PUNCHING ABOVE ITS WEIGHT:

The CP140 Aurora Experience within Task Force Libeccio and Operation MOBILE

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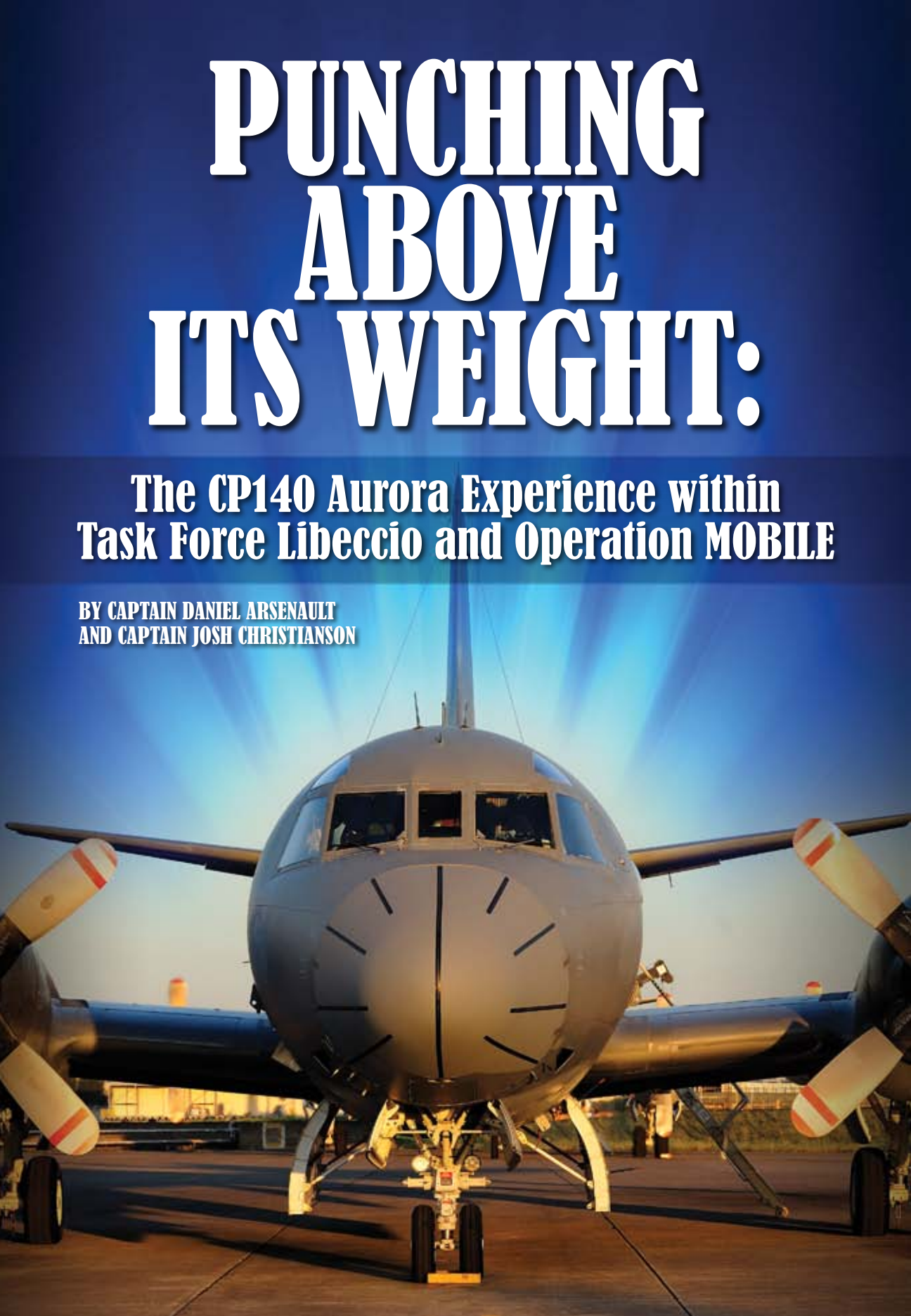

Few airborne platforms in the world have as broad a spectrum of roles as the modern long-range patrol aircraft (LRPA). Canada's LRPA, the CP140 Aurora, is no exception and over the past two decades, it has seen its scope of operations expand from the naval surface and subsurface missions of the cold war era. In the past 12 months, CP140s have been conducting operations in overland intelligence, surveillance, reconnaissance and control (ISR&C);[1] naval gunfire support (NGS); overland strike coordination and reconnaissance (SCAR);[2] maritime interdiction; psychological operations; counter narcotics; fisheries and sovereignty patrols; search and rescue; and support to other government departments (OGDs).

