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Issue 1/2016

# AVIATION SAFETY LETTER

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*Learn from the mistakes of others;  
You'll not live long enough to make them all yourself...*



Canada

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## 2015 David Charles Abramson Memorial (DCAM) Flight Instructor Safety Award

The 13<sup>th</sup> recipient of the annual DCAM Flight Instructor Safety Award for 2015 was Catherine Lynn Press of Chinook Helicopters, BC. Catherine holds both fixed wing and helicopter licenses, was the first woman in Canada to hold a helicopter instructor rating and is the only Canadian helicopter pilot to hold a Chinese licence.

Her contributions to aviation over the years, especially in the helicopter training sector have been significant; in the capacity of instructor, pilot examiner and business leader.

It is felt by many that the good safety record in commercial helicopter operations throughout Western Canada is in many ways attributable to the high quality of training offered by Catherine Press and her team at Chinook Helicopters.

Cathy Press: *“It is very important for the aviation training industry to have recognition such as the DCAM Flight Instructor Safety Award. This Award encourages instructors to constantly upgrade their skills and professionalism & those they work with, in the aviation industry.”*

*“The great thing about aviation is, it constantly is challenging one’s personal development. My job is to help other people to realize their potential for their own paths in aviation while maintaining safety. The DCAM Award has made me want to work even harder.”*

The annual DCAM Award promotes flight safety by recognizing exceptional flight instructors in Canada and has brought recognition and awareness to the flight instructor community. The recognition of excellence within this segment of our industry raises safety awareness, which will hopefully be passed on for many years to come.

The deadline for nominations for the 2016 award is September 14, 2016. For details, please visit [www.dcamaward.com](http://www.dcamaward.com) △



*Left to right—Rikki Abramson, Catherine Press & Jane Abramson.  
Photo courtesy of Mike Doiron*

## Increases in Large Bird Populations and High Aircraft Speeds Could Result in Damaging Impacts

*By Marie-France Noel, Wildlife Management Specialist, Aerodromes Standards, Civil Aviation, Transport Canada*



Transport Canada (TC) has been collecting data on wildlife strikes for many years through their Bird Strike Information System (BSIS). Per *Canadian Aviation Regulation* (CAR) 302.303, airports are required to report their wildlife strikes to the Minister of Transport. With the collected data, the department is able to produce reports to evaluate trends and bird strike risk that may cause accidents or damage aircraft. For airport managers, recording details relating to wildlife strikes, such as the species involved and the damage to aircraft is crucial to properly managing hazardous wildlife found in the vicinity of the airport and maintaining safety standards.

It has been understood for many years now that strikes involving larger birds are most likely to result in aircraft damage despite small birds being struck more often (see [Figure 1](#) and [Figure 2](#)). In Canada, 577 wildlife strikes were reported from 2005 to 2014. Of the reported strikes, bird species were identified and reported in 327 (56%) cases (see [Table 1](#)). Obviously, in order to obtain this kind of

information, all personnel involved—including pilots, maintenance personnel and airlines—should report wildlife strike details when there is evidence, such as blood or damage to aircraft. Wildlife species identification can prove to be a challenge when a wildlife expert is not available to airport staff. For help identifying species, consult with the Bird Strike Association of Canada. This association offers free photo identification services; association members can also receive discounts on morphological (feather) or DNA species identification services from Canadian universities.

Analysis of BSIS data demonstrated that nearly half (46%) of damaging bird strikes involved gulls or geese. In addition, larger birds were most likely to cause damage to aircraft (see Figure 2 and Table 2). Analysis of this database demonstrates that the average damaging strike involved birds with an average mass of 1.9 kg (or 4.2 lb) while the median mass of birds that caused damaging strikes was 995 g (or 2.2 lb), the average size of a red-tailed hawk. Between 2005 and 2014, 32% of damaging strikes in Canada involved bird species weighing more than four pounds. Aircraft certification standards require aircraft to sustain strikes up to 4 pounds (1.8 kg). For this reason, airports should strive to keep the average weight of bird species struck at Canadian airports below 1800 g.



*An impact with a Western Grebe (3 lbs) caused considerable damage to this helicopter. The bird struck the pilot in the face.*

This can prove to be challenging for airports as populations of Canada geese, particularly resident Canada geese, has increased substantially in recent years. The resident Canada goose often weighs over 6 kilograms (10 lbs). Canada geese accounted for 17% of damaging strikes between 2005 and 2014 where the species involved was known. When the two most commonly damaging species are compared, less than six percent of gull strikes caused aircraft damage between 2010 and 2014 while more than one in four Canada geese strikes cause damage to the aircraft struck. Despite gulls being struck more often, geese are most likely to damage an aircraft if struck due their larger size.

This would be consistent with how the impact force of a bird strike is calculated (Transport, 2004) as larger birds generate larger impact force and will therefore be more likely to cause aircraft damage. Other birds that caused more than 10 damaging strikes in Canada between 2005 and 2014 and that should be considered to be problematic are ducks (30), particularly mallards, as well as raptors such as hawks (29), eagles (18) and owls (15).

