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William J. Hughes Technical Center
Aviation Research Division
Atlantic City International Airport
New Jersey 08405

A Database Management System for General Aviation Safety

June 2014

Final Report

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16. Abstract

The research team at Embry Riddle Aeronautical University (ERAU) conducted a series of analyses to find patterns and associations among general aviation (GA) accidents and incidents. This research work is intended to provide the Federal Aviation Administration (FAA) with analyses of fatal and nonfatal accidents by examining the National Transportation Safety Board (NTSB) database. The analyses presented in this report focused mainly on examining GA accidents that occurred between 1982 and 2007.

This report is divided into three major phases. Phase 1 relates to GA accident frequencies for all accidents and incidents nationally. It presents charts and frequencies on number of accidents, time of day, month of the year, phases of flight, and purpose of the flights from 1982-2007 for both fatal and nonfatal accidents. Phase 2 focuses these statistics on a regional basis. According to the FAA, nine regions are identified within the U.S. The national statistics in Phase 1 are filtered for each of the regions and are presented in Phase 2. Phase 3 provides an analysis of the ten most frequent primary causes of fatal and nonfatal GA accidents on a national basis between 1982 and 2007. This phase identifies the top ten primary causes for fatal and nonfatal accidents and compares them on the basis of 5-year intervals to determine how these causes change and shift over time.

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LIST OF ACRONYMS

CFR	Title 14 Code of Federal Regulations
FAA	Federal Aviation Administration
GA	General Aviation
IFR	Instrument flight rules
IMC	Instrument meteorological conditions
NTSB	National Transportation Safety Board
VFR	Visual Flight Rules
VS	Vertical Speed

EXECUTIVE SUMMARY

Air transportation has a superior safety record compared to other modes of transportation; it was accountable for about 0.03% of all transportation-related accidents that occurred in the U.S. via air, highways, and railroads between 1990 and 2007, while highways and railroads were responsible for 99.86% and 0.11%, respectively. In the same period, only 1.98% of all fatalities occurred in the air transport-related accidents, whereas 95.56% of fatalities took place on the highways and 2.46% on the railways. On average, around 42,000 people die in the U.S. on the highways every year. On the other hand, air transportation accidents annually take fewer than 900 lives.

This study was based on the Federal Aviation Administration (FAA)-provided database containing approximately 300 MB of data on more than 65,000 events (accidents/incidents). The analyses considered queries and data mining of this database combined with other publicly available FAA reports and analyses. This report focuses mainly on examining general aviation (GA) accidents that occurred between 1982 and 2007. Fatal and nonfatal accidents that occurred in 2008 were excluded because, by the time the database was received (in 2009), some of the final causes of the 2008 accidents had not been identified.

This report is divided into three major phases. Phase 1 relates to GA accident frequencies for all accidents and incidents nationally. It presents charts and frequencies on the number of accidents, time of day, month, phases of flight, and purpose of the flights from 1982-2007 for both fatal and nonfatal accidents. Phase 2 focuses these statistics on a regional basis. According to the FAA, nine regions are identified within the U.S. The national statistics in Phase 1 are filtered for each of the regions and are presented in Phase 2. Phase 3 provides an analysis of the ten most frequent primary causes of fatal and nonfatal GA accidents on a national basis between 1982 and 2007. This phase identifies the top ten primary causes for fatal and nonfatal accidents and compares them at 5-year intervals to determine how these causes change and shift over time.

1. INTRODUCTION.

1.1 PURPOSE.

The main focus of this study was to examine general aviation (GA) accidents (Title 14 Code of Federal Regulations (CFR) Part 91) and identify relationships between flight elements and risk factors that result in fatal accidents. In particular, the study highlighted the patterns among the fatal GA accidents and determined how different factors contributed to accidents being fatal or nonfatal.

1.2 BACKGROUND.

According to the Bureau of Transportation Statistics of the U.S. Department of Transportation, aviation has a superior safety record compared to other modes of transportation. Air transportation was accountable for about 0.03% of all transportation-related accidents that occurred in the U.S. in the air, on the highways, and railroads between 1990 and 2007, while highways and railroads were responsible for 99.86% and 0.11%, respectively. In the same period, only 1.98% of all fatalities occurred in air transport-related accidents, whereas 95.56% of fatalities took place on the highways and 2.46% on the railways. On average, approximately 42,000 people die in the U.S. on the highways every year, whereas air transportation accidents cause less than 900 deaths annually.

However, if all aviation accidents in the U.S. are categorized into commercial air carrier and GA accidents, it is clearly evident that the distribution of accidents and fatalities among the subgroups is very uneven. On average, more than 80% of all air transport accidents are GA. GA is typically classified as the operation of civilian aircraft for purposes other than commercial passenger transport, including personal, business, and instructional flying.

2. THE NATIONAL TRANSPORTATION SAFETY BOARD DATABASE.

Federal regulations require the pilot/operator of an aircraft to notify the Regional Office of the National Transportation Safety Board (NTSB) nearest to the accident or incident immediately. An accident is defined as an occurrence during an aircraft operation that takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death, or serious injury, or in which the aircraft receives substantial damage. An incident is defined as any occurrence other than an accident that could affect the safety of aircraft operations. A Pilot/Operator Aircraft Accident/Incident Report (NTSB Form 6120.1) is used to record the facts, conditions, and circumstances related to the accident/incident. The form consists of nine pages of more than 200 different query items that are grouped into location and time of accident/incident, aircraft information, owner/operator information, collision information, weather information, airport information, and pilot information. Narrative sections are provided to describe how the accident/incident occurred and are typically completed after the investigation is finished and all the contributing factors are known. The final, complete report can take several years to be delivered after the accident/incident.

The Federal Aviation Administration (FAA) provided an Oracle database, which contained about 300 MB of data with more than 65,000 events (accidents/incidents). The following analyses are based on queries and data mining of this database combined with other publicly available FAA reports and analyses. The analyses presented in this report focus mainly on examining GA accidents that occurred between 1982 and 2007. Fatal and nonfatal accidents in 2008 are excluded from this report because, by the time the database was received (in 2009), some of the final causes of the 2008 accidents were not identified.

3. PHASE 1—GA ACCIDENTS—NATIONAL FREQUENCY.

3.1 GENERAL FREQUENCY CHARTS.

Phase 1 of this report focused on the patterns of GA accidents over specific periods on a national basis. The first part of Phase 1 attempted to provide some general trends for fatal and nonfatal accidents. The data used for these analyses began on January 1, 1982 and ended on December 31, 2007. The first examination of the number of accidents confirmed that GA accounts for approximately 85% to 88% of the total number of aviation accidents occurring in the U.S. (see figures 1 and 2). These figures show that, despite the decrease in both the total number of aviation accidents and GA accidents, the contribution of GA accidents over all aviation accidents is still higher.

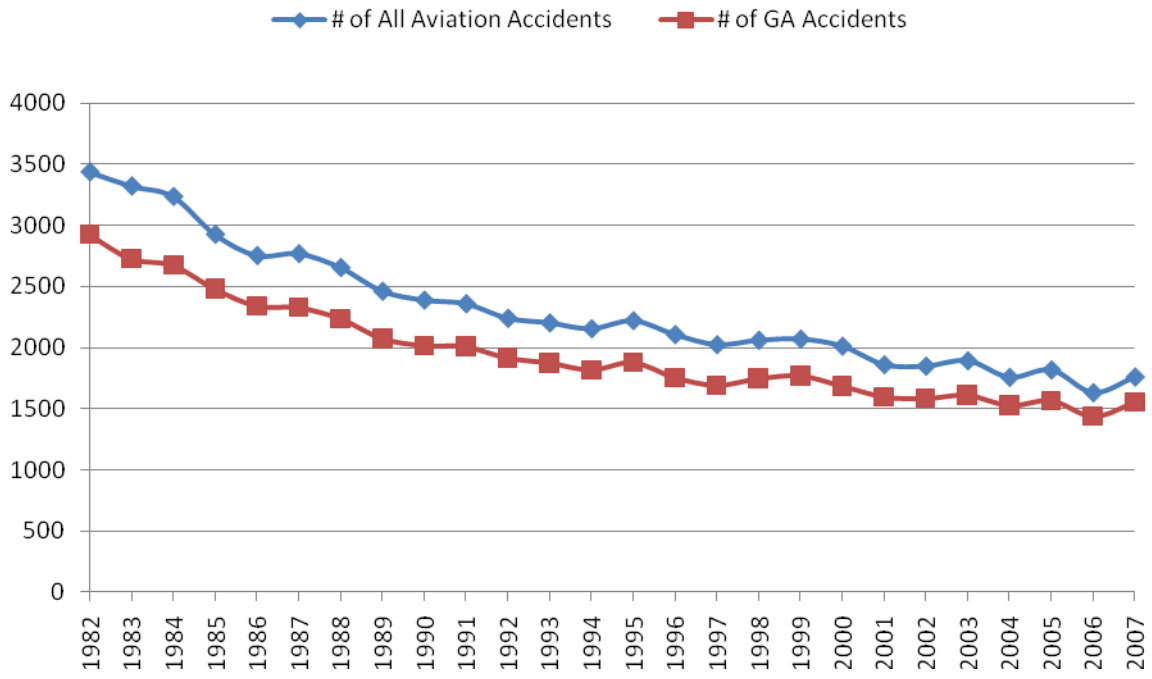

Figure 1. Number of All Aviation and GA Accidents in the U.S. (1982 through 2007)

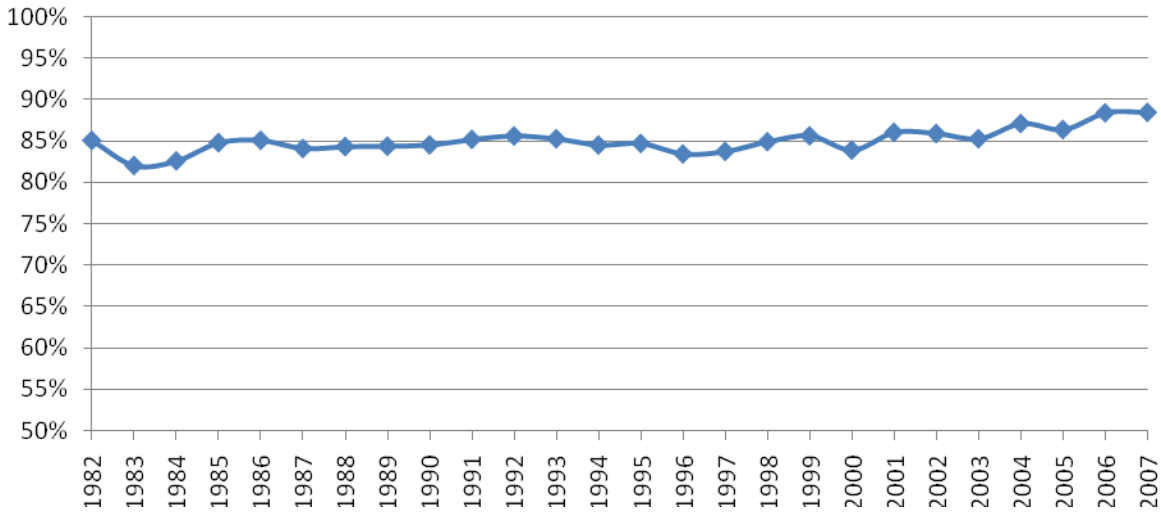

Figure 2. Percentages of GA Accidents in the U.S. (1982 through 2007)

Figures 3 through 5 present the number of both fatal and nonfatal GA accidents over the same time period. As these figures suggest, the number of accidents are declining—most likely due to safety measures introduced by the FAA.

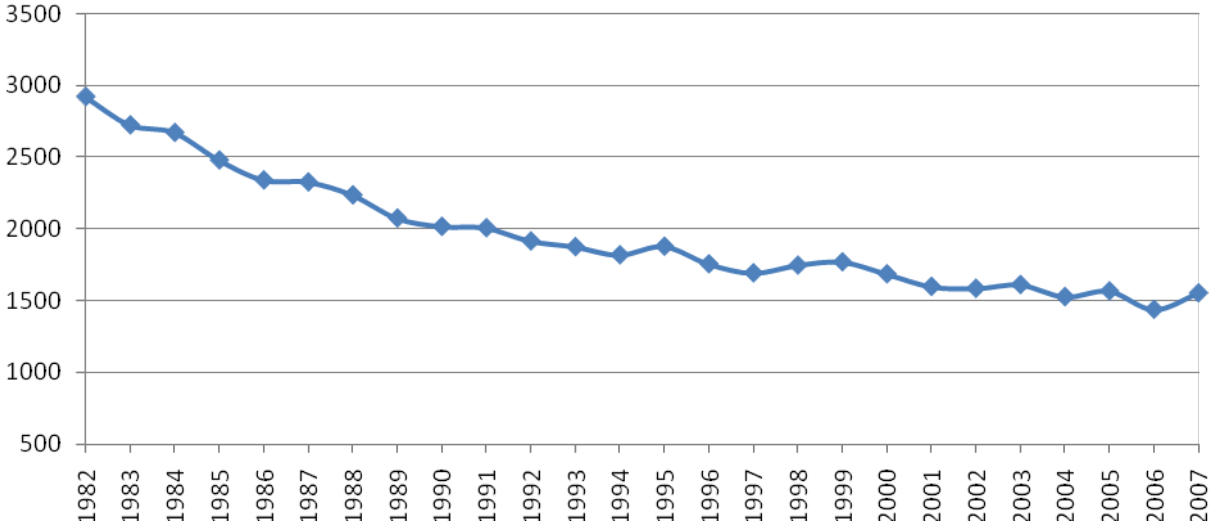

Figure 3. Number of Fatal GA Accidents (1982 through 2007)

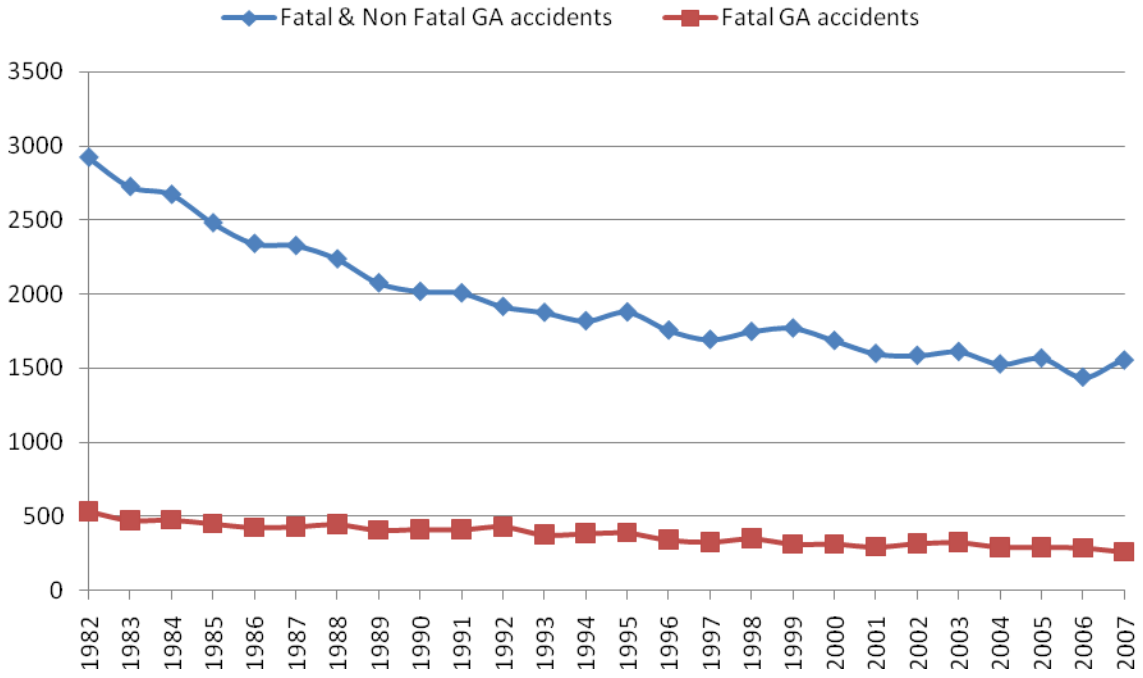

Figure 4. Number of Total GA and Fatal GA Accidents (1982 through 2007)

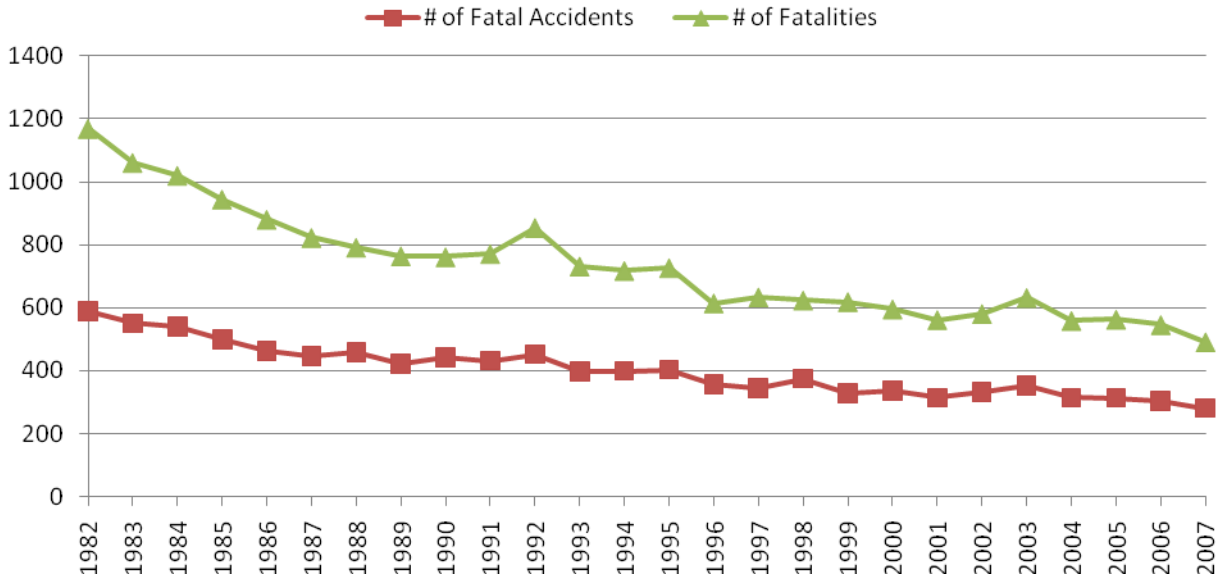

Figure 5. Number of Fatal GA Accidents and Fatalities in the U.S. (1982 through 2007)

Figure 6 shows the comparison between the number of total GA accidents (fatal and nonfatal) per 100,000 flight hours, as estimated by the FAA, and the number of GA accidents that caused fatal injuries per 100,000 flight hours. The rates are computed by dividing the number of GA accidents by the number of GA flight hours per 100,000.

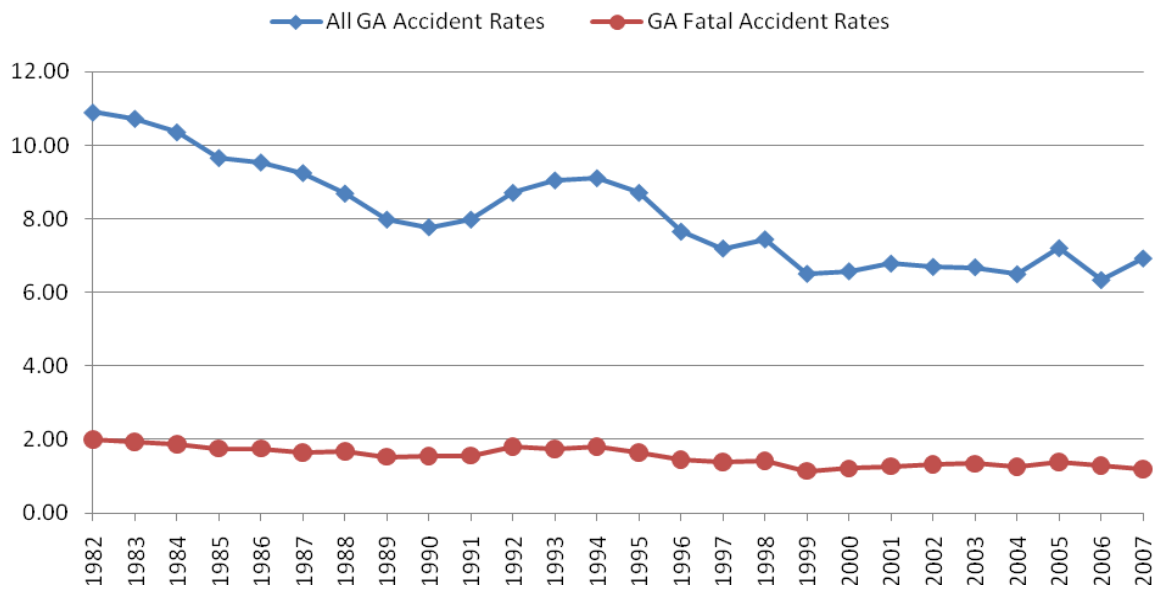

Figure 6. Number of Total GA and Fatal GA Accidents per 100,000 Flight Hours

Furthermore, the team compiled and analyzed the GA accidents data on an hourly and monthly basis to identify how the accidents change over time. The time-based statistical data considered a 26-year time period, which was divided into three decades: 1982-1991, 1992-2001, and 2002-2007. Taking into account the actual number of accidents over different times of day*, the rates of accidents each hour that represent how many fatal or nonfatal accidents were calculated at each hour relative to the number of accidents in that period (see figures 7 through 10). Fatal accident rates are represented in blue while nonfatal accidents are represented in yellow. Note that the yellow and blue percentages combined total 100%.

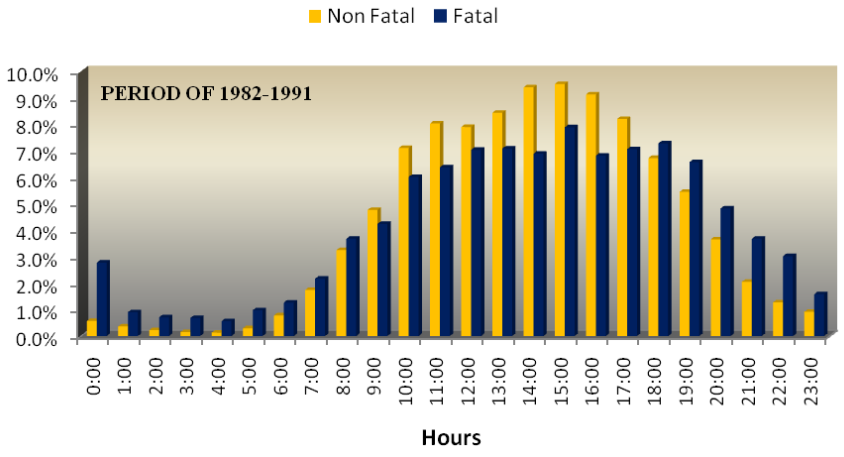

Figure 7. Fatal and Nonfatal GA Accident Rates Based on Time of Day (1982-1991)

* In this report, "morning" is defined as the hours between 6 a.m. and 12 p.m. "Night" is defined as the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time.

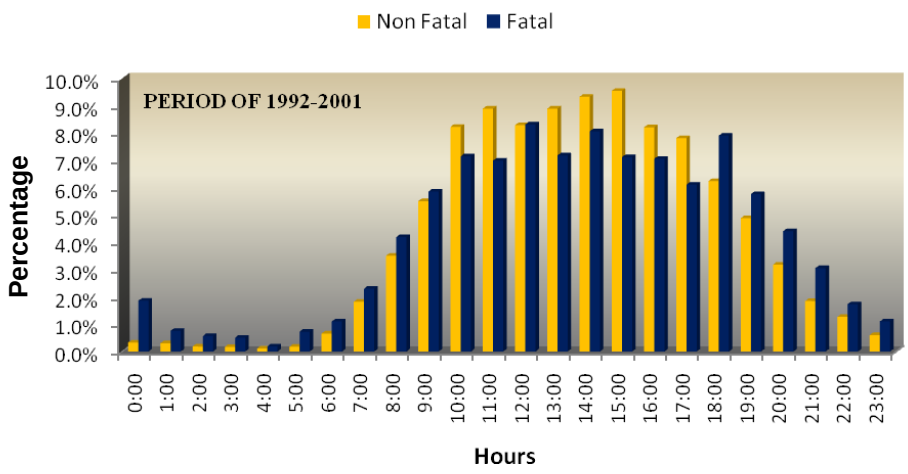

Figure 8. Fatal and Nonfatal GA Accident Rates Based on Time of Day (1992-2001)

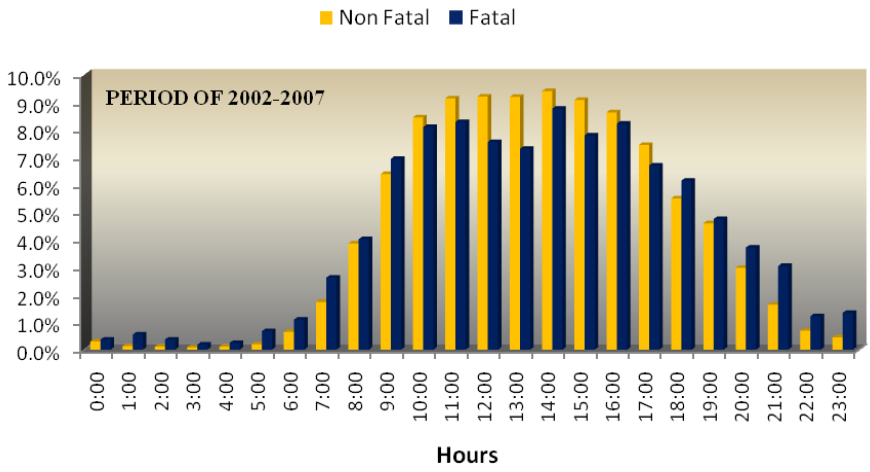

Figure 9. Fatal and Nonfatal GA Accident Rates Based on Time of Day (2002-2007)

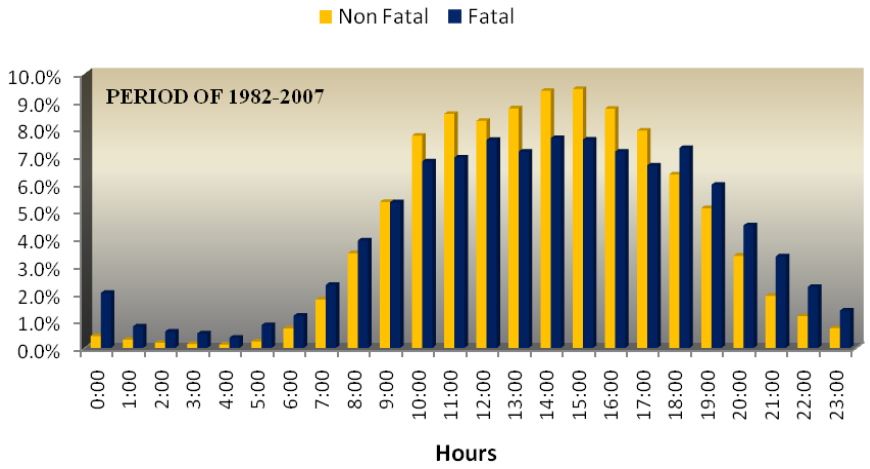

Figure 10. Fatal and Nonfatal GA Accident Rates Based on Time of Day (1982-2007)

Figure 10 summarizes fatal and nonfatal GA accident rates, based on the time of day, between 1982 and 2007. Generally, figures 7 through 10 show that the percentages of fatal accidents exceeded the percentages of nonfatal accidents during nighttime and early morning (between 6 p.m. and 9 a.m.).

In addition to time of day, the team identified how the accidents change over different months of the year and how the percentage of fatal accidents changed over the last 5 (2003-2007), 10 (1998-2007), and 20 (1988-2007) years. Figures 11 and 12 present the distribution of fatal and nonfatal accidents over 12 months.

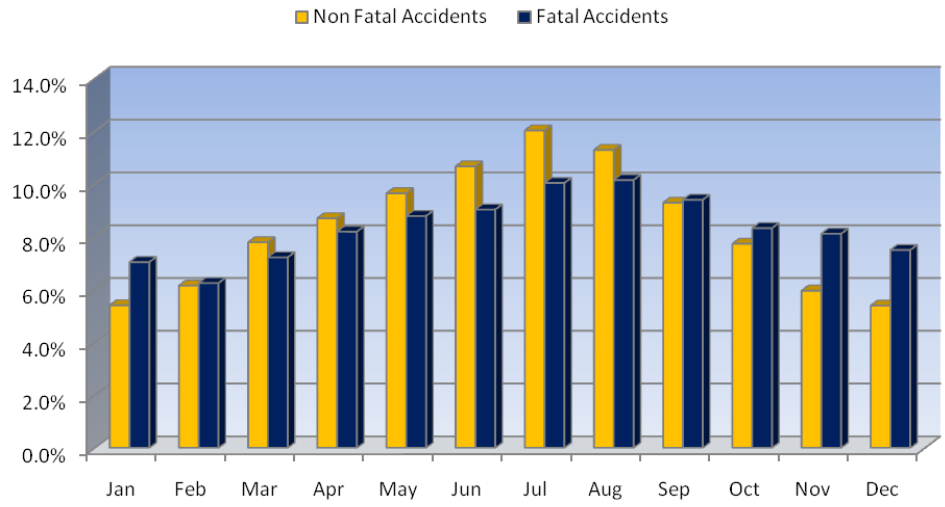

Figure 11. Percentages of Fatal and Nonfatal GA Accidents by Month (1982-2007)

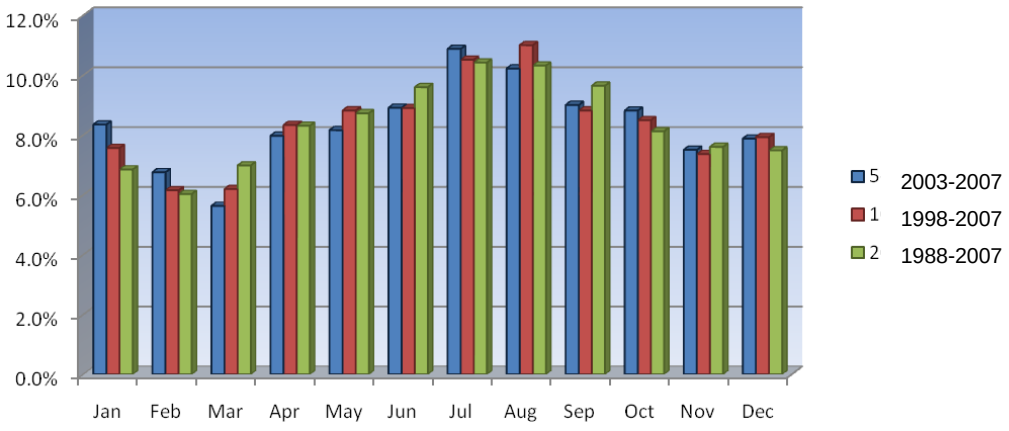

Figure 12. Percentages of Fatal GA Accidents by Month
(2003-2007, 1998-2007, and 1988-2007 time periods)

According to figure 11, between 1982 and 2007, the number of both fatal and nonfatal accidents, as expected, peaked in the summer months; this could be caused by an increase in air traffic, as

the weather is more suitable for flying. This figure also shows that the cold/winter months have a higher percentage of fatal accidents than other seasons.

Figure 12 compares the percentage of fatal accidents over different months of the year for 5-, 10-, and 20-year periods within the 1988-2007 time frame. It suggests that the percentage of fatal accidents increased in the 5-year period (2003-2007) for January, February, July, and October compared to the 10-year period (1998-2007), and even between the 10-year period and the 20-year period (1988-2008). Interestingly, as the number of accidents peaks in the middle of the year, the highest percentages of fatal accidents occur in the months of July and August. This trend persisted over the 5-, 10-, and 20-year periods.

3.2 PHASES OF FLIGHT.

This section presents a stream of analysis on GA accidents based on phases of flight. The NTSB coding manual identifies 48 phases of flight grouped into 17 categories, which have been reduced to 11 phases for this report. These phases include standing, taxi, takeoff, climb, cruise, descent, approach, missed approach, landing, maneuvering, and other. Appendix B presents the details on the phase classifications used in this report.

Figure 13 represents a comparison of accident frequency by phase of flight involved in both fatal and nonfatal GA accidents that occur during the period under consideration. Almost half of all nonfatal accidents occur during the landing phase. This phase includes flare, touchdown, roll, aborted landing, as well as emergency landing and emergency landing after takeoff. As the figure suggests, the second highest rate for nonfatal accidents is in the takeoff phase. The takeoff phase includes roll, run, initial climb, and aborted takeoff. Based on the same figure, descent contributes the highest rate of fatal accidents, followed by maneuvering, cruise, approach, and takeoff. The descent phase includes emergency descent, normal descent, and uncontrolled descent. Figure 14 presents the percentage of fatal accidents across the 5-, 10-, and 20-year periods defined above.

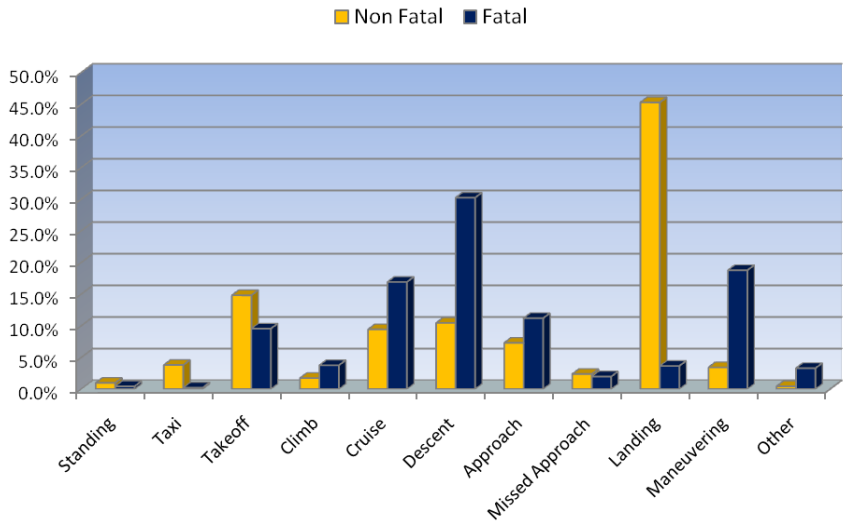

Figure 13. Percentages of GA Accidents by Phases of Flight (1982 and 2007)

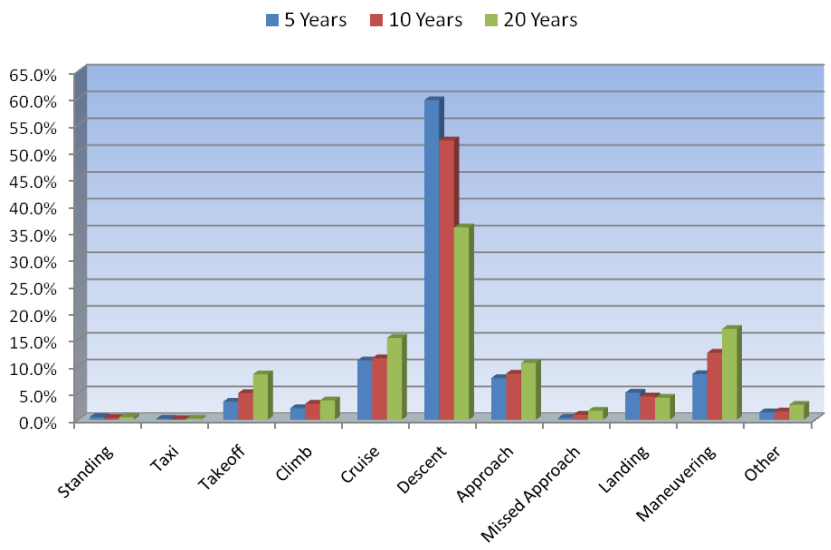

Figure 14. Percentages of Fatal GA Accidents by Phases of Flight (2003-2007, 1998-2007, and 1988-2007 time periods)

As suggested by figure 14, during the last 5 years of the study (2003-2007), the number of fatal accidents occurring during descent increased compared to the last 10 years (1998-2007). This trend continues when the 10- and 20-year percentages are compared. The same pattern occurred in the landing phase, but the increase was not as significant as the descent phase. The tendency was for the other phases to decline in the frequency of fatal accidents during the last 10 years of the study (1998-2007) compared to the last 20 years (1988-2007), followed by the last 5 years (2003-2007) from the last 10 years (1998-2007).

Figure 15 confirms the trend that there is an increasing number of fatal accidents occurring during the descent phase. There were some significant increases in the trend during 1984, 1991, 1998, 2001, 2002, and 2003.

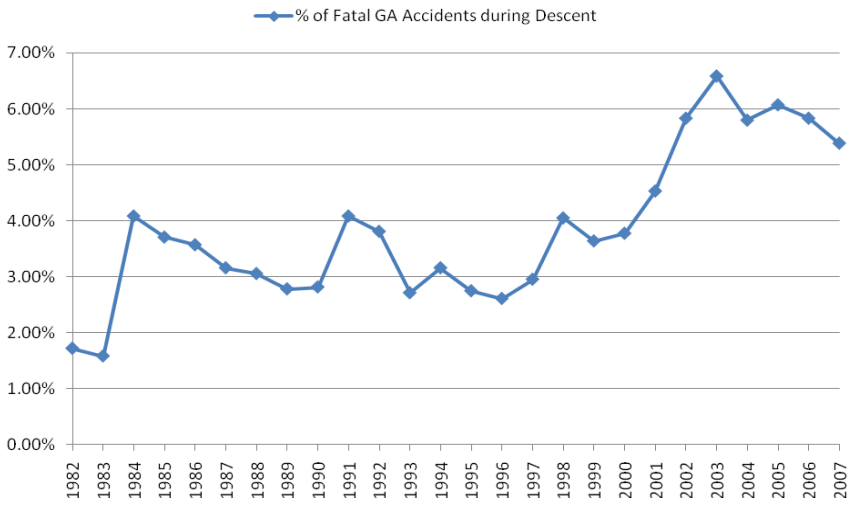

Figure 15. Percentages of Fatal GA Accidents During the Descent Phase

3.3 PURPOSE OF FLIGHT.

GA's versatility is represented by the wide variety of operations from recreational to personal and commercial operations. This section summarizes GA accident data grouped by purpose of flight (or type of operation), as mentioned on NTSB Form 6120.1; these data are compared to the number of active aircraft available on the specific period based on the FAA statistical data on GA and 14 CFR Part 135 activity surveys for the last 18 years (1990 to 2007). All accident data used in this report were extracted from the NTSB accident database for flights under 14 CFR Part 91. Fatal and nonfatal accidents in 2008 are excluded from this report because by the time the database was received (in 2009), some of the causes of the 2008 accidents had not been identified.

NTSB Form 6120.1 mentions 14 different categories of purpose of flight, such as personal, business, executive/corporate, instructional, ferry, positioning, aerial use, air drop, air race/show, flight test, public use, as well as two other types of operations in separate fields (i.e., revenue sightseeing and air medical operations). The FAA surveys define 13 categories of such operations. Appendix C of this report shows the description of each category (with the exception of the Public Use category) based on the FAA documents used to conduct the 2007 General Aviation and Part 135 Activity Survey. According to FAA's Methodology for the 2007 General Aviation and Part 135 Activity Survey, since 2000, the FAA excluded Public Use from the survey, keeping it independent of other use categories, because it was not mutually exclusive with respect to other flight activity.

This report presents the frequency of accidents that occurred during different types of operations and compares the number of accidents to the number of active aircraft available for the specific operations between 1990 and 2007. The following sections discuss the categories of operations mentioned in GA and 14 CFR Part 135 Activity Survey and provide a summary of the analyses performed.

3.3.1 Category 1: Aerial Application.

According to the FAA, aerial application operation is basically used for the purpose of dispensing any substance, such as pesticide, directly affecting agriculture, horticulture, forest preservation, health, firefighting, or for any other pest control operations. This section specifically compares the number of accidents to the number of active aircraft flown for aerial application. Figures 16 and 17 present the number of active aircraft and the number of accidents, including fatal and nonfatal, between 1990 and 2007. Figure 18 shows the percentage of GA accidents for the active aircraft.

Figure 16 shows that the number of active aircraft flown for aerial application operations has decreased for the last 18 years. On the other hand, the number of accidents involving aircrafts used for the same operation did not decrease. Thus, as shown in figure 18, the percentage of accidents that occurred during aerial operations tended to increase, especially after 2003. However, based on figures 16 and 17, the number of accidents that occurred during this operation was relatively small compared to the number of active aircraft flown for the same purpose. For

example, in 2006, out of 3430 active aircrafts flown for aerial application, there were four accidents.

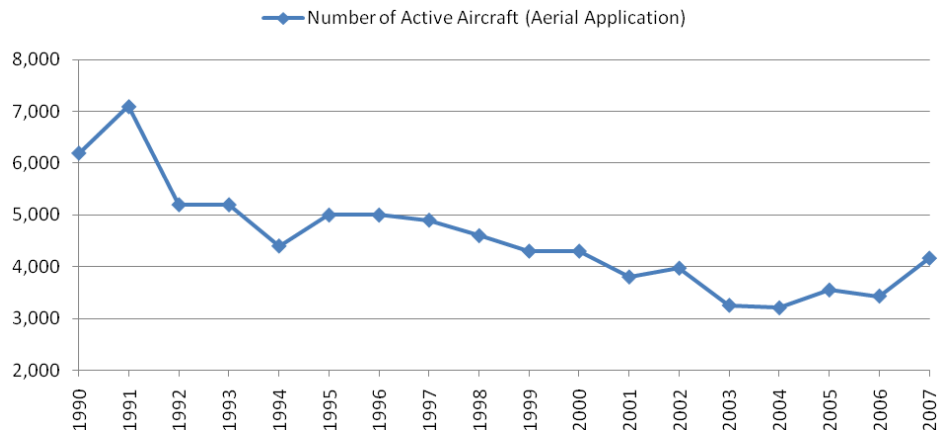

Figure 16. Number of Active Aircraft Used for Aerial Application (1990-2007)

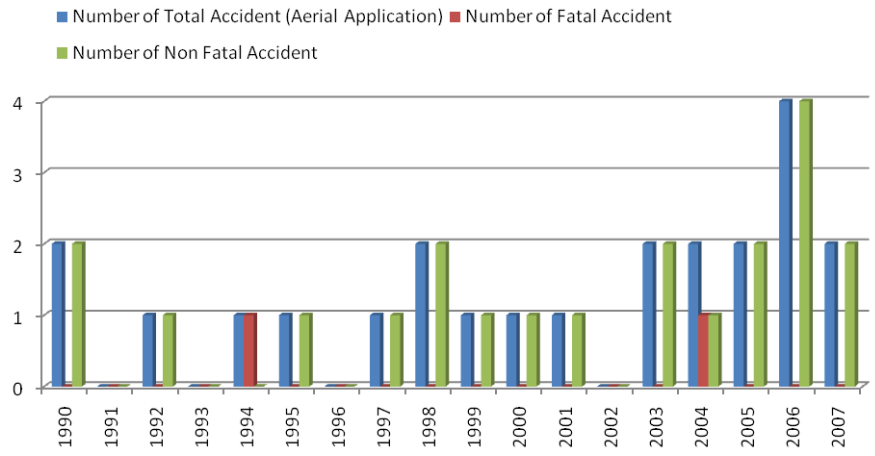

Figure 17. Number of Accidents That Occurred During Aerial Application Flights (1990-2007)

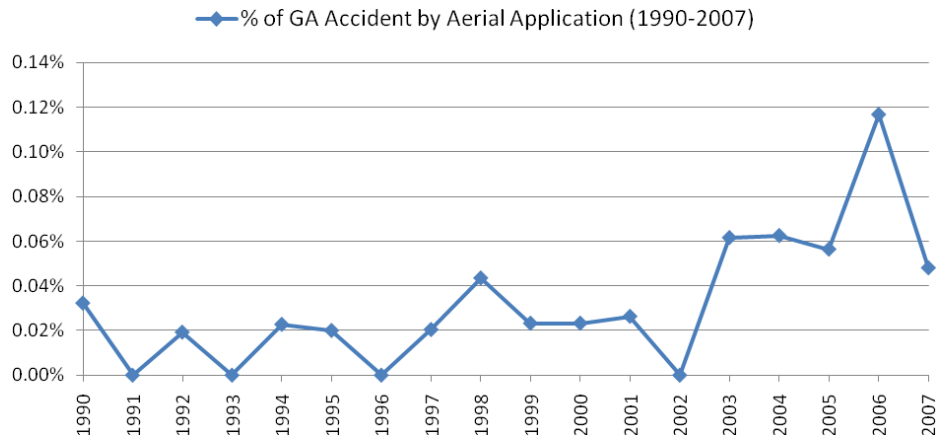

Figure 18. Percentages of GA Accidents During Aerial Application Operation (1990-2007)

3.3.2 Category 2: Aerial Observation.

According to NTSB Form 6120.1, aerial observation operations include aerial mapping/ photography, patrol, search and rescue, hunting, highway traffic advisory, ranching, surveillance, oil and mineral exploration, criminal pursuit, and fish spotting. This category presents the number and percentage of accident occurred during aerial observation flights between 1990 and 2007.

Figure 19 shows that the number of active aircraft used for aerial observation operations varies between 3000 and 6000 aircraft, with the lowest number in 1996. Figure 20 shows a small increase in the number of active aircraft in 2007 compared to 1990.

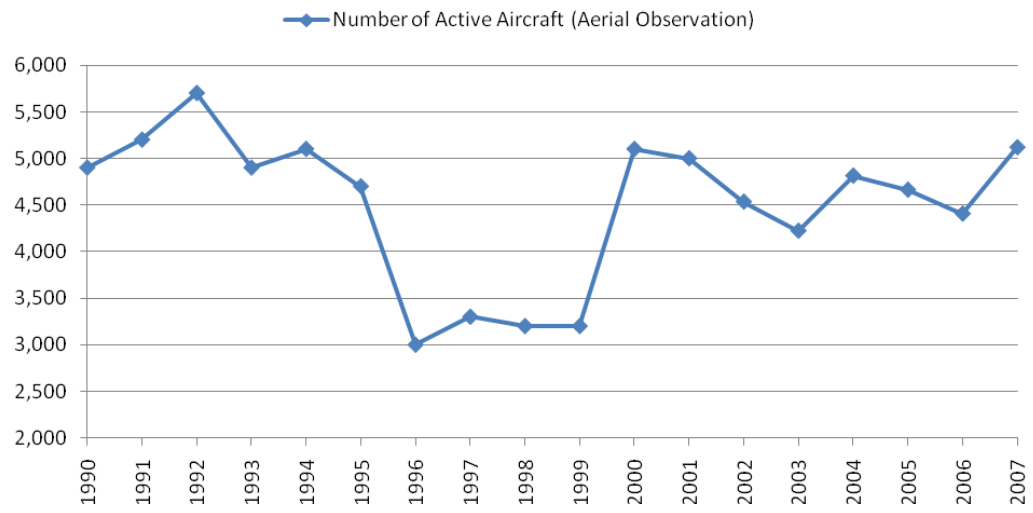

Figure 19. Number of Active Aircraft Used for Aerial Observation Operation (1990-2007)

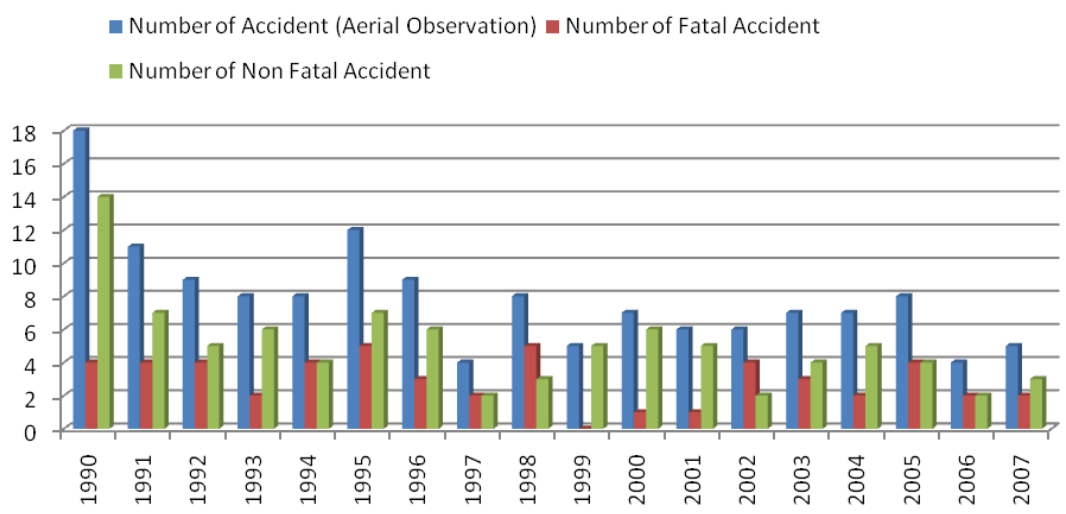

Figure 20. Number of Accidents That Occurred During Aerial Observation Flights (1990-2007)

Unlike the number of active aircraft, the number of accidents generally decreased between 1990 and 2007. This trend led to the decrease in the percentage of accidents, as shown in figure 21.

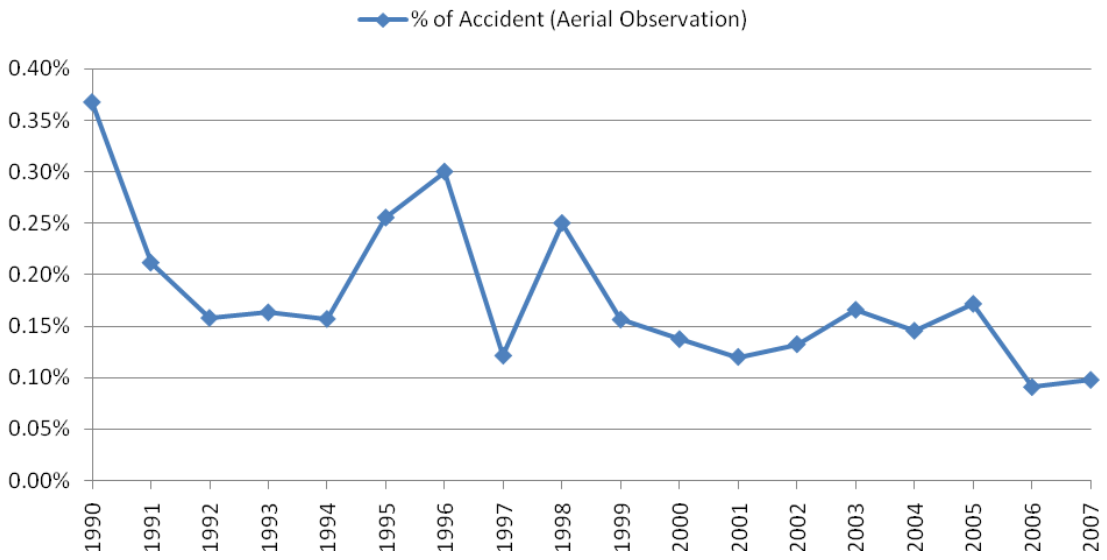

Figure 21. Percentages of Accidents That Occurred During Aerial Observation Operations (1990-2007)

Because the number of accidents decreased while the number of active aircraft fluctuated, the percentage of accidents also fluctuated, trending toward a decline. Considering the number of active aircraft, the percentage of accidents was very minimal. In 2007, there was a total of five accidents out of 5118 active aircrafts.

3.3.3 Category 3: "Other" Aerial Application.

According to FAA statistical data on GA and 14 CFR Part 135 activity surveys, other aerial operations include all other aerial applications, such as public health sprayings, cloud seeding, and fire fighting, including forest fires. On the other hand, NTSB Form 6120.1 mentions another category of aerial operation called Air Drop, which is defined as aerial operations, other than aerial application, that are intended to release items in flight. This report includes other aerial/air drop operations under the category of "Other" (Category 9).

3.3.4 Category 4: Air Medical Services.

This report provides statistical data only for air medical operations under 14 CFR Part 91 (although there is another air medical operation under 14 CFR Part 135). According to the FAA, air medical services include flights conducted for carrying medical personnel, patients, or organs, as well as for medical rescue operations.

Based on the FAA statistical data on general aviation, the air medical category was added to the surveys in 1999 and was divided into two separate types in 2004 to capture air medical

operations under 14 CFR Part 135 and those not covered by 14 CFR Part 135. Figures 22 and 23 show the number of active aircraft flown for the purpose of air medical operations from 1999 to 2007 and the number of accidents that occurred in each year.

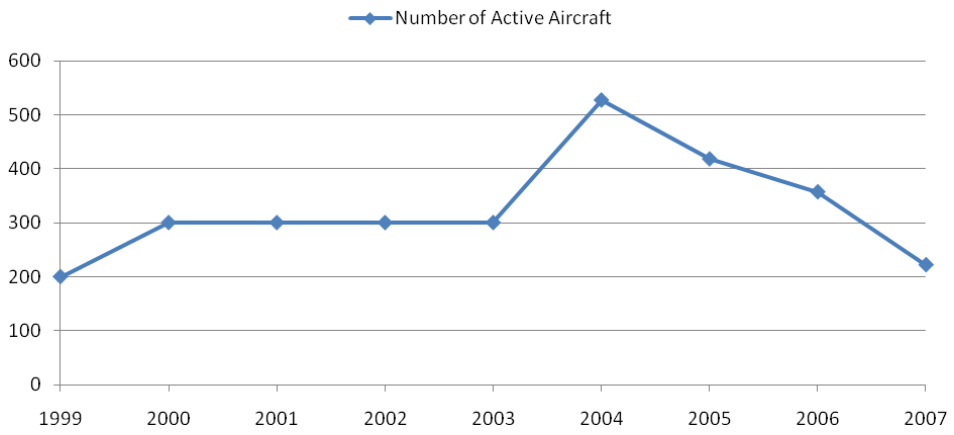

Figure 22. Number of Active Aircraft Used for Air Medical Operations (1990-2007)

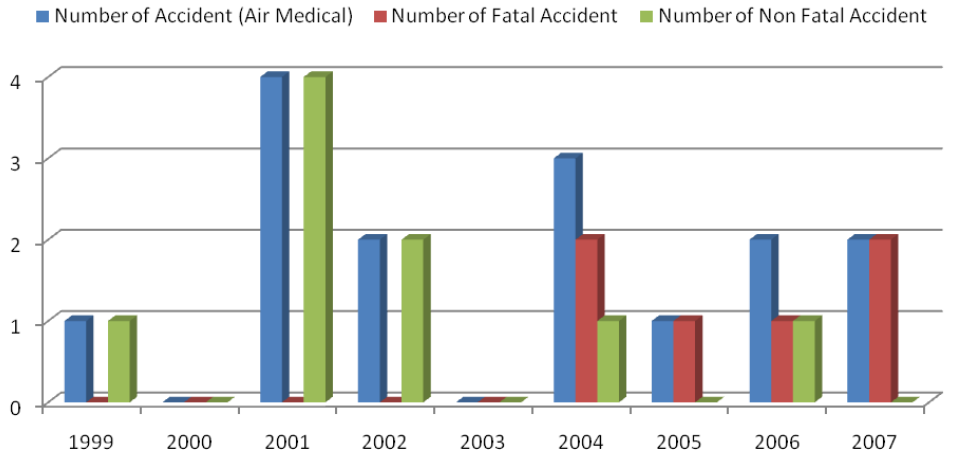

Figure 23. Number of Accidents That Occurred During Air Medical Services (1999-2007)

The number of accidents in this category varies from zero to four. There is no pattern or trend for these numbers, but the number of fatal accidents increased from zero in 2003 to two in 2004 and continued until 2007.

