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Report A-016/2016

Accident involving a Robin DR-400-180 aircraft, registration F-GXBB, in the town of Arbizu, Navarre (Spain) on 19 May 2016

GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO

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COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

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Foreword

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances of the accident object of the investigation, and its probable causes and consequences.

In accordance with the provisions in Article 5.4.1 of Annex 13 of the International Civil Aviation Convention; and with articles 5.5 of Regulation (UE) nº 996/2010, of the European Parliament and the Council, of 20 October 2010; Article 15 of Law 21/2003 on Air Safety and articles 1., 4. and 21.2 of Regulation 389/1998, this investigation is exclusively of a technical nature, and its objective is the prevention of future civil aviation accidents and incidents by issuing, if necessary, safety recommendations to prevent from their reoccurrence. The investigation is not pointed to establish blame or liability whatsoever, and it's not prejudging the possible decision taken by the judicial authorities. Therefore, and according to above norms and regulations, the investigation was carried out using procedures not necessarily subject to the guarantees and rights usually used for the evidences in a judicial process.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This report was originally issued in Spanish. This English translation is provided for information purposes only.

Contents

Abbreviations

° ' "	Sexagesimal degrees, minutes and seconds
° C	Degrees centigrade
"	Inches
AEMET	National Weather Service
AEPAL	Spanish Association of Light Aircraft Pilots
AESA	National Aviation Safety Agency
AGL	Above ground level
AIP	Aeronautical information publication
AOPA	Association of Pilots Owners of Aircraft
ATC	Air traffic control
cm	Centimeter(s)
CSIC	Spanish National Research Council
CTR	Control zone
E	East
EASA	European Aviation Safety Agency
FAE	Federación Aeronáutica Española
FAR	Federal Aviation Regulations of the United States
ft	Feet
gr	Grams
h	Hours
hPa	Hectopascals
JAR	Joint Aviation Regulations
Kg	Kilograms
Km	Kilometers
Km/h	Kilometers/hour
kt	Knots
L	Liters
LEPP	ICAO location indicator for the Pamplona Airport (Spain)
LESO	ICAO location indicator for the San Sebastian Airport (Spain)
LEVT	ICAO location indicator for the Vitoria Airport (Spain)
LFBY	ICAO location indicator for the Dax/Seyresse aerodrome (France)
LPCO	ICAO location indicator for the Coimbra aerodrome (Portugal)
LT	Local time
m	Meters
MHz	Megahertz
Min	Minutes
Mm	Millimeters

MTOW	Maximum takeoff weight
N	North
N/A	Not affected
P/N	Part number
QNH	Altimeter sub-scale setting to obtain elevation when on the ground
RFAE	Real Federación Aeronáutica Española
S	South
s	Seconds
S/N	Serial number
SEO	Spanish Ornithological Society
TAF	Aerodrome forecast
UTC	Coordinated universal time
VDL	Correction for defective distant vision
VFR	Visual flight rules
W	West

Synopsis

Owner:	Aeroclub of Creil-Senlis-Chantilly
Operator:	Same
Aircraft:	Robin DR-400-180, s/n: 2499, registration F-GXBB
Date and time:	Thursday, 19 May 2016 at 18:10 LT[1]
Site of accident:	Within the town center of Arbizu (Navarre, Spain)
Persons onboard:	1 pilot and 2 companions, killed
Type of flight:	General aviation – Pleasure – International - VFR
Phase of flight:	Cruise
Date of approval:	April 25th of 2018

Summary of the event:

Three pilots were making the return flight from the aerodrome of Coimbra to the aerodrome of Dax/Seyresse in France. The direct visual flight had taken off at 14:45 and was expected to last 3:30 hours.

Due to problems posed by the clouds, the crew attempted to land at the Vitoria Airport, but it was closed until 18:45. Then, over the radio, the crew expressed their desire to proceed to Pamplona.

Between 18:00 and 18:05, while flying over point E of the Vitoria CTR at 3500 ft, the radio exchanges between the crew and Bilbao approach and the Vitoria tower indicated a change in preferences, as the crew opted to proceed toward San Sebastian.

While the Vitoria tower and Bilbao approach were coordinating, radar contact with the aircraft was lost. The pilot had informed ATC that they were flying in the clouds, but in visual contact with the ground. The final radio communication between the Vitoria tower and the aircraft, which was intermittent, took place at 18:06.

At 18:10, some eyewitnesses heard the sound of an impact in the air, and associated with it the engine noise from a flying aircraft. They were then able to see the aircraft

1 All times in this report are local (UTC + 2h).

flying in a circular path at a steep downward angle in the direction of the houses in the town of Arbizu. This was followed by the sound of an impact.

The aircraft impacted the roof of a three-story house.Then fell to the ground in the middle of a street in the town of Arbizu, also impacting the side wall and backyard garden of a detached house. It finally came to a stop in a fenced plot located between two houses. All three occupants were killed as a result of the impact and the aircraft was completely destroyed. There was no fire.

The carcass of a vulture was found in a field near the location of the eyewitnesses. It had signs of a fatal trauma, indicative of an impact with the aircraft.

The cause of the accident was the loss of control of the aircraft, possibly due to striking a griffon vulture, caused by the improper planning of the long-duration visual flight between Coimbra (Portugal) to Dax/Seyresse (France).

The following factors contributed to the accident:

- The weather conditions, in terms of the cloud cover in the Araquil Valley, which limited the flight ceiling to below the peaks on either side of the valley.
- The presence of a large number of griffon vultures, estimated at around 200, gliding in the Araquil Valley.

The investigators have concluded that the planning of this long-distance visual flight was deficient, especially in terms of the crew's evaluation of the weather conditions along the route and the conditions at the alternate aerodromes in the event of potential diversions and changes to their flight plan. As a result, a safety recommendation is issued to the Aeroclub of Creil-Senlis-Chantilly.

REC 04/2018: It is recommended that the Aeroclub of Creil-Senlis-Chantilly, where the crew were based, incorporate documentation and improve the training of the pilots at the club in the area of preparing long-distance visual flights, primarily in the following two aspects: evaluating weather conditions en route and conditions at the alternate aerodromes in the event of potential diversions and flight plan changes.

In light of the large increase in and abundance of griffon vulture populations in the Iberian Peninsula in the last decades, of the great concern over the potential risk that this poses to general aviation and of the recent catastrophic accidents in Spain involving small aircraft, which have underscored the catastrophic potential that a bird strike has for said aircraft, the following safety recommendation is issued to Spain's Ministry of Agriculture, Fishing, Food and the Environment:

REC 05/18: It is recommended that the Ministry of Agriculture, Fishing, Food and the Environment boost and coordinate actions to minimize the excessive concentration and proliferation of griffon vulture (Gyps fulvus) colonies with the autonomous communities and for the whole of the Spanish territory affected.

1. FACTUAL INFORMATION

1.1. History of the flight

The pilot and two companions, who were also pilots and members of the Aeroclub of Creil-Senlis-Chantilly, had previously flown, on Tuesday the 17th, to Portugal and they were flying back. They took off from the aerodrome of Coimbra (LPCO) at 14:45 on a visual flight direct to the aerodrome of Dax/Seyresse (LFBY) in France, on a planned route over Zamora, Valladolid, San Sebastian and Biarritz. The flight was expected to last 3:30 hours and the alternate aerodrome they had chosen was also Biarritz.