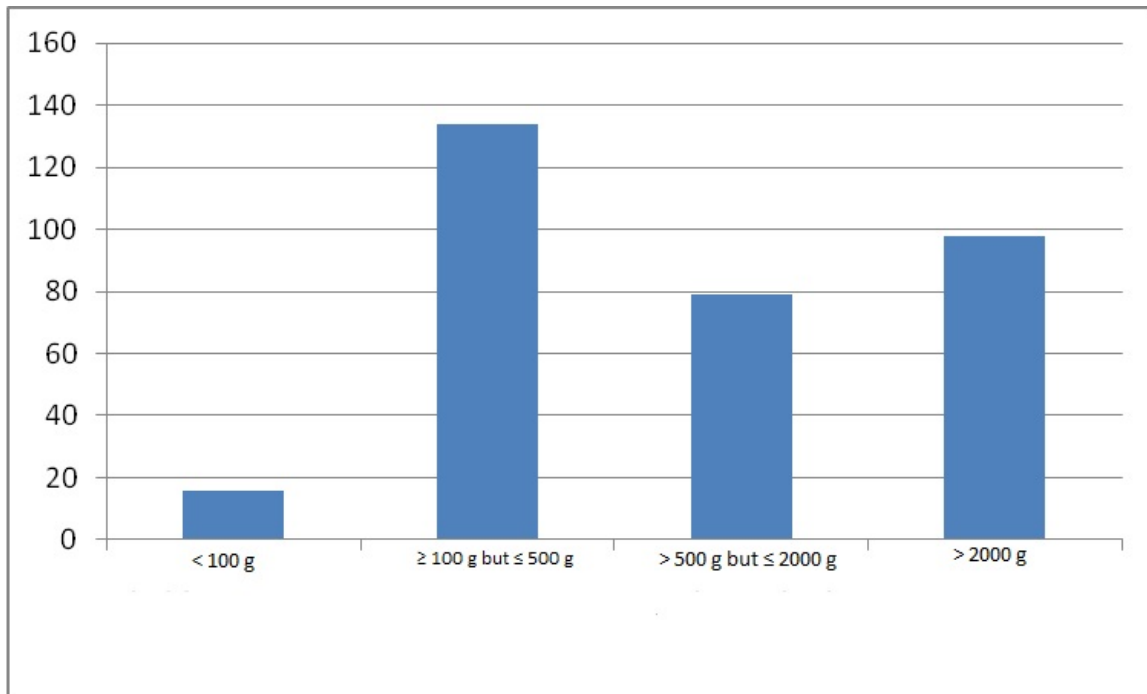
Bird size is not the only factor that heavily influences the risk of damaging an aircraft when struck. The equation to calculate the impact force between two objects stipulates that velocity increases the impact force exponentially. For this reason, the aircraft speed under 10 000 ft AGL has been regulated by TC. Per the CARs, below 10 000 ft, aircraft speed should be kept speed below 250 kt, if possible. This regulation is intended to reduce the impact force should the aircraft collide with a wildlife species, since the majority of wildlife are struck below 10 000 ft. The speed of an aircraft exponentially increases the kinetic energy generated from the impact. For this reason, a slight increase in speed could result in catastrophic impact forces and damage compared to a slightly lower speed. As an example, a 12-lb Canada goose struck by an airplane flying 50-mph at liftoff generates the kinetic energy of a 1 000-lb weight dropped from a height of 10 ft.

A catastrophic wildlife incident has not occurred in Canada for some time now, however, with the population of Canada geese, snow geese, snowy owls and other large bird species on the rise, the likelihood of a major accident arising also increases. In light of this information, we encourage all pilots as well as airport managers to take the appropriate precautionary measures. Airport managers should also inform TC if no wildlife strikes have occurred within the past year. The department will be requesting wildlife strike reports from airports once again in 2016 and we encourage everyone to report wildlife strikes and near misses via the BSIS portal at <http://wwwapps.tc.gc.ca/Saf-Sec-Sur/2/bsis/>.

For those who wanted to get involved with wildlife management at airports or who seek additional information, species identification or advice, please contact the Bird Strike Association of Canada at <http://www.canadianbirdstrike.ca>. △



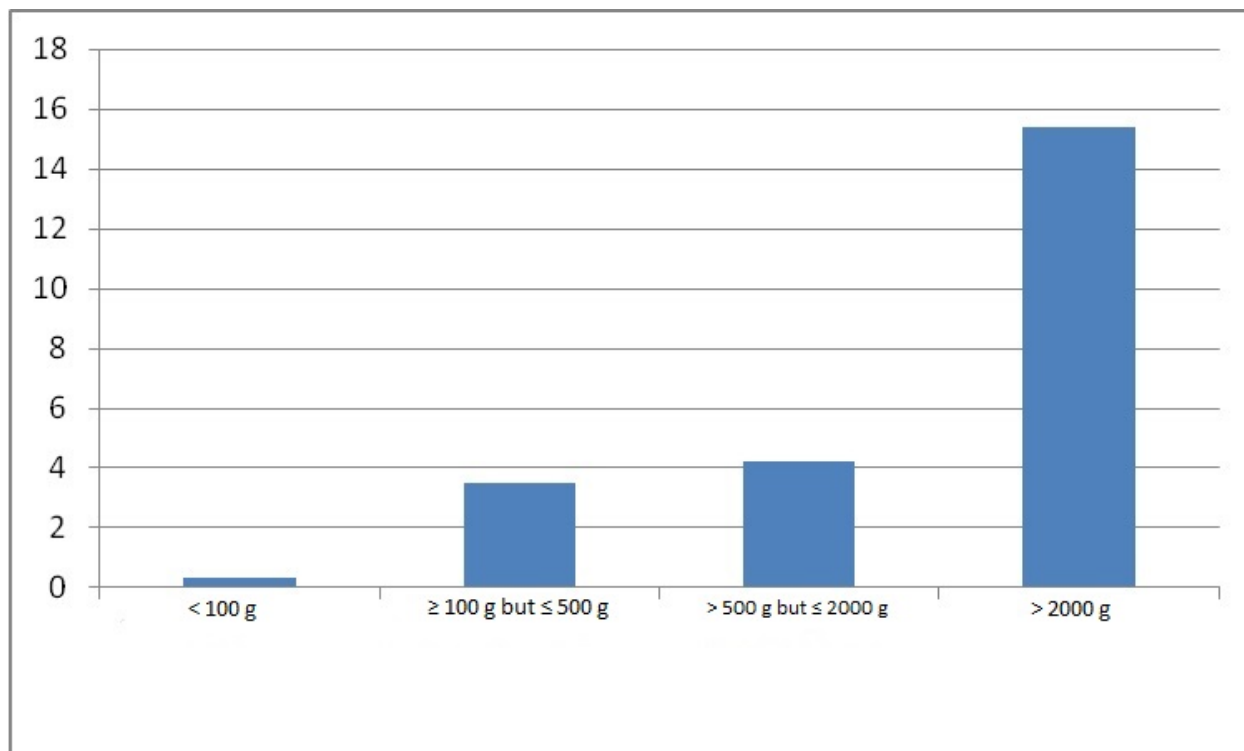
**Figure 1—Bird Mass vs Number of Strikes That Cause Damage (2005-2014) for All Airports in Canada**



