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

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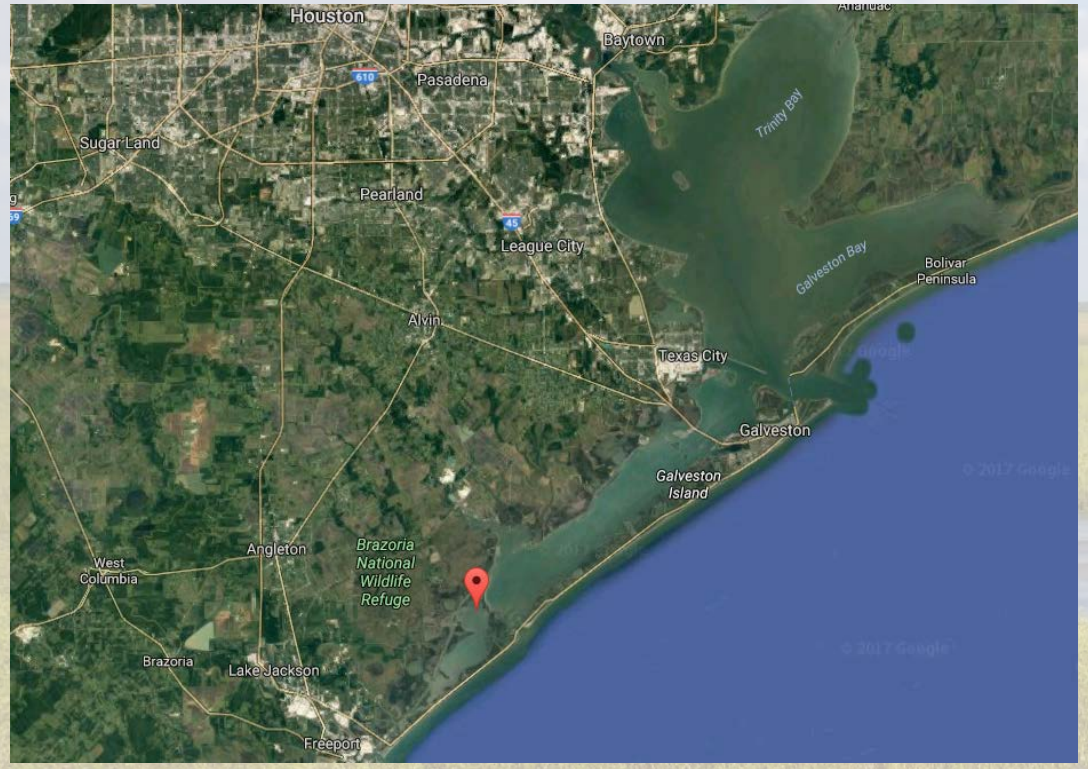
Research Objectives