These roles continue to grow and evolve with technology and the joint force commander's (JFC's) demand for real-time situational awareness, regardless of the battlespace. In March 2011, a long-range patrol (LRP) air expeditionary unit (AEU) deployed as part of Task Force (TF) Libeccio, the air campaign within Operation (Op) MOBILE, providing the commander with that crucial awareness. Operation MOBILE refers to Canada's contribution to Op UNIFIED PROTECTOR, the North Atlantic Treaty Organization- (NATO-) led mission in Libya, which included a maritime arms embargo authorized under United Nation (UN) Security Council Resolution 1970, and was subsequently strengthened with the passing of Resolution 1973 and the establishment of a no-fly zone.[3] The ultimate goal of this contribution was the protection of civilians in Libya. It was also the first LRP Canadian Expeditionary Force Command deployment out of Canada since supporting Op ATHENA in 2009[4] and the first sustained, multiple-crew rotation deployment for the CP140 since Op APOLLO in 2003.[5]

This article will first summarize the experience of the LRP force in its preparation to deploy, highlighting the benefits of a robust readiness and training program. Secondly, the article will look at the platform from a capability perspective and examine the LRP force's role within the overall NATO mission, touching on each of the new mission roles and allied partnerships encountered in theatre. Lastly, the future of LRP operations will be introduced as the aircraft transitions to a new tactical suite in the Block III update, and the community modernizes existing tactics, techniques, and procedures (TTP), all with a challenging deployment still in sharp focus. Writing a new chapter in LRP history over the seven months in theatre, TF Libeccio was perhaps the most significant milestone in the evolution of the Aurora's role since the end of the cold war itself.

ALWAYS AT A STATE OF HIGH READINESS

Poised as one of Canada's high-readiness aircraft fleets, the LRP force maintains a high-readiness crew on each coast, at 14 Wing Greenwood and 19 Wing Comox, ready to deploy for up to six months on short notice. Meeting individual battle task standards (IBTS) has been part of this posture for almost five years and ensures personnel meet all Canadian Expeditionary Force Command deployment requirements. For the LRP community, this means the majority of aircrew, support staff, and technicians are already "green" across the board when given orders to deploy. Likewise, the annual personnel readiness verification (APRV) process is taken seriously, allowing the Departure Assistance Group (DAG) to be as seamless as possible. The community has also learned that developing administrative contingency plans to deploy at a moment's notice pays great dividends in the long run. This can be as simple as meeting with the unit health services manager, supply officer, or readiness training flight commander, among others, and coming up with a plan to put multiple groups of mission personnel through training quickly and efficiently. This planning could even be

looked at pragmatically as a readiness exercise with the mission support flight (MSF) under the air expeditionary wing construct.

By virtue of having so many roles assigned to one platform, CP140 aircrews have a robust plan to maintain proficiency in many of the designated warfare disciplines. Before being declared operationally ready to deploy, a CP140 crew must complete crew-based training qualifications, exercising their ability to perform not only as individual operators, but also synergistically as a crew. These structured training evolutions, dubbed "crew quals," range from traditional antisubmarine warfare (ASW), to combined joint overland support of forces through intelligence, surveillance, and reconnaissance (ISR), and full-motion video streamed to a remote video receiver in the hands of a soldier conducting section attacks. The other benefit to these evolutions is the full-crew feedback, debriefing, standards, and training cell input, followed by submitting an event synopsis to the squadron commanding officer, who ultimately approves the crew's tactics and decision making.

Deploying to a new, unknown base for sustained operations is a challenging task. The CP140 deployable mission support centre (DMSC) allows for the operational support function of typical Aurora missions to continue as normal, even in the most austere conditions, and is perhaps one of the highlights of our deployed capability.[6] From the outside, it appears as a modest, olive, drab sea container, but once set up (in a mere four to six hours), it houses a full-service, classified network server, providing reachback to higher headquarters, multiple computer workstations, printers, chart-plotters, a briefing space with projector, very/ultra high frequency (V/UHF), HF, and satellite phone capability. It also contains heaters and air conditioners to adapt to climactic extremes, and when off the power grid, it can be powered by diesel generators common among many allied nations. During Op MOBILE, all CP140 aircrew briefings and post-flight video analysis took place in the DMSC.

