National Transportation Safety Board

Review of U.S. Civil Aviation Accidents

Review of Aircraft Accident Data 2010

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Calendar Year 2010

National Transportation Safety Board

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Abstract: The National Transportation Safety Board's (NTSB) *Review of U.S. Civil Aviation Accidents, Calendar Year 2010* covers aircraft accidents regulated under Title 14 *Code of Federal Regulations* Parts 121 and 135 as well as general aviation accidents. In total, 1,500 accidents occurred in 2010, involving 1,520 U.S.-registered aircraft. Approximately 18 percent (275) of these accidents were fatal, resulting in 470 fatalities. General aviation accidents accounted for nearly 96 percent of total accidents and about 97 percent of fatal accidents in 2010. Data for the years 2001–2009 are included to provide historical context for the 2010 statistics. The details of the circumstances of the accidents are presented throughout this report. Readers may download a copy of the accident dataset at http://www.ntsb.gov/data/aviation_stats.html.

This report is published before the NTSB issues final probable cause statements for all accidents in 2010. Probable cause statements will be posted as they are released at http://www.ntsb.gov/data/aviation_stats.html.

Photos courtesy of Jefferson McMillan.

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1.0 Executive Summary

From January 1, 2010, through December 31, 2010, 1,520 U.S.-registered civil aircraft were involved in 1,500 accidents, of which 275 were fatal accidents resulting in 470 fatalities. Table 1 shows the number of accidents, fatal accidents, and fatalities for each of the major segments of U.S. civil aviation for 2010.

Table 1. Total accidents, fatal accidents, and fatalities for major segments of U.S. civil aviation, 2010.

Segment	Number of Accidents	Number of Fatal Accidents	Total Fatalities
Total U.S. Civil Aviation Accidents	1500	275	470
Part 121	28	1	2
Part 135[1]	37	6	17
General Aviation[2]	1435	268	451

1.1 Findings

Although this report does not produce conclusions or recommendations, the National Transportation Safety Board (NTSB) has developed several findings from the review of these statistical data. The principal findings of this review are as follows:

1.1.1 Part 121 Operations

- From 2001 through 2010, Part 121 passenger enplanements increased, but the total flight hours and revenue flights remained steady.
- In 2010, 96 percent of Part 121 accidents were classified as either injury or damage accidents, which is an increase from 83 percent in 2009.
- There was one Part 121 accident classified as “major” in 2010, a decrease from two in 2009.
- The majority of Part 121 accidents in 2010 involved scheduled, domestic passenger flights.
- The most prevalent defining event for Part 121 accidents in 2010 was turbulence encounter, which accounted for 26 percent of all Part 121 accidents, but did not result in aircraft damage or multiple injuries.

[1] These accident counts include all facets of Part 135, to include those conducted as sightseeing and air medical operations. In chapter 2 of this report, sightseeing and air medical operation accidents are not included in aggregate numbers. Rather, they are outlined in a separate section of this chapter.

[2] General aviation includes all operations not conducted under Parts 121, 135, or 129. This includes operations of public aircraft. These accident counts include sightseeing and air medical operations. In chapter 5 of this report, sightseeing and air medical operation accidents are not included in the aggregate number. Rather, they are outlined in a separate section in chapter 4.

1.1.2 Part 135 Operations

- Six accidents occurred in 2010 which involved scheduled Part 135 flights. All occurred in fixed-wing airplanes, and none of these accidents resulted in fatalities. All but one of these accidents occurred in Alaska.
- Initial climb was the most common phase of flight for accidents involving scheduled Part 135 aircraft.
- Fixed-wing airplanes were involved in 21 of the 24 Part 135 air taxi accidents that occurred during 2010. Four of these 21 accidents were fatal, which resulted in a total of 9 fatalities. Other collisions were the most common defining event for these accidents.
- Helicopters were involved in three Part 135 air taxi accidents, and none of these accidents resulted in fatalities.

1.1.3 Air Medical Operations

- From 2001 through 2010, 33 percent of helicopter emergency medical services (HEMS) accidents were fatal.
- In 2010, there were 13 HEMS accidents, 7 of which were fatal. One HEMS accident involved a midair collision of a HEMS aircraft with a general aviation aircraft. The accident resulted in two fatalities.
- All fatal HEMS accidents in 2010 occurred during airborne phases of flight.

1.1.4 Sightseeing and Air Tour Operations

- From 2001 through 2010, balloons accounted for 49 percent of all aircraft involved in Part 91 sightseeing accidents.
- Between 2005 and 2010, Part 135 air tour accidents declined by about 67 percent, from 9 in 2005 to 3 in 2010.

1.1.5 General Aviation Operations

- In 2010, general aviation accidents accounted for 96 percent of all accidents, 97 percent of fatal accidents, and 96 percent of total fatalities of all U.S. civil aviation.
- Most personal flying accidents (89 percent) involved single-engine, piston-powered airplanes.
- Loss of control in flight accounted for the majority of fatal personal flying accidents and system and component failure (powerplant) accounted for the majority of non-fatal personal flying accidents. Landing was the most common phase of flight associated with non-fatal personal flying accidents.
- During 2010, 81 percent of instructional flying accidents involved fixed-wing airplanes, while 17 percent involved helicopters.
- Seven percent of aerial application accidents in 2010 were fatal, and four percent of the accident aircraft were destroyed.
- Over the past decade, public aircraft accidents were almost evenly split between fixed-wing airplanes and helicopters (52 percent and 48 percent, respectively).

2.0 Introduction

The NTSB's *Review of U.S. Civil Aviation Accidents, 2010* reviews all civil aviation accidents that occurred between January 1, 2010, and December 31, 2010. This report combines air carriers (regulated by Title 14 *Code of Federal Regulations* [CFR] Part 121), commuter and on-demand carriers (regulated by 14 CFR Part 135), and general aviation. This report is published before the adoption of the probable cause for all accidents that were reviewed.[3]

U.S. civil aviation encompasses a broad variety of aircraft and pilots, flying for many different purposes. These operations can range from light-sport and private flights to commercial air carrier operations. Civil aviation in the United States is regulated by the U.S. Federal Aviation Administration (FAA).[4] The FAA makes a very broad distinction between commercial and general aviation operations. Commercial operations are defined as those carriers that operate aircraft in revenue service, either for the purpose of passenger or cargo transport.[5] These carriers are regulated by Parts 121 and 135.

Most air carriers regulated by Part 121 fly large, transport-category aircraft for the purpose of passenger travel. However, some carriers operating under Part 121 haul cargo only. Both passenger and cargo Part 121 operators normally conduct operations in controlled airspace and at specific, uncontrolled airports that are able to provide certain weather, maintenance, and operational equipment and support.

Part 135 applies to commuter and on-demand operations into airports that may not have the services required by Part 121. Part 135 has different regulatory requirements than those for Part 121 operators.

Part 121 and Part 135 operations can be further classified into scheduled and non-scheduled services. Scheduled operators offer set departure locations, departure times, and arrival locations in advance of the flight's departure. Non-scheduled operators, or on-demand operators, do not offer set locations and times, but instead rely on their customers to set the departure and arrival locations and times. Some examples of non-scheduled operations include Part 121 cargo operations, Part 135 air taxi operations, and certain emergency medical transport operations.

In contrast, general aviation operations encompass all those not covered by Part 121 or Part 135 (or those covered by Part 129, which applies to foreign carriers operating in U.S. airspace). While Part 121 and Part 135 operations are very specific, general aviation encompasses a wide variety of operations, involving an even wider array of aircraft. General aviation includes all non-commercial operations, including flying for pleasure and business, along with very specific commercial operations, such as flight training and banner or glider towing. The accidents in each division of U.S. civil aviation will be discussed in subsequent sections of this report.

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[3] Probable cause data will be published periodically by the NTSB and made available online at: http://www.ntsb.gov/data/aviation_stats.html.

[4] Information on the Federal Aviation Administration, its mission, vision, and values can be found on their website: www.faa.gov.

[5] Title 14 CFR Part 1.

3.0 Commercial Air Transport Accidents—Part 121

This section provides a summary of the activity and experiences of air carriers regulated by Part 121. These operators generally fly large, transport category aircraft carrying passengers and/or cargo for hire.

3.1 Part 121 Flight Activity

Figure 1 shows the revenue flights (departures) and revenue hours of Part 121 operators, systemwide,[6] from 2001 through 2010. The majority of this activity involved scheduled, domestic passenger service conducted by legacy and regional carriers. Figure 2 shows the number of systemwide passenger enplanements for the same period.[7] Overall, passenger enplanements increased from 2001 to 2010, while the total revenue flights and hours remained relatively steady.

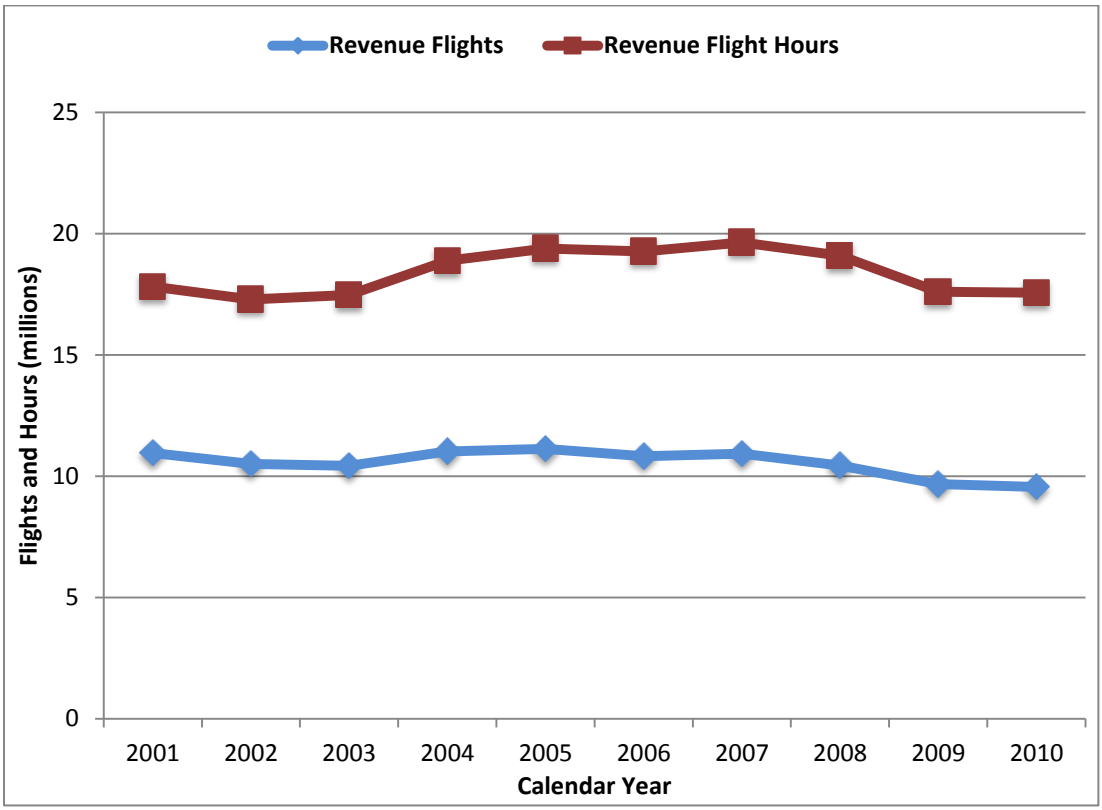

Figure 1. Part 121 revenue flights and revenue hours, 2001–2010.

[6] Systemwide refers to all operators in a given CFR Part. In this case, systemwide refers to all Part 121 operators, both domestic and international, cargo and passenger, and scheduled and non-scheduled.

[7] Data for total revenue flights and total revenue hours were compiled by the FAA and provided to the NTSB. Data for total enplanements were gathered from Form T-100, which were compiled by the Bureau of Transportation Statistics.

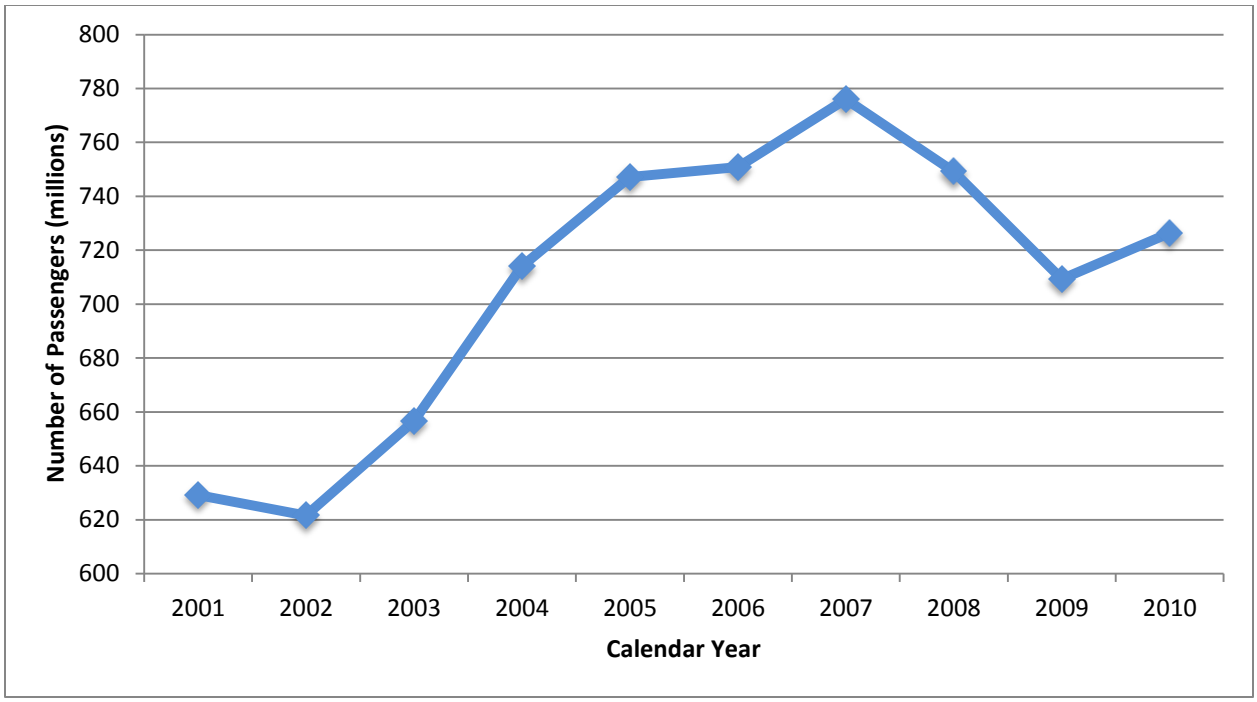

Figure 2. Part 121 passenger enplanements, systemwide, 2001–2010.

3.2 Part 121 Accident Experience

Table 2 shows the classifications used by the NTSB to categorize aviation accidents according to their severity.

Table 2. NTSB accident severity classification scheme for Part 121 aviation.[8]

Severity	Criteria
Major	The aircraft was destroyed, OR There were multiple fatalities, OR There was one fatality AND substantial damage to the aircraft.
Serious	A single fatality without substantial damage to the aircraft, OR At least one serious injury AND the aircraft was substantially damaged.
Injury	Non-fatal accident with at least one serious injury but no substantial damage to the aircraft.
Damage	No person was killed or seriously injured, but the aircraft was substantially damaged.

[8] *Federal Register*, Vol 61, Number 235 (December 5,1996). p. 64540–64541

Table 3 summarizes Part 121 accidents between 2001 and 2010 categorized by the NTSB severity classification. The majority of accidents for the ten-year period fell into the damage category. In 2010, 27 of the 28 Part 121 accidents were classified as either injury or damage.[9]

Table 3. Part 121 accidents by NTSB severity classifications, 2001–2010.

Severity	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Major	5	1	2	4	2	2	0	4	2	1
Serious	1	1	3	0	3	2	2	1	3	0
Injury	19	14	24	15	11	7	14	8	15	13
Damage	21	25	25	11	24	22	12	15	10	14

Although the total number of accidents can show the occurrences during a particular time period, it is important to consider the accident rate in relation to the relative risk of occurrence, such as the ratio of accidents to a suitable measure. These ratios rely on the availability and accuracy of the exposure measures, specifically hours of service and number of departures for Part 121 operators, reported to the Office of Airline Information within the Bureau of Transportation Statistics (BTS).[10]

These reports to BTS represent a 100 percent census of air carrier activity. For accident risk associated with takeoff and landings (for example, hard landings and runway excursions), the number of flights or departures is a good measure of exposure to risk. For risk that is associated with time aloft (for example, turbulence encounters), the total flight time can provide a better index of exposure. Both types of rates are presented in the aggregate analysis in this section.

Figure 3 adjusts the total annual accident frequency by the two exposure measures.[11] Accident rates for both measures of exposure have decreased over the decade and have remained below four accidents per million revenue flights and below two accidents per million revenue hours since 2006.

[9] The crash of United Parcel Service Flight 6 (NTSB: DCA10RA092) was the only major accident in 2010. Because the accident was investigated by a foreign agency (UAE General Civil Aviation Authority [GCAA]), the NTSB only published a preliminary report. This report can be obtained at the following link: http://www.ntsb.gov/aviationquery/brief.aspx?ev_id=20100903X54913&key=1.

[10] Reporting required by 14 CFR Part 241.

[11] Data for total revenue flights and total revenue hours were compiled by the FAA and excludes any acts of terrorism, suicide, or sabotage.

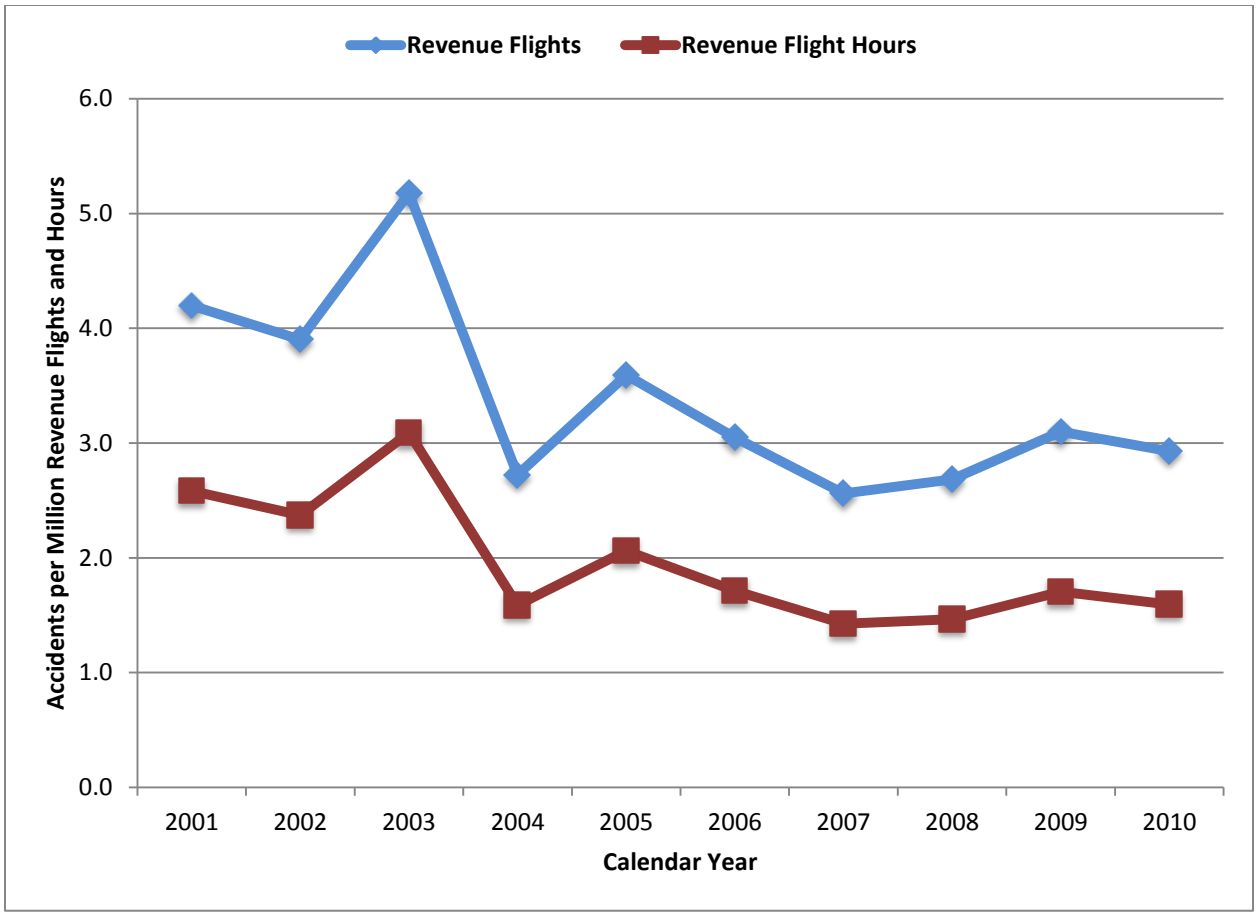

Figure 3. Part 121 accidents per revenue flights and revenue flight hours, 2001–2010.

3.3 Details of Part 121 Accidents for 2010

There were 28 accidents involving 31 Part 121 aircraft in 2010 (3 accidents involved an on-ground collision/contact between 6 Part 121 aircraft). Figure 4 shows the geographic distribution of the Part 121 accident aircraft for which geospatial data are available.[12]

[12] Geospatial data can be any dataset that includes geographic references, such as latitude and longitude coordinates, city and state pairings, or zip codes. Accident DCA10FA076 lacked sufficient data to plot its location on these maps. According to the accident record, the accident occurred over the Pacific Ocean.

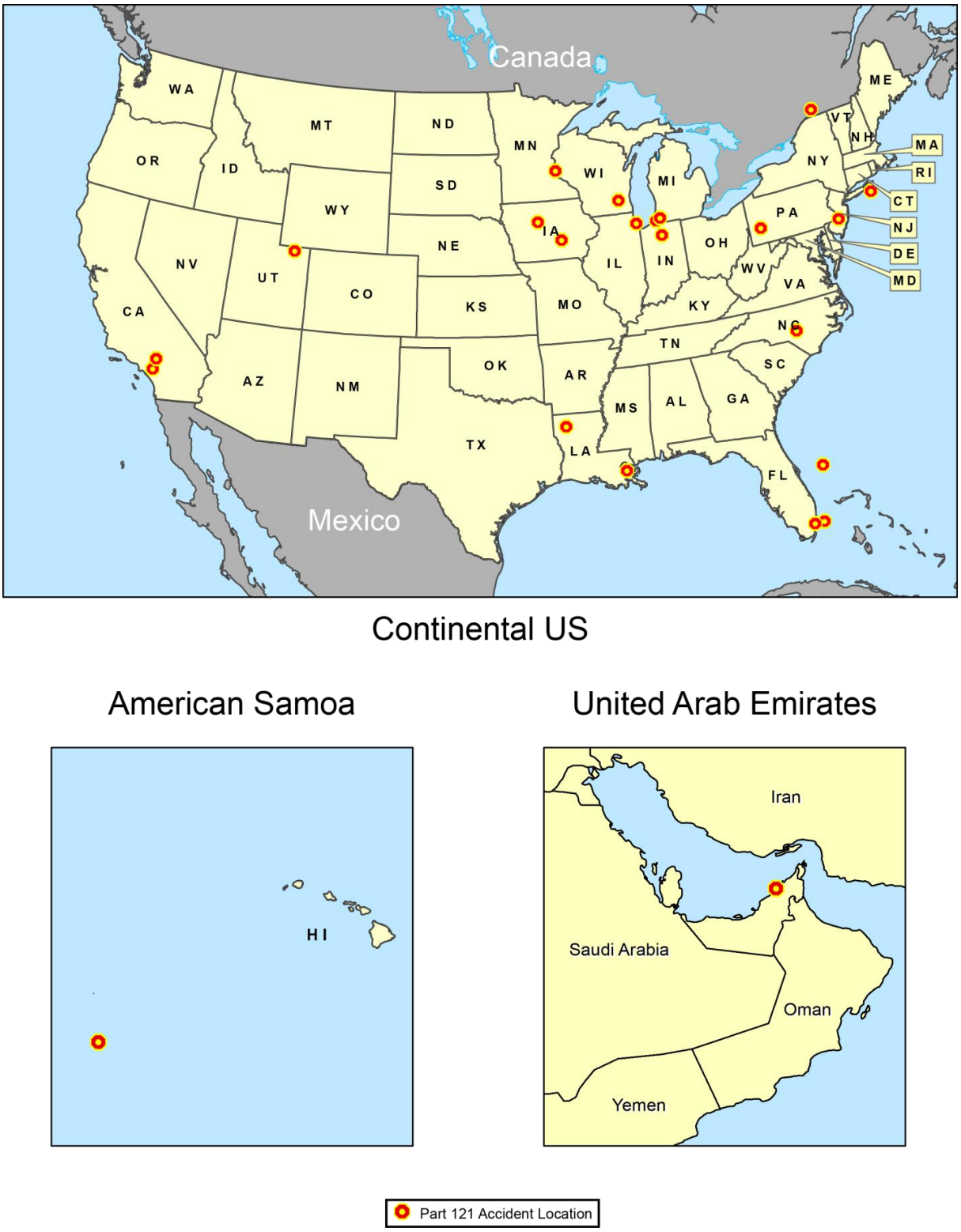

Figure 4. Locations of Part 121 accidents with available GPS coordinates, 2010.

Table 4 shows the distribution of Part 21 accident aircraft in total and fatal accidents. The operational dichotomies are presented for: passenger versus cargo operations, domestic versus international routes, and scheduled versus non-scheduled flights. The majority of accident aircraft were engaged in scheduled, domestic passenger operations. However, the one fatal Part 121 accident in 2010 involved a non-scheduled, international cargo flight.

Table 4. Operational dichotomies of Part 121 accidents, 2010.

Operational Dichotomies	Number of Aircraft Involved in Accidents	Fatal Accidents
Passenger	28	0
Cargo	3	1
Total	31	1
Domestic	24	0
International	7	1
Total	31	1
Scheduled	28	0
Non-Scheduled	3	1
Total	31	1

3.4 Accident Categories

Some of the statistical summaries in this report use accident categories that were developed by the Commercial Aviation Safety Team (CAST)/International Civil Aviation Organization (ICAO) Common Taxonomy Team (CICTT).[13] CICTT category development focuses on coding aircraft accident occurrences and phases of flight in a standardized and logical manner. In categorizing U.S. civil aviation accidents, the NTSB can use multiple CICTT categories to describe an accident. For ease of use, the NTSB identifies one category as the defining event for each accident, which this report uses to categorize each accident. Definitions of each defining event and phase of flight can be found in appendix A. Table 5 shows the defining event for all Part 121 accident aircraft. Table 6 shows the phase of flight for each accident aircraft.[14]

[13] C. Stephens and others, "Standardizing International Taxonomies: Common taxonomy is an indispensable tool to define common safety issues and complementary ways to globally enhance aviation safety." Presented at the ISASI 2007 Seminar, Singapore, August 27–30, 2007.

[14] In this report, most figures are quantified using accident aircraft. This is done to accurately represent the total number of U.S. civil aircraft involved in accidents for the year. This means that an accident involving a collision of two or more aircraft will be counted more than once in these figures. All figures are labeled as either using this method or using the number of accidents.

Table 5. Defining events for Part 121 accidents, 2010.

Defining Event	Number of Aircraft Involved in Accidents
Turbulence Encounter	8
Ground Collision	5
Ground Handling	4
Birdstrike	3
Abrupt Maneuver	2
Cabin Safety	2
System/Component Failure (Non-Powerplant)	2
Other Collision	2
Windshear/Thunderstorm	1
Unknown/Undetermined	2

Table 6. Phase of flight for Part 121 accidents, 2010.

