Air Accident Investigation Unit
(Belgium)
Federal Public Service
Mobility and Transport
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Safety Investigation Report

Ref. AAIU-2022-09-12-01
Issue date: 29 October 2024
Status: Final

Scope: Limited

As per ICAO Annex 13 and EU regulation EU 996/2010, decisions regarding whether to conduct a civil aviation safety investigation, and the extent of an investigation, are based on many factors, including the level of safety benefit expected to be drawn from such an investigation.
For this occurrence, a limited-scope, fact-gathering investigation and analysis was conducted in order to produce a short summary report. The investigation mainly focussed on the actions and conditions directly relating to the occurrence and might not cover all aspects of the aircraft operation and/or possible underlying safety factors due to the expected safety benefit of it and/or the extent of evidence/resources available.

SYNOPSYS

Occurrence class	Serious Incident
Occurrence category	Birdstrike (BIRD)
Date and time[1]	Monday 12 September 2022 12:50 UTC
Location	Airspace class G above Itegem, submunicipality of Heist-op-den-Berg
Aircraft	Grumman American AA-5B Tiger
Aircraft category	Fixed wing - Small aeroplane (MTOW ≤ 5700 kg)
Location of departure	Aerodrome of Grimbergen (EBGB)
Planned destination	Aerodrome of Zwartberg/Genk (EBZW)
Type of operation	Non-commercial - Cross-country
Phase of flight	En route (cruise)
Injuries	None
Aircraft damage	Substantial

What happened

During a flight in airspace class G at an altitude 1500 ft AMSL, a bird strike occurred. A gull (800 gr) shattered the windshield, entered the cockpit and landed on the rear seat. The bird impacted the pilot's head causing the headset to be torn off and its goggles smeared. After declaring a PAN PAN, the aircraft landed safely back on the aerodrome of EBGB.

[1] All time data in this report are indicated in UTC, unless otherwise specified

What the AAIU found as safety topics

Systemic	Organisational	Development – Equipment certification - Regulator
	Technical	Aircraft structures – Windshield - Damaged
	Operational	Non determined
	Human	Non determined
	Environmental	Physical environment – Object/animal/Subtance – Birds – Effect on operation

1 THE OCCURRENCE

The aircraft took off from the aerodrome of Grimbergen (EBGB) around 12:38 UTC. Inbound the VOR BUN, between Herenthout and Heist-op-den-Berg, flying level at a speed of 110 KIAS and at an altitude 1500 ft AMSL, a bird strike occurred. A gull (800 gr) shattered the windshield, entered the cockpit and landed on the rear seat. The bird impacted the pilot's head causing the headset to be torn off and its goggles smeared.

The pilot declared a Pan Pan to Brussels Info for return straight to EBGB , The communication was very difficult due to deafening noise of the wind and prop wash. This difficult communication may explain why Brussels Info had understood "fire in the cockpit".

The aircraft landed uneventfully in EBGB and both occupants could leave the aircraft without any injury. According to the passenger, the bird came from above. The propeller showed no impact damage.

