

AVIATION INVESTIGATION REPORT

A00P0047

AIR PROXIMITY EVENT

BETWEEN

WEST COAST AIR

DE HAVILLAND DHC-6 TWIN OTTER C-GQKN

AND

CESSNA 172 N8522U

VICTORIA INTERNATIONAL AIRPORT, 8 NM N

VICTORIA, BRITISH COLUMBIA

31 MARCH 2000

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

## Aviation Investigation Report

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### *Summary*

A Cessna 172, registration N8522U, serial number 17252422, was en route from Arlington, Washington, to Nanaimo, British Columbia. The aircraft was flying under visual flight rules (VFR) at 4500 feet above sea level on a northwesterly heading. On initial contact, the Victoria, British Columbia, terminal airspace (YYJ) terminal controller assigned a transponder code, radar identified the flight, and approved the flight to proceed as requested to Nanaimo. About one minute later, a West Coast Air de Havilland DHC-6 (Twin Otter), call sign C606, serial number 94, checked in with the YYJ terminal controller. The Twin Otter was radar identified and approved to proceed to Victoria Harbour at 4500 feet above sea level on a south-southwesterly heading.

Another controller reported for duty at this time. The first transmission received by the new controller when he took over the Victoria VFR traffic advisory frequency was an advisory from the Cessna pilot stating that he was descending because of a Twin Otter. At about 1018 Pacific daylight time, the Cessna and the Twin Otter came into proximity of each other, necessitating evasive action by the Cessna pilot. The Twin Otter pilot did not see the Cessna in time to take evasive action.

*Ce rapport est également disponible en français.*

## *Other Factual Information*

The Victoria, British Columbia, airport weather conditions recorded about 30 minutes before the occurrence indicated high, thin, overcast clouds and unlimited visibility. The weather was sunny and is not considered to have contributed to this occurrence.

The Cessna pilot held a valid Airline Transport Pilot License and a current medical certificate, both issued by the US Federal Aviation Administration. This licence is recognized in Canada. The pilot had accumulated about 10 400 total flying hours, of which about 1500 hours were on the Cessna 172. The previous day, the pilot had worked a standard 7.5-hour duty day, with normal rest time. In the 90 days before the incident, he had flown 15 hours, including 5.5 hours in the previous 30 days.

The Cessna was equipped with external lighting consisting of navigation lights, a rotating beacon, and two landing lights mounted on the left wing leading edge. Only the rotating beacon was on at the time of the occurrence. The aircraft was equipped with a transponder but did not have a traffic alert and collision-avoidance system (TCAS).

The front-seat passenger of the Cessna spotted the Twin Otter off the right wing tip and advised the pilot. The evasive manoeuvre consisted of rapidly descending about 200 feet straight ahead in a wings-level attitude and returning to 4500 feet. The flight continued on to Nanaimo as planned.<sup>1</sup>

The Twin Otter, flown by the captain, had departed Vancouver Harbour on the operator's regularly scheduled visual flight rules (VFR) flight 117 to Victoria. The crew contacted the Victoria terminal airspace (YYJ) terminal controller about 10 nautical miles (nm) south of Vancouver International Airport, when the aircraft was level at 4500 feet above sea level. The Twin Otter was radar identified and approved to continue to Victoria Harbour. When the Twin Otter captain saw the conflicting Cessna, the Cessna was already in the evasive descent and passing in front of and below the Twin Otter. No evasive action was taken by the crew of the Twin Otter. During this event, the Twin Otter co-pilot had been occupied with cockpit duties and never did establish visual contact with the Cessna.

The Twin Otter was equipped with external lighting consisting of navigation lights, a rotating beacon, and two pulse-type landing lights, one mounted in the leading edge of each wing (modified to incorporate a pulse function that continually turns each light on and off in an alternating fashion). The operator's standard operating procedures require that the landing/pulse lights remain on from before take-off until after landing. The aircraft was equipped with a transponder but did not have a TCAS.

