Exploring the utility of multi-mission aircraft (MMA) in wildfire operations in Alberta

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Introduction

Multi-mission aircraft (MMA) are aircraft that can be used in a broad variety of missions. Based on its setup and configuration, these aircraft can be used for missions such as: intelligence, surveillance, and reconnaissance (ISR) missions, maritime and overland surveillance, search and rescue (SAR), anti-submarine warfare (ASW), and air ambulance. Specific to applications in wildfire operations, the use cases for a multi-mission aircraft can vary from detection, personnel overwatch, aviation monitoring.

To learn more about the utility of multi-mission aircraft in wildfire operations, FPInnovations reached out to subject matter experts at the Colorado Division of Fire Prevention and Control (DFPC) who have implemented a multi-mission aircraft program with demonstrable success. *A notable portion of the information presented in this InfoNote was obtained from publicly available Colorado DFPC documents and represented here. All information sources are listed in the References section with credit dully allocated to its authors and agencies*. Information gathered from these documents were extrapolated to assess feasibility in Alberta Wildfire's operations to allow for a more applicable use-case exploration.

Aircraft

The MMA program at Colorado DFPC consists of two Pilatus PC-12 airplanes (Figure 1) outfitted with infrared (IR) and electro-optical (EO) sensors. The PC-12 is a pressurized, single-engine, turbo-prop aircraft with long-endurance. The aircraft has a cruise speed of 285-kn, has a ~2500-ft runway requirement for take-off and landing, has a service ceiling of 30,000-ft, and is fully instrument-flight rules (IFR) capable. The PC-12 aircraft has an FAA-approved type certificate.

In Canada, The PC-12 received Transport Canada type certification in 2020. Most recently, the 2023 fire season saw a PC-12 from Bridger Aerospace be used in the capacity of an aerial supervision platform.

Other MMA programs make use of different aircraft such as Partenavia P-68 Observer (Oregon Department of Forestry), Beechcraft King Air (California Office of Emergency Services), and the Kodiak 100 (Washington Department of Natural Resources).

Figure 1. A Pilatus PC-12 on display at the 2023 Aerial Firefighting Series: Asia Pacific Conference & Exhibition in Dubbo, Australia.

Use of MMA in the State of Colorado

The following quoted information is obtained from the MMA program website:

 "The primary mission of the program is detection in addition to providing near real time information to ground forces during initial attack on wildfires. Incident Commanders can order these aircraft to detect and recon wildland fires and aid them in making sound tactical decisions, improving the safety and efficiency of the response. The MMA can also support other all-risk emergencies. The MMA is a complete system that provides critical intelligence, images, and

communications capabilities. It is integrated with the Colorado Wildfire Information System (CO-WIMS), geospatial database that displays incident images and details to local Fire Managers through a web-based application."

Airspace

MMA generally operate at 18,000 to 20,000-ft above sea-level (ASL). This is above any NOTAMs placed on the wildfire (Figure 2). MMA operations should therefore not interfere with regular fixed-wing or rotary-wing operations on the fireline.

Sensor suite

The MMA initially used a Wescam MX™-15 sensor ball that contains three cameras – two electro-optical (EO) cameras that have a narrow and wide field of views as well as an infrared (IR) camera. The sensor suite has since been upgraded to the Star SAFIRE® 380 HD to allow for improved mid-wave infrared capability as well as added short-wave infrared capability.

Data processing and dissemination

In Colorado DFPC's MMA, the on-board software system has been adapted for use in wildland fire operations and other civilian all-hazard events. The sensor suite, in conjunction with the software/hardware system (Churchill ATOM Mission Computers and Airborne Displays 21" and 12" touchscreen monitors), allows for image and video capture, development of vector products, as well as mapped information products such as fire perimeters,

locations of new starts/detections, spot fires, and location of infrastructure.

On-board internet services (GoGo ATG-5000 3G Internet) facilitates data transfer in the form of .KML files (geographic data), .JPG files (photos), and .MP4 files (videos). This on-board internet service allows the transfer of information in near real time either via email, cloud services, or through the Colorado Wildfire Information Management System (CO-WIMS). Information is normally delivered within minutes of being collected.