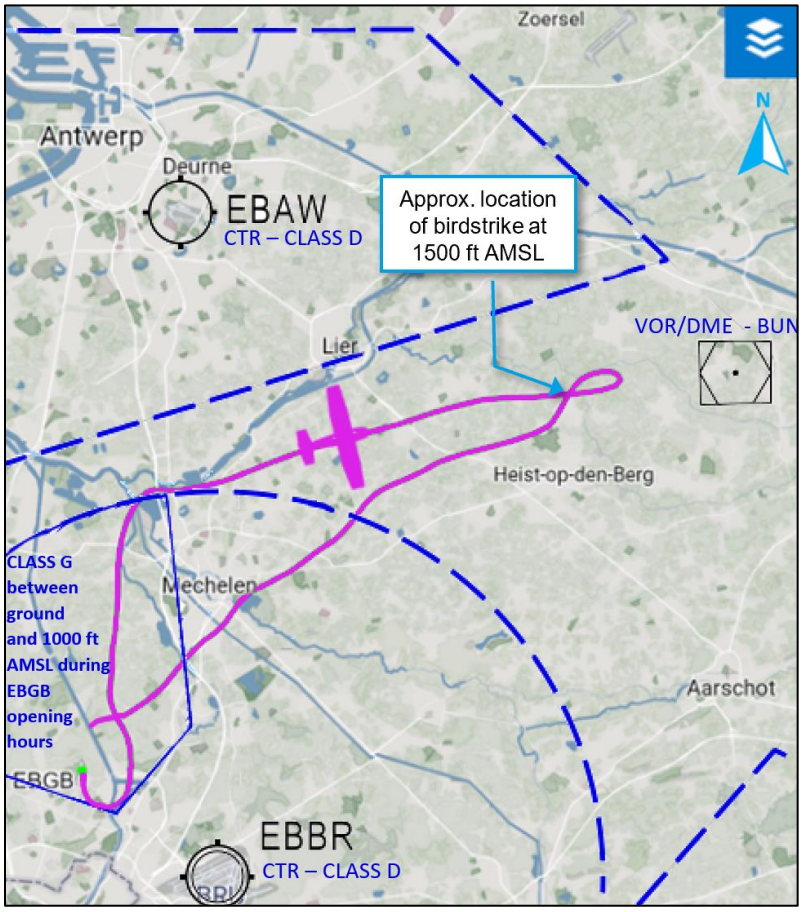

Figure 1: reconstructed flight path with help of flight tracker service FlightAware

Figure 2 : shattered windshield and impact traces in cockpit, no traces on the propeller

Figure 3 : the concerned herring gull, weighing 800 g

2 CONTEXTUAL INFORMATION

2.1 Aircraft information

2.1.1 General

Table 1 : General aircraft data

General	
Manufacturer	Grumman Aerospace Corporation
Model:	Grumman American AA-5B Tiger
History	
Year of built:	1975
Registration:	Registered by the Belgian CAA
Serial:	AA5B-0197
Engine	
Engine type	carbureted, direct-drive, air-cooled, horizontally opposed, normally aspirated, reciprocating four-cylinder
Engine manufacturer and model	Lycoming O320-A4M
Serial	L20867-36A
Propeller	
Propeller type	Fixed-pitch two blade aluminium
Propeller manufacturer and model	McCauley 1A170 FFA7563
Serial	P77749

The Type Certificate No. A16EA was issued on 12 November 1971. Certification basis was FAR 23.

The AA-5B has a cruise speed of 139 KIAS (75% power).

2.1.2 Certification specifications

This aircraft's certification basis was US FAR23. This is similar to the European CS-23.

EASA CS 23.2320 about the occupants' physical environment for normal category aeroplanes[2] requires the applicant to design the aeroplane to:

- protect the pilot against serious injury due to hazards originating from high energy, associated with systems and equipment; and
- protect the occupants from serious injury due to breakage of windshields, windows, and canopies

[2] Aeroplanes with a passenger seating configuration of 19 or less and a maximum certified take-off mass of 8 618 kg (19 000 pounds) or less

Only for Level 4[3] aeroplanes, each windshield and its supporting structure directly in front of the pilot must withstand, without penetration, the impact equivalent to a two-pound bird when the velocity of the aeroplane is equal to the aeroplane's maximum approach flap speed.

2.2 Meteorological information

That day, a weak to moderate wind from the south temporarily carried warmer air. As a result, afternoon temperatures reached up to 25 degrees in the centre of Belgium.

