Lessons Learned – monitoring waterbird populations with a drone

The challenge

Waterbirds often nest in largely inaccessible colonies in flooded habitats and in dense aggregations and thus monitoring their populations accurately is a challenge. Prespa holds large populations of waterbirds, among them two species of pelicans (Dalmatian pelican and great white pelican), six species of herons (great white egret, little egret, grey heron, purple heron, squacco heron and night heron), the glossy ibis and two species of cormorants (great cormorant and pygmy cormorant), whose populations are systematically monitored by the SPP. Pelican colonies are located on islets consisting of reed rhizomes in Lesser Prespa Lake, while pygmy cormorant and heron colonies are situated within dense reedbeds growing in deep water (>2m) spread all around the fringes of Lesser Prespa Lake.

Until 2010, the main methods used for monitoring pelican colonies in Prespa were counts from vantage points and regular visits to the colonies. Visits to pelican colonies to count nests or young provide valuable information, yet they can cause major disturbance, especially in large colonies, and they require not inconsiderable amounts of time and preparation. As Prespa pelican populations grew significantly over the last thirty years, due to a series of management measures, site visits were no longer an option after 2000, as the risk of serious disturbance had significantly increased. Counts performed from vantage points do not cause disturbance, but sometimes fail to provide full coverage of the colony, because of the orientation of nesting sites, vegetation or other factors, and thus they may lack accuracy.

Respectively, until 2010, the mixed heron-pygmy cormorant colonies were monitored through a combination of methods: counts from vantage points (only for the larger species, i.e. great white egret and grey heron) and arrival-departure counts at dusk for the other species, for which visual counts of nests are very problematic even from a high vantage point. The latter method provides only approximate results and although it can be used for determining population trends it lacks accuracy.

The solution

Drones (or UAVs: unmanned aerial vehicles) are remote-controlled aerial devices capable of collecting high-resolution spatial data in difficult-to-access areas, without significant disturbance to the breeding birds, and with an affordable cost, depending on the surface to be covered (Sarda-Palomera et al. 2012).

The use of a drone for monitoring waterbird colonies can provide extra data to verify or correct erroneous estimations from other census methods, caused by e.g. the overcrowding of waterbirds on colonies. The purchase and operation of a drone is relatively low-cost and so drones can serve as a handy tool for monitoring waterbird colonies.

Multi-rotors are the main type of drone used for bird monitoring and research and also the type that the SPP uses. Quadcopters (four propeller drones) are the most common multi-rotor drones. They are the easiest and cheapest option. They are limited to around 20-30 minutes' use at a time, making them unsuitable for long distance work.

Lessons learned

The results of more than 10 years of drone use in Prespa demonstrate the suitability of the method for detailed monitoring of waterbird colonies and its applicability for obtaining long-term, comparable breeding population data. There are some important lessons we have learned along the way:

- Potential users should be aware that some basic training is necessary and a good knowledge of the area where one operates is essential. In addition, licenses are mandatory to fly them in most countries, while the heights at which they can be flown, the maximum distance from the operator, which places they can fly in and what purposes they can be used for, are regulated by laws.
- This method should be used complementary to other methods. It should be stressed that if one bases their research on drone use, then one should have the ability to replace the drone immediately in case of a crash, or be able to apply alternative methods. If this is not ensured then there is a risk of losing a whole sampling season, especially if the phenomenon being studied takes place inside narrow time frames, such as breeding.

- Flight execution: the drone can take off from land or water (e.g. from a boat or a floating raft) but this should be at least 100 m away from the colony. It ascends to about 60 m or higher and approaches the nesting site. Then, photography work can start: it is recommended to take 1-2 vertical and a few oblique photos facing several sides of the nesting site. The oblique photos can prove very useful during image analysis, as they provide more insight into what is going on under a sitting bird (e.g. it may have very small young that cannot be detected on a vertical image, due to being concealed by its body). The number of photos to be taken is decided in relation to the various circumstances and special needs at each site. In some cases, 1-2 photos can be enough.
- Flight height: a flight height of 40-60 m is considered adequate for obtaining images of sufficiently high resolution to accurately detect individual nests in the image, but without causing disturbance to the breeding birds. These high-resolution images (20 megapixels or higher is the ideal camera resolution), at the height of 40-60 m, are satisfactory with respect to the average physical dimensions of pelicans, herons and pygmy cormorants. Flights below 40 m may trigger adverse reactions in the birds and should be avoided.
- Become familiar with behavioural signs of adverse reaction: A drone approaching a waterbird colony and flying too low will trigger alertness: birds turn their heads towards the sky looking for what is generating the strange noise – in relatively quiet areas, drones are quite audible, and can be heard 200-300 m away. If the drone persists for more than a few seconds, then they may fly away. If that happens and the flight is taking place during incubation, then the risk of causing eggs to roll out of the nest or to break is very high. Therefore, the operator has to be extremely cautious in the early stages of nesting and on no occasion cause the drone to descend under the suggested threshold of 40 m.
- Flight duration and approaching colonies: a drone approaching a bird vertically is usually more disturbing, perhaps because it is associated with a predator attack (Vas et al. 2015), thus vertical hovering over waterbird colonies should be kept at a minimum, just a few seconds to take the images needed. Even if behavioural changes are not recorded during most approaches – when these approaches are made in compliance with the flight height recommendations – this does not mean that the drone presence is not stressful for them. Hence, the drone operator should limit total flight time over each nesting site to a minimum to ensure minimal impact.
- Flight schedule throughout the breeding period: the primary focus for monitoring, in waterbird colonies, is counting nests. Another important breeding parameter that is usually desirable is breeding success, and thus an efficient count of young is also needed. In order to accomplish these tasks, 2-4 flights may be required during the breeding period. The available record of all facts and events related to the year's breeding should be taken in account, as well as the observations of the colony from vantage points.
- Environmental conditions that provide optimal flight conditions are high visibility and low wind speeds. To minimize the effect of hard midday light, special lens filters can be used to reduce the amount of light which enters the camera. Alternatively, light cloudy days are preferred, and – as with standard wildlife photography – early and late in the day is the best time to photograph. In bright sunshine the control tablet is hard to see, due to glare on the screen. Special sun shades can be very helpful with this.
- Image analysis: a simple grid drawn over the image may prove helpful for a more efficient and less time-consuming count, especially of large colonies. Gridlines should be given a code to assist the process, e.g. vertical gridlines can be given numbers and horizontal gridlines can be given letters. Even in the cases of small colonies where a grid is not needed, a painting programme can serve as a tool for marking nests or young, or drawing lines or circles for various causes. Drone images are georeferenced and thus have highly essential information that enhances their utility. Nevertheless, it is useful to include one or more stable reference points in the image, such as trees. Such fixed points could be used for practical comparisons between years, as well as for more accurate surface and distance measurements. Drone images of waterbird colonies can also be used for nest measurements, to determine nest density and minimum proximity distance.

Literature cited

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