بسم الله الرحمن الرحيم

ACCIDENT INVESTIGATION COORDINATING COMMITTTEE

ACCIDENT REPORT ON 8Q-TMD

(Twin Otter crash at Maadhiggaru Falhu, South Male' Atoll, Maldives on 11th July 2011)

Operator: **Trans Maldivian Airways**
Manufacturer: **De Havilland (Canadian)**
Model: **DHC-6-300 (Floatplane – Wipaire 13000)**

INTRODUCTION

Maldives is a signatory to the Convention on International Civil Aviation (Chicago 1944) which established the International Civil Aviation Organisation. Article 26 of the Chicago Convention obligates the conduct of accident investigation of civil aircraft to the state of occurrence.

The Accident Investigation Coordinating Committee (AICC) is vested with the responsibility of the obligations of Article 26 and therefore this accident was investigated by the AICC with assistance of the technical the staff of the Civil Aviation Department (CAD).

The Accident was notified to CAD at 0920 hrs (LT) by Trans Maldivian Airways. ICAO, Viking, Wipaire, TSB and Transport Canada was notified by CAD. The Accident Investigating Coordinating Committee reached the accident site at 1500 hrs. The flight time from Male' International Airport to Maadhiggaru Falhu is approximately 10 minutes.

In accordance with Annex 13 to Convention on International Civil Aviation, it was not the purpose of this investigation to apportion blame or liability. The sole objective of this investigation and the Final Report is to prevent accidents and incidents.

Unless otherwise stated, recommendations in this report are addressed to the CAD. It is CAD who will decide on implementation.

All times in this report are in Local Time unless otherwise stated. Time Difference between Local and UTC is +5 hrs.

The report is released on 25 December 2011.

Mr. Abdul Razzak Idris, Chairperson
Accident Investigation Coordinating Committee

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List of Abbreviations

AICC	:	Accident Investigation Coordinating Committee
C of A	:	Certificate of Airworthiness
C of R	:	Certificate of renewal
CAD	:	Civil Aviation Department
CAR	:	Civil Aviation Regulation
CVR	:	Cockpit Voice Recorder
ICAO	:	International Civil Aviation Organization
LH	:	Left hand
LT	:	Local time
MAR	:	Maldivian Airworthiness Requirements
MAT	:	Maldivian Air Taxi Pvt. Ltd
MCAR	:	Maldivian Civil Aviation Regulation
MEL	:	Minimum Equipment List
MTOW	:	Maximum takeoff weight
PIC	:	Pilot in command
PROP	:	Propeller
RH	:	Right hand
SIC	:	Second in command
VFR	:	Visual Flight Rules

Synopsis

The 8Q-TMD aircraft took-off from water runway of Male' International Airport North Bound Left (NL) at 0820 hrs local time on 11 July 2011 for a routine training flight bound to Maadhiggaru Falhu (a lagoon located approximately 15 nautical miles south west of the Male' International Airport). The sky was clear with good visibility and wind 8-10 knots from west and south west.

During the training 5 landings and take-offs were made simulating different conditions of flight. Crew confirmed that all these landings and take-offs were made inside the lagoon except the last landing where the crew decided to land on open water outside the lagoon. Crew were simulating single engine landing with a tail wind.

As per the crew, the aircraft initial touch down was smooth. However, they stroke a wave which made the aircraft bounce up for about 20 feet. With the low power the aircraft hit the water again, resulting in multiple float attachments to break. Both front and main spreader bars broke and floats rose up twisted, hitting the engine bottom cowlings. Propeller cut was found on top front of both floats.

The investigation identified the following causal factor(s):

Impact with a high swell during landing followed by a high bounce and hard landing resulting in both float attachments being damaged and detached with major structural damages. Major contributing factor was higher than normal touch down speed due to abnormal landing configuration.