JACK OF ALL TRADES

Before diving into a discussion on the new roles adopted by the CP140, it would be prudent to briefly address its history and foundations. Originally designed to conduct complex ASW, antisurface warfare (ASUW) and limited maritime ISR roles, Canada took delivery of the first of 18 CP140 Aurora aircraft in May 1980. As a variant of the Lockheed P-3 Orion aircraft, the Aurora was distinctly Canadian even from the outset, and at the time had an ASW and ASUW capability unparalleled by other fleets. With a persistent sub-surface maritime threat, continuing cold war tensions, and a requirement for the surveillance of Canada's many maritime approaches, the Aurora was a much-anticipated platform by strategic planners.[7]

Fortunately, not only did the Aurora inherit the extended range and persistence capability of its predecessor, the CP107 Argus, but its impressive array of sensors allowed it to easily meet Canada's maritime ISR requirements. These same factors allowed for a relatively seamless transition to many environments and roles. Nevertheless, after nearly 20 years of venerable service, the legacy 1970s' technology was not only on the verge of becoming obsolete and difficult to maintain, but was also falling behind in its ability to meet contemporary roles and work in a joint and/or combined environment. In the early 1990s, as the world adapted to the end of the cold war, discussion had already begun regarding new roles and capabilities for Canada's LRP fleet. It was out of necessity and a desire to begin the transition from a maritime patrol aircraft (MPA) to multi-mission aircraft (MMA) that the Aurora Incremental Modernization Project (AIMP) was born and would come to include three series, or blocks, of upgrades.[8] The first two AIMP blocks are fully complete and include upgraded navigation and communication avionics in both the flight deck and the tactical compartment. The Block III update

comprised an almost entirely new sensor and data processing suite and is currently installed on three Greenwood aircraft. Block III will be discussed further below. In many respects, the Aurora's design, recent upgrades, and crew-station layout make this a versatile aircraft, as recently demonstrated overseas.

Both of the aircraft deployed on Op MOBILE were Block II variants suitable to the operational environment, although the new Block III sensor suite would have been a great asset. The modernized CP140 brought a number of unique capabilities to the fight. The radio-communication-suite upgrade provided aircrew and embarked mission specialists with an impressive communications "switchboard" to speak directly with as many as six agencies simultaneously, allowing for an agile and seamless transition to almost any command and control role.

The installation of the WesCam MX-20 electro-optics/infrared (EO/IR) camera in 2006, together with the overland electronic mission suite (OEMS) in 2009, done concurrently with AIMP upgrades, offered a data-fusion-based capability growth. The OEMS is a three-laptop suite, integrated with mission systems organic to the tactical compartment of the CP140. It enhances situational awareness, provides smart-cueing of the EO/IR camera, and assists target prioritization, greatly improving the final imagery product with embedded event markers.[9] Imagery can be digitally stored, with basic analysis in flight and downloaded upon landing. With the tactical common data link (TCDL) capability, video can be directly transmitted to remote video receivers (RVRs) or surface terminal equipment (STE) that can literally take control of the camera manoeuvring, similar to the control element of an unmanned aerial system.

The OEMS also receives maritime automatic identification system (AIS) "hits" that provide real-time position and movement of shipping traffic within line of sight (LOS) range, significantly improving our area coverage during domestic roles of maritime surveillance and fisheries monitoring. The CP140, in fact, was tasked to correlate the same AIS data collected by RADARSAT2 as a part of its proof of concept. All these improvements allowed crews to rapidly locate, identify, and forward required imagery (including video) and intelligence to supported commanders and agencies. While Aurora crews have been training to conduct ISR since the late 1990s, until recently, this role was considered secondary to the primary task of conducting ASW and ASUW. The camera was procured to replace the aging Forward Looking IR camera, not as an outright capability expansion. This imagery asset was extremely valuable in theatre because of its ability to collect imagery, day and night, and provide the global positioning system (GPS) position of the camera's boresight.

