MARK BATHRICK INTERVIEW

Mark Bathrick, Director, Office of Aviation Services (OAS), U.S. Department of Interior (DoL), USA. AFF16 talked to Andrew Drwiega, editorial consultant for Tangent Link.

Andrew Drwiega (AD): Mark, let's start with establishing an understanding of how the DoL uses its Unmanned Aerial Systems (UAS).

Mark Bathrick (MB): Only twenty five percent of our flying is flown in connection with wildfires. The other 75% is in support of Interior's other natural resources management responsibilities. DOI manages over 500 million acres in the U.S., that's about 1 in every 5 acres. UAS help us fulfil our responsibility to manage these vast public lands through their inherent ability to tackle dull, dirty, dangerous, denied access missions. From surveying vast stretches of remote wilderness, monitoring seismic zones and active volcanos, locating lost people who need rescuing, assessing the population of native, threatened, endangered or even invasive species, to preserving our archeological history, UAS have provided DOI with new opportunities to achieve better Science, improved Safety, cost Savings, and improved Service across our mission portfolio.

AD: What, in your experience, are the biggest misconceptions regarding the use of UAS?

MB: There are two competing misperceptions. The first is the external view (outside DoL) held by some in the community that these are rogue robots and that they are there to spy on us; their fears embody all the negatives perceived from their military use and built up by the media.

This is part of the wider general conspiracy theory regarding the intent of the Federal government. To counter this when we do go out to conduct Aerial surveys, we encourage individual project operators to engage with the local community and let them know what we are using them for, and why this work is important. When this is done proactively, we have found the community to be very supportive of their use and often express interest in seeing the results of the work we conduct.

The second misperception, more internal now, is that UAS are little more than toys or just another piece of field equipment like a hammer or a shovel. The view of some is that there is nothing special about them. Regardless of their size and weight, they are still aircraft and subject to the same laws of physics and the same unforgiving nature that is inherent in aviation.

All operators need to be aware of operating limitations and what happens if contact with the UAS is broken due to extended operating distances. One of my

briefings discusses the kinetic energy they can generate, either by falling out of the sky or even a low mass travelling at high speed at ground level (like a rotorblade).

AD: How did the Department of the Interior begin using UAS systems?

MB: Initially we received three types of ex-military aircraft worth $25 million - but free of charge - through the Federal Excess Property Program in 2006, saving a lot of taxpayer money. The UAS programme was conceived when I arrived at the DoL in early 2006.

We got between 150-200 UAS in total. The programme meant that we had complete UAS, together with boxes of spare parts, so that ensured a good flow of capability. It allowed us to fly these in a variety of missions in quick order, learning a lot, very quickly; just like an entrepreneur would iterate a new product.

From 2006-09 we developed policies and partnerships with Department of Defense (DoD), the military, the FAA and other agencies. We had to build an operating culture. In 2009 we got our first RQ-11 Ravens and then the RQ-16C T-Hawks. Part of the strategy was to operationally test and evaluate them in representative missions. We did receive some transition training in how to operate them from contractors and then we developed our own training programme that would be mission specific to meet the DoL's needs.

We had dozens of these UAS that we hadn't needed to spend money to buy. When we damaged one to the point where it wasn't easily repairable, then we would destroy it which is what the military was going to do anyway.

Once we identified our requirements we were able to go to the commercial sector who could provide commercial variants more specific to our needs. We now have three different commercial types from Falcom although we are still using the ex-military ones. Those will be phase out when we eventually run out of the spares.

AD: Who did you identify in the commercial sector?

MB: We have a contract with Falcon Unmanned of Colorado and Pulse Aerospace of Kansas. We are now using the Falcon fixed wing, Falcon Hover and Pulse Vapour. We have an arrangement for Indefinite Delivery, Indefinite Quantity (IDIQ), so there is no specific number. We know the technology is changing and we aren't sure yet what the appetite of our agencies will be.

AD: Can you give an example the benefit a particular UAS mission has delivered?

