Statens haverikommission
Swedish Accident Investigation Authority

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Final report RL 2013:09e

Accident on 11 August 2012
involving the aircraft N-84142
on the lake Hultebräan, Kalmar County.

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The report is also available on our website: www.havkom.se

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Statens haverikommission
Swedish Accident Investigation Authority

The Swedish Transport Agency
Civil Aviation and Maritime Department

Final report RL 2013:09e

The Swedish Accident Investigation Authority (Statens haverikommission, SHK) has investigated an accident that occurred on 11 August 2012 on Hultebräan lake, Kalmar county, involving an aircraft with the registration N-84142.

SHK hereby submits under the Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation, a final report on the investigation.

This document is a translation of the original Swedish report.

On behalf of the Swedish Accident Investigation Authority,

Jonas Bäckstrand Sakari Havbrandt

Contents

General observations

The Swedish Accident Investigation Authority (Statens haverikommission – SHK) is a state authority with the task of investigating accidents and incidents with the aim of improving safety. SHK accident investigations are intended to clarify, as far as possible, the sequence of events and their causes, as well as damages and other consequences. The results of an investigation shall provide the basis for decisions aiming at preventing a similar event from occurring again, or limiting the effects of such an event. The investigation shall also provide a basis for assessment of the performance of rescue services and, when appropriate, for improvements to these rescue services.

SHK accident investigations thus aim at answering three questions: *What happened? Why did it happen? How can a similar event be avoided in the future?*

SHK does not have any supervisory role and its investigations do not deal with issues of guilt, blame or liability for damages. Therefore, accidents and incidents are neither investigated nor described in the report from any such perspective. These issues are, when appropriate, dealt with by judicial authorities or, e.g. by insurance companies. The task of SHK also does not include investigation how persons affected by an accident or incident have been cared for by hospital services, once an emergency operation has been concluded. Measures in support of such individuals by the social services, for example in the form of post crisis management, also are not the subject of the investigation.

The investigation of aviation accidents and incidents is mainly regulated by the Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation. The investigation is carried out in accordance with the Chicago Convention Annex 13.

The investigation

SHK was notified on 11 August 2012 that an accident involving an aircraft with the registration N-84142 had occurred at 12.25 hrs that day on the lake Hultebräan, Kalmar County.

The accident has been investigated by SHK represented by Mr Jonas Bäckstrand, Chairperson, Mr Sakari Havbrandt, Investigator in Charge and Mr Urban Kjellberg, Investigator specialising in Fire and Rescue Services.

The investigation team of SHK was assisted by Ms Liselotte Yregård as a medical expert.

The investigation was followed by Mr Berndt Kolm of the Swedish Transport Agency.

Report RL 2013:09e

Aircraft; registration and type	N-84142, LAKE 250
Class/Airworthiness	Normal, valid Certificate of Airworthiness
Owner	Plane Fun inc. TR Trustee
Time of occurrence	11-08-2012, 12.25 hrs in daylight Note: All times are given in Swedish daylight saving time (UTC + 2 hrs)
Place	Lake Hultebräan, Kalmar County, (pos. 5639N, 01546 E; 10 m above sea level)
Type of flight	Private
Weather	According to SMHI's analysis: N-NW wind, 2-5 kts, visibility >10 km, no clouds below 3000 feet, temp/dewpoint +19/+11 °C, QNH[1] 1024 hPa
Persons on board;	
crew members	1
passengers	1
Injuries to persons	Serious
Damage to aircraft	Substantially damaged
Other damage	Limited fuel and oil spill in Hultebräan lake
Pilot:	
Age, licence	60 years, PPL[2]
Total flying hours	3383 hours, of which 350 hours on type
Flying hours previous 90 days	51 hours, of which 10 hours on type
Number of landings previous 90 days	80, of which 31 on type

[1] QNH - Atmospheric pressure adjusted to sea level.
[2] PPL - Private Pilot Licence.

Summary

The intention was to make a local pleasure flight. The pilot took off from the lake and returned to land after just under half an hour. When making contact with the water, the aircraft's forebody broke up, nosed over and ended up floating upside down with the tail pointing in the direction of travel.

