DATA VISUALIZATION ON BIRD-STRIKE

INTRODUCTION

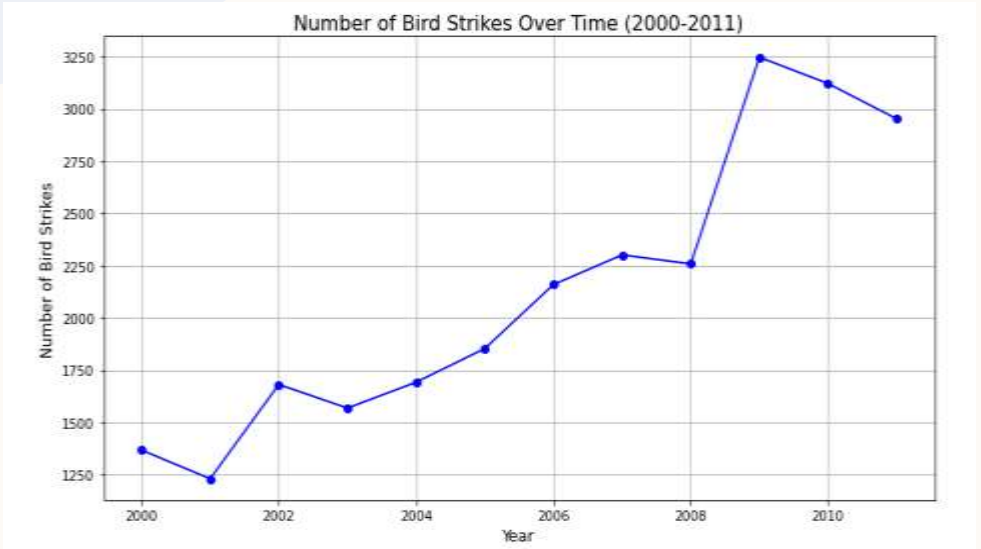
In the realm of transport and communication, analytics play a pivotal role in addressing pressing environmental and safety challenges. Among these, **bird strikes**—collisions between birds and aircraft during various flight phases—pose a significant concern. These incidents can lead to considerable damage to aircraft structures and, especially for jet engines, may result in dangerous loss of thrust if birds are ingested. This risk is heightened during take-off, initial climb, approach, and landing, when aircraft are at lower altitudes with increased bird activity.

The Federal Aviation Administration (FAA) has collected extensive data on bird strikes from 2000 to 2011. By analyzing this data, we can gain insights into the frequency and impact of these collisions. Our goal is to understand these trends better and explore innovative solutions, including technological advancements and artificial intelligence, to

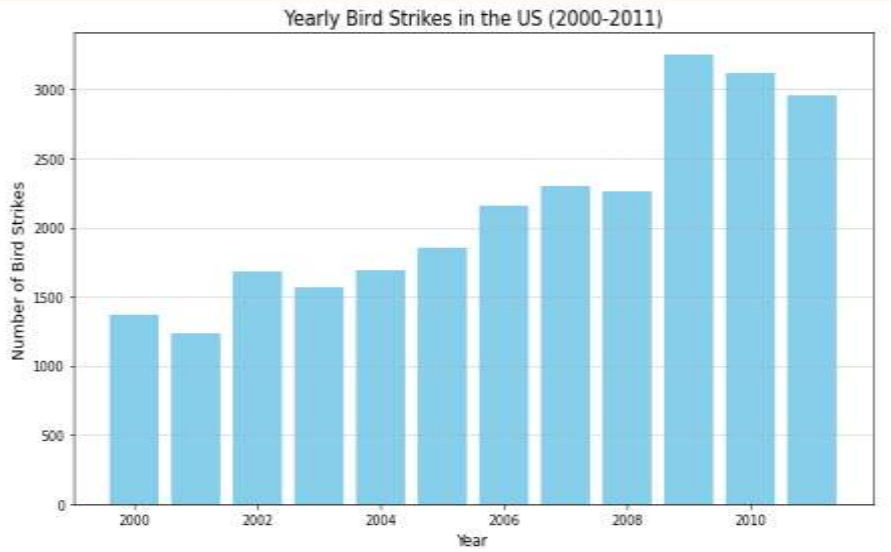
CASE STUDIES

- Visuals Depicting the Number of Bird Strikes
- Yearly Analysis & Bird Strikes in the US
- Top 10 US Airlines in terms of having encountered bird strikes
- Airports with most incidents of bird strikes – Top 50
- Yearly Cost Incurred due to Bird Strikes:
- When do most bird strikes occur?
- Altitude of Aeroplanes at the time of strike
- Phase of flight at the time of the strike.
- Average Altitude of the Aeroplanes in different phases at the time of strike
- Effect of Bird Strikes & Impact on Flight
- Effect of Strike at Different Altitude
- Were Pilots Informed? & Prior Warning and Effect of Strike Relation