The METAR at the time of the incident in EBBR:

121250Z 17004KT 120V210 CAVOK 24/11 Q1014 NOSIG=

2.3 Additional information

2.3.1 Background information herring gull activity in Belgium

The *Research Institute Nature and Forest* of the Flemish government (*Instituut voor Natuur- en Bosonderzoek, INBO*) was contacted. They confirmed the concerned bird as being a first calendar year herring gull.
They stated that a flying altitude up to 1500 ft AMSL is not usual, but that it certainly cannot be ruled out either. Gulls, like birds of prey, sometimes circle very high in the sky using warm rising air. Also, some foraging activities take place high in the air. Finally, high-altitude flying is not uncommon for gulls, especially migratory movements and long-distance flights can take place at higher altitudes.
About the location they stated that gulls make frequent use of inland areas (agricultural areas are very much in demand, but also urban areas and industry sites) and especially in autumn they are very scattered throughout Flanders. These are often gulls from the more northern breeding areas, such as the Netherlands, which cross our country or even use it as a wintering ground. Our own gulls from coastal breeding colonies are somewhat more coastal-bound, although some really do migrate inland.
The most activity is suspected to occur in autumn and winter.

The institute possesses over a lot of data on the whereabouts of gulls on the coast because they have fitted a lot of gulls with GPS transmitters there. But there's little knowledge about domestic gulls. There are smaller breeding colonies in Antwerp, in Brussels and in Limburg, but as mentioned, it is suspected that most of the birds we encounter inland are from Dutch and other northern breeding colonies. It is not just the herring gull, by the way; lesser black-backed gull and gull also occur in large numbers in the inland:

[3] Aeroplanes with a maximum seating configuration of 10 to 19 passengers.

In 2020 a report on the status and trends of breeding bird species in Flanders was published. The long-term trend (1990-2018) of the breeding population of the herring gulls in Flanders was an increase, however the short-term trend (2007-2018) showed a decrease. In 2016 the specie was added to the red list as being near threatened, so not endangered yet.

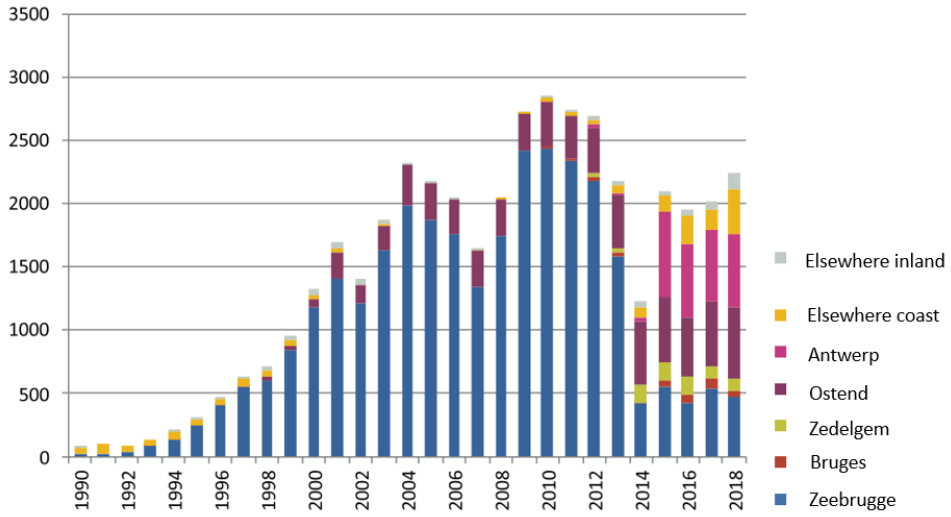

Figure 4 : Trend of herring gull (numbers of pairs) in Flanders during the period 1990-2018

The European trend direction based on data collected in 26 member states over the period 2008-2018 was for the herring gull considered as not significant in the report.

2.3.2 Other bird strikes in general aviation over Belgian territory 2019-2023

Regulation (EU) N° 376/2014 on the reporting, analysis and follow-up of occurrences in civil aviation provides the means for collecting information on safety occurrences to the European database – ECCAIRS 2 ((European Aviation Safety Reporting Portal)). Data about bird strikes are collected from both pilot community and airport authorities.
A search for bird strike events in the ECCAIRS database was done for the 5-year period of 2019-2023.