MB: Yes. Our first operational UAS mission was in 2010, using the RQ-11 Raven. We were doing a survey of Sandhill Cranes in a Colorado wildlife refuge. They come every year to have their young and it is important to conduct a census. In the past,

it had been attempted by using manned aircraft but they were loud, costly and difficult to schedule. That had led to a reversion of conducting the census on foot over the terrain which was difficult to achieve and the results were not precise.

The Raven is battery powered, quiet, hand launched and has EO/IR sensor. We launched at dawn when the birds were not active. The Raven was pre-programmed with a route which took it over nesting grounds at 100 feet without disturbing the birds. The recorded images could be downloaded and our personnel could actually tell the difference between a crane and a duck. The scientists loved it as they not only had an accurate survey but they could also see where the birds were nesting and near what types of plants and sources of food.

Animal, vegetable, mineral - we will count it. We are responsible for land and species management, so we are constantly looking at things like migratory birds, invasive species of grass, animals and geological changes. We collect data on everything that is within public lands. We also UAS to search for individuals who might be lost or conducting illegal activities on public lands.

We have now demonstrated UAS across 19 different applications. One of my phrases is: "There is not a commercial application for drones that I know of that the DoL has not tested or is planning to test."

AD: How did you negotiate with the FAA to gain UAS operating permissions?

MB: Key to our strategy from the beginning was collaboration and partnership with the FAA. I am sensitive to their plight and I endeavor to help them develop cases that show how things can be done. They have been tremendous partners for us and have responded by granting us increasing authority to operate. Initially we had authority to operate anywhere in Class G airspace up to 400 feet without having to complete a COA (Certificate of Waiver or Authorisation). We would file and fly without having to get prior approval. When I first started approval times could be longer than a year.

We developed our own training programme and now have a database of 500+ questions and answers regarding UAS operation. To be a drone pilot it used to be the case that you had to take the FAA pilot test but this included elements such as knowing airport lighting that our operators would never come across. We developed a test for our UAS operators only and asked the FAA to consider our training programme as a workable equivalent. They agreed on the condition that

they could use the programme to help qualify personnel from other agencies. I understand that it will now be part of the foundation for the new UAS certification programme for operators.

This long close partnership with the FAA was key to negotiating an agreement that is key to being able to realistically employ drones on wildfires. In a wildfire, visibility is always reduced because of the smoke. If we were limited to employing drones only within visual line of sight, their utility would be severely limited. To address this, we worked closely with the FAA to forge an agreement that allows DOI to operate beyond visual line of sight (BVLOS) within any Temporary Flight Restriction (TFR) established over the fire. This was the first agreement of its kind and enabled us to successfully test small reconnaissance drones over two actual fires last year. In both cases, we were able to safely and efficiently separate the manned and unmanned aircraft operating on the fire and gained great experience in how to best employ these assets in concert with one another.

AD: What was the connection with NASA?

MB: We have partnered with NASA on a number of areas. Our first conversation was when we had some Avinc Dragon Eye drones from the USMC although we didn't get to fly them. We then went with Raven. I had talked with NASA previously regarding a Very Large Air Tanker (VLAT) study concerning performance and air worthiness. This was the NASA Ames Research Group at Mountain View, California. They had an air worthiness board for their own drone testing and they were able to visit us at Boise, Idaho, to run tests and provided me with a written approval for our UAS operations which I attach to my letter and shows substance to our work. So we have a close relationship with NASA.

AD: Are you also examining how new technologies may be adapted by the DoL for use with UAS, such as ground penetrating radar?

MB: Any new strategy always centres around how much money we have, what our infrastructure is, where our personnel are and so on. We have to tailor our UAS to be either small enough to be airport and runway independent or, in the case of the large Lockheed Martin K-Max, have the capability to operate far afield and not be tied to an airport. It will still be a long time before unmanned aircraft will fly on a regular basis out of commercial airports. My usual questions are what UAS can I put on the back of a truck, carry on a horse or put in a back-pack, or preposition like the K-Max so that it is supported and can operate in remote areas.