DATA VISUALIZATION

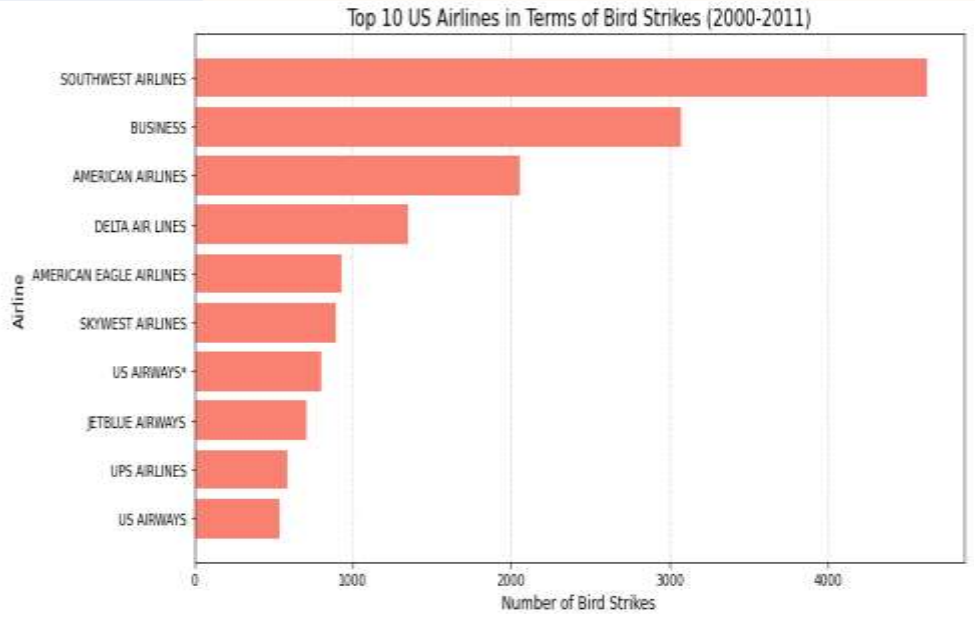


1. Visuals Depicting the Number of Bird Strikes

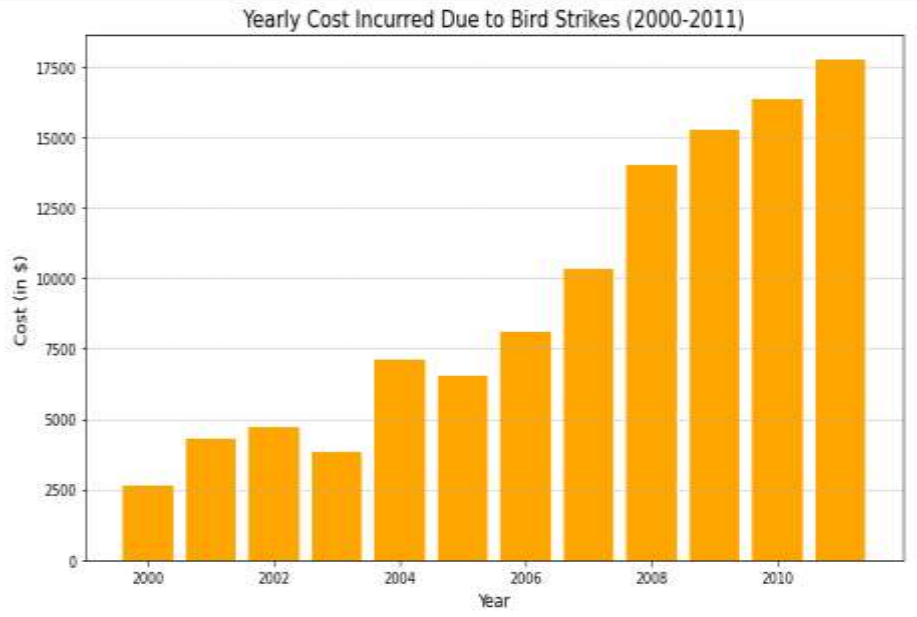


2. Yearly Analysis & Bird Strikes in the US

DATA VISUALIZATION

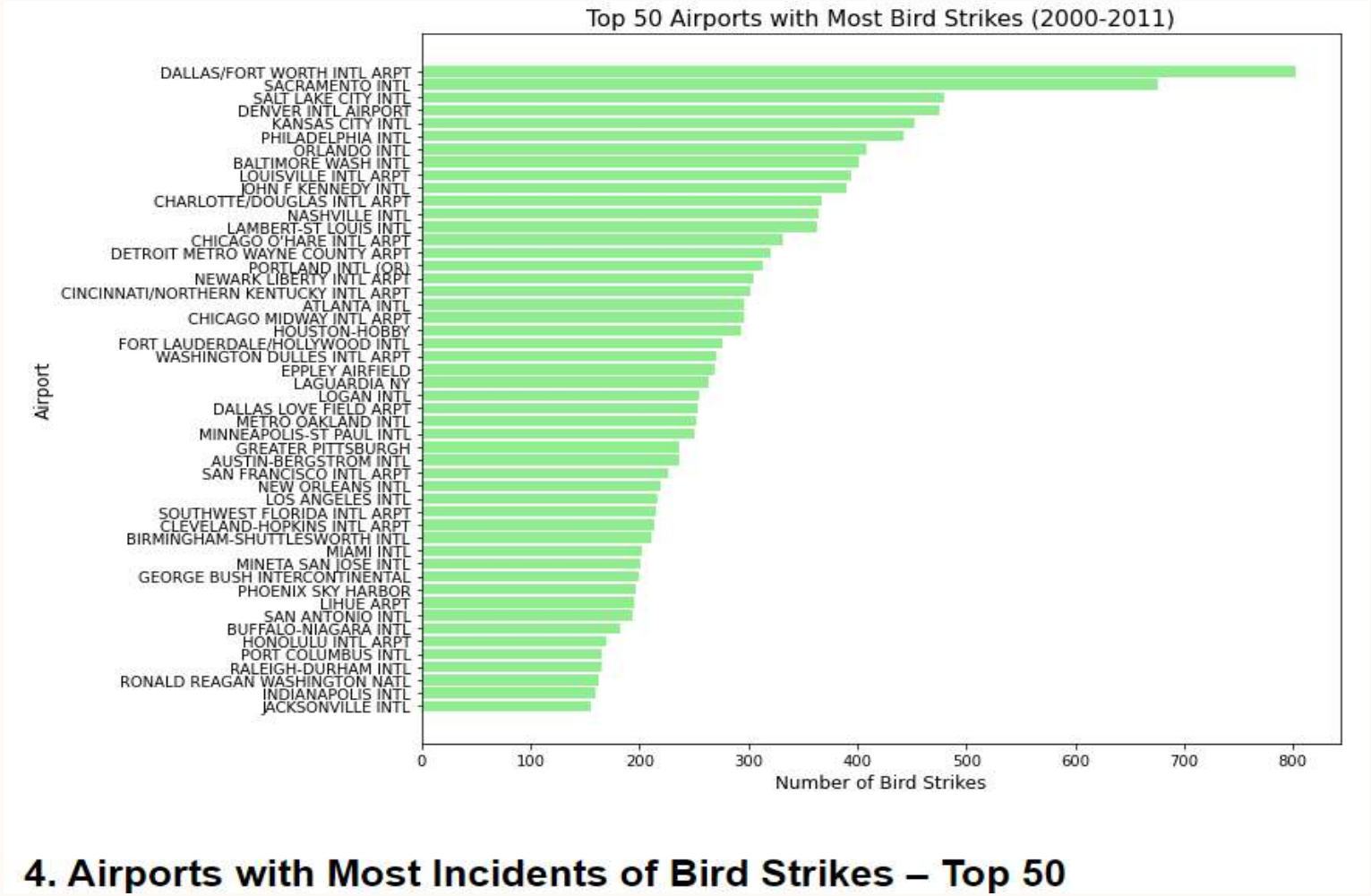


3: Top 10 US Airlines in Terms of Bird Strikes



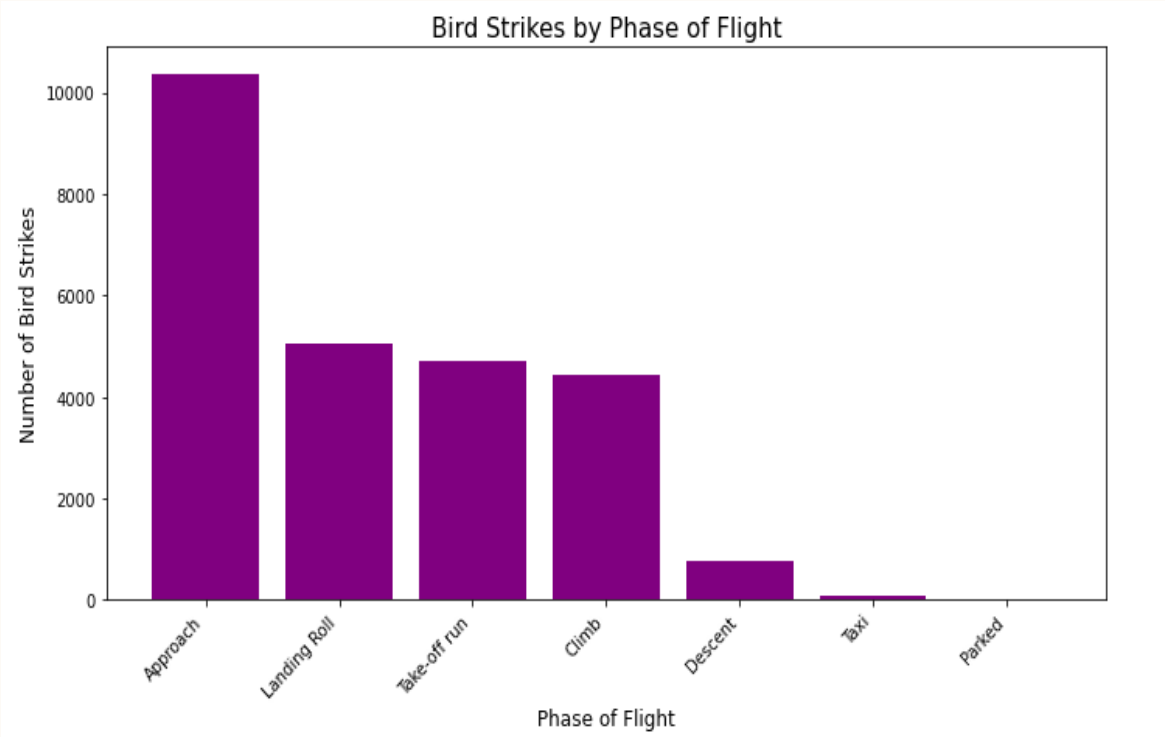
5. Yearly Cost Incurred Due to Bird Strikes