The majority of the data collected originates from the reporting of Commercial Aviation activity. However, General Aviation encompasses many different activities, aircraft are smaller, fly at lower altitude, etc.., Within the data of General Aviation, the reporting of smaller aeroclub/training organization aircraft have been extracted, based on the weight class (covers Cessna 172, Piper PA28, etc..).

Table 2 : bird strike reports 2019-2023 in Belgium

Year	Total number of bird strike reports	General Aviation (**)	Aircraft with MTOM < 2.25 T	Helicopters
2019	478	21	13	0
2020	228	10	5	0

2021	458	34	14	0
2022	562	28	10	2
2023 (*)	343	17	8	2
Totals:	2069	110	50	4

(*) up to September.
(**) includes business aviation

From the 50 incident reports concerning aircraft with a MTOM < 2.25 T, the zone hit by the bird was the canopy (3), the leading edge of the wing (6), the propeller (2) or the landing gear. The most critical damage was to the canopy (broken canopy (2)).

Only 1 of these reported incidents (next to the incident subject of this report) occurred en route:

Date and time:	1 June 2019, time not known
Aircraft:	Robin DR-400

Narrative:

During cruise at 3000 ft in the vicinity of point Romeo (EBLG CTR), just before climbing to 4000 ft as cleared by ATC, we got hit by a bird on the left wing, breaking the landing light. During impact, a small shock was felt in the rudder. We directly checked engine parameters and airplane controllability, all appeared to be OK. We announced the bird strike to ATC and decided to proceed back to EBST. As a precaution, we made a low pass above EBST tower to check the gear status. All found OK followed by an uneventful landing in EBST on RWY 24.

Period of the year

From the analysis of the 50 bird strikes reported by small aircraft, the monthly distribution corresponds with the general figures (meaning the distribution is caused by the bird activity, not the aviation activity).

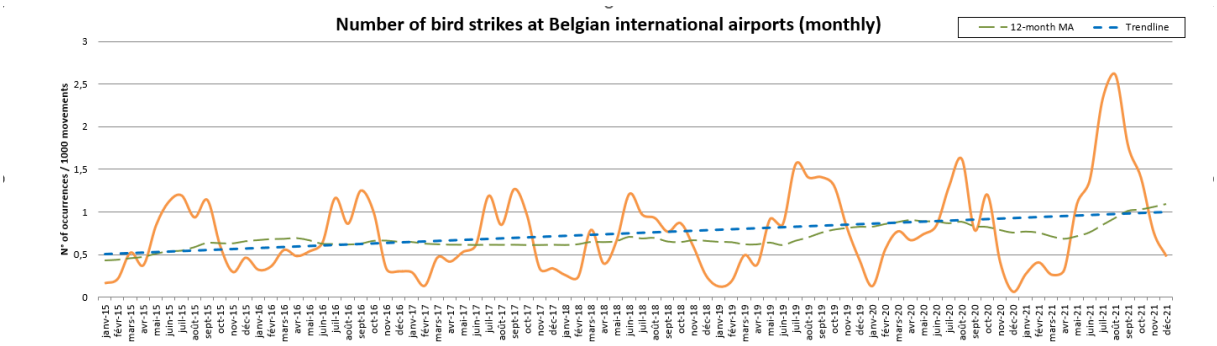

Figure 5 : bird strikes at Belgian international airports (data from Belgian Civil Aviation Authority)

