Canadian Ultralight Accidents in Water (1990 to 2020)

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INTRODUCTION: Recently, an analysis of Canadian seaplane accidents terminating in water (1995–2019) was conducted, but ultralight water accidents were excluded due to differences from general aviation operations. This is the first literature that reports a series of ultralight accidents that occurred in water. The purpose of this paper is to identify the circumstances surrounding ultralight water accidents in Canada and to identify actions with the potential to improve survival.

METHODS: Ultralight water accidents that were reported to the Transportation Safety Board of Canada between 1990 and 2020 were reviewed.

RESULTS: Of the 1021 accidents that involved ultralights, 114 terminated in water, involving 155 occupants and 8 fatalities, yielding an occupant mortality rate of 5%. Of the accidents, 52% occurred during landing. There was less than 15 s warning in 78% of cases, which included five (63%) fatalities. The aircraft inverted in 40% of the accidents and, in 21%, it sank immediately. Loss of control was the terminal cause of the accident in 43% of cases, while adverse environmental conditions were reported in 38% of accidents. Little or no details were included on lifejacket or restraint harness use, status of emergency exits, water temperature, or occupant diving experience or underwater escape training.

CONCLUSIONS: The mortality rate in ultralight aircraft water accidents was less than half that of helicopter and seaplane ditchings, but the lack of warning time was similar. All pilots and passengers need to have a well-practiced survival schema before strapping in and can benefit from underwater escape training.

KEYWORDS: ultralight, seaplane, ditching, warning time, escape, crash.

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In 2021, at the request of Transport Canada, survival from Canadian seaplane water accidents between 1995 and 2019 were reported.[9] There were 487 accidents involving 1144 occupants (487 pilots, 657 passengers). The mortality rate was 13% and the principal cause of death was drowning from being trapped within the cabin. There was less than 15 s warning of the impending accident in 86% of cases. A warning time of around 15 s or less is considered an accident characteristic that adversely affects survivability. Over 50% of the seaplanes inverted and 10% floated briefly then sank. Inversion and rapid sinking were both found to be particularly deadly outcomes in this type of accident. While not identical, these factors were in general agreement with those identified for fixed-wing fighter aircraft[5] and what the Transportation Safety Board of Canada (TSB) has published on seaplane accidents[13] and with the findings in ditched helicopter survival reports.[1–3] Ultralight accidents were not included in the 2021 review on seaplanes[9] because ultralights are operated differently from general aviation (GA) seaplanes and are categorized differently by Transport Canada.[4] Ultralight aircraft in Canada are distinguished from GA aircraft by their light weight, low speed, and limited occupancy (a maximum of two people). The Canadian Aviation Regulations divide ultralights into advanced and basic categories. Advanced ultralights must comply with standards for design, construction, performance, modification, and maintenance, whereas basic ultralights do not have such compliance requirements. Further, some ultralights have been assembled by their owners from factory-supplied kits.

Using the classification system of the U.S. Federal Aviation Regulations, advanced ultralights—which accounted for approximately half of the accidents reported in this study—would

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be classified as light sport aircraft. The remainder—basic ultralights—would be classified as ultralights.[7]

Like seaplane accident reports, reports of ultralight accidents on land or water are rarely published in the scientific literature.[6,8,10] Therefore, only comparison to the percentage of fatal or serious injuries can be made. Furthermore, accident rates based on flights or flying hours cannot be determined because Canada does not require aircraft usage to be reported. The purpose of this paper is to identify the circumstances surrounding ultralight water accidents in Canada, compare these to seaplane and helicopter accidents to assess if similar human factors considerations apply, and to identify actions with the potential to improve survival.

METHODS

The authors were interested in all ultralight accidents in water, irrespective of whether the aircraft was fitted with floats or not. After an extensive search of available databases, it was determined that the only reliable data available was the information reported to, or gathered by, the TSB. This data was accessible either digitally on the public website (tsb.gc.ca) or in paper copy physically located in the TSB archives. For this latter data source, a Senior Statistical Analyst from TSB provided assistance. He and a team member searched for additional data in paper files that had not been entered into the electronic TSB database. The narratives and quantitative data from both these sources were extracted and loaded on Microsoft Excel®, reviewed by all four investigators, and transformed as required to support descriptive analysis. For example, when assessing environmental factors, the TSB narrative data was searched for a description of the wind and water conditions, and the accident environmental conditions were recorded in accordance with our classification system.

