AVIATION OCCURRENCE REPORT

COLLISION WITH TERRAIN

HARBOUR AIR
DE HAVILLAND DHC-2 BEAVER C-FDTI
SANDSPIT, BRITISH COLUMBIA 34 nm W
23 JUNE 1994

REPORT NUMBER A94P0121

Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

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Synopsis

The amphibious de Havilland DHC-2 Beaver departed from a floating fishing resort with the pilot, one passenger, and a load of fish on board, for a 30-minute flight to Sandspit, British Columbia. When the aircraft did not arrive at Sandspit, a search was organized. The aircraft was later found submerged in the water at Hunter Point, about seven nautical miles from the point of departure. The pilot and passenger had been fatally injured and the aircraft was destroyed.

The Board determined that the aircraft likely stalled at an altitude insufficient to permit a recovery. The reason why the aircraft may have stalled could not be determined.

Ce rapport est également disponible en français.

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5.0 Appendices

1.0 Factual Information

1.1 History of the Flight

The amphibious DHC-2 Beaver was being operated from the Harbour Air base at Sandspit, British Columbia, located on the Queen Charlotte Islands. On the first flight on the day of the accident, the aircraft carried baggage from the Sandspit Airport to a floating fishing resort at anchor in Givenchy Bay. This bay is located in the Kano Inlet on the west coast of the Queen Charlotte Islands, 28 nautical miles[1] (nm) west of Sandspit. On board the aircraft with the pilot was a passenger who would remain with the flight for the return trip to Sandspit.

The aircraft departed Sandspit under visual flight rules (VFR)[2] at 1015 Pacific daylight time (PDT)[3] and landed at the fishing resort at 1039. The pilot had taken the most direct route to the destination through a low pass and over Yakoun Lake. He advised the company dispatch on the company radio frequency that the weather was quite poor along that route and that he planned to take the Skidegate Channel for the return trip.

1 Units are consistent with official manuals, documents, reports, and instructions used by or issued to the crew.

2 See Glossary for all abbreviations and acronyms.

3 All times are PDT (Coordinated Universal Time [UTC] minus seven hours) unless otherwise stated.

On arrival at the Givenchy resort, the aircraft was loaded with the fish to be transported to Sandspit; it then departed Givenchy at 1051.

When the aircraft did not arrive at Sandspit, a search was organized. The wreckage was located at 1245 at Hunter Point, about 7 nm from Givenchy, at latitude 53°15'N, longitude 132°42'W. The accident had occurred during the hours of daylight at approximately 1100. The aircraft was destroyed and the pilot and passenger were fatally injured upon impact.

1.2 Injuries to Persons

	Crew	Passengers	Others	Total
Fatal	1	1	-	2
Serious	-	-	-	-
Minor/None	-	-	-	-
Total	1	1	-	2

1.3 Damage to Aircraft

The aircraft was destroyed by the impact and by exposure to the ocean surf.

1.4 Other Damage

There was no other property damage.

1.5 Personnel Information

	Captain
Age	29
Pilot Licence	Commercial
Medical Expiry Date	94-07-01
Total Flying Time	2,586 hr
Total on Type	1,268 hr
Total Last 90 Days	119 hr
Total on Type Last 90 Days	119 hr
Hours on Duty Prior to Occurrence	4 hr
Hours off Duty Prior to Work Period	12+ hr

This summer season was the second that the pilot had worked for Harbour Air. He had performed the same duties in Sandspit during the previous year. He had been on duty for 16 consecutive days prior to the accident

and had flown 52 hours during that time. Friends and colleagues stated that the pilot had spent the evening before the day of the accident quietly, and that he had rested for six to eight hours. He was reported to have been in good spirits on the morning of the accident.

The *Harbour Air Operations Manual* contains a Transport Canada (TC) approved training syllabus. Company records indicate that the pilot had completed the required training. The pilot was considered to be a capable and knowledgable pilot by the chief pilot, colleagues, and passengers.

