National Transportation Safety Board

Review of U.S. Civil Aviation Accidents

Review of Aircraft Accident Data 2007–2009

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Review of U.S. Civil Aviation Accidents
2007–2009

National Transportation Safety Board

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Abstract: This Review of U.S. Civil Aviation Accidents, 2007–2009 reviews all civil aviation accidents investigated by the NTSB since the period covered by the 2006 Annual Reviews of Air Carrier and General Aviation Accidents. Both of those annual reviews were published in 2010, after the NTSB had determined the probable cause for virtually all of the accidents that had occurred during the reporting year. The present review is, thus, a significant departure from past practice, one that staff believes will provide for a more timely, comprehensive, and interesting review of the accident experience of U.S. civil aviation.

Civil aviation in the United States encompasses an extremely wide range of aircraft operations, from pleasure flights in light sport aircraft to helicopter emergency medical service (HEMS) operations to scheduled domestic and international passenger service in large transport aircraft. The first change in the format of this report is to include this entire range of flying within one document to provide a more comprehensive picture of U.S. civil aviation.

The statistical summaries in this report employ a coding structure developed by the Commercial Aviation Safety Team (CAST) of the International Civil Aviation Organization (ICAO) to describe the important circumstances of aviation accidents, rather than the probable cause determined by the NTSB for each individual accident. This change allows for the publication of a more timely report without diminishing its descriptive rigor. Probable cause for each accident will be published on the NTSB website as soon as it is available, and will also be used in aggregate analyses in statistical studies of specific safety issues conducted periodically.

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EXECUTIVE SUMMARY

During the three years from January 1, 2007, through December 31, 2009, a total of 5,019 U.S.-registered civil aircraft were involved in 4,958 accidents fatally injuring 1,641 persons. Table 1 shows the number of accidents, the number of fatal accidents, and the number of persons killed for each year in each of the major sectors of U.S. civil aviation.

	2007			2008			2009		
	Number of Accidents			Number of Accidents			Number of Accidents		
Sector	Total	Fatal	Fatalities	Total	Fatal	Fatalities	Total	Fatal	Fatalities
Total U.S. Civil Aviation	1745	303	540	1659	297	566	1554	276	535
Part 121	28	1	1	28	2	3	30	2	52
Part 135 Scheduled	3	0	0	7	0	0	2	0	0
Part 135 On Demand	62	14	43	58	20	69	47	2	17
Part 91–General Aviation	1652	288	496	1567	275	494	1477	273	475
Unregulated/Foreign Registration	27	7	10	13	5	8	16	4	4

Table 1. Total accidents, fatal accidents, and fatalities for all sectors of U.S. civil aviation, 2007–2009. The subcategories (Part 121, Part 135, and Part 91) sum to more than the total of U.S. civil aviation accidents because some accidents involve collisions between aircraft operated under different regulations and are, therefore, counted in more than one category.

The principal findings of this review of U.S. civil aviation accidents during the 2007–2009 period are as follows.

Part 121

The Part 121 accident rates per million departures and per million revenue flight hours have declined from 2000 to 2009. These rates have remained below 3 accidents per million departures and near 1.5 accidents per million revenue flight hours between 2007 and 2009.

Between 2007 and 2009, turbulence encounters during the en route phase of flight was the most common defining event for Part 121 accidents, followed by on-ground collisions between aircraft.

Part 135

Accidents and accident rates for scheduled Part 135 carriers have been relatively low and stable during the 2000–2009 period, and only 12 accidents (none fatal) occurred between 2007 and 2009. Most of these accidents occurred in Alaska, and all involved fixed-wing airplanes.

Both fixed-wing airplane and helicopter air taxi accidents have decreased slightly across the decade, but accident rates have increased in the past two years, driven primarily by a more rapid decline in air taxi flight hours than in the incidence of accidents.

Air Medical

Air medical accidents were dominated by helicopters flying emergency medical service operations, rather than transfers of medical patients between airports in either fixed-wing airplanes or helicopters.

EMS flights in helicopters, under Part 91 regulations (without patients aboard), exhibited substantially higher accident rates than any other category of air medical flying.

Sightseeing and Air Tours

Balloons accounted for about one-half of sightseeing accidents, with fixed-wing airplanes and helicopters accounting for roughly one-quarter each. Most balloon accidents involved non-fatal hard landing events.

Helicopters were used for most Part 135 air tour operations. More than half of air tour helicopter accidents involved system or component failures.

General Aviation

General aviation (GA) has experienced a substantial decline in flight activity across the decade and a modest decline in accidents. The overall accident rate has remained relatively flat at around 6 accidents per 100,000 flight hours, and the fatal rate has stayed at about 1 fatal accident per 100,000 flight hours.

Most general aviation accidents involved personal flights in single-engine airplanes.

The volume of personal flying has declined substantially over the decade, while the number of accidents has remained relatively flat, thus the accident rates have trended higher. The total accident rate per 100,000 flight hours is above 12, while the fatal accident rate is slightly above 2 per 100,000 flight hours.

Instructional flying has declined markedly across the decade, and the instructional accident rate has been relatively flat and below the overall GA rate. Loss of control on ground or in flight and hard landings were the primary defining events for instructional accidents, mostly on approach and landing or on takeoff.

Aerial application of agricultural products exhibited higher total and fatal accident rates than the average for all general aviation. Power plant failures, collisions due to low altitude operation, and loss of control in flight were the primary defining accident events for these agricultural flying operations.

Ferry and positioning accidents have declined slightly across the decade. Most ferry and positioning accidents involved piston aircraft. Power plant failures and loss of control in flight were the most common defining accident events for these aircraft. Exposure data are not available to compute accident rates.

Self-reported business flying activity and accidents declined across the decade. This segment of general aviation showed one of the lowest total accident rates (only slightly above 1 per 100,000 hours) and fatal accident rates (below .5 per 100,000 flight hours).

The number of public use accidents has declined moderately across the decade, but accident rates cannot be calculated because of the absence of exposure data.

INTRODUCTION

The National Transportation Safety Board's Review of U.S. Civil Aviation Accidents, 2007–2009 reviews all civil aviation accidents investigated by the NTSB since the period covered by the 2006 Annual Reviews of Air Carrier and General Aviation Accidents.[1] This report departs from previous Annual Reviews. First, previous annual reports of air carrier and general aviation accident experience were published as separate documents, but the present report reviews all U.S. civil aviation accident experience in a single report. Second, previous reports were published only after the National Transportation Safety Board (NTSB) had determined the probable cause for virtually all of the accidents that had occurred in the reporting year. This report provides a more timely review of recent aviation accident experience. In order to achieve this timeliness, this report is published prior to the adoption of the official probable cause for some of the accidents investigated during the reporting period.[2]

The statistical summaries provided in this report focus on the broad categories of civil aviation accidents and the kinds of operations, the types of aircraft, and the pilots involved in them. These categorizations use a coding structure developed by the Commercial Aviation Safety Team (CAST) of the International Civil Aviation Organization (ICAO). The CAST/ICAO Common Taxonomy Team (CICTT),[3] comprised of U.S. and international government and industry experts, has developed consensus coding of aircraft accident categories and associated phases of flight that are useful in describing the characteristic circumstances of aviation accidents. Multiple CICTT codes can be used to identify a sequence of events or occurrences leading to an accident. For ease of interpretation, the NTSB identifies one of the CICTT event codes as the defining event for each accident, and that is the categorization used in this report. Associated with each of the CICTT event codes is a specific phase of flight. Definitions of the event and phase of flight codes are presented in Appendix A.[4]

Civil aviation encompasses a wide range of aircraft, operated for many different purposes, from light sport aircraft operated by amateur pilots desiring to experience the joy of flying to helicopters engaged in emergency medical services to large transport aircraft providing scheduled passenger service. In the United States, civil aviation is regulated by the U.S. Federal Aviation Administration (FAA), and a broad distinction is made between commercial air carrier operations and general aviation operations. Air carriers are defined as operators that fly aircraft in revenue service, and these operators are regulated by Title 14 *Code of Federal Regulations* (CFR) Parts 121 and 135. Part 121 usually refers to operators who fly large transport-category aircraft in controlled airspace and controlled airports that have available specific weather, navigational,

1. *Annual Review of Aircraft Accident Data: U.S. Air Carrier Operations, Calendar Year 2006*, NTSB/ARC-10-01, (Washington, DC: National Transportation Safety Board, 2010); *Annual Review of U.S. General Aviation Accident Data 2006*, NTSB/ARG-10-01, (Washington, DC: National Transportation Safety Board, 2010).
2. Probable cause data will be considered in separate statistical studies of aviation accident issues published periodically by the NTSB, and these data will be made available online at: <http://www.ntsb.gov/aviation/stats.htm>.
3. 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.
4. The event and phase of flight definitions and usage notes may also be found at the CICTT website: <http://www.intlaviationstandards.org/>.

operational, and maintenance support. Part 135 regulates commercial air carriers flying smaller aircraft with nine or fewer passenger seats, often into smaller airports that do not provide the services required to support Part 121 operations. Air carrier operations under either Part 121 or Part 135 may be scheduled, meaning that the operator offers, in advance, the departure location, departure time, and arrival location. Operations may alternatively be non-scheduled or on-demand, meaning that the departure location, departure time, and arrival location are negotiated with the customer. Non-scheduled Part 121 operations include cargo flights and certain charter flights in transport-category aircraft, whereas on-demand Part 135 operations include charter, air-taxi, and certain medical transport operations.

General aviation is any civil aircraft operation that is not covered by 14 CFR Parts 121 or 135 (or Part 129, which applies to foreign air carriers). An extremely wide variety of flying operations, using a broad range of aircraft, are included within general aviation. Most non-commercial aviation, including personal flying and business flying, is governed by Part 91 regulations. Some commercial, or revenue, operations, such as flight instruction, aerial application of agricultural products, paid sightseeing, some air medical flights, and executive/corporate flying, are conducted under Part 91. Non-revenue ferry and repositioning flights of aircraft normally flown in revenue service under Parts 121 or 135 are also included under Part 91, as are public use operations of Federal, state, and local government agencies. The accident rates of each of these sectors of U.S. civil aviation will be discussed in subsequent sections of this report.

COMMERCIAL AIR TRANSPORT ACCIDENTS—PART 121

This section provides a summary of the activity and accident experience of large transport aircraft engaged in revenue operations involving the transport of both passengers and cargo.

Part 121 Flight Activity

Figure 1 summarizes the activity in all of U.S. commercial aviation regulated by 14 CFR Part 121 from 2000 through 2009. The majority of Part 121 flying during this period involved domestic passenger services. Figure 2 shows the number of passengers who flew, systemwide, during this period.

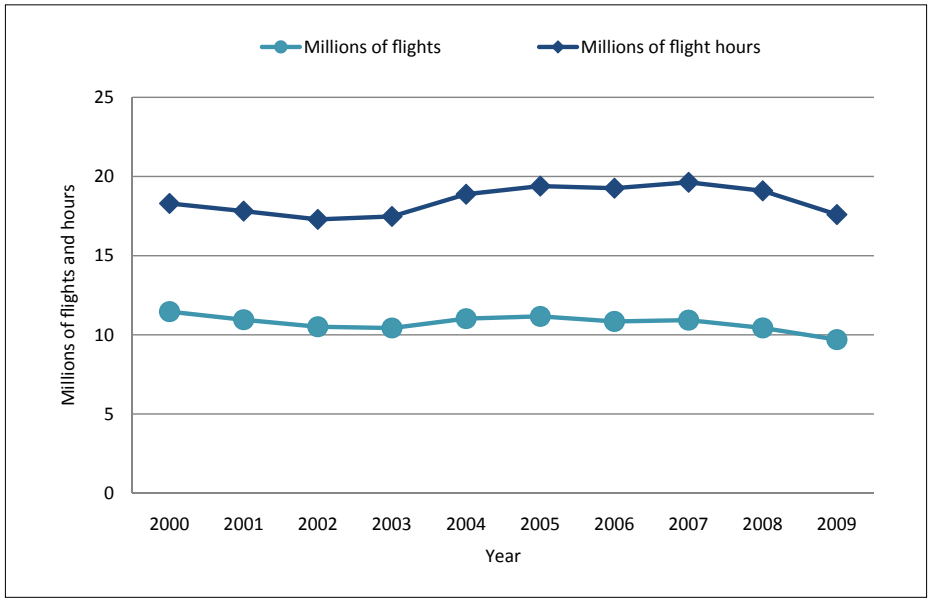

Figure 1. Systemwide Part 121 flights and revenue flight hours (both in millions) per year, 2000–2009. Data provided by the FAA.

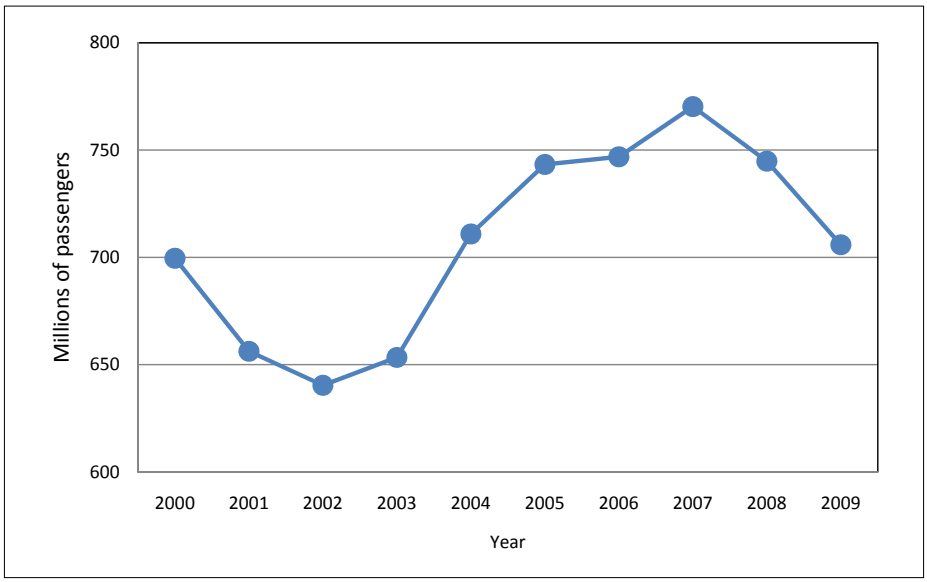

Figure 2. Total Part 121 passenger enplanements, systemwide, 2000–2009. Data provided by the FAA.

Declines in all of these activity measures are apparent during 2008 and 2009.

Part 121 Accident Experience

The NTSB uses the classification scheme shown in table 2 to categorize Part 121 aviation accidents according to their severity.[5]

Severity	Criteria
Major	The aircraft was destroyed (a hull loss in industry terminology), 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.

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

Table 3 summarizes Part 121 accidents between 2000 and 2009 according to the NTSB severity classification. Most of the Part 121 accidents throughout the decade were either injury or damage accidents.

5. "NTSB Notice of Proposed Statistical Reporting Changes and Request for Comment," *Federal Register*, vol. 61, no. 235 (December 5, 1996), p. 64540-64541.

Severity	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Major	3	5	1	2	4	2	2	0	4	2
Serious	3	1	1	3	0	3	2	2	1	3
Injury	20	19	14	24	15	11	7	14	8	15
Damage	30	21	25	25	11	24	22	12	15	10

Table 3. Part 121 accidents by NTSB severity classification, 2000–2009.

It is important to consider accidents in relation to their relative risk of occurrence on the basis of an appropriate measure of exposure to that risk. Figure 3 normalizes, or adjusts, total annual accident counts by two such exposure measures: the total number of flights and the number of revenue flight hours reported by the air carriers. Both depend upon the availability of accurate measures of risk exposure (e.g., departures and revenue flight hours) which, in the case of Part 121 operators, are reported to the Office of Airline Information within the Bureau of Transportation Statistics.[6]

These reports represent a 100 percent census of air carrier activity. For accident risks associated principally with takeoffs and landings (e.g., hard landings and runway excursions) the number of flights or departures provides a good basis to normalize exposure to risk. On the other hand, for risks that are mainly associated with the time aloft (e.g., turbulence encounters and crew fatigue) the total flight time can provide a better index of exposure. Both types of rates are presented in the aggregate analyses of this section.

The data points in this graph are the overall accident rates per million departures (flights), and per million revenue flight hours. Overall Part 121 accident rates have decreased markedly since the beginning of the decade and have remained below 3 per million departures and well below 2 per million revenue flight hours during the 2007 through 2009 period.

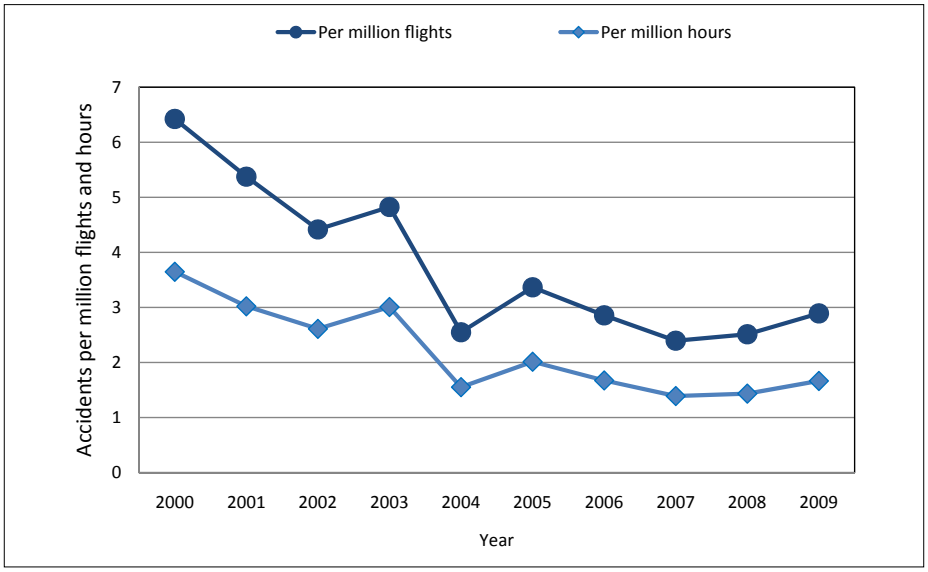

Figure 3. Annual Part 121 accident rates per million departures (flights) and per million revenue flight hours, 2000–2009. Data based on U.S. Department of Transportation's Office of Airline Information Schedule T-100 data.

6. Reporting required by 14 CFR Part 217 and Part 241.

Details of Part 121 Accidents between 2007–2009

There were a total of 91 Part 121 aircraft involved in 86 accidents from 2007 through 2009 (five of the accidents involved collision/contact between 10 Part 121 aircraft). Figure 4 shows the geographic distribution of the 79 accidents for which geospatial coordinates were available.

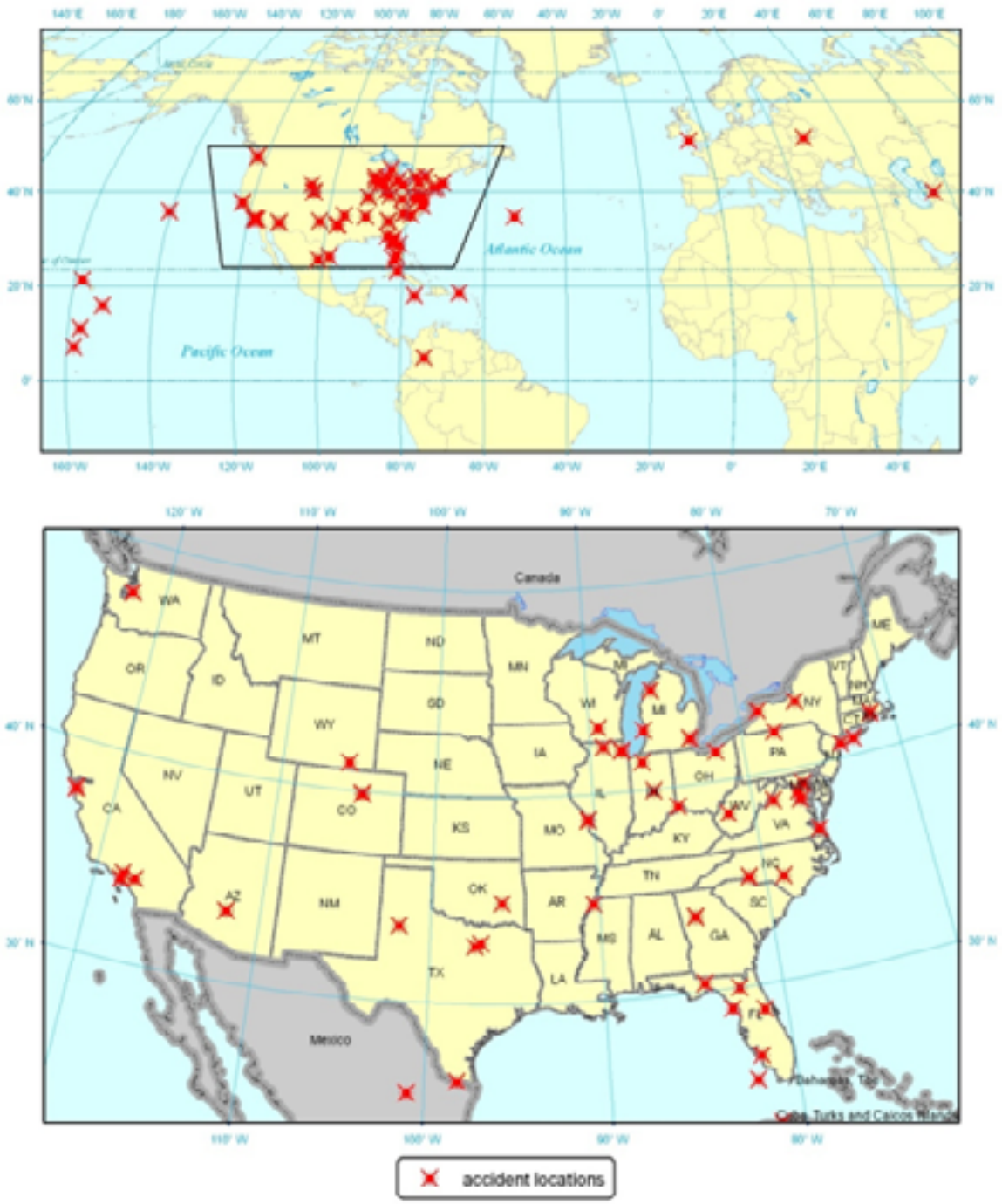

Figure 4. Part 121 accidents worldwide and in the United States for accidents with available GPS coordinates, 2007–2009. (Some turbulence encounters and foreign accidents lacked these data.)

