

DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION



AIRCRAFT BIRD STRIKES  
SUMMARY AND ANALYSIS  
CALENDAR YEAR 1978



## INTRODUCTION

This summary presents important data elements of aircraft bird strikes reported within the United States and its possessions during calendar year 1978. It was prepared from information collected under a voluntary bird strike reporting program that is dependent on the aviation system users for the primary data. This voluntary contribution of data is vital in identifying problem areas where a bird control program can be effective. Based upon data from other countries and from the United States Air Force, it is estimated that 15 to 20 percent of the total number of bird strikes are reported; therefore, it should be noted that all data reported herein is subject to reporting limitations.

## DATA SOURCES

Collection, validation, and analysis of bird strike data required the use of several different sources. Duplicate data sources were combined in some instances to provide greater detail. In several cases, the collection began with a report completed by the pilot, with the reported strike being followed through repair work and insurance claims. The assistance provided by air carrier maintenance personnel, aircraft manufacturers, and insurance underwriters in compiling cost data is appreciated. The following reporting sources were used to prepare this summary and analysis:

1. FAA Bird Strike/Incident Report, FAA Form 3830
2. FAA Bird Strike/Incident Report, FAA Form 5200-7 (supercedes FAA Form 3830)
3. FAA Service Difficulty Program reports
  - a. Service Difficulty Report, FAA Form 8070-1
  - b. Malfunction or Defect Report, FAA Form 8330-2
  - c. Maintenance Difficulty Record, FAA Form 8330-3
4. National Transportation Board Aircraft Accident Reports
5. ICAO Bird Strike/Incident Report Form
6. Summaries from the Bird Strike Committee Europe
7. FAA Air Traffic Activity Reports
8. Air carrier maintenance data
9. Aircraft manufacturer data

## TERMS DEFINED

Bird Strike - A collision between a bird and an aircraft. Also included are strikes involving insects (two cases reported) and bats (four cases reported).

Bird Strike Rate - Number of bird strikes reported for an airport (during the takeoff, initial climb, approach, or landing phase of flight) per 10,000 aircraft operations.

Aircraft Operations - Total number of arrivals or departures at an airport. Touch-and-go approaches are treated as two operations, a landing and a takeoff.

Air Carrier Bird Strikes - Bird strikes which occurred with aircraft holding a Certificate of Public Convenience and Necessity issued by the Civil Aeronautics Board to conduct scheduled services over specified routes. Also included are nonscheduled or charter operations conducted by certificated air carriers.

General Aviation Bird Strikes - All other aviation excluding military aviation.

Serious Bird Strike - Bird strikes involving injury or loss of life; loss of aircraft; damage/loss/shutdown of more than one engine on multiengine aircraft; uncontained engine failure; fire; penetration of the bird through the airframe; major structural damage; unusual or dangerous features impairing safe flight; and power loss or failure on single-engine aircraft.

Raptor - A bird of prey, owls, hawks, eagles, and vultures.

#### GENERAL DISCUSSION

The nonmandatory reporting of bird strike incidents provides the Office of Airport Standards with necessary information to develop and manage a national bird hazard reduction program to improve operational safety on airports. While some of the data identifies overall trends, there is insufficient data to draw statistically valid conclusions about the bird strike problem for any given airport. Likewise, the number of bird strikes reported by an airport do not necessarily reflect the true nature of the problem. For example, one airport which reported only two bird strikes in 1978 had one aircraft accident where birds were a contributing factor and one strike that caused partial power loss on a twin-engine turboprop aircraft. Other airports experienced 10 to 15 bird strikes without recording any damage. A complete listing of airports reporting bird strikes is provided in Appendix 1.

In 1978, there were 788 bird strikes reported, with 489 of these strikes being reported by air carrier aircraft. The total number of reports received was 115 percent higher than in the previous year. This increased reporting is attributed to the new FAA Form 5200-7, Bird Strike/Incident Report, which simplified reporting requirements. This new reporting format is being widely distributed throughout the aviation community and should provide a statistically significant data base for future analysis.

SUMMARY OF DATA1. Reported Bird Strikes

General Aviation Aircraft	=	287
Air Carrier Aircraft	=	489
Helicopters	=	<u>12</u>
TOTAL		788

2. Fatalities/Injuries Reported

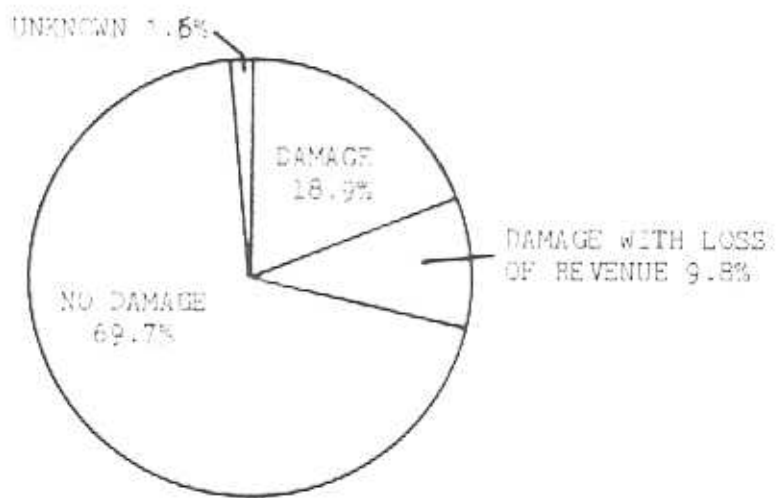
No fatalities were recorded in 1978; however, 39 people were injured in 7 separate incidents. See Appendix 2, Summary of Serious Bird Strikes for Civil Aviation for specific details. Six of the seven reported incidents involved windshield failures following impact with a bird, and injuries were limited to cuts and abrasions on the face and arms. Eye injuries were reported in three of the six windshield penetrations.

3. Cost of Bird Strike Damage

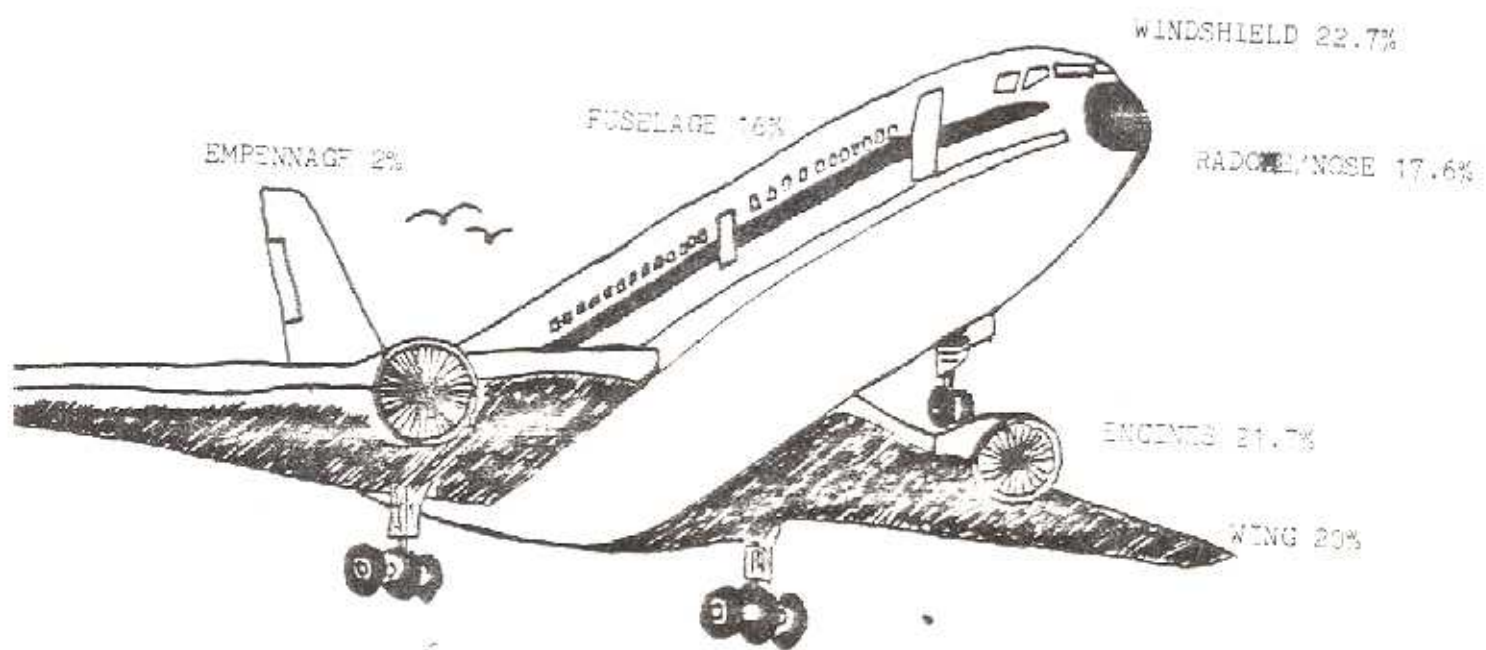
Damage cost was determined by analyzing descriptions of damage and following up on repairs where the repair location could be identified. Cost of replacement parts were determined by interviewing airline maintenance personnel and aircraft manufacturers. Labor rates of \$14 to \$25 per hour were provided by insurance underwriters. Manhours required to repair general aviation aircraft damages were estimated by interviewing five fixed base operators located across the country. The actual total cost of bird strikes could never be accurately identified because of the many variables associated with aircraft operating costs such as lost revenue, depreciation, rerouting of passengers, etc.