DATA VISUALIZATION

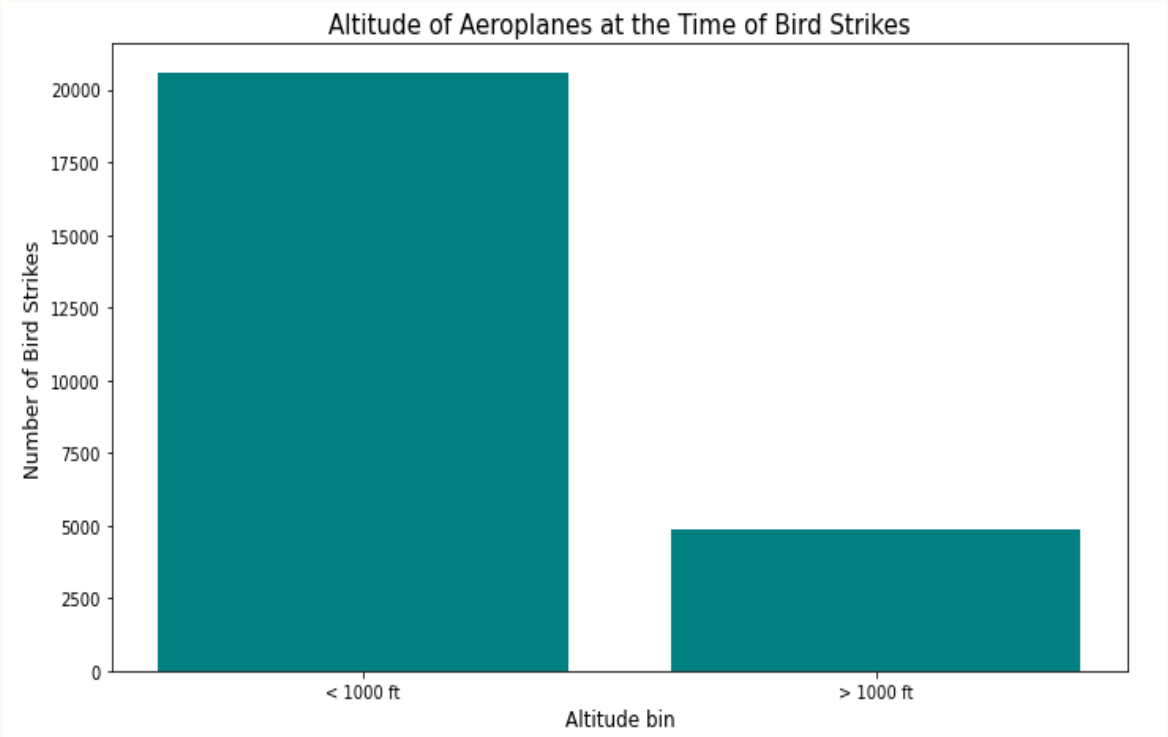


4. Airports with Most Incidents of Bird Strikes – Top 50

DATA VISUALIZATION

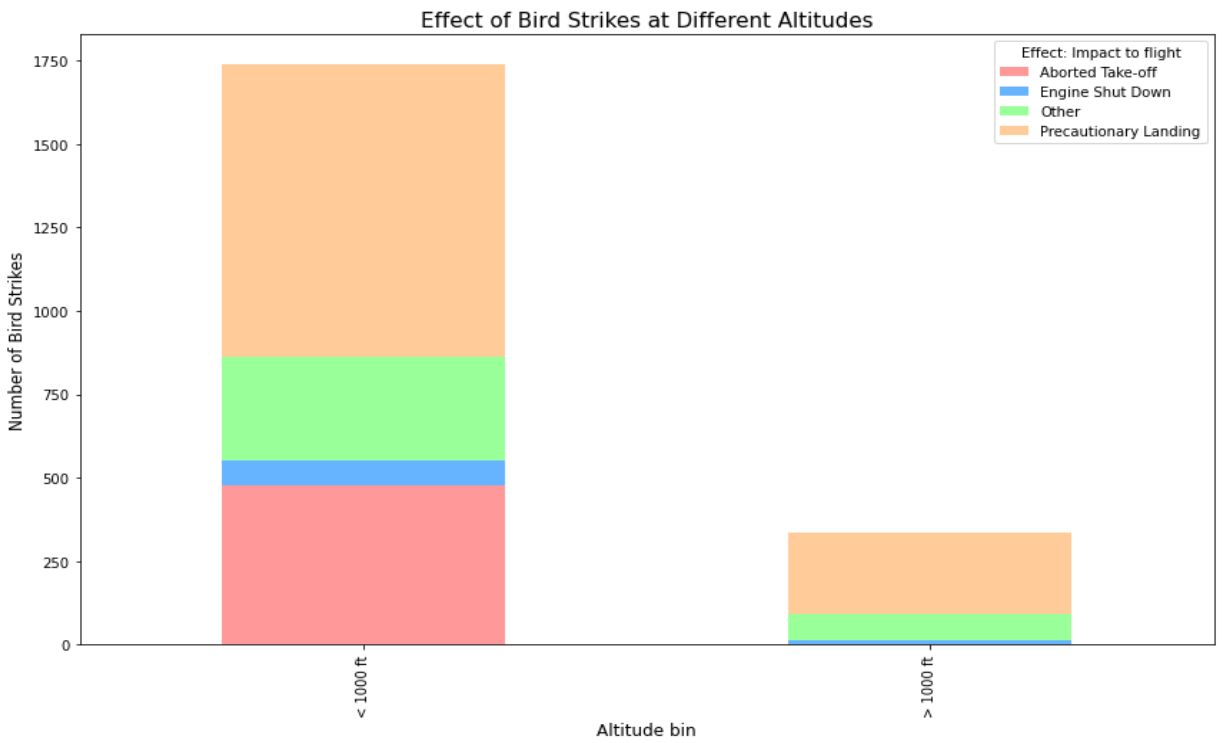


6. When Do Most Bird Strikes Occur?

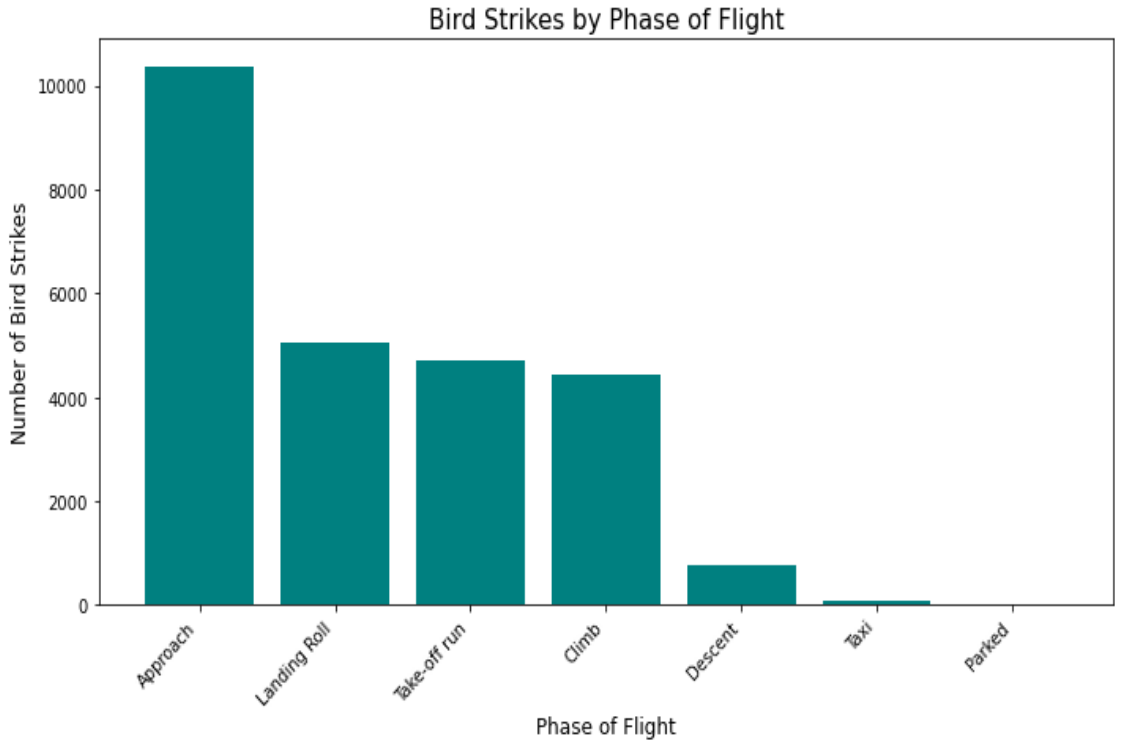


7 Altitude of aeroplanes at the time of strike

DATA VISUALIZATION

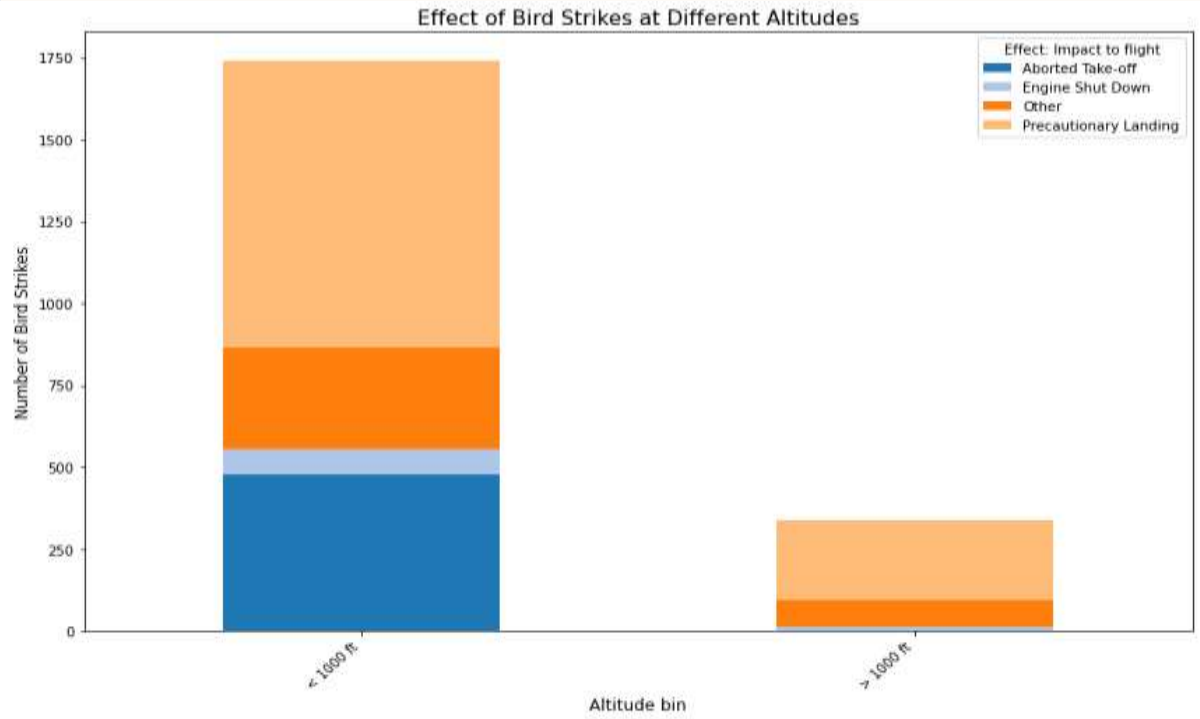


9 Average Altitude of the aeroplanes in different phases at the time of strike ¶

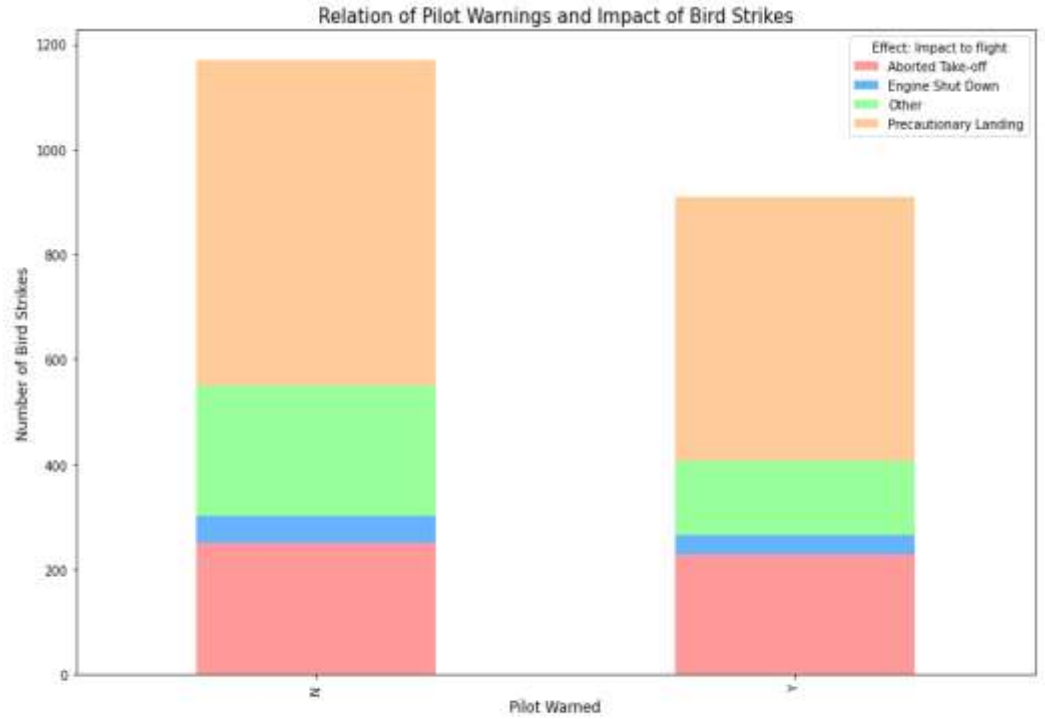


8 Phase of flight at the time of the strike.

DATA VISUALIZATION

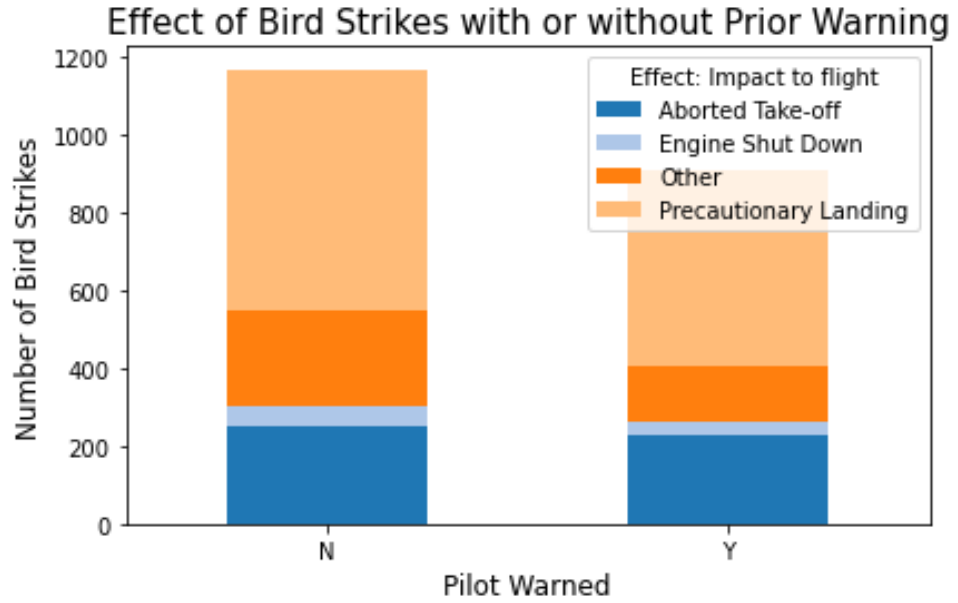


11 Effect of Strike at Different Altitude



10 Effect of Bird Strikes & Impact on Flight

DATA VISUALIZATION



12 Were Pilots Informed? & Prior Warning and Effect of Strike Relation

THANK YOU

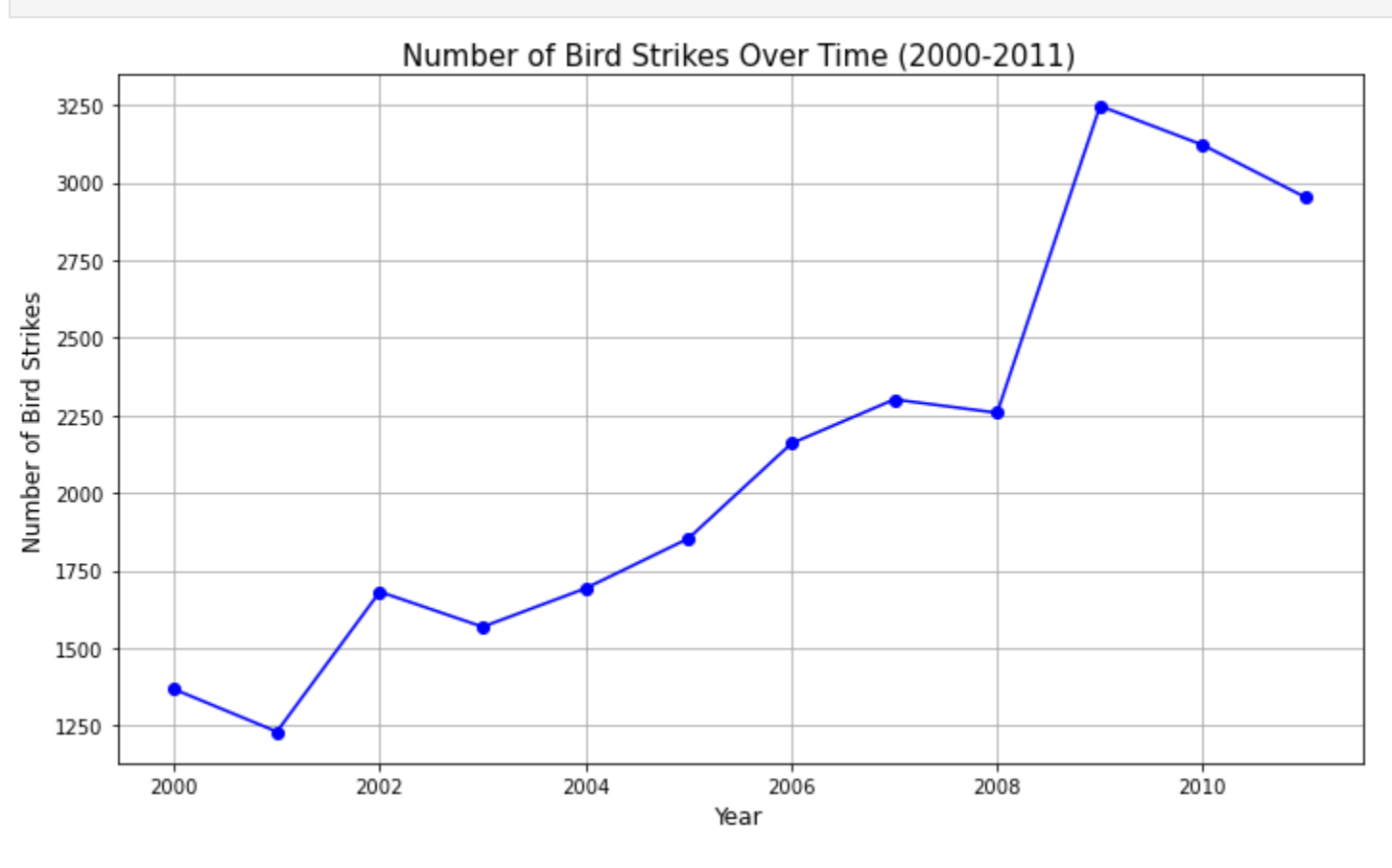
In [1]:
```python
# Import necessary libraries
import pandas as pd

# Load the dataset
file_path = 'Bird Strikes.csv'
bird_strikes_df = pd.read_csv(file_path)

# Display the first few rows of the dataset to inspect its structure
bird_strikes_df.head(), bird_strikes_df.columns
```

```
C:\Users\vivek\anaconda3\lib\site-packages\pandas\core\computation\expressions.py:21: UserWarning: Pandas requires version '2.8.4' or newer of 'numexpr' (version '2.7.3' currently installed).
  from pandas.core.computation.check import NUMEXPR_INSTALLED
C:\Users\vivek\anaconda3\lib\site-packages\pandas\core\arrays\masked.py:60: UserWarning: Pandas requires version '1.3.6' or newer of 'bottleneck' (version '1.3.2' currently installed).
  from pandas.core import (
```

Out[1]:
```
(   Record ID Aircraft: Type                Airport: Name Altitude bin  \
 0     202152       Airplane                 LAGUARDIA NY    > 1000 ft
 1     208159       Airplane  DALLAS/FORT WORTH INTL ARPT    < 1000 ft
 2     207601       Airplane            LAKEFRONT AIRPORT    < 1000 ft
 3     215953       Airplane          SEATTLE-TACOMA INTL    < 1000 ft
 4     219878       Airplane                 NORFOLK INTL    < 1000 ft

   Aircraft: Make/Model Wildlife: Number struck  \
 0            B-737-400                Over 100
 1                MD-80                Over 100
 2                C-500                Over 100
 3            B-737-400                Over 100
 4         CL-RJ100/200                Over 100

    Wildlife: Number Struck Actual Effect: Impact to flight     FlightDate  \
 0                             859         Engine Shut Down  11/23/00 0:00
 1                             424                      NaN   7/25/01 0:00
 2                             261                      NaN   9/14/01 0:00
 3                             806    Precautionary Landing    9/5/02 0:00
 4                             942                      NaN   6/23/03 0:00

   Effect: Indicated Damage  ... Remains of wildlife sent to Smithsonian  \
 0            Caused damage  ...                                   False
 1            Caused damage  ...                                   False
 2                No damage  ...                                   False
 3                No damage  ...                                   False
 4                No damage  ...                                   False