The pilot in charge of communications established radio contact with Bilbao approach at 17:24, while flying north of Burgos at an altitude of 6500 ft.

Later, at 17:52, by which time radar contact with the flight had been lost, the aircraft was transferred to the Vitoria control tower. The aircraft was flying north of this airfield at 3800 ft. The pilot asked the Vitoria tower to amend the flight plan and land at that field, which the tower denied, since the airport was closed until 18:45.

Figure 1. Image of the aircraft before the event.

After expressing some concerns, the pilot stated his desire to proceed to Pamplona. At 18:00, he reported passing point E of the Vitoria CTR. Three minutes later, as the controller was coordinating the traffic with Pamplona, the pilot reported they were flying at 3500 ft and passing point E, following the highway to San Sebastian. These intentions were then confirmed, along with the transponder code, and the pilot was transferred to 127.45h MHz, the Bilbao approach frequency.

As the Vitoria tower and Bilbao approach were coordinating, it was confirmed that radar contact had been lost and the pilot reported they were flying between the clouds. The final radio communication between the Vitoria tower and the aircraft took place at 18:06. It was intermittent, with the pilot confirming they were flying at an altitude that was below the radio coverage in the area.

At 18:10 on the afternoon of Thursday, 19 May, some eyewitnesses located 300 meters west of the Arbizu town center and north of the A-10 highway, heard the thud of an impact in the air, along with the sound of the engine of an aircraft in flight. They looked upward in the direction of the noise and saw the aircraft flying in a circular path while turning left and descending sharply, in the direction of the homes in the town of Arbizu, followed by a louder impact noise.

The marks left by the airplane and the debris showed that it initially impacted the roof of a three-story house. It then struck the ground upside down in the middle of a street in the town, and then hit the side wall and backyard garden of a detached house before coming to a stop in a fenced plot between two houses.

The final part of the airplane's trajectory took place at high speed with a strong vertical component. The three occupants were killed on impact and the aircraft was completely destroyed. The impact did not cause a fire.

The remains of the vulture that must have been struck by the aircraft were found in a field located 400 m west of Arbizu, near where the eyewitnesses were located.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Other
Fatal	1	2	3	
Serious				
Minor				N/A
None				N/A
TOTAL	**1**	**2**	**3**	

1.3. Damage to aircraft

The aircraft was completely destroyed.

1.4. Other damage

The different impacts against buildings and the ground before coming to a full stop caused damage to various houses in the town of Arbizu: several components on the roof of a three-story house broke and detached; scrapes, holes and marks on the

outer side wall of another detached house, as well as a broken backyard fence; damage from impact by heavy components and stains from engine compartment liquids on the main façade of another duplex single-family house as well as the complete fracture of the building envelope in another partially developed plot.

1.5. Personnel information

Onboard were three pilots, all with private pilot licenses. The operating flight plan did not identify which of them was in control, and the violence and destruction of the impact made it impossible to ascertain the location of each pilot in the cockpit. As a result, the qualifications and experience of all three are described.

Pilot #1: 54-year old male with a private pilot license since 25 November 2010, valid until 31 December 2017, with single-engine piston and night ratings since November 2012. He had had a national airplane pilot license, called A81 in France, since 5 December 1989. His last class-2 medical certificate was from December 2015 and he had a VDL restriction to correct for near-sightedness, which required him to have a spare set of glasses in the cockpit. It was valid for one year. The information gathered indicates that he had around 300 flight hours of experience.

Pilot #2: 53-year old woman with a private pilot license since 5 February 2010, valid until 31 January 2018, with single-engine piston and night ratings since November 2011. She had had a national airplane pilot license (A81) since 13 May 2009. The information gathered indicates that she had 200 flight hours of experience.

Pilot #3: 69-year old male with a private pilot license since 28 May 2009, valid until 30 April 2017, with single-engine piston and night ratings since November 2011. He had an English proficiency level of 4, valid until 30 June 2015. He had had a national airplane pilot license (A81) since 30 June 2008. The information gathered indicates that he had 150 flight hours of experience.

1.6. Aircraft information

1.6.1. General information

- Manufacturer and model: Robin DR-400-180
- Registration: F-GXBB
- Serial number: 2499
- Year of construction: 2001

- Owner and operator: Aeroclub of Creil-Senlis-Chantilly
- Airworthiness review certificate: issued on 09/01/2016
- Engines, number/manufacturer and model: one (1) Lycoming O-360-A3A, s/n: L28176-36E
- Propellers, part number (P/N), model and s/n: Sensenich 76 EM 8S50, 76" diameter with two fixed-pitch metal blades.
- Empty weight: 758 kg
- Maximum takeoff weight: 1315 kg
- Wingspan: 8.72 m
- Maximum cruise speed: 140 kt
- Fuel capacity: 190 L expandable to 240 l with a supplementary tank
- Range: 1100 Km
- Airframe hours: 4,350
- Engine hours: 1,988

EASA A.367 type certificate in the Normal and Utility Category, reference date 21/03/1971, and airworthiness requirements France AIR 2052, amendment of 06/06/1966 and FAR 23 amendment 7.

For aircraft certified under FAR 23, there are no certification requirements for bird strikes in the Normal and Utility categories. The subsequent amendments were confirmed not to include any bird strike requirements.

1.6.2. Maintenance records

The aircraft's last airworthiness review certificate had been issued on 9 January 2016, with 4315 flight hours on the aircraft.

The last annual/100-h inspection had been conducted on 3 May 2016, at which time the aircraft had flown 730 hours since its last overhaul.

The engine had its last 100-h maintenance inspection on the same date, 3 May 2016, at which time it had operated for 1,953 hours since its last overhaul.

A check of the flight logs showed that the aircraft had flown approximately 35 hours since its last maintenance inspection in May 2016.

1.7. Meteorological information

1.7.1. At the site of the event.

All of the statements collected from the site of the event, Arbizu, from those who recalled the local weather conditions on the evening of Thursday, 19 May 2016, indicated that the sky was overcast. Horizontal visibility was not limited, but the mountaintops were not visible, either to the north or to the south. It was not raining at the time, but it had drizzled that morning. There was little to no wind at the base of the valley.

In the half hour before the event, weather information had been provided to an overflying aircraft by the Vitoria Tower indicating wind from 010º at 11 kt, varying in direction between 330º and 040º, unlimited visibility, few clouds at 4,200 ft, temperature 18º C, dew point 10º C and a QNH of 1,022 hPa.

The crash occurred in a town located in the Araquil Valley, in the county of Barranca/ Sakana, in the northwest of Navarre. The valley runs approximately from west to east and is flanked by the Aralar Mountains to the north and Urbasa and Andía mountains to the south. The A-10 highway, which links Vitoria and Pamplona, runs through the center of the valley.

The weather report provided by AEMET indicates that there were abundant, stationary clouds at the western edge of the Pyrenees, giving rise to instability and showers in the area of Barranca.