General Aviation Damage Costs	=	\$ 694,892
Air Carrier Damage Costs	=	9,476,610
Helicopter Damage Costs	=	<u>4,250</u>
ESTIMATED TOTAL DAMAGE COST		\$10,175,752
Reported Loss of Revenue	=	\$413,765
Estimated Additional Loss	=	<u>63,660</u>
ESTIMATED TOTAL REVENUE LOSS		\$477,425

4. Summary of Damaging Bird Strikes



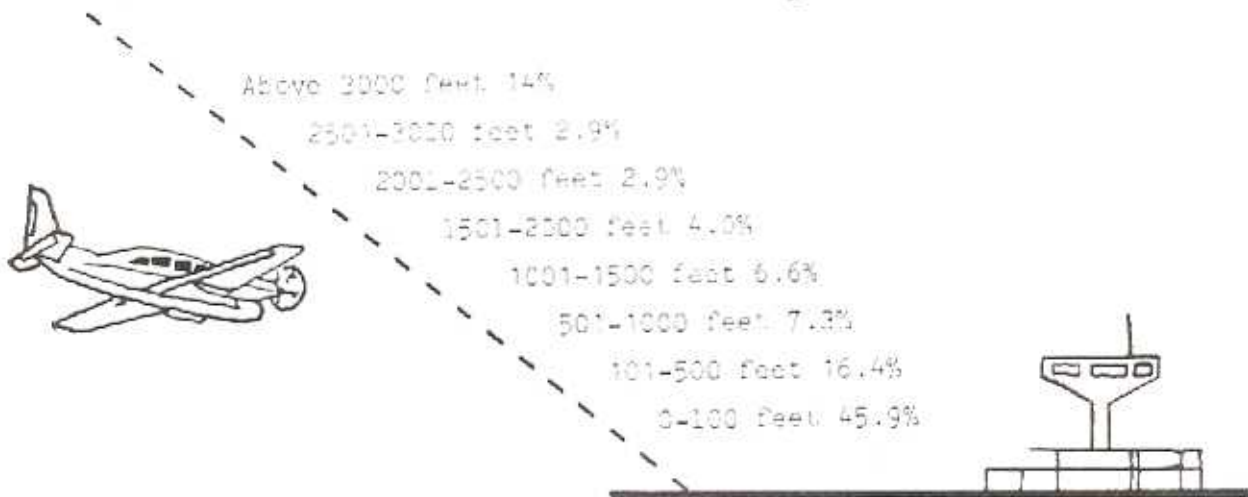
5. Summary of Aircraft Components Struck



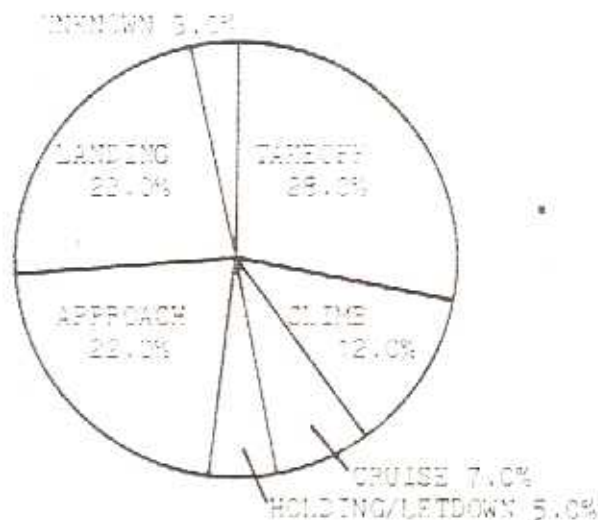
Bird strike locations on the airframe are not distributed based on cross-sectional or frontal surface area, but rather by where the bird strike is most apparent to the pilot. Strikes to engines, windshields, and the nose area are easily observed by the aircrew during flight. Glancing blows to the fuselage or nondamaging strikes to the empennage section may go unnoticed.

The engine strikes resulted in damage in 65 of 111 reported incidents (58.5 percent). Windshield failures with the bird penetrating into the cockpit occurred in 6 of 116 strikes (5.9 percent); however, 26 additional incidents involved cracking, layer separation on laminated windows, or failure of inner or outer panes of glass.

6. Summary of Bird Strikes by Reported Altitude



7. Summary of Bird Strikes by Phase of Flight



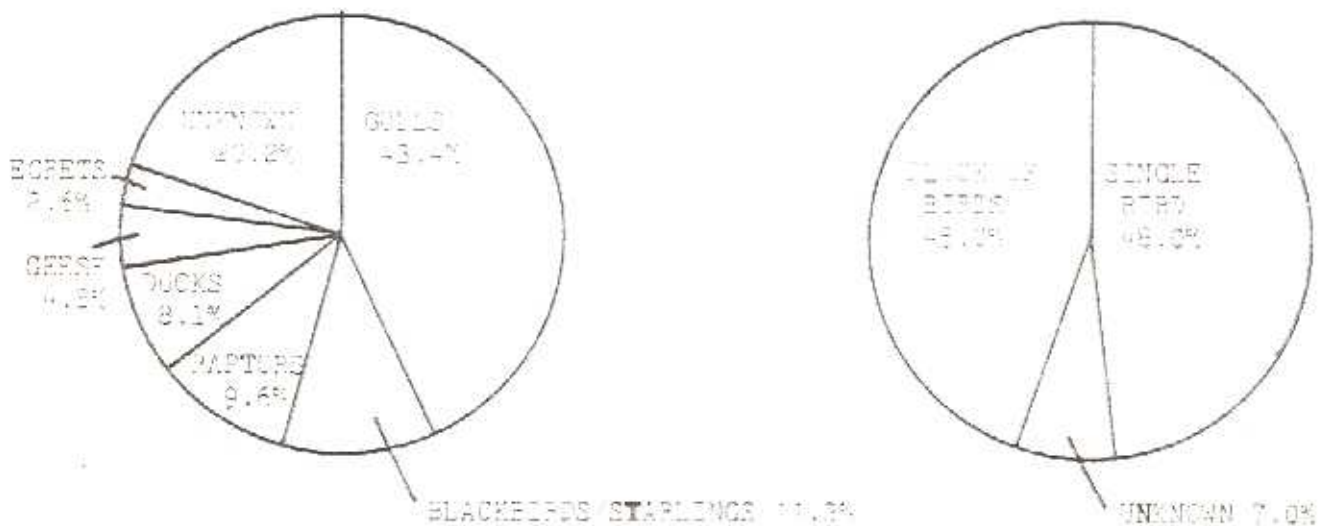
For purposes of analysis, the following altitude parameters were used:

- Takeoff: Takeoff ground run to 100 feet above the ground
- Climb: 100 feet to level off
- Cruise: Level flight in the enroute environment
- Holding: Established at any altitude in a prescribed holding pattern
- Descent: Descent from cruise altitude to either an instrument approach fix or traffic pattern altitude
- Approach: Instrument approach fix altitude or traffic pattern altitude down to 200 feet above the ground
- Landing: 200 feet above the ground to completion of the landing roll

The combined percentages for takeoff, approach, and landing (73%) gives the percentage of bird strikes which occur on or near the airport. With nearly three-fourths of all bird strikes occurring on or near airports, the FAA bird hazard reduction program emphasizes reduction in bird populations on airports through habitat management and bird scaring patrols.

