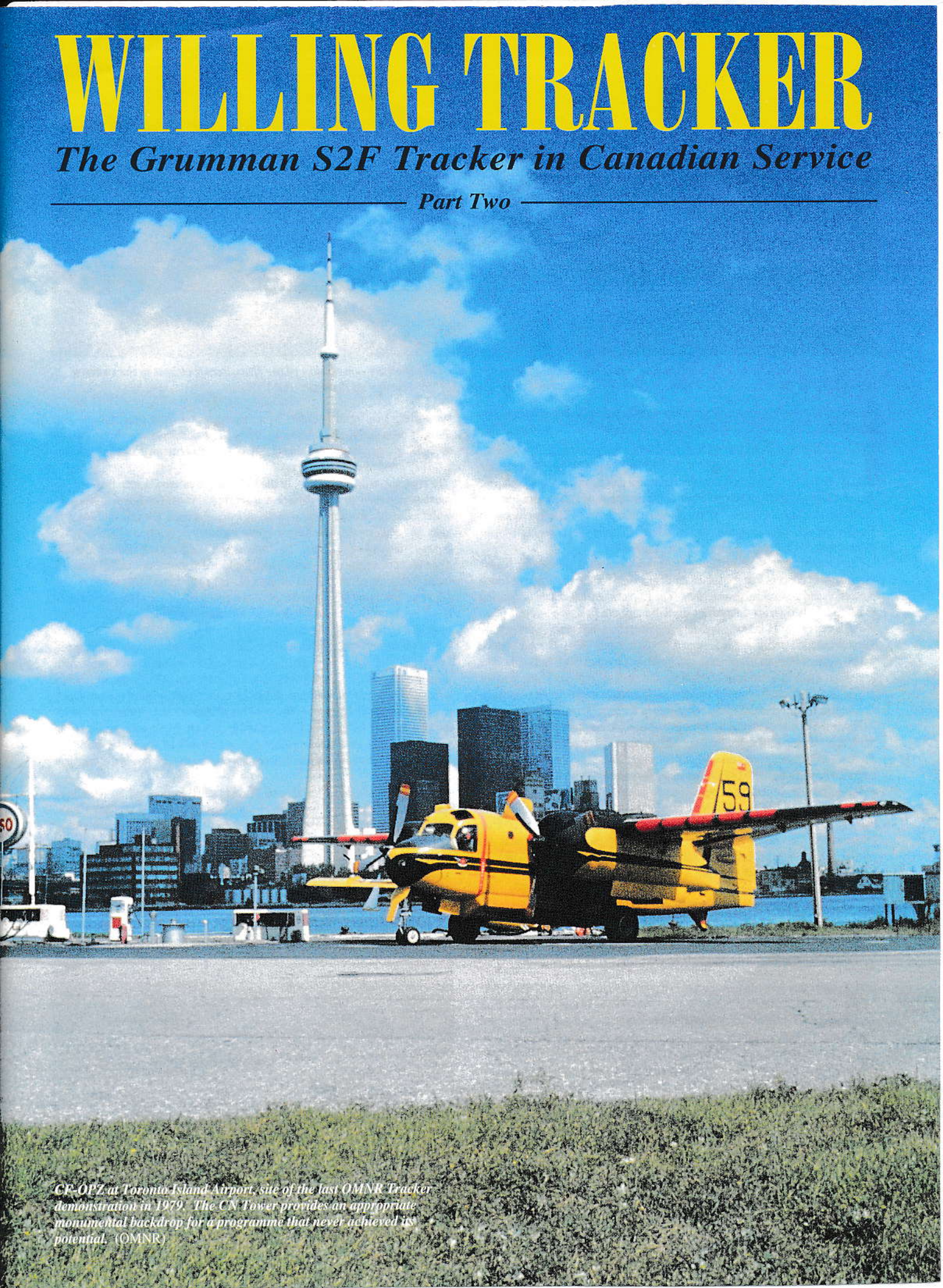
WILLING TRACKER

The Grumman S2F Tracker in Canadian Service

Part Two



CF-OFZ at Toronto Island Airport, site of the last OMNR Tracker demonstration in 1979. The CN Tower provides an appropriate monumental backdrop for a programme that never achieved its potential. (OMNR)

Line-up of the full OMNR Tracker fleet at Sault Ste Marie in the spring of 1973 following conversion of the five aircraft closest to the camera (CF-OPU, 'V, 'W, 'X and 'Y). Proof-of-concept conversion CF-OPZ (tanker '59') brings up the rear. (OMNR)

Robert M Stitt

LIKE MOST REGIONS of Canada, the province of Ontario experiences a large number of wildfires each summer, losing an average of 495 acres (200,000 hectares) of forest and bush land to 1,900 fires. The Forestry Branch of the provincial Department of Lands and Forests contracted the first use of aircraft for forest protection in 1922. when it leased Curtiss HS-2L flying-boats (or 'H-boats' as they were known) from Laurentide Air Service of Grand Mere, Quebec.

The Department was sufficiently impressed with the aerial forest management concept that it issued a tender in 1924 for the provision of forest protection and general survey services. The Department subsequently decided to establish its own air operations division and the first two aircraft of an initial batch of 13 'H-boats' were duly delivered by Laurentide to the newly-formed Ontario Provincial Air Service (OPAS) in April 1924. The Air Service began hiring pilots and engineers and building the necessary infrastructure to support the fleet, including a central base located at Sault Ste Marie (known as *The Soo*), thus establishing an era of water-based forest protection operations in Ontario that continues to this day.

OPAS went on to operate a wide variety of water-borne types. Two Loening Air Yachts were added to the fleet in 1925 and up to 14 de Havilland DH.60X Moths were on strength by the end of the 1920s. The early fleet also included two de Havilland D.H.61 Giant Moths that were used for forest dusting; a Canadian-designed Vickers Vedette amphibian which undertook photographic missions; plus four all-metal Hamilton H-47 seaplanes, two Fairchild 71-Cs and a Fairchild KR-34. Perhaps the Service's most enduring contribution to the development of the bushplane industry was its participation with de Havilland Aircraft of Canada (DHC) in the design definition of the DHC-2 Beaver.