Perhaps one of the most valuable features of the Aurora is one that has existed all along: its endurance. Its ability to loiter over 12 hours allows for an unparalleled level of persistence, typically seen only with unmanned aerial system. This endurance, coupled with the

CF Photo: Sgt Pete Nicholson

room for extra crew members, makes it the ideal choice for the long-duration operations. This endurance enhances the role of an airborne command and control node, but in the context of ISR, it provides more than just opportunities for periodic reconnaissance (go and look), emphasizing the role of a true surveillance asset (go and watch).[10] Collecting uninterrupted imagery and fusing other intelligence sources (radio chatter, electronic emissions, vehicle movements, etc.) allow analysts to break down and identify patterns of life and accurately analyse complex targets.

Perhaps one of the most valuable features of the Aurora is one that has existed all along: its endurance.

Moreover, by virtue of being a multi-crew/multi-sensor platform, the gathering and interpretation of information from an array of sensors, providing an integrated, precise, and reliable picture of the situation below, can be performed simultaneously. To illustrate this fact, it was not uncommon while deployed on Op MOBILE to see the crew carrying out multiple tasks at once: performing overland ISR with the EO/IR while monitoring vessels of interest (VOI) via AIS[11] and radar, while also transmitting "warning and compliance" (psychological operations) messages to pro-Ghaddafi fighters over the radios. This multi-mission capability, combined with the newer sensors and data processing capability in Block III, will secure the CP140 Aurora as Canada's only strategic MMA.

OPENING NEW DOORS: ROLE EXPANSION IN THE HEAT OF BATTLE

When given the short-notice order to deploy in mid-March 2011, two OEMS-equipped Block II CP140s, one each crewed by 405 Squadron (Sqn) and 407 Sqn, departed 14 Wing Greenwood and flew directly to United States (US) Naval Air Station Sigonella, Italy, an established base of operations. Once the basic logistical requirements were secured (accommodations, vehicles, food, etc.), the challenge of integrating the Canadian LRP detachment into the entire Op ODYSSEY DAWN[12] and Op UNIFIED PROTECTOR force structure was instrumental to ensuring the crews were airborne and executing their missions accordingly. This required coordination with the overall Canadian headquarters (HQ) in Naples, the air component commander in Poggio-Renatico, and the TF commander, all of whom were tremendously busy setting up as well.

With respect to mission coordination, briefing the crews with intelligence summaries, and keeping apprised of continuously changing air tasking orders (ATOs), the DMSC established an excellent reputation in theatre. Visitors were consistently impressed and often wondered how to procure a similar resource for their detachment. The DMSC's most impressive quality during Op MOBILE was its functionality as a robust and capable operations centre. It easily surpassed the required 90-day serviceability mark as a classified network server, and was still going strong towards the 180-day point on mission close-out.

EMBARGO ENFORCEMENT

When the flying operations began, the Aurora's assigned role was the traditional task of maritime surveillance with the added benefit of the AIS. With the ability to quickly extract the surface contact data and relay it with data link into the real-time global contact database, our crews provided the NATO maritime forces along the coast of Libya with a much greater horizon, making their job of enforcing the embargo much easier. The CP140s, along with other LRPA, were hailing and providing assessments of shipping traffic,

fishing vessels, and port movements within the area of operations. Warning broadcasts were also made on maritime radio channels, advising anyone listening that NATO was watching their actions, to lay down their arms, and that anyone carrying weapons would be met with appropriate force.[13]

Throughout the entire deployment, the CP140 was always prepared for its secondary task of search and rescue. On every sortie, two 10-person survival-kits-air-droppable (SKAD) were carried in the bomb bay in the event an allied or civilian aircraft might have to ditch, or if a vessel was in distress. The Aurora was also tasked to conduct duckbutt duties, escorting numerous CF188 Hornet fighters enroute between Canada and Sicily throughout the deployment.

With such a high volume of warships along the Libyan coast, the Aurora was also tasked to detect and survey any type of rigid-hull inflatable boat that could pose a terrorist threat to surface vessels. This task was not taken lightly, as approximately a decade earlier, a rigid-hull inflatable boat-sized craft attacked the United States Ship (USS) *Cole* in the Port of Aden. Within weeks, and after some of the Aurora imagery products had made their way to strategic decision makers in Naples, the primary role of the Aurora soon changed to meet the intelligence- and imagery-product demand.