The low-level weather forecast map that was valid for 14:00 indicated very cloudy skies for the area, with stratus, stratocumulus and cumulus clouds, with a cloud base between 1,200 and 6,500 ft and a ceiling between 3,000 and 8,000 ft; moderate turbulence between 6,000 and 12,000 ft; darkening in the mountains due to the clouds. The forecast also called for increased low-level winds locally.

At the Pamplona Airport, winds were recorded from the north at an average speed of 30 km/h (16.2 kt), gusting to 50 km/h (27 kt), between 15:30 and 19:00. The sky was overcast.

1.7.2. En route.

The weather conditions at the departure and arrival aerodromes allowed for visual flight, with some limits due to clouds at the Dax aerodrome above 3000 ft. Along the route, the weather conditions forecast by the aerodrome forecasts (TAF) at their waypoints, as per their flight plan, indicated the presence of scattered clouds at the

northwest end of the Pyrenees/east end of the Cantabrian Mountains and/or very cloudy skies. This forecast indicated a high likelihood of encountering difficulties during a visual flight to fly into France via the Bay of Biscay.

The 13:00 TAF for Vitoria for the 24 hours after 14:00 called for scattered clouds at 2500 ft and very cloudy skies at 3500 ft; temporarily from 14:00 to 17:00, with a probability of 40%, visibility of 3000 meters, drizzle, fog and very cloudy skies at 1400 ft.

The 13:00 TAF for San Sebastian called for scattered clouds at 2500 ft and very cloudy skies at 4500 ft; between 14:00 and 17:00 with a probability of 40%, visibility of 4000 m, drizzle and very cloudy skies at 1000 ft.

The TAF for Pamplona, only available for 16;00, called for better conditions, with scattered clouds at 2500 and 3500 ft, temporarily from 17:00 to 22:00, wind from 340º at 15 kt, gusting to 25 kt, very cloudy skies were forecast at 1400 ft, but only between 22:00 and 02:00 on the next day.

1.8. Aids to navigation

The flight was being conducted under visual flight rules, and thus aids to navigation were not necessarily being used.

1.9. Communications

The first radio transmission from the crew of aircraft F-GXBB was with Bilbao Approach, on a frequency of 127.45 MHz at 17:24, during which the crew reported they had tried to contact Madrid Control but had been unable to.

Efforts were made to transfer from this control station to Vitoria Tower and Bilbao Tower, but they were not carried out because the crew was not interested in these airports. At 17:41, prompted by the controller, the crew confirmed they were in visual contact with the ground.

At 17:43, the crew asked to speak with the San Sebastian Airport, and the Bilbao Approach controller informed them they were in the Vitoria CTR.

At 17:50, the controller asked about their flight level, which was 3,800 ft, and informed the crew that radar coverage was above 6,000 ft, confirming the flight was not under radar coverage.

At 17:52, the crew was transferred to the Vitoria Tower CTR, which was informed that the flight was in their area and circling because they were having problems advancing due to the clouds. At that point, the flight was not being displayed on the radar screens at either control unit, which had stopped tracking the aircraft at 17:41.

The crew then spoke with the Vitoria tower, stating that they were north of the airport at an altitude of 3,800 ft, and that they were wondering if they could amend their flight plan to Dax and proceed to Vitoria, and asked if this was possible. The controller replied that the Vitoria Airport was not operational at the time, and stood by for the crew's intentions.

The Vitoria control tower tried to establish radio contact with the crew at 17:22 and in the minutes that followed, but was not able to, not even after trying on the emergency frequency of 121.5 MHz. In the radio communications, the control tower limited itself to providing and requesting concise information. The tower also reproached the crew for not being on either the tower frequency or the emergency frequency, on which they should have communicated before calling Bilbao approach.

The pilot was hesitant and stated they were amending their documentation. A short time later the crew decided to divert to the Pamplona Airport. The controller then asked them to confirm leaving the Vitoria CTR via point E, located in Salvatierra, next to the A-10 highway, east of the city of Vitoria, and cleared them to remain at their current altitude of 3,800 ft, some 1,100 ft above the reference altitude for the airport's circuit (1,000 ft AGL, 2,700 ft altitude), and to enter and leave the CTR. At 18:00, the crew reported crossing point E to the tower.

A few minutes later, at 18:03, while the Vitoria tower attempted to coordinate with the Pamplona tower, the crew reported their position at 3,500 ft, crossing point E and following the highway to San Sebastian. The Vitoria controller interrupted efforts to coordinate with Pamplona and asked the crew to confirm their intentions. The crew of airplane F-GXBB confirmed they had decided to divert to the San Sebastian Airport, after which the transponder code was confirmed. The crew was then transferred to the Bilbao Approach frequency, 127.45 MHZ, which they acknowledged.

After coordinating with Bilbao Approach, the Vitoria tower controller again spoke with the crew at 18:06. The crew replied, but the communication was intermittent, although the controller understood they were still at 3,000 ft and had acknowledged the frequency from the last radio transfer. The Vitoria Tower did not make or receive any additional calls from the aircraft.

At 18:17, the Bilbao Approach controller began efforts to communicate with the aircraft, from which he had heard nothing since it had been transferred to Bilbao

Approach from the Vitoria control tower. These efforts were unsuccessful despite using a commercial flight in the area to relay messages to the Robin aircraft.

1.10. Aerodrome information

The aircraft had taken off from the aerodrome of Coimbra (LPCO), located southwest of the city of Coimbra (Portugal), with one asphalt runway in a 16/34 orientation measuring 920x30 meters.

Along the flight route, over the north of the province of Burgos, the crew asked to divert to the Vitoria Airport (LEVT). This is primarily a cargo airport that operates mainly at night. In the summer, the airport is closed on Thursdays from 08:30 until 18:45 (this airport, which used to be open 24 hours a day, had its operating schedule reduced in the autumn of 2012). This airport is located 8 km northwest of the city of Vitoria at an elevation of 1,682 ft. It has one asphalt runway in a 04/22 orientation that is 3500-m long and 45-m wide.

When the crew was informed that the Vitoria Airport was closed, they opted for the Pamplona Airport (LEPP), also later considering the possibility of the San Sebastian Airport (LESO).

The Pamplona Airport is located 6 km south of the city. It has one asphalt runway in a 15/33 orientation that is 2205 meters long and 45 meters wide.

The San Sebastian Airport is located 22 km northeast of San Sebastian, in the town of Hondarribia. It has one asphalt runway in a 04/22 orientation that is 1590 meters long and 45 meters wide.

Along the flight route, before reaching Vitoria, is the Burgos Airport, which is located 4 km east of the city at an elevation of 2962 ft. It has one asphalt runway in a 04/22 orientation that is 1200 meters long and 45 meters wide.

1.11. Flight recorders

The aircraft did not have flight recorders, nor were they required to be installed by the applicable law.

1.11.1. Information from the radar track.

The radar track was available from 16:53, when the aircraft was north of the Valladolid Airport at an altitude of between 6000 and 7000 ft, flying to the northeast toward the Burgos Airport and the Vitoria CTR.

The information in the radar track confirms the average path, altitude, speed and heading of the aircraft. The important data and parameters selected from this radar information are summarized below:

At 17:23, it continued on this course and altitude, passing abeam of the Burgos Airport and 4 miles north of the airfield.