Bombing Fires

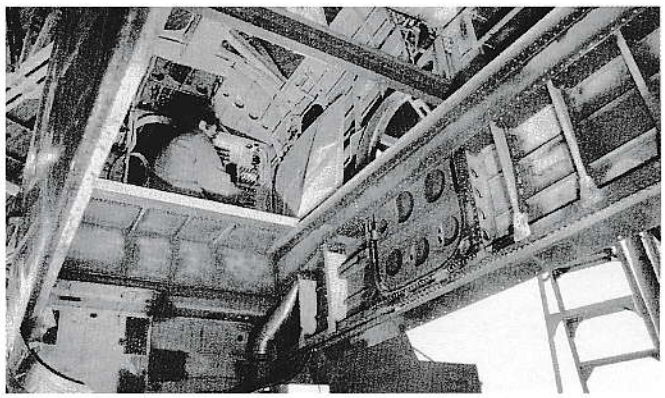
Meanwhile, back in 1944, a casual conversation between North Bay forester Pete Marchildon and OPAS pilot Carl Crossley was to result in a whole new concept for aerial forest protection. Crossley mused that there might be a way to bomb fires the same way that strategic points such as bridges were being bombed in Europe. If a fire in a hard-to-reach spot could be attacked from the air while it was still small, it could perhaps be suppressed until ground crews arrived to put it out. Crossley spent the winter designing a scoop and drop system for a Noorduyn Norseman floatplane and went on to successfully demonstrate the concept on a lightning-caused fire in August 1945, the first recorded use of a 'water-bomber'.

Despite the promise of Crossley's initiative, it was to be 1957 before Air Service pilot Tom Cooke resurrected the water-bombing concept by adding open tanks to the top of each float on an Otter. Each tank contained 80 Imp gal (363 litre) and was filled by probes as the aircraft planed across a water surface; the tanks were counterbalanced to return to the upright position after a drop. The Air Service subsequently adopted the concept for all its Otters and Beavers, the Otters later being fitted with a 210 Imp gal (954 litre) belly tank. In 1965 the Air Service equipped its Turbo Beavers with internal float tanks totalling 140 Imp gal (636 litre) and later added a similar system to its new Twin Otters. The Air Service achieved great success in supporting fire-fighting crews by scooping water from nearby lakes and making repeated fire suppressing drops. The concept came to be known as 'gallons-per-hour' or 'direct attack' and went on to revolutionise wildfire control in many parts of Canada.

In contrast, wildfire control in the USA and western Canada had, for the most-part, taken a very different direction. With far fewer bodies of water available from which to make repetitive scoops, the forest protection agencies and private speciality aviation industry developed a different fire containment system called the 'one strike' concept or 'initial attack'. This system employed strategically placed groups of land-based air tankers equipped to deliver chemical fire retardants. As soon as the forest service identified a new wildfire that could not be controlled by ground-based resources, it would dispatch sufficient aircraft to contain the fire, ideally with one round of retardant.

Though critics argued that land-based aircraft were sometimes handicapped by having to return to the nearest base to reload, the advantages of this system were that the valuable aircraft were able to quickly and more positively contain a fire with a retardant barrier and then be back on the ground sooner, ready to control the next outbreak. The land-based aircraft also offered the ability to complement the use of water-scooping aircraft, by flying directly to the fire and laying down a retardant fire guard while the water-bombers located a suitable water surface before suppressing the fire inside the retardant line.

It was Department of Lands and Forests staff, impressed by what they had learned during fire management courses in the US in the late 1960s, who first promoted the idea of adding land-based aircraft with retardant delivery capability to Ontario's fire control system. The regional and district fire fighters, with their strong water-based fire suppression background, were less enthusiastic about the new concept but the decision was made to proceed and the Department began negotiations with the Federal Government's Crown Assets Disposal Corporation to acquire a surplus Canadian Armed Forces Tracker for trials.



The gutted interior of a Tracker during reconfiguration to a Firecat. The retardant tank support frame is visible part way up the opening while the profile of the original port-side torpedo bay can be seen to the lower left. (Conair)

 Note: Line 3 should read "495,000 acres".

Assessing the Tracker

When it became known that ten CAF Trackers were available for disposal, the Associate Committee on Agriculture and Forestry Aviation of the National Research Council of Canada established a task force to report on the Tracker's suitability for both wildfire control and forest spraying. The team consisted of representatives from the National Aeronautical Establishment of the National Research Council, the Canadian Transport Commission, the Ministry of Transport, Canadian International Paper Co and Hicks and Lawrence Ltd.

The task force conducted a very thorough flight evaluation of the Tracker and identified some important wildfire control attributes including an 8,000lb (3,629kg) payload, good performance and manoeuvrability, and an excellent field of view for the pilot. Their conclusion was that the Tracker had the potential to make a very effective air tanker but also noted a number of characteristics that first needed to be considered.

From a handling perspective, the task force found that the short-coupled Tracker displayed marginal longitudinal stability and shallow longitudinal stick force gradients. To the pilot this meant that the Tracker gave little 'feel' in pitch; when displaced from a trimmed airspeed, the nose tended to stay at a particular pitch angle rather than returning to trimmed flight and trimming in pitch required considerable effort.

The team regarded stall recovery as excellent but the Tracker displayed a decrease in static longitudinal stability at low speed and high power settings, reducing the available nose-down control for pitch-up and stall recoveries. In addition, the artificial stall warning system did not provide a consistent indication of an impending stall, particularly in accelerated flight and at bank angles greater than 30°. Finally, the braking system, which Grumman had deliberately designed to be light duty for the limited use on carrier decks, tended to fade at the end of the landing roll.

However, none of these characteristics was considered to be critical to the success of the Tracker as an air tanker and Ontario's Department of Lands and Forests completed the purchase of CS2F-2 Tracker c/n DH-57, the former RCN 1558, on October 7, 1970. The aircraft received the registration CF-OPZ and was flown from storage at CFB Shearwater to the Air Service's base at Sault Ste Marie for conversion to the world's first Tracker air tanker.