EVOLUTION BEGINS, TRANSITIONING TO COASTAL ISR

The Aurora's transition to an overland role was not immediate. As the intelligence picture became clearer, and the nature of the anti-air threat better understood, stand-off distances were reduced. Closing near the coastal cities and main supply routes exponentially increased the quality and resolution of the imagery, giving the product increasing value to operational planners. The abilities to follow troop movements and fuel trucks and to monitor all traffic flows and many other patterns of life were quickly identified as preferred missions, as ISR platforms were already stretched thin. After a typical sortie, full-motion video (FMV) was downloaded from the OEMS, and the DMSC intelligence cell had less than a four-hour turnaround to get the excellent imagery product into the headquarters. The crew would also debrief the mission support staff and submit a detailed post-mission report to commanders in Naples. This information was then turned around quickly for input into joint targeting boards, for ISR mission prioritization, and for building onto the mosaic of strategic intelligence. It was not uncommon to see Canadian LRP imagery products praised at higher headquarters for being professionally composed, high quality, and often the first with "eyes-on," an important piece of the overall intelligence picture.

The Aurora's performance on these early missions, combined with many of the unique capabilities previously discussed, made it the natural choice for coastal and eventually inland ISR&C missions. Overland and coastal ISR, although new in the relative history of the LRP community, are anything but an afterthought. In fact, over the past decade, the role has been fully embraced by the fleet (as seen with the camera and OEMS) and the doctrine, with corresponding TTP to train with in place. However, finding agencies and organizations willing to train with has been difficult.

Operation MOBILE's successes were built largely on LRP operational employment during ISR missions such as Op PODIUM (the Vancouver Winter Olympics), Op CADENCE (the 2010 G8/G20 Summit), Op TATOU (the 2009 Commonwealth Heads of Government Summit), and the Applanix camera mapping missions in Afghanistan in 2009. A tremendous amount of combat-related ISR experience also resides within the fleet as the Heron unmanned aircraft (UA) capability in Kandahar was manned by LRP squadron personnel who then rotated back onto Aurora crews after their Op ATHENA

deployments. Unlike previous maritime roles, where proficiency was largely gained on exercise, ISR exposure has been built under the stress of no-fail missions. The ISR training opportunities during combined and/or joint exercises are often few and far between, but have lately been changing for the better.

CROSS-CUEING WITH MULTIPLE PLATFORMS

The air component of Op UNIFIED PROTECTOR had many different ISR assets, with specific sensors tailored to the needs of their respective contributing nations. The effective and synergistic use of these assets, while airborne simultaneously, quickly became a priority in order to optimize the precious time in the operations area with eyes on the ground. Initially, most information of tactical value was reported through airborne warning and control system (AWACS) aircraft to the combined air operations centre. Radio nets quickly became overwhelmed with information reports, and not all information had the required certainty to make clear and concise decisions.

Progressively, cross-cueing of the various platforms became the norm, offering more analysis and corroborative information before passing it along to the combined air operations centre. On other occasions, UAs were assigned to investigate tactical reports from Aurora crews, and where positive identification was possible, legitimate targets were engaged by armed UAs or strike aircraft waiting in dynamic targeting queues. While the Aurora's sensors are numerous, other in-theatre aircraft had sensor and data-fusion capabilities beyond our means as a Block II aircraft. Nevertheless, by coordinating with assets, using "talk-on" procedures to identify targets and points of interest—following vehicles along main supply routes picked up by a moving target indicator, for example—the whole intelligence product was much greater than the sum of its parts.

CF Photo: Cpl Mathieu St-Amour

NAVAL GUNFIRE SUPPORT

Naval gunfire support is both old and new for the LRP community. With our maritime roots, the ASUW role has been exercised for decades; however, this traditional job was ship versus ship and involved firing missiles / gun salvos well beyond the radar or visual horizon of the vessel. With NGS, the firing unit manoeuvres relatively close to the target (within 30 kilometres) that it plans to engage. Trained spotters from allied nations accompanied crews on missions, and once targets were located with EO/IR, the spotter positively identified the contact, verified compliance to rules of engagement, provided assessments to estimate collateral damage (if any), and passed required information to the participating naval units.

It was the Canadian Aurora that became the preferred platform among the allies for this mission as the EO/IR camera provided superior imagery, and the communications suite and numerous multi-band radios allowed seamless reporting to surface vessels without compromising required routine mission communications. The NGS has not been exercised domestically with the CP140 and Canadian naval ships; however, as a result of Op MOBILE, doctrine development—along with tactical discussions with the Navy—is currently being explored to codify this joint Canadian capability—NGS.