Phase of Flight	Number of Aircraft Involved in Accidents
En Route	12
Standing	6
Pushback/Tow	4
Approach	4
Taxi	2
Initial Climb	1
Unknown/Undetermined	2

The most common defining event for all Part 121 accident aircraft was a turbulence encounter and all but one of the turbulence encounters occurred during the en route phase of flight. Turbulence encounters accounted for 26 percent of all Part 121 accidents in 2010. No aircraft involved in these turbulence encounters sustained any damage. The next most frequent defining event for Part 121 accidents in 2010 was ground collisions between aircraft or between aircraft and ground vehicles, such as tugs, baggage carts, and company vehicles. A ground collision occurs when one of the aircraft involved is taxiing to or from a runway. None of the ground collision accidents resulted in any serious injuries, but three resulted in substantial damage to the aircraft. Three of the five accidents occurred during daylight hours.

Ground handling accounted for the third most frequent defining event for Part 121 accidents in 2010. Ground handling can include external preflight configuration errors[15] prior to movement and collisions while the aircraft is in the standing phase of flight. No occupant was injured in any of the four ground handling accidents that occurred during 2010; however, all of the accident aircraft received substantial damage.

[15] Preflight configuration errors can include leaving hoses attached to the aircraft prior to pushback or mishandling of the ground equipment attached to the aircraft at time of pushback.

Birdstrikes, including engine ingestion or impact, accounted for the fourth most frequent defining event for Part 121 accidents in 2010. No injuries resulted from these accidents, but all aircraft received substantial damage. Two of the three accidents occurred during approach and the other occurred during the en route phase of flight. All three birdstrike accidents occurred during daytime and in VMC.

Appendix B provides a link to the listing of all 31 accident-involved Part 121 aircraft.

Photo 1. The Bombardier CL-600-2B19 is an example of a small jet.

3.5 Accident Pilot Characteristics

Table 7 summarizes the average age and flight experience of Part 121 pilots[16] involved in accidents during 2010 as a function of the accident aircraft body type.[17]

Table 7. Average age and flight experience of Part 121 accident pilots by aircraft type, 2010.

Pilot Age/ Flight Experience	Aircraft Type			
	Wide Body	Narrow Body	Small Jet	Turboprop
Pilot Age	57.5	52	42	35
Total Flight Time (hours)	21,619	13,179	8,622	7,800
Time in Type of Accident Aircraft (hours)	1,690.5	7,824	3,755.5	7,000

[16] The flight crew statistics were obtained only from the pilot listed first (normally the captain) in the NTSB accident investigation report. Also, the demographics only include those accidents where flight crew data was available. (Some preliminary reports do not have flight crew data available)

[17] For the purpose of this report, wide-body aircraft are large, twin aisle (in passenger configuration), jet aircraft such as the B-747/767/777; narrow-body aircraft are medium range, single-aisle, jet aircraft such as the DC-9, A-320, and B-737; small jet are short haul aircraft such as the ERJ-135/147/170 and the CL-600, usually with less than 100 seats; turboprop aircraft are short- to medium-haul gas turbine-powered aircraft with propellers such as the SAAB 340 and DeHavilland Canada DHC-8.

4.0 Commercial Air Transport Accidents—Part 135

Title 14 CFR Part 135 governs both scheduled carriers flying aircraft with fewer than 10 passenger seats and on-demand passenger or cargo services using either fixed-wing airplanes or helicopters. On-demand passenger services include air taxi, air medical, and air tour operations. Figure 5 shows the locations of 36 of the 37 Part 135 accidents that occurred in 2010.[18]

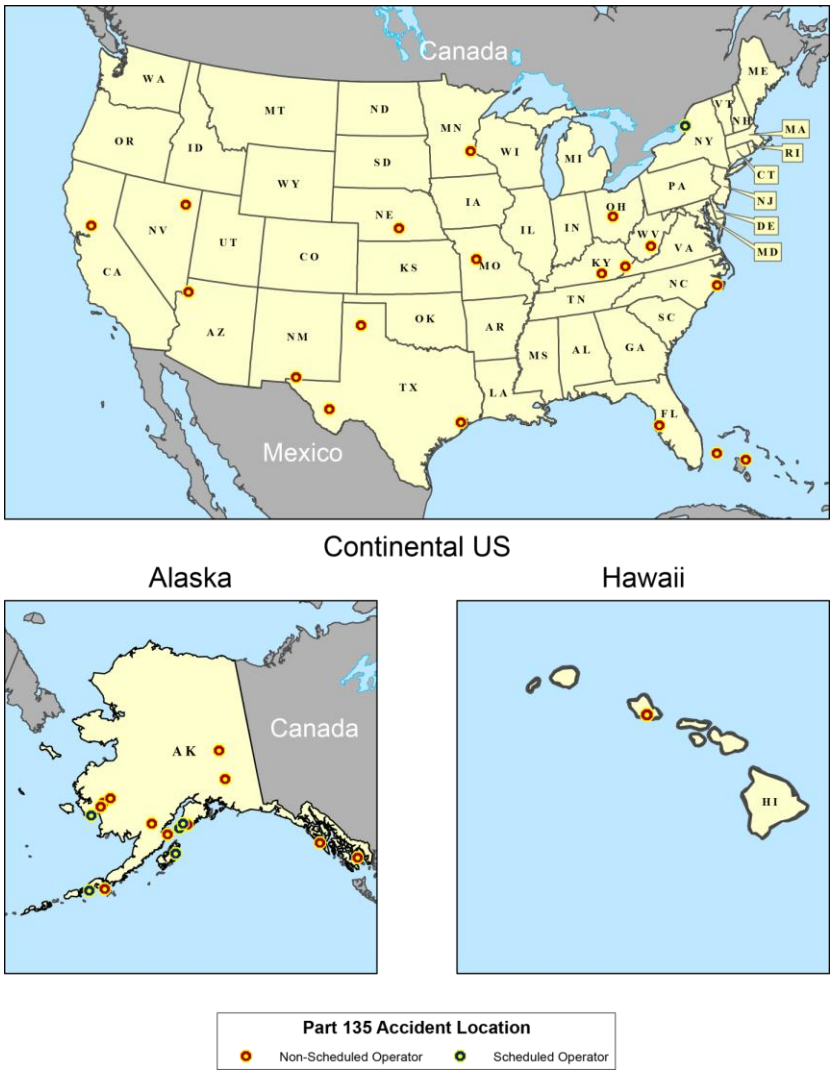

Figure 5. Locations of Part 135 accidents with available GPS coordinates, 2010.

[18] ERA11LA100, a non-fatal, Part 135 on-demand accident that occurred near St. Thomas, USVI, contained georeferencing data, but is not depicted in this figure.

Scheduled commuter operations and on-demand air taxi operations will be discussed separately in this section. Air medical and sightseeing flights also will be discussed later in this section, but note that both operate under Part 135 and Part 91, depending on the type of mission they are flying.

4.1 Scheduled Part 135 Operators

Figure 6 shows the total revenue flights and revenue hours for scheduled Part 135 operations from 2001 through 2010.

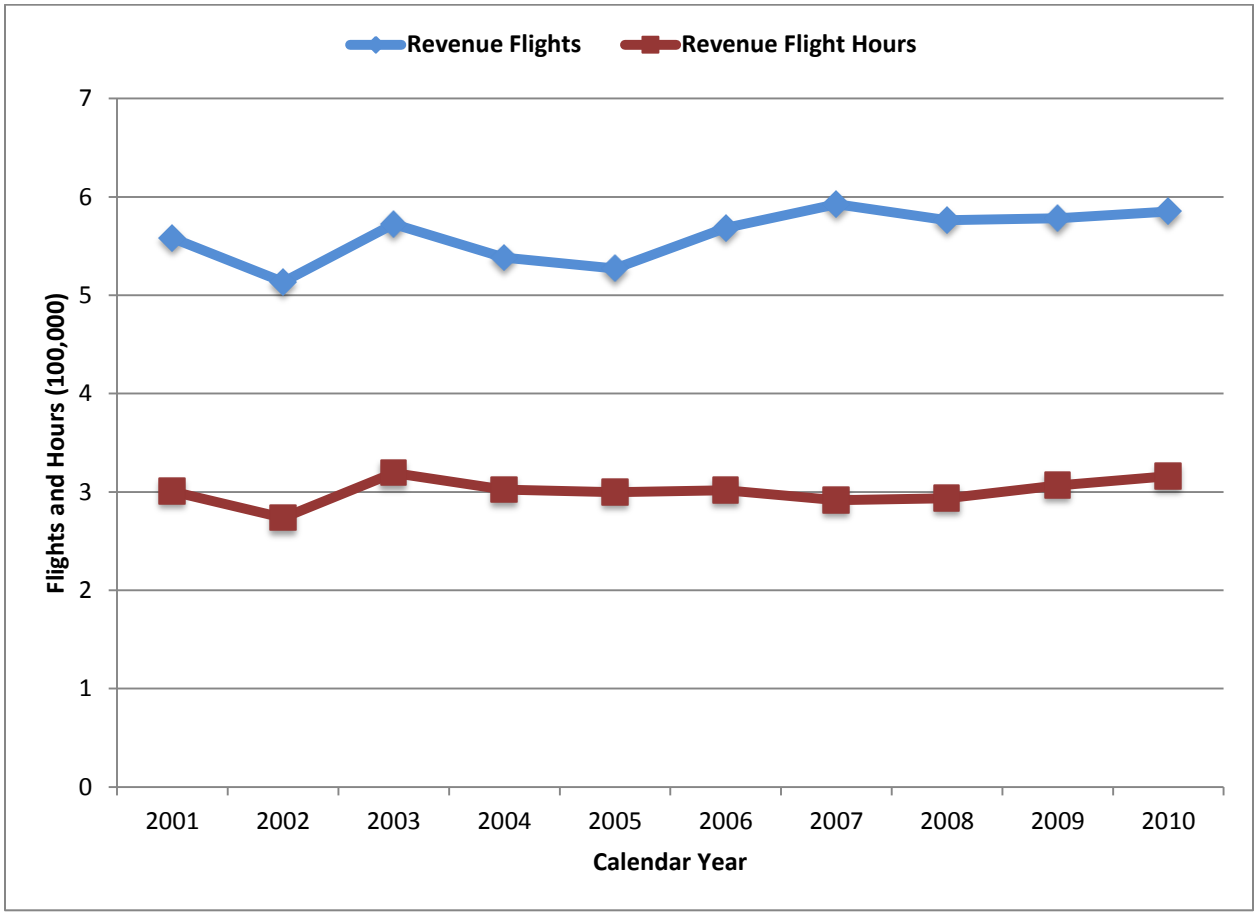

Figure 6. Scheduled Part 135 revenue flights and revenue flight hours, 2001–2010.

Figure 7 shows the number of accidents for scheduled Part 135 flights.[19] The total number of accidents for scheduled Part 135 has remained at or below seven accidents per year since 2001. Figure 8 shows the accident rate for scheduled Part 135 flights from 2001 through 2010, normalized by the total revenue flights and revenue hours.

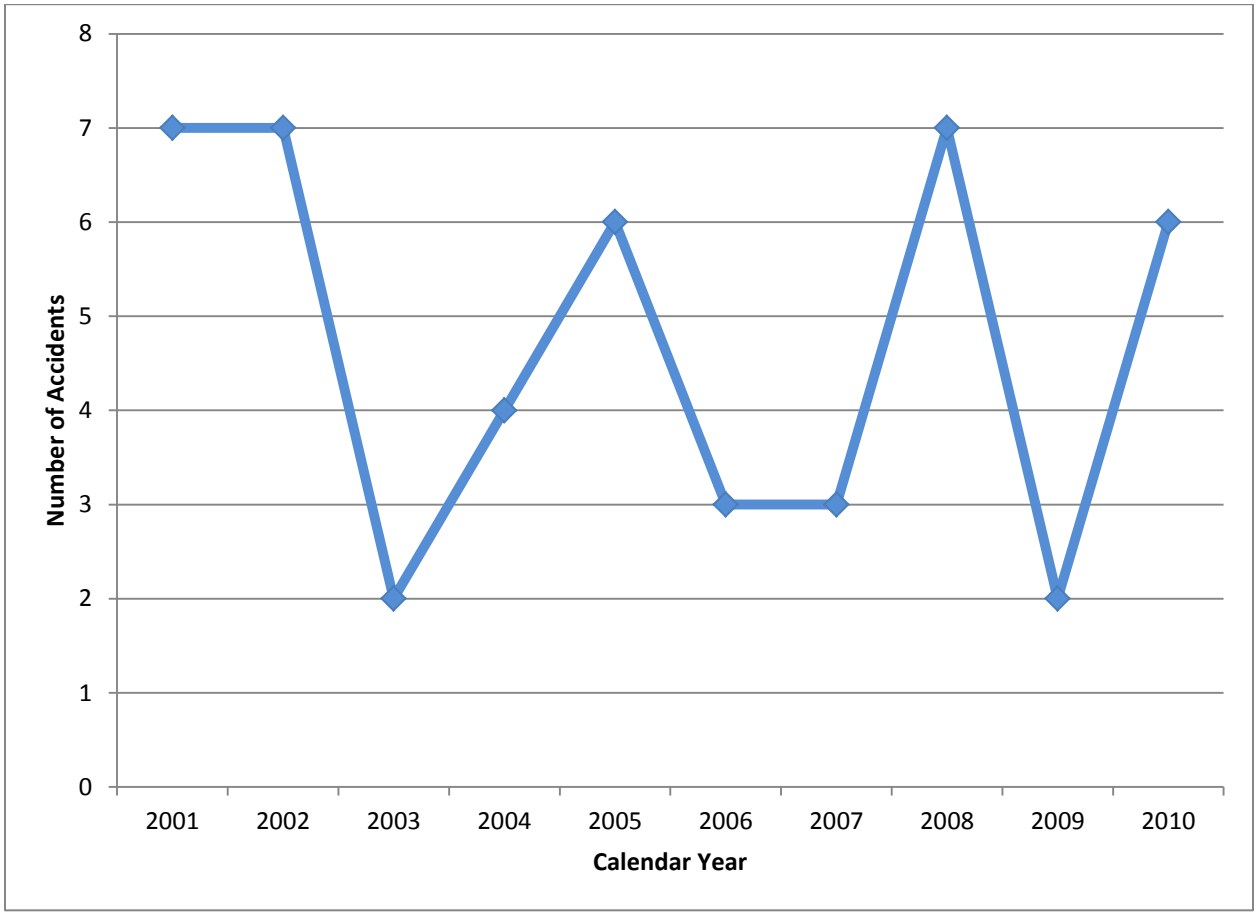

Figure 7. Accidents by Scheduled Part 135 carriers, 2001–2010.

[19] Chart based on exposure data compiled by the FAA and does not include accidents that occurred due to acts of terrorism, suicide, or sabotage.

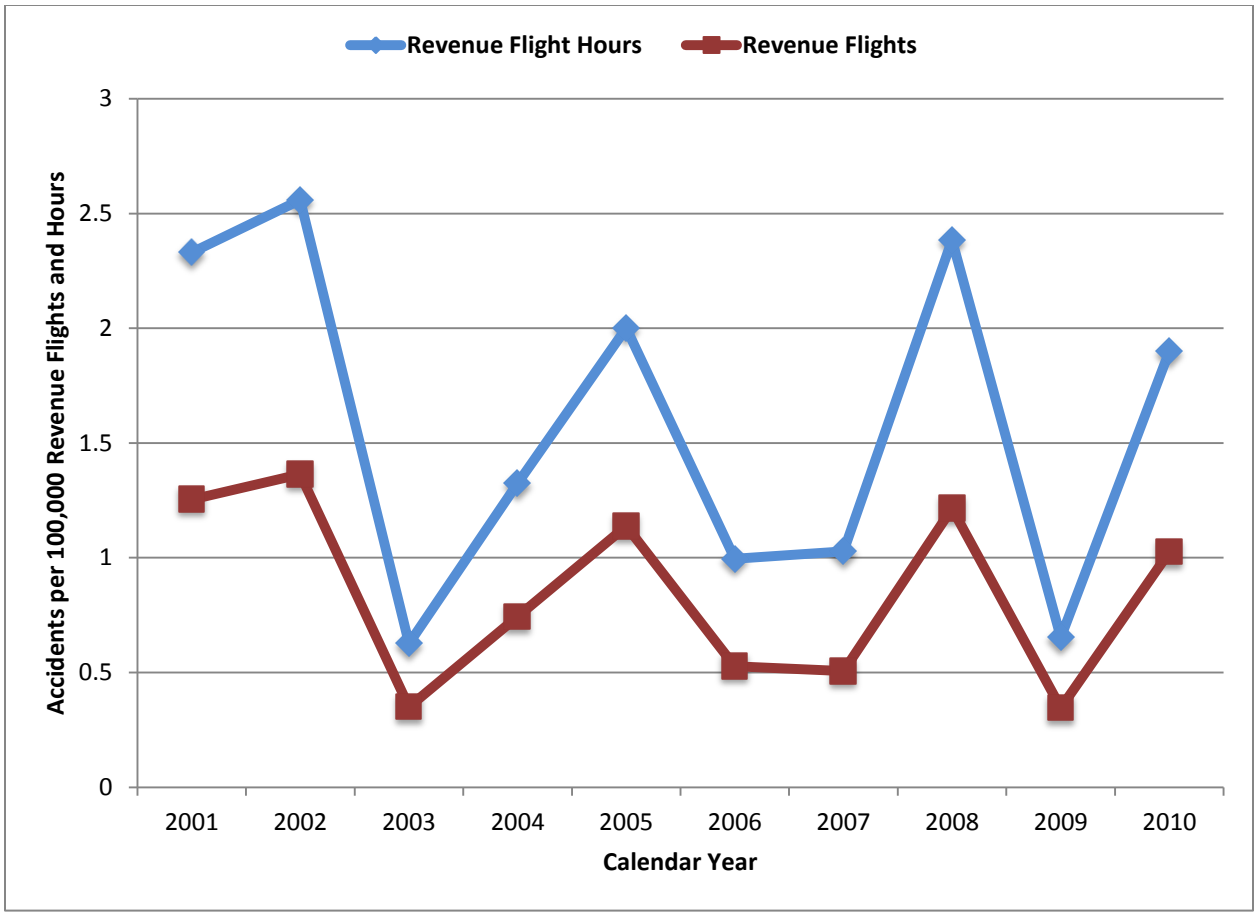

Figure 8. Accident rates for scheduled Part 135 operations per revenue flights and revenue flight hours, 2001–2010.

There were six accidents involving Part 135 scheduled flights. No passenger or crewmember was fatally injured in any of these accidents, but one accident resulted in serious injuries. Each of the accident aircraft incurred substantial damage. Five of the six accidents involved a reciprocating single- or multi-engine airplane, and the other accident involved a turboprop airplane. All but one of the accidents occurred in Alaska. Each of the six accidents involved a different defining event. These defining events include abnormal runway contact, loss of control in flight, system or component malfunction or failure powerplant, system or component malfunction or failure non-powerplant, runway excursion, and structural icing. Three of the six accidents occurred during initial climb. Two of the remaining accidents occurred during the landing phase and one occurred during approach. All six accidents occurred during daylight hours.

Pilots involved in these accidents had an average total flight time of 10,445 hours, with a range from 1,631 to 30,000 hours, and had an average time in the type of accident aircraft of 1,067 hours, with a range from 106 to 2,000 hours.

4.2 Air Taxi Part 135 Operators

Air taxi flights made up approximately 84 percent of all Part 135 accidents in 2010. Figure 9 shows the activity of air taxi operations for both fixed-wing airplanes and helicopters from 2004 through 2010.[20] The majority of air taxi flights during 2010 were conducted in fixed-wing airplanes, and this activity has decreased since 2007. However, helicopter flight hours have increased since 2004.

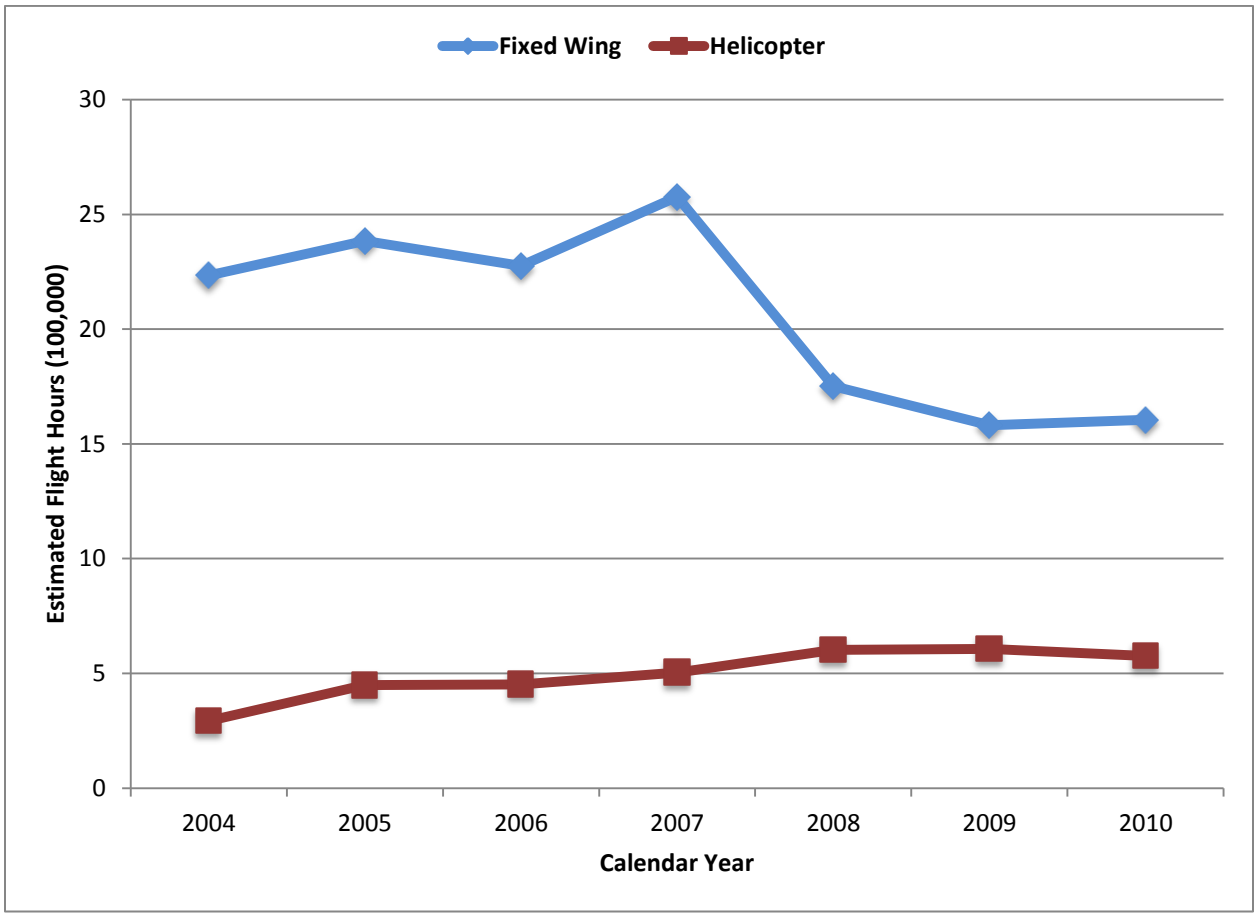

Figure 9. Part 135 air taxi flight hours by aircraft type, 2004–2010.

[20] The FAA has collected data on Part 135 air taxi operators through the General Aviation and Part 135 Activity Survey (GA Survey). Although data is available prior to 2004 for air taxi operations, those data do not distinguish between Part 135 commuter and Part 135 air taxi operations.

Unlike scheduled Part 135 operators, air taxi operators are not required to report all flight information to the FAA, including operating hours and departures. Instead, the FAA estimates the operating hours in the annual General Aviation and Part 135 Activity Survey (GA Survey).[21] The FAA sends out an annual questionnaire to all non-scheduled Part 135 and some general aviation owners and operators, whose participation is voluntary. The exposure data used for Part 135 air taxi and general aviation operations were derived from the results of this survey. In 2004, the FAA began to distinguish between Part 135 air taxi and other non-scheduled Part 135 operations.

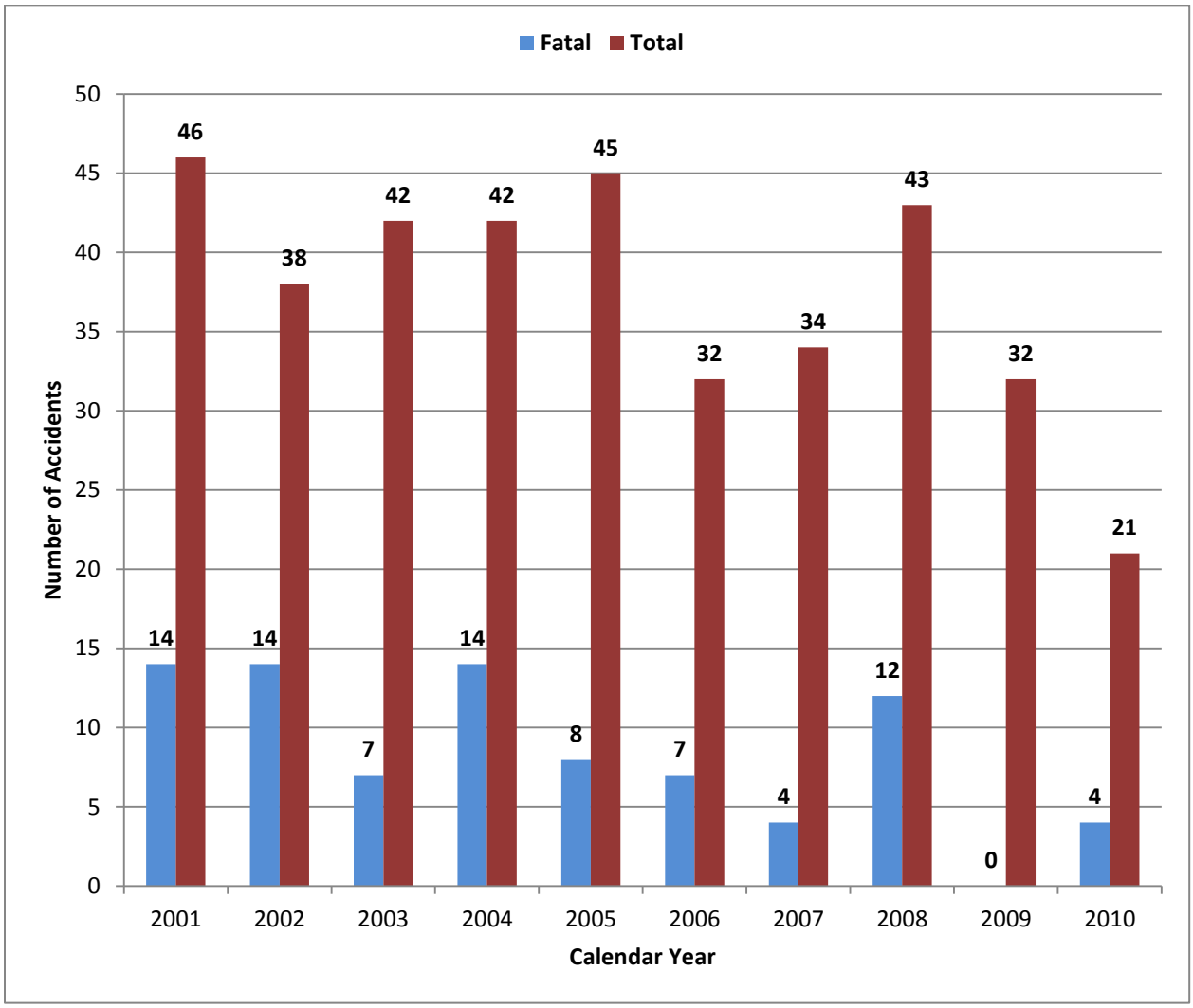

Figure 10. Total and fatal accidents by Part 135 air taxi fixed-wing airplanes, 2001–2010.

Figure 10 shows the number of total and fatal air taxi accidents involving fixed-wing airplanes from 2001 through 2010, and Figure 11 shows the same data for helicopters.

[21] See http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/ for more information about this survey.