Figure 24 shows that the percentage of accidents in air medical increased for the last two years. In 2007, there were two accidents, both fatal, out of 222 active aircrafts flown for the same operation. Note that the numbers being compared in this figure exclude the number of active aircraft and accidents that occurred during air medical operations under 14 CFR Part 135.

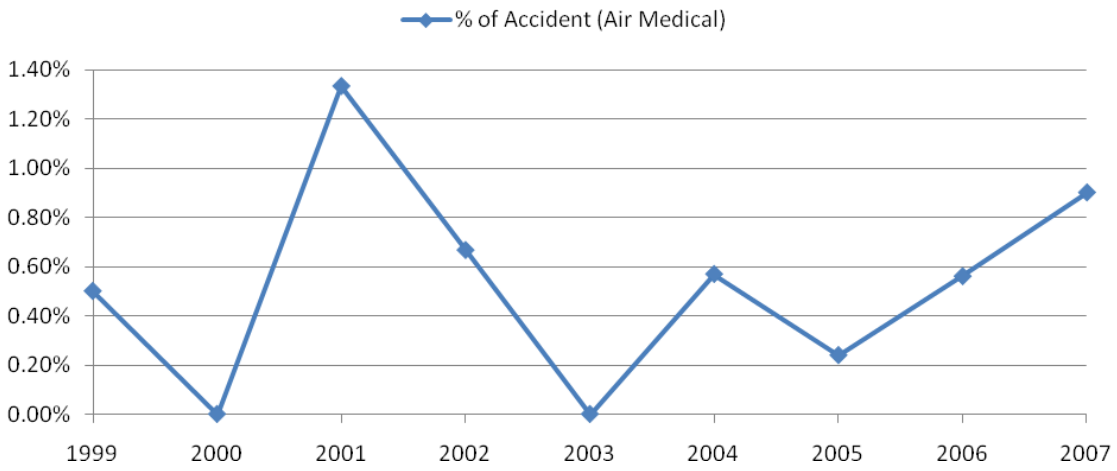

Figure 24. Percentages of Accidents That Occurred During Air Medical Services (1999-2007)

3.3.5 Category 5: Business Transportation.

According to the FAA, the business transportation category includes flights conducted by a person or persons without any paid professional flight crew for the purpose of furthering business, including transportation to and from business meetings or work. This does not include corporate/executive operations, air taxi, or commuter operations.

Figure 25 shows the number of active aircraft flown for business transportation from 1990 to 2007. It shows a significant increase in 1998 with 32,600 aircraft and a steep decline in 1999 with 24,500 aircraft.

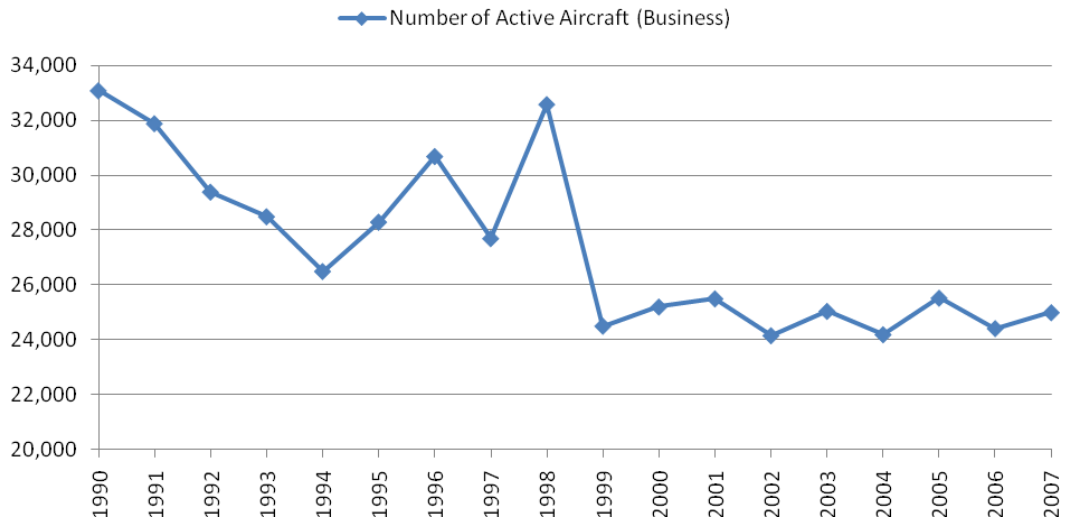

Figure 25. Number of Active Aircraft Used in Business Transportation Operations (1990-2007)

Figure 26 shows that the trend for the number of accidents in business transportation declined for the 18-year period (1990-2007). However, the number of nonfatal accidents increased from 26 in 2006 to 38 in 2007, while the number of fatal accidents decreased from 15 to 10.

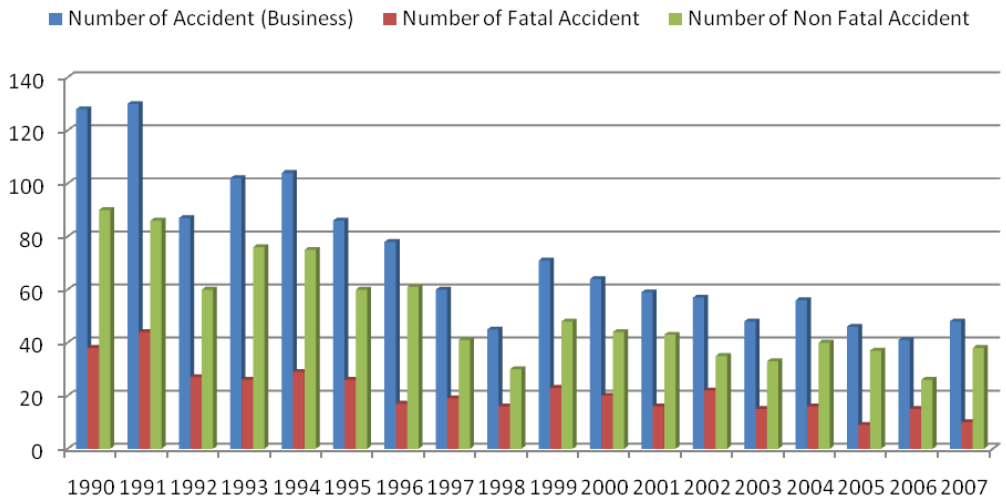

Figure 26. Number of Accidents That Occurred in Business Transportation Operations (1990-2007)

Figure 27 presents the percentage of accidents that occurred during business transportation and confirms the declining number of accidents from 1990 to 2007. As shown in figure 25, the number of active aircraft increased significantly in 1998, while the number of accidents decreased by 25%, from 60 to 45. On the other hand, the percentage of accidents seems to have increased significantly in 1999. The number of active aircraft decreased to 24,500, but the number of accidents increased by 57% from 45 to 71.

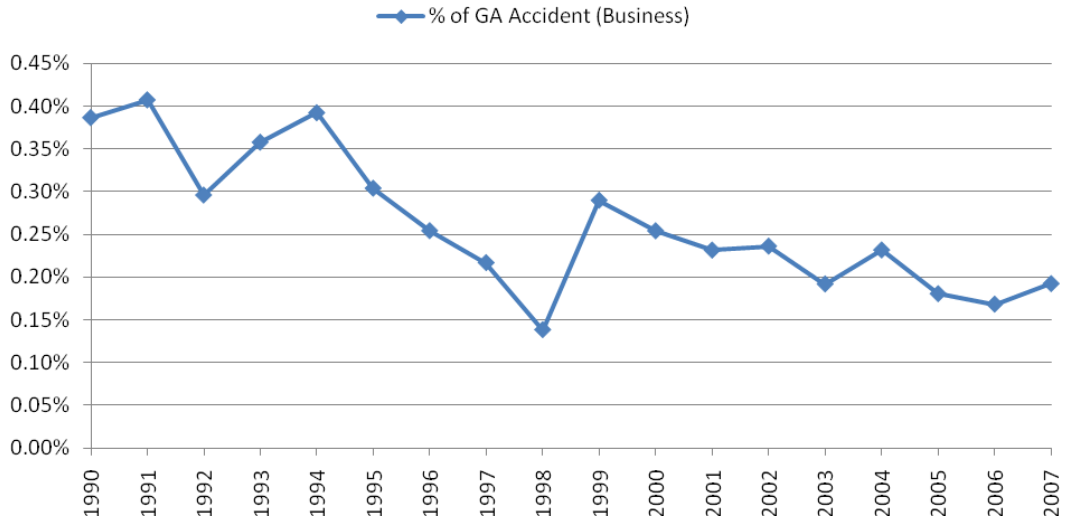

Figure 27. Percentages of GA Accidents That Occurred in Business Transportation Operations (1990-2007)

3.3.6 Category 6: Corporate/Executive.

The Corporate/Executive category includes flights conducted by a person, or persons, with a paid professional flight crew for the purpose of doing business.

Figure 28 shows that the number of aircraft used for corporate/executive operations increased from 1990 to 2007.

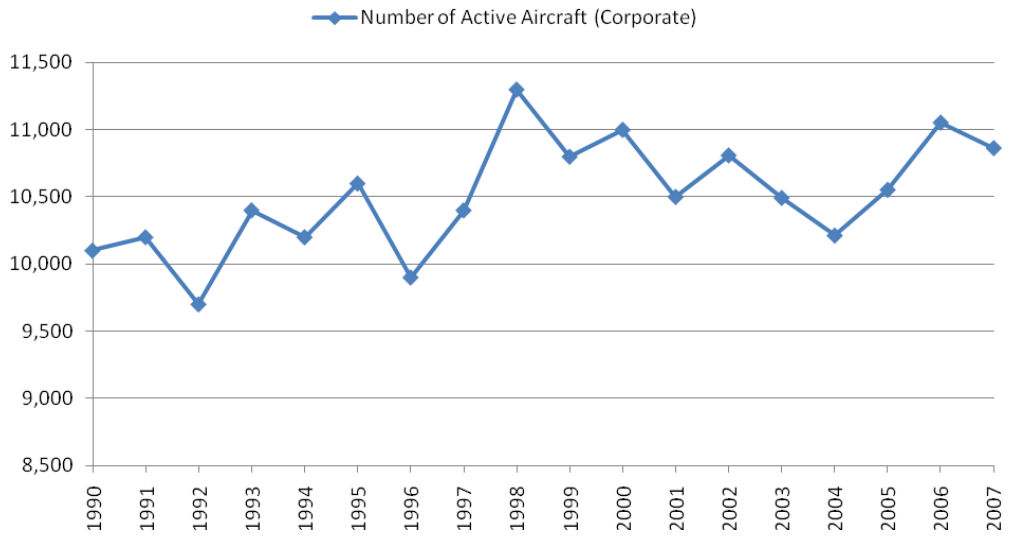

Figure 28. Number of Active Aircraft Used in Corporate/Executive Operations (1990-2007)

The number of accidents fluctuated in a range between 4 and 16 from 1990-2007, as shown in figure 29. In comparison to the numbers of active aircraft, the number of accidents is relatively small. Thus, as shown in figure 30, the percentage of accidents is less than 0.2%.

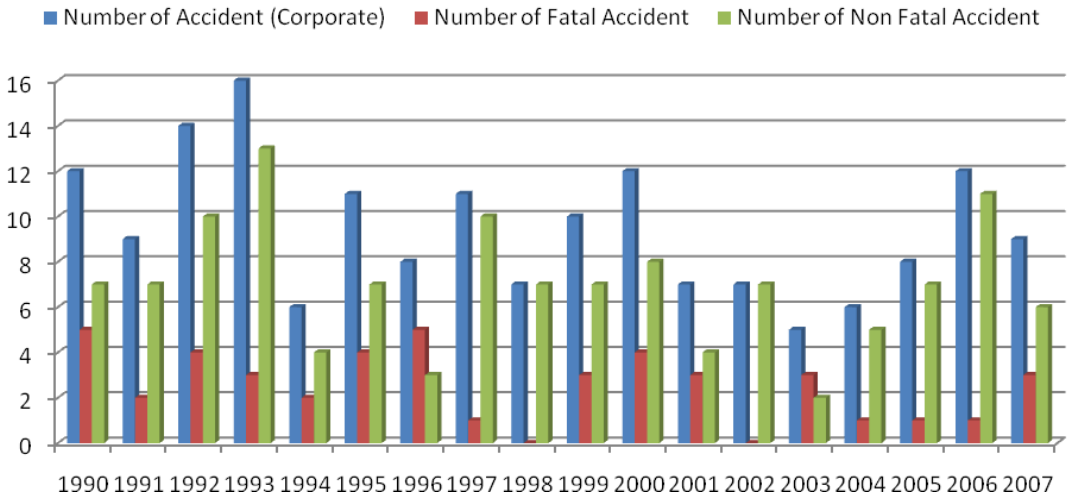

Figure 29. Number of Accidents That Occurred in Corporate/Executive Operations (1990-2007)

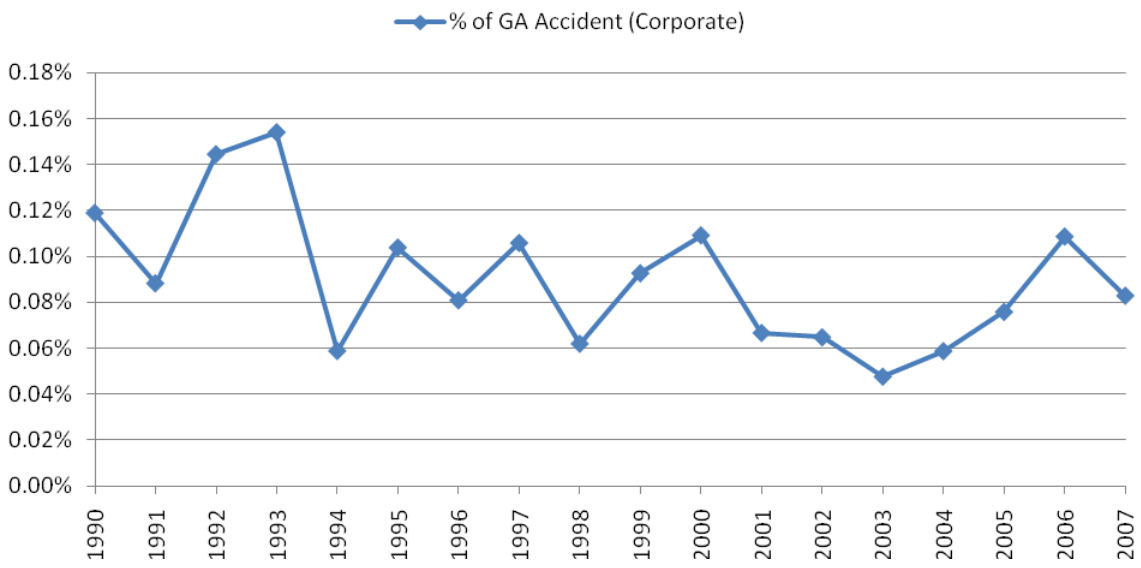

Figure 30. Percentages of Accidents That Occurred in Corporate/Executive Operations (1990-2007)

Figure 30 presents the percentage of accidents for the number of aircraft flown for corporate/executive use between 1990 and 2008. Like the number of active aircraft and accidents, the percentage of accidents is relatively stable throughout the periods. There was a steep decline in 1994 because the number of accidents decreased significantly from 16 to 6, although the number of active aircraft also decreased from 10,400 to 10,200.

3.3.7 Category 7: External Load.

The external load category includes operations under 14 CFR Part 133, Rotorcraft External Load Operations. Examples include helicopter hoisting and hauling logs. Thus, it is not included in this report.

3.3.8 Category 8: Instructional.

The FAA defines this category as aircraft operations that are under the supervision of a flight instructor or for air carrier training, including student pilot—solo. Personal proficiency flight operations and personal flight reviews, as required by federal air regulations, are excluded. Also excluded from this category are positioning flights, ferrying, and sales demonstrations.

Figure 31 shows the number of active aircraft used for instructional operations based on the FAA surveys. The number of active aircraft in 2007 is slightly less than in 1990. Figures 32 and 33 present the number of accidents and their respective percentages. Like the number of active aircraft, the number of accidents occurring during instructional flights also decreased slightly, but the number of fatal accidents remained at a very low level. Figure 33 shows that the percentage of accidents remained relatively similar throughout this 18-year period (1990-2007).

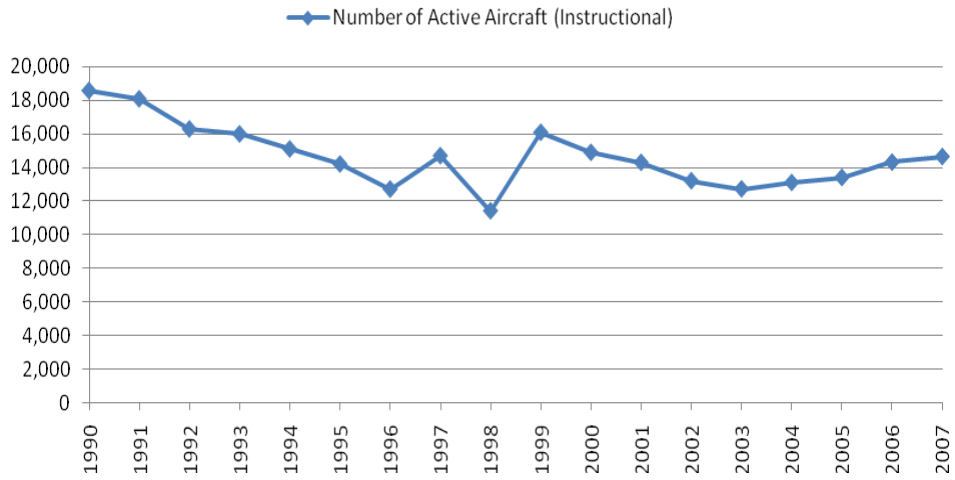

Figure 31. Number of Active Aircraft Used for Instructional Operations (1990-2007)

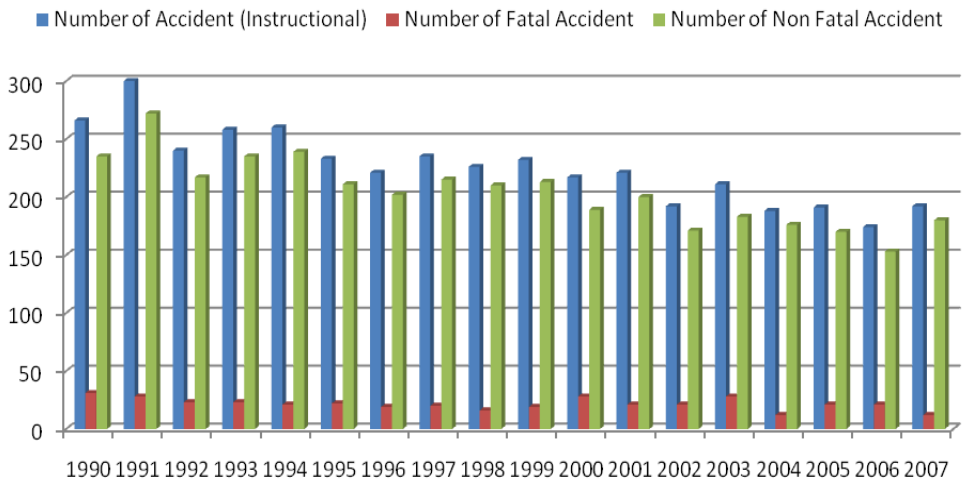

Figure 32. Number of Accidents That Occurred During Instructional Operations (1990-2007)

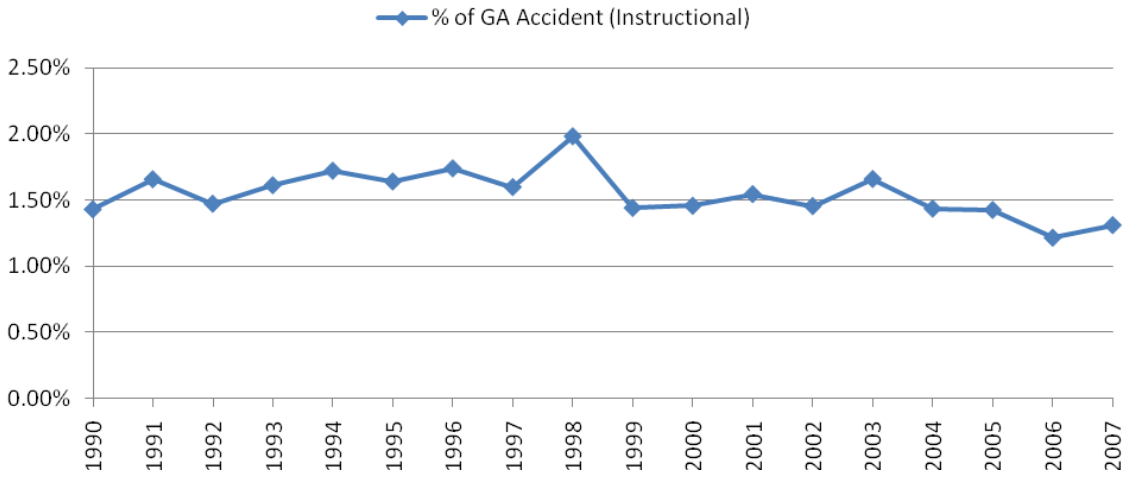

Figure 33. Percentages of Accidents That Occurred During Instructional Operations (1990-2007)

3.3.9 Category 9: Other.

According to FAA surveys, Category 9 includes positioning flights, proficiency flights, training, ferrying, and sales demonstrations. However, NTSB Form 6120.1 classifies positioning and ferrying as a separate category. This report includes positioning and ferrying, as well as air drop, unknown, flight test, air race/show, and skydiving under the category of Other.

Figure 34 shows the number of active aircraft used for the purpose of positioning, ferrying, flight test, sales demonstrations, air drop, air race/show, and flight test. The FAA survey data for the category of Other from 1999 to 2003 were not available. Thus, figure 34 includes only the number of active aircraft used in Aerial Other operations between 1999 and 2003.

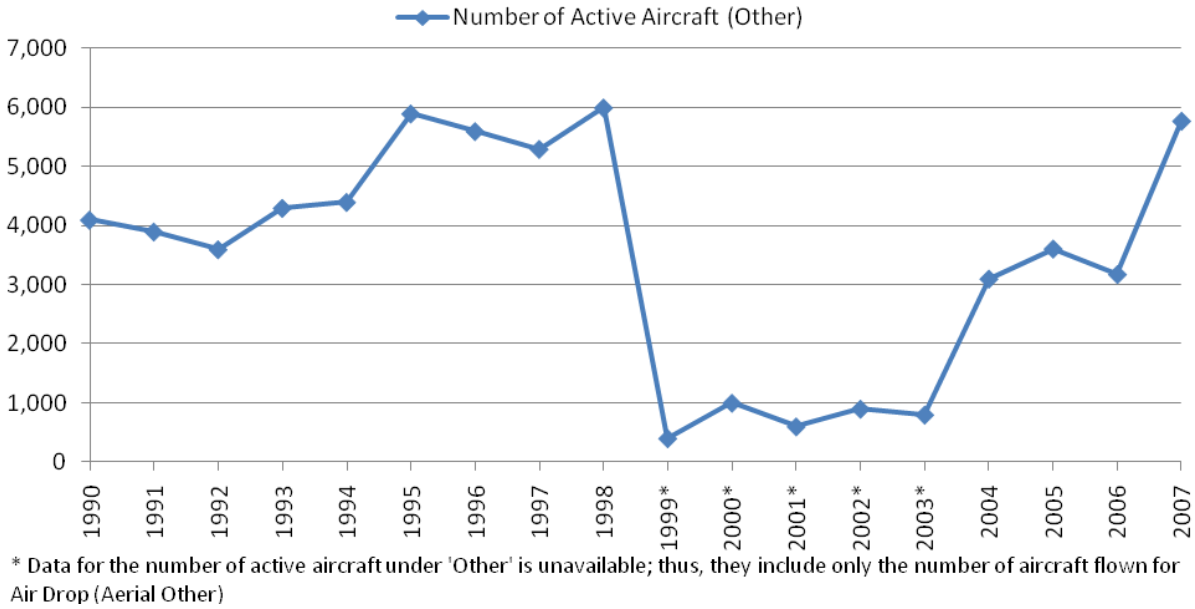

Figure 34. Number of Active Aircraft Used for Other Operations (1990-2007)

Figure 35 shows the number of accidents that occurred during other operations, including air drop from 1990 to 2007. Since there are no data available for the Other category between 1999 and 2003, this figure represents the number of accidents that occurred in air drop operation only (1999-2003).

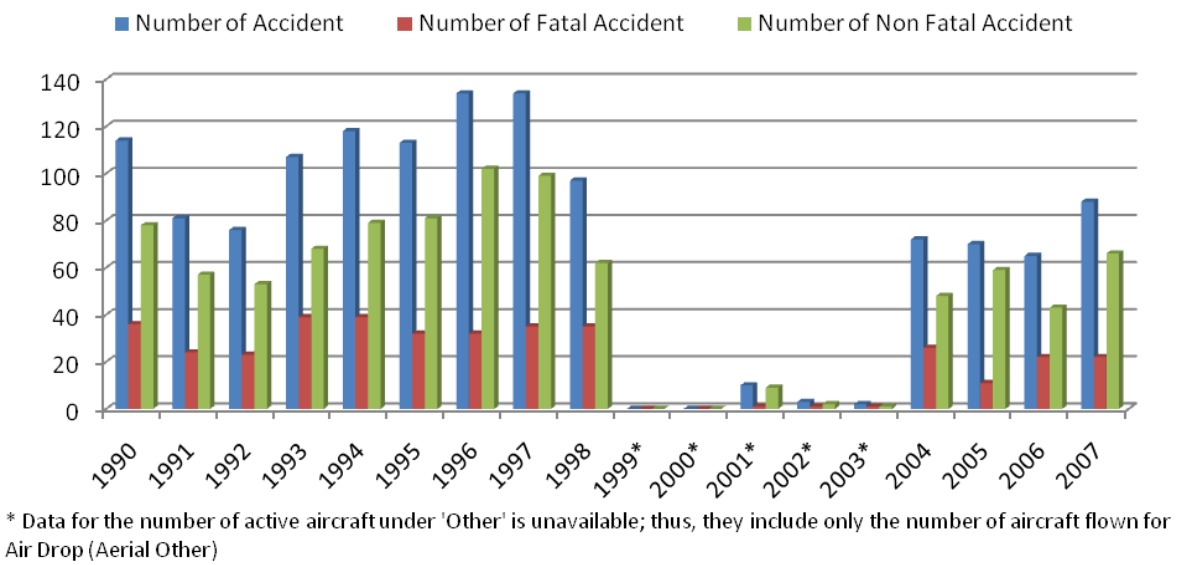

Figure 35. Number of Accidents That Occurred During Other Operations (1990-2007)

Figure 36 presents the percentage of GA accidents for the number of active aircraft flown for operations, such as air drop, ferrying, positioning, air race/show, flight test, and skydiving. Unfortunately, data for the number of active aircraft flown for this category were unavailable (except for air drop data) from 1999 to 2003. Thus, in 1999 and 2000, the number of accidents may appear lower than it actually is. Further research should be done for this purpose.

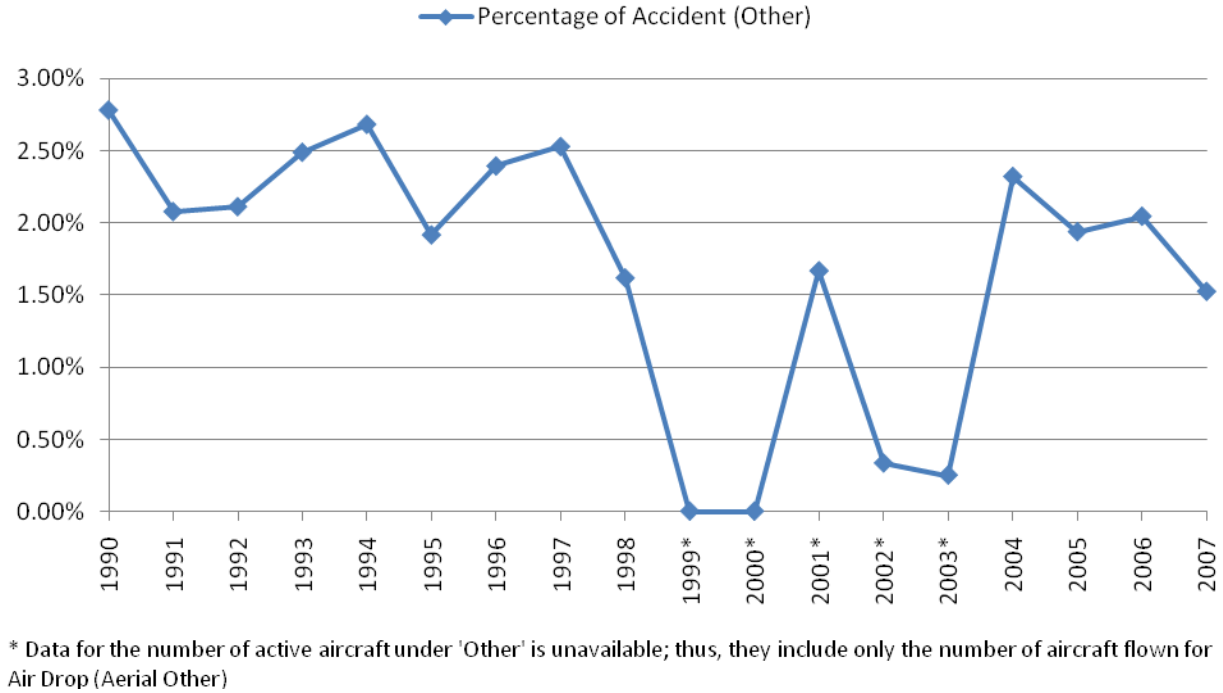

Figure 36. Percentages of GA Accidents During Other Operations (1990-2008)

3.3.10 Category 10: Other Work Use.

FAA surveys classify the Other Work Use category as aircraft operations for construction (excluding 14 CFR Part 135 operation), parachuting, aerial advertising, towing gliders, etc. Thus, this category includes gliders and banner tow.

Figure 37 shows the fluctuations of the number of active aircraft used under the category of Other Work Use, glider towing, and banner towing throughout the 18-year period (1990-2007). The year 1999 shows the highest number of aircraft (2400 aircraft) used for this purpose.

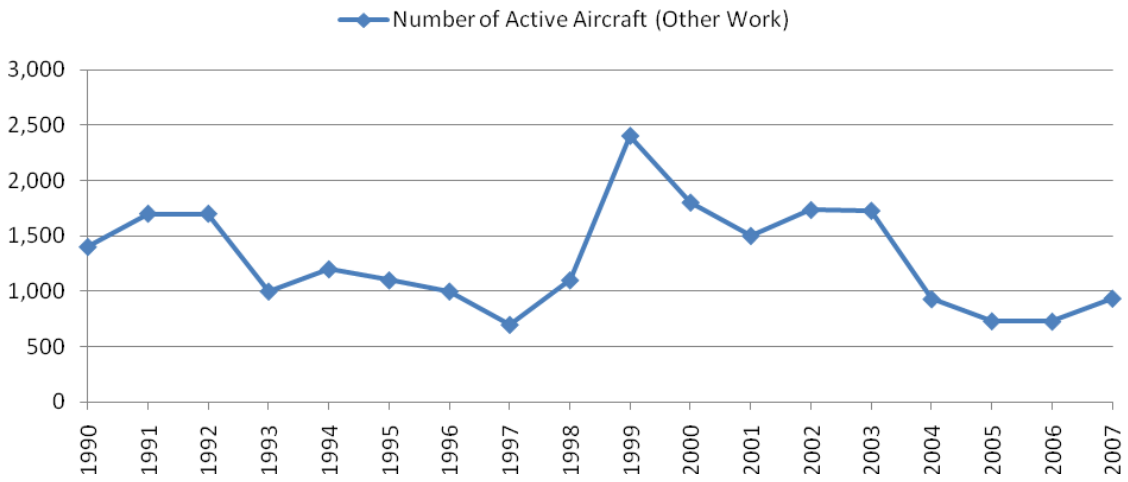

Figure 37. Number of Active Aircraft Used for Other Work Operations (1990-2007)

Like the number of active aircraft, the number of accidents, both fatal and nonfatal, fluctuates throughout the periods and results in a slight increase in general, as shown in figure 38. Although the number of both fatal and nonfatal accidents in 2007 is lower than in 2006, it is still higher than the number of accidents in 1990.

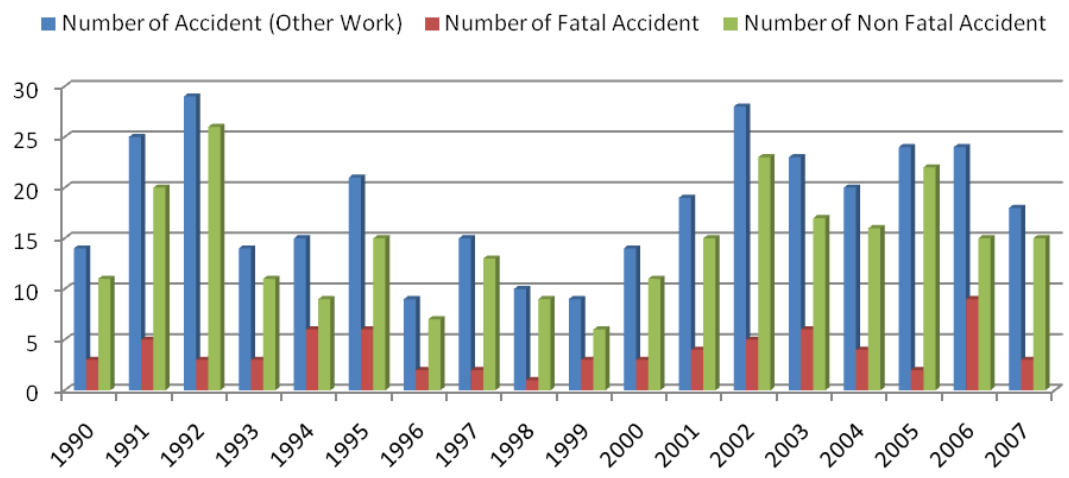

Figure 38. Number of Accidents That Occurred for Other Work Operations (1990-2007)

Figure 39 shows the percentage of GA accidents for the number of active aircraft flown under the category of other work use, such as glider towing, banner, and all flights. In 2006, there were 24 accidents out of 729 aircrafts flown. These numbers differ slightly from the previous year, which had the same number of accidents out of 732 aircraft flown.

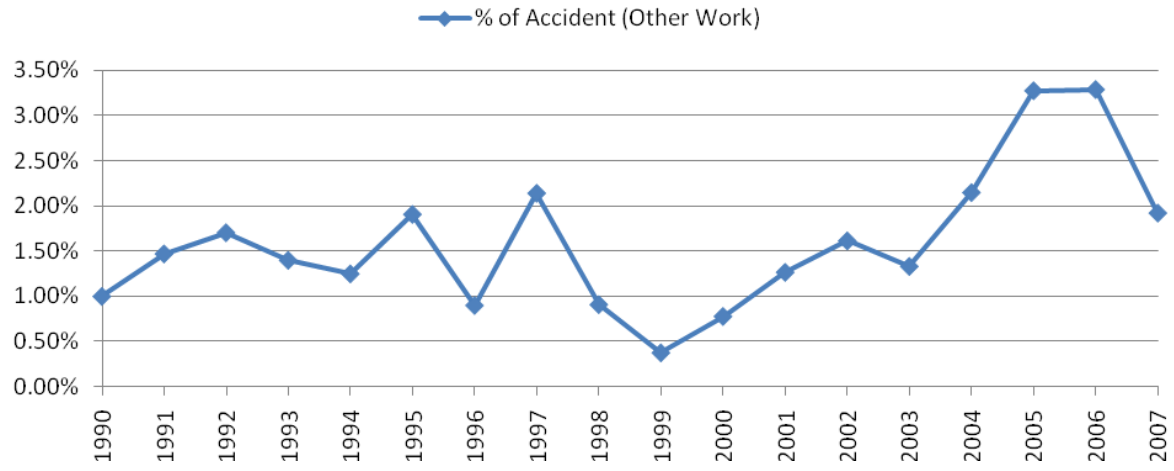

Figure 39. Percentages of Accidents That Occurred During Other Work Operations (1990-2007)

3.3.11 Category 11: Personal.

According to the FAA, personal operations include flights for personal reasons (excluding business transportation), such as for pleasure or personal transportation. This also includes practice or proficiency flights performed under flight instructor supervision that are not part of an approved flight training program. Figures 40 and 41 present the number of active aircraft and the number of fatal and nonfatal accidents during personal operations between 1990 and 2007. Figure 42 shows the percentage of GA accidents for the number of active aircraft.

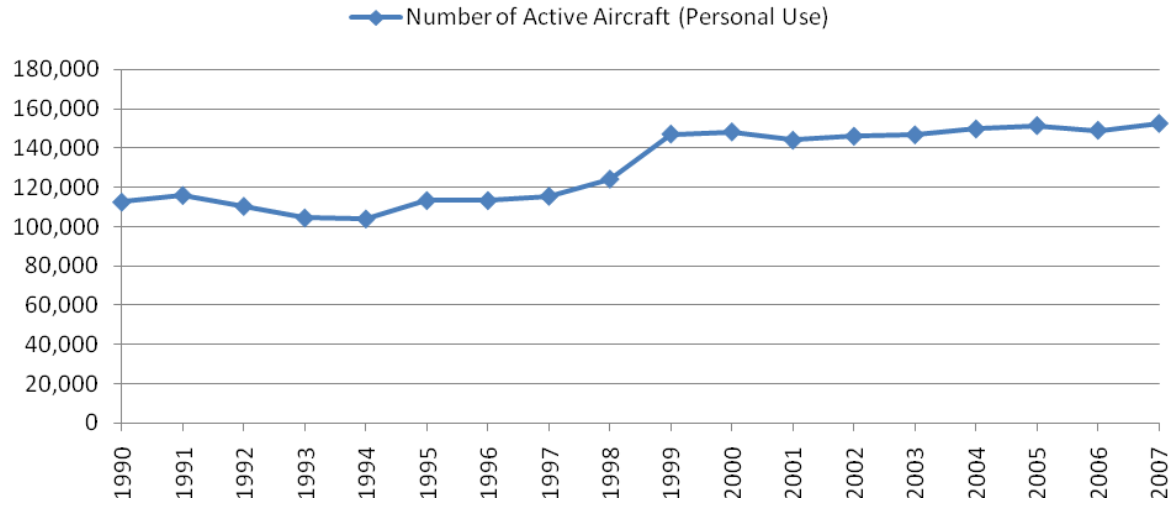

Figure 40. Number of Active Aircraft Used for Personal Operations (1990-2007)

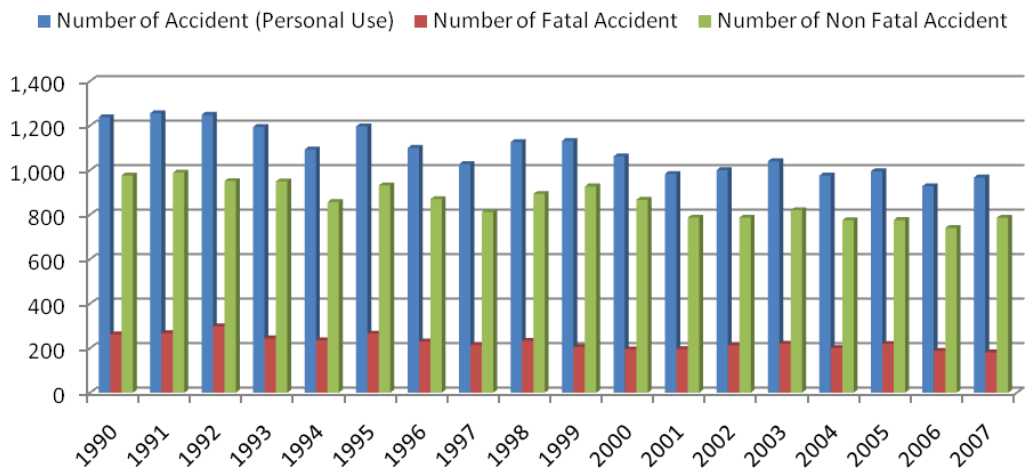

Figure 41. Number of Accidents That Occurred During Personal Operations (1990-2007)

Figure 40 shows that the number of aircraft used for personal operations increased between 1990 and 2007. In 1990, 112,600 aircraft were used for personal operations, while in 2007, 152,514 aircraft were used.

The number of total accidents that occurred in personal operations decreased and the number of fatal accidents also decreased slightly throughout the period. The increase in the number of aircraft and the decline in the number of accidents led to the decrease in the percentage of accidents for the number of active aircraft.

Figure 42 shows the percentages of GA accidents occurred during personal operations under 14 CFR Part 91 out of the number of active aircrafts flown for that purpose. Here, the trend shows a decline over the period under consideration. The decline in the number of accidents in this specific operation significantly influenced the total number of accidents under 14 CFR Part 91, since personal operations contributes the highest number of GA flights.

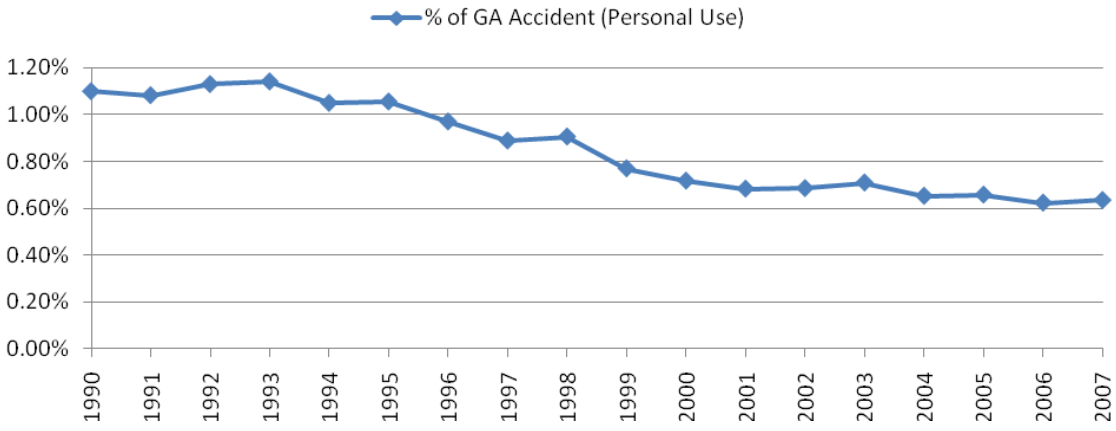

Figure 42. Percentages of GA Accidents That Occurred During Personal Operations (1990-2007)

3.3.12 Category 12: Public Use.

In NTSB Form 6120.1, the FAA classifies public use operations as federal, state, or local government flight operations such as official travel, law-enforcement, low-level observation, aerial application, firefighting, search and rescue, biological or geological resource management, or aeronautical research. Military operations are not included under public use.

The FAA excluded the Public Use category from the survey because it was not mutually exclusive with respect to other flight activity. For this reason, only 4 years of data were available for the number of active aircraft. Thus, this report only presents the number of accidents that occurred under this category.

As shown in figure 43, the number of accidents that occurred during public use operations decreased slightly in terms of fatal accidents. In 1995, there was a relatively large number of accidents compared to other years.

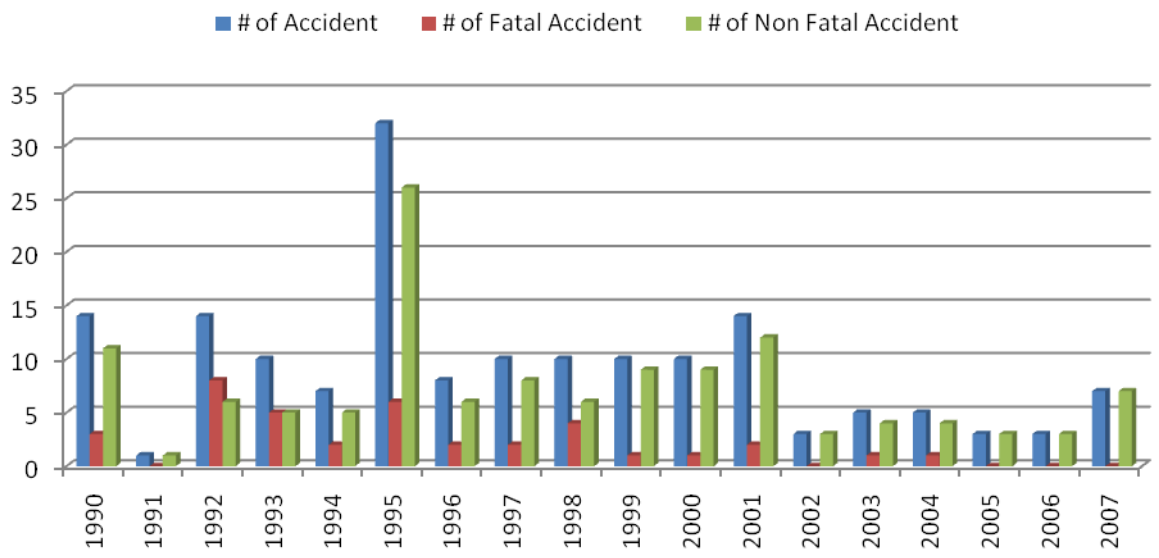

Figure 43. Number of Accidents That Occurred During Public Use Operations (1990-2007)

3.3.13 Category 13: Sightseeing.

According to NTSB Form 6120.1, a revenue sightseeing flight is a flight that was conducted for revenue sightseeing operation under 14 CFR Part 91. In the GA and 14 CFR Part 135 Activity Survey, the sightseeing category was introduced in 1993. Thus, the data for active aircraft for this category are not available prior to 1993, as shown in figure 44.

The number of accidents that occurred during sightseeing operations decreased after 1997, as shown in figure 45. In 2003, there were no accidents involving aircraft used for sightseeing; in 2007, there were two accidents, but neither was fatal.

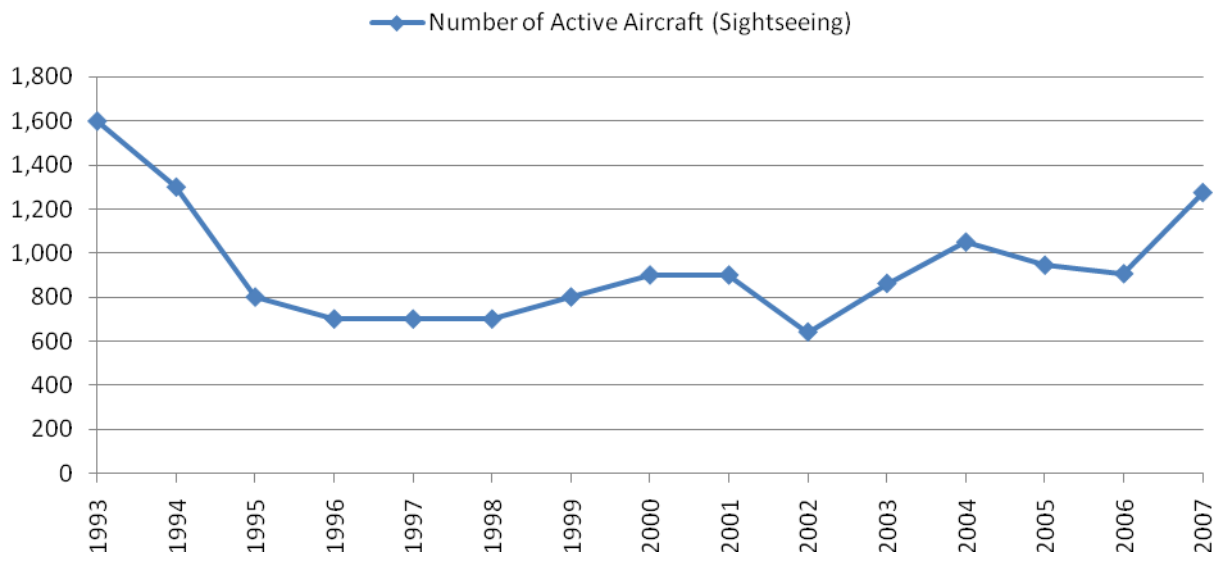

Figure 44. Number of Active Aircraft Used for Sightseeing Operations (1993-2007)

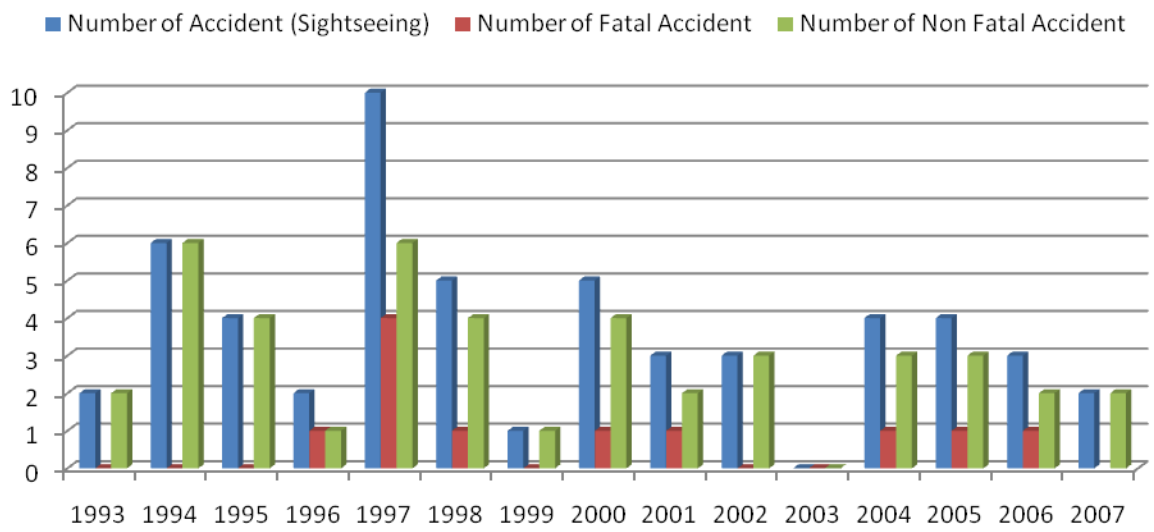

Figure 45. Number of Accidents That Occurred During Sightseeing Operations (1993-2007)

Figure 46 shows the percentage of GA accidents that occurred during sightseeing operations. For 3 consecutive years (1996-1998), the number of active aircraft flown for sightseeing operations was the same (700); but the number of accidents varied greatly, which explains the spike shown in figure 46. In 1997, there were ten accidents, four of which were fatal, out of 700 active aircraft flown. In comparison, in 1996, there were two accidents out of 700 aircraft, and in 1998, there were five accidents out of 700 aircraft. Data for the number of active aircraft were unavailable prior to 1993.

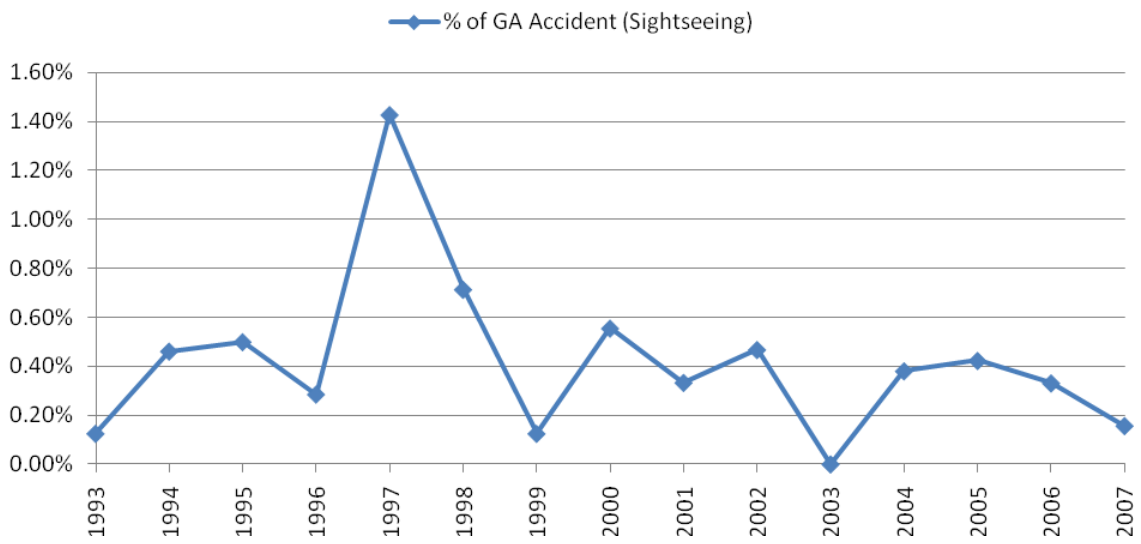

Figure 46. Percentages of GA Accidents During Sightseeing Operations (1993-2007)

3.3.14 Summary.

Figure 47 compares the ratio between the total number of accidents that occurred in the different types of GA operations and the total number of aircraft flown between 1990 and 2007. It appears that, although the personal operations category has the highest number of accidents of any other category, instructional operations have the highest percentage of accidents. The low percentage of accidents for the number of aircraft flown for personal use is caused by the wide use of this type of operation.

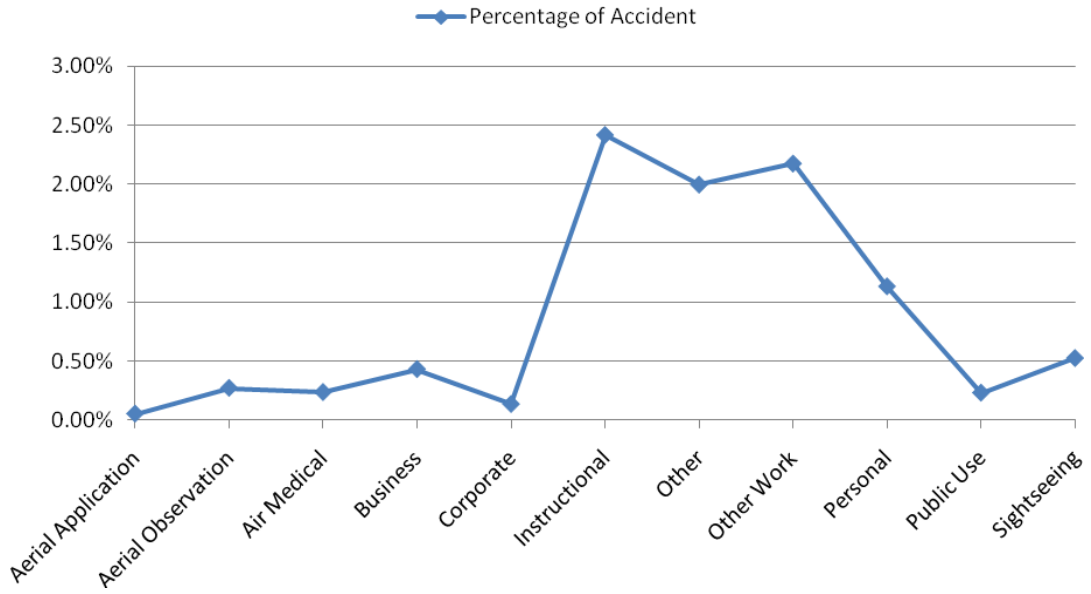

Figure 47. Percentages of GA Accidents for Aircraft Flown for Different Operations

Figure 48 compares the percentages of both the number of active aircraft and the number of accidents that occurred during different operation types between 1990 and 2007. It confirms that personal operations contributed the highest rates of both active aircraft and accidents. Note that this figure does not include other aerial and external load (see sections 3.3.3 and 3.3.7).