The Twin Otter captain held a valid Airline Transport Pilot Licence and a current aviation medical certificate. The medical certificate had a restriction requiring glasses to be worn; the pilot was wearing his glasses at the

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<sup>1</sup> The optimum avoidance response depends on the time to impact. Research indicates that, outside 10 seconds to the point of closest approach, the pilot should use compatible manoeuvres combining speed, altitude, and heading change. However, once the aircraft are inside the range of approximately 10 seconds to impact, the pilot should employ an altitude change only. This conclusion is based on an argument that, when two aircraft are confined in close quarters, the essential action is to minimize the relative cross-sectional areas of each aircraft. Under these circumstances, it has been generally found that any application of bank will increase the relative cross-sectional area and thereby increase the probability of impact. [J.L. Harris, Sr., "Avoid', The Unanalyzed Partner of 'See'", *Forum* 16, 2 (1983): 12-17.]

time. The captain had accumulated about 32 000 total flying hours, including about 17 000 hours on the Twin Otter. In the previous 48 hours, he had about 10 hours' flight time and about 23 hours' duty time. In the previous 90 days, he had 97 hours' flight time. The pilot's Twin Otter pilot proficiency check was valid until 01 May 2000. He did not have a current instrument flight rating, nor was one required for this operation.

The Twin Otter co-pilot held a valid Commercial Pilot Licence and a current aviation medical certificate. He had accumulated about 1200 total flying hours, including 60 hours on the Twin Otter. In the previous 48 hours, he had 5 hours' flight time and 12 hours' duty time. In the previous 90 days, about 60 hours of flight time were recorded. The co-pilot's Twin Otter pilot proficiency check was valid until 01 April 2001. His instrument flight rating was valid until 01 March 2001, subject to currency requirements.

This incident has been identified as an air proximity event. No conditions were identified that would have interfered with normal aircraft operation. Technical examinations of the aircraft and their components were therefore not carried out.

The Nav Canada Area Control Centre in Vancouver is responsible for providing air traffic control (ATC) services in the airspace where this event occurred. Sometime before the day shift started at 0630, the midnight duty shift manager was advised that two controllers would not be present for their shifts.<sup>2</sup> The shift manager therefore revised the day shift schedule and decided not to withdraw a controller from a scheduled training course in the building that day. The revised schedule ensured that at least three people would be on shift at any given time; the original schedule called for three to six people at various times throughout the day. To mitigate the staffing and workload problem, traffic restrictions were placed in effect that would limit the number of instrument flight rules (IFR) training aircraft to two within the combined YYJ/YCD sectors until 1000. A fourth controller was not scheduled to arrive until 1015.

At 0630, the YYJ terminal controller, who was the acting shift supervisor, arrived and performed a functions review, which included a staffing-level assessment. He also reviewed the traffic restrictions that were in effect. The shift supervisor mistakenly believed that a fourth controller would arrive at 1000 rather than at 1015 as scheduled (due to minimum rest requirements). The shift supervisor must ensure adequate staffing levels, so he discussed the situation with the other two controllers on duty at 0630. They considered the traffic restrictions already in place to mitigate the staffing situation and decided to proceed with the current plan. Consequently, as of 0700, the unit would have three controllers on shift (including the shift supervisor) when four were scheduled, and as of 0900, the unit would still have three controllers on shift when five were scheduled.

If a shift supervisor feels that the staffing level is inadequate, he/she must report the concerns to the duty shift manager and attempt to resolve the issue. At 0700, a qualified controller reported to work to sign in, as normal, before going elsewhere in the building for his training course. Because of the shortage of staff, the shift supervisor requested this controller to withdraw from the training course and work a control position. The request was denied by the midnight shift manager, who was still present although he was not the current duty shift manager. The current duty shift manager was not notified of the request, and the request was not repeated. After 0900, the unit was staffed with three controllers when five were originally scheduled. The established relief break routine continued, with each controller working for about one hour and then taking a break of about 30 minutes.

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

At 1000, four events occurred: one controller was on a break, leaving two controllers active, in accordance with the established routine; the fourth controller did not arrive as expected (mistakenly) by the shift supervisor; the traffic restrictions ended, as planned; and the normal IFR traffic workload and complexity was increasing.

Sometime between 1000 and 1015, the shift supervisor expressed his concern to his colleague about the late arrival of the fourth controller. It was at this time that he became aware that the fourth controller was not scheduled until 1015. Although the workload was increasing, the shift supervisor did not recall the third controller from his break to assist, nor did he exercise other options to control his workload, such as requesting tower controllers in Victoria and Vancouver to reduce their departure rates for aircraft proceeding into his airspace, cancelling the provision of radar service to training aircraft at Nanaimo, or cancelling radar service to VFR aircraft already in his airspace and directing them to descend below the floor of the YYJ VFR traffic advisory (VTA).

A search of the TSB database identified 40 Air Traffic Services-related investigations between 1990 and 2000 in which the shift supervisor was working a control position at the time of the occurrence.