Table 4 shows the distribution of aircraft involved in total and fatal (shown in parentheses) accidents. Accident summaries are presented for: cargo versus passenger operations; domestic versus international routes; and scheduled versus non-scheduled flights. Most of the accidents involved scheduled, domestic, passenger flights. On the other hand, the most severe Part 121 accidents did not conform to this pattern. The five fatal Part 121 accidents involved 3 non-scheduled, international, cargo flights; 1 non-scheduled, domestic passenger flight; and only one scheduled, domestic, passenger flight. A total of 59 persons were fatally injured in these five accidents, including 50 in the crash of the scheduled, domestic, passenger flight of the Colgan Air turboprop airplane in New York in February 2009.[7]

	Number of aircraft involved in accidents (fatal accidents)			
Operational Dichotomies	2007	2008	2009	Total
Passenger	28 (1)	25 (0)	27 (1)	80 (2)
Cargo	1 (0)	7 (2)	3 (1)	11 (3)
Domestic	20 (1)	25 (0)	21 (1)	66 (2)
International	9 (0)	7 (2)	9 (1)	25 (3)
Scheduled	27 (0)	24 (0)	26 (1)	77 (1)
Non-Scheduled	2 (1)	8 (2)	4 (1)	14 (4)
Total	29 (1)	32 (2)	30 (2)	91 (5)

Table 4. Part 121 accidents by the operational dichotomies passenger versus cargo; domestic versus international; and scheduled versus non-scheduled, 2007–2009. (Note that each dichotomy sums to the total row.)

Accident Categories

Figure 5 shows the distribution of accidents by the defining event for the four categories of aircraft[8] (wide body jets, narrow body jets, small jets, and turboprop aircraft) used in Part 121 operations. Figure 6 shows the phases of flight associated with these events, again by aircraft category.

7. See <http://www.ntsb.gov/investigations/summary/AAR1001.html> for a summary of the NTSB report on this accident. The full accident report is also available through this link.

8. For the purpose of this report wide body jets are large, twin aisle (in passenger configuration) jet transports such as the B-747/767/777 and A-330/340/380; narrow body jets are medium range, single-aisle jet aircraft such as the DC-9/MD-80, A-320, AND B-737 models; Small jets are short- to medium-haul jet aircraft such as the Embraer ERJ, Bombardier CRJ, usually with less than 100 seats; turboprop aircraft are short- to medium-haul gas turbine-powered aircraft with propellers such as the ATR-42/72 and Bombardier DHC-8/Q400.

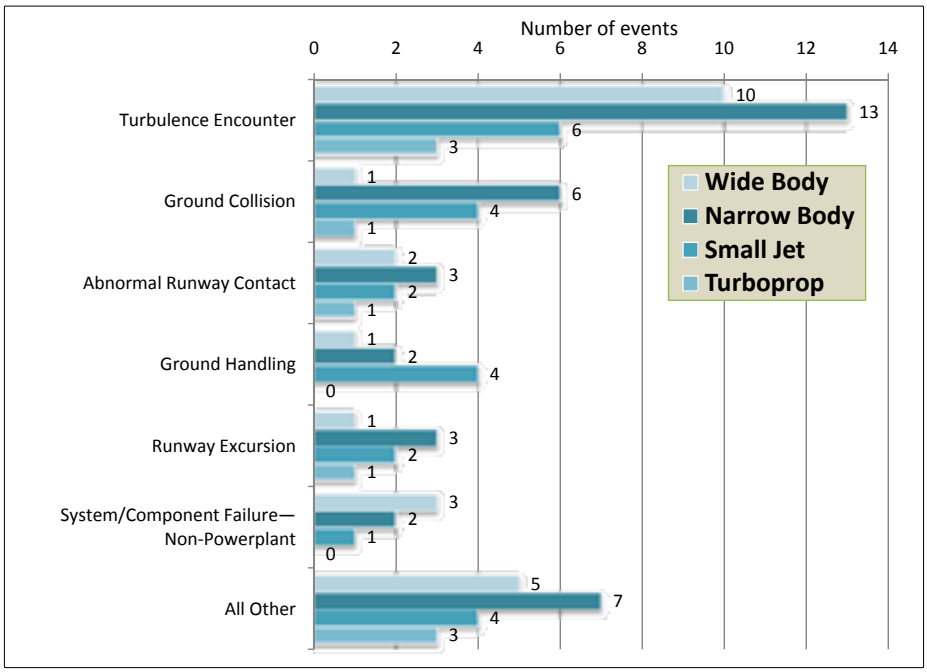

Figure 5. Most frequently observed defining events for Part 121 aircraft accidents by aircraft type, 2007–2009.

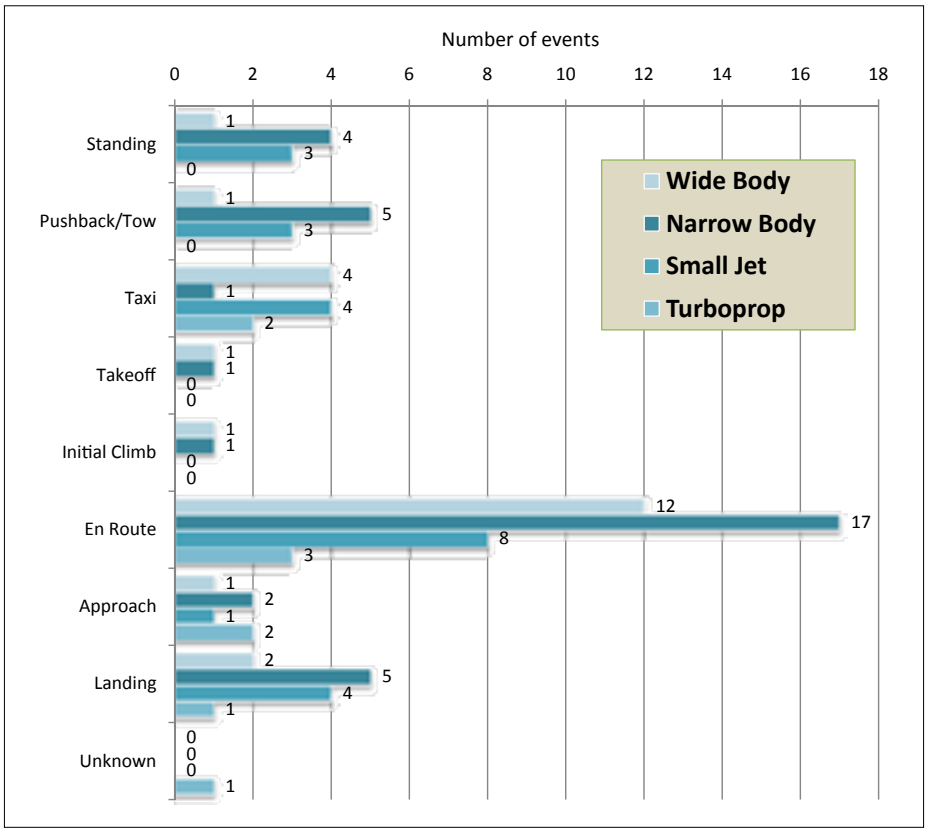

Figure 6. Phase of flight associated with the defining accident events for Part 121 accident-involved aircraft by aircraft type, 2007–2009.

By far the most prevalent type of accident, for all types of aircraft, was a turbulence encounter. Turbulence encounters accounted for more than one-third of the accident events, and all but one of the 32 encounters with turbulence occurred during en route phases of flight (the other was on approach). Most of these accidents (29 of 32) resulted in serious injury to a single passenger or cabin crew member, but in one case two persons were seriously injured and in another case six persons were seriously injured. Minor aircraft damage was reported in only 2 of the 32 turbulence accidents. All of these accidents fall within the NTSB injury accident severity category.

The next most frequent event, particularly for narrow body and small jet aircraft, were ground collisions between aircraft or between aircraft and ground vehicles, such as tugs and baggage carts. There were eight ground collision accidents involving 12 Part 121 aircraft. Only 5 of the 12 aircraft involved in ground collisions were moving under their own power, 2 were standing and 5 were being pushed or towed by tugs. Only one of these accidents resulted in a serious personal injury, but 10 of the 12 aircraft were substantially damaged. Instrument meteorological conditions were reported for only one of the ground collision accidents.

A tail strike on landing. Abnormal runway contact encompasses several types of incidents, including long/fast landings, off-center landings, crabbed landings, and nose-wheel first touchdowns. (Photo courtesy Airliners.net, Thomas Luthi.)

Abnormal runway contact events, such as hard landings and tail strikes, were the third most common category of defining accident event, particularly for the three categories of jet aircraft. One of these accidents, involving a wide body aircraft on landing in Narita, Japan, destroyed the aircraft and fatally injured the two crew members. One other abnormal runway contact accident resulted in a serious injury to an individual. Six of the eight aircraft involved in these accidents were substantially damaged. Seven of the eight abnormal runway contact accidents occurred on landing. The phase of flight was unknown for the other aircraft because the accident was only recorded after the structural damage had been found upon inspection of the aircraft and it was not determined when the damage had been done.

Ground handling was the fourth largest category of defining accident events, with all seven of the involved aircraft experiencing substantial damage but no persons experiencing injury. One of these six accidents involved two Part 121 aircraft that were pushed into each other by tugs. Five of the seven aircraft were standing or being pushed or towed when the ground handling accident occurred.

This Boeing 737 airplane was destroyed during a runway excursion when it ran off the runway while attempting takeoff.

Runway excursions were observed in five landing and two takeoff accidents. The most severe runway excursion destroyed a Boeing 737 airplane during an attempted takeoff from the Denver International Airport[9] on December 20, 2008, and resulted in serious injuries to five individuals aboard. The other six aircraft involved in runway excursion events were substantially damaged. Visual meteorological conditions (VMC) were reported in four of the seven accidents.

System or component failures, other than in power plants, accounted for six accidents and resulted in the destruction of one aircraft and substantial damage to four others. One of the six accidents resulted in serious injury to an individual. Four of the accidents occurred while the aircraft was airborne, two during en route flight, and two on approach.

9. The full report of this accident is available at <http://www.ntsb.gov/investigations/summary/AAR1004.html>.

The other event categories accounted for relatively small numbers of both accidents and aircraft. Notably, the most catastrophic accident during this three year period, the crash of the Colgan Air[10] turboprop aircraft that killed 49 passengers and crew aboard the aircraft and one individual on the ground, resulted from a loss of control in flight. There were four accidents resulting from bird strikes. Appendix B provides a link to a listing of all 91 accident-involved aircraft.

Accident Pilot Characteristics

Table 5 summarizes the age and flight experience of accident pilots as a function of the type of aircraft involved in Part 121 accidents from 2007–2009. These demographics describe at least two different cadres of pilots. Pilots of the narrow body and wide body jet aircraft were, on average, a decade older than the pilots of small jets and turboprop aircraft. The pilots of the two groups of larger jet-powered aircraft also had more than twice as much total flying experience than the small jet and turboprop pilots. Interestingly, the difference among the groups in relation to the time spent in the type of aircraft is not substantial.

Pilot Age/ Flight Experience	Aircraft Type			
	Wide Body	Narrow Body	Small Jet	Turboprop
Pilot Age	51.5 (40–60)	49 (39–59)	37 (26–56)	36 (26–47)
Total Flying Time (hours)	11,196 (5,004–15,000)	11,178 (4,000–22,500)	5,965 (3,749–22,812)	3,481 (2,250–7,800)
Time in Aircraft Class (hours)	2,394 (193–7,591)	4,246 (303–19,300)	2,751 (101–4,772)	2,000 (110–3,789)

Table 5. Average (median) and range of accident pilot age and flight experience by aircraft type, 2007–2009.

10. The full report of this accident is available at <http://www.ntsb.gov/investigations/summary/AAR1001.html>.

COMMERCIAL AIR TRANSPORT ACCIDENTS—PART 135

Title 14 CFR Part 135 governs both scheduled (primarily passenger service) 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 certain air tour operations. Figure 7 shows the locations of the 183 Part 135 accidents that occurred between 2007 and 2009.

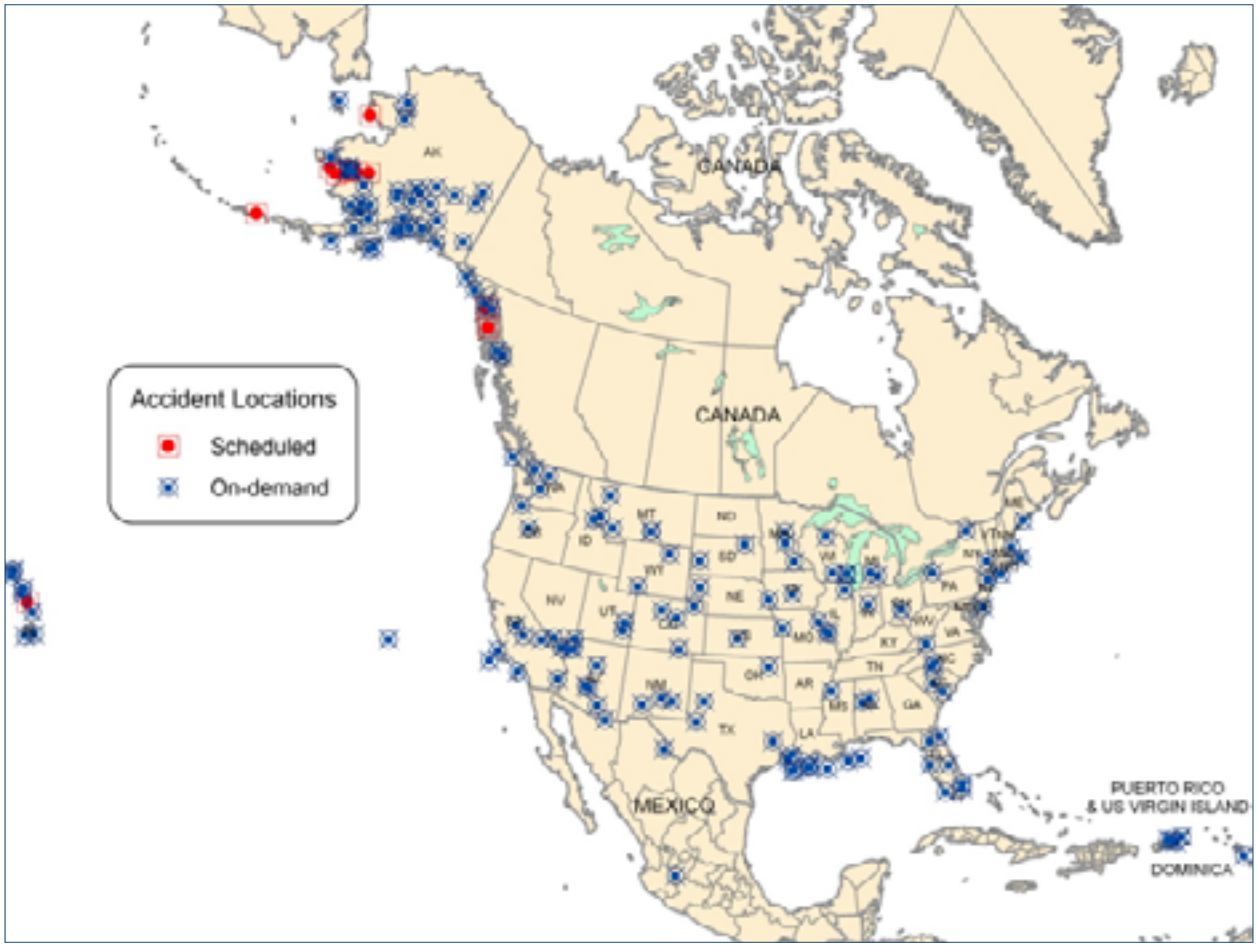

Figure 7. Locations of accidents for scheduled (red) and on-demand (blue) Part 135 operators, 2007–2009.

Scheduled commuter service and air taxi accidents will be discussed separately in this section. Air medical and air tour/sightseeing accidents will also be covered here; although, these operations are conducted under both 14 CFR Part 135 and Part 91.

Accidents of Scheduled Part 135 Operators

Scheduled passenger operations governed by Part 135, sometimes referred to as "commuter aviation," are restricted to aircraft with 9 or fewer passenger seats.

Figure 8 shows the flight activity of this segment of commercial aviation from 2000 to 2009. This activity level has been relatively stable during that period.

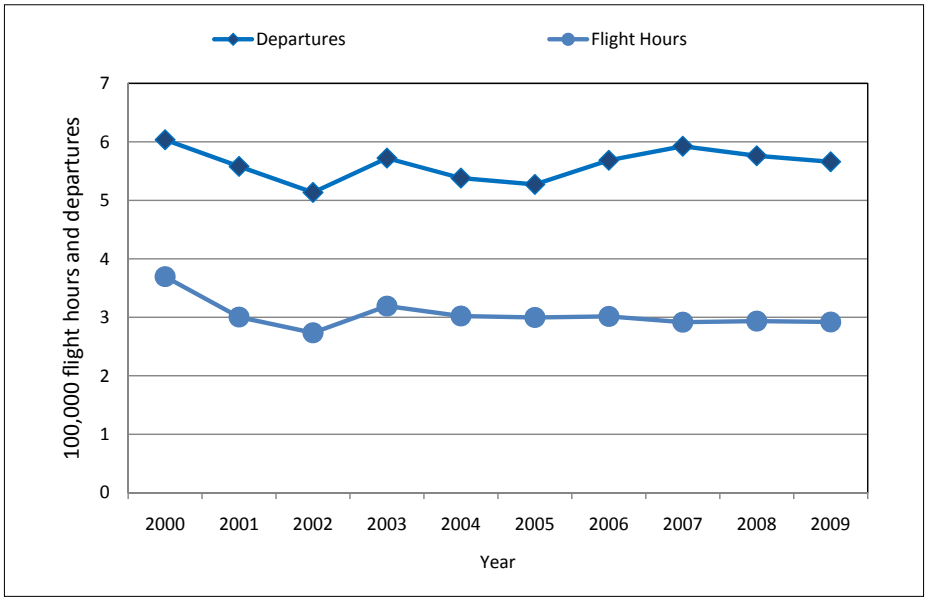

Figure 8. Scheduled Part 135 flying activity, departures (flights) and revenue flight hours, 2000–2009.

Figure 9 shows the accidents by scheduled Part 135 carriers. Figure 10 shows the accident rates, per 100,000 departures and per 100,000 flight hours.

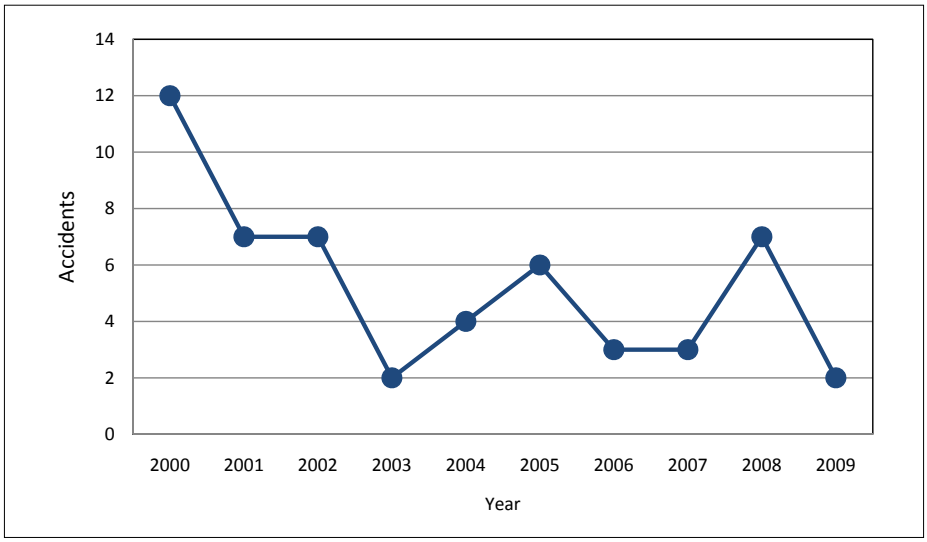

Figure 9. Accidents by scheduled Part 135 carriers, 2000–2009.

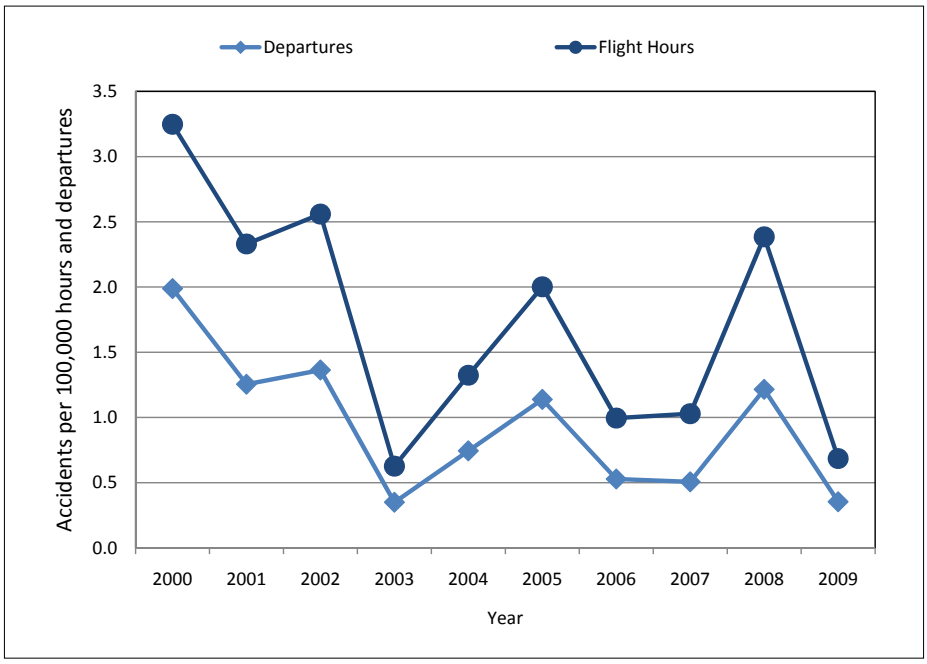

Figure 10. Accident rates per 100,000 departures and per 100,000 flight hours for scheduled Part 135 operators, 2000–2009.

There were a total of 12 accidents of scheduled Part 135 operators (none of them fatal), involving 13 aircraft, between 2007 and 2009. One accident was a ground collision between two scheduled Part 135 commuter aircraft. All were fixed-wing airplanes, and all but one occurred in Alaska (the other accident occurred in Hawaii). Three aircraft were single-engine turboprops, six were single-engine piston aircraft, and four were twin-engine piston aircraft. In these 12 accidents, three passengers were seriously injured, and the remaining 20 passengers and crew received minor or no injuries. One of the 13 aircraft was destroyed in the accident, and the other 12 were substantially damaged. Appendix B contains a link to a listing of the 13 aircraft and the circumstances of the accidents.

The Cessna Caravan 208 is a typical Scheduled Part 135 airplane.