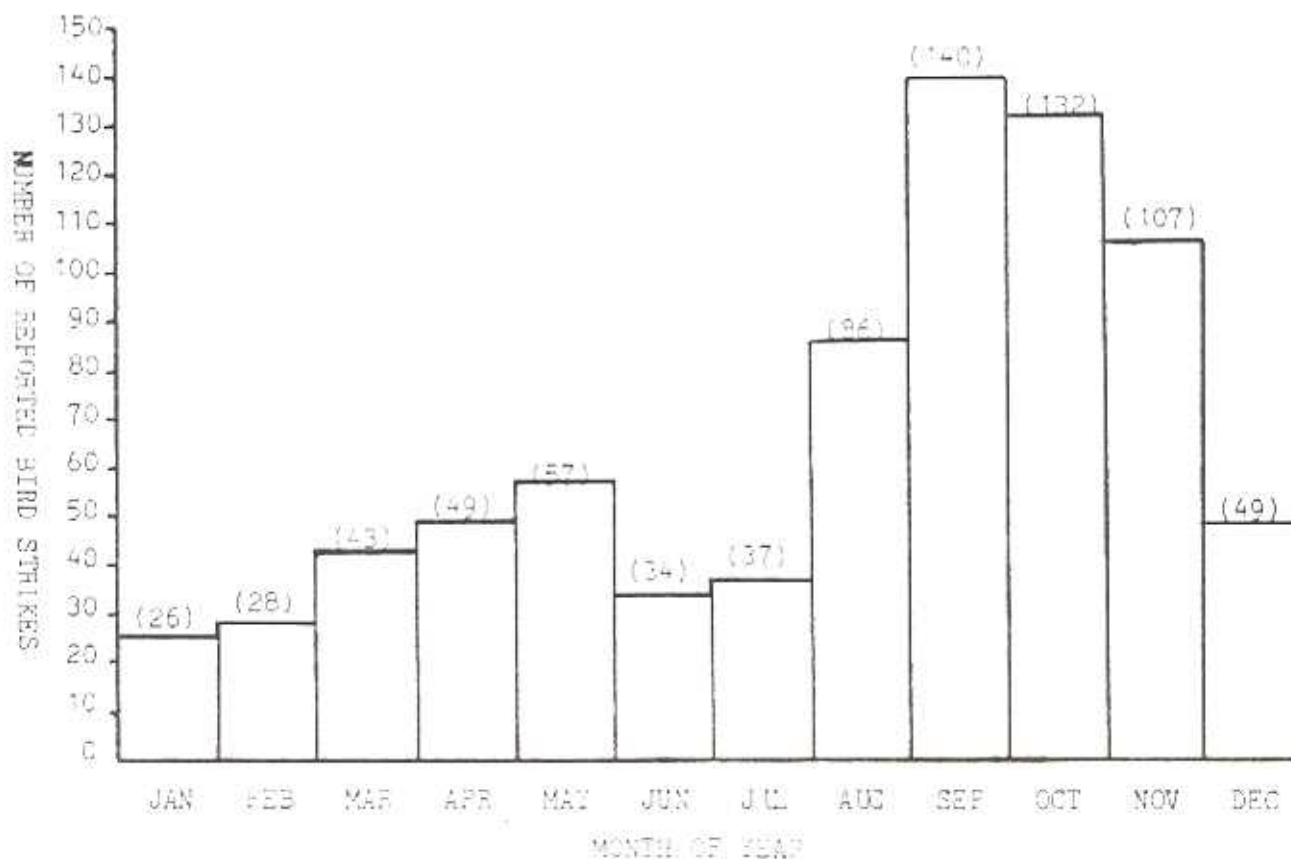
#### 8. Summary of Bird Strikes by Type and Number of Birds

In 57 percent of the reported bird strikes, the bird was seen before impact. In only 35 incidents out of the 788 reported, pilots had enough time to take some kind of evasive action. The following data reflects percentages of bird types and numbers:



9. Summary of Bird Strikes by Month.

Bird migration plays a key role in the monthly distribution of bird strikes. Because of increased bird flight activity, the risk of having a bird strike increases sharply in the fall and early winter months. A smaller increase occurs in early spring when the birds return to their nesting areas.

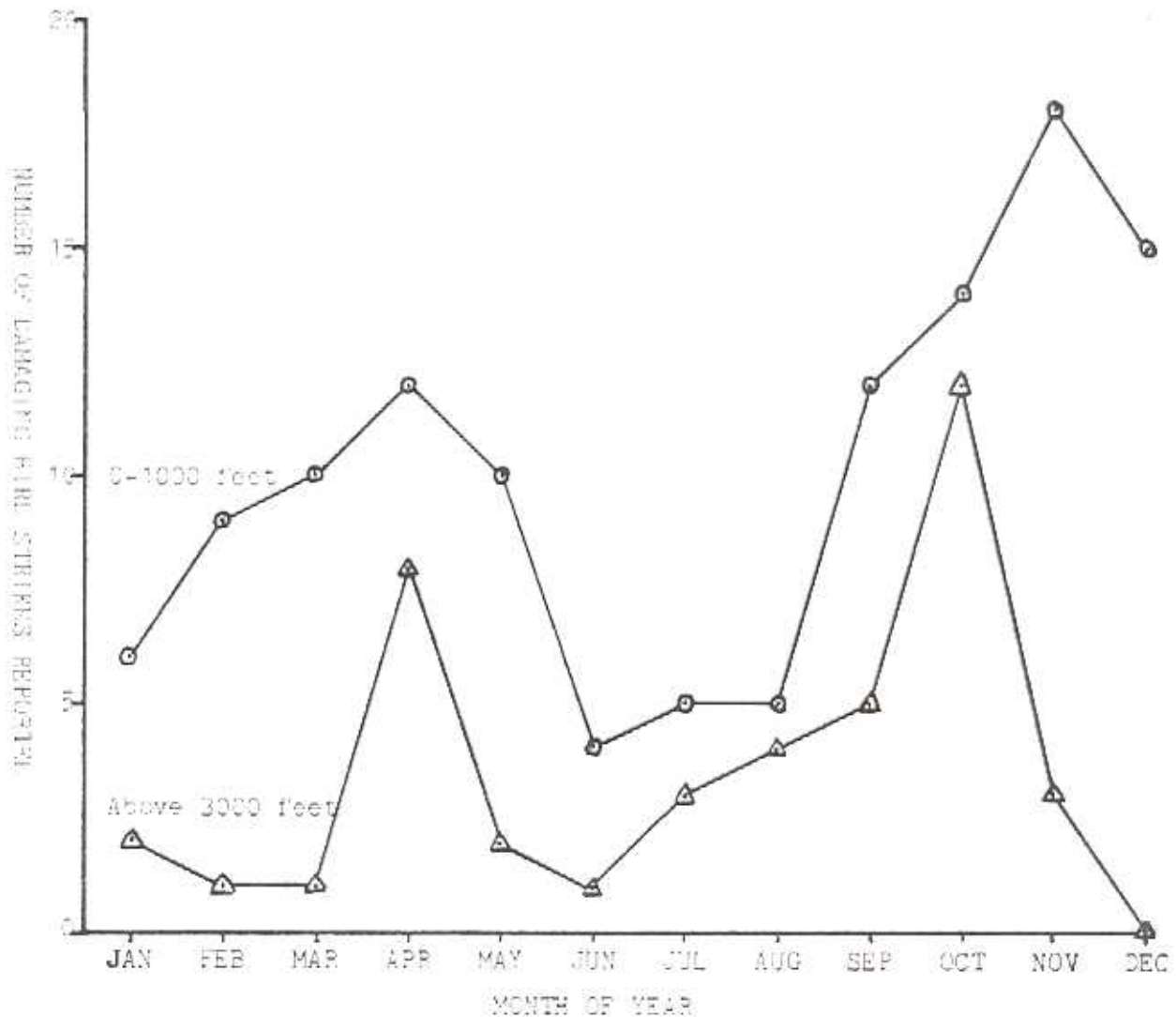


Knowing where damaging bird strikes are most likely to occur during certain times of the year could be of significant safety value for aircraft operating in a low altitude environment. Specific benefits can be seen for determining the safest flight altitude for military low-level training missions and low altitude enroute altitudes for helicopters and other aircraft.

