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Short Communication

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Unmanned Aerial Vehicles (UAVs) for Surveying Freshwater Turtle Populations: Methodology Adjustment

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Abstract: Unmanned aerial vehicles (colloquially known as drones) equipped with a high-definition camera are regularly used in the monitoring of various species. To our knowledge, the current study presents first data on the successful application of drones in herpetological studies. In two field trips (ca. 50 min of aerial observation time), we registered a total of nine adult specimens of two freshwater turtle species from two localities. The main positives of using a drone include allowing access to otherwise hard to access areas, storing recorded photos or videos on memory card and watching recordings in real time from a laptop. The negatives include inability to fly in suboptimal conditions, difficulty in detecting smaller animals and possibly causing disturbance to more sensitive species. We also highlight the features that we consider to be most useful for specialized herpetological surveys.

Key words: drones, habitats, herpetology, monitoring, population

Introduction

The Unmanned Aerial Vehicle (UAV), commonly known as a drone, is an aircraft without a human pilot aboard. Its flight is controlled either autonomously by onboard computers or by the remote control of a pilot on the ground or in another vehicle. Surveys with drones are routinely conducted to assess and monitor a number of both animal (mammals and birds, e.g. Hodgson et al. 2013, Vermeulen et al. 2013, Wilson et al. 2017) and plant species (Cruzan et al. 2016). UAVs may facilitate more accurate, human-risk free aerial surveys and allow for monitoring of areas, which would otherwise be inaccessible to humans (i.e. wetland habitats overgrown with reed). Because of their relatively small size, drones are less likely to disturb the studied animal than direct observation (Hodgson et al. 2016). As far as we know, they have not been used in herpetological studies. Therefore, we carried a preliminary survey as a proof-of-concept that such utilization of UAVs is also suitable for the rapid and cheap detection of aquatic turtles.

Materials and Methods

We used a Phantom 3 Professional drone with ultra-high definition video (3840×2160) and 12 MP photo camera. This model has several very useful functions, among which HD video transmission in real time, LiPo battery with a 4480 mAh capacity (providing a flight time of approximately 23 min, depending on weather conditions), power control system, flight controller (maximum transmission distance of up to 5 km when unobstructed and free of interference), ability to navigate back to predetermined "home point"), velocity up to 30 km/h. The total weight of the drone is 1280 g (battery and propellers included) and the diagonal size is 350 mm (propellers excluded); operating temperature is 0–40°C, maximum tilt angle is 35° and the hover accuracy range is within 0.1 m (vertical) and 0.3 m (horizontal).

Freshwater turtles were recorded from two localities in Sofia, Bulgaria: a lake in the Druzhba neighbourhood and ponds in the city's South Park. The first locality was visited on 1st May (between 14:00 h and 15:00 h) and the second – on 24th August

2015 (between 13:00 h and 14:00 h). At both localities, we conducted a 15-minute flight over the water surface near the shore (where turtle basking locations are usually situated for both water basins) and towards the centre of the ponds (i.e. above the water surface). The localities were chosen because of their easy access combined with the relatively low number of people visiting them on a daily basis.

Results and Discussion

We successfully registered six Red-ear Sliders (*Trachemys scripta elegans* Wied-Neuwied, 1839) from the Druzhba Lake and three European Pond Turtles (*Emys orbicularis* L., 1758) from the South Park.

On-site tests determined that the best height for surveillance was 10 m, as above that height turtles were not clearly visible and below 10 m the noise of the engines and the silhouette of the drone disturbed the basking animals (Fig. 1). When flying directly above the water surface, the camera was perpendicular to the drone in order to minimize glare; when surveying the shore, the camera angle was approximately 45°. In this way, filming distance to ground or water level was 10 m and 14 m, respectively. Speeds over 7 km/h at 10 m also disturbed the turtles. We were able to register specimens basking on the shore as well as turtles swimming under the water surface (at approximately up to 20 cm). Sometimes the sound from the propellers of the passing drone seemed to stimulate water frog vocalization for the next 15–20 seconds. However, frogs could not be easily detected and identified from the photographs and the recorded video.

There are a number of aspects in the use of a drone that can be considered helpful for surveys of herpetofauna in general and fresh water turtles in particular:

1. Allowing access to otherwise difficult to access or inaccessible areas.
2. Causing less disturbance to the observed animals compared to most methods for direct observation.
3. Detecting not only basking but also submerged turtles; some of the observed specimens were swimming below the water surface, which presents another advantage of this method over the direct observation from the shore.
4. Ability to hover while changing the camera direction and angle.
5. The video can be viewed live on a laptop screen as well as recorded for subsequent processing.
6. The option for storing recorded video or photos on memory card (up to 32 GB) is useful in documenting the observations.
7. The built-in GPS allows for easy positioning of the registered animals on a map.
8. Autopilot can be programmed to follow a