Both persons on board, who were seriously injured, were assisted by people in boats on the lake hurrying to them.

A witness to the accident stated that the aircraft came in at a higher speed and steeper angle to the water than normal. After the first water contact, the aircraft bounced up again, to nose over immediately upon the second contact.

The accident was caused by the following factors:

- The design of the aircraft model's fuselage entails that small deviations from the ideal angle of attitude upon water contact involve a risk that the nose will be sucked down into the water.
- The engine's mass that is highly positioned contributes to the aircraft tipping forward when the water resistance increases.

Recommendations

None.

1. FACTUAL INFORMATION

1.1 History of the flight

The intention was to make a local pleasure flight. The pilot took off from the lake and returned to land after just under half an hour. When making contact with the water, the aircraft's forebody broke up, nosed over and ended up floating upside down with the tail pointing in the direction of travel.

The passenger, who was sitting in the front, right-hand seat, stated that after the first water contact, the aircraft lifted into the air again and that there was a violent stop upon making contact with the water for the second time. In the next moment, she found herself deep under water and saw air bubbles and objects above her. She swam up to the surface, but discovered that she was not able to swim with her legs. She surfaced near the left wing of the aircraft and was able to hang on to it.

The pilot, who was sitting in the front, left-hand seat, stated that he perceived a normal touchdown and that there was a sudden halt while gliding “on the step”[3]. He was convinced that the aircraft had run aground. When the aircraft stopped, he found himself strapped into his seat, upside down and under the water. He managed to unfasten himself and exit the cabin, and found that the passenger was already at the surface of the water when he emerged.

Both persons on board, who were seriously injured, were assisted by people in boats on the lake hurrying to them. The pilot could be taken ashore for transportation via ambulance to the hospital, while the passenger experienced severe pain during attempts to get her up into a boat. A life raft found aboard the aircraft was inflated and functioned as a buoyancy aid for the passenger until she was winched up by a rescue helicopter.

A witness to the accident, who was in a boat on the lake, stated that he has previously seen many landings with the aircraft in question. His perception was that the aircraft came in at a higher speed and steeper angle to the water than normal. After the first water contact, the aircraft bounced up again, to nose over immediately upon the second contact.

The accident occurred at position 5639 N, 01546 E; 10 m above sea level.

1.2 Injuries to persons

	Crew members	Passengers	Total	Others
Fatal	–	–	–	–
Serious	1	1	2	–
Minor	–	–	–	Not applicable
None	–	–	–	Not applicable
Total	1	1	2	–

[3] On the step – expression for when the aircraft is aquaplaning; see 1.16.2 for further information

The pilot was exposed to blunt trauma to the chest, which resulted in his sustaining two rib fractures and air entering one of the pleurae (pneumothorax).

The passenger sustained a complicated pelvic fracture and multiple wounds to one thigh, lower leg and foot.

1.3 Damage to the aircraft

Substantially damaged. The nose section is broken off level with the backrests of the front seats. The right-hand support float is detached from the wing.

Fig. 1. Aircraft following salvage.

1.4 Other damage

There was a limited discharge of oil and/or aviation fuel of type AVGAS 100LL. The discharge only gave rise to a light oil sheen.

1.5 Personnel information

1.5.1 Pilot

The Pilot was 60 years old at the time and had a valid PPL.

Flying hours				
Latest	24 hours	7 days	90 days	Total
All types	2	3	51	3384
This type	2	3	10	350

Number of landings this type previous 90 days: 31.
Type rating on type concluded in 2000.
Latest PC (Proficiency Check) carried out on 05-06-2012 on LAKE 250.

1.6 Aircraft information

1.6.1 Airworthiness and maintenance

Aircraft	
TC-holder	AEROFAB INC
Model	LAKE 250
Serial number	69
Year of manufacture	1988
Gross mass	Max authorised gross mass 1425 kg, actual ~1230 kg
Centre of gravity	153,6 ” behind the reference plane, permitted range 152” -158 ”
Total flying time	1036 hours
Flying time since latest inspection	10 hours
Engine	
Model	Lycoming TIO-540
Operating time since last periodic inspection, hours	*10*

The aircraft had a valid Certificate of Airworthiness.