1.6 Aircraft Information

Manufacturer	de Havilland
Type	DHC-2 MK 1
Year of Manufacture	1949
Serial Number	37
Certificate of Airworthiness (Flight Permit)	Valid
Total Airframe Time	11,615 hr
Engine Type (number of)	Pratt & Whitney R-985-AN-14B (1)
Propeller/Rotor Type (number of)	Hamilton Standard 2030-237 (1)
Maximum Allowable Take-off Weight	5,100 lb - land 5,000 lb - water
Recommended Fuel Type(s)	80/87 or higher octane if 80/87 is unavailable
Fuel Type Used	100 LL

A 100-hour inspection had been completed on 10 June 1994, during which no maintenance deficiencies were found. The aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

The operator had been concerned with excessive fuel consumption on this aircraft. The carburettor was replaced on 20 May 1994 in an attempt to correct high fuel consumption. The pilot of this aircraft had been tracking the fuel consumption since that date, and his records indicate that the fuel consumption was normal, that is, about 20 US gallons per hour.

1.7 Meteorological Information

Meteorological information for the flight was obtained by the pilot from the company dispatcher. The company dispatcher received weather information directly from the various locations that the aircraft was scheduled to fly to. The Sandspit Flight Service Station (FSS) was located immediately adjacent to the company office, but it is not known if the pilot used any information from this source. The Area Forecast (FA) valid for the time of the accident predicted occasional ceilings of 4,000 to 6,000 feet above sea level (asl) with the visibility greater than six miles. The FA warned of extensive low-level moisture over the sea and onshore, which could have given ceilings between 0 and 1,500 feet above ground level (agl) with a visibility between zero and four miles in fog.

The Sandspit weather observation (SA) at 1000 on 23 June 1994 indicated a broken ceiling of 2,800 feet agl, with visibility greater than 15 miles, temperature 16 degrees Celsius, dew point 12 degrees Celsius, and the wind from 260 degrees at 8 knots.

The weather on the west side of the islands was somewhat worse. The 1100 weather observation for Langara, 60 nm northwest of the accident site, reported a visibility of 1/8 of a mile in fog.

The marine captain of the floating fishing resort reported that the ceiling had been between 500 and 800 feet agl in the Givenchy anchorage on the morning of the accident. Pilots flying in the vicinity of the crash site shortly after the accident reported ceilings between 200 and 300 feet agl near Hunter Point. No fog was observed and visibility below the cloud was reported to be good.

Witnesses who were fishing nearby observed the aircraft as it emerged from Kano inlet and flew around Hunter Point at the south end of the mouth of Kano Inlet. Since they were about four miles away they could not hear the engine, and they did not observe anything unusual about the aircraft's flight path. They

reported that the ceiling was low, at an estimated height of 200 to 300 feet above the surface of the water, and that the visibility was good. From their vantage point, they could identify a landmark located three miles beyond Hunter Point and seven miles from their position.

The witnesses also commented on the calm conditions. This area is normally subject to strong winds and rough water, but on the day of the accident, the wind was light and the water was calm.

1.7.1 Pertinent Air Navigation Order and Air Regulation

Air Navigation Order (ANO) Series V, Number 3, Paragraph (5)(b) states that, while operating under VFR, other than in Controlled Airspace, "when an aircraft is flown at less than 700 feet vertically from the ground or water,

(i) flight visibility shall not be less than one mile, and

(ii) the aircraft shall be flown clear of any cloud."

This ANO also defines an area in British Columbia where the required flight visibility must not be less than two miles. The accident occurred in this area.

Section 534, paragraph (6) of the Air Regulations states the following:

> A person may, over non-populous areas or over open water, fly an aircraft at a lower altitude than that specified in paragraph (2)(b) (which requires 500 feet above the highest obstacle within a radius of 500 feet from the aircraft) where:
>
> (a) the flight is conducted without creating a hazard to persons or property; and
>
> (b) ... the aircraft is not flown at a distance less than 500 feet from any person, vessel, vehicle or structure.

1.7.2 Coastal Weather Operations

The flight was being conducted in accordance with VFR weather limits as specified by regulation. Aircraft operators routinely schedule VFR flights in similar weather conditions along the British Columbia coastline. Low-level flight below overcast sky conditions in a floatplane while over water does not entail all of the risks associated with low flying in similar conditions over land. There are few obstacles protruding from the water, although bridges and wire spans may present a danger. In the event of an engine failure, the water usually provides a site for a forced landing.