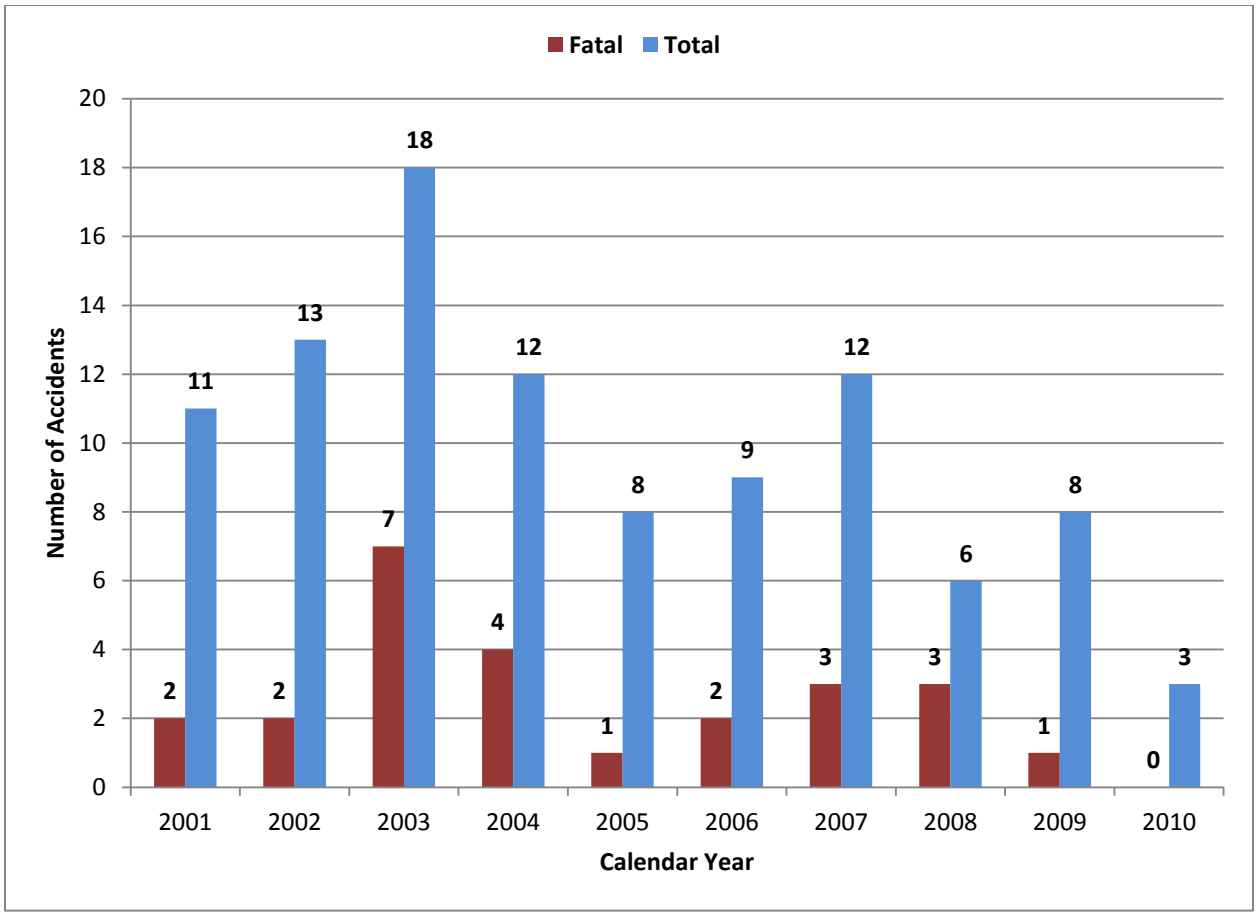

Figure 11. Total and fatal accidents by Part 135 air taxi helicopters, 2001–2010.

Figure 12 shows the air taxi fatal and non-fatal accident rates for fixed-wing airplanes since 2004, when the FAA began segregating these data in the GA Survey. Figure 13 shows the same rates for helicopters, also since 2004.

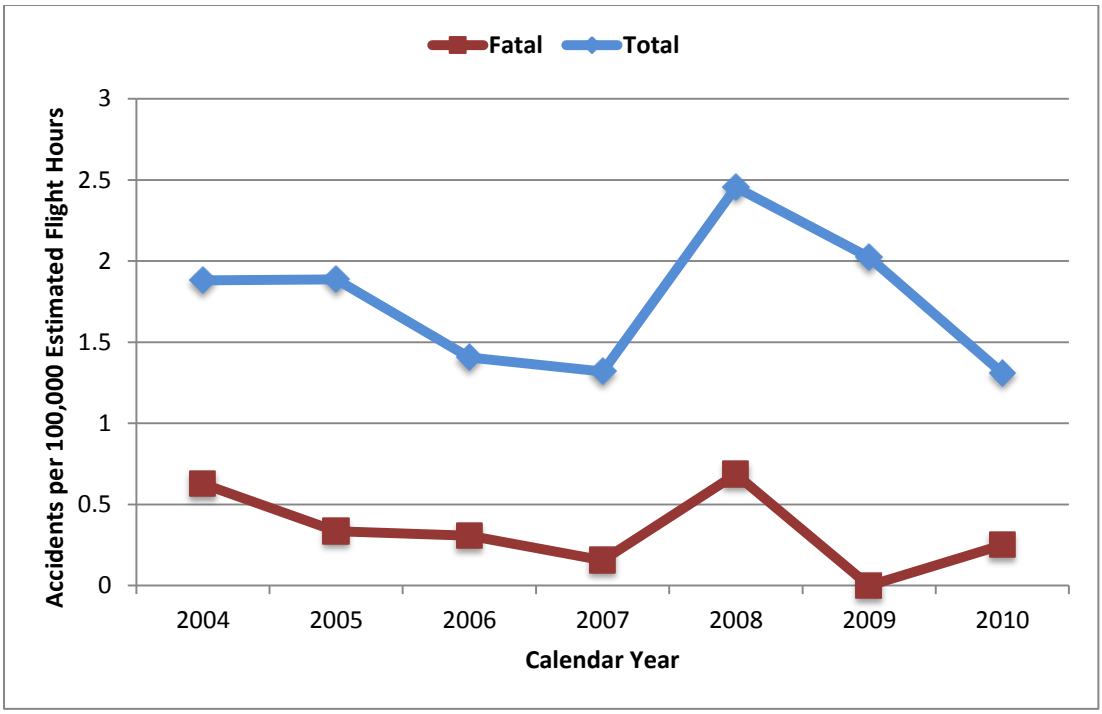

Figure 12. Total and fatal accident rates for Part 135 air taxi fixed-wing airplanes, 2004–2010.

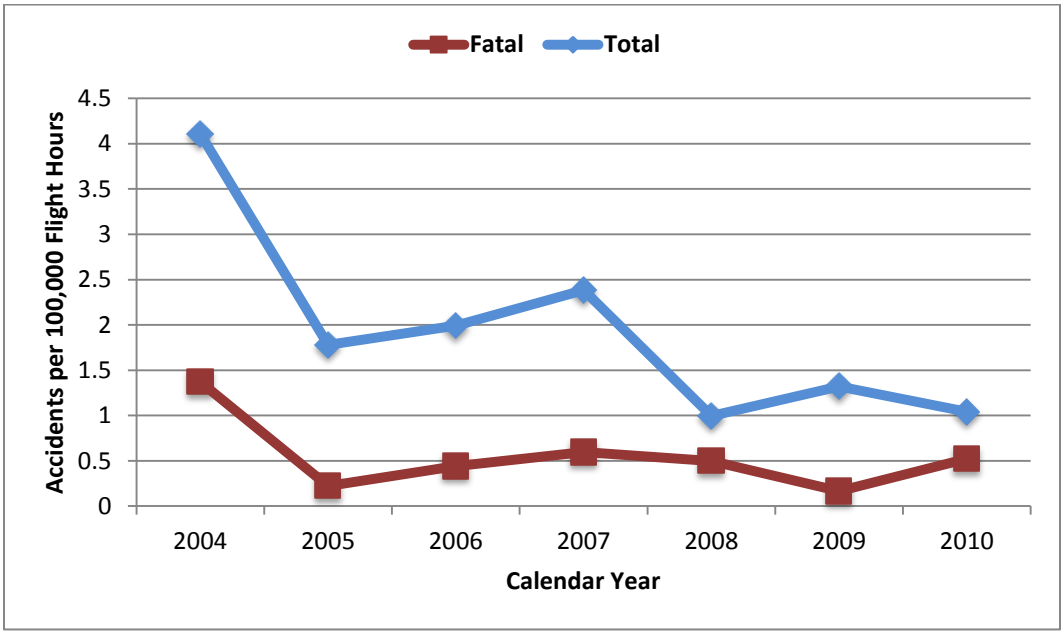

Figure 13. Total and fatal accident rates for Part 135 air taxi helicopters, 2004–2010.

4.2.1 Part 135 Air Taxi: Fixed-Wing Airplane

Twenty-two fixed-wing airplanes were involved in 21 Part 135 air taxi accidents in 2010. Of these, four accidents resulted in nine fatalities and one accident resulted in serious injuries. Two of the accident aircraft were destroyed during the accident, 19 sustained substantial damage, and 1 sustained minor damage.

Photo 2. The Cessna 525 Citation is a twin-engine, turbojet aircraft often used in Part 135 on-demand service.

Table 8 shows the top five defining events for the 22 fixed-wing aircraft that were involved in air taxi accidents during 2010. Loss of control (both ground and in flight) was the most common defining event, with four non-fatal accidents and one fatal accident. Other collision events were the second most prevalent defining event, accounting for three non-fatal accidents and one fatal accident.

Table 8. Defining events for Part 135 air taxi accidents involving fixed-wing airplanes, 2010.

Defining Event	Non-fatal accident-involved aircraft	Fatal accident-involved aircraft
Loss of Control on Ground	3	0
Other Collision	3	1
Miscellaneous/Other	3	0
System/Component Failure (Powerplant)	2	0
Loss of Control In Flight	1	1
Unknown	0	2
All Other	6	0

Table 9 shows the phase of flight associated with each of the 22 Part 135 air taxi accident-involved, fixed-wing airplanes. Landing accounted for the most total accidents.

Table 9. Phase of flight for Part 135 air taxi accidents involving fixed-wing airplanes, 2010.

Phase of Flight	Non-Fatal accident involved aircraft	Fatal accident involved aircraft
Landing	5	0
Taxi	3	0
Approach	3	1
Initial Climb	2	1
En Route	1	0
Takeoff	2	0
Standing	2	0
Maneuvering	0	1
Unknown	0	1

Pilots involved in these accidents had an average total flight time of 5,459 hours, with a range from 611 to 16,010 hours, and an average time in the type of accident aircraft of 2,502 hours, with a range from 208 to 10,000 hours.

4.2.2 Part 135 Air Taxi: Helicopter

In 2010, there were three accidents involving Part 135 air taxi helicopters. None of these accidents were fatal, but two of the accidents resulted in serious injuries. All three accident helicopters sustained substantial damage. Each accident involved a different defining event. System/component failure (powerplant) and loss of control in flight were the two defining events for accidents resulting in serious injuries.

Pilots involved in these accidents had an average total flight time of 11,679 hours, with a range between 5,100 and 19,000, and an average time in accident aircraft type of 5,167 hours, with a range of 2,500 to 9,500.

4.3 Air Medical Operation Accidents

Air medical operations are conducted under both Part 135 and Part 91, depending on the type of mission being flown.[22] The FAA has issued guidance on the operation of air medical services and what operations can be conducted under each part.[23] In addition, some air medical operations, particularly for emergency medical services, are conducted by state or local governments as public aircraft operations.

[22] The type of missions could include interfacility transport, which would be operated under Part 135, and missions such as refueling and repositioning, which could be operated under Part 91.

[23] (a) *Emergency Medical Services/Airplane*, Advisory Circular AC-135-15, (Washington, DC: U.S. Department of Transportation, Federal Aviation Administration, November 19, 1990). (b) *Emergency Medical Services/Helicopter*, Advisory Circular AC-135-14A, (Washington, DC: U.S. Department of Transportation, Federal Aviation Administration, June 20, 1991).

Air medical operations can be further separated as a function of the type of aircraft that are used. Fixed-wing airplanes are more often used for inter-facility transportation of patients or organs and use established airport facilities. Emergency medical service operations most often make use of helicopters, and they often use unimproved landing sites at accident sites and helipads at hospitals or medical facilities.

Figure 14 shows the total number of fixed-wing airplanes involved in air medical accidents between 2001 and 2010 operating under Part 91 and Part 135. Eleven of the 32 fixed-wing air medical accidents (34 percent) involved fatalities over the decade. Relatively few of the total air medical accidents involved fixed-wing airplanes. The only air medical fixed-wing airplane accident in 2010 was a fatal Part 135 flight with a defining event of controlled flight into terrain.

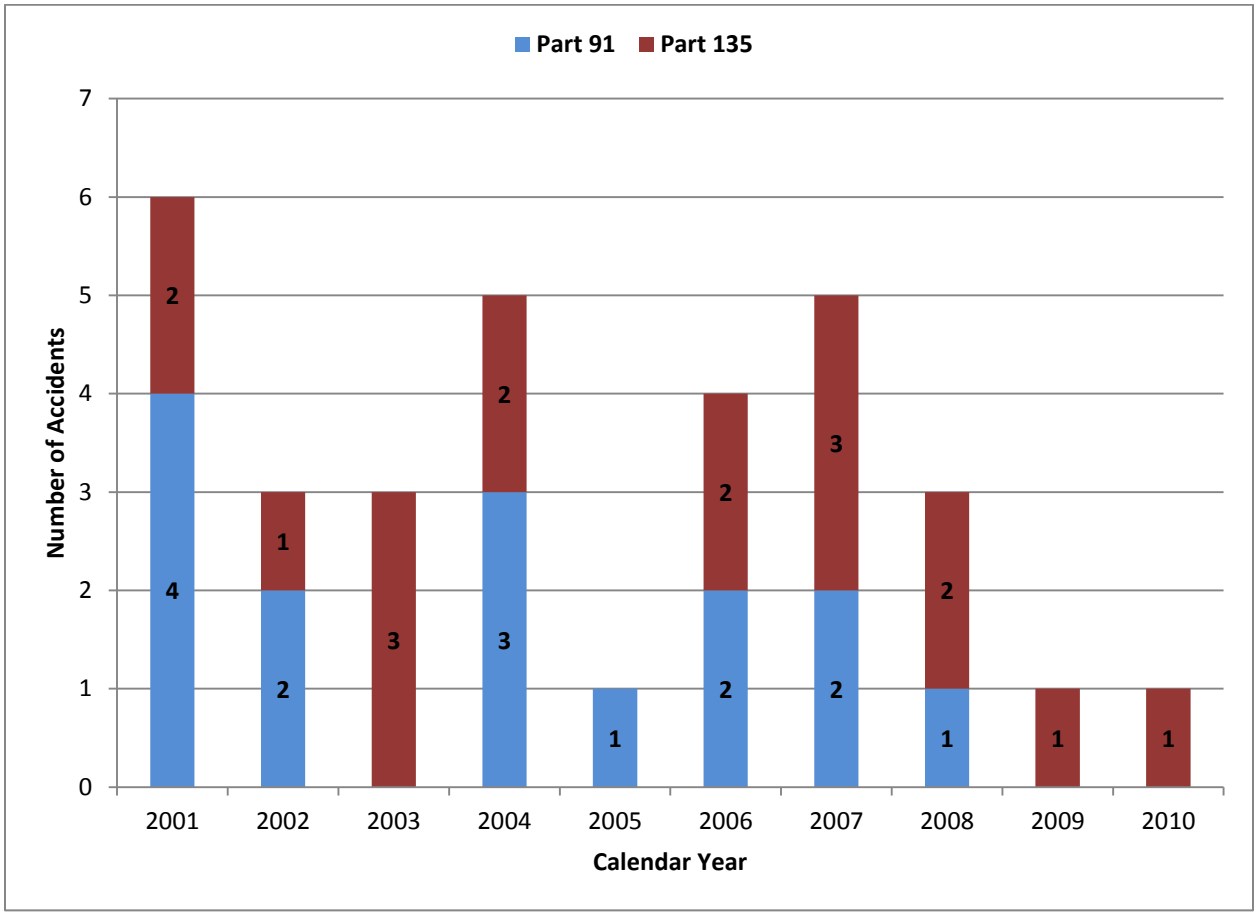

Figure 14. Number of fixed-wing airplanes involved in Part 91 and Part 135 air medical accidents, 2010.

Helicopter emergency medical services (HEMS) accounted for about 80 percent of all air medical accidents during the ten-year period. Unlike most fixed-wing air medical operations, HEMS often do not operate out of established aerodromes. Instead, they operate in off-airport locations where patients are in need of critical, timely care. Figure 15 shows the number of

HEMS accident aircraft operating under Part 91, Part 135, and as public aircraft operations.[24] Figure 16 shows the number of HEMS accident aircraft that were involved in fatal accidents during the decade.

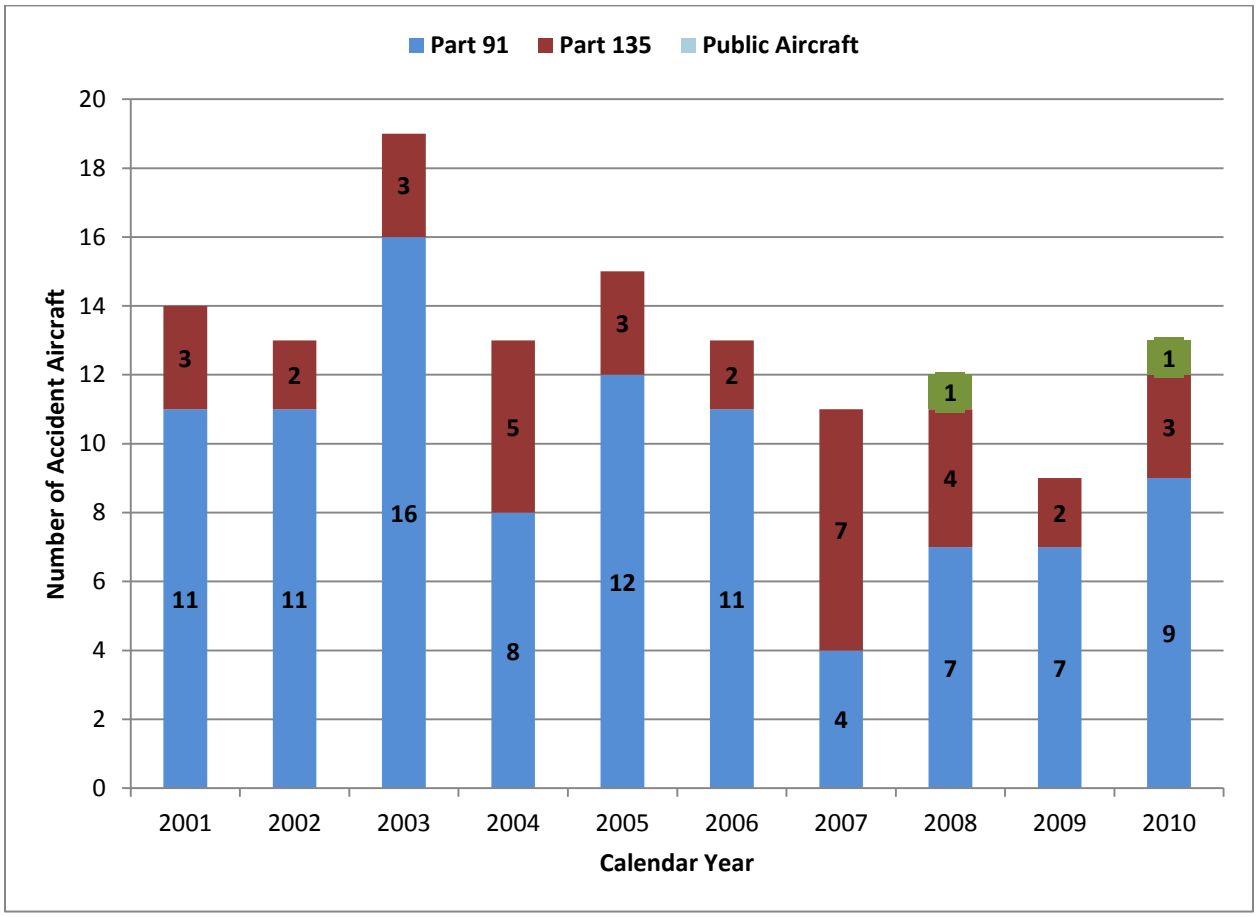

Figure 15. Number of helicopters involved in all air medical accidents by type of operation, 2001–2010.

[24] This figure differs from the 2007–2009 report because this report uses accident aircraft. In 2001, for example, there was one accident that involved a collision of two aircraft. In the 2007–2009 report, that accident was counted once, but in this report, it was counted twice, once for each aircraft. Other figures in this report may follow the same pattern and the differences will be listed in the figure caption.

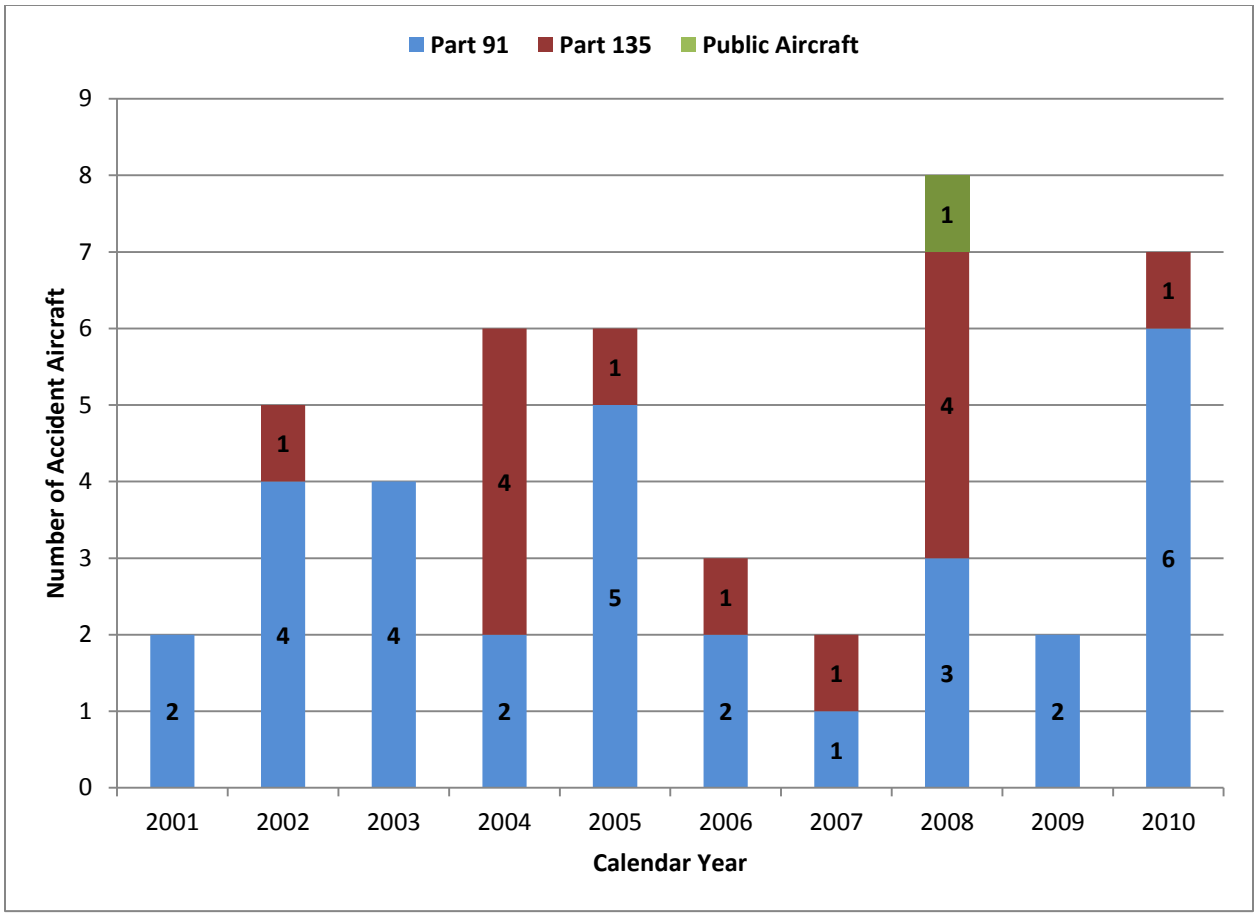

Figure 16. Number of helicopters involved in fatal air medical accidents by type of operation, 2001–2010.

In 2010, 9 of the 13 HEMS accident aircraft were operating under Part 91, 3 were operating under Part 135, and 1 was operating as a public aircraft. Seven of the HEMS accidents resulted in fatal injuries. Six of the seven fatal HEMS accidents involved flights operating under Part 91 and only one was operating under Part 135. Of the seven fatal accidents, three occurred at night and four occurred during daylight hours.

Table 10. Defining events for helicopter air medical accidents by type of operation, 2010.

Defining Event	Aircraft Operating Under Part 91	Aircraft Operating Under Part 135	Aircraft Operating Under Public Aircraft Operations
Other Collision	3	0	1
System/Component Failure (Powerplant)	1	1	0
Unknown	2	0	0
Controlled Flight into Terrain	0	1	0
Abnormal Runway Contact	0	1	0
Midair Collision	1	0	0
Other/Miscellaneous	1	0	0
System/Component Failure (Non-Powerplant)	1	0	0

Table 10 shows the defining events for the 13 HEMS aircraft involved in accidents during 2010. One accident resulted from controlled flight into terrain. There was one midair collision in which a HEMS aircraft collided with a general aviation aircraft. This accident resulted in two fatalities from the general aviation aircraft and no injuries to any crewmembers in the HEMS aircraft. The HEMS aircraft was not carrying patients at the time of the accident and made a safe landing with only minor damage. Table 11 shows the phase of flight for all aircraft involved in HEMS accidents. All fatal HEMS accidents occurred during airborne phases of flight, such as en route or approach.

Table 11. Phase of flight for helicopter air medical accidents by type of operation, 2010.

Phase of Flight	Part 91 Operations	Part 135 Operations	Public Aircraft Operations
En Route	4	0	0
Maneuvering	2	1	0
Takeoff	0	1	1
Approach	1	0	0
Emergency Descent	1	0	0
Landing	0	1	0
Standing	1	0	0

HEMS accident pilots had a total flight time average of 8,566 hours, with a range of 2,452 to 17,610 hours. The pilot's average time in the type of accident aircraft was 1,275 hours, with a range of 1 to 9,544 hours.

4.4 Sightseeing and Air Tours Accidents

Sightseeing flights were specifically defined by the FAA's final rulemaking on National Air Tour Safety Standards,[25] which was published in February 2007 and finalized a month later.[26] These regulations define sightseeing operations and classify the operators into three groups. One group relates to Part 121 and 135 operators, the second group is Part 91 operators who are operating under 14 CFR 119.1(e)(2),[27] and the third group includes all other commercial operators flying under Part 91. The final rules also combine all operations, regardless of group, into new Part 136 regulations. This particular part sets forth certain safety and management rules in order to promote a safe and efficient air tour system in the United States. Although this rule is comprehensive for airplanes and helicopters, it does not regulate gliders or balloons operating under the commercial exceptions in Part 91. The GA Survey has distinguished between Part 135 air tour operations and Part 91 paid sightseeing operations since 2004. Figure 17 shows the estimated activity for paid Part 91 sightseeing operations from 2004 through 2010. Activity in this particular segment is dominated mostly by fixed-wing airplanes and helicopters.