Communications

The aircraft has three VHF-FM radios, and one 800 MHz radio. The 800 MHz radio capability is limited to line of sight with no repeated channels. On-board internet services function above 10,000-ft.

Crew requirements

A minimum crew of two is required for MMAs – one pilot and one mission system operator (MSO). Often, two operators are required to manage the demanding workload.

Response time, mission duration, duty day

Colorado DPFC's program has aircraft airborne 20-minutes after notification during a heightened alert status, 4-hours after notification in standard alert status, and has a loiter time as much as 5+ hours. Typical mission duration is 4 to 5 hours. Aircraft and crew are generally on a 14- hour duty day with an 8-hour flight limit. Assuming cruising speed of
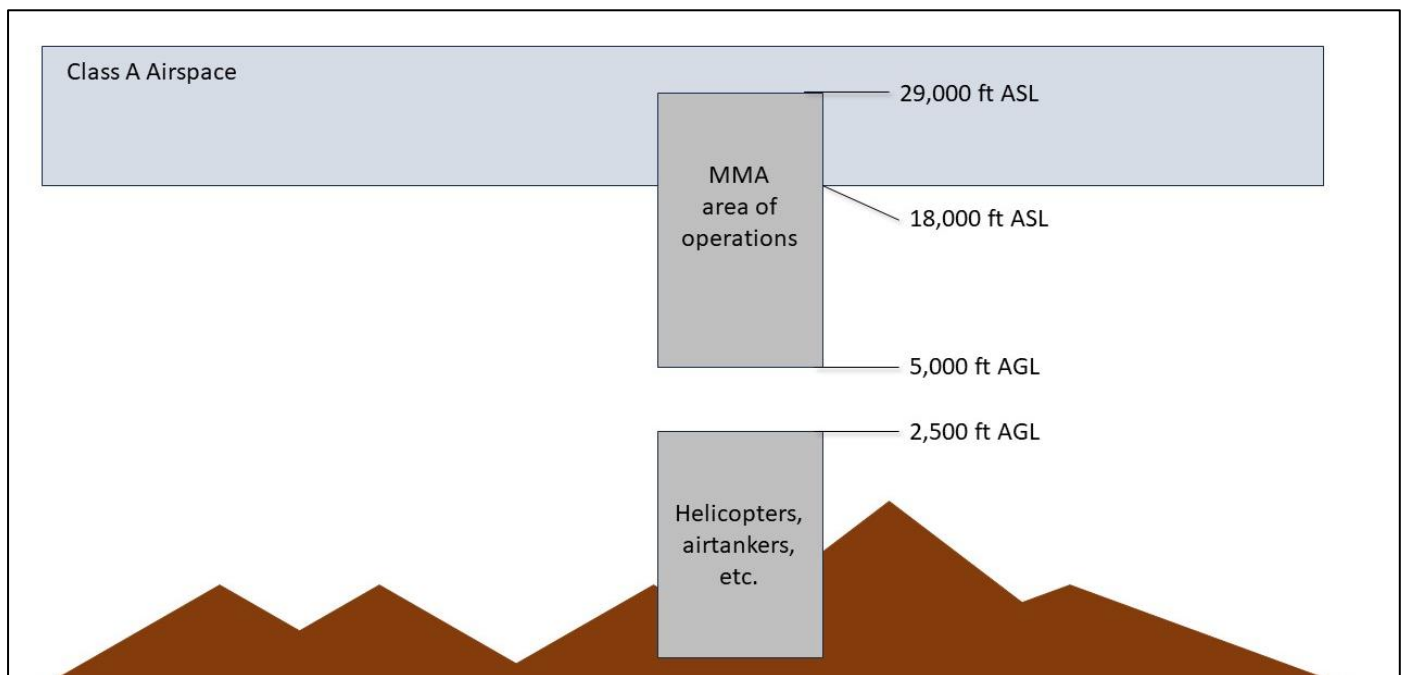

Figure 2. Pictorial representation of where an MMA would operate on a wildfire.