1. FACTUAL INFORMATION

Operator:	Trans Maldivian Airways Pvt. Ltd. (Maldivian Air Operator Certificate Holder No.001)
Aircraft Type:	DHC6-300 (on Wipline floats)
Aircraft Manufacturer:	De Havilland
Aircraft Owner:	Trans Maldivian Airways
Nationality:	Maldivian registered
Registration:	8Q-TMD
Place of Accident:	Maadhiggaru Falhu, South Male' Atoll
Date and Time:	11 July 2011 09:10 hrs**.**

1.1 History of Flight.

On the 11th of July 2011 TMA flight 201A (8Q-TMD) took-off from North bound left at 08:20hrs for annual re-current training flight. There were no passengers or a cabin crew on board the aircraft. The crew was given one-hour block time to return back to MLE as both pilots were scheduled to do a commercial flight at 930 hrs.

The sky was clear with good visibility. Wind was from West and Southwest direction with 8-10 knots.

A number of training drills were carried out over the training lagoon, which included steep turns, stalls, high speed decent and a rejected takeoff. As a final maneuver of the training, the captain gave a simulated single engine landing. Power was reduced on RH engine to simulate this exercise.

At three hundred feet on final approach to land on easterly direction the copilot called full flaps and propellers full fine followed by before landing checklist. After completing the checklist, the Captain told the copilot the area chosen to land even though it was outside the lagoon in the deep waters, it was clear for landing.

According to the crew, Initial touchdown of the airplane on water was smooth but a wave passed underneath the floats making the airplane bounce approximately 20 feet above water. Airplane was high above water at very low airspeed, and the aircraft banked to the right. Co-pilot immediately corrected and banked the airplane to the left. Left hand float touched the water hard which made some of the supporting attachments to the fuselage to break. The

impact resulted in the airplane to bounce back and turned to the right hand side and broke some of the supporting struts on the right hand side as well. Following that, airplane pivoted to right hand side where wind was blowing. It was approximately 0915 hrs local time.

The captain immediately cut both the fuel levers when the airplane came to a complete halt. When the crew analyzed the situation, they found both floats have flipped ninety degrees outwards and the engine cowlings were resting on sideways of the floats. The propellers have shredded the floats more deeply on the right side.

The accident was notified to TMA base immediately. CAD and AICC were informed by the Quality and Safety Manager at 0935 hrs.

Investigation Team was able to reach the site at 1500 hrs

1.2 Injury to persons

Injuries	***Crew***	***Passengers***	***Total in the aircraft***	***others***
Fatal	0	0	**0**	**NIL**
Serious	0	0	**0**	**NIL**
Minor	0	0	**0**	**NIL**
None	**2**	**0**	**2**	**NIL**
Total	**2**	**0**	**2**	**NIL**

1.3 Damages to aircraft

Both LH and RH Float was almost detached from the aircraft and twisted with a cut out formed on the forward of the floats by propellers (appendix 1). Both LH and RH wing struts were bent (appendix 2). Blade tips on both propellers were bent and some part torn off (appendix 3). RH forward step and RH rear stem were detached from aircraft and found near the aircraft wreckage.

Substantial damaged was done to the aircraft due the fact that it was on the reef half submerged for almost three days (appendix 4). Further damage was caused during the salvage operation (appendix 5)

1.4 Other damage

No other damage reported.

1.5 Personnel information

1.5.1 Captain –

Age:	34
Nationality:	Maldivian
Gender:	Male
Type of Licence:	Airline Transport Pilot Licence (Aeroplanes)
Medical issued on:	10 September 2010
Medical expires on:	10 September 2012
Type of medical:	Class 1
Licence initial issued on:	13 October 2005
Licence expires on:	13 October 2011
Types flown:	DHC-6 (on Maldivian licence)
Hours on type:	5470
Ratings:	DHC-6 Float Plane
Last Proficiency check:	22 May 2011
Total hours as PIC:	3387
Total flight time:	5732

1.5.2 Co-pilot –

Age:	44
Nationality:	Sri Lankan
Gender:	Male
Type of Licence:	Commercial Pilot Licence (Aeroplanes)
Medical issued on:	01 December 2010
Medical expires on:	31 December 2011
Type of medical:	Class 1
Licence issued on:	3 January 2010
Licence expires on:	3 January 2012
Types flown:	DHC-6 (on Maldivian Licence)
Hours on type:	2450
Ratings:	DHC-6 Float Plane
Last Proficiency check:	19 January 2011
Total hours as SIC:	2650
Total flight time:	2650

1.6 Aircraft information

1.6.1 General information –

Aircraft manufacturer:	De-Havilland of Canada
Model:	DHC-6-300 Twin Otter
Serial number:	530

Year of manufacture:	1977
Nationality:	Maldivian registration number CR-166
Registration marks:	8Q-TMD
Validity of C of R:	Perpetual
Validity of C of A:	Perpetual
Validity of ARC:	10 June 2012
Name of owner:	Hummingbird Island Airlines
Name of operator:	Trans Maldivian Airways Pvt Ltd.