The thirteen accident-involved aircraft experienced a range of different defining accident events during different phases of flight, and there was far less commonality among these occurrences than was the case for the more numerous Part 121 accidents during the three-year period. As indicated previously, two of the aircraft were involved in a single ground collision. Three aircraft collided with objects during takeoff or landing and two were involved in ground handling accidents. Single instances of power plant failures, loss of control in flight, fuel exhaustion, fire not associated with impact, controlled flight into terrain, and an undetermined event accounted for the remaining accidents. Three accidents, involving four aircraft, occurred on the ground; the remaining nine accidents occurred during airborne phases of flight.

Nine of the 12 accidents (involving 10 aircraft) occurred in daytime, two at dusk, and one in dark-night

light conditions. Ten accidents occurred under VMC, only two occurred under instrument meteorological conditions (IMC). The median age of the 13 pilots involved in these accidents was 49, with a range from 24 to 66. Median total flying time was 3,791 hours, ranging from 800 to 24,850 hours. Median time in the type of accident aircraft among the 13 pilots was 1,110 hours, with a range from 98 to 7,402 hours.

Air Taxi Accidents under Part 135

The largest of the on-demand categories of commercial flying regulated by Part 135 is the air taxi sector. Figure 11 shows the activity of fixed-wing airplanes and helicopters making up the air taxi fleet from 2004 through 2009. Air medical and air tour operations are not included in this figure and are addressed later in this section.

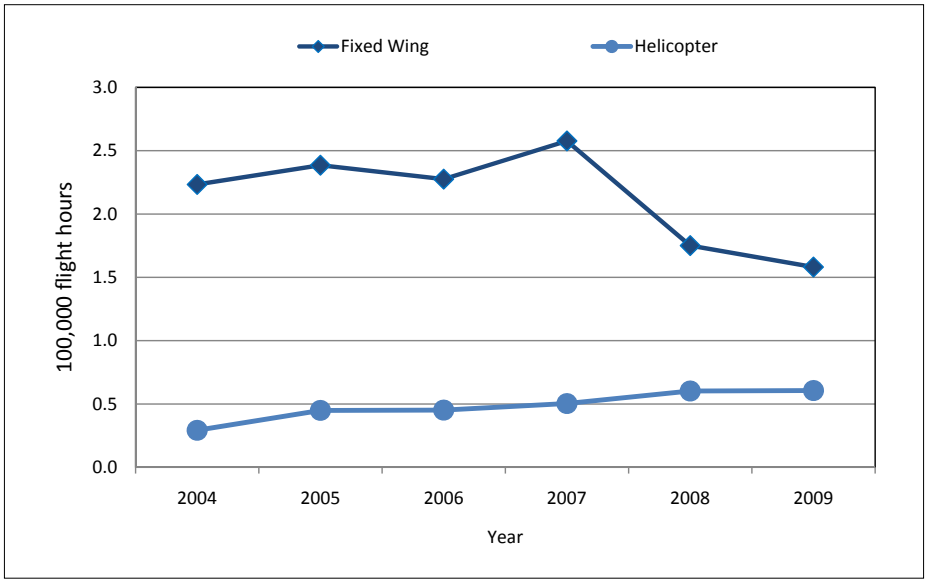

Figure 11. Air taxi flight hours (excluding air medical and air tour operations) estimated from the FAA's General Aviation and Part 135 Activity Survey, 2004–2009.

The Cessna 421 is a common air taxi fixed-wing airplane used in on demand operations.

Unlike the scheduled Part 135 carriers, air taxis (and air medical and air tour operators) are not required to submit reports accounting for all flight operations, including each departure, revenue flight hours, passenger enplanements, and similar data. Instead, the activity of nonscheduled Part 135 operations is estimated using the annual General Aviation and Part 135 Activity (GAP135A) Survey. This voluntary survey is sent to all air taxi operators, and exposure data are derived from these estimates of annual revenue flight hours. The FAA survey has only distinguished between Part 135 air taxis and other nonscheduled Part 135 operations since 2004. Most air taxi operations were conducted in fixed-wing airplanes, and

this activity has declined markedly since 2007. Helicopter flight hours have increased modestly throughout the six-year period.

Figure 12 shows the number of air taxi accidents for both fixed-wing airplanes and helicopters during the last decade. The majority of these accidents, as well as flight hours, involved fixed-wing airplanes.

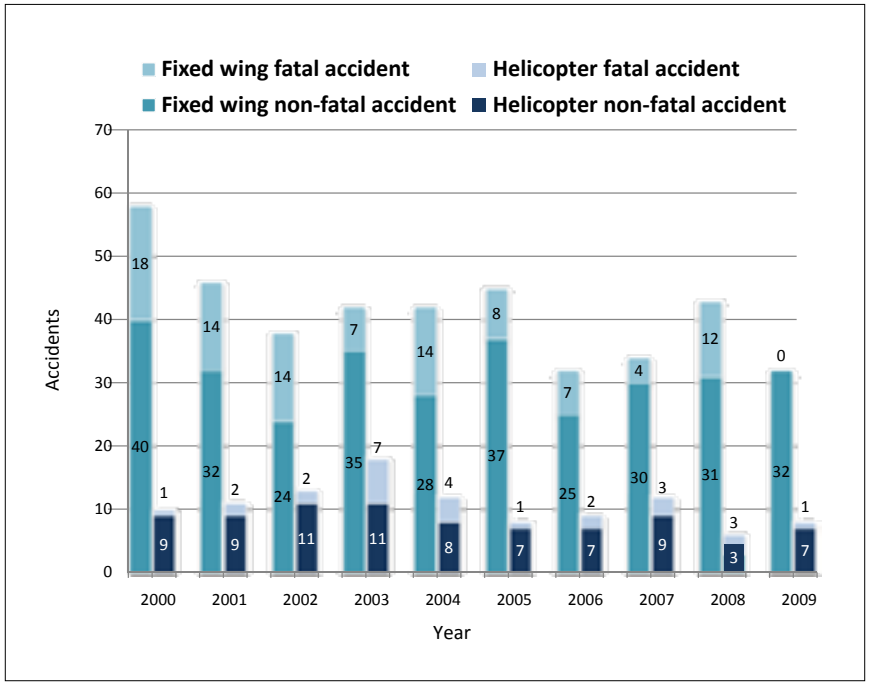

Figure 12. Air taxi accidents and fatal accidents by aircraft type, 2000–2009.

Figure 13 shows the air taxi accident rates since 2004, when the FAA began segregating these data in the activity survey.

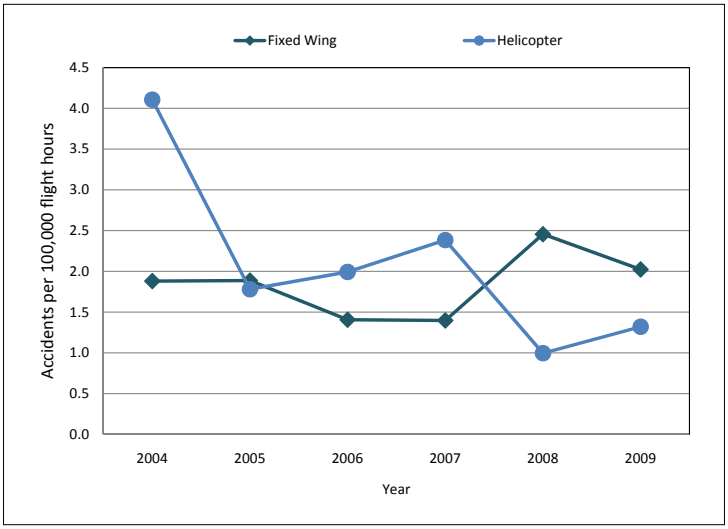

Figure 13. Air taxi accidents per 100,000 flight hours by aircraft type, 2004–2009.

There were 111 fixed-wing air taxi airplanes involved in 109 accidents from 2007 through 2009. Sixteen of these accidents resulted in fatal injuries to 43 individuals. During this period, there were 26 helicopters involved in 26 accidents, including 7 that were fatal to 27 individuals. Most of the accidents occurred during daylight conditions (69 of the 111 fixed-wing airplane accidents, and 23 of the 26 helicopter accidents). Similarly, most accidents (88 of 109 fixed-wing airplane and 22 of 26 helicopter accidents) occurred under VMC. Ten of the fixed-wing airplane air taxis were destroyed in these accidents and 100 were substantially damaged (1 airplane was undamaged). Six accident-involved air taxi helicopters were destroyed and the remaining 20 were substantially damaged.

Figure 14 shows the defining accident events for the 109 fixed-wing airplane air taxi accidents that occurred between 2007 and 2009, including the 16 fatal accidents. Loss of control in flight and controlled flight into terrain accounted for 12 of the 16 fatal fixed-wing airplane air taxi accidents. The most common defining event for fixed-wing airplane accidents was abnormal runway contact, although system component failures of both power plants and non-power plants accounted for nearly one-quarter of the total accidents. Loss of control in flight and ground collisions were the next most common events overall.

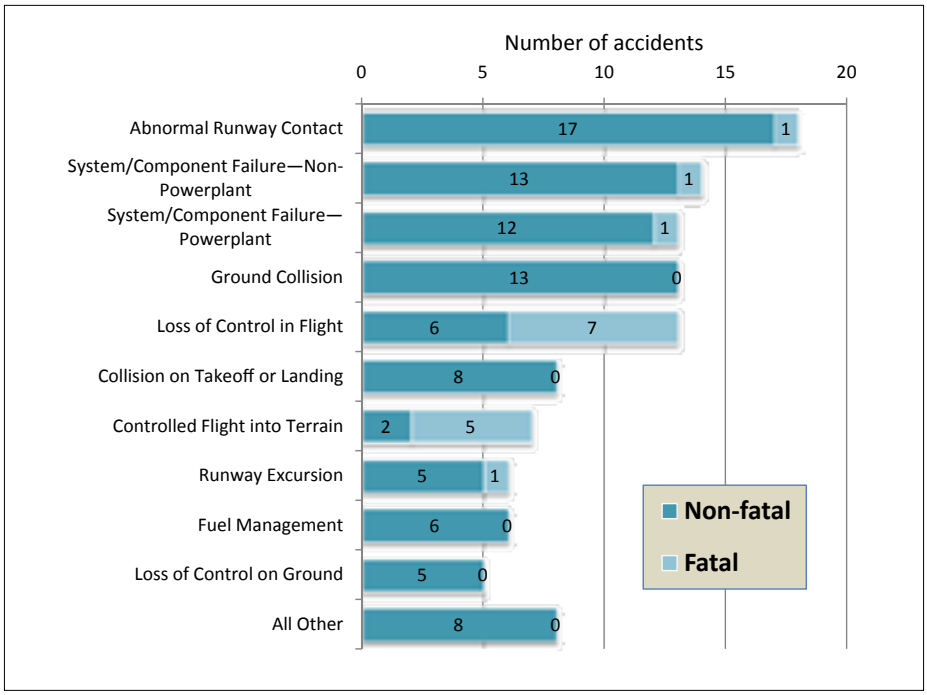

Figure 14. Defining accident events for fatal and non-fatal fixed-wing airplane air taxi accidents, 2007–2009.

Figure 15 shows the phases of flight associated with these defining events for fatal and non-fatal fixed-wing airplane accidents. All of the fatal crashes occurred during airborne phases of flight, with approach, en route, and initial climb accounting for approximately equal proportions of the fatal accidents. Landing was the most common phase of flight for total accidents, which is consistent with the fact that the largest number of total accidents involved abnormal runway contact. Significant numbers of total accidents occurred during airborne phases, including takeoff, initial climb, and en route.

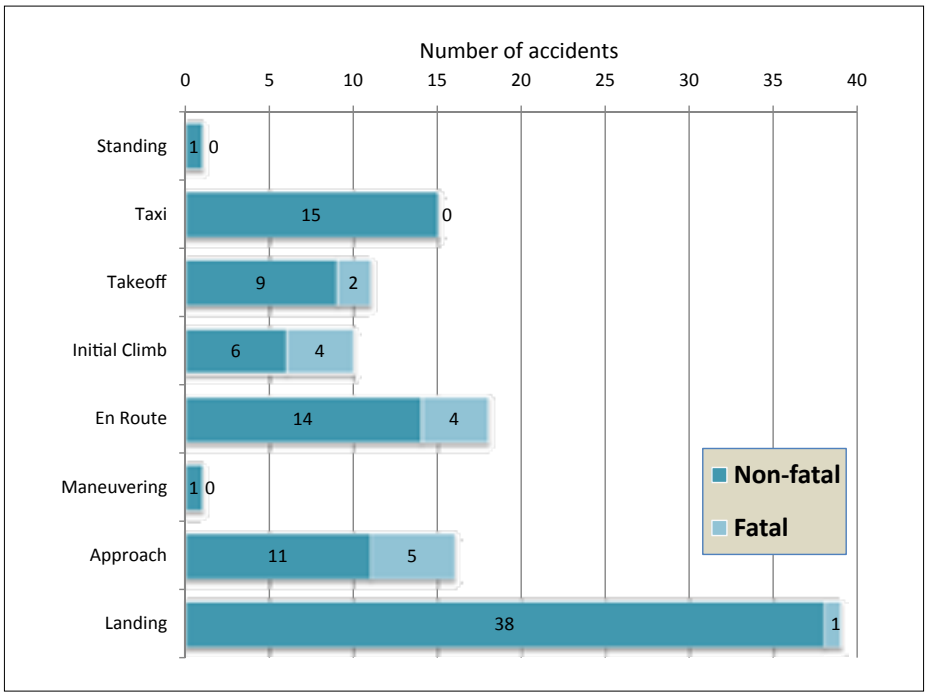

Figure 15. Phase of flight associated with the defining events for fatal and non-fatal fixed-wing airplane air taxi accidents, 2007–2009.

Figure 16 shows the defining events for the 26 helicopter air taxi accidents, including the 7 fatal crashes.

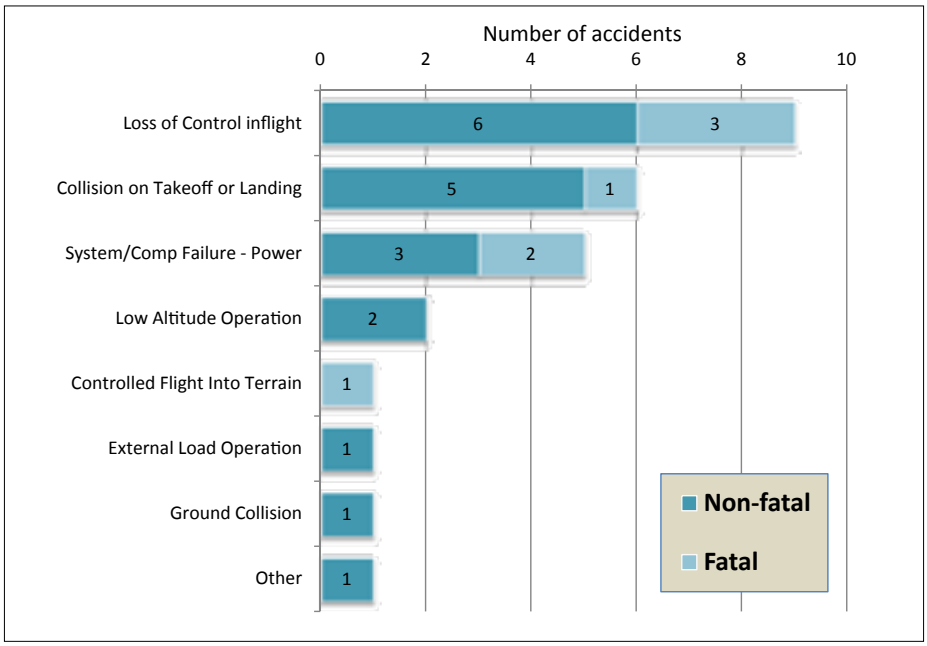

Figure 16. Defining accident events for fatal and non-fatal helicopter air taxi accidents, 2007–2009.

Loss of control in flight was the most common event for both fatal and non-fatal helicopter crashes, followed by collisions on takeoff or landing and system component failure of the power plant. Figure 17 shows the phases of flight associated with these events.

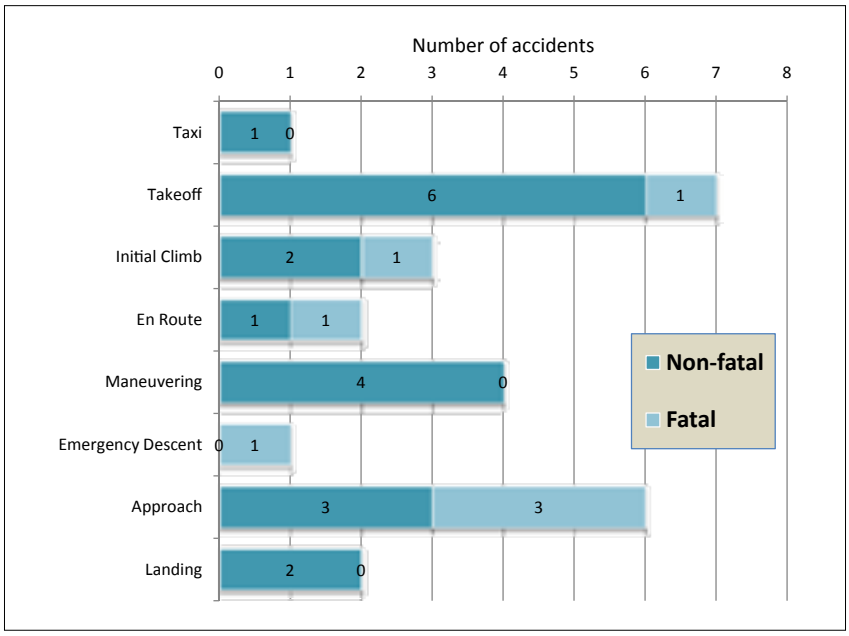

Figure 17. Phases of flight associated with events for fatal and non-fatal helicopter air taxi accidents, 2007–2009.

Takeoff, approach, and maneuvering phases of flight were associated with the largest number of total accidents and with more than half of the fatal accidents.

The median age of accident-involved, fixed-wing airplane air taxi pilots was 41 years (ranging from 20 to 78) compared with a median age of 51 years (ranging from 25 to 73) for accident-involved helicopter pilots. Fixed-wing airplane pilots involved in air taxi accidents had a median of 4,500 hours total flight experience and 685 hours in the type of accident aircraft. Accident-involved helicopter pilots had a median total flying time of 7,200 hours, with a median of 920 hours in the type of accident helicopter.

EMS helicopters, such as the one shown, operate under both Part 135 and Part 91, depending on whether patients are on board.

Air Medical Accidents under Parts 135 and 91

Air medical operations are conducted under both Part 135 and Part 91, depending on whether patients are being carried on board the aircraft. Trips en route to pick up patients or organs, or to reposition aircraft after accomplishing patient transport operations, are ordinarily conducted under Part 91. Trips conducted to transport patients or organs on board are conducted under Part 135. In addition, some air medical operations, particularly for emergency medical services, are conducted by state or local government entities as public use flights, whether patients are on board or not. 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 interfacility transportation of patients or organs and use established airport facilities. Emergency medical service operations most often make use of helicopters, and they use unimproved landing sites at accident scenes and helipads at hospitals or medical facilities.

Figure 18 shows the number of accidents for fixed-wing airplanes operating under Parts 91 and 135 between 2000 and 2009. Relatively few fixed-wing airplane accidents were observed, and only 10 of them were fatal over the course of the decade.

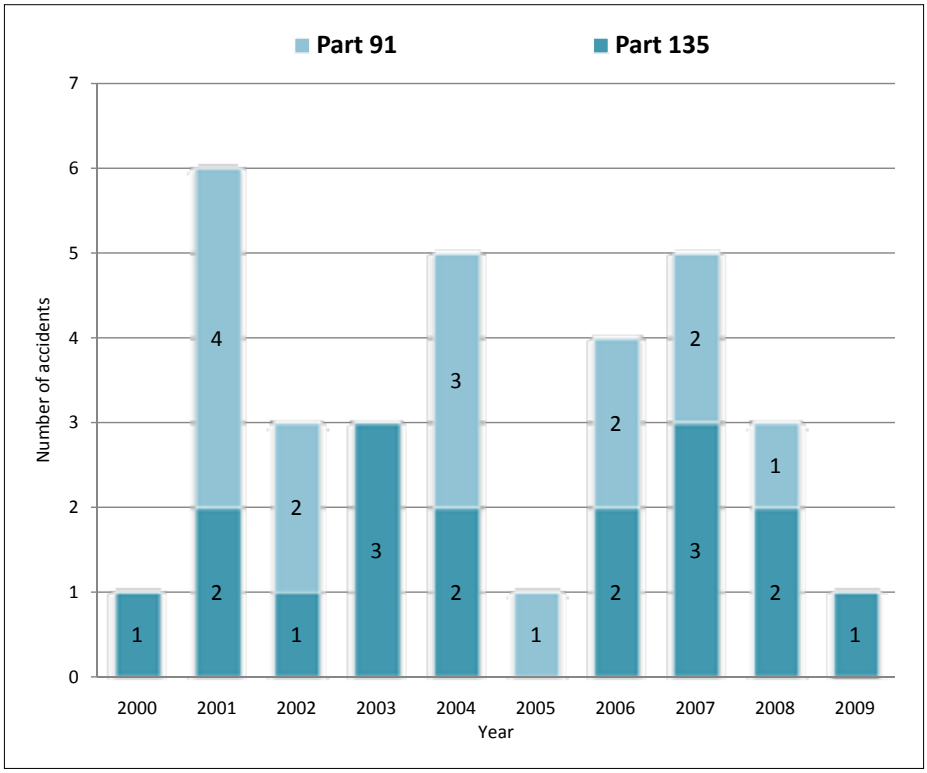

Figure 18. Fixed-wing airplane air medical accidents under Parts 91 and 135 operations, 2000–2009.

Figure 19 shows the number of helicopter air medical accidents operating under Parts 91 and 135 between 2000 and 2009. Figure 20 shows the fatal helicopter air medical accidents for this same period.