Similar to the seaplane study,[9] a survival event tree was created involving the pilot and passenger (if carried) from flight planning through embarking, taxiing, takeoff, flight, and landing to the safe return of the ultralight alongside the dock or airfield. The factors examined were: 1) preflight details; 2) factors at the point of impact; 3) post-impact factors; and 4) post-escape factors. Factors associated specifically with the occupants and other aspects of survivability were also investigated and included: pilot experience; evidence of underwater escape training and diving experience; water temperature; status of emergency exits; use of restraint harnesses and life jackets; and the contribution of environmental conditions.

Occurrences where the ultralight landed long and ended up on the beach, or where, after some minor incident, the pilot managed to taxi to the dock and safely disembark the passenger (if carried), were excluded from the analysis. These types of occurrences were not evaluated due to the fact that there were few threats to occupant survival and virtually no injuries or fatalities.

For the majority of human or survivability factors reported, no specified classification system existed. Based on the authors' experience in classifying water ditching,[3,9] the authors created classifications where they were not specified by the TSB, such as warning time.

In previous studies of helicopter and seaplane accidents,[3,9,11] an adequate warning time to take a deep breath, check the seat harness and survival suit, and adopt the crash position prior to sudden water entry were found to be critical to survival. In the current ultralight study, all four authors reviewed the accident reports and available video evidence and estimated whether or not there was less than 15 s warning. Maritime survival educators have historically used this crude but practical number to emphasize advice to crew and passengers that they must be aware of the potential for ditching at any time during the critical phases of flight and, should an event occur, there would be little to no warning, as indicated by the designation of less than 15 s. The assignment of 15 s warning to accidents following this process is consistent with the methods presented in previous publications.[3,9]

When appropriate, a two-tailed Fisher's exact test was used to identify potential differences in categorical variables of sustaining a fatal or serious injury. Fisher's exact was chosen over Chi-squared analysis given the lack of data in the majority of instances, where more than 20% of cells had an expected frequency of less than five. A value of $P < 0.05$ was used as the indicator of statistical significance and all such analyses were performed using SPSS 28.0 (IBM Corp., Armonk, NY, USA). In instances where data was not normally distributed, the median and interquartile range were used to describe the dispersion of the data.

RESULTS

General

A total of 1021 ultralight accidents from 1990 through 2020 were reviewed for the mention of "lake", "river", "sea", or "water" in the narrative. Of these accidents, 114 (11%) terminated in water. There were 155 occupants involved in these accidents (1.4 occupants per accident), including 114 pilots and 41 passengers (6 of whom were student pilots). There were 8 fatalities, 8 serious injuries, and 25 minor injuries which occurred across 31 accidents. In 13 of the accidents at least 1 occupant sustained a fatal or serious injury, while at least 1 occupant in the remaining 18 accidents sustained only a minor injury. There were 39 different models of aircraft involved, of which 88 (77%) were equipped with floats, 16 had wheeled landing gear, and 8 were "flying boat" designs. For two aircraft there was not enough detail in the accident data to determine the landing gear configuration. The cabin configurations of the ultralights, ranked from most to least common, were enclosed [$N = 42$ (37%)], convertible [$N = 41$ (36%)], open [$N = 21$ (18%)], partially enclosed [$N = 6$ (5%)], and unknown [$N = 4$ (4%)].

