DRONES – ALL YOU NEEDED TO KNOW BUT WERE TOO SHY TO ASK

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PHOTO BY: GENERAL ATOMICS AERONAUTICAL SYSTEMS, INC.

The Military grade UAS Grey Eagle.

What the security services call surveillance, conservationists term monitoring. There is little difference between following the movements of a terrorist and following the movements of a rogue elephant. It should come as no surprise then that equipment developed by the military has been, and continues to be, adapted and developed for wildlife conservation.

Fixed wing aircraft and helicopters have long been employed for a range of conservation tasks but at great expense. One conservation organisation quoted $1200 an hour for use of a helicopter in anti-poaching operations! A much less expensive alternative, in both capital and running costs, are Unmanned Aerial Vehicles (UAV's) sometimes called drones. The variety of shapes and sizes available, and consequent costs, is surprising.

Today, about 45 countries fly more than 600 different UAV models; in the USA alone, there are approximately 280 companies, academic institutions, and government groups developing more than 200 different UAS designs ranging in price from $1,000 to $26 million. The mass ranges from a few kilos up to one tonne, the range from few kilometres up to 500 km, the flight altitude from a few hundred metres to 5 km, and the endurance from some minutes to 2-3 days.

Most people know only of the military drones seen on television shooting missiles on enemy targets. Little is known of the huge interest that has been aroused by the internet community DIY Drones with over 25,000 members who fly drones that they have either assembled themselves or have purchased ready-made from a growing number of companies supplying the amateur market. Chinese companies are among the leaders in this field offering drones with the same capabilities as of military ones but sometimes at prices less than $1000. However, there is a clear trade-off between portability/size, long-distance capability and cost.

What is a UAV?

A UAV is now defined as an aircraft that has the capability of autonomous flight typically pre-programmed via Global Positioning System (GPS). This differentiates it from a radio controlled aircraft which is manually operated or from uncontrolled vehicles such as balloons or rockets. As a UAV has a ground control element, it is more appropriate to use the term Unmanned Aerial System (UAS).

The key ingredient in a drone is the autopilot. Today, all the sensors

PHOTO BY: DIY DRONES

APM Mission Planner – one software solution for UAV missions.

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1. Quadcopter 2.Versa X6 with camera 3. OFM Octocopter
4. Seawind EP based arduplane 5. SurVoyeur UAV 6.VA Helicopter

required to make a functioning autopilot have become radically smaller and cheaper. Gyroscopes, which measure rates of rotation; magnetometers, which act as digital compasses; pressure sensors, which measure atmospheric pressure to calculate altitude; accelerometers, to measure the force of gravity - all the capabilities of these technologies are now embedded in tiny chips that can be readily acquired. The single-chip microprocessor that steers the plane based on input from all the sensors has undergone an even more impressive transformation, thanks to the rise of the smart-phone with its shift to the hyper-efficient "reduced instruction set computing" architectures. These chips are perfect for drones: fast and power-efficient processors that can go beyond following a pre-programmed mission and start to think for themselves.

The smart-phone/drone connection goes beyond the processors. A standard smart-phone has a full suite of sophisticated inertial sensors to detect its position. The demand for high quality cameras in phones launched a revolution in image-capture chips. Similarly the need for smaller, better GPS in phones has resulted in a thumbnail-sized device costing as little as $9 today. The same goes for components such as wireless radio modules, memory and batteries.

Appropriate software enables the flight path of a mission to be pre-programmed by simply clicking on waypoints in a Google satellite map interface. The ground speed and altitude can be set for each waypoint and the UAV can be programmed to take-off, land and circle over a particular point for a specified number of turns or duration.

TO HELP LOCATE AND RECOVER A DRONE IN DENSE HABITAT SUCH AS A FOREST, A GPS TRACKER CAN BE FITTED WHICH USES A SIM CARD TO TEXT VIA SMS THE COORDINATES OF ITS LOCATION TO A MOBILE PHONE AT SET INTERVALS.

To help locate and recover a drone in dense habitat such as a forest, a GPS Tracker can be fitted which uses a SIM card to text via SMS the coordinates of its location to a mobile phone at set intervals.

Some of the low cost UAV's look like scaled down helicopters and aeroplanes. Others, such as the more recently developed quadcopter, are easier to explain with a photograph.