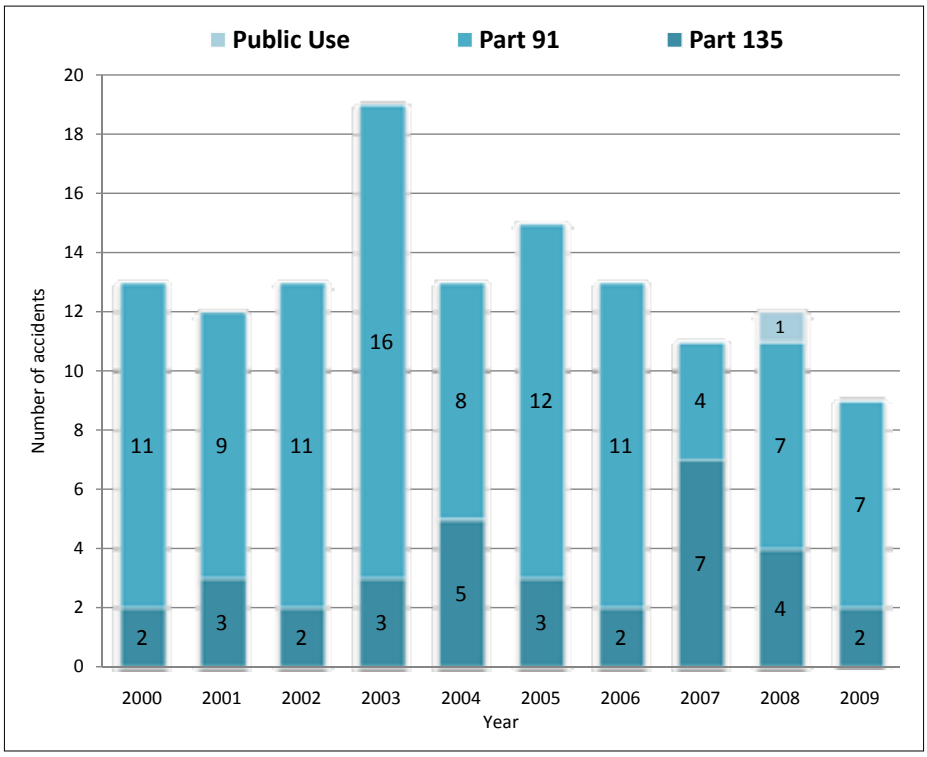

Figure 19. Total helicopter air medical accidents under Parts 91 and 135 operations, 2000–2009.

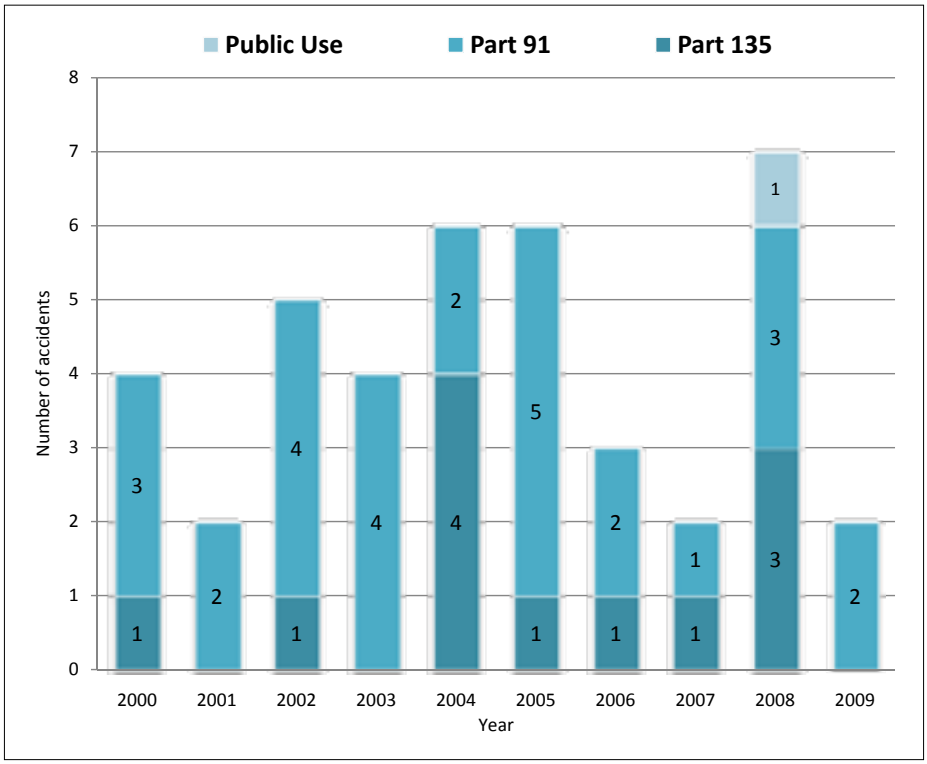

Figure 20. Fatal helicopter air medical accidents by FAR Part, 2000–2009.

Although the General Aviation and Part 135 Activity Survey has estimated flight hours for fixed-wing airplane air medical transports under both Part 91 and Part 135 since 2004, the low volume of flight activity in this segment of air medical transport precludes the calculation of reliable accident rates.

Figure 21 shows the Part 91 and Part 135 accident rates for helicopters engaged in emergency medical service operations from 2004 through 2009. Accident rates for Part 91 helicopter air medical transport were markedly higher than Part 135 helicopter air medical operations throughout the six year period for which exposure data are available.

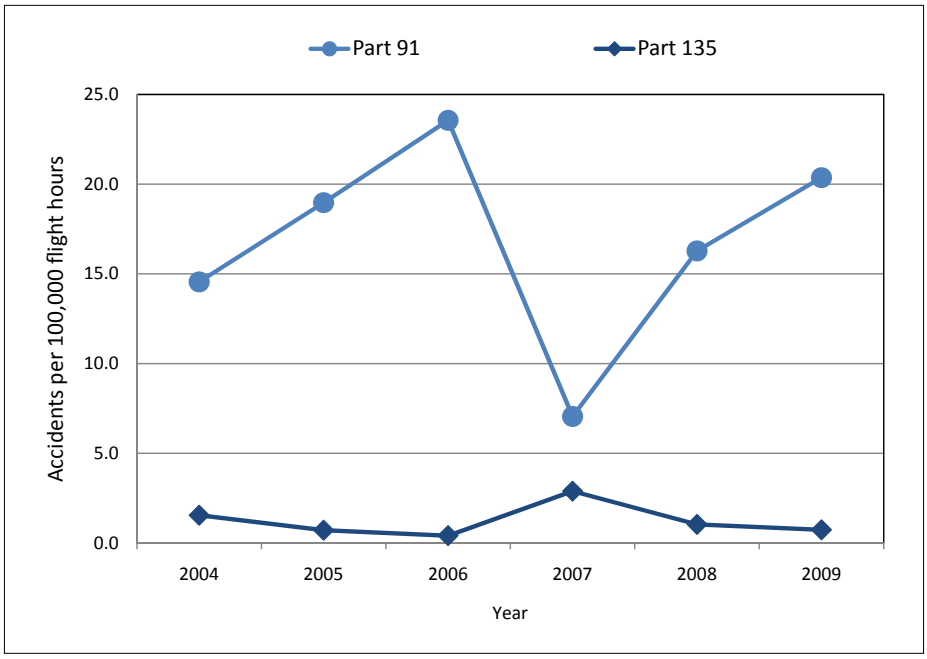

Figure 21. Accident rates per 100,000 flight hours for helicopters in emergency medical service operations under Part 91 and Part 135, 2004–2009.

Three of the nine fixed-wing airplanes involved in air medical accidents between 2007 and 2009 involved controlled flight into terrain and were fatal crashes. The other fatal fixed-wing airplane air medical crash during the 2007 to 2009 period was a Cessna Citation that experienced a non-power plant system/component failure during initial climb.[11] The other five accidents were non-fatal and involved a range of defining events.

Figure 22 shows the distribution of defining accident events for the 32 helicopters involved in 31 accidents from 2007 to 2009. Eighteen of these aircraft were being operated under Part 91, thirteen under Part 135, and one as a public use flight (with patients on board). Eleven of these accidents, involving 12 helicopters, were fatal. Collision with objects on takeoff or landing accounted for 7 of the 31 accidents, but none of these crashes were fatal. On the other hand, four of the five controlled flight into terrain accidents were fatal, including the crash of the Maryland State Police public use flight carrying automobile accident victims on approach to Andrews Air Force Base.[12] Two of the three loss of control in-flight accidents were fatal crashes, as were two of the three unintended flights

11. The full report of this accident may be found at <http://www.ntsb.gov/doclib/reports/2009/AAR0906.pdf>.
12. The full report of this accident may be found at <http://www.ntsb.gov/doclib/reports/2009/AAR0907.pdf>.

into instrument meteorological conditions accidents. The midair collision between two Part 135 helicopters in Flagstaff, Arizona, in June 2008 was also fatal to all aboard the two aircraft. The other two fatal accidents involved a non-power plant system/component failure and an event coded as other. Figure 23 shows the phases of flight during which these events occurred. All of the fatal accidents occurred during airborne phases, including en route, approach, maneuvering, and emergency descent.

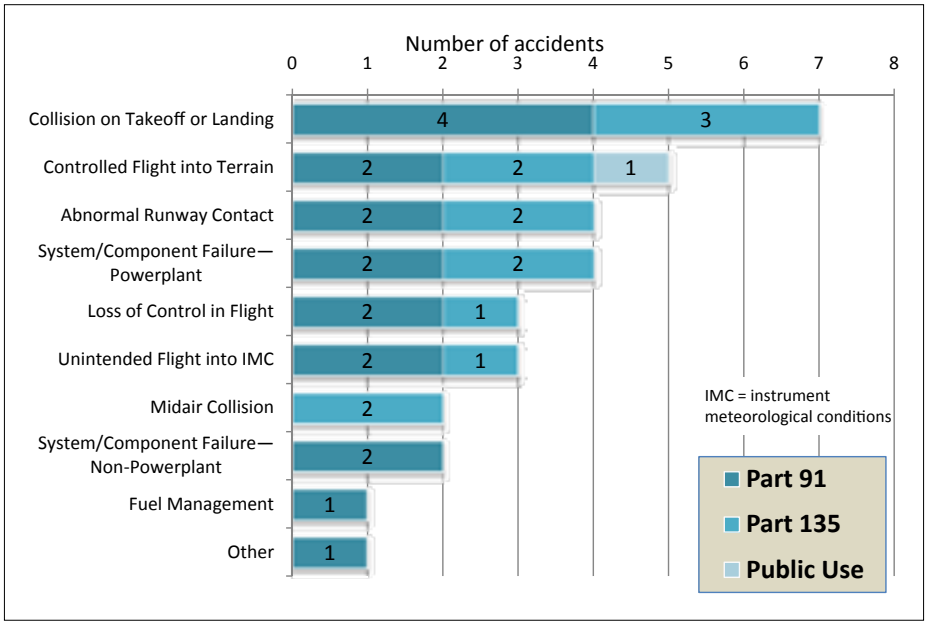

Figure 22. Defining accident events for air medical helicopters involved in accidents operating as Part 91, Part 135, and public use flights, 2007–2009.

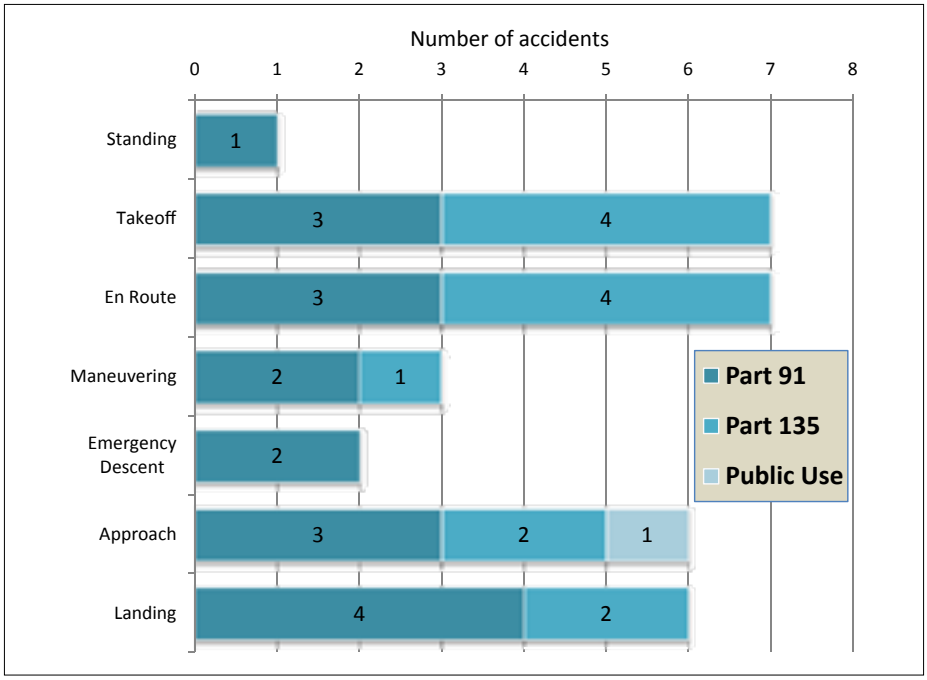

Figure 23. Phase of flight associated with the defining events for air medical helicopter accidents, 2007–2009.

The median age for air medical pilots operating fixed-wing airplanes involved in accidents from 2007 to 2009 was 45.5, with a range from 28 to 59 years. The median total flight time for these pilots was 7,125 hours, ranging from 2,685 to 18,000 hours. Median time in the accident fixed-wing airplane type was 683 hours, ranging from 23 to 4,000 hours.

Accident helicopter pilots' median age was 54, ranging from 35 to 69. Median total flight hours were 7,125, with a range from 2,685 to 18,000. The median time in the type of accident helicopter was 375 hours, ranging from 11 to 4,241.

Hot air balloons are used in a large proportion of sightseeing flights.

Air Tours and Sightseeing Accidents

Air tour and sightseeing operations are defined in the FAA's final rule on National Air Tour Safety Standards,[13] which was published in February 2007. The various parts of the rule became effective between March 15 and September 11, 2007. This new rule consolidated safety regulations under a new Part 136 that is applicable to commercial air tour operations under Part 135/121, as well as those commercial operations that are permitted to operate under Part 91 for non-stop flights of 25 statute miles or less from the departure airport. Part 136 regulations do not apply to balloons and gliders operated for commercial sightseeing purposes under Part 91. The General Aviation and Part 135 Activity Survey has distinguished between Part 135 air tour operations and Part 91 paid sightseeing operations since 2004. Figure 24 shows the estimated flight hours accumulated by commercial sightseeing operations regulated under Part 91 from 2004 to 2009. Activity in this segment of paid sightseeing is distributed primarily between fixed-wing airplanes, helicopters, and balloons. Gliders contribute a much smaller proportion of total flight hours.

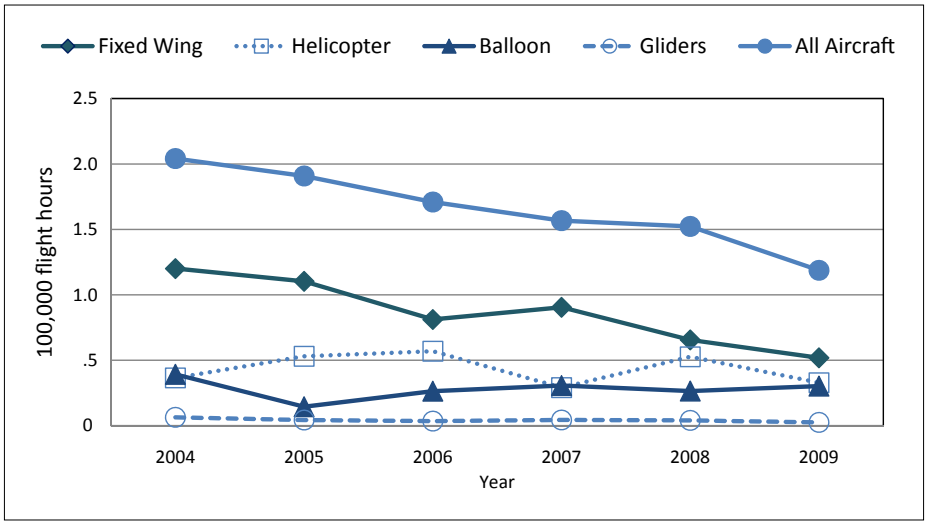

Figure 24. Part 91 sightseeing flight hours by aircraft type, estimated from the General Aviation and Part 135 Activity Survey, 2004–2009.

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

Figure 25 shows the estimated air tour activity under Part 135. The only appreciable Part 135 activity was conducted in fixed-wing airplanes and helicopters, with substantially more of this activity in helicopters.

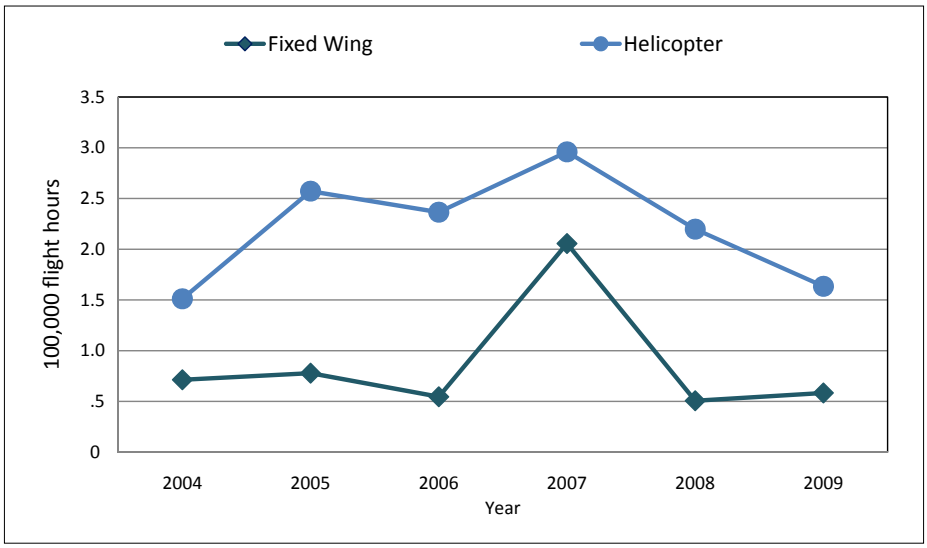

Figure 25. Part 135 air tour flight hours by aircraft type estimated from the General Aviation and Part 135 Activity Survey, 2004–2009.

Figure 26 shows total and fatal Part 135 air tours accidents that occurred between 2000 and 2009. Figure 27 shows total and fatal Part 91 sightseeing accidents during these years. Although there is modest year-to-year variation in total accidents, there is no obvious trend, either up or down, in these accidents across the period. Sixteen percent of these accidents were fatal.

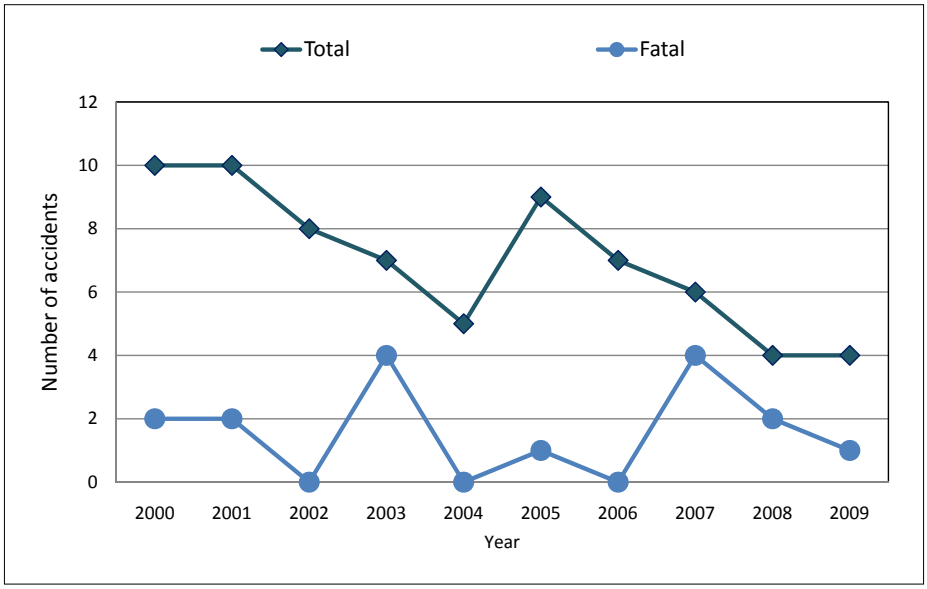

Figure 26. Total and fatal Part 135 air tour accidents, 2000–2009.

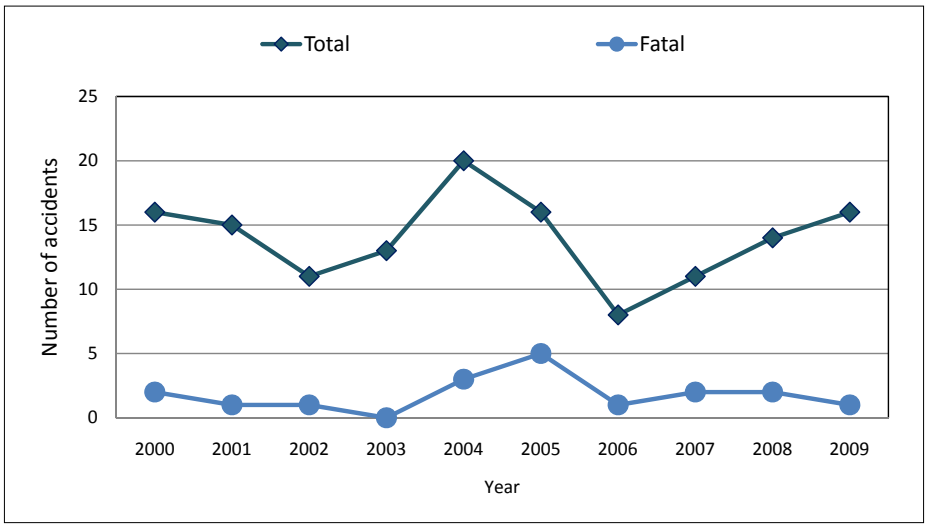

Figure 27. Total and fatal Part 91 sightseeing accidents, 2000–2009.

Figure 28 shows Part 91 sightseeing accidents by the type of aircraft involved. Balloons accounted for nearly half (68 of 140) of the total accidents during the decade, while fixed-wing airplanes (35) and helicopters (32) accounted for most of the rest. Figure 29 plots the accident rates per 100,000 flight hours for these aircraft types during the six-year period from 2004 through 2009 for which the General Aviation and Part 135 Survey data are available. The relatively large proportion of balloon accidents and the relatively limited estimated flight hours for balloon sightseeing operations combine to produce very high accident rates throughout the period.