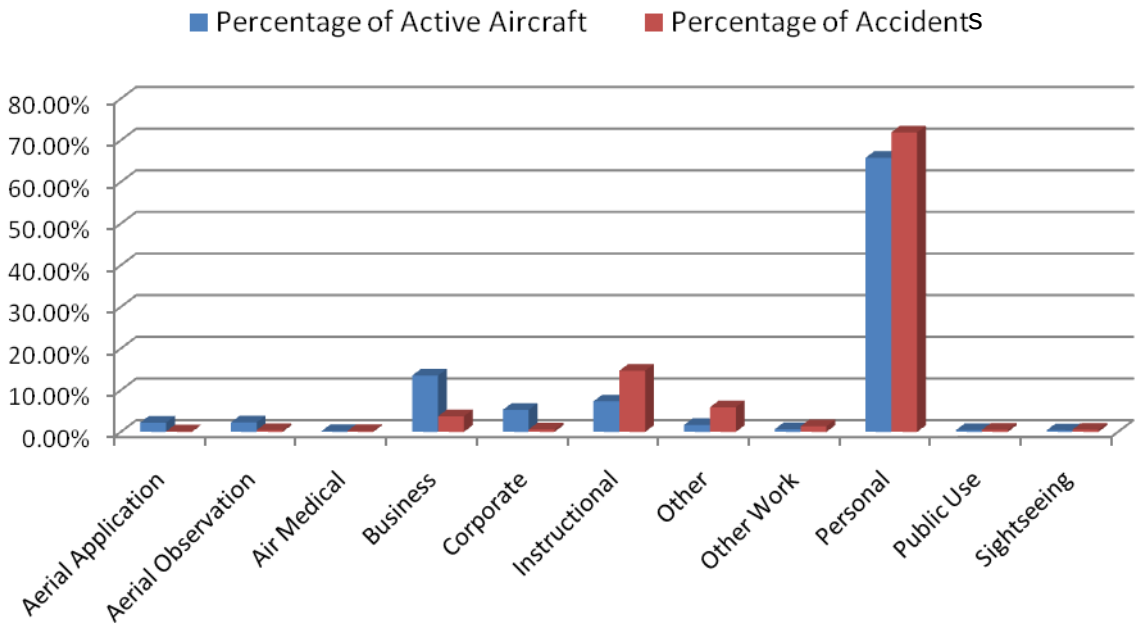

Figure 48. Comparison of Percentages of GA Accidents and Percentages of Active Aircraft Flown

4. PHASE 2—GA ACCIDENT ANALYSES (FREQUENCY BY REGIONS).

In addition to the national statistical data of the GA accidents, GA accident data for each FAA region throughout the U.S. were also analyzed. The following lists all nine regions as defined by the FAA:

1. Western Pacific Region, consisting of Arizona, California, Hawaii, and Nevada

2. Southwest Region, consisting of Arkansas, Louisiana, New Mexico, Oklahoma, and Texas

3. Alaskan Region, covering Alaska

4. Central Region, consisting of Iowa, Kansas, Missouri, and Nebraska

5. Great Lakes Region, consisting of Illinois, Indiana, Michigan, Minnesota, North Dakota, Ohio, South Dakota, and Wisconsin

6. New England Region, consisting of Connecticut, Massachusetts, Maine, New Hampshire, Rhode Island, and Vermont

7. Northwest Mountain Region, consisting of Colorado, Idaho, Montana, Oregon, Utah, Washington, and Wyoming

8. Southern Region, consisting of Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, Puerto Rico, South Carolina, and Tennessee

9. Eastern Region, consisting of Delaware, Maryland, New Jersey, New York, Pennsylvania, Virginia, West Virginia, and Washington DC

4.1 REGION 1: WESTERN PACIFIC.

4.1.1 Frequency of GA Accidents in the Western Pacific Region.

Figure 49 exhibits the number of GA fatal and nonfatal accidents that occurred in the Western Pacific Region.

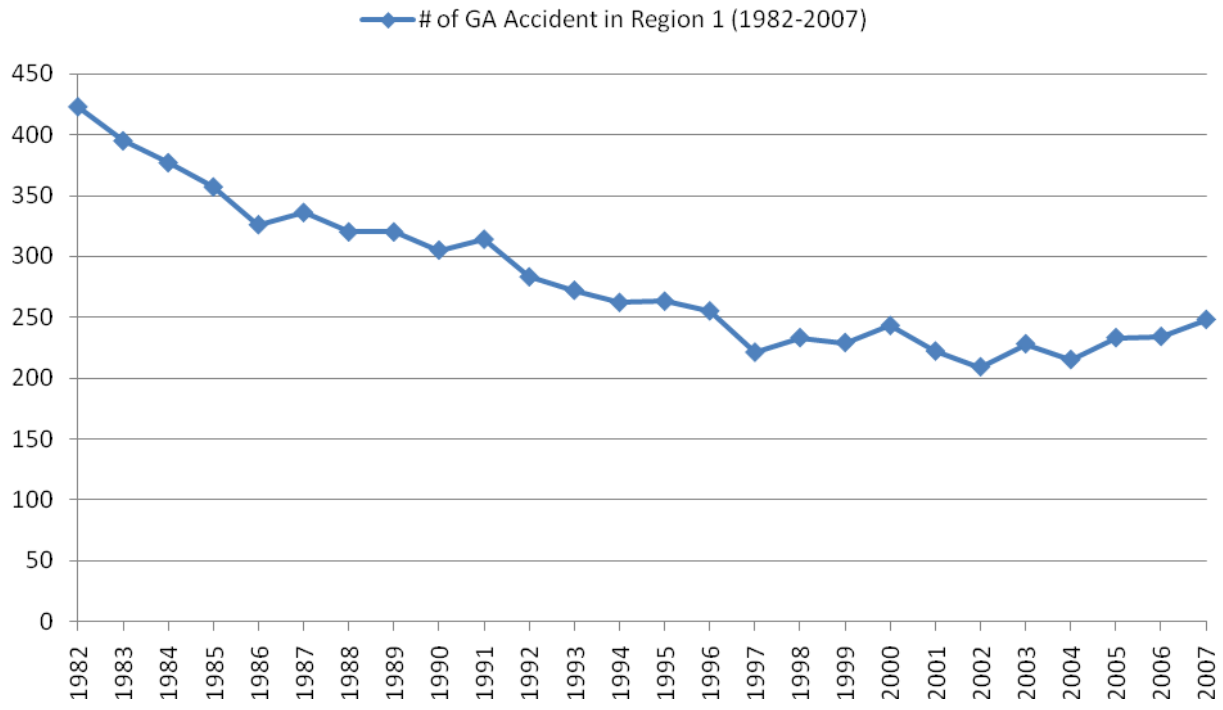

Figure 49. Number of GA Accidents Between 1982 and 2007, Western Pacific Region

In general, the number of GA accidents in the Western Pacific Region decreased over 26 years (1982-2007). However, the numbers increased significantly in the years 2000, 2003, 2005, and 2007, with increases of 6.11%, 9.09%, 8.37%, and 5.98%, respectively.

Compared to the national figures, the number of GA accidents in the Western Pacific Region contributed a higher percentage for the last several years of the study, as shown in figure 50. There were 423 accidents in this region in 1982 and 2926 accidents nationwide in the same year.

These numbers indicate that the Western Pacific Region contributed 14.46% of the total GA accidents in the U.S. In 2007, 248 accidents occurred in this region out of 1553 accidents nationwide. These numbers suggest that the Western Pacific Region contributes almost 16% of GA accidents in the U.S. These two percentages suggest that the percentage of accidents have indeed increased in this region compared to national figures.

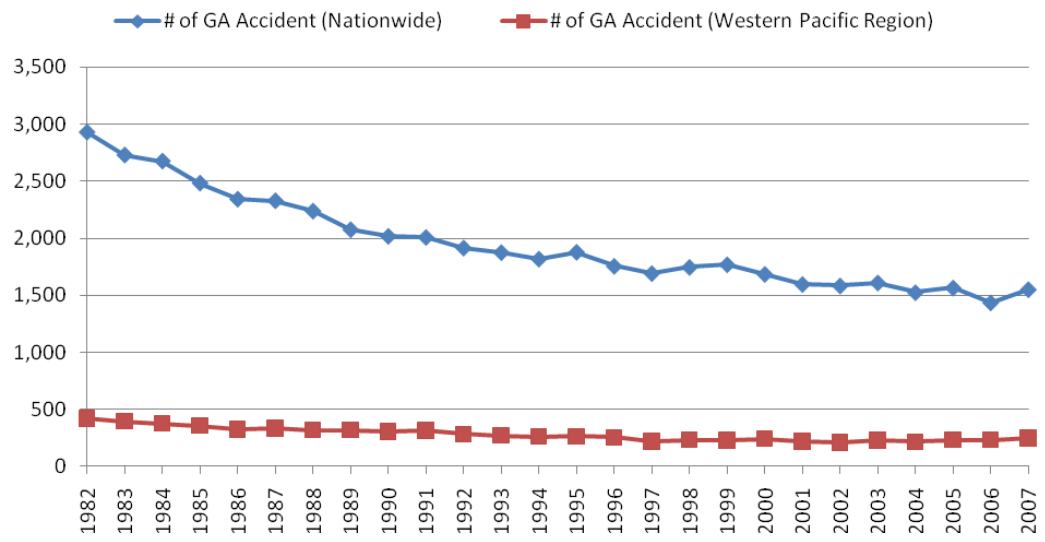

Figure 50. Number of GA Accidents Nationwide vs. the Western Pacific Region From 1982 to 2007

Figure 51 shows the number of fatal GA accidents in the Western Pacific Region between 1982 and 2007. During this time period, despite some fluctuations, the number of fatal accidents decreased. In 1982, there were 112 fatal accidents in this region, while, in 2007, there were 42 accidents. There was a significant increase in 2006, with 61 accidents (a 35.6% increase from 2005).

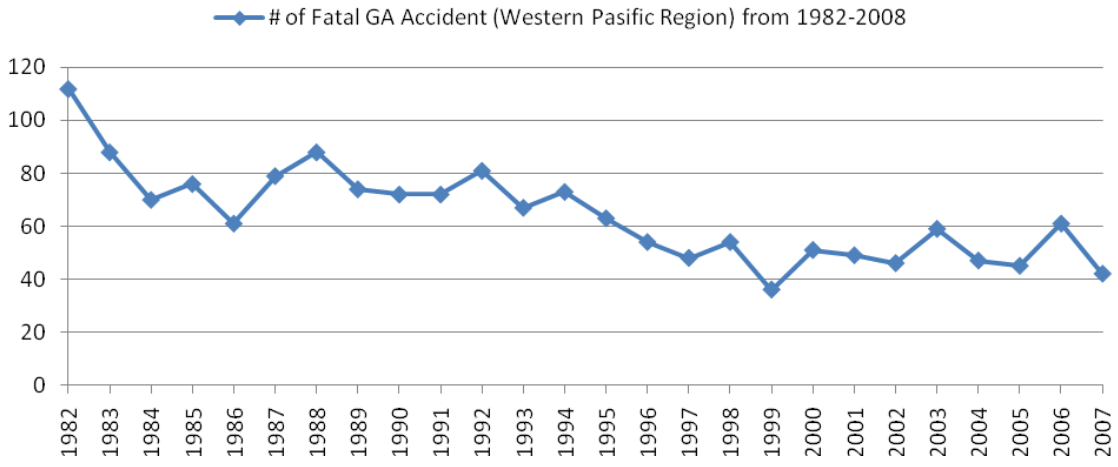

Figure 51. Number of Fatal GA Accidents From 1982 to 2007, Western Pacific Region

4.1.2 Percentage of GA Accidents by Month.

Figure 52 represents the percentage of both fatal and nonfatal GA accidents in the Western Pacific Region for each month over the 26-year study period. Generally, the percentages of fatal accidents exceed the number of nonfatal accidents at the beginning and the end of the year. There is no significant difference in the frequency of accidents throughout the months. The highest number of accidents occurs in June while the highest number of fatal accidents occurs in November.

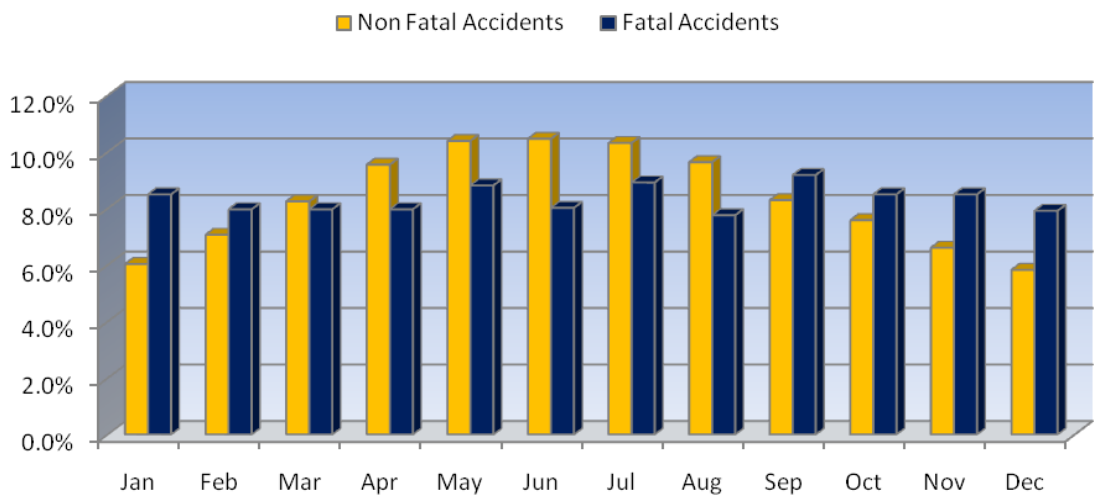

Figure 52. Percentages of Fatal and Nonfatal GA Accidents by Month, Western Pacific Region

Figure 53 summarizes fatal accidents in the Western Pacific Region for 5-, 10-, and 20-year periods. The percentage of fatal accidents increases in January, February, July, October, and November between 2003 and 2007 compared to the 1998-2007 and the 1998-2007 time periods.

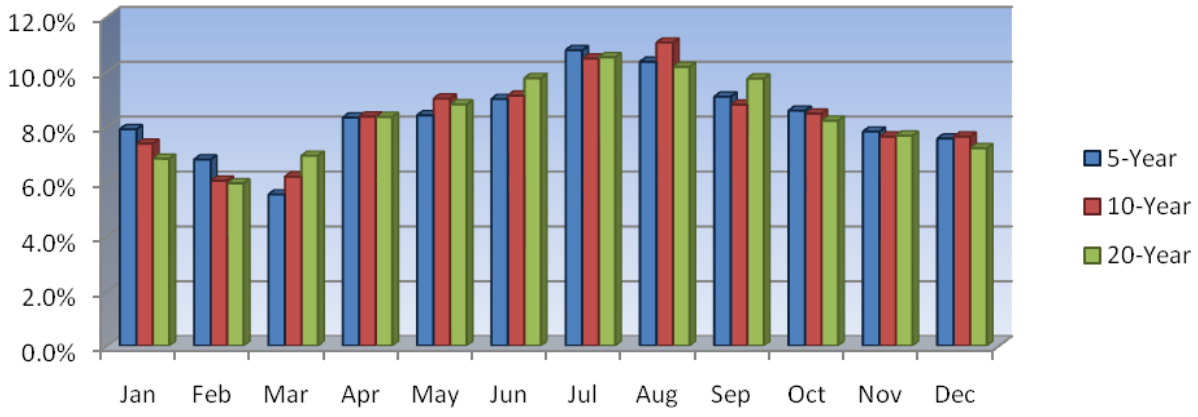

Figure 53. Percentages of Fatal GA Accidents in the Western Pacific Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.1.3 Percentages of GA Accidents Based on Phases of Flight.

Figure 54 compares the percentage of fatal and nonfatal GA accidents for the Western Pacific Region grouped by phases of flight. The percentages of fatal accidents are high in several phases, such as Descent, Cruise, and Maneuvering. On the other hand, there is a high percentage of nonfatal accidents during the Landing phase (similar to the national data). The categorization of the phases of flight used in this report is described in appendix B.

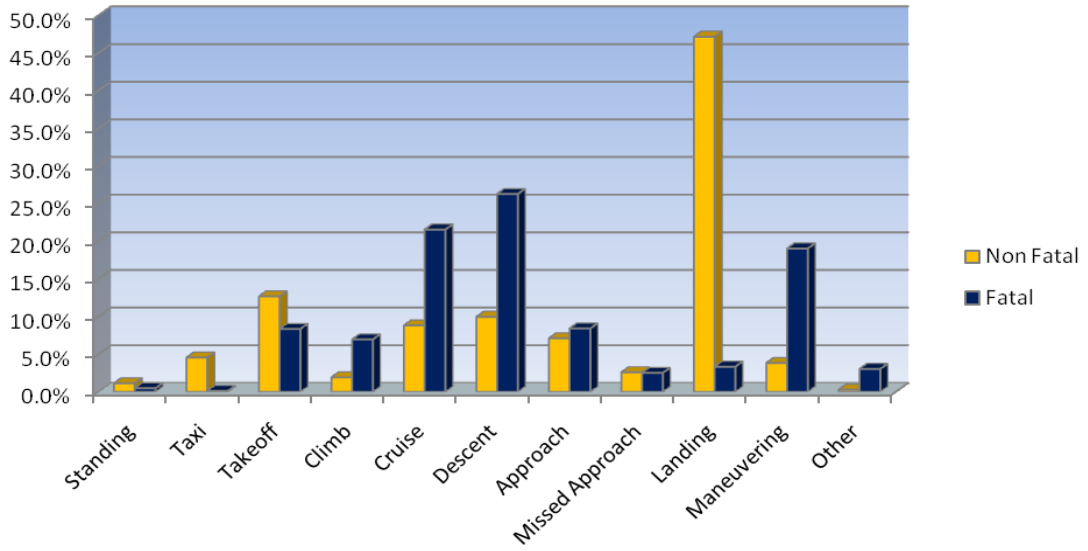

Figure 54. Percentages of Fatal and Nonfatal GA Accidents by Phase of Flight, Western Pacific Region (1982-2007)

Figure 55 represents a comparison of fatal GA accidents in the Western Pacific Region during the 2003-2007, 1998-2007, and 1988-2007 time periods. The figure shows that the percentage of accidents during the descent phase increased significantly over the 2003-2007 time period compared to the 1998-2007 and 1988-2007 time periods. Additionally, the percentage of fatal accidents during Maneuvering and Cruise phases increased during the 2003-2007 time period compared to the 1998-2007 time period.

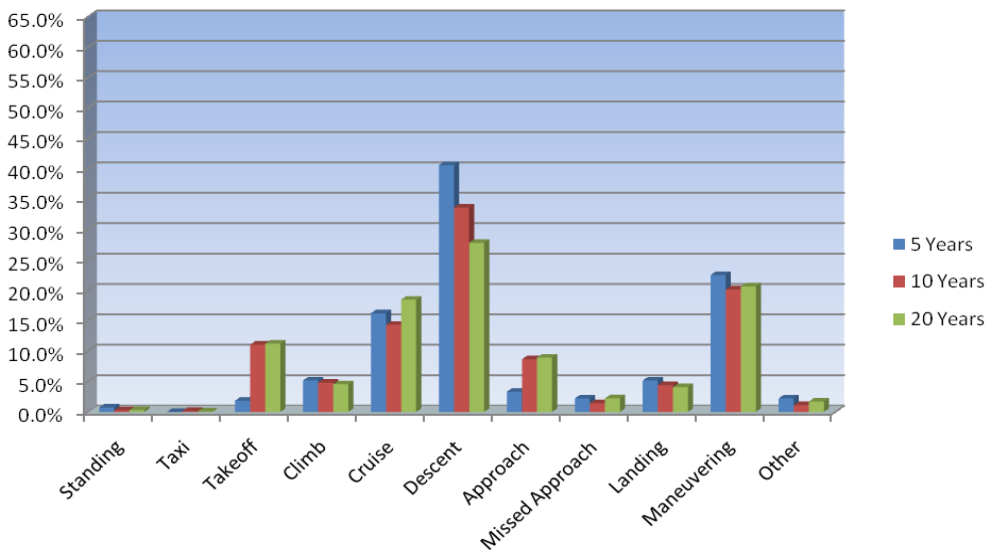

Figure 55. Percentages of Fatal GA Accidents by Phase of Flight (2003-2007, 1998-2007, and 1988-2007 time periods)

4.1.4 Percentages of GA Accidents Based on Time of Day.

Figures 56 through 59 show the comparison of the percentages of fatal and nonfatal GA accidents that occurred in the Western Pacific Region during specific times of day.

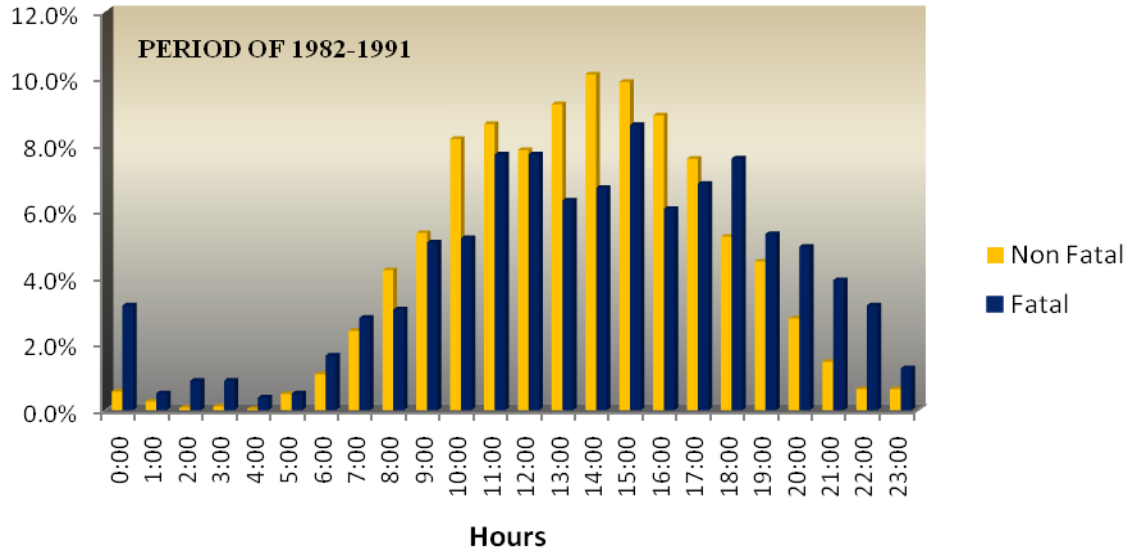

Figure 56. Percentages of Fatal and Nonfatal Accidents by Time of Day, Western Pacific Region (1982-1991)

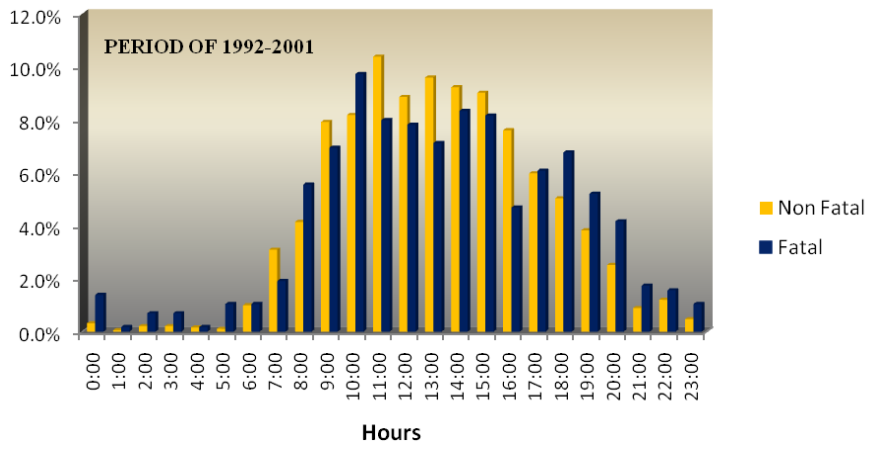

Figure 57. Percentages of Fatal and Nonfatal Accidents by Time of Day, Western Pacific Region (1992-2001)

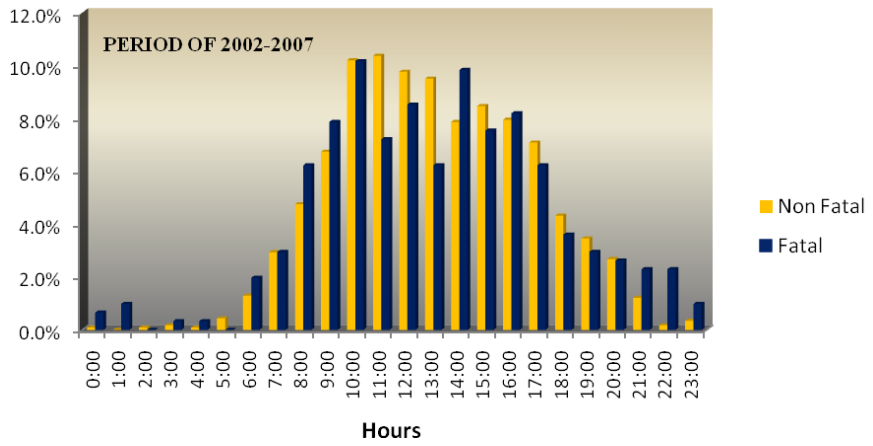

Figure 58. Percentages of Fatal and Nonfatal Accidents by Time of Day, Western Pacific Region (2002-2007)

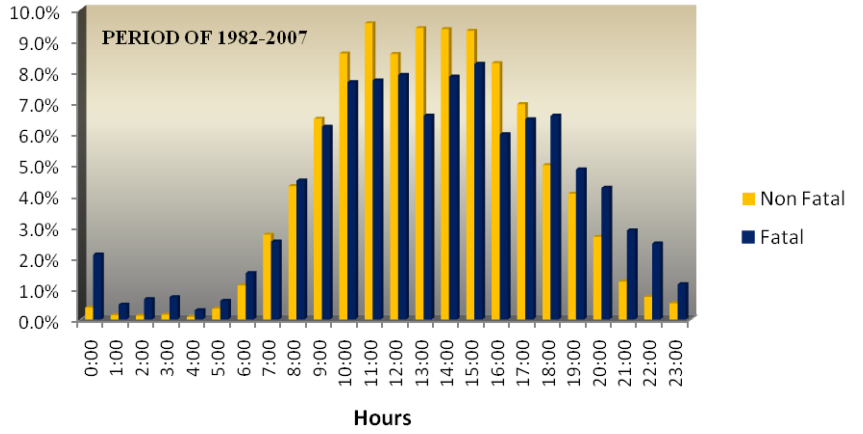

Figure 59. Percentages of Fatal and Nonfatal Accidents by Time of Day, Western Pacific Region (1982-2007)

Figure 56 shows that the percentage of fatal accidents exceeded the percentage of nonfatal accidents during some times of day, such as in the evening and early morning. The same trend occurs between 1992 and 2001, as shown in figure 57.

Figure 58 shows that the percentage of fatal accidents exceeds that of nonfatal accidents during the time period from late night until morning. However, there was an exception at 2 p.m. when the percentage of fatal accidents significantly exceeded the nonfatal.

Figure 59 summarizes the comparison of the percentage of fatal and nonfatal GA accidents by time of day for the 1982 to 2007 time period. Generally, the percentage of fatal accidents exceeded the percentage of nonfatal accidents between 6 p.m. and 6 a.m.

4.2 REGION 2: SOUTHWEST.

4.2.1 Frequency of GA Accidents in the Southwest Region.

Figure 60 exhibits the number of GA accidents, both fatal and nonfatal occurred in the Southwest Region.

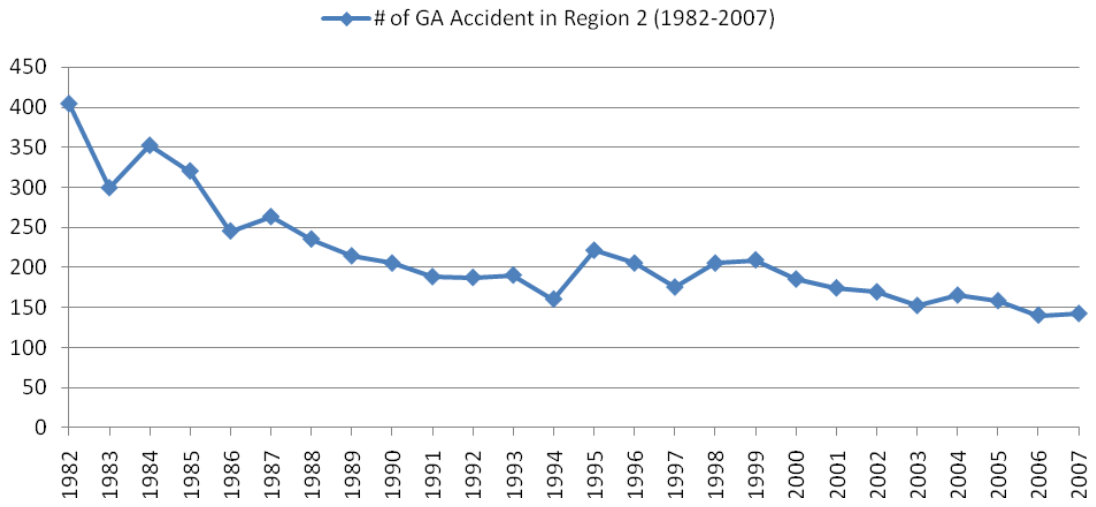

Figure 60. Number of GA Accidents Between 1982 and 2007, Southwest Region

In general, the number of GA accidents in the Southwest region decreased over 26 years, although there were several significant increases in 1984, 1987, 1995, and 1998. In 2007, the number of GA accidents in the Southwest Region was 142, which increased 1.43% from 2006. In 1995, the number of GA accidents in the Southwest Region increased dramatically from 160 to 221, or 38%.

Figure 61 compares the number of GA accidents nationwide to those in the Southwest Region. In 1982, there were 404 GA accidents in the Southwest Region compared to 2926 accidents nationwide; that means the Southwest Region contributed 13.8% of the national GA accidents. In 2007, the Southwest Region contributed 9.14% of GA accidents in the U.S., which confirms

that the number of accidents in the Southwest Region decreased faster than the nationwide numbers.

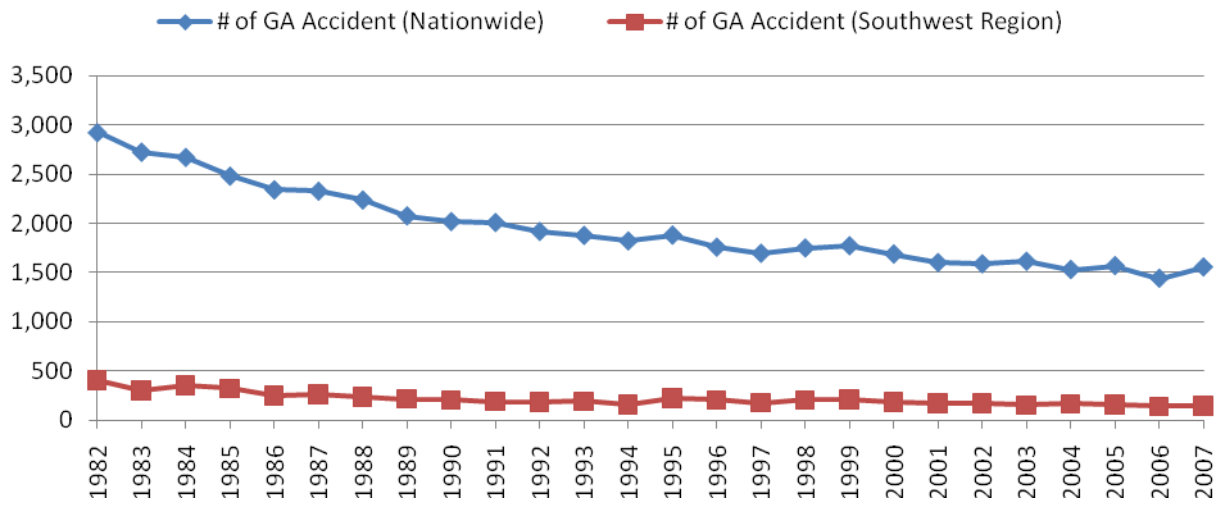

Figure 61. Number of GA Accidents Nationwide vs. the Southwest Region From 1982 to 2007

Figure 62 shows the number of fatal GA accidents in the Southwest Region for a 26-year period (1982-2007). Despite some fluctuations, the number of fatal accidents decreased. The number of fatal GA accidents in 2007 was just more than half the number in 1982.

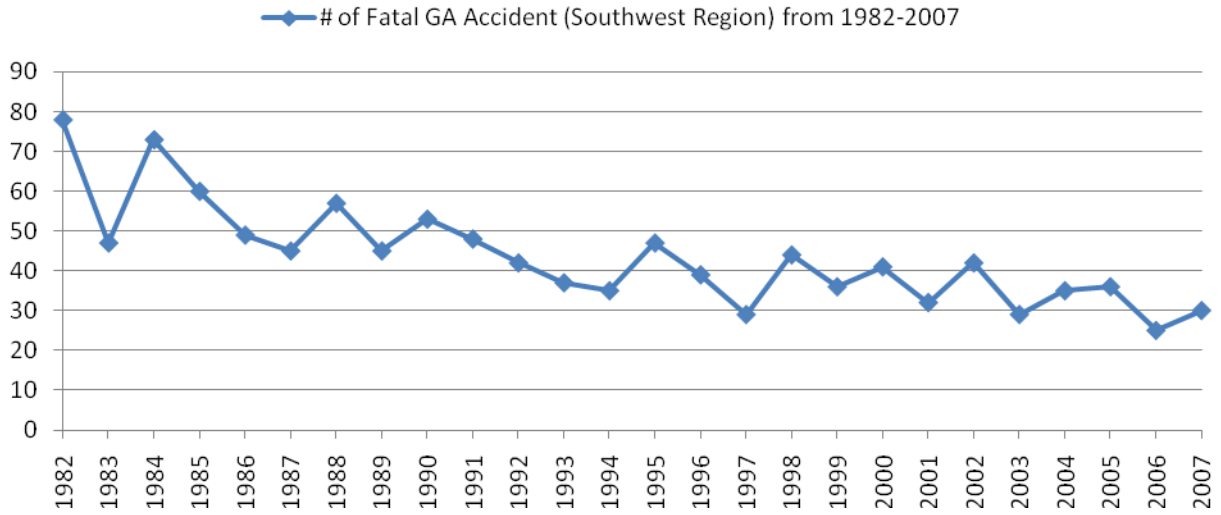

Figure 62. Number of Fatal GA Accidents From 1982 to 2008, Southwest Region

4.2.2 Percentages of GA Accidents by Month.

Figure 63 represents the percentage of both fatal and nonfatal GA accidents in the Southwest Region for each month between 1982 and 2007. The percentage of fatal accidents significantly exceeded nonfatal accidents in January, November, and December. The highest number of total accidents, along with the number of fatal accidents, occurred in May.

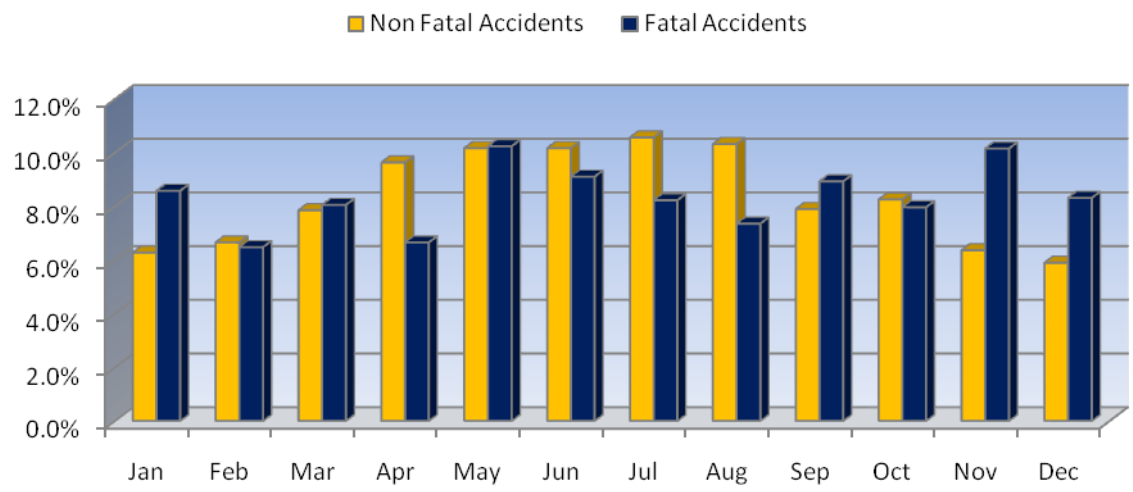

Figure 63. Percentages of Fatal and Nonfatal GA Accidents by Month, Southwest Region (1982-2007)

Figure 64 summarizes fatal accidents in the Southwest Region for 5-, 10-, and 20-year periods. The percentage of accidents in January and February increased for the 1988-2007 time period.

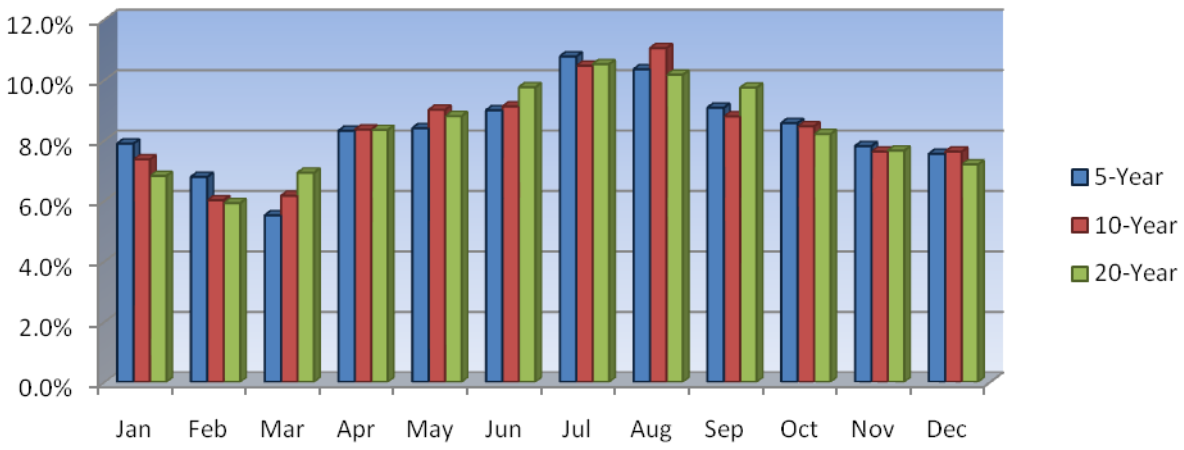

Figure 64. Percentages of Fatal GA Accidents by Month, Southwest Region

4.2.3 Percentages of GA Accidents Based on Phases of Flight.

Figure 65 compares percentage of fatal and nonfatal GA accidents for Southwest Region grouped by phases of flight. The percentage of fatal accidents was significantly high during the Descent, Maneuvering, and Cruise phases. On the other hand, there was a significantly high percentage of nonfatal accidents during the Landing phase. The categorization of the phases of flight used in this report is described in appendix B.

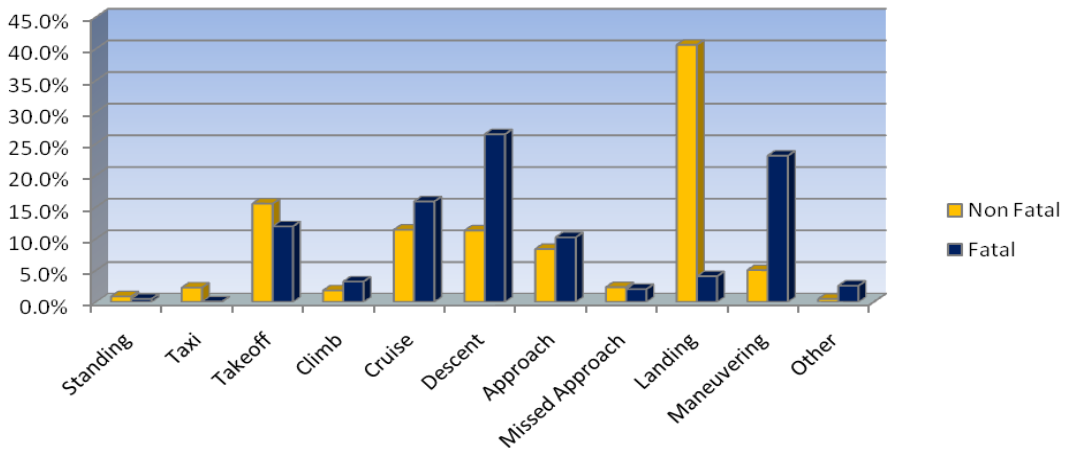

Figure 65. Percentages of Fatal and Nonfatal GA Accidents by Phases of Flight, Southwest Region

Figure 66 represents a comparison of fatal GA accidents in the Southwest Region during the 2003-2007, 1998-2007, and 1988-2007 time periods. Figure 66 shows that the percentage of accidents during the Descent phase increased for the 2003-2007 time period compared to the 1998-2007 time period, as well as the 1988-2007 time period.

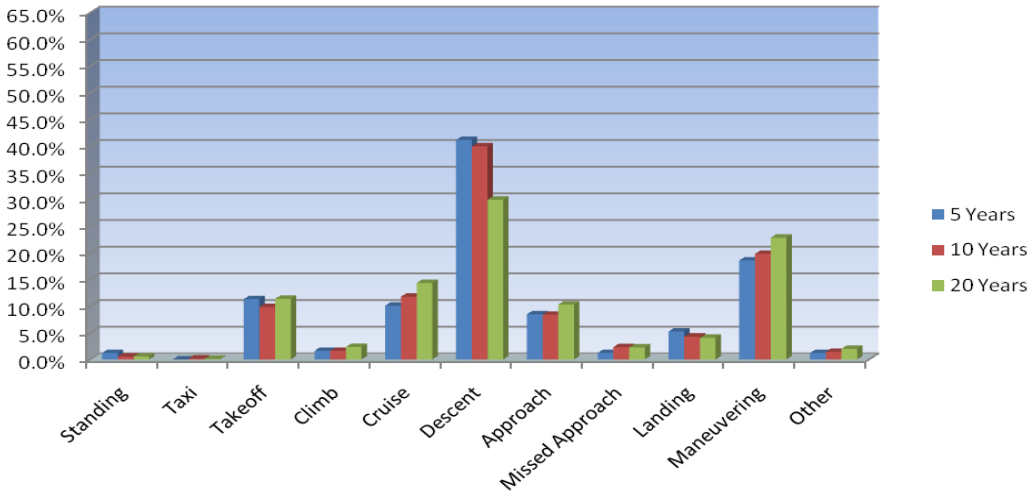

Figure 66. Percentages of Fatal GA Accidents by Phases of Flight, Southwest Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.2.4 Percentages of GA Accidents Based on Time of Day.

Figures 67 through 70 show the comparisons of the percentages of fatal and nonfatal GA accidents that occurred in the Southwest Region during specific times of day.

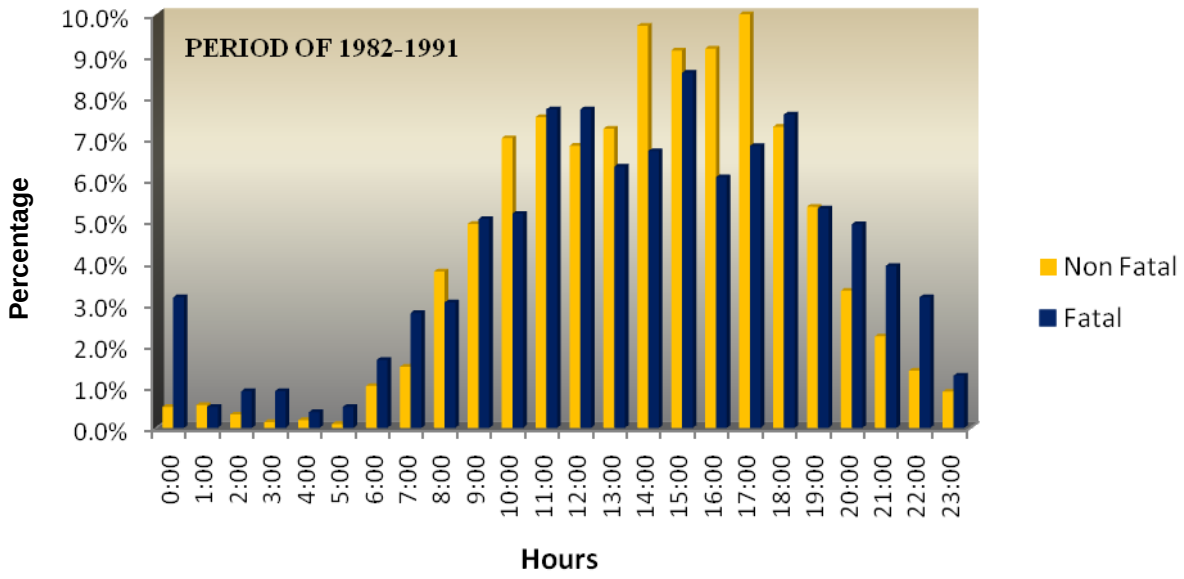

Figure 67. Percentages of Fatal and Nonfatal Accidents by Time of Day, Southwest Region (1982-1991)

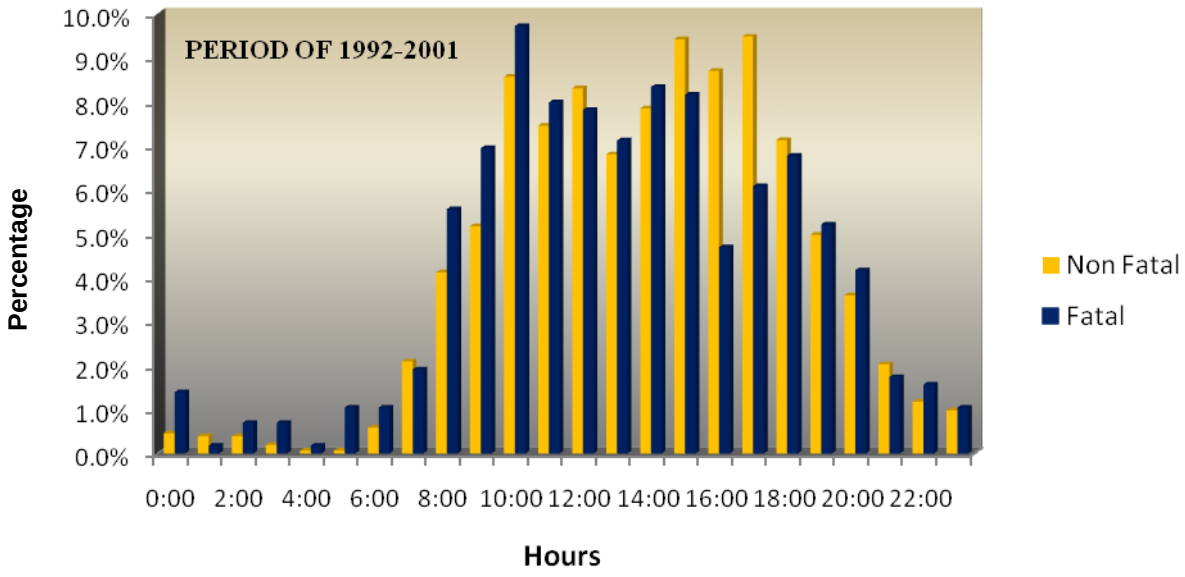

Figure 68. Percentages of Fatal and Nonfatal Accidents by Time of Day, Southwest Region (1992-2001)

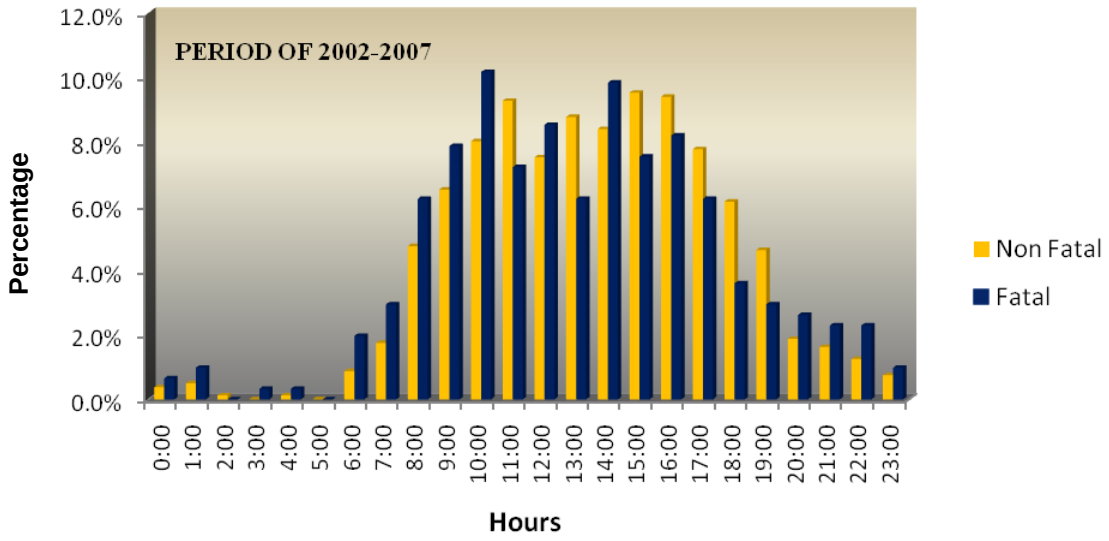

Figure 69. Percentages of Fatal and Nonfatal Accidents by Time of Day, Southwest Region (2002-2007)

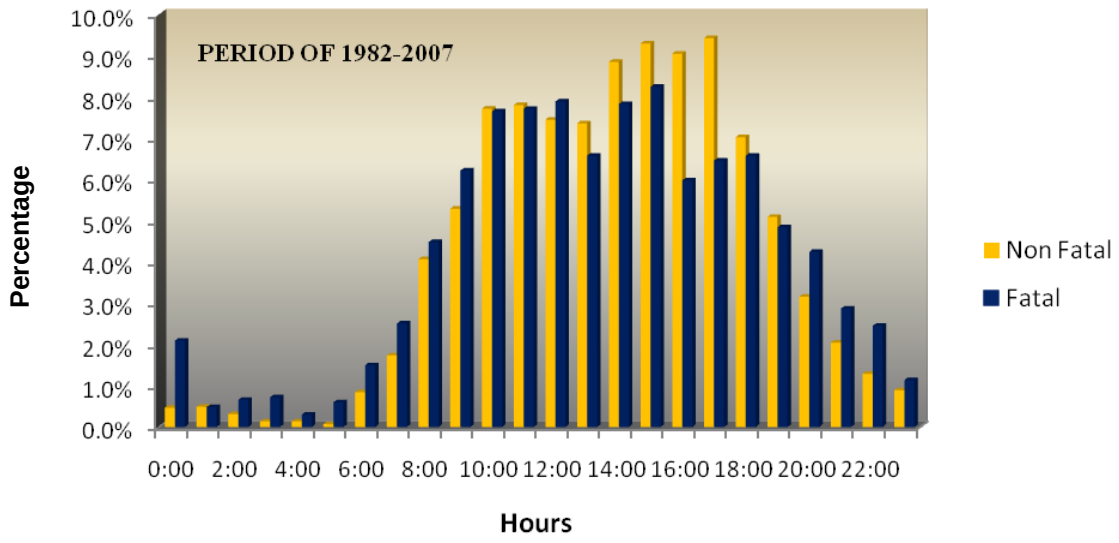

Figure 70. Percentages of Fatal and Nonfatal Accidents by Time of Day, Southwest Region (1982-2007)

Figure 67 compares the percentages of fatal and nonfatal GA accidents that occurred in the Southwest Region between 1982 and 1991 grouped by time of day. The percentage of fatal accidents exceeded the percentage of nonfatal accidents during some times of day, such as in the evening and early morning.

Figure 68 shows that the percentage of fatal accidents exceeded nonfatal accidents at the same trend as in figure 67 (i.e., fatal accidents exceeded the nonfatal accidents during the evening until early in the morning).

Figure 69 shows that the percentage of fatal accidents exceeded that of nonfatal accidents during late night until morning. However, there was an exception at 2 p.m., when the percentage of fatal accidents exceeded that of nonfatal ones significantly.

Figure 70 shows the comparison of the percentages of fatal and nonfatal GA accidents during the time of day for the 1982 to 2007 time period. Generally, the percentage of fatal accidents exceeded the percentage of nonfatal accidents between 6 p.m. and 6 a.m.

4.3 REGION 3: ALASKAN.

4.3.1 Frequency of GA Accidents in the Alaskan Region.

Figure 71 exhibits the number of both fatal and nonfatal GA accidents that occurred in the Alaskan Region.

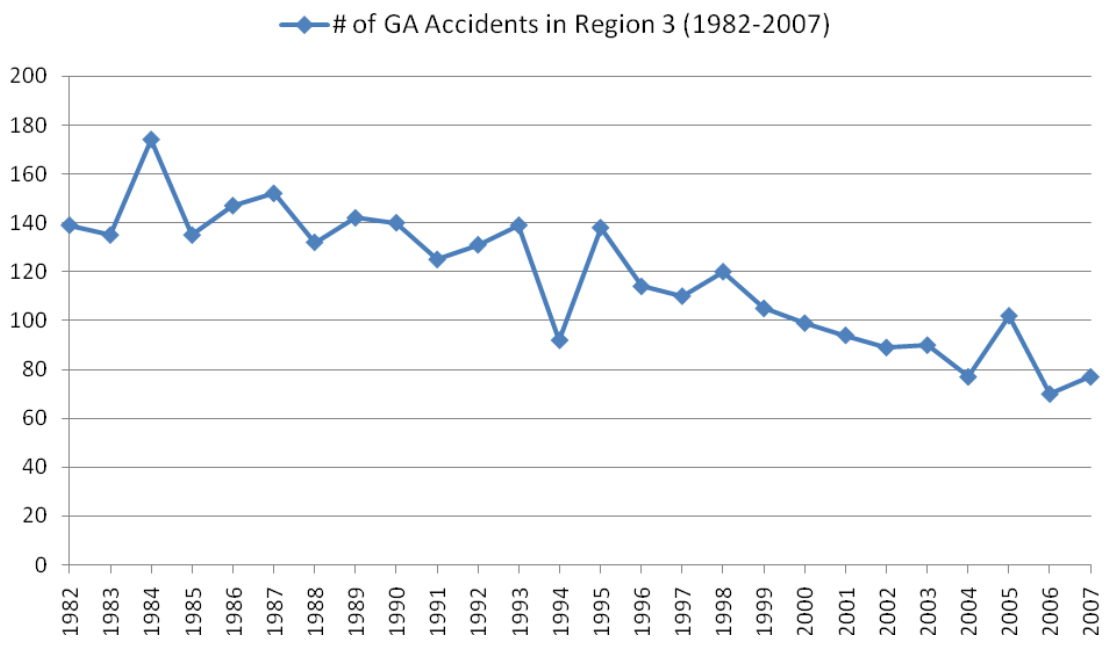

Figure 71. Number of GA Accidents Between 1982 and 2007, Alaskan Region

Despite some fluctuations, the number of GA accidents in the Alaskan Region decreased over the 26-year period (1982-2007). In 1994, the number of GA accident in the Alaskan Region dropped from 139 to 92, and then increased again to 138 in 1995. In 2007, the number of GA accidents in the Alaskan Region was 77, or a 1.43% increase from 2006, after a sharp increase in 2005 and sharp decrease in 2006.