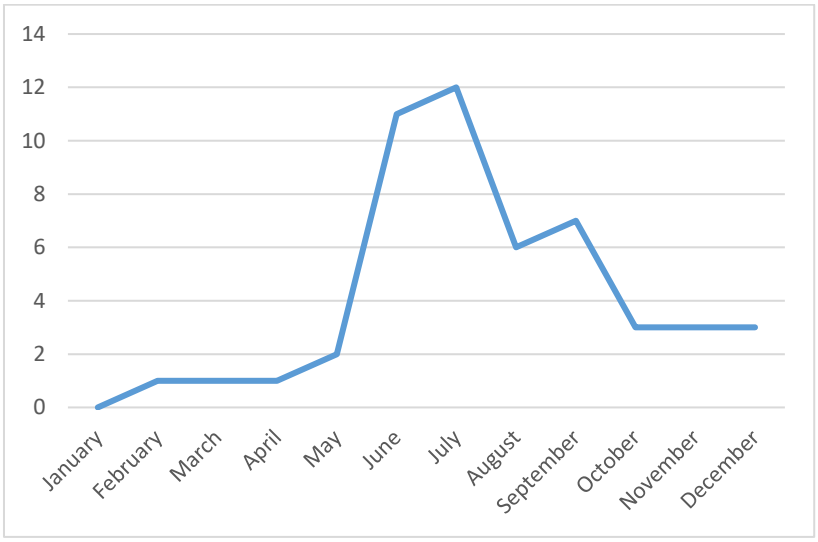

Figure 6 : Bird strikes 2019-2023 - monthly distribution aircraft with MTOM<2,25T

Bird species

The birds species involved, when identified in the report, are:

Table 3 : species and their characteristics involved in bird strikes

Species	Size (cm)	Mass (g)	Nr of reports
Pigeon	60-80	250-520	8
Dove	25-35	240-380	1
Starling	19-23	58-101	1
Crow	50	400-600	1
European herring gull (seagull)	60- 67	700-1500	2
Kestrel	32-35	200-280	3
Busard	50-57	62 -1400	1
Pheasant	70-90	1000	1

Unfortunately, when damage to the aircraft are reported, the bird species are not specified, with the exception of the occurrence investigated in this report.

Phase of flight

Take-off/initial climb: 21
En route: 2 (4)
Final: 4
Landing: 14
Taxi: 1
Touch and go: 4
Unknown: 4

All of the bird strikes with helicopters (number between brackets) occurred during cruise (en route), whereas for fixed-wing aircraft this only accounts for less than 5% of the incidents. An explanation for this could be that helicopters generally cruise at lower altitudes.

Location

The vast majority of the reports concerns occurrences at the international airports, EBAW (16), EBOS (14), EBKT (9), EBCI (5), there are very few reports (4) of smaller airfields.

2.3.3 General bird activity and migration in Belgium

Chapter ENR 5.6 of the Belgian Aeronautical Information Publication (AIP) handles about bird migration and areas with sensitive fauna.

Considering the migration the following is stated: The spring migration takes place between mid-February and the end of May, the most active part being in April and May. This migration is more dispersed and less spectacular than the autumn one. The principal direction over Belgium is northeast.

The autumn migration lasts for more than three months. The first flight movements can already be seen from the end of July, while the last movements of any significance are completed by the end of November. They have a typical stream of movement with periods of relative calm interspersed with periods of very intense migration. Between mid-August and mid-November migratory birds are particularly active. The movement takes place in a mostly southwest direction.

When on actual migration, most birds make long flights at often high levels in contrast to their flying at relative low altitudes during their stay in the concentration areas.

Although a great part of the bird population that is dangerous to aircraft, start migrating from concentration areas, according to radar observations migration often appears to take place over a broad front, covering nearly the entire Belgian territory.

About the concentrations:

As elsewhere in the world, headlands, inland waters and shallow estuaries attract flocks of birds for breeding, roosting and feeding at various times of the year. Within 10 NM or so of such locations concentrations of birds flying mostly below 1 000 FT may be encountered.

In order to lessen the risk of bird strikes, pilots of low flying aircraft should, whenever possible, avoid flying at less than 1 000 ft above surface level over areas where birds are likely to concentrate. Where it is necessary to fly lower than this, pilots should bear in mind that the risk of bird strike increases with speed (it is a fact that birds rarely hit an object moving slower than 80 kt).

2.3.4 EASA Study: Bird Strike Damage & Windshield Bird Strike

In 2009, the European Aviation Safety Agency (EASA) commissioned a study that was carried out by Atkins and the UK Food & Environment Research Agency (FERA). Its aim was to investigate the adequacy of the current aircraft certification requirement in relation to current and future bird strike risks on aircraft structures and windshields. The bird strike data presented in the report covers US, Canada and UK reported bird strikes from 1990 to 2007 which accounted for approximately 11,000 incidents for which complete data on aircraft type, speed and bird species were available.