                                              Remarks Wildlife: Size  \
 0  FLT 753. PILOT REPTD A HUNDRED BIRDS ON UNKN T...         Medium
 1  102 CARCASSES FOUND. 1 LDG LIGHT ON NOSE GEAR ...          Small
 2  FLEW UNDER A VERY LARGE FLOCK OF BIRDS OVER AP...          Small
 3  NOTAM WARNING. 26 BIRDS HIT THE A/C, FORCING A...          Small
 4                                   NO DMG REPTD.          Small

   Conditions: Sky      Wildlife: Species  Pilot warned of birds or wildlife?  \
 0        No Cloud  Unknown bird - medium                                  N
 1      Some Cloud            Rock pigeon                                  Y
 2        No Cloud      European starling                                  N
 3      Some Cloud      European starling                                  Y
 4        No Cloud      European starling                                  N

    Cost: Total $ Feet above ground Number of people injured Is Aircraft Large?
 0         30,736             1,500                        0                Yes
 1              0                 0                        0                 No
 2              0                50                        0                 No
 3              0                50                        0                Yes
 4              0                50                        0                 No

 [5 rows x 26 columns],
 Index(['Record ID', 'Aircraft: Type', 'Airport: Name', 'Altitude bin',
        'Aircraft: Make/Model', 'Wildlife: Number struck',
        'Wildlife: Number Struck Actual', 'Effect: Impact to flight',
        'FlightDate', 'Effect: Indicated Damage',
        'Aircraft: Number of engines?', 'Aircraft: Airline/Operator',
        'Origin State', 'When: Phase of flight', 'Conditions: Precipitation',
        'Remains of wildlife collected?',
        'Remains of wildlife sent to Smithsonian', 'Remarks', 'Wildlife: Size',
        'Conditions: Sky', 'Wildlife: Species',
        'Pilot warned of birds or wildlife?', 'Cost: Total $',
        'Feet above ground', 'Number of people injured', 'Is Aircraft Large?'],
       dtype='object'))
```

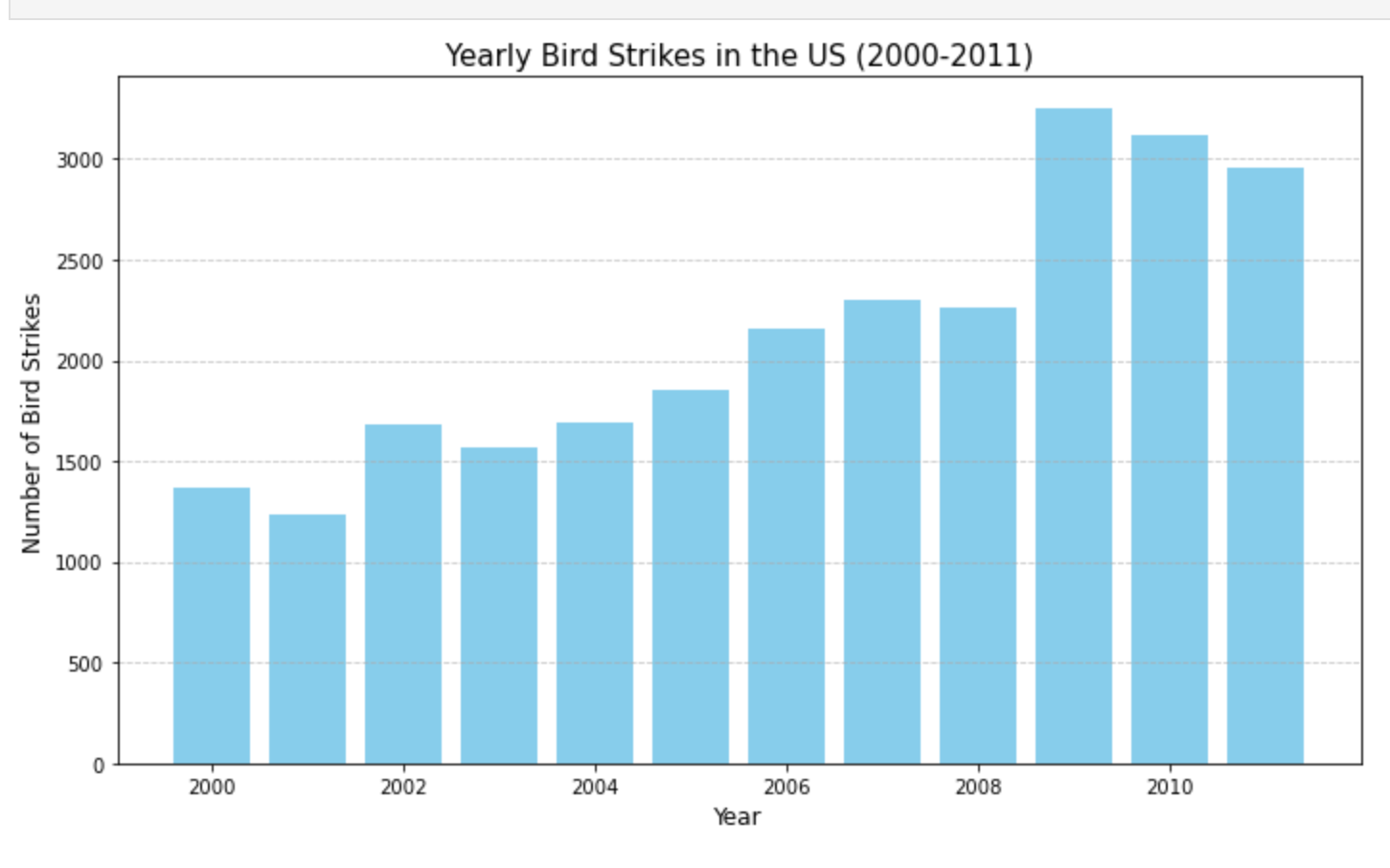
Case studies

In [4]:
```python
import matplotlib.pyplot as plt
import numpy as np

# Check for any NaN or invalid values in 'Year' and 'Number of Bird Strikes'
bird_strikes_per_year.dropna(subset=['Year', 'Number of Bird Strikes'], inplace=True)

# Convert to integer and numeric types, if necessary
bird_strikes_per_year['Year'] = pd.to_numeric(bird_strikes_per_year['Year'], errors='coerce').astype(int)
bird_strikes_per_year['Number of Bird Strikes'] = pd.to_numeric(bird_strikes_per_year['Number of Bird Strikes'], errors='coerce')

# Ensure the columns are numpy arrays to avoid multi-dimensional indexing issues
years = bird_strikes_per_year['Year'].to_numpy()
strikes = bird_strikes_per_year['Number of Bird Strikes'].to_numpy()

# Plot the data
plt.figure(figsize=(10, 6))
plt.plot(years, strikes, marker='o', color='b')
plt.title('Number of Bird Strikes Over Time (2000-2011)', fontsize=15)
plt.xlabel('Year', fontsize=12)
plt.ylabel('Number of Bird Strikes', fontsize=12)
plt.grid(True)
plt.tight_layout()
plt.show()
```



