Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A08P0241

AERODYNAMIC STALL – COLLISION WITH TERRAIN

PACIFIC COASTAL AIRLINES
GRUMMAN G-21A GOOSE C-GPCD
ALICE LAKE, BRITISH COLUMBIA
03 AUGUST 2008

Canada

Aviation Investigation Report

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Summary

At 0708 Pacific daylight time, the Pacific Coastal Airlines G-21A amphibian (registration C-GPCD, serial number B76) operating as a charter flight departed Port Hardy Airport, British Columbia, on a visual flight rules flight to Chamiss Bay, British Columbia. At 0849 and again at 0908, the flight follower attempted to contact the tugboat meeting the aircraft at Chamiss Bay by radiotelephone but was unsuccessful. At 0953, the flight follower reported the aircraft overdue to the Joint Rescue Coordination Centre in Victoria, British Columbia, and an aerial search was initiated. A search and rescue aircraft located the wreckage on a hillside near Alice Lake, approximately 14 nautical miles from its departure point. A post-crash fire had ignited. The emergency locator transmitter had been destroyed in the crash and did not transmit. The accident happened at about 0722. Of the seven occupants, the pilot and four passengers were fatally injured, one passenger suffered serious injuries, while another suffered minor injures. The two survivors were evacuated from the accident site at approximately 1610.

Ce rapport est également disponible en français.

Other Factual Information

The accident flight was one of a series of charters to transport a logging company's personnel from Port Hardy, British Columbia, to a company facility at Chamiss Bay, British Columbia. Chamiss Bay is located approximately 37 nautical miles (nm) south of Port Hardy, on the west coast of Vancouver Island, British Columbia. The flight was conducted under the auspices of Pacific Coastal Airlines' air taxi operations certificate issued under subpart 703 of the *Canadian Aviation Regulations* (CARs). The flight was conducted under visual flight rules (VFR) by a single pilot.

Port Hardy is Pacific Coastal Airlines' principal floatplane base. The company operates a Type D operational control system under which operational control is delegated to the pilot-in-command of a flight. [1] The *Company Operations Manual* (COM) requires that, before the flight, the pilot-in-command establish how the flight will be monitored and by whom. [2] In this case, Pacific Coastal Airlines had a company flight watch facility at Port Hardy. The COM also requires the pilot-in-command to maintain communications with the flight watch facility, [3] to monitor air traffic control and company frequencies, and to transmit position reports to Pacific Coastal Airlines' flight watch facility. [4] Given the terrain and its impact on direct radio communications, it was not unusual for a flight to be out of contact with the flight watch facility for some time. Moreover, it was not unusual for company floatplane pilots to land and wait for improvements in weather or other conditions before proceeding to their destination without communicating this to the flight follower. The COM requires that, while out of range of company communications facilities, the pilot-in-command communicate any changes to the flight watch facility as soon as possible via an air traffic services unit or by telephone. [5]

Photo 1. Grumman G-21A Goose

The pilot was certified and qualified for the flight in accordance with existing regulations. He had been employed by the company for 1 ½ years. Experienced with this type of flight operation, he had accumulated 3998 hours of flight time, including 500 hours on the Grumman Goose (see Photo 1). The pilot had received all required company training. As well, he had received pilot decision making and mountain flying training. The pilot had never been instrument rated; however, he had had basic instrument flight training and had successfully passed the written exam for an

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1 Section 723.16, Operational Control System, of the *Canadian Aviation Regulations* (CARs): "Operational control is delegated to the pilot-in-command of a flight by the Operations Manager who retains responsibility for the day-to-day conduct of flight operations."

2 Pacific Coastal Airlines' *Company Operations Manual*, section 2.4.1, amendment No. 15, dated 06 March 2008.

3 Ibid., section 1.4.7, In-Flight Duties, paragraph P.

4 Ibid., section 2.4.5, Flight Watch – Following and Communications – Type D, paragraph D.

5 Ibid., paragraphs E and F.

instrument rating in 2005. This was the pilot's fifth day of work following two days off. He had flown 17 hours in the last seven days and had been on duty for 1 hour and 22 minutes at the time of the accident. Nothing was found to suggest that he might have been fatigued.

The Grumman G-21A Goose is an amphibious aircraft used by Pacific Coastal Airlines for passenger transportation along the Pacific coast. It is a piston-powered, propeller-driven, unpressurized, twin-engine aircraft with a total seating capacity of 10. The aircraft was certified for flight in visual meteorological conditions. It was equipped with the standard configuration of flight instruments and a portable global positioning system (GPS). It also had a very high frequency (VHF) transceiver and a frequency modulation (FM) radio. Communications were, therefore, subject to line-of-sight limitations where range is dependent on height. Records indicate that the aircraft was certified, equipped, and maintained in accordance with existing regulations and approved procedures.