**Table 1—Species and Mass of Birds Involved in Damaging Strikes**

26 of 98 (26%) Canada geese strikes caused damage (2010-2015)
51 of 908 (6%) gull strikes caused damage between (2010-2015)
MEDIAN mass of birds causing damage (2005-2014): 995 g, the size of a red-tailed hawk
AVERAGE mass of birds causing damage (2005-2014): 1900 g
Number of damaging strikes reported (2005-2014): 577
Number of damaging strikes with the species identified (2005-2014): 327
Percentage of damaging strikes that involved species over 4 lb (2010-2014): 32%
Number of damaging strikes reported (2010-2014): 236
Number of damaging strikes with the species identified (2010-2014): 129
<b>Species involved in more than 10 damaging strikes (2005-2014):</b>
Gulls (130), Canada geese (54), Ducks (30), Hawks (29), Eagles (18), Owls (15)

**Figure 2—Percentage of Damaging Strikes by Bird Mass  
for All Airports in Canada (2010-2014)**



**Table 2—Bird Mass vs Total Bird Strikes, Damaging Strikes and  
Percentage of Damaging Strikes by Bird Mass (2010-2014)**

Bird Mass	Total Birds Struck	Damaging Strikes	% of Birds That Caused Damage
≤ 100 g	1546	5	0.323415
>100 g ≤ 500 g	1296	45	3.472222
>500 g ≤ 2000 g	688	29	4.215116
> 2000 g	325	50	15.38462

#### References

Cornell La of Ornithology. All About Birds Web site: <http://www.allaboutbirds.org/Page.aspx?pid=1189>  
Canada. Department of Transport. *Sharing the Skies: An Aviation Guide to the Managemen of Wildlife Hazards* (TP 13549). Ottawa, 2004.  
Canada. Department of Transport. *Wildlife Control Procedures Manual* (TP 11500) Ottawa, 2015.

## Watch for Mixed Instrumentation in Gliders

At approximately 14:55 PST, on April 10, 2004, at the Alberni Valley Regional Airport (CBS8), B.C., a Blanik L-13 glider, with an instructor and a student on board, was towed to altitude for an introduction flight. The instrument suite was unusual in this glider, as the altimeter in the back seat was in meters (as opposed to the front seat altimeter, which was in feet), and both airspeed indicators were in miles per hour. The instructor had reportedly been reminded of this mixed instrumentation, as it was different from the previous glider he had flown.

Upon returning to CBS8, the instructor took control of the glider at approximately 152 m AGL (500 ft AGL) and indicated to the student that he intended to land on Runway 30. During the descent, the aircraft crossed the end of Runway 30 and entered a shallow-banked left turn from about 107 m AGL (350 ft AGL). The rate of roll and the bank angle were assessed by soaring club members watching from the ground to be consistent with a controlled gliding manoeuvre; however, the direction of the turn was abnormal. The “rule of thumb” is that a pilot should not turn away from the runway when below circuit altitude. After about 180° of turn and at an estimated altitude of 76 m AGL (250 ft AGL), the aircraft appeared to stall; the nose dropped and the aircraft entered a spin to the left. There was no recovery. The location of the crash was approximately 500 m (1 640 ft) short of Runway 30. Both occupants were seriously injured and evacuated to hospital. The instructor, who was sitting in the rear seat, succumbed to his injuries two days later.

The Office of the Chief Coroner of British Columbia investigated the death of the instructor; it was assisted by the Transportation Safety Board of Canada (TSB) which conducted a Class 5 investigation (TSB File A04P0111). While not ideal, the mixed instrumentation set-up was reviewed and considered acceptable for that particular aircraft at the time.

Evidence could not be found relating the mixed instrumentation to a role in the accident; nevertheless, the coroner recommended that the aviation community be made aware of the increased possibility of error when operating aircraft with mixed instrumentation. For instance, a pilot who normally flies with a traditional altimeter in feet, and who is suddenly made to fly with an altimeter in meters could misinterpret—in a busy moment—his or her altitude.

The coroner also encountered difficulties in tracking down the true status of the instructor’s medical certificate. While it was eventually determined that the instructor’s medical certificate was adequate to instruct on gliders, the coroner recommended that all flying clubs, schools and flying associations require that a copy of each member’s most current medical certificate(s) be kept on file prior to any flying. △



*Rear instrument panel from the Blanik, showing the altimeter in meters.*

## Civil Aviation Issues Reporting System (CAIRS)

**IMPORTANT NOTICE:** Please note that as of **March 31, 2016**, the Civil Aviation Issues Reporting System (CAIRS) database has been decommissioned. We have streamlined our service delivery processes in order to improve efficiencies, and as a result of these changes, the aviation community and the public will report issues or concerns through the Civil Aviation Communications Centre, which currently provides a central point of contact for email and phone requests about the Program. Please contact us by the methods outlined: **Requests to:** [services@tc.gc.ca](mailto:services@tc.gc.ca) or by **Facsimile** 613-957-4208 **Questions to:** 1-800-305-2059

In an effort to maintain confidentiality, steps have been taken by the communication centre to handle confidential enquiries, but incoming submission must be **clearly** marked as confidential in the title and body of the submission. △

## Risk Assessment in General Aviation

by Michael Schuster. Michael Schuster is an airline captain, Class 1 flight instructor and principal consultant at Aviation Solutions. He can be reached at [mjs@aviationsolutions.net](mailto:mjs@aviationsolutions.net).

In February 1998, a DA20 Katana crashed on the frozen surface of Lake Manitoba killing both the flight instructor and the student. It was determined that the flight pressed on into poor weather until it encountered whiteout conditions.<sup>1</sup>

Ten years later, in August 2008, a C172 crashed northwest of Toronto killing one and injuring two (one seriously) during a general aviation (GA) flight. The Transportation Safety Board of Canada (TSB) concluded that the pilot and his two passengers, both pilots, were most likely asleep.<sup>2</sup>

At first glance, these two accidents appear to have nothing in common. However, both are examples of flights that may have proceeded without an adequate risk assessment.