To determine whether migration influenced other parameters, an analysis was made between the time of year and altitude of reported bird strikes. Altitude information was reported in 682 incidents, of which 205 bird strikes resulted in aircraft damage. Each altitude category as defined in Part 6 of this summary was evaluated over the 12 months. The data for each altitude category can be summarized as follows:

- a. 0-100 Feet: While the overall number of bird strikes rose in March, April, and May, a decline in percentage of bird strikes in this altitude category was observed. This decline is expected and reflects a shift in bird flight altitudes due to migration. An increase in percentage of low altitude bird strikes in June and July combined with a decrease in overall bird strikes during this same period reflects an increase in feeding flight activity on airports following the nesting season. With the beginning of migration in August, another decline in percentage of low altitude bird strikes due to migration is observed, followed by an increase in November and December, again reflecting an increase in local bird flight activity.
- b. 101-500 Feet: The same trends appear as described above; however, changes in percentage of bird strikes in this altitude category are less dramatic because of the size of the data.
- c. 501-1,000 Feet: Slight increases in the percentage of bird strikes occur in May and October; however, the changes are small and no significance can be attached to these changes beyond the possible influence of migration.
- d. 1,001-1,500 Feet: Increases occur in March, May, and during the fall migration from August through September.
- e. 1,501-2,000 Feet: No apparent trends.
- f. 2,001-2,500 Feet: No apparent trends.
- g. 2,501-3,000 Feet: Slight increases that correspond to spring and fall increases as reflected in the total number of reported bird strikes.
- h. Above 3,000 Feet: Significant increases in April and May, reflecting spring migration, followed by a decline in percentage of bird strikes for June. A significant increase in July to 17 percent of the total bird strikes occurs with this percentage remaining fairly constant until November. This increase is attributed to increased raptor strikes during the summer months, followed by the fall migration.

Grouping these altitude categories and plotting the number of damaging bird strikes against the months gives the following:



No significant changes were noted for combined altitudes of 1,001-2,000 or 2,001-3,000 feet. Data for these two altitude ranges were omitted from the above graph for clarity. Spring and fall migration peaks are clearly evident. The rise in damaging bird strikes from June through August in the above 3,000 feet category is caused by raptor strikes.

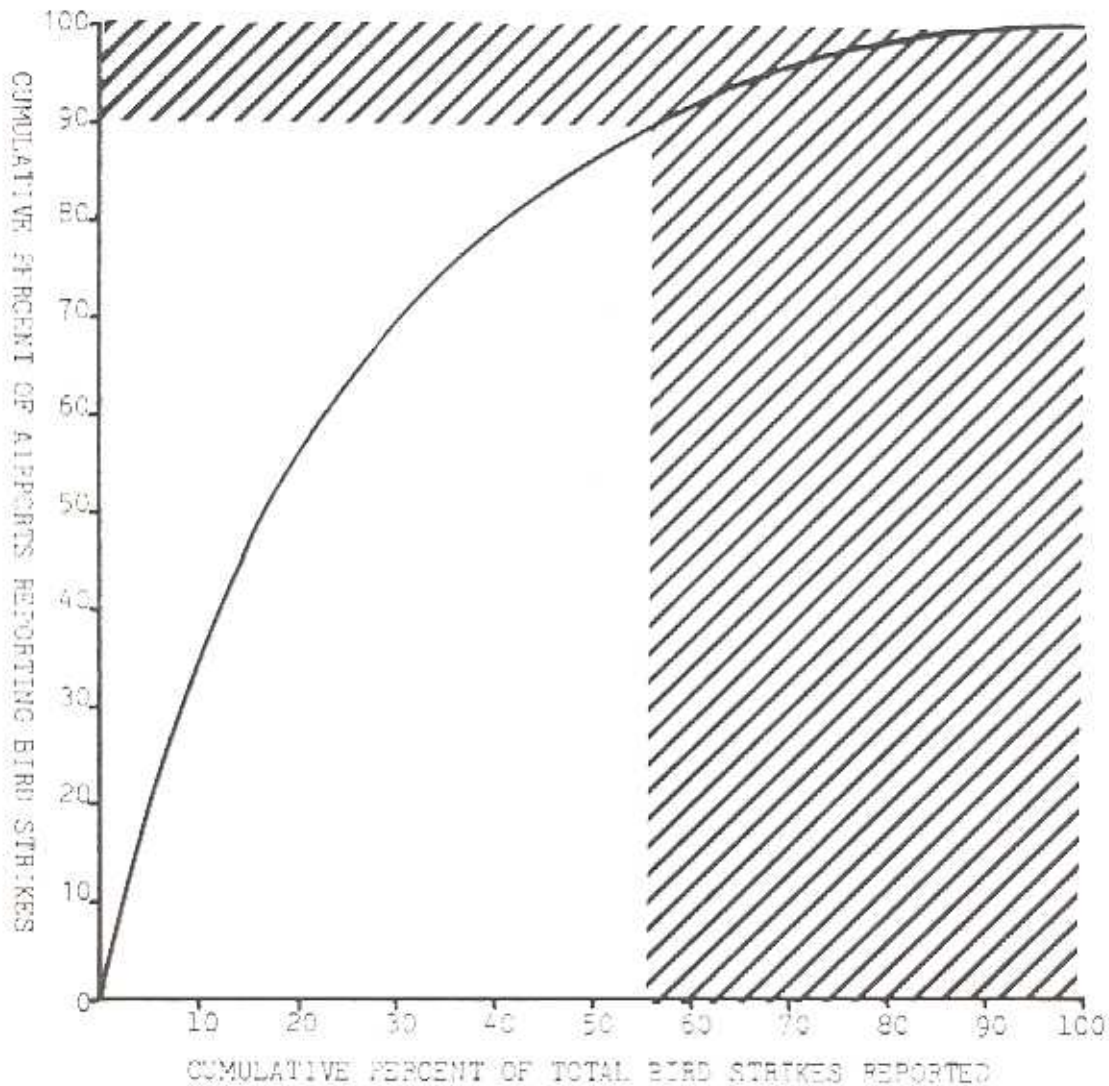
Although the data base is insufficient to show statistically significant differences in bird strike altitude categories, the trends for this year identify a potential altitude band of 1,500-2,500 feet where bird strikes appear to be less likely to occur. While no conclusion can be drawn at this time, several more years of altitude data could possibly identify altitudes to avoid while flying during certain seasons of the year. There may also be a similar altitude variability associated with day versus night bird strikes.

#### 10. Summary of Airport Bird Strike Data

Insufficient data exists to show whether an individual airport has a serious bird hazard based on bird strike reporting alone. Bird strike rates are not conclusive evidence of the degree of hazard because of the low number of strikes reported. In European countries and in Canada where bird strike reporting is more representative, a bird strike rate of 3 to 6 strikes per 10,000 operations is common. By comparison, U.S. airports are averaging 3.9 bird strikes per 100,000 movements, a factor of ten difference. This difference can be accounted for by two factors, the low number of strikes reported and the large number of operations for U.S. airports as compared to airports in other countries. For example, London's Heathrow Airport had a bird strike rate in 1976 of 3.7 strikes/10,000 operations, based on 48 bird strikes and 131,239 operations (Source: Bird Strike Committee Europe). John F. Kennedy International Airport reported 32 bird strikes in 1978 and had 343,561 operations or 0.93 strikes per 10,000 movements. If only 15 to 20 percent of the strikes are being reported, then a more realistic strike rate for Kennedy would be 4.2 to 6.2 strikes/10,000 operations. This rate is in closer agreement with data collected for airports in other countries where the reporting system is more accurate. Rates for selected U.S. airports are given in Appendix 1.

In summarizing the airport reporting bird strikes, a comparison was made between the cumulative percent of airports reporting bird strikes (223 airports) versus the cumulative percent of reported bird strikes (693 incidents where the airport is known). As can be seen from the graph on the following page, a nonlinear relationship exists between the airports and the number of bird strikes. The cross-hatched area is added to emphasize the bird strike distribution among airports.

## TOTAL AIRPORTS REPORTING VS. TOTAL BIRD STRIKES



Ten percent of the airports accounted for 44 percent of the total number of bird strikes reported. This 10 percent segment represents 22 airports, all are FAR Part 139 certificated airports. Many of these same 22 airports also recorded high numbers of bird strikes in 1976 and 1977, some have bird patrols and others are in the process of developing bird hazard control programs.