Until 17:37, it continued under these same conditions until it exited the Burgos CTR, where it started to change its course to the east and descend. Its flight path also became more erratic (less linear).

At 17:41, twenty miles southwest of the Vitoria Airport, the aircraft disappeared from the radar display while on an easterly course (93°) at an altitude of 5100 ft.

No more radar information on the airplane was available after that time because its flight level, as was learned from radio communications, was below the radar coverage altitude.

1.12. Wreckage and impact information

Because the wreckage was located in the middle of a town, and due to the extreme damage to the wreckage, it was agreed that the wreckage would be removed in a container and transferred to a safe location. The accident investigation team reached the site the next morning and was able to examine the impact marks left and the aircraft wreckage recovered.

1.12.1. Impact marks and aircraft trajectory.

The first impact mark left by an airplane component was found on the eaves of a rooftop of a three-story house in Arbizu, from which a small number of shingles had broken and detached.

On the asphalt ground of a street in the town, a few meters beyond the first house, there was a mark from a strong impact left by a metallic component, along with

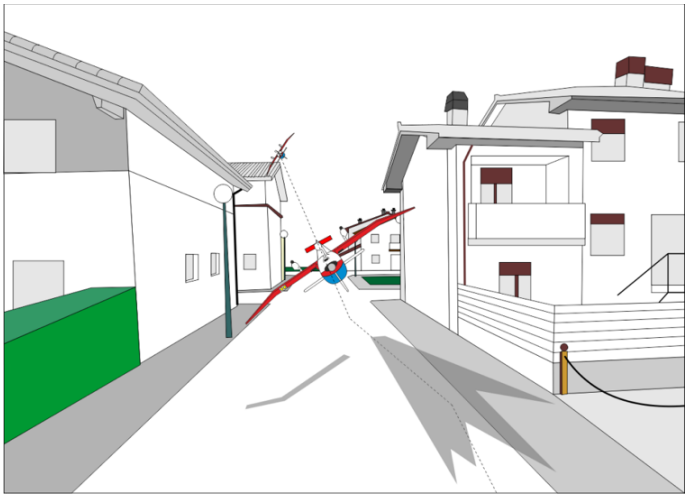

Figure 2. Diagram of the aircraft's trajectory and attitude on impact.

blackened traces of oil. The inlet angle indicated by the line connecting the first two impact points yields an angle with the horizontal of 45 to 60º.

To the right of that point where the engine/propeller impacted there was a linear mark that, due to its color and shape, corresponded to the leading edge of a wing. The variation in the dihedral angle of the outer wing was noticeable, but in the inverse direction, indicating that the left wing, and therefore the aircraft, was in an upside down position.

On the left side of the impact point, the marks extended to the vertical wall of another house. While there is no clear sign that the wing impacted, there are several grouped impacts of smaller components. After this main impact area, other debris from the airplane's structure was scattered along the street, the backyard of a house, another street perpendicular to the first and the façades of several houses and plots on the other side of this street.

Most of the airplane wreckage ended up against a tractor that was parked inside a partially developed plot of land. Mixed in with it was debris from the façade, which had been knocked down. Multiple components that had detached from the airplane had impacted vehicles parked on both streets, street furniture and, primarily, the stone façade of a two-story house to the left of the main wreckage.

The direction of the impact marks and the debris field deviated some 20º to the left from the first street, which runs approximately southwest to northeast (45º).

1.12.2. Investigation of aircraft wreckage.

Given the possibility that some component detached from the airplane in flight, the investigators focused on locating any debris in and around Arbizu that could have come from the aircraft, but no such component, part or debris was found.

Figure 3. Two-dimensional reconstruction of the wreckage.

Despite the extent of the damage and destruction to the aircraft debris that was collected, it was transported to a large hangar in an effort to rebuild the aircraft so

as to narrow down the surface or zone that struck the vulture, as well as to potentially identify any remains of the bird and any missing components that may have detached from the airplane.

All of the pieces of fabric covering the wings were located and identified. They accounted for the entirety of the wing surface, with no wing parts missing. The damage to the structure of the wing, made mostly of wood, was significant and allowed for a very limited two-dimensional reconstruction. This reconstruction, however, revealed that there were no components missing, which indicates that no components detached from the airplane prior to impacting the ground.

Of note during the reconstruction of the wing structure is the fact that the least damaged structural component was the box for the main outboard beam on the right wing, in the zone where the wing's dihedral angle increases. The greater integrity and less damage to that structural element could well indicate that the outboard part of the right wing did not preserve its structural integrity upon impacting the ground. This is also consistent with the absence of a clear wing imprint at the impact point with the ground (on the side wall of a house on the left side of the airplane's direction of motion, and considering that the outline of the left wing was on the right side).

The majority of the control surfaces on the tail section (horizontal and vertical stabilizers and elevators) was found less damaged and with no signs of a concentrated impact or partial detachment, with the exception of the fin, from which significant debris was identified with that was more heavily damaged.

1.13. Medical and pathological information

The absence of signs that the physiological and/or medical condition of the crew had any type of effect on the conduct and outcome of the flight, in terms of the flight planning, radio communications with control centers, etc., and the fact that there were three pilots onboard, deterred investigators from gathering and analyzing medical and pathological information from the pilots and other personnel involved.

1.14. Fire

There was no fire during the flight due to the bird strike, or on the ground due to the impact with the terrain.

1.15. Survival aspects

After a certain moment, which, according to the eyewitnesses, was the impact with the vulture, the aircraft followed an erratic trajectory both horizontally and in terms of its steep descent. The aircraft crashed to the ground at a high speed and angle of attack, meaning the energy of the impact was very high. Moreover, the area where the airplane impacted the ground contained resistant surfaces and vertical walls made of construction materials, resulting in a large deceleration. These conditions of the aircraft's impact reduced the likelihood of survival of the aircraft's occupants.

The fact that the aircraft crashed to the ground in the center of the town or Arbizu made officials fear that the impact had created additional victims, but merely by chance it so happened that the aircraft did not directly impact an occupied dwelling or vehicle or an unwary pedestrian.

1.16. Tests and research

1.16.1. Analysis of the carcass of the bird involved.

Based on the testimony of the eyewitnesses who saw the start of the sudden change in the airplane's trajectory and heard the impact, the Civil Guard found the carcass of a vulture in a field west of the town or Arbizu, a few meters away from the Shrine of San Juan. The carcass was collected and sent for an autopsy and analysis to the Biodiversity Service of the public agency Gestión Ambiental de Navarra S.A.

The bird was characterized as follows:

- Species – Griffon vulture (Gyps fulvus)
- Adult male (over six years old), physical condition 2 out of 3.
- Weight and size – 5,250 gr as delivered, folded wing 645 mm, P3 (length of a primary feather, indicative of bird's wingspan) 372 mm
- Other – asymmetric molting, specimen well preserved.

Figure 4. Carcass of the griffon vulture found in Arbizu.

The distal part of the bird's right wing had been amputated at the metacarpals, there was an open wound in the abdomen and trauma. No buckshot was found and there were no signs of disease.