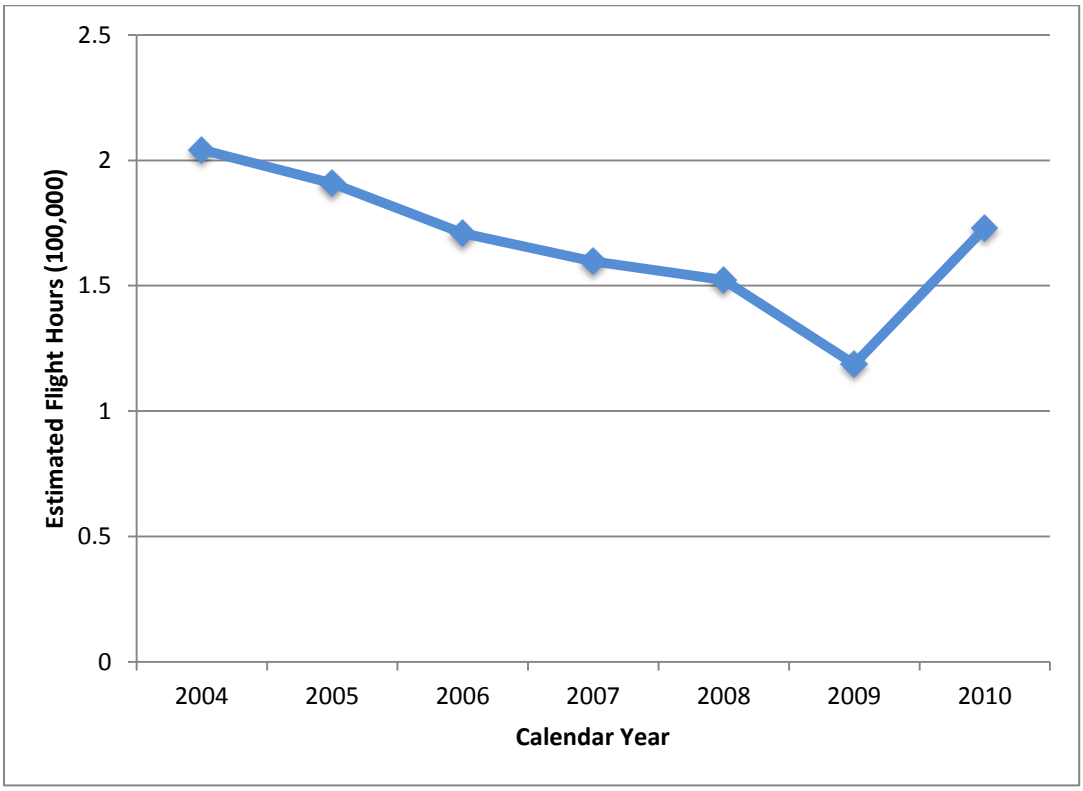

Figure 17. Part 91 sightseeing flight hours, 2004–2010.

[25] *Federal Register*, vol. 72, no. 29 (February 13, 2007), p. 6884.

[26] All final rules became effective on March 15, 2007, with the exception of certain amendments to Parts 119, 121, and 135, and those became effective on September 11, 2007.

[27] This particular federal regulation, also known as the 25 mile exception rule, allows certain sightseeing operators, who would normally have to be certificated and operate under Part 135, to operate under Part 91 only if the flight will originate and terminate at the same airport and the flight will not go outside of a 25 mile radius from the originating airport. These particular operators must have a letter of authorization issued under 14 CFR 91.147 in order to deviate from the normal Part 119 requirement.

4.4.1 Part 91 Sightseeing Accidents

Figure 18 shows the total and fatal Part 91 sightseeing accidents from 2001 through 2010. While there is some variation in the total number of accidents each year, the number of fatal accidents remained below five per year.

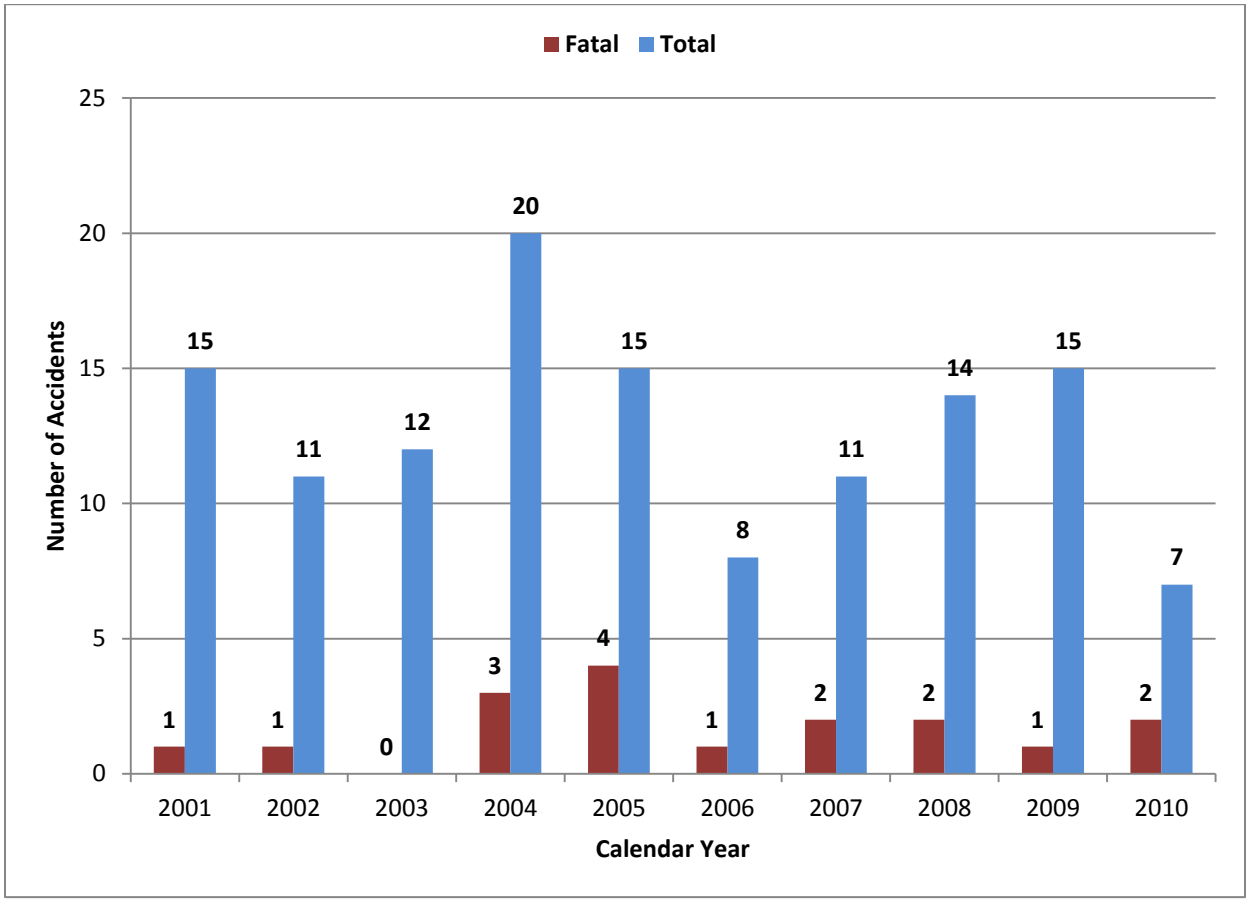

Figure 18. Total and fatal Part 91 sightseeing accidents, 2001–2010.

Figure 19 shows the number of Part 91 sightseeing accident aircraft by type from 2001 through 2010.[28] During the ten-year period, balloons accounted for nearly 50 percent (63 out of 128) of the accident aircraft, followed by fixed-wing airplanes (33), helicopters (27), and gliders (5). Figure 20 shows the accident rate for Part 91 sightseeing operations from 2004 through 2010, the years in which the GA Survey separated sightseeing and air tour flights.

[28] Figure 19 shows only the four major aircraft types used in Part 91 sightseeing operations. Some aircraft types are not included, such as weight-shift aircraft and blimps.

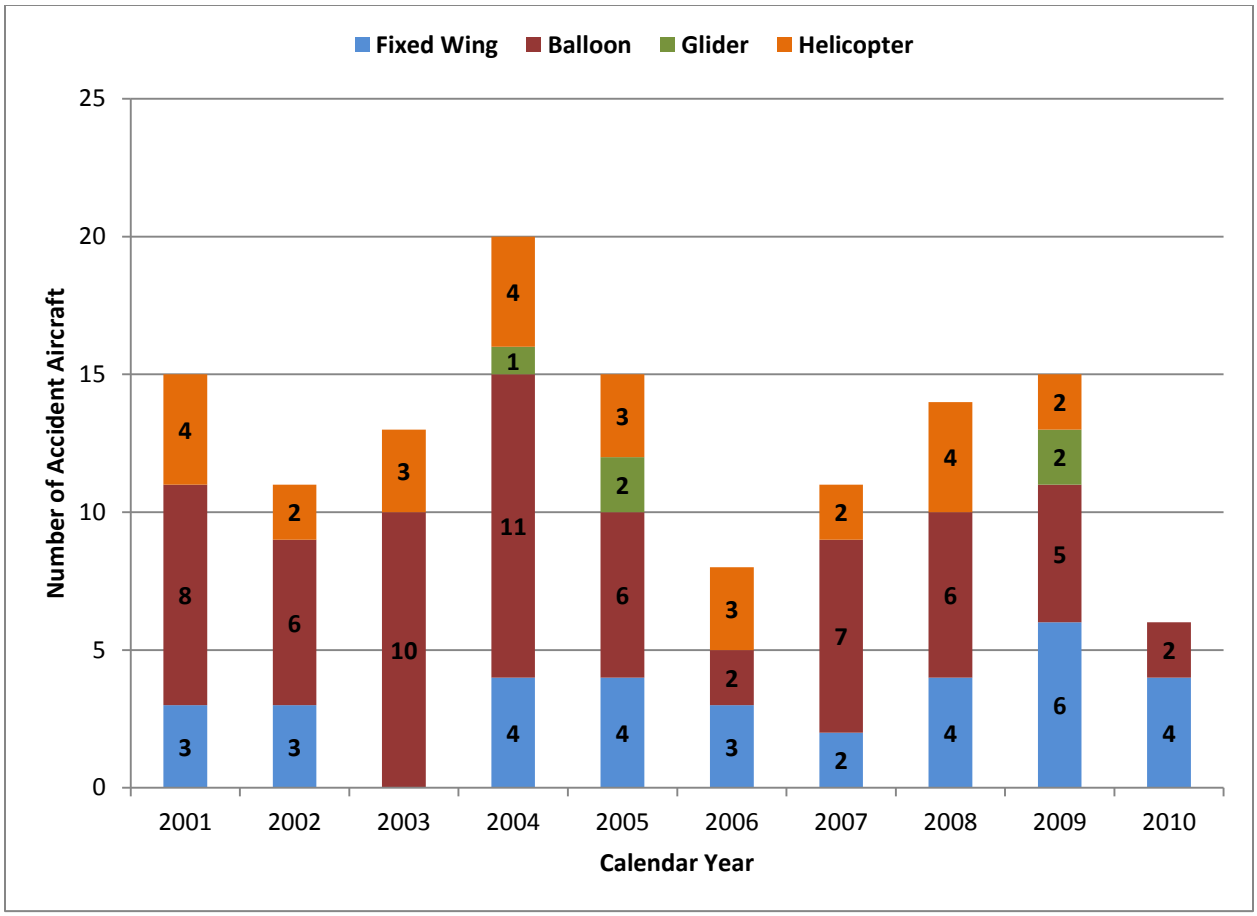

Figure 19. Total aircraft involved in Part 91 sightseeing accidents by aircraft type, 2001–2010.

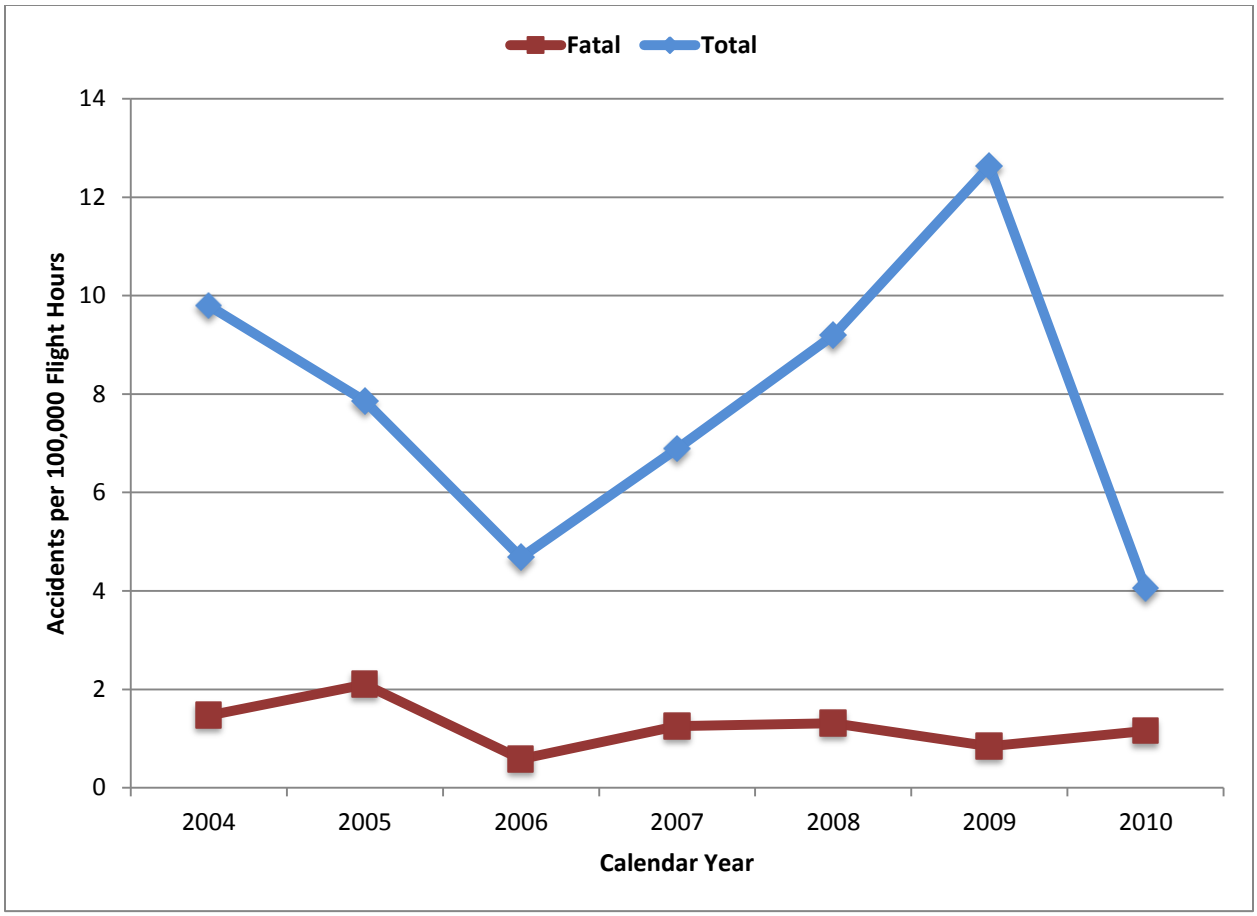

Figure 20. Total and fatal accident rates for Part 91 sightseeing flights, 2004–2010.

In 2010, there were six Part 91 sightseeing accidents, with two of those accidents resulting in fatalities. One accident involved a ground collision with another general aviation aircraft. Table 12 shows the defining events for all accident aircraft that operated as Part 91 sightseeing flights in 2010. Abnormal runway contact and system/component failure were the most common defining events. Both system/component failure accidents occurred during airborne phases of flight and involved fixed-wing airplanes. Both abnormal runway contact accidents involved hard landings of balloons that resulted in substantial damage to the aircraft.

Table 12. Defining events for Part 91 sightseeing accidents, 2010.

Defining Event	Accident aircraft
System/Component Failure (Powerplant)	2
Abnormal Runway Contact	2
Ground Collision	1
Other Collision	1

4.4.2 Part 135 Non-Scheduled Air Tours

Figure 21 shows the estimated activity for Part 135 air tours from the GA Survey. For Part 135 air tours, there was noticeably more activity in helicopters.

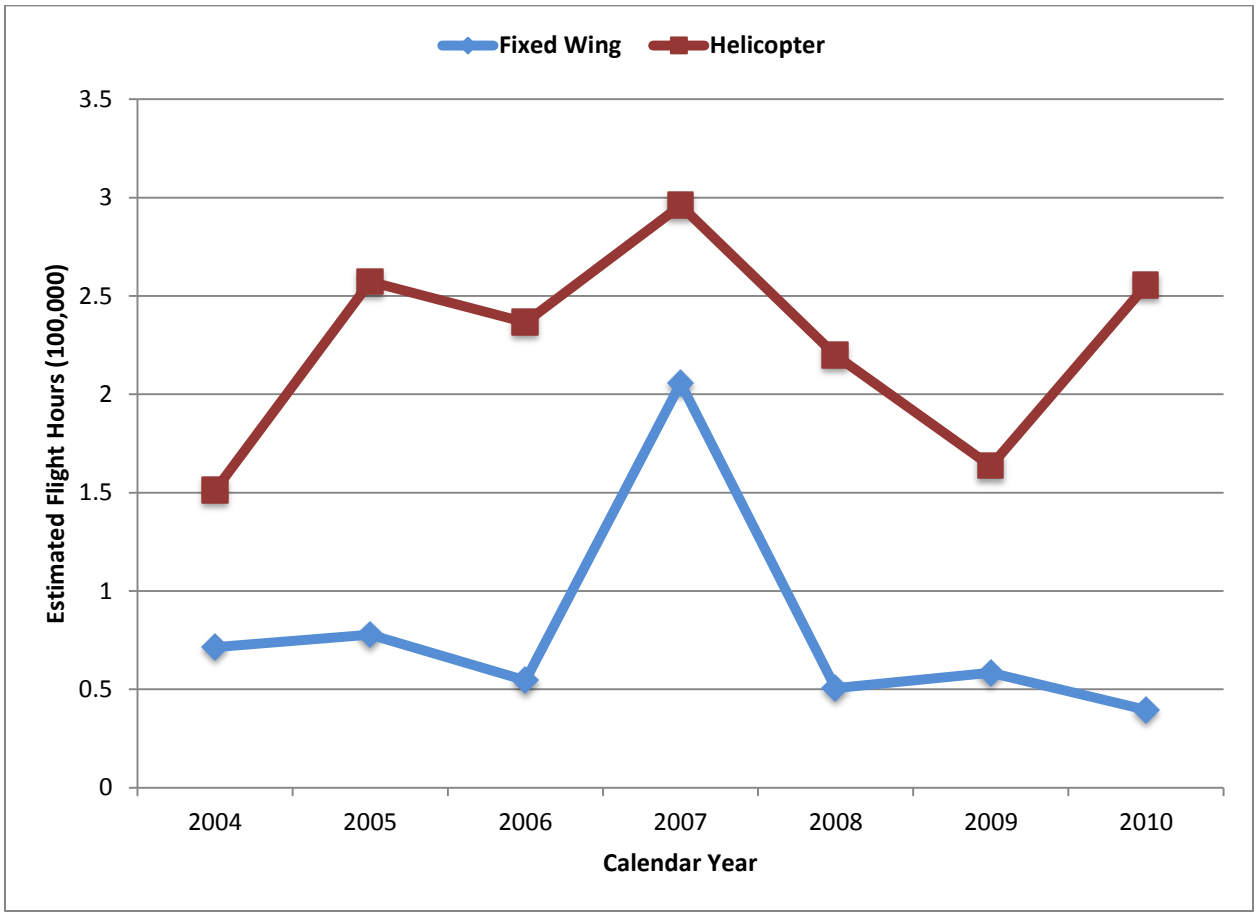

Figure 21. Estimated flight hours for Part 135 air tours by aircraft type, 2004–2010.

Figure 22 plots the total and fatal Part 135 air tour accidents from 2001 through 2010. Over the ten-year period, Part 135 air tour accidents fluctuated annually but declined overall to three total accidents and no fatal accidents in 2010. Fatal accidents remained at or below four accidents for any year of the decade. Figure 23 shows the total Part 135 air tour accident aircraft by type between 2001 and 2010.

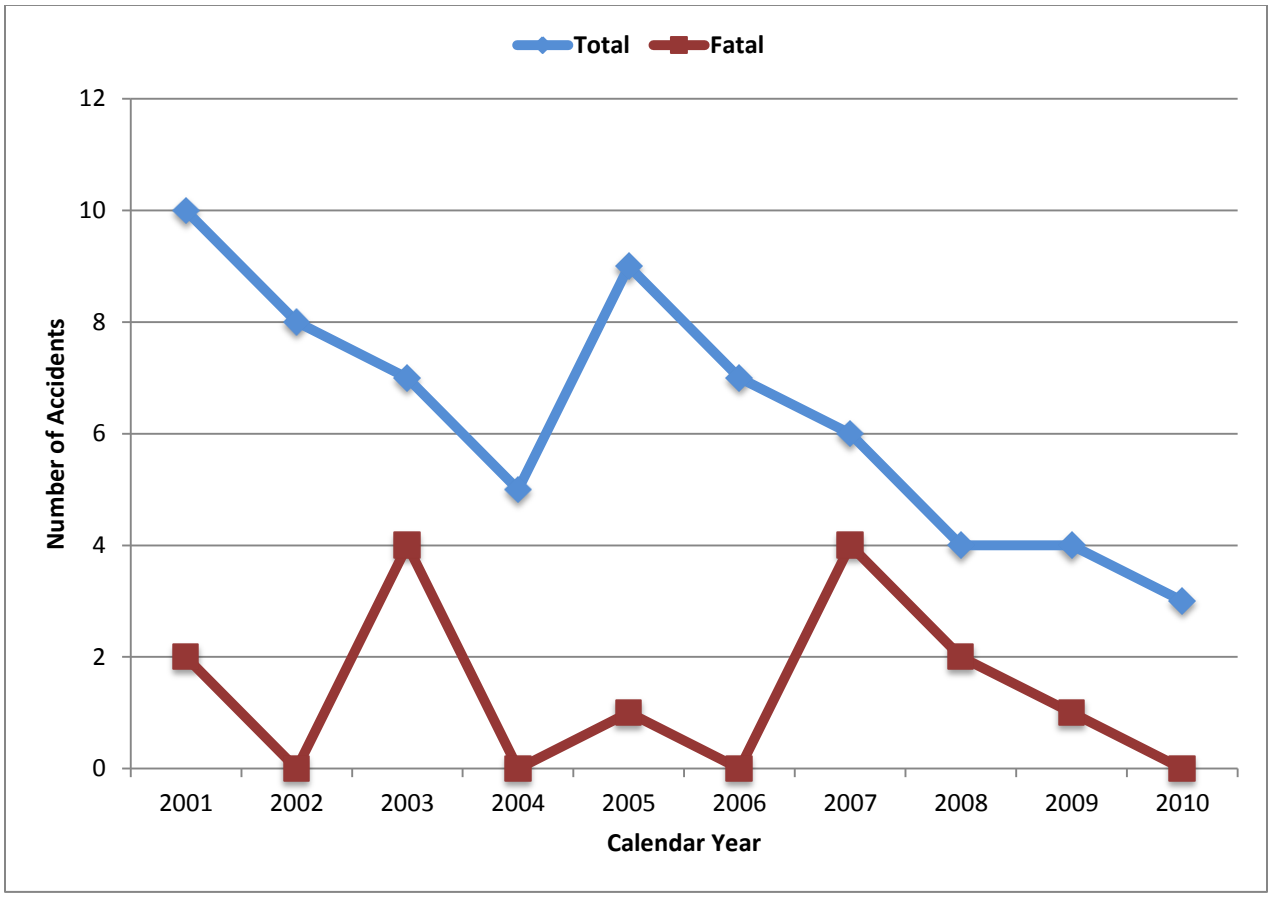

Figure 22. Total and fatal Part 135 air tour accidents, 2001–2010.

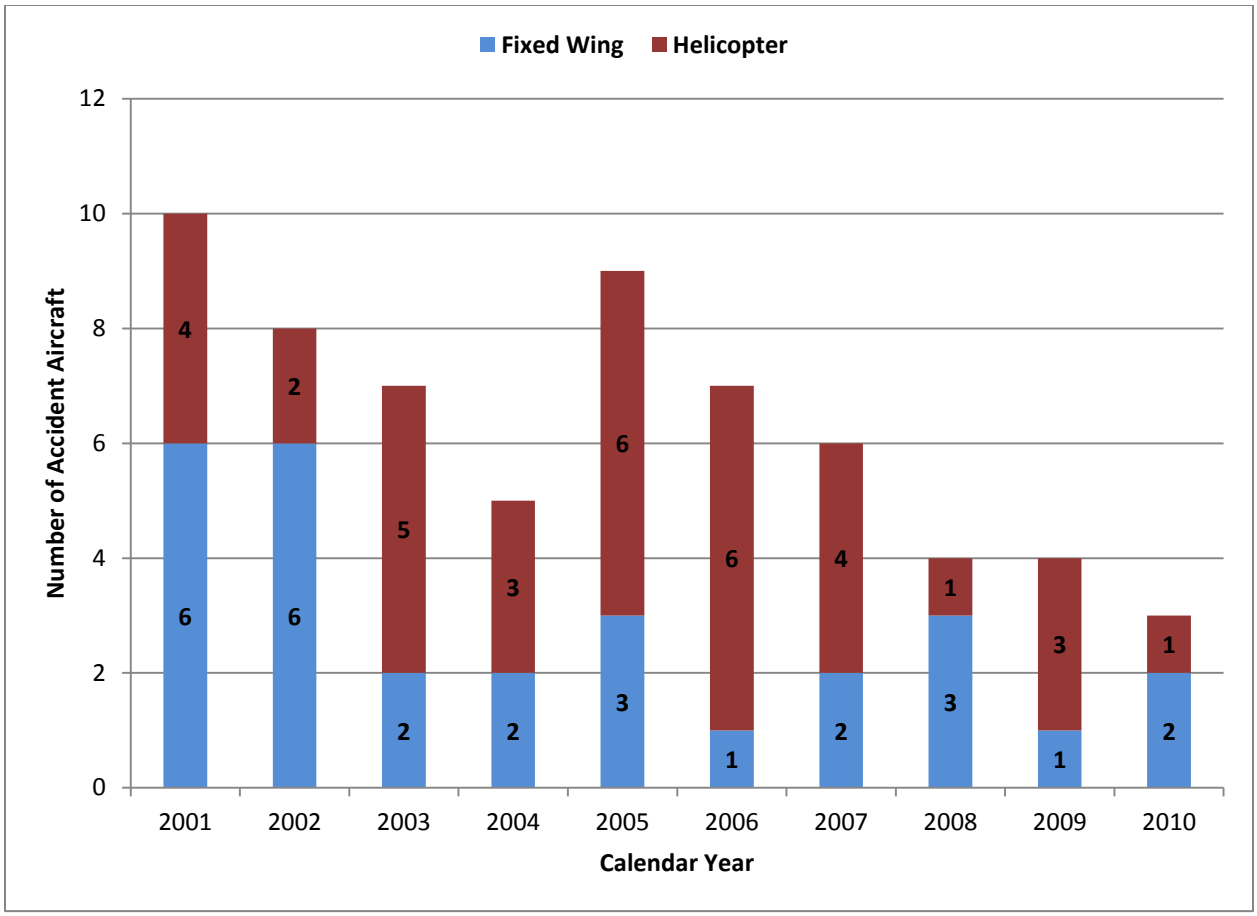

Figure 23. Number of aircraft involved in Part 135 air tour accidents by aircraft type, 2001-2010.

In 2010, three aircraft were involved in Part 135 air tour accidents. These accidents resulted in no injuries, but each accident aircraft received substantial damage. Two of the three accidents occurred in fixed-wing airplanes and had a defining event of loss of engine power. The other accident occurred in a helicopter and involved a collision with objects. All three accidents occurred in VMC.