The number of accidents per year ranged from 0 (2011) to 13 (1997), with a median of 3 and an interquartile range of 3. **Fig. 1** shows the count of accidents per 5-yr span during this

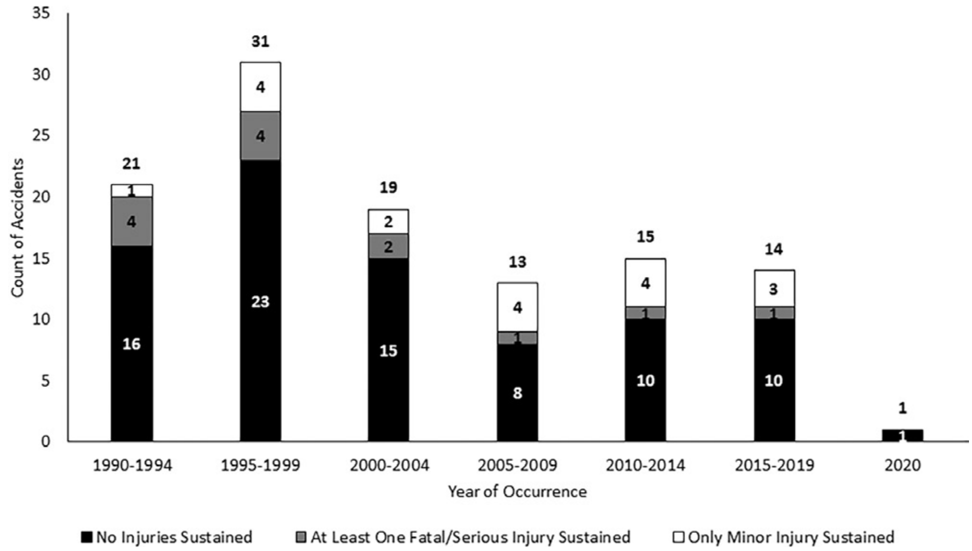

Fig. 1. Count of ultralight accidents terminating in water annually.

time, stratified by the number of accidents in which at least one fatal/serious injury or only minor injury had occurred.

Accidents occurred across nine provinces and territories, while one accident of a Canadian registered ultralight with a planned route over southern Ontario, Canada, occurred in the St. Lawrence River in northern New York in the United States, near the Canadian border. The majority of accidents occurred in Ontario [*N* = 44 (39%)], Quebec [*N* = 33 (29%)], and British Columbia [*N* = 19 (17%)]. The majority of fatalities (*N* = 6) occurred in Quebec. All the accidents occurred during daylight hours between April and November, inclusive. No water temperatures were recorded. When considering the number of accidents per year within each province and territory, the maximum number of accidents in a single province or territory in a single year was five, which occurred three times across Ontario (1993 and 1997) and Quebec (1996).

Preflight Details

In the 11 accidents where pilot flight hours were recorded, no pilot had more than 720 flying hours. In the three accidents where a fatality occurred and flight hours were recorded, the pilots were the sole occupants and had 720, 200, and 53 total flying hours, respectively. A total of 10 accidents involved training of a novice pilot, accounting for 2 fatalities and 4 serious injuries.

The existence of previous underwater escape training (UET) was only documented in one case. There were no reports of pilot or passenger swimming ability or diving experience, or the existence of a preflight briefing (if carrying a passenger).

Factors at the Point of Impact

The primary cause of each accident—the event determined to have set in motion the accident sequence—was attributable to human [*N* = 80 (70%)] or mechanical [*N* = 27 (24%)] factors in most accidents. When human factors were found to have contributed to the accident, there were nine accidents in which at least one fatal or serious injury occurred. Fisher's exact test found no significant association between the primary cause of human factors and sustaining a fatal or serious injury ($P = 0.196$).

Most accidents occurred during landing [*N* = 59 (52%)], while the remainder occurred during takeoff [*N* = 30 (26%)], cruise [*N* = 11 (10%)], taxiing [*N* = 6 (5%)], and while attempting a touch and go [*N* = 6 (5%)]. When considering the primary cause of the accident by phase of flight, most accidents occurred when human factors contributed to the accident during the landing phase [*N* = 46 (40%)]. In this condition there were five accidents which resulted in at least one fatal or serious injury (**Table I**).

There were less than 15 s of warning time in 89 (78%) accidents. Of these, 18 caused harm to the occupants, where 5 fatal injuries, 8 serious injuries, and 14 minor injuries were sustained.

The terminal cause of most accidents was a loss of control [*N* = 49 (43%)], followed by emergency landings [*N* = 17 (15%)] and mechanical failures [*N* = 10 (9%)]. Loss of control was the main terminal cause during the landing [*N* = 30 (26%)] and takeoff [*N* = 15 (13%)] phases of flight, and included a combined 8 accidents in which at least one fatal or serious injury was sustained (**Table II**). Fisher's exact test found that there was a statistically significant association between the accident occurring during the landing or takeoff (combined) phases of flight and the occupants sustaining fatal or serious injury ($P = 0.005$).