The examination yielded the following conclusions:

With its wing cut, the vulture could not maneuver. The open abdominal wound seemed to be associated with the strike/impact and the primary cause of death. The severed distal part of the wing accounted for one-third of the wing's length and weighed about one kilo. The vulture's total wingspan would have been in the two-meter range. It was a healthy male with a total estimated weight of 6.5 kg.

1.16.2. Investigation into the presence of organic material from the vulture on the aircraft wreckage.

Assistance from the specialists in the Civil Guard's Identification Department was requested and received for this task. Three zones of interest were identified in the wreckage for the analysis: a) right wing, b) propeller and c) skin of the left wing. The surfaces on the tail assembly did not seem to be affected.

These three areas were examined under white light and forensic light. Any traces of blood found on the wreckage were ready to be confirmed using luminol.

In zone a), which included the entire right wing, no traces of organic material from a bird were found. In the area where the dihedral angle changes, which is where a crack was found in both the skin and the structure, and which was thus considered to be the most likely impact zone, nothing was found.

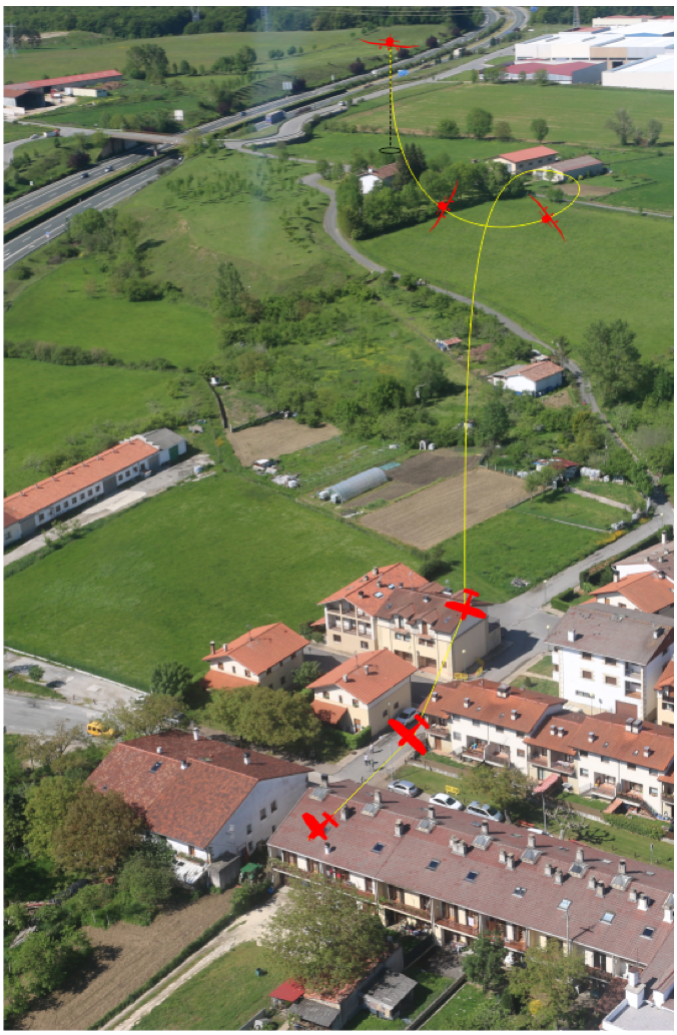

Figure 5. Trajectory after striking the griffon vulture.

In zone b), no traces were found of organic material on the metallic propeller, which was to be expected since one of the vulture's wings was severed.

Similarly, no organic material from a bird was found in zone c).

Since no traces of blood were found in the potential zones where the vulture might have impacted, luminol (chemiluminescent chemical) was not used to confirm the presence of hemoglobin.

1.17. Organizational and management information

The Aeroclub of Creil-Senlis-Chantilly, a non-profit association that has been active since 1946, specifies multiple missions on its website: to welcome visitors who want to discover aviation, to advise and train new members who want to learn to fly, and to offer pilots who are already licensed a range of devices to meet their needs.

1.18. Additional information

1.18.1. Eyewitness statements

Two eyewitnesses were identified, one who was west of the town center of Arbizu and another north of the A-10 highway (E-1 and E-2), near the shrine of San Juan, located 300 m away from the town, both of whom heard the aircraft and who saw its subsequent trajectory. Both started watching it when they heard a noticeable change in its sound. One was even able to describe it as a thud. The airplane was flying low and it was easy to make out. They saw it fly in a circular path and then downward at an increasingly vertical angle, ending with a bang and a noise that was much louder in the center of town. They heard the initial noise when the aircraft was flying over the shrine or a little west of it. They did not see anything detach from the airplane, nor did they see a vulture fall to the ground. They correctly described the airplane's colors as primarily white and blue. They described

Figure 6. Location of the eyewitnesses.

the temperature conditions, stating that the temperature was good, the sky was overcast except for some summits in the south, and that it had drizzled in the morning and early afternoon.

The description provided by these eyewitnesses and information taken from the impact marks were used to draw the diagram of the airplane's final trajectory, Figure 5.

Other accounts from eyewitnesses in the village provided information on other aspects of the final moments of the flight and the impact with the ground.

One of them (E3) was on the same street where the initial impact with the ground took place. He described hearing the sound of the airplane and then saw and heard the initial impact against the roof, from which he saw several tiles detach. He then saw the airplane impact the ground twenty meters later, and then strike the wall of another house. Then, due to its inertia and to the change in direction caused by this impact, it traveled into the gap between two houses. As for the flight attitude of the aircraft when he first saw it, he could only say that it seemed to be banking at a left angle of about 45º. As concerns the weather, he recalled that it was cloudy and overcast but that it was not raining. When he approached the place where the aircraft wreckage came to a stop, he saw human remains. Two officers from the Traffic Civil Guard reported to the scene right away.

Another eyewitness (E4) was in the town square, some fifty meters north of the impact site. He heard the noise of an airplane that was descending and watched it for a while as it descended. He described the descent as being very vertical. He could not see it impact the houses, but he heard what he described as a loud dragging noise. He went to the impact site and described debris from wooden planks and boards (structural debris from the airplane mixed with that from a garden fence), some metallic debris, like twisted tanks, and how the parked vehicles were stained and blackened by a dark substance. He also recalled that it was a pleasant afternoon, though it was overcast and San Donato Mountain was in the clouds (in the Andía Mountains, south of Barranca, at an elevation of 1493 m).

In their statement, the traffic officers (E6 and E7), who responded quickly as they were riding on highway A-10 to the west and saw the aircraft's trajectory, recalled seeing that the airplane's right wing was lower (from their perspective, this would have been the airplane's left wing, as they saw it head on), at a bank angle of about 45º. It was descending. (The other officer described the characteristics of the flight similarly but more sharply, and said the airplane was nosediving with the right wing lower). They lost sight of it beneath the trees and did not see it impact the ground. They quickly proceeded to the scene and called it in. They reached the crash site in about two minutes. They were able to identify the aircraft wreckage and tried to

cordon off the area, talk to eyewitnesses and find out if anyone else had been injured by the impact. When they looked up into the sky, they saw a large number of vultures flying in a column to the west and south. They recalled it had rained in the early afternoon (at about 14:00), but at that time it was cloudy, with no fog or mist.

