Remote Sensing and Data Collection for Oil Spill Response in Canada

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Transport Canada
Aircraft Services Directorate (ASD) Overview

• Federal Government internal aviation service provider since 1936
• 44 Aircraft, 325 Staff, 15 Bases across Canada
• Considered as an Air Operator just like all other commercial operators in Canada
• Under Canadian Aviation Regulations, Aircraft Services Directorate is considered as an:
  • Air Operator Certificate (AOC)
  • Approved Maintenance Organization (AMO)
  • Approved Engineering Organization (AEO)
  • Approved Training Organization (ATO) maintenance)
National Aerial Surveillance Program (NASP)

- 1968: Pollution patrols commenced over the Great Lakes & St. Lawrence Seaway
- 1991: NASP created by CCG and expanded to East and West Coasts
- 2003: NASP transferred to TC from CCG
- 2005: Arctic patrols began in partnership with ECCC
- 2009: Dash-7 modernization completed, Arctic patrols commenced with new remote sensing equipment
- 2018: NASP transferred from Marine Safety & Security to Aircraft Services
NASP Goals

- Prevention of pollution from ships
- Protection of the marine environment from the adverse effects of shipping
- Protection of the North Atlantic Right Whale
Program Resources

3 DEDICATED TC Aircraft
- 3 teams that cover Canada’s 3 Oceans
- ~50 People across Canada

+ Access to 5 Contracted Private Industry aircraft
The Surveillance Challenge

Canada’s North vs Europe
Map of Transport Canada & CCG Bases
Aircraft Service Assignment - 2017

- CESSNA C550 CITATION II (6)
- KING AIR C-90A (5)
- DASH 7 (1)
- DASH-8 (2)
- BELL 407 (3)
- BELL 407 (3)
- BELL 206 B, JET RANGER (1)
- BELL 429 (15)
- BELL 412EPI (7)
- CL 601/604 CHALLENGER (4)
Operational Mandate

- Accidental or intentional discharges of oil
- Protection of the North Atlantic Right Whale
- Steady increase in commercial shipping
- The prevention of oiled wildlife
- Identification of vessels and their activity in marine protected areas
- Marine Domain Awareness
- Ensure public confidence in Canada’s Transportation System
2018-2019 NASP Flight Coverage
(as of January 31st, 2019)
ISTOP - The Integrated Satellite Tracking of Pollution Program

Environment and Climate Change Canada

Environnement et Changement climatique Canada
Integrated Satellite Tracking of Pollution Program (ISTOP)

• The NASP works closely with ECCC’s ISTOP program.

• ISTOP serves as a marine pollution early warning system. It uses SAR sensors on multiple satellites to monitor and detect surface hydrocarbons in Canadian waters.

• ISTOP monitors extensive marine areas and helps direct aircraft to locations of potential pollution incidents in near real time, allowing the NASP crews to confirm and investigate the incident.

• ISTOP patrols are used to investigate possible oil-slicks and possible polluters.
Workflow

- Satellite data is ordered 3 weeks in advance
- Down linked to ground stations at Gatineau, Prince Albert or Inuvik — sent to CIS via T3 link
- The image is processed
- Image analyzed in near real time <60 min
- If an anomaly is suspected CCG ROC & Surveillance Aircraft notified
- Reports distributed to partners <75 min
| **Weight:** | 34,500 pounds |
| **Length:** | 73 feet |
| **Wingspan:** | 85 feet |
| **Patrol speed:** | 200 knots |
| **Max altitude:** | 25,000 feet |
| **Range:** | 1,300 nautical miles |
| **Endurance:** | 6.5 hours |
| **Crew:** | 2 Pilots, 2-3 Surveillance Officers, 2 Aircraft Maintenance Engineers |
NASP Surveillance System
Maritime Surveillance System (MSS6000)

Comprised of six components/sensors:

- Side Looking Airborne Radar (SLAR) – *anomaly detection*
- Electro-optical Infrared Camera System (EO/IR) – *source identification*
- Infrared / Ultraviolet Line Scanner (IR/UV) – *oil analysis*
- Digital Still & Video Camera Systems – *evidence support*
- Automatic Identification System (AIS) – *evidence support*
- Satellite Communication System – *communication to the ground*
Side Looking Airborne Radar (SLAR)

- Primary sensor for anomaly and target detection
- Active sensor
- Insensitive to weather and light conditions
- Sensitive to wind conditions – 5 to 25 knots
- Resolution: 60m x 60 m
- X-Band Radar
SLAR - Range

Effective Pollution range - sea clutter
(0 ~ 15 nm per side)

SLAR total range
90 nm (45 nm per side)
Electro Optical Infrared (EO/IR) Camera

- Target Identification and Analysis
- Covert and Overt Operations
- Great Evidence Collection
- Laser Illuminator can read ship names and IMO # at night without any auxiliary lighting