STRIKE COORDINATION AND RECONNAISSANCE

If there was a culminating point for new mission profiles previously discussed, and for the CP140's communication and coordination abilities, strike coordination and reconnaissance were that point. After the Libyan capital (Tripoli) fell in late September, and Colonel Ghaddafi went into hiding, mission profiles quickly moved entirely overland, improving imagery quality exponentially. Bringing the Aurora closer to the action provided a more precise picture of ground activity, facilitated the identification of targets, and established a more detailed pattern of life in areas that could not be imaged when the Aurora was limited to the Mediterranean. Furthermore, with that same degree of cross-cueing, and being closer and better linked with the UA fleets, information flow from the Aurora platform was more timely and corroborative than previously experienced.

The Aurora flew its first SCAR mission on 22 September 2011, assisting a fighter aircraft being talked-on to its target using information from CP140 sensors.[14] Similar to the NGS missions, an embarked SCAR coordinator flew with the crew and was responsible for certain communication, establishing collateral damage estimates, adhering to rules of engagement and positively identifying military installations as legitimate targets—certainly not an easy task.

SCAR missions are by definition a form of deep air support flown for the purpose of acquiring and reporting deep air support targets, and coordinating armed reconnaissance or air interdiction missions upon these targets. In most cases, this translated into flying over specific geographical locations in Libya; searching for, detecting, and identifying targets; followed by subsequently coordinating the attack by assigned fighters or UVs. The benefits of the Aurora in these types of missions were that it identified targets well, arguably better than many UVs with smaller, less capable cameras, and efficiently relayed movement details, ongoing battle damage estimation, and coordinated subsequent strike actions. In addition, it remained overtop the area for sustained periods, allowing the time to build an accurate picture of activities, patterns of life, further target correlation, collateral damage estimates, and final post-attack damage assessments.

BLOCK III AND BEYOND

Now that TF Libeccio has closed out with the completion of Op MOBILE and all mission aircraft, detachment staff, and the beloved DMSC have returned to Canada, it is time to take a step back and learn from the mission. How can the LRP community take the trials and successes in theatre to the drawing board for combined and/or joint doctrine improvement and mission role development? With the transition to Block III, perhaps most importantly, how can the mission systems and the training of aircrew for use across a full spectrum of roles be optimized? Upgrades now in progress will only increase the amount of information at operators' fingertips. Without continuing to train in complex air-centric, ISR mission environments in real time, the result will be that tangible and operational proficiency will erode. The right exercise will provide crews with wide-spectrum mission opportunities that push and/or emphasize the need to rapidly prioritize this information and get it out of the airplane and down to the user as timely and accurately as possible, while ensuring both security of data and uninterrupted connectivity. With Block II, the imagery product was limited to EO/IR video and still photographs. With Block III, imaging radars will provide almost monochrome photo quality shots of terrain, through moisture, and at greater ranges, as well as enhancing returns from objects like tanks, buildings, and stationary aircraft. While cloud cover was often an impediment before, it is only a minor nuisance with the Block III. The new radar processor will improve the ability to track more dynamic and hard-to-resolve targets both in the overland and maritime environments. This translates to fewer lost targets in complicated and busy environments.

An improved electronic support measure (ESM) system has brought the CP140 to a state-of-the-art capability and places the Aurora in the category of a true, modern electronic intelligence (ELINT) collection platform, or even capable of electronic warfare (EW) roles. A new acoustic processing system and magnetic anomaly detection (MAD) system will ensure the LRP community remains effective and capable in the traditional "bread-and-butter" ASW and ASUW role and will dramatically increase the ability of the aircraft to search, detect, track, and prosecute increasingly sophisticated subsurface targets.

There is also new life being breathed into the Aurora airframe. Ten CP140s are currently scheduled for a structural life-extension project, giving a further 15,000 hours of flying time per aircraft, with the first one rolled out in December 2011.[15] In short, although the aircraft may be aging, recent development and recognition of its ever-increasing capabilities will translate into a rebirth of the Aurora as Canada's ISR&C leader.