1.6.2 Description of parts or systems related to the accident

The aircraft is an amphibious aircraft, i.e., it can be operated both on land and water. The landing gear is retractable and is kept in the retracted position during operations on water.

The engine, which with its mounting weighs approximately 350 kg, is located in a nacelle on top of the aircraft.

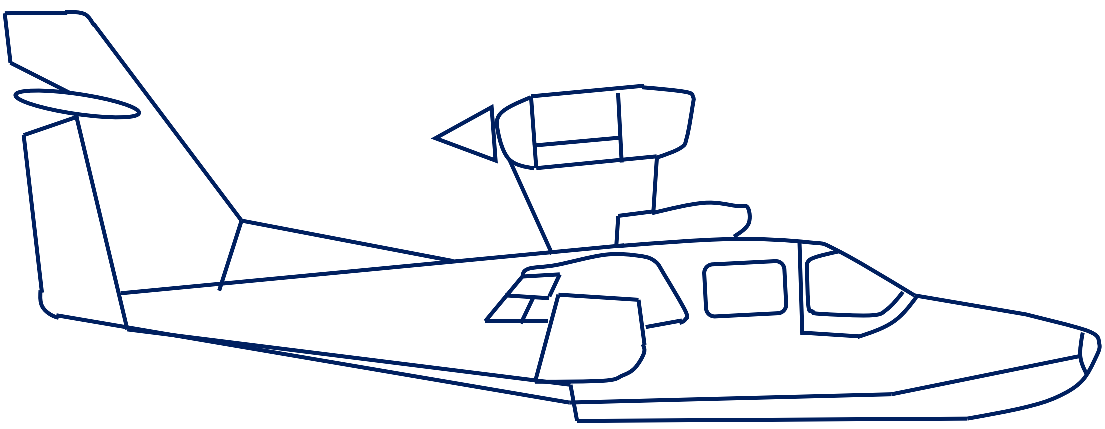

Fig. 2. Side view of the aircraft type.

1.7 Meteorological information

According to SMHI's analysis: N-NW wind, 2-5 kts, visibility >10 km, no clouds below 3000 feet, temp/dewpoint +19/+11 °C, QNH 1024 hPa.

According to the pilot and the witness at the location, there was only a light wind, but this was enough to cause ripples on the surface of the water so that the pilot had a good reference.

1.8 Aids to navigation

Not applicable.

1.9 Radio communications

Not applicable.

1.10 Aerodrome information

Not applicable.

1.11 Flight recorders

The aircraft featured a built-in GPS, though this did not have any recordings of the flight.

1.12 Accident site and aircraft wreckage

1.12.1 Accident site

Fig. 3. The arrow shows the approach and direction of the landing. The accident occurred at the tip of the arrow. Fig. from Google.

1.12.2 Aircraft wreckage

The aircraft cabin was severely demolished. The belt and harness for the front right-hand seat were fastened.

The front of the aircraft was almost entirely severed level with the front seats. On the left-hand side some structure remained, holding the parts together. The panels on the underside of the aircraft at the point of the break showed signs of tensile failure and the topside of the nose had compression folding. Overall, the break showed that the nose had been bent upwards and to the left.

The landing gear was in the retracted position. The right support float was detached and was found floating on the water.

The panels on the underside of the nose had soft but large indentations. The lacquer was intact and had no marks from contact with an object.

Fig. 4. The nose was broken off and no structure remained around the front, right-hand seat.

Fig. 5. The underside of the nose, with soft indentations.

Fig. 6. The topside of the nose had compression folding.

1.13 Medical information

Nothing indicates that the mental and physical condition of the pilot were impaired before or during the flight.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 The rescue operation

There were a number of persons in rowing boats on the lake Hultebräan when the aircraft crashed during an attempt to land on the lake. Two of those persons called SOS Alarm via 112 at 12.23 hrs to alert it to the incident. From the information provided during the conversation, it was evident that two persons had managed unassisted to exit the aircraft that was upside down in the water several hundred metres from land. Both individuals were injured but conscious and were able to confirm that there had been no others on board. They received help to stay afloat as the aircraft sank to the bottom shortly after the accident. Both 112 calls were transferred from SOS Alarm to the Air Rescue Coordination Centre at JRCC[4].