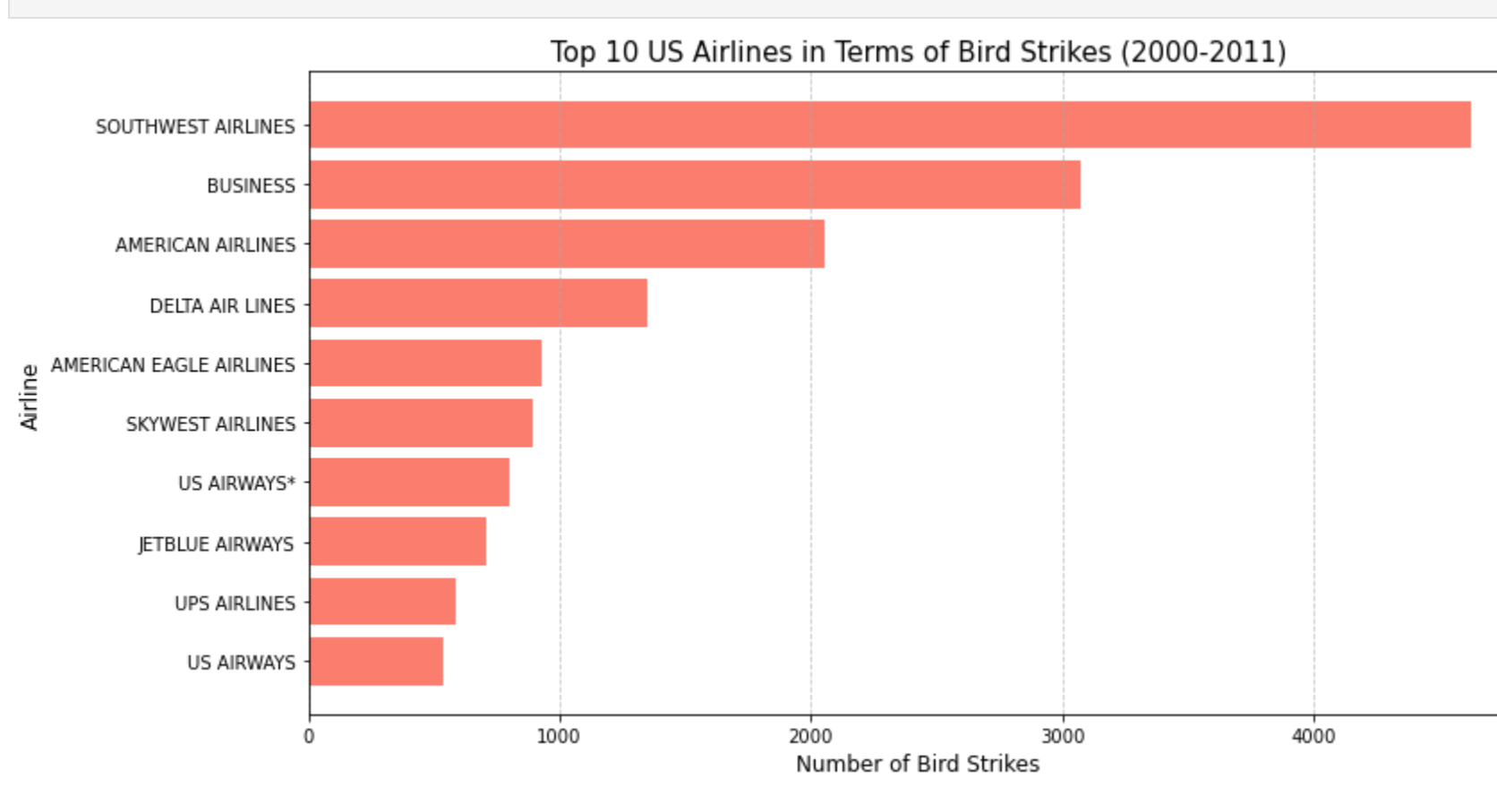
1. Visuals Depicting the Number of Bird Strikes

In [5]:
```python
plt.figure(figsize=(10, 6))
plt.bar(bird_strikes_per_year['Year'], bird_strikes_per_year['Number of Bird Strikes'], color='skyblue')
plt.title('Yearly Bird Strikes in the US (2000-2011)', fontsize=15)
plt.xlabel('Year', fontsize=12)
plt.ylabel('Number of Bird Strikes', fontsize=12)
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```



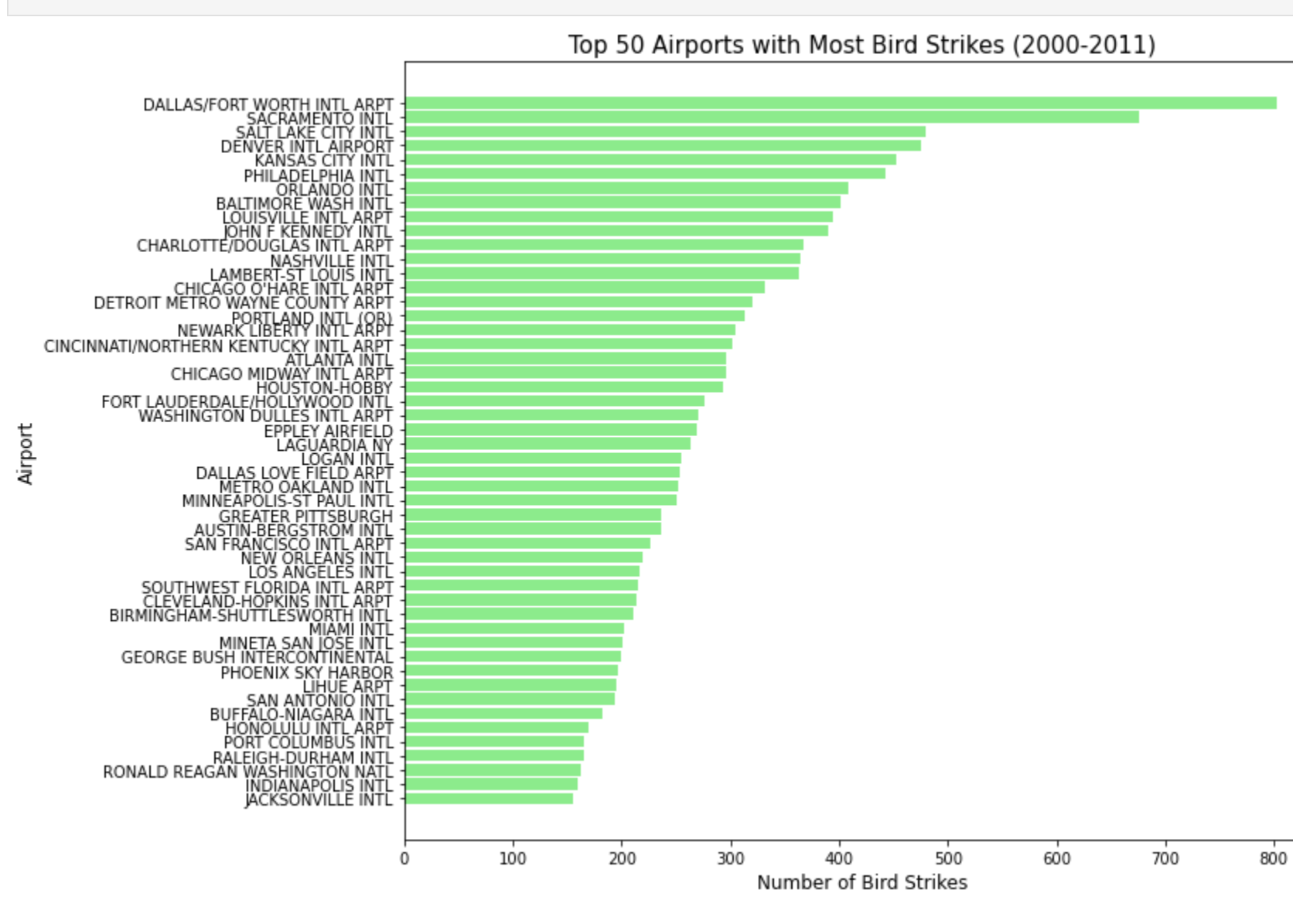
2. Yearly Analysis & Bird Strikes in the US

In [6]:
```python
# Group by the 'Aircraft: Airline/Operator' column to find the top 10 airlines with the most bird strikes
top_airlines = bird_strikes_df.groupby('Aircraft: Airline/Operator').size().reset_index(name='Number of Bird Strikes')

# Sort the airlines by the number of bird strikes in descending order and take the top 10
top_10_airlines = top_airlines.sort_values(by='Number of Bird Strikes', ascending=False).head(10)

# Plot the top 10 airlines
plt.figure(figsize=(12, 6))
plt.barh(top_10_airlines['Aircraft: Airline/Operator'], top_10_airlines['Number of Bird Strikes'], color='salmon')
plt.title('Top 10 US Airlines in Terms of Bird Strikes (2000-2011)', fontsize=15)
plt.xlabel('Number of Bird Strikes', fontsize=12)
plt.ylabel('Airline', fontsize=12)
plt.gca().invert_yaxis()  # Invert y-axis to have the top airline at the top
plt.grid(axis='x', linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```



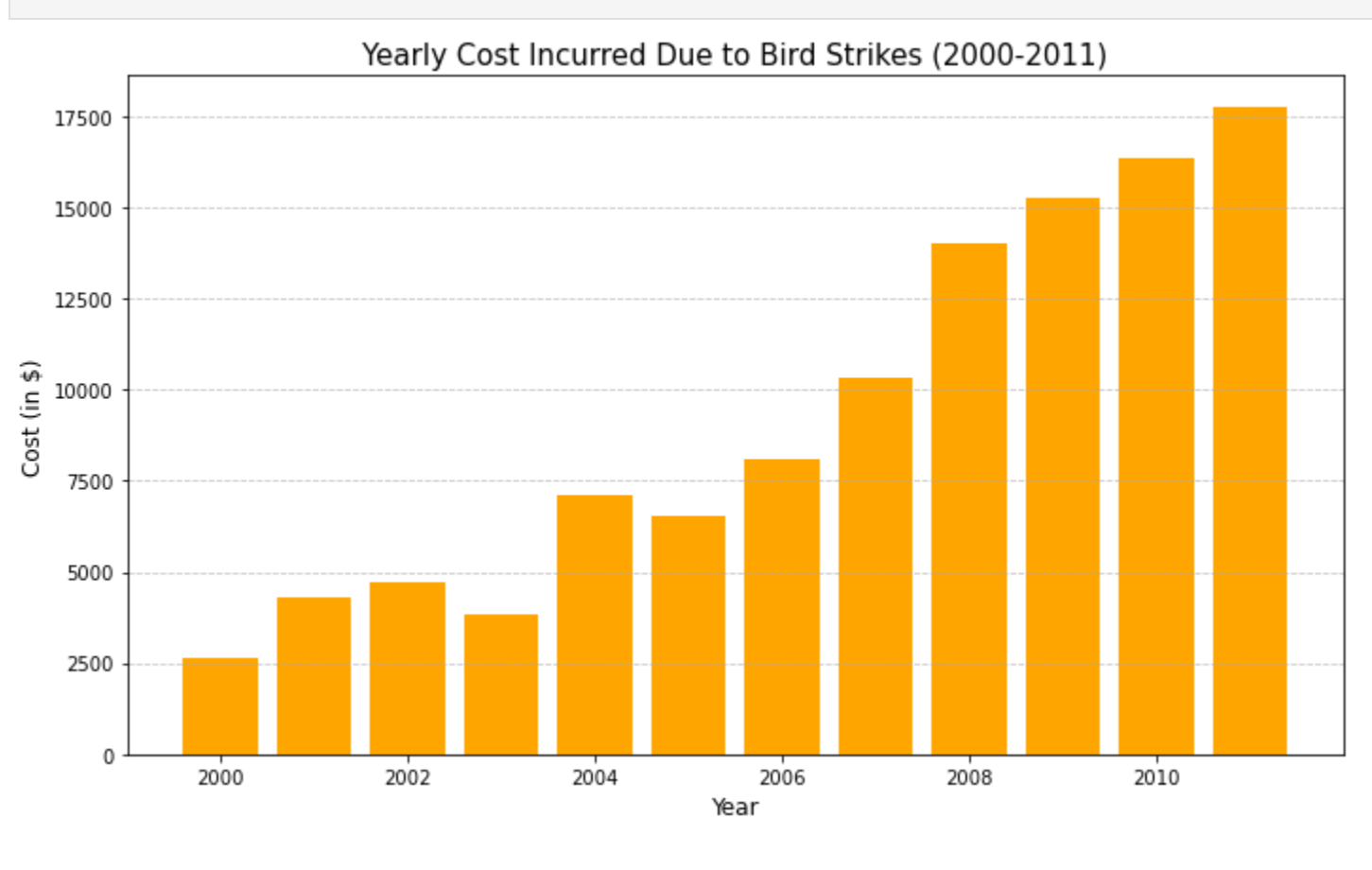
3: Top 10 US Airlines in Terms of Bird Strikes