Figure 72 compares the number of GA accidents nationwide with the number in the Alaskan Region. In 1982, there were 139 GA accidents in the Alaskan Region compared to 2926 accidents nationwide, which means the Alaskan Region contributed 4.75% of national GA accidents. The percentage increased in 1990, when the Alaskan Region contributed 6.94% of GA accidents nationwide, and in 1993, when the percentage was 7.41%.

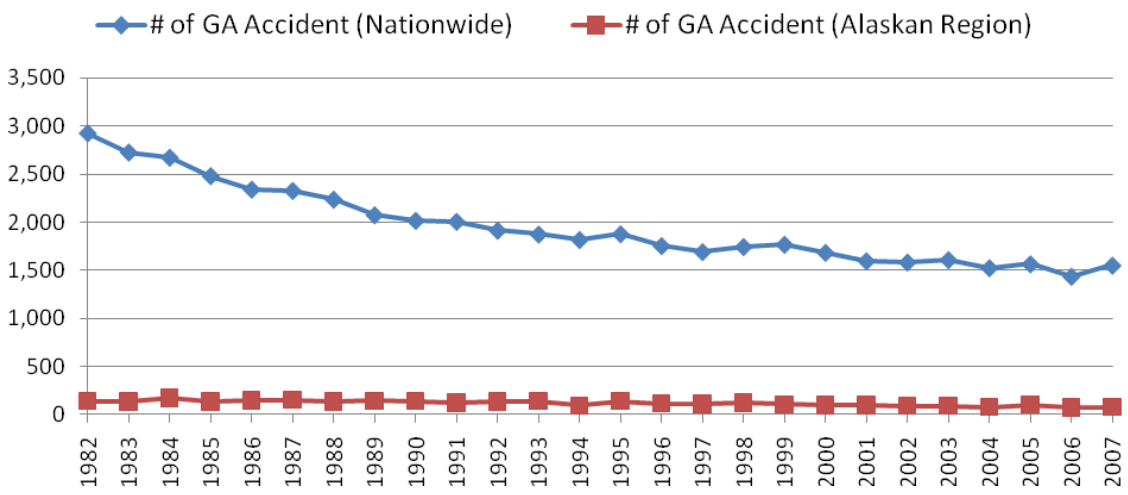

Figure 72. Number of GA Accidents Nationwide vs. the Alaskan Region From 1982 to 2007

Figure 73 shows the number of fatal GA accidents in the Alaskan Region for a 26-year period (1982-2007). Despite some fluctuations, the number decreased over those 26 years. The lowest number of fatal accidents occurred in 2001 with 3 accidents, while the highest number of accidents occurred in 1988 with 20 accidents. In 2007, the number of accident was 7, or a 22% decrease from 2006.

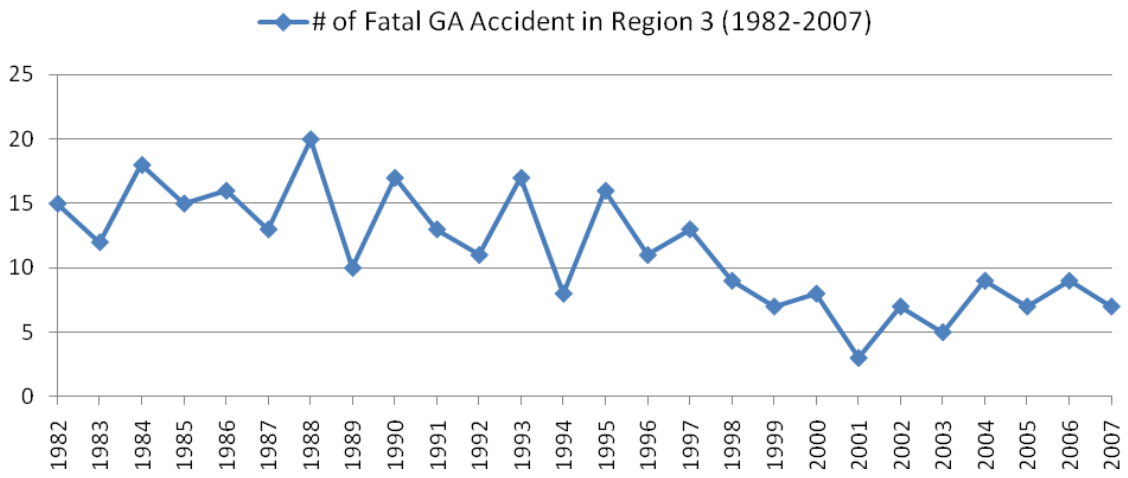

Figure 73. Number of Fatal GA Accidents From 1982 to 2007, Alaskan Region

4.3.2 Percentages of GA Accidents by Month.

Figure 74 represents the percentage of both fatal and nonfatal GA accidents in the Alaskan Region for each month over the 26-year period (1982-2007). The percentage of fatal accidents exceeded nonfatal accidents significantly in July and August, with 50 and 67 fatal accidents, respectively.

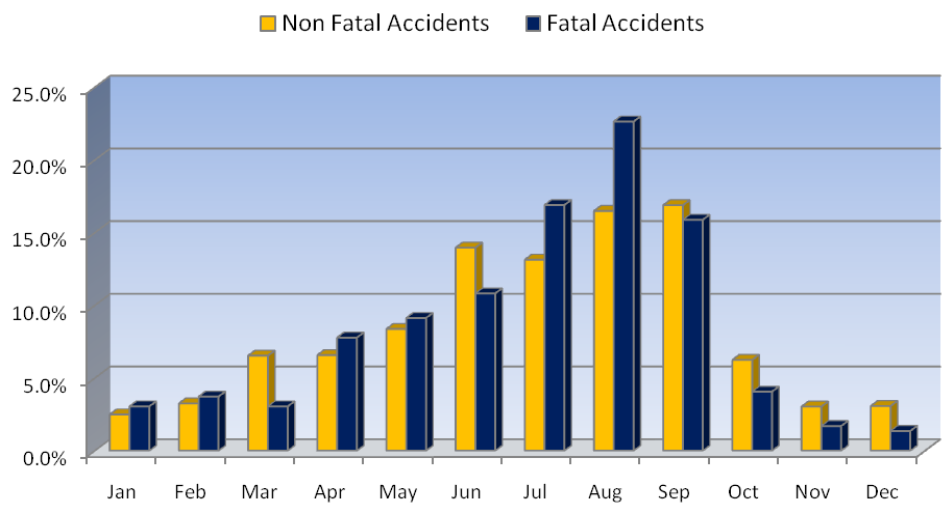

Figure 74. Percentages of Fatal and Nonfatal GA Accidents by Month, Alaskan Region

The increase and decrease in the number of accidents between months are quite significant. The month of August had the highest number of total GA accidents in this region with 524 accidents. During the 26 years, there were 515 accidents in September, while only 185 accidents occurred in October. In January, there were only 78 accidents; in November and December, there were 89 accidents recorded over 26 years. Compared to other regions and the national data, the number of accidents in this region is not spread equally throughout the year.

Figure 75 shows the fatal accidents in the Alaskan Region for 5-, 10-, and 20-year periods grouped by month. The percentage of accidents that occurred in April, July, October, and November increased in 2003-2007 compared to 1998-2007 and 1988-2007. This confirms that the accident frequency peaks in August and September, then drops in October.

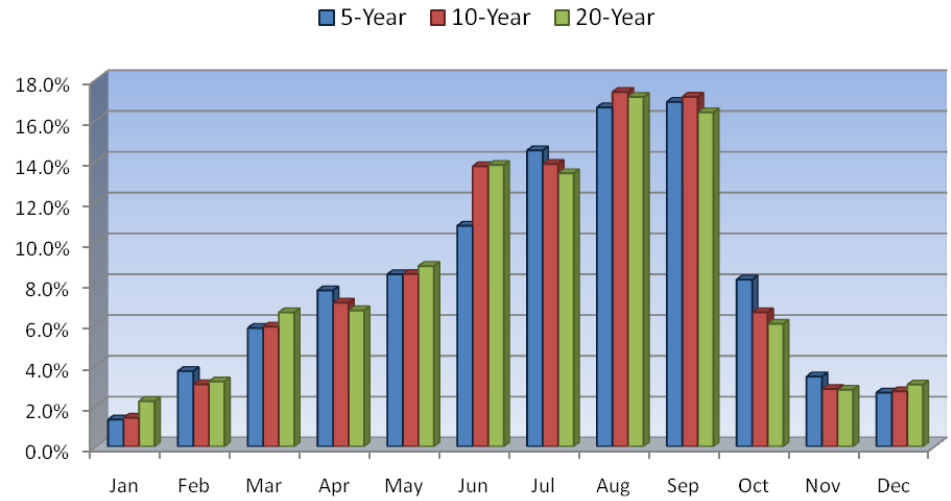

Figure 75. Percentage of Fatal GA Accidents by Month, Alaskan Region
(2003-2007, 1998-2007, and 1988-2007 time periods)

4.3.3 Percentages of GA Accidents by Phases of Flight.

Figure 76 compares the percentages of fatal and nonfatal GA accidents for the Alaskan Region grouped by phases of flight. The percentage of fatal accidents is significantly higher during Maneuvering, Descent, Cruise, and Takeoff. On the other hand, nonfatal accidents dominated during the Landing phase. Appendix B describes the category of phases of flight in more detail.

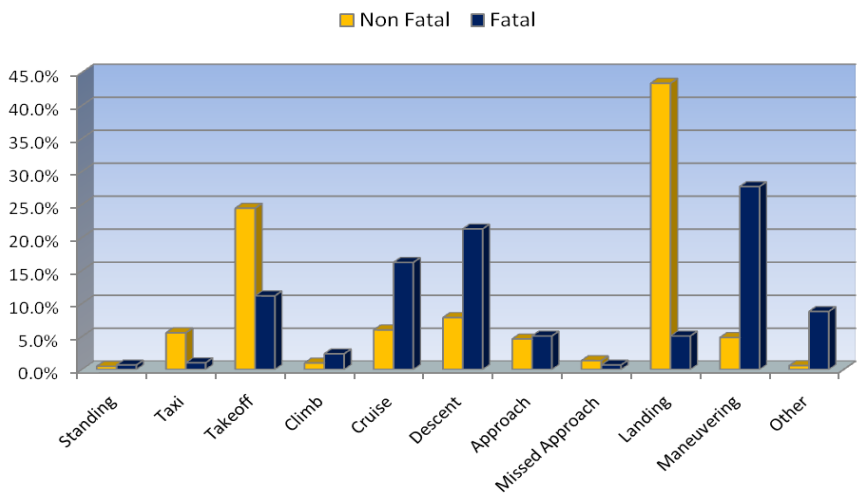

Figure 76. Percentages of Fatal and Nonfatal Accidents by Phases of Flight, Alaskan Region (1982-2007)

Figure 77 represents a comparison of fatal GA accidents in the Alaskan Region during the 2003-2007, 1998-2007, and 1988-2007 time periods. The figure shows that the percentage of accidents during the Descent phase increased for the 2003-2007 time period compared to the 1998-2007 time period and the 1988-2007 time period. The same pattern is evident in the Approach and Cruise phases.

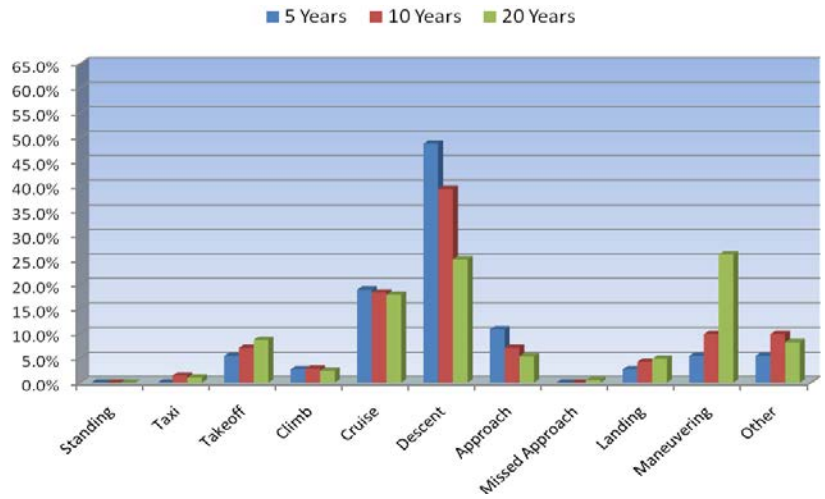

Figure 77. Percentages of Fatal GA Accidents by Phases of Flight, Alaskan Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.3.4 Percentages of GA Accidents Based on Time of Day.

Figures 78 through 81 show comparisons between the percentages of fatal and nonfatal GA accidents that occurred in the Alaskan Region during specific times of day.

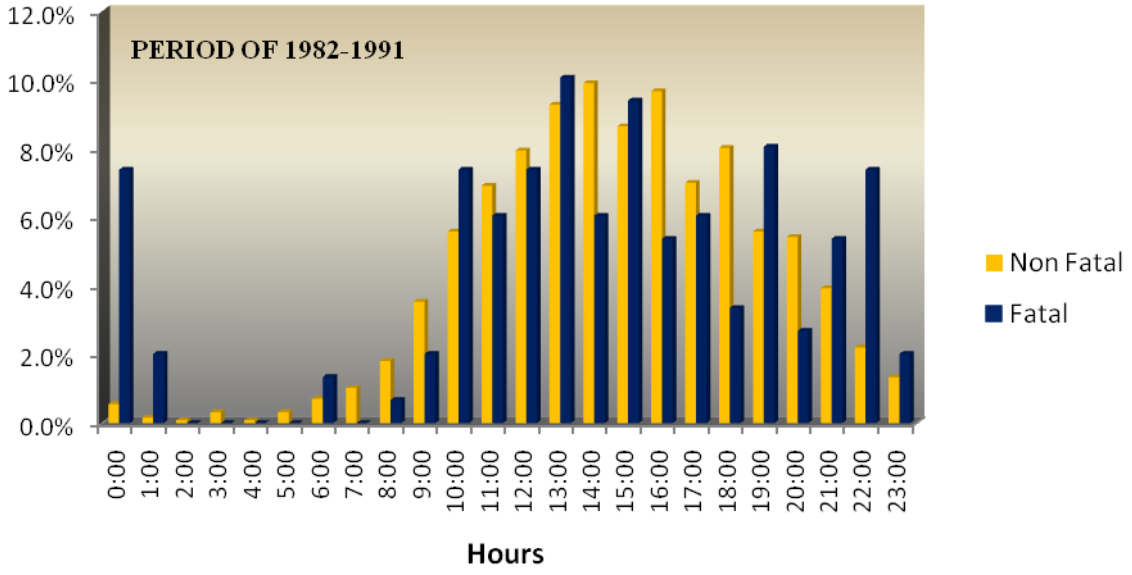

Figure 78. Percentages of Fatal and Nonfatal Accidents by Time of Day, Alaskan Region (1982-1991)

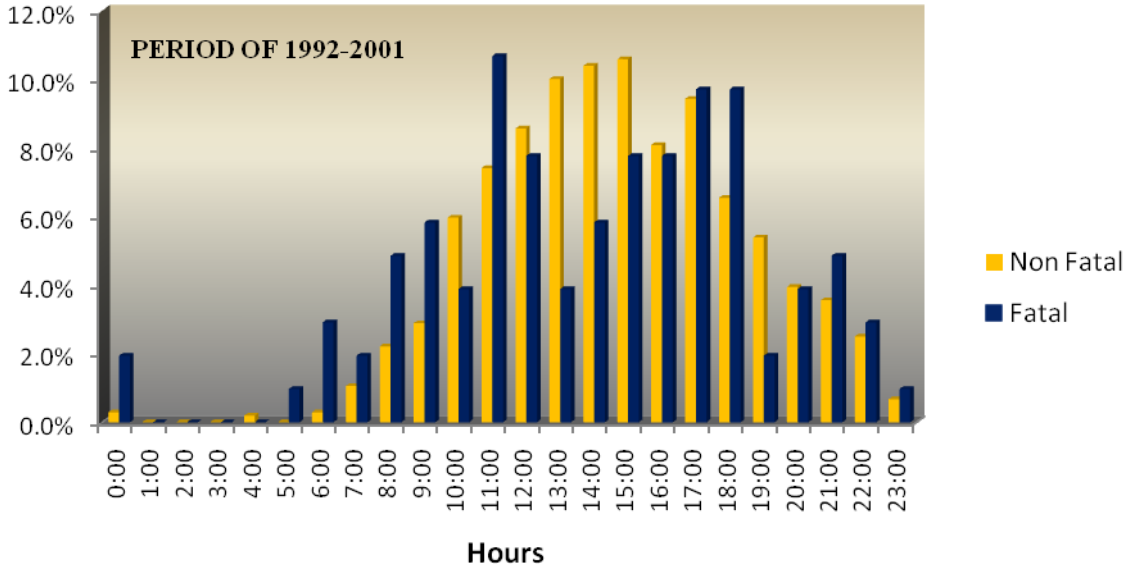

Figure 79. Percentages of Fatal and Nonfatal Accidents by Time of Day, Alaskan Region (1992-2001)

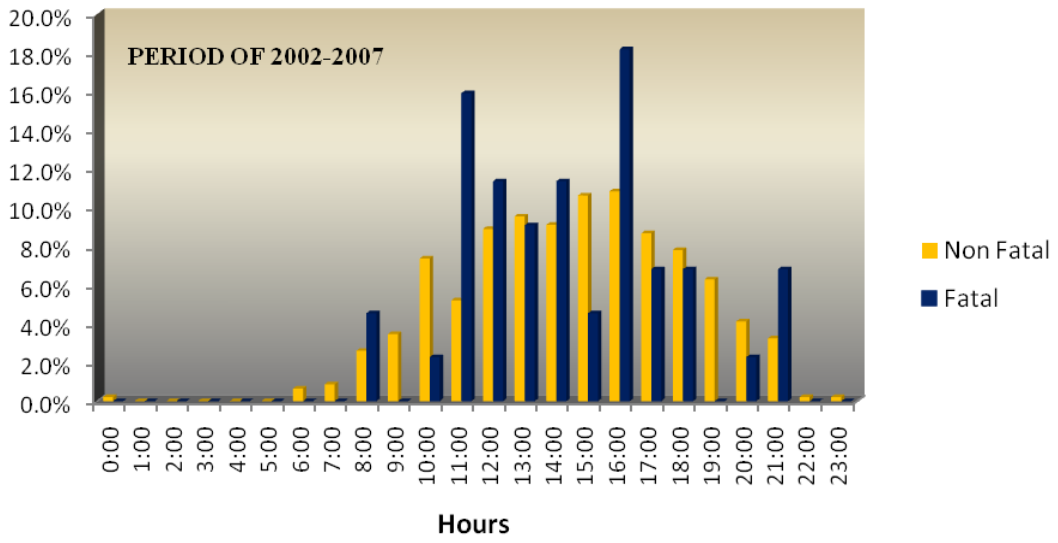

Figure 80. Percentages of Fatal and Nonfatal Accidents by Time of Day, Alaskan Region (2002-2007)

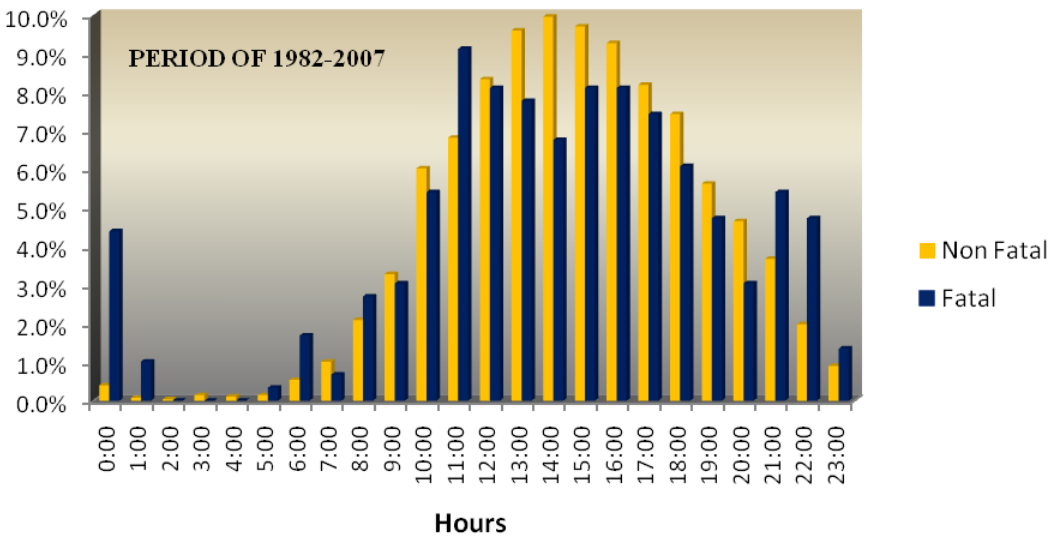

Figure 81. Percentages of Fatal and Nonfatal Accidents by Time of Day, Alaskan Region (1982-2007)

Figure 78 shows the percentages of fatal and nonfatal GA accidents that occurred in the Alaskan Region between 1982 and 1991, grouped by time of day. Unlike other regions, the percentage of fatal accidents exceeded the percentages of nonfatal accidents in some time periods, but surprisingly, the percentage of fatal accidents was quite high between 12 a.m. and 1 a.m.

Figure 79 shows that the percentage of fatal accidents exceeded the nonfatal percentage at a different trend than in figure 78. The number of accidents increased significantly between 11 a.m. and 12 p.m. The fatal percentage exceeded the nonfatal percentage mostly in the period from the evening until late morning.

Figure 80 shows that there were no accidents between 1 a.m. and 5 a.m. in the 2002-2007 time period. However, during the daytime the number of fatal accidents exceeded the number of nonfatal accidents significantly.

Figure 81 shows the comparison of the percentages of fatal and nonfatal GA accidents based on time of day from 1982 to 2007. Generally, the percentage of fatal accidents exceeded the percentage of nonfatal accidents between 9 p.m. and 8 a.m. in the morning.

4.4 REGION 4: CENTRAL.

4.4.1 Frequency of GA Accidents in the Central Region.

Figure 82 exhibits the number of both fatal and nonfatal accidents that occurred in the Central Region.

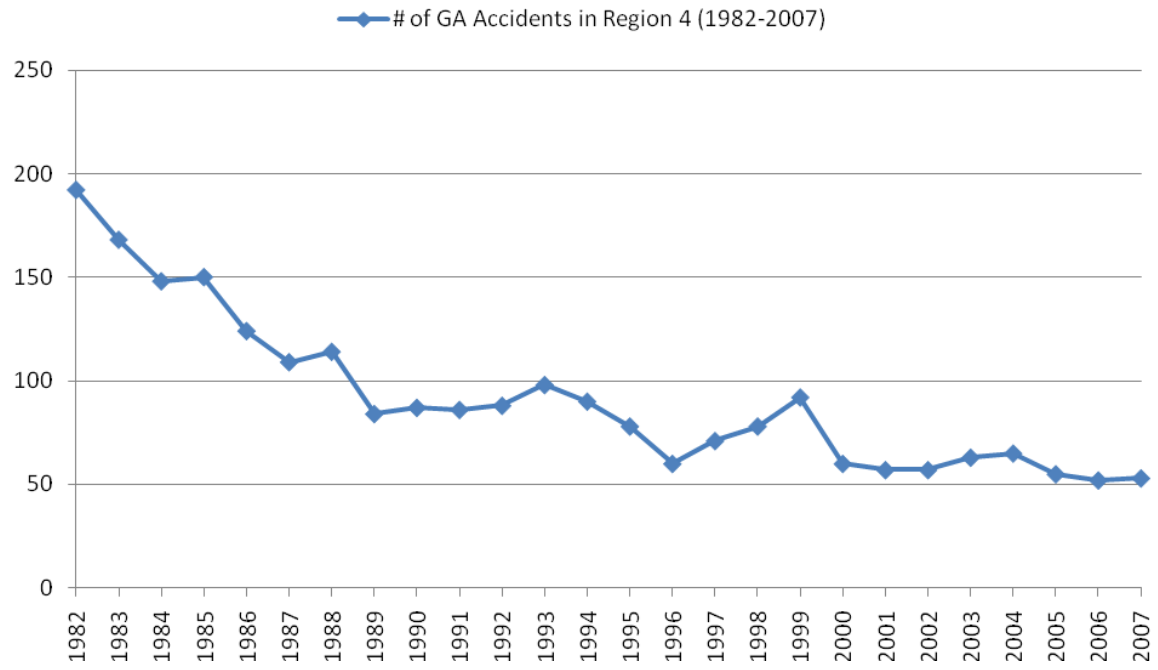

Figure 82. Number of GA Accidents Between 1982 and 2007, Central Region

In general, the number of GA accidents in the Central Region decreased significantly over 26 years. In 2007, there were 53 accidents, which is almost 25% of the total number of accidents in 1982. The steep decline happened during the 1980s when the number of accidents decreased by more than half. That number continued to decrease for the following years in the studied time periods.

Figure 83 compares the number of GA accidents nationwide with the number in the Central Region. The percentage of accidents in the Central Region decreased over the 26-year period from 6.56% in 1982 to 3.41% in 2007. That means the number of GA accidents in the Central Region declined faster than the national number of accidents.

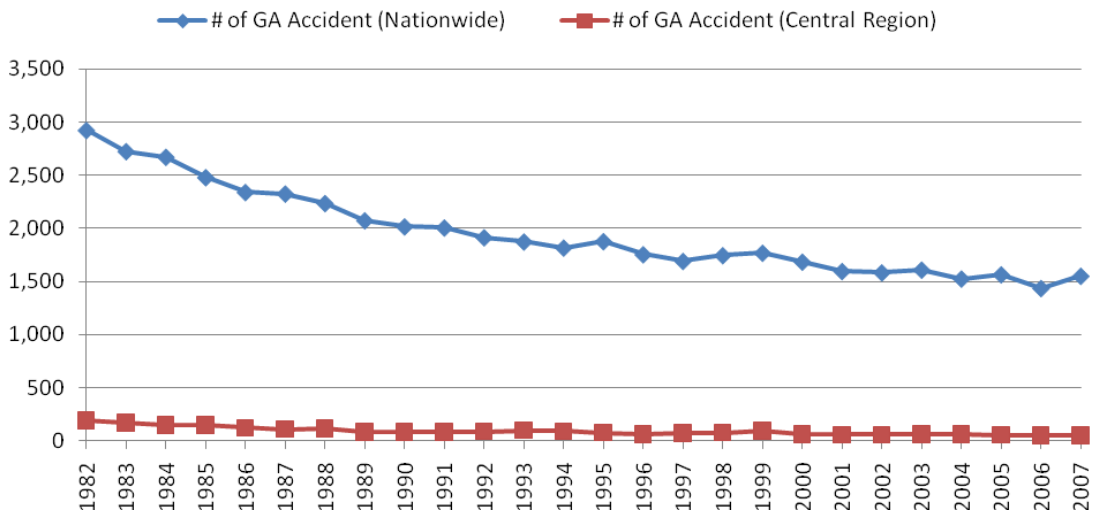

Figure 83. Number of GA Accidents Nationwide vs. Central Region From 1982 to 2007

Figure 84 shows the number of fatal GA accidents in the Central Region for the 26-year period. Despite some fluctuations, the number has decreased from 1982-2007. The lowest number of fatal accidents occurred in 2003 with 8 accidents, while the highest number of accidents occurred in 1982 with 28 accidents. In 2007, the number of accidents was 7, or a 22% decrease from 2006 and a 64% decrease from 1982.

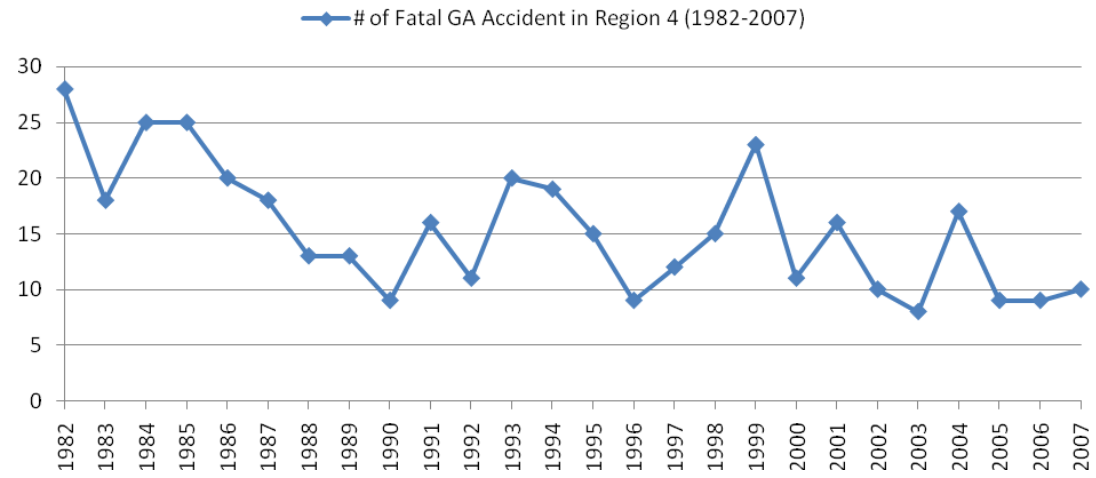

Figure 84. Number of Fatal GA Accidents in the Central Region From 1982 to 2007

4.4.2 Percentages of GA Accidents by Month.

Figure 85 represents the percentages of both fatal and nonfatal GA accidents in the Central Region for each month over the 26-year period. The percentage of fatal accidents exceeded nonfatal accidents significantly in April and November with 49 and 42 fatal accidents, respectively. The number of accidents is spread almost equally throughout the year; however, the highest number of accidents took place in July with 289 total accidents, while the lowest number of accidents occurred in February with 134 accidents.

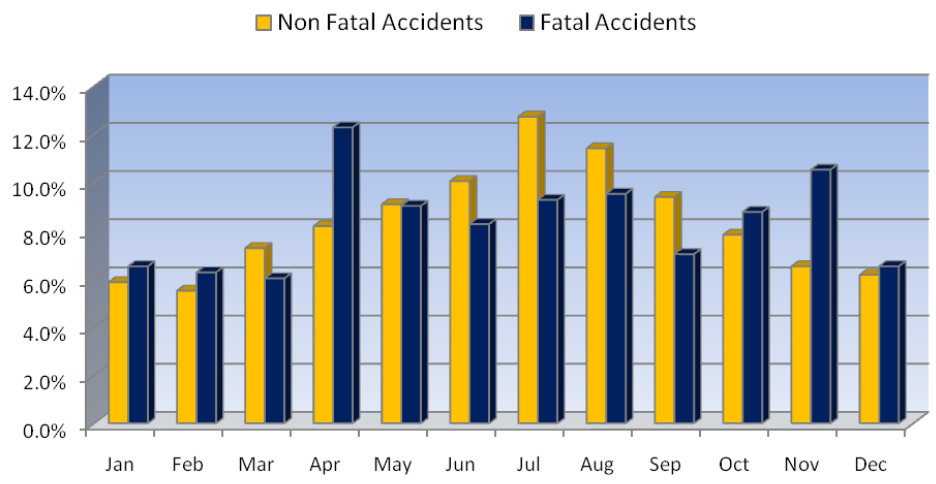

Figure 85. Percentages of Fatal and Nonfatal GA Accidents by Month, Central Region

Figure 86 summarizes fatal accidents in the Central Region for 5-, 10- and 20-year periods based on months. The percentage of accidents that occurred in February, March, April, and November increased significantly during the 2003-2007 time period compared to the 1998-2007 time period. On the other hand, there were no fatal accidents in May during the 2003-2007 time period. Furthermore, the number of accidents in June increased for the 2003-2007 time period compared to the 1998-2007 and 1988-2007 time periods.

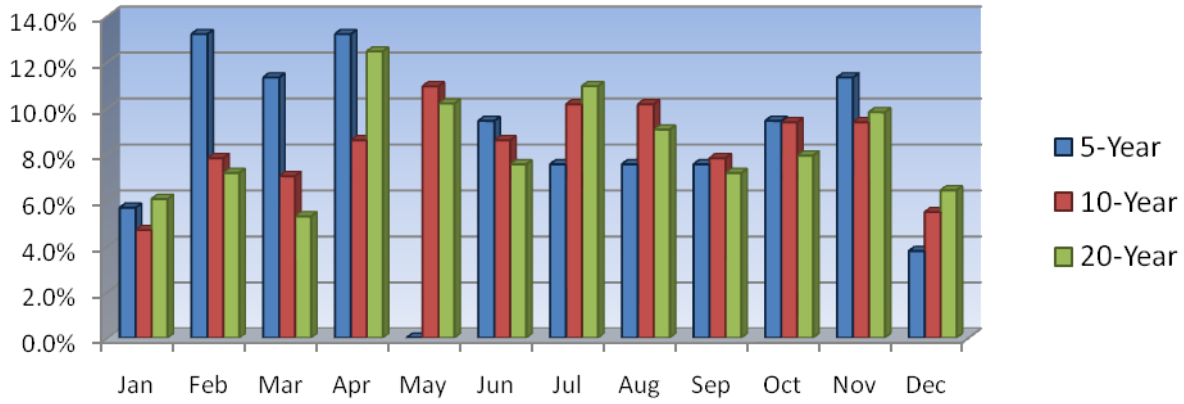

Figure 86. Percentages of Fatal GA Accidents by Month in the Central Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.4.3 Percentage of GA Accidents Based on Phases of Flight.

Figure 87 compares the percentages of fatal and nonfatal GA accidents for the Central Region grouped by phases of flight. The percentage of fatal accidents is significantly higher during the Descent, Maneuvering, Cruise, Approach, and Takeoff phases. However, nonfatal accidents dominated during the Landing plase. Appendix B describes the phases of flight category in more detail.

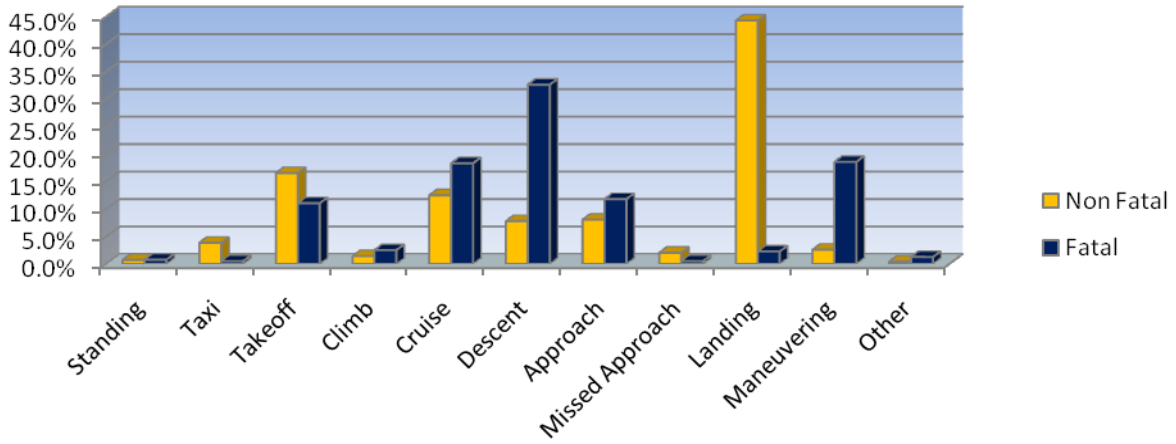

Figure 87. Percentages of Fatal and Nonfatal GA Accidents by Phases of Flight, Central Region (1982-2007)

Figure 88 represents a comparison of fatal GA accidents in the Central Region during the 2003-2007, 1998-2007, and 1988-2007 time periods. Figure 88 shows that the percentage of accidents during the Descent phase increased significantly for the 2003-2007 time period compared to the 1998-2007 time period, as well as the 1988-2007 time period.

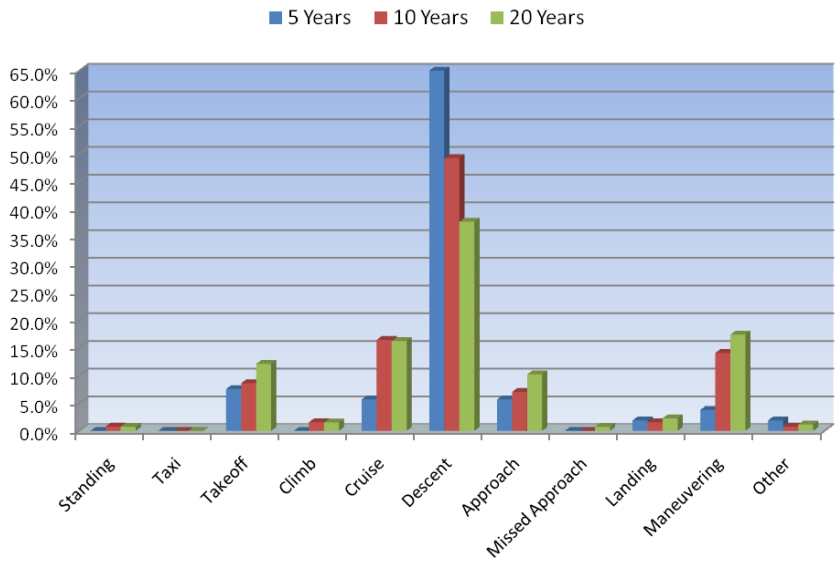

Figure 88. Percentages of Fatal GA Accidents by Phases of Flight for the Central Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.4.4 Percentages of GA Accidents Based on Time of Day.

Figures 89 through 92 show comparisons of the percentages of fatal and nonfatal GA accidents that occurred in the Central Region during specific times of day.

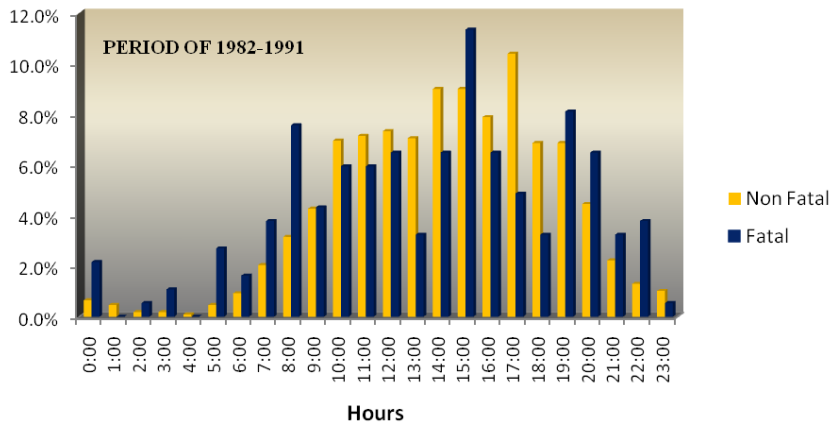

Figure 89. Percentages of Fatal and Nonfatal Accidents by Time of Day, Central Region (1982-1991)

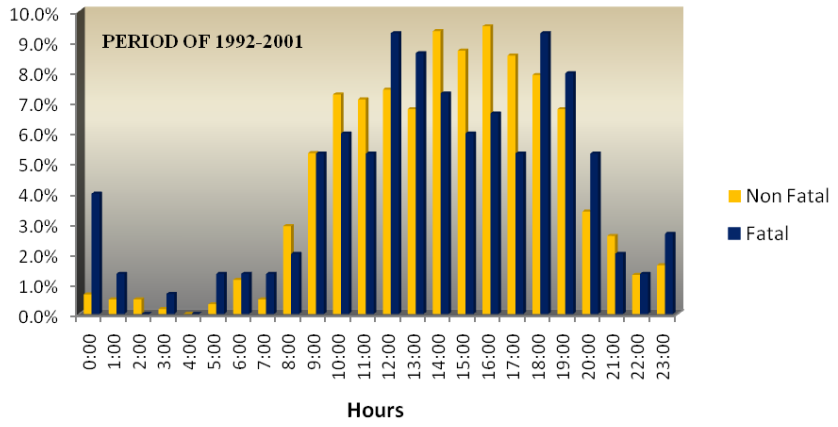

Figure 90. Percentages of Fatal and Nonfatal Accidents by Time of Day, Central Region (1992-2001)

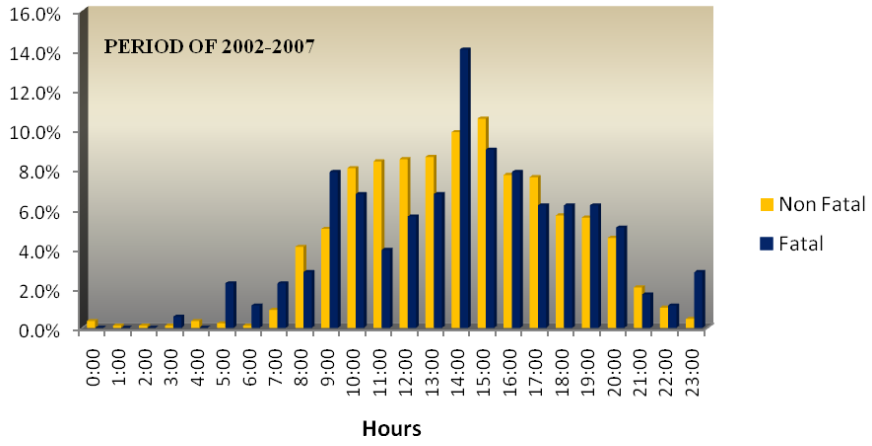

Figure 91. Percentages of Fatal and Nonfatal Accidents by Time of Day, Central Region (2002-2007)

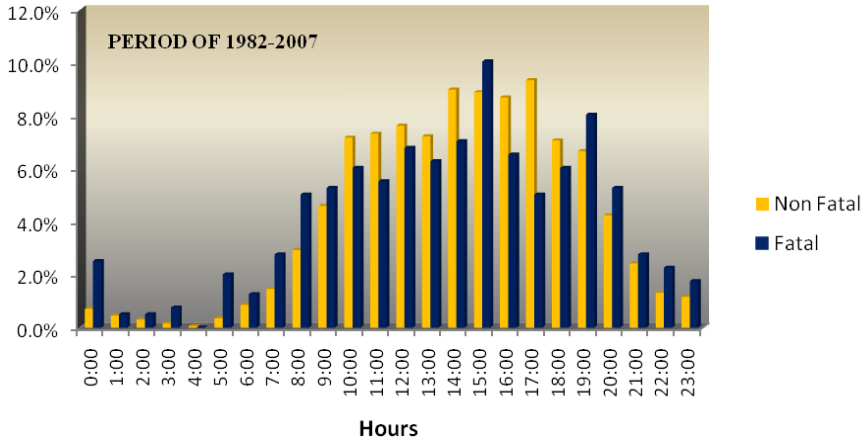

Figure 92. Percentages of Fatal and Nonfatal Accidents by Time of Day, Central Region (1982-2007)

Figure 89 compares the percentages of fatal and nonfatal GA accidents that occurred in the Central Region between 1982 and 1991 grouped by time of day. Unlike other regions, the percentage of fatal accidents exceeded the percentage of nonfatal accidents in some time periods. The number of accidents that occurred between 3 p.m. and 4 p.m. was the highest among all other times of day. 40 fatal accidents and 176 nonfatal accidents occurred between those hours.

Figure 90 shows that the percentage of fatal accidents exceeded the percentage of nonfatal accidents at a different trend than figure 89. The number of accidents was high during daylight, but no accident occurred between 4 a.m. and 5 a.m. The percentage of fatal accidents exceeded that of nonfatal accidents mostly at night and in the early morning.

Figure 91 shows that, during daytime hours, the percentage of fatal accidents exceeded the percentage of nonfatal accidents significantly.

Figure 92 shows the percentages of fatal and nonfatal GA accidents based on time of day from 1982 to 2007. Generally, the percentage of fatal accidents exceeded the percentage of nonfatal accidents between 7 p.m. and 9 a.m. However, the same pattern happened between 3 p.m. and 4 p.m. when the highest number of fatal, as well as total accidents occurred.

4.5 REGION 5: GREAT LAKES.

4.5.1 Frequency of GA Accidents in the Great Lakes Region.

Figure 93 shows the total number of both fatal and nonfatal GA accidents that occurred in this region during the 26-year time period.

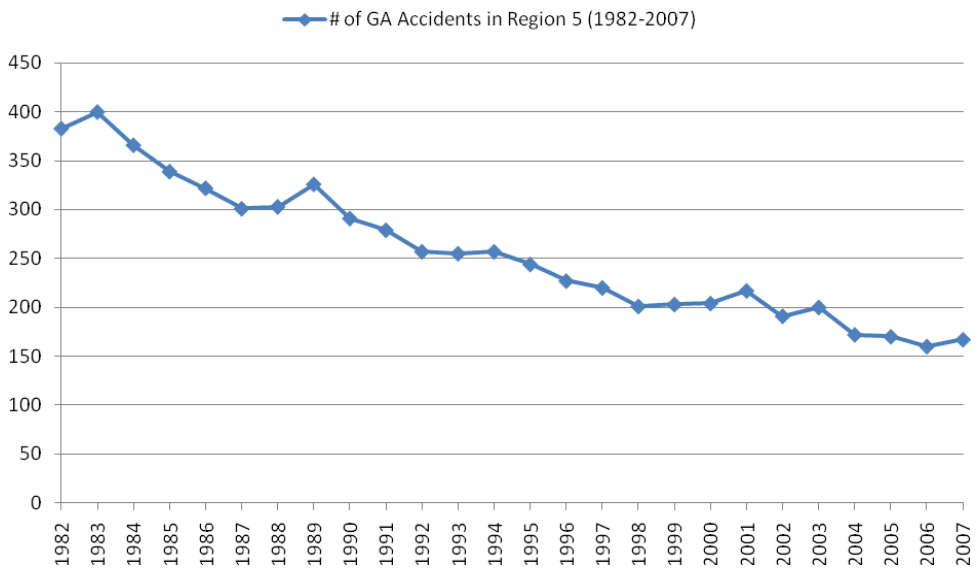

Figure 93. Number of GA Accidents Between 1982 and 2007, Great Lakes Region

In general, the number of GA accidents in the Great Lakes Region decreased significantly over 26 years. In 2007, there were 167 accidents, which is almost half the total number of accidents that occurred in 1982, when there were more than 380 accidents. During the 1990s, the total number of accidents decreased continuously by almost half (i.e., 326 accidents in 1989 to 201 accidents in 1998). For the remainder of the 26-year period, the number of accidents actually shifted up and down. Finally, the number of accidents went up 7 percentage points in 2007 from the 2006 number.

Figure 94 compares the number of GA accidents nationwide with the number in the Great Lakes Region. The percentage of accidents in this region decreased over the 26-year period from 13.09% in 1982 to 10.75% in 2007. Therefore, the number of GA accidents in the Great Lakes Region declined faster than the national percentage, even though, in some years, the percentage increased. In total, there were 6,655 GA accidents in the Great Lakes Region compared to 50,840 accidents that occurred in the U.S. during the 26-year period.

Figure 95 shows the number of fatal GA accidents in the Great Lakes Region for the 26-year period. Despite some fluctuations, the number decreased from 1982 to 2007. The lowest number of fatal accidents occurred in 2004 and 2005 with each having 24 accidents, while the highest number of accidents occurred in 1990 with 55 accidents. In 2007, 28 fatal accidents occurred, which was a 22% decrease from 2006 and a 46% decrease from the number of accidents in 1982.

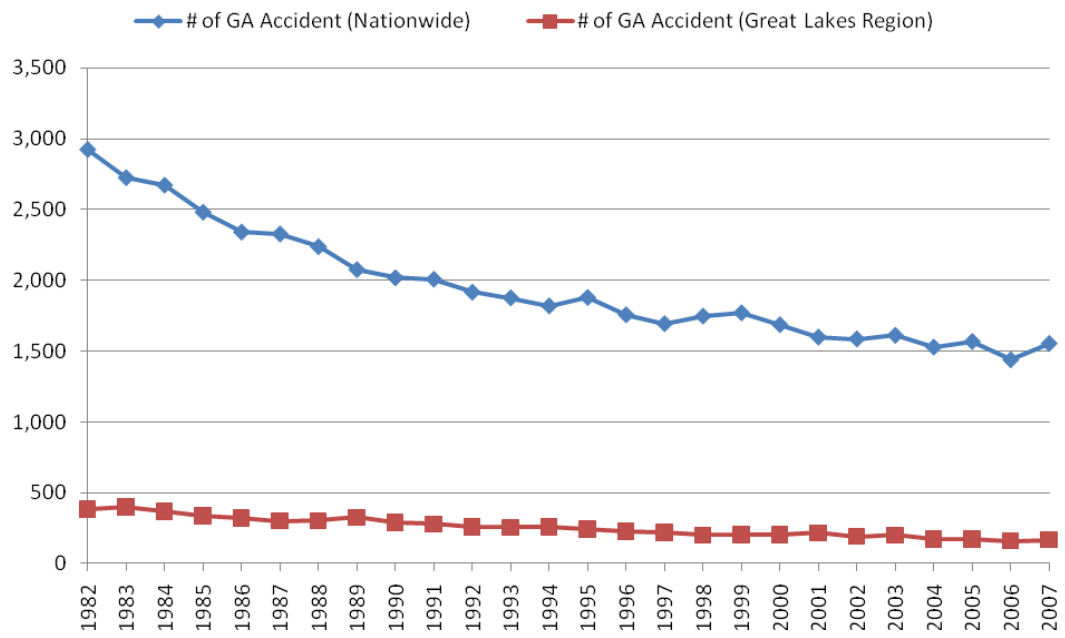

Figure 94. Number of GA Accidents Nationwide vs. the Great Lakes Region From 1982 to 2007

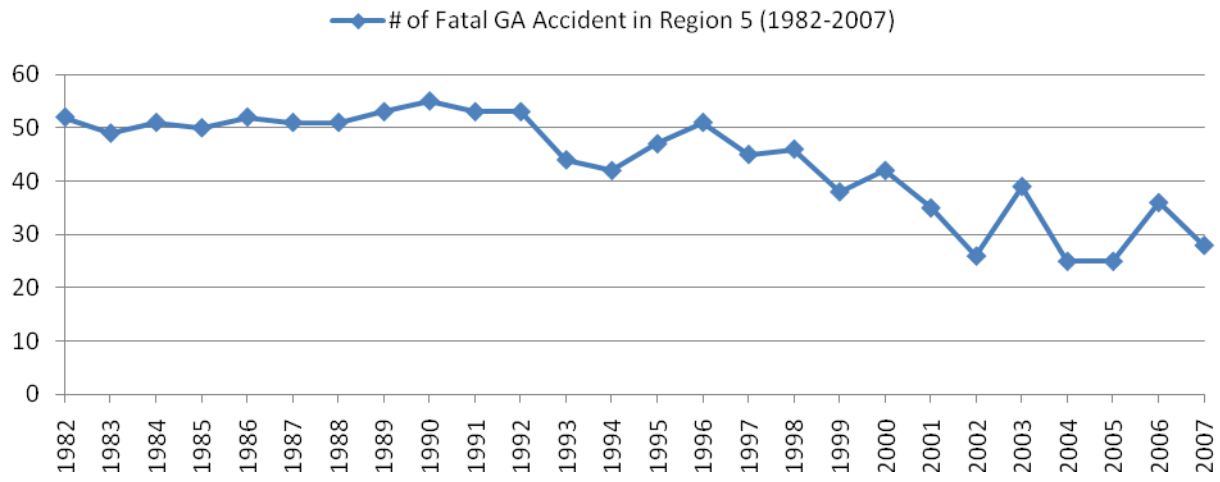

Figure 95. Number of Fatal GA Accidents From 1982 to 2007, Great Lakes Region

4.5.2 Percentages of GA Accidents by Month.

Figure 96 shows the percentages of both fatal and nonfatal GA accidents in the Great Lakes Region for each month during the 26-year period. The percentage of fatal accidents significantly exceeded the percentage of nonfatal accidents in August through December. The total number of accidents, however, peaked in July with 960 accidents; December had the least number of accidents with 346.

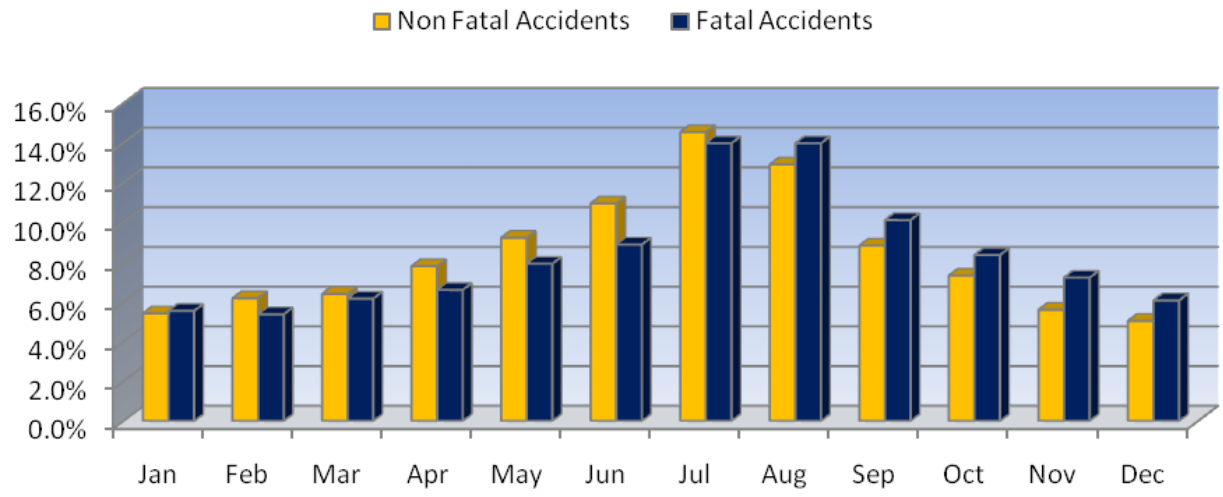

Figure 96. Percentages of Fatal and Nonfatal GA Accidents by Month, Great Lakes Region

Figure 97 shows fatal accidents in the Great Lakes Region for 5-, 10-, and 20-year periods grouped by month. The percentage of accidents that occurred in March, May, September, and December increased significantly from 2003-2007 compared to the 1998-2007 time period. In June, the percentage of fatal accidents increased again to 8.5% after a slight decrease in the 1998-2007 time period. Similar patterns occurred in the months of September and December, but with a higher rate of increase for the 2003-2007 time period compared to the 1998-2007 period. Furthermore, the number of accidents in May continued to increase for the 2003-2007 time period compared to the 1998-2007 and 1988-2007 time periods.