270-kn, Figure 3 presents in-flight response times in 15-minute increments (up to 60-minutes) if an aircraft was hypothetically stationed at the Loon River airtanker base.

Financial model

The model currently utilized by Colorado DFPC is a state-owned, contractor operated model (also known as government owned, contractor operator i.e., GOCO). The state manages the MMA program with operation and maintenance contracted out.

Cost estimates

General estimates (in USD) are $3,800 a day with an hourly flight rate of $1,800. This includes the aircraft and pilot salary. These estimates do not cover operator salary, overtime, or subsistence.

Utility in wildfire operations in Alberta

▪ **Priority setting** – The use of MMAs for intelligence gathering allows for priority setting of objectives throughout the province. Owing to its high-altitude flying as well as notable cruising speed, MMAs can cover large distances in 4 to 5-hour mission durations, capturing relevant information. This allows for province-wide objective priority setting with the latest information at hand.

▪ **Detection** – Due to its high-altitude intelligence gathering abilities, the MMA can quickly detect new starts over a large spatial area. This is particularly useful after frontal passages that involve significant lightning activity. The MMA was primarily procured in the states Colorado and Oregon as detection tools. Both states have demonstrated its utility wherein the MMA was able to quickly identity new starts ahead of other reporting methods. Of note, Oregon Department of
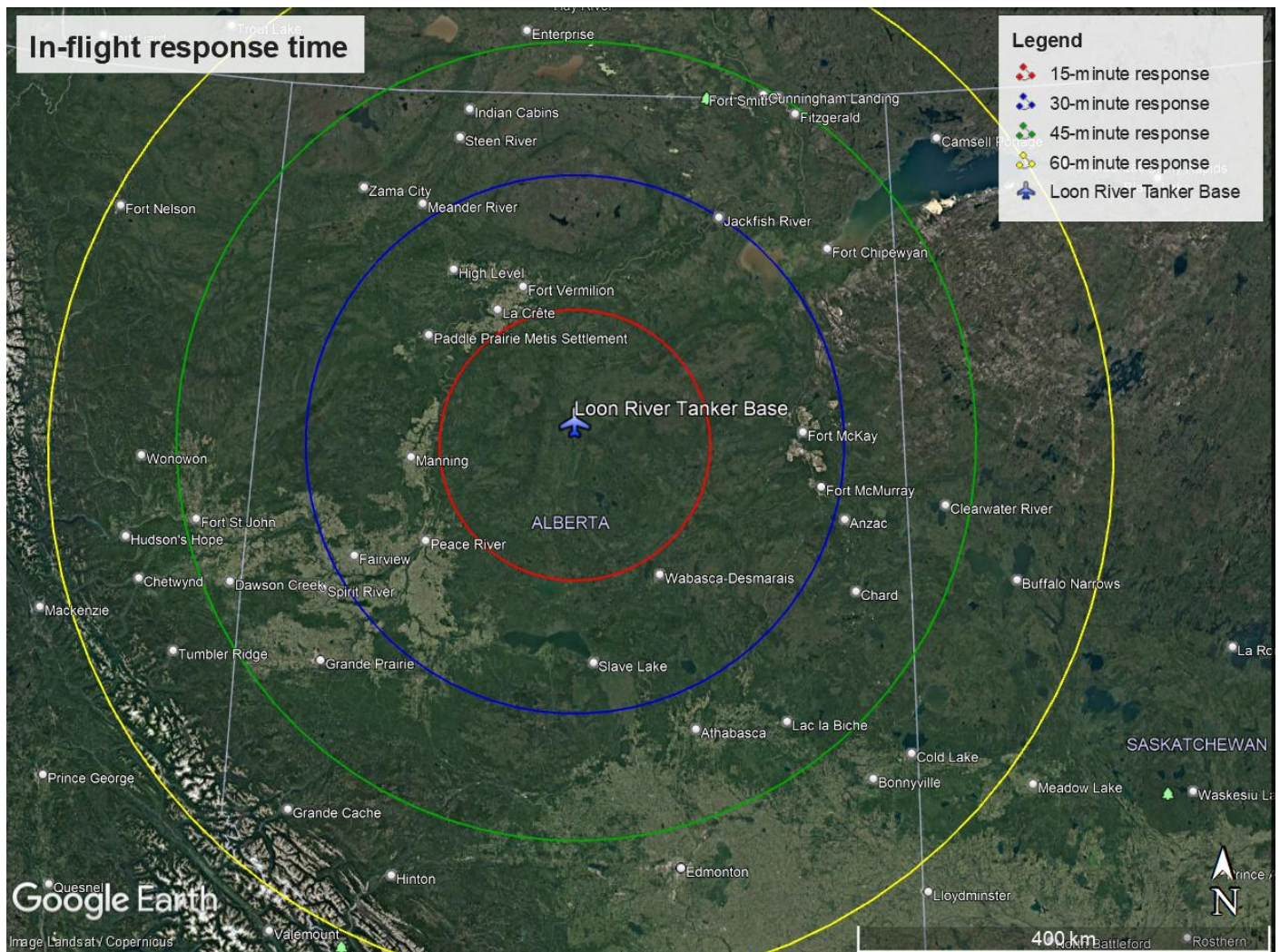