A constant danger in low flying, however, is the lack of time to react to an unusual or emergency situation. For example, an inadvertent loss of control that occurs at low altitude seldom affords the pilot sufficient time to cope with the situation, and he is frequently unable to avoid contact with the land or water.

1.8 Weight and Balance

The Type Approval Data Sheet and the Transport Canada (TC) approved *DHC-2 Beaver Flight Manual* specify maximum allowable weights for different landing gear configurations. A wheel-equipped Beaver has a maximum allowable weight of 5,100 pounds, while a float-equipped Beaver is limited to 5,090 pounds. An amphibious Beaver operates on both land and water and the maximum allowable weight depends on the surface that it is being operated from. When operating from land, the maximum weight is 5,100 pounds, but, when operating from water, it is 5,000 pounds.

On departure from Sandspit, the pilot reported by radio to the company dispatcher that he had 324 pounds of fuel on board. Based on normal fuel consumption and the estimated times en route, at the time of the accident the aircraft would have had at least 209 pounds of fuel on board. At the fishing resort,

1,150 pounds of fish were reportedly loaded onto the aircraft. The resort estimated the weight of the cleaned fish by use of a fixed percentage of the weight of the whole fish, and random checks made by the resort indicated that their estimates were generally higher than actual figures. The actual weight of the load carried could not be determined since the majority of the load was consumed by sea lions after the accident. The estimated weight of the aircraft at the time of the accident was 5,295 pounds, which is 295 pounds over the maximum allowable in this configuration.

Section 6 of the TC approved *Company Operations Manual* for Harbour Air included a table listing the operating specifications for their various aircraft. It correctly identified the maximum allowable weight for both float-equipped and wheel-equipped Beavers, but made no reference to the special case of the amphibious Beaver. Journey log-book entries indicated that the pilot was not aware of the lower maximum allowable weight for amphibious Beavers operating on water. For example, two days before the accident, while operating from water, he entered into the journey log two flights with gross weights over 5,000 pounds. On the accident flight, the aircraft's estimated load exceeded both the land and water maximum weight limits.

Based on estimates of where the load was being carried, the centre of gravity (C of G) was estimated to have been within the prescribed limits.

1.9 Accident Site Information

The accident site was at sea level on a rocky shoal, just west of Hunter Point. At high water the wreckage was submerged, but at low water the rocks are exposed and it was possible to walk out on the rocks to the crash site. Tide information obtained during the investigation shows that, at the time of the accident, the tide was halfway between high and low water. The rocks would have been visible at this stage, though possibly covered with less than one foot of water. It is unlikely that the pilot would have considered this area as a suitable landing area, even in the event of an emergency.

1.10 Wreckage and Impact Information

The aircraft struck the rocks and surf in a nose-down, left-wing-low attitude. The left wing had impact damage on the outboard leading edge. The forward portion of both floats had been pushed up and had broken away from the remainder of the floats; the left float showed more damage than the right. The bottoms of the floats did not display any impact damage or indications of contact with the rocks. Only one area of broken rock was found to indicate a point of impact. The direction of flight immediately prior to impact could not be determined. The engine was found directly below the point of impact, indicating that the aircraft did not move forward after impact. The wings were found at the same location as the engine, but the fuselage had floated 150 feet away. The damage to the occurrence aircraft is consistent with damage resulting from impact at slow speed, in the order of 60 knots.

The aircraft was retrieved from the water and examined at the site. The landing wheels were up and the flaps were in the take-off position. All flight control surfaces were present and, except for the cables that had been purposely cut during the wreckage retrieval process, no deficiencies with control continuity were found. All cockpit controls were found to have been bent to the left.

Both propeller blades were bent back smoothly almost 90 degrees. Leading edge damage and chord-wise scratches were visible on one blade only. The propeller shaft was bent at a five-degree angle to the left. Engine accessories on the left side of the engine were either torn off or badly damaged.

The wreckage was transported to the TSB Regional wreckage examination facility. Disassembly of the engine revealed no pre-impact malfunction or failure which would have prevented the engine from developing full power.