- 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

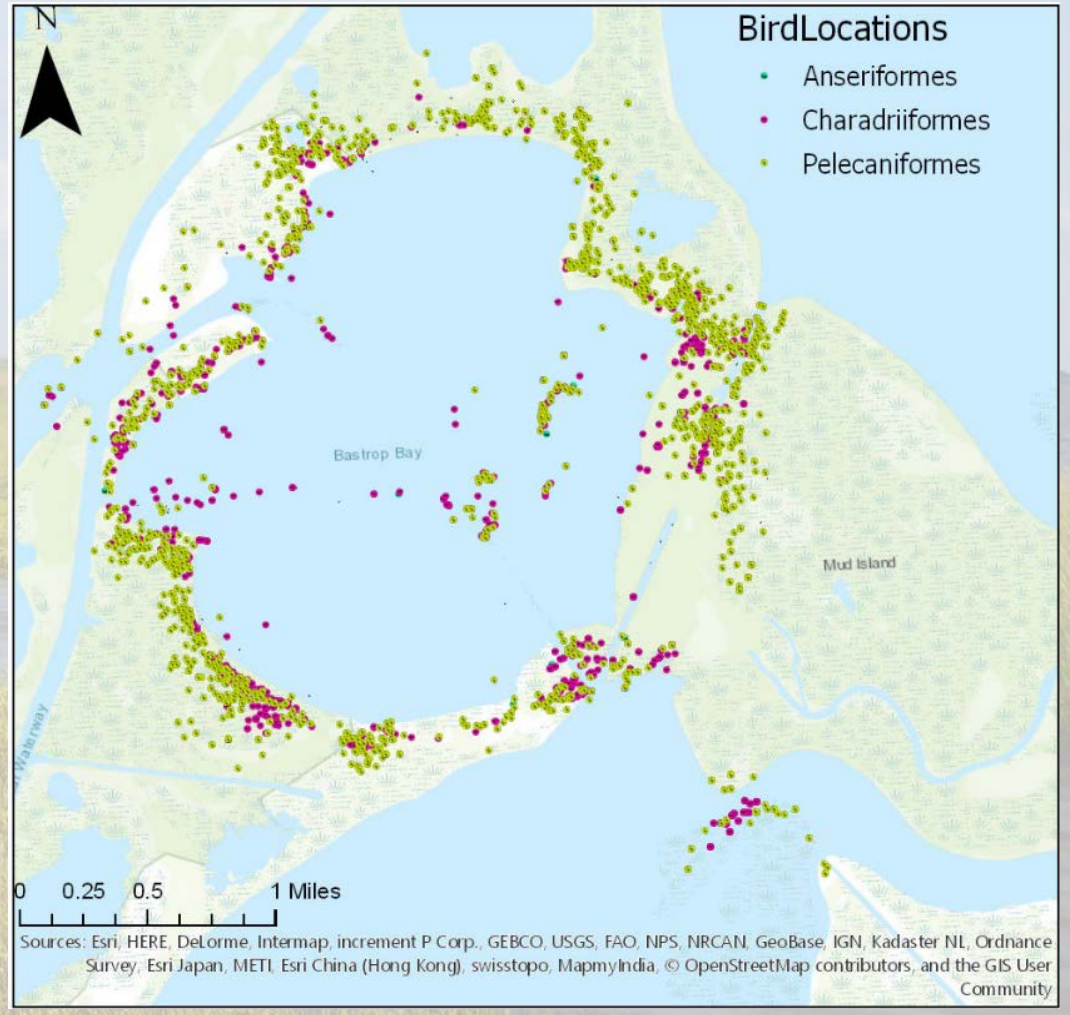
Bastrop Bay



- 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

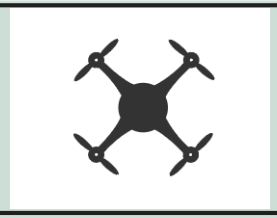
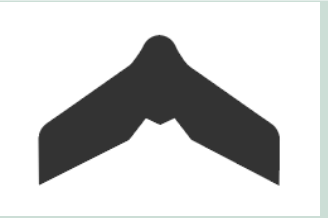
Fixed-Wing UAV