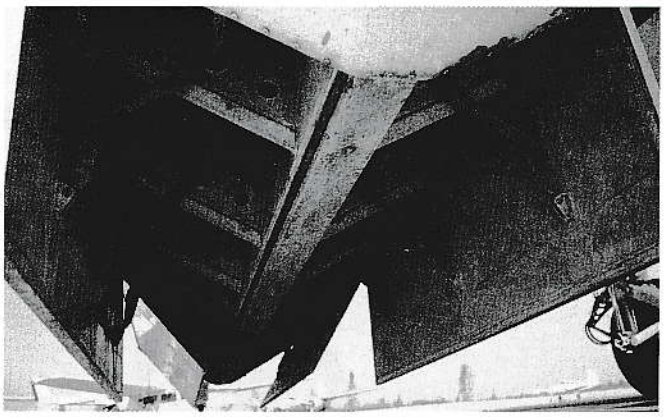
Tracker Ups and Downs

The Department retained Field Aviation of Toronto to design and certify the Tracker's retardant delivery system. The Field team was lead by Knox Hawkshaw, a much-respected pioneer in aerial delivery technology and designer of the very successful scooping system for the PBY-5A Canso water-bomber. The Department contracted the original manufacturer, DHC, to undertake the necessary certification test flying.

The first phase of the programme was to strip the Tracker's port side torpedo bay and install a steel 'boilerplate' tank to allow an initial evaluation of centre of gravity shifts and pitch-up characteristics during the retardant drop. After first undertaking an aft centre of gravity evaluation flight in Tracker 12173, DHC's Chief Engineering Test Pilot Bob Fowler took CF-OPZ-X through the initial series of test flights at Downsview between February 25 and March 18, 1971. As expected the Tracker, with its short tail arm, displayed a firm but manageable pitch-up immediately after the drop as the wing unloaded and the horizontal stabiliser entered the low pressure area created by the descending water load.

Papa Zulu was then returned to Sault Ste Marie in the early summer for installation of a full prototype tank. At this point Air Service staff elected to lead the design work with Field completing the drawings and approvals. The Air Service did not have a lot of retardant delivery system design experience and Field eventually took back the responsibility with the Air Service constructing the system. However, the tank unfortunately had a number of deficiencies that were to plague the conversion throughout the Ontario Tracker programme.

In planning the retardant tank installation, Hawkshaw elected not to touch the Tracker's central structural keel or the floor above the port side torpedo bay. The result was a semi-recessed 800 Imp gal (3,634 litre), four-compartment system with two forward and two aft doors. A later modification featured a flow restrictor system called Fire-trac which was intended to increase the retardant coverage on the ground. The system worked very well with unthickened retardant but when the Department switched to adding a thickening agent, the Fire-trac tended to choke, resulting in an inconsistent drop pattern. As a result, the system saw very little use before being removed from service. The Air Service later added larger mainwheels to better distribute the Tracker's weight during hot summer conditions as well as to enhance braking by improving heat dissipation.



Worm's eye view of the Field Aviation 800 Imp gal (3,634 litre) retardant delivery system, developed with the Ontario Department of Lands and Forests. The wide, light-weight tank doors proved difficult to seal. (Ralph Campbell for OMNR)

Without any experience in land-based operations, the Department contracted Kenting Aviation of Toronto to manage and crew the new initial attack operation. Kenting was an executive aircraft operator that also provided speciality services such as ice patrols with a Douglas DC-4 and water-bombing services with Cansos. Kenting in turn secured the services of Alexander Linkewich, a fire control pilot with considerable initial attack experience flying Grumman TBM Avengers in British Columbia and Grumman F7F Tigercats with Sis-Q Flying Services in California.

The test programme proceeded smoothly and the Tracker was ready for grid testing of the tank system by the end of September. To complete certification, Fowler and Department of Transport test pilot Seth Grossmith (formerly with VX 10) conducted five acceptance flights between October 21 and 27, bringing the total for the programme to 77 flights. The aircraft performed well in all respects and Kenting was confident it had a long-term commitment to operate the aircraft.

The Tracker had yet to fight a fire when Linkewich and fellow Kenting pilot Bill Nash flew 'OPZ to British Columbia, demonstrating the aircraft to the BC Forest Service at Kamloops on November 6, 1971. At the time the Forest Service was contracting Grumman Avengers and newly-introduced Douglas A-26 Invaders from land-based air tanker pioneer, Conair Aviation. Conair pilots were given the opportunity to evaluate 'OPZ at Kamloops and this event was to set in motion a plan to introduce wildfire control Trackers in British Columbia. Nash then flew 'OPZ to Quebec City for a demonstration to the Quebec Air Service on November 18 after which the aircraft returned to Sault Ste Marie for additional conversion work. Shortly afterwards, the Department of Lands and Forests was renamed as the Ontario Ministry of Natural Resources (OMNR).

The Ministry established a network of retardant air tanker bases across the southern part of the province and first put Tracker 'OPZ to work in the Sudbury region of Ontario in the spring of 1972. This was the ideal location for introducing the new initial attack capability since the region did not have as many water scooping surfaces as other areas of the province. The region also had a unique wildfire control problem since accumulations of combustible sulphur from the region's nickel smelters encouraged fires to spread over bare rocky ground with an eerie blue glow.

Kenting had meanwhile acquired two A-26 Invader air tanker conversions from Arizona, CF-KBM and CF-KBZ, to form a three-aircraft initial attack group with Tracker *Papa Zulu*. The new programme got off to a shaky start when the Ministry contracted two TBM Avenger air tankers during a fire flap, an initiative that was not well received by the Air Service pilots. And then came another indication that the implementation of the programme was not going to be an easy task when the Ministry dispatched Beaver water-scoopers to the first two fires, followed by the single Tracker which shuttled between the base and the fire without the assistance of the A-26s. Kenting re-emphasised the need to send all three land-based aircraft immediately to contain the fire and the group was then able to achieve a dramatic string of successes, containing 35 consecutive new wildfires without having to return with additional retardant.

After such a promising start, the group was reduced to one A-26 and the Tracker following redeployment to the Dryden air tanker base and local fire managers again started favouring the traditional water-bombing technique. Kenting operated the Tracker for the first full season but the Ministry decided to manage the programme from 1973 onwards and cancelled the operating contract with Kenting. ►

Conair Firecat '566' delivers a load of fire-containing retardant. Full-length tank compartments produce a streamlined charge, reducing erosion during the drop (as indicated by the relatively unbroken leading edge) and resulting in better distribution around a fire. C-FOPV served with the RCN as CS2F-1 1535 and with the Ontario Ministry of Natural Resources as tanker '55'. (via Conair)

Into 'Production'

The Ministry had in the meantime acquired a further six former CAF Trackers. The Air Service converted five aircraft during the winter of 1972, the sixth aircraft being set aside as a source of spare parts, and brought the tank system in 'OPZ up to the latest configuration. From 1973 the Ministry deployed the Trackers in one group of two and one group of three, each with a Piper Aztec 'bird dog', while the sixth aircraft, 'OPZ, remained a 'rover', piloted by the Chief Pilot Wally Warner and dispatched from Sault Ste Marie to regions with a high fire hazard or used for training as required.