There are currently a number of non-line-of-sight communication technologies, some of which allow real-time tracking, available to operators: for example, high frequency (HF) transceivers, satellite telephones, or commercially available GPS-based tracking devices that provide internet-based messages to flight followers. The aircraft was not equipped with any of these.

The graphical area forecast for the area of the accident effective at 0500, [6] 2 hours and 22 minutes before the accident, called for the following conditions: overcast clouds based at 800 to 1200 feet above sea level (asl) with tops at 3000 feet asl, prevailing visibility greater than 6 statute miles (sm), patchy visibilities from ¾ to 3 sm in light drizzle and mist with ceilings from 300 to 500 feet above ground level (agl).

The aviation routine weather report (METAR) for Port Hardy issued at 0700 was as follows: wind calm, visibility 20 sm, overcast clouds at 1000 feet agl, temperature 12°C, dew point 10°C, altimeter setting 30.18 inches of mercury, remarks: 8 oktas [7] stratocumulus, sea-level pressure 1022 hectopascals. Clouds were located on a mountain ridge to the south and southwest of the Port Hardy Airport. Before departure, the pilot contacted a representative of the logging company at Chamiss Bay to inquire about the weather conditions. The weather was reported as sunny skies and good visibility.

A direct route from Port Hardy to Chamiss Bay requires flying over a ridge of mountains with heights above 2000 feet asl and takes approximately 30 minutes to complete (see the solid line in Figure 1). In inclement weather, a number of passes are available to facilitate crossing the higher terrain near Alice Lake. Alternately, pilots can proceed south from Port Hardy towards Quatsino Sound, then west down the sound to the Pacific Ocean, then south along the coast to Chamiss Bay (see the dashed line in Figure 1). With the exception of the area immediately south of the Port Hardy Airport, the terrain along this route is much lower; in fact, it is near sea level. However, this route takes 30 minutes longer. In good weather conditions, pilots fly the direct route. In poor weather conditions, pilots typically use one of the passes or take the alternate route along the coast.

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6 All times are Pacific daylight time (Coordinated Universal Time minus seven hours).

7 An okta is a unit of measurement expressing the extent of cloud cover, with one okta equal to one-eighth of the sky.

The pilot of the accident flight was familiar with the route from Port Hardy to Chamiss Bay. The pilot informed the flight watch facility that he would take the aircraft south out of Port Hardy towards Alice Lake, Victoria Lake, and onward to Chamiss Bay. If he could not make his way through, he would attempt to get to Quatsino Sound either by doubling back or by a pass either from Alice Lake or Victoria Lake. Estimated time of arrival at Chamiss Bay was between 0730 and 0800, depending on the route taken.

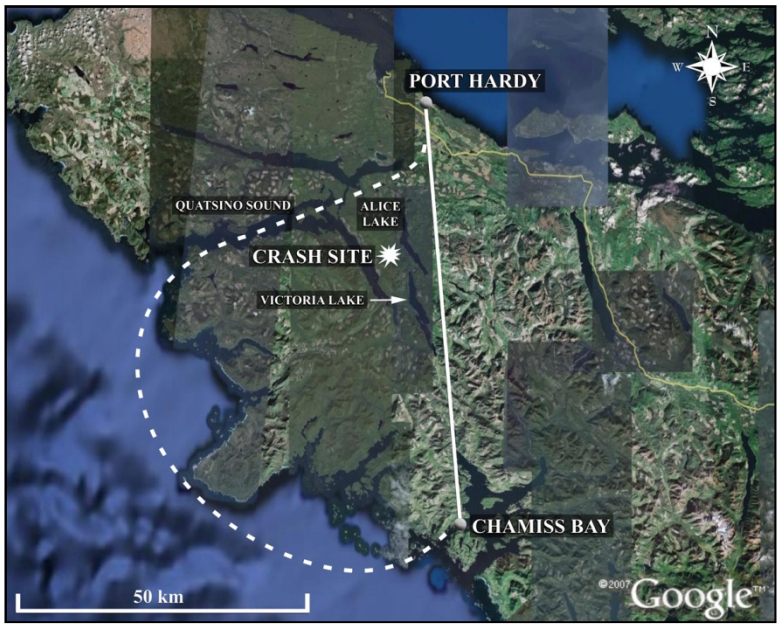

Figure 1. Routes and accident site

The aircraft took off from Port Hardy at 0708 and flew south on the direct track to Chamiss Bay. The flight was conducted clear of cloud and below the overcast ceiling. Several minutes later, the aircraft passed to the west of Alice Lake and east of a northwest–southeast ridge. Spot heights in the surrounding area are in excess of 2000 feet. As the aircraft approached the higher terrain, it began to climb gradually, and then more abruptly, to cross the cloud-covered ridge. Shortly thereafter, the aircraft's nose rose abruptly, the aircraft shuddered, the left wing dropped, and the aircraft descended steeply. The aircraft's wings then levelled and the nose began to rise. Before the aircraft's sink rate could be arrested, it struck the tree tops and fell to the ground beneath a dense canopy of foliage.