Upgrades currently underway as part of Block III of AIMP will not only ensure joint interoperability, but also render the CP140 one of the most capable MMA in the world, with its only true rival being the Boeing P-8 Poseidon.[16] With the eventual inclusion of the OEMS system into the organic mission hardware and software, the ability to share information with joint platforms is almost limitless. For example, an object moving on the ground, undetectable to the human eye, even with the EO/IR, could be detected by a moving target indicator, correlated on a map to negate terrain features, analysed for motion characteristics, pushed onto the Link-16 network, identified by a closer CP140 with imaging radar, and prosecuted by an armed UA, fighter, land force, or naval warship, all within minutes. Reducing the sensor-to-shooter loop is what Block III will champion in the long run. The new data management system helps the crew manage the fire hose

of sensor information coming into and being transmitted out of the aircraft—the sky is literally the limit in employing this aircraft in the myriad of roles it may be called on to fill.

CONCLUSION

It is a central tenet of RCAF doctrine that flexibility is the key to air power, and this tenet was once again clearly displayed by the CP140 Aurora. Nowhere is this more important than in Canada, given its vast areas to protect in the overland and maritime domains, and the Aurora's versatility and long legs. Operation MOBILE was another mission in which the LRP force was able to perform extraordinarily well with short notice to deploy. History has demonstrated that the LRP community must be capable of responding rapidly to unexpected events, both domestically and abroad. Not only were LRP crews from both coasts able to fulfill classic maritime surveillance duties, but they repeatedly met and exceeded expectations to fill new and demanding roles overland in Libya. The future of the CP140 community will depend on the two pillars of success: its people and its technology. Regardless of the mission, the robust problem-solving skills and exemplary performance of CP140 aircrew, support staff and technicians, the experience and synergy derived from a "swept-up" crew that has flown together for months, a maintenance crew that always has a serviceable aircraft ready to fly, and the technological advances coming into service, the Aurora will be a force multiplier that will allow the commander to react decisively in the fog of war for years to come.

OPERATION MOBILE: A SNAPSHOT

The Canadian LRP Detachment was comprised of approximately 80 personnel, including aircrew, technicians, and support staff. By the end of the operation, 181 sorties had been conducted and over 1400 hours airborne logged, representing nearly 100 per cent mission accomplishment. Most impressive was the versatility of the aircraft to conduct missions well outside the typical maritime role associated with the CP140, including ISR, NGS, strike coordination and armed reconnaissance-coordinator (SCAR-C), and cross-cueing missions with both fighter and UA assets both off the coast and overland in Libya.

Task Force Libeccio was the land-based component of Op MOBILE, comprising the TF HQ in Naples, Italy; the Air Coordination Element in Poggio-Renatico, Italy; and the Sicily Air Wing with flying detachments in Trapani and Sigonella, Italy. Task Force Libeccio had approximately 400 Canadian Forces personnel.

The Sicily Air Wing was made up of four air operations flights and two close-support flights in two detachments. The Sigonella Detachment consisted of the CP140 Aurora Flight. The Trapani Detachment included CF188 Hornet Flight, CC150 Polaris Flight, CC130J Hercules Flight, operational support flight, and mission support flight.

Operation MOBILE also had a maritime component: the HALIFAX class frigate Her Majesty's Canadian Ship (HMCS) CHARLOTTETOWN, relieved in August by HMCS VANCOUVER, patrolled the inshore waters of Libya as part of Combined Task Group 455.01, part of Combined Joint Task Force Unified Protector.

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tor wings at the Canadian Forces Aerospace Navigation School (CFANS) in 2006. He recently returned from Op MOBILE, flying as a tactical navigator on the CP140 Aurora as a part of TF Libeccio.

Captain Josh Christianson is an air combat systems officer, flying as an acoustic sensor officer on the CP140 Aurora. He graduated from the University of Calgary with a Bachelor of Science in Molecular Biology, followed by a Masters of Science in Immunology from the University of Alberta, prior to enrolling in the CF in 2005 from Edmonton, Alberta, and obtaining his navigator wings at CFANS in 2008. He completed his on-the-job training with 404 LRP and Training Sqn and in 2010 was posted to 405 LRP Sqn, 14 Wing Greenwood. He recently returned from Op MOBILE as part of TF Libeccio.