Conclusions and recommendations for CS-23 and CS-27 small helicopter

Airframe bird strikes are a relatively rare cause of accidents, representing only 0.3% of the total aircraft Fatal Accident Frequency Rate from all causes. However there are significantly more airframe strikes than engine strikes (by a ratio of 4.6 to 1). 51 accidents worldwide have been identified since 1962, of which only 14 (7 of them fatal), fell within the scope of this study. All of these accidents were to CS-23 and CS-27 aircraft. Where accidents have occurred, they have usually been associated with high energy impacts – heavy birds (greater than 2 lb/0.9 kg) encountered at relatively high speed, resulting in Kinetic Energies of impact that are often several times the certification values.

Windshield penetration was a feature of 50% of all accidents. A detailed analysis of windshield strikes showed a strong correlation between impact kinetic energy (KE), certification requirements and probability of damage. Increasing the certification requirement is very effective in reducing the incidence of damage.

In CS-23 (excluding commuter) and CS-27 aircraft categories there are currently no specific bird strike requirements and this is reflected in a higher rate of bird strike accidents (particularly windshield penetrations). Based on the accident record to date, a pre-existing requirement that such aircraft withstand collision with a 2lb/1kg bird at Vmo/Vh[4] may have avoided 26% of the CS-23 accidents reported.

It may, however, be difficult to engineer an effective solution to increasing the bird strike resistance of these aircraft at acceptable cost. Additionally, due to the relatively low turn over rate, a change in the regulations may take some time to be effective. The use of helmets and visors might therefore represent a more practical and timely option.

None of the accidents appeared to be due to damage to modern avionic systems or composite materials.

[4] Vmo: Maximum Operating Speed
Vh: Maximum speed in level flight at maximum continuous power

2.3.5 Bird strike incidents and accidents in the neighbouring countries

In addition to the conclusion of the EASA report described above, which used events that occurred in Canada, the UK and the USA, the database of the SIA[5]'s of the neighbouring countries the UK, France, Germany and The Netherlands have been searched for the sake of this investigation.

18 investigation reports have been found (2003- 2023) involving bird-related events:

- 14 have been classified as accidents, including 3 fatal accidents for a total of 7 fatalities
  - 4 accidents involved bird strikes en route, of which 1 fatal. 2 of those accidents involved the windshield being hit
  - 6 accidents occurred during approach / landing phase of which 1 fatal. 2 of those accidents involved the windshield being hit
  - 2 accidents occurred during intentional maneuvering at low altitudes, of which 1 fatal
  - 2 accidents occurred during take-off.
  - The bird species involved in accident concern mainly large bird of prey cormorants, geese,
- 2 serious incidents
  - the bird struck the left windscreen causing it to shatter. The remains of the bird entered the cockpit and hit the pilot, dislodging his headset.
  - At take-off, a goose hit the horizontal stabilizer of a parachute-carrying C208.
- 2 incidents

Some conclusions:

- 15 events involve material damage only;
- 5 of the 19 events involve the windscreen being hit;
- 4 events occurred en route. Those were all classified as accident. The higher damage can be explained by the higher airspeed during this phase of flight;
- Unlike commercial aviation, bird strikes in general aviation are not concentrated in the vicinity of airports/ airfields. General aviation airplane fly at lower heights, increasing the probability of encountering birds. Finding birds at altitudes of 5000 ft AMSL or above, although rare, is not uncommon. Ducks and larger birds such as geese and cranes can fly up to altitudes of 10000 ft;
- The most critical accidents were caused by impact with large, heavy birds species such as birds of prey (vultures,….), cormorants, geese.
- Bird strikes with smaller birds usually result in smaller damage but also can include damage on the canopy.

[5] SIA: The national (Civil Aviation) Safety Investigation Authority of a member state as defined in regulation (EU) 996/2010 and who is in charge of the independent safety investigation of accidents and serious incidents.