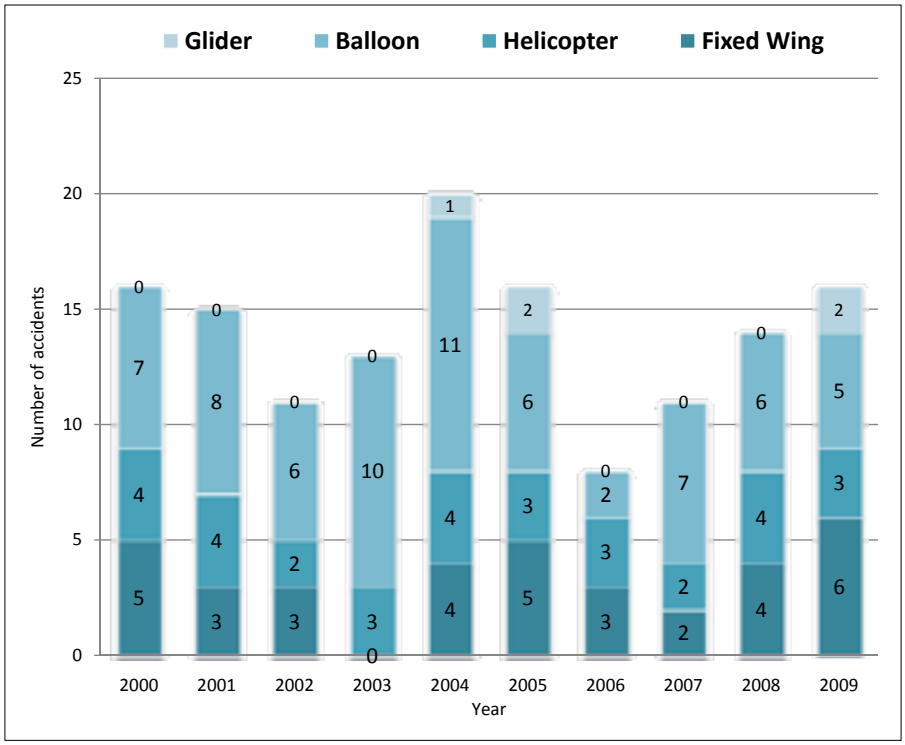

Figure 28. Part 91 sightseeing accidents by aircraft type, 2000–2009.

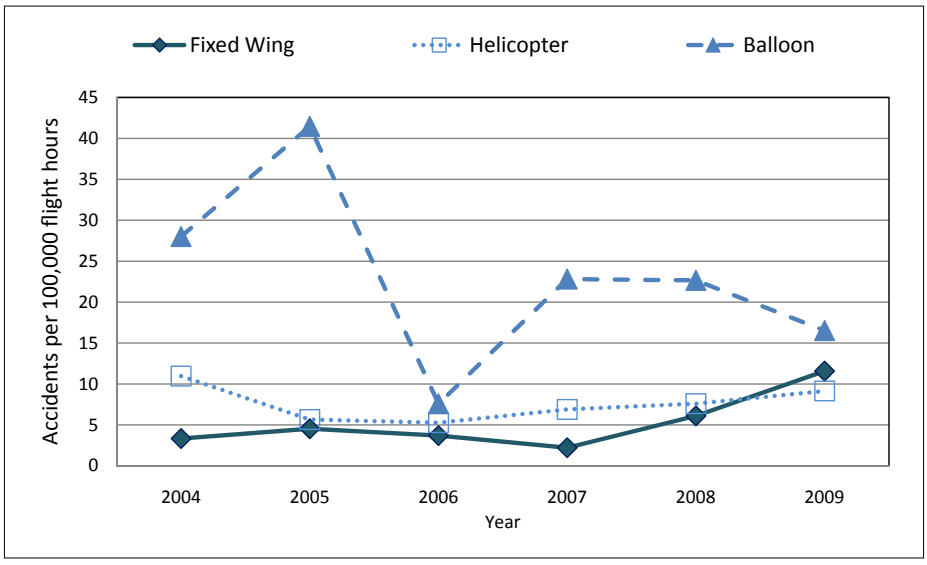

Figure 29. Accident rates per 100,000 flight hours for Part 91 sightseeing flights based on the General Aviation and Part 135 Activity Survey estimates of activity, 2004–2009.

Figure 30 shows the defining accident events for the Part 91 sightseeing accidents from 2007 to 2009. Most of the balloon accidents (14 of 18) involved hard landing events, and most (7 of 12) fixed-wing airplane accidents involved loss of control during takeoff or landing. Most helicopter accidents involved loss of control or collisions with objects during takeoff or maneuvering. Helicopters also experienced power plant or other system failures in one-third of the accidents.

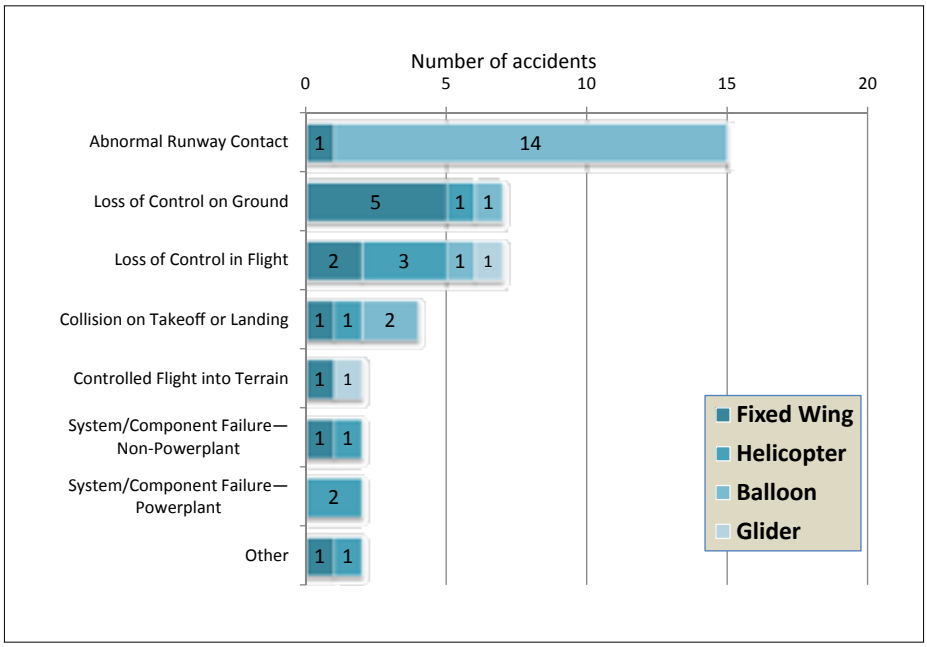

Figure 30. Defining accident events for Part 91 sightseeing accidents, 2007–2009.

Figure 31 plots Part 135 air tour accidents from 2000 to 2009 for fixed-wing airplanes and helicopters. Figure 32 shows the accident rates for these aircraft types from 2004 to 2009 for which survey data are available. The low frequency of these accidents precludes the identification of a reliable trend across time in either accident frequency or accident rate. More than half (five of eight) of the air tour helicopter accidents between 2007 and 2009 were associated with system or component failures; the other three accidents included a midair collision, a ground handling event, and a bird strike. Each of the six fixed-wing airplane accidents during this period was associated with a different accident event, thus there was no pattern discernable among these accidents.

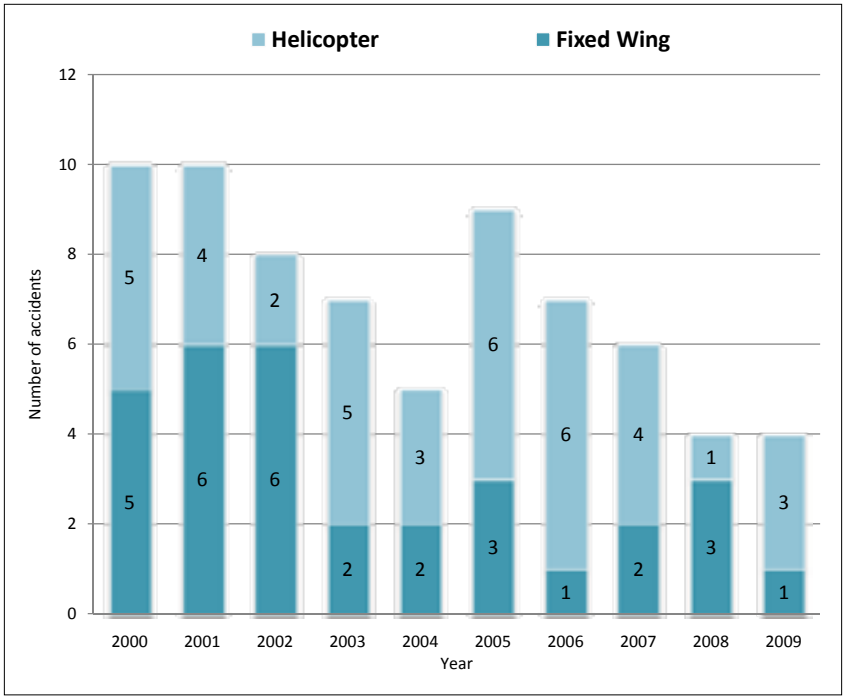

Figure 31. Part 135 air tour accidents by aircraft type, 2000–2009.

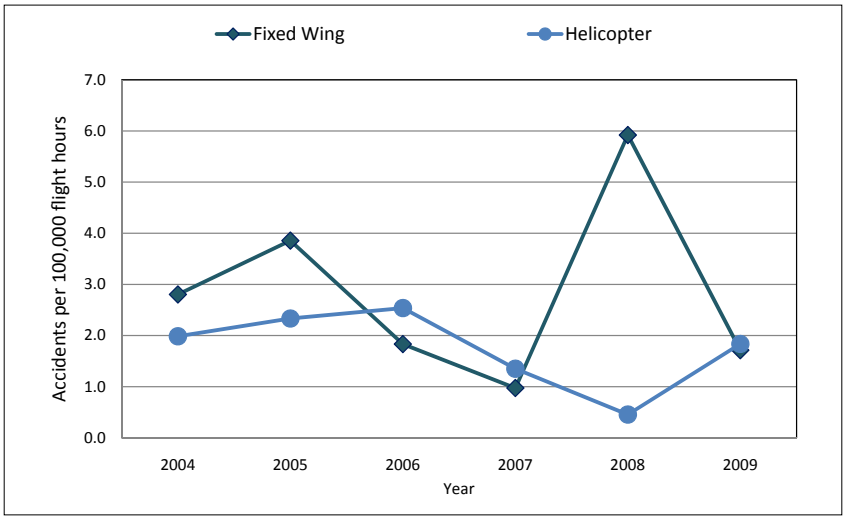

Figure 32. Part 135 air tour accidents per 100,000 flight hours for fixed-wing airplanes and helicopters, 2000–2009.

GENERAL AVIATION ACCIDENTS

Figure 33 shows fatal and non-fatal general aviation accidents, and Figure 34 shows the numbers of aircraft involved in these accident as well as fatalities for the 2000–2009 period. As noted in the Introduction, general aviation includes all flight activity except that conducted under FAR Parts 121 and 135. The data in these figures include air medical and sightseeing accidents conducted under Part 91, but not those conducted under Part 135.

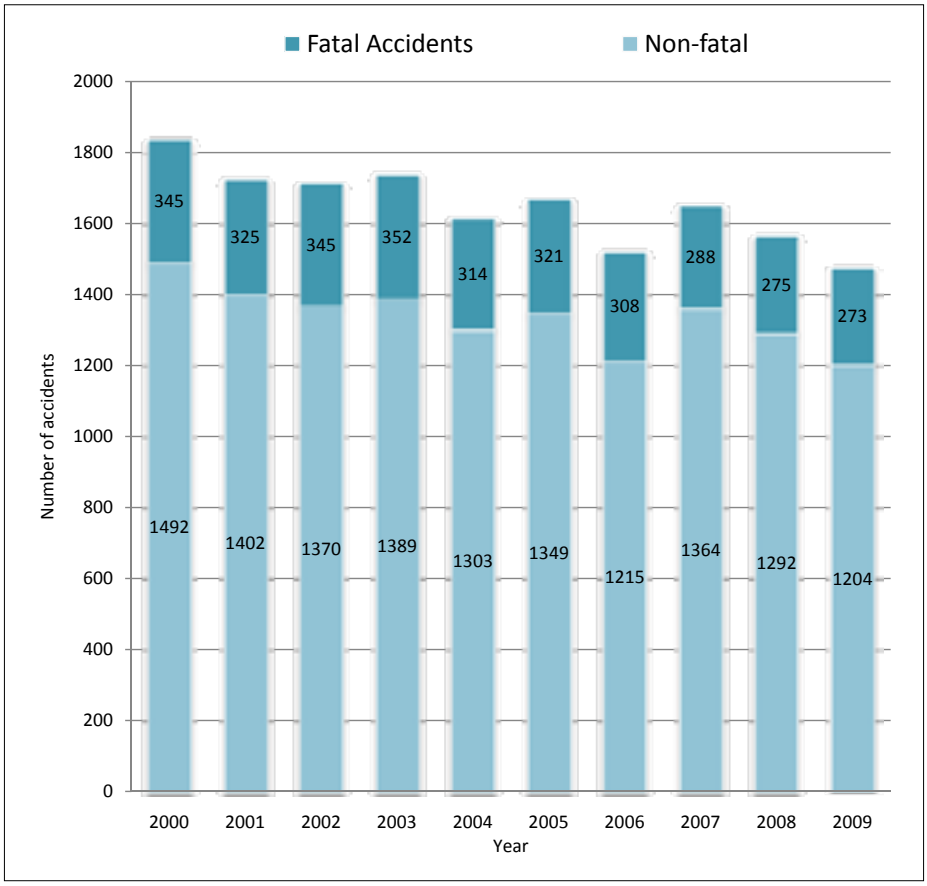

Figure 33. All general aviation fatal and non-fatal accidents, 2000–2009.

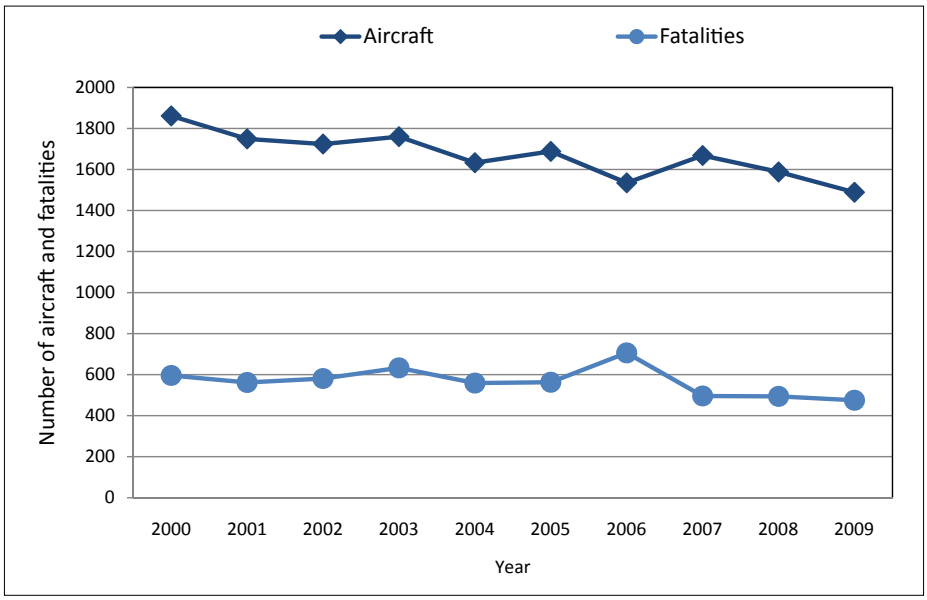

Figure 34. General aviation accident-involved aircraft and fatalities, 2000–2009.

A declining trend in both total and fatal general aviation accidents is evident across the decade despite the diversity of flying that is represented by these data. Figure 35 shows the total flight hours for all segments of general aviation, as estimated from the General Aviation and Part 135 Activity Survey. The drop in flight hours between 2000 and 2002 is likely due to the restrictions imposed on general aviation flying after the terrorist attacks of September 11, 2001, and the drop in hours from 2007 through 2009 likely reflects economic factors.

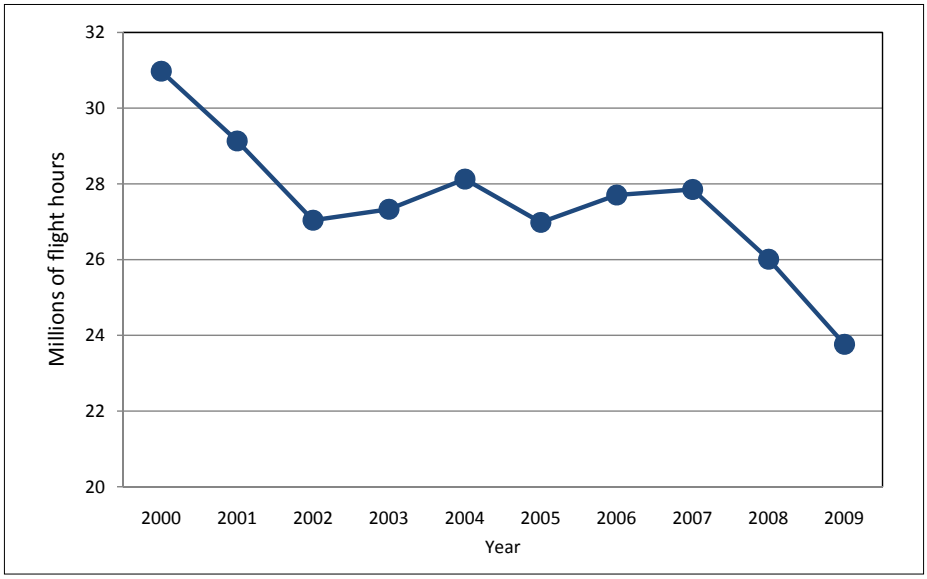

Figure 35. Millions of flight hours accumulated across all segments of general aviation, estimated from the General Aviation and Part 135 Activity Survey, 2000–2009.

Figure 36 plots total and fatal general aviation accident rates across all segments of general aviation. The flatness of these curves across the decade suggests that the modestly decreasing trend in annual accident numbers was primarily due to a reduction in flying.

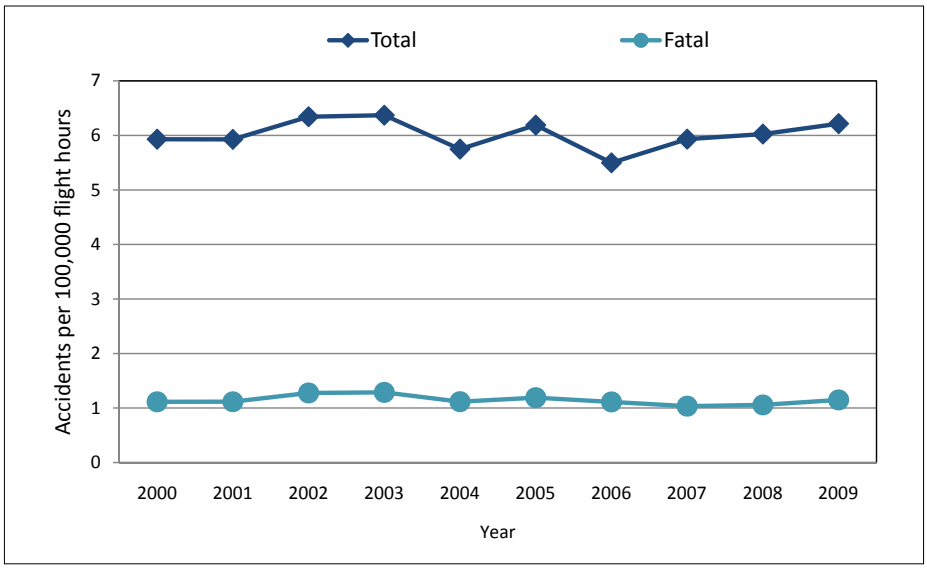

Figure 36. Total and fatal general aviation accident rates per 100,000 flight hours, estimated from the General Aviation and Part 135 Activity Survey, 2000–2009.

Figure 37 shows the geographic distribution of 4,660 of the 4,745 general aviation accidents from 2007 through 2009. The other 85 general aviation accidents include 12 in Puerto Rico, 2 in the U.S. Virgin Islands, 64 in other countries, 3 in the Pacific Ocean, 1 in the Atlantic Ocean, and 3 in the Gulf of Mexico.

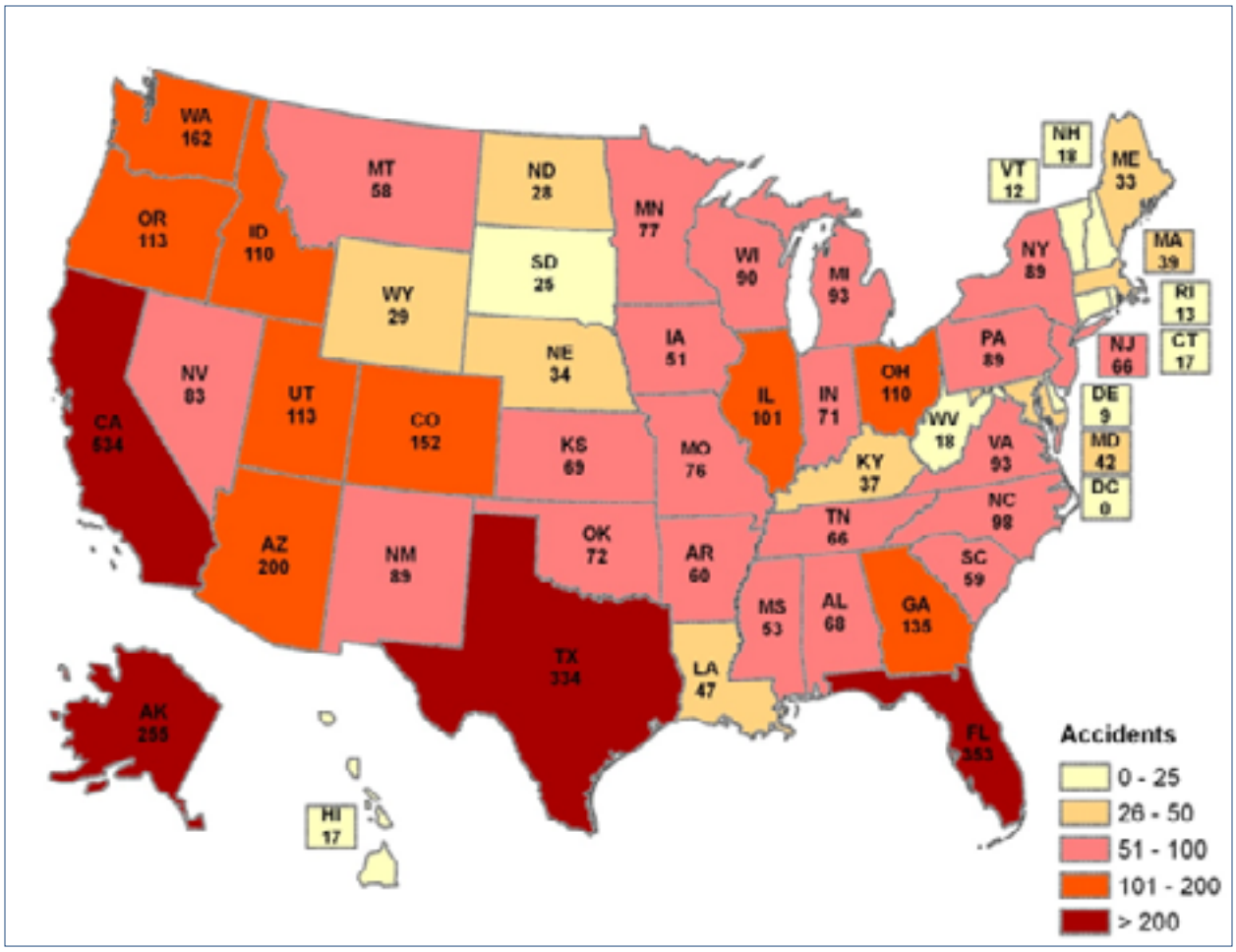

Figure 37. Geographic distribution of general aviation accidents, 2007–2009.