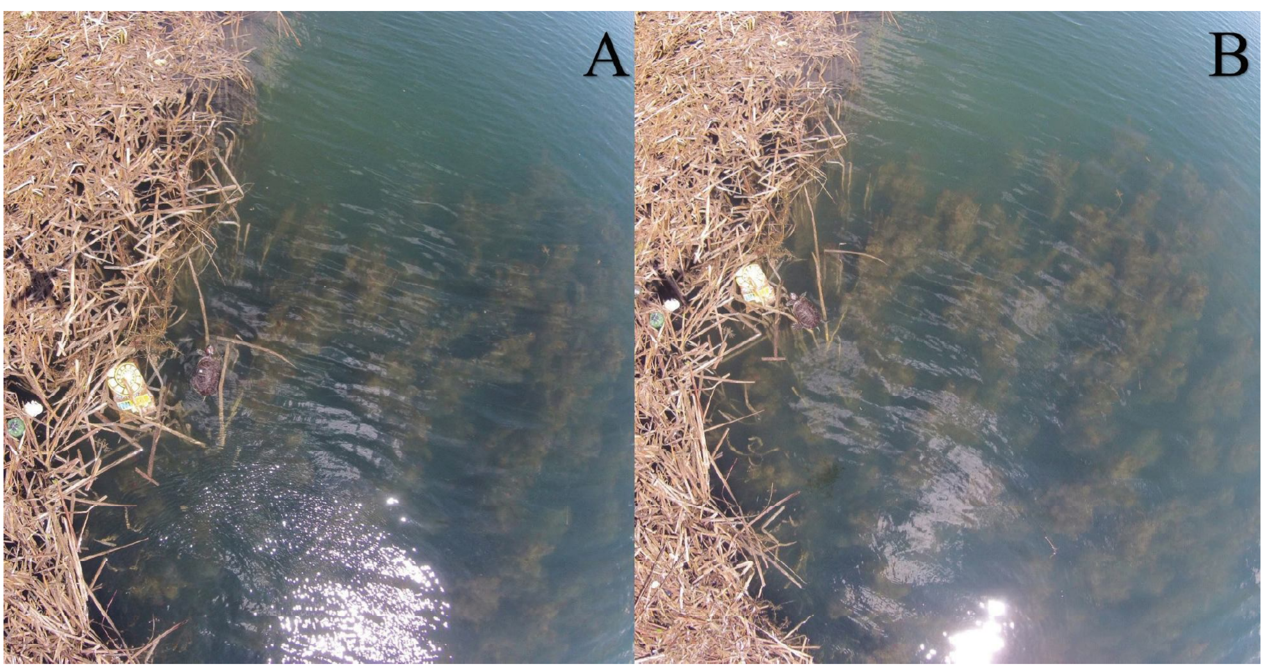

Fig. 1. A) A still image from the drone at a height of 6 m. The propeller causes significant ripples on the water surface, which disturbed a Red-ear Slider from its basking location; B) A still-image from the drone at a height of 10 m. The propeller causes almost no ripples, while the Red-ear Slider is still clearly visible

certain route at a given elevation, which can be useful in terms of repeatability of transects and standardization.

The drone-based investigations have some drawbacks and limitations:

1. The drone cannot fly during heavy rain or strong winds (over 20 km/h).

2. Autopilot does not function in no-fly zones (e.g. close to airports). This could possibly change in the near future, as the use of such technology might become more regulated.

3. Difficulty in detecting smaller animals (< than 15 cm at a resolution of 12 MP and height of 10 m; also depending on current weather conditions).

4. Relatively short flight time.

5. More sensitive species or individuals from pristine habitats might be disturbed by the movements and the sound of a flying drone.

Both localities of this study are from an urban environment and all animals there are – to some extent – accustomed to a higher level of disturbance. It is possible that turtles from pristine ponds are more easily disturbed and consequently should be monitored at a greater distance, which might be inefficient. We highlight several drone features which, in our opinion, would be the most useful in herpetological surveys:

1. Ability to change camera angle and direction while hovering with a narrow accuracy range – the narrow accuracy range will ensure that the drone remains stable and does not move while the camera surveys nearby terrain features.

2. High-definition camera with optical zoom option – when uncertain of the species, the drone operator could zoom in without moving the drone closer (i.e. less risk to scare away the observed specimen).

3. Silent propellers, combined with small size – less risk to scare away the observed specimen.

4. Improved water resistance (ideally waterproof) – less risk of irreparable damage if submerged under water because of malfunction, gust of wind, etc.

5. Long battery endurance – more time for aerial surveillance.

6. Ability to navigate to a predetermined "home" point if signal from the controller is lost – important when working in less than ideal conditions.

7. Ability to avoid obstacles during automatic flight – important when working in less than ideal conditions.

8. Ability to save GPS tracks during manual flight – useful in terms of repeatability of transects and standardization.

Overall UAVs present a new and exciting trend that could prove to be very useful in herpetological studies. However, further testing is needed in order for the full potential of the drones to be realized. Considering the fast pace of development in these technologies (e.g. the Phantom 4 model has an avoid obstacle ability), we expect that the usefulness of drones could only increase in the foreseeable future.

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