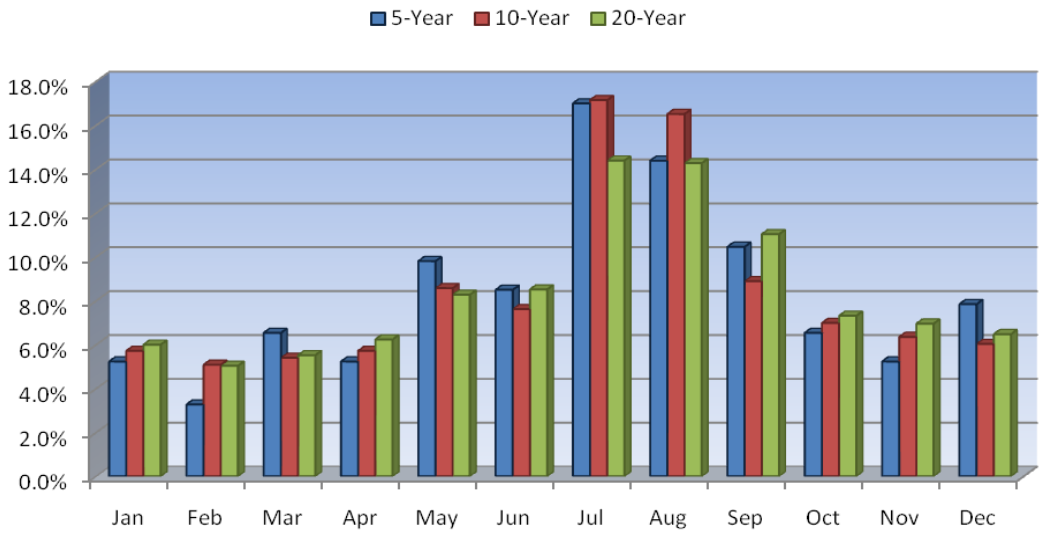

Figure 97. Percentages of Fatal GA Accidents by Month, Great Lakes Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.5.3 Percentages of GA Accidents Based on Phases of Flight.

Figure 98 compares the percentages of fatal and nonfatal GA accidents for the Great Lakes Region grouped by phase of flight between 1982 and 2007. The percentage of fatal accidents was significantly higher than the percentage of nonfatal accidents during the Descent and Maneuvering phases. The highest number of fatal accidents (330 accidents) occurred in the Descent phase, as shown in figure 99. The Descent phase is followed by the Maneuvering, Approach, and Cruise phases with 225, 160, and 136, respectively. On the other hand, nonfatal accidents occurred most during the Landing phase, similar to the trend of other regions. Appendix B describes the category of phases of flight in more detail.

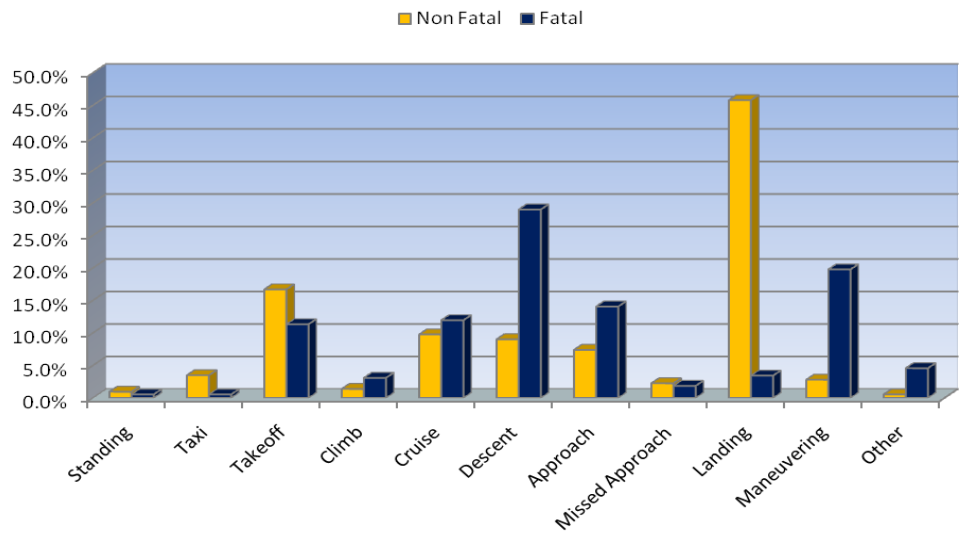

Figure 98. Percentages of Fatal and Nonfatal GA Accidents by Phases of Flight, Great Lakes Region (1982-2007)

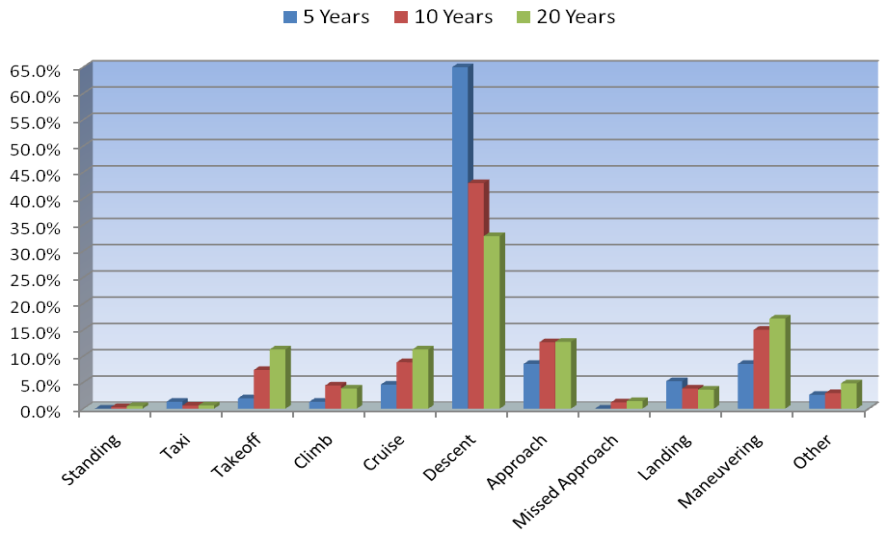

Figure 99. Percentages of Fatal GA Accidents by Phases of Flight, Great Lakes Region (2003-2007, 1998-2007, and 1988-2007 time periods)

Figure 99 shows a comparison of fatal GA accidents in the Great Lakes Region during the 2003-2007, 1998-2007, and 1988-2007 time periods. The figure confirms that the number of accidents during the Descent phase was higher than the other phases of flight. Additionally, that percentage continued to increase for the 10-year time period compared to the 20-year time period and for the 5-year time period compared to the 10-year time period.

4.5.4 Percentages of GA Accidents Based on Time of Day.

Figures 100 through 103 show the comparison of the percentages of fatal and nonfatal GA accidents that occurred in the Great Lakes Region grouped by time of day.

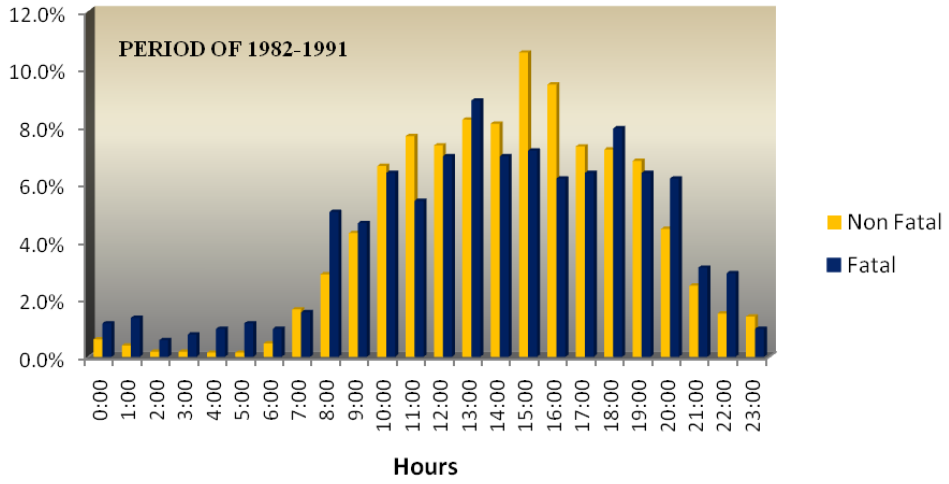

Figure 100. Percentages of Fatal and Nonfatal Accidents by Time of Day, Great Lakes Region (1982-1991)

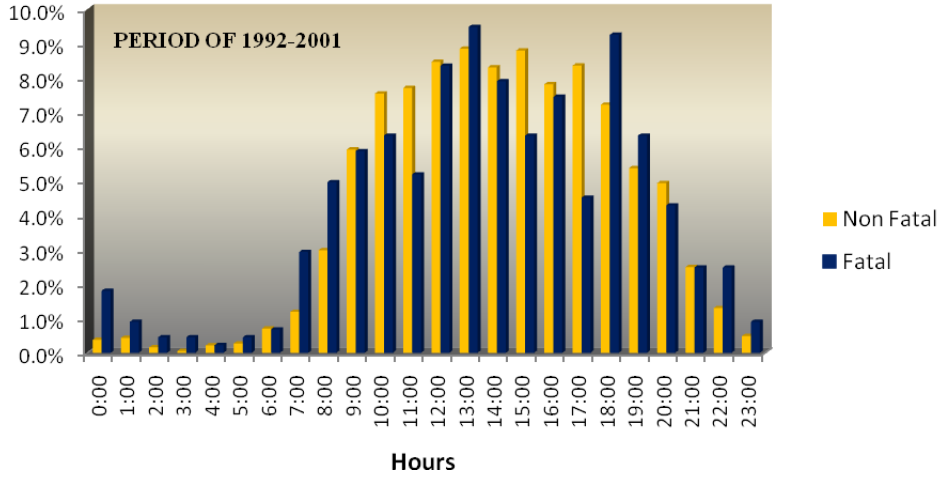

Figure 101. Percentages of Fatal and Nonfatal Accidents by Time of Day, Great Lakes Region (1992-2001)

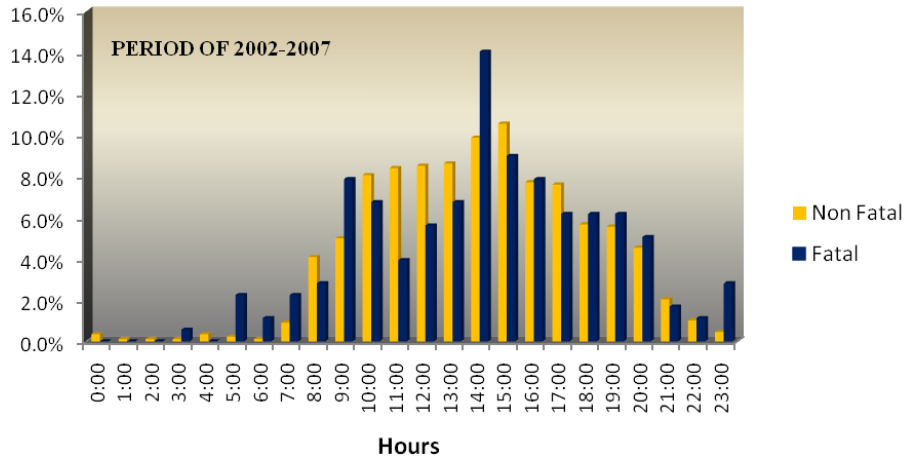

Figure 102. Percentages of Fatal and Nonfatal Accidents by Time of Day, Great Lakes Region (2002-2007)

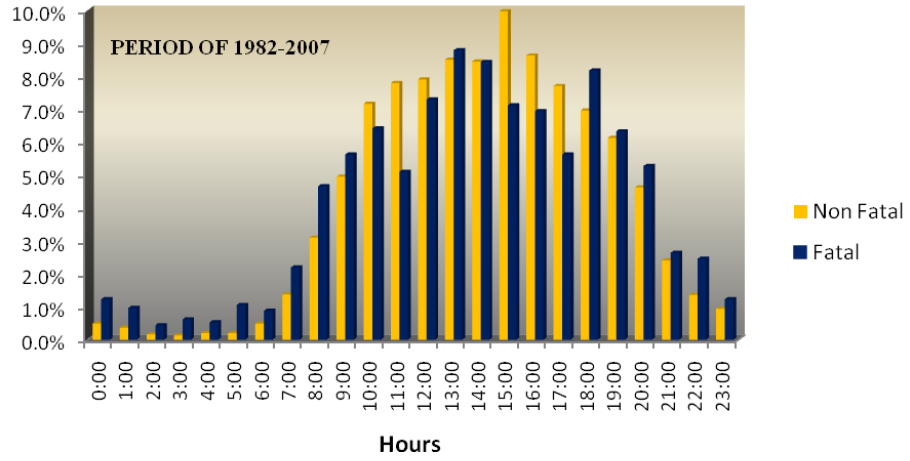

Figure 103. Percentages of Fatal and Nonfatal Accidents by Time of Day, Great Lakes Region (1982-2007)

Figure 100 compares the percentage of fatal and nonfatal GA accidents that occurred in the Great Lakes Region between 1982 and 1991, grouped by time of day. There are significant differences between the percentage of fatal and nonfatal accidents that occurred at 3 p.m. and 4 p.m., but in this case, nonfatal accidents exceeded fatal accidents. The percentage of fatal accidents significantly exceeded the percentage of nonfatal accidents at both 8 a.m. and 8 p.m. The highest number of fatal accidents, however, occurred at 1 p.m.

Figure 101 shows that the percentage of fatal accidents exceeded the nonfatal percentage from 6 p.m. to 8 a.m.

Based on the raw data extracted from the NTSB database, there were no fatal accidents recorded between 12 a.m. and 3 a.m. Only one fatal accident occurred between 3 a.m. and 4 a.m. and no fatal accidents occurred between 4 a.m. and 5 a.m. However, one accident had no information

about the actual time of occurrence. The number of fatal GA accidents peaked at 2 p.m. with 25 accidents. Figure 102 shows that the percentage of fatal accidents at 2 p.m. far exceeded the percentage of nonfatal accidents.

Figure 103 shows the comparison of the percentage of fatal and nonfatal GA accidents grouped by time of day from 1982 to 2007. Generally, the percentage of fatal accidents exceeded the percentage of nonfatal accidents between 6 p.m. and 9 a.m. However, the same pattern happened between 1 p.m. and 2 p.m. when the highest number of fatal accidents occurred.

4.6 REGION 6: NEW ENGLAND.

4.6.1 Frequency of GA Accidents in the New England Region.

Figure 104 shows the number of both fatal and nonfatal GA accidents that occurred in the New England Region.

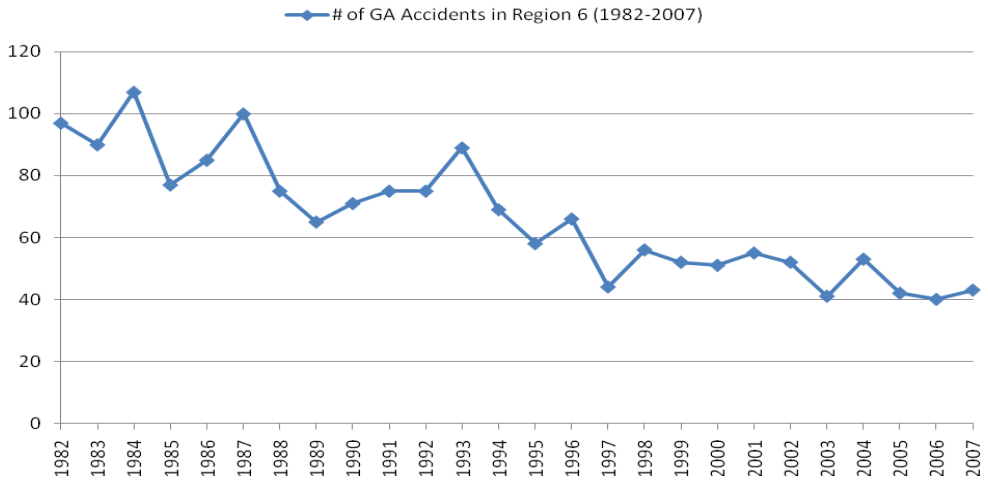

Figure 104. Number of GA Accidents Between 1982 and 2007, New England Region

In general, the number of GA accidents in the New England Region decreased significantly over 26 years, as shown in figure 104. There were 53 accidents in 2007, which is half the total number of accidents in 1982.

Figure 105 shows the number of GA accidents nationwide versus the number in the New England Region. Generally, the trend for the number of accidents in this region was a slight decrease over the 26-year period and ranged from 4.74% in 1993 to 2.55% in 2003. The percentage of accidents in this region was relatively small compared to other regions. The highest percentage of GA accidents in this region was 4.74% in 1993, with 89 GA accidents in the region compared to 1876 accidents nationwide. In 2007, there were 43 GA accidents (or 2.77%) in this region compared to 1553 GA accidents nationwide.

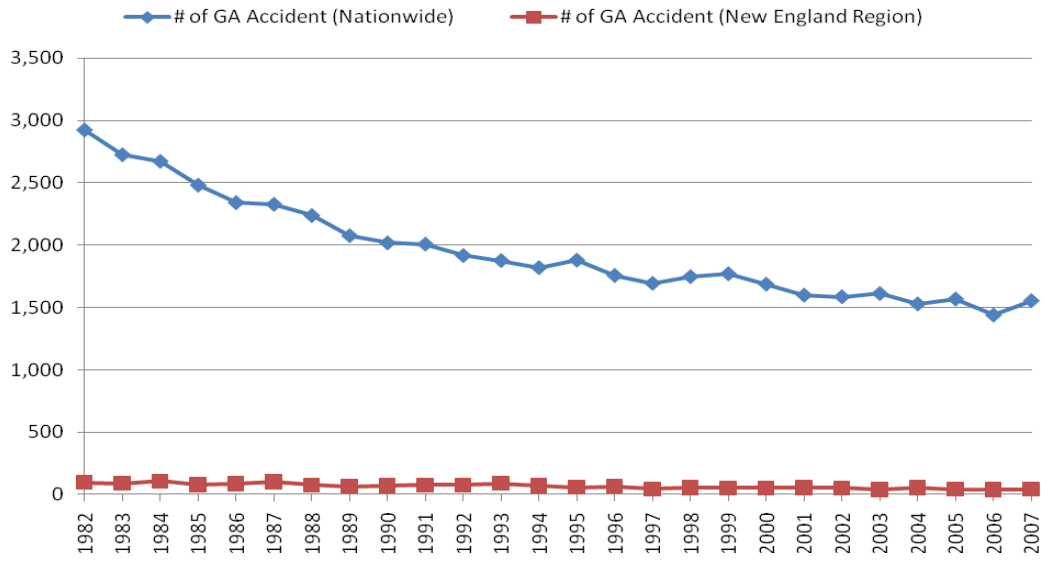

Figure 105. Number of GA Accidents Nationwide vs. the New England Region From 1982 to 2007

Figure 106 presents the number of fatal GA accidents in the New England Region over a 26-year period. Despite some fluctuations, the number decreased over 26 years. The lowest number of fatal accidents occurred in 2006 with 5 accidents, while the highest number of accidents occurred in 1984 with 26 accidents. In 2007, there were 6 fatal accidents, a 1-point increase from 2006.

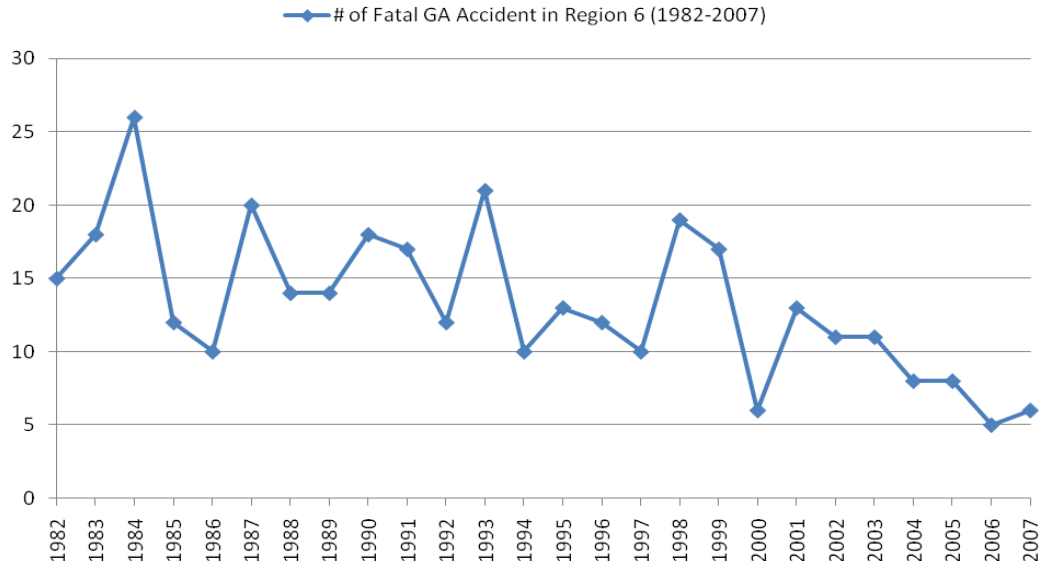

Figure 106. Number of Fatal GA Accidents From 1982 to 2007, New England Region

4.6.2 Percentages of GA Accidents by Month.

Figure 107 represents the percentage of both fatal and nonfatal GA accidents in the New England Region for each month over the 26-year period. The percentage of fatal accidents exceeded the

nonfatal accidents for several months, with the highest number of fatal accidents (46) in August. The highest number of total accidents was 226, which occurred in July.

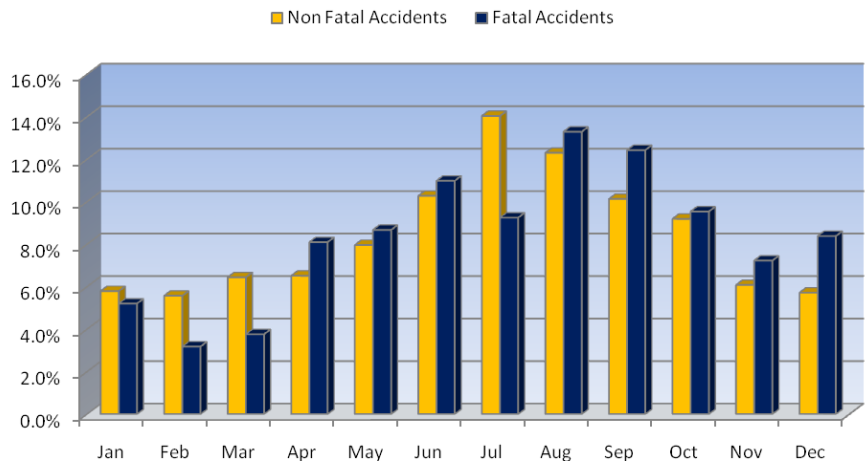

Figure 107. Percentages of Fatal and Nonfatal GA Accidents by Month, New England Region (1988-2007)

Figure 108 shows the percentage of fatal accidents in the New England Region for 5-, 10-, and 20-year periods grouped by month. The figure shows an interesting result that, in some months, the percentage of fatal accidents increased for the 2003-2007 time period compared to the 1998-2007 time period, notably in the months of June, July, August, and November. The month of August yielded the most significant increase in fatal accidents for the 2003-2007 time period and it contributed the highest number of accidents throughout the periods studied. In January, however, there were no fatal accidents during the 2003-2007 time period.

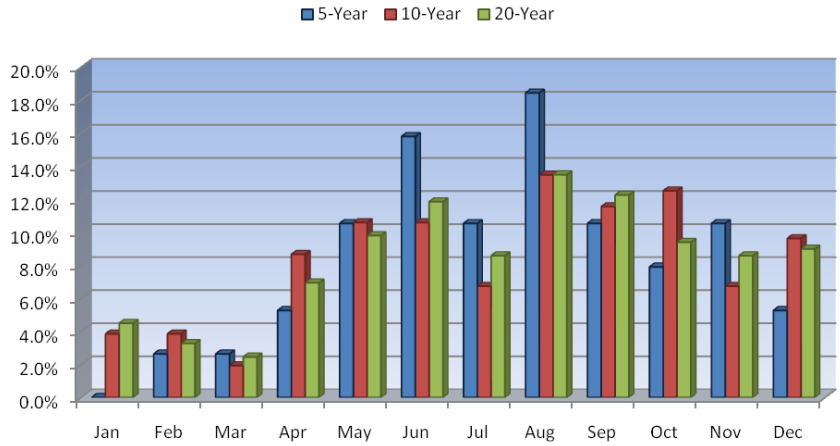

Figure 108. Percentages of Fatal GA Accidents by Month, New England Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.6.3 Percentages of GA Accidents Based on Phases of Flight.

Figure 109 compares the percentage of fatal and nonfatal GA accidents for New England Region grouped by phases of flight. According to the figure, most fatal accidents occurred during the Descent, Cruise, Approach, and Maneuvering phases with more than 10% each. On the other hand, nonfatal accidents occurred most during the Landing phase. Appendix B describes the category of phases of flight in more detail.

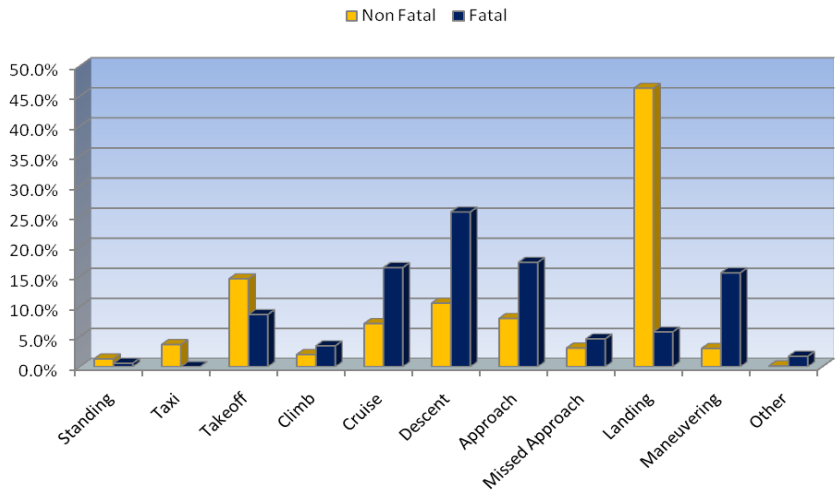

Figure 109. Percentages of Fatal and Nonfatal GA Accidents by Phases of Flight, New England Region (1982-2007)

Figure 110 shows a comparison of fatal GA accidents in the New England Region during 2003-2007, 1998-2007, and 1988-2007 time periods by phases of flight. The figure shows that the percentage of accidents during the Descent phase increased significantly for the 2003-2007 time period compared to the 1998-2007 and the 1988-2007 time periods.

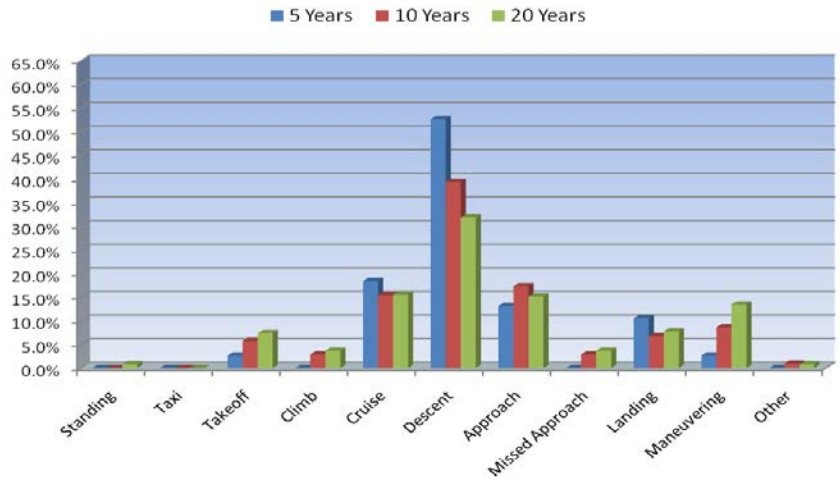

Figure 110. Percentages of Fatal GA Accidents by Phases of Flight, New England Region (2003-2007,1998-2007, and 1988-2007 time periods)

4.6.4 Percentages of GA Accidents Based on Time of Day.

Figures 111 through 114 show the comparison of the percentages of fatal and nonfatal GA accidents that occurred in the New England Region for specific times of day.

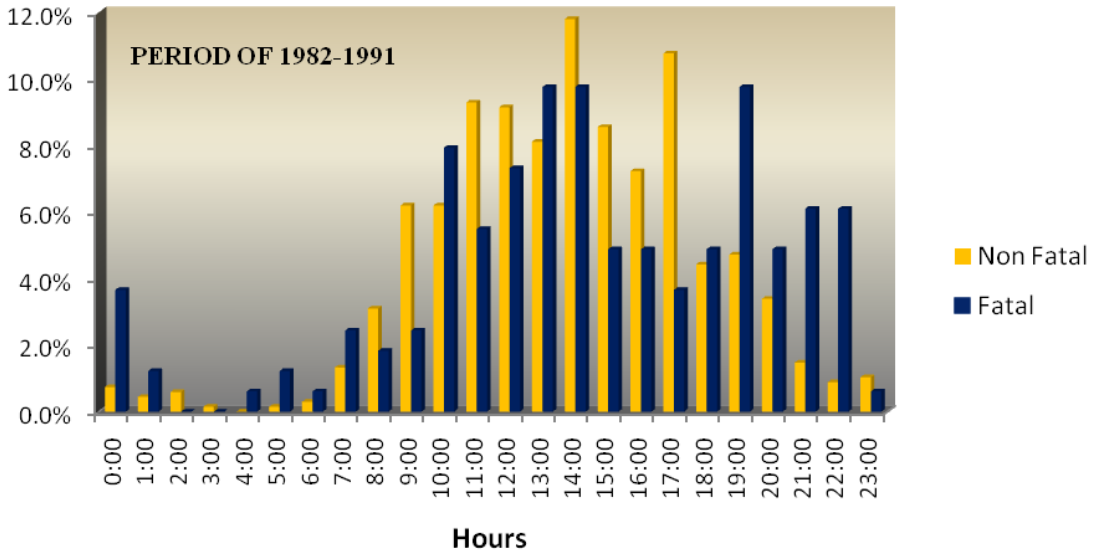

Figure 111. Percentages of Fatal and Nonfatal Accidents by Time of Day, New England Region (1982-1991)

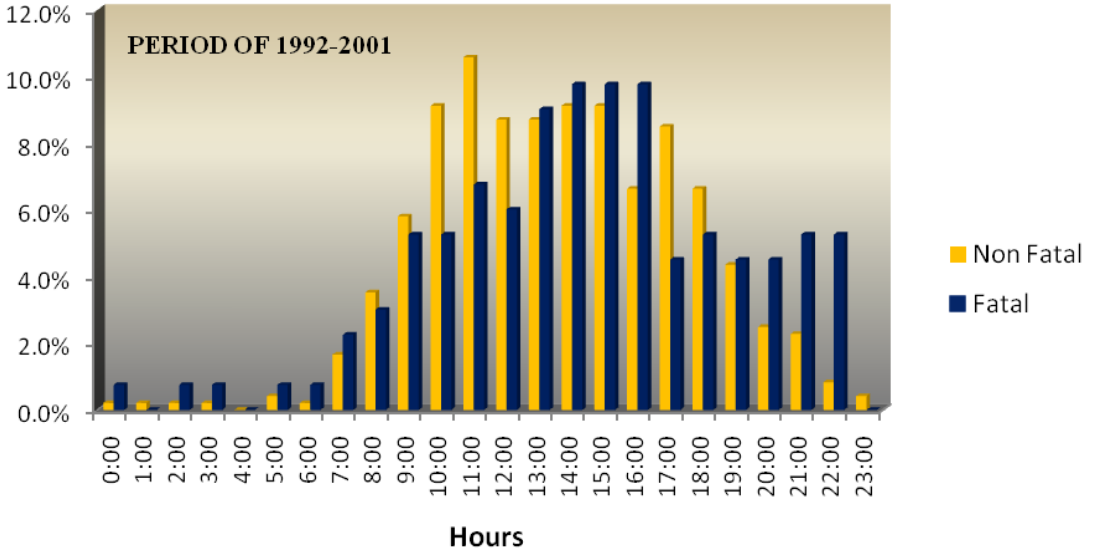

Figure 112. Percentages of Fatal and Nonfatal Accidents by Time of Day, New England Region (1992-2001)

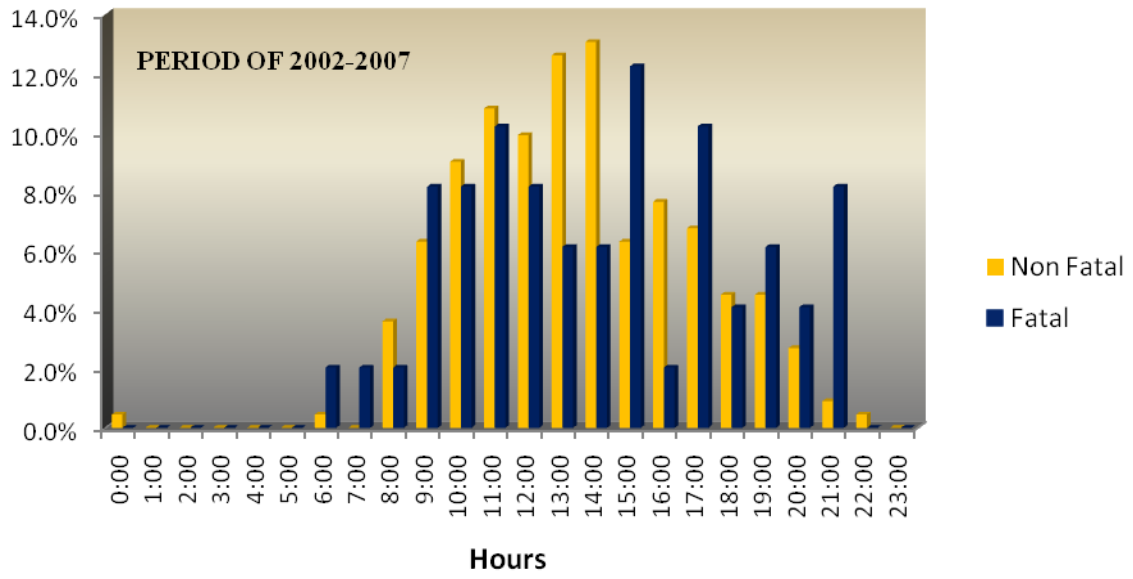

Figure 113. Percentages of Fatal and Nonfatal Accidents by Time of Day, New England Region (2002-2007)

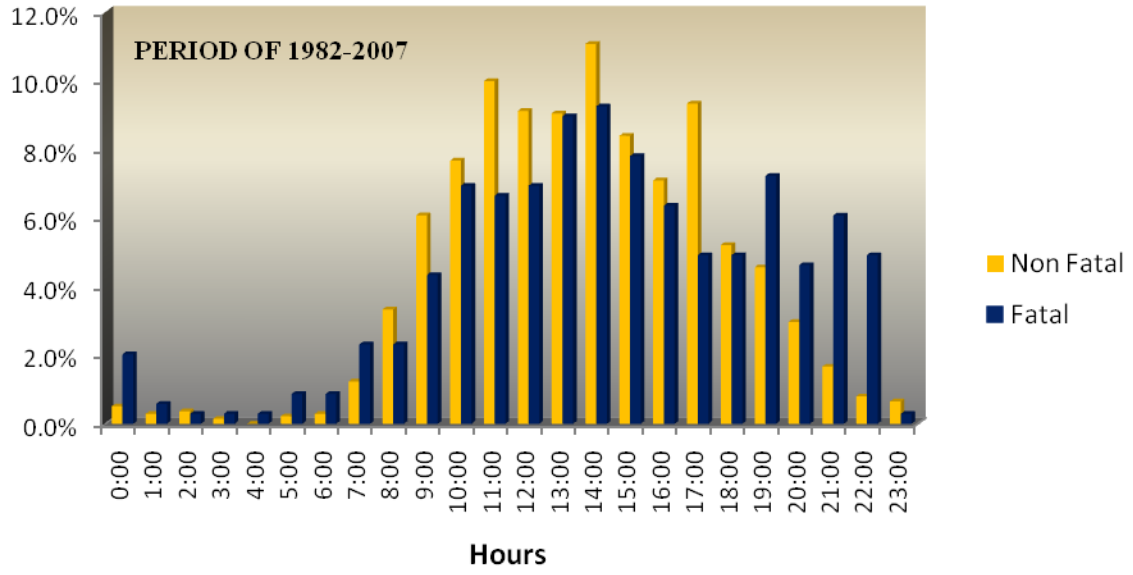

Figure 114. Percentages of Fatal and Nonfatal Accidents by Time of Day, New England Region (1982-2007)

Figure 111 shows the percentages of fatal and nonfatal GA accidents that occurred in the New England Region between 1982 and 1991 grouped by time of day. Mostly, the percentage of fatal accidents exceeded the percentage of nonfatal accidents during day, night, or early morning with two exceptions occurring at 10 a.m. and 11 p.m. The number of accidents that occurred between 2 p.m. and 3 p.m., however, was the highest among other times of day, with a total of 96 accidents, 16 of which were fatal.

Figure 112 shows that the percentage of fatal accidents exceeded the percentage of nonfatal accidents at a different trend than the other figures. The number of accidents is high during the hours of 8 a.m. to 6 p.m. but no accidents occurred between 4 a.m. and 5 a.m. The percentage of fatal accidents exceeded the percentage of nonfatal accidents mostly at night and in the early morning. However, unlike the trend of other periods or regions, the percentage of fatal accidents also exceeded the percentage of nonfatal accidents in the middle of day (i.e., between 2 p.m. and 5 p.m).

Based on the raw data that was extracted from the NTSB database, there were no accidents between 1 a.m. and 6 a.m. or between 11 p.m. and 12 a.m. Figure 113 shows that, during random times of day, the percentage of fatal accidents exceeded the percentage of nonfatal accidents (e.g., between 3 p.m. and 9 p.m.).

Figure 114 compares the percentages of fatal and nonfatal GA accidents based on time of day from 1982 to 2007. Generally, the percentage of fatal accidents exceeded the percentage of nonfatal accidents between 7 p.m. and 7 a.m. The highest number of accidents occurred at 2 p.m., with 185 total accidents, including 32 fatal accidents.

4.7 REGION 7: NORTHWEST MOUNTAIN.

4.7.1 Frequency of GA Accidents in the Northwest Mountain Region.

Figure 115 shows the number of both fatal and nonfatal GA accidents that occurred in the Northwest Mountain Region.

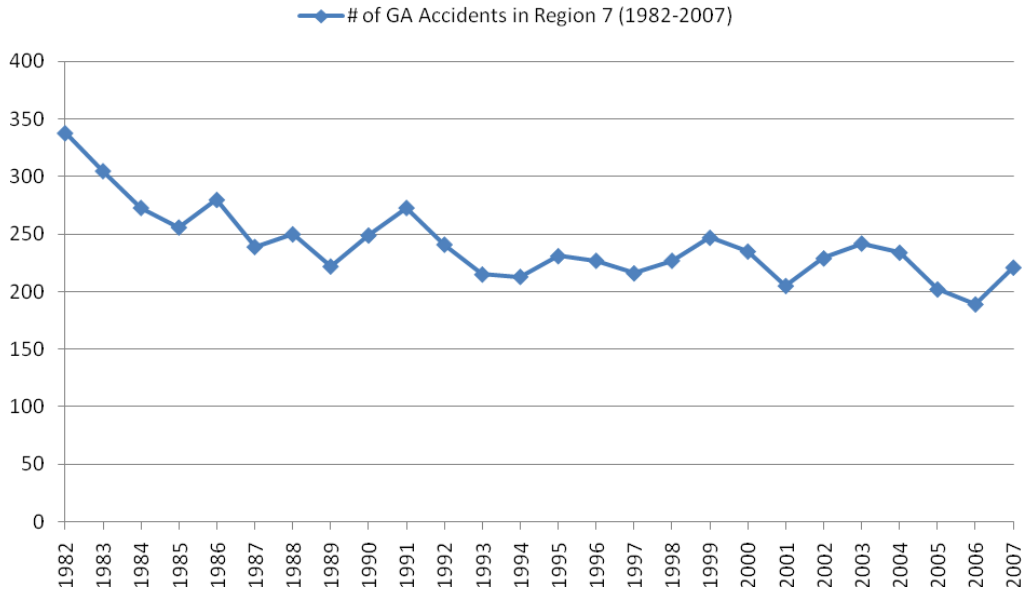

Figure 115. Number of GA Accidents Between 1982 and 2007, Northwest Mountain Region

In general, the number of GA accidents in the Northwest Mountain Region decreased over 26 years. There were 221 accidents in 2007, which is a 35% decrease from the number of GA accidents in 1982. It is important to note that the number of GA accidents in 2007 increased by 17% (with 189 accidents) from 2006.

Figure 116 compares the number of GA accidents nationwide with the number of accidents in the Northwest Mountain Region. In 1990, there were 338 accidents in this region compared to 2926 accidents nationwide, while in 2007, 221 accidents occurred in this region and 1553 occurred nationwide. The number of GA accidents in this region declined slower than the national number of accidents.

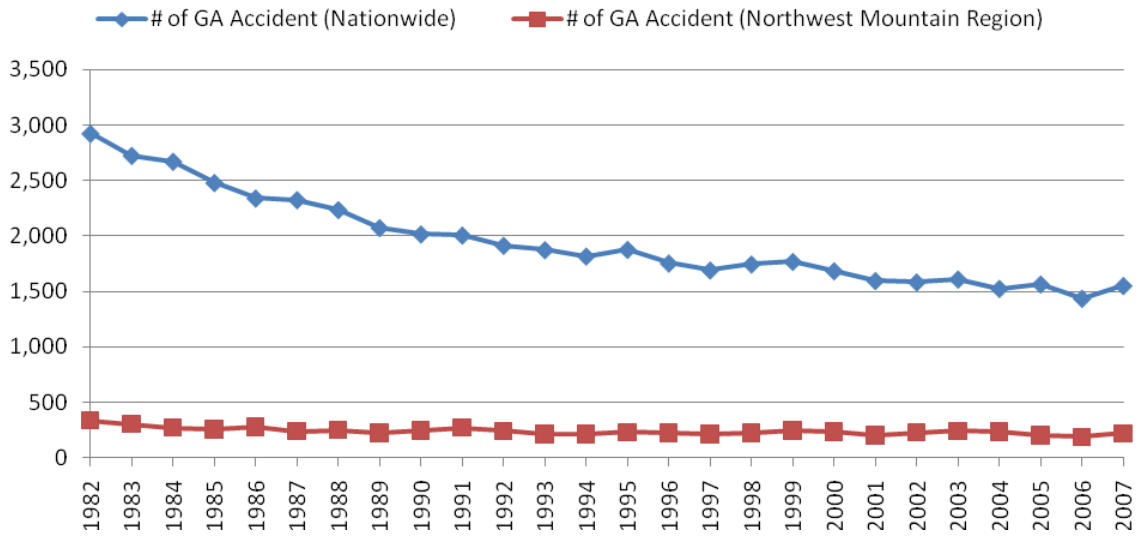

Figure 116. Number of GA Accidents Nationwide vs. the Northwest Mountain Region From 1982 to 2007

Figure 117 presents the number of fatal GA accidents in the Northwest Mountain Region from 1982-2007. Despite some fluctuations, the number decreased over this period. The lowest number of fatal accidents occurred in 2006 with 26 accidents, while the highest number of accidents occurred in 1983 with 72 accidents. In 2007, the number of accidents increased by more than 42%—from 26 accidents in 2006 to 37 accidents in 2007.

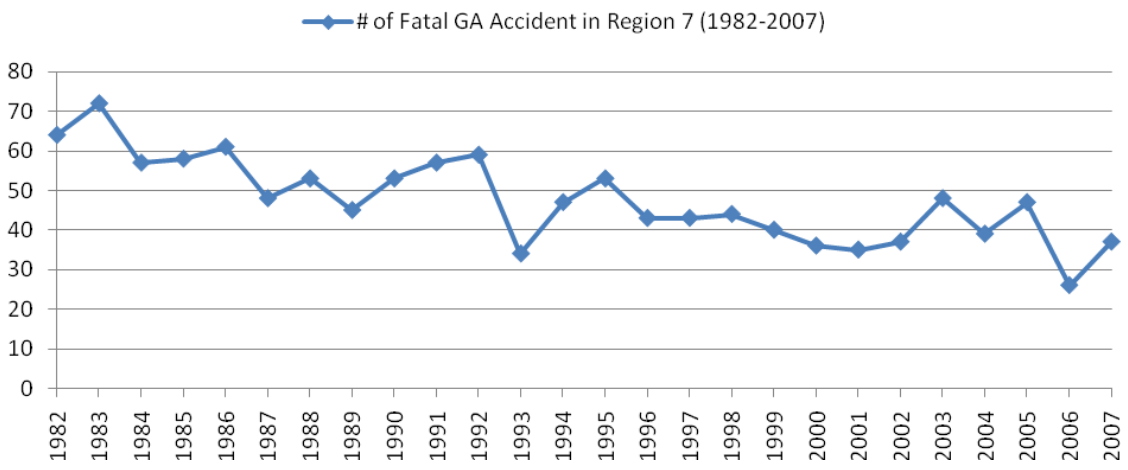

Figure 117. Number of Fatal GA Accidents From 1982 to 2007, Northwest Mountain Region

4.7.2 Percentages of GA Accidents by Month.

Figure 118 represents the percentage of both fatal and nonfatal GA accidents in the Northwest Mountain Region for each month over a 26-year period (1982-2007). The percentages of fatal and nonfatal accidents are generally distributed equally throughout the years. The month of July contributed the highest number of both fatal and nonfatal accidents with 151 and 691 accidents, respectively.

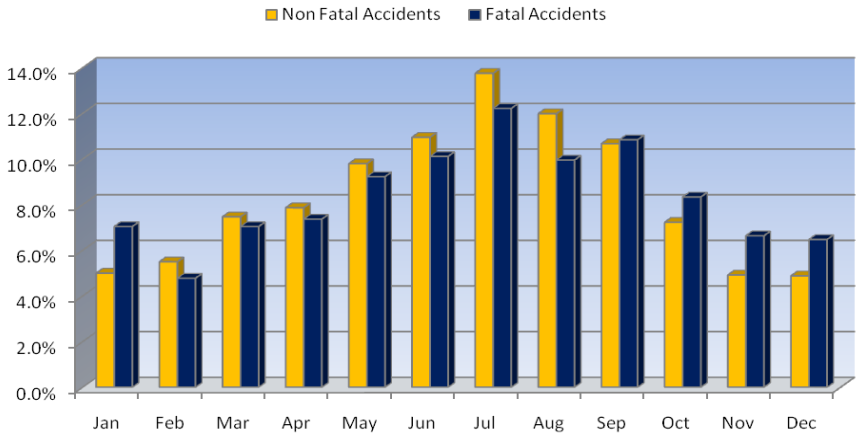

Figure 118. Percentages of Fatal and Nonfatal GA Accidents by Month, Northwest Mountain Region

Figure 119 summarizes fatal accidents in the Northwest Mountain Region for 5-, 10-, and 20-year periods grouped by month. The percentage of accidents increased significantly in the 2003-2007 time period compared to the 1998-2007 time period in several months, such as January, February, May, June, August, October, and December. Furthermore, the trend shows that in January, June, and August, the percentage of fatal accidents continued to increase for the 1998-2007 and 1988-2007 time periods.

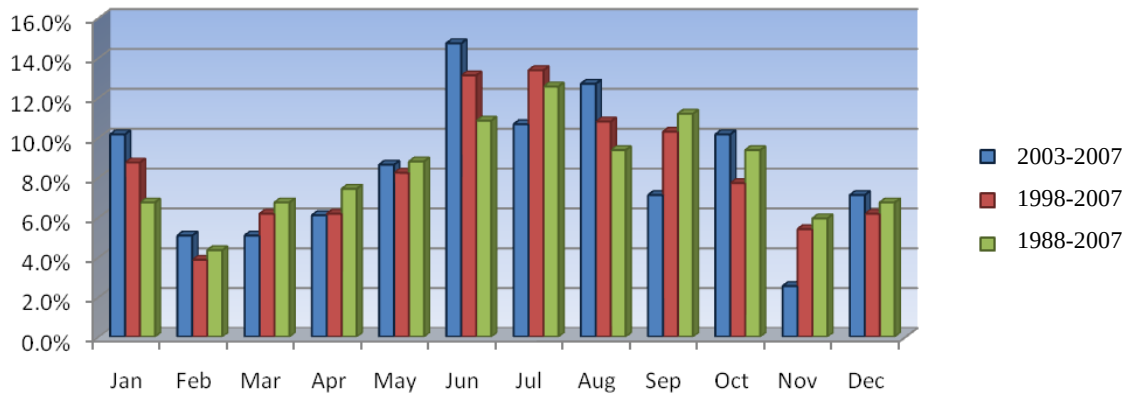

Figure 119. Percentages of Fatal GA Accidents by Month, Northwest Mountain Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.7.3 Percentages of GA Accidents Based on Phases of Flight.

Figure 120 compares the percentages of fatal and nonfatal GA accidents for the Northwest Mountain Region grouped by phases of flight. The percentage of fatal accidents is significantly high during the Descent, Maneuvering, and Cruise phases. On the other hand, the nonfatal accident percentage was dominated by accidents that occurred during the Landing phase. Appendix B describes the phases of flight in more detail.

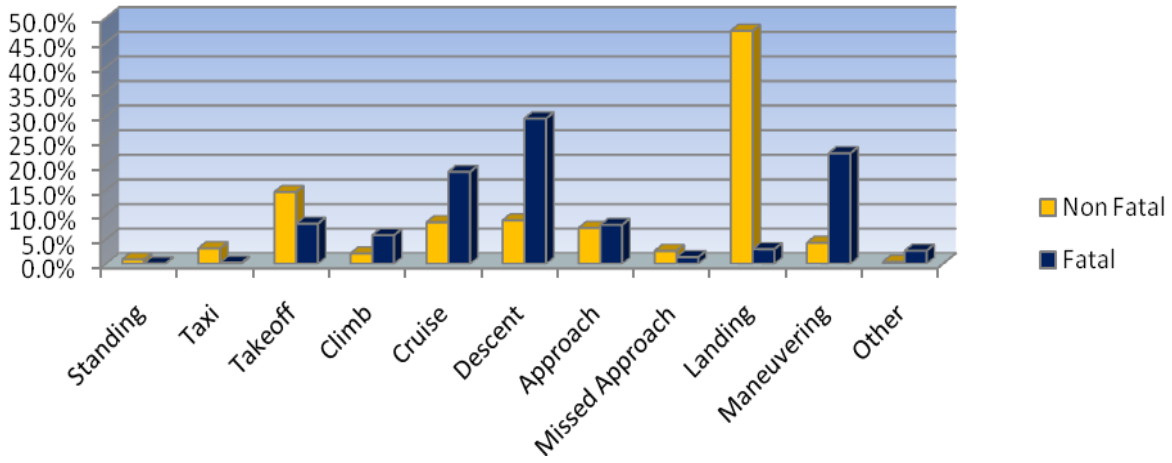

Figure 120. Percentages of Fatal and Nonfatal Accidents by Phases of Flight, Northwest Mountain Region (1982-2007)

Figure 121 represents a comparison of fatal GA accidents in the Northwest Mountain Region during the 2003-2007, 1998-2007, and 1988-2007 time periods. The figure shows that the percentage of accidents during the Descent phase increased significantly for the 2003-2007 time period compared to the 1998-2007 and 1988-2007 time periods.

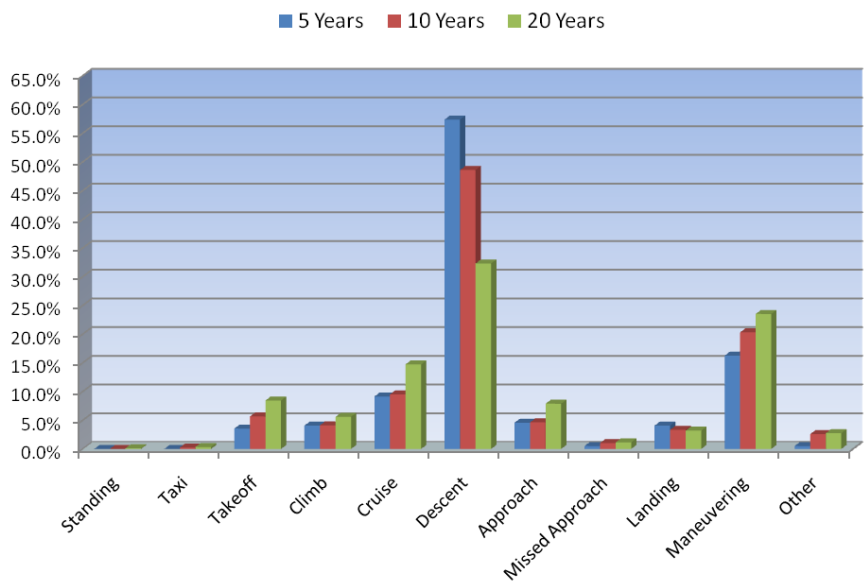

Figure 121. Percentages of Fatal Accidents by Phases of Flight, Northwest Mountain Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.7.4 Percentage of GA Accidents Based on Time of Day.

Figures 122 through 125 compare the percentages of fatal and nonfatal GA accidents that occurred in the Northwest Mountain Region during specified times of day.