Regarding environmental factors, strong and/or gusty winds were determined to have played a role in 19 accidents, 3 of which involved fatal or serious injuries. No environmental conditions are known to have contributed to 63 (55%) accidents; these resulted in 3 fatalities and 6 serious injuries (**Table III**). Fisher's exact test found that there was no significant association between the contribution of environmental conditions to the accident and sustaining a fatal or serious injury ($P = 0.945$).

Table I. Number of Accidents by Primary Cause and Phase of Flight.

PRIMARY CAUSE BY PHASE OF FLIGHT	ACCIDENTS [*N* (%)]	ACCIDENTS W/ FATAL / SERIOUS INJURY [*N* (%)]	# FATAL INJURIES [*N* (%)]	# SERIOUS INJURIES [*N* (%)]	# MINOR INJURIES [*N* (%)]
Human					
Total	80 (70%)	9 (69%)	6 (75%)	6 (75%)	16 (64%)
Landing	46	5	4	2	8
Takeoff	21	1	0	1	5
Cruise	5	2	2	1	3
Taxiing	4	0	0	0	0
Touch and go	4	1	0	2	0
Mechanical					
Total	27 (24%)	2 (15%)	0 (0%)	2 (25%)	8 (32%)
Landing	9	1	0	1	4
Takeoff	8	1	0	1	4
Cruise	6	0	0	0	0
Taxiing	2	0	0	0	0
Touch and go	2	0	0	0	0
Unknown					
Total	7 (6%)	2 (15%)	2 (25%)	0 (0%)	1 (4%)
Landing	4	0	0	0	1
Unknown	2	2	2	0	0
Takeoff	1	0	0	0	0
Grand Total	114	13	8	8	25

Percentage values may not equal 100%, due to rounding error.

Postimpact and Postescape Factors

After impact with the water, 19 ultralights nosed-over during the accident sequence before coming to rest, resulting in 2 fatalities. Once at rest, 55 (48%) floated on the surface and 24 (21%) sank immediately, while 3 others (3%) sank after floating for some time. In 44 (39%) cases the aircraft fuselage inverted immediately, while in 24 (21%) cases the aircraft remained upright (**Table IV**). In the 27 (24%) accidents where both aspects of the final position were unknown, 3 fatalities and 7 serious injuries occurred and no more than a single fatal injury occurred within any of the other 87 (76%) known conditions presented in Table IV.

The use of the restraint harness was not reported in 103 (90%) cases, which included 6 fatalities. In the 11 cases where the use of the restraint harness was known, it was reported to have been worn correctly in 9 cases (1 fatality), incorrectly in 1 case, and not to have been worn in the 11th case (1 fatality).

Similarly, the use of a life jacket was not reported in 104 (91%) cases, which included 6 fatalities. In the 10 cases where the use of a lifejacket was known, it was reported to have been worn correctly in 8 cases (1 fatality), available but not worn in 1 case, and not to have been available in the other (1 fatality).

Information on cause of death was available for only two fatalities. One case was head injury; the other was drowning. In 60 (53%) cases, there was no information about occupant egress or post-accident survival activities; in 73 (64%) cases, there was no information about post-accident rescue activity; and in 46 (40%) cases, there was no information about either occupant egress and survival or post-accident rescue.

Where egress, survival, and rescue were referenced in the data, the most common scenario was for the occupants to have egressed unassisted, sat on or clung to the floating wreckage, and been rescued by local boaters without extensive delay. There were reports of injured or unconscious occupants being assisted from the cabin by other occupants and also reports of occupants self-rescuing by swimming to shore.

Egress difficulty was reported or apparent in six cases, while in eight other cases it was reported or apparent that the occupants had no difficulty with egress. For the remaining 101 (89%) cases, there was no data or discussion of egress difficulty.