The quadcopter is basically a helicopter with four rotors which gives it greater manoeuvrability and can quietly hover in place and point its powerful camera to people and objects on the ground. Quadrotors are currently used for surveillance and reconnaissance by law enforcement agencies and the military as well as search and rescue missions in urban environments. There are also six and eight rotor UAV's.

While adapted military drones were used to observe dolphin populations in the 1980s when hundreds of thousands of them were dying in tuna nets, the

ASCTEC Falcon 8 Aerial Imaging Octocopter

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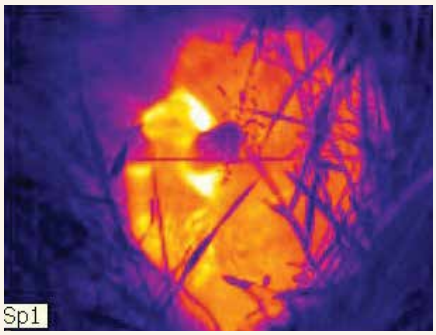

Thermal image of a deer fawn captured from the AsTec Falcon 8 'Flying Wild Saviour'

first evaluation of monitoring marine mammals using UAVs was carried out in the US in 2006 with an objective of using them in Arctic offshore areas where weather conditions are dangerous for manned aircraft surveys.

More recently the Sea Shepherd Conservation Society has employed drones to survey large areas of the Antarctic Ocean in pursuit of Japanese whaling boats. Previously they had been used in Libya to monitor blue fin tuna poachers. Long range capability is essential to find and keep on the tail of the whalers and while helicopters are used they are expensive to fly and cannot fly in the wind conditions that the drone can. The Osprey drones from the company Hangar 18 can fly approximately 200 miles from the survey ships. While the basic model costs $8,000, the Sea Shepherd organisation required a more expensive deluxe model, outfitted with cameras, GPS, and more robust motors to allow them to fly longer and farther than a basic version.

In 2010, a small UAS was developed to monitor changes in breeding population size of the Black-headed Gull. Fine-scale aerial images were taken from which geo-referenced data on nest locations were obtained without causing colony disturbance, which would not otherwise be possible via direct ground observations. The UAS weighed 2.0 kg, and flew at 30 to 40 km/ hour, 30 to 40 metres above ground. The approximate cost of the model aircraft plus all extra components and camera was around $2,000.

During pasture mowing, many wild animals that are not easy to see in the long grass, especially roe deer fawns, are killed by mowing machines. By flying some 30 to 40 metres above ground the 'Flying Wild Saviour', an octocopter UAV fitted with a lightweight thermal infrared camera, was used to detect hotspots. The copter was positioned at a lower altitude above the hot spot and, by observing the thermal and visual videostream on the ground monitor, the source was identified. A hand-held GPS device could then guide the rescue team to the fawn's position.

Specialists writing for the online publication Kenyanaviation.com report safety and regulatory implications for drones in Kenya and the wider international community. Drones can pose a danger to manned aircraft straying into busy air traffic lanes, leading to collisions and some incidents have already been reported in countries where drones are more widespread. As drones are remotely piloted, the operator cannot see other aircraft in the vicinity. Most drones do not have radar or collision avoidance systems and have no link to the air traffic control system thereby flying in complete ignorance of local air traffic conditions.

In the US, UK, Australia, and other countries where drones are used, it is specified that drones above a certain size must be operated by a trained pilot but those drones considered to be model aircraft do not require a pilot licence but still require training in the use of model aircraft. Some modification of the laws applied by the relevant Civil Aviation Authorities for the licensing of pilots for ordinary aircraft might be required in future to accommodate drones.

There may be a need for rules controlling the radio spectrum used by drones. Drones utilize radio frequencies that enable the ground-based pilot to control the aircraft and to transmit video and images from onboard sensors to the control station. This means that a portion of the radio spectrum should be allocated for use by drone aircraft. The law would also need to specify the type of radio equipment to be used so that drone operators did not interfere with each others' aircraft.

Security issues could arise where the equipment employed might compromise military operations or be operating in or near militarily sensitive areas.

Given the potential importance of the use of UAV's to wildlife conservation, these issues need to be sorted out as soon as possible.