APPENDIX 1 - SUMMARY OF BIRD STRIKES BY AIRPORT

Airports Reporting Five or More Bird Strikes

<u>Airport Name</u>	<u>Number of Bird Strikes</u>	<u>Total 1978 Operations</u>	<u>Bird Strike Rate</u>
The William B. Hartsfield Atlanta International, GA	34	557,992	0.61
John F. Kennedy International, NY	32	343,561	0.93
Tampa International, FL	22	223,135	0.99
Chicago-O'Hare International, IL	22	760,579	0.29
LaGuardia, NY	16	367,325	0.44
Newark International, NJ	16	210,260	0.76
San Francisco International, CA	16	362,571	0.44
Los Angeles International, CA	14	538,807	0.26
Portland International, OR	14	230,425	0.61
Birmingham Municipal, AL	13	205,246	0.63
Norfolk International, VA	12	186,588	0.64
Detroit Metropolitan Wayne County, MI	11	267,862	0.41
Memphis International, TN	11	349,298	0.31
Bush Field, GA	10	85,597	1.17
Philadelphia International, PA	9	340,584	0.26
General Edward Lawrence Logan International, MA	8	376,759	0.21
St. Petersburg - Clearwater International, FL	8	216,577	0.37
Stanfield Field, KY	8	132,200	0.61
Des Moines Municipal, IA	7	217,306	0.32
Sacramento Metropolitan, CA	7	164,821	0.42
Santa Barbara Municipal, CA	7	228,163	0.31
Dallas-Fort Worth Regional, TX	6	406,631	0.15
Appleby Airfield, NE	6	173,069	0.35
Indianapolis International, IN	6	216,229	0.28
Dankbury Municipal, CT	5	154,105	0.32
Duluth International, MN	5	81,043	0.62
Fanning Field, ID	5	64,321	0.78
Fresno Air Terminal, CA	5	259,092	0.15
Kahului, HI	5	125,289	0.40
Libbe, HI	5	74,583	0.67
Moses Lake Municipal, WA	5	191,861	0.26
Sacramento Executive, CA	5	220,036	0.23
Tulsa International, OK	5	215,190	0.23
Vero Beach Municipal, FL	5	204,086	0.24
Washington National, DC	5	352,044	0.14

Airports Reporting Less Than Five Bird Strikes

<u>Airport Name</u>	<u>Number of Bird Strikes</u>
Alexander Hamilton (St. Croix)	4
Athens Municipal, GA	4
Boeing Field, WA	4
Fresno Air Terminal, CA	4
Gainesville Municipal, FL	4
Greater Cincinnati, KY	4
Lakefront, LA	4
Miami International, FL	4
Minneapolis-St. Paul International, MN	4
Raleigh-Durham, NC	4
Salt Lake City International, UT	4
Sarasota-Bradenton, FL	4
Seattle-Tacoma International, WA	4
Willow Run, MI	4
Roanoke/Woodrum Municipal, VA	4
Adams Field, AR	3
Baltimore-Washington International, MD	3
Carl T. Jones (Huntsville-Madison Co.), AL	3
Chemung County, NY	3
General Mitchell Field, WI	3
Honolulu International, HI	3
Houston Intercontinental, TX	3
Kanawha, WV	3
Lambert-St. Louis International, MO	3
Ft. Lauderdale-Hollywood International, FL	3
Malcolm McKinnon, GA	3
Medford-Jackson County, OR	3
Merrill C. Meigs, IL	3
Nashville Metropolitan, TN	3
New Orleans International/Moisant Field, LA	3
Oakland-Pontiac, MI	3
Palo Alto Airport of Santa Clara County, CA	3
Pal-Waukeec, IL	3
Pendleton Municipal, OR	3
Phoenix Sky Harbor International, AZ	3
San Carlos, CA	3
San Diego International-Lindbergh Field, CA	3
Stapleton International, CO	3
Teterboro, NJ	3
Addison, TX	2
Adrau Airpark, TX	2
Anniston-Galchon County, AL	2
Bangor International, ME	2
Capital City, MI	2
Clatsop County, OR	2
Dane County Regional/Truax Field, WI	2

<u>Airport Name</u>	<u>Number of Bird Strikes</u>
Daytona Beach Regional, FL	2
Douglas Municipal, NC	2
Florence City-County, SC	2
General Lyman Field, HI	2
Greater Buffalo International, NY	2
Greater Pittsburgh International, PA	2
Hartford-Brainard, CT	2
Jacksonville International, FL	2
Joe Foss Field, SD	2
Kalamazoo Municipal, MI	2
Kodiak, AK	2
Lafayette Regional, LA	2
Lebanon Regional, NH	2
Lee County, VA	2
Merced Municipal, CA	2
Metropolitan Oakland International, CA	2
Napa County, CA	2
New Hanover, PA	2
New Hanover County, NC	2
Olympia, WA	2
Ontario International, CA	2
Orange County, CA	2
Port Columbus International, OH	2
Reno International, NV	2
Richard Byrd International, VA	2
Robert Mueller Municipal, TX	2
Rock County, NB	2
Rosecrans Memorial, MO	2
Ross Field, MI	2
San Antonio International, TX	2
Snohomish County/Paine Field, WA	2
Spokane International, WA	2
Stockton Metropolitan, CA	2
Syracuse Hancock International, NY	2
Tweed-New Haven, CT	2
Walla Walla City-County, WA	2
Wilkes-Barre/Scranton, PA	2
Williamsport-Lycoming County, PA	2
Will Rogers World, OK	2
Aiken Municipal, SC	1
Albany County, NY	1
Amarillo International, TX	1
Aspen-Pitkin County/Sardy Field, CO	1
Auburn Municipal, GA	1
Barnstable Municipal, MA	1
Bishop, MI	1
Bradley International, CT	1

<u>Airport Name</u>	<u>Number of Bird Strikes</u>
Bowerman, WA	1
Brown Field Municipal, CA	1
Cedar Grove Airpark, WA	1
Cedar Rapids Municipal, IA	1
City of Colorado Springs Municipal, CO	1
Chandler Field, OK	1
Charlie Brown County, GA	1
Chatham Municipal, MA	1
Cherry Ridge, LA	1
Chicagoland, IL	1
Columbus Metropolitan, GA	1
Delta County, MI	1
Dekalb-Peachtree, GA	1
Dillingham Field, HI	1
Dulles International, D.C.	1
Dupage County, IL	1
Dutchess County, NY	1
Ely Municipal, MN	1
Emporia Municipal, KS	1
Fairbanks International, AL	1
Festus Memorial, MO	1
Fitchburg Municipal, MA	1
Fort Forgan Municipal, CO	1
Fort Wayne Municipal, IN	1
Frost Ranch, TX	1
George M. Bryan, MS	1
Gogebic County, MI	1
Gould Peterson Municipal, MO	1
Grand Rapids Itasca County, MN	1
Greater Peoria, IL	1
Greater Rockford, IL	1
Greenville Downtown, SC	1
Griffing Sandusky, OH	1
Hermiston Municipal, OR	1
Hollywood-Burbank, CA	1
Hook Field Municipal, OH	1
Hunter, TN	1
Islip MacArthur, NY	1
Jefferson City Memorial, MO	1
Johnson-Bell Field, MT	1
Josier Municipal, FL	1
Joplin Municipal, MO	1
Kansas City International, KS	1
Kingsley Field, OR	1
Lake Charles Municipal, LA	1
Lebanon-Springfield, KY	1
Lee Glimes Memorial, GA	1
Lincoln Municipal, NE	1
Linden, NJ	1

<u>Airport Name</u>	<u>Number of Bird Strikes</u>
Long Beach/Daugherty Field, CA	1
Lubbock International, TX	1
Mahlon Sweet Field, OR	1
Manteo, NC	1
McGhee Tyson, TN	1
Meadows Field, CA	1
Mercer County, IL	1
Michiana Regional, IN	1
Monmouth County, NJ	1
Monroe County, IN	1
Mount Hawley Auxiliary, IL	1
Muskegon County, MI	1
NAFEC Atlantic City, NJ	1
New River Valley, VA	1
North Philadelphia, PA	1
Ogden Municipal, UT	1
Outagamie County, WI	1
Patrick Henry International, VA	1
Pitts Field, OK	1
Plymouth Municipal, NC	1
Portland-Hillsboro, OR	1
Port Walker Sea Plane Base, AK	1
Purdue University, IN	1
Pullman/Moscow Regional, WA	1
Quad-City, IL	1
Renton Municipal, WA	1
Rexburg-Madison County, ID	1
Rochester-Monroe County, NY	1
Rostraver, PA	1
St. George Municipal, UT	1
Salina Municipal, KS	1
San Jose Municipal, CA	1
Scholer Field, TX	1
Searle Field, NE	1
Sharpe S Strip, MI	1
Shemya AFB, AK	1
Smith Reynolds, NC	1
Sonoma Valley, CA	1
Tacoma Industrial, WA	1
Tallahassee Municipal, FL	1
Tri-Cities, WA	1
Tucson International, AZ	1
Valdosta Municipal, GA	1
Venice Municipal, FL	1

