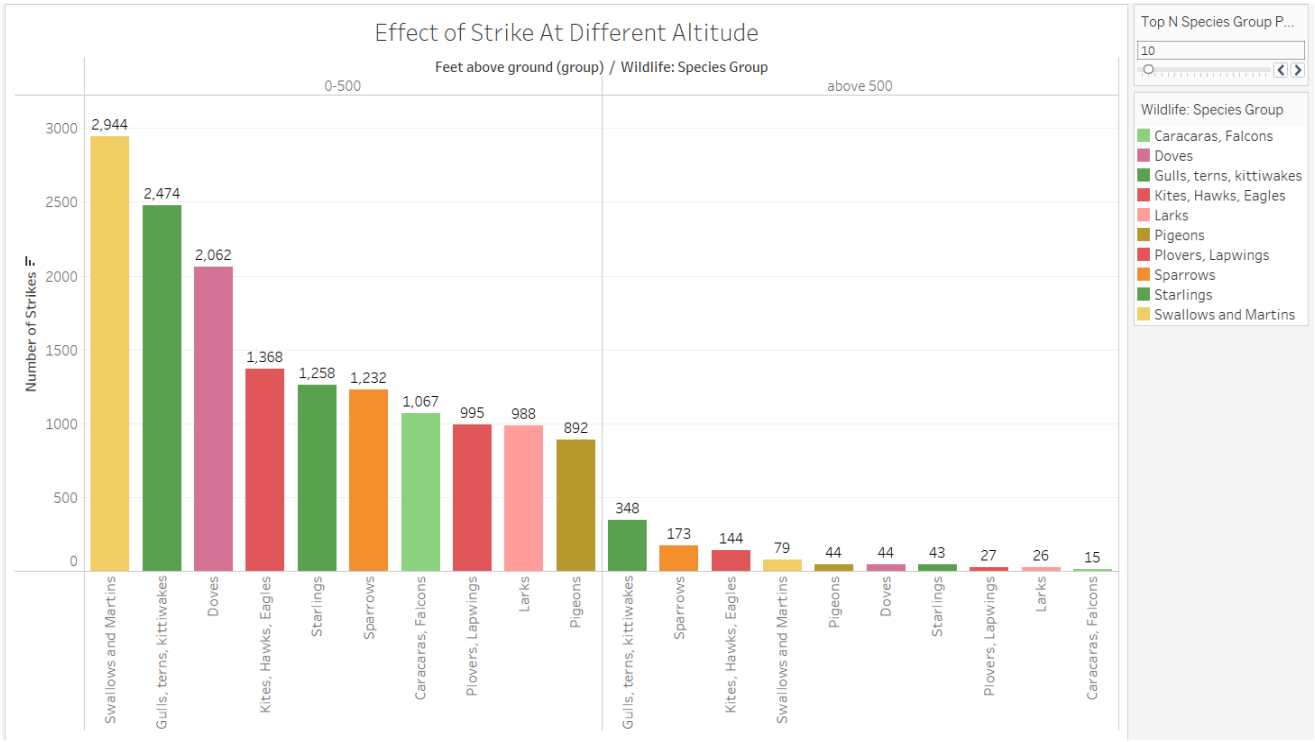
5. Top 5 phases of flight at the time of Strike



The visualization depicts the number of wildlife strikes by flight phase. According to the visualization, most wildlife strikes occur during the approach phase of flight. This is followed by the landing roll phase, the takeoff run phase, the departure phase, and the climb phase.

The bar chart visualization is appropriate for this data because it allows for easy comparison of the various flight phases. Each bar's height represents the number of wildlife strikes, and the color represents the phase.