From SOS Alarm, the emergency services were alerted, starting with an advance alert[5] to the fire station in Nybro approximately one minute after receiving the 112 call. A few minutes later, the fire station in Emmaboda was also alerted. Two ambulances were alerted at 12.25 hrs, and the police were notified five minutes later. Divers were requisitioned from the Kalmar Fire Department following a decision from the on-call head of the rescue operation at Nybro emergency services. From JRCC, a rescue helicopter (SAR[6] helicopter) was alerted at 12.26 hrs which at the time was in the vicinity of Växjö.

Of the alerted rescue units, the rescue helicopter was the first unit to arrive at the scene of the accident; at 12.40 hrs, which is 17 minutes after the 112 call was received. Five minutes later, a rescue swimmer had been winched down into the water close to the injured persons. Around that time, the first of the rescue units and both ambulances arrived at the bathing area close to the scene of the accident.

The most severely injured person was winched up to the rescue helicopter in a stretcher. One of the medical personnel from the ambulances, in the capacity of the healthcare services' medical officer, wished to make contact with the crew of the rescue helicopter. This was hampered by the fact that the helicopter did not feature a built-in Rakel[7] radio system. The facility to communicate via Rakel was available in both the emergency service's units and the ambulances. Rakel extends across all of Sweden and functions as a national communication system for collaboration and management for organisations working with security, health or order. In connection with the Swedish Maritime Administration's acquisition of new rescue helicopters, these will be equipped so as to facilitate communication via Rakel. The helicopters are planned to enter active SAR duty during the period 2013-2014.

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4 JRCC: Joint Rescue Coordination Centre.
5 Advance alert: An alert is sent via text message during the interview with the person who has called 112.
6 SAR: Search And Rescue.
7 Rakel: RAdioKommunikation för Effektiv Ledning; the Swedish national digital communications system used by the emergency services and others.

Before the rescue helicopter left the area, however, the medical personnel received information from the helicopter conveyed via the emergency services and the old interoperability channel, the "brandriksfrekvensen" [national frequency for fire emergencies]. The patient was then flown to Blekinge Hospital in Karlskrona where the helicopter landed at 13.23 hrs, which is one hour after the received 112 call.

The pilot was helped ashore by private individuals by means of small boats. The medical personnel from the ambulance who were standing by at the nearby bathing area took over care of the patient, who was transported to Kalmar County Hospital. The patient arrived at the hospital's emergency ward at 13.56 hrs, which is approximately one and a half hours after the received 112 call.

Once both injured persons had been transported away from the site, the rescue operation then turned to searching for the aircraft, which had sunk, and checking whether there was any discharge of fuel or other substances harmful to the environment. The emergency services also noted that Hultebräan lake was a water reservoir for Kalmar. To obtain advice in the situation that had arisen, the environmental salvage manager and representatives of Kalmar Vatten AB and VAKA were contacted. VAKA is the National Water Catastrophe group and can be reached via SOS Alarm. VAKA provides support to municipalities and regions exposed to or in risk of being exposed to acute problems with the supply of drinking water. On-call officials at Kalmar County Administrative Board were also informed.

It was decided that the aircraft would be salvaged due to the risks to the drinking water reservoir associated with the potential discharge of fuel, etc. Shortly before 19.00 hrs, the aircraft was located by means of an echo sounder at a depth of 4.7 m. At the same time, the discharge of smaller quantities of oil products was identified. The aircraft was lifted up to the surface using low-pressure lifting cushions, which divers attached to the wings close to the aircraft body, and which were then inflated.

Fig. 7. The aircraft lying upside down on the surface of the water after having been lifted with inflatable lifting cushions. Photo: Göran Johansson, Sydostnyheter.

Thereafter, the upside down aircraft was towed approximately 500 m to the bathing area. In order to clean up any discharges, booms were placed around the aircraft before the requisitioned heavy tow truck with crane lifted the aircraft ashore at 23.40 hrs, approximately 11 ½ hours after the accident.

Fig. 8. The aircraft was placed upside down on the ground.Photo: Göran Johansson, Sydostnyheter.