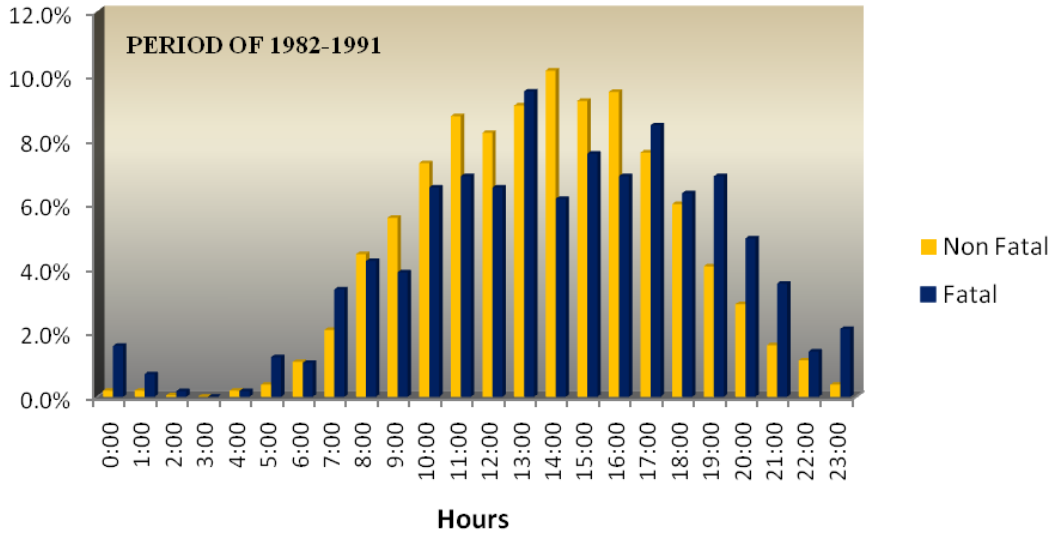

Figure 122. Percentages of Fatal and Nonfatal Accidents by Time of Day, Northwest Mountain Region (1982-1991)

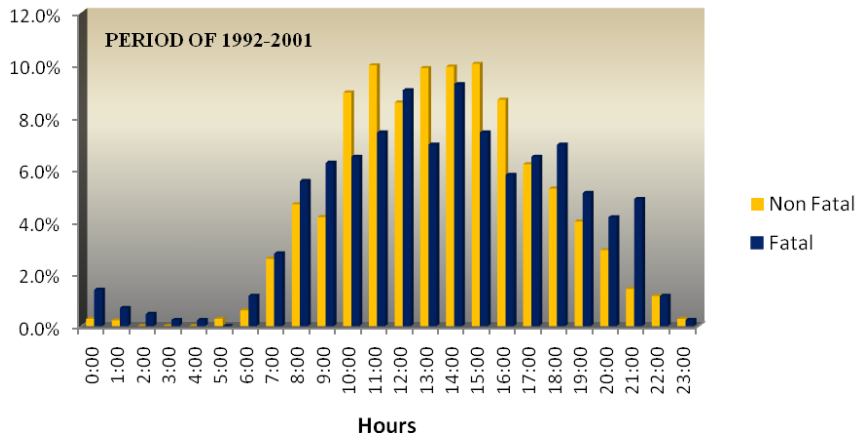

Figure 123. Percentages of Fatal and Nonfatal Accidents by Time of Day, Northwest Mountain Region (1992-2001)

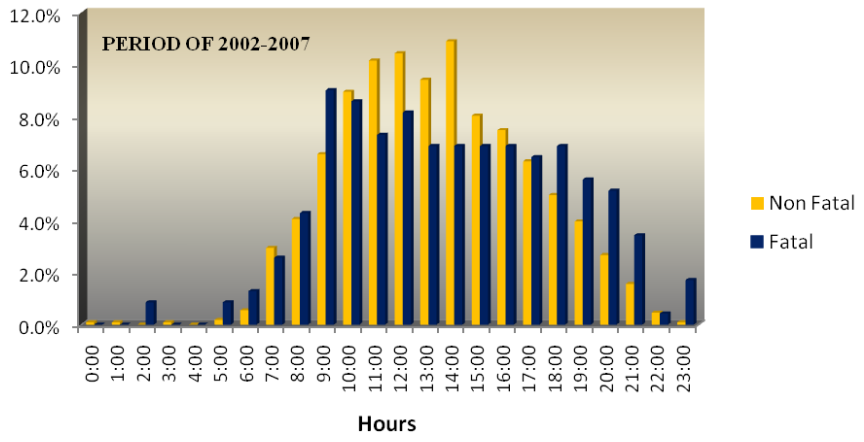

Figure 124. Percentages of Fatal and Nonfatal Accidents by Time of Day, Northwest Mountain Region (2002-2007)

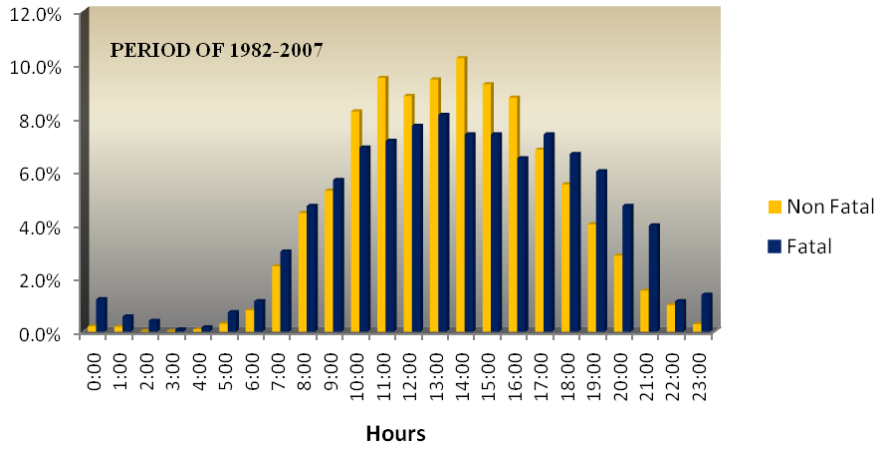

Figure 125. Percentages of Fatal and Nonfatal Accidents by Time of Day, Northwest Mountain Region (1982-2007)

Figure 122 compares the percentages of fatal and nonfatal GA accidents that occurred in the Northwest Mountain Region between 1982 and 1991, grouped by time of day. Like other regions, the percentage of fatal accidents exceeded the percentage of nonfatal accidents in the evening and morning with the exception of 1 p.m. The percentage of accidents that occurred between 1 p.m. and 4 p.m. was the highest than any other time of day. There were 35 fatal accidents and 215 nonfatal accidents that occurred between those times.

Figure 123 shows that, from 1992-2001, the trend shifted from the previous time period in that most of the GA accidents occurred earlier in the day. However, the total number of both fatal and nonfatal accidents decreased from the previous time period. The percentage of fatal accidents exceeded the percentage of nonfatal accidents mostly at night and in the early morning.

Figure 124 shows that at certain times of day in the 2002-2007 time period, there were no fatal accidents. The highest number of accidents occurred at 2 p.m., with a total of 134 accidents, 16 of which were fatal.

Figure 125 compares the percentages of fatal and nonfatal GA accidents based on time of day from 1982 to 2007. Generally, the percentage of fatal accidents exceeded the percentage of nonfatal accidents between 5 p.m. and 9 a.m. During the 26-year period, only two accidents occurred at 3 a.m.—one fatal and one nonfatal.

4.8 REGION 8: SOUTHERN.

4.8.1 Frequency of GA Accidents in the Southern Region.

Figure 126 shows the number of both fatal and nonfatal GA accidents that occurred in the Southern Region.

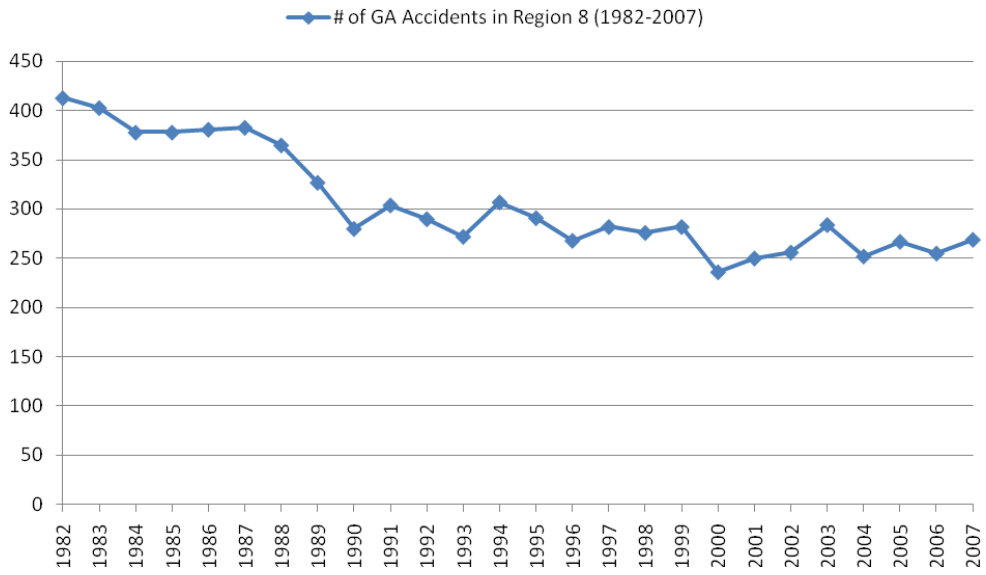

Figure 126. Number of GA Accidents Between 1982 and 2007, Southern Region

In general, the number of GA accidents in the Southern Region decreased over the 26-year period (1982-2007). However, the significant drops in the number of accidents were mostly observed during the 1980s. For the 1988-2007 time period, the number of GA accidents in this region did not change significantly. In 1990, the number of GA accidents was 280, the lowest since 1982, and in 2007, the number was 269.

Figure 127 compares the number of GA accidents nationwide with the number in the Southern Region. As shown in the figure, the number of accidents in this region increased relative to the number of accidents nationwide. This is proven by the percentage of accidents in the region over the number of accidents in the country. The percentage of the number of accidents in this region increased over the 26-year period from 14.11% in 1982 to 17.32% in 2007. This trend may have been caused by the slow decrease between 1990 and 2007.

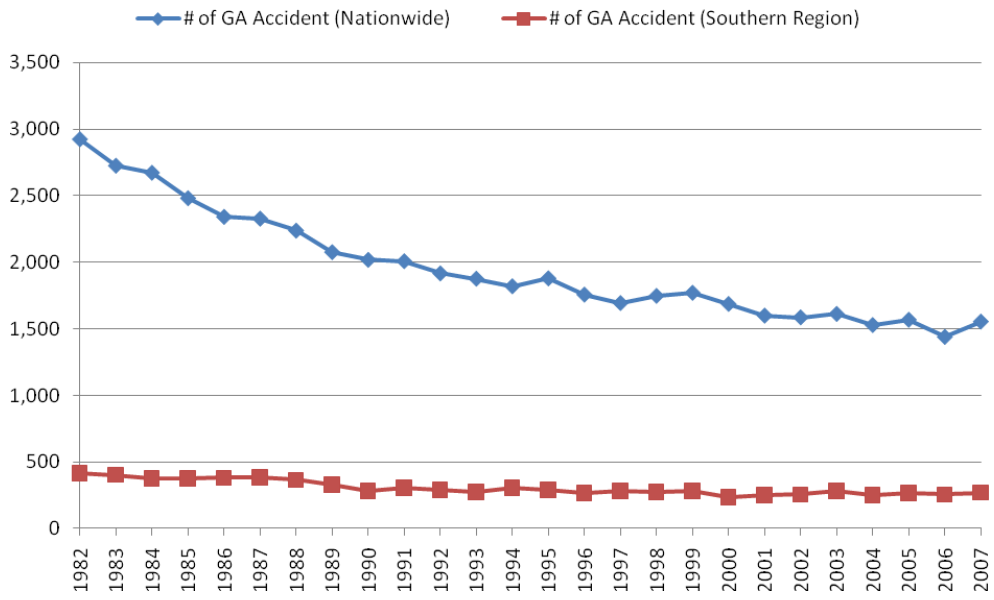

Figure 127. Number of GA Accidents Nationwide vs. the Southern Region From 1982 to 2007

Figure 128 shows the number of fatal GA accidents in the Southern Region for a 26-year period (1982-2007) and, despite some fluctuations, the number decreased over that period. The lowest number of fatal accidents occurred in 2007 with 46 accidents, while the highest number occurred in 1989 with 82 accidents.

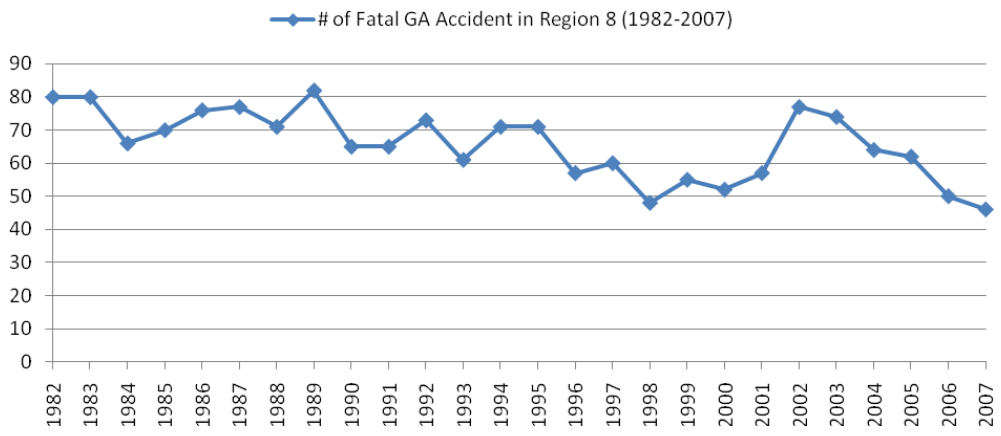

Figure 128. Number of Fatal GA Accidents From 1982 to 2007, Southern Region

4.8.2 Percentages of GA Accidents by Month.

Figure 129 represents the percentages of both fatal and nonfatal GA accidents in the Southern Region for each month over the 26-year period between 1982 and 2007. The percentage of fatal accidents was spread almost equally throughout the year with the highest number of both fatal and nonfatal accidents taking place in April. The number of fatal accidents exceeded the number of nonfatal accidents at the beginning and the end of the year. This shows that fatal accidents dominated nonfatal accidents in the winter season.

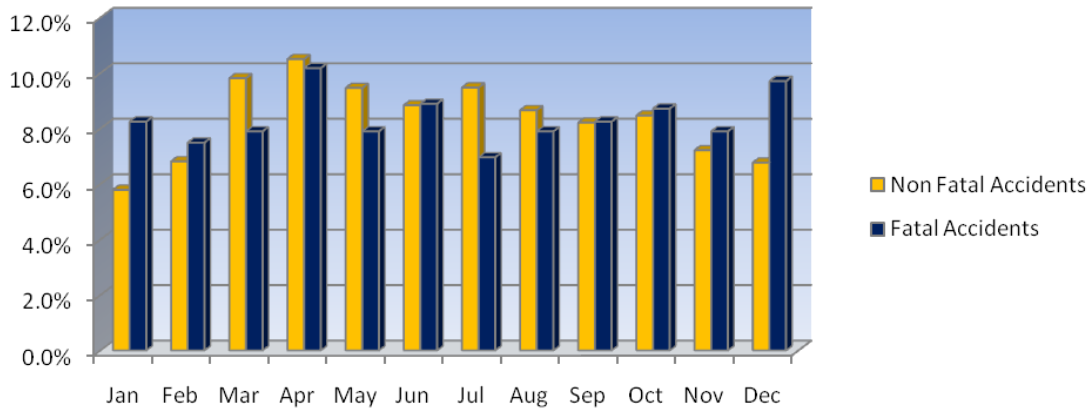

Figure 129. Percentages of Fatal and Nonfatal GA Accidents by Month, Southern Region

Figure 130 shows the percentages of fatal accidents in the Southern Region for 5-, 10-, and 20-year periods by month. The figure shows that there have been changes in the pattern of GA accidents during the 2003-2007 time period compared to the 1998-2007 and 1988-2007 time periods. For example, in February, May, and September, the trend was increasing, but in the 2003-2007 time period, the percentage decreased. The percentage of accidents that occurred in January continued to increase during the 26-year period. However, in the months of March,

August, and November, the percentage of fatal accidents continued to decrease from 1982 to 2007.

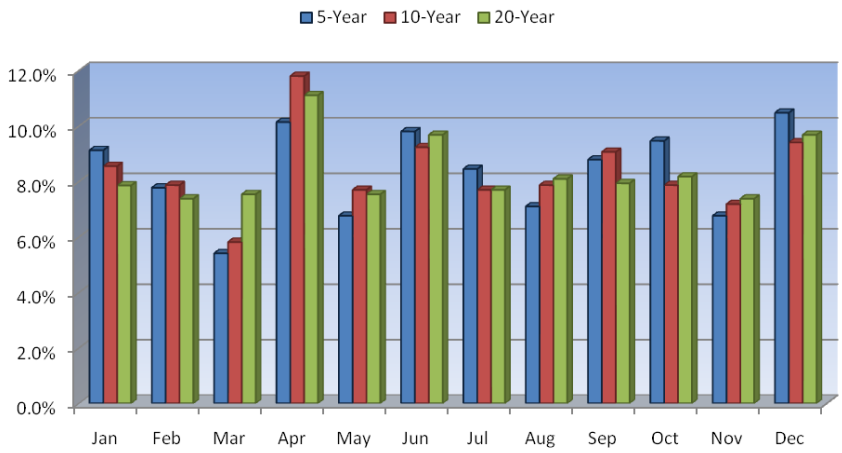

Figure 130. Percentages of Fatal GA Accidents by Month in the Southern Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.8.3 Percentages of GA Accidents Based on Phases of Flight.

Figure 131 compares the percentages of fatal and nonfatal GA accidents for the Southern Region grouped by phases of flight. The percentage of fatal accidents was significantly high during the Descent, Maneuvering, Cruise, and Approach phases. On the other hand, the nonfatal accident percentage was dominated by accidents that occurred during the Landing phase. Appendix B describes the phases of flight in more detail.

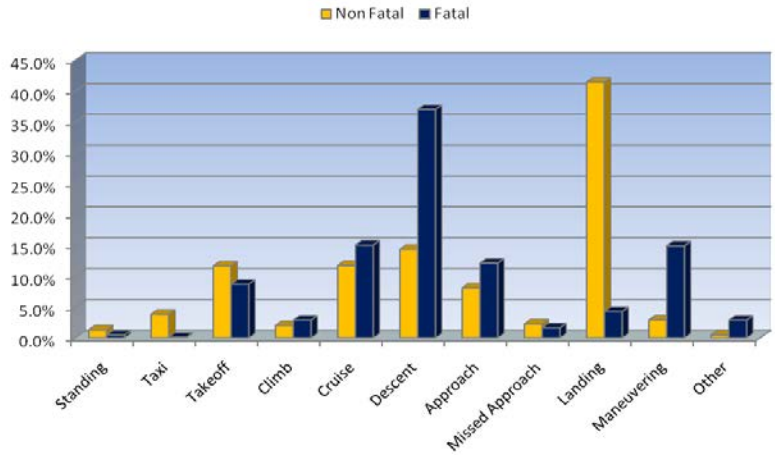

Figure 131. Percentages of Fatal and Nonfatal Accidents by Phases of Flight, Southern Region (1982-2007)

Figure 132 represents a comparison of fatal GA accidents in the Southern Region during the 2003-2007, 1998-2007, and 1988-2007 time periods by phases of flight. The figure shows that the percentage of accidents during the Descent phase increased significantly for the 2003-2007

time period compared to the 1998-2007 and 1988-2007 time periods. The trend for the Cruise phase changed for the 2003-2007 time period compared to the 1998-2007 and 1988-2007 time periods.

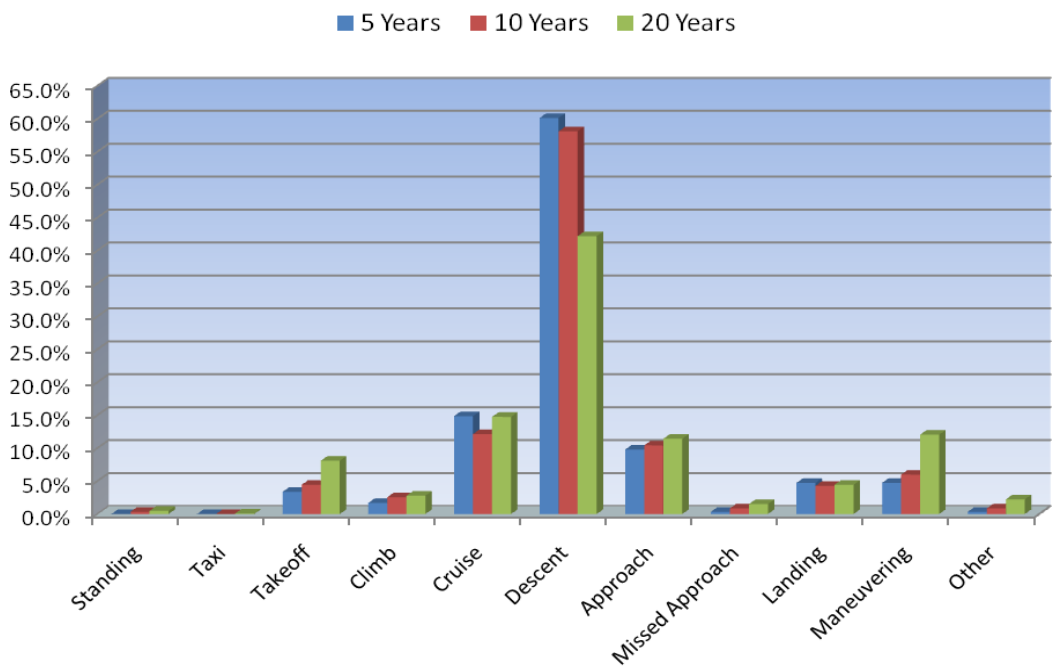

Figure 132. Percentages of Fatal Accidents by Phases of Flight, Southern Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.8.4 Percentages of GA Accidents Based on Time of Day.

Figures 133 through 136 show the percentages of fatal and nonfatal GA accidents that occurred in the Southern Region during specified times of day.

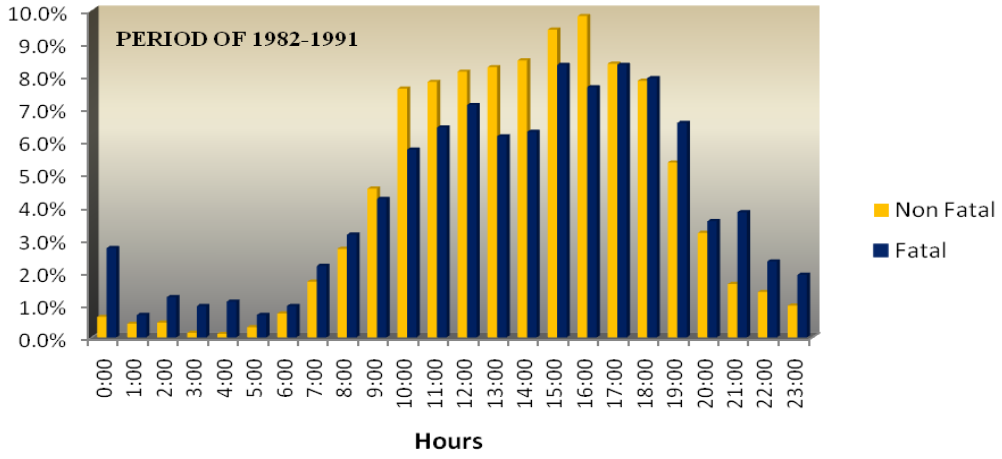

Figure 133. Percentages of Fatal and Nonfatal Accidents by Time of Day, Southern Region (1982-1991)

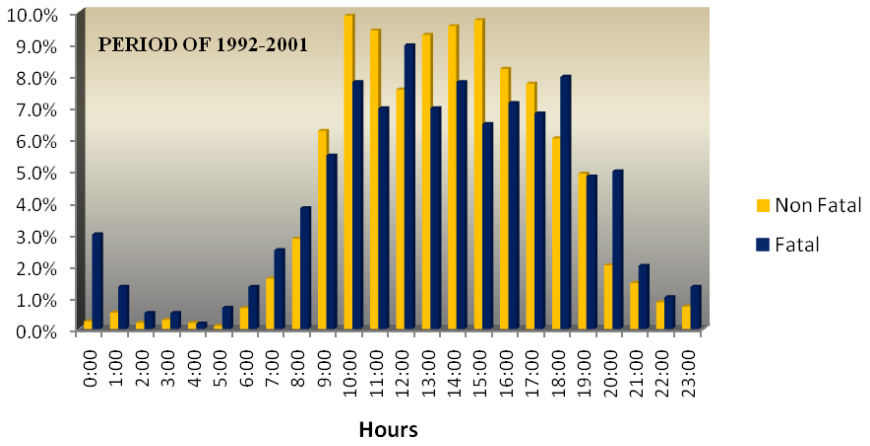

Figure 134. Percentages of Fatal and Nonfatal Accidents by Time of Day, Southern Region (1992-2001)

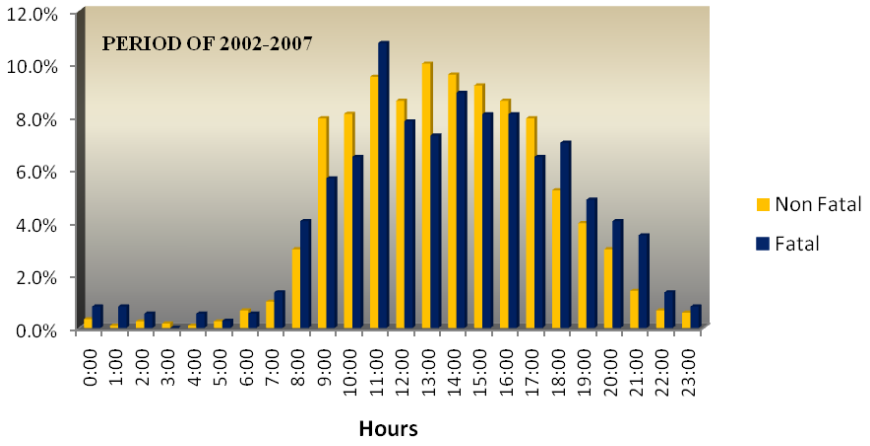

Figure 135. Percentages of Fatal and Nonfatal Accidents by Time of Day, Southern Region (2002-2007)

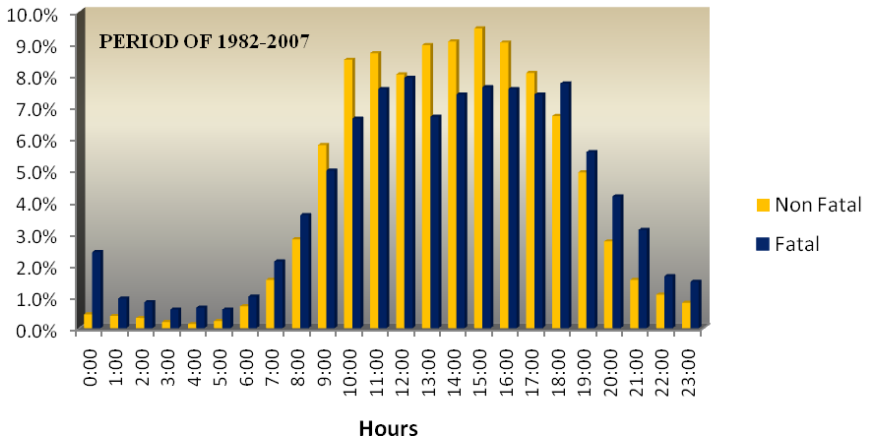

Figure 136. Percentages of Fatal and Nonfatal Accidents by Time of Day, Southern Region (1982-2007)

Figure 133 compares the percentages of fatal and nonfatal GA accidents that occurred in the Southern Region between 1982 and 1991 grouped by time of day. The percentage of fatal accidents exceeded the percentage of nonfatal accidents from 6 p.m. to 8 a.m.

Figure 134 shows that, in the 1992-2001 time period, the percentage of fatal accidents exceeded the percentage of nonfatal accidents at a different trend from figure 133. The percentage of fatal accidents exceeded nonfatal accidents mostly at night and in the early morning, but there was one exception at 12 p.m.

Figure 135 shows that, in the 2002-2007 time period, the percentage of fatal accidents exceeded the percentage of nonfatal accidents at a different trend from figure 134. The percentage of fatal accidents exceeded nonfatal accidents between 6 p.m. and 8 a.m. However, there was one exception at 11 a.m., when the percentage of fatal accidents significantly exceeded nonfatal accidents and when the number of fatal accidents reached its peak.

Figure 136 compares the percentages of fatal and nonfatal GA accidents based on time of day from 1982 to 2007. Generally, the percentage of fatal accidents exceeded the percentage of nonfatal accidents between 6 p.m. and 8 a.m.

4.9 REGION 9: EASTERN.

4.9.1 Frequency of GA Accidents in the Eastern Region.

Figure 137 shows the number of both fatal and nonfatal GA accidents that occurred in the Eastern Region.

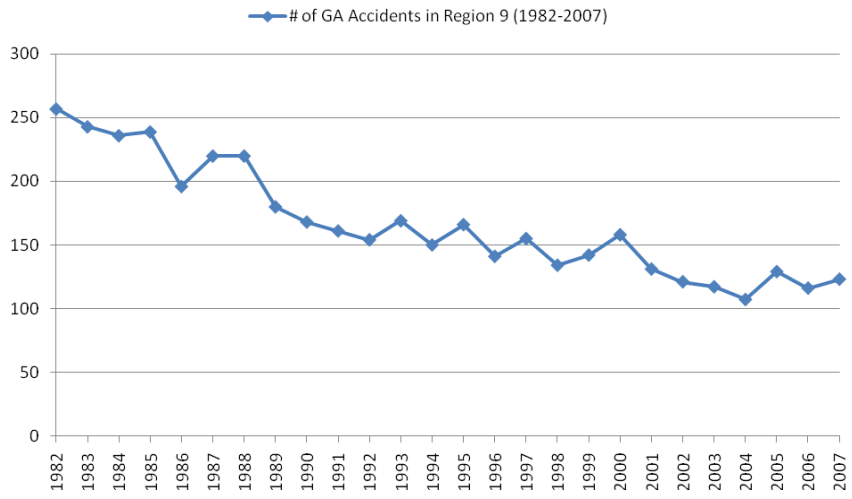

Figure 137. Number of GA Accidents Between 1982 and 2007, Eastern Region

In general, the number of GA accidents in the Eastern Region decreased significantly over 26 years. In 1982, 257 GA accidents occurred in the Eastern Region, and in 2007, 123 accidents occurred. There was a significant increase from 107 accidents in 2004 to 129 accidents in 2005.

Figure 138 compares the number of GA accidents nationwide with the number of accidents in the Eastern Region. The percentage of accidents in this region slightly decreased over the 26-year period from 8.78% in 1982 to 7.92% in 2007. Therefore, the number of GA accidents in the Eastern Region declined more slowly than the national number of accidents.

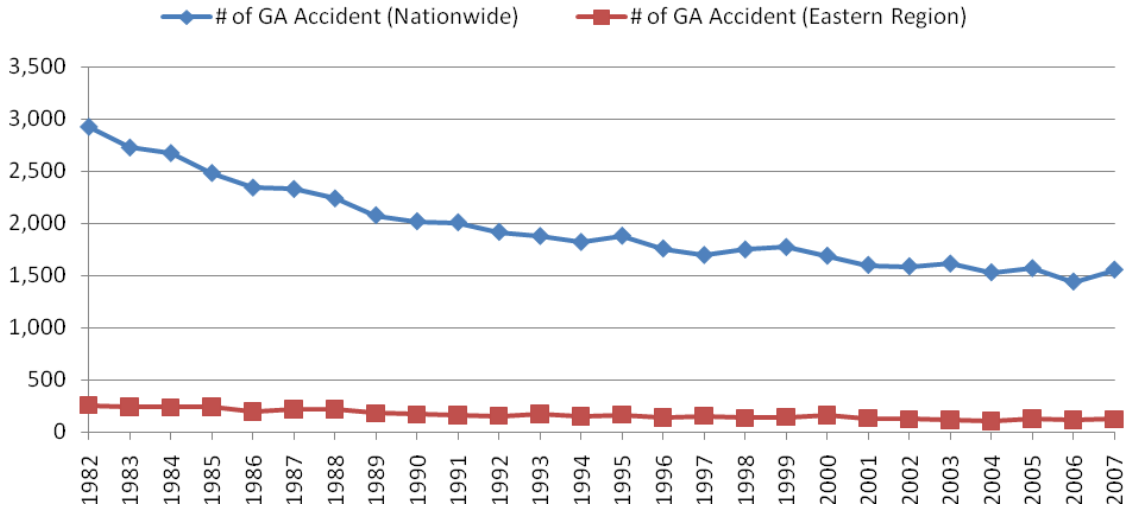

Figure 138. Number of GA Accidents Nationwide vs. the Eastern Region From 1982 to 2007

Figure 139 shows the number of fatal GA accidents in the Eastern Region for the 26-year period (1982-2007). Despite some fluctuations, the number decreased over the 1982-2007 time period. The lowest number of fatal accidents occurred in 2004 with 20 accidents, while the highest number of accidents occurred in 1985 and 1986, with 46 accidents each. The number of fatal accidents increased in 2005 and 2006. In 2007, however, the number decreased over 39% from 37 to 26 accidents.

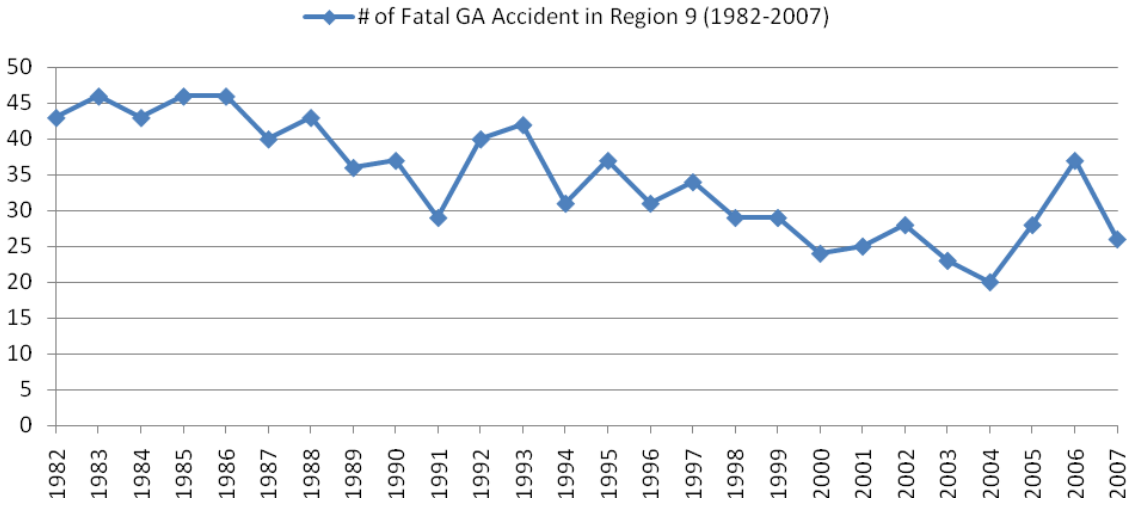

Figure 139. Number of Fatal GA Accidents From 1982 to 2007, Eastern Region

4.9.2 Percentages of GA Accidents by Month.

Figure 140 represents the percentages of both fatal and nonfatal GA accidents in the Eastern Region for each month over the 26-year period. Unlike any other region, the percentage of fatal accidents in this region significantly exceeded nonfatal accidents at the end of the year (November and December). However, in March, April, August, and September, the percentage of fatal accidents exceeded nonfatal. This rarely happened in other regions.

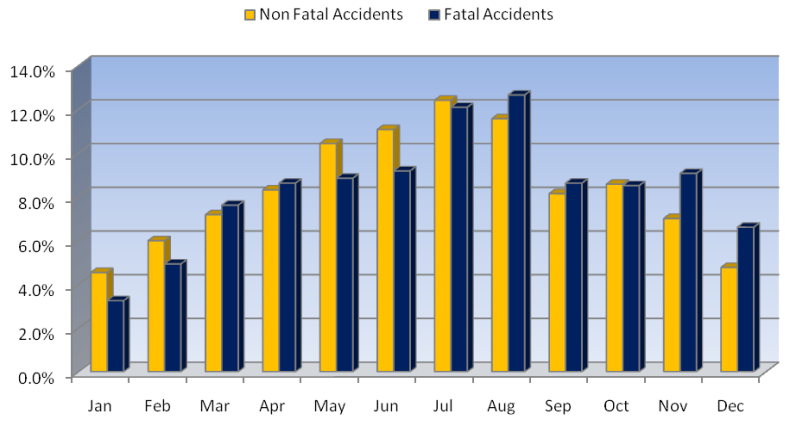

Figure 140. Percentages of Fatal and Nonfatal GA Accidents by Month, Eastern Region

Figure 141 compares the percentages of fatal accidents in the Eastern Region for 5-, 10-, and 20-year periods, based on month. The percentages of accidents that occurred in February, April, June, July, and October increased significantly in the 2003-2007 time period compared to the 1998-2007 time period. Similar patterns happened in September and December, but with less of a rate of increase for the 2003-2007 time period compared to the 1998-2007 time period. Furthermore, in May, the percentage of fatal accidents decreased for the 2003-2007 time period, while it increased during the 1998-2007 time period.

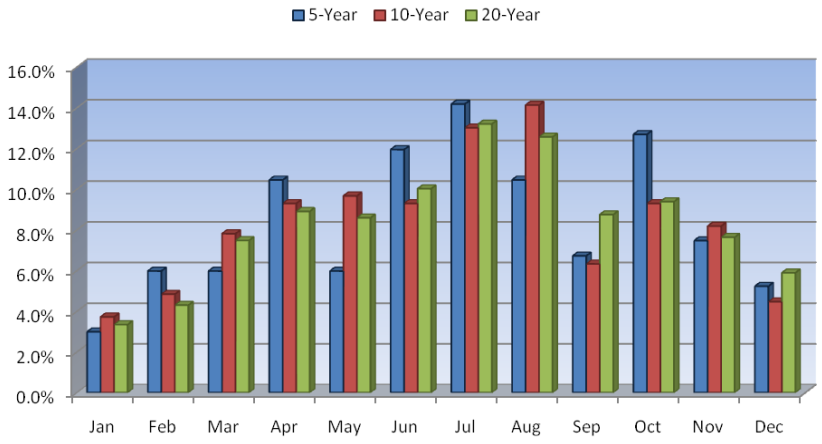

Figure 141. Percentages of Fatal GA Accidents by Month, Eastern Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.9.3 Percentages of GA Accidents Based on Phases of Flight.

Figure 142 compares the percentages of fatal and nonfatal GA accidents for the Eastern Region grouped by phases of flight. The percentages of fatal accidents was significantly high during the Descent, Maneuvering, Cruise, and Approach phases. The Landing phase dominated the percentage of nonfatal accidents. Appendix B describes the phases of flight in more detail.

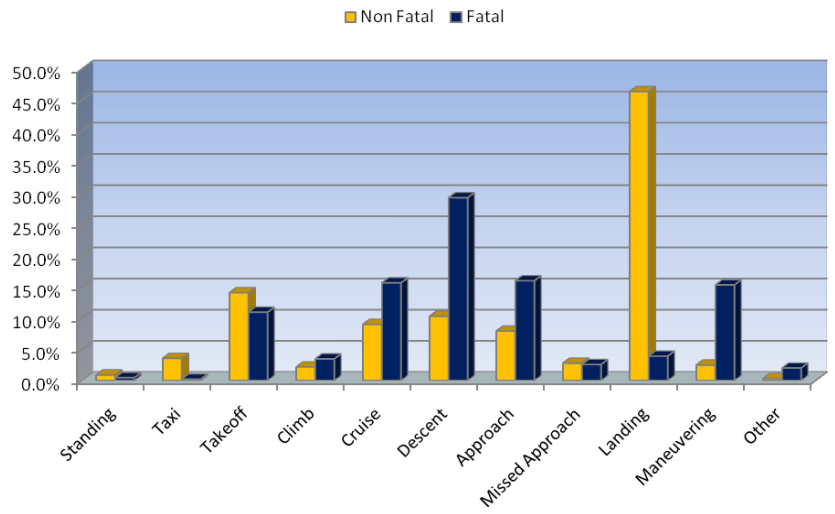

Figure 142. Percentages of Fatal and Nonfatal GA Accidents by Phases of Flight, Eastern Region (1982-2007)

Figure 143 compares the percentages of fatal GA accidents in the Eastern Region during the 2003-2007, 1998-2007, and 1988-2007 time periods. The figure shows that the percentage of accidents during the Descent phase increased significantly for the 2003-2007 time period, compared to the 1998-2007 and 1988-2007 time periods.

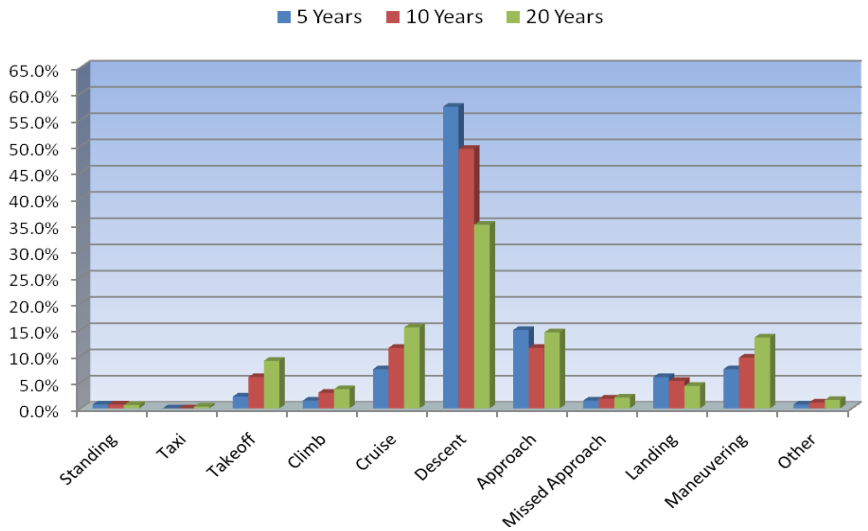

Figure 143. Percentages of Fatal Accidents by Phases of Flight, Eastern Region (2003-2007, 1998-2007, and 1988-2007 time periods)

4.9.4 Percentages of GA Accidents Based on Time of Day.

Figures 144 through 147 show the comparison of the percentages of fatal and nonfatal GA accidents that occurred in the Eastern Region during specified times of day.

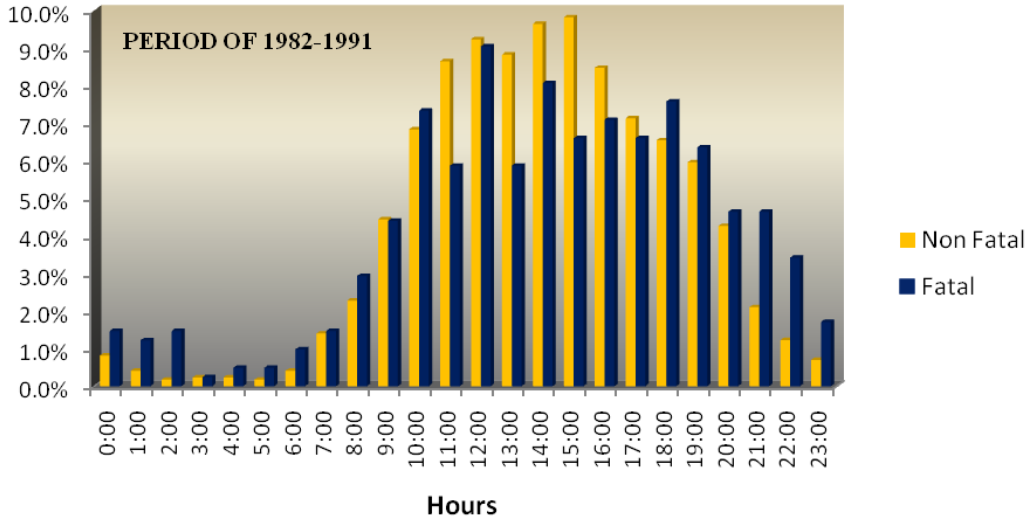

Figure 144. Percentages of Fatal and Nonfatal Accidents by Time of Day, Eastern Region (1982-1991)

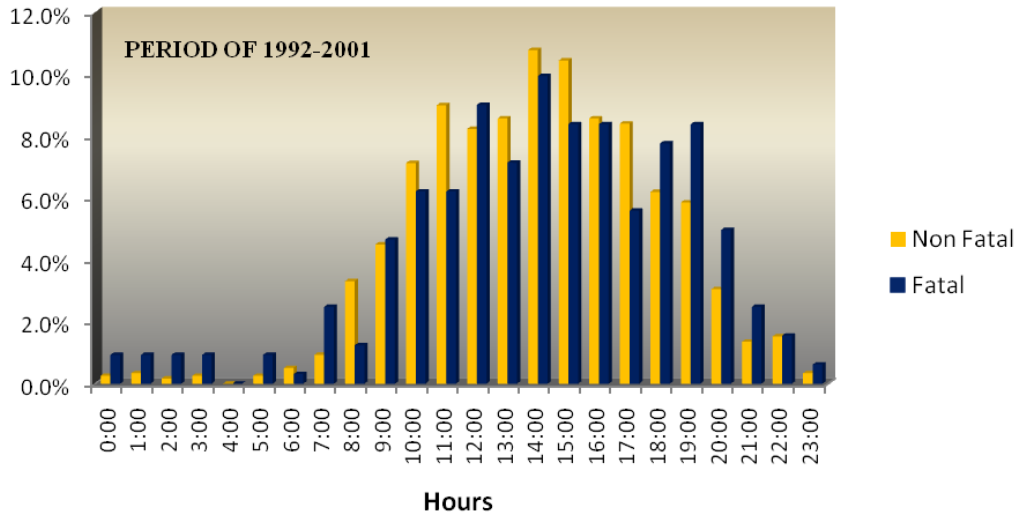

Figure 145. Percentages of Fatal and Nonfatal Accidents by Time of Day, Eastern Region (1992-2001)

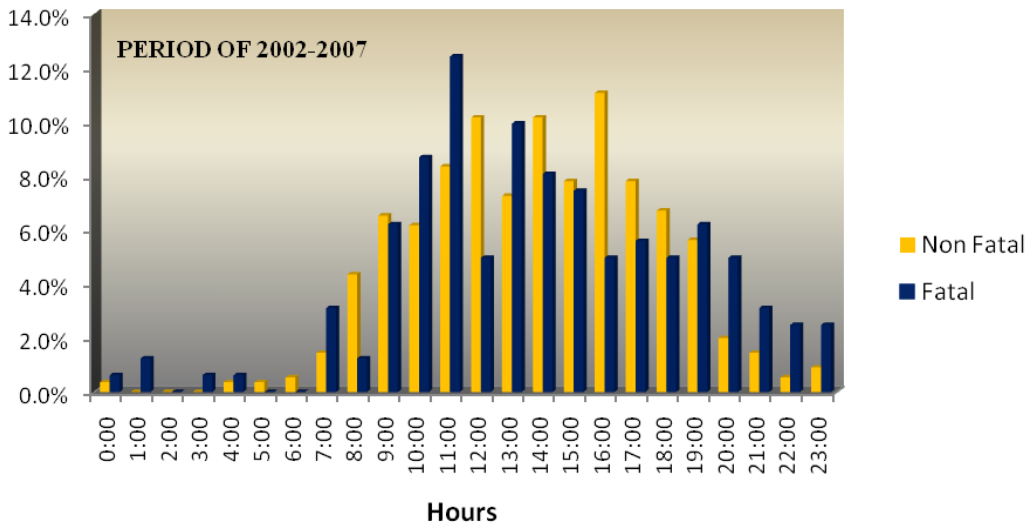

Figure 146. Percentages of Fatal and Nonfatal Accidents by Time of Day, Eastern Region (2002-2007)

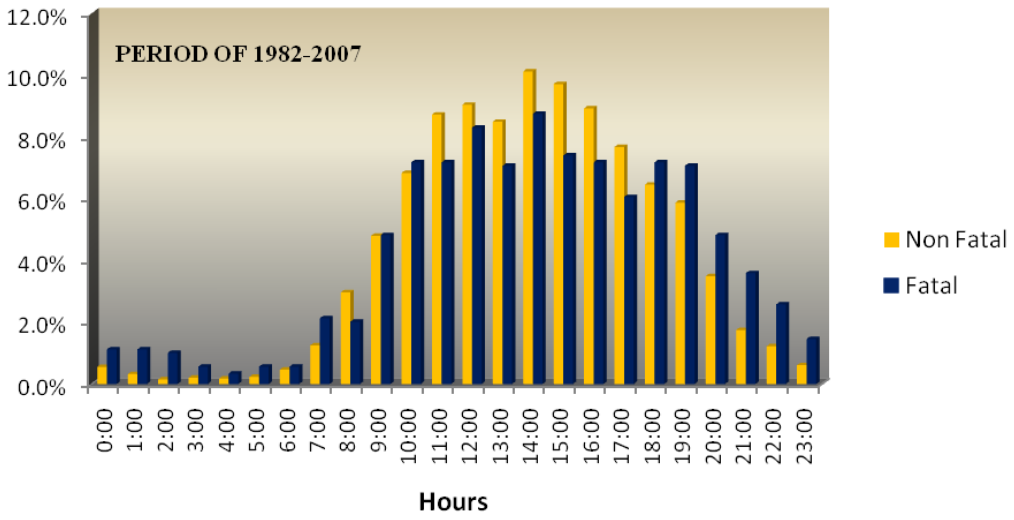

Figure 147. Percentages of Fatal and Nonfatal Accidents by Time of Day, Eastern Region (1982-2007)

Figure 144 compares the percentages of fatal and nonfatal GA accidents that occurred in the Eastern Region between 1982 and 1991, grouped by time of day. The percentage of fatal accidents exceeded the percentage of nonfatal accidents between 6 p.m. and 8 a.m. The number of accidents that occurred between 2 p.m. and 3 p.m. was the highest of all times of day. There were 33 fatal accidents and 165 nonfatal accidents that occurred between those times.

The frequency of fatal accidents was higher than that of nonfatal accidents between 6 p.m. and 7 a.m. with the exception of 12 p.m.

Figure 146 shows that there were no accidents between 2 a.m. and 3 a.m. during the years 2002 to 2007. However, there were some exceptions when the percentage of fatal accidents exceeded nonfatal accidents: 10 a.m., 11 a.m., and 1 p.m. During night hours (from 7 p.m. to 4 a.m.), the percentage of fatal accidents exceeded the percentage of nonfatal accidents.

Figure 147 compares the percentages of fatal and nonfatal GA accidents based on time of day from 1982 to 2007. Generally, the percentage of fatal accidents exceeded the percentage of nonfatal accidents between 6 p.m. and 7 a.m.

5. PHASE 3—THE TEN MOST FREQUENT PRIMARY CAUSES OF GA ACCIDENTS (NATIONAL).

In this phase, the team performed an analysis of the ten most frequent primary causes of fatal accidents and incidents of GA accidents between 1982 and 2007 in the U.S. This report summarizes these ten primary causes for both fatal and nonfatal GA accidents.

The NTSB database provides up to five occurrences (major events) for each accident and up to ten sequences of events for each occurrence. These occurrences describe the chain of events that led to the accident. In this report, the primary or first cause, which may have triggered the chain of events, was isolated. The analysis, therefore, concentrated on frequencies and percentages of these primary causes. Therefore, throughout this report, primary cause refers to the first cause in the sequence of events.

A first or primary cause is defined as the initial event within the sequence of events that ultimately led to the accident or incident. Contributing factors were excluded from the analysis because they are not causal in nature. Appendix A.3 presents the query process for extracting the primary causes from the NTSB database. Additionally, appendix D provides the subject codes and possible modifiers for the ten primary causes discussed in this report.

The analysis was divided into four major sections. Section 5.1 identifies the ten primary causes broken down by the 2003-2007, 1998-2007, and 1988-2007 time periods for all types of aircraft on a national basis for fatal GA accidents. Section 5.2 presents the ten primary causes of fatal GA accidents for nonoverlapping 5-year periods. Sections 5.3 and 5.4 present the ten primary causes grouped by the 2003-2007, 1998-2007, and 1988-2007 time periods and for nonoverlapping 5-year periods for nonfatal GA accidents from 1988 to 2007, respectively.

5.1 ANALYSIS OF TEN PRIMARY CAUSES FOR FATAL GA ACCIDENTS (2003-2007, 1998-2007, AND 1988-2007 TIME PERIODS).

Figures 148 through 153 present the ten primary causes for fatal accidents for all aircraft types for the 2003-2007, 1998-2007, and 1988-2007 time periods on a national basis. The frequency (number of fatal accidents) and the percentages are presented. Figures 154 through 155 provide a comparison of the primary causes for these fatal accidents over the 5-, 10-, and 20-year time periods.

As the figures suggest, ten frequent primary causes were responsible for more than 50% of fatal accidents from 1982-2007.

