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Preliminary Assessment of Shorebird and Wading Bird Populations in Galveston Bay Using Unmanned Aerial Vehicles

Anna Vallery¹, George Guillen¹,², Marc Mokrech²

University of Houston – Clear Lake

¹College of Science and Engineering
²The Environmental Institute of Houston
Acknowledgements

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Research Objectives

• 1. Identify foraging habitat preferences in Galveston Bay shorebirds and wading birds

• 2. Determine if the available UAV technology could be used to survey shorebird and wading birds, answering these questions with more ease than traditional methods
Bastrop Bay

- Surveys were completed at several locations around Bastrop Bay
  - Southwestern portion of Galveston Bay
  - Brazoria National Wildlife Refuge
- Bastrop is relatively undisturbed
  - Agriculture
  - Several rural subdivisions are found along the bayou
- Bastrop Bay watershed is approximately 217 square miles
Methods for Traditional Surveys

• Surveys were conducted bi-monthly from August 2016 to July 2017
  • Surveyed the entirety of Bastrop Bay’s interior, noting any birds, their location, substrate, and behavior.

• Analyses
  • ArcGIS - Hot spot
  • ArcGIS - Cluster
  • Summary Statistics
Unmanned Aerial Vehicles

- Unmanned Aerial Vehicles (or “drones”) are increasingly being used across biological and ecological research (Anderson & Gatson, 2013)
  - More affordable than traditional survey methods
  - Easy to use
  - Safe
- Several models of UAV on the market
  - Fixed-wing
  - Multi-rotor
UAVs in Avian Research

• Aircraft crashes have been found to be the number one cause of mortality among biologists in the field (Sasse, 2003).

• UAVs have only recently been applied to survey birds
  • Colonies of wading birds (Abd-Elrahman et al., 2005)
  • Canada Geese (Chabot & Bird, 2012)
  • Black-headed Gulls (Sarda-Palomera et al., 2012)
  • Adélie penguins (Rümmler et al., 2016)
Fixed-Wing UAV

- QUESTUAV AQUA Drone
  - Equipped with Sony A6000 camera (24.3 megapixel)
  - Immediately observed disturbance across species present
  - Recorded behavioral response
    - At varying flight heights
    - For varying flight patterns
Fixed-Wing UAV
Multi-Rotor UAV

- Phantom 4 pro quadcopter UAV
- Disturbance was visibly less than the fixed-wing UAV
- Possible to fly closer to all species with less disturbance than FW
  - Obtaining clearer photos & video
- Major factors in disturbance: Height vs. Speed
Multi-Rotor UAV Video
## Quadcopter vs Fixed Wing

<table>
<thead>
<tr>
<th></th>
<th>Phantom 4 Quadcopter</th>
<th>QUESTUAV AQUA Fixed Wing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Launch</strong></td>
<td>Quadcopter can be launched with ease from almost any flat surface.</td>
<td>Requires a larger area to launch as well as good weather. FW must also be launched into the wind.</td>
</tr>
<tr>
<td><strong>Flight Height</strong></td>
<td>Can fly as low as desired.</td>
<td>Flight height is more dependent on wind speed and weather conditions.</td>
</tr>
<tr>
<td><strong>Survey Area Size</strong></td>
<td>Can only cover a small area at a time.</td>
<td>Can cover very large areas at a time.</td>
</tr>
<tr>
<td><strong>Noise Level</strong></td>
<td>Less noisy</td>
<td>More noisy</td>
</tr>
<tr>
<td><strong>Shape</strong></td>
<td>Novel shape, less impact on birds.</td>
<td>“Predatory” shape may impact behavioral response by birds (particularly when circling).</td>
</tr>
<tr>
<td><strong>Video/Photo Quality</strong></td>
<td>Can fly lower, obtaining higher quality images with camera.</td>
<td>Has to fly higher, requiring a better camera than QC for quality images.</td>
</tr>
<tr>
<td><strong>Battery</strong></td>
<td>Surveys are short as a result of battery life.</td>
<td>Battery life can provide longer surveys covering more area.</td>
</tr>
<tr>
<td><strong>Waterproof</strong></td>
<td>Not waterproof.</td>
<td>Waterproof.</td>
</tr>
<tr>
<td><strong>Overall Disturbance</strong></td>
<td>Able to obtain better photos and video with less disturbance than FW UAV.</td>
<td>Overall, disturbance was greater and photo and video quality was less.</td>
</tr>
</tbody>
</table>
Analysis

- Analyses include data from both Fixed-Wing and Quadcopter surveys
  - 5 fixed-wing surveys and 4 quadcopter surveys
- Order Charadriiformes
  - 100% of birds flushed at some point during fixed-wing surveys
  - 62% of birds flushed at some point during quadcopter surveys
Analysis

- ArcGIS photo georeferencing
  - Count all visible birds without double-counts
  - Determine exact location at time of survey

- Mapping Bird Locations
  - Cluster
  - Hot Spot
ArcGIS Full Motion Video

- ArcGIS video georeferencing
  - Full Motion Video
  - Count all visible birds
  - Determine exact location, behavior, and substrate at time of survey
Preliminary Conclusions

• UAVs have the ability to make surveying waterbirds easier and more accurate than before
• Quadcopter, or multi-rotor, UAVs are more appropriate for studying waterbirds than fixed-wing
  • Ease of use
    • Launch
    • Photo and video quality
    • Control
  • Behavior
    • Less impact than fixed-wing
    • Approach pattern can be modified to achieve minimal disturbance and maximum identification
Future Research and Development

• Develop optimal methods for surveying these species of bird
  • Model ideal speed and height to determine best UAV approach methodology
  • Finalize incorporation of ArcGIS Full Motion Video technology for obtaining accurate results
  • Incorporate improved new cameras technology coming to the market

• Should be able to replace or augment traditional survey methods with UAV surveying when standard operating procedures are created
Continuation

• EIH is currently searching for funding to continue this project, specifically targeting oyster reef habitat used by waterbirds.
• Other associated applications of UAV technology – mapping SAV, saltmarsh and mangrove habitat.
Questions?
References