1.18.2. Trend in griffon vulture populations in Spain.

On its website, the Spanish Ornithological Society (SEO) provides the following information: the griffon vulture (gyps fulvus) is a large bird of prey with a length ranging from 95 to 100 cm, a wingspan between 230 and 265 cm and with a weight ranging from 6 to 9 kg in adult specimens. The griffon vulture is a bird that glides more than it flies. It can reach altitudes of 1,800 to 3,500 meters above sea level, though in exceptional circumstances, it can reach altitudes of up to 6,000 meters.

The Biology Station in Doñana, part of the CSIC, was conducting a study on the ecology of griffon vulture movements in Spain, and one of the first findings of this study, which they were kind enough to share, is that griffon vultures do not usually fly higher than 800 m above ground level.

According to information provided by Doñana, this bird of prey is found along most mountain chains - with the exception of the westernmost section of the Cantabrian Mountains and most of the mountains along the Mediterranean coast – as well as in plains crossed by relatively large rivers. They are most commonly found in regions with predominantly limestone substrates, though there are also excellent breeding areas in siliceous sites. Most of the population is found in Aragon, Castile and Leon, as well as in Andalusia, Navarre, Castile-La Mancha and Extremadura. The bird is not found in Galicia, the Balearic or Canary Islands, or in Ceuta and Melilla. Despite this distribution, the griffon vulture, which is capable of traveling extremely long distances, can usually be found in places far away from its breeding grounds in search of food, or forming temporary flocks in locations with abundant resources.

In 2008, the SEO issued the following publication on vulture populations, "The Griffon Vulture in Spain. Reproductive Population in 2008 and Census Method". At that time, the population was estimated to number between 91,000 and 95,000, with 1,560 colonies identified. Independently of where the colonies are located, one thing to consider is that a vulture is capable of traveling hundreds of kilometers every day.

The population trend in previous years (the first griffon vulture census in Spain was taken in 1979, when 3,200 breeding pairs were estimated to exist, resulting in a maximum of 15,000 specimens), and the fact that their habitat conditions have

remained favorable, indicate that the current vulture population in Spain is in excess of 100,000 specimens, by far the largest European population of this species.

Figure 7. Griffon vultures present in the sky over Arbizu the day after the accident

Based on direct sightings by eyewitnesses and investigators on the day of the event and on subsequent days in the county of Barranca/Sakana, most of the griffon vultures in this area were gliding in the skies over the towns of Arbizu and Echarri-Aranaz, possibly due to the uplift conditions present. The number of specimens present was estimated at around 200 (Figure 6 shows some of the most visible specimens in the photograph, which does not represent the large number of birds present in the sky).

As for the flying behavior of these birds, and according to the experts in aviation and gliding clubs and organizations, this is primarily a gliding bird that flies by relying on updrafts, created either by thermals or ridge lift. They usually fly no higher than the convective layer, which is lower in the winter and does not normally exceed 1500 ft. While in straight flight, these birds are normally looking at the ground, and would presumably not notice the presence of an airplane. When faced with an unexpected threat, vultures will fold their wings and dive. Therefore, when encountering vultures, an airplane will usually pass them overhead or, if this is not possible, with sufficient lateral separation. In a frontal encounter, the best and safest evasive maneuver is to gain altitude by pulling on the stick to pitch the airplane up and climb quickly, since a vulture will avoid the encounter by descending. If an impact is inevitable, pitching up is also the best course of action as it will reduce the airplane's speed while at the same time better protect the control surfaces in the tail assembly.

1.18.3. Other similar events.

Already in 2016, there had been two other catastrophic accidents involving small aircraft striking griffon vultures while in flight.

A-01/2016: On 16 January 2016, a SOCATA TB-20 aircraft, with a MTOW of 1400 kg, a seating capacity of four and certified as per FAR-23 Amendments 1-16, struck an adult griffon vulture as it was flying over the Serranía de Cuenca National Park at

an altitude of 6400 ft (corresponding to a height above ground level of 600 meters). All four occupants died.

A-10/2016: On 30 March 2016, a CESSNA 172R aircraft, with a MTOW of 1111 kg, a seating capacity of four and certified as per FAR-23 Amendments 1-6, struck an adult griffon vulture as it was flying over the town of Perales de Tajuña (Madrid) at an altitude of 3000 ft (equivalent to a height above ground level of 155 meters). All three occupants died.

A-23/2016: On 7 July 2016, the cockpit of a GLASER DIRKS DG-300 ELAN aircraft, a single-seater glider with a MTOW of 500 kg and certified as per JAR 22 (CS 22), struck a griffon vulture in Sabiñanigo (Huesca) at an altitude of 7500 ft (equivalent to a height above ground level of 1500 meters). The pilot sustained minor injuries and was able to keep control of the aircraft and land.

As a result of the investigations into these accidents, safety recommendation REC 58/16 was issued: It is recommended that ENAIRE update the bird activity chart and the migration route charts for larger bird species published in the AIP dated 26 December 2002, to reflect the current distribution of colonies of vultures and other birds that are suitable for inclusion in said chart, and their migratory routes.

The information on the presence of birds has been improved and updated in the Spain AIP, Aeronautical Information Publication. Traditionally included in point ENR 5.6, "Bird migrations and activity", this section of the AIP is now called "Migratory flights of birds and areas with sensitive wildlife", which includes three bird activity maps, one of which contains updated information on griffon vultures.

Spain's National Aviation Safety Agency (AESA) has published a leaflet with recommendations for avoiding bird strikes.

In September 2017, the National Aviation Safety Agency published a pamphlet titled "Bird Strikes, a Common Risk with Local Characteristics". The pamphlet is in part a translation of an AOPA operational safety letter. It also uses information published in the AIP Spain and recommendations presented by AEPAL/AOPA Spain at the 1st National Aviation and Wildlife Forum.

Moreover, by virtue of what EASA specified in Regulation (EU) No. 139/2014 of the Commission, of 12 February 2014, and specifically in AMC1 ADR.OPS.B.020, which contains the requirement that States have a national wildlife strike hazard reduction program, AESA will establish a National Aviation and Wildlife Program. In order to promote this program, the 1st National Aviation and Wildlife Forum was held on 8 June 2017, with representatives from the affected sector.

1.19. Useful or effective investigation techniques

None.

2. ANALYSIS

2.1. General

The flight was a long-distance flight for a small aircraft, though within its range. It was a visual flight that was exposed to changing weather conditions over the long route.

Although no specific information on the flight plan preparations was available, it is reasonable to assume that, since all three occupants were pilots with valid licenses and ratings, they would have evaluated and prepared for the flight even before they encountered unforeseen variables.

The traffic density or presence of aerodrome control zones that place limitations on visual flights would not have posed a problem along their intended route, though their path did cross various mountain ranges and several different geographic areas, meaning the flight was more exposed to significant changes in meteorological conditions.

After passing the halfway point of their planned route, they had problems continuing along their route when they ran into clouds in the control zone of the Vitoria Airport. This forced them to descend from their previous altitude of 6500 ft to 3500 ft.