Not withstanding the commitment to introducing the Tracker and some early successes, the initial attack concept using retardant was never to be fully embraced by the regional and district fire personnel; unfortunately the idea had not been well introduced to the fire-fighters in the field, many of whom doubted that the new initial attack tactics could be blended with the direct attack water-based system they had worked so hard to develop over the previous 15 years. In addition, the Canadair CL-215 (see page 74) was now a reality and there was growing momentum for this purpose-built water-bomber to be added to the Ontario fleet, though in the event this was not to take place until 1985.

For the Tracker crews, the reluctance to use the new land-based resource meant that they would often find themselves sitting on a base for extended

CF-OPZ pictured at Kenora, Ontario in 1974 before installation of the large mainwheels. The Ontario fleet has long been known as the 'Yellow Birds'. (Larry Milberry)

periods, expecting to be dispatched to a new fire in the hot, windy fire conditions, only to be dispatched hours after a Beaver or a Twin Otter had begun suppressing the fire with water. Not surprisingly, since the success of the initial attack and retardant use depended on rapid intervention by sufficient aircraft, the Tracker programme began to fall from favour, particularly as the forest districts had to pay the budget for each fire and considered the retardant to be an unrewarding expense.

And there were other problems on the bases. While the Tracker itself was proving to be an excellent performer, the retardant delivery system was giving the field maintenance personnel many headaches. The broad tank doors, which were of light construction, would not seal properly and the release cables for the emergency drop system had to be rigged very carefully to

Turbo Firecat 'T1' displays its compact yet purposeful lines during a pre-delivery test flight. The addition of PT6A-67AF turboprops will enable this former RCN Tracker to remain a protector of Mediterranean forests well into the next century. (Keith Wade)

ensure that all four doors opened at the same time; the Tracker's narrow centre of gravity envelope dictated that the pilot not be confronted with having only the two forward or two aft tanks dump in an emergency.

In 1977 Air Service maintenance staff discovered corrosion of the wing spar caps in-board of the engine nacelles. This had occurred where steel pins used to hinge the leading and trailing edge sections in-board of the nacelles had reacted with the aluminium spar caps following several years of maritime operations on the *Bonaventure*. Other areas showing signs of corrosion included inside the rear fuselage and throughout the original wiring system. The Ministry dispatched two aircraft to IMP of Halifax for repairs while a further two were withdrawn from service, 'OPZ undertaking its last flight with the Air Service in the hands of Wally Warner on September 21, 1977.

The cost of the repairs further dampened enthusiasm for the Tracker programme and the final blow came in 1979 when the Fire Management division, the prime user of the Air Service's fleet, took over all air operations. The prevailing wish of the new management was to switch to a large fleet of Otters and dispose of the Trackers.

After much hard work and dedication by the Air Service's flight and maintenance crews, a perfect eight year safety record and a growing acceptance that the land-based air tanker could indeed make a valuable contribution to wildfire management in Ontario, the Tracker programme came to an end. The final demonstration of an Air Service Tracker took place during the Canadian National Exhibition air show at the Toronto Island

Firecats 'T7' and 'T8' pose over British Columbia's Coastal Mountains prior to delivery to 'Sécurité Civile' in the spring of 1984. They were former US Navy S-2As 136491 and 136409. (Conair)

DHC CS2F Trackers Sold To Civilian Operators

C/n	Mark	RCN/CAF Serial	Civilian History
DH-19	CS2F-1	1520	C-GWUP: Field Aviation spec conversion, 1977; Conair, 1982; Conair Firecat '568', 1983.
DH-24	CS2F-1	1525	CF-IOF: OMNR. CF-OPY: OMNR conversion '58', 1972. C-FOPY: Conair, 1980; Conair Firecat '569', 1985.
DH-29	CS2F-1	1530	CF-OPT: OMNR spares airframe, 1972. C-GMXY: Conair, 1980. F-ZBAT: DSC Firecat 'T3', 1982.
DH-31	CS2F-1	1532	CF-OPX: OMNR conversion '57', 1972 C-FOPX: Conair, 1980; Conair Firecat '565', 1981.
DH-32	CS2F-1	1533	CF-OPW: OMNR conversion '56', 1972. C-FOPW: Conair, 1980. F-ZBAU: DSC Firecat 'T2', 1982.
DH-33	CS2F-1/	1534/12134	N9AG: Airborne COD Mk.I Geophysics, 1975. C-GWTX: Conair Firecat '564', 1980.
DH-34	CS2F-1	1535	CF-OPV: OMNR conversion '55', 1972. C-FOPV: Conair, 1980; Conair Firecat '566', 1981.
DH-35	CS2F-1	1536	C-GHQY: Conair, 1975; Conair Firecat '562', 1979.
DH-36	CS2F-1	1537	C-GHQZ: Conair, 1975; Conair Firecat '561', 1978.
DH-37	CS2F-1	1538	C-GHWK: Field Aviation spec conversion, 1977; Conair, 1982; Gov't of Saskatchewan, Conair Firecat '2', 1984.
DH-38	CS2F-1	1539	CF-OPU: OMNR conversion '54', 1972. C-FOPU: Conair; Conair Firecat '564', 1981.
DH-39	CS2F-1/ COD Mk.II	1540/12140	N99261: Airborne Geophysics, 1975. C-GWUO: Conair '563', 1980.
DH-40	CS2F-1	1541	Conair, 1991.
DH-43	CS2F-2/3	1544	Conair, 1991.
DH-44	CS2F-2	1545	C-FUCS: Aero Components Support, 1995.
DH-45	CS2F-2/3	1546/12146	C-GEQG: Government of Saskatchewan spares airframe, 1975.
DH-46	CS2F-2/3	1547/12147	C-FKUQ: Conair, 1991.
DH-49	CS2F-2/3	1550/12150	C-FKUR: Conair, 1991.
DH-51	CS2F-2/3	1552/12152	C-GEHR: Gov't of Saskatchewan '3', Field conversion, 1975.
DH-53	CS2F-2/3	1554/12154	C-GEQC: Gov't of Saskatchewan '4', Field conversion, 1975.
DH-54	CS2F-2/3	1555/12155	C-FLQZ: Conair, 1991.
DH-55	CS2F-2/3	1556/12156	C-FKUV: Conair, 1991.
DH-57	CS2F-2	1558	CF-OPZ: OMNR conversion '59', 1970. C-FOPZ: Conair, 1980. F-ZBAZ: DSC Firecat 'T1', 1982; Turbo Firecat, 1995.
DH-58	CS2F-2/3	1559/12159	C-FLRA: Conair, 1991.
DH-59	CS2F-2/3	1560/12160	C-GEHQ: Gov't of Saskatchewan '2', Field conversion, 1975.
DH-60	CS2F-2/3	1561/12161	C-FKUW: Conair, 1991.
DH-61	CS2F-2	1562	C-FUCV: Aero-Composites Canada, 1995.
DH-62	CS2F-2/3	1563/12163	C-FKVB: Conair, 1991.
DH-63	CS2F-2/3	1564/12164	Conair, 1991.
DH-64	CS2F-2/3	1565/12165	C-FLRB: Conair, 1991.
DH-65	CS2F-2/3	1566/12166	C-FLRD: Conair, 1991.
DH-67	CS2F-2/3	1568/12168	C-FKVD: Conair, 1991.
DH-68	CS2F-2/3	1569/12169	C-FKVF: Conair, 1991.
DH-72	CS2F-2/3	1573/12173	C-FKVG: Conair, 1991.
DH-73	CS2F-2/3	1574/12174	C-FLRF: Conair, 1991.
DH-76	CS2F-2	1577	C-FUDH: Aero-Composites Canada, 1995.
DH-77	CS2F-2/3	1578/12178	C-FKVK: Conair, 1991.
DH-79	CS2F-2/3	1580/12180	C-FKVL: Conair, 1991.
DH-80	CS2F-2/3	1581/12181	C-FKVN: Conair, 1991.
DH-82	CS2F-2/3	1583/12183	C-FKVP: Conair, 1991.
DH-84	CS2F-2/3	1585/12185	C-GTRT: IMP Turbo Tracker, 1987. Conair, 1991.
DH-88	CS2F-2/3	1589/12189	C-FKVQ: Conair, 1991.