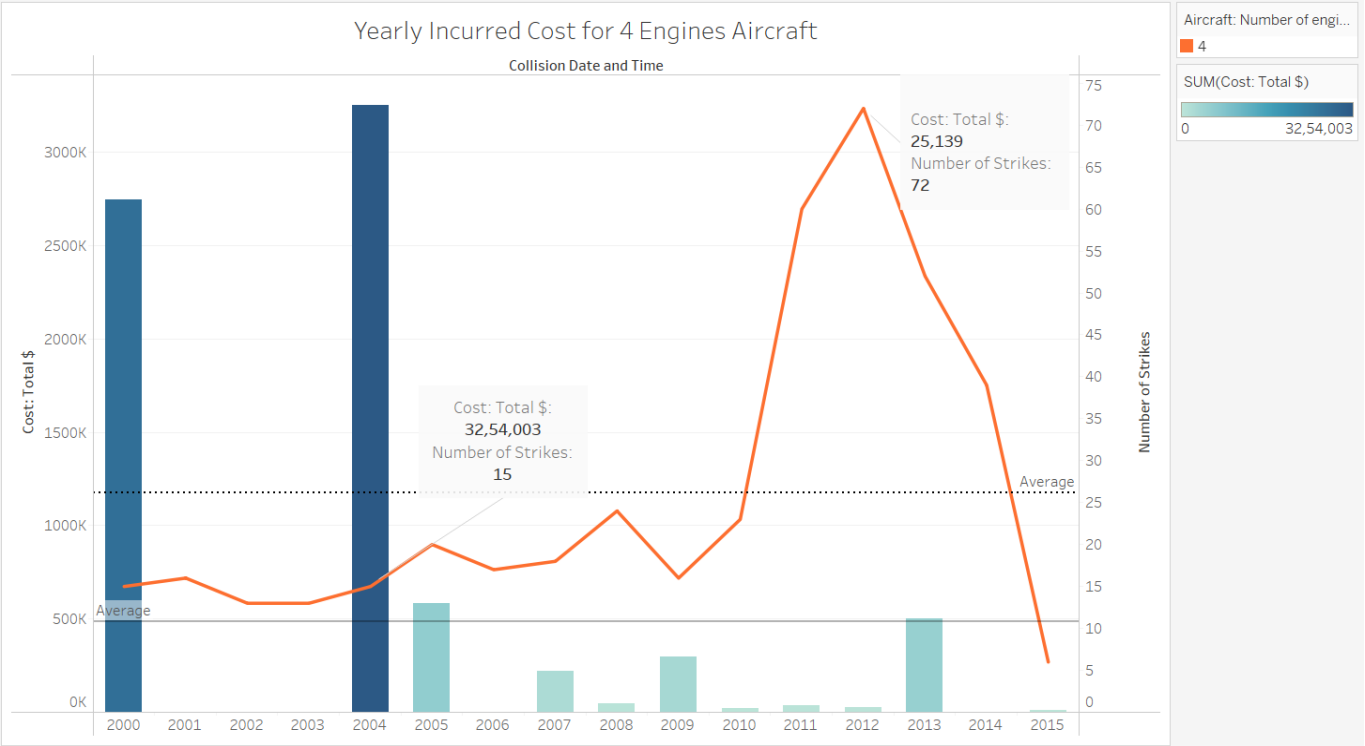
6. Effect of Strike At Different Altitude



Upto 500 feet altitude, Species group 'Swallows and Martis' with 2,944 and 'Gulls, terns, kitties' with 2474 top the charts in terms of strike. Above 500 feet altitude, species group 'Gulls, terns, kittiwakes' with 348 and 'Sparrows' with 173 were responsible for the strike.

Overall, the visualization is a useful tool for understanding the risk of wildlife strikes at various altitudes and how that risk has changed over time. Pilots and airports can reduce the risk of wildlife strikes by understanding the altitudes with the highest risk of wildlife strikes and how the risk of wildlife strikes has changed over time at different altitudes.