The two passengers seated rearmost in the aircraft exited through a tear in the fuselage aft of the left rear exit. One of the survivors had difficulty releasing his seat-belt. It is unknown whether this was as a result of the seat-belt installation, injuries sustained during impact, or both. The fuel tanks were breached by the impact forces, spilling a considerable quantity of fuel. Soon after, electrical arcing from exposed wires ignited an intense fire.

Between 0826 and 0953, the flight follower at Port Hardy made several attempts to ascertain the aircraft's position. These included unsuccessful attempts to contact the pilot directly on the radio, two failed attempts by radiotelephone to contact the tugboat that was meeting the aircraft, and unsuccessful attempts by other company aircraft to contact the pilot on 122.2 MHz and the company frequency. At 0929, another Pacific Coastal Airlines G-21A aircraft was dispatched to trace the route of the accident flight and to attempt to contact and/or locate the aircraft. The second aircraft flew the entire route to destination but did not locate the aircraft. At 0953, the flight follower advised the Victoria Joint Rescue Coordination Centre that the aircraft had not arrived at Chamiss Bay.

A Canadian Forces Buffalo aircraft and a Cormorant helicopter were dispatched from Comox, British Columbia, to search for the missing aircraft. Retracing the aircraft's presumed track, search and rescue (SAR) aircraft flew in the vicinity of the accident site several times. However, the emergency locator transmitter (ELT) had been destroyed in the crash and was not operating; furthermore, the downed aircraft was hidden in dense forest. As a result, the SAR aircraft were

initially unable to locate the wreckage. The less seriously injured survivor used his cellular telephone to call for help with limited success before the battery charge became insufficient for further voice transmissions. He later succeeded in completing several text messages, advising that he could hear the search aircraft at times. The missing aircraft was located at 1610 and SAR technicians were lowered from the helicopter to the site. The two survivors were evacuated approximately 8 hours and 48 minutes after the accident occurred.

The wreckage was found on the east face of a steep, densely wooded slope, at an elevation of 1860 feet asl, with trees reaching to 160 feet. Except for the engines, tail section, left wing-tip, and sponson, most of the aircraft was destroyed. Because the GPS had been consumed by fire, its data could not be retrieved.

Both engines and propellers were shipped to the TSB regional facility for further examination. Because of substantial differences in damage between the two propellers, TSB investigators carried out a propeller teardown, assisted by a representative of the propeller manufacturer. The right propeller showed severe impact damage. The left propeller did not show evidence of a significant impact. It was concluded that both propellers were rotating with power and were not feathered at time of impact. No discrepancies were noted that would have precluded normal operation, and all damage was consistent with impact damage. It was concluded that the difference in damage to the two propellers was due to different object strikes during impact, rather than a substantial difference in power output. The engines were disassembled to the extent necessary to determine that no major malfunctions had occurred.

The aircraft was not designed, and therefore not equipped, with a stall warning system. The company provided stall recovery training during both the pilot's initial and recurrent type training in March 2007 and 2008, respectively. When practising stalls on the G-21A aircraft, pilots were trained to initiate recovery at the very first indication of an approaching stall, which is a buffet. This is emphasized during training because, when the full stall angle is reached, a significant loss of altitude occurs before full recovery can be made.

Analysis

Nothing was found to indicate that there was any airframe or system malfunction before or during the flight. This analysis focuses on weather, decision making, aircraft performance, ELT performance, and flight following.

The weather at Port Hardy was VFR, consistent with the forecast. Even though the ceiling was at 1000 feet agl, the visibility was very good at 20 sm. The pilot likely expected the clouds observed along the mountain ridge to the south and southwest of the airport to be patchy as per the graphical area forecast. Knowing that the weather at Chamiss Bay was sunny with good visibility, the pilot likely considered the clouds on the mountain tops as local phenomena, which he could negotiate to successfully cross the ridge. This assessment of the weather likely led the pilot to choose the direct route.