DISCUSSION

Canada is the second-largest country in the world by total area and is 9% covered by lakes and rivers. It has had an active and growing civil aviation sector since the dawn of powered flight. The ultralight sector of GA has grown consistently since its origins in the mid-1970s. These aircraft are attractive to pilot owners because of their low cost, handling qualities, and, for some, the opportunity to complete the assembly of their aircraft. Those equipped with floats or hulls can be operated from the lakes and rivers that adjoin some owners' remote properties. Due to their increasing popularity, the number of ultralight accidents is expected to increase as well.

In Canada, accident reporting is mandatory regardless of the classification of the aircraft. For that reason, the current dataset contains most of the occurrences that involved death or serious injury, or where the aircraft sustained significant damage. Ultralight accidents that do not incur a fatality or significant airframe damage are not required to be reported to the TSB. If there has been damage to property, but no deaths, serious injuries, or major damage to the aircraft, the accident may be investigated by local authorities. There is no central registry to record these minor occurrences that are not reportable to TSB.

Table II. Number of Accidents by Phase of Flight & Terminal Cause.

PHASE OF FLIGHT BY TERMINAL CAUSE	ACCIDENTS [*N* (%)]	ACCIDENTS W/ FATAL / SERIOUS INJURY [*N* (%)]	# FATAL INJURIES [*N* (%)]	# SERIOUS INJURIES [*N* (%)]	# MINOR INJURIES [*N* (%)]
Landing					
Total	59 (52%)	6 (46%)	4 (50%)	3 (38%)	13 (52%)
Loss of Control	30	2	2	0	5
Amphibious Floats Wheels Down	6	1	1	0	2
Stall on Approach	6	2	1	2	2
Emergency Landing	5	1	0	1	1
Obstruction in Water	5	0	0	0	0
Mechanical Failure	3	0	0	0	2
N/A	2	0	0	0	1
Environmental: Wind	2	0	0	0	0
Takeoff					
Total	30 (26%)	2 (15%)	0 (0%)	2 (25%)	9 (36%)
Loss of Control	15	0	0	0	2
Emergency Landing	7	1	0	1	4
Stall on Departure	5	1	0	1	3
Mechanical Failure	2	0	0	0	0
Obstruction in Water	1	0	0	0	0
Cruise					
Total	11 (10%)	2 (15%)	2 (25%)	1 (13%)	3 (12%)
Emergency Landing	5	0	0	0	1
Other: CFIT	2	2	2	1	2
Amphibious Floats Wheels Down	1	0	0	0	0
Loss of Control	1	0	0	0	0
Distraction	1	0	0	0	0
Mechanical Failure	1	0	0	0	0
Taxiing					
Total	6 (5%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Environmental: Wind	2	0	0	0	0
Mechanical Failure	2	0	0	0	0
Obstruction in Water	1	0	0	0	0
Environmental: Waves	1	0	0	0	0
Touch and go					
Total	6 (5%)	1 (8%)	0 (0%)	2 (25%)	0 (0%)
Loss of Control	3	0	0	0	0
Mechanical Failure	2	0	0	0	0
Stall on Approach	1	1	0	2	0
Unknown					
Total	2 (2%)	2 (15%)	2 (25%)	0 (0%)	0 (0%)
Grand Total	114	13	8	8	25

Percentage values may not equal 100%, due to rounding error.
N/A: not available.

In previously published ultralight studies, accidents into water have never been specifically discussed. The other published studies that were reviewed make no reference to a water landing. For that reason, only comparisons of aggregate data such as number of events, number of fatalities, and serious injuries is possible.

In a 2006 report on 66 accidents in the United States, 33% were fatal and there were serious injuries in 35%.[10] In a 2018

Table III. Number of Accidents by Environmental Factor.

ENVIRONMENTAL FACTORS	ACCIDENTS [*N* (%)]	ACCIDENTS W/ FATAL / SERIOUS INJURY [*N* (%)]	# FATAL INJURIES [*N* (%)]	# SERIOUS INJURIES [*N* (%)]	# MINOR INJURIES [*N* (%)]
None	63 (55%)	8 (62%)	3 (38%)	6 (75%)	17 (68%)
Strong / Gusty Winds	19 (17%)	3 (23%)	3 (38%)	2 (25%)	2 (8%)
Glassy Water	10 (9%)				1 (4%)
Unknown	8 (7%)	1 (8%)	1 (13%)		4 (16%)
Obstruction in Water	7 (6%)				
High Waves	3 (3%)	1 (8%)	1 (13%)		1 (4%)
Strong / Gusty Winds + Waves	2 (< 2%)				
Wake	2 (< 2%)				
Total	114	13	8	8	25

Percentage values may not equal 100%, due to rounding error.