At 1009, the YYJ terminal controller was contacted by the Cessna pilot. In the process of radar identifying the aircraft, the controller recorded the time, aircraft registration, aircraft type, destination, route, and altitude on the "VFR Traffic Record". At about 1010, the YYJ terminal controller was contacted by the Twin Otter pilot, who was about 10 nm south of Vancouver International Airport. The controller recorded the same information for the Twin Otter as for the Cessna on the same traffic record sheet. He did not make any notation to serve as a reminder that these aircraft required further attention.

At 1015, the fourth controller arrived in accordance with the revised schedule. The shift supervisor requested the arriving controller to take over the YYJ VTA sector so that he (the shift supervisor) could focus on the IFR traffic at Victoria and Nanaimo. The combined YYJ terminal position was busy at the time, and the prescribed handoff briefing could not be coordinated or completed. The arriving controller began the equipment transfer process to open the VTA position, intending to accept VTA traffic from the shift supervisor as he was able to hand off control of each aircraft. The arriving controller was just taking his position at 1018 when he received an advisory transmission from the Cessna pilot, who had to descend because of a Twin Otter. The shift supervisor did not hear the transmission from the Cessna because he was no longer monitoring the VTA frequency. No traffic advisories were directed to any of the aircraft involved in the occurrence.

The YYJ terminal controller was also serving as the acting shift supervisor for the Victoria terminal complex. He held a valid ATC licence and had qualified in the Victoria complex of the Vancouver Area Control Centre in 1996. He was working his sixth day shift after six days off. In the previous 48 hours, he had worked 8.5 hours each day and had finished at 1500 on the day before the occurrence. Records indicate that he had not received training to work in a supervisory capacity, nor is such training provided. On the day of the occurrence, his day shift as the acting shift supervisor began at 0630. The controller was working an equal share of the time with other controllers in an active control position, which is reported to be a normal situation. Before the incident time of 1018, the controller had been on duty for 3 hours 48 minutes. The personnel utilization record shows that the controller had taken two breaks; however, he could not recall having taken a break.

Canadian airspace is divided into seven classes, one of which is Class C airspace. The airspace may be divided further into different types of controlled airspace, one of which is the terminal control area (TCA). A TCA is established at high-traffic airports to provide a control service. TCA operating rules are established by the classification of the airspace within the TCA. *Aeronautical Information Publication* (AIP), section RAC (Rules of the Air and Air Traffic Services) 2.8.3, describes Class C airspace:

Class C airspace is a controlled airspace within which both IFR and VFR flights are permitted, but VFR flights require a clearance from ATC to enter. ATC separation is provided between all aircraft operating under IFR and, as necessary to resolve possible conflicts, between VFR and IFR aircraft. Aircraft will be provided with traffic information. Conflict resolution will be provided, upon request, after VFR aircraft is provided with traffic information.

AIP, section RAC 2.5.1, states:

... the “see and be seen” principle of VFR separation cannot always provide positive separation. Accordingly, in certain airspace and at certain altitudes VFR flight is either prohibited or subject to specific restrictions prior to entry and during flight.

This incident occurred within the Victoria TCA, which is designated as Class C airspace. Within this airspace, ATC is obligated to provide traffic advisory information to assist pilots in seeing and avoiding other aircraft to minimize the risk of conflict or collision.

Radar is the primary tool used by controllers in the Victoria TCA to monitor traffic and ensure that adequate separation is maintained between IFR aircraft. It is also used to determine when traffic advisories are required to prevent conflicts involving VFR aircraft. Radar by itself may not provide enough information to the controller to highlight potential aircraft conflicts under all circumstances. Other tools that help controllers maintain situational awareness of aircraft traffic include flight progress strip marking and handling procedures, progress strip board design and management, and various radar display tools and scanning techniques.

In *Air Traffic Services Bulletin* #ATSI-8709, Nav Canada recommends “cocking of flight progress strips” to serve as reminders of flights that require further attention. In this procedure, controllers lift (cock) one end of an individual plastic holder so that it protrudes above the others. These holders, stacked in order on a slanted board, each contain a strip of paper with a record of data pertaining to an IFR flight. Flight progress strips, however, are not used in the Victoria terminal complex for tracking VFR flights. Rather, the “VFR Traffic Record”, a separate single sheet of paper, is used to record VFR traffic. Interviews of controllers did not reveal a common or recommended procedure used on this record for tracking flights in a continually changing environment or for identifying flights that require further attention.

## *Analysis*

Weather, aircraft mechanical defects, ATC equipment, and participants' medical conditions are not considered to have contributed to this occurrence. The investigation focused on why the conflict between the Cessna and Twin Otter was not detected and resolved and why the pilots did not see each other in sufficient time to prevent a conflict.