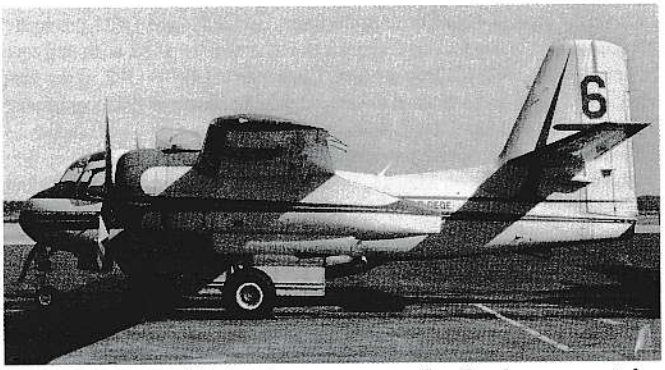
Ontario's proof-of-concept Tracker air tanker CF-OPZ makes a four-door drop of water at Downsview during the 1971 certification trials. Retardant would more normally be delivered in two door salvoes or two- or four-door strings. (de Havilland Inc)

DHC CS2F Trackers Sold To Civilian Operators

DH-89	CS2F-2/3	1590/12190	C-FKVR: Conair, 1991.
DH-90	CS2F-2	1591	C-GABC: Field Aviation spec conversion, 1977; Conair, 1982; Conair Firecat '567', 1983.
DH-92	CS2F-2/3	1593/12193	C-GEQE: Gov't of Saskatchewan '6', Field conversion, 1975.
DH-94	CS2F-2/3	1595/12195	C-FKUF: Conair, 1991; Turbo Firecat '577', 1992.
DH-95	CS2F-2/3	1596/12196	C-FKVS: Conair, 1991.
DH-96	CS2F-2/3	1597/12197	C-FLRH: Conair, 1991.
DH-97	CS2F-2/3	1598/12198	C-GEHP: Gov't of Saskatchewan '1', Field conversion, 1975.
DH-98	CS2F-2/3	1599/12199	C-GEQD: Gov't of Saskatchewan '5', Field conversion, 1975.
DH-99	CS2F-2	1600	C-FUDQ: Aero-Composites Canada, 1995.

Of the 99 CS2F Trackers built by de Havilland Aircraft of Canada, 51 have been acquired by civilian operators. Of the remainder:

- Seventeen were transferred to the Netherlands Navy (MLD) and taken on strength between December 6, 1960 and September 18, 1961 (CS2F-1s: 1502-06, 09, 1511-16, 1518, 1522-24 and 1526);
- Nineteen were written off in accidents (CS2F-1s: 1508, 1510, 1517, 1519, 1527, 1521, 1542 and 1543; CS2F-2s: 1553, 1571, 1584 and 1586; CS2F-3s: 1572, 1592 and 1594; and CP-121s: 12170, 12175, 12179 and 12182);
- One was tested to destruction by the National Research Council: (CP-121: 12167);
- Eight are preserved (CS2F-1s: 1507 and 1531; CS2F-2: 1551; CP-121s: 12148, 12157, 12176, 12187 and 12188);
- Two were last recorded as instructional airframes and are believed to have been cannibalised (CS2F-1: 1528 and CS2F-2 1549).
- One was reported sold to a broker and its fate is unconfirmed (CS2F-1: 1521).



The Government of Saskatchewan operates five Trackers converted by Field Aviation to the Ontario air tanker configuration and one Conair Firecat. C-GEQE is a Field conversion, pictured at Prince Albert in May 1995. Note the stiffeners added to the tank doors to aid sealing. (Steve Tournay)

Airport on September 2, 1979, with chief pilot Wally Warner at the controls of C-FOPU and the following year Ontario offered its Tracker fleet for sale.

Other Customers

There was considerable outside interest in the OMNR air tanker conversion of the Tracker. The Ministry provided design drawings to the State of California for their S-2 programme, initiated in September 1971 with the lease from the US Navy of four TS-2As. Venables Aircraft Co converted two of the Trackers based on the Ontario design, BuNo 136458 (N400DF, call-sign 'T70') and 136514 (N403DF, 'T71'), and operated the aircraft under evaluation during 1973. However, the California Department of Forestry and Fire Protection (CDF) was not entirely happy with the system's performance and subsequently retained Winters Aviation of Los Angeles to design a new air tanker conversion and Aero Union of Chico to conduct the installation; 'T70' and 'T71' were subsequently scrapped. The CDF eventually acquired 67 former US military S-2 airframes of which 27 were converted to the Winters design (one of these, N426DF, was converted to Garrett TPE331-14GR turbine engine configuration by Marsh Aviation) and 14 are currently operated by Serv-Air Inc for the CDF.