*DA20 accident at Lake Manitoba in February 1998  
(TSB file A98C0030)*

Whether we realize it or not, pilots assess risk everyday using metrics such as weather forecasts, runway conditions and deferred aircraft defects. Flight instructors are also responsible for assessing a great variety of risks to both themselves and their students. For instance, instructors must evaluate a student's performance over the long and short term before the student's first solo flight. Risk is a constantly changing variable that comes from many internal and external sources. Pilots and instructors may find that certain risks are acceptable, while others are not.

But what constitutes *acceptable risk*? Pilots generally do not accept unnecessary risk (such as taking off with a thunderstorm overhead the airport). Other times, the risk is so small that it is obviously worth commencing the flight (such as an unserviceable attitude indicator on an otherwise ideal visual meteorological conditions [VMC] day). Most of the time, the risk falls somewhere in between. Regrettably, there is often no formal process by which the risk associated with GA and training flights is assessed.

In the two examples above, as in all accidents, there were many links in the accident chain. In the first accident, time pressures, poor weather and lack of an instrument rating for the pilot-in-command (PIC) were cited as contributing factors. In the second accident, fatigue, weight and balance, and improper flight following were identified as risk factors. We know that pilots assess risk with every flight; but as a group, aviators keep getting caught in situations where multiple risk factors add up to an accident or incident. How can we identify and address these risks before it's too late?

A tool already in use by many charter and corporate operators can help in GA. It's called the **flight risk assessment tool (FRAT)** and it is easy to implement and use. Unlike airline operations where the same routes are regularly flown to the same airports, charters take pilots into new airports, local weather environments, unique airspace, and other special situations on an almost daily basis.

The self-dispatch environment, constantly changing variables and variety of threats are very similar to what occurs in GA and flight training. FRAT can be used by flight schools for both training and rental flights; pilots who own and operate their own personal aircraft can implement FRAT as well.

<sup>1</sup> TSB Report [A98C0030](#), which was also summarized in Aviation Safety Letter Issue 1/2001.

<sup>2</sup> TSB Report [A08O0233](#), which was also summarized in Aviation Safety Letter Issue 1/2011.



FRAT is a system that quantifies risk. It can either complement or replace other pre-flight risk assessment systems such as IMSAFE or PAVE that you may already use. It also helps identify risks that you may not have previously considered. Because FRAT is quantifiable, it helps remove ego and emotion from the analysis.

To use FRAT, a checklist of possible threats is consulted and a score is assigned to each threat that you are likely to encounter during your flight. Greater threats have a higher score. If the total score for your flight exceeds a pre-determined threshold, you need to consult someone about the risk. In flight training, the chief flight instructor (CFI) or another supervisor may be consulted to accept, mitigate or reject the risk. A private pilot may choose to consult their past instructor or a mentor with more experience to assist in evaluating the risk. A PIC is always accountable for their actions or inactions. As the score climbs, FRAT alerts the pilot to look closely at the risk involved. Instructors should give their students an opportunity before every flight to identify hazards, assess risk and make suggestions to mitigate risk. That way, they will develop the necessary pilot decision-making skills.

For example, consider a dual flight towards a night rating. Points may be awarded for a flight after 23:00 local time, the instructor being a Class 4, the student having less than 50 hr on type, etc. In this example, should the risk score exceed the pre-set threshold, the CFI may choose to assign a more experienced instructor, permit the flight if the crew rest received was adequate and the duty day short, or cancel the flight altogether. Though not perfect, many risks that would otherwise add up can be trapped, accounted for and assessed.

If you're a private pilot who owns an aircraft, your FRAT checklist may consider items such as how many hours you've flown recently, how strong the crosswind is, how low the visibility may be, and how many items on your aircraft are unserviceable. While none of these items in themselves prevents you from undertaking a legal flight, the cumulative effect is something worth considering.

While this is a tool any pilot can use, it is also a great benefit for management in maintaining operational control and can be embedded in operational procedures. The TSB noted in the final report of the second accident that "reliance on a pilot's own judgment to prevent fatigue-related accidents is an ineffective defence mechanism". In other words, a quantifiable system such as FRAT is preferable.

Every FRAT checklist is different, and the points awarded will be based on your operation. Operators based at towered airports may assign more risk to flights into uncontrolled aerodromes; whereas pilots based at small aerodromes would assign greater risk to traveling into controlled airports with heavy traffic and a mix of aircraft sizes. A good sample is the Federal Aviation Administration (FAA) [Information for Operators \(InFO 07015\)](#), which is available on the FAA Web site. Though designed for charter operations, it can be easily modified to accommodate any operation—such as flight training units or private aircraft. Some online flight planning Web sites, such as [www.fltplan.com](http://www.fltplan.com), even allow you to develop your own customizable FRAT assessment on their site.

Consider how you and your operation deal with daily operational risk. Do you have personal limits? Is there a series of rules and regulations that the operator sets? That's a start. But you can seriously increase your risk without breaking any of the rules—following the rules alone does not make you impervious to risk.

A two minute quantitative measurement before your flight can help indicate if the risk level is getting too high and provide an opportunity to mitigate or reject the risk before it is too late. △

<b>Flight Training FRAT Checklist Items</b> <i>(abbreviated sample, not a comprehensive list)</i>	
<u>ITEM</u>	<u>SCORE</u>
Instructor class IV	5
Instructor <30 hr on type	5
Student solo <30 hr on type	5
Pilot <15 hr in 30 days	3
Pilot <25 hr since licensed	4
Uncontrolled aerodrome	3
Wet runway	2
Winter operation	4
Twilight operation	2
Night operation	5
Pop-up flight (<4 hr notice)	3
No weather station at destination	4
Thunderstorms or icing forecast	5
Crosswind >10 kt	3
Surface wind >20 kt	3
Aircraft with 1 deferred defect	3
Aircraft with >1 deferred defect	4
<i>Any score over 20 points must be referred to the chief flight instructor (CFI) to accept, mitigate or reject the risk.</i>	

## Gliders: Advancements in Collision Avoidance Technology

*by Robert A. Russel. Rob has been a glider pilot since 2002. He currently flies and volunteers at the SOSA Gliding Club at the Rockton Aerodrome (CPT3), near Hamilton, Ont., when he is not busy at his day job in IT incident and problem management.*

The Transportation Safety Board of Canada (TSB) released its final report<sup>3</sup> into a tragic mid-air collision on June 29, 2013, near Pemberton, B.C., between a STEMME S10-VT motor glider and a Cessna 150F. Both aircraft were destroyed and all four people—two in each aircraft—perished.