## SUMMARY OF SERIOUS BIRD STRIKES

## CIVIL AVIATION

This summary provides information on reported serious bird strikes worldwide. Data sources include National Transportation Safety Board summaries, International Civil Aviation Organization bird strike reports, summaries prepared by the Bird Strike Committee Europe, and data from the Federal Aviation Administration (FAA) Bird Strike/Incident Report, FAA Form 5200-7. Serious bird strikes are those collisions between aircraft and birds where one or more of the following occurs:

- a. Injury or loss of life;
- b. Loss of aircraft;
- c. Damage/loss/shutdown of more than one engine on multiengine aircraft;
- d. Uncontained engine failure;
- e. Fire;
- f. Penetration of the bird through the airframe;
- g. Major structural damage; and/or
- h. Particularly unusual or dangerous features (obscuration of visibility, helicopter rotor or transmission damage, damage to pitot-static systems, etc.).

Details on accidents/incidents are provided, where available, to amplify the seriousness or significance of the bird strike.

April 3, 1912 - Model EX Wright Pusher, Long Beach, California - Bird strike hazard history was made on this date with the crash of the Wright Flyer and the death of Calbraith Perry Rodgers. This first reported crash and fatality occurred as Cal Rodgers was flying low along the beach and hit a gull, causing the aircraft to plunge into the ocean. The pilot was pinned under the wreckage and drowned. One fatality.

About 1955 - Light Aircraft, Aberdare Mountains, Kenya - Aircraft hit a vulture during enroute phase of flight and crashed. One fatality.

January 10, 1959 - Light Aircraft Serengeti National Park, Tanganyika - Aircraft struck a vulture and crashed. One fatality.

March 10, 1960 - Air Carrier Lockheed Electra, Boston, Massachusetts - Aircraft hit a flock of starlings resulting in engine power loss. Aircraft crashed with 62 fatalities.

July 15, 1962 - Air Carrier DC-3, Lahore, West Pakistan - Copilot killed when vulture penetrated windshield. Aircraft landed safely by injured pilot. One fatality.

APPENDIX 2

September 1962 - Air Carrier Vanguard, Edinburgh, Scotland - On takeoff from Turnhouse Airport, aircraft encountered a flock of gulls. NR 2 and NR 4 engines failed, NR 3 engine damaged, but pilot made a successful landing with no injuries.

November 23, 1962 - Air Carrier Viscount, Maryland - Enroute aircraft encountered flock of whistling swans and struck one, resulting in loss of aircraft control. Aircraft crashed with 17 fatalities.

March 1963 - Beechcraft Enroute Over California - Aircraft struck common loon and crashed. One fatality.

February 1964 - Turbulent, Belfast Northern Ireland - Aircraft hit a gull and crashed. One fatality.

July 28, 1963 - Commercial Air Taxi Falcon, Cleveland, Ohio - On takeoff from Burke Lakefront Airport, aircraft hit a flock of birds causing failure of both engines due to flameout; aircraft subsequently crashed in the lake. Three crewmen injured.

November 17, 1968 - Beechcraft 95, Hamilton, Illinois - Aircraft collided with a goose, breaking windshield. Pilot made a forced landing.

November 20, 1968 - Business Beechcraft 95, Cairo, Illinois - Enroute aircraft hit a flock of geese with substantial damage to the vertical stabilizer. Aircraft made a safe landing with no injuries.

January 12, 1969 - Air Carrier B-707, Sydney, Australia - Takeoff aborted after  $V_1$  due to partial power loss caused by bird ingestion. Aircraft gear collapsed after leaving the runway. Crew of 11 with 125 passengers, no significant injuries.

March 11, 1969 - Air Taxi Bell 45 Helicopter, Tularosa, New Mexico - Tail rotor separated in flight after hitting eagle. Autorotative landing made, no injuries, aircraft substantially damaged.

October 13, 1969 - Piper PA-23, De Moines, Iowa - Aircraft struck a flock of large birds at 3,500 feet MSL. Pilot made a forced landing at Des Moines after aircraft experienced flight control difficulties and substantial structural damage.

March 12, 1970 - Cessna 150, Opalocka, Florida - On student pilot's first solo, the aircraft struck a flock of gulls on takeoff. The windshield was broken and pilot attempted a forced landing resulting in substantial aircraft damage.

August 8, 1970 - Hughes 269B Helicopter, Big Rock, Virginia - The helicopter hit a bird and while the pilot was checking for damage, he allowed the helicopter to descend and strike a powerline. The helicopter crashed and the pilot sustained serious injuries.

November 12, 1970 - Bellanca 14 Flight Test, Santa Rosa, California - Aircraft's right wing hit a turkey vulture, causing substantial damage to wing. Aircraft landed without further incident.

July 2, 1971 - Cessna 180, British Columbia - An enroute bird strike with a bald eagle caused the aircraft to crash. Three fatalities.

August 18, 1971 - Air Carrier DC-9, Savannah, Georgia - During climb, aircraft hit a black vulture. The bird broke the radome and penetrated the pressure bulkhead and into the cockpit. Precautionary landing made with no injuries to 5 crew and 56 passengers.

September 9, 1971 - Cessna 180, Minot, North Dakota - On landing approach, aircraft hit two gulls diverting attention of pilot resulting in hard landing, gear collapse, and ground loop. Aircraft destroyed and pilot received minor injuries.

March 26, 1972 - Piper PA-28, Lower Lake, California - On final approach, aircraft hit an owl, puncturing leading edge of right wing resulting in loss of fuel. Aircraft landed with no further incidents.

April 16, 1972 - Mitsubishi MU-2, Atlantic City, New Jersey - On climb, the aircraft hit a flock of geese, breaking the windshield and incapacitating one or both pilots. Aircraft entered an uncontrolled descent and crashed in the Atlantic Ocean. Two crew and one passenger killed.

October 22, 1972 - Cessna 175, Miami, Florida - On descent for landing, aircraft hit a black vulture causing damage to the wing. Airflow over wing was altered sufficiently to cause a significant increase in stall speed.

December 15, 1972 - Air Carrier B-747, Miami, Florida - On takeoff, pilot experienced excessive vibration in NR 4 engine and shut the engine down, returning to land. Aircraft also had a bird ingestion on NR 3 engine, jamming thrust reverser mechanism. Upon landing on a wet runway, the aircraft hydroplaned, braking and reverse thrust were ineffective. Aircraft rolled beyond the end of the runway and the gear collapsed. Crew of 11 and 149 passengers escaped without injury.

February 2, 1973 - Bell 206B Helicopter, Lake Charles, Louisiana - During cruise the helicopter hit a black vulture which jammed between the transmission and the swash plate, and the cyclic control tube was broken. A power-off autorotative landing was made resulting in substantial damage because of a hard landing.

February 26, 1973 - Learjet Atlanta, Georgia - Aircraft departed Peachtree-Dekalb Airport and struck a flock of brown-headed cowbirds resulting in complete failure of one engine and partial power loss on the remaining engine. Aircraft crashed killing two crew, five passengers, and one person on the ground. The aircraft was destroyed.

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July 31, 1973 - Aerial Spray Callair A-9A, Grygla, Minnesota - Aircraft struck a sandhill crane during a spray swath, damaged the right aileron, and the pilot was unable to maintain aircraft control. Aircraft was destroyed and pilot seriously injured.

November 7, 1973 - Piper PA 32, Corpus Christi, Texas - Aircraft collided with large flock of birds while climbing through 4,000 feet above ground requiring an emergency landing. Aircraft sustained substantial airframe skin damage.

August 22, 1974 - American Avco AA5, Enroute Near Homestead, Florida - Aircraft hit a bird at 500 feet above ground level and the aircraft hit a tree after momentary loss of control. Aircraft damaged during crash landing.

October 16, 1974 - Cessna 500, New Haven, Connecticut - During takeoff from Tweed-New Haven Airport, the aircraft ingested gulls in the NR 1 engine. Takeoff was aborted. Aircraft hydroplaned and left the runway, hitting a ditch and destroying the aircraft. Two crew and one passenger escaped without injury.