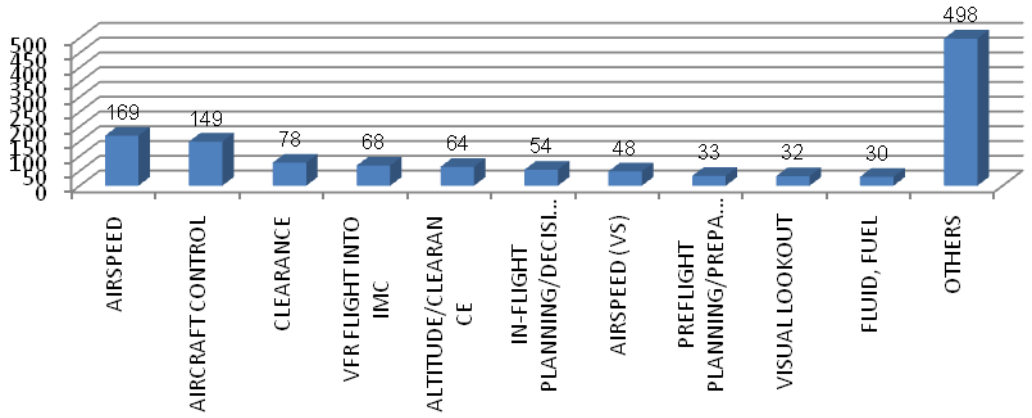

Figure 148. Frequencies of the Ten Primary Causes of Fatal GA Accidents (2003-2007)

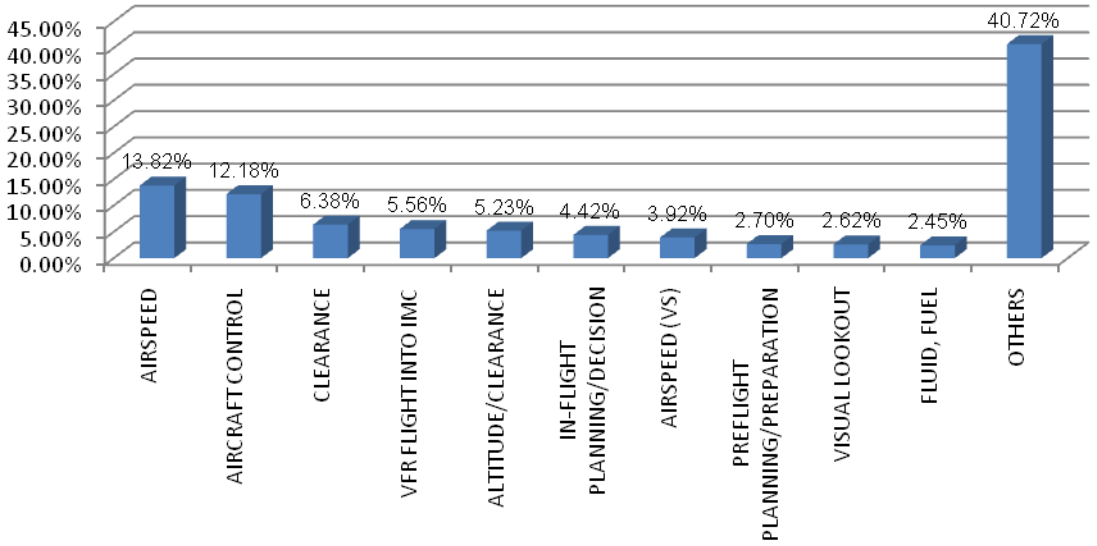

Figure 149. Percentages of the Ten Primary Causes of Fatal GA Accidents (2003-2007)

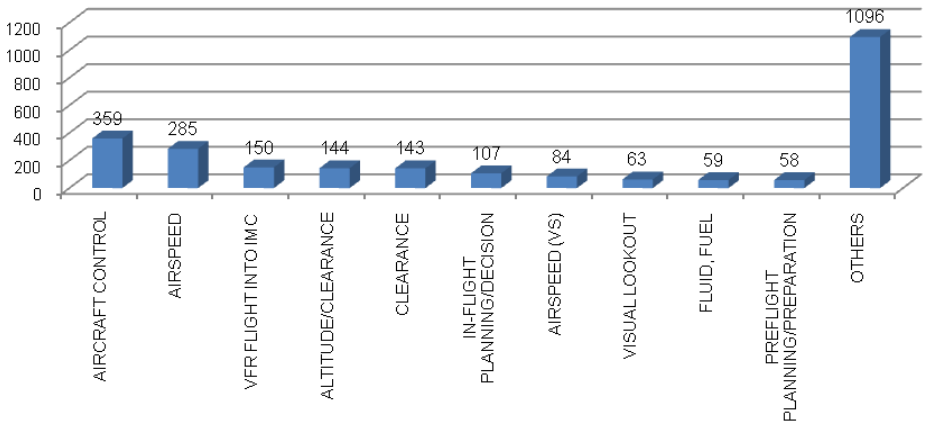

Figure 150. Frequencies of the Ten Primary Causes of Fatal GA Accidents (1998-2007)

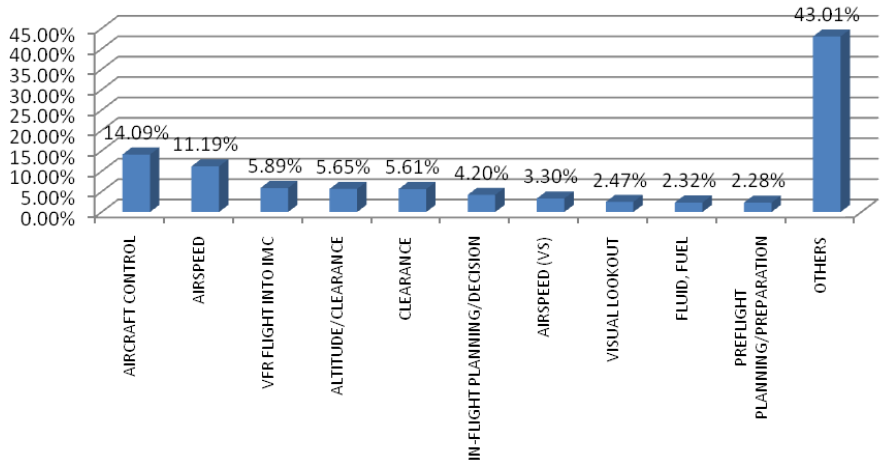

Figure 151. Percentages of the Ten Primary Causes of Fatal GA Accidents (1998-2007)

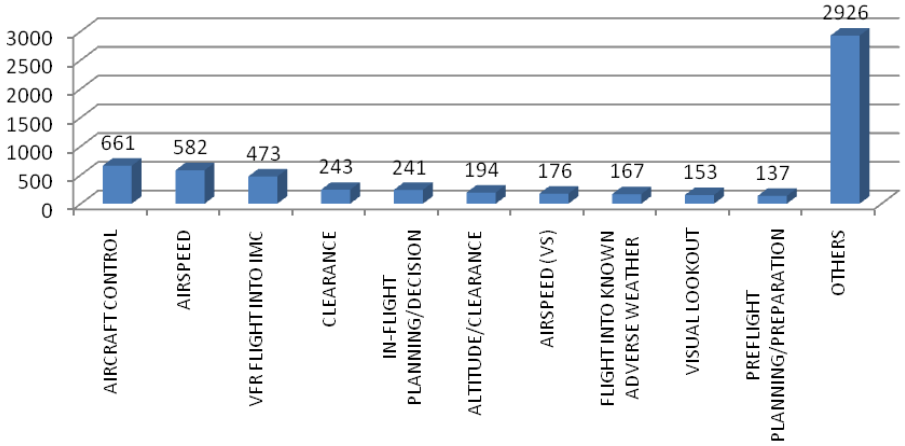

Figure 152. Frequencies of the Ten Primary Causes of Fatal GA Accidents (1988-2007)

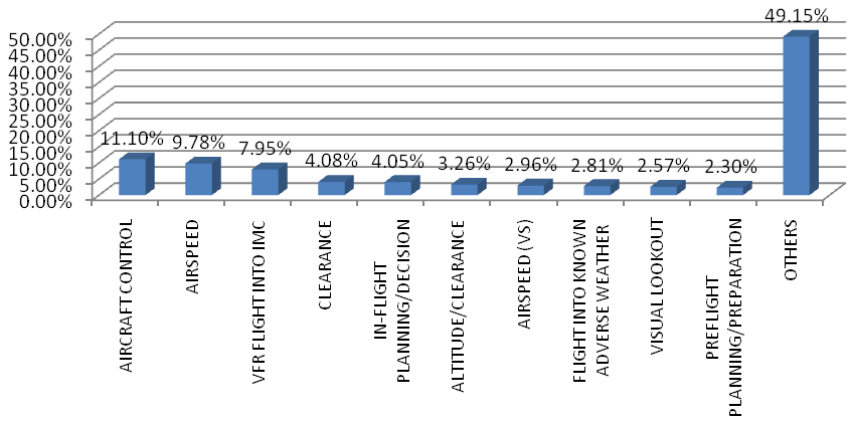

Figure 153. Percentages of Ten Primary Causes of Fatal GA Accidents (1988-2007)

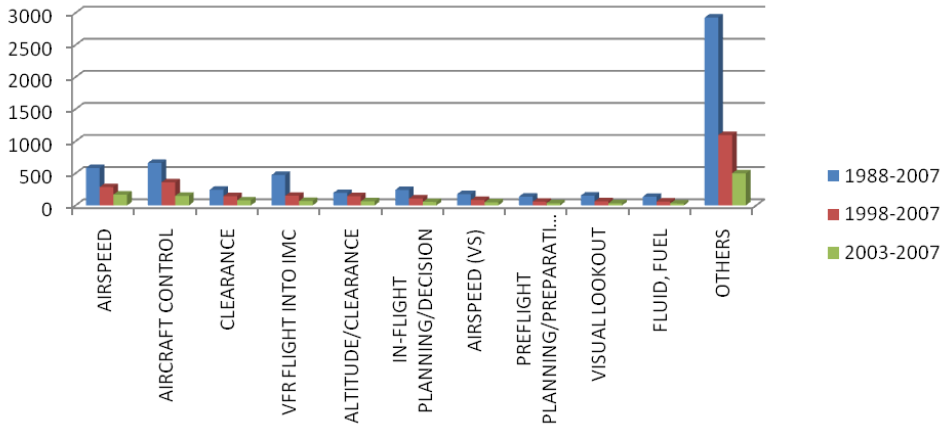

Figure 154. Frequencies of the Ten Primary Causes of Fatal GA Accidents (2003-2007, 1998-2007, and 1988-2007 time periods)

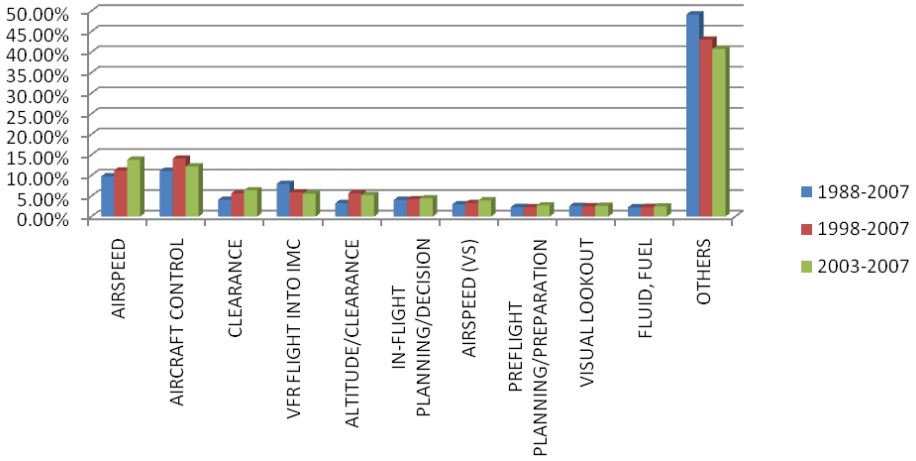

Figure 155. Percentages of the Ten Primary Causes of Fatal GA Accidents (2003-2007, 1998-2007, and 1988-2007 time periods)

Table 1 summarizes the ranking of these 10 primary causes over the 2003-2007, 1998-2007, and 1988-2007 time periods. For example, for the 1988-2007 time period, the primary cause for fatal accidents was visual flight rules (VFR) flights into instrumental meteorological conditions (IMC). However, over the 2003-2007 and 1998-2007 time periods, the primary cause shifted to aircraft control. It is interesting to note that the ranking of primary causes over the 2003-2007 and 1998-2007 time periods was consistent. Airspeed was consistently the second-ranking primary cause for fatal accidents.

Table 1. Ranking of the Primary Causes for Fatal Aircraft Accidents
(1988-2007, 1998-2007, and 2003-2007 time periods)

Primary Cause	1988-2007	1998-2007	2003-2007
Airspeed	2	2	1
Aircraft control	1	1	2
Clearance	4	5	3
VFR flight into IMC	3	3	4
Altitude/clearance	6	4	5
In-flight planning/decision	5	6	6
Airspeed (VS)	7	7	7
Preflight planning/preparation	9	10	8
Visual lookout	8	8	9
Fluid, fuel	10	9	10

5.2 ANALYSIS FOR THE TEN PRIMARY CAUSES OF FATAL ACCIDENTS BASED ON NONOVERLAPPING 5-YEAR PERIODS.

The statistics presented in section 5.1 involved overlapping the data over different years. For example, the fatal accidents from 1993-2002 (10-year period) included the fatal accidents from 2003-2007 (5-year period). Similarly, the fatal accidents from 1988-2007 (20-year period) included the accidents for both the 5- and 10-year periods. This approach has the advantage of showing the impact of recent data on the overall patterns of accidents. A disadvantage of this aggregation is that the pattern shifts of primary causes cannot be fully analyzed over the years.

To address this drawback, the 26-year data were divided into five separate groups, each for 5-year periods, as follows:

- 1982-1987
- 1988-1992
- 1993-1997
- 1998-2002
- 2003-2007

The analyses of fatal accidents were performed for each group. Figures 156 through 165 present the primary causes for fatal accidents for each 5-year period. Figures 166-167 provide comparisons of the primary causes for fatal accidents for all these 5-year periods.

As the figures suggest, ten primary causes are responsible for more than 50% of fatal accidents for the 2003-2007 and 1998-2007 time periods.

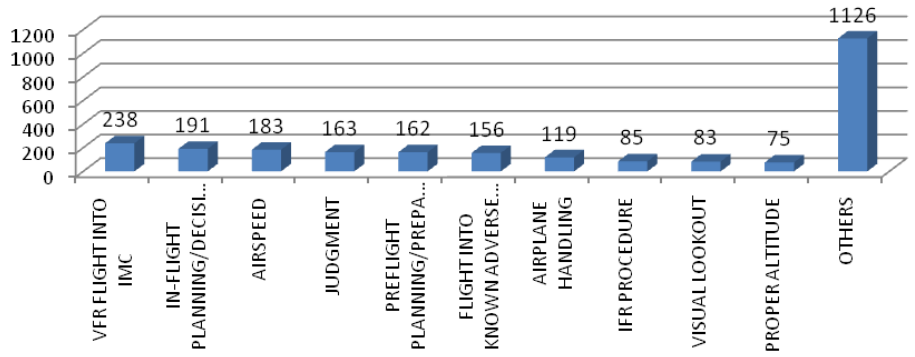

Figure 156. Frequencies of the Ten Primary Causes of Fatal GA Accidents (1982-1987)

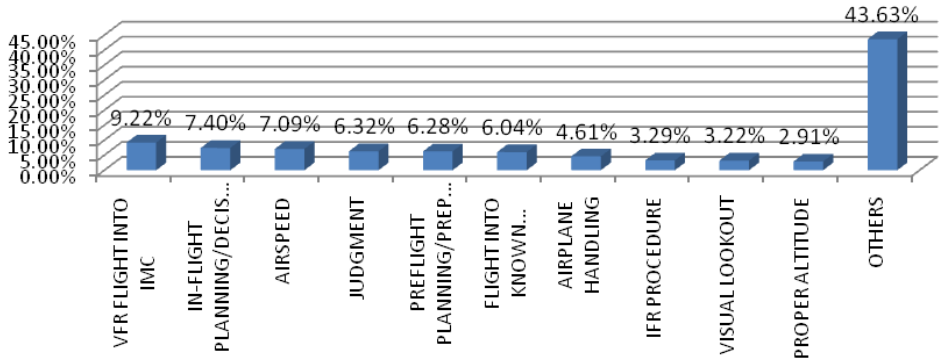

Figure 157. Percentages of the Ten Primary Causes of Fatal GA Accidents (1982-1987)

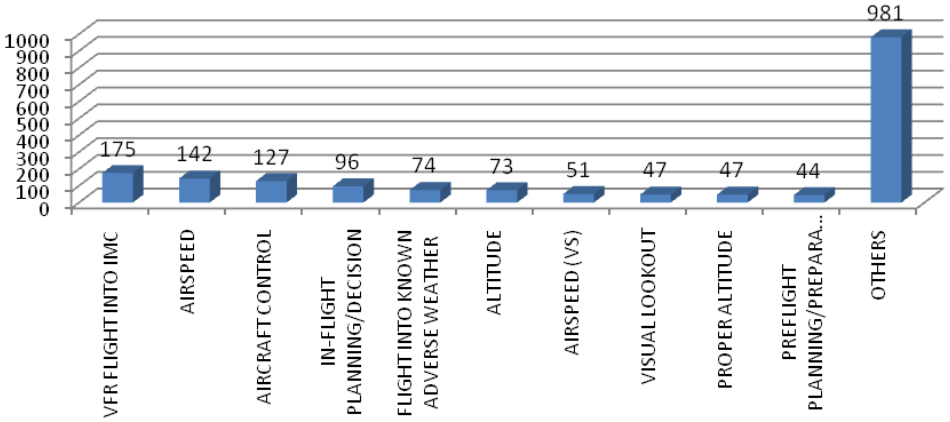

Figure 158. Frequencies of the Ten Primary Causes of Fatal GA Accidents (1988-1992)

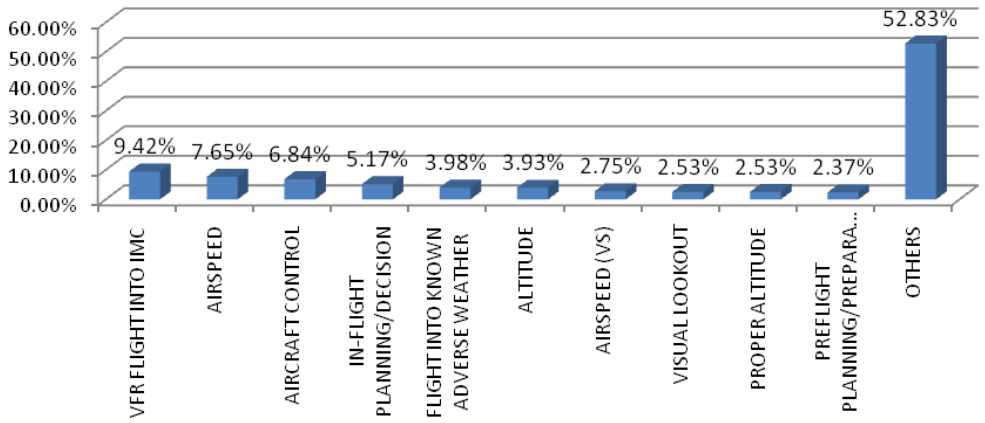

Figure 159. Percentages of the Ten Primary Causes of Fatal GA Accidents (1988-1992)

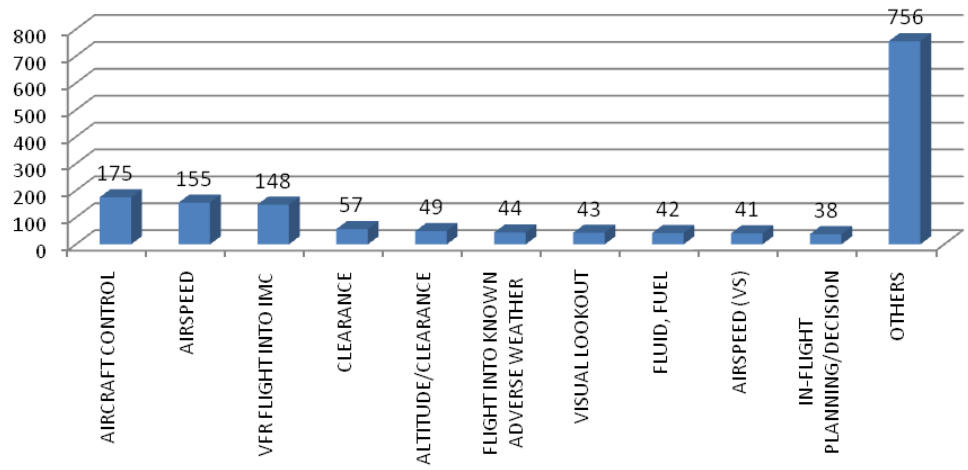

Figure 160. Frequencies of the Ten Primary Causes of Fatal GA Accidents (1993-1997)

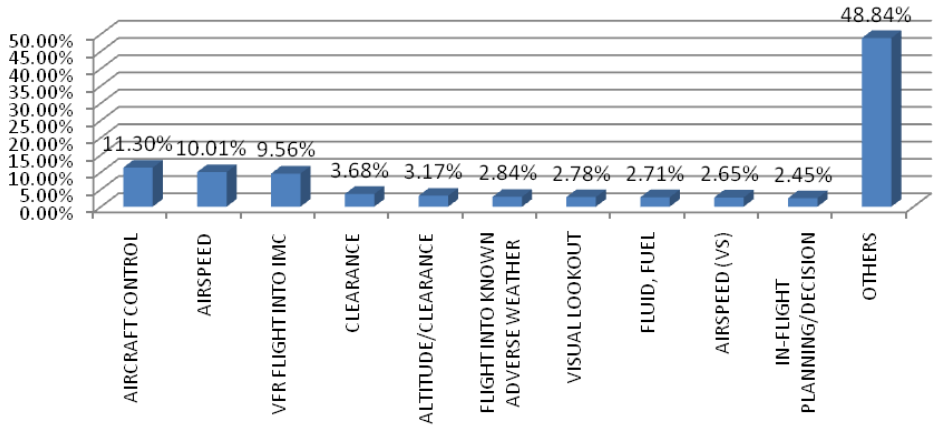

Figure 161. Percentages of the Ten Primary Causes of Fatal GA Accidents (1993-1997)

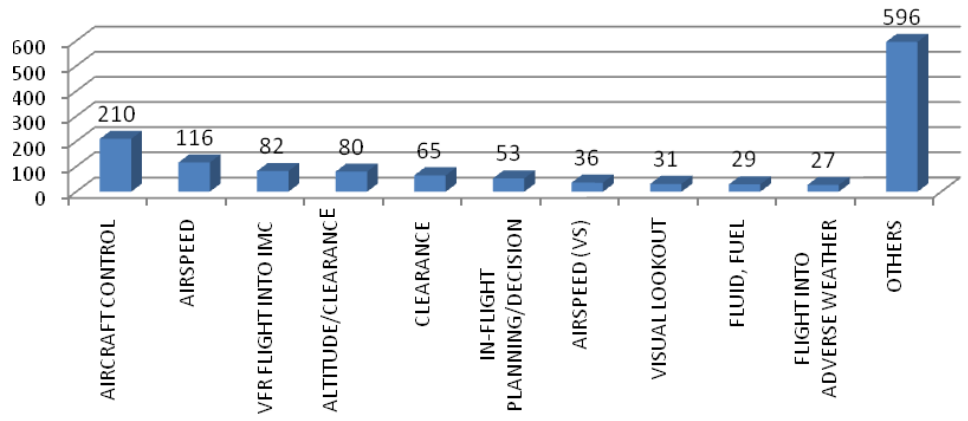

Figure 162. Frequencies of the Ten Primary Causes of Fatal GA Accidents (1998-2002)

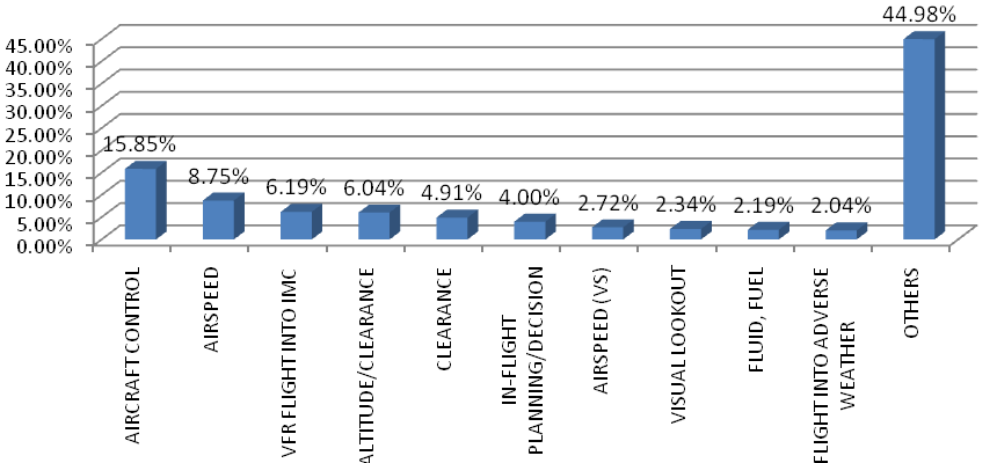

Figure 163. Percentages of the Ten Primary Causes of Fatal GA Accidents (1998-2002)

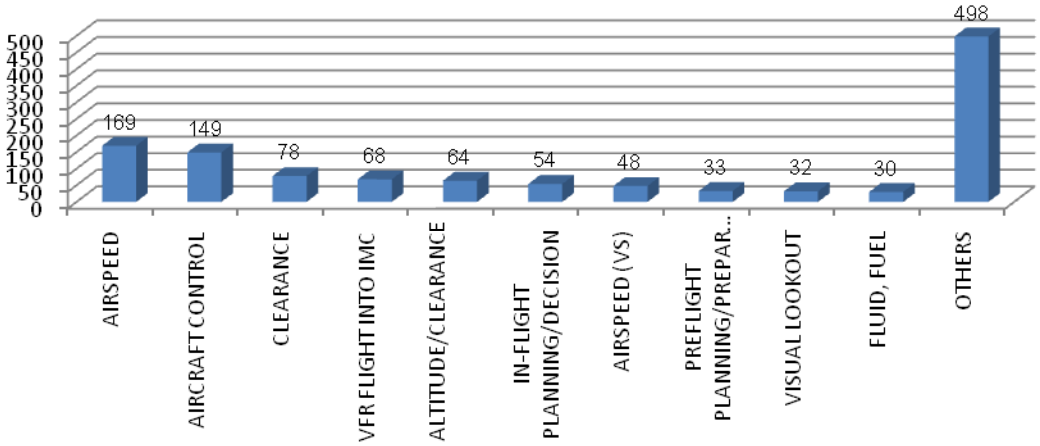

Figure 164. Frequencies of the Ten Primary Causes of Fatal GA Accidents (2003-2007)

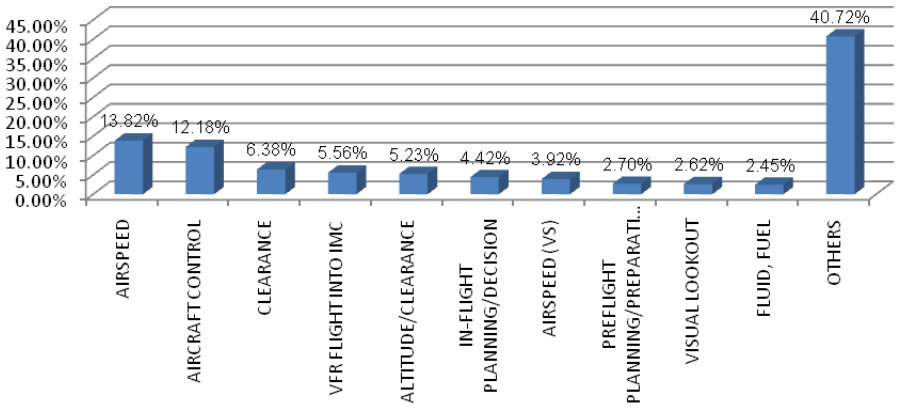

Figure 165. Percentages of the Ten Primary Causes of Fatal GA Accidents (2003-2007)

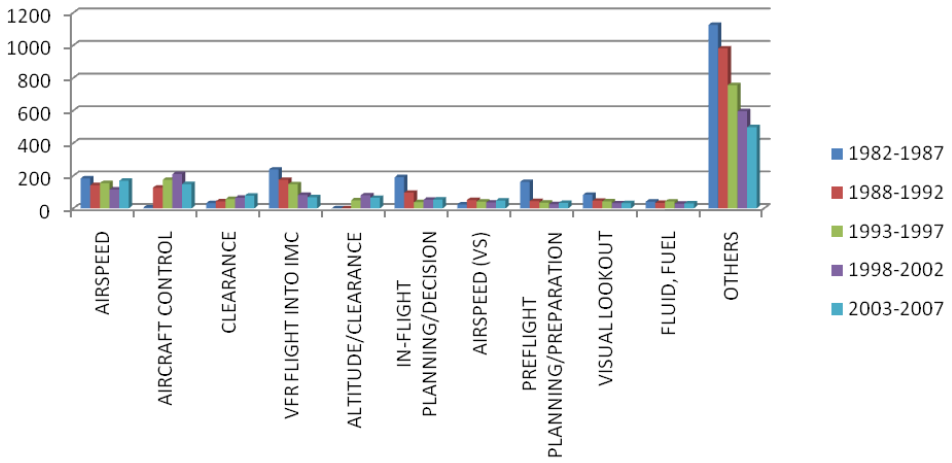

Figure 166. Frequencies of the Ten Primary Causes of Fatal GA Accidents for Each 5-Year Period (1982-2007)

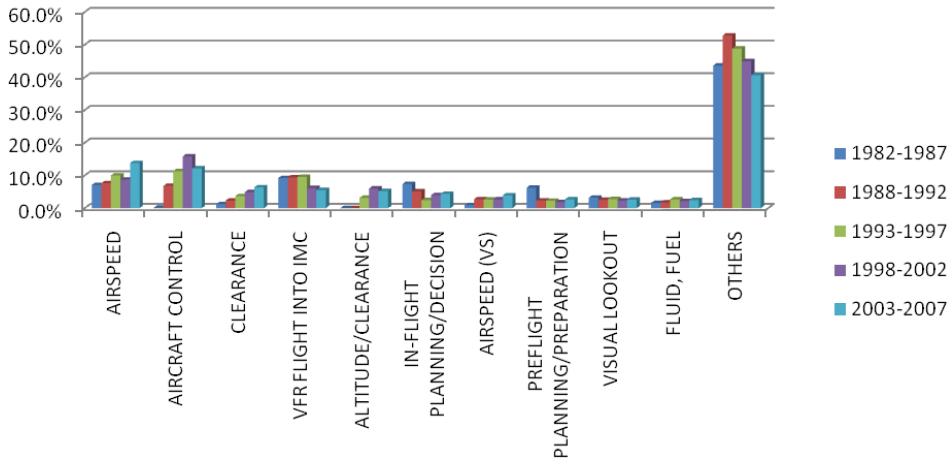

Figure 167. Percentages of the Ten Primary Causes of Fatal GA Accidents for Each 5-Year Period (1982-2007)

Table 2 presents the ranking of the ten primary causes of fatal accidents for each 5-year period.

Table 2. Comparison of Primary Causes of Fatal Accidents Among the 5-Year Periods

Primary Cause	1982-1987	1988-1992	1993-1997	1998-2002	2003-2007
Airspeed	3	2	2	2	1
Aircraft control	9	3	1	1	2
Clearance	7	8	4	5	3
VFR flight into IMC	1	1	3	3	4
Altitude/clearance	10	10	5	4	5
In-flight planning/decision	2	4	9	6	6
Airspeed (VS)	8	5	8	7	7
Preflight planning/preparation	4	7	10	10	8
Visual lookout	5	6	6	8	9
Fluid, fuel	6	9	7	9	10

As the table suggests, the top three primary causes were relatively stable between 1998 and 2007. However, the ranking of airspeed increased from 2003 to 2007 compared to the previous years. It became the number one cause for fatal GA accidents instead of Aircraft Control, which was the main cause in the previous 5-year period.

It would be of interest to further study the three primary causes that occur in almost all the groups. Figures 168 through 170 provide a closer examination of these primary causes on a yearly basis. As indicated in table 2, airspeed, aircraft control, and clearance are the three main primary causes of fatal accidents over the last 5-year period of this study (2003-2007).

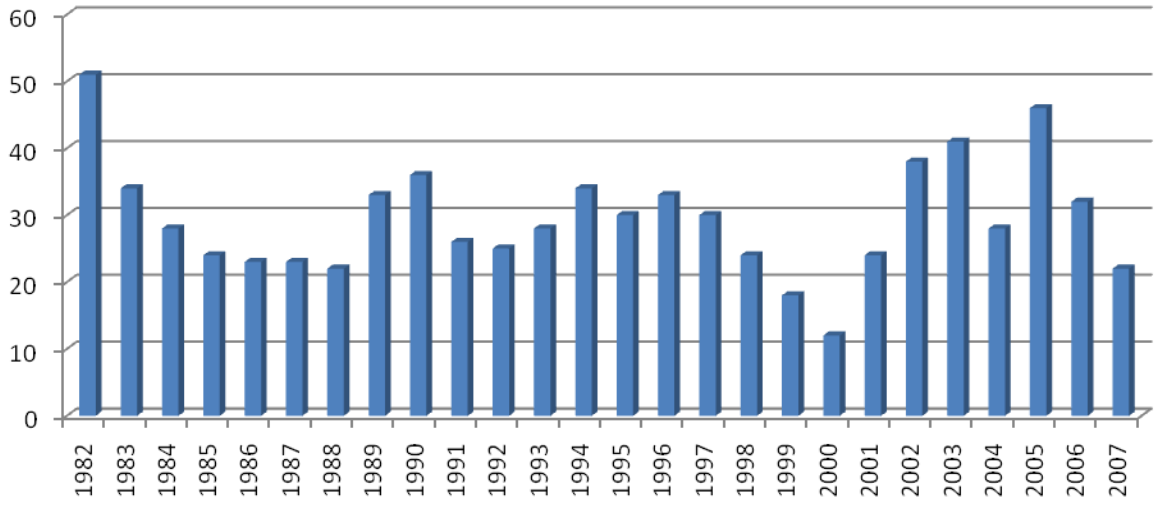

Figure 168. Frequency of Fatal Accidents Attributed to Airspeed by Year

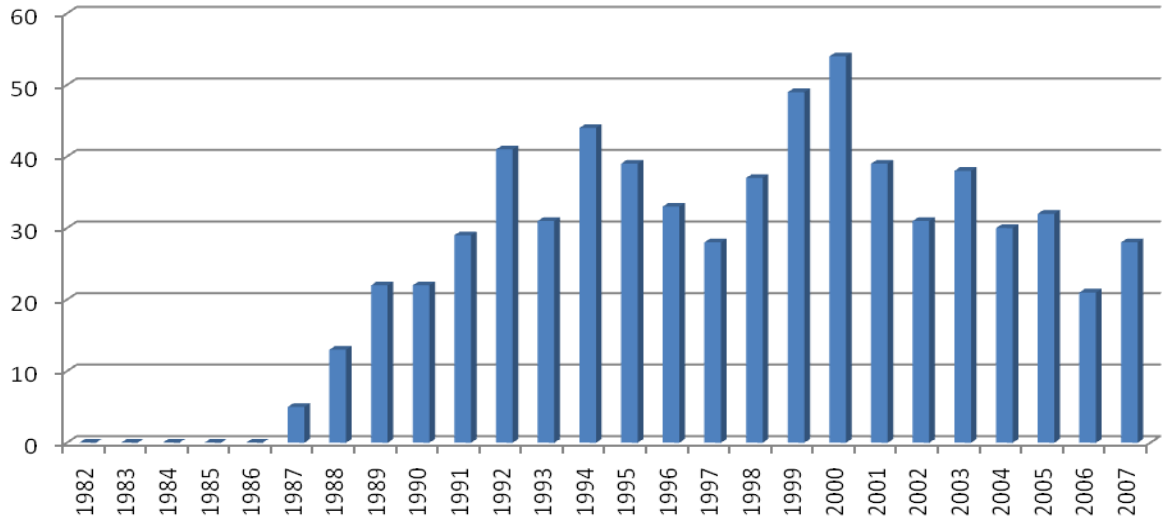

Figure 169. Frequency of Fatal Accidents Attributed to Aircraft Control by Year

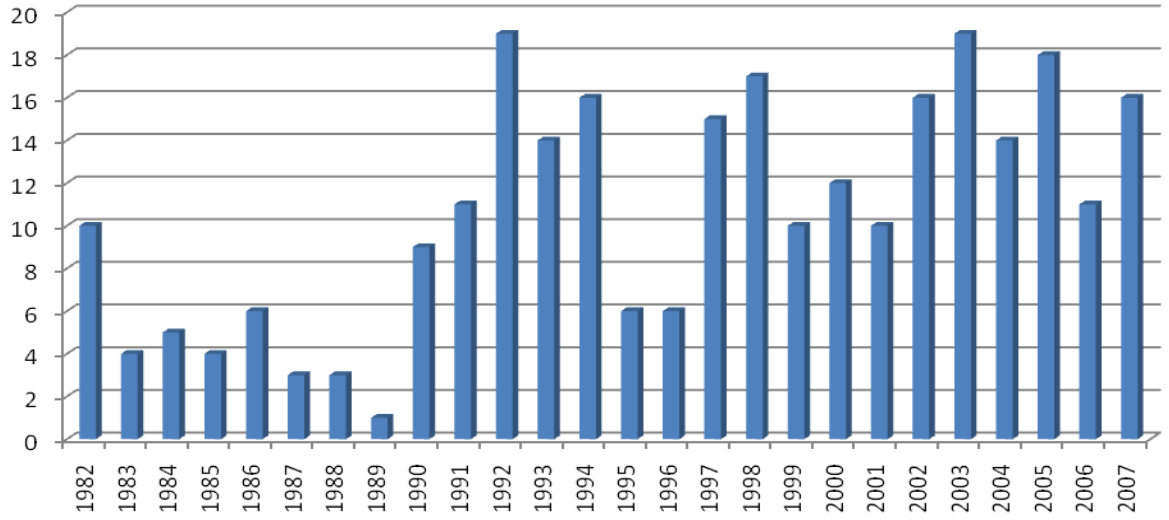

Figure 170. Frequency of Fatal Accidents Attributed to Clearance by Year

5.3 ANALYSIS OF THE PRIMARY CAUSES OF NONFATAL GA ACCIDENTS OVER 5-, 10-, AND 20-YEAR PERIODS.

An important question is how the identified primary causes of fatal accidents influence nonfatal accidents, i.e., are the primary causes the same for nonfatal accidents? Similar analysis was performed to determine the primary causes of nonfatal accidents.

Figures 171 through 176 show the ten primary causes for nonfatal accidents for all aircraft types for 5-, 10-, and 20-year periods on a national basis. The frequency (number of fatal accidents) and the percentages are presented.

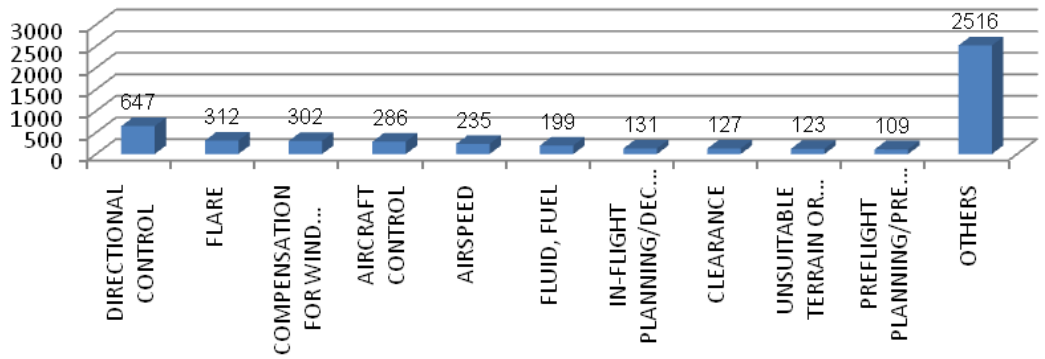

Figure 171. Frequencies of the Ten Primary Causes of Nonfatal GA Accidents (2003-2007)

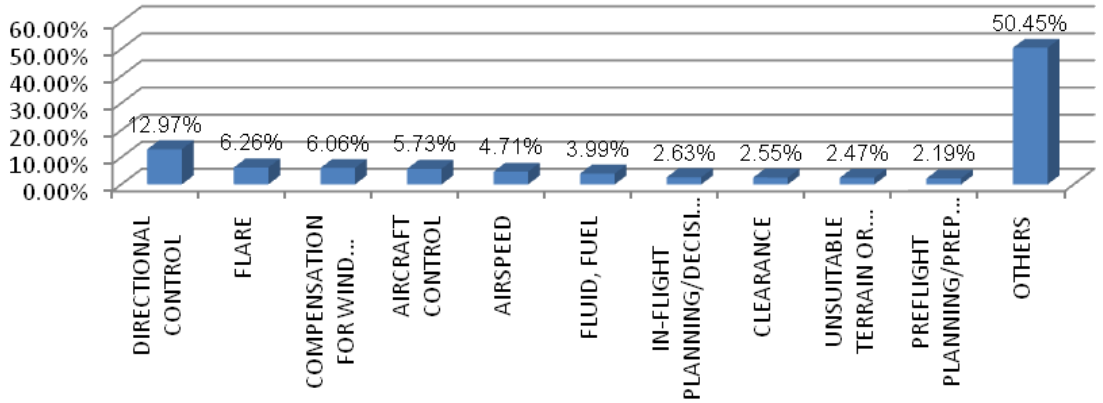

Figure 172. Percentages of the Ten Primary Causes of Nonfatal GA Accidents (2003-2007)

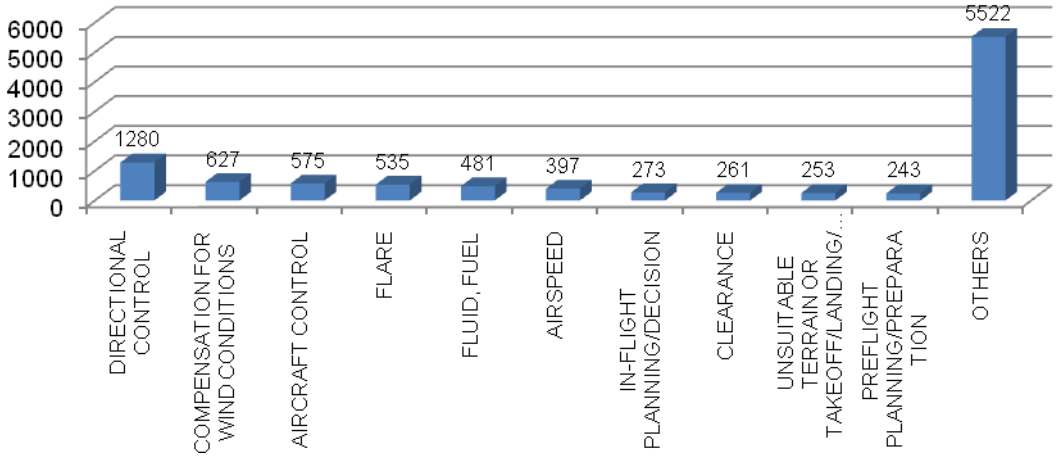

Figure 173. Frequencies of the Ten Primary Causes of Nonfatal GA Accidents (1998-2007)

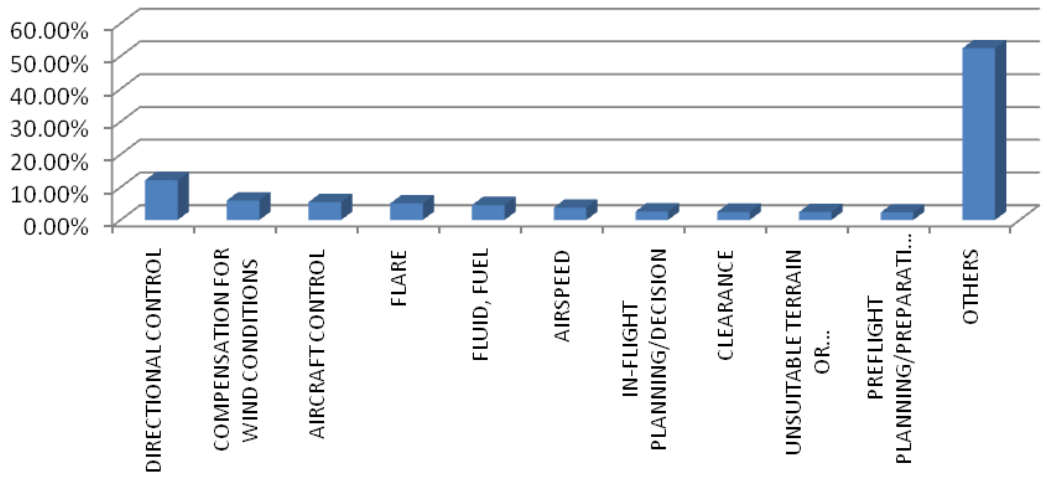

Figure 174. Percentages of the Ten Primary Causes of Nonfatal GA Accidents (1998-2007)

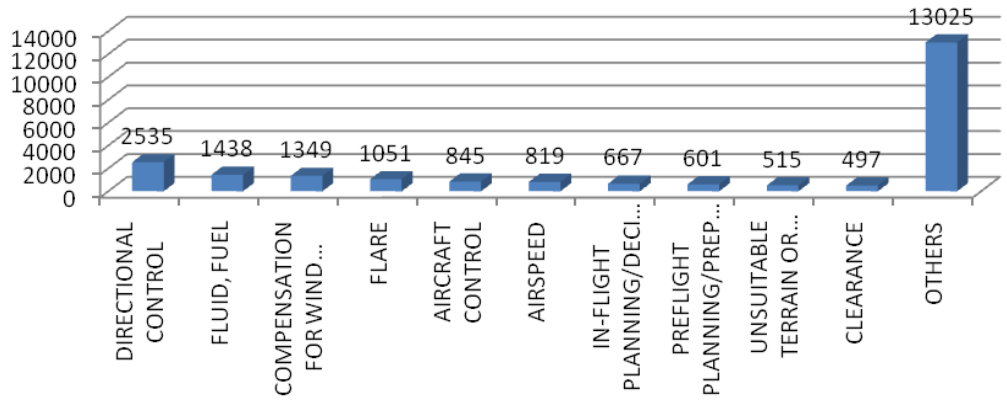

Figure 175. Frequencies of the Ten Primary Causes of Nonfatal GA Accidents (1988-2007)

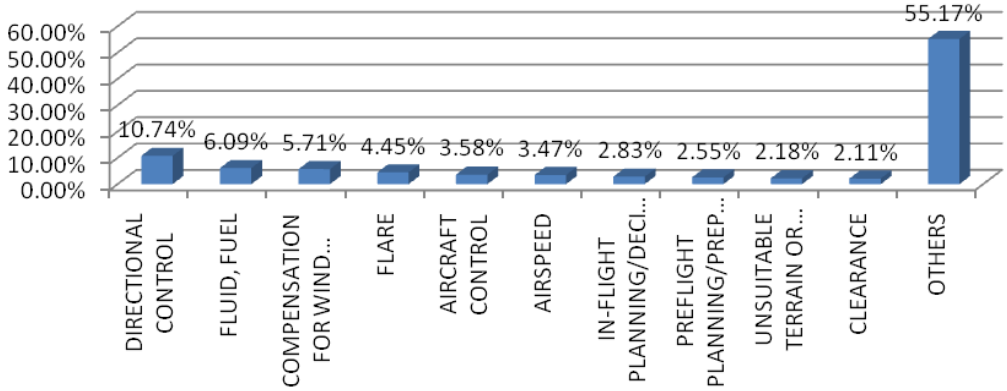

Figure 176. Percentages of the Ten Primary Causes of Nonfatal GA Accidents (1988-2007)

Figures 177 through 178 provide a comparison of primary causes for nonfatal accidents for the 5-, 10-, and 20-year periods.

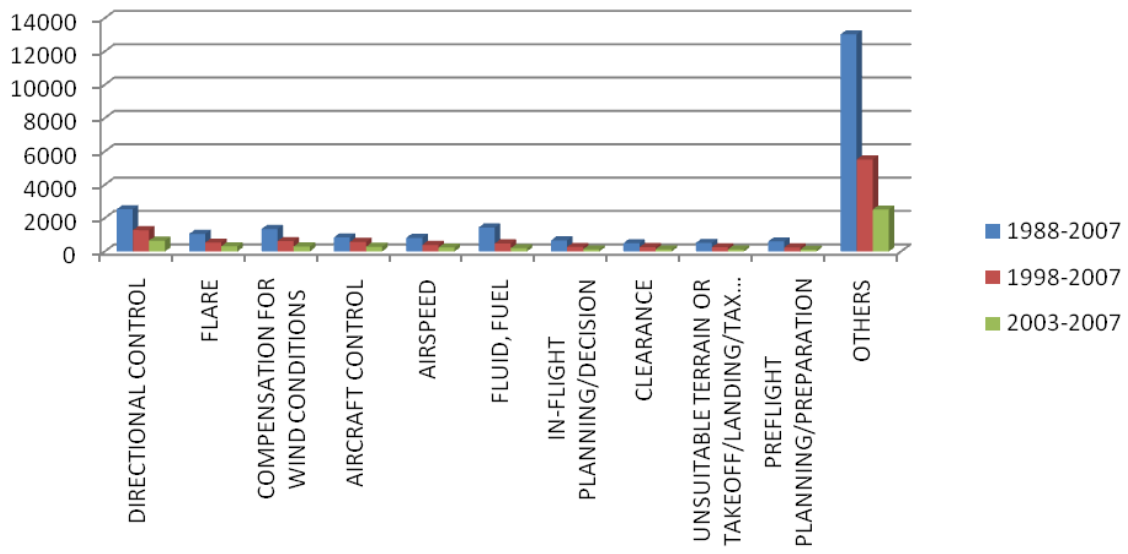

Figure 177. Comparison of Frequencies of the Ten Primary Causes of Nonfatal GA Accidents (2003-2007, 1998-2007, and 1988-2007 time periods)

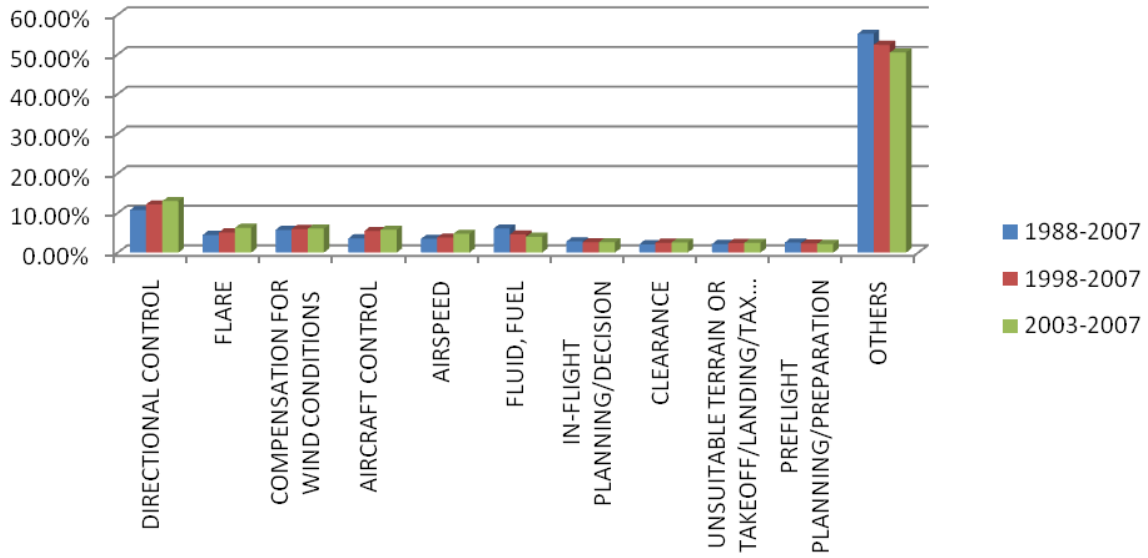

Figure 178. Comparison of Percentages of the Ten Primary Causes of Nonfatal GA Accidents (2003-2007, 1998-2007, and 1988-2007 time periods)

Table 3 summarizes the ranking of the ten primary causes for the 1988-2007, 1998-2007, and 2003-2007 time periods. For example, for these 5-, 10-, and 20-year time periods, the primary cause for nonfatal accidents was directional control. It was interesting to note that the primary causes for nonfatal accidents were different from fatal accident causes. The statistical analyses will study these differences in the next phase of this project.

Table 3. Ranking of Primary Causes for Nonfatal Aircraft Accidents
(1988-2007, 1998-2007, and 2003-2007 time periods)

Primary Cause	1988-2007	1998-2007	2003-2007
Directional control	1	1	1
Flare	4	4	2
Compensation for wind conditions	3	2	3
Aircraft control	5	3	4
Airspeed	6	6	5
Fluid, fuel	2	5	6
In-flight planning/decision	7	7	7
Clearance	10	8	8
Unsuitable terrain or takeoff/landing/taxi area	9	9	9
Preflight planning/preparation	8	10	10

5.4 NONFATAL GA ACCIDENT ANALYSIS BASED ON NONOVERLAPPING 5-YEAR PERIODS.

Similar to the fatal accident analyses, the statistics presented in section 5.3 involved overlapping the data over different years. For example, the nonfatal accidents from 1983-2002 (10-year period) includes the nonfatal accidents from 1998-2002 (5-year period). Similarly, the nonfatal accidents from 1983-2002 (20-year period) includes the accidents of both 5- and 10-year periods. To address this issue, the 20-year data were divided into four separate 5-year periods as follows:

- 1982-1987
- 1988-1992
- 1993-1997
- 1998-2002
- 2003-2007

The analyses of nonfatal accidents were performed for each period. Figures 179 through 188 present the primary causes for nonfatal accidents for each 5-year period listed above.