Sensors include:
- Electro-optical Wide Camera
- Electro-optical Narrow Camera
- Infrared Camera
- Laser Illuminator
Electro-Optical Camera
Digital Still & Video Camera Systems

GPS Annotated Data:
- Date: 2007-01-29
- Time: 16:09:03
- Latitude: N44° 58.40
- Longitude: W066° 24.31
- Altitude: 590 ft
- Heading: 46.2°
- Mission #: TC950_015
- Image #: 0024
Digital Still & Video Camera Systems
Great Tool for Pollution Documentation

Distinctive rainbow colours

Colours become more terra-cotta and turquoise as thickness increases
IR/UV Line Scanner

IR reveals thicker parts
UV detects total spread
Automatic Identification System
Satellite Communication System
Video Streaming

- Password Protected
- Situational awareness for senior management and Incident Command Post staff
- Available to select TC and OGD staff
- Expensive
  Stream only when required
NASP’s Role in Response to an Incident

- Determine and rapidly relay incident size and extent
- Map / quantify the spill
- Provide aerial support to response crews by vectoring to combatable oil
- Provide situational awareness to the incident command team and other government departments
Notable Oil Pollution Incidents

• 2010 – Deepwater Horizon Spill
• 2013 – Lac Mégantic Train Derailment
• 2015 – M/V Marathassa
• 2016 – Husky North Saskatchewan River Spill
• 2016 – Nathan E. Stewart Tug Grounding
• 2018 – Manolis L Bulk Oil Removal
Deepwater Horizon Spill - 2010

NASP support of DWH 2010

- Deployed to Houma for 11 weeks
- Flew 297 hours in support of the response
- First NASP operation with heavy oil identification using the SLAR
Lac Mégantic Train Derailment - 2013
M/V Marathassa - 2015
IR/UV scanning was attempted, but due to the nature of the area, was deemed ineffective.
Nathan E. Stewart - 2016

32 days of surveillance
225,000 L of Diesel
Manolis L Operation – 2016/2018
Manolis L Operation
Manolis L Operation
Research and Development - Spothawk
Spothawk - TDF

- Aim is to improve the output of the NASP's array of sensors for a number of application areas including oil spill situational awareness, marine mammal monitoring, ice reconnaissance by introducing:
  - real-time processing / terrain correction
  - sensor cross-cueing
  - geospatial intelligence creation and fusion
Spothawk

GEOSPATIAL INTELLIGENCE

- Live, automated processing, dissemination
- Common GeoTIFF output
- Highly compressed (~1.5MB for 60,000 square km) low cost, fast file transfer
- Common Operating Picture – READY
- Use SLAR imagery directly for ice charting
Spothawk

VISUAL COMMUNICATIONS

- Geospatial Fusion of SLAR with Ice Charts
- Click a WEB-link or the small attachment to view and share on any device
- See the mission results in-context, minutes after completion.
- Make and support decisions with minimal time investment
RPAS Operations - Transport Canada

• Dedicated project team
• Working on operationalizing the RPAS concept to support NASP Operations in the future
• Have conducted sea trials, land trials, and BVLOS testing.
• Operations continuing in 2019 to support the North Atlantic Right Whale Initiative
• End State – MALE RPAS augmenting the NASP
RPAS - Sea Based Tests

- Schiebel Camcopter S-100 with the Wescam MX-10
- Successfully tested for BVLOS operations aboard the CCGS George R. Pearkes
- Tested off the East Coast of Canada in participation with the Canadian Coast Guard
RPAS - Land Based Tests

- TC has used the RPAS SeaHunter for two years
- In cooperation with University of Alaska Fairbanks and Griffon Aerospace
- The SeaHunter is a proven design with a robust airframe
- A low cost surrogate for larger, more complex UAVs
- Large and flexible payload capacity
RPAS - Land Based Tests

- 46 flight hours BVLOS without incident
- Flights in cloud, snow, night, sub-zero temperatures (-35 C)
- Maximum range flown - 80 NM
- Maximum altitude attained - 15,000 MSL
- Maximum useable endurance - 8 hours
- Flight under ATC control in mixed use airspace
- Fully automatic takeoff and landings
- Streamed real-time payload video and ship traffic data
- Validated ice detection and avoidance capabilities
RPAS - Seahunter

• SeaHunter Specifications:
  • Twin-150cc fuel-injected engines
  • Steerable nose gear
  • Piccolo Autopilot
  • Electro-Optical, Infrared sensors
  • Easily deployed with a low logistics footprint
RPAS - North Atlantic Right Whale Monitoring