January 26, 1975, Pushpak Trainer, Patalia, India - Aircraft was in the traffic pattern when it struck a vulture. The wing strut was damaged causing loss of control. The aircraft was destroyed on impact.

April 12, 1975 - Piper PA-30, Iowa City, Iowa - Aircraft was in the traffic pattern, hit a flock of ducks causing substantial airframe damage.

June 14, 1975 - North American NA-265, Watertown, South Dakota - Aircraft hit a flock of gulls on takeoff resulting in complete loss of power due to flame-outs on both engines. Aircraft wingtip contacted instrument approach light T bar stand before crashing off the end of the runway. Two crew and one passenger seriously injured, three other passengers sustained minor injury.

November 12, 1975 - Air Carrier DC-10, J. F. Kennedy Airport, New York - On takeoff roll, the DC-10 ingested gulls into the NR 3 engine resulting in engine fire and engine disintegration. Aircraft aborted takeoff but was unable to use thrust reversers and hydraulic failure occurred. Aircraft was destroyed by fire. Two of eleven crew seriously injured, 128 passengers escaped without injury. The low number of injuries was attributed to rapid evacuation. The majority of the passengers were airline flight attendants.

January 26, 1976 - Cessna 150, Bath, South Carolina - While enroute, aircraft hit a hawk, shattering the windshield. Pilot made a forced landing in an open field and hit tree stumps causing substantial damage to aircraft. Pilot and passenger sustained minor injuries.

February 13, 1976 - Air Carrier B-747, Orly Paris, France - During takeoff, gulls were struck after V<sub>1</sub> with birds being ingested into NR 1 and NR 4 engines. Takeoff was continued, fuel was jettisoned, and aircraft landed. NR 1 engine sustained major damage, NR 4 required replacement of fan blades.

May 18, 1976 - Aerial Spray Hughes 369 Helicopter, Elkhart, Kansas - During a spray swath run, a bird struck the spray boom brace, and the brace hit the tail boom. Aircraft crashed causing significant damage. Pilot was not injured.

June 12, 1976 - Cessna 210, McMinnville, Oregon - During cruise, bird impacted nose gear doors and jammed the doors in the closed position. Aircraft landed gear-up causing substantial damage to lower nose cowling.

August 27, 1976 - Air Carrier B-747, Hong Kong - At 400 feet on takeoff, two large birds passed under the right wing. A 13 by 6-inch hole was found in the flap canoe fairing outboard of the NR 3 engine. Remains of a small hawk were found.

September 4, 1976 - Cessna 150, Luton, United Kingdom - Aircraft hit a flock of pigeons with damage to the propeller and windshield. Pilot made a forced landing following engine shutdown.

November 12, 1976 - Falcon 20, Naples, Florida - Before the aircraft departed, airport personnel dispersed birds from the airport. Approximately 30 birds circled the airport and the departing aircraft struck these birds on takeoff. Both engines failed and aircraft made a forced landing off the airport. Two crew and nine passengers were seriously injured on impact. Gulls identified as ring-billed gulls.

January 14, 1977 - Air Carrier DC-8, Amsterdam, Netherlands - On takeoff, aircraft struck a flock of gulls and ingested birds into NR 1 and NR 2 engines, requiring immediate shutdown of NR 2 engine. Fuel was jettisoned and aircraft returned for landing.

February 10, 1977 - Piper PA-28, Nottingham, United Kingdom - During climbout, aircraft struck a flock of lapwings breaking the windshield and causing facial lacerations to the pilot. A safe landing was made.

April 7, 1977 - Piper PA-23, Glasgow, United Kingdom - At 3,000 feet above ground level and 160 knots, the aircraft struck a less black-backed gull causing a 12-inch diameter hole in the wing leading edge. Aircraft landed without further incident.

April 14, 1977 - Cessna 150, Atlanta, Georgia - On a local flight, aircraft hit a hawk, windshield was destroyed, and aircraft landed without further incident. One crewman seriously injured, other crewman received minor lacerations.

April 23, 1977 - Aero Commander, Chicago, Illinois - Pilot was advised of birds on the runway at Meigs Field. Pilot took off into a flock of birds, ingesting gulls in one engine. Aircraft emergency procedures were improperly executed and aircraft entered a spin and crashed in the water, killing the pilot and three passengers.

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April 25, 1977 - Hiller 1100H Helicopter, Enroute Near Watson Island, Florida - Tail rotor separated following impact with bird. Forced landing resulted in substantial damage to helicopter. Pilot and four passengers escaped injury.

July 3, 1977 - Air Charter Lockheed Electra (U.S. location unknown) - NR 2 engine ingested birds and had to be shut down during the approach. Following inspection, NR 3 engine was also damaged requiring two engine changes.

August 5, 1977 - Air Carrier Convair 440, Oernskoeldsvik, Sweden - During descent out of 1,700 feet and at 240 knots, aircraft struck a buzzard, puncturing an 8-inch hole in the wing leading edge outboard of the engine.

August 9, 1977 - Air Carrier E-707, San Francisco, California - Aircraft struck birds on takeoff with the NR 1 engine experiencing a compressor stall. Aircraft returned for landing. NR 1 engine compressor destroyed, requiring engine change; NR 4 engine fan blades also required repair.

August 9, 1977 - Air Taxi Beech 18, Sioux Falls, South Dakota - During a night flight, aircraft hit a bird with impact occurring on the windshield dividing bar, breaking the left windshield. Pilot received minor injuries.

August 30, 1977 - Air Taxi Cessna 170B, Colovin, Alaska - On takeoff climb, aircraft hit a bird which penetrated the engine cowling and struck the ignition system lead wires causing partial power loss. Aircraft was forced to ditch resulting in substantial water damage to aircraft. Pilot and four passengers survived with only minor injuries.

September 12, 1977 - Aerial Spray Callair A-6, Cedar City, Utah - A mourning dove was ingested blocking airflow to the engine. Engine failed and aircraft was destroyed in crash. The pilot was seriously injured.

September 15, 1977 - Air Carrier B-737, Honolulu, Hawaii - On approach, a Frigate bird hit first officer's windshield shattering all panes and showering crewmembers with glass. Windshield bowed in but did not fail completely. Captain landed aircraft without further incident.

September 16, 1977 - Lear 24, Baton Rouge, Louisiana - Aircraft aborted a takeoff on a wet runway following an engine ingestion and failure. Aircraft left the end of the runway and struck a ditch causing significant aircraft damage. Two crew and six passengers were not injured.

November 3, 1977 - Air Carrier B-747, Newark Airport, New York - Bird strike immediately after takeoff resulted in an engine ingestion on NR 3 engine. Immediate power loss and engine vibration forced engine shutdown and return for landing. Post-flight inspection revealed that a fan blade had detached making a 7 x 8-1/2-inch hole in the nose cowl and extensive damage to the compressor section. The bird was a gull.

1977 - Air Carrier B-747SP, Haneda, Tokyo, Japan (exact date unknown) - At approximately 2,700 feet, several sharp explosions and airframe jolts occurred as aircraft struck birds. Flames were observed in vicinity of NR 1 engine following bird ingestion. NR 1 engine was shut down, NR 2 engine EGT began to climb and it too was shut down as EGT reached 920°. Aircraft continued climb (takeoff weight 523,300 lbs.) until passing 3,800 feet and 220 knots. A restart of NR 2 engine was unsuccessful. NR 1 engine was restarted but smoke began to fill the cabin, so NR 1 was again shut down as EGT passed through 700°. The aircraft landed 13 minutes after takeoff at 70,000 lbs. over maximum landing weight. NR 2 engine bearing failure occurred as a result of the bird strike. No significant damage was found in NR 1 engine.

January 9, 1978 - Falcon Fan Jet, Merced, California - Aircraft descending through 2,000 feet and in the clouds struck a goose. The bird penetrated the right wing leading edge, damaging wing spars and puncturing the fuel cell. Aircraft made a successful landing.

January 10, 1978 - Cessna 172, Sacramento, California - Aircraft climbing through 3,000 feet struck a goose causing windshield failure and injury to the pilot and one passenger. Aircraft made an emergency landing and both the pilot and passenger were treated for lacerations on the face and hands.

January 23, 1978 - Air Carrier B-707, Ben Gurion Tal Aviv, Israel - During takeoff, the aircraft hit a flock of gulls with an unknown number of birds entering the NR 2 engine, causing an engine fire. Aircraft returned and landed. Loss of engine caused by fan and compressor failure.