Figure 3. In-flight response time of an MMA in Alberta (assuming situated at Loon River tanker base, cruising speed of 270-kn).

Forestry does use their MMA in conjunction with night-vision imaging systems (NVIS).

- **Intelligence gathering and situational awareness** – The sensor suite allows operators to detect heat sources from large distances. This information can be relayed to personnel on ground in near real time, allowing for safer operations. Information to ground personnel such as fire activity and growth, rate-of-spread, access, escape routes, safety zones, etc. have been found to be good use of this platform. The platform can also be used to gain information such as preliminary damage assessments to structures and other infrastructure.
- **Predictive fire modelling** – MMA in certain jurisdictions (e.g., Cal OES) have integrated prediction modelling including rapidly updated predictions based on new information provided by field personnel, cameras, and aircraft.
- **Mapping services** – System operators can generate fire perimeter maps along with data points of interest (spot fires, new starts, values at risk, etc.).
- **Air-attack platform** – The MMAs can function as a birddog, provided appropriate personnel are available. This offers redundancy in the provincial aircraft fleet.

Limitations

- **Sensors**
  - The IR sensor can see through smoke, but not clouds. The EO sensor's view can also be limited by clouds.
  - Night operations limit the use of the electro-optical cameras.
- **Communications**
  - Near real time delivery of information requires suitable cellular network on the ground for the end-user to receive the information being sent from the aircraft.
  - On-board internet functionality requires the aircraft to be above 10,000-ft.
- **Accuracy of data**
  - The MMA does not produce survey quality imagery. However, Colorado DFPC indicated that images loaded in CO-WIMS are typically correctly registered within 3-8%. Less variability in terrain as well as less distance between the aircraft and the subject allow for better accuracy.
- **Utility in wildfire operations**
  - The use of MMAs as birddog aircraft (i.e., in low altitudes and specific flight patterns) can limit the utility of the sensor suite for intelligence gathering and mapping services due to the limited field of view at the reduced altitude.

Conclusion

MMA programs have been successfully implemented in several other wildfire agencies with the primary purpose of detection and intelligence gathering. Such a program would be of utility for objective priority setting as well as services of detection missions after the passage of fronts that pose a heightened lightning risk. Its utility in various forms such as mapping services and as a birddog platform further demonstrate its potential value to a wildfire agency. With its high-altitude flights, sensor suites, and fast cruise speed, MMAs can offer significant coverage of the province, thereby providing improved intelligence for informed decision making.

References

- MMA Briefing Paper – 'Colorado Multi-Mission Aircraft (MMA)' – https://ftp.wildfire.gov/public/incident_specific_data/calif_n/2017%20FEDERAL_Incidents/MMA_Support_2017/MMA%20Briefing%20Paper.pdf (Accessed on January 5, 2024).
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Acknowledgements

Disclaimer

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