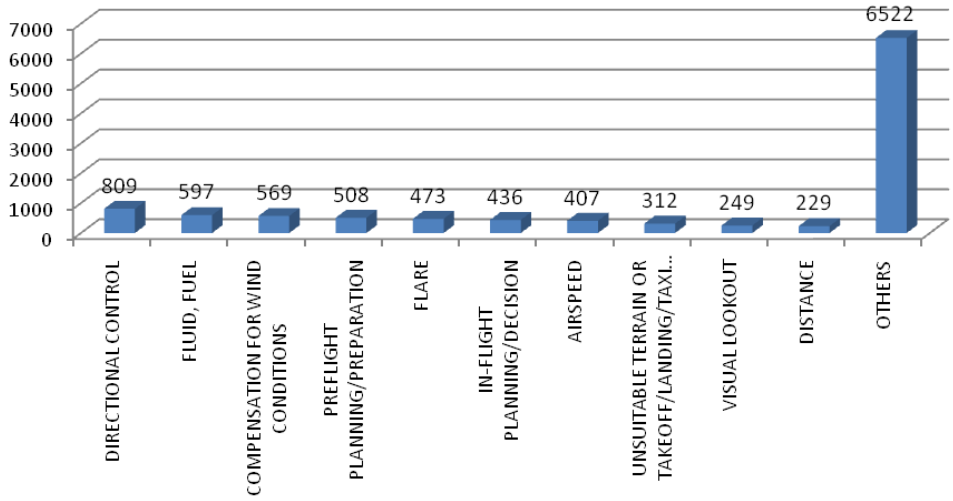

Figure 179. Frequencies of the Ten Primary Causes of Nonfatal GA Accidents (1982-1987)

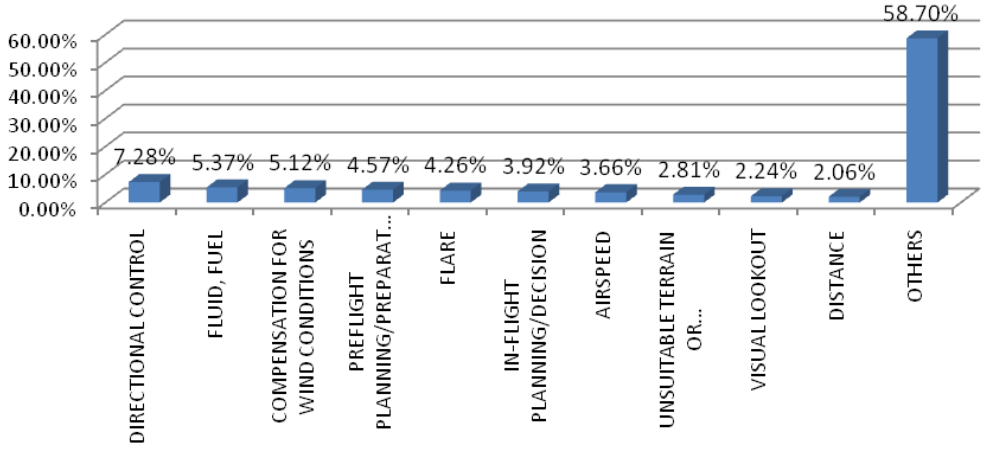

Figure 180. Percentages of the Ten Primary Causes of Nonfatal GA Accidents (1982-1987)

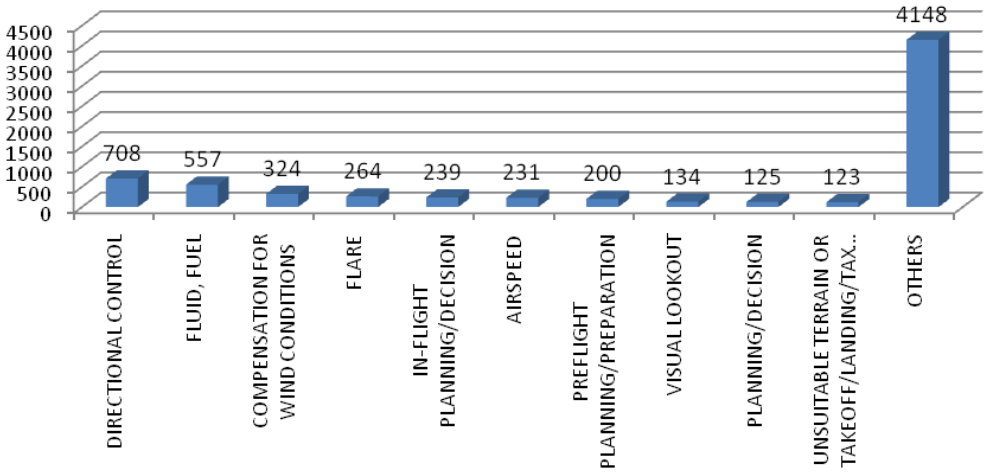

Figure 181. Frequencies of the Ten Primary Causes of Nonfatal GA Accidents (1988-1992)

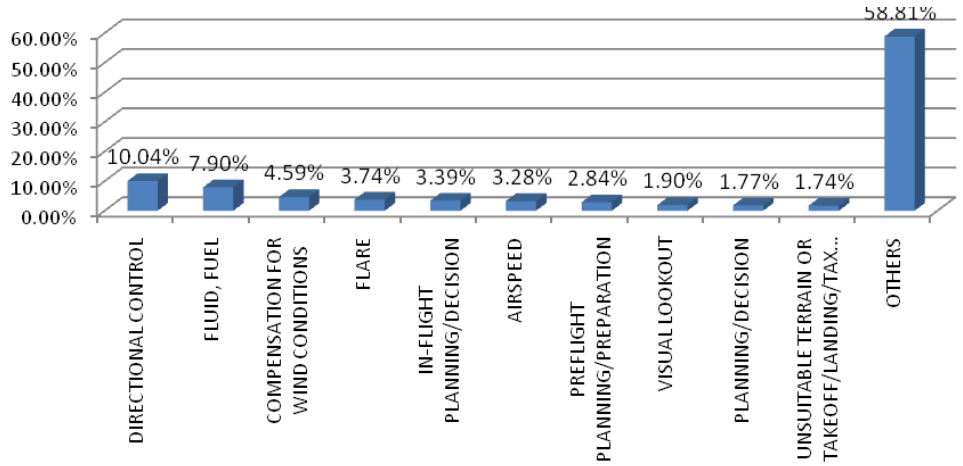

Figure 182. Percentages of the Ten Primary Causes of Nonfatal GA Accidents (1988-1992)

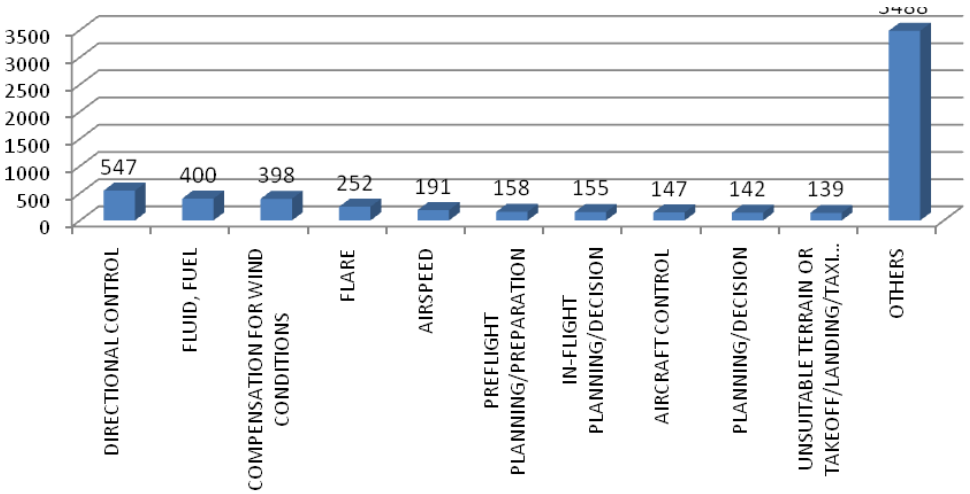

Figure 183. Frequencies of the Ten Primary Causes of Nonfatal GA Accidents (1993-1997)

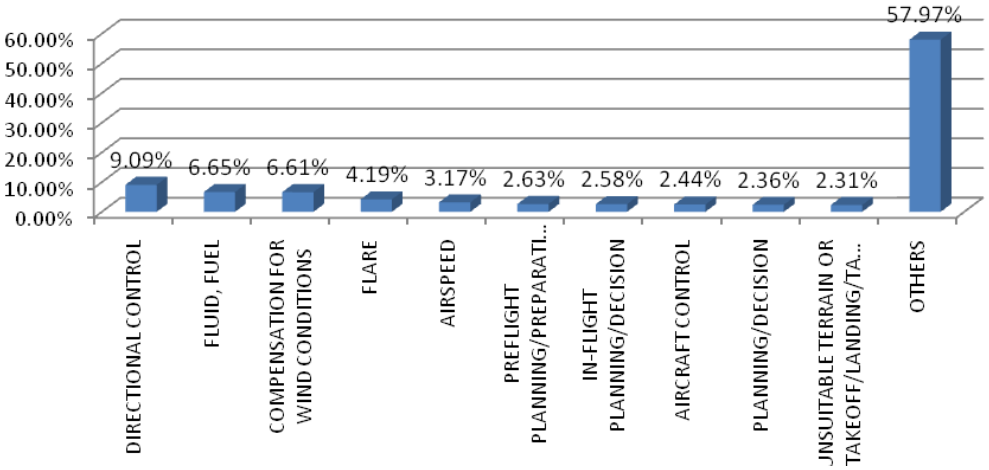

Figure 184. Percentages of the Ten Primary Causes of Nonfatal GA Accidents (1993-1997)

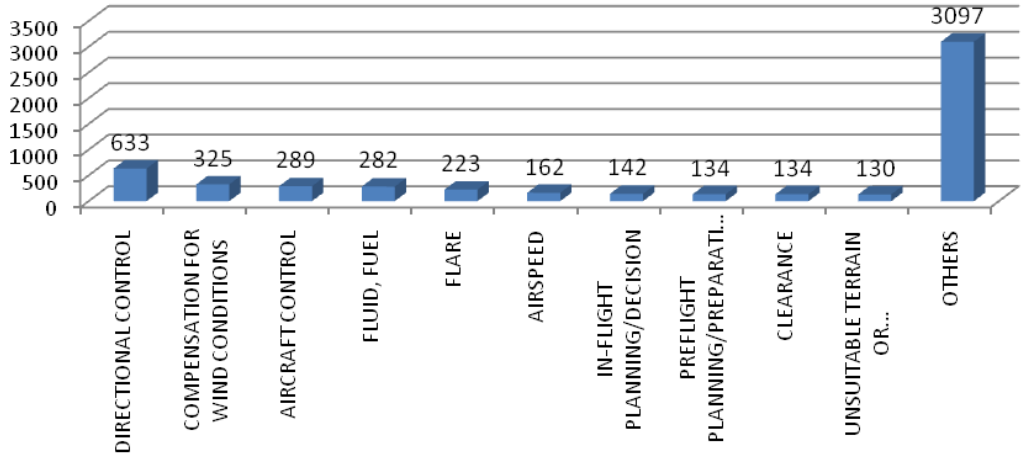

Figure 185. Frequencies of the Ten Primary Causes of Nonfatal GA Accidents (1998-2002)

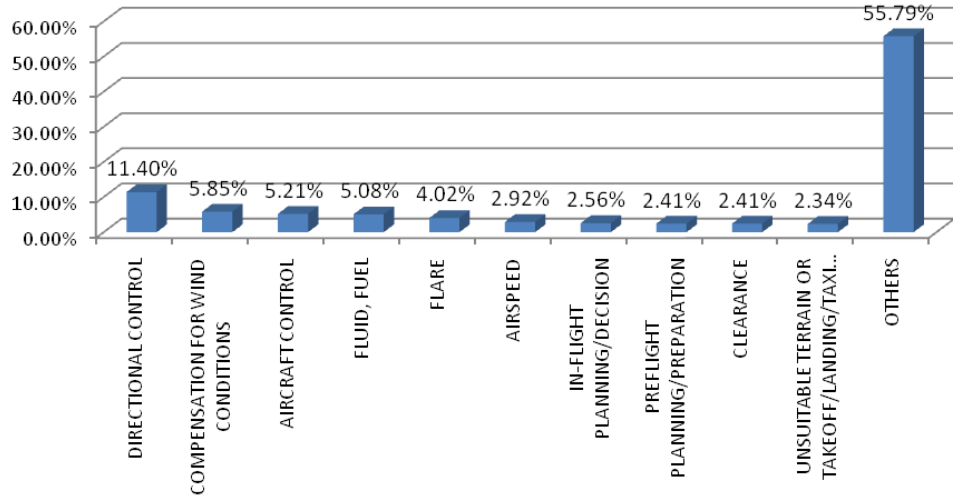

Figure 186. Percentages of the Ten Primary Causes of Nonfatal GA Accidents (1998-2002)

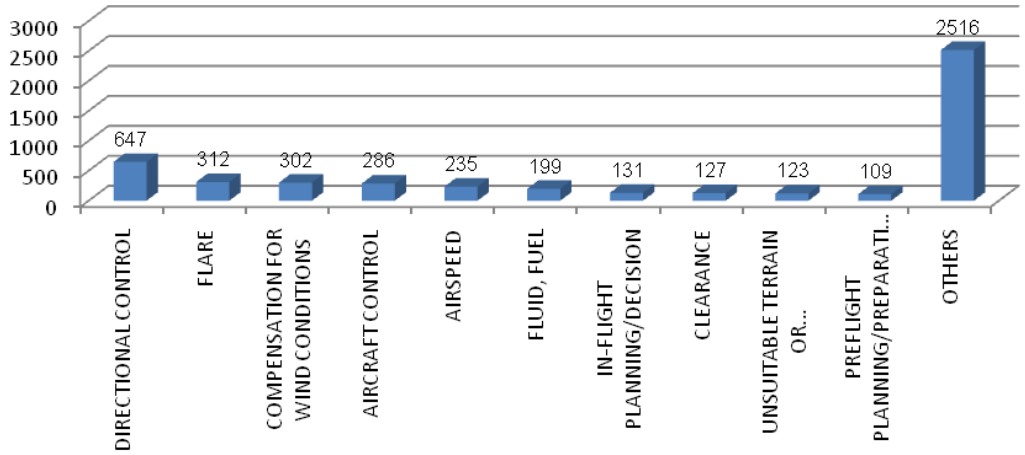

Figure 187. Frequencies of the Ten Primary Causes of Nonfatal GA Accidents (2003-2007)

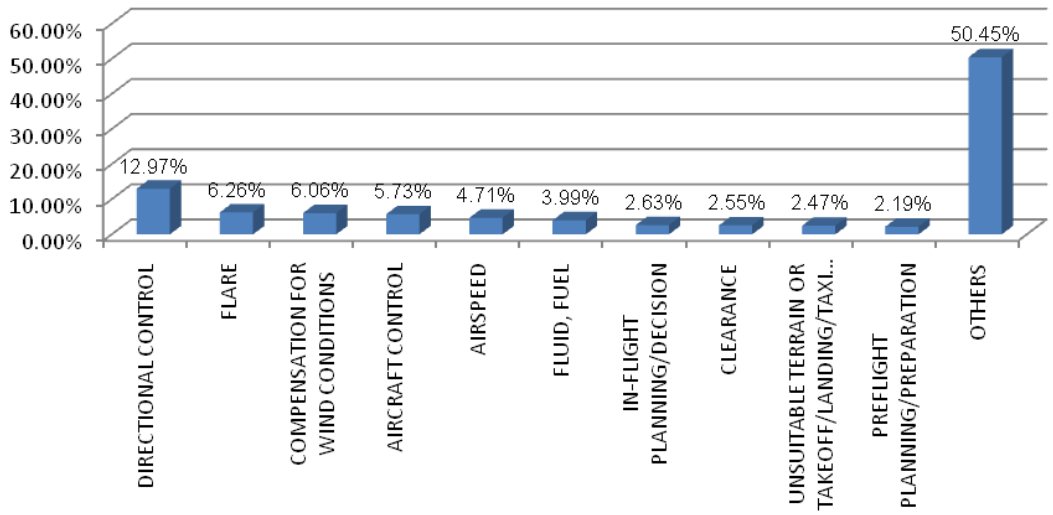

Figure 188. Percentages of the Ten Primary Causes of Nonfatal GA Accidents (2003-2007)

Figures 189 through 190 provide comparisons of all the 5-year periods for the primary causes of nonfatal accidents.

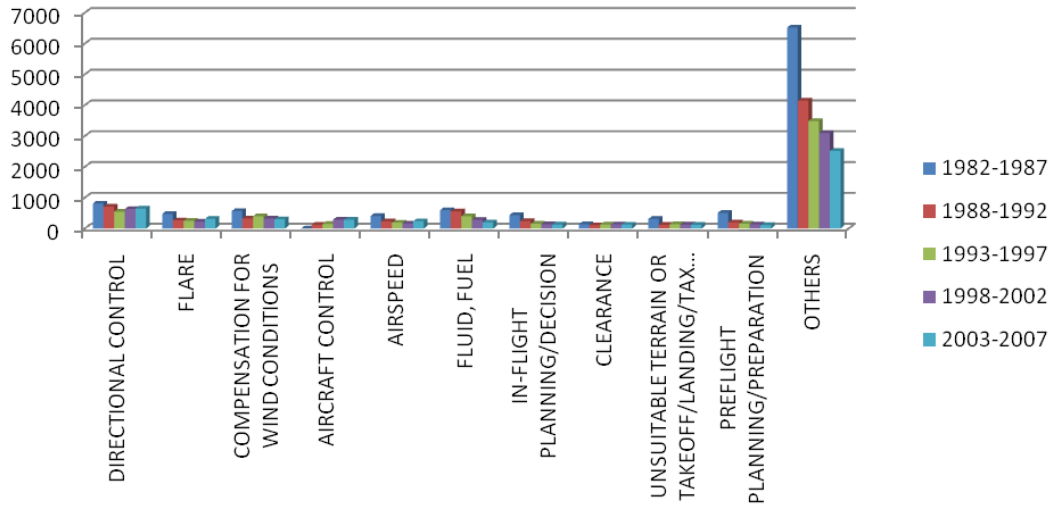

Figure 189. Comparison of Frequencies of the Ten Primary Causes of Nonfatal GA Accidents by 5-Year Periods (1982-2007)

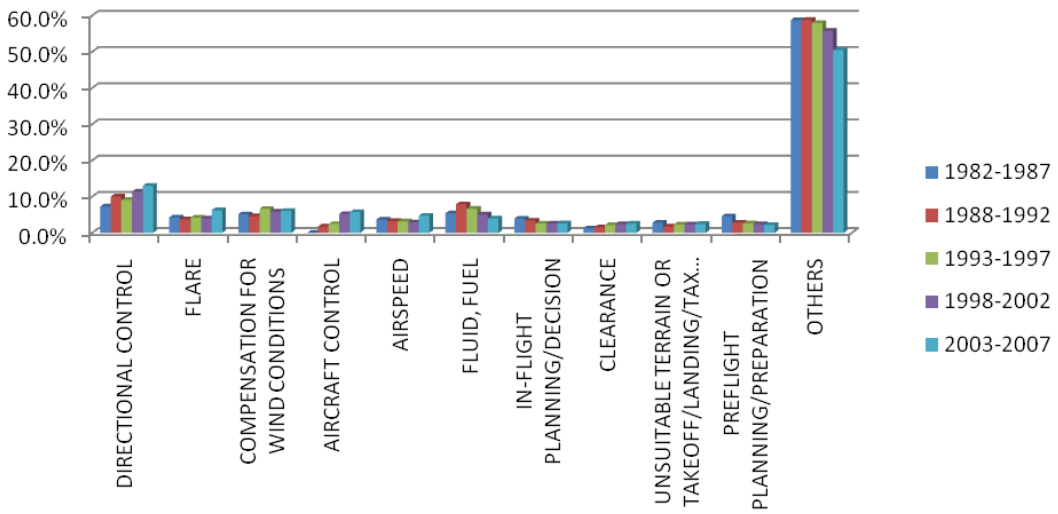

Figure 190. Percentages of the Ten Primary Causes of Nonfatal GA Accidents by 5-Year Periods (1982-2007)

Table 4 presents the ranking of the primary causes of nonfatal accidents in four groups of 5-year periods.

Table 4. Comparison of Primary Causes of Nonfatal Accidents Among the 5-Year Periods

Primary Cause	1982-1987	1988-1992	1993-1997	1998-2002	2003-2007
Directional control	1	1	1	1	1
Flare	5	4	4	5	2
Compensation for wind conditions	3	3	3	2	3
Aircraft control	10	8	8	3	4
Airspeed	7	6	5	6	5
Fluid, fuel	2	2	2	4	6
In-flight planning/decision	6	5	7	7	7
Clearance	9	10	10	8	8
Unsuitable terrain or takeoff/landing/taxi area	8	8	9	10	9
Preflight planning/preparation	4	7	6	8	10

As the table suggests, the top three primary causes were stable between 1982 and 2002, but they shifted in the 2003-2007 time period, especially for flare, fluid, fuel, and aircraft control. Directional control remained at the top of the list and compensation for wind conditions stayed in the top three. Figures 191 through 193 provide a closer examination of these primary causes on a yearly basis. It would be of interest to further study the primary causes that occurred as the top three in almost all time periods.

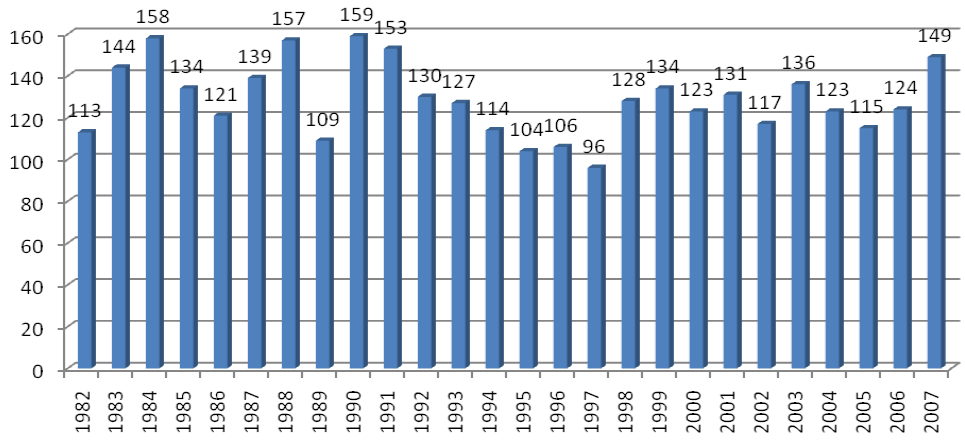

Figure 191. Frequency of Nonfatal Accidents Attributed to Directional Control by Year

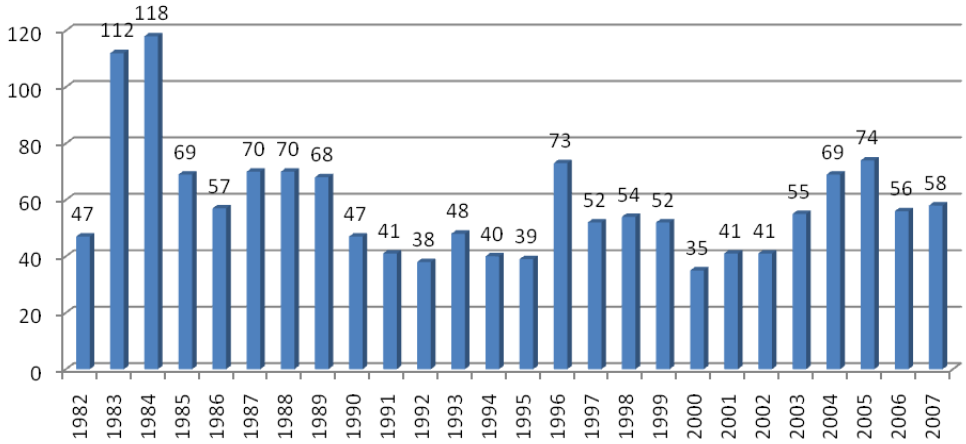

Figure 192. Frequency of Nonfatal Accidents Attributed to Flare by Year

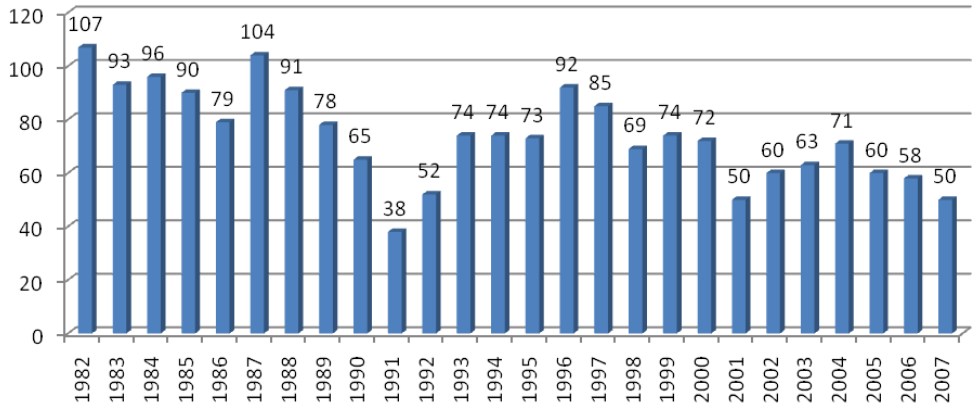

Figure 193. Frequency of Nonfatal Accidents Attributed to Compensation for Wind Condition by Year

6. CONCLUSIONS AND FUTURE WORK.

The frequency of general aviation (GA) accidents decreased for the 26 years studied; however, the decline in the number of fatal accidents was not as rapid as the reduction of accidents for the entire aviation industry. In 5-, 10-, and 20-year comparisons, there was a decrease in the percentage of accidents in some phases of flight, while other phases saw an increase. As a result, this project compared the frequency of accidents in different phases of flight based on both nonoverlapping and overlapping periods. Based on the type of operation (purpose of flight), the highest rate of GA accidents was for instructional use, although the number of accidents occurring in personal-use flights was higher due to the greater frequency of flights. In addition, the rate of accidents for personal use decreased, while the rate for instructional flights held steady at 1.5%.

On a regional basis, the Alaskan Region had a unique trend in the general frequency, monthly basis or time of day, and phases of flight. The percentage of accidents in Alaska increased compared to accidents nationwide, although it had the third smallest number of accidents (after the New England and Central Regions) among the nine regions. On a monthly basis, the frequency of fatal accidents in Alaska peaks in August and drops in October until the end of the year before increasing again in January. Unlike any other region, the highest percentage of fatal accidents in Alaska is during the Maneuvering phase of flight rather than Descent. Based on time of day, fatal accident rates in Alaska were very high at midnight compared to other regions.

For the 2003-2007 time period, the most frequent primary causes of fatal accidents have shifted. Between 1993 and 2002, aircraft control was the most frequent primary cause. From 2003 to 2007, airspeed took over the first position ahead of aircraft control. For nonfatal accidents, directional control was the most frequent primary cause from 1988 to 2007. Flare, however, rose to the number two cause of nonfatal accidents for the 2003-2007 time period.

Some of the potential extensions and further investigation to this study include:

- Analysis of the ten primary causes that lead to fatal and nonfatal accidents for each region by aircraft complexity and pilot demographics. The study that was presented in this report aggregates all pilots, all aircraft, and all states. It is likely the primary causes for fatal and nonfatal accidents are different among different regions. Furthermore, it will be of interest to determine if aircraft complexity (such as horsepower) plays any role in accidents to be fatal or nonfatal. Pilot demographics, such as age, gender, training, and past history, can be important factors in identifying patterns among fatal and nonfatal accidents. The proposed study would investigate these primary causes by region, aircraft complexity, and pilot demographics.

- Statistical analyses on existing GA accidents and incidents database on a regional basis to identify associations and patterns between flight elements and risk factors. Some of this research could include single- and multi-factor analysis for:

  - Pilot experience
  - Pilot age and gender
  - Light conditions
  - Weather conditions
  - Equipment used
  - Maintenance

- Study of text mining of GA safety data, specifically Aviation Safety Reporting System reports and integration into existing research.

APPENDIX A—DATABASE QUERY PROCEDURE

The data for this analysis were gathered from the National Transportation Safety Board (NTSB) accidents and incidents database. The following queries are made for collecting national and regional frequency data of general aviation (GA) accidents. The procedure to query the database consisted of two main steps. First, a denormalized table was created that consisted of a grouping of all the relevant data fields from multiple tables. This new table was then used as a common data set for multiple queries based on the varying parameters of interest under investigation.

A.1 QUERIES FOR PHASE 1 AND 2.

The SQL query statement below creates a denormalized table called `New_1982-2007` containing the fields `EVENT_ID, NTSB_RPRT_NBR, EV_TYPE_DESC, FLTCNDCT_CODE, INJURY_DESC, CAUSE_FACTOR, EVENT_YEAR, EVENT_LCL_TIME, LIGHT_COND_DESC, FLT_PHASE, EVENT_STATE_CODE, ACFT_TYPE_CODE,` and `EVENT_MONTH`:

```
SELECT      STAGE_NTSB2_BRIEF_REPORT_TBL.EVENT_ID,
            STAGE_NTSB2_BRIEF_REPORT_TBL.NTSB_RPRT_NBR,
            STAGE_NTSB2_BRIEF_REPORT_TBL.EV_TYPE_DESC,
            STAGE_NTSB2_AIRCRAFT_LIST.FLTCNDCT_CODE,
            STAGE_NTSB2_BRIEF_REPORT_TBL.INJURY_DESC,
            STAGE_NTSB2_SEQ_OF_EVENTS_DATA.CAUSE_FACTOR,
            Year([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]) AS EVENT_YEAR,
            STAGE_NTSB2_EVENT_DATA.EVENT_LCL_TIME,
            STAGE_NTSB2_EVENT_DATA.LIGHT_COND_DESC,
            STAGE_NTSB2_OCCURRENCE_DATA.FLT_PHASE,
            STAGE_NTSB2_EVENT_DATA.EVENT_STATE_CODE,
            STAGE_NTSB2_AIRCRAFT_LIST.ACFT_TYPE_CODE,
            Month([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]) AS
            EVENT_MONTH INTO New_1982-2007
FROM        STAGE_NTSB2_AIRCRAFT_LIST INNER JOIN
            (((((STAGE_NTSB2_EVENT_DATA INNER JOIN
            STAGE_NTSB2_BRIEF_REPORT_TBL ON
            STAGE_NTSB2_EVENT_DATA.EVENT_ID =
            STAGE_NTSB2_BRIEF_REPORT_TBL.EVENT_ID) INNER JOIN
            STAGE_NTSB2_FLIGHT_CREW_DATA ON
            STAGE_NTSB2_EVENT_DATA.EVENT_ID =
            STAGE_NTSB2_FLIGHT_CREW_DATA.EVENT_ID) INNER JOIN
            STAGE_NTSB2_FLIGHT_TIME_DATA ON
            (STAGE_NTSB2_FLIGHT_CREW_DATA.FLIGHT_CREW_NBR =
            STAGE_NTSB2_FLIGHT_TIME_DATA.FLIGHT_CREW_NBR) AND
            (STAGE_NTSB2_FLIGHT_CREW_DATA.ACFT_SEQ =
            STAGE_NTSB2_FLIGHT_TIME_DATA.ACFT_SEQ) AND
            (STAGE_NTSB2_FLIGHT_CREW_DATA.EVENT_ID =
            STAGE_NTSB2_FLIGHT_TIME_DATA.EVENT_ID) AND
            (STAGE_NTSB2_EVENT_DATA.EVENT_ID =
            STAGE_NTSB2_FLIGHT_TIME_DATA.EVENT_ID)) INNER JOIN
            STAGE_NTSB2_OCCURRENCE_DATA ON
            STAGE_NTSB2_EVENT_DATA.EVENT_ID =
            STAGE_NTSB2_OCCURRENCE_DATA.EVENT_ID) INNER JOIN
```

```
            STAGE_NTSB2_SEQ_OF_EVENTS_DATA ON
            (STAGE_NTSB2_OCCURRENCE_DATA.OCCURRENCE_NBR =
            STAGE_NTSB2_SEQ_OF_EVENTS_DATA.OCCURRENCE_NBR) AND
            (STAGE_NTSB2_OCCURRENCE_DATA.ACFT_SEQ =
            STAGE_NTSB2_SEQ_OF_EVENTS_DATA.ACFT_SEQ) AND
            (STAGE_NTSB2_OCCURRENCE_DATA.EVENT_ID =
            STAGE_NTSB2_SEQ_OF_EVENTS_DATA.EVENT_ID) AND
            (STAGE_NTSB2_EVENT_DATA.EVENT_ID =
            STAGE_NTSB2_SEQ_OF_EVENTS_DATA.EVENT_ID)) ON
            (STAGE_NTSB2_EVENT_DATA.EVENT_ID =
            STAGE_NTSB2_AIRCRAFT_LIST.EVENT_ID) AND
            (STAGE_NTSB2_AIRCRAFT_LIST.EVENT_ID =
            STAGE_NTSB2_BRIEF_REPORT_TBL.EVENT_ID) AND
            (STAGE_NTSB2_AIRCRAFT_LIST.ACFT_SEQ =
            STAGE_NTSB2_BRIEF_REPORT_TBL.ACFT_SEQ) AND
            (STAGE_NTSB2_AIRCRAFT_LIST.EVENT_ID =
            STAGE_NTSB2_FLIGHT_CREW_DATA.EVENT_ID) AND
            (STAGE_NTSB2_AIRCRAFT_LIST.ACFT_SEQ =
            STAGE_NTSB2_FLIGHT_CREW_DATA.ACFT_SEQ) AND
            (STAGE_NTSB2_AIRCRAFT_LIST.EVENT_ID =
            STAGE_NTSB2_OCCURRENCE_DATA.EVENT_ID) AND
            (STAGE_NTSB2_AIRCRAFT_LIST.ACFT_SEQ =
            STAGE_NTSB2_OCCURRENCE_DATA.ACFT_SEQ)
GROUP BY    STAGE_NTSB2_BRIEF_REPORT_TBL.EVENT_ID,
            STAGE_NTSB2_BRIEF_REPORT_TBL.NTSB_RPRT_NBR,
            STAGE_NTSB2_BRIEF_REPORT_TBL.EV_TYPE_DESC,
            STAGE_NTSB2_AIRCRAFT_LIST.FLTCNDCT_CODE,
            STAGE_NTSB2_BRIEF_REPORT_TBL.INJURY_DESC,
            STAGE_NTSB2_SEQ_OF_EVENTS_DATA.CAUSE_FACTOR,
            Year([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]),
            STAGE_NTSB2_EVENT_DATA.EVENT_LCL_TIME,
            STAGE_NTSB2_EVENT_DATA.LIGHT_COND_DESC,
            STAGE_NTSB2_OCCURRENCE_DATA.FLT_PHASE,
            STAGE_NTSB2_EVENT_DATA.EVENT_STATE_CODE,
            STAGE_NTSB2_AIRCRAFT_LIST.ACFT_TYPE_CODE,
            Month([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE])
HAVING      (((STAGE_NTSB2_AIRCRAFT_LIST.FLTCNDCT_CODE) Is Not Null) AND
            ((STAGE_NTSB2_BRIEF_REPORT_TBL.INJURY_DESC) Is Not Null) AND
            ((Year([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]))>=1982 And
            (Year([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]))<=2007))
ORDER BY    STAGE_NTSB2_BRIEF_REPORT_TBL.NTSB_RPRT_NBR;
```

The following queries customize the denormalized table `New_1982-2007` to gather the required data, such as monthly GA accident frequency, time frequency, and frequency of GA accident by phases of flight, both nationally and by region.

To get fatal GA accidents involving AIR (aircraft)-type only in year 2000:

```
SELECT     EVENT_ID, NTSB_RPRT_NBR, FLTCNDCT_CODE, INJURY_DESC,
           EVENT_YEAR, EVENT_MONTH, EVENT_LCL_TIME, FLT_PHASE,
           ACFT_TYPE_CODE
FROM       [New_1982-2007]
```

```
WHERE      ACFT_TYPE_CODE="AIR" AND FLTCNDCT_CODE="091" AND
           INJURY_DESC="fatal" AND EVENT_YEAR=2000;
```

To get nonfatal GA accidents involving AIR-type only in the year 2000:

```
SELECT     EVENT_ID, NTSB_RPRT_NBR, FLTCNDCT_CODE, INJURY_DESC,
           EVENT_YEAR, EVENT_MONTH, EVENT_LCL_TIME, FLT_PHASE,
           ACFT_TYPE_CODE
FROM       [New_1982-2007]
WHERE      ACFT_TYPE_CODE="AIR" AND FLTCNDCT_CODE="091" AND Not
           INJURY_DESC="fatal" AND EVENT_YEAR=2000;
```

To get data of fatal GA accidents involving AIR-type only that occurred in February:

```
SELECT     EVENT_ID, NTSB_RPRT_NBR, FLTCNDCT_CODE, INJURY_DESC,
           EVENT_YEAR, EVENT_MONTH, EVENT_LCL_TIME, FLT_PHASE,
           ACFT_TYPE_CODE
FROM       [New_1982-2007]
WHERE      ACFT_TYPE_CODE="AIR" AND FLTCNDCT_CODE="091" AND
           INJURY_DESC="fatal" AND EVENT_MONTH=2;
```

To get data of fatal GA accidents involving AIR-type that occurred between 6 a.m. and 7 a.m.:

```
SELECT     EVENT_ID, NTSB_RPRT_NBR, FLTCNDCT_CODE, INJURY_DESC,
           EVENT_YEAR, EVENT_MONTH, EVENT_LCL_TIME, FLT_PHASE,
           ACFT_TYPE_CODE
FROM       [New_1982-2007]
WHERE      ACFT_TYPE_CODE="AIR" AND FLTCNDCT_CODE="091" AND
           INJURY_DESC="fatal" AND EVENT_LCL_TIME>=600 AND
           EVENT_LCL_TIME<=660;
```

A.2 QUERIES FOR PURPOSE OF FLIGHT.

The data for this section were gathered from the NTSB Accidents and Incidents Database. The following queries were made for collecting national and regional frequency data of GA accidents. The procedure to query the database consisted of two main steps. First, a denormalized table was created that consisted of a grouping of all the relevant data fields from multiple tables. This new table was then used as a common data set for multiple queries based on the varying parameters of interest under investigation.

```
SELECT     STAGE_NTSB2_BRIEF_REPORT_TBL.EVENT_ID,
           STAGE_NTSB2_BRIEF_REPORT_TBL.NTSB_RPRT_NBR,
           STAGE_NTSB2_BRIEF_REPORT_TBL.EV_TYPE_DESC,
           STAGE_NTSB2_AIRCRAFT_LIST.FLTCNDCT_CODE,
           STAGE_NTSB2_BRIEF_REPORT_TBL.INJURY_DESC,
           Year([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]) AS EVENT_YEAR,
           Month([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE])            AS
           EVENT_MONTH,          STAGE_NTSB2_EVENT_DATA.EVENT_LCL_TIME,
           STAGE_NTSB2_OCCURRENCE_DATA.FLT_PHASE,
           STAGE_NTSB2_EVENT_DATA.EVENT_STATE_CODE,
           STAGE_NTSB2_AIRCRAFT_LIST.ACFT_TYPE_CODE,
```

```
          STAGE_NTSB2_AIRCRAFT_LIST.OPRTR_PERSNL_BIZ_DESC          INTO
          [Purpose_1982-2007]
FROM      STAGE_NTSB2_AIRCRAFT_LIST              INNER              JOIN
          (((((STAGE_NTSB2_EVENT_DATA             INNER             JOIN
          STAGE_NTSB2_BRIEF_REPORT_TBL                                ON
          STAGE_NTSB2_EVENT_DATA.EVENT_ID                              =
          STAGE_NTSB2_BRIEF_REPORT_TBL.EVENT_ID)       INNER        JOIN
          STAGE_NTSB2_FLIGHT_CREW_DATA                                ON
          STAGE_NTSB2_EVENT_DATA.EVENT_ID                              =
          STAGE_NTSB2_FLIGHT_CREW_DATA.EVENT_ID)       INNER        JOIN
          STAGE_NTSB2_FLIGHT_TIME_DATA                                ON
          (STAGE_NTSB2_FLIGHT_CREW_DATA.FLIGHT_CREW_NBR                =
          STAGE_NTSB2_FLIGHT_TIME_DATA.FLIGHT_CREW_NBR)              AND
          (STAGE_NTSB2_FLIGHT_CREW_DATA.ACFT_SEQ                       =
          STAGE_NTSB2_FLIGHT_TIME_DATA.ACFT_SEQ)                     AND
          (STAGE_NTSB2_FLIGHT_CREW_DATA.EVENT_ID                       =
          STAGE_NTSB2_FLIGHT_TIME_DATA.EVENT_ID)                     AND
          (STAGE_NTSB2_EVENT_DATA.EVENT_ID                             =
          STAGE_NTSB2_FLIGHT_TIME_DATA.EVENT_ID))       INNER       JOIN
          STAGE_NTSB2_OCCURRENCE_DATA                                 ON
          STAGE_NTSB2_EVENT_DATA.EVENT_ID                              =
          STAGE_NTSB2_OCCURRENCE_DATA.EVENT_ID)        INNER        JOIN
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA                              ON
          (STAGE_NTSB2_OCCURRENCE_DATA.OCCURRENCE_NBR                  =
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.OCCURRENCE_NBR)             AND
          (STAGE_NTSB2_OCCURRENCE_DATA.ACFT_SEQ                        =
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.ACFT_SEQ)                   AND
          (STAGE_NTSB2_OCCURRENCE_DATA.EVENT_ID                        =
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.EVENT_ID)                   AND
          (STAGE_NTSB2_EVENT_DATA.EVENT_ID                             =
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.EVENT_ID))                   ON
          (STAGE_NTSB2_EVENT_DATA.EVENT_ID                             =
          STAGE_NTSB2_AIRCRAFT_LIST.EVENT_ID)                        AND
          (STAGE_NTSB2_AIRCRAFT_LIST.EVENT_ID                          =
          STAGE_NTSB2_BRIEF_REPORT_TBL.EVENT_ID)                     AND
          (STAGE_NTSB2_AIRCRAFT_LIST.ACFT_SEQ                          =
          STAGE_NTSB2_BRIEF_REPORT_TBL.ACFT_SEQ)                     AND
          (STAGE_NTSB2_AIRCRAFT_LIST.EVENT_ID                          =
          STAGE_NTSB2_FLIGHT_CREW_DATA.EVENT_ID)                     AND
          (STAGE_NTSB2_AIRCRAFT_LIST.ACFT_SEQ                          =
          STAGE_NTSB2_FLIGHT_CREW_DATA.ACFT_SEQ)                     AND
          (STAGE_NTSB2_AIRCRAFT_LIST.EVENT_ID                          =
          STAGE_NTSB2_OCCURRENCE_DATA.EVENT_ID)                      AND
          (STAGE_NTSB2_AIRCRAFT_LIST.ACFT_SEQ                          =
          STAGE_NTSB2_OCCURRENCE_DATA.ACFT_SEQ)
GROUP BY  STAGE_NTSB2_BRIEF_REPORT_TBL.EVENT_ID,
          STAGE_NTSB2_BRIEF_REPORT_TBL.NTSB_RPRT_NBR,
          STAGE_NTSB2_BRIEF_REPORT_TBL.EV_TYPE_DESC,
          STAGE_NTSB2_AIRCRAFT_LIST.FLTCNDCT_CODE,
          STAGE_NTSB2_BRIEF_REPORT_TBL.INJURY_DESC,
          Year([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]),
          Month([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]),
          STAGE_NTSB2_EVENT_DATA.EVENT_LCL_TIME,
          STAGE_NTSB2_OCCURRENCE_DATA.FLT_PHASE,
```

```
          STAGE_NTSB2_EVENT_DATA.EVENT_STATE_CODE,
          STAGE_NTSB2_AIRCRAFT_LIST.ACFT_TYPE_CODE,
          STAGE_NTSB2_AIRCRAFT_LIST.OPRTR_PERSNL_BIZ_DESC
HAVING    (((STAGE_NTSB2_AIRCRAFT_LIST.FLTCNDCT_CODE) Is Not Null) AND
          ((STAGE_NTSB2_BRIEF_REPORT_TBL.INJURY_DESC) Is Not Null) AND
          ((Year([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]))>=1982    And
          (Year([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]))<=2007)    AND
          ((STAGE_NTSB2_AIRCRAFT_LIST.ACFT_TYPE_CODE) Is Not Null) AND
          ((STAGE_NTSB2_AIRCRAFT_LIST.OPRTR_PERSNL_BIZ_DESC)   Is   Not
          Null))
ORDER BY  STAGE_NTSB2_BRIEF_REPORT_TBL.NTSB_RPRT_NBR;
```

A.3 QUERIES FOR PHASE 3.

The data for this analysis were gathered from the NTSB accidents and incidents database. The procedure to query the database consisted of two main steps. First, a denormalized table was created that consisted of a grouping of all the relevant data fields from multiple tables. This new table was then used as a common data set for multiple queries based on the varying parameters of interest under investigation.

The SQL query statement below creates a denormalized table called `FIRST_CAUSES_National` containing the fields `NTSB_RPRT_NBR`, `EVENT_ID`, `EVENT_YEAR`, `INJURY_DESC`, `CAUSE_FACTOR_CODE`, `SUBJECT`, `SUBJECT_CODE`, and `REGION`:

```
SELECT    STAGE_NTSB2_EVENT_DATA.NTSB_RPRT_NBR,
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.EVENT_ID,
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.SUBJECT_CODE,
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.SUBJECT,
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.CAUSE_FACTOR_CODE,
          Year([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE]) AS EVENT_YEAR,
          STAGE_NTSB2_BRIEF_REPORT_TBL.INJURY_DESC,
          STAGE_NTSB2_REGIONS.REGION AS REGION INTO
          [FIRST_CAUSES_National]
FROM      STAGE_NTSB2_REGIONS INNER JOIN
          ((STAGE_NTSB2_EVENT_DATA INNER JOIN
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA ON
          STAGE_NTSB2_EVENT_DATA.EVENT_ID =
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.EVENT_ID) INNER JOIN
          (STAGE_NTSB2_AIRCRAFT_LIST INNER JOIN
          STAGE_NTSB2_BRIEF_REPORT_TBL ON
          (STAGE_NTSB2_AIRCRAFT_LIST.EVENT_ID =
          STAGE_NTSB2_BRIEF_REPORT_TBL.EVENT_ID) AND
          (STAGE_NTSB2_AIRCRAFT_LIST.ACFT_SEQ =
          STAGE_NTSB2_BRIEF_REPORT_TBL.ACFT_SEQ)) ON
          STAGE_NTSB2_EVENT_DATA.EVENT_ID =
          STAGE_NTSB2_AIRCRAFT_LIST.EVENT_ID) ON
          STAGE_NTSB2_REGIONS.STATE =
          STAGE_NTSB2_EVENT_DATA.EVENT_STATE_CODE
WHERE     (((STAGE_NTSB2_SEQ_OF_EVENTS_DATA.SUBJECT_CODE) Is Not Null
          And (STAGE_NTSB2_SEQ_OF_EVENTS_DATA.SUBJECT_CODE)<>25000)
          AND ((STAGE_NTSB2_SEQ_OF_EVENTS_DATA.CAUSE_FACTOR_CODE)="c")
          AND ((Year([STAGE_NTSB2_EVENT_DATA.EVENT_LCL_DATE])) Between
```

```
          1982 And 2007) AND
          ((STAGE_NTSB2_BRIEF_REPORT_TBL.INJURY_DESC) Is Not Null) AND
          ((STAGE_NTSB2_AIRCRAFT_LIST.FLTCNDCT_CODE)="091") AND
          ((STAGE_NTSB2_AIRCRAFT_LIST.ACFT_TYPE_CODE)="air") AND
          ((STAGE_NTSB2_EVENT_DATA.EV_TYPE_DESC) Is Not Null))
ORDER BY  STAGE_NTSB2_SEQ_OF_EVENTS_DATA.EVENT_ID,
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.OCCURRENCE_NBR,
          STAGE_NTSB2_SEQ_OF_EVENTS_DATA.SEQ_EVENT_NBR;
```

The two SQL query statements below provide general framework that uses the results from the `FIRST_CAUSES_National` table to generate unique `SUBJECT_CODE` and its frequency of occurrence, as well as the name of the `SUBJECT` itself based on an appropriate combination of the fields `EVENT_YEAR` and `INJURY_DESC`. The combination of both query statements gives the list of first causes of fatal GA accidents. The specific example below generates a list of all unique first causes that contributed to fatal accidents or incidents between 1982 and 2007. Note the use of the `DISTINCT` clause in the `SELECT` statement for generating the name of the subject, which ensures that only one unique subject is generated for an event (in this specific example, causes only).

```
SELECT    SUBJECT_CODE, COUNT(SUBJECT_CODE) AS FREQUENCY
FROM      [FIRST_CAUSES_National]
WHERE     (EVENT_YEAR Between 1982 And 1987) AND (INJURY_DESC="fatal")
GROUP BY  SUBJECT_CODE;

SELECT DISTINCT SUBJECT_CODE, SUBJECT
FROM      FIRST_CAUSES_National
WHERE     (EVENT_YEAR Between 1982 And 1987) AND
          (INJURY_DESC="fatal");
```

APPENDIX B—PHASES OF FLIGHT GROUPS

To describe causal factors, 11 phases of flight are used. These phases were obtained from the National Transportation Safety Board (NTSB) database and ordered by NTSB Flight Phase Codes. The codes corresponding to the various phases available in the NTSB database and the derived phases of flight used in this report are presented below.

Standing:

500	Standing	⇒	**Standing**
501	Standing – Preflight	⇒	**Standing**
502	Standing – Starting Engine(s)	⇒	**Standing**
503	Standing – Engine(s) Operating	⇒	**Standing**
504	Standing – Engine(s) Not Operating	⇒	**Standing**
505	Standing – Idling Rotors	⇒	**Standing**

Taxi:

510	Taxi	⇒	**Taxi**
511	Taxi – Pushback/Tow	⇒	**Taxi**
512	Taxi – To Takeoff	⇒	**Taxi**
513	Taxi – From Landing	⇒	**Taxi**
514	Taxi – Aerial	⇒	**Taxi**

Takeoff:

520	Takeoff	⇒	**Takeoff**
521	Takeoff – Roll/Run	⇒	**Takeoff**
522	Takeoff – Initial Climb	⇒	**Takeoff**
523	Takeoff – Aborted	⇒	**Takeoff**

Climb:

530	Climb	⇒	**Climb**
531	Climb – To Cruise	⇒	**Climb**

Cruise:

540	Cruise	⇒	**Cruise**
541	Cruise – Normal	⇒	**Cruise**

Descent:

550	Descent	⇒	**Descent**
551	Descent – Normal	⇒	**Descent**
552	Descent – Emergency	⇒	**Descent**
553	Descent – Uncontrolled	⇒	**Descent**

Approach:

560	Approach	⇒	**Approach**
561	Approach – Visual Flight Rules (VFR) Pattern – Downwind	⇒	**Approach**
562	Approach – VFR Pattern – Base Turn	⇒	**Approach**
563	Approach – VFR Pattern – Base Leg/Base to Final	⇒	**Approach**
564	Approach – VFR Pattern – Final Approach	⇒	**Approach**
566	Approach – IAF to FAF/Outer Marker (IFR)	⇒	**Approach**

567	Approach – FAF/Outer Marker to Threshold (IFR)	⇒	**Approach**
568	Approach – Circling (IFR)	⇒	**Approach**

Go Around:

565	Go-Around (VFR)	⇒	**Missed Approach**

Missed Approach:

569	Missed Approach (IFR)	⇒	**Missed Approach**

Landing:

570	Landing	⇒	**Landing**
571	Landing – Flare/Touchdown	⇒	**Landing**
572	Landing – Roll	⇒	**Landing**
573	Landing – Aborted	⇒	**Landing**

Emergency Landing:

574	Emergency Landing	⇒	**Landing**
575	Emergency Landing After Takeoff	⇒	**Landing**
576	Emergency Descent/Landing	⇒	**Descent**

Maneuvering:

580	Maneuvering	⇒	**Maneuvering**
581	Maneuvering – Aerial Application	⇒	**Maneuvering**
582	Maneuvering – Turn to Reverse	⇒	**Maneuvering**
583	Maneuvering – Turn to Landing	⇒	**Maneuvering**
542	Maneuvering – Holding (IFR)	⇒	**Maneuvering**

Hover:

590	Hover	⇒	**Other**
591	Hover – In Ground Effect	⇒	**Other**
592	Hover – Out of Ground Effect	⇒	**Other**

Other:

600	Other	⇒	**Other**

Unknown:

610	Unknown	⇒	**Other**

APPENDIX C—PURPOSE OF FLIGHT CATEGORIES

The following definitions are excerpted from the National Transportation Safety Board Form 6120.1 and the General Aviation and Title 14 Code of Federal Regulations (CFR) Part 135 Activity Survey.

Category	
General Use	Personal/Recreation—Flying for personal reasons (excludes business transportation)
	Instructional—Flying under the supervision of a flight instructor, including student pilot solo (excludes positioning flights, proficiency flights, training, ferrying, sales demos)
	Business Transportation—Individual or group use for business transportation without a paid flight crew
	Corporate/Executive Transportation—Individual or group business transportation with a paid flight crew (includes fractional ownership)
	Air Medical Services—Air ambulance services, rescue, human organ transportation, emergency medical services (excludes Air Medical Services conducted under 14 CFR Part 135)
	Sight-seeing—Commercial sight-seeing conducted under 14 CFR Part 91
	Aerial Observation—Aerial mapping/photography, patrol, search and rescue, hunting, traffic advisory, ranching, surveillance, oil and mineral exploration, etc.
	Aerial Application in Agriculture and Forestry—Crop and timber production, including fertilizer and pesticide application
	Other Aerial Application—Public health sprayings, cloud seeding, fire fighting including forest fires, etc.
	External Load—Operation under 14 CFR Part 133, rotorcraft external load operations; examples include: helicopter hoist, hauling logs, etc.
	Other Work Use—Construction work (excluding 14 CFR Part 135 operation), parachuting, aerial advertising, towing gliders, etc.
	Other—Positioning flights, proficiency flights, training, ferrying, sales demos, etc.

APPENDIX D—CODES AND DEFINITION FOR CAUSES

The codes and definitions mentioned in this appendix were adopted from the National Transportation Safety Board (NTSB) Coding Manual.

CAUSE_CODE	CAUSE_Desc	MODIFIER_CODE	MODIFIER_ Desc.
24566	AIRCRAFT CONTROL	3127	NOT MAINTAINED
24566	AIRCRAFT CONTROL	3140	UNCONTROLLED
24566	AIRCRAFT CONTROL	3115	INADEQUATE
24566	AIRCRAFT CONTROL	3122	NOT ATTAINED
24566	AIRCRAFT CONTROL	3131	NOT POSSIBLE
24566	AIRCRAFT CONTROL	3146	ABRUPT
24506	AIRSPEED	3127	NOT MAINTAINED
24506	AIRSPEED	3115	INADEQUATE
24506	AIRSPEED	3108	EXCESSIVE
24506	AIRSPEED	3120	MISJUDGED
24506	AIRSPEED	3101	BELOW
24506	AIRSPEED	3109	IMPROPER
24506	AIRSPEED	3122	NOT ATTAINED
24506	AIRSPEED	3125	NOT IDENTIFIED
24506	AIRSPEED	3129	NOT OBTAINED
24566	AIRSPEED (VS)	3127	NOT MAINTAINED
24566	AIRSPEED (VS)	3107	EXCEEDED
24566	AIRSPEED (VS)	3115	INADEQUATE
24566	AIRSPEED (VS)	3122	NOT ATTAINED
24566	AIRSPEED (VS)	3129	NOT OBTAINED
24566	AIRSPEED (VS)	3112	ABRUPT
24518	ALTITUDE/CLEARANCE	3115	INADEQUATE
24518	ALTITUDE/CLEARANCE	3120	MISJUDGED
24518	ALTITUDE/CLEARANCE	3127	NOT MAINTAINED
24518	ALTITUDE/CLEARANCE	3109	IMPROPER
24518	ALTITUDE/CLEARANCE	3122	NOT ATTAINED
24518	ALTITUDE/CLEARANCE	3106	DISREGARDED
24518	CLEARANCE	3115	INADEQUATE
24518	CLEARANCE	3120	MISJUDGED
24518	CLEARANCE	3127	NOT MAINTAINED
24518	CLEARANCE	3109	IMPROPER
24518	CLEARANCE	3122	NOT ATTAINED
24518	CLEARANCE	3106	DISREGARDED
24026	COMPENSATION FOR WIND CONDITIONS	3109	IMPROPER
24026	COMPENSATION FOR WIND CONDITIONS	3122	NOT ATTAINED
24026	COMPENSATION FOR WIND CONDITIONS	3131	NOT POSSIBLE
24539	DIRECTIONAL CONTROL	3127	NOT MAINTAINED
24535	FLARE	3120	MISJUDGED
24535	FLARE	3109	IMPROPER
17001	FLUID, FUEL	1131	EXHAUSTION

CAUSE_CODE	CAUSE_Desc	MODIFIER_CODE	MODIFIER_ Desc.
17001	FLUID, FUEL	1183	STARVATION
17001	FLUID, FUEL	1147	IMPROPER
17001	FLUID, FUEL	1193	WATER
17001	FLUID, FUEL	1115	CONTAMINATION
17001	FLUID, FUEL	1146	ICE
24010	IN-FLIGHTPLANNING/DECISION	3109	IMPROPER
24010	IN-FLIGHT PLANNING/DECISION	3136	POOR
24010	IN-FLIGHT PLANNING/DECISION	3115	INADEQUATE
24010	IN-FLIGHT PLANNING/DECISION	3111	INACCURATE
24010	IN-FLIGHT PLANNING/DECISION	3120	MISJUDGED
24010	IN-FLIGHT PLANNING/DECISION	3128	NOT PERFORMED
24010	IN-FLIGHT PLANNING/DECISION	3129	NOT OBTAINED
24001	PREFLIGHT PLANNING/PREPARATION	3115	INADEQUATE
24001	PREFLIGHT PLANNING/PREPARATION	3109	IMPROPER
24001	PREFLIGHT PLANNING/PREPARATION	3136	POOR
24001	PREFLIGHT PLANNING/PREPARATION	3128	NOT PERFORMED
24001	PREFLIGHT PLANNING/PREPARATION	3110	IMPROPER USE OF
24001	PREFLIGHT PLANNING/PREPARATION	3130	NOT UNDERSTOOD
24001	PREFLIGHT PLANNING/PREPARATION	3135	PERFORMED
24001	PREFLIGHT PLANNING/PREPARATION	3114	INTENTIONAL
24001	PREFLIGHT PLANNING/PREPARATION	3120	MISJUDGED
24001	UNSUITABLE TERRAIN OR TAKEOFF/LANDING/TAXI AREA	3114	INTENTIONAL
24001	UNSUITABLE TERRAIN OR TAKEOFF/LANDING/TAXI AREA	3109	IMPROPER
24001	UNSUITABLE TERRAIN OR TAKEOFF/LANDING/TAXI AREA	3133	NOT SELECTED
24001	UNSUITABLE TERRAIN OR TAKEOFF/LANDING/TAXI AREA	3120	MISJUDGED
24001	UNSUITABLE TERRAIN OR TAKEOFF/LANDING/TAXI AREA	3110	IMPROPER USE OF
24001	UNSUITABLE TERRAIN OR TAKEOFF/LANDING/TAXI AREA	3130	NOT UNDERSTOOD
24015	VFR FLIGHT INTO IMC	3118	INITIATED
24015	VFR FLIGHT INTO IMC	3114	INTENTIONAL
24015	VFR FLIGHT INTO IMC	3115	INADEQUATE
24021	VISUAL LOOKOUT	3115	INADEQUATE
24021	VISUAL LOOKOUT	3127	NOT MAINTAINED
24021	VISUAL LOOKOUT	3136	POOR
24021	VISUAL LOOKOUT	3131	NOT POSSIBLE
24021	VISUAL LOOKOUT	3112	INATTENTIVE
24021	VISUAL LOOKOUT	3128	NOT PERFORMED
24021	VISUAL LOOKOUT	3138	REDUCED
24021	VISUAL LOOKOUT	3145	RESTRICTED