"UAS, a new tool for tracking migration"

AEROMAB PROJECT (Aerospace Technologies applied to Biological Conservation)

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The general objective of AEROMAB project is to evaluate and develop methodologies for environmental conservation through the use of aerospace technologies. In particular, it focuses on the use of unmanned aircraft, internationally known as UAS (Unmanned Aerial Systems). We work with reduced size and weight aircrafts that incorporate cameras and telemetry systems that transmit position data and images in real time from the aircraft to the ground station where the operator is.

The use of conventional aircraft for monitoring wildlife in conservation biology is common, and there are many natural areas that routinely conduct over-flights. The UAS offer potential advantages over conventional planes because they are able to obtain equivalent data and produce less noise, are potentially cheaper, require less logistics and avoid the risk associated with manned flight.

So far, we have made 26 flights with electric Radio Control planes and 2 with FPV (First Person View) planes in Doñana National Park between February 15 and March 15 2010 in order to test the systems for aerial surveys.

Different species of birds were photographed on the flights: *Anser anser, Grus grus, Ciconia ciconia, Phoenicoperus ruber, Fulica atra, Anas platyrhynchos, Egretta garzetta, Bubulcus ibis, Ardea cinerea, Plegadis falcinellus, Anas acuta, Anas clypeata, Anas penelope, Aythya ferina, Netta rufina, Porphyrio porphyrio, Milvus milvus, Circus aeruginosus.*

We made several experiments to try different methods for census birds in the marshlands, practicing different trajectories with the planes to sweep completely an area and using the pictures as samples.

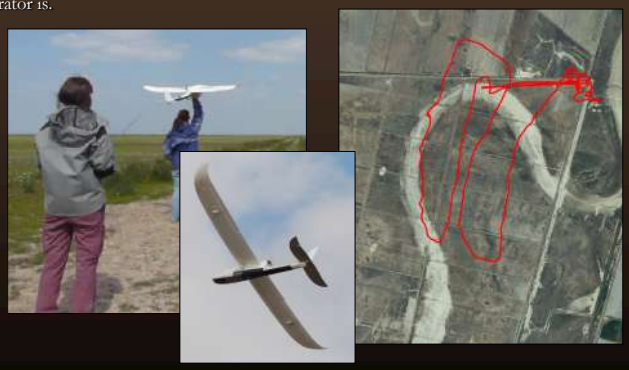

Image 1: fieldwork with the planes. Trajectory of the FPV system.

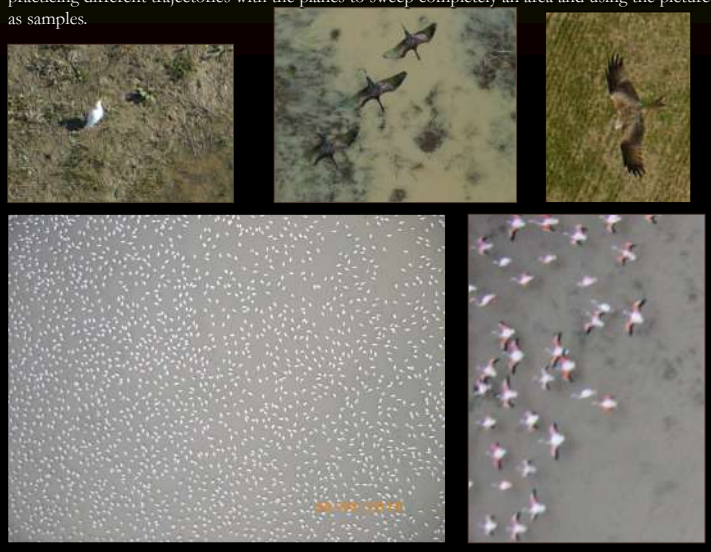

Image 2: pictures obtained with the onboard cameras: *Bubulcus ibis, Plegadis falcinellus, Milvus migrans, Phoenicopterus ruber*

AERIAL PHOTOGRAPHY

Most convenient type of flight:

The best range of heights for taking pictures with enough quality to distinguish species of birds is between 50 and 150 m. Ideally, the speed of the plane has to be between 10-40 km /h. The pilot must try to keep the aircraft stable in the horizontal plane, which is achieved making the turns with the tail rudder.

Location of the cameras:

The cameras were located in three different places (in all cases focusing directly to the ground). In the under part of the plane embedded in the fuselage, under the wing secured with a Velcro strap and at over the wing with the objective through it. Although the three configurations rendered positive results, the last location proved to be the best as it allows easy access to the controls of the camera and the objective is farther from the ground at landing, so that the probability of damaging the lens when hitting objects on the ground is minimized.

Shooting systems:

-Pentax Optio S12: we used a trigger system every 2 seconds via IR remote control.

-Panasonic Lumix: we use a servo anchored to the fuselage that made constant pressure on the shutter button and we programmed the camera in infinite shooting mode. The time between shots depends on how long it takes to the camera to focus (variable).

Best modes for getting good quality pictures:

Two types of commercial cameras were used: Pentax Optio S12 and Panasonic Lumix LX3. The best configuration for each of them was:

-Pentax Optio S12: "sport" mode MF infinite or AF Standard, ISO automatic 64-400, White balance automatic, One push PF activated. Better results were obtained with no zoom.

-Panasonic Lumix LX3: mode S (shutter priority) 1:2.000, AF infinite, ISO automatic, White balance automatic, AF mode spot, Metering mode spot. Good results were obtained with and without zoom.

EVALUATION OF IMPACT ON THE BIRDS

We have flown in different settings and have recorded the behavioural responses of several groups of birds.

Our preliminary results show that:

-Small UAS have a significantly lower impact than conventional aircrafts.

- Small UAS have a similar or lesser impact than cars.

Three phases can be distinguished by its effects on bird behavior:

1-Take off (motor at maximum power) has the greatest impact.

-direct approach can produce flee behavior in birds.

2-During flight (half power motor)

-at less than 100m from the birds it produces alert or exploratory behavior.

-at more than 100m from the birds (or with motor off between 40-100m) it produces exploratory behavior or no reaction.

3-Landing:

-only behavioral response detected in birds in direct approaches.

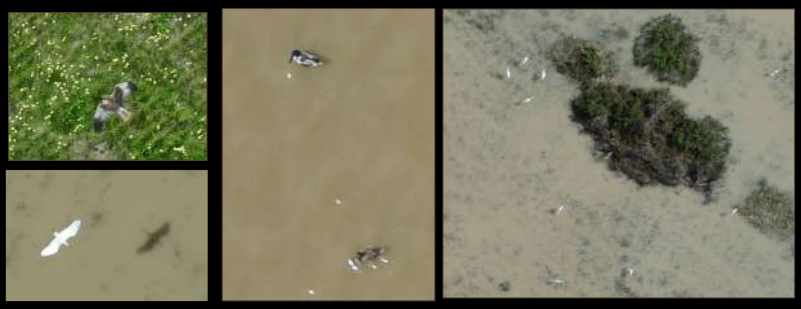

Image 3: pictures obtained with the onboard cameras: *Circus aeruginosus, Anas clypeata, Egretta garzetta,*

CONCLUSIONS

The preliminary results obtained can guess that UAS are a promising technology and make possible numerous applications for the study of migration, specially during the concentration of birds in stopover areas or corridors, and it will be particularly useful in remote areas where other methods are more complicated or expensive.

The next tasks on the project include the testing of new planes that incorporate most advanced technologies and higher performance cameras, such as Infrared and Ultra Violet, which offer a new field of possibilities for the monitoring of wildlife.

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