The radio communications in search of help and the decisions they made led them to fly in the Araquil Valley, where the cloud ceiling was below the elevation of the summits on either side of the valley. This is also an area frequented by griffon vultures, which glide on updrafts provided by thermals or ridge lift.

When the airplane struck a vulture, it resulted in the crew's loss of control of the airplane, causing it to spiral downward until it impacted the ground.

2.2. Flight operations

2.2.1. Flight preparation.

As verified in the meteorological information collected, the forecast for the north of the Iberian Peninsula called for dense clouds likely at low altitudes, which could hamper crossing the mountains into France along their planned route.

In light of the weather forecast along the route and the problems the crew had deciding where to go as an alternate to their planned destination, it seems clear that the crew did not prepare the flight properly.

The flight plan did not specify an alternate aerodrome in Spain as an optional destination if the flight plan was changed due to problems proceeding in visual conditions to the destination. Since this option was not anticipated, the pilots must not have gathered information on the aerodromes and did not know about the special hours of operation of the Vitoria Airport, of or the location of the Burgos Airport, which they had just flown over.

If the crew had considered the weather information available when preparing for their long-duration visual flight, they could have anticipated some of the potential problems with continuing to their destination, prepared alternates and been more familiar with other potential destination airports, like the three options offered by the airports of Vitoria, Pamplona and San Sebastian. They might also have considered diverting or doubling back to return to good weather conditions, and planned an alternate destination aerodrome where they could land safely. As a result, a safety recommendation is issued to the Aeroclub of Creil-Senlis-Chantilly, where the crew were based, to improve the training of the pilots at the club in the area of preparing long-distance visual flights, primarily in the following two aspects: evaluating weather conditions and the characteristics of the alternate aerodromes in the event of potential diversions and flight plan changes

Given the absence of flight recorders or of a statement from the occupants, it was not possible to retrieve evidence to determine if the crew were paying attention to the outside environment, but a factor that was probably very present in the three catastrophic accidents that occurred in 2016 may have been the crews' inattentiveness to the outside to detect the presence of potential obstacles. In the case at hand, the crew's attention may have been distracted by a discussion and search for alternatives to continue the flight after they encountered weather conditions that were adverse to visual flight.

The presence of a large number of vultures in the Barranca/Sakana Valley flying in updrafts was very evident from the ground, and it seems unlikely that a crew paying attention to the outside of the aircraft would have missed the presence of these large obstacles. The statements provided do not indicate that any evasive maneuver was made by the airplane prior to impacting the vulture, though it is possible that none of the eyewitnesses was paying attention to the airplane before hearing the sound of the impact between the airplane and the vulture.

The history of similar events, the gradual and constant increase in the number of large birds in the skies over Spain and the serious consequences that striking these obstacles have on flying aircraft make it imperative to remind all flying clubs, academies and general aviation pilots of the importance of remaining vigilant of the outside environment so as to identify the presence of large birds and avoid the possibility of a bird strike.

2.2.2. Crew's decisions.

The crew's decisions and indecisions resulted in the aircraft flying in a confined airspace, the Barranca/Sakana Valley, limited on either side by the mountains and overhead by the clouds, which covered the valley, forcing the crew to fly below the mountaintops on both sides.

Once over Vitoria, the pilots circled and were forced to descend from a cruise level of 6500 ft to 3000 ft, due to the appearance of clouds and to their ceiling. When they decided to continue to the northeast and enter the Barranca/Sakana Valley, a space enclosed by the low clouds, the possibility existed that this space would be closed off, leaving them with no way out. This demonstrates a certain lack of experience and the absence of criteria for continuing the visual flight safely.

In these conditions, as they were continuing through the valley, the crew of the aircraft encountered a large number of gliding vultures covering much of the sky over the valley. As investigators confirmed at the location, with so many large birds in the aircraft's path, it was likely that the aircraft would impact a bird that was unaware of its presence.

The initial decision to proceed to Pamplona, to the east, given the weather conditions present and which had forced them to descend below the surrounding mountaintops, was not correct, but the final decision made, to proceed to San Sebastian, to the north, was even less correct, since it drove them into a more mountainous area, one in which they might become trapped with no way out that allowed them to maintain visual contact with the ground.

2.2.3. Support from air traffic control with visual flight.

Investigators analyzed the communications between the Vitoria tower and the various Bilbao approach stations and the accident aircraft and other aircraft flying in the area.

Initially, aircraft F-GXBB was in contact with Bilbao approach. The Bilbao controller transferred it to the Vitoria tower since, in his own words (in Spanish), "FGXBB is in your area doing three-sixties and so on. They don't seem to have a way through. They ran into clouds, ok?" Later, when the crew contacted the controller in the Vitoria tower, they said "I am over the north of your field at three thousand eight hundred feet, and I think I could divert to for my flight plan to Dax in France and to land in your field. Is it possible?" The controller replied that it was not possible to land in Vitoria because the airfield was not operational, and asked the pilot to report his intentions. The pilot eventually decided to go to Pamplona, and informed the controller of this.

2.3. Aircraft

The aircraft satisfied the requirements to make this flight. There is no reason to suspect that its operating condition had any effect on the conduct and consequences of its impact with the vulture, a bird of large proportions.

Small aircraft certified under FAR 23 or similar regulations adopted by other countries have no special requirements involving their structural resistance to withstand bird strikes.

The aforementioned information on preventing and reducing the risk of impacting birds, as well as other reports on impact data (Wildlife Strikes to Civil Aircraft in the United States 1990-2015, by the Federal Aviation Administration and the Department of Agriculture of the United States), indicate that in-flight impacts with birds weighing more than 2 kg, depending on the energy of the impact (which goes up with the relative speed between the two) and the area of impact on the aircraft, could be potentially catastrophic to small aircraft by causing significant structural damage to the airplane and rendering it uncontrollable from that moment on. For large aircraft, the probability of causing damage exceeds 30%.

As the other accidents occurring in 2016 have shown, there is a very high likelihood of suffering a catastrophic accident as a result of striking a large bird in flight. Because of this, as stated in the previous point, it is necessary to alert general aviation pilots to raise and maintain their awareness of the environment outside the aircraft when flying so that they can identify the presence of large birds along their flight path and avoid the possibility of a collision, a collision made potentially catastrophic by the design and construction of small aircraft.

2.3.1. Type of impact and damage to aircraft.

The investigation of the aircraft wreckage using special methods to determine the presence of organic matter did not yield any positive findings; therefore, it was not possible to confirm which aircraft component struck the vulture.

The forensic study of the bird indicated the possibility that one of its wings, the end of which was severed, could have struck the airplane's propeller, while the abdominal wound, identified as the main cause of death, seems to have been associated with the impact with the aircraft.

This would result in an impact with a surface on the airplane two-thirds of the distance of one of the vulture's wings plus the outside diameter of the propeller, that is, 1.56 to 1.66 m (60-70 cm for the vulture and 96 cm for the propeller) away from

the airplane's longitudinal axis, which for the airplane's wing, is between the inboard third and its halfway point.

A partial reconstruction of the aircraft wreckage confirmed that not having found parts of the aircraft detached in flight was consistent with the fact that no significant elements were missing from the aircraft's aerodynamic surfaces. It also confirmed that the fabric covering both wings was fully accounted for among the wreckage gathered at the impact point.