The rescue operation was concluded once the aircraft was lying on the ground by the bathing area, whereupon the operation turned to environmental salvage. The emergency services' operation was concluded at around 02.30 hrs.

1.15.2 The injured parties' perception of the rotor wake from the rescue helicopter

Both injured persons have stated that they perceived the rotor wake from the helicopter to be very unpleasant and that it made it difficult to breathe. They questioned why the helicopter remained close to the site once the rescue swimmer was detached and was preparing to winch up the injured passenger.

The helicopter commander has stated that they had moved to the side once the rescue swimmer was unhooked, but that it is necessary to maintain such a distance that hand signals from the rescue swimmer can still be understood.

1.16 Tests and research

1.16.1 History of the aircraft type

The first of the LAKE family of aircraft was built in 1948. It was a two-seater aircraft with a 115 horsepower engine. Thereafter, the aircraft model has been developed in several stages; becoming slightly larger, having more seats and a higher engine power. In total, over 1000 aircraft have been built, most of which in the 200 and 250 series. Around 140 units of the type in question have been manufactured.

When performing a cursory search at the US National Transport Safety Board (NTSB), 10 accidents with a similar sequence of events were found.

1.16.2 *The mechanics of water contact*

A seaplane can obtain lifting capacity on the water surface via two different types of reaction. Standing still, or at a low speed, lifting capacity is obtained via the aircraft floating, i.e., the fuselage displaces the amount of water required to support the weight of the aircraft. When the speed increases, the lifting capacity goes from the aircraft floating to it beginning to aquaplane. This means that lifting capacity is obtained via hydrodynamic forces in roughly the same way as when a person is water-skiing. The wings also give a certain lift when the speed increases. When the speed is sufficient for the wings to support the entire aircraft, it can lift from the water. When landing, the process is in reverse.

In order to obtain hydrodynamic lifting capacity, the bottom of the aircraft has a "step", which is a notch or recess in the bottom panels so that the water is released from the underside of the aircraft body.

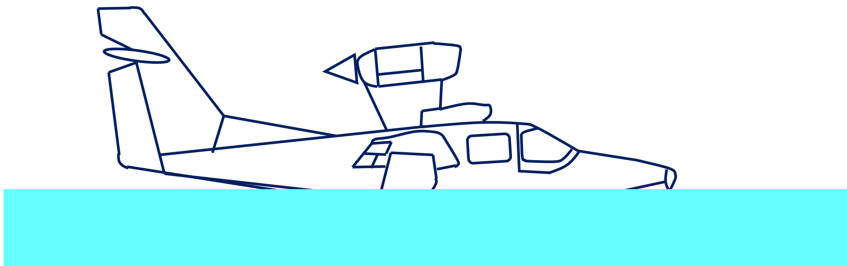

Fig. 9. Aircraft floating.

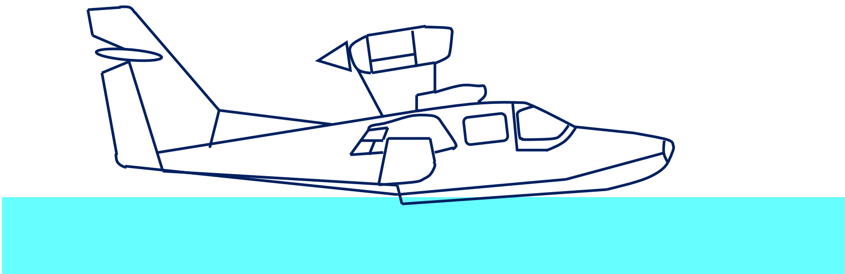

Fig. 10. Aircraft aquaplaning.

The step breaking the water surface is crucial to the aquaplaning functioning as intended. If the underside of the aircraft makes contact with the surface of the water without the step breaking the surface of the water, the water will be led upwards, along the fuselage. The reaction force from the water acting upwards will pull the aircraft downwards and deeper into the water. This in turn means that the area of contact with the water increases, which increases the friction, thus producing a greater braking force against the water.

