Which Drone Should You Buy to Study Dolphins?: Assessing Dolphin Response Behavior at Various Heights With Commonly Used Platforms

Savannah Damiano and Jason Bruck

Department of Biology, Stephen F. Austin State University, Nacogdoches, TX

Introduction

Drones are becoming a commonly used platform for understanding dolphin behavior. However, this can be an intimidating field to approach as data is sparse on which commonly used drone types are the best to use for marine mammal research.

There is a need to further investigate the advantages and disadvantages of various drone types for marine mammal studies when it comes to disturbance factors.

Three commonly used DJI drone platforms were used to evaluate how drones affect the behavior of dolphins, the DJI Mini 2, the DJI Mavic 2 Enterprise Advanced, and the DJI Inspire 2.

The DJI Mavic Enterprise Advanced is infrared thermography (IRT) capable, meaning it can take thermal photographs. With this drone, we want to test if a dolphin's breath was visible in IRT. If possible, this could be a useful tool for tracking wild dolphins in murky water.

We collected response data in 2022 from 11 animals under human care at Dolphin Quest Bermuda, a public facility accredited by American Humane and the Alliance of Marine Mammal Parks and Aquariums.

This is part of a larger study comparing responses of animals under human care with animals in wild and heavily disturbed populations to study how resident dolphins habituate to the presence of drones.

Methods

A behavioral study was conducted to assess dolphin look and submerge response at various heights.

The drone began at a starting height of 300 feet and lowered in 10 ft increments for 10 seconds.

At each height, dolphin responses were recorded.

A generalized linear model was performed with Systat 11 with number of looks as a dependent variable and drone type and height as factors. A post hoc analysis was conducted with the Inspire 2 data with submerge time and look number as dependent measurements.

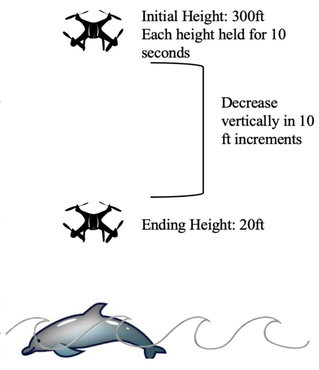

Figure 1. Schematic of approach methods

To collect IRT images, the DJI Mavic 2 Enterprise Advanced was used as a handheld camera. An individual would sit on the dock and hold the camera at eyelevel while pointing the IRT camera at the dolphin's blowhole. Another individual recorded the event via the controller.

The trainer would ask the dolphin for a chuff (a learned exhalation behavior). The chuff was video recorded in IRT and analyzed.

Results

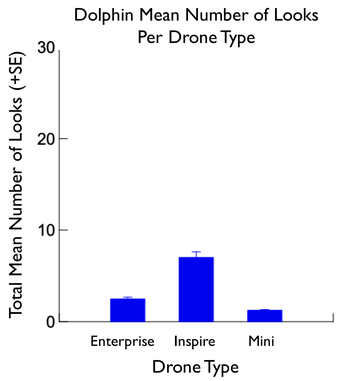

Figure 2. Dolphin mean (+SE) number of total looks per drone type for three different DJI models: Mavic 2 Enterprise Advanced, Inspire 2 and Mini 2. GLM indicated that drone-type was a significant factor explaining look behavior in dolphins ($p < 0.001$).

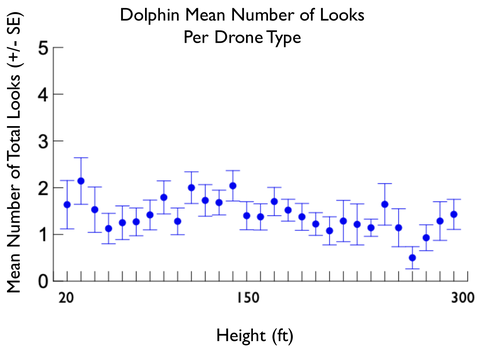

Figure 3. Dolphin looks per drone height for 31 flight sessions. Testing began at 300 feet and the drone descended 10 feet every 10 seconds. GLM indicated that height was not a factor explaining look behavior in dolphins ($p = 0.80$).

