Utilization of small unmanned aerial systems for mapping of Napatree Point Conservation Area

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Christina bringing the Phantom in for landing with Greg, Pete and Chris. Photo courtesy of Janice Sassi.

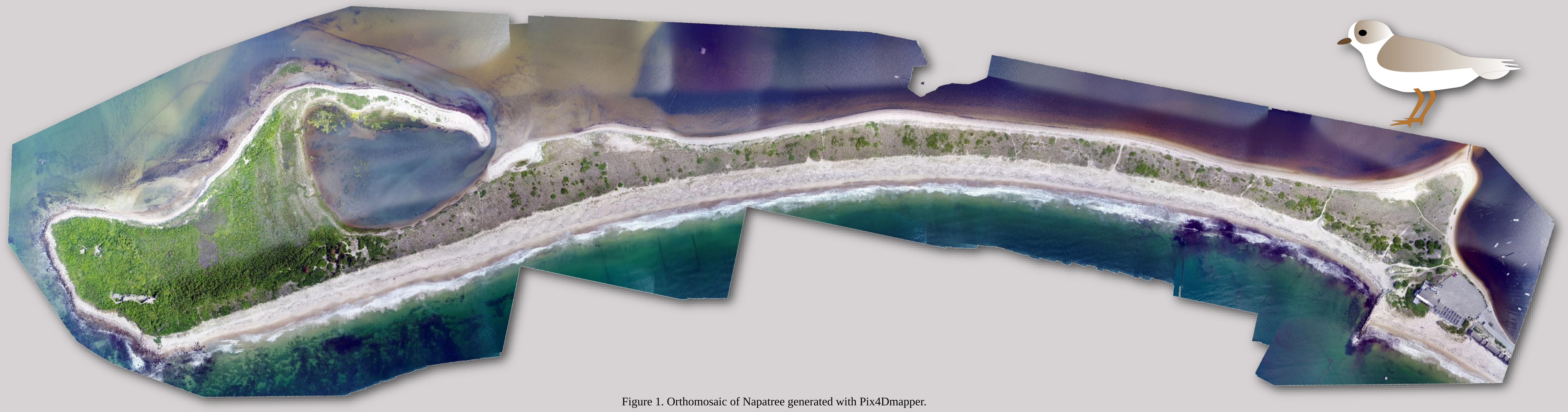


Figure 1. Orthomosaic of Napatree generated with Pix4Dmapper.

Christina looking up in the sky for the Phantom. Photo courtesy of Pete August.

Introduction

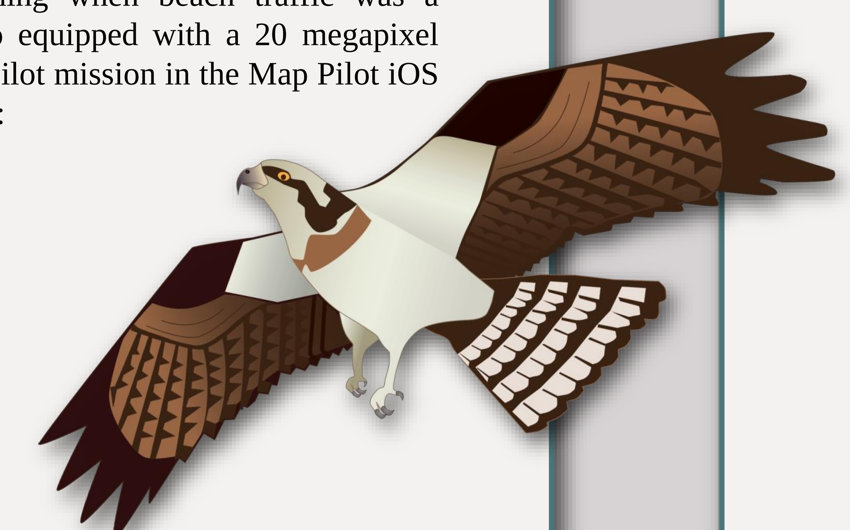
Napatree Point Conservation Area is a 1.5-mile-long sandy spit extending into Little Narragansett Bay in Westerly, RI (Figure 1). It has been declared to be a Globally Important Bird Area by the Audubon Society for its diversity of shorebirds and migratory species. Napatree is a storm-driven ecosystem. Monitoring storm-induced habitat and sand dune changes requires the ability to gather detailed aerial imagery on short notice (before and after storm events). The purpose of this project was to determine the utility and cost effectiveness of using small unmanned aerial systems (UAS) to gather imagery for high resolution mapping of habitats. We used a DJI Phantom 4 Pro UAS to gather imagery for this project.

Methods

Data collection was performed early in the morning when beach traffic was a minimum on June 21, 2017. A DJI Phantom 4 Pro equipped with a 20 megapixel camera was controlled using a pre-programmed autopilot mission in the Map Pilot iOS software application. The mission specifications were:

Camera Settings
- Autofocus
- JPEG format
- Sunny white balance

Mission Parameters
- Altitude – 120 meters
- Max flight speed – 9.6 meters/second
- Forward/lateral overlap – 75/70%
- Camera angle - 90° (straight down)



The aircraft was launched from a 5.5-meter motor vessel anchored in Little Narragansett Bay on a mostly sunny day with a slight breeze. A linear mission (Figure 2) was flown and completed in a few hours with two separate flights. Points of known location, or ground control points (GCPs), were recorded using RTK (Real Time Kinematic) global positioning technology in the Rhode Island State Plane Feet NAD 1983 coordinate system with an estimated 2-centimeter positional accuracy.