February 9, 1978 - Bell 206 B Helicopter, Lake Arthur, Louisiana - Helicopter approaching the coast at 300 feet hit a duck with the bird penetrating the lower right front bubble.

February 11, 1978 - Air Carrier B-727, San Diego, California - On approach to Lindbergh Field, the aircraft struck a golden eagle, destroying the radome. Aircraft made a successful landing. The bird was found lodged in the pressure bulkhead behind the radar antenna.

February 23, 1978 - Beech Bonanza, Sacramento, California - During descent at night, aircraft encountered a flock of ducks with one duck hitting the wing leading edge, tearing the aircraft skin and rupturing the fuel tank. Aircraft declared an emergency and landed, all fuel was lost from the wing.

February 24, 1978 - Air Commuter Bell Jet Ranger Helicopter, Newark, New Jersey - At 500 feet and 100 knots, helicopter hit a bird at night, breaking the windshield and cutting the pilot's face and arms.

February 29, 1978 - Air Carrier DC-10, San Francisco Int'l, California - On takeoff, the aircraft struck a flock of gulls, breaking the nose radome and ingesting birds into the NR 1 engine. The aircraft returned and landed. Inspection of the CF-6 engine revealed that 20 fan blades had failed.

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March 7, 1978 - Piper PA-31, Sacramento Executive Airport, California - During a night flight, the aircraft struck a flock of ducks, two ducks broke through the windshield injuring the pilot and his passenger. A successful emergency landing was made.

March 13, 1978 - Gulfstream I, Kalamazoo, Michigan - During takeoff roll, the aircraft struck a flock of ducks which were flying low across the runway. A six-inch tip of one propeller blade was broken off, causing increased turboprop engine vibration. The takeoff was aborted without further incident.

March 16, 1978 - Falcon Fanjet 20, Newark, New Jersey - At 200 feet on takeoff climb, the aircraft struck a flock of birds. One bird tore a hole in the right flap while another bird entered the right engine resulting in failure of the blades in the first, second, and third stage compressor.

March 29, 1978 - Piper PA-28, Tweed-New Haven Airport, Connecticut - On approach to the airport, the aircraft hit a gull at 2,000 feet. The bird passed through the right side of the windshield, no injuries.

April 4, 1978 - Commuter Skyvan SH 7, Near Philadelphia, Pennsylvania - During level flight at 3,500 feet, the right front windshield was destroyed by a bird. No injuries reported.

April 19, 1978 - Lear 24, Pal Waukee Airport, Chicago, Illinois - On takeoff roll, birds were ingested into both engines. Takeoff aborted when both engines flamed out.

April 22, 1978 - Tiger AA5B, Near Stonesville, Ohio - During a night flight at 2,500 feet, the aircraft hit a hawk. The bird passed through the windshield injuring the passenger in the right seat.

June 7, 1978 - Air Carrier B-737, Stockton, California - Climbing through 2,000 feet, the aircraft hit a single bird, bending the inboard trailing edge flap. Damage was sufficient to jam the flaps in a split flap configuration, affecting aircraft performance.

June 26, 1978 - Piper Navajo, Walla Walla, Washington - On takeoff, aircraft struck a bird that jammed in the nose gear, causing a gear retraction problem. Aircraft landed without incident. Bird was removed and gear retraction tests showed no damage.

June 28, 1978 - Air Carrier DC-9, Indianapolis, Indiana - Immediately after takeoff, the aircraft hit a blackbird, striking the pilot mast resulting in loss of the aircraft pitot-static system.

July 25, 1978 - Air Carrier Convair 580, Kalamazoo, Michigan - At lift off, the aircraft ingested an American kestrel in the No. 1 engine and the engine autofeathered. This loss of power resulted in a crash landing in a nearby field, destroying the aircraft. The aircraft carried three crewmembers and 37 passengers. One crewmember and one passenger were seriously injured, 28 others sustained minor injuries.

July 31, 1978 - Piper PA28, Madison, Wisconsin - During cruise at 5,500 feet, aircraft encountered a flock of ducks; a bird broke the underwing fuel drain causing complete loss of wing tank fuel. Aircraft made an immediate landing with the engine quitting on landing roll due to fuel starvation.

August 13, 1978 - Air Carrier B727, Near Houston, Texas - While holding at 10,000 feet MSL, aircraft hit a flock of ducks. Two access doors were torn loose on the left side of the aircraft. On post flight inspection, three fuselage dents and one three-inch diameter hole in the fuselage were also found.

August 23, 1978 - Cessna 150, Danburg, Connecticut - At 100 feet in the take-off climb, the aircraft struck a Canadian goose, puncturing a three-inch by four-inch hole in the wing leading edge.

August 28, 1978 - Piper PA24, Portland International Airport, Oregon - On takeoff, aircraft ingested starlings into the heat muff, resulting in a fire in the duct.

September 3, 1978 - Air Carrier DC-8, Tampa, Florida - Immediately after landing, the aircraft rolled through a flock of gulls that were rising off the runway. Birds were ingested into engine NR 3 and NR 4, the fire warning lights flickered, and the engines were shut down immediately. Maintenance inspection revealed no engine damage.

September 10, 1978 - Air Carrier DC-10, Portland International Airport, Oregon - Aircraft took off from Portland and ingested a gull in the NR 1 engine. The engine was shut down and the aircraft returned to Portland. The aircraft engine was checked and no damage was detected. The aircraft then made an uneventful 20-minute flight to Seattle-Tacoma Airport. On departure from Seattle, the NR 1 engine vibration began to increase, requiring engine shutdown.

September 21, 1978 - DC-3, Oakland, California - Immediately after takeoff, the DC-3 collided with a large bird, possibly a hawk, shattering the copilot's windshield. Glass fragments cut the copilot's face and eyes causing permanent vision impairment. Second officer received cuts about the face and hands. Pilot landed aircraft without further incident.

September 22, 1978 - Air Carrier B-737, Flint, Michigan - On takeoff roll, aircraft ingested gulls in both engines, an immediate power reduction was made and aircraft aborted the takeoff. The engines were cleaned and released for service with no damage.

September 1978 - Air Taxi Cessna 402, Honolulu, Hawaii - Cruising at 1,000 feet over the water, the aircraft struck a frigate bird, shattering the windshield and destroying some flight instruments.

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October 2, 1978 - Air Carrier B-747, San Francisco International Airport, California - On takeoff roll, aircraft experienced two compressor stalls following injection of domestic pigeons into two engines. Aircraft aborted the takeoff. Engines were checked and no damage was found. Two tires were replaced because of the high-speed abort.

October 27, 1978 - Piper PA-32, Location Unknown - At 6,000 feet, aircraft struck a bird at night resulting in failure of the right windshield, lacerating the passenger's face and hands.

October 28, 1978 - Air Carrier B-737, Cleveland, Ohio - Descending through 8,000 feet at 250 knots, the aircraft struck a flock of ducks. One duck passed through the right side fuselage. Remains were found in the forward baggage hold.

October 30, 1978 - Falcon Fanjet 20, Ft. Lauderdale, Florida - At 800 feet on takeoff climb, the aircraft struck a brown pelican. The right engine nacelle was destroyed, the bird was ingested, destroying the right engine; and the engine mount was bent, tearing the fuselage skin aft of the engine mount. The pelican weighed about eight pounds.

November 2, 1978 - Air Carrier B-727, Portland International Airport, Oregon - Aircraft aborted takeoff after hitting a hawk. The hawk broke the stall warning sensor resulting in stall warning stick shaker activation just prior to V<sub>1</sub>.

November 20, 1978 - Cessna 172, Birmingham, Alabama - On takeoff climb, the aircraft hit a large bird, blocking off airflow at the engine air intake resulting in a loss of power and a forced landing. No injuries reported.

November 24, 1978 - Air Carrier Fairchild FH227, Des Moines, Iowa - During the approach to Des Moines Airport, the aircraft struck a goose at 2,500 feet, causing damage to the nose gear door. The nose gear could not be lowered requiring a nose gear up landing. No injuries were reported; however, extensive damage was done to the forward undercarriage of the aircraft.

December 11, 1978 - Cessna Citation, Lebanon, New Hampshire - During landing, the aircraft hit a snowy owl that was hunting by the light of the approach lights. The bird made a large hole in the leading edge of the left wing, rupturing the fuel cells.