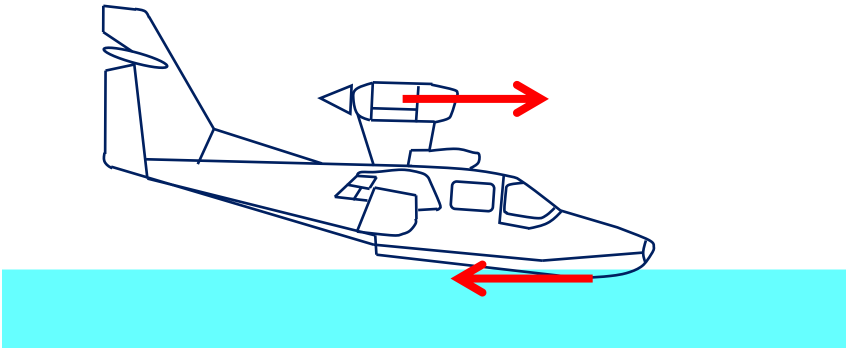

Fig. 11. The step does not break the water surface.

1.17 Organisational and management information

Not applicable.

1.18 Other

1.18.1 Gender equality issues

Not applicable.

1.18.2 Environmental aspects

According to information from the pilot, there were approximately 60 litres of aviation fuel (AVGAS 100LL) in the aircraft's tanks at the time of the accident. This assessment was based on the fuel gauges and estimated consumption since the last refuel.

The rescue team stated that they had handled approximately 70 litres of fuel. This does not however eliminate the possibility that a small amount of fuel was released into the lake.

In addition, the aircraft's system contained roughly 10 litres of engine oil and a small quantity of hydraulic oil. It has not been established how much of this remained in the wreckage.

According to information from the rescue team, there were only signs of a limited, light oil sheen on the lake.

1.19 Special or effective methods of investigation

None.

2. ANALYSIS

2.1 Sequence of events

Based on the witness statements and the damage to the aircraft, the likely sequence of events can be described as follows, with reference to fig. 12:

1. A normal approach.
2. A first water contact that resulted in a bounce.
3. The aircraft briefly left the water.
4. A second water contact with the nose slightly too low so that the step did not break the surface of the water. As the right support float is broken off and the nose shows signs of being bent to the left, it is likely that the aircraft was drifting slightly to the right when touching down.
5. The nose was sucked down into the water, resulting in a great drag. The engine's mass and high position resulted in the aircraft beginning to tip forward at the same time as the nose was broken off.
6. The passenger went out through the bottom of the aircraft and received wounds from the ruptured and sharp bottom panels.
7. The passenger found herself deep under water and saw air bubbles and parts of the wreckage above her.
8. The passenger swam up to the surface and grabbed hold of the wing. The pilot unfastened himself, exited the wreckage and swam up to the surface.

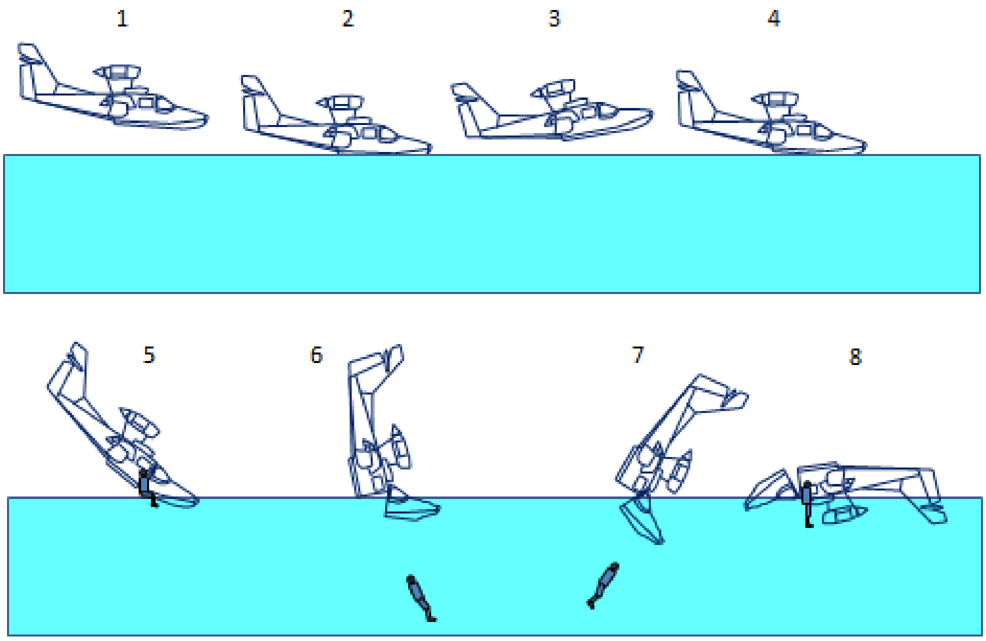

Fig. 12. This series of images provides a likely sequence of events in schematic form.