The unaltered images were uploaded into Pix4Dmapper software and processed to create an orthomosaic of Napatree. An orthomosaic differs from a regular image mosaic because spatial distortions are removed from the orthomosaic. The GCPs were converted to UTM 19N coordinates and used to assign real-world coordinates to, or georeference, the orthomosaic.

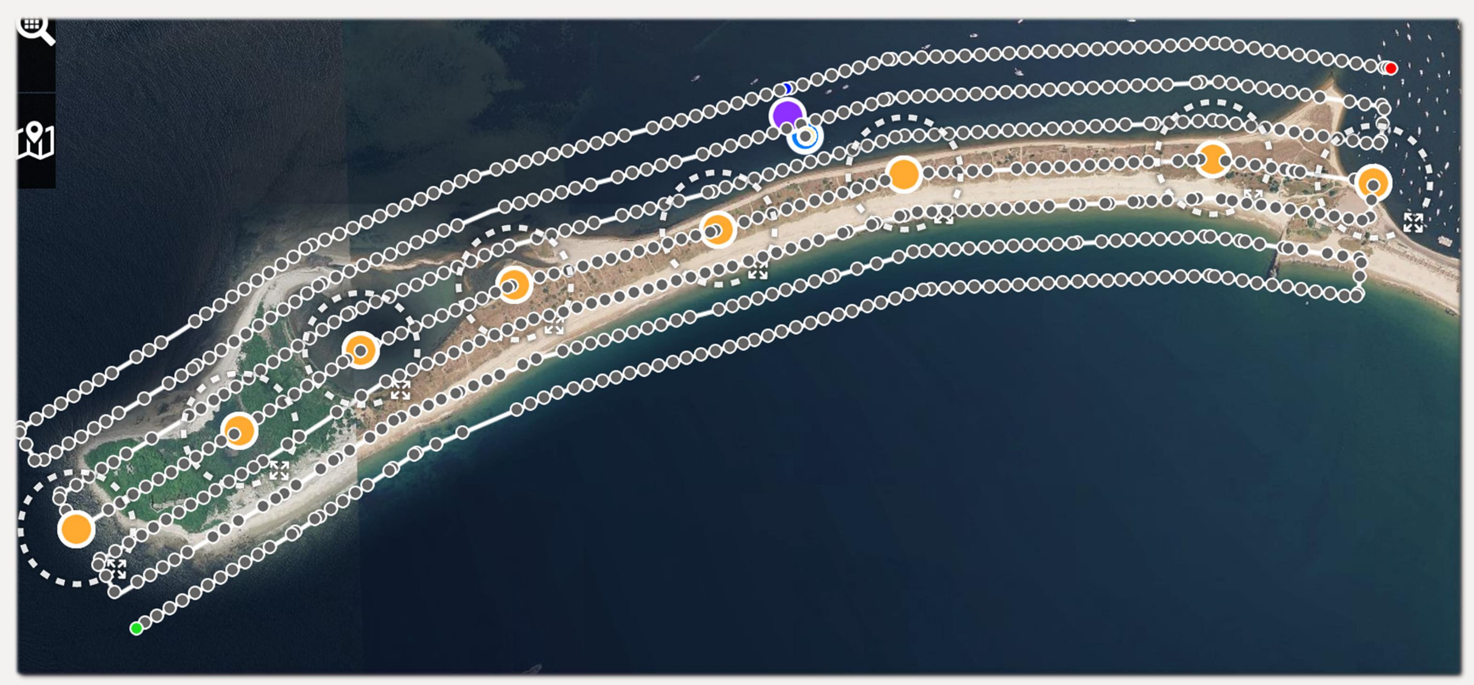


Figure 2. Flight lines for Napatree mapping mission. The grey dots represent an image capture.

Spatial Accuracy

	Error X cm	Error Y cm
Mean (centimeters)	-1.7	-1.4
Standard Deviation (centimeters)	4.9	6.6

Table 1. Horizontal orthomosaic error calculated by Pix4Dmapper (n=6).

	Error cm
Mean (centimeters)	118.8
Standard Deviation (centimeters)	51.1

Table 2. Horizontal orthomosaic error calculated manually against 2008 RIGIS imagery (n=17).

Results

Pix4Dmapper produced an orthomosaic of Napatree with a pixel size of 3.14 centimeters (Figure 1). Seventeen GCPs were used to georeference the orthomosaic, and six GCPs were used as checkpoints. Using the checkpoints, Pix4D estimated the horizontal (x, y) error, which indicate the accuracy of the georeferencing (Table 1). Errors were also estimated manually in ArcGIS using 17 validation points and tested against a high resolution (10-centimeter pixel size) RIGIS image of Napatree obtained in 2008 (Table 2).

Conclusion

This research shows that consumer UAS's are an affordable and effective means for high resolution mapping projects. As with any UAS, consumer or commercial, data collection can be tailored to meet the needs of the specific project. Although consumer UAS were not engineered for planimetric mapping purposes, many different software applications are available to design and plan such missions. These applications make it easy for the user to obtain quality imagery needed for mapping. Another advantage of using UAS over conventional mapping methods is spatial resolution. The baseline map of Napatree created for this project has a spatial resolution of 3.14 centimeters, compared to a spatial resolution of 1.13 meters for the most recent RIGIS imagery of Napatree. Future research should be done to determine the utility of consumer UAS for 3D mapping and terrain modeling.

Acknowledgements

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