2.3.6 Other publications

- EGAST Leaflet GA6

  Back in 2013, the former *European General Aviation Safety Team* (EGAST) published a leaflet GA 6 about the risk of bird strikes. However this edition was translated from a German AOPA Safety Letter. Apart from some general considerations, the description of the bird activation and regions of populations was limited to the German territory.

- UK CAA SafetySense Leaflet 10C Bird Avoidance

  Includes advice to provide greater awareness of the risk, and further reduce the number of collisions as well as help pilots to minimise the consequences if a bird strike does occur.

3 ANALYSIS

3.1 The risk of bird strikes

The risk of a bird strike en route can be evaluated by considering both the probability and the severity. In order to evaluate this, this investigation focused on the following;

- The certification specifications
- Activity and trend of the bird species involved in this accident
- General expected bird migration over Belgium territory
- Number of bird strikes in general aviation in Belgium and their circumstances
- Number of birds strikes over the world - and more specifically in the neighbouring countries as similar activity might be expected - in general aviation and their circumstances

From the data, we can conclude that the overall risk of bird strikes to the general aviation (aircraft with a MTOM<2.25T) is low in Belgium, especially en route, due to:

- The bird strikes occur mostly with small-size species with a weight of 100 – 500 g, making the forces on impact relatively low.
- Large migrating birds are also present in Belgium, but encounters with them is quite rare (migration at night, aircraft-shy species). It concerns;
  - Cormorants;
  - Great Egret;
  - Crane.

The number of bird strikes might increase in the coming years, if the trend for the years 2015-2021 continues. However, there is no increase in population of the bird species involved in this incident.

The highest danger of bird strikes for aircraft with a MTOM < 2.25T would be an encounter with a heavy bird (such as the European Herring gull (seagull)) in flight resulting in damage to the canopy. Two such events are recorded for the period 2019-2023.

3.2 Management of the risk in general aviation

In managing risk all that can be controlled are the design and testing of the aircraft driven by certification specifications, the aircraft's flight profile and, to a limited extent, the populations of birds near airports.

This incident showed that in-flight collisions with birds can lead to a bird penetrating the cockpit and they don't necessarily will be stopped by the rotating propeller. The windshields of most general aviation aircraft are not required to be able to withstand bird strikes.

Concerning the period of the year it is seen that there is an increase of bird strikes during the period May-October. This can be declared by both the bird migration as the increased activity within (general) aviation in that time of the year.
No valid conclusion can be drawn regarding the location of the event; it did not occur in the close vicinity of any sanctuary or breeding area.

The EGAST leaflet GA 6 states that VFR flights should maintain at least the minimum cruise altitude of 2000 ft AGL for overland flights. UK CAA speaks about 2500 ft AGL. However in the dense airspace of Belgium that's often not possible when flying in uncontrolled airspace. Next to that, there's a case where a bird strike occurred even above 3000 ft AGL in Belgium.

3.3 Reporting bird strikes

There are indications that not all bird strikes for General Aviation, in particular involving smaller aircraft are reported.

- Most reports concern occurrences at a major airport; there are very few reports from flights involving small airfields. The presence of airport authorities might facilitate the reporting.
- There are no reports from the ULM community in the database (Regulation (EU) N° 376/2014 is not applicable to this category of aircraft, however they should also be facing the same risk).
- Over 30 % of the reports are concerning foreign-registered aircraft. This is clearly an over-representation of this group with respect to Belgian-registered aircraft.

3.4 Use of goggles

The pilot reported that his goggles were smeared due to the bird strike.

EASA rule MED.B.070 from EASA part-MED imposes that a spare set of similarly correcting spectacles, for distant or near vision as applicable, shall be readily available for immediate use when exercising the privileges of the applicable licence.

This incident is an example of a realistic condition where this spare set of spectacles could be needed and also shows that the importance of having this readily available in the cockpit and not stored in e.g. a bag on the back seat.