The investigation of the aircraft wreckage also revealed, thanks to the minor damage found on the outboard third of the main beam on the right wing, and given the extreme damage to this wooden beam, the possibility that the tip of this wing had lost its structural integrity before the aircraft crashed into the ground. This wing would thus not have provided as much lift, which would explain the relatively lesser damage it exhibited. This possibility also agrees with the fact that the right wing left no discernible mark on the ground, as well as with the airplane's inverted attitude. In contrast, most of the leading edge on the left wing left a mark on the ground.

Although a combination of these findings means that the vulture most likely impacted the airplane at the midpoint of the airplane's right wing, negatively affecting the structural integrity of said wing, what is certain is that the condition of the wreckage and the absence of organic matter from the bird on the parts examined made it impossible to determine the exact area where the vulture impacted the airplane; or whether, due to the impact, it caused the pilot to lose control of the airplane, resulting in the airplane impacting the ground upside down at a high angle of attack.

2.4. Mid-air encounters with large birds

In light of all the findings that have been compiled, which are presented below, and of the extensive experience of the Royal Spanish Aeronautical Federation (RFAE or FAE), which includes glider clubs, organizations, and experts on the flying patterns of these birds in general aviation settings, which are presented below, certain preventive measures are proposed at the end of the chapter in order to minimize and avoid the risk of a bird strike.

a) The design and certification of aircraft with a MTOW below 5700 kg in the normal, semi-acrobatic and acrobatic categories, like the accident aircraft, do not contain requirements for bird strike resistance.

b) The likelihood of encountering birds in flight drops considerably as the altitude increases, but remains high at up to 2,400 ft above ground level.

c) Large birds are easy to detect in the sky due to their large wingspan, which makes them more visible.

d) The quick succession of three fatal events in Spain in 2016, with a total of ten fatalities, underscores the catastrophic potential of an aircraft impacting a large bird.

e) The use of new equipment and navigational aids is changing the behaviors and habits of pilots in terms of their onboard tasks when flying under visual flight rules.

f) The distribution of the vulture population in Spain has increased significantly in recent years (based on a 30- to 40-year history), both due to a higher number colonies and to their distribution in the peninsula, and to the extensive range of the birds, which can be as much as several hundred kilometers.

g) Pilots must take into consideration the behavior of vultures. They ascend in circles, rising atop thermals or ridge lifts, and when they sense any danger, they fold their wings and let themselves fall.

h) Experienced pilots who frequently fly in areas with large numbers of these birds have developed a scan process when they see birds in flight, which entails looking quickly to the front and above to try to detect the presence of additional birds to avoid bird strikes, since these birds frequently fly in groups.

i) The available data for griffon vulture populations over most of the Spanish mainland indicates this species, which is still on the List of Specially Protected Wild Species, is recovered and abundant.

In light of these considerations and of the large increase in and abundance of griffon vulture populations in the Iberian Peninsula in the last decades, of the great concern over the potential risk that this poses to general aviation and of the recent catastrophic accidents in Spain involving small aircraft, which have underscored the catastrophic potential that a bird strike has for said aircraft, a safety recommendation is issued to Spain's Ministry of Agriculture and Fishing, Food and the Environment.

3. CONCLUSIONS

3.1. Findings

- All the pilots in the airplane had valid and in force licenses and medical certificates.
- It was not possible to determine who the pilot flying was or which pilot had filled out the flight plan.
- The aircraft's documentation was valid and in force and the aircraft was airworthy.
- The flight during which the event took place was being made under visual flight rules with a planned duration of 3:30 hours.
- Before reaching the Vitoria Airport CTR, the crew ran into clouds and they descended below 5,000 ft in order to stay in visual contact with the ground, although this resulted in radar contact being lost.
- During their radio communications with Bilbao approach, the crew indicated they were in visual contact with the ground, but circling due to problems continuing the flight.
- While in radio contact with the Vitoria tower, the crew decided to change their flight plan to head first to Vitoria before changing to Pamplona upon learning that Vitoria was not operational.
- When over point E, Salvatierra, at an altitude of 3,500 ft, the crew reported their intention to proceed to the San Sebastian Airport.
- The last radio contact was at 18:06, and it was intermittent due to the low coverage at that flight level.
- The aircraft was flying east along the Barranca/Sakana Valley, where the cloud ceiling was below the summits on either side of the valley.
- The statements provided indicated that when west of Arbizu, the airplane changed its attitude and flight path from straight and level to a descending spiral.
- The carcass of a griffon vulture was found in a nearby field. It had significant traumatic injuries and its weight was estimated to be 6.5 kg.
- The aircraft impacted the ground at high speed. It was only by chance that there were no victims on the ground, since the aircraft impacted the ground in the center of the town of Arbizu.
- The aircraft impacted the ground upside down at a high vertical angle and speed.

- No components were found that detached from the airplane in-flight. This is consistent with the partial reconstruction of the wreckage. All of the outer skin and components of the aerodynamic and control surfaces were also accounted for.
- The condition of the aircraft wreckage and the absence of organic matter from a bird on the parts that were examined made it impossible to determine the exact area where the vulture impacted the airplane.
- No evidence could be found to confirm which component or part of the aircraft struck the griffon vulture while in flight.
- Neither the bird strike nor the impact against the ground caused a fire.
- The aircraft's high-energy impact with the ground made it impossible for the occupants to survive.

3.2. Causes/Contributing factors

The cause of the accident was the loss of control of the aircraft, possibly due to striking a griffon vulture, caused by the improper planning of a long-duration visual flight between Coimbra (Portugal) to Dax/Seyresse (France).

The following factors contributed to the accident:

- The weather conditions, in terms of the cloud cover in the Araquil Valley, which limited the flight ceiling to below the peaks on either side of the valley.
- The presence of a large number of griffon vultures, estimated at around 200, gliding in the Araquil Valley.

4. SAFETY RECOMENDACIONS

The investigators have concluded that the planning of this long-distance visual flight was deficient, especially in terms of the crew's evaluation of the weather conditions along the route and the conditions at the alternate aerodromes in the event of potential diversions and changes to their flight plan. As a result, a safety recommendation is issued to the Aeroclub of Creil-Senlis-Chantilly.

REC 04/2018: It is recommended that the Aeroclub of Creil-Senlis-Chantilly, where the crew were based, incorporate documentation and improve the training of the pilots at the club in the area of preparing long-distance visual flights, primarily in the following two areas: evaluating weather conditions en route and conditions at the alternate aerodromes in the event of potential diversions and flight plan changes.

In light of the large increase in and abundance of griffon vulture populations in the Iberian Peninsula in the last decades, of the great concern over the potential risk that this poses to general aviation and of the recent catastrophic accidents in Spain involving small aircraft, which have underscored the catastrophic potential that a bird strike has for said aircraft, the following safety recommendation is issued to Spain's Ministry of Agricultureand Fishing, Food and the Environment:

REC 05/18: It is recommended that the Ministry of Agriculture and Fishing, Food and the Environment boost and coordinate actions to minimize the excessive concentration and proliferation of griffon vulture (Gyps fulvus) colonies with the autonomous communities and for the whole of the on Spanish territory affected.