5.0 General Aviation Accidents

General aviation is the umbrella term for any operation that does not operate under Parts 121, 135, or 129. In 2010, general aviation accounted for 96 percent of all aviation accidents, 97 percent of fatal aviation accidents, and 96 percent of all fatalities for U.S. civil aviation. In addition, general aviation accounted for 51 percent of the estimated total flight time of all U.S. civil aviation in 2010. Figure 24 shows total and fatal general aviation accidents from 2001 through 2010. Figure 25 shows the number of total and fatal accident aircraft for the same period.[29]

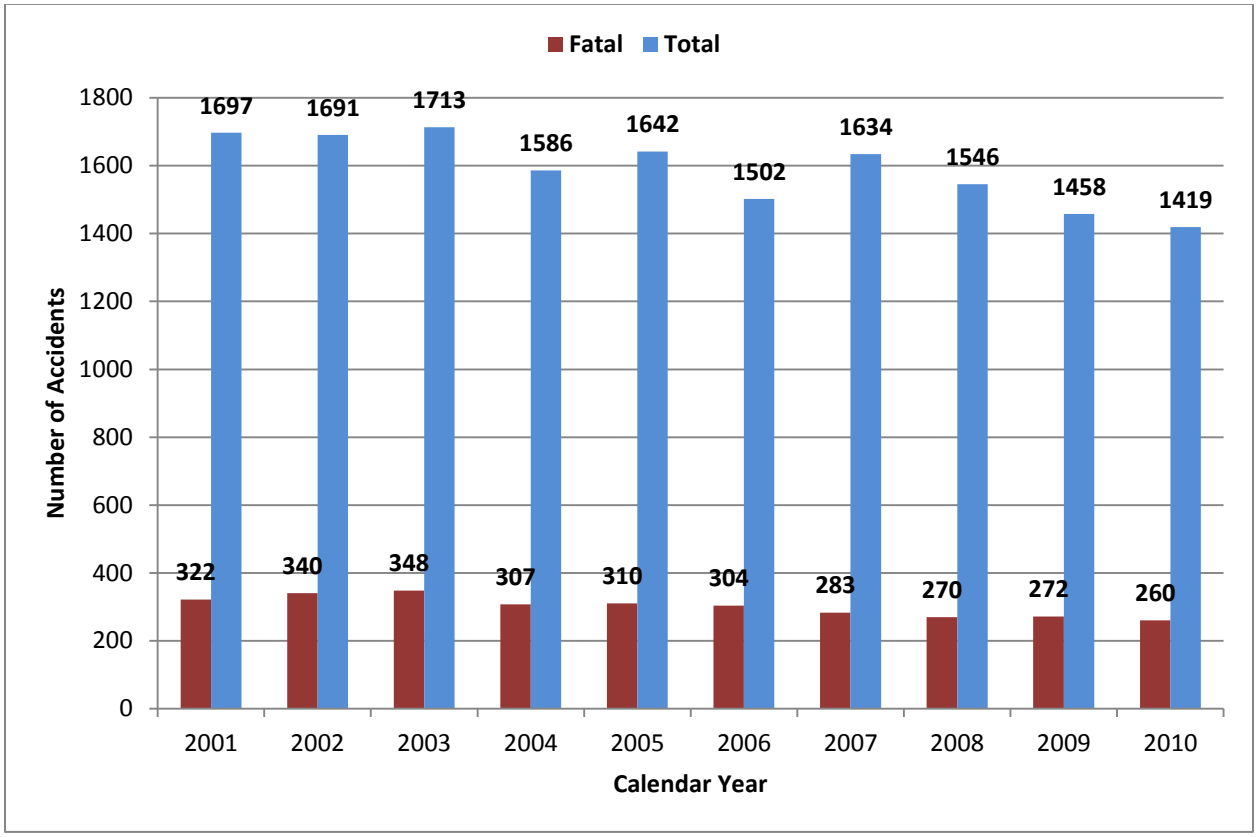

Figure 24. Total and fatal general aviation accidents, 2001–2010.

[29] This and subsequent figures do not include air medical, sightseeing, or air tour operations, as they were discussed in previous sections of this report.

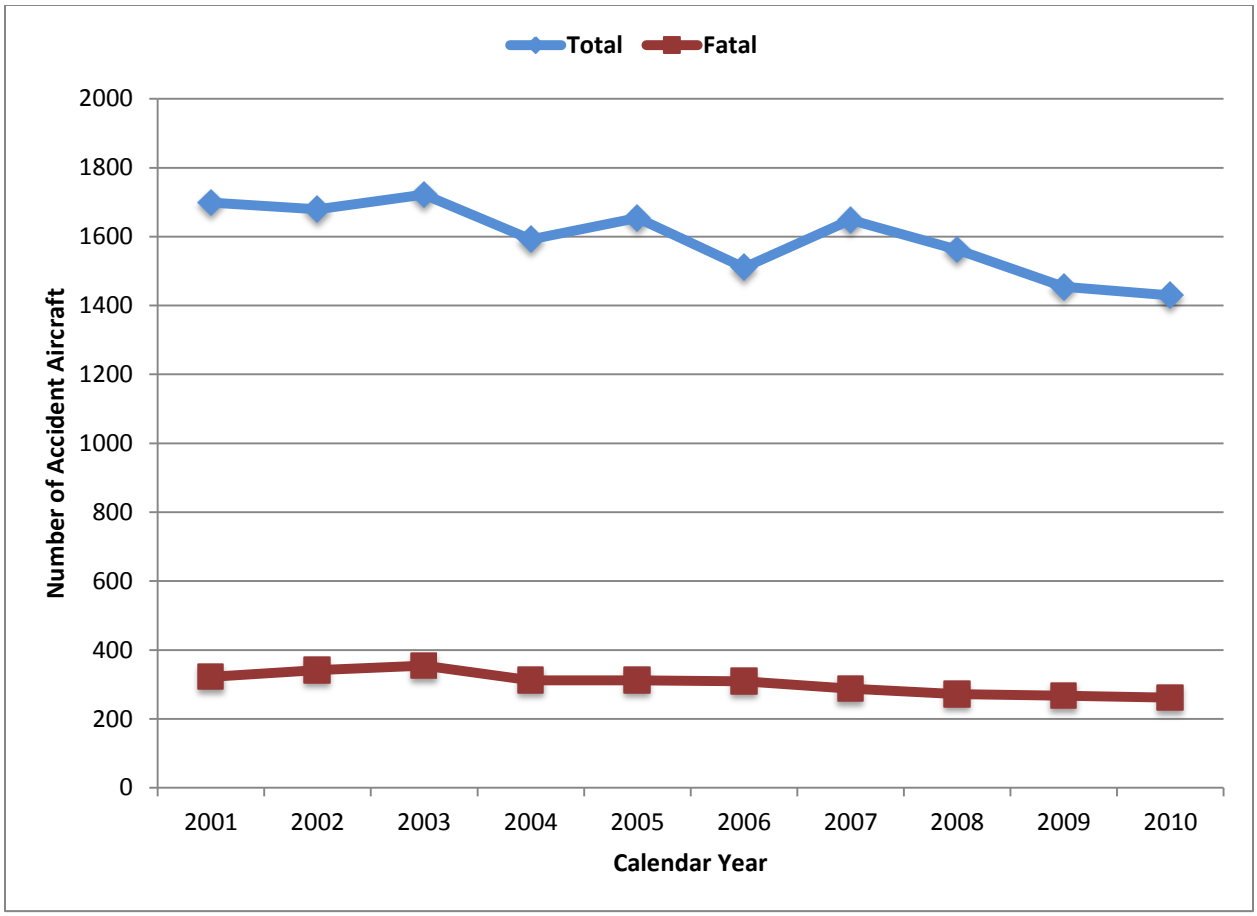

Figure 25. Number of aircraft involved in general aviation accidents, 2001–2010.

The number of general aviation accidents declined over the decade. However, the number of fatal accidents remained relatively stable over the ten-year period. Figure 26 shows the estimated total flight hours for general aviation based on the GA Survey. Figure 27 plots the total and fatal accident rates for general aviation.

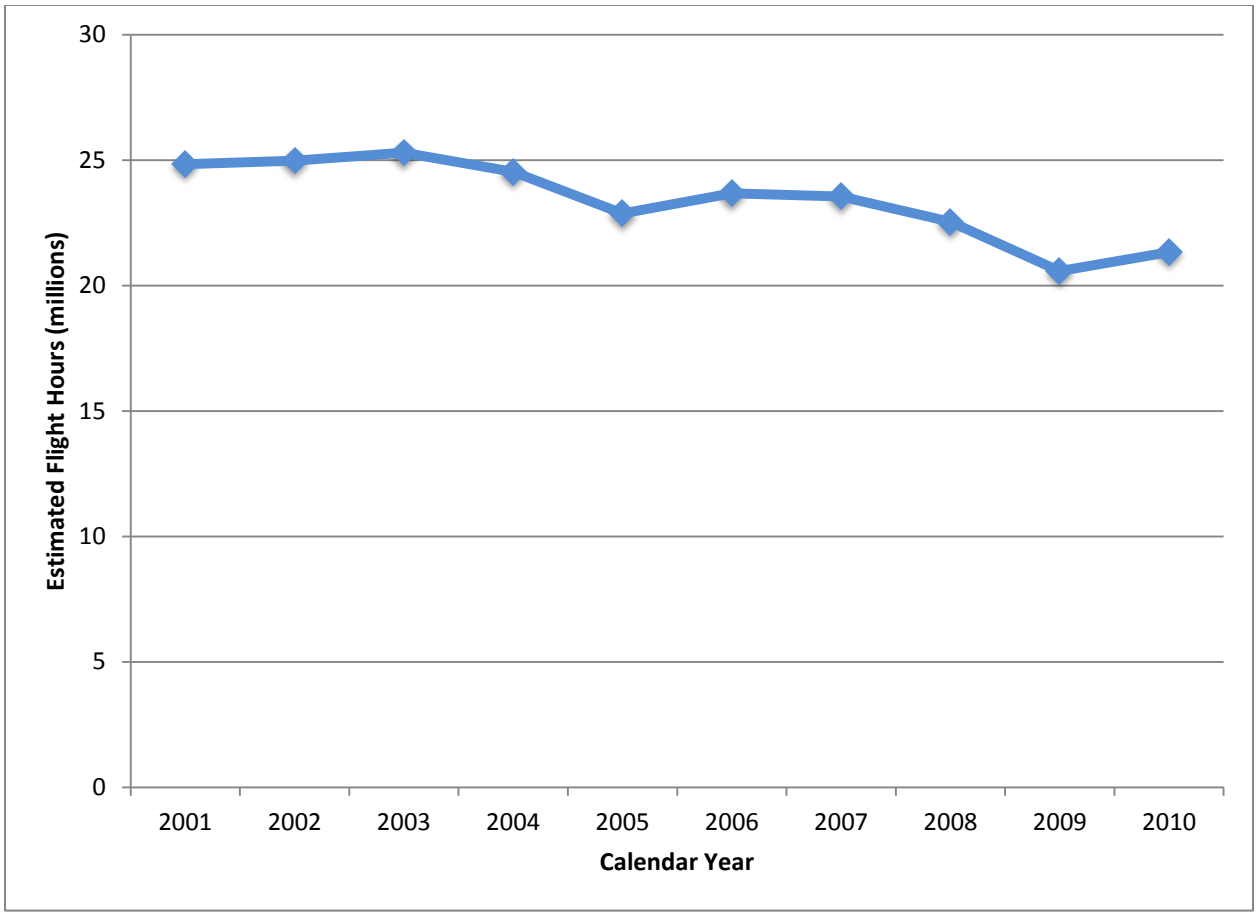

Figure 26. Estimated general aviation flight hours, 2001–2010.

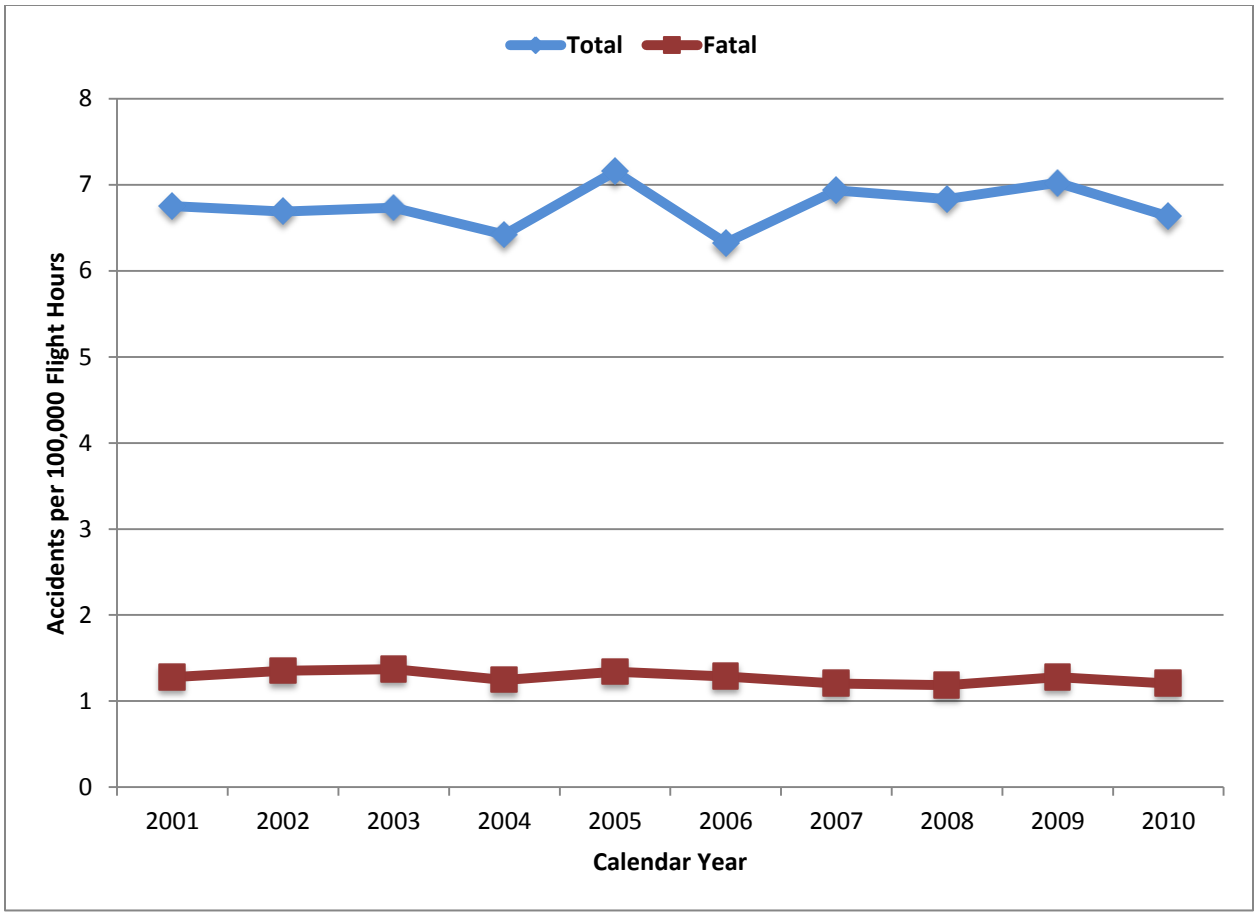

Figure 27. Total and fatal accident rates for general aviation, 2001–2010.

Figure 28 shows the geographic distribution of the 1,390 general aviation accidents in 2010, by state, for which geospatial data are available. For comparison, figure 29 shows the current number of U.S. civil-registered aircraft by state.[30]

[30] Data obtained from the FAA as reported in the GA Survey in table 1.3, which lists "Active General Aviation and Air Taxi Aircraft by Primary Use."

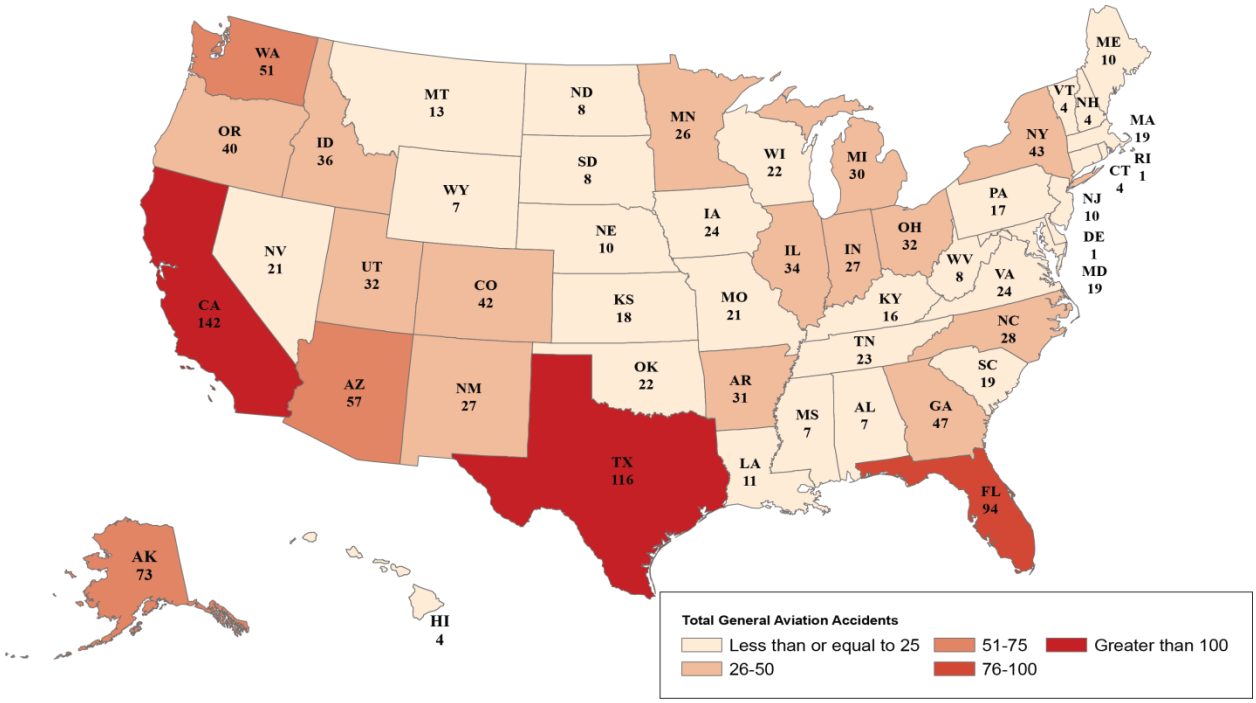

Figure 28. Geographic distribution of general aviation accident aircraft with available GPS coordinates, 2010.

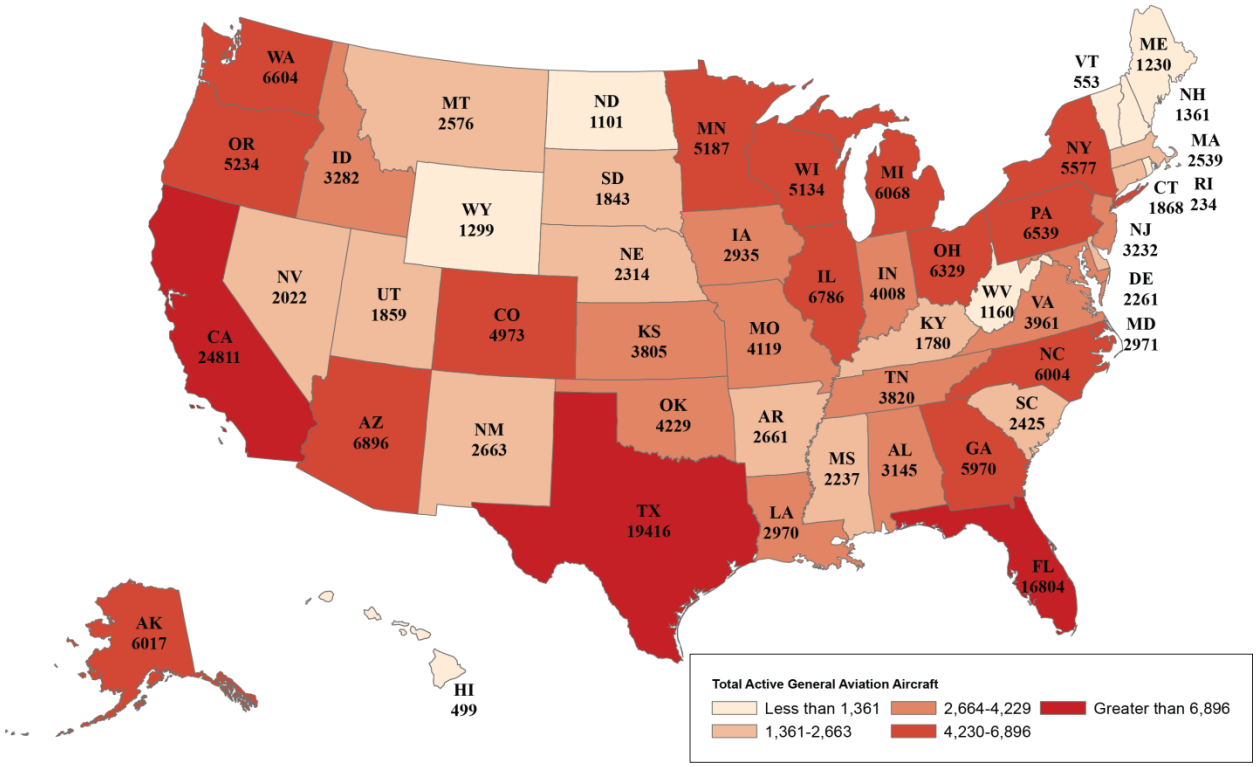

Figure 29. Geographic distribution of U.S. civil-registered general aviation aircraft.[31]

[31] Data from table 1.8, chapter 1 of the 2010 GA Survey.

General aviation covers a wide range of operations and aircraft, from powered parachutes and light sport aircraft to turboprops and jets used for a variety of flying. General aviation includes some types of commercial activities. The sections that follow discuss the top five types of general aviation operations based on their number of accidents and, where appropriate, examine the types of aircraft involved in these accidents. Table 13 shows the purpose of flight, by aircraft type, for the 1,433 aircraft involved in general aviation accidents in 2010.

Table 13. Number of general aviation accident aircraft by aircraft type and purpose of flight, 2010.

Purpose of Flight	Fixed Wing	Helicopter	Balloon	Glider	Other Aircraft	Total
Personal	912	33	5	25	24	999
Flight Instruction	140	23	1	4	4	172
Aerial Application	60	23	0	0	0	83
Business	38	7	1	0	0	46
Public Aircraft Operations	15	8	0	0	0	23
Positioning	16	6	0	0	0	22
Other Work Use	10	7	0	1	0	18
Flight test	12	2	0	0	0	14
Ferry	11	0	0	0	0	11
Aerial Observation	5	5	0	0	0	10
External Load	0	5	0	1	0	6
Unknown	6	1	0	0	0	7
Air Race/Show	1	0	2	2	0	5
Banner Towing	5	0	0	0	0	5
Executive/Corporate	5	0	0	0	0	5
Glider Tow	3	0	0	1	0	4
Skydiving	3	0	0	0	0	3
Total	1,242	120	9	34	28	1,433

The majority of general aviation accidents in 2010 involved personal flying in fixed-wing airplanes, which accounted for 64 percent (912) of the accidents, followed by flight instruction in fixed-wing airplanes, which accounted for 10 percent (140) of the accidents. Aerial application, business, and public aircraft operations followed next in accident frequency in 2010. Fixed-wing airplanes accounted for 87 percent (1,242) of all general aviation accidents, helicopters accounted for 8 percent (120), and all other aircraft accounted for the remaining 5 percent (71).

5.1 Personal Flying

From local currency flights to long distance, cross-country flights, personal flying involves a wide variety of flight activities and aircraft. Figure 30 shows the estimated flight hours for personal flying from 2001 through 2010 based on the GA Survey. Most personal flying was conducted in fixed-wing airplanes, leading to a higher exposure for these types of aircraft. In particular, the GA Survey estimates that 78 percent of personal flying was conducted in single-engine, piston-driven airplanes in 2010. The volume of personal flying decreased significantly between 2003 and 2010.

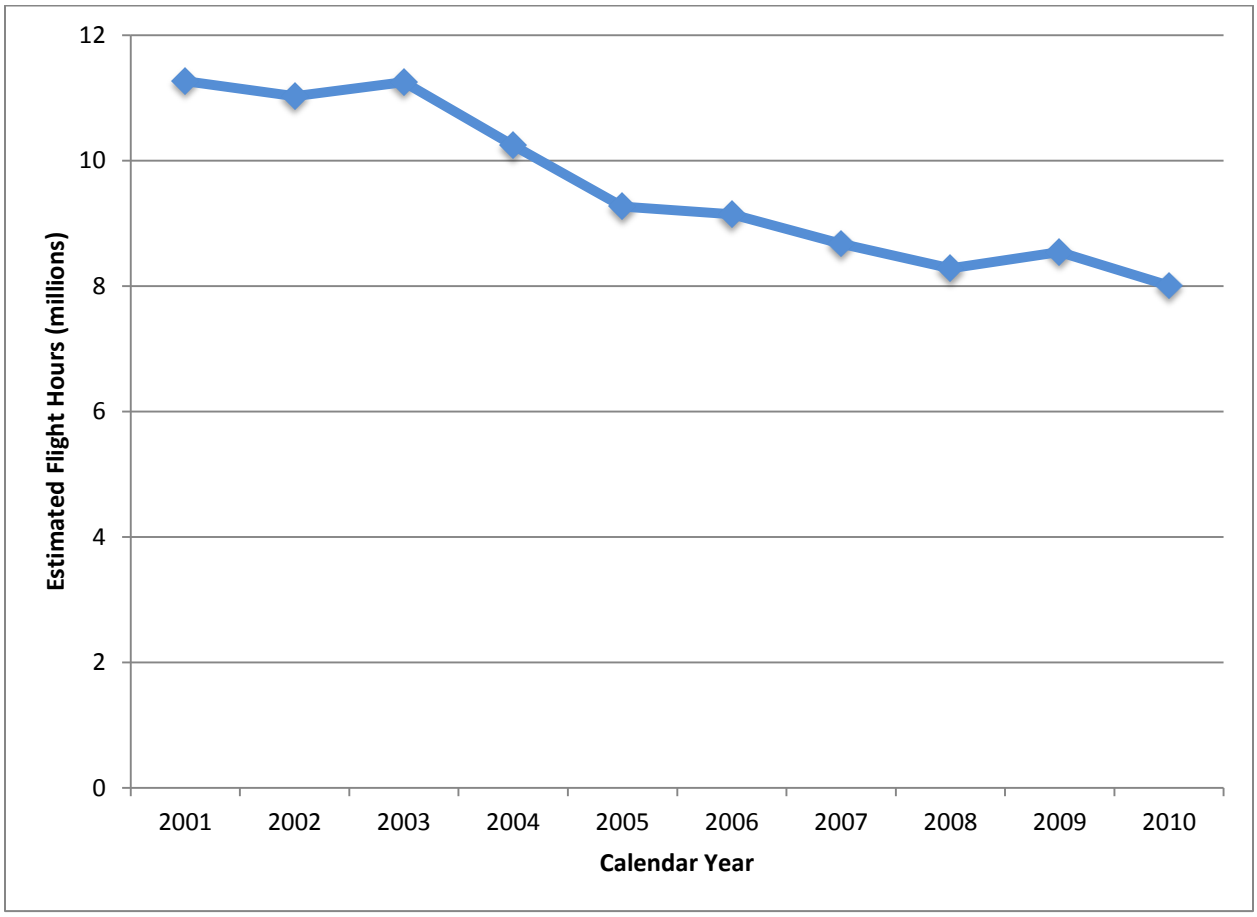

Figure 30. Estimated flight hours for personal flying, 2001–2010.

Figure 31 shows the number of total and fatal personal flying accidents in 2010. Over the ten-year period, personal flying accidents ranged from 1,080 in 2001 to 990 in 2010.