In [7]:
```python
top_airports = bird_strikes_df.groupby('Airport: Name').size().reset_index(name='Number of Bird Strikes')
top_50_airports = top_airports.sort_values(by='Number of Bird Strikes', ascending=False).head(50)

plt.figure(figsize=(12, 8))
plt.barh(top_50_airports['Airport: Name'], top_50_airports['Number of Bird Strikes'], color='lightgreen')
plt.title('Top 50 Airports with Most Bird Strikes (2000-2011)', fontsize=15)
plt.xlabel('Number of Bird Strikes', fontsize=12)
plt.ylabel('Airport', fontsize=12)
plt.gca().invert_yaxis()
plt.tight_layout()
plt.show()
```



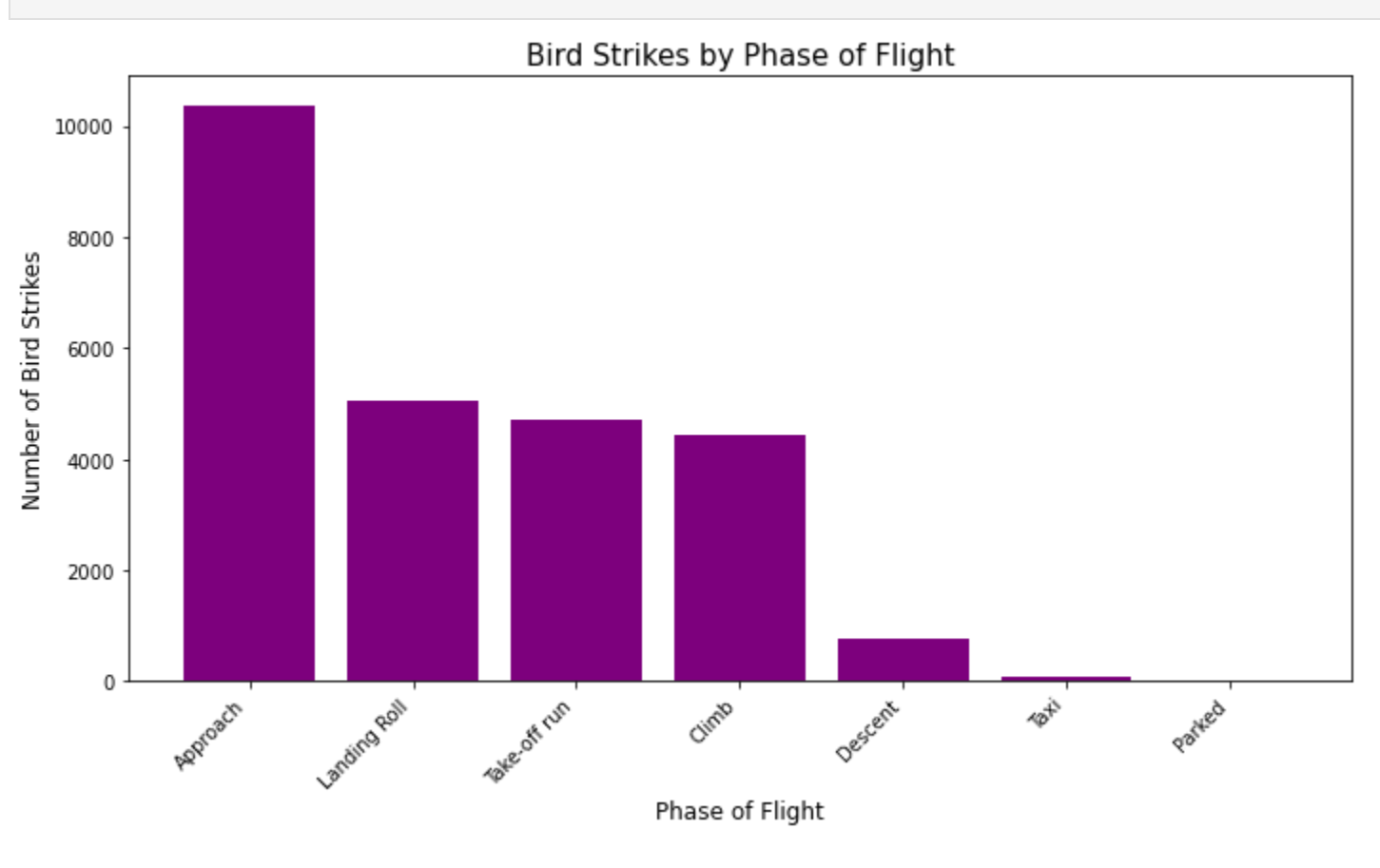
4. Airports with Most Incidents of Bird Strikes – Top 50

In [8]:
```python
bird_strikes_df['Cost: Total $'] = pd.to_numeric(bird_strikes_df['Cost: Total $'], errors='coerce')
yearly_cost = bird_strikes_df.groupby('Year')['Cost: Total $'].sum().reset_index()

plt.figure(figsize=(10, 6))
plt.bar(yearly_cost['Year'], yearly_cost['Cost: Total $'], color='orange')
plt.title('Yearly Cost Incurred Due to Bird Strikes (2000-2011)', fontsize=15)
plt.xlabel('Year', fontsize=12)
plt.ylabel('Cost (in $)', fontsize=12)
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.tight_layout()
plt.show()
```



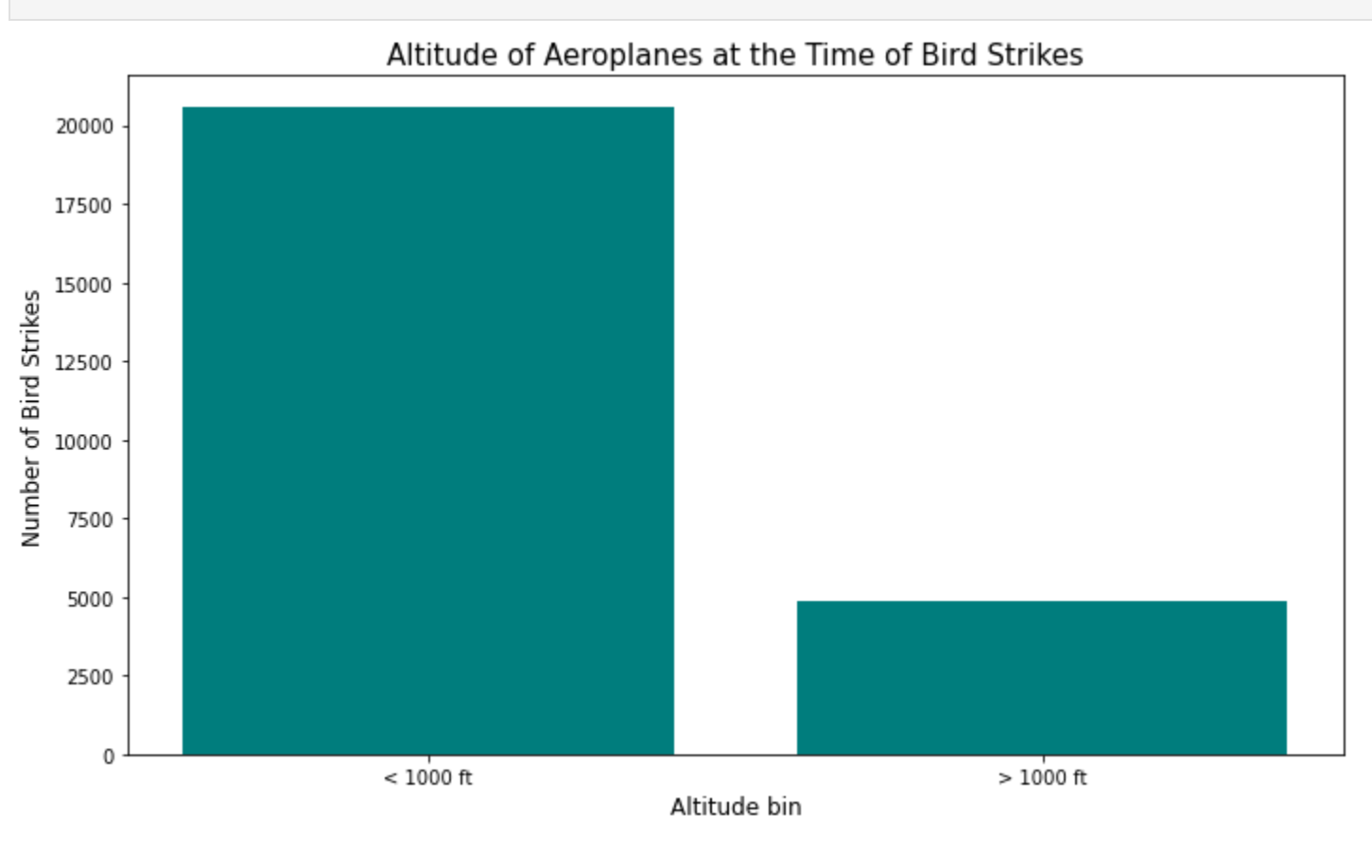
5. Yearly Cost Incurred Due to Bird Strikes

In [30]:
```python
import pandas as pd
import matplotlib.pyplot as plt

# Load the dataset
bird_strikes_data = pd.read_csv('Bird Strikes.csv')



# Perform the analysis with the correct column name
phase_of_flight_counts = bird_strikes_data['When: Phase of flight'].value_counts().reset_index()

# Renaming the columns for clarity
phase_of_flight_counts.columns = ['Flight Phase', 'Number of Bird Strikes']

# Plotting the bar chart
plt.figure(figsize=(10, 6))
plt.bar(phase_of_flight_counts['Flight Phase'], phase_of_flight_counts['Number of Bird Strikes'], color='purple')
plt.title('Bird Strikes by Phase of Flight', fontsize=15)
plt.xlabel('Phase of Flight', fontsize=12)
plt.ylabel('Number of Bird Strikes', fontsize=12)
plt.xticks(rotation=45, ha='right')
plt.tight_layout()
plt.show()
```