In its analysis, the TSB said that the relative position of each of the occurrence aircraft just before the collision would have made visual acquisition difficult. The main TSB finding relating to cause and contributing factors was that “the converging 3-dimensional tracks of the 2 aircraft caused blind spots for the pilots. That factor, coupled with physiological vision limitations<sup>4</sup>, reduced opportunities for collision detection. As a result, the available reaction time was reduced to a point at which a mid-air collision could not be avoided.”

The TSB report discussed collision avoidance equipment at length, and it remarked that neither aircraft was fitted with any such device, nor were they required to be by regulation. However, from a risk perspective, the TSB concluded that “if the see-and-avoid principle is relied upon as the sole means of collision avoidance when operating in visual flight rules [VFR] conditions, then there is a continued risk of collision.” It is easy to agree with that last statement; inconspicuously, this is a suggestion to install such a device where practical.

This subject is of critical importance to the glider community, considering that there was yet another fatal mid-air collision between two gliders on September 3, 2011, 7 NM southeast of Invermere Airport, B.C. The Pemberton report led me to submit this article for the *Aviation Safety Letter* (ASL), as a follow-up to the excellent article by Dan Cook on the PowerFLARM® collision avoidance system published in [ASL Issue 3/2012](#). It is important to re-emphasize the value of collision avoidance systems such as PowerFLARM® and of its technological advancements and additional capabilities over the basic FLARM®.

### **FLARM®**

The base functionality of a FLARM® consists of a global positioning system (GPS) receiver that is constantly calculating and transmitting both its current position and its projected positions. Other FLARM® units in other aircraft will receive these signals, show the target on either a dedicated display or a compatible moving-map navigational display, and algorithmically determine if there is a risk of collision. If a collision risk is projected, both pilots are notified. Simply alerting the pilot of nearby aircraft (as would happen with transponders, the traffic alert and collision avoidance system [TCAS] or a portable collision avoidance system [PCAS]) would lead to an unnecessary symphony of alarms, since light aircraft, and especially gliders, regularly fly in close proximity.

The greatest collision risk for a glider is from another glider, primarily when climbing in a thermal with many other gliders. The functionality of FLARM® has proven its usefulness to many pilots, and many Canadian gliders are already equipped. FLARM® has already been adopted as mandatory equipment for most competition flying, including for the Canadian National Soaring Championships. However, the risk of collision with powered aircraft remains a concern.

Gliders continue to maintain a transponder exemption in the *Canadian Aviation Regulations* (CARs), primarily due to power limitations. Transponders transmit over a much greater distance to ground stations at a power level that would too quickly drain the batteries in gliders, leaving them no radio (NORDO) and without their battery-powered instruments. FLARM® systems only transmit over about a 10-mi. range, putting much less of a strain on batteries.

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<sup>3</sup> TSB Final Report A13P0127—text cited in this article comes from this final report.

<sup>4</sup> Physiological factors linked to the limitations of the see-and-avoid principle. Read the complete TSB Final Report A13P0127 (see link above) for more details.

## PowerFLARM®

PowerFLARM® devices are the next technological leap for pilots, receiving collision avoidance information not only from other FLARM® equipped aircraft but also from transponder-equipped aircraft and providing alarms for less than \$1,700<sup>5</sup>. When a powered aircraft's transponder is queried by a ground station or by an overflying TCAS, the transponder's response will be received and analyzed by the PowerFLARM® device.

The position of an automatic dependent surveillance-broadcast (ADS-B) Mode-S transponder will be known to the PowerFLARM® device and used just like another FLARM® aircraft. For Mode-A/C transponders, only the range and altitude difference will be known. Instead of appearing as a point on the display, the Mode A/C will be shown as a ring. Several online videos provide examples of the PowerFLARM® alarms and displays in use.

This enhanced capability to detect and advise of powered aircraft is a key improvement to the pilot's ability to see-and-avoid. Even though the powered aircraft would also have to carry a FLARM® in order to see other aircraft, now a PowerFLARM®-equipped glider pilot will receive a warning and have the opportunity to react to a previously unseen threat.

Because of the success of FLARM® in the gliding community, powered aircraft owners are since a few years also installing FLARM® at an unprecedented rate. Most new PowerFLARM® installations today are in fact in powered aircraft, including helicopters. Another segment where FLARM® is currently gaining traction is in UAVs, or drones. Drone operators have started equipping their drones with FLARM®, both to see other aircraft but also for other aircraft to see them.

Another improvement in PowerFLARM® over the old classic FLARM® is the increased range. With PowerFLARM®, most installations have a range exceeding 10 km. With classic FLARM®, the range was usually 3-5 km. The difference can be life-saving in head-on situations, like the one in the Pemberton report.

Of course, technology is only an aid to collision avoidance, and pilots remain primarily reliant on the principle of see-and-avoid, which always requires vigilance and collaboration. Pilots are always welcome to visit glider operations to learn about them and share about themselves. Most Canadian glider fields require prior permission (PPR) for landing so make sure to call ahead. To find a glider field near you, go to [www.sac.ca](http://www.sac.ca). △



*Example of FLARM display provided by FLARM Technology Ltd.*



*Example of FLARM display provided by FLARM Technology Ltd.*

<sup>5</sup> Note that costs quoted in the ASL are always provided by the author and are approximate. They can vary with time, location and other factors.





Reprinted from *Vortex*, Issue 3/2004.