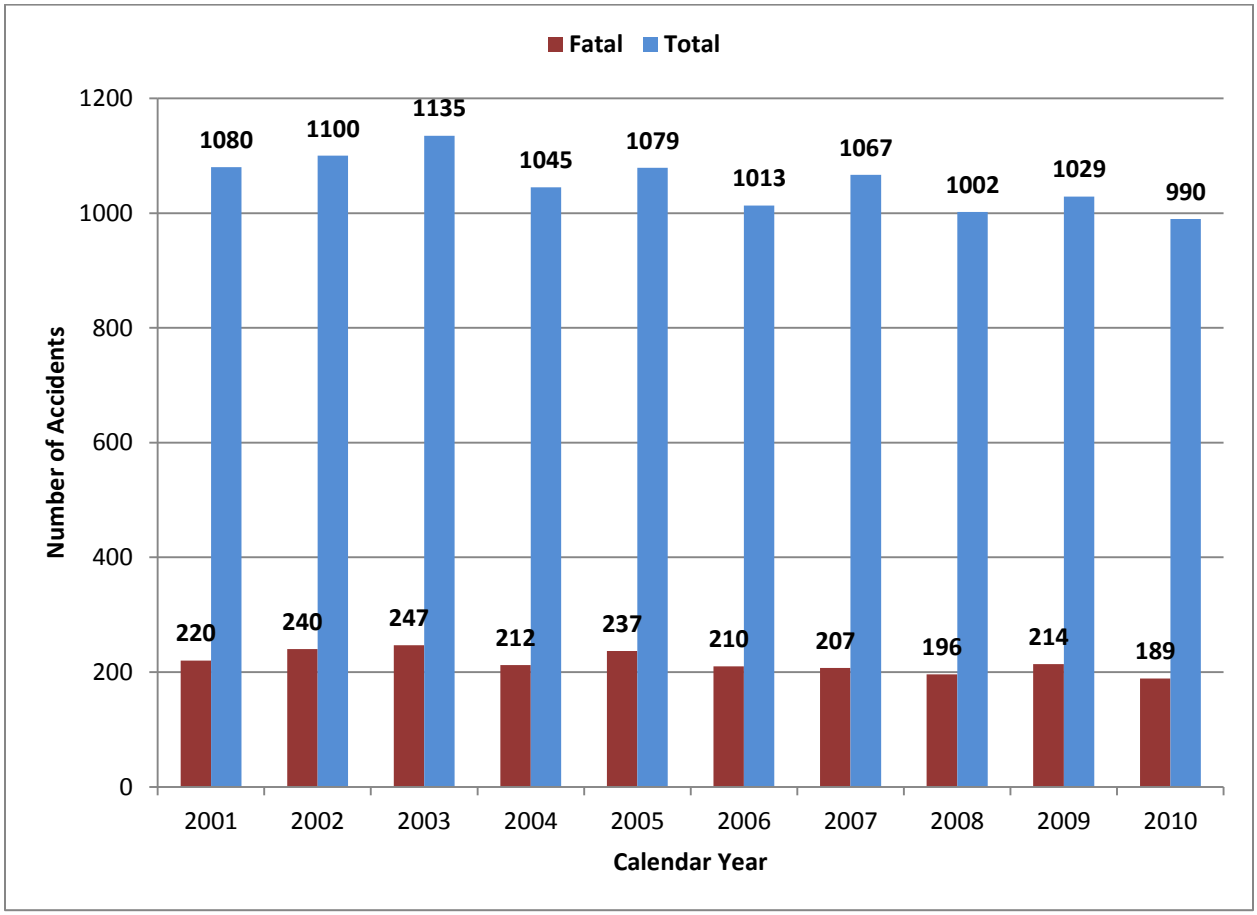

Figure 31. Total and fatal personal flying accidents, 2001–2010.

Figure 32 plots the accident rates associated with these data. The accident rate for personal flying increased over the decade, rising to about 12 accidents per 100,000 hours. The fatal accident rate for the decade remained stable.

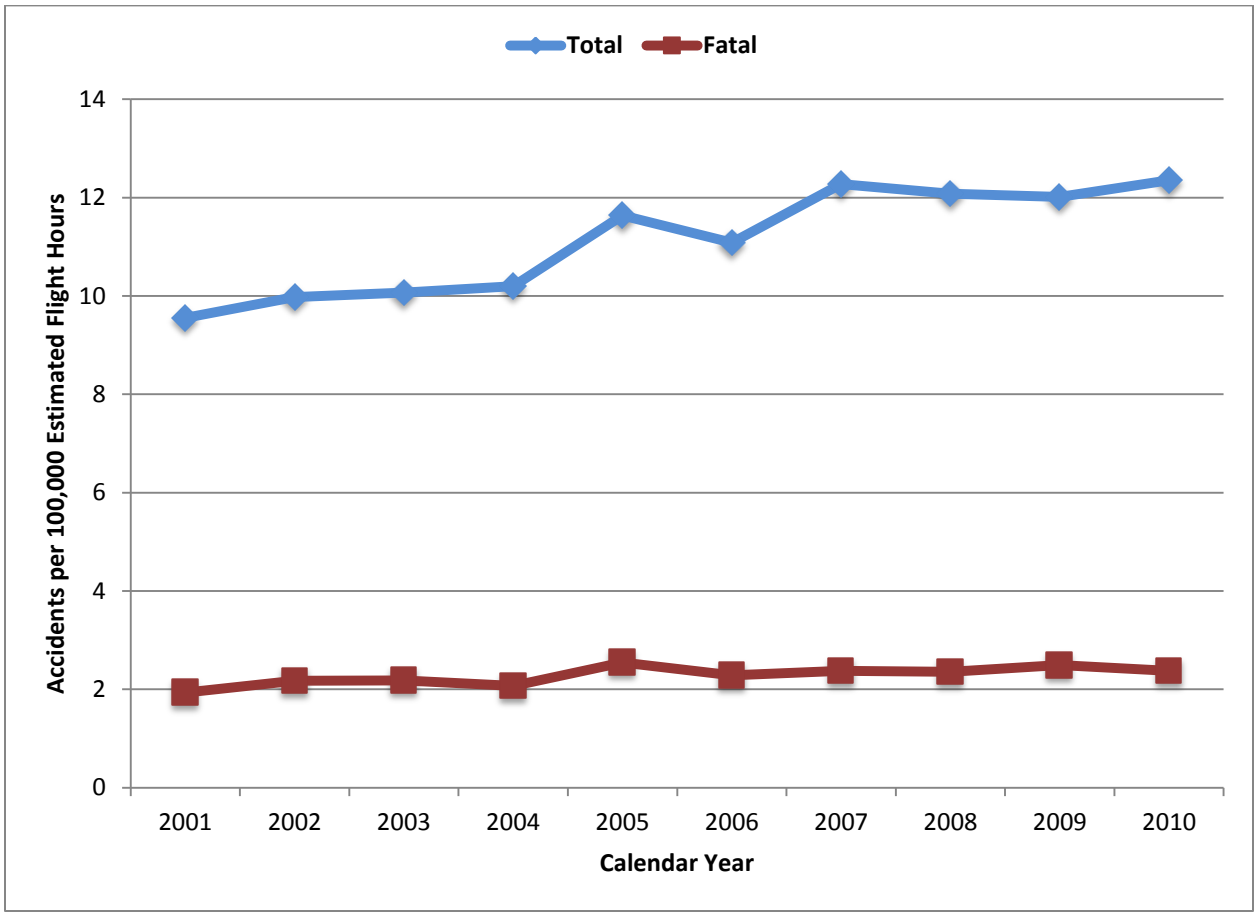

Figure 32. Accident rates for personal flying, 2001–2010.

Figure 33 shows the defining events for the 999 aircraft involved in personal flying accidents during 2010.

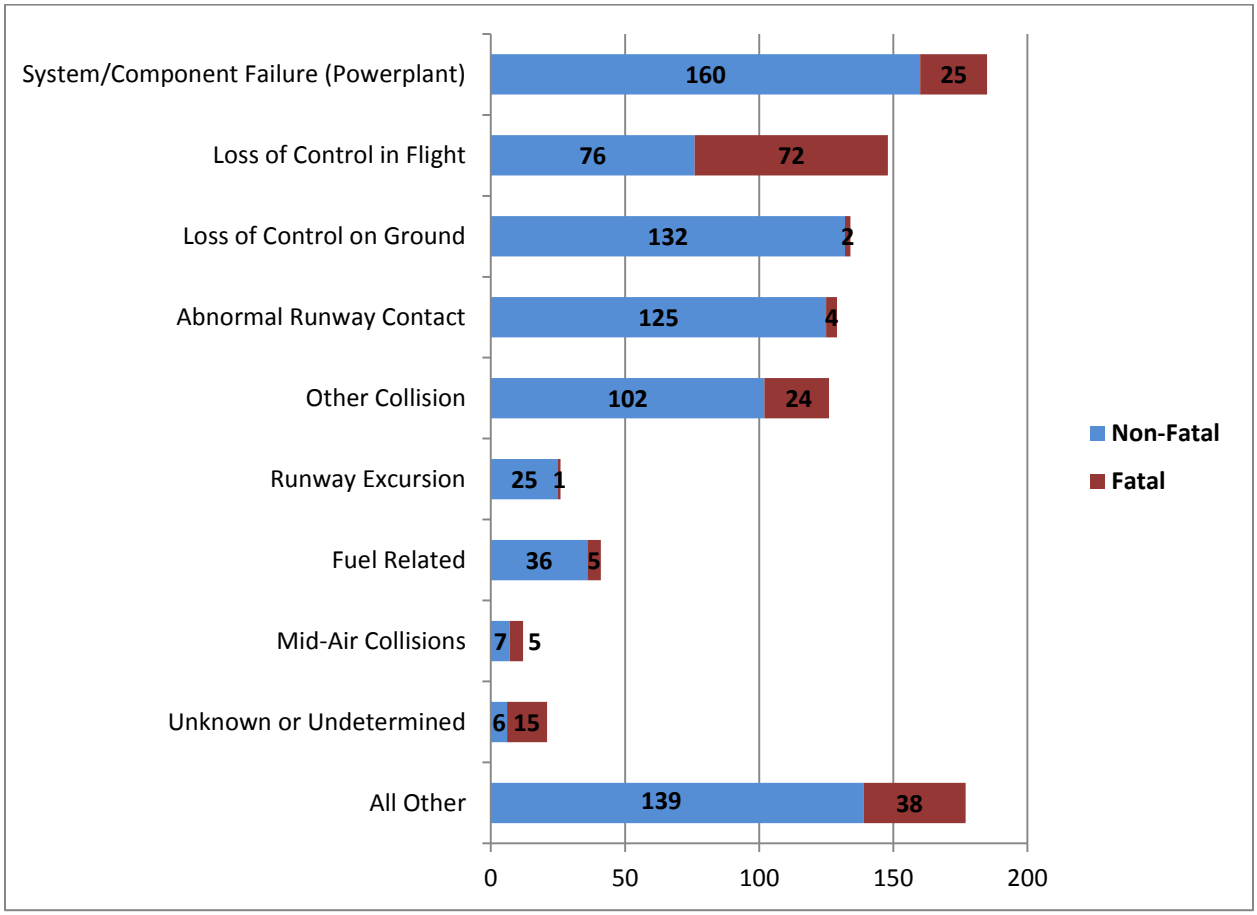

Figure 33. Defining events for personal flying accidents, 2010.

System and component malfunction or failure accounted for about 20 percent of the non-fatal and about 13 percent of the fatal accidents in 2010. Loss of control in flight accounted for the largest proportion of fatal accidents in 2010 (about 38 percent). Figure 34 shows the phase of flight corresponding to each defining event for personal flying accidents in 2010.

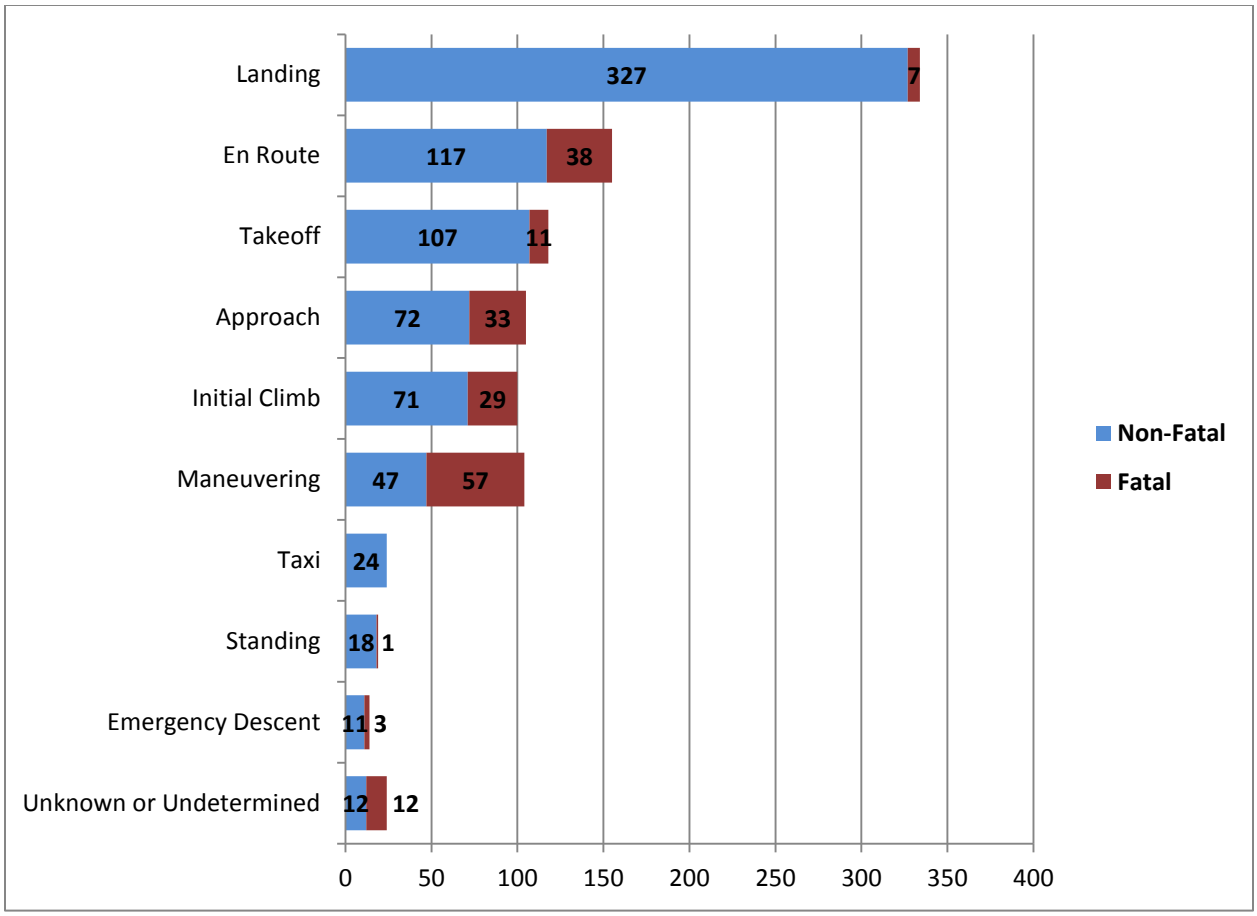

Figure 34. Phase of flight for personal flying accidents, 2010.

The majority of total personal flying accidents occurred during the landing phase, followed closely by the en route phase. The majority of fatal personal flying accidents occurred during the maneuvering phase.

Pilots involved in personal flying accidents had an average total flight time of 2,863 total hours, with a range of 20 to 31,270 hours. The average time in the type of accident aircraft was 460 hours, with a range of 1 to 10,000 hours.

Photo 3. The Cessna 172 is one of the most popular single-engine aircraft used in general aviation.

5.2 Instructional Flying

Figure 35 shows the GA Survey estimate of instructional flying activity from 2001 through 2010.

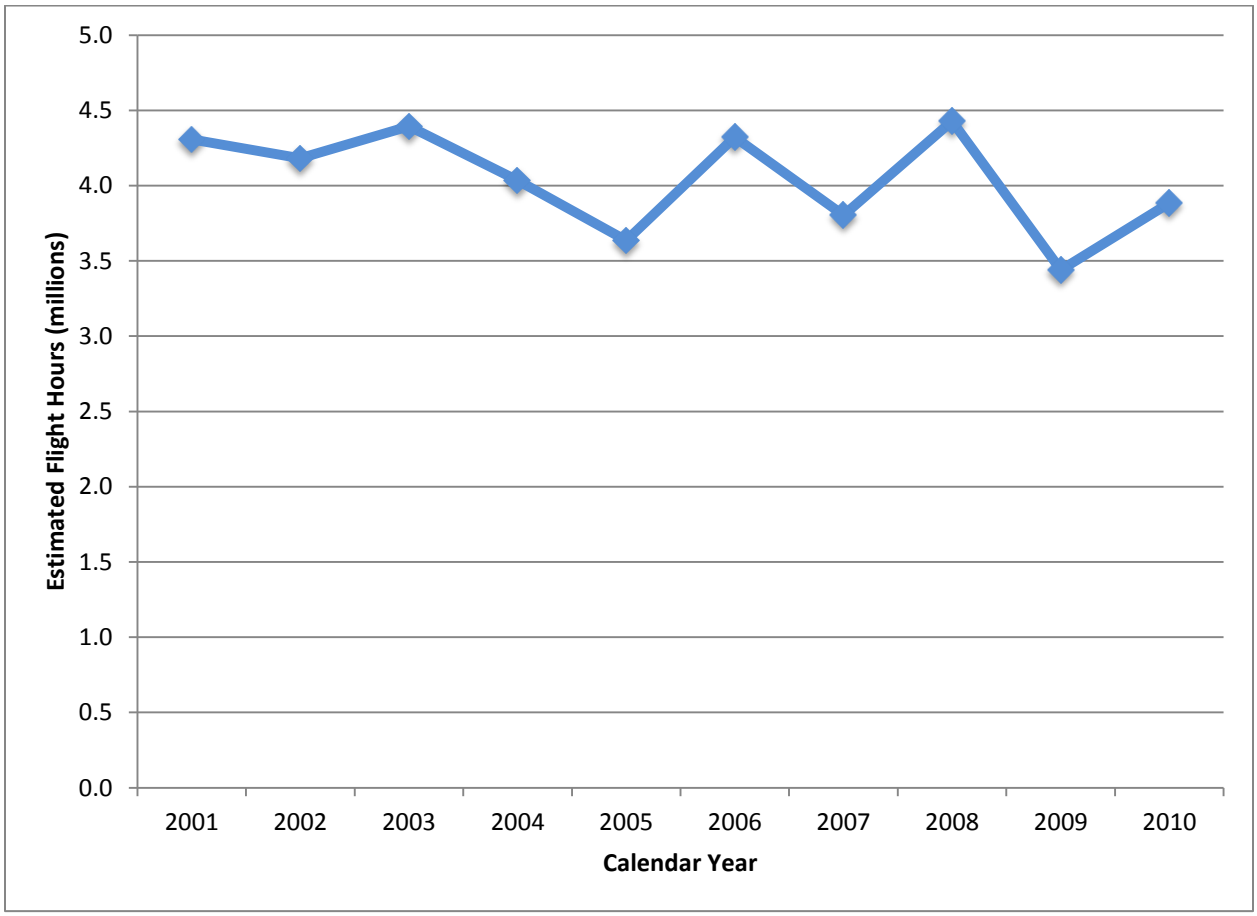

Figure 35. Estimated flight hours for instructional flying, 2004–2010.

Figure 36 shows the number of total and fatal accidents for instructional flying between 2001 and 2010. Figure 37 shows the total and fatal accident rates for the same period.

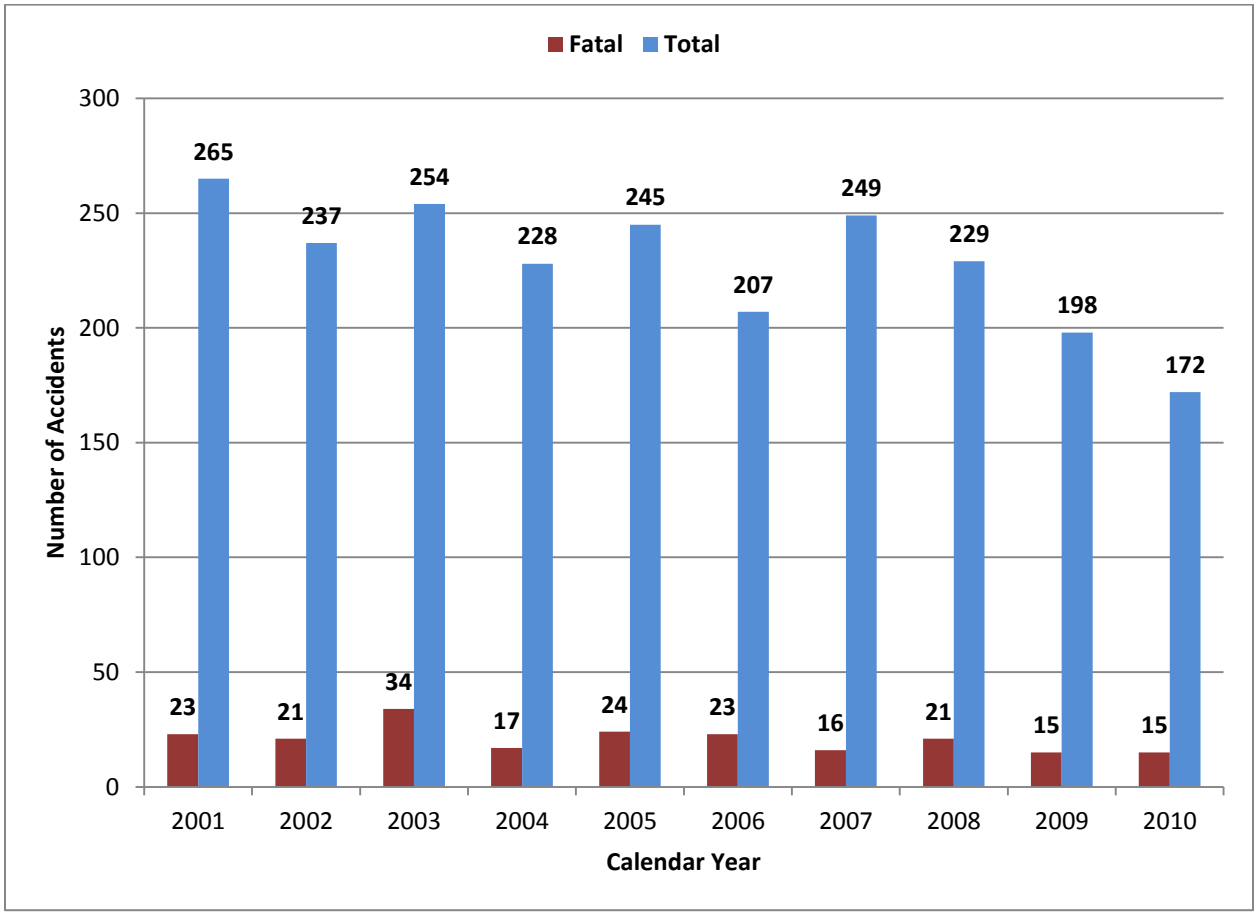

Figure 36. Total and fatal instructional flying accidents, 2001–2010.

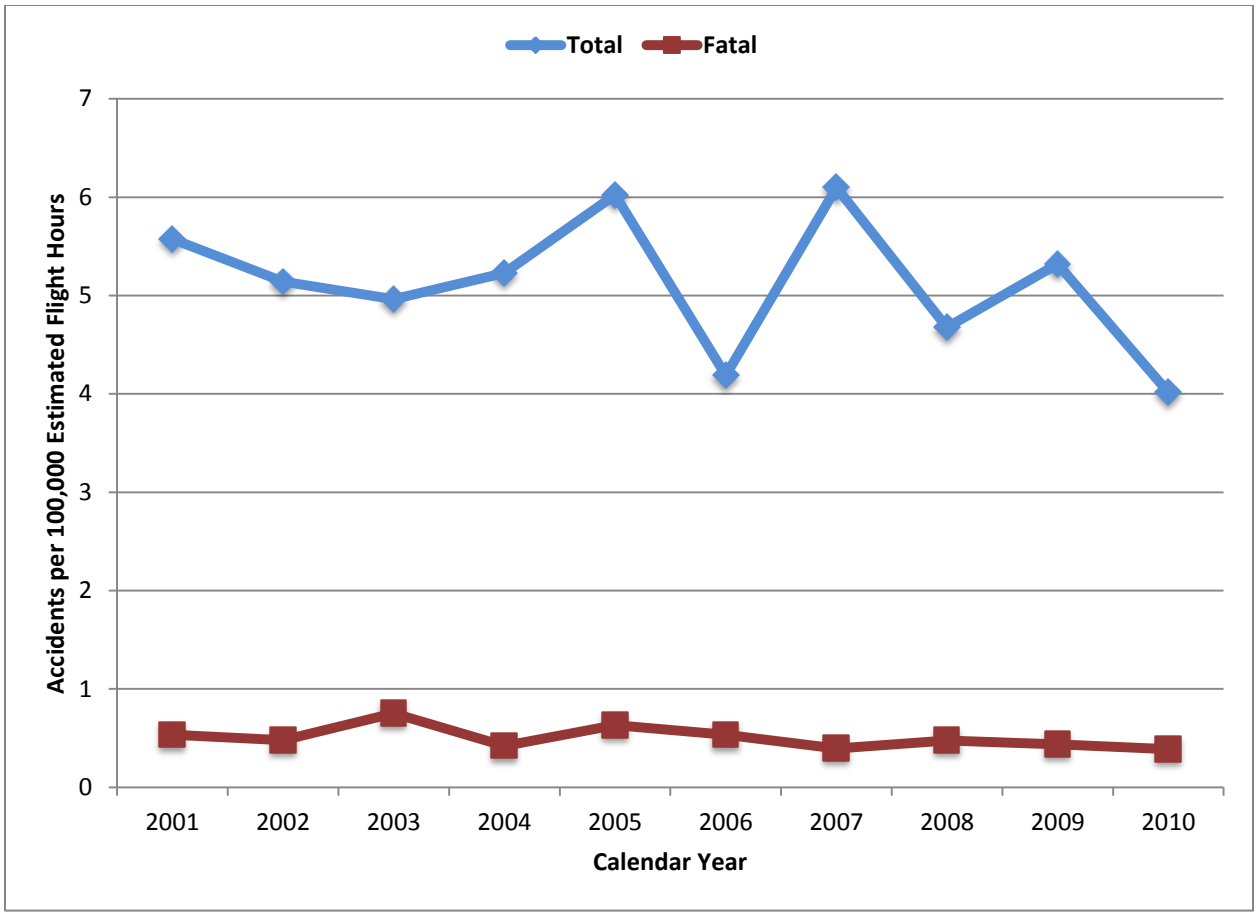

Figure 37. Total and fatal instructional flying accident rates, 2001–2010.

For the decade, 81 percent of all instructional flying accidents occurred in fixed-wing airplanes and 17 percent occurred in helicopters. The remaining two percent occurred in balloons, blimps, gliders, and other types of small aircraft. Both the total and fatal average instructional accident rates for the decade are below the total general aviation accident rate average. During the ten-year period, 9 percent of the instructional flying accidents resulted in fatalities, compared to 19 percent of all general aviation accidents that involved fatalities.

Figure 38 depicts the defining events for the 172 aircraft involved in instructional flying accidents during 2010, and figure 39 shows the corresponding phase of flight.