What speaks against the first part of the sequence of events is the pilot's statement that there was only one touchdown and that there was a sudden halt while gliding “on the step”. However, the statements of the passenger and a witness that support the described sequence of events are concordant.

The fact that the bottom panels show no signs of contact with any hard object speaks against the pilot's suspicion that the aircraft had run aground. Furthermore, the passenger's movement through the water speaks against there being any shallow at the site of the accident.

2.2 Characteristics of the aircraft model upon water contact

Fig. 2 and fig. 11 show that the underside of the fuselage has a long, level section which is horizontal in a normal flight position. This means that an abnormal flight position is not necessary in order for the step to be in the air when contact is made with the water.

In the case where the front part of the bottom achieves water contact without the step breaking the water surface, the nose will be sucked down into the water in the manner described in chapter 1.16.2. When the wet surface increases, so does the water drag, which in turn causes the aircraft to tip forwards as a result of the heavy engine which is positioned high up. The engine with its mounting weighs approximately 350 kg, which is close to 30 % of the total mass. When the aircraft tips forward, the nose is pushed deeper into the water, which results in a further increase in water drag. Furthermore, the wings' lifting capacity declines as the angle of attack decreases. The force on the nose that is pushed down in the water may then result in the forebody breaking up.

The sequence accelerates and occurs so quickly that the pilot has no chance to react and counteract it.

2.3 The accident

There were good conditions for a successful landing. The pilot had relatively large experience of this aircraft model and of the landing site in question. In addition, the weather was good, with a light wind which was yet sufficient to produce ripples so that a good reference to the water surface was obtained.

It is likely that the difference in angle, upon contact with the water, between a normal and a catastrophic landing is very small. This means that there is no area in which there is a moderate landing that could serve as a warning.

This could explain why the pilot has previously succeeded in a great number of landings that were perceived as normal.

According to the passenger and one witness, the aircraft bounced once on the surface of the water and the accident occurred on the final water contact. The pilot stated that the accident occurred when gliding “on the step” after a normal landing.

It has not been possible to establish the first part of the sequence of events with certainty. If it is assumed that there was a bounce that the pilot did not perceive, this may explain why the second water contact did not come to take place with the required precision since the pilot then believed that the aircraft was already gliding “on the step”.

2.4 Rescue operation

Collaboration at the site of an accident is made easier if the participating rescue and medical units have aids for being able to communicate with one another. At the aircraft crash, both the municipal rescue team and the ambulances had access to Rakel. The rescue helicopter did not have Rakel built in, which hampered communication with the land units.

As the Swedish Maritime Administration has stated that the new rescue helicopters to be commissioned 2013-2014 will have built-in Rakel, the possibility for communication should improve considerably.

3 CONCLUSIONS

3.1 Findings

a) The pilot was qualified to perform the flight.
b) The aircraft had a valid Certificate of Airworthiness.
c) Nothing indicates that there were technical faults in the aircraft.
d) A number of accidents have occurred with this aircraft type in connection with water contact.
e) The result of the rescue and medical operation was that the damage/-injuries were limited and the patients were taken into care in an effective manner.
f) Communication between the units on the ground and the rescue helicopter was hampered as a result of not all participating units having access to a common radio communication system.

3.2 Causes

The accident was caused by the following factors:

- The design of the aircraft model's fuselage entails that small deviations from the ideal angle of attitude upon water contact involve a risk that the nose will be sucked down into the water.
- The engine's mass that is highly positioned contributes to the aircraft tipping forward when the water resistance increases.

4. RECOMMENDATIONS

None.