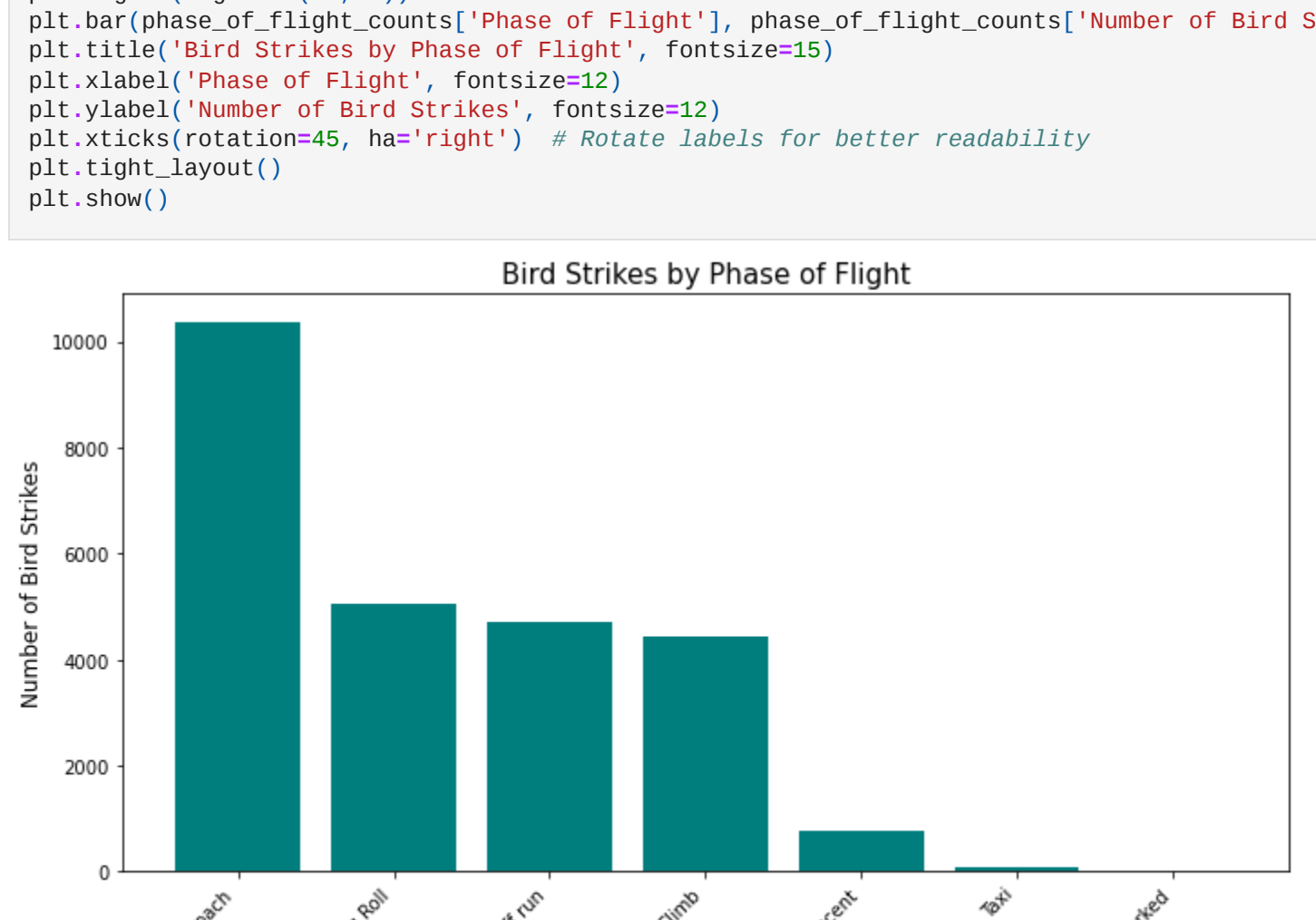
6. When Do Most Bird Strikes Occur?

In [24]:
```python
altitude_counts = bird_strikes_data['Altitude bin'].value_counts().reset_index(name='Number of Bird Strikes')
altitude_counts.columns = ['Altitude bin', 'Number of Bird Strikes']

plt.figure(figsize=(10, 6))
plt.bar(altitude_counts['Altitude bin'], altitude_counts['Number of Bird Strikes'], color='teal')
plt.title('Altitude of Aeroplanes at the Time of Bird Strikes', fontsize=15)
plt.xlabel('Altitude bin', fontsize=12)
plt.ylabel('Number of Bird Strikes', fontsize=12)
plt.tight_layout()
plt.show()
```



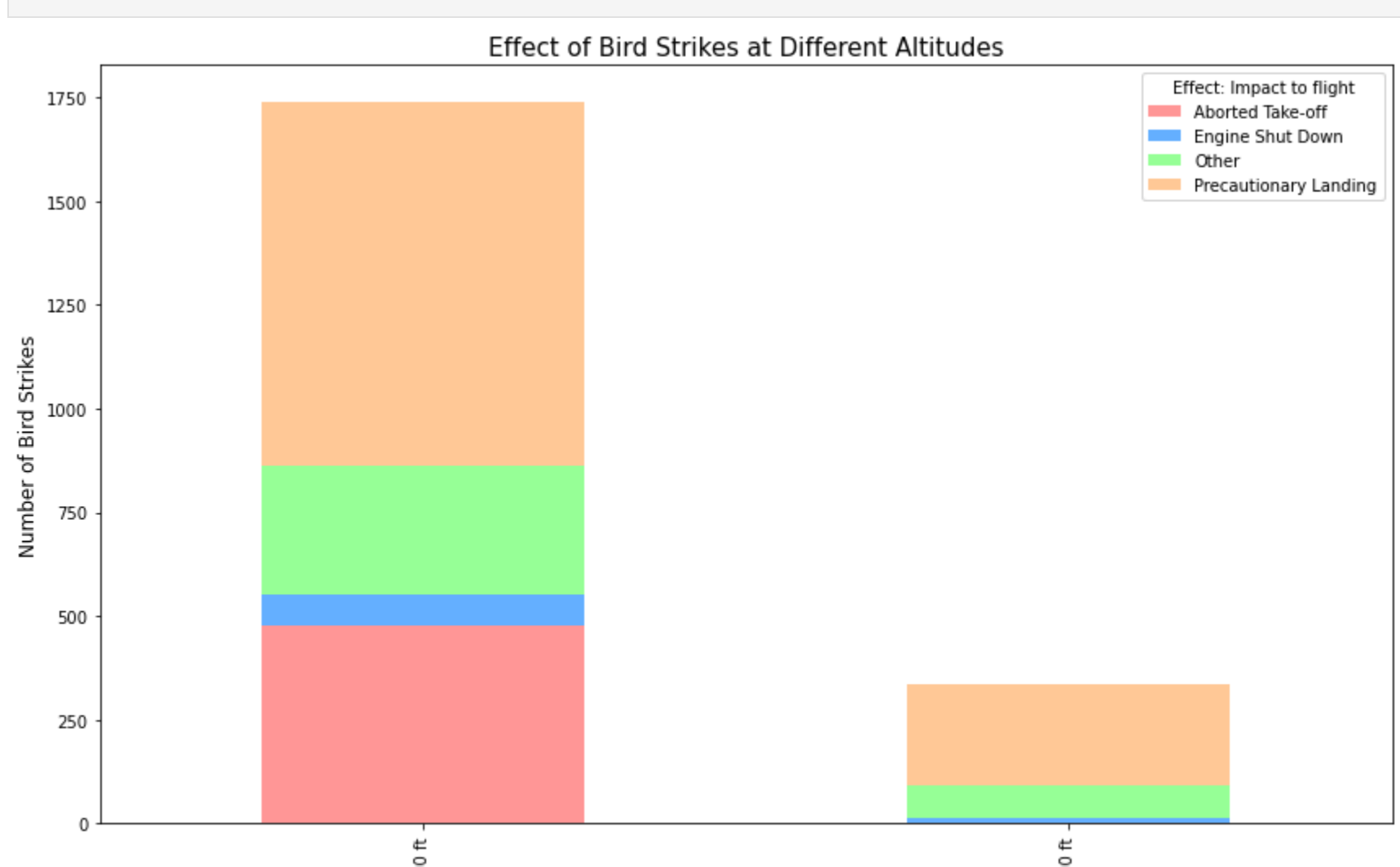
7 Altitude of aeroplanes at the time of strike

In [25]:
```python
import pandas as pd
import matplotlib.pyplot as plt

# Load the dataset
bird_strikes_data = pd.read_csv('Bird Strikes.csv')

# Count the occurrences of each phase of flight
phase_of_flight_counts = bird_strikes_data['When: Phase of flight'].value_counts().reset_index(name='Number of Bird Strikes')
phase_of_flight_counts.columns = ['Phase of Flight', 'Number of Bird Strikes']

# Plotting the bar chart
plt.figure(figsize=(10, 6))
plt.bar(phase_of_flight_counts['Phase of Flight'], phase_of_flight_counts['Number of Bird Strikes'], color='teal')
plt.title('Bird Strikes by Phase of Flight', fontsize=15)
plt.xlabel('Phase of Flight', fontsize=12)
plt.ylabel('Number of Bird Strikes', fontsize=12)
plt.xticks(rotation=45, ha='right')  # Rotate labels for better readability
plt.tight_layout()
plt.show()
```



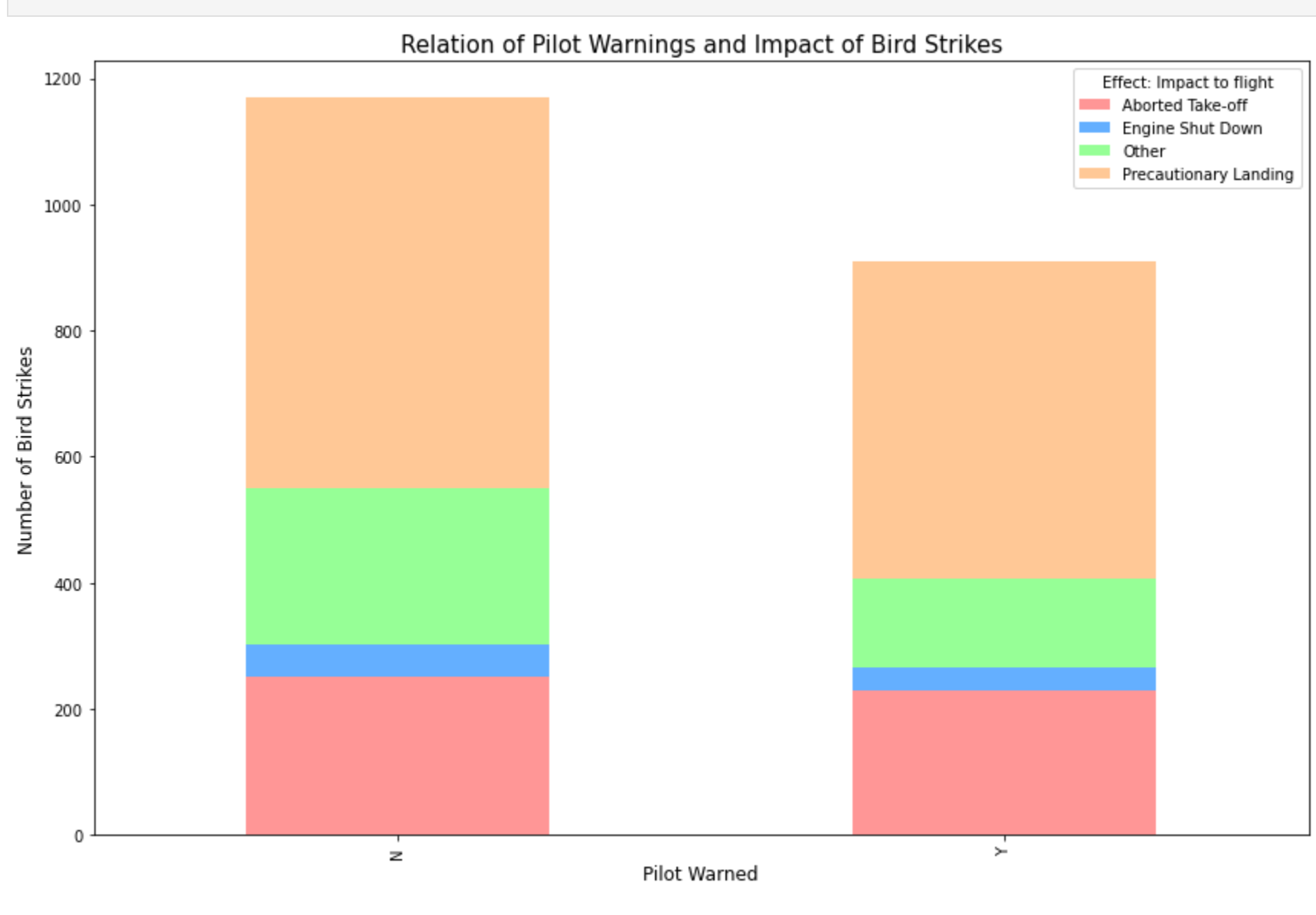
8 Phase of flight at the time of the strike.