As indicated earlier, general aviation encompasses a wide range of aircraft types, from the DC-10 performing fire suppression to gliders and powered parachutes being flown for personal enjoyment. Similarly, the types of operations performed in these aircraft include a variety of commercial flying activities, as well as a wide range of recreational flying. This section will discuss the principal categories or types of flying separately, and, where appropriate, will examine the types of aircraft used in these flying activities. Table 6 shows the reported types of flying by aircraft category for the 4,654 aircraft involved in general aviation accidents from 2007 through 2009, excluding sightseeing and air medical aircraft operating under Part 91.

Purpose of Flight	Airplane	Helicopter	Glider	Other Aircraft	Total
Personal Flying	2810	126	80	87	3103
Flight Instruction	533	117	22	7	679
Aerial Application	210	32	0	0	242
Positioning/Ferry	111	27	0	0	138
Business	108	13	0	0	121
Public Use	40	30	0	0	70
Flight Test	45	6	1	2	54
Other Work	25	21	0	1	47
Aerial Observation	25	17	0	0	42
Air Show	20	1	2	5	28
Sky Diving	24	0	0	0	24
Executive/Corporate	17	4	0	0	21
Banner Towing	20	0	0	0	20
External Load	0	15	0	0	15
Glider Towing	9	0	0	0	9
Firefighting	4	3	0	0	7
Air Drop	2	1	0	0	3
Unknown	23	4	0	4	31
Total	4025	417	105	107	4654

Table 6. Accident-involved aircraft by aircraft type and the purpose of flight, 2007–2009.

The majority of these accidents (60%) involved personal flights in fixed-wing airplanes. The next most frequent category of accident flight was flight instruction, also in fixed-wing airplanes. Aerial application of agricultural products, positioning and ferry flights, and business flying ranked next in accident frequency during this three-year period. The great majority of accident-involved aircraft across all purposes of flight were fixed-wing airplanes (86%), with helicopters accounting for 9% of the accident aircraft and all other types of aircraft accounting for less than 5%.

Personal Flying

Flying for a wide variety of personal reasons accounts for the vast majority of general aviation activity and, consequently, for the greatest proportion of general aviation accidents. Figure 38 shows the estimated flight hours for personal flying from 2000 through 2009. The greatest proportion of this flying was accomplished in fixed-wing aircraft, particularly single-engine piston airplanes. The volume of personal flying has declined substantially over the decade.

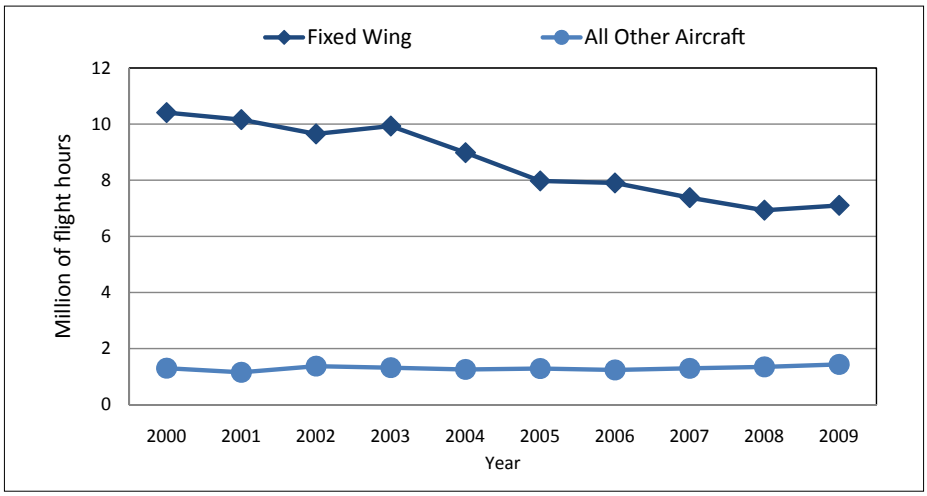

Figure 38. Estimated personal flying flight hours in fixed-wing aircraft and all other aircraft from the General Aviation and Part 135 Activity Survey, 2000–2009.

Figure 39 plots the number of fatal and non-fatal personal flying accidents during the same period.

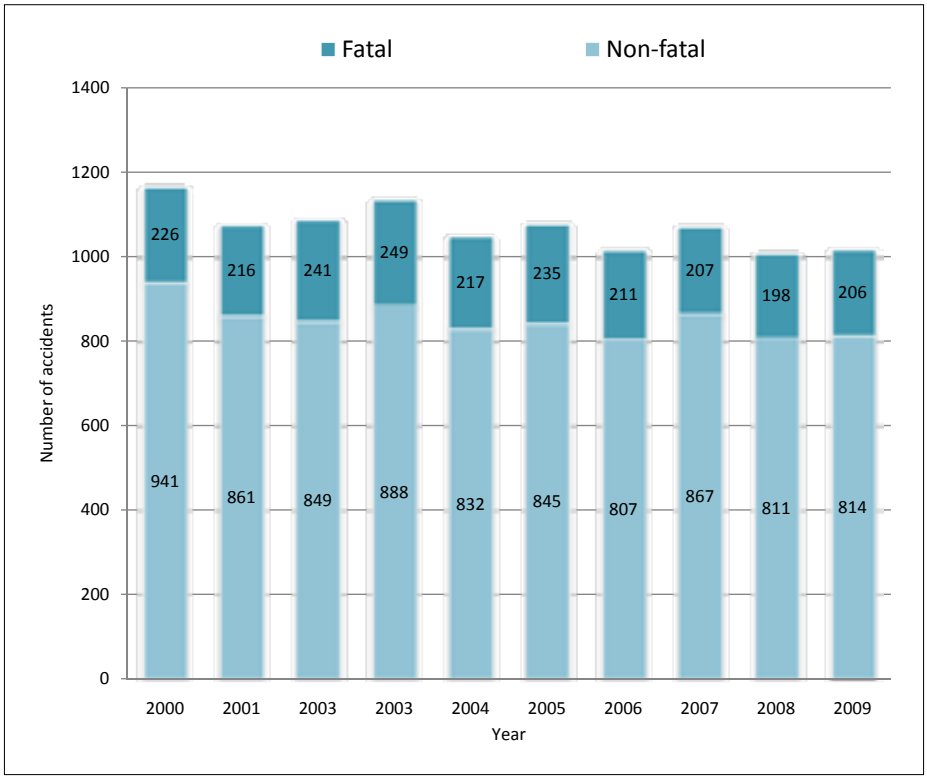

Figure 39. Fatal and non-fatal personal flying accidents, 2000–2009.

There is a slight decline in total accidents across the ten year period, although the annual numbers of fatal accidents is relatively flat across the period. Figure 40 plots the accident rates associated with these data.

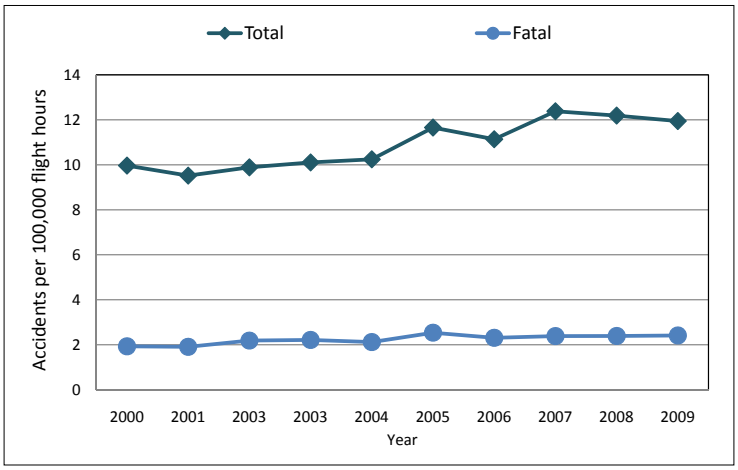

Figure 40. Total and fatal personal flying accident rates, 2000–2009.

Total personal flying accidents have risen from around 10 to more than 12 accidents per 100,000 flight hours across the decade, while fatal accidents have climbed just above 2 per 100,000 hours during the decade. Both rates are substantially above the average of all GA flying (see figure 36).

Figure 41 shows the distribution of defining accident events for the 3,103 total and 611 fatal personal flying accidents (in all aircraft types) from 2007 through 2009.

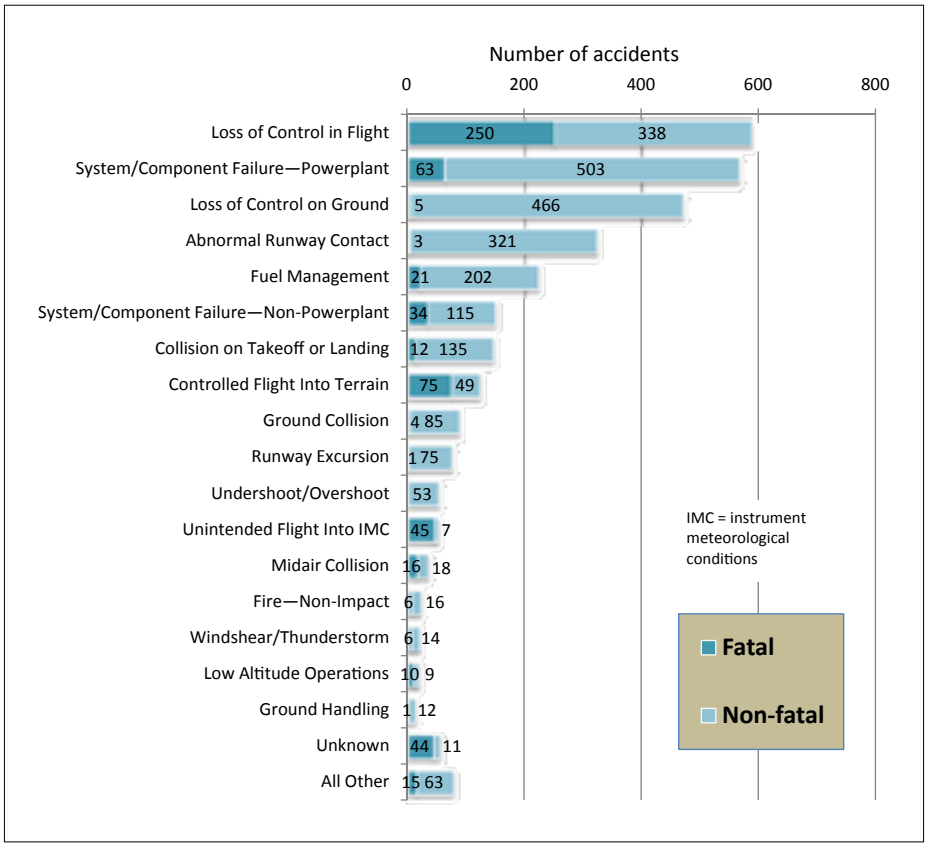

Figure 41. Defining accident events in fatal and non-fatal personal flying accidents, 2007–2009.

Loss of control in flight and on the ground and power plant failures were the most common defining events for total accidents, followed by hard landings or other abnormal runway contact. Loss of control in flight accounted for the greatest proportion (41%) of the fatal personal flying accidents. Figure 42 shows the phases of flight associated with these events.

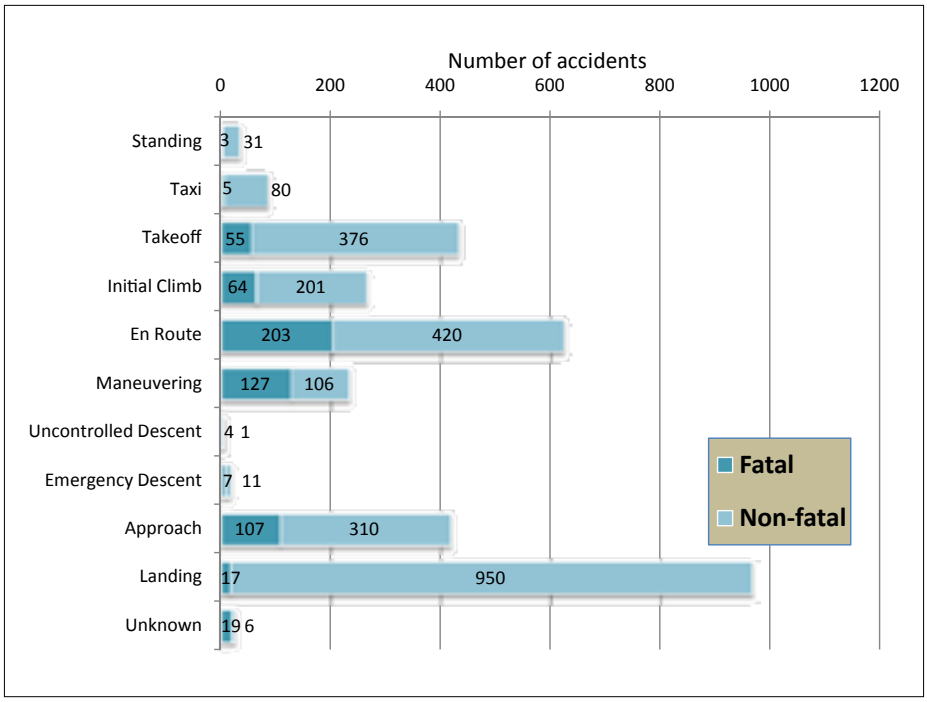

Figure 42. Phases of flight associated with personal flying accident events, 2007–2009.

Takeoff and landing accounted for 45% of the total personal flying accidents, while en route, maneuvering, and approach phases accounted for most (72%) of the fatal accidents.

The median age of pilots involved in personal flying accidents from 2007 through 2009 was 55 years, ranging from 16 to 89. The median reported total flying time for these pilots was 812 hours, ranging from 0 to 46,208. The median time in the type of accident aircraft was 122 hours, with a range from 0 to 10,000 hours.

Instructional Flying

Figure 43 shows the General Aviation and Part 135 Activity Survey estimate of instructional flying activity from 2000 through 2009.

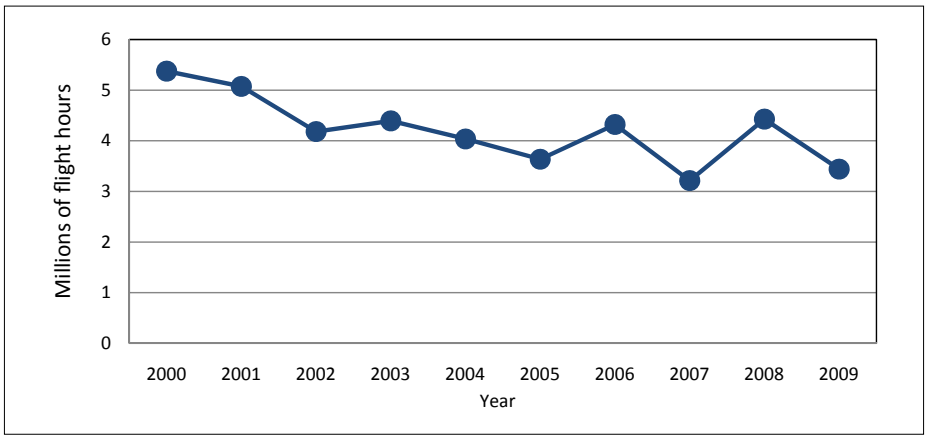

Figure 43. Instructional flight hours for all aircraft, estimated from the General Aviation and Part 135 Survey, 2000–2009.

Most of the instructional flying activity involved fixed-wing airplanes, and the flight time reported for instruction has declined markedly over the decade. Figure 44 shows fatal and nonfatal instructional flying accidents over the decade, and Figure 45 shows the overall and fatal accident rates per 100,000 flight hours.

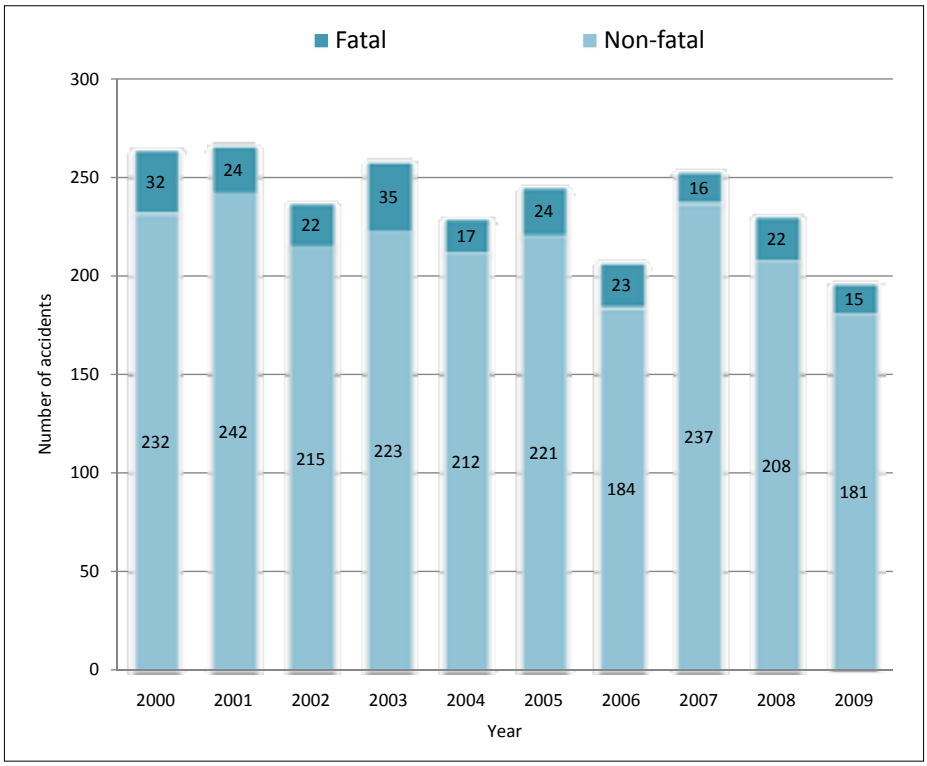

Figure 44. Fatal and non-fatal instructional flying accidents, 2000–2009.

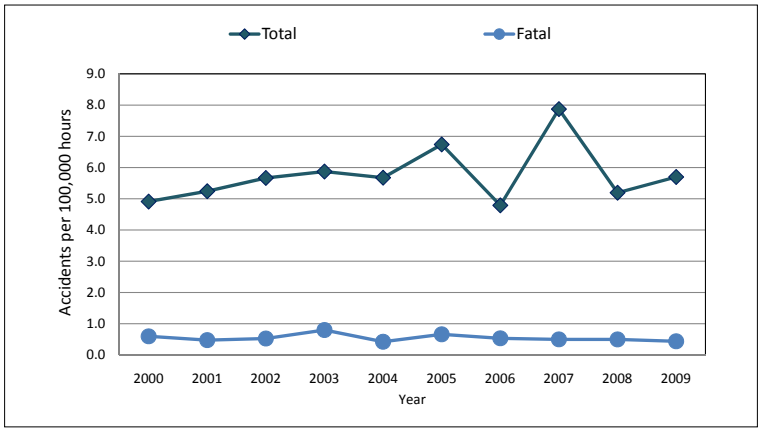

Figure 45. Total and fatal instructional flying accident rates per 100,000 flight hours, 2000–2009.

During the decade, 74% of total instructional flying accidents and 72% of fatal instructional flying accidents involved single-engine, fixed-wing airplanes, while single-engine helicopters accounted for 16% of total and 11% of fatal instructional flying accidents. While the total instructional flying accident rate is only slightly below the average for all of general aviation, the fatal rate is substantially lower (see figure 36). During the decade, less than 10% of instructional flying accidents resulted in a fatality.

Figure 46 shows the defining accident events associated with the 679 instructional flying accidents that occurred between 2007 and 2009 for all aircraft types, and Figure 47 shows the phases of flight associated with these events.

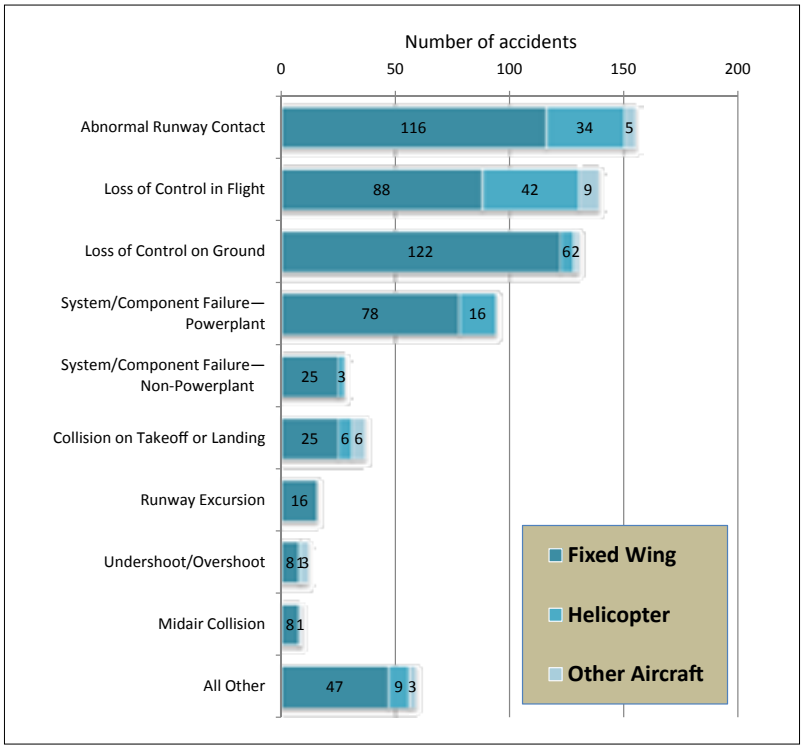

Figure 46. Defining accident events for instructional flying accidents in fixed-wing airplane, helicopter, and other aircraft types, 2007–2009.