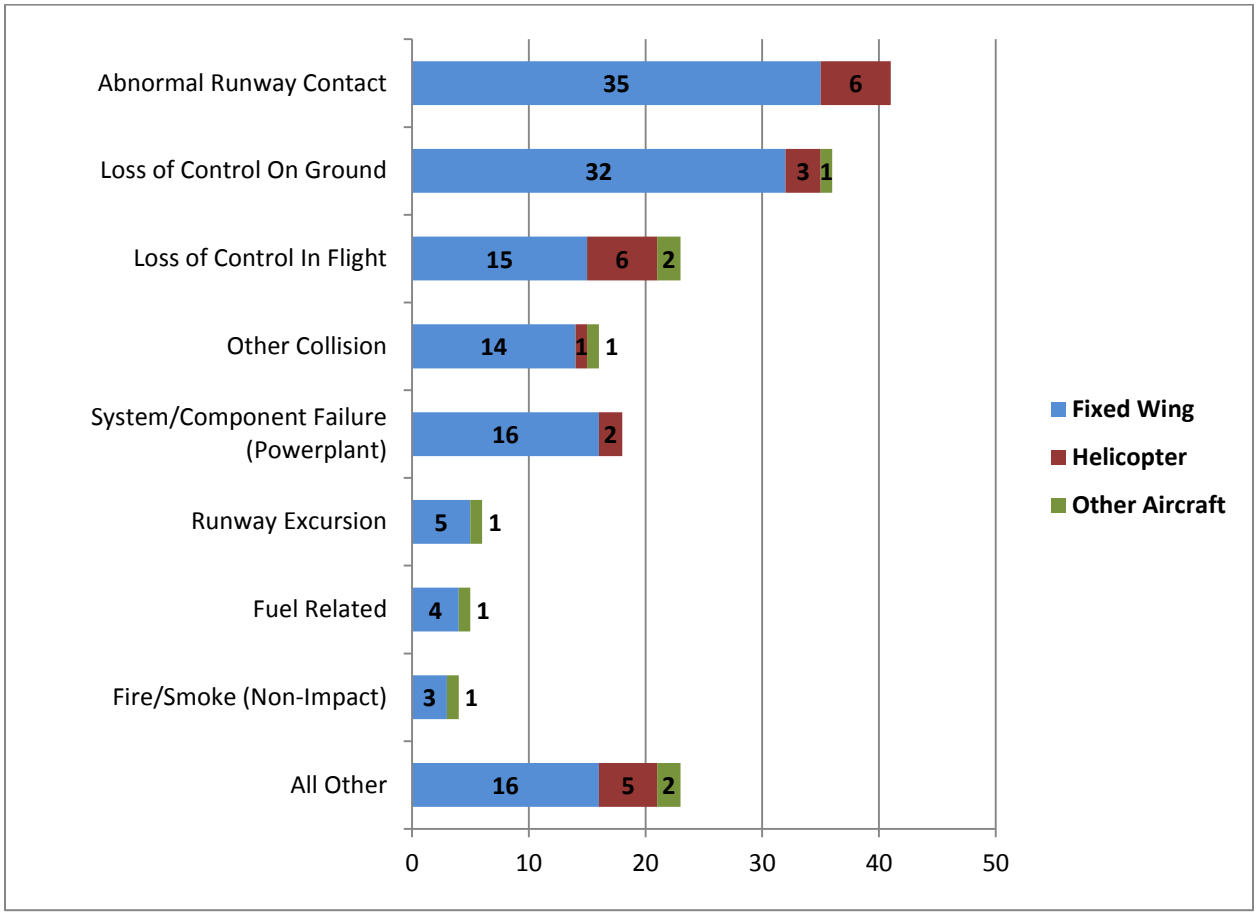

Figure 38. Defining events for instructional flying accidents by aircraft type, 2010.

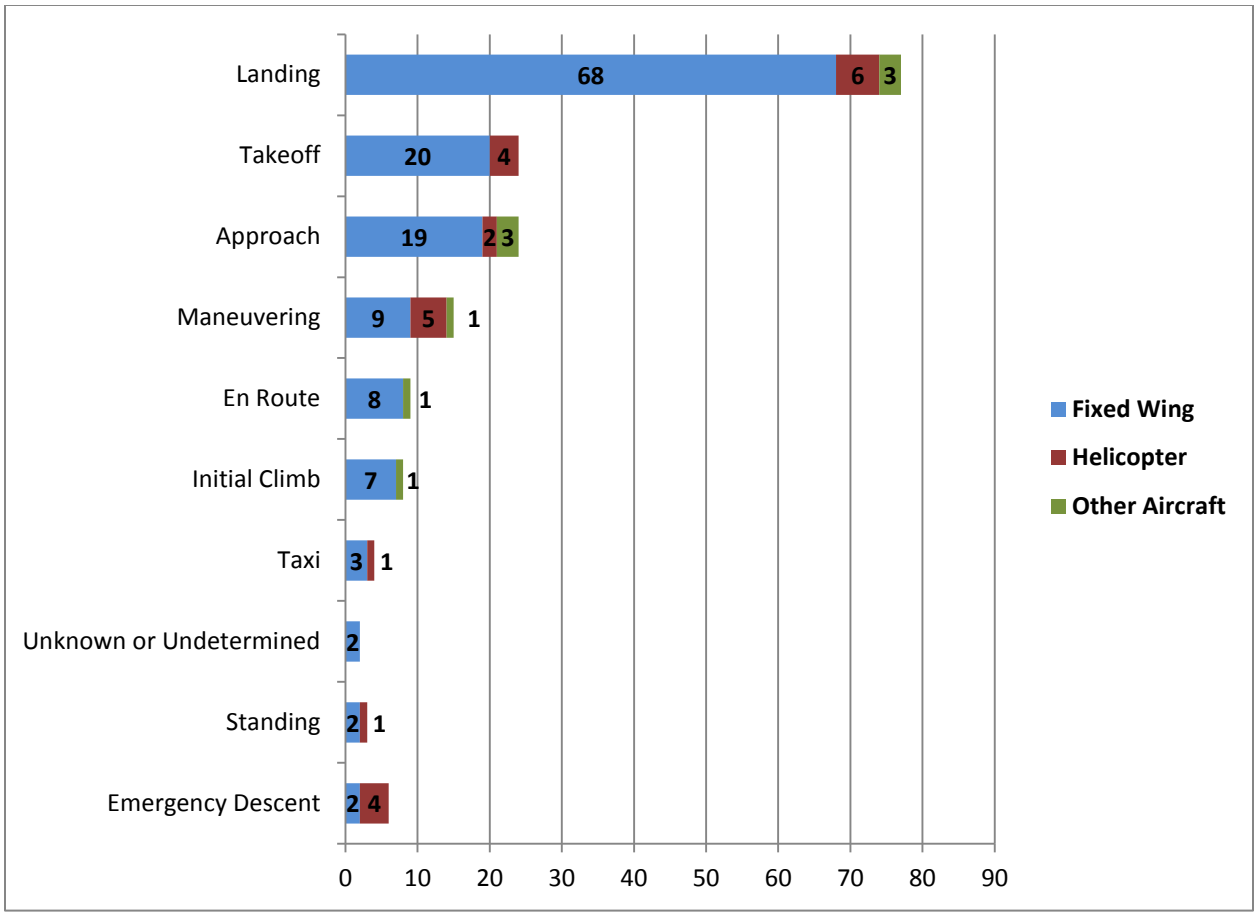

Figure 39. Phase of flight for instructional flying accidents by aircraft type, 2010.

Abnormal runway contact was the most prevalent defining event, followed by loss of control on ground. The majority of all aerial application events occurred during the landing phase of flight.

For pilot demographics in instructional flying, this report uses the pilot identified on the accident report as *Pilot 1*.[32] Pilots involved in these accidents had an average total flight time of 3,274 hours, with a range of 13 to 35,000 hours. Their average time in the type of accident aircraft was 494 hours, with a range of 1 to 15,000 hours.

5.3 Agricultural Aircraft Operations

Aerial application flights are regulated by 14 CFR Part 137 and are defined in that section as "the operation of an aircraft for the purpose of (1) dispensing any economic poison, (2) dispensing any other substance intended for plant nourishment, soil treatment, propagation of plant life or pest control, or (3) engaging in dispensing activities directly affecting agriculture,

[32] The pilot listed as *Pilot 1* is usually the pilot flying the aircraft at the time of the accident. This could mean that *Pilot 1* could either be the student or the instructor and may account for the wide range of ages and total time listed for instructional accidents.

horticulture, or forest preservation." Fixed-wing airplanes and helicopters are both used in aerial application, but most operations are accomplished in fixed-wing airplanes. Figure 40 shows the estimated flight hours of fixed-wing airplanes and helicopters involved in aerial application from 2001 through 2010, based on the estimates from the GA Survey.

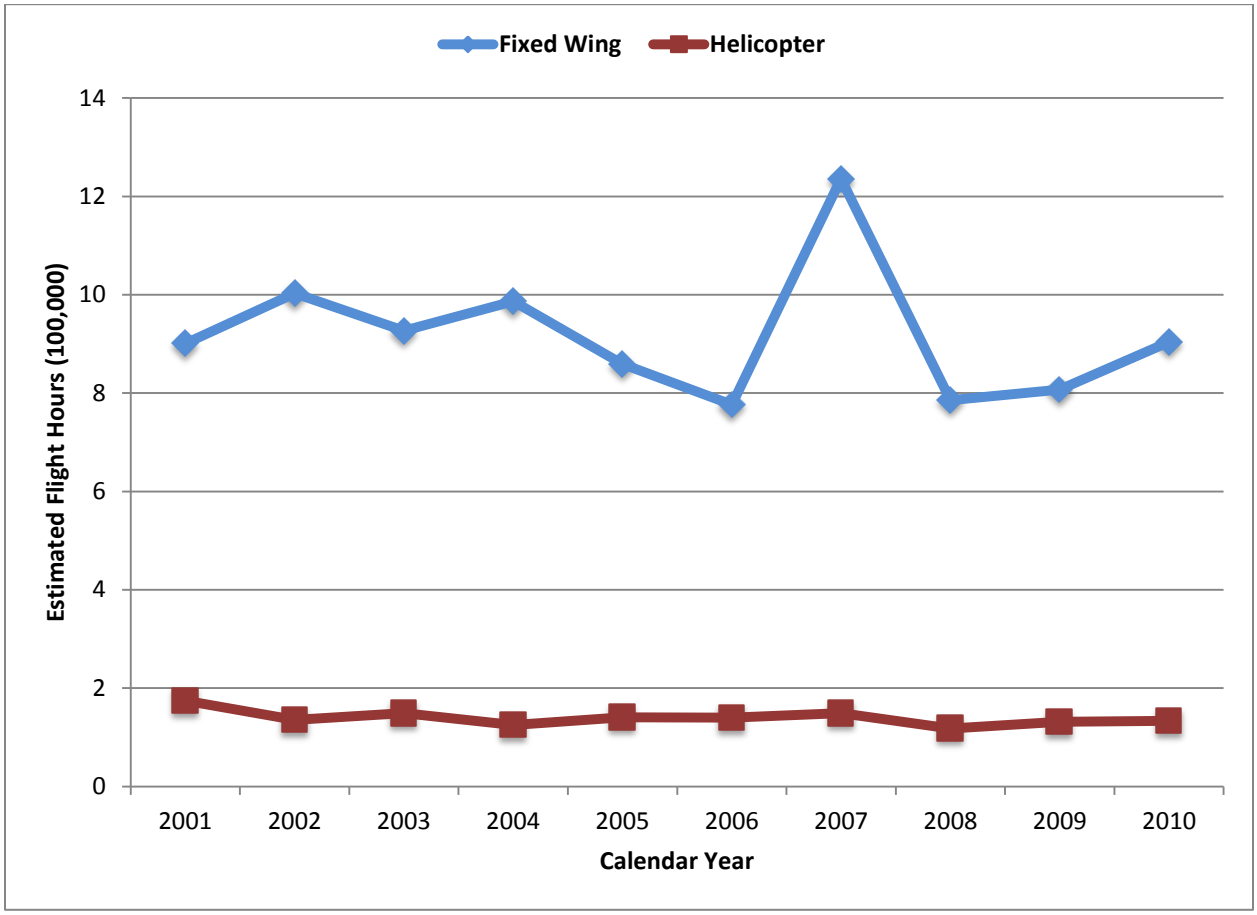

Figure 40. Estimated flight hours for aerial application by aircraft type, 2001–2010.

Figure 41 shows the number of total and fatal aerial application accidents that involved fixed-wing airplanes from 2001 through 2010, and figure 42 shows the same data for helicopters.[33] Most of the accidents involved fixed-wing airplanes. Eight percent of all aerial application accidents were fatal and four percent of the aircraft were destroyed in the accident.

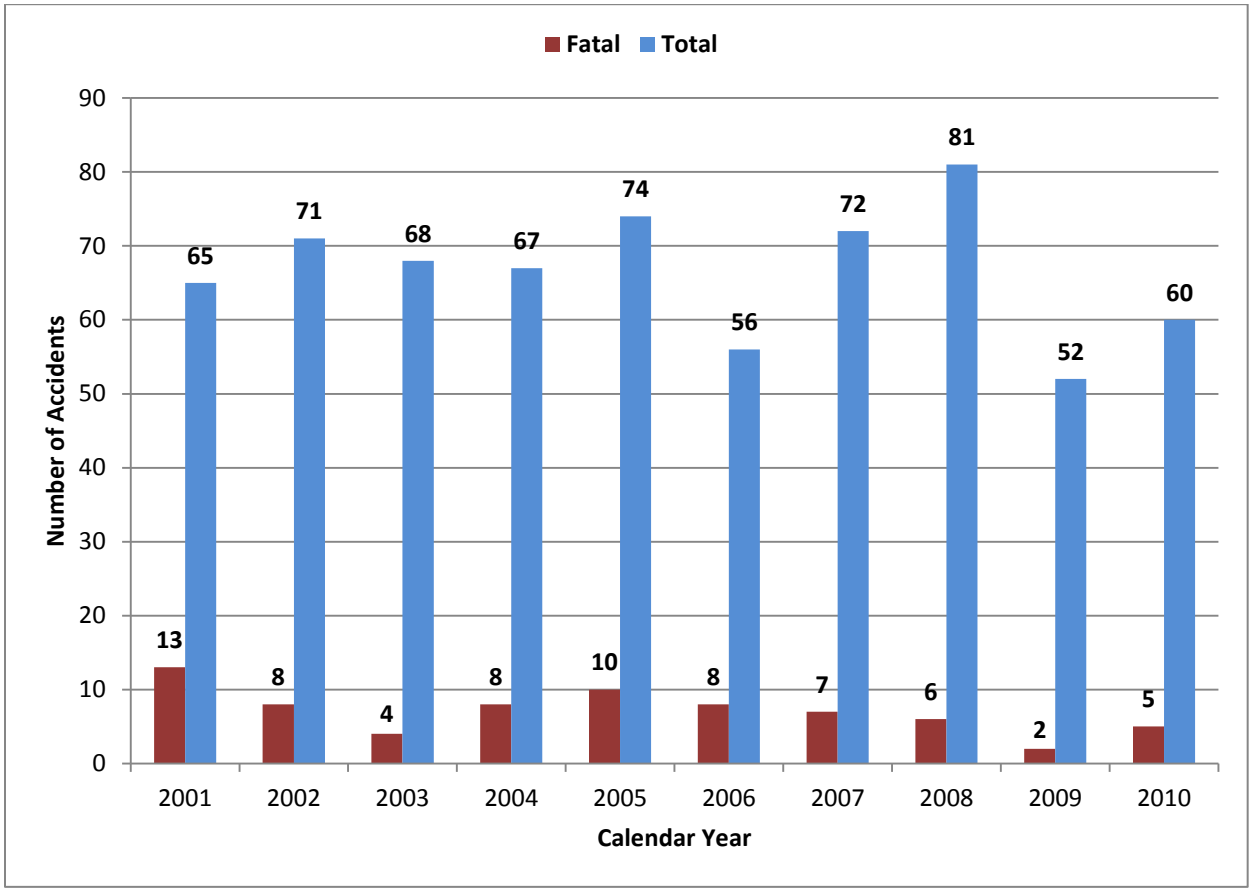

Figure 41. Total and fatal aerial application accidents involving fixed-wing airplanes, 2001–2010.

[33] ERA09LA490 was changed after the publication of the 2007–2009 report from aerial application to positioning.

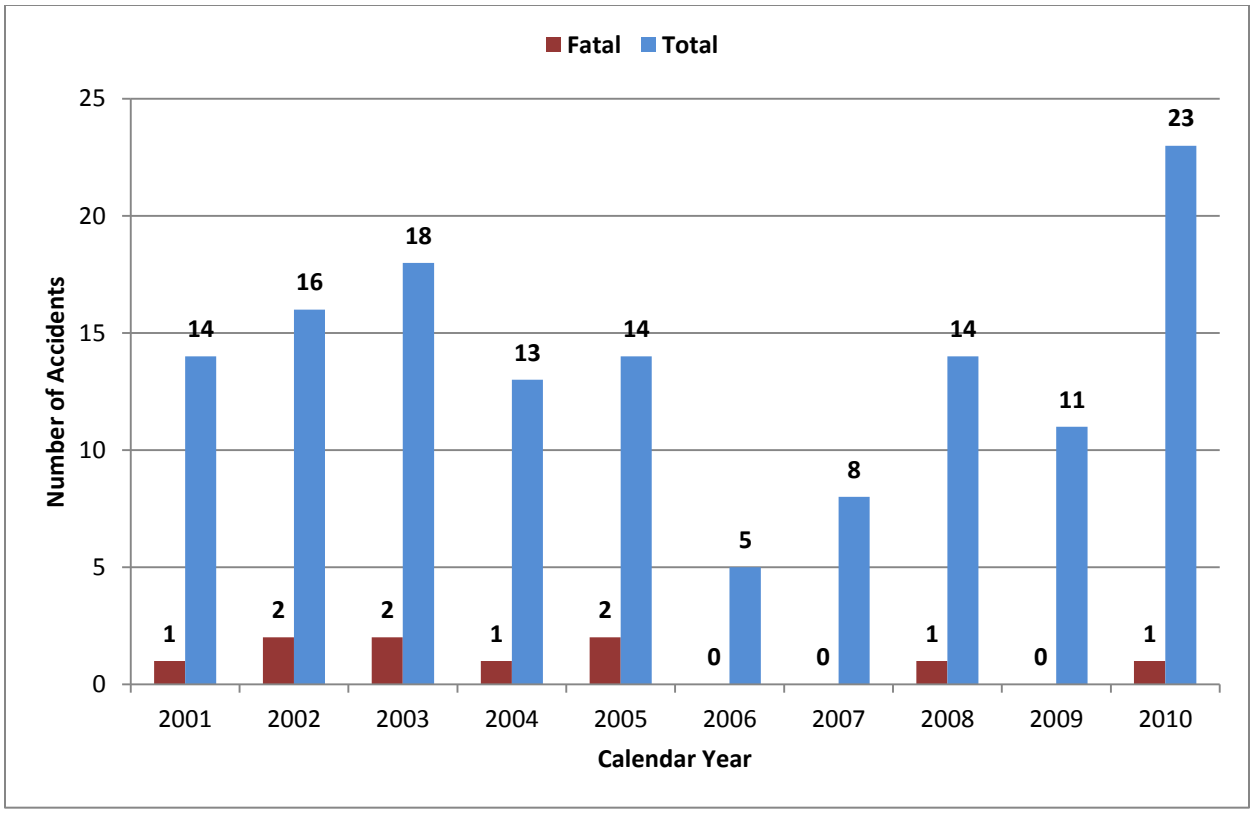

Figure 42. Total and fatal aerial application accidents involving helicopters, 2001–2010.

Figure 43 shows the total and fatal accident rates per 100,000 flight hours for fixed-wing airplanes involved in aerial application from 2001 to 2010, and figure 44 shows the same data for helicopters. For both fixed-wing and helicopter aircraft, the ten-year average total accident rate (7.3 accidents and 9.9 accidents per 100,000 estimated hours respectively) is above the ten-year average total general aviation accident rate (6.8 accidents per 100,000 estimated hours). For helicopters, the ten-year average total accident rate is above that of the ten-year general aviation accident rate and is also almost three times that of fixed-wing airplanes.

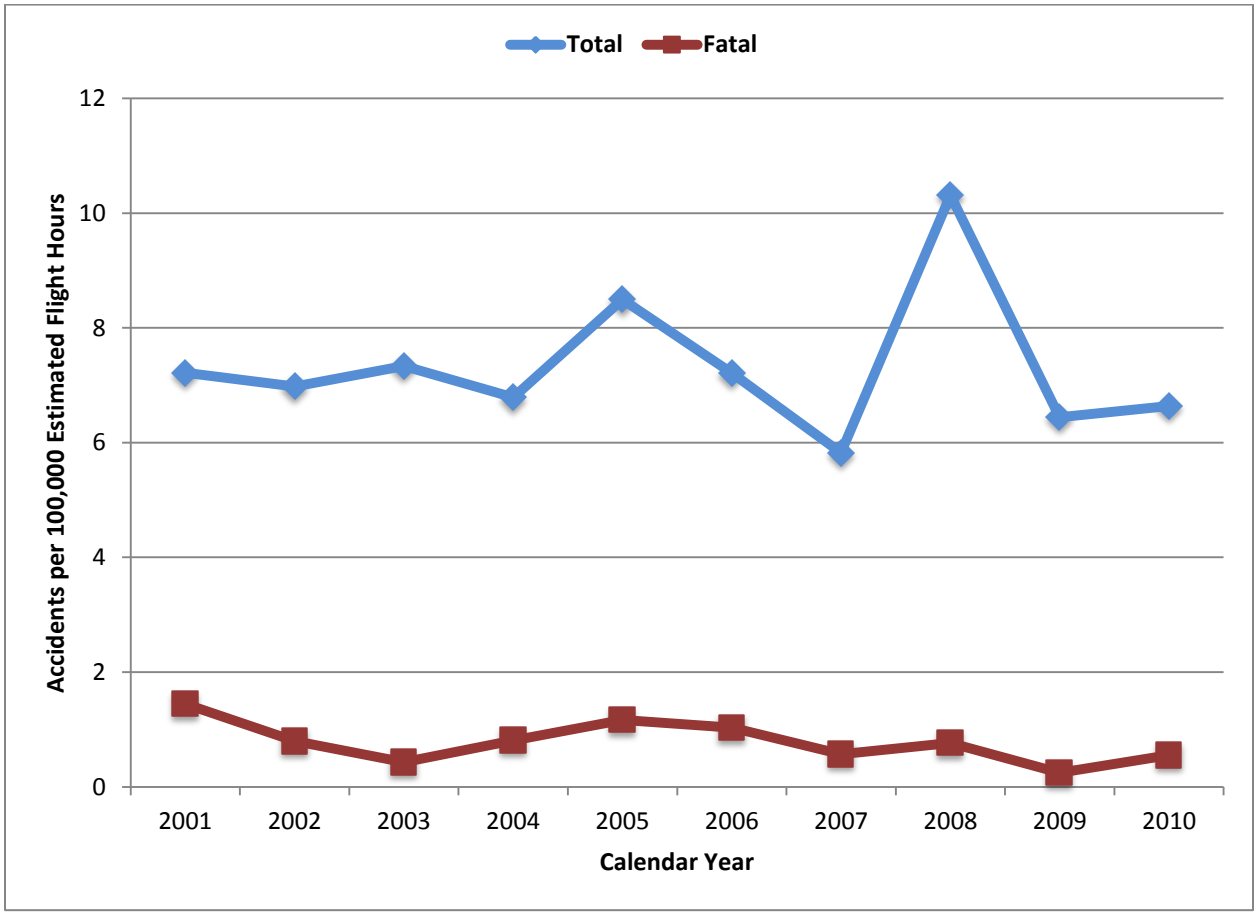

Figure 43. Total and fatal fixed-wing airplane aerial application accident rates, 2001–2010.

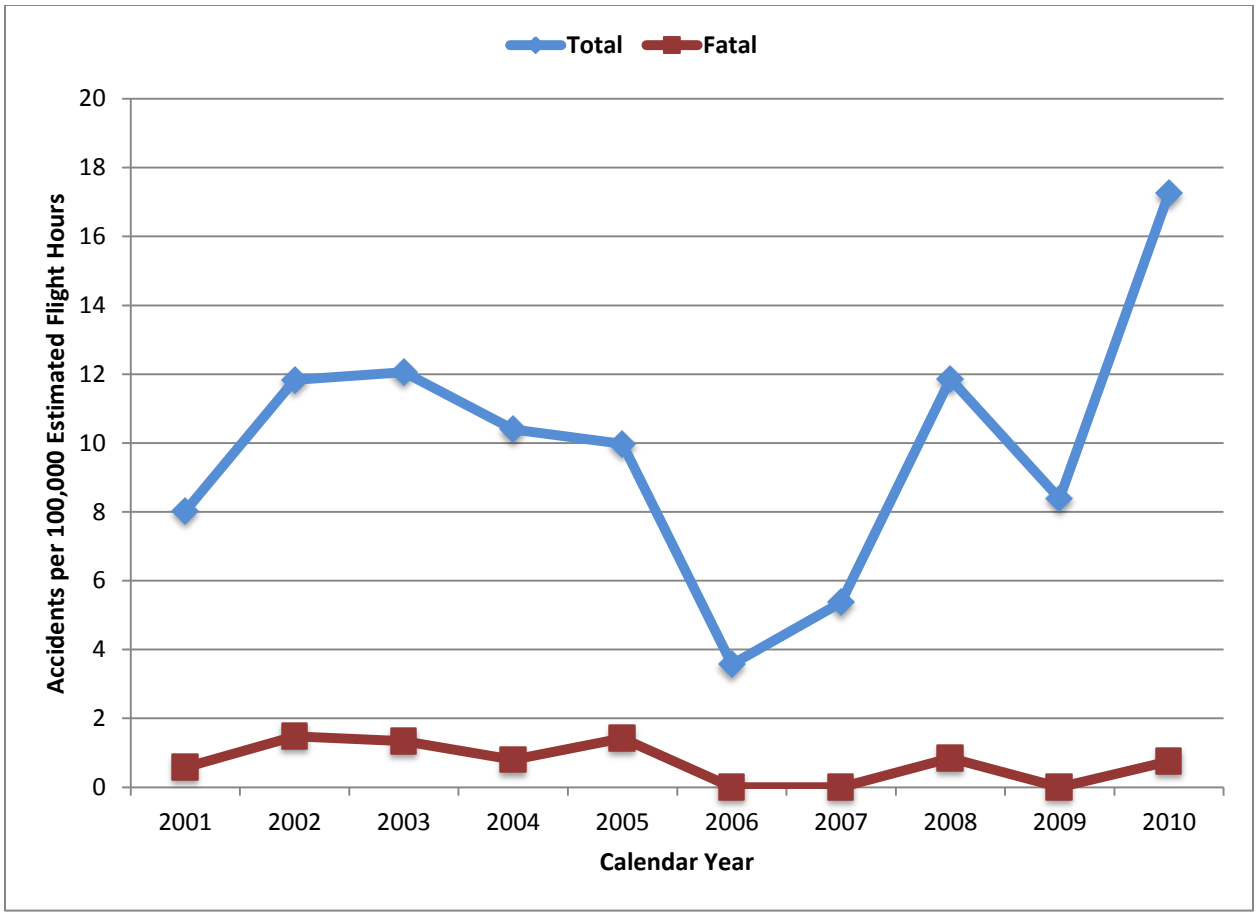

Figure 44. Total and fatal helicopter aerial application accident rates, 2001–2010.

Table 14 shows the defining events for all aircraft involved in aerial application accidents, and Table 15 shows the associated phase of flight.

Table 14. Defining events for aerial application accidents by aircraft type, 2010.

Defining Event	Fixed-Wing Airplane	Helicopter
Other Collision	19	8
System/Component Failure (Powerplant)	21	7
Loss of Control on Ground	6	0
Loss of Control in Flight	4	2
System/Component Failure (Non-Powerplant)	3	1
Fuel Related	1	1
Runway Excursion	2	0
Controlled Flight into Terrain	0	1
Ground Collision	1	0
Abnormal Runway Contact	1	2
Miscellaneous/Other	0	1
Unknown	1	0

Table 15. Phase of flight for aerial application accidents by aircraft type, 2010.

Phase of Flight	Fixed-Wing Airplane	Helicopter
Maneuvering	29	14
Takeoff	15	2
Landing	8	3
Initial Climb	3	1
En Route	3	0
Uncontrolled Descent	1	1
Approach	0	1
Standing	0	1
Taxi	1	0

System/Component malfunction was the defining event that accounted for the largest proportion of aerial application accidents in 2010. Other collisions and loss of control on ground and in flight accounted for the next two most occurring defining events.

Pilots involved in these accidents had an average total flight time of 10,379 hours. Aerial application accident pilots had an average time in the type of accident aircraft of 2,919 hours, with a range of 20 to 25,000 hours.

5.4 Business Flying

Business flying can include flight operations by an owner or employee of a company who is not paid for the sole purpose of flying the aircraft. Figure 45 shows the total flight hours of business flying from 2001 through 2010, estimated from the GA Survey data.