ABBREVIATIONS

AIMP	Aurora Incremental Modernization Project
AIS	automatic identification system
ASUW	antisurface warfare
ASW	antisubmarine warfare
DMSC	deployable mission support centre
EO	electro-optics
HQ	headquarters
IR	infrared
ISR	intelligence, surveillance and reconnaissance
ISR&C	intelligence, surveillance, reconnaissance and control
LRP	long-range patrol
LRPA	long-range patrol aircraft
MMA	multi-mission aircraft
NGS	naval gunfire support
OEMS	overland electronic mission suite
Op	operation
SAR	search and rescue
SCAR	strike coordination and armed reconnaissance
Sqn	squadron
TF	task force
UA	unmanned aircraft

NOTES

1. Intelligence, surveillance, reconnaissance and control (ISR&C) is not recognized RCAF doctrine; however, it is commonly employed within the Canadian long-range patrol community. It is described as "being comprised of all weapons systems that contribute to the airborne gathering of information in support of the land or naval commander, and maritime control in the ASW role." Department of National Defence (DND), "14 Wing Campaign Plan," unpublished document available from 14 Wing, Greenwood.

2. Strike coordination and reconnaissance (SCAR) is not recognized RCAF doctrine. It is United States Joint Doctrine that is taught/utilized as required with respect to coalition operations. The Auroras deployed on Op MOBILE were employed in that capacity once it was deemed safe to operate in-land/overland within the Libyan area of responsibility and their MX-20 camera was deemed one of the better cameras for that task.

3. DND, *Operation MOBILE: National Defence and Canadian Forces Response to the Situation in Libya*, http://www.forces.gc.ca/site/feature-vedette/2011/02/libya-libye-eng.asp (accessed August 17, 2012).

4. Two CP140s deployed with the Mapping & Charting Establishment (MCE) to produce high-resolution and stereo colour imagery of Afghanistan, providing International Security Assistance Force (ISAF) soldiers on the ground with a much anticipated tool to improve situational awareness, flying over 300 hours.

5. Two CP140s deployed to support the maritime situational awareness role in the Persian Gulf and delivered reconnaissance and surveillance support to the maritime coalition forces, flying over 4300 hours.

6. DND, "14 Wing CP140 Aurora participates on Operation NANOOK, http://www.rcaf-arc.forces.gc.ca/14w-14e/nr-sp/index-eng.asp?id=10962 (accessed August 17, 2012).

7. Graham Edwards, "The Future of the CP140 Aurora," *Canadian Air Force Journal* 3, no. 3 (Summer 2010), http://www.rcaf-arc.forces.gc.ca/CFAWC/eLibrary/Journal/Vol3-2010/Iss3-Summer/Sections/07-The_Future_of_the_CP140_Aurora_e.pdf (accessed August 17, 2012).

8. Dalhousie University, Centre for Foreign Policy Studies, "CP140 Aurora Modernization," *Canadian Naval Review*, http://naval.review.cfps.dal.ca/forum/view.php?topic=38 (accessed August 17, 2012).

9. Similar to scene-selection on a DVD, shortening post-flight analysis time, and crew hand-over briefings to intelligence cell image analysts.

10. Ron Walker, "What Happened to Air Force ISR?" Canadian Forces Command and Staff College, Joint Command Staff Programme, 2009.

11. The AIS is similar to an aircraft transponder, although transmitted data-packets contain information on vessel size, persons on board, course and speed, departure and destination ports, etc.

12. Operation ODYSSEY DAWN was the US-led mission against pro-Ghaddafi Libyan forces to enforce UN Security Council Resolution 1973 (no-fly zone) and ended 31 March 11, at which point Op UNIFIED PROTECTOR continued under the direction of NATO HQ in Naples.

13. Murray Brewster, "Canadian surveillance planes join the propaganda war in Libya," *Canadian Press, iPolitics*, 29 July 2011, http://www.ipolitics.ca/2011/07/29/canadian-surveillance-planes-join-propaganda-war-urge-gadhafi-forces-to-go-home/ (accessed August 17, 2012).

14. DND, "Auroras fly first missions over Libya," http://www.cefcom.forces.gc.ca/pa-ap/fs-ev/2011/10/04-eng.asp (accessed August 17, 2012).

15. Canada Newswire, "IMP Aerospace rolls out first CP140 Aurora aircraft with new wings for the Royal Canadian Air Force," http://www.newswire.ca/en/story/892979/imp-aerospace-rolls-out-first-cp-140-aurora-aircraft-with-new-wings-for-the-royal-canadian-air-force (accessed August 17, 2012).

16. Dalhousie University.