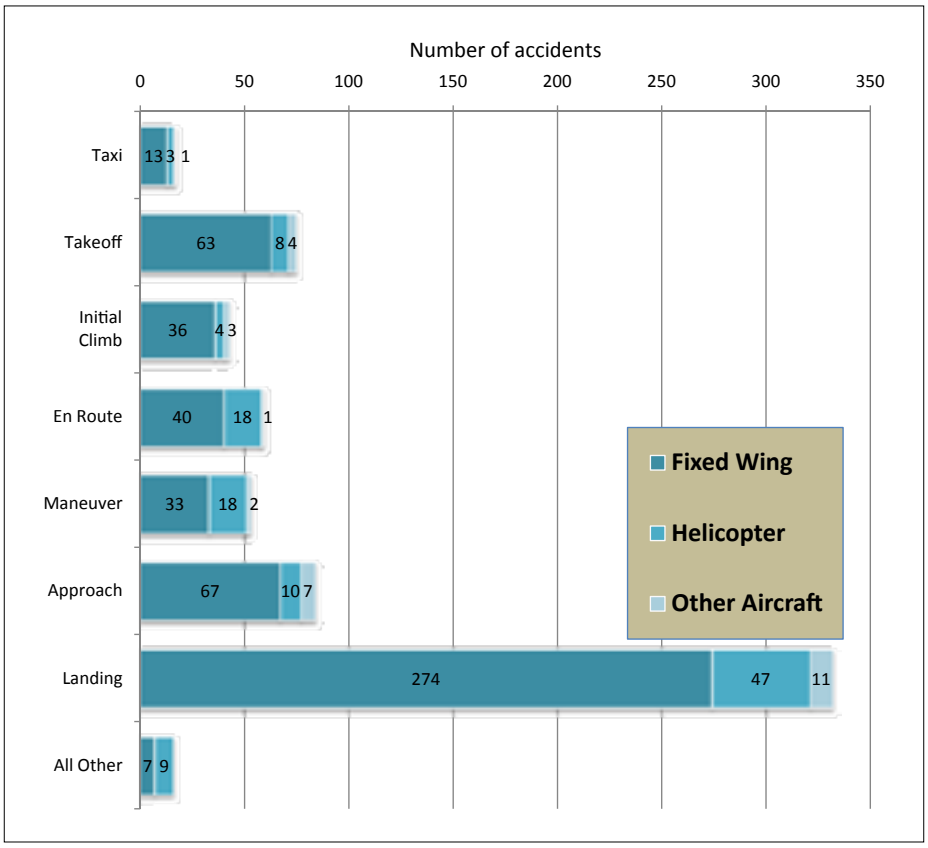

Figure 47. Phases of flight associated with defining events in instructional flying accidents, 2007–2009.

Loss of control on the ground or in flight and abnormal runway contact (e.g., hard landings) accounted for the great majority of defining accident events for instructional flying accidents in both fixed-wing airplanes and helicopters. Not surprisingly, the vast majority of these events occurred during takeoff or approach and landing.

The median age of the individuals identified as the "pilot flying" in instructional flying accidents was 38 years. The median total flying time was 500 hours, and the median time in the type of accident aircraft was 65 hours.

Aerial Application

Agricultural aircraft operations, sometimes referred to as "aerial application," are regulated under 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, horticulture, or forest preservation . . .".[14] Figure 48 shows the estimated flight hours of fixed-wing airplanes and helicopters in the performance of these

14. See 14 CFR Part 137.1.

agricultural aircraft operations from 2000 through 2009, based on estimates from the General Aviation and Part 135 Activity Survey. Most of this work was accomplished by fixed-wing airplanes.

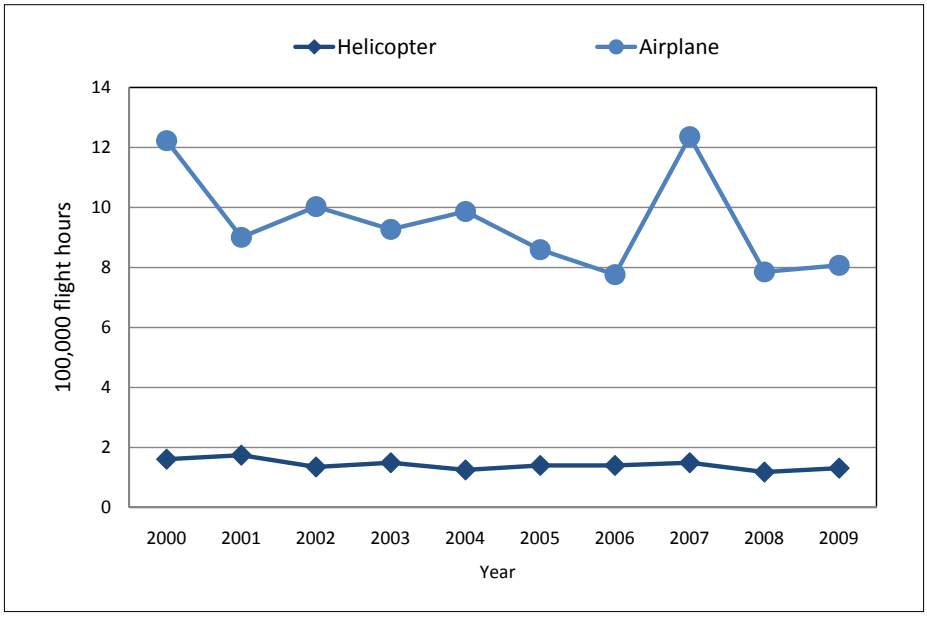

Figure 48. Agricultural operation flight hours in helicopters and fixed-wing airplanes, estimated from the General Aviation and Part 135 Activity Survey, 2000–2009.

Figure 49 shows the fatal and non-fatal accidents for both fixed-wing airplanes and helicopters engaged in agricultural operations during the decade. As would be expected, the majority of accidents occurred in fixed-wing airplanes. Approximately 11% of all agricultural operations accidents involved a fatal injury.

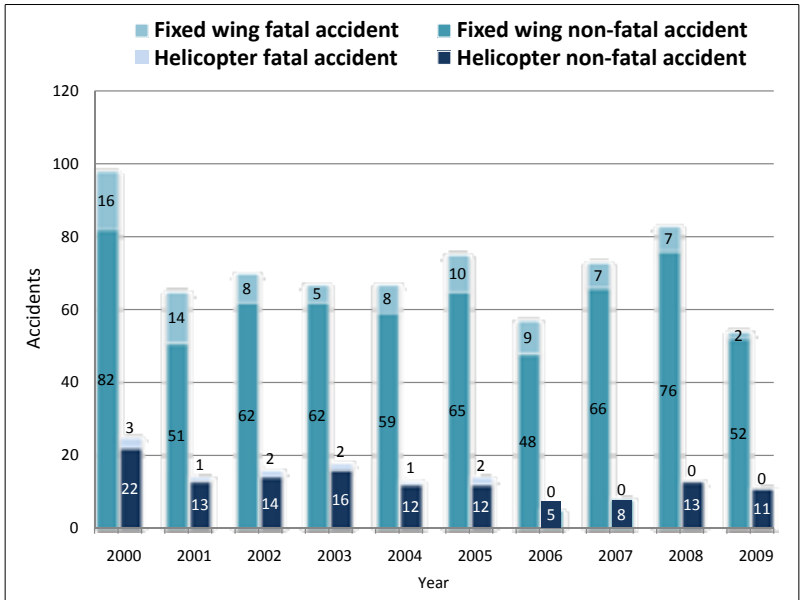

Figure 49. Fatal and non-fatal accidents for fixed-wing airplanes and helicopters performing aerial application, 2000–2009.

Figure 50 shows the total and fatal accident rates per 100,000 flight hours for all aircraft engaged in aerial application operations during the decade. Both total and fatal accident rates for these operations are somewhat higher than the average of all general aviation (see figure 36).

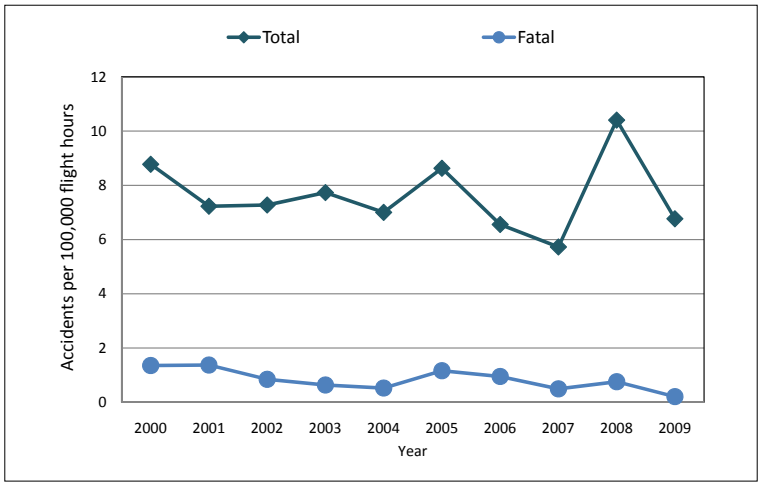

Figure 50. Total and fatal accident rates for all aircraft involved in aerial application, 2000–2009.

Figure 51 plots the defining accident events for fixed-wing airplanes and helicopters involved in aerial application from 2007 through 2009, and Figure 52 shows the phases of flight associated with these events.

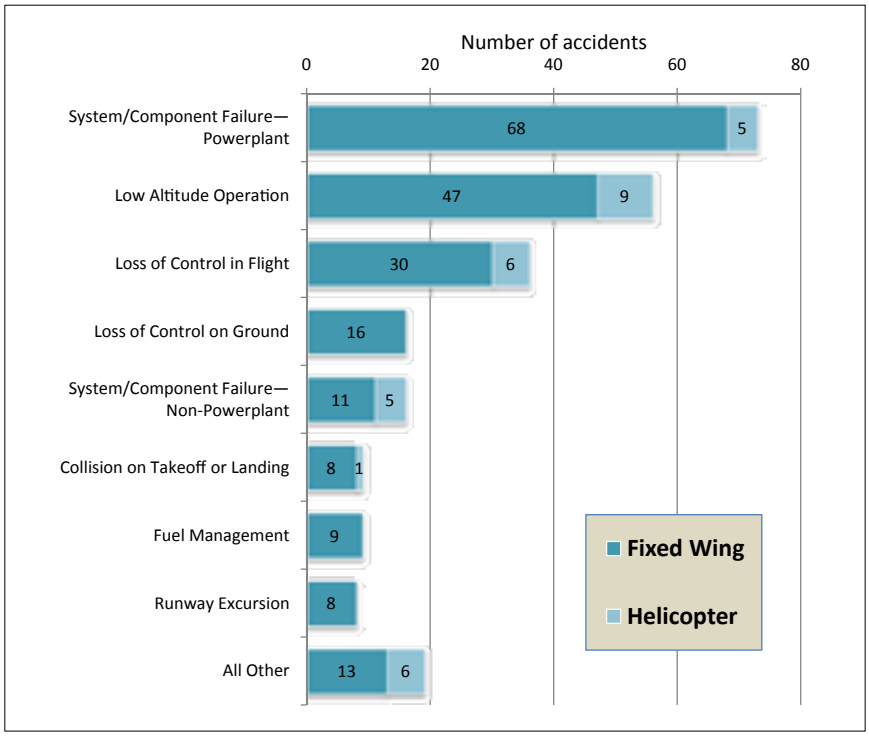

Figure 51. Defining accident events for fixed-wing airplanes and helicopters involved in aerial application accidents, 2007–2009.

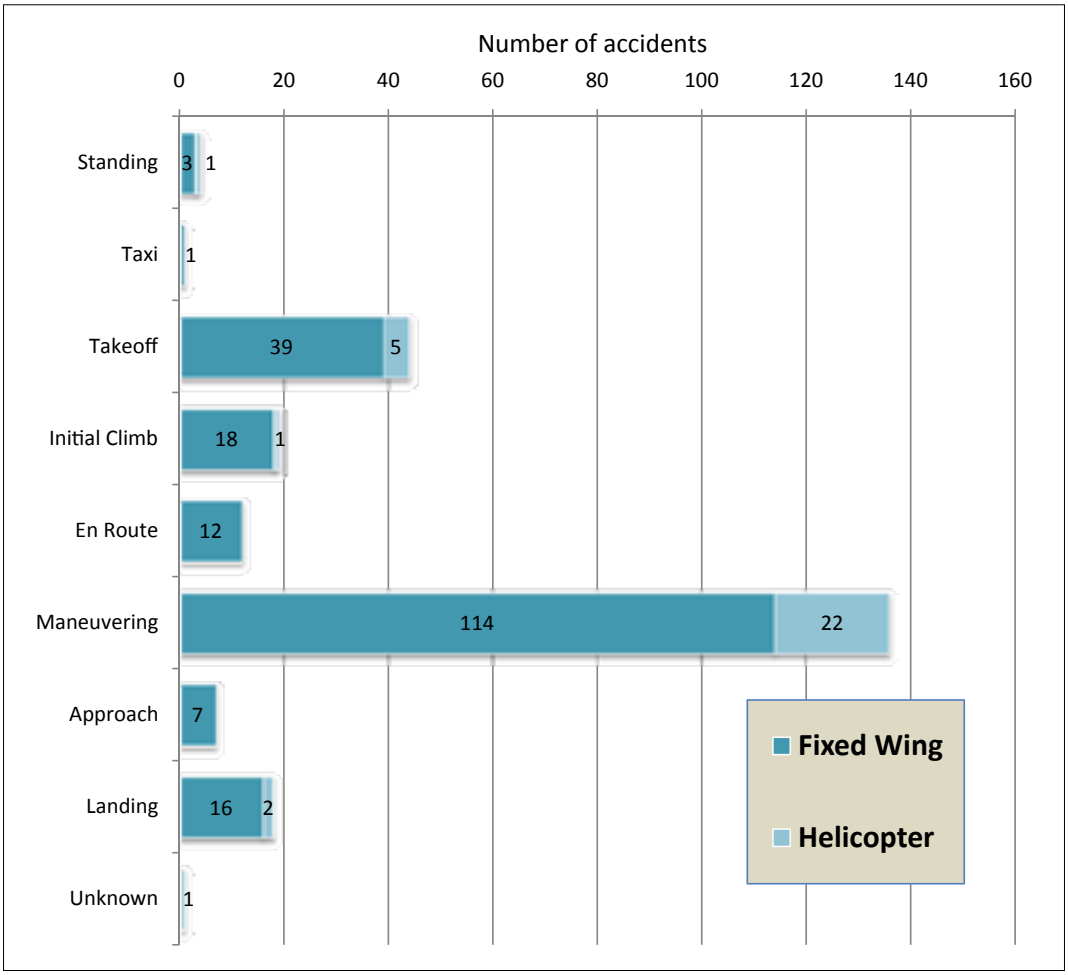

Figure 52. Phase of flight associated with defining events for aerial application accidents, 2007–2009.

Aircraft involved in aerial application or crop dusting typically engage in low-altitude operations, as shown in this photograph.

System/component failures were the leading events for fixed-wing airplanes, followed by low-altitude operations and loss of control in flight or on the ground. Low-altitude operation includes events such as collisions with power lines, fences, and other obstacles or terrain while deliberately operating close to the ground. Of course, aerial application, such as crop spraying, is a type of flying at high risk for these hazards. Low-altitude operations, loss of control in flight, and system component failures were also the principal accident events for helicopters. As might be expected for these kinds of operations, maneuvering was the most common phase of flight for the defining accident event.

The median age of accident-involved aerial application pilots was 49 years, ranging from 19 to 76. The median total flying time for these pilots was 7,908 hours, and the median time in the type of accident aircraft was 917.5 hours.

Ferry and Positioning

Ferry flights are non-revenue operations involved with delivering an aircraft from one location to another. The delivery of newly purchased aircraft frequently involves ferry operations. The ferrying of an aircraft that does not meet applicable airworthiness requirements but is capable of safe flight may require a "special flight permit" or "ferry permit" issued by the FAA.[15] Positioning flights are non-revenue flights conducted for similar purposes, but particularly for flying an aircraft to the location at which it will be put into revenue service. For example, the Part 91-governed aspects of air medical flights without patients on board are often categorized as positioning flights. A wide range of aircraft used for commercial purposes are "ferried" or "positioned," and there is no required reporting of such flight activity or a survey to estimate its extent.

Figure 53 plots the combined total of ferry and positioning flights resulting in accidents between 2000 and 2009 for all types of aircraft. The majority of these crashes involved fixed-wing airplanes: 33% single-engine piston airplanes, 14% multi-engine piston airplanes, 12% turboprop airplanes, and 10% jet airplanes. Approximately 30% of the accident aircraft were helicopters, and there was one blimp and 1 balloon involved in this group of accidents during the decade. Approximately 24% of these accidents were fatal, compared with about 19% for all GA accidents. As indicated previously, no exposure data (flight hours or departures) are available to calculate accident rates for these types of flying.

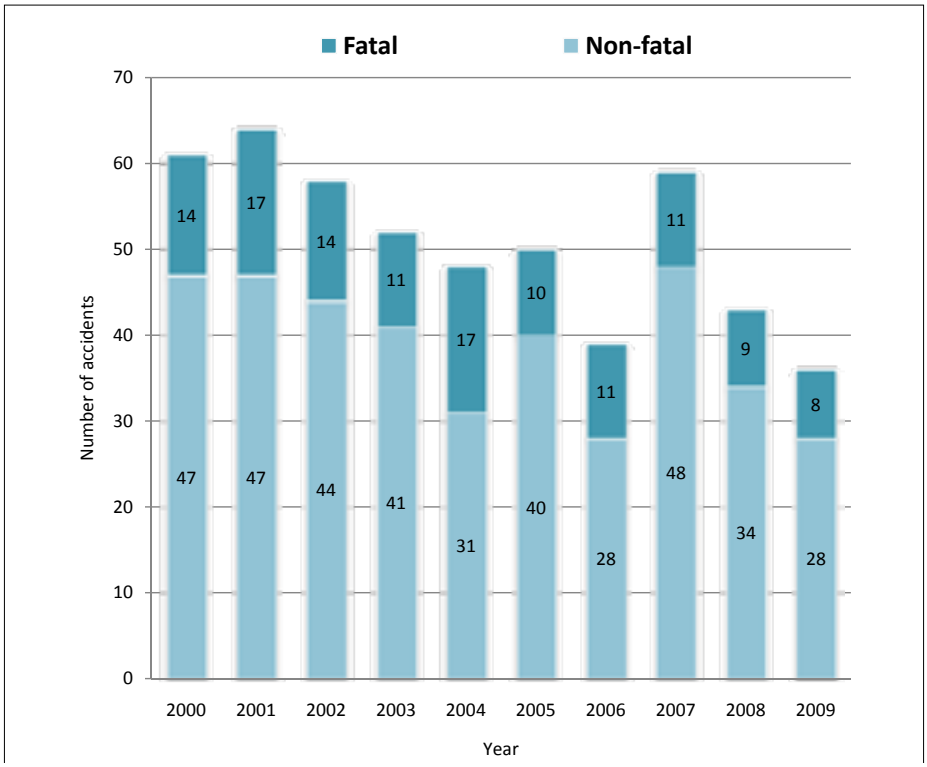

Figure 53. Fatal and non-fatal ferry and positioning accidents for all types of aircraft, 2000–2009.

15. 14 CFR Part 21.197.

Figure 54 shows the defining events for fatal and non-fatal ferry and positioning accidents from 2007 through 2009.

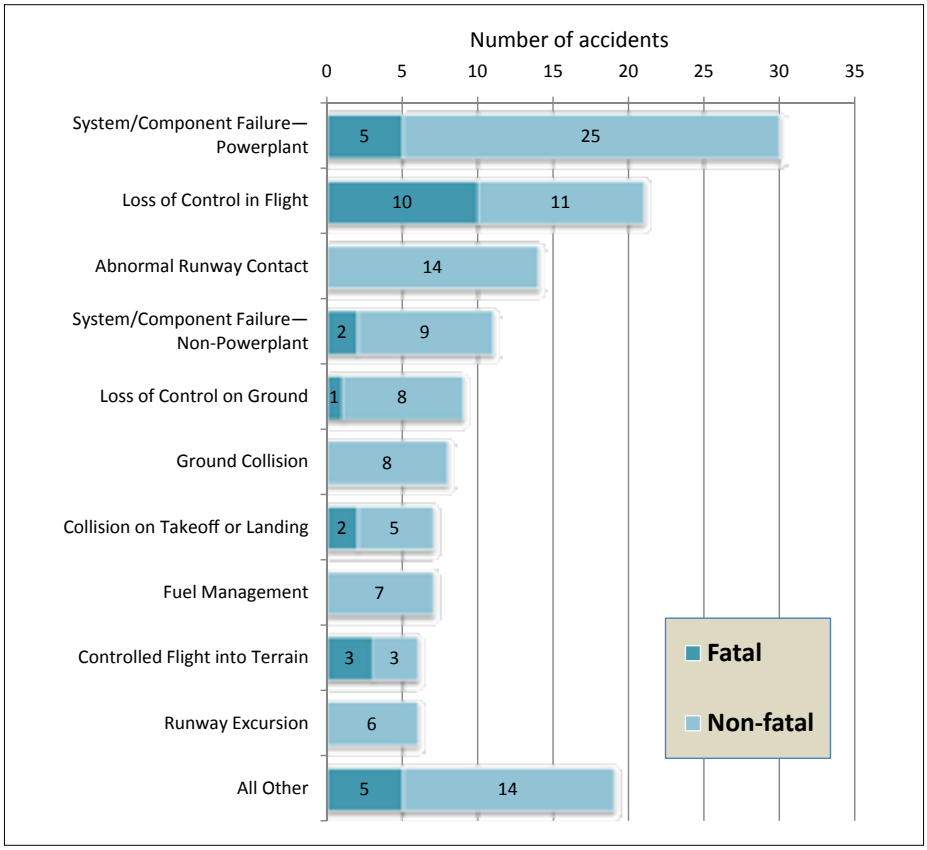

Figure 54. Defining events for ferry and positioning accidents, 2007–2009.

System/component failures of power plants were the most common defining accident event, followed by loss of control in flight and hard landings. Loss of control in flight was the event most frequently associated with fatal accidents for these types of flying. Figure 55 shows the phases of flight associated with these events.