1.6.2 Aircraft History –

Total flying hours since: -

- Manufacture:	34746.1 hrs
- Last periodic inspection:	122. 5 hrs

Total Flight cycles: 62428

Last inspection carried out at TAT: 34623.6 hrs (EMMA #32) on 30 May 2011

1.6.3 Engines and propellers –

Right engine:

Manufacturer:	Pratt & Whitney (Canada)
Year of manufacture:	May 1975
Model:	PT6A-27
Serial number:	PCE40405
Total Hours since new:	31559.9
Last overhaul date:	05 May 2010
Hours since overhaul:	1268.9
Last check carried out:	EMMA #32
Hours since last check:	122.5 hrs

Left engine:

Manufacturer:	Pratt & Whitney (Canada)
Year of manufacture:	1976
Model:	PT6A-27
Serial number:	PCE51058
Total Hours since new:	8175.6
Last overhaul date:	01 Jun 2010
Hours since overhaul:	244.1
Last check carried out:	EMMA #32
Hours since last check:	122.5 hrs

Right propeller:

Manufacturer:	Hartzell Propellers Inc
Year of manufacture:	Aug 1984
Model:	HC-B3TN-3D
Serial number:	BUA25309
Last overhaul date:	16 Jun 2010
Hours since overhaul:	1102.3
Last check carried out:	EMMA#32

Left propeller:

Manufacturer:	Hartzell Propellers Inc
Year of manufacture:	November 1996
Model:	HC-B3TN-3D
Serial number:	BUA19567
Last overhaul date:	16 Mar 2011
Hours since overhaul:	348.7
Last check carried out:	EMMA#32

1.6.4 Fuel –

Type of fuel used:	Jet A1
Amount of fuel on board:	1200 lbs

1.6.5 Accessories – No Component failed.

1.6.6 Defects – NIL

1.6.7 Aircraft load –

Certified take-off mass:	12,500 lbs
Certified landing mass:	12,500 lbs
Take-off mass as per load sheet:	9687 lbs

1.7 Meteorological information

The meteorological condition at and around the Maadhiggaru Falhu area, according to the meteorological department at 1500hrs local time was as follows:

Wind 270/12 KT, Visibility 10km, clouds scattered at 1800 and, temperature 29 deg C dew point 24 QNH 1011mb. The accident occurred during daylight at about 0915 hrs local time.

1.8 Aids to navigation

No navigational aids were available at the site of landing. The aircraft was operating under VFR condition. Navigational aids were not a contributing factor of the accident.

1.9 Communications

Two VHF sets COM1 and COM2 were both serviceable at the time of departure. No communication problem was reported.

1.10 Aerodrome information

The area was a training area located at Maadhiggaru Falhu. The position of aircraft when AICC arrived was N 040053 E 732259.

1.11 Flight Recorders

The aircraft was not fitted with any flight recorders and none was required by the regulation. (The aircraft is type certified below the weight category 5700kg; Refer MAR Series-C9, 4.2)

1.12 Wreckage and impact information

The Accident was notified to CAD at 0935 hrs (LT) by Trans Maldivian Airways. Accident Investigating Coordinating Committee (AICC) members left Male' International Airport at 1430 hrs and reached Accident site at 1500 hrs. The flight time from Male International Airport to Maadhiggaru Falhu was approximately 20 minutes.

1.13 Medical and pathological information

Examinations were performed on all the crew of the aircraft. There was no evidence of any pre-existing disease, alcohol, drugs or any toxic substance in either of the pilots which may have caused or contributed to the cause of the accident.

1.14 Fire

There was no evidence of fire before or after impact.