Ontario also agreed to allow the Canadian province of Saskatchewan to use their design. Saskatchewan acquired seven former RCN Trackers in 1975 of which six were converted at Field Aviation's facilities in Calgary, the other being kept as a source of spare parts. Five are still operational alongside the province's fleet of three PBY-5A Cansos, four CL-215s and one replacement Conair Firecat which is flown by North America's only female air tanker captain, Janet Storring. Saskatchewan experienced the same problems with the tank system as the OMNR but over the years developed a series of fixes that included replacing the cable-actuated emergency drop mechanism with a hydraulic system with its own accumulator and separate lines and replacing the door activating mechanism with a computerised system.

Field Aviation converted a further three Trackers 'on spec' but these were to languish at Calgary Airport for several years before being purchased by Conair.

Conair and the French Connection

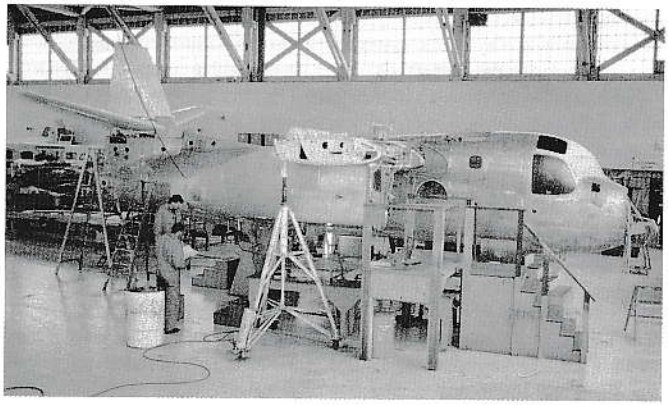
By the summer of 1975, British Columbian speciality operator Conair Aviation was close to retiring its fleet of fire control Grumman TBM Avengers, some 18 years after they were first introduced by predecessor Skyway Air Services. In anticipation of this, Conair had introduced the larger and faster Douglas A-26 Invader in 1970. But by the mid-1970s the company was looking ahead to introduce a new type that offered the manoeuvrability of the TBM and the retardant capacity of the A-26, while eliminating the maintenance difficulties associated with the Invader's R-2800-59 Double Wasp engines.

The evaluation of CF-OPZ in 1971 had demonstrated to both Conair and the BC Forest Service that the Tracker was an ideal long term replacement for both types and the company therefore began procurement of former RCN Trackers with the purchase in 1975 of two aircraft, C-GHQZ (c/n DH-36) and C-GHQY (c/n DH-35).

In designing what would become the Firecat, Conair had the benefit of reviewing the previous modifications by Field and Winters. The most radical design change was to gut the Tracker's centre fuselage, including removal of the torpedo bay and the lower portion of the central keel, and install a rectangular tank mounting frame 7in (17.8cm) above the original floor level. The four compartment doors of the removable 725 Imp gal (3,295 litre) tank lay flush with the lower fuselage while their full length arrangement and other refinements produced a more streamlined retardant charge, resulting in reduced retardant erosion immediately after the drop and a 30% improvement in distribution on the ground. The longitudinal door arrangement also eliminated the centre of gravity problems inherent in the two-forward, two-aft door arrangement of the Ontario design. Other system improvements included more venting area, including use of the upper portion of the side crew entrance door (pilots enter the Firecat via a ladder and the port escape hatch), and computer control of the retardant drop sequence.

Conair's conversion approach was to completely strip each aircraft, including removal of some 3,000lb (1,360kg) of redundant military equipment; repair the airframe where necessary; and overhaul and rebuild the entire electrical and hydraulic systems. Conair adopted the Ontario large mainwheel modification and also added a cut-out in the lower rear nacelle to allow the main undercarriage to lower in the event that the shrink link broke; the shrink link shortened the heavy undercarriage on retraction to keep the centre of gravity within limits. The name 'Firecat' was selected to reflect the Tracker's wildfire control role and the Grumman tradition for

Initial attack group of three Firecats on 'Red Alert' stand-by at the BC Forest Service's Abbotsford Air Tanker Base in July 1995. The first aircraft would be loaded with retardant and airborne within 10 minutes of the dispatch horn sounding. Note the boarding ladder to allow the pilot access to the open port escape hatch. (Author)



DSC Firecat 'T-1' under conversion to Turbo Firecat configuration in early 1995. Conair completely strips the Tracker airframe and rebuilds all systems to 'as new' condition. (Author)

Sécurité Civile's *first Firecat, 'T1' (formerly Navy 1558 and CF-OPZ), being loaded with retardant at Marignane in June 1982, shortly after delivery from Canada. In common with all DSC aircraft, the Firecat carries a quasi-military registration, in this case F-ZBAZ.* (Hubert Bolzinger, DSC)

using a feline theme in naming its products.

The first two Firecats entered service in 1978 and 1979 respectively. However, disposal of RCN Trackers did not proceed as quickly as expected and, following purchase in 1980 of the two former RCN Carrier On-board Delivery (COD) conversions from the US civilian market, Conair was very pleased to purchase the retired OMNR Trackers and the three Field conversions stored at Calgary Airport.

Conair took delivery of the Ontario Tracker fleet over the summer of 1980, the aircraft being made airworthy by Conair crews and flown in pairs across Canada to Abbotsford. The Conair purchase also included the spares aircraft which, to the surprise of many, Conair reassembled drawing on its store of Tracker parts and flew back to Abbotsford. Conair pilot Al Kydd flew C-FOPZ to Abbotsford over August 27 and 28, 1980, following a 30 minute test flight the previous day.

While the Ontario fleet had been retired, in part, because of spar cap corrosion, Conair had by now developed a spar splice procedure that allowed the Tracker's wing to be restored to full structural integrity with relative ease. The company also routinely replaced large sections of the spot-welded wing and fuselage skin to restore the Tracker to original condition.