4 FINDINGS

4.1 Findings as to causes and contributing factors

- The bird strike occurred with a bird of 800 g at an airspeed of 110 KIAS.
- In CS-23, there is no pre-existing requirement for aircraft levels lower than level 4 (less than 10 seats) to withstand such a collision.
- No valid conclusion can be drawn regarding the location of the event; it did not occur in the close vicinity of any sanctuary or breeding area.

4.2 Findings as to risks

- There are indications that still not all bird strikes within general aviation in Belgium are reported. Without complete data it is difficult to identify trends and risk areas.
- A spare set of spectacles could be needed and it's important to have this readily available in the cockpit and not stored in e.g. a bag on the back seat.

4.3 Positive factor identified during this incident

- The PAN PAN enabled the pilot to fly the shortest route through controlled airspace to land asap back in EBGB.

4.4 Other findings

- There is no increase in population of the bird species involved in this incident, and thus no increase in specific risk.

5 SAFETY ACTIONS, MESSAGES AND/OR RECOMMENDATIONS

Most of the following safety tips are extracted out of the UK CAA Leaflet 10C Bird Avoidance

Safety messages:

- Plan to fly **as high as possible**
- **Avoid bird sanctuaries** and coastlines in spring and autumn
- Small general aviation aeroplane and helicopter windshields are not required to be tested against bird impact and the propeller gives little protection.

  If the **windshield is broken (or cracked), slow the aircraft to** reduce wind blast, follow approved procedures (depressurise a pressurised aircraft), **use spare glasses, sunglasses or smoke goggles** to reduce the effect of wind, precipitation, or debris, but remember to fly the aircraft.
- If you see birds ahead of you, and it is safe to do so, **attempt to pass above the birds** as they usually break-away downwards when threatened. Be particularly careful when near the ground, and never do anything that might lead to a stall or spin.
- If dense bird concentrations are expected, **avoid high-speed descent and approach**. Halving the speed results in a quarter of the impact energy
- If flocks of birds are visible on the approach, **go-around early**. The approach may be clear on a second attempt.
- **Report ALL bird strikes** via the European Aviation Safety Reporting Portal (ECCAIRS-2).

ABOUT THIS REPORT

General	
What?	Safety investigation reports are a technical document that reflects the views of the investigation team on the circumstances that led to the accident or serious incident and is conducted in accordance with Annex 13 to the Convention on International Civil Aviation and Regulation (EU) No 996/2010.
Objective	**The sole objective of safety investigations is the determination of the causes, and to define safety recommendations in order to prevent future accidents and incidents. It is not the purpose of this investigation to apportion blame or liability.** In particular, Article 17-3 of Regulation (EU) 996/2010 stipulates that the safety recommendations made in this report do not constitute any suspicion of guilt or responsibility.
Investigation authority	The Air Accident Investigation Unit of Belgium (AAIU for the rest of this publication). It is the Belgian permanent national civil aviation safety investigation authority as defined in Article 4 of Regulation (EU) No 996/2010 and established in accordance with the Royal Decree of 8 December 1998. This unit is part of the Federal Public Service Mobility and Transport and is functionally independent from the Belgian Civil Aviation Authority and other interested parties.
This investigation	
Investigation initiation	AAIU was notified of the occurrence by Skeyes. Considering the nature and limited damage it was decided to not travel to the scene of this incident.
Scope	**Limited** As per ICAO Annex 13 and EU regulation EU 996/2010, decisions regarding whether to conduct a civil aviation safety investigation, and the extent of an investigation, are based on many factors, including the level of safety benefit expected to be drawn from such an investigation. For this occurrence, a limited-scope, fact-gathering investigation and analysis was conducted in order to produce a short summary report. The investigation mainly focussed on the actions and conditions directly relating to the occurrence and might not cover all aspects of the aircraft operation and/or possible underlying safety factors due to the expected safety benefit of it and/or the extent of evidence/resources available.
Other parties involved	None
	AAIU Belgium would like to thank the mentioned parties above and all other entities and individuals that have contributed to this safety investigation.