As the flight proceeded towards the higher terrain, the pilot likely discovered that the cloud coverage was more extensive than observed from the ground, with hilltops obscured. Considering that the pilot was not instrument rated and the aircraft was not certified for instrument flight rules (IFR) flight, he would have rejected the idea of climbing into the clouds and proceeding under IFR. Instead, his options would have been to turn around (either return

to Port Hardy or double back to follow the low-level route along the coast), continue towards a pass that would allow him to cross the ridge into better weather, or try to fly above the clouds on the ridge and below the overcast ceiling. It is likely that he found the weather conditions at the pass to be unsuitable and instead elected to climb above the ridge and below the overcast ceiling. The climb began, gently at first, then more abruptly with what was probably full climb power. With clouds obscuring the ridge, the pilot would have recognized the risk of flight into terrain if he allowed the aircraft to penetrate the clouds. During the climb, the aircraft reached the stall angle and the left wing dropped. This caused the aircraft to lose considerable height. The pilot was able to recover from the stall in a nose-down attitude. Before he could raise the nose to the level position, the aircraft struck the tops of several trees, which slowed the aircraft before it fell to the ground.

The failure of the ELT to activate upon impact significantly increased the risk to survivors. In this case, the ELT was destroyed on impact, which hindered SAR efforts to locate the downed aircraft.

It is unknown whether the pilot attempted to contact flight following in the moments before the accident. The fact that the aircraft could not be reached did not alarm the company flight following because it was not unusual for aircraft to be out of radio range of the flight watch facility. It was also not unusual for pilots to land somewhere along their route to wait for weather to improve before continuing to destination. As a result, the company did not notify the Victoria Joint Rescue Coordination Centre until 0953, about one hour after the aircraft's expected arrival time back at Port Hardy. The lack of an effective means of tracking the flight progress led to delays in SAR action. These delays increased the risk to survivors.

Findings as to Causes and Contributing Factors

1. While likely climbing to fly above a cloud-covered ridge and below the overcast ceiling, the aircraft stalled aerodynamically at a height from which full recovery could not be made before striking the trees.

2. The aircraft broke apart upon impact, and electrical arcing from exposed wires in the presence of spilled fuel caused a fire that consumed most of the aircraft.

Findings as to Risk

1. While the company's established communications procedures and infrastructure met the regulatory requirements, they were not effective in ascertaining an aircraft's position and flight progress, which delayed critical search and rescue (SAR) action.

2. The emergency locator transmitter was destroyed in the crash and failed to operate, making it difficult for SAR to find the aircraft. This prolonged the time the injured survivors had to wait for rescue and medical attention.

Safety Action Taken

Transportation Safety Board of Canada

On 17 December 2008, the TSB issued Safety Advisory A08P0241-D1-A1 (*Augmentation of the Emergency Locator Transmitter System Capabilities*) to Transport Canada. The safety advisory suggested that Transport Canada may wish to amend flight following requirements to encourage operators to subscribe to a global positioning system (GPS)-linked satellite tracking system or another presently available method that would ensure that near real-time location information is available to the operator and search and rescue (SAR) units.

Pacific Coastal Airlines

After conducting a risk assessment of its routes, Pacific Coastal Airlines selected the latitude system, which provides an emergency locator transmitter (ELT)-like function. This system has been installed on all company floatplanes.

The company conducted flight tests to ensure that the stall characteristics of the G-21A aircraft met expectations held before the accident. Single-engine performance was also demonstrated with a full load, and the flap retraction processes during roll out after landing were investigated. Some of this testing resulted in changes to the company's standard operating procedures.

The company implemented a revised *G-21A Operating Manual* to incorporate more modern training standards and expanded knowledge of the aircraft. Information was gathered from other operators, and an expanded description of stall characteristics based on the flight testing was included.

The company examined the training and standards for the G-21A and made some revisions that reflect those of its *Canadian Aviation Regulations* (CARs) subpart 704 and subpart 705 operations.

The company has recognized the need for a tailored pilot decision making (PDM) course for its subpart 703 visual flight rules (VFR) floatplane pilots. Coastal Pacific Aviation, a flight training unit, has been contracted to create a special PDM course for single-pilot float operations. The instructors involved are former employees of the company, and the company has worked closely with them to develop the course outline. The course is to consist of one day of classroom instruction and one of practical instruction in a simulator. Emphasis will be on cockpit resources for a single pilot, decision making processes, physiological and psychological effects, GPS issues, and a review of relevant accidents.

The company has instituted VFR line checks as part of its monitoring and quality control, which are similar to its subpart 704 and subpart 705 operations.

The company reviewed its safety management system manual and included revised risk assessment procedures. It also reviewed accident investigation procedures and contracted with outside consultants to conduct three days of accident investigation and risk assessment training for company management and supervisors.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 19 January 2010.

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