Table IV. Ultralight Final Positions After Impact.

FINAL POSITION (% GRAND TOTAL)	INVERTED IMMEDIATELY	N/A	UPRIGHT	UPRIGHT, THEN INVERTED	TOTAL
Floated	28 (25%)	6 (5%)	21 (18%)		55 (48%)
N/A	5 (4%)	27 (24%)			32 (28%)
Sank Immediately	11 (10%)	11 (10%)	1 (1%)	1 (1%)	24 (21%)
Floated, then Sank			2 (2%)	1 (1%)	3 (3%)
Total	44 (39%)	44 (39%)	24 (21%)	2 (2%)	Grand Total = 114

N/A: not available.

report based on 307 accidents, 252 occurred in the United Kingdom, 35 occurred in Portugal, and 20 occurred in the United States.[6] The 2018 study reported that the fatal injuries occurred in 3% of the United Kingdom accidents, 46% of the Portuguese, and 30% of the accidents in the United States.

In indicating a mortality rate (defined as [# fatalities/# occupants] x 100) of 5%, our findings are in general agreement with those reported in the 2018 study for the United Kingdom and substantially lower than those for Portugal and the United States. The 5% mortality rate for the ultralight accidents in our study is lower than the finding of 13% for Canadian seaplane water accidents[9] and the finding of 15% for worldwide helicopter ditchings.[2,3,11]

Why is the occupant of a seaplane more than twice as likely to perish in a water accident as the occupant of an ultralight? There are several hypotheses to explain the differences in accident mortality, including the fact that in the event of an accident, Canadian seaplanes have been found to carry more passengers (2.3 occupants per accident[9]) than ultralights (1.4 occupants per accident). As such, more occupants are expected to be seated in the rear of the aircraft, which creates more difficult access to emergency exits than pilots or front row passengers and, in some cases, rear row exits are more complex to operate. In addition, GA-category seaplanes will often operate to more remote locations, land and take off at higher speeds than ultralights, and they are rarely configured with open or partially open cabins, which is the case for some ultralights. These differences between seaplanes and ultralights could influence how quickly rescue was accomplished, the amount of kinetic energy that was dissipated during the crash sequence, and the increased difficulty for occupants to egress the cabin. Our study did not attempt to explore further the apparent difference in mortality rates between ultralight and seaplane water accidents.

In a report of 200 cases involving home-built aircraft, compared to GA, home-builds had a higher rate of accidents associated with causal factors of mechanical failure (43% vs. 23% for GA) and crashing on takeoff and climb-out (36% vs. 22% for GA).[8] This report also noted that recreational flying and the age (60+) of the pilot were more often a factor in home-built accidents than in GA accidents. In 24% of the accidents in the current study, mechanical failure was determined to have been the primary cause. No ages were reported in any accident.

It has been reported that accidents originating during the takeoff and climb-out phase were more common with ultralights than with other types of aircraft.[10] Cruise flight was the most common accident phase for ultralight aircraft in that study (50%). In contrast, the current study found that landing was the most common flight phase (52%) in which the accident occurred, followed by takeoff (26%). The importance of remaining vigilant throughout the landing and takeoff phases of flight is further emphasized by its statistically significant association with sustaining a fatal or serious injury.

One study found that pilots with a low amount of flying time (less than 40 h) were significantly more likely to have been involved in fatal crashes and/or to crash because of losing control.[10] In the current study, there was not sufficient data to make any comment on the relationship between pilot hours of experience and the probability of an accident terminating in the water.

Gender, average age, and flying hours did not differ substantially in UK, Portuguese, and U.S. ultralight accidents.[6] No comparison to these figures could be made because little to none of this data was recorded in any Canadian accidents. Further, no data exists pertaining to the gender of any of the occupants, nor did enough data exist on pilot hours or training to make any reliable comparison.