- August 2018 - Flew total distance of 2,984 nm - Beyond Visual Line of Sight (BVLOS) using satellite communications links
- Flew in high density traffic zone under a NOTAM 5.1 exemption and under air traffic control
- First time in Canada that RPAS integrated with regular air traffic at commercial, controlled airport under Air Traffic Control
- Successfully identified NARW - validated by Marine Mammal Observers on site
- Artificial Intelligence (AI) software demonstrated that it can filter and identify whale related images
- RPAS collection methodology potentially more capable of species identification at higher wind speeds (above 15kts) that manned aircraft
Future Initiatives

• Acquiring a Remotely-Piloted Aircraft System
• Building a NASP Complex in the Arctic
• Acquiring a Fourth Surveillance Aircraft
• Upgrading to MX15 HDi
Examples of Recent High Profile Incidents

The NASP has provided surveillance for the following events:

• 2010 – Deepwater Horizon Spill (*assistance to the US Coast Guard during spill in Gulf of Mexico*)
• 2013 – Lac Mégantic Train Derailment (*provided top-cover surveillance to senior government officials and first responders*)
• 2014 – RCMP Moncton Shooting (*located assailant*)
• 2016 – Fort McMurray Wildfire (*provided support to provincial government and first responders*)
• 2017 – BC Wildfires Eastern Ontario and Quebec Floods (*provided support situational awareness to government officials*)
• 2017 – RCMP Public Safety event – Nunavut (*delivered intelligence and surveillance to law enforcement officials*)
• Current support to the North Atlantic Right Whale Initiative on Canada’s East Coast (*performing surveillance activities and providing data to various government departments*)
Conclusion

• Transport Canada has a zero tolerance policy for illegal discharges and we are committed to protecting the marine environment.

• Investing in new technology development and infrastructure will prepare the NASP for future system upgrades and operations.

• RPAS will augment the NASP’s fixed wing assets in the coming years.
Thank You

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Surveillance Of Sea Surface Activities in Canada

The surveillance of surface activities is done by various Federal Government Departments including:

- Transport Canada
- Department of Fisheries and Oceans
- Department of National Defence

Transport Canada through the National Aerial Surveillance Program (NASP) works collaboratively with other departments to minimize duplication during maritime patrols.
The main goals of the NASP are to:

- prevent pollution from ships;
- protect the marine environment;
- position Canada to be a world leader in aerial marine surveillance;
- strengthen Canada’s marine security by enhancing marine domain awareness;
- support environmentally-friendly economic development;
- support the North Atlantic Right Whale (NARW) Initiative;
- provide situational awareness to the Government of Canada during environmental incidents (Government Operations Centre); and
- support safe and efficient transportation of shipping in ice infested waters.
The main objectives of the NASP are to:

- enforce the pollution prevention regulations while acting as a deterrent to potential polluters;
- provide situational awareness during emergencies;
- provide program support to other government departments (OGDs) requiring intelligence, surveillance and reconnaissance data;
- provide ice reconnaissance support so ships can navigate safely through ice infested waters economically;
- identify and report NARW sightings in the Dynamic Shipping Zone;
- enhance maritime domain awareness so the Government of Canada can manage maritime activities or respond to threats / events within Canada’s maritime domain
NASP Priorities

The main priorities of the NASP are:

• Search and Assist
• Emergency response (recovery mission/floods/national emergency)
• Urgent Tasking requiring immediate action / response (examples)
  o Pollution incident or event reported through TC Sitcen
  o Reported anomaly from satellites through the Integrated Satellite Tracking of Pollution)
  o Maritime Security event
  o Ice related emergency (i.e ship stuck in ice)
• Daily routine pollution prevention patrols – always have a primary mission and secondary mission
• Non-Urgent Taskings - Special requests by clients / other agencies (i.e. pictures of harbours & ports, etc
Planning for NASP Routine Operations

The primary objective of the NASP is to act as a deterrent to potential polluters through the enforcement of Canada’s marine pollution prevention regulations effected under the CSA2001 and MARPOL 73/78.

Routine patrols are primarily conducted to overfly commercial vessels that are underway for visual inspection as well as by means of remote sensing equipment for compliance with the pollution prevention regulations:

The planning of these daily routine operations is an in-depth process that relies on daily intelligence products such as:

- ISTOP reports of potential anomalies
- Satellite AIS reports on vessel traffic
- Vessel of interest reports from the MSOCs (Vessels Entering Eastern Canada (VEEC) or Vessels Entering Western Canada (VEWC)
- De-confliction with DND or DFO
- Weather over the local area
Planning for NASP Routine Operations (Cont’d)

- Prior to each flight the Regional NASP Manager or mission lead reviews all available products to plan the most efficient flight track.
- The flight track is sent to many Government Departments via a predetermined distribution list for situational awareness.
- Occasionally, an event will happen which requires an urgent tasking of the NASP aircraft and the asset is rerouted in flight.
- Most often, the flight is conducted as planned without deviation from the plan.

It should be noted that an overriding requirement during all NASP missions is the acquisition of security related information in support of the protection of the Canadian public.