The Firecat programme received a further boost with an order from French civil protection agency *Direction de la Sécurité Civile* (DSC). DSC had begun wildfire control operations along the Mediterranean coast with PBY-5A and PBY-6A Cansos in 1963; these were replaced by a fleet of 12 Canadair CL-215 water bombers in 1970. Because of the severe fire control conditions in southern France — extensive woodlands, long dry periods, high temperatures, strong Mistral outflow winds and mountainous terrain — DSC had begun to experiment with flying loaded patrols with the CL-215, a concept it named *Guet Aérien Armé* (literally 'armed aerial war'). DSC added the first of five 2,500 Imp gal (11,350 litre) Douglas DC-6s in 1980 but, even with this added capacity, there was still a need for a fast air tanker of at least 660 Imp gal (3,000 litre) capacity that could operate in the *Guet Aérien Armé* role more cost-effectively than the larger but relatively slow 'Canadair'.

Conair's Firecat fitted the requirement perfectly and DSC promptly placed its first order for three aircraft in December of 1981 with delivery in time for the 1982 wildfire season. Conair selected CF-OPZ as the first Firecat for France and converted the aircraft over the winter of 1981, completing the conversion on May 9, 1982, in accordance with Transport Canada approval P78-001. Conair's operations manager Barrie Madu conducted the first post conversion flight on May 11, 1982, and, after 4.6 hours of flight testing and 1.1 hours of acceptance flying, 'T1' was accepted by Guy Ragus, then second-in-command at DSC's main base at Marignane Airport, Marseilles.

The delivery of Firecats 'T1' and 'T2' was to be the first of many Conair Firecat and Turbo Firecat trans-Atlantic flights. Only three CS2F Trackers had previously made the east-bound Atlantic crossing — the *Bonaventure* trials aircraft in 1957 and CS2F-2 1561 in May 1958 — and only the last had made the return flight. The Firecats departed Abbotsford on May 19, 1982, 'T1' crewed by Madu and Ragus, and temporarily registered for the ferry flight as F-WZLS, while 'T2' (F-WZLQ) was flown by former RCN Tracker and Banshee pilot John Truran, accompanied by former OMNR engineer Chris Goddard.

The two aircraft staged through Calgary, The Pas, Churchill, Frobisher, Sondrestrom, Reykjavik, Glasgow and Southend before landing at Marignane on May 24 after 33.1 flight hours. 'T1' arrived with 3,882.3 airframe hours and was officially placed in DSC service that day as F-ZBAZ; Conair delivered the former Ontario spares aircraft as 'T3' later in the year. Truran remained at Marignane to conduct Tracker type checks for 15 DSC pilots, most of whom were former *Aéronavale* aircrew with fire control experience on the Canso, CL-215 or Douglas DC-6.

From 1982 until 1985, DSC employed its Firecats (or 'Trackers' as the French prefer to call them) on single aircraft, two-pilot loaded patrols. With the delivery of the ninth aircraft in 1986 the Firecats were flown in pairs and from 1987 DSC deployed its fleet in five two-aircraft detachments based at Carcassonne, Nimes, Hyenes, Nice and Bastia on the island of Corsica.

The *Secteur Tracker* went on to develop a strong sense of pride in its loaded patrol concept, achieving an enviable record of making the initial attack on 70% of all fires requiring aerial intervention and bringing 90% of these under immediate control. The two-and-a-half hour patrols begin late in the morning and continue until last light, the objective being to make an initial attack on any new fire within 10 minutes.

Conair produced 32 piston-engined Firecats between 1978 and 1991 (14 for DSC, one for Saskatchewan and 17 for its own fleet). The company added Trackers operated by the US Navy and Marine Corps to its Canadian Type Approval in 1983 and eventually acquired 42 Grumman S-2A variants of which 21 have been converted to piston or turbine-engined Firecats. The Firecat became the backbone of British Columbia's initial attack programme in the southern half of the province with the Douglas DC-6 providing the heavy air tanker capability, predominately in the north. Conair has fielded a maximum of 12 single-pilot Firecats, operated in four three-aircraft groups with a Piper Aerostar 'bird dog' acting as spotter and control.

Turbos and Life Extension

By the mid-1980s DSC was experiencing growing difficulties in acquiring adequate quantities of aviation gasoline, engine spare parts and expertise in radial engine maintenance. Well pleased with the Firecat and the armed patrol concept, DSC elected to re-engine its Trackers with turboprop engines and in August 1987 selected Conair's Turbo Firecat conversion powered by Pratt & Whitney Canada PT6A-67AF turboprops to progressively replace its piston-engined fleet. Conair delivered the proof-of-concept Turbo Firecat 'T16', a former Firecat from its own fleet, in August 1988 and by 1994 DSC had received nine aircraft. Of these, six were converted from Firecats and three were converted from scratch; all were based on Grumman-built airframes. (For the full Turbo Firecat story, see *Turbo Firecat — Fighting Flames with Turbines*, in *AIR International* June 1991.).

Considered to be fastest and best handling piston-engined Tracker in the DSC fleet, 'T1' left Marignane for conversion to Turbo Firecat configuration on September 31, 1994, piloted by Conair's DC-6 check pilot, Rod Boles. 'T1' had accumulated 2,858.8 flight hours in French service, made 4,151 landings and 2,689 fire control drops totalling 1,949,022 Imp gal (8,860,255 litres) of retardant. For the Atlantic crossing, 'T1' flew in the company of two Conair Firecats and a DC-6 returning to Abbotsford after completing a wildfire control contract for the Government of Catalunya. The shorter-legged Firecats routed via Southend, Stornaway, Inverness, Reykjavik, Sondrestrom, Frobisher and La Ronge, arriving at Conair's Abbotsford facilities on October 4; 'T1's second Atlantic crossing took 28.7 flight hours, giving her a still modest total of 6,769.8 airframe hours.

Modern aircraft structural technology was in its infancy when the

Tracker first took to the air. Aircraft designs of the early 1950s were largely based on static strength considerations with structural test programmes formulated to first identify areas of weakness and then determine strengthening requirements when problems occurred.

The de Havilland Comet jetliner disasters of 1954 showed that structures primarily designed for static strength could fail catastrophically following rapid crack propagation from fatigue concentration points. This discovery resulted in a change in design philosophy to develop structures which either exhibited a negligible probability of fatigue failure or which could sustain a high proportion of their design load in the presence of extensive structural damage. The latter approach emphasised the importance of timely identification and correction of readily-detectable damage during routine inspections.