Previous work demonstrated that warning time was critical to surviving a helicopter ditching.[3] Even though warning time was rarely noted in the TSB's data, it was clear from 89 (78%) narratives that the accidents occurred suddenly and unexpectedly. As a result, most occupants received no indications of an impending crisis until the accident sequence began to unfold. In these cases, we estimated that the warning time was less than 15 s.[3]

As these 89 accidents progressed, 4 of which had fatalities, there was minimal warning time for the pilot or passengers to prepare themselves mentally and physically for their impending immersion. Ultralights inverted in 46 (40%) accidents and sank in 13 of those cases. These factors are common to helicopter and seaplane ditchings.[2,3,11] Anyone aboard an ultralight that flies over water must be mentally and physically prepared for sudden unexpected immersion in water.[9] The additional complications and risks arising from immersion in cold water are relevant to some of these ultralight accidents because temperatures below 15 °C are common in large lakes and coastal waters during the Canadian ultralight operating season.

Limitations

Safety studies of the GA sector in many jurisdictions have been impaired by the absence of reliable information—the number of hours flown or the total number of aircraft movements in the sector each year. This has made it impossible to generate statistics comparable to those used in the commercial aviation sector, such as accidents per 100,000 flying hours. Ultralight safety studies are further impaired because in major jurisdictions such as the United States, ultralights are not required to be registered, so the size of the active fleet is unclear. For these cases, it is not possible to normalize based on the number of accidents or fatal accidents per registered aircraft and none of the existing papers mention whether any of the ultralights were involved in a water accident.

Similarly, the scale of ultralight operation worldwide is not widely known. In 1987 there were 15,000 such machines in the United States and, in 2010, there were 4375 in the United Kingdom and 410 in Portugal.[6] The number of ultralights in Canada, based on Transport Canada registration data, has grown steadily from about 3000 in the mid-1980s to about 8000 presently. During the same period, the GA fleet has ranged in size from 20,000 to 25,000 aircraft.[12] Additionally, the TSB occurrence and accident data that is readily available to the public does not contain any age information for the people involved.

Another weakness of the current study is that the data on water accident-related human factors such as water temperature, underwater egress training, restraint harnesses, and life jackets is very scant in the TSB records. Where we have nonetheless attempted to classify and analyze some aspect of the data such as warning time, we run the risk of the data being skewed and leading us to an incorrect conclusion. To mitigate this risk, we have limited our analysis and conclusions to only those factors where we had a degree of confidence. For other factors, such as water temperature, we have refrained from performing analysis or drawing conclusions, instead pointing out the need to consistently gather and report the missing data in our recommendations. Otherwise, how can regulators improve standards and manufacturers introduce new technology?

Conclusions

From 1990 through 2020, there were a total of 114 accidents where a Canadian ultralight aircraft terminated in water, with a mortality rate of 5%. This mortality rate is lower than the finding of 13% for Canadian seaplane water accidents[9] and the finding of 15% for worldwide helicopter ditchings.[2,3,11] Occupants of ultralight aircraft are advised to remain vigilant during landing and takeoff as these phases of flight were significantly associated with sustaining a fatal or serious injury in the event of an accident in water.

The prime object in accident investigation is to save lives, and the cause of the accident is not always the cause of death. As in previous studies of aircraft landing in water, the authors have often found scant evidence of many of the survivability factors that led up to the cause of death.

Recommendations

Transport Canada, the Canadian transportation regulator, should issue a bulletin available to all owners of ultralight aircraft, making them aware of the fact there will be little or no warning in the case of ditching and that it would be an advantage if they undertook a course in UET. For the TSB, it is recommended to develop an aircraft investigator checklist for all water accidents which includes human and survivability factors, including water temperature, warning time, use of harnesses or life jackets, evidence of swimming and diving ability, UET, and the availability and use of the emergency exits. Further, for the Transportation Safety Board, the Canadian accident investigation authority, it is recommended to collect more detailed accident information for ultralight accidents, filling in the many gaps noted previously, and to encourage other national accident investigation authorities to gather data for all of their ultralight accidents.

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