The stormy weather we are talking about in this number are the kind we typically see on those hot summer days when harmless cumulous clouds, nurtured by daytime heating, mature into dark grey cumulonimbus clouds, and thunderstorms rumble across the landscape.

Thunderstorms can occur at any time of year, as long as there is sufficient moisture and a lifting mechanism, but they are much more common in the summer months. They are fascinating examples of nature's power—so much so that in Greek, Roman, and Norse mythologies, the God of Thunder (Zeus, Jupiter and Thor, respectively) wielded the most power, and was ruler of all gods. But the power and unpredictable nature of thunderstorms is no myth, and *avoidance* is the only real strategy helicopter pilots have for dealing with them, in either IFR or VFR conditions. Cumulonimbus clouds, thunder, and lightning have been the subject of much study and research over the years, and a flip through your old weather books or a search on the Internet can turn up volumes of information. This article will not focus on the science of thunderstorms, rather on the hazards that exist in and around them. In the **Tips and Tails** section of *Vortex*, Issue 3/2004, you will find a story of a pilot who pushed a little too close but was lucky enough to have escaped with nothing more than a scary story and lesson that won't soon be forgotten. Sadly, not everyone has been that fortunate—even the highly experienced can be surprised by the intensity of a thunderstorm, and the speed with which they can overtake an area.

On May 2, 1992, a Bell 204B was employed on an aerial construction operation at an automotive plant in Oakville, Ontario. The job had been going smoothly, with 40 of 47 scheduled lifts completed in the morning before shutting down for fuel and lunch. After lunch, things went horribly wrong. In its report into the accident (A9200144), the Transportation Safety Board of Canada (TSB) states: "*The first lift of the afternoon was taken to the roof, but, because of flight conditions, the load was not as stable as the earlier morning lifts... After placing the load, the helicopter returned to the loading area and picked up another load. The weather conditions further deteriorated such that the load was unstable and the workmen on the roof could not handle it. The pilot took the load off the roof and hovered over a parking lot area adjacent to the loading area. While hovering in this area, the thunderstorm precipitated what was described as a torrential downpour with associated hail. The aircraft was observed to suddenly bank to the left and pitch nose-down 45 degrees, then turn quickly to the south and fly away with the slung load trailing behind. While in forward flight,*



*the load was jettisoned and the helicopter was observed to pitch tail over nose twice. The aircraft struck an asphalt surface behind a building about 2,000 feet from the loading area and then struck a wire mesh fence. A post-crash fire engulfed the cockpit. The pilot was thrown clear of the aircraft and sustained fatal injuries.”*

The report also says: “No direct observations of downdraft speeds were obtainable for this event; however, analysis of the vertical sounding of the air mass indicated potential downdraft speeds of 40 to 50 knots in any significant cell developing in the air mass. Conventional radar returns indicated that a sudden onset of heavy rain began at the accident location between 1250 and 1300 EDT. The strength of the radar echoes indicated a rain rate of approximately 35 to 50 millimetres per hour.”

To put that in perspective, a 50 kt downdraft is approximately 4 000 ft/min—difficult to overcome in any helicopter, and the monthly average rainfall for Toronto (Pearson Airport) in May is 67 mm. The accident pilot was considered very skilled and well respected, with almost 15 000 hr of helicopter time, and significant sling experience. It is easy for all of us to put ourselves in his position—almost at the end of the job, just a few more lifts to go, the pressure to finish the work in the back of our minds. *Just one more lift, and if that doesn't go well, I'll call it off.*

Thunderstorms sometimes form in groups of cells known as a squall line. This narrow band of active storms creates a significant hazard to aviation, as it may be too long to detour around, and too severe to penetrate. They develop in moist, unstable air, often on or ahead of a cold front, but may occur with no associated frontal activity. They frequently contain steady-state thunderstorms and form rapidly, usually reaching maximum intensity in the late afternoon and early evening.

The cumulonimbus cloud packs just about every weather hazard known to aviation, often in one vicious bundle. Some of the individual hazards helicopter pilots face around thunderstorms are:

**Turbulence**—Potentially hazardous turbulence is present in and around all thunderstorms, with severe storms having the ability to destroy an aircraft, whether parked or in-flight. The strongest turbulence within the cloud occurs in the shear between updrafts and downdrafts. Outside the cloud, shear turbulence may be found several thousand feet above, and up to 20 mi. from a severe storm. Gust fronts can extend up to 15 mi. ahead of precipitation associated with a major storm, causing rapid and sometimes drastic changes in surface winds.

**Precipitation**—Usually intense in and around storms, and may fall as rain, hail or both. Rain can reduce visibility to zero, and may do so almost instantaneously, posing a serious threat to VFR flight. Hail is formed when supercooled droplets are carried aloft and freeze. Once a drop has frozen, others attach to it, and the hailstone grows—sometimes into a huge ball of ice. Eventually, they fall, possibly some distance from the storm core—hail may be encountered in clear air several miles from large storms. It goes without saying that hailstones can cause severe damage to a helicopter rotor system or fuselage.

**Altimeter Error**—Atmospheric pressure usually falls rapidly with the approach of a storm, then rises sharply with the onset of the first gust and arrival of the cold downdraft and rainfall, falling back to normal as the cell passes. This can have a significant effect on altimeters, creating dangerous errors in altitude information.

**Lightning**—Helicopters and lightning do not mix well. Nearby lightning can temporarily blind the pilot, disrupt radio communication on some frequencies, and induce permanent errors in the magnetic compass. Lightning strikes can damage communication equipment, puncture aircraft skin, and cause unseen thermal damage to rotor systems, engine bearings and other internal components, as the electricity passes through the aircraft.