ATC is obligated to provide traffic information to aircraft operating within Class C airspace, but pilots operating under VFR are also required to visually scan for other traffic. However, the "see and be seen" principle has known limitations. There was no ATC traffic advisory broadcast to either aircraft, and both were on VFR flight plans. Therefore, both crews had to rely solely on the "see and be seen" principle to avoid conflicts. Aircraft equipped with TCAS would likely have detected this conflict and allowed the pilots to take action earlier. Because of the proximity and the tracks of the aircraft, it is likely that the Cessna pilot's visual acquisition of the Twin Otter and his evasive action of a wings-level, straight-ahead descent prevented a midair collision.

A sequence of events in the Victoria terminal complex, involving numerous decisions, resulted in the undetected conflict between the Cessna and the Twin Otter. Because an area control centre is a very fluid and dynamic environment, attempting to match staffing levels with a fluctuating and at times unpredictable workload can be very challenging. When revising the day shift schedule, the midnight duty shift manager placed a high degree of importance on completing the training scheduled for one controller. To mitigate the risk of the known staffing shortage, he also imposed traffic restrictions on the sector airspace until 1000; however, this was 15 minutes short of the scheduled arrival time of the fourth controller. Although the shift supervisor accepted the revised scheduling plan, including the traffic restrictions, a lack of confidence in the plan became evident when, within 30 minutes, he requested the assistance of the controller scheduled for training. When his request was denied, he made no further attempt to address his concerns, nor did the shift manager. Had the shift supervisor been performing supervisory functions, the risk of an event taking place would have been reduced.

Between 1000 and 1018, the workload of the YYJ terminal controller increased substantially because of the normal increase in IFR traffic. The concentration of the controller / acting shift supervisor may have been affected by the perceived late arrival of the fourth controller, while he was already shorthanded, and the knowledge that traffic restrictions were no longer in effect. Recognizing when to open or close sectors is an important aspect of the supervisory role, yet for undetermined reasons, an available controller was not recalled from a break to open the YYJ VTA sector. *Squawk 7700 Safety Bulletin*, published by Nav Canada, states in issue 9401 that investigations have found that the untimely opening and closing of control sectors has contributed to subsequent operating irregularities. The supervisor must always remain attentive to the workload to ensure that the sector does not become overloaded, and another control position should be prepared so that immediate action can be taken to open a sector.

When the controller radar identified the Twin Otter, he did not perceive a conflict with the Cessna. He therefore did not integrate this information into his plan. The "VFR Traffic Record" did not provide an adequate reminder to supplement his radar-scanning technique. The controller did not employ any methods to control his workload (such as holding aircraft on the ground), and by 1015, his attention was divided among numerous tasks. Because of his workload, he was unable to complete the handoff briefing to the fourth controller, who had arrived at his scheduled start time.

### *Findings as to Causes and Contributing Factors*

1. The pilots of the two aircraft did not see each other in time to prevent the conflict.
2. Traffic advisories concerning a possible conflict were not passed to the Cessna or the Twin Otter.
3. The Cessna's flight path was not considered when the controller radar identified and approved the Twin Otter's route and altitude.
4. The controller did not detect the conflict. His attention was divided among numerous tasks, including shift supervision, which likely caused his radar-scanning technique to deteriorate.

### *Findings as to Risk*

1. Traffic restrictions were put in place to mitigate the Victoria terminal staffing situation. However, these restrictions terminated 15 minutes before the fourth controller was scheduled to arrive.
2. At the time of the occurrence, the Victoria terminal complex was operating with three controllers (one of whom was on a break) when five were scheduled.
3. The Victoria visual flight rules (VFR) traffic advisory (VTA) sector was not opened in a timely manner.
4. By 1015, the Victoria terminal airspace controller's workload had increased substantially. None of the available methods to control his increasing workload was employed.
5. Available conflict-identification tools were not employed as a defence to supplement the controller's radar-scanning technique.
6. By 1015, the controller was task saturated and was unable to complete the prescribed handoff briefing to the new controller.

### *Other Findings*

1. Both incident aircraft were equipped with transponders; however, neither aircraft was equipped with a traffic alert and collision-avoidance system (TCAS). A TCAS would probably have alerted both pilots to the conflict.
2. The Victoria terminal complex does not have established procedures to identify traffic conflicts on the "VFR Traffic Record".

3. Nav Canada training records indicate that the shift supervisor had not received training to perform the supervisory role.

*This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 21 June 2001.*

*Appendix A—Area of Conflict*