1.15 Survival Aspect

Aircraft drifted to East and came to a halt on the reef. As the aircraft started taking in water and slowly sinking, the crew put on life jackets and got on the roof.

Some amount of fuel leaked to the sea from the aircraft.

A rescue team from TMA and Coast Guard helped to secure the aircraft to the reef to a void further drifting. Crew were brought back to base on a second rescue flight.

1.16 Tests and research

Some selected structural parts (eg: Front and main spreader bars) of the aircraft and the float attachments were sent to a laboratory for material testing for fatigue failures (Appendix 8).

1.17 Organizational and management information

The company is a Civil Aviation Department (CAD) approved Air Operator Certificate holder (AOC 001). Regular inspections and periodical flight checks were conducted on the company and crew respectively by CAD to verify compliance and competency. The company had undergone a Cockpit and Cabin En-route check on 14th April 2010. MCAR-145 and CAMO audit was carried out on 20th -24th April 2011.

1.18 Additional Information

None

1.19 Useful or Effective Investigation Techniques

After the accident, the flight crew had a medical check-up done at AMDC Clinic. Urine was tested for narcotics and the results were negative.

2. ANALYSIS

Interviews with the crewmembers were carried out and these were compared with the actual damage to the aircraft. Engineers damage analysis reports and photographs were analysed to identify the actual damage as there were secondary damage on aircraft due to current, waves and the reef (appendix 5). Also more damage occurred during the salvage operation.

The company did a metallurgy investigation on several parts of the airplane. Analysis report states "no obvious indications of fatigue or other pre-existing crack were visible" (Appendix 8).

No CVR or FDR installed in the aircraft as it was exempted by the regulation.

3. CONCLUSIONS

(a) Findings

- Both pilots were qualified, experienced, adequately rested and medically fit to conduct the flight.
- This flight was the third (annual recurrent) training flight conducted by the captain.
- The aircraft was within the certified weight limitations for both take–off and landing.
- The aircraft was released serviceable.
- There was time pressure to get back to do two different commercial flights for both pilots. Both departures were scheduled at 0930hrs. The captain did not know about the commercial flight until he came to work that morning (The additional flight was due to a reported sick leave of another captain).
- On the final leg of the training flight, the aircraft landed tail wind, with a simulated single engine, into the channel outside of the reef.

- As per the wreckage pictures, the flap selector was set to zero flaps and the flap angle indicator showed zero flaps (appendix 6). Some of the external photos taken by crewmembers while the aircraft was drifting also shows the flap was at zero position.
- As per the metallurgy report, no obvious indications of fatigue or other pre-existing crack were visible. These factors are suggestive of an overload failure indicating that the load experienced during the incident exceeded the strength of the materials. (Appendix 8)

(b) Causal Factor(s)

AICC determines that the probable cause(s) of the accident to be:

Impact with a high swell during landing followed by a high bounce and hard landing resulting in both float attachments being damaged and detached with major structural damages. Major contributing factor was higher than normal touch down speed due to abnormal landing configuration.

(c) Other Contributing Factors

- Selection of inappropriate landing site (channel) and landing direction (tail wind) based on surface conditions present at that time.
- Simulation of multiple emergencies.
- Abnormal landing configuration (flaps at zero) for single engine landing.
- Time pressure to complete the training and return to commercial operations.

4. RECOMMENDATIONS

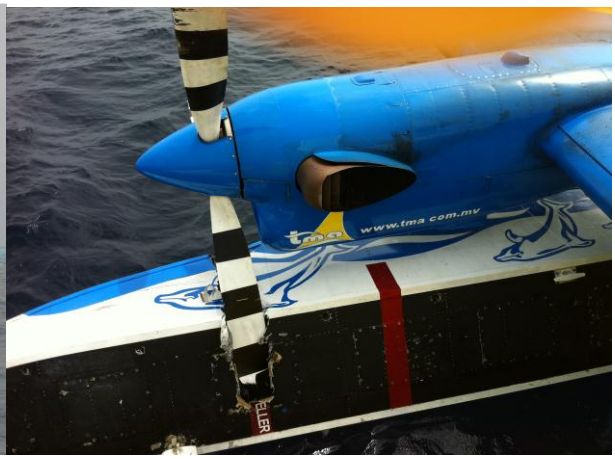
- Operator to review the training SOPs on single engine operations and emergencies.
- DHC-6 Twin Otter Full Flight Simulator (FFS) training is to be given to all Type Rating Instructors (TRI) and Type Rating Examiners (TRE).
- Civil Aviation Department to formally designate flight training areas
- Adequate time to be allocated for debriefing and review between training flights and commercial flights for instructors and crew involved.
- Proper planning of all the manoeuvres to meet the requirements of the training flight and the time allocated.
- No multiple emergencies to be simulated simultaneously on training flights.