In July 2002, a Sikorsky S-76 helicopter operating in the North Sea crashed, killing 11 people. The British Air Accident Investigations Branch (AAIB) report concluded that one main rotor blade had failed in fatigue. A manufacturing anomaly in the scarf joint between the two titanium leading edge strips of the rotor blade was found in the investigation. In addition, the area exhibited thermal damage. From the report: “*The fatigue initiation point of the blade's titanium spar was on the upper surface in the area of the inboard edge of the scarf joint between the two piece titanium leading edge erosion strip. Microscopic examination of the initiation point indicates that it had suffered intense thermal damage. The area has the appearance of and discolouration similar to an electrical 'spot weld'.*”

The blade had been struck by lightning in 1999. The report concluded that the manufacturing anomaly, exacerbated by the thermal damage from the lightning strike had caused the blade to fail. Contrary to what we might think, lightning strikes may be relatively

benign events, and may not always be obvious to the pilot. But every strike has the potential to cause serious damage to the helicopter. If you suspect that you have been struck by lightning, have the aircraft thoroughly inspected immediately.

As mentioned earlier, give these powerful weather phenomena a wide berth, and make the decision to land or clear the area at the first sign of an approaching storm. If you are lucky enough to have a dispatch facility with radar information, or are in contact with Flight Service, monitor storm activity through them. If the storm cannot be avoided, the safest place to weather it out is on the ground, shut down, with the blades tied—preferably while you are safely inside a building, drinking coffee.

With information from the TSB, the AAIB, and the United States Department of Transportation Federal Aviation Administration (FAA) [Advisory Circular 00-24C](#), *Thunderstorms*. △

## TSB Final Report Summaries

*The following summaries are extracted from final reports issued by the Transportation Safety Board of Canada (TSB). They have been de-identified and include the TSB's synopsis and selected findings. Some excerpts from the analysis section may be included, where needed, to better understand the findings. Unless otherwise specified, all photos and illustrations were provided by the TSB. For the benefit of our readers, all the occurrence titles below are now hyperlinked to the full TSB report on the TSB Web site. —Ed.*

### TSB Final Report A14W0046 Runway incursion

On 29 March 2014, the Beech 1900D was being taxied by company maintenance personnel to the holding bay of Runway 29 at the Calgary International Airport, Alberta, during the hours of darkness. The tower controller issued initial taxi instructions to depart Apron V, proceed via Taxiway N and Runway 26 to hold short of Taxiway Y. At 0024, Mountain Daylight Time, a runway incursion occurred when the Beech 1900D entered the active runway (Runway 17R) at the threshold of Runway 35L. A departing Boeing 737-700 was already airborne when the Beech 1900D entered the runway.

### TSB Final Report A14Q0148 Runway excursion

On 28 September 2014, a de Havilland DHC-6-300 Twin Otter aircraft, was on a charter flight from Lourdes-de-Blanc-Sablon, Quebec, to La Tabatière, Quebec, with 2 crew members and 17 passengers on board. The aircraft touched down about 750 ft beyond the threshold of Runway 23. During the rollout, the captain determined that the aircraft would not stop before reaching the end of the runway, and initiated a high-speed left turn onto the taxiway. The aircraft skidded to the right, and the right propeller struck a runway identification sign before the aircraft came to a stop. The aircraft sustained substantial damage. There were no injuries, and no fire occurred. The 406-megahertz emergency locator transmitter did not activate. The accident occurred at 1512, Atlantic Standard Time, in daylight.

### TSB Final Report A14Q0060 Collision with wires



*Impact site (Source: Héli-Boréal)*

On 13 May 2014, an Eurocopter AS 350 BA helicopter was on a flight to inspect power-line vegetation encroachment with a pilot and an observer on board. The flight surveyed a 25-kilovolt power distribution line, which ran adjacent to a service road leading to Hydro-Québec's Sainte-Marguerite power dam. While completing a right turn in a valley, the pilot noticed a 315-kilovolt power transmission line crossing perpendicular to the direction of flight. The right turn was increased to avoid the transmission line, but one of the helicopter's main rotor blades struck the lower wire. The resulting damage to the rotor blade caused severe vibrations, which made it difficult to control the helicopter. While on approach to land in a small clearing under the 315-kilovolt transmission line, the helicopter's skid gear contacted trees. The helicopter rolled to the left and fell approximately 50 ft through the trees, coming to rest on its left side in the snow. Both occupants sustained serious injuries, yet were able to exit the aircraft. The helicopter was substantially damaged. The 406-megahertz emergency locator transmitter activated on impact. The Cospas-Sarsat International Satellite System for Search and Rescue did not receive a signal until 25 min after the accident. There was no post-impact fire. The accident occurred in daylight hours at 1020, Eastern Daylight Time.

TSB Final Report A14O0077 Loss of control–Collision with water

On 24 May 2014, privately-registered Cessna 185E equipped with amphibious floats, departed the Guelph Airpark for a flight to Taylor Lake, Ontario. The pilot was the sole occupant of the aircraft. While conducting a glassy water landing, the floats dug into the water, the pilot lost control, and the aircraft cartwheeled and sank. The aircraft fuselage was damaged by impact forces, and the pilot's door could not be opened. The pilot survived the impact but was not able to escape the submerged aircraft and drowned. The aircraft was equipped with an emergency locator transmitter which activated; however, no signal was received due to the antenna being submerged. The accident occurred during hours of daylight at approximately 0740, Eastern Daylight Time.



Submerged aircraft.

(Source: Ontario Provincial Police)

TSB Final Report A13W0120 Engine failure after takeoff and collision with terrain

On 19 August 2013, a Douglas DC-3C was operating as a scheduled passenger flight from Yellowknife, Northwest Territories, to Hay River, Northwest Territories. After lift-off from Runway 16 at 1708, Mountain Daylight Time, there was a fire in the right engine. The crew performed an emergency engine shutdown and made a low-altitude right turn towards Runway 10. The aircraft struck a stand of trees southwest of the threshold of Runway 10 and touched down south of the runway with the landing gear retracted. An aircraft evacuation was accomplished and there were no injuries to the 3 crew members or the 21 passengers. There was no post-impact fire and the 406 MHz emergency locator transmitter did not activate.