Some engine instruments and the low-fuel-pressure warning light bulb were sent to the TSB Engineering Branch Laboratory for examination. The engine tachometer was reading 3,700 revolutions per minute (rpm) when the aircraft was recovered from the water. The laboratory examined this tachometer and all the other instruments, but found no reliable information. Examination of the low-fuel-pressure warning light bulb revealed that it was serviceable prior to impact, and that it was not illuminated at impact. The fuel pressure switch was tested and found to activate when pressure dropped below 0.5 pounds per square inch (psi). According to the *Beaver Flight Manual* this switch should activate at 3 psi. However, due to the extensive mechanical and water damage that the switch incurred, its serviceability prior to impact could not be determined.

The fuel tank selector was found in the centre position when the aircraft was recovered from the water. There was no measurable fuel in any tank since the aircraft had been submerged and inverted in the ocean surf for almost 48 hours, and the tanks had been breached.

1.11 Medical Information

There was no evidence that incapacitation or physiological factors affected the pilot's performance.

1.12 Fire

There was no evidence of fire either before or after the occurrence.

1.13 Survival Aspects

Both occupants were wearing lap belts only. Shoulder harnesses were not installed on this aircraft, nor were they required by regulation. Sixteen boxes of fish had been loaded into the aircraft, but only four were still in the cabin when the divers examined the wreckage after the accident. The front windscreen was completely shattered and was the only opening through which the boxes could have been ejected. The cargo net was found inside the cabin with no evidence of stretching or damage at the attachment fittings, indicating that it had not been used during this flight. However, the cargo net was for use in the aft portion of the fuselage and it would not have been possible to secure all of the boxes with that net even if it had been used. A rope was found tied to the tie down rings inside the cabin and there was evidence that it had been used in an attempt to secure the boxes within the cabin.

No emergency locator transmitter (ELT) signal was received by any station or aircraft in the area because the ELT had been submerged.

1.14 Fuel System

The fuel system of the Beaver consists of three tanks located under the cabin floor which are selected individually from a cockpit fuel selector. The refuelling procedure that the pilot normally followed was to refuel the tanks sequentially from the forward tank to the rear tank. In flight, the pilot habitually used the fuel in the opposite order, that is, from the aft to the forward tank. Experienced Beaver pilots report that it is a common practice to exhaust the fuel in one tank before switching to another tank. They normally wait for indications of dropping fuel pressure, from the fuel pressure gauge or the low-fuel-pressure warning light, and then switch tanks. They do not normally allow the engine to stop during this procedure.

1.15 Flight Characteristics

The following notes are taken from the *DHC-2 Beaver Flight Manual*, Section IV, with regard to flight characteristics.

> The aircraft is easy to fly and is docile down to the stall... The stall is gentle at all normal conditions of load and flap and may be anticipated by a slight vibration, which increases as flap is lowered. The aircraft will pitch if no yaw is present. If yaw is permitted, the aircraft has a tendency to roll. Prompt corrective action must be initiated to prevent the roll from developing.

1.16 Non-Revenue Passenger

The passenger, a pilot employed by another company, boarded the aircraft at Sandspit as a non-revenue passenger. He intended to remain with the flight until it landed again at Sandspit, before departing for Vancouver later that afternoon.

When a non-revenue passenger was to be carried on a Harbour Air flight, the understood procedure was that permission to board the passenger would be obtained through the dispatch coordinator before departure. The accident pilot did not obtain prior permission to board the passenger; he did, however, notify dispatch by radio as he taxied out that he was carrying an extra person on board.

The accident aircraft was equipped with one control yoke. By design, this control yoke can be swung over to either the left or the right cockpit seat; only the left seat, however, was equipped with rudder pedals.

The control yoke was found on the left side of the cockpit when the aircraft was recovered from the water. The left seat was occupied by the pilot-in-command.

1.17 Birds

During the course of the on-site investigation, the TSB investigators noted the concentration of bald eagles at and near Hunter Point. On two occasions during flights to and from the accident site, some avoidance manoeuvres were necessary to avoid a bird strike.

2.0 Analysis

2.1 Crash Scenarios

The accident occurred in a desolate area and there were no eye-witnesses to the crash. On the basis of the wreckage information and the information provided by people who saw the aircraft en route, it was established that the aircraft was flying at low altitude, at low airspeed, and with flaps in the take-off position. Evidently, as the aircraft rounded Hunter Point, something caused the pilot to lose control of the aircraft and crash.