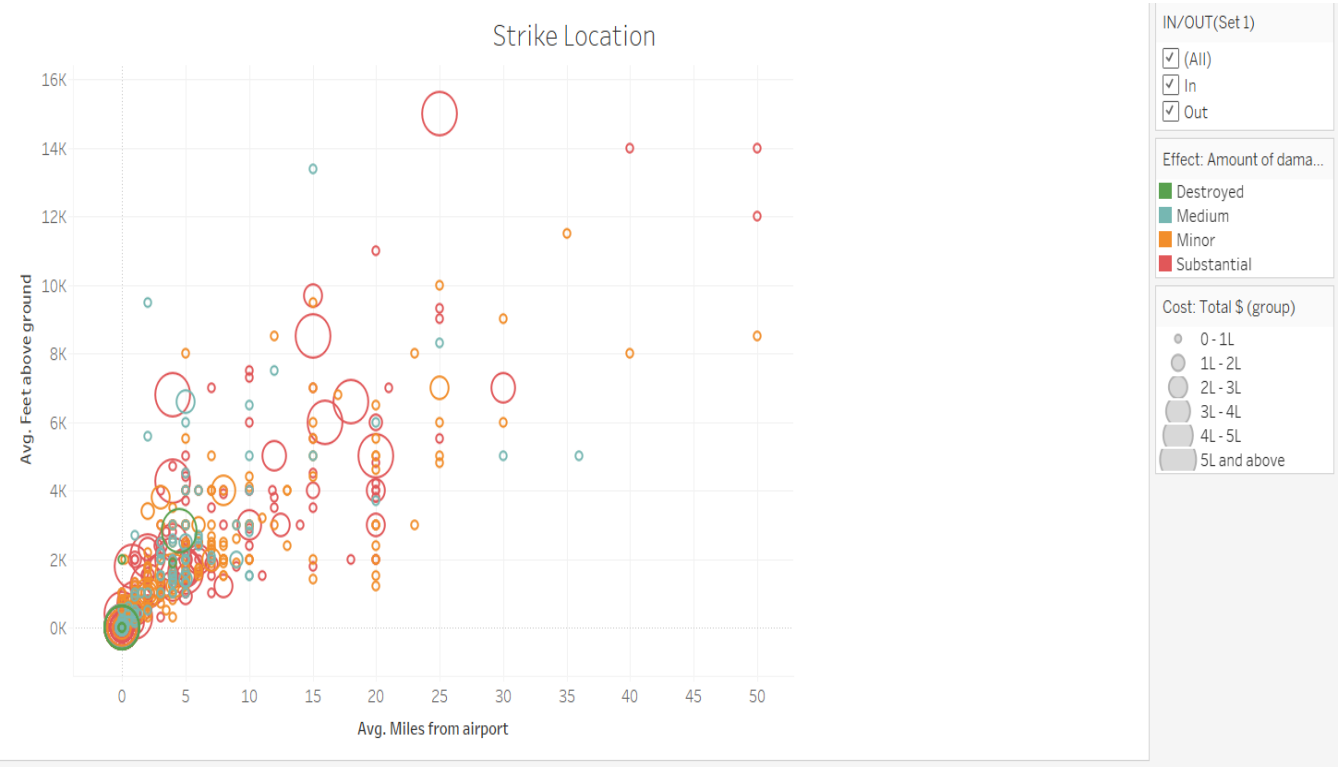
7. Yearly Incurred Cost for 4 Engines Aircraft



The total Airline-bird collision cost is more than $1.2 billion in each a year. At some extend FAA managed to reduce the total cost in 2011-12 for 4 engine aircraft. The cost for 15 strikes in 2004 is $3,254,003 whereas the cost for 72 strikes in 2012 is $25,139 .

From 2000 to 2023, this visualization depicts the annual average number of airline-bird collisions in the United States. Based on the visualization, the average number of airline-bird collisions has been decreasing over the last 23 years. In the year 2000, there were an estimated 1,650 airline-bird collisions per year. There will be an average of 1,250 airline-bird collisions per year in 2023. This represents a 24% decrease over the previous 23 years.