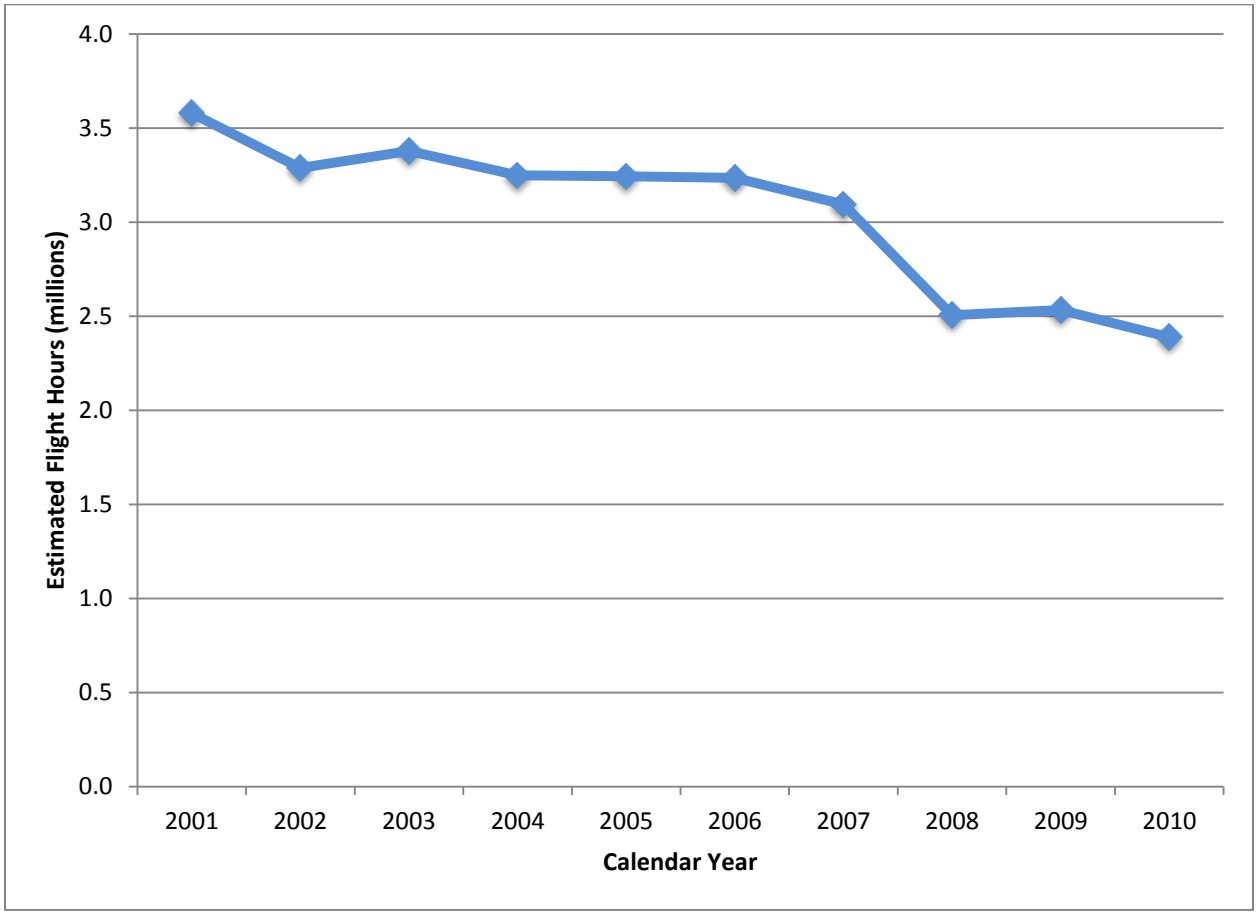

Figure 45. Estimated total flight hours for business flying, 2001–2010.

Figure 46 shows the number of total and fatal business flying accidents from 2001 through 2010. There was a decrease in total business flying accidents over the decade. Over the ten-year period, 86 percent of business flying accidents involved fixed-wing airplanes and 13 percent involved helicopters. Figure 47 shows the total and fatal accident rates for business flying in 2010.

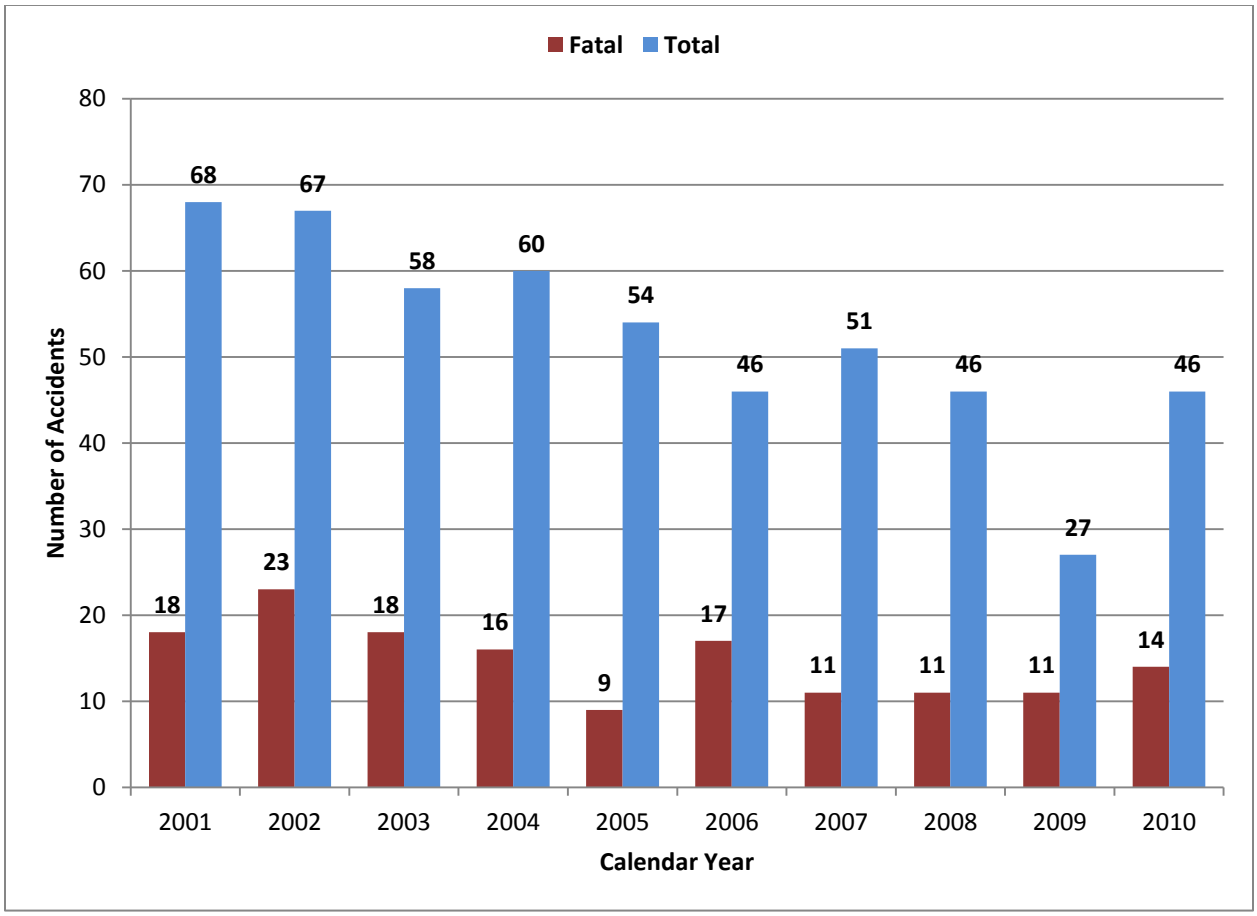

Figure 46. Total and fatal business flying accidents, 2001–2010.

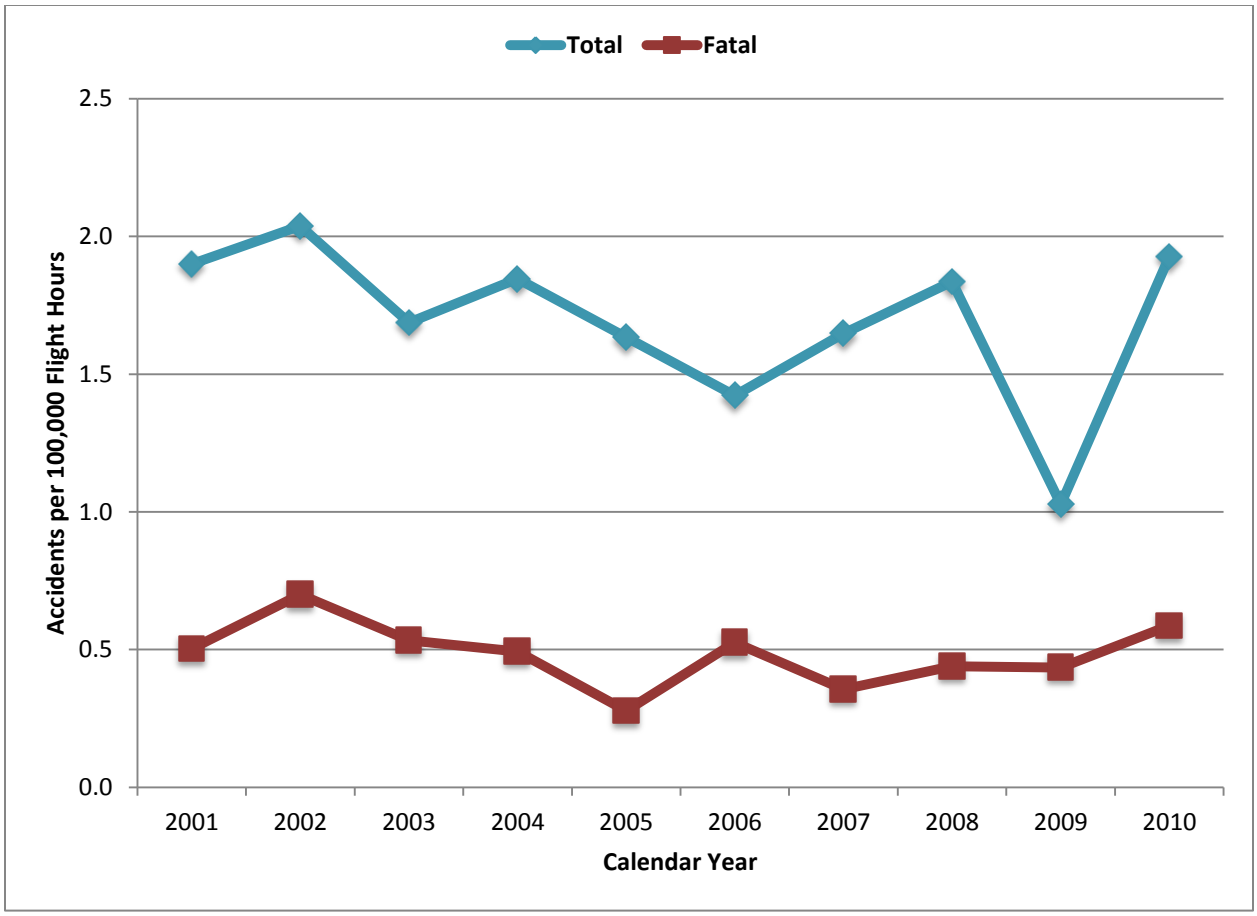

Figure 47. Total and fatal business flying accident rates, 2001–2010.

Photo 4. The Socata TBM-700 is a high performance turboprop, used for business flights in general aviation

Table 16 shows the defining events for the 46 aircraft involved in business flying accidents during 2010. Loss of control accounted for most fatal accidents in 2010, and other collisions accounted for the most non-fatal accidents.

Table 16. **Defining events for business flying accidents, 2010.**

Defining Event	Non-Fatal	Fatal
Loss of Control In Flight	2	6
Loss of Control On Ground	4	0
System/Component Failure (Powerplant)	5	3
Other Collision	8	0
System/Component Failure (Non-Powerplant)	3	0
Runway Excursion	2	0
Abnormal Runway Contact	6	0
All Other	2	5

Table 17 categorizes the phase of flight for the associated defining events of business accidents in 2010. The majority occurred during landing, followed by approach and initial climb. The majority of fatal accidents occurred during approach, en route, and maneuvering phases of flight, with each phase accounting for three accidents.

Table 17. Phase of flight for business flying accidents, 2010.

Phase of Flight	Non-Fatal	Fatal
Landing	17	0
Approach	2	3
Initial Climb	3	2
En Route	1	3
Taxi	3	0
Maneuvering	0	3
Unknown	0	2
Takeoff	2	0
Emergency Descent	2	0
Standing	2	1

Pilots involved in these accidents had an average total flight time of 4,877 hours, with a range of 1 to 27,000 hours, and an average time in the type of accident aircraft of 1,027 hours, with a range of 1 to 8,000 hours.

5.5 Public Aircraft Operations

Public aircraft, as defined by FAA Act of 1958 (as amended), are "aircraft operated by or on behalf of the United States Government, a state, the District of Columbia, a territory or possession of the United States, or a political subdivision of one of these governments."[34] Public

[34] 49 USC 40102 (a) (37).

aircraft operations cover all aircraft used by any federal, state, or local government that is not used for commercial purposes. Their functions cover a very wide range of activities, from aerial firefighting and search and rescue to emergency management and police operations. Although some air medical flights are conducted under public aircraft operations, these flights have been excluded from this section because they were discussed in the Part 135 Air Medical section of this report. There is no common reporting practice for public aircraft operations, so no exposure data were listed either by BTS or the GA Survey.

Over the decade, 52 percent (156 out of 298) of accidents involving public aircraft occurred in fixed-wing airplanes and 48 percent (142 out of 298) occurred in helicopters. Figure 48 shows the number of total and fatal accidents for public aircraft operations conducted in fixed-wing airplanes between 2001 and 2010, and figure 49 shows the same data for helicopters.

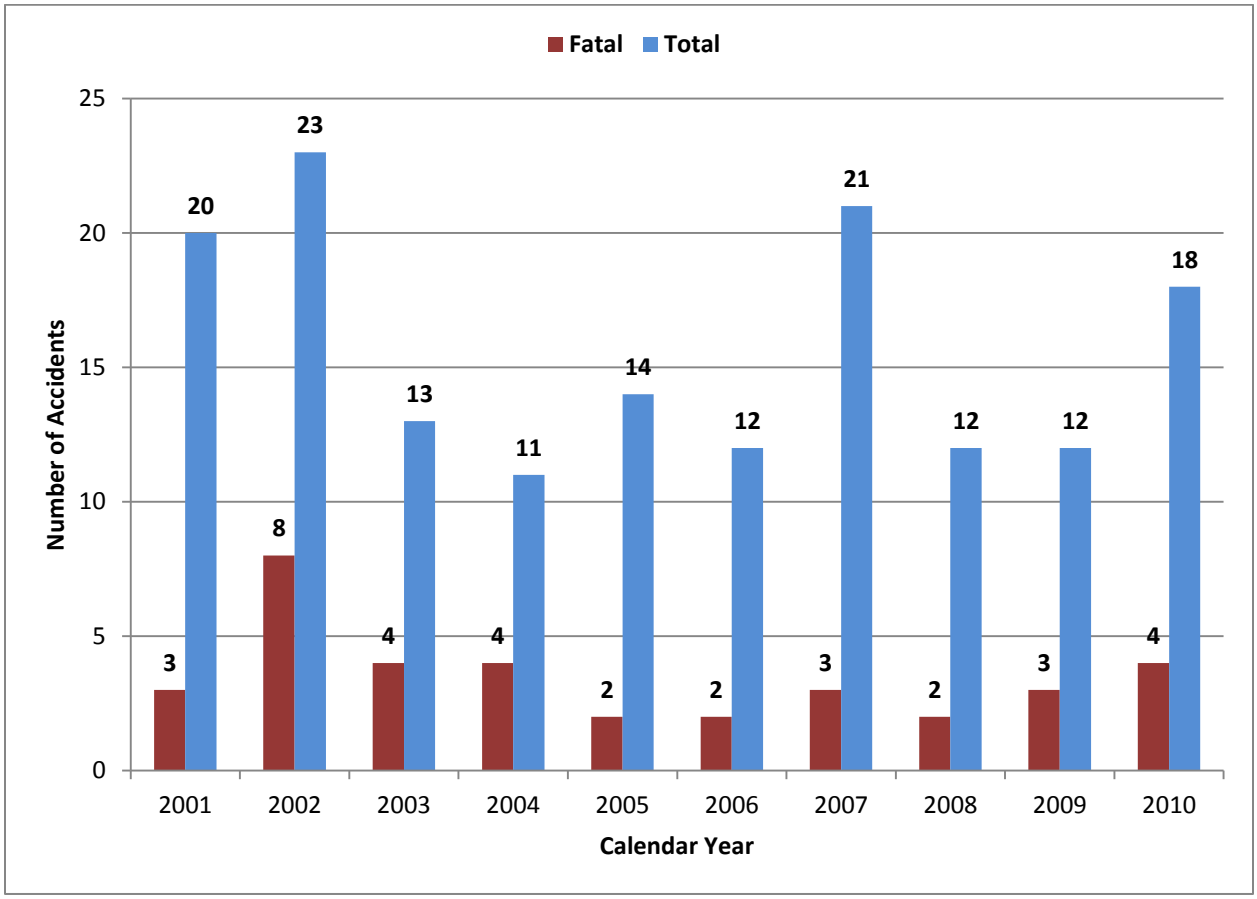

Figure 48. Total and fatal accidents of public aircraft operations involving fixed-wing airplanes, 2001–2010.

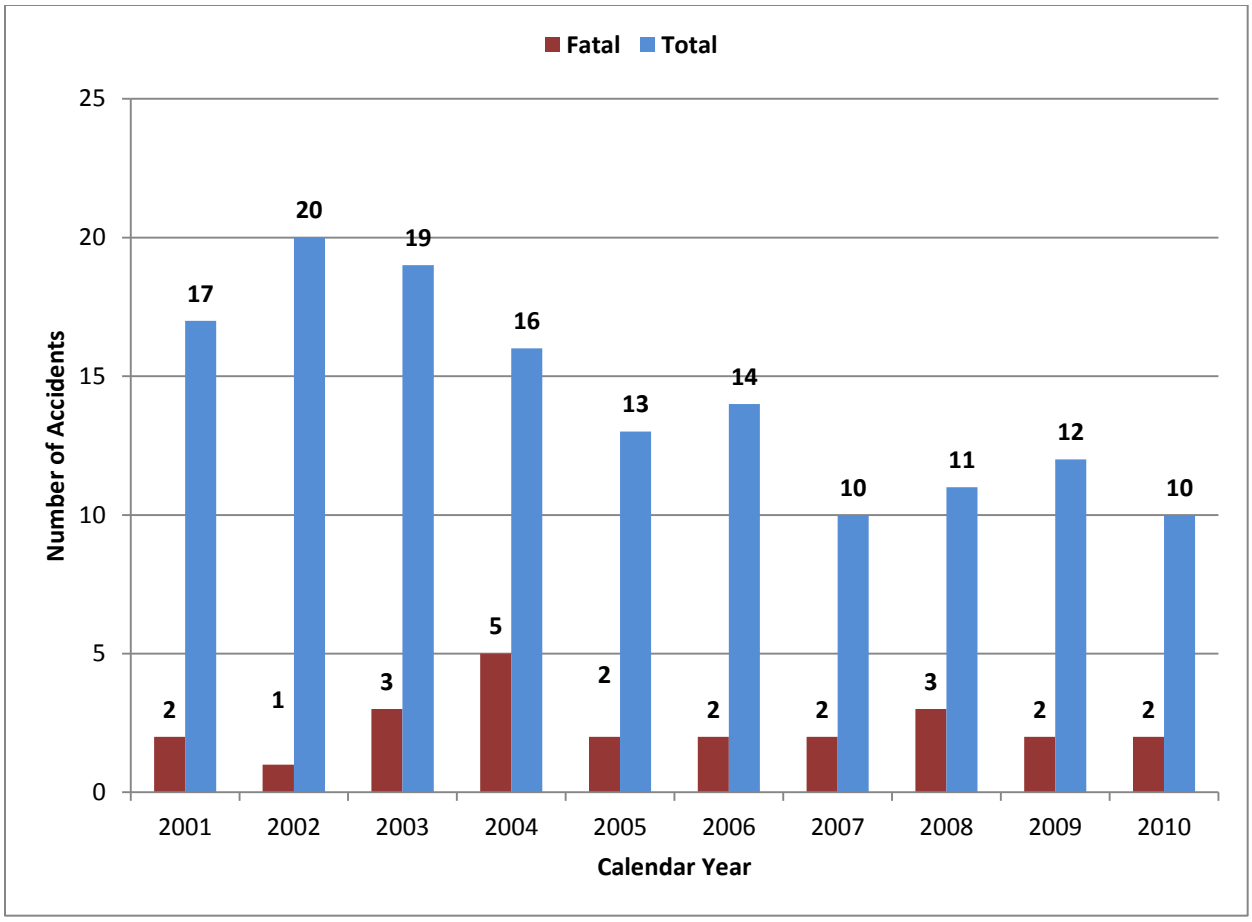

Figure 49. Total and fatal accidents of public aircraft operations involving helicopters, 2001–2010.

Table 18 lists the defining events for aircraft involved in accidents of public aircraft operations. System/component failure accounted for most of the defining events, followed by other collisions.

Table 18. Defining events for public aircraft operation accidents by aircraft type, 2010.

Defining Event	Fixed-Wing Airplane	Helicopter
System/Component Failure (Powerplant)	4	3
Other Collision	4	1
Loss of Control on Ground	3	0
Birdstrike	2	0
Controlled Flight into Terrain or Object	2	1
All Other	3	5

Table 19 shows the phase of flight associated with each defining event. The majority of all public aircraft accidents in fixed-wing aircraft occurred during the en route phase of flight. In contrast, helicopter public aircraft accidents were more prevalent in the maneuvering phase of flight.

Table 19. Phase of flight for public aircraft operation accidents by aircraft type, 2010.

Phase of Flight	Fixed-Wing Airplane	Helicopter
En Route	7	1
Landing	4	2
Maneuvering	1	6
Initial Climb	2	0
Uncontrolled Descent	1	1
Approach	2	0
Taxi	1	0

Pilots of fixed wing aircraft involved in these accidents had an average total flight time of 3,839 hours, with a range of 685 to 11,600 hours, and an average time in the type of accident aircraft of 728 hours, with a range of 106 to 1,426 hours. Pilots of helicopters involved in these accidents average total flight time was 8,654 hours, with a range of 929 to 18,000 hours. Their average time in the type of accident aircraft was 1,740 hours, with a range of 929 to 3,369 hours.

Appendix A

CAST/ICAO COMMON TAXONOMY TEAM AVIATION OCCURRENCE/EVENT CATEGORIES AND PHASE OF FLIGHT DEFINITIONS[35]

Aviation Occurrence/Event Categories

Occurrence/Event	Acronym	Description
Abnormal Runway Contact	**ARC**	Any landing or takeoff involving abnormal runway or landing surface contact.
Abrupt Maneuver	**AMAN**	The intentional abrupt maneuvering of the aircraft by the flight crew.
Aerodrome	**ADRM**	Occurrences involving aerodrome design, service, or functionality issues.
Bird	**BIRD**	Occurrences involving collisions/near collisions with birds or wildlife.
Air Traffic Management/Communications, Navigation, Surveillance	**ATM**	Occurrences involving air traffic management (ATM) or communications, navigation or surveillance (CNS) service issues.
Cabin Safety Events	**CABIN**	Miscellaneous occurrences in the passenger cabin of transport category aircraft.
Controlled Flight Into Terrain	**CFIT**	In-flight collision or near collision with terrain, water, or obstacle without indication of loss of control.
Evacuation	**EVAC**	Occurrences where either persons are injured during evacuation, an unnecessary evacuation was performed, evacuation equipment failed to perform as required, or the evacuation contributed to the severity of the occurrence.
Fire – Non-Impact	**F-NI**	Fire or smoke in or on the aircraft, in flight or on the ground, which is not the result of impact.
Fire – Post-Impact	**F-POST**	Fire or smoke resulting from impact.
Fuel Related	**FUEL**	One or more powerplants experienced reduced or no power output due to fuel exhaustion, fuel starvation/mismanagement, fuel contamination/wrong fuel, or carburetor or induction icing.
Ground Handling	**RAMP**	Occurrences during, or as a result of, ground handling operations.
Ground Collision	**GCOL**	Collision while taxiing to or from a runway in use.
Icing	**ICE**	Accumulation of snow, ice, freezing rain, or frost on aircraft surfaces that adversely affects aircraft control or performance.
Loss of Control on Ground	**LOC-G**	Loss of aircraft control while the aircraft is on the ground.

(continued)

[35] The defining event and phase of flight definitions and usage notes may also be found at the CICTT website: http://www.intlaviationstandards.org/.

Occurrence/Event	Acronym	Description
Loss of Control In Flight	**LOC-I**	Loss of aircraft control while in flight, or extreme deviation from intended flightpath.
Low Altitude Operation	**LALT**	Collision or near collision with obstacles while intentionally operating near the surface, excluding takeoff or landing.
Midair Collision	**MAC**	Loss of separation, near midair collisions and midair collisions between aircraft in flight.
Other	**OTHR**	Any occurrence not covered under another category.
Runway Excursion	**RE**	A veer off or overrun off the runway surface.
Runway Incursion - Animal	**RI-A**	Collision with or evasive action taken by an aircraft to avoid an animal on a runway or on a helipad/helideck in use.
Runway Incursion - Vehicle	**RI-VAP**	Any occurrence at an aerdrome involving the incorrect presence of an aircraft, vehicle or person on the protected surface designated for landing or takeoff of aircraft.
Security Related	**SEC**	Criminal/security acts which result in accidents or incidents.
System/Component Failure – Non-Power	**SCF-NP**	Failure or malfunction of an aircraft system or component other than the powerplant.
System/Component Failure – Powerplant	**SCF-PP**	Failure or malfunction of an aircraft system or component related to the powerplant.
Turbulence Encounter	**TURB**	In flight turbulence encounter.
Unintended Flight In IMC	**UIMC**	Unintended flight into instrument meteorological conditions.
Undershoot/Overshoot	**USOS**	A touchdown off the runway/helipad/helideck surface.
Unknown	**UNK**	Insufficient information exists to categorize the occurrence.
Windshear/Thunderstorm	**WSTRW**	Flight into windshear or thunderstorm.
External Load	**EXTL**	Occurrences during or as a result of external load or external cargo operations.
Collision on Takeoff or Landing	**CTOL**	Collision with obstacles during takeoff or landing while airborne.
Loss of Lift	**LOLI**	Landing en-route due to loss of lift conditions. Applicable only to aircraft that rely on static lift.
Glider Towing	**GTOW**	Premature release, inadvertent release or non-release during towing, or impact with towing aircraft or winch.

Phases of Flight

Phase	Acronym	Description
Standing	**STD**	Prior to pushback or taxi, or after arrival, at the gate, ramp or parking area, while the aircraft is stationary.
Pushback/Tow	**PBT**	Aircraft is moving in the gate, ramp, or parking area, assisted by a tow vehicle or tug.
Taxi	**TXI**	The aircraft is moving on the aerodrome surface under its own power prior to takeoff or after landing.
Takeoff	**TOF**	From the application of takeoff power, through rotation and to an altitude of 35 feet above runway elevation.
Initial Climb	**ICL**	From the end of the Takeoff sub-phase to the first prescribed power reduction, or until reaching 1000 feet above runway elevation or the VFR pattern, whichever comes first.
En route	**ENR**	IFR: From completion of Initial Climb through cruise altitude and completion of controlled descent to the Initial Approach Fix; VFR: From completion of Initial Climb through cruise and controlled descent to the VFR pattern altitude or 1000 feet above runway elevation, whichever comes first.
Maneuvering	**MNV**	Intentional low altitude or aerobatic flight operations.
Approach	**APR**	Instrument Flight Rules (IFR): From the Initial Approach Fix (IAF) to the beginning of the landing flare. Visual Flight Rules (VFR): From the point of VFR pattern entry, or 1000 feet above the runway elevation, to the beginning of the landing flare.
Landing	**LDG**	From the beginning of the landing flare until the aircraft exits the landing runway, comes to a stop on the runway, or when power is applied for takeoff in the case of a touch-and-go landing.
Emergency Descent	**EMG**	A controlled descent during any airborne phase in response to a perceived emergency situation.
Uncontrolled Descent	**UND**	A descent during any airborne phase in which the aircraft does not sustain controlled flight.
Post-Impact	**PIM**	Any of that portion of the flight which occurs after impact with a person, object, obstacle or terrain.
Unknown	**UNK**	Phase of flight is not discernable from the information available.

Appendix B

U.S. Civil Aviation Accidents, 2001–2010

The datasets used for this report are available at http://www.ntsb.gov/data/aviation_stats.html. Also available are the ArcGIS shape files used in creating the maps in this report.

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