TSB Final Report A13P0127 Mid-air collision

The privately registered Cessna 150F departed Lillooet, British Columbia, for Nanaimo, British Columbia, with the pilot, 1 passenger, and a dog on board. A privately registered Stemme S10-VT motor glider was inbound to Pemberton, British Columbia, after a local sightseeing flight, with the pilot and 1 passenger on board. Both aircraft were being operated in accordance with visual flight rules. At approximately 1218, Pacific Daylight Time, the 2 aircraft collided about 3 nautical miles west of Pemberton and struck the ground in the Nairn Falls Provincial Park Campsite. There were 2 main accident sites about 0.3 nautical miles apart. Both aircraft were destroyed, and there were no survivors. There was an intense post-impact fire, which consumed the cockpit and engine compartment of the glider. The Cessna engine compartment suffered a small post-impact fire, which self-extinguished. No emergency locator transmitter signals were detected at the time of the accident.

Approximate distance	View	Approximate time to impact
1 nm		14 sec.
1/2 nm		7 sec.
1/4 nm		4 sec.
1/8 nm		2 sec.
1/16 nm		1 sec.

Time to impact for 2 aircraft approaching each other at 250 knots (Source: Transport Canada, TP 12863, Human Factors for Aviation–Basic Handbook [2003])

## Night-flying Quiz

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*Here are some questions to test your knowledge and get you back in the night-flying mode.*

1. What is the official definition of night? (according to the *Canadian Aviation Regulations* [CARs])
2. You are allowed to take off from but not land at an unlighted aerodrome at night. True or False?
3. In addition to the operational and emergency equipment required on board the aircraft, what extra piece of equipment must also be carried at night?
4. An aircraft operated in night visual flight rules (NVFR) shall carry an amount of fuel that is sufficient to allow the aircraft to fly to the destination aerodrome and to continue flying for a period of \_\_\_\_ min at normal cruising speed.
  - a) 30
  - b) 45
  - c) 20
  - d) 60
5. The minimum flight visibility required to operate an your aircraft NVFR at less than 1000 ft AGL is:
  - (a) not less than one mile;
  - (b) not less than three miles;
  - (c) not less than half a mile; or
  - (d) not less than two miles.
6. For night vision, it takes time for our eyes to fully adapt to the dark. In general, approximately how long will this process take?
  - (a) 15 min
  - (b) 30 min
  - (c) 45 min
  - (d) 60 min
7. There are several things that a pilot can do to protect his/her night vision, these include:
  - (a) using the dimmest acceptable interior lighting;
  - (b) if it is necessary to use a bright light, closing one eye in order to prevent losing night adaptation in that eye;
  - (c) wearing sunglasses in bright light situations; or
  - (d) all of the above.
8. While flying at night, under what conditions should you turn the cockpit lighting up to full bright?
  - (a) All the time, in order to see the flight and engine instruments clearly.
  - (b) Never, in order to preserve your night vision adaptation.
  - (c) When flying in an area of thunderstorms.
  - (d) Only when reading a chart or flight publication.
9. You are planning to depart from an airport that has a positive control zone at night. You are told by ATC that the weather has gone below VFR and special VFR (SVFR) is in effect. Can you legally continue with your takeoff and departure?  
Yes or No?



10. While conducting a pre-flight check of your aircraft for a night flight, you discover that the anti-collision light is not working. You are allowed to proceed with your night flight as long as it is repaired prior to your next flight. True or False?
11. The pilot-in-command is required to carry spare fuses during the flight for his/her aircraft. True or False?
12. Where would you look to find information on an aircraft radio control of aerodrome lighting (ARCAL) system?
13. You are taxiing out to the runway with two passengers on board to depart on a local flight. When you go to turn on the landing light, you realize that it is not working. For this situation, which of the following statements is/are correct:
  - (a) You may continue with the flight as long as you remain within 25 NM of the airport.
  - (b) You may continue anyway.
  - (c) You may continue only without passengers on board.
  - (d) You cannot continue at all.
14. Serviceable aircraft position lights are required for any night flight. True or False?
15. Under dim lighting conditions when the level of illumination is below the intensity of moonlight, the central vision can become diminished to the extent that looking directly at the moon may, in fact, cause it to disappear. True or False?
16. If you are being affected by a somatogravic illusion during a normal takeoff and departure, the body may incorrectly sense that the aircraft is:
  - (a) pitching up;
  - (b) rolling;
  - (c) pitching down; or
  - (d) accelerating.
17. Many accidents have occurred at night, in clear visual conditions, while the aircraft was on approach over water or dark ground. A contributing factor in these accidents has been sighted as the black-hole effect. This illusion will:
  - (a) cause the pilot to see his/her approach as too high and land short;
  - (b) have no effect on the glide path angle;
  - (c) cause the pilot to see his/her approach as too low and land long; or
  - (d) not occur if the runway is near a brightly lit city.
18. Fatigue is an insidious enemy of pilots as it will decrease an individual's mental ability. After 18 hr of wakefulness, people exhibit a \_\_\_\_\_ % decrease in the ability to perform mental tasks.
  - a) 10
  - b) 20
  - c) 30
  - d) 40

*The answers to the quiz can be found on page 18.*



## Answers to the Night-flying Quiz

1. CAR 101.01: “the time between the end of evening civil twilight and the beginning of morning civil twilight.”
2. False. You may not takeoff from or land at an unlighted aerodrome at night unless the flight is conducted without creating a hazard to persons or property on the surface and the aircraft is operated for the purpose of a police operation that is conducted in the service of a police authority or for the purpose of saving human life. (CAR 602.40)
3. A flashlight that is readily available to each crew member. (CAR 602.60)
4. (b) 45 min for aircraft other than a helicopter or (c) 20 min for a helicopters (CAR 602.88(3))
5. (b) not less than three miles (CAR 602.115)
6. (b) 30 min (TP 12863)
7. (d) (TP 12863)
8. (c) (A.I.P. AIR 2.7.2 )
9. No, when the aeroplane is operated during the night, the authorization is for the purpose of allowing the aircraft to land at the destination airport. (CAR 602.117)
10. False (CAR 605.16)
11. True (CAR 605.16(e))
12. *Canada Flight Supplement* (CFS), General Section
13. (c) (CAR 605.16)
14. True (CAR 605.16)
15. True (TP 12863E, page 71, paragraph 3)
16. (a) (TP 12863E, page 103)
17. (a) (TP 12863E, page 83)
18. (c) (TP 12863E, page 60)