We are driving industry and researchers into looking at how larger sensors can be miniaturised for use in smaller UAS. This is governed by the sensor's weight, form factor and how much electrical and processing power it requires to operate - which governs the size of the UAS and vice versa.

We are currently interested in interchangeable payloads as well as a common ground station. One of the advantages of the two Falcons is that they use the same ground control station. There are standards that will naturally develop over time. Drones now use tablets and there is mission planning software with way-points.

AD: With respect to aerial firefighting, what's your vision or prediction for the future of drones in this mission area?

MB: Great question! Drones, like other aerial firefighting aircraft are tools in the incident manager's kit used to support our ground firefighters who are the ones who actually contain and extinguish wildfires. What drones offer are unique and complementary abilities to their manned aircraft partners that promise to increase the efficiency, enhance the safety, and reduce the overall cost and loss associated with wildfires. Within 5 years, I believe drones will be an integral tool in how wildfires are combatted, worldwide.

First, I see drones helping in the early identification of wildfire ignitions, particularly following dry lightning events. I could see drones being used as autonomous wildfire spotters, strategically positioned in self-contained "lookout" towers that would serve as landing pad, recharging station, and data transfer node. Here, the drone could be launched to conduct routine and systematic ignition patrols or be sent out following a lightning event to specific lightning strike positions, pinpointing ignitions before they grew too large.

As you know, 95-98% of all wildfires are suppressed during initial attack and it is only the few large fires that aren't successfully contained that are the source of most of the cost and loss associated with wildfires. However, what people don't appreciate is that many of these large fires start as small fires that occur close to or during periods (e.g. night) when ground firefighters and traditional manned aircraft are unable to attack the fire. As a result of the delay in attacking them, some of these small fires grow too large to be easily contained when firefighters and manned aircraft can eventually brought to bear. This is another opportunity to leverage the capabilities of unmanned aircraft to safely operate at night and in reduced visibility.

Imagine if just one of these large fires, that ignited during a night period when manned aircraft don't traditionally operate could be attacked and contained or extinguished?

For the large fires that do occur, drones will provide ground and aerial firefighters and incident commanders with new levels of support. Drones with over 24 hour endurance, launched from within the confines of the fire's Temporary Flight Restriction (TFR) will hold overhead in a dedicated altitude band, providing real time data, voice, and video relay services. Free from the terrain masking and multi-path interference issues that often plague traditional hilltop repeaters, these "relay drones" will provide incident commanders with reliable communications with field

divisions and every ground firefighter with "in your hand and on demand" visual intelligence on the fire location, warnings, fellow forces, etc. This visual data will be gathered by similar drones equipped with electro-optical, infrared, and other sensors, processed into usable products, and delivered to those who need it as decision aids.

During the day, when visual flight can be maintained, manned aircraft will continue as the backbone of the direct attack and logistic support operations. As night falls and continuing during the morning periods when the smoke inversion that often occurs prevents safe manned aircraft operations (typically 16 hours each day), optionally piloted helicopters that flew during the day as manned aircraft will continue to fly from within the TFR, delivering suppressant on the fire, providing needed supplies to firefighters in the field, and if necessary conducting emergency extraction of injured firefighters. By being able to operate in 2/3 of the day when the fire has traditionally not been attacked, time when the fire is often at its most vulnerable (lower winds, reduced temperature, higher relative humidity), large fires are contained quicker, with less cost and loss of landscape, structures, and lives.

Following the fire, drones will quickly map the burned area, providing valuable data on areas at greatest risk of erosion, ensuring scarce rehab resources are used where needed most, first. Seeding drones will be used to map the best places for planting and without hazarding ground personnel, plant acres of new tree seeds with a calculated high yield probability.

These are some of the unique and complementary capabilities I believe drones will soon bring to the wildland firefighter's toolbox.

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