The aircraft remained in the ocean surf for 48 hours and the wreckage sustained further damage during this time. The damage to the aircraft was consistent with an impact at slow speed, in the order of 60 knots. The most likely explanation is that the aircraft stalled at a height above the water that was insufficient to allow the pilot time to recover before the aircraft struck the water. The nose-down, left-wing-low attitude at impact is not usual in these flight circumstances and indicates a loss of control prior to impact. This analysis concentrates on four possible scenarios for this loss of control.

2.1.1 Fuel Starvation

If the pilot followed the practice of exhausting the fuel from one tank prior to switching to a tank containing fuel, the engine may have stopped because of fuel starvation. At low altitude, he probably would not have had time to restart the engine before being forced to land on the rocky tidal flat. Had he attempted to stretch the glide to a more suitable landing area, the aircraft may have stalled.

2.1.2 Forced Landing

It is possible that an emergency situation required the pilot to force-land on the rocky tidal flat, and that the floats struck rocks, flipping the aircraft over. The lack of damage to the underside of the floats, however, does not support this scenario.

2.1.3 Bird Strike

The local eagle population is concentrated in Hunter Point, and it is possible that the sudden appearance of an eagle startled the pilot and caused him to pull up quickly to avoid the bird. At the aircraft's high weight and low speed, this could have caused a stall. Any evidence of such a bird strike would have been obscured by the impact damage and removed by the washing effect of the surf.

2.1.4 Stall During a Turn

In all likelihood, when the pilot rounded Hunter Point, he would have encountered low ceilings that may have appeared as poor visibility. As he continued the left turn around the point, he may have started to slow down and descend. The weather and changing flight profile may have caused a distraction that led to a stall.

2.2 Engine Power

There was no sign of a pre-impact engine malfunction. Although the evidence obtained from the engine tachometer and the propeller indicate that the engine was operating at impact, it could not be determined how much power was being developed.

2.3 Weather

The weather at the time of the occurrence caused the pilot to fly at a low altitude, probably at no more than 200 feet asl. It is unlikely that this altitude would have allowed the pilot sufficient time to recover from a stall or other loss of control situation. Additionally, the low ceilings, reduced visibility, and calm water would have made it difficult to judge the aircraft's altitude and attitude. This may have contributed to the loss of control as detailed above or it may have caused the pilot to unintentionally allow the aircraft to contact the rocks or water and subsequently lose control.

2.4 Survival Aspects

Shoulder harnesses were not installed on this aircraft, nor were they required by regulation. The cargo was tied down with a rope. Because of the extensive damage to the aircraft, it could not be determined if the use of enhanced cargo restraints or shoulder harnesses would have increased the likelihood of survival.

3.0 Conclusions

3.1 Findings

1. The TC approved company operations manual did not identify the maximum allowable weights for an amphibious Beaver.

2. The ceiling in the Hunter Point area was estimated at between 200 and 300 feet at the time of the accident.

3. The pilot most likely lost control of the aircraft when it stalled at an altitude too low to permit effective recovery.

4. A cargo net was available but was not suitable for the load being carried. A rope was used to secure the load.

3.2 Causes

The aircraft likely stalled at an altitude insufficient to permit recovery. The reason why the aircraft may have stalled could not be determined.

4.0 Safety Action

The Board has no aviation safety recommendations to issue at this time.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson, John W. Stants, and members Gerald E. Bennett, Zita Brunet, the Hon. Wilfred R. DuPont and Hugh MacNeil, authorized the release of this report on 14 March 1995.

Appendix A - List of Supporting Reports

The following TSB Engineering Branch Laboratory Report was completed:

LP 93/94 - Instrument Analysis.

This report is available upon request from the Transportation Safety Board of Canada.

Appendix B - Glossary

agl	above ground level
ANO	Air Navigation Order
asl	above sea level
C of G	centre of gravity
ELT	emergency locator transmitter
FA	area forecast
FSS	Flight Service Station
hr	hour(s)
lb	pound(s)
LL	low lead
nm	nautical miles
PDT	Pacific daylight time
psi	pounds per square inch
rpm	revolutions per minute
SA	surface actual weather
TC	Transport Canada
TSB	Transportation Safety Board of Canada
VFR	visual flight rules
'	minute(s)
"	second(s)
°	degree(s)
°M	degrees of the magnetic compass