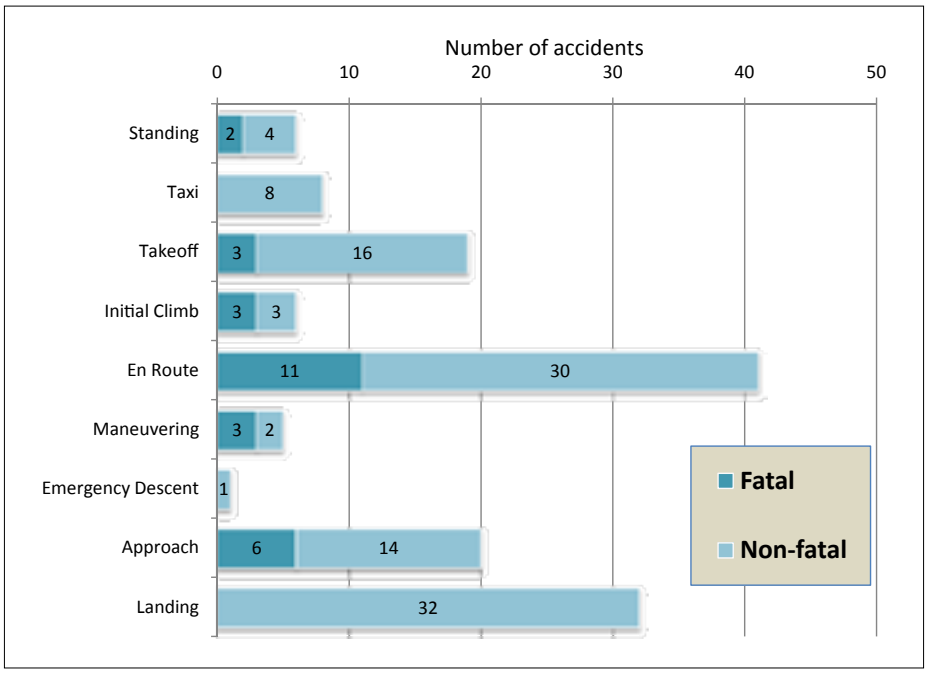

Figure 55. Phases of flight associated with the defining events for ferry and positioning accidents, 2007–2009.

Overall, these accidents most commonly occurred during en route phases of flight or during approach and landing phases. The majority of fatal accidents occurred during en route flight.

The median age of accident pilots of fixed-wing airplanes involved in ferry or positioning flights was 47 years (ranging from 25 to 71), while for accident pilots of helicopters the median age was 46 years (ranging from 29 to 71). The median total flying time for accident pilots of fixed-wing airplanes was 3,510 hours (range from 80 to 20,170), while for accident pilots of helicopters the median total flight time was 5,500 hours (ranging from 611 to 35,000). The median time in the type of accident aircraft for fixed-wing airplane pilots was 300 hours (ranging from 30 to 10,000), while the median time in the accident aircraft type for helicopter pilots was 580 hours (ranging from 62 to 21,000).

Business Flying

Business flying is the use of any GA aircraft for business purposes, and it is distinct from corporate flying (involving a paid crew), which is also conducted under Part 91. Figure 56 shows the total hours of business flying estimated in the General Aviation and Part 135 Activity Survey from 2000 through 2009. In 2009, 72% of the business flight hours estimated by the General Aviation and Part 135 Activity Survey were flown in piston airplanes (56% in single-engine piston aircraft), 10% in turboprop airplanes, 11% in jet airplanes, and less than 3% in helicopters.

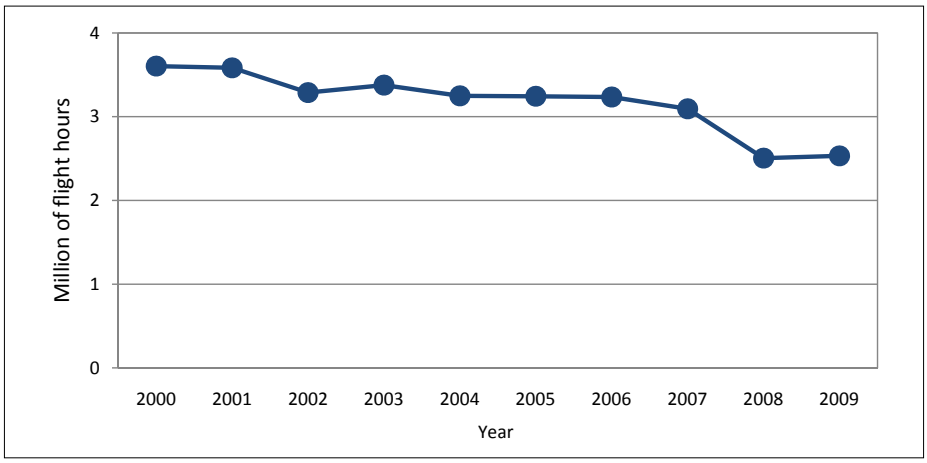

Figure 56. Total business flying estimated in the General Aviation and Part 135 Survey, 2000–2009.

Figure 57 shows the fatal and non-fatal business flying accidents from 2000 through 2009.

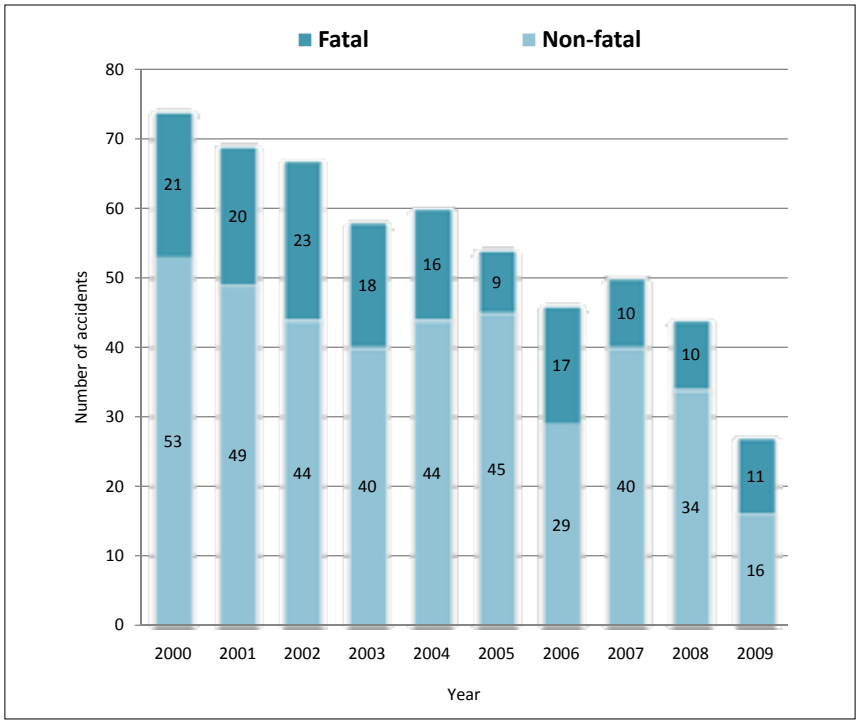

Figure 57. Fatal and non-fatal business flying accidents, 2000–2009.

Total accidents show a decline across the decade. During the decade, 54% of the business flying accidents were in single-engine piston airplanes, 16% in twin-engine piston airplanes, 12% in helicopters (either piston or turbine), 10% in turboprop airplanes, and 6.5% in jet airplanes. Figure 58 shows the total and fatal accident rates for all business flying over the decade. They both show a modest decline over the ten-year period and are substantially below the overall GA accident rates shown in figure 36.

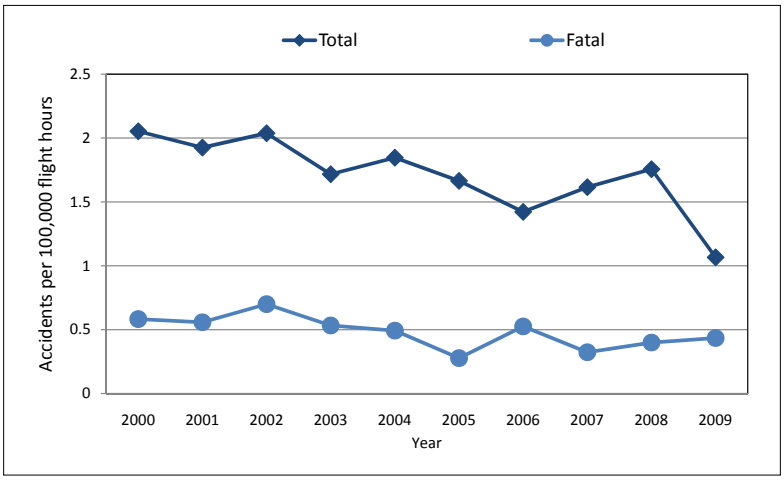

Figure 58. Total and fatal business flying accidents per 100,000 flight hours, 2000–2009.

Figure 59 shows the distribution of defining accident events for all business flying accidents from 2007 through 2009. Loss of control (in flight or on the ground) accounted for the largest proportion of total accidents, followed by system/component failures. Loss of control in flight accounted for the greatest proportion of fatal business flying accidents, followed by controlled flight into terrain and collisions on takeoff or landing.

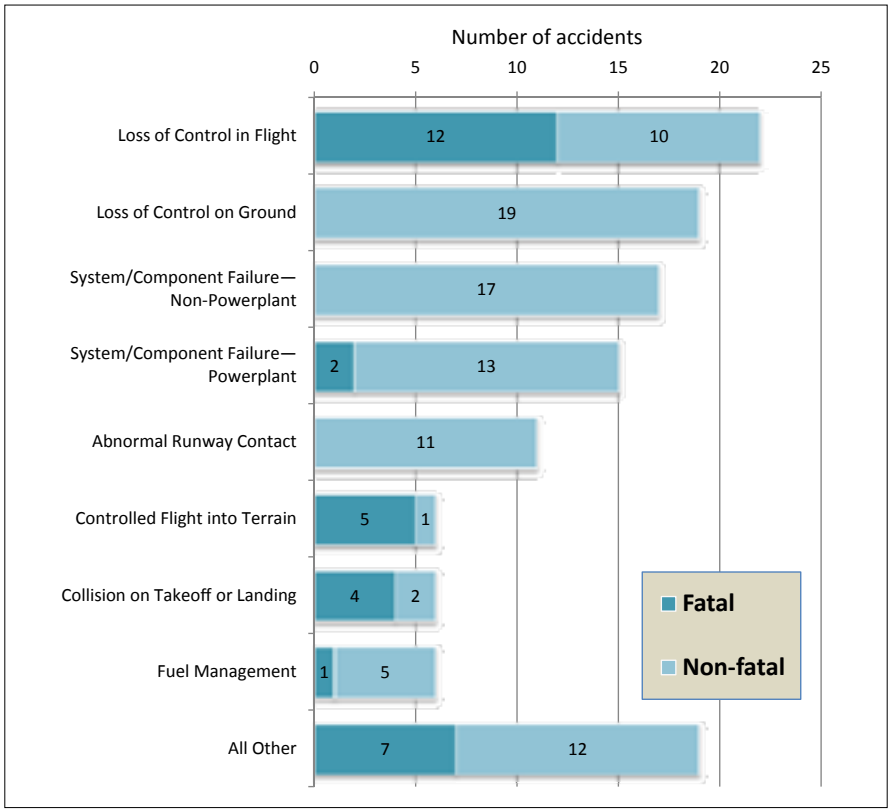

Figure 59. Defining events for fatal and non-fatal business flying accidents, 2007–2009.

Figure 60 shows the phases of flight for these events. As might be expected, landings, and to a lesser extent, takeoffs, are associated with a large proportion of the total defining accident events. On the other hand, en route flight, approach, and initial climb are associated with most of the loss of control in flight and collision accidents that accounted for business flying fatalities.

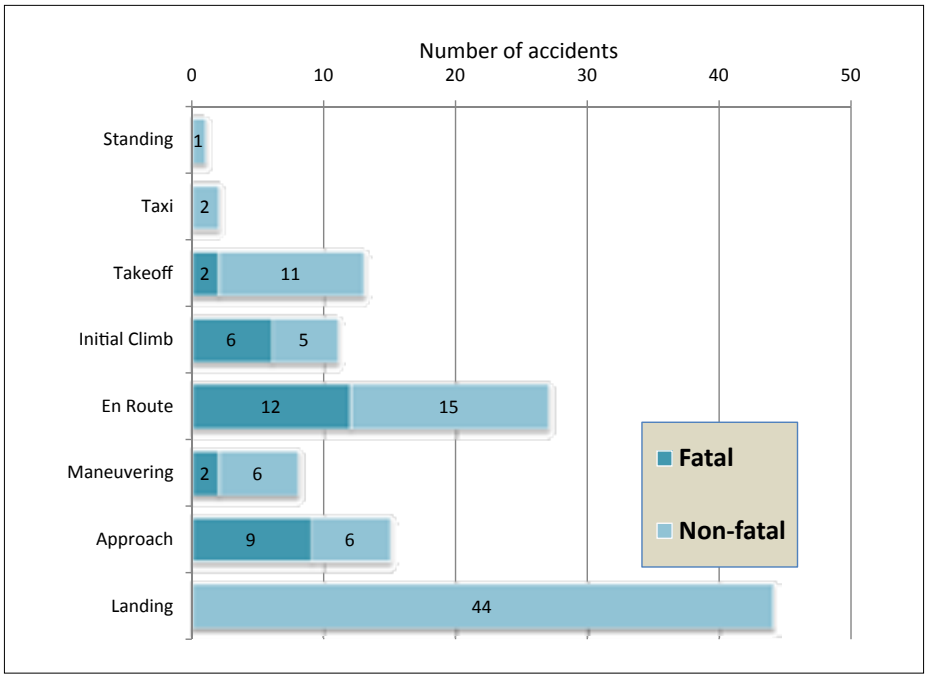

Figure 60. Phases of flight associated with defining accident events for business flying accidents, 2007–2009.

The median age of accident pilots engaged in business flying was 52 years, ranging from 23 to 81. The median total flying time logged for these pilots was 3,000 hours, with a range from 60 to 40,000. The median time in the type of accident aircraft was 407 hours, ranging from 1 to 11,000 hours.

Public Use

Public aircraft are defined in 14 CFR Part 1 as ". . . aircraft used only for the United States Government; . . . and aircraft owned and operated by the government of a State, the District of Columbia, or a territory or possession of the United States or a political subdivision of one of these governments . . ." for other than commercial purposes. A number of functions are performed by Federal, state, and local governments in such aircraft, including law enforcement, firefighting, search and rescue, and resource management functions. Such operations are not covered by most FAA regulations. No common reporting of flight activity is required of these government entities, and these operators are not contacted for the FAA's General Aviation and Part 135 Activity Survey.

Figure 61 shows the numbers of fatal and non-fatal public use accidents in fixed-wing airplanes and helicopters from 2000 through 2009. Across the decade, both total and fatal accidents are relatively evenly distributed between fixed-wing airplanes (138 total; 28 fatal) and

helicopters (148 total; 30 fatal), and the proportion of all accidents that were fatal (20%) is similar to the proportion of all GA accidents that are fatal.

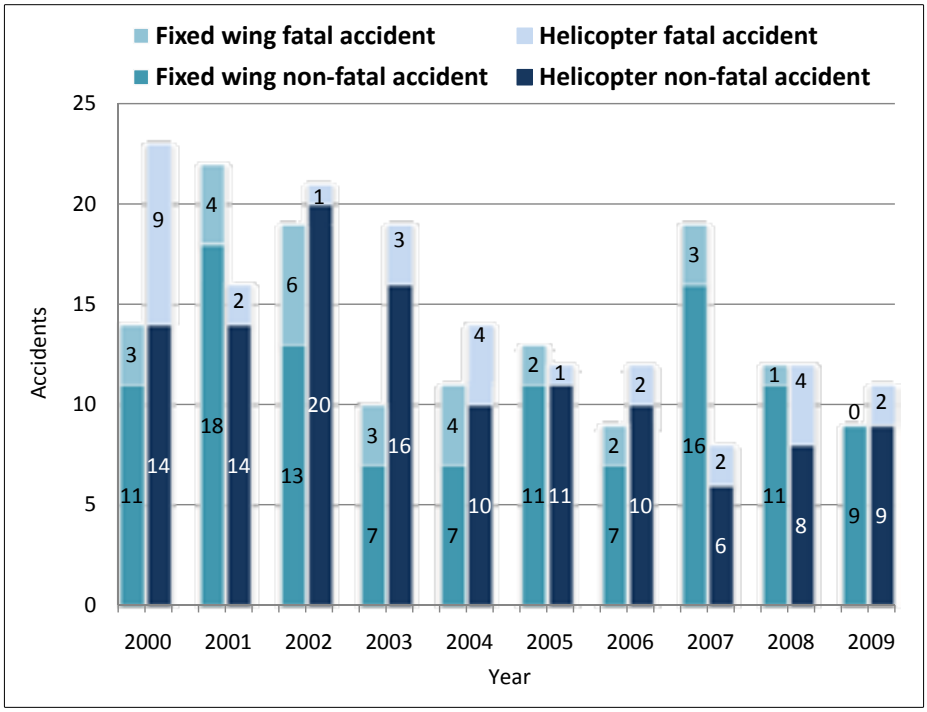

Figure 61. Fatal and non-fatal public use airplane and helicopter accidents, 2000–2009.

State and local police often use helicopters for law enforcement activities, and this type of flying is a common example of public use flights.

Figure 62 shows the distribution of defining accident events for both fixed-wing airplanes and helicopters involved in public use accidents from 2007 through 2009. Loss of control in flight, hard landings (abnormal runway contact), and system/component failures of power plants were the most frequent events for helicopters involved in these accidents. The fatal helicopter accidents during this period were associated with loss of control in flight, low altitude operations, ground handling, and unintended flight into IMC. A broader range of defining accident events were observed for the fixed-wing airplanes, the most common being hard landings, loss of control on the ground and in flight, and system/component failures of power plants. All four of the fatal fixed-wing airplane accidents in this period were associated with loss of control in flight.

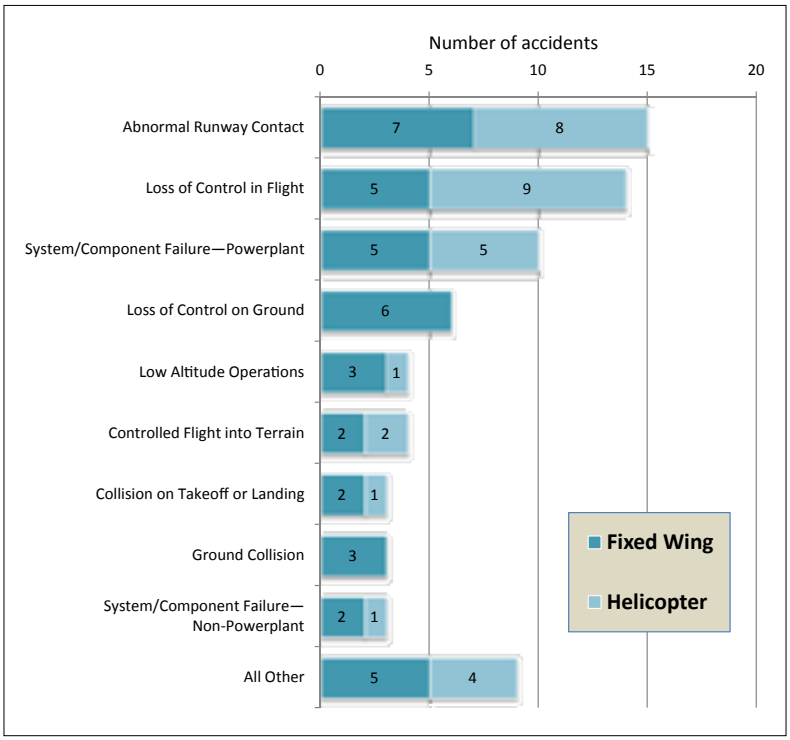

Figure 62. Defining accident events for fixed-wing airplane and helicopter public use accidents, 2007–2009.

Figure 63 shows the phases of flight associated with these defining accident events for both fixed-wing airplanes and helicopters. Most of the public use fixed-wing airplane and helicopter accidents occurred during maneuvering or landing phases of flight.

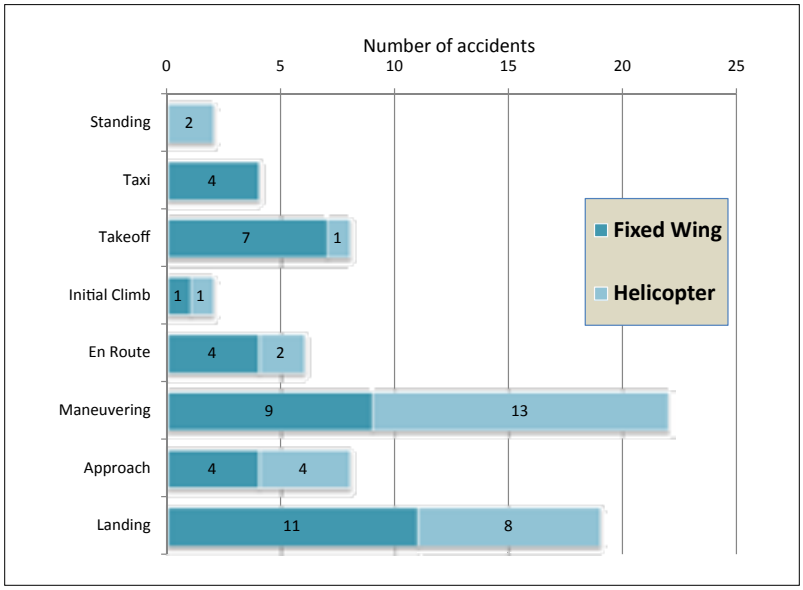

Figure 63. Phases of flight associated with the defining accident events for helicopter and fixed-wing airplane public use accidents, 2007–2009.

The median age of accident pilots operating fixed-wing airplanes for public use flying was 47 years, ranging from 25 to 71, while for helicopter pilots the median age was 46 years, ranging from 29 to 71. Median total flying time logged for fixed-wing airplane accident pilots was 3,510 hours, ranging from 80 to 20,170. Helicopter pilots' median total flying time was 5,500 hours, ranging from 611 to 35,000. Total time in the type of accident aircraft was 300 hours (ranging from 30 to 10,000 hours) for fixed-wing airplane pilots and 580 hours (ranging from 62 to 21,000 hours) for helicopter pilots.

APPENDIX A

CAST/ICAO Common Taxonomy Team Aviation Occurrence/Event Categories and Phase of Flight Definitions[16]

16. The event and phase of flight definitions and usage notes may also be found at the CICTT worksite: <http://www.intlaviationstandards.org/>.

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.
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.

(continued)

AVIATION OCCURRENCE/EVENT CATEGORIES (continued)

Occurrence/Event	Acronym	Description
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.
Collsion 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 abouve 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

Part 121 Accidents: 2007–2009

Aviation datasets for Part 121 accidents for 2007–2009 are available at http://www.ntsb.gov/data/aviation_stats.html


NATIONAL TRANSPORTATION SAFETY BOARD
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