In [17]:
```python
altitude_effect = bird_strikes_df.groupby(['Altitude bin', 'Effect: Impact to flight']).size().unstack(fill_value=0)

altitude_effect.plot(kind='bar', stacked=True, figsize=(12, 8), color=['#ff9999','#66b3ff','#99ff99','#ffcc99'])
plt.title('Effect of Bird Strikes at Different Altitudes', fontsize=15)
plt.xlabel('Altitude bin', fontsize=12)
plt.ylabel('Number of Bird Strikes', fontsize=12)
plt.tight_layout()
plt.show()
```



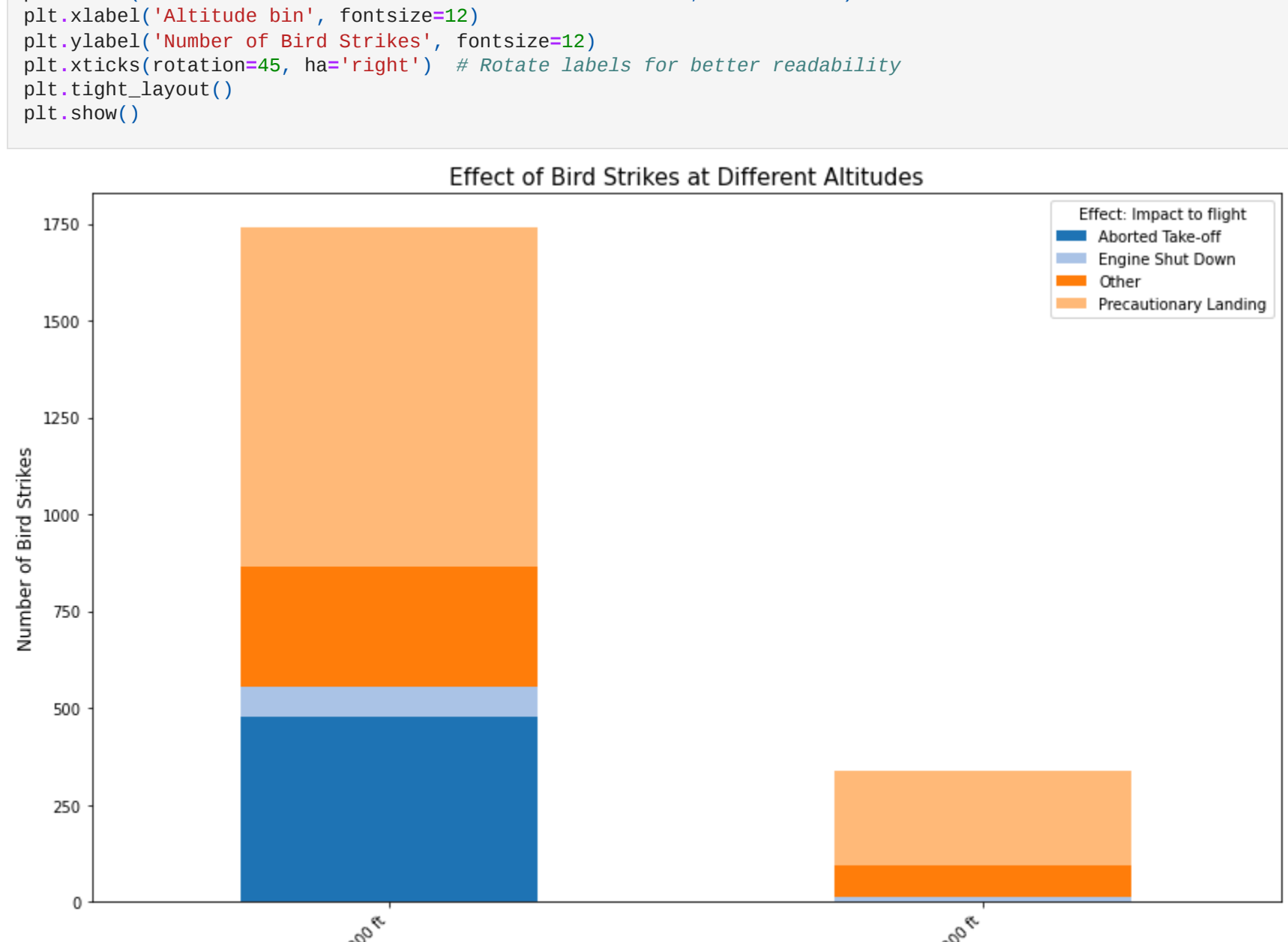
9 Average Altitude of the aeroplanes in different phases at the time of strike

In [18]:
```python
warning_effect_relation = bird_strikes_df.groupby(['Pilot warned of birds or wildlife?', 'Effect: Impact to flight']).size().unstack(fill_value=0)

warning_effect_relation.plot(kind='bar', stacked=True, figsize=(12, 8), color=['#ff9999','#66b3ff','#99ff99','#ffcc99'])
plt.title('Relation of Pilot Warnings and Impact of Bird Strikes', fontsize=15)
plt.xlabel('Pilot Warned', fontsize=12)
plt.ylabel('Number of Bird Strikes', fontsize=12)
plt.tight_layout()
plt.show()
```



10 Effect of Bird Strikes & Impact on Flight

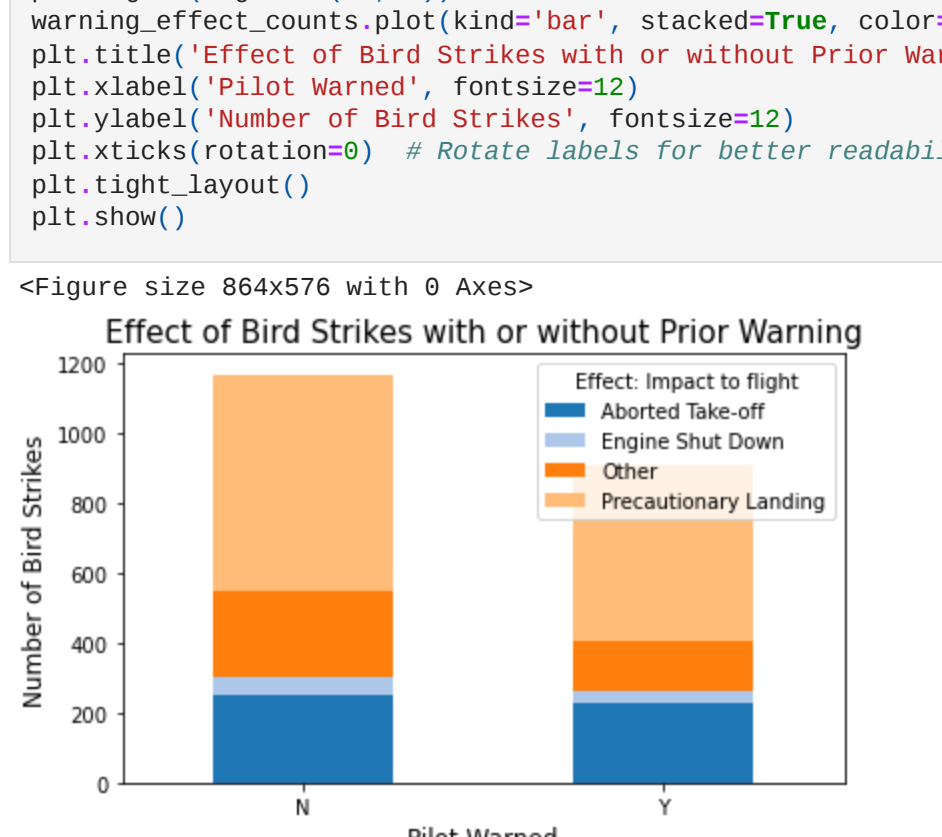
In [27]:
```python
import pandas as pd
import matplotlib.pyplot as plt

# Load the dataset
bird_strikes_data = pd.read_csv('Bird Strikes.csv')

# Group by 'Altitude bin' and 'Effect: Impact to flight' and count occurrences
effect_by_altitude = bird_strikes_data.groupby(['Altitude bin', 'Effect: Impact to flight']).size().unstack(fill_value=0)

# Plotting the stacked bar chart without using colormap
plt.figure(figsize=(12, 8))
effect_by_altitude.plot(kind='bar', stacked=True, ax=plt.gca(), color=plt.get_cmap('tab20').colors)
plt.title('Effect of Bird Strikes at Different Altitudes', fontsize=15)
plt.xlabel('Altitude bin', fontsize=12)
plt.ylabel('Number of Bird Strikes', fontsize=12)
plt.xticks(rotation=45, ha='right')  # Rotate labels for better readability
plt.tight_layout()
plt.show()
```



11 Effect of Strike at Different Altitude

In [28]:
```python
import pandas as pd
import matplotlib.pyplot as plt

# Load the dataset
bird_strikes_data = pd.read_csv('Bird Strikes.csv')

# Count occurrences of effects by whether pilots were warned or not
warning_effect_counts = bird_strikes_data.groupby(['Pilot warned of birds or wildlife?', 'Effect: Impact to flight']).size().unstack(fill_value=0)

# Plotting the stacked bar chart
plt.figure(figsize=(12, 8))
warning_effect_counts.plot(kind='bar', stacked=True, color=plt.get_cmap('tab20').colors)
plt.title('Effect of Bird Strikes with or without Prior Warning', fontsize=15)
plt.xlabel('Pilot Warned', fontsize=12)
plt.ylabel('Number of Bird Strikes', fontsize=12)
plt.xticks(rotation=0)  # Rotate labels for better readability
plt.tight_layout()
plt.show()
```

```
<Figure size 864x576 with 0 Axes>
```



12 Were Pilots Informed? & Prior Warning and Effect of Strike Relation

In [ ]: