# Sightseeing Accidents with Helicopters and Fixed-Wing Aircraft

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**BACKGROUND:** Sightseeing operations are characterized by the presence of passengers as well as favorable light and weather conditions. They include both fixed-wing aircraft and helicopters, an aspect that allows for a comparison of these two types of aircraft in similar operations.

**METHODS:** A total of 95 accident reports from 2008 until 2018 were extracted from the NTSB online database, with each mentioning commercial sightseeing as their operation.

**RESULTS:** Out of a total of 95 accidents, 16 were fatal with a total of 58 people suffering fatal injuries. On average 3.625 people died in each fatal accident. There were significantly more accidents in Alaska and Hawaii than expected. There were significantly more accidents caused by the maintenance crew in helicopters than in airplanes, but significantly more pilot-related accidents in fixed-wing aircraft compared to helicopters. Despite favorable light and weather conditions, 37 accidents reported the environment as a contributing factor to the accident.

**CONCLUSION:** Sightseeing accidents show a pronounced difference between helicopters and airplane accidents that point to different approaches when improving safety in either category. Although night and instrument meteorological conditions are largely absent in the dataset, wind conditions and unsuitable terrain are frequently mentioned. The experience of the pilots and the specific geography of the sightseeing area are likely to affect operational safety the most. The specific dangers of unsuitable terrain affect both helicopters and fixed-wing operations and may be assuaged by specific training or briefings.

**KEYWORDS:** helicopters, general aviation, Hawaii, Alaska.

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Sightseeing operations are characterized by the presence of passengers as well as favorable light and weather conditions. Their operations may include unusual environments, such as glaciers and mountains, and are likely to be more prominent in tourist areas and in tourist seasons, such as the summer months. The operations include both fixed-wing aircraft and helicopters, which allows for a comparison of these two types of aircraft in similar operations and in presumably favorable meteorological environments.

The added responsibility of a sightseeing pilot to carry passengers highlights the significance of safety in this type of operation. While weather as well as unfavorable light conditions have been identified as the main factors for fatal accidents for air carriers and general aviation, sightseeing accidents are likely to point to different factors that may mitigate the number of fatalities or the overall number of accidents.[1,2,4]

The difference between fixed-wing aircraft and helicopters in sightseeing operations should also take into account the types of aircraft that are involved. For instance, turbine-engine helicopters may carry a larger number of passengers than those with a piston engine, but operating such machines is commonly more expensive. Turbine-engine helicopters are often operated by more experienced pilots and do not necessarily compare to operations with fixed-wing aircraft using reciprocating engines.

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Where necessary, we highlight the differences between fixed-wing aircraft and helicopters to make the data more insightful.

This study compares and relates causes of both fatal and nonfatal accidents in sightseeing. It highlights the difference between factors affecting helicopter and airplane accidents and contrasts sightseeing with other types of operations.

## METHODS

For an analysis of sightseeing accidents, we drew our dataset from the National Transportation Safety Board (NTSB) Aviation Online Database using their Case Analysis and Reporting Online (CAROL) interface.[8] We extracted all airplane and helicopter accidents that mentioned "commercial sightseeing" as their operation. Only completed reports were selected and the selection was limited by accidents taking place in the United States from 1/1/2008 until 12/31/2018. The total dataset includes 95 accidents.

Each accident report has a factual and a probable cause statement that summarizes the findings of the NTSB investigator with a narrative statement, a set of findings that determines the cause and contributing factors of the incident, as well as data on the pilot, aircraft, airfield, and meteorological conditions. The categorical data were extracted from each report while the narrative statements were coded for elements specific to sightseeing, such as unusual landing areas or the role of passengers in an accident.

Significant associations were sought that distinguished fatal from nonfatal accidents to assist in identifying strategies to mitigate the number of fatal accidents as well as the total number of accidents. We used a Pearson's Chi-squared analysis and, in the case of counts lower than 5, a Fisher exact test at the significance level of 0.05 to determine the significance of relations between categorical data in our dataset.

## RESULTS

Out of a total of 95 accidents, 16 (16.8%) were fatal with a total of 58 people suffering fatal injuries, i.e., for every fatal accident an average of 3.625 people died. An additional 24 people reported serious injuries. Fixed-wing aircraft counted 9 fatal accidents out of a total of 55 accidents and helicopter aircraft involved 7 fatal accidents among a total of 40 accidents; the proportion of fatal accidents was not significantly different. Only 4 aircraft were completely destroyed and 2 others suffered minor or no damage, with the remainder reporting substantial damage ($N = 88$). One case did not report the damage to the aircraft.

The mean pilot age was 47.7 yr with a median total flight time of 3100 h. The helicopter and fixed-wing pilots' median age was 38 and 52 yr of age, respectively. The helicopter pilots' median total flight experience was 2100 h and 4681.5 h for fixed-wing pilots.

During the investigated time period, most accidents occurred in 2017 ($N = 14$) and the fewest in 2010, 2012, and 2015 ($N = 6$). The most common months for accidents were June ($N = 21$), July ($N = 13$), and August ($N = 9$) and the least common October ($N = 3$), December ($N = 3$), and January ($N = 3$).

The highest number of accidents was found in Alaska ($N = 20$) and Florida ($N = 11$), with 3 and 0 fatal accidents, respectively. Both Hawaii ($N = 9$) and Alaska ($N = 20$) were significantly overrepresented in our sample when comparing our dataset to the total number of accidents in the United States. There were significantly more accidents that occurred in Hawaii in our sightseeing sample (9 out of 95) than in the United States as a whole (89 out of 14,939; $\chi^2 = 114.89$, df $= 1$, $P < 0.0001$). Similarly, there were significantly more accidents in Alaska in our sample (20 out of 95) than in the general U.S. dataset for this period (1011 out of 15,861; $\chi^2 = 33.66$, df $= 1$, $P < 0.0001$). Accidents in Alaska included 19 fixed-wing airplanes and 1 helicopter while the Hawaiian accidents involved 1 airplane and 8 helicopters.

The dataset had a similar number of airplane ($N = 55$) and helicopter ($N = 40$) accidents. Most of the operations in our accident set were conducted under Part 91, General Aviation ($N = 39$), with 8 fatal accidents, and Part 135, Air Taxi and Commuter Nonscheduled operations ($N = 56$), also with 8 fatal accidents. Part 91 accidents did not have a significantly higher proportion of fatalities ($P > 0.05$) than Part 135. There were 24 accidents with airplanes operating under Part 135 and 12 with helicopters, but this difference was not significant ($P > 0.05$).

In total 22 aircraft had a turbine engine, while 73 had a reciprocating engine. However, almost every airplane in the sample had a reciprocating engine (52 out of 55), with the helicopters accounting for most of the turbine engines.

Most fatal accidents occurred during the enroute flight phase (11 out of 16), which is significantly more than the other flight phases combined ($\chi^2 = 5.60$, df $= 1$, $P < 0.05$; **Table I**). Weather conditions were reported as visual meteorological conditions (VMC) in all cases. Most accidents ($N = 93$) occurred in daylight conditions with only 2 occurring at dusk,

**Table I.** Helicopter vs. Fixed-Wing Aircraft.

| | HELICOPTER PILOT | FIXED-WING PILOT | HELICOPTER | FIXED-WING AIRCRAFT |
|---|---|---|---|---|
| Age | 38 | 52 | | |
| Experience | 2100 | 4681.5 | | |
| Accidents | | | 40 | 55 |
| Reciprocating engine | | | 21 | 52 |
| Turbine engine | | | 19 | 3 |
| Causes attributed to the pilot | | | 13 | 36 |
| Causes attributed to maintenance crew | | | 10 | 3 |

both of which were fatal (out of a total of 16 fatal accidents in the dataset). One of the accidents that occurred at dusk resulted in one of the four destroyed aircraft in the overall sample.

In addition to VMC and daylight conditions, there were 37 (39%) reports in the dataset that mentioned the environment as a contributing factor to the accident in which pilot errors occurred. These elements included wind gusts ($N = 4$), cross and variable wind ($N = 5$), unsuitable terrain ($N = 6$), clouds ($N = 2$), rain ($N = 1$), and other meteorological conditions ($N = 1$). They contributed to the improper recovery from a bounced landing ($N = 7$), collision with trees ($N = 3$), and insufficient speed ($N = 3$). More than half of the fatal accident reports in the dataset (9 out of 16) mentioned the environment as a contributing factor.

According to the NTSB investigators, most accidents involved human factors and were attributed by the NTSB to the pilot ($N = 48$), flight crew ($N = 1$), maintenance crew (13), and passengers ($N = 2$); i.e., 64 out of 95 (67.4%). Most other accidents had an unknown or undetermined cause. For instance, an aircraft could not be recovered due to the inaccessible nature of the accident site or an aircraft suffered equipment issues that could not be attributed to the maintenance crew due to a lack of information. None of these latter accidents were attributed mainly to the environment. Whenever meteorological conditions were mentioned, they were described as contributing to accidents in which human factors were already involved.

Out of the 16 fatal accidents, 10 were pilot-related, 3 were attributed to maintenance, and the cause of the 3 remaining accidents could not be determined. The primary cause of an accident was attributed to the pilot in 48 cases (50.5%), but differed between helicopters and fixed-wing aircraft. For instance, an improper choice of unusual terrain when taking off, landing, and taxiing included four fixed-wing aircraft and two helicopters. Inadequate speed and altitude only included airplanes ($N = 6$). There were significantly more accidents attributed to the pilot of airplanes (36 out of 55) than those of helicopters (13 out of 40; $\chi^2 = 10.07$, df $= 1$, $P < 0.01$).

Another 13 accidents were attributed to equipment failure and also implicated the maintenance crew (13.7%), of which 4 were fatal and 2 involved serious injuries. Helicopter accidents included five such accidents due to improper inspection vs. one for airplane accidents, and six accidents due to fuel management while fixed-wing aircraft had four. There were significantly more accidents with causes attributed to the maintenance crew in helicopters (10 out of 40) than in airplanes (3 out of 55) ($\chi^2 = 7.49$, df $= 1$, $P < 0.05$). Most equipment-related accidents were related to the engine as shown in **Table II**.

Finally, two accidents had causes that were partly attributed to passengers. In one case, it concerned the improper decision to hold their cellphone outside of the aircraft, which subsequently struck the tail rotor of a helicopter; and in the other case, it involved improper seating, which created contact with the fuel valve. Both accidents had the primary cause attributed to the pilot due to their failure to provide an adequate preflight briefing.

## DISCUSSION

Sightseeing accidents have a lower fatality rate (16.2%) than general aviation accidents (18–23%), which may be explained by the absence of unfavorable weather and light conditions.[2] In our dataset the median number of flight hours for pilots in sightseeing accidents shows that they were more experienced than in general aviation, although the literature is unclear whether experience always has a positive effect on the fatality rate.[2,5,7] Unfortunately, when a fatal accident during sightseeing occurred, an average of 3.6 people suffered fatal injuries because sightseeing flights commonly carry several passengers. This average is much higher than for general aviation accidents, where a factor of 1.9 has been reported.[7]

Sightseeing accidents are concentrated in the summer months and occur significantly more often in Hawaii and Alaska. It is noted that Hawaii and Alaska are also states with the most single-engine turbine helicopter accidents when all operations are combined.[5] While Alaska has been given much attention in the aviation safety literature, Hawaii is largely absent but highlights the importance of state-specific studies.[3,9]

Sightseeing accidents show a pronounced difference between helicopters and airplane accidents that point to different approaches when improving safety in either category. Both types of accidents were affected by human factors, but helicopters showed mostly equipment-related causes while airplanes suffered predominantly from pilot-related causes (see Table I). This difference is at least partially explained by the dominant presence of turbine-engine helicopters, as opposed to reciprocating engines with airplanes (see Table II). The former requires more investment and often has more experienced pilots. This same predominance of equipment-related accidents is found in general studies of turbine-engine helicopters.[5] A lack of denominator data for this type of operation precludes statements concerning the relative risk of either airplane or helicopter in sightseeing operations. Also, the proportion of fatal accidents is not significantly different between the two types of aircraft; therefore, it should not be suggested that fixed-wing aircraft are less safe in sightseeing operations.[6] Although night and instrument meteorological conditions are largely absent in the

**Table II.** Equipment-Related Accidents.

| MAINTENANCE-RELATED ACCIDENTS | HELICOPTER RECIPROCATING | HELICOPTER TURBINE | FIXED-WING RECIPROCATING | FIXED-WING TURBINE |
|---|---|---|---|---|
| Main engine | 2 nonfatal 1 fatal | 1 nonfatal | 2 nonfatal 2 fatal | 1 nonfatal |
| Tail rotor | 1 nonfatal | 1 fatal | 0 | 0 |
| Landing gear | 0 | 1 nonfatal | 1 nonfatal | 0 |

dataset, both wind conditions and unsuitable terrain are frequently mentioned as environmental factors.

Future studies may indicate the extent to which turbine-engine helicopter operations might be preferred to fixed-wing aircraft where small numbers of passengers are concerned. The distribution of helicopter and fixed-wing sightseeing operations may be different per state and preclude a comparison without accounting for geography. Further research on Hawaii and Alaska in combination with denominator data for each state may indicate to what extent the environment explains the number of accidents related to a specific type of aircraft within sightseeing operations.

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