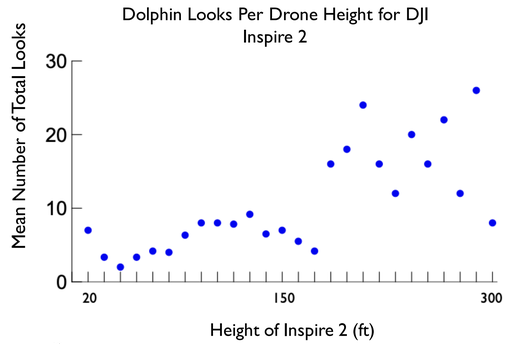

Figure 4. Dolphin mean number of total looks for the DJI Inspire 2 ($p > 0.0001$).

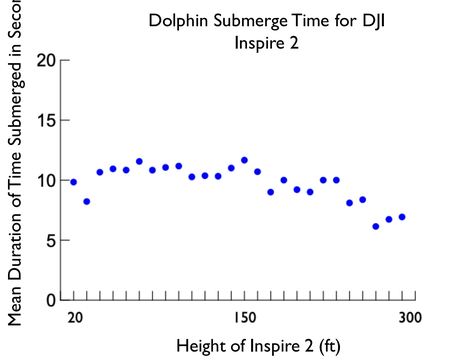

Figure 5. Dolphin mean duration of submersion for the DJI Inspire 2.

Did drone type affect dolphin behavior?
Yes; the average number of looks of the dolphins varied with drone type. $F(2, 607) = 134.23$; $p < .0001$ (Figure 2).

Did drone height affect dolphin behavior?
As a whole no (for all three drone types taken together); the number of look ups by dolphin did not vary with height, $F(28, 607) = 0.77$; $p = 0.80$ (Figure 3).

Did drone height affect dolphin behavior for DJI Inspire 2, specifically?
With the DJI Inspire 2, dolphins seem to change look behavior for submerge behavior as drone gets closer. $F(1,982) = 3.63$; $p < 0.0001$ (Figure 4 & 5).

Is a dolphin's breath visible in IRT?
Yes, there is a distinct heat signature from the exhalation (Figure 6).

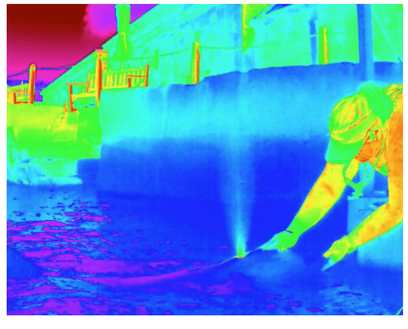

Figure 6. Bottlenose dolphin exhalation in infrared thermography

Figure 7. Dolphin (on right) exhibiting a side roll behavior when drone is stationed above.

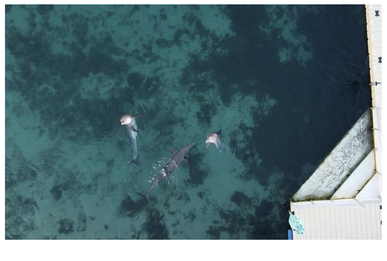

Figure 8. Dolphins exhibiting a spy hop behavior when drone is stationed above.

Drone Types

Figure 9. (Left to right) DJI Mini 2, (quiet, but more readily subject to 'blow away'), DJI Mavic 2 Enterprise Advanced (thermal camera ±2°C temperature measurement accuracy), DJI Inspire 2 (wind resistance, can handle ocean air currents, high resolution camera, dual pilot controls, standard on marine mammal research).

Discussion

Unsurprisingly the drone with the most look responses was the Inspire 2 which has a much higher noise profile (~83dB).

The Mavic 2 Enterprise Advanced (~79dB) was the next most looked at drone followed by the Mini 2 (~74dB).

While height is not an overall factor in disturbance from 20-300 ft for all drones taken as a whole, at the higher heights (210- 300 feet), there are significantly more looks per dolphin for DJI Inspire 2. This may be explained by dolphin submerging and looking less underwater (between 20 to 250 feet) with that drone type.

Data are now being analyzed for habituation responses. Should habituation occur, these drones could prove to be a useful and noninvasive technique in the future of dolphin management and conservation when used repeatedly in the same location.

For dolphin research, the DJI Mini would be recommended for discrete and non-invasive research in calm winds.

The DJI Mavic 2 Enterprise Advanced would be recommended for thermal imagery research and as a good all-around drone. Likewise, this drone could be affective in research that requires capturing dolphin exhalation in thermal photography and videography.

The DJI Inspire 2 would be recommended for high wind gusts and dual operator controls, however, one should expect animal disturbance with this drone type.

Next steps are to evaluate dolphin behaviors to the SwellPro Splash Drone 4, the DJI Avata, and the DJI Mini 3 in May 2023.

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