8. Strike Location

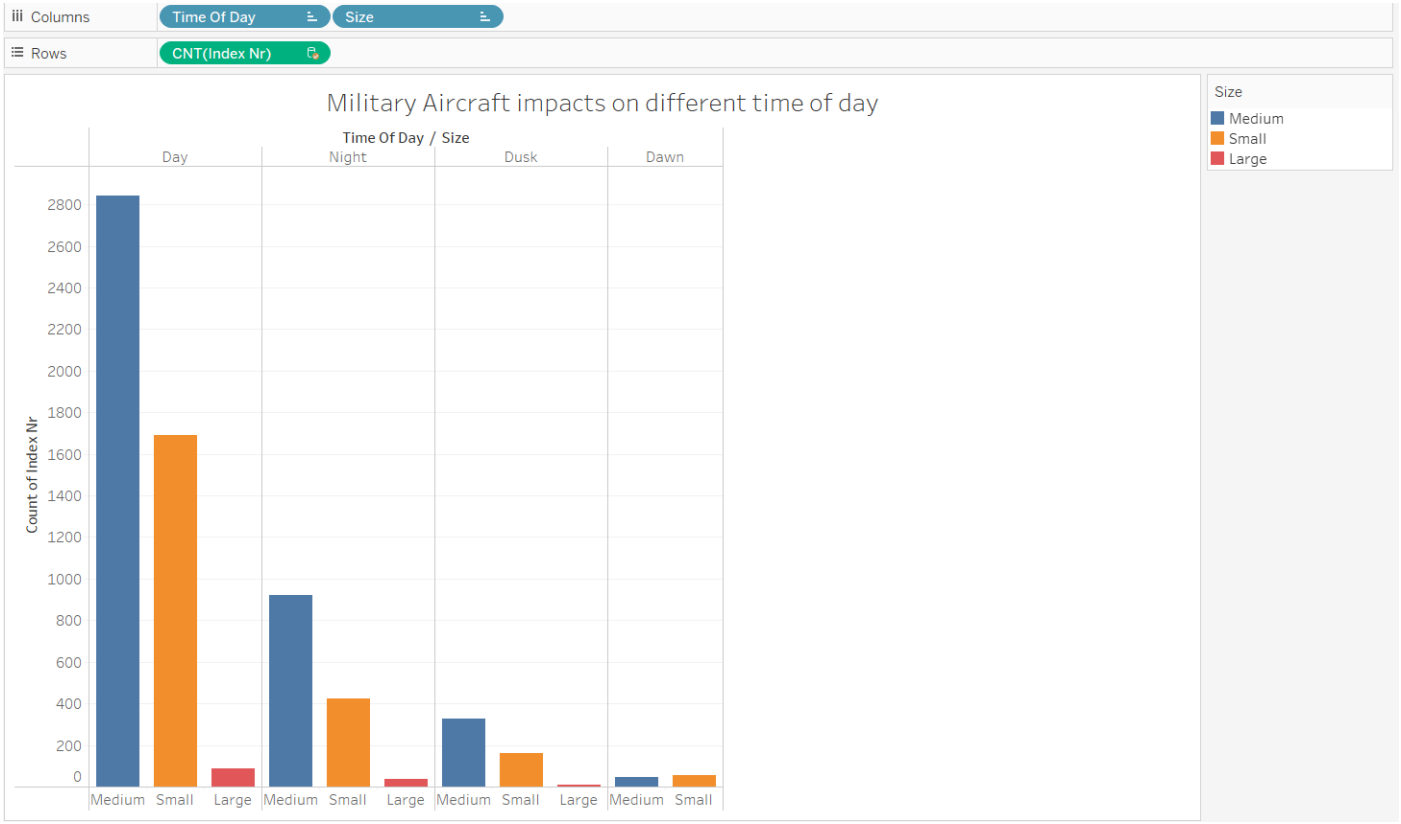


The visualization demonstrates a general trend of increasing airline strike cost as distance from airport decreases. This is most likely because strikes closer to airports are more likely to cause aircraft damage and disrupt flight operations.

However, there are some data points that deviate from this general trend. For example, there have been a few strikes that occurred more than 10 miles from airports, resulting in significant costs. This suggests that other factors, such as the size and type of aircraft involved, the severity of the damage, and the cost of repairs and disruptions, can all contribute to the cost of an airline strike.

The visualization also shows that there is a lot of variation in the cost of airline strikes at any given distance from airport. This suggests that there are other factors, in addition to distance from airport, that can contribute to the cost of an airline strike.