As released from the RCN, the Tracker was determined to have an airframe life of 6,000 hours with its new civilian operators. In certifying the piston-engined Firecat, Conair obtained approval, following flight loads testing with the support of the National Research Council and the Ontario Ministry of Natural Resources, to extend the airframe life to 14,000 flight hours; each flight hour above 6,000 hours was then factored to reflect the high frequency of stresses applied to the airframe in the wildfire control environment.

By the mid-1980s some of the early Firecats were approaching their 14,000 hour limit and, with the imminent delivery of the re-engined Turbo Firecat, it became imperative to further increase the Tracker's airframe life. With its intimate knowledge of the Tracker airframe together with access to the results of full-scale fatigue testing in Japan and Canada in 1966 and 1979 respectively and the National Research Council's 1978 analysis of the Tracker airframe for the fire control role, Conair's engineering department developed a Supplemental Structural Inspection Programme to increase the Tracker's life to 25,000 flight hours. The programme requires periodic inspection of 23 key points on the Tracker's structure and adds at least a further 20 years of airframe life in the wildfire control role.

The transformation from Firecat to Turbo Firecat involves a complete stripping and rebuilding of the airframe and systems to an 'as new' standard. In addition to the new powerplants and associated engine truss, nacelle, firewall and cowling changes, the reconfiguration includes an all-new instrument flight rules (IFR) cockpit, new electrical system, improved hydraulics, under-wing 105 Imp gal (477 litre) fuel tanks, a single-point refuelling system and a further gross take-off weight increase to 27,500lb (12,474kg). The turboprop development and certification programme also provided an opportunity for Conair to address the last of the Tracker's unresolved handling and systems characteristics.

Adding a new powerplant and propeller combination to an existing design always carries an element of risk even, as in the case of the Conair conversion to the PT6A-67AF engine when the engine power is roughly equivalent: 1,424shp (1,062kW) for the PT6 — or 1,509eshp (1,126kW) including the exhaust jet effect — *versus* 1,475hp (1,100kW) for the Wright R-1820 using 100/130 Avgas in the civilian environment. Conair discovered that the higher energy airstream from the initial six-bladed composite and final five-bladed aluminium propellers in fact progressively improved the Tracker's pitch and directional stability but still not enough to satisfy the prevailing certification requirements.

The simplest 'fix' was to add vortex generators to the top surface of the horizontal stabiliser just ahead of the elevator and to the vertical stabiliser at about 10% chord. This low cost modification had a dramatic affect on the Tracker's handling qualities; not only was longitudinal stability substantially improved all the way to the stall but the Tracker's elevator system now provided the pilot with a progressive control force that gave a positive recovery in pitch when the controls were released and ease of trimming in all configurations. To further improve the 'feel' of the Tracker in pitch, Conair added an elevator 'down spring' feature from Grumman's C-1A Trader, thereby improving the apparent longitudinal stability by obliging the pilot to trim against the spring.

Conair also determined during flight tests that the SERA (see Part One) system was more powerful than required and reduced the rudder and rudder trimmer sweep angles from 20° each to 18° and 15° respectively; this change provided adequate single-engine control while reducing rudder unlock forces. All in all, the Tracker now flew better than ever and without the ever-present noise and vibration of the piston-engined configuration. The Turbo Firecat cruises at 210kts (389km/h), some 30kts (56km/h) faster than the Tracker, and allows descent rates of 2,500ft (760m) per minute or more while maintaining a retardant drop speed of 120kts (222km/h), a very useful capability when placing retardant around a fire in mountainous terrain.

Certification flight test crew for the Ontario Department of Lands and Forests' air tanker conversion in front of Tracker CF-OPZ-X at Downsview in 1971. Right to left are Bill Nash of Kenting, Seth Grossmith of the Department of Transport (now Transport Canada), Bob Fowler of de Havilland, Alexander Linkewich of Kenting and a trio of flight test engineers. (DHC via Bill Nash)

Other flight-related changes included moving the static source to a boom on the port wing-tip, thereby reducing the static pressure error from up to nine knots to only one knot, and replacing the Safe Flight stall warning system with a state-of the-art combined angle-of-attack and stall warning system that allows the pilot to fly the aircraft to maximum performance in the demanding fire control environment.

The AoA system was later fitted to all piston-engined Firecats and Trackers in civilian use including those operated by the CDF and the Government of Saskatchewan.

The new PT6 powerplant has proved exceptionally responsive and reliable and the warm-up and run-up times associated with piston engines are now eliminated, reducing aircraft response time when dispatched to a fire. The Turbo Firecat also offers improved climb and single-engine performance in the hot-and-high conditions typically encountered around forest fires, the PT6A-67AF maintaining its rated power up to 37°C (99°F).

The lighter turboprop powerplants required that as much weight as possible be moved forward to restore the original centre of gravity range. While adding two nickel-cadmium batteries and about 560lb (254kg) of lead ballast within a new extended nose cone, Conair was also able to remove approximately 80lb (36kg) of weight from the tail area, including the retractable tailwheel and structure related to the arrester hook; the original mechanical link from the tailwheel actuator to the elevator circuit was replaced with a hydraulic servo. Conair also took the opportunity to replace the Tracker's brakes with a heavy duty system, thus addressing the last of the undesirable characteristics identified by the National Research Council task force some 20 years earlier.

DH-57 Flies On

De Havilland CS2F-2 Tracker c/n DH-57 flew for the first time in its fourth major configuration, Conair Turbo Firecat 'T1' for *Sécurité Civile* of France, on June 19, 1995, piloted by Conair's Firecat check pilot Tim Paul. On June 30 Guy Ragus, now *Conseiller Technique Aéronautique* at DSC, accepted 'T1' at Conair's Abbotsford headquarters for the second time in 13 years. The aircraft departed two days later on its delivery flight to France, temporarily marked F-WEOL, and arrived at Marignane on July 4; after final acceptance at Marignane, 'T1' was placed 'on line' on July 11, ready for the 1995 wildfire season.

With a life expectancy of at least another two decades, it is certain that the rejuvenated 'T1' and its Tracker *alumni* will be flying well beyond the 50th anniversary of the S-2's first flight and perhaps 50 years from its own first flight. And far from being a museum piece given the occasional airing in front of an admiring crowd, this warbird-turned-fire-fighter will be working as hard as the willing Tracker has ever worked, ready to seek and confound its quarry below.

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