Report compiled by:
Accident Investigation Coordinating Committee
Date: 25 December 2011

5. APPENDICES

Appendix 1

Both floats almost detached from aircraft and twisted



Propeller cut on right float

Appendix 2

RH wing strut damaged

LH wing strut damaged

Appendix 3

RH Propeller blades bent and some parts worn off

LH propeller blade damage

Appendix 4

Aircraft half submerged (on the day of accident)

Aircraft half submerged (after 2 days of accident)

Appendix 5

Secondary damage by current, reef and waves

Damage during salvage operation

Appendix 6

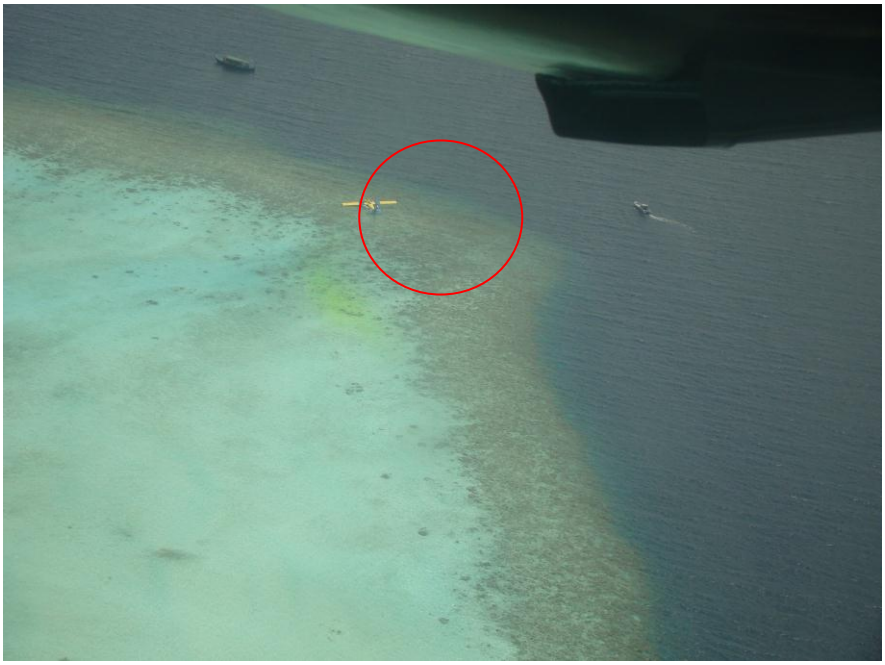
Flap selector shows zero flaps

Aircraft Flap position at zero
(before the rescue team arrived)

Appendix 7

7.1 Location Map showing the wreckage

7.2 Arial view of the accident site



Appendix 8

Conclusion of Metallurgy report

All fractures were observed on the parts received and were judged to be macroscopically ductile. No obvious indications of fatigue or other pre-existing cracks were visible. Seven fractures were removed and observed with a scanning electron microscope. One surface was contaminated and could not be used. Of the other six fractures two had mostly ductile features and four had a mix of ductile and brittle features. These factors are suggestive of an overload failure indicating that the load experienced during the incident exceeded the strength of the materials. The mechanical, chemical and microstructural properties are considered adequate for the application. It was not possible to distinguish corrosion that may have been on the fracture surface before the final failure from corrosion products that formed after the final failure due to exposure to the surrounding sea. To improve this condition will require using a stronger material, thicker parts or avoiding such overload occurrences.

END OF REPORT