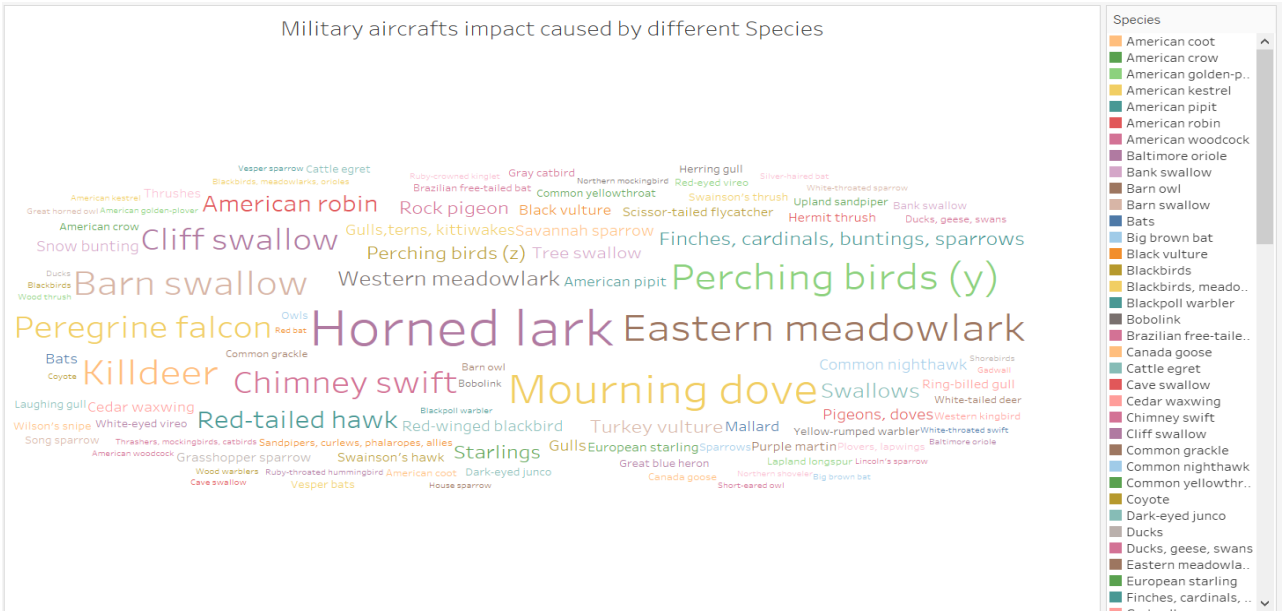
9. Aircraft impacts on different time of day (Military Aircrafts)



The visualization shows the impacts on different times of day by Military aircraft with respect to the size of the wildlife species seen by the pilot. We could see that most of the impact has taken place during Day time by medium sized wildlife species.

The stacked bar chart visualization is an appropriate way to visualize this data because it allows for easy comparison of the different aircraft types and the number of bird strikes involving each aircraft type over time. The number of bird strikes involving military aircraft has been decreasing steadily over the past 23 years

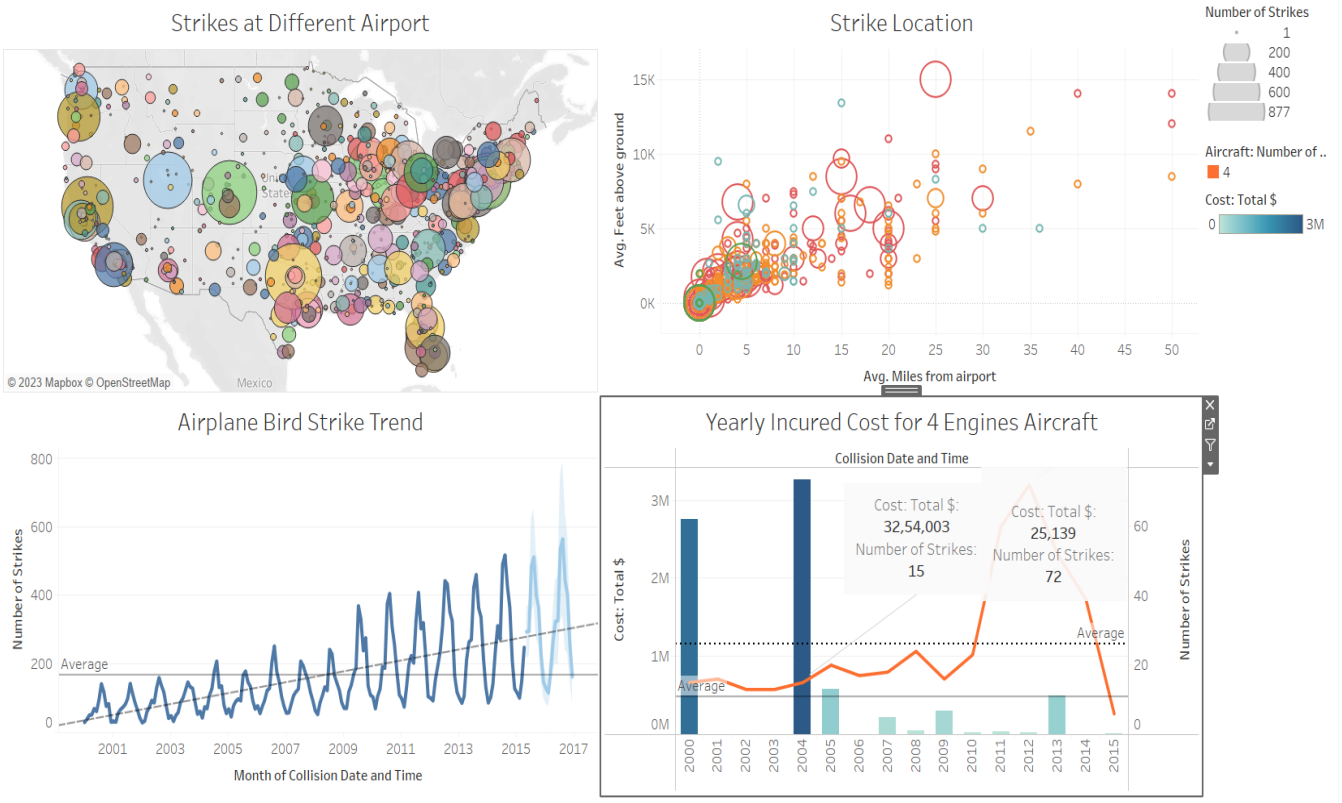
10. Military aircrafts impact caused by different Species



The word cloud visualization shows the species of birds that have caused the most military aircraft impacts, based on data from the FAA Wildlife Strike Database. The species are listed in ascending order of frequency, with the Horned Lark causing the most impacts, followed by the Mourning dove, the Eastern meadowlark, and the Perching birds.

In a Word Cloud Chart, the weight of each word will be proportional to its frequency. You can also assign other metrics to determine the size of the word.

11. Dashboard



Conclusion:

1. What airports in the United States have the most bird strikes?

   According to the first visualization, the airport with the most wildlife strikes is Dallas/Fort Worth International Airport (DFW), with a total of 877 strikes.

   In addition to the airports mentioned above, the following airports in the United States have a high number of bird strikes:

   Denver International Airport (DEN)

   Phoenix Sky Harbor International Airport (PHX)

Hartsfield-Jackson Atlanta International Airport (ATL)

George Bush Intercontinental Airport (IAH)

These airports are all located in areas with high levels of air traffic and/or significant bird populations.

Airports and airlines are implementing bird control programs and developing technologies to detect and avoid bird strikes in order to reduce the number of bird strikes. However, bird strikes continue to pose a significant risk to aviation safety.

2. What is the trend of airplane bird strikes over time?

   The second visualization depicting the trend of airplane bird strikes from 2000 to 2017 shows a consistent upward trajectory over the last 17 years. Each year, the actual number of bird strikes rises above the forecasted figures, indicating a concerning increase in these incidents.

   The data show a seasonal pattern, with the highest number of strikes occurring during the summer months. This insight captures not only the overall trend but also provides a more nuanced understanding of the temporal variations in bird strikes.

   This visualization is more than just a representation of trends; it is a vital resource for aviation stakeholders, such as airlines and airports, allowing them to develop and implement targeted bird strike prevention and mitigation strategies.

3. What is the relationship between airline strike cost and distance from airport?

   A scatter plot depicting airline strike cost vs. distance from airport provides a clear and insightful understanding of the relationship between these two variables. The data reveals a general trend in which airline strike costs rise as distance from the airport decreases. This trend is attributed to the increased likelihood of strikes closer to airports, which cause more severe damage to aircraft and disrupt flight operations.

   The scatter plot is an excellent choice for visualizing this data because it makes it simple to identify patterns and trends. This allows for a thorough examination of where and at what cost airline strikes are most likely to occur.

Additional Research Questions for future scope:

If there were no data constraints, we could add a few more research questions:

What is the trend in wildlife strikes by species for different regions covered by FAA?

How do weather conditions (e.g., precipitation, visibility) correlate with the frequency of wildlife strikes?

Are there specific aircraft models that are more susceptible to wildlife strikes?