Multi-Rotor UAV

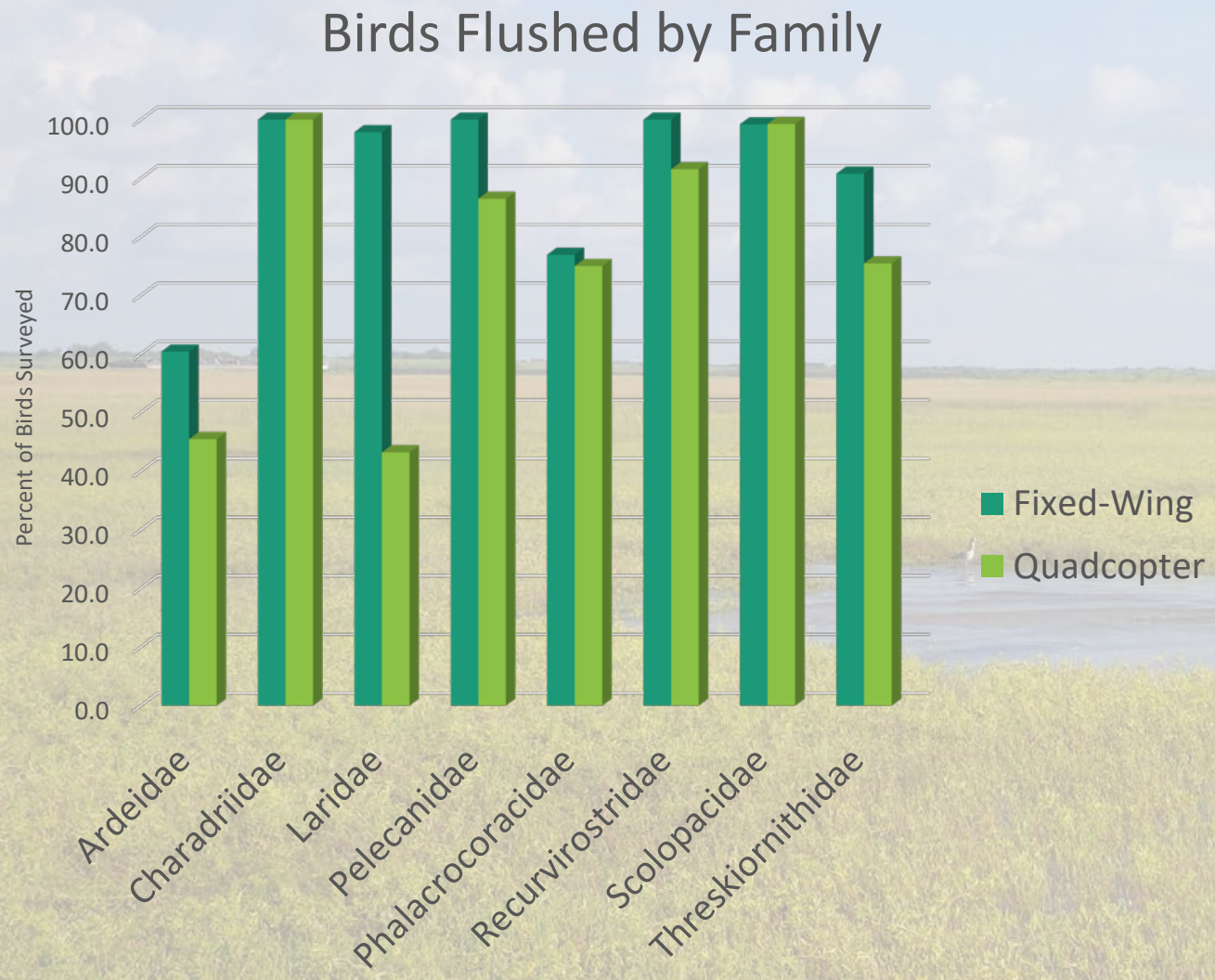
- Phantom 4 pro quadcopter UAV
- Disturbance was visibly less than the fixed-wing UAV
- Possible to fly closer to all species with less disturbance than FW
  - Obtaining clearer photos & video
- Major factors in disturbance: Height vs. Speed

Multi-Rotor UAV Video

Quadcopter vs Fixed Wing

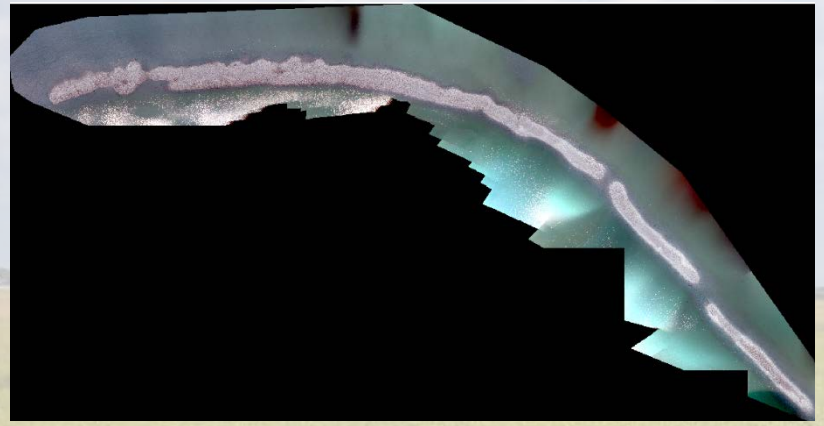
	Phantom 4 Quadcopter	QUESTUAV AQUA Fixed Wing
Launch	Quadcopter can be launched with ease from almost any flat surface.	Requires a larger area to launch as well as good weather. FW must also be launched into the wind.
Flight Height	Can fly as low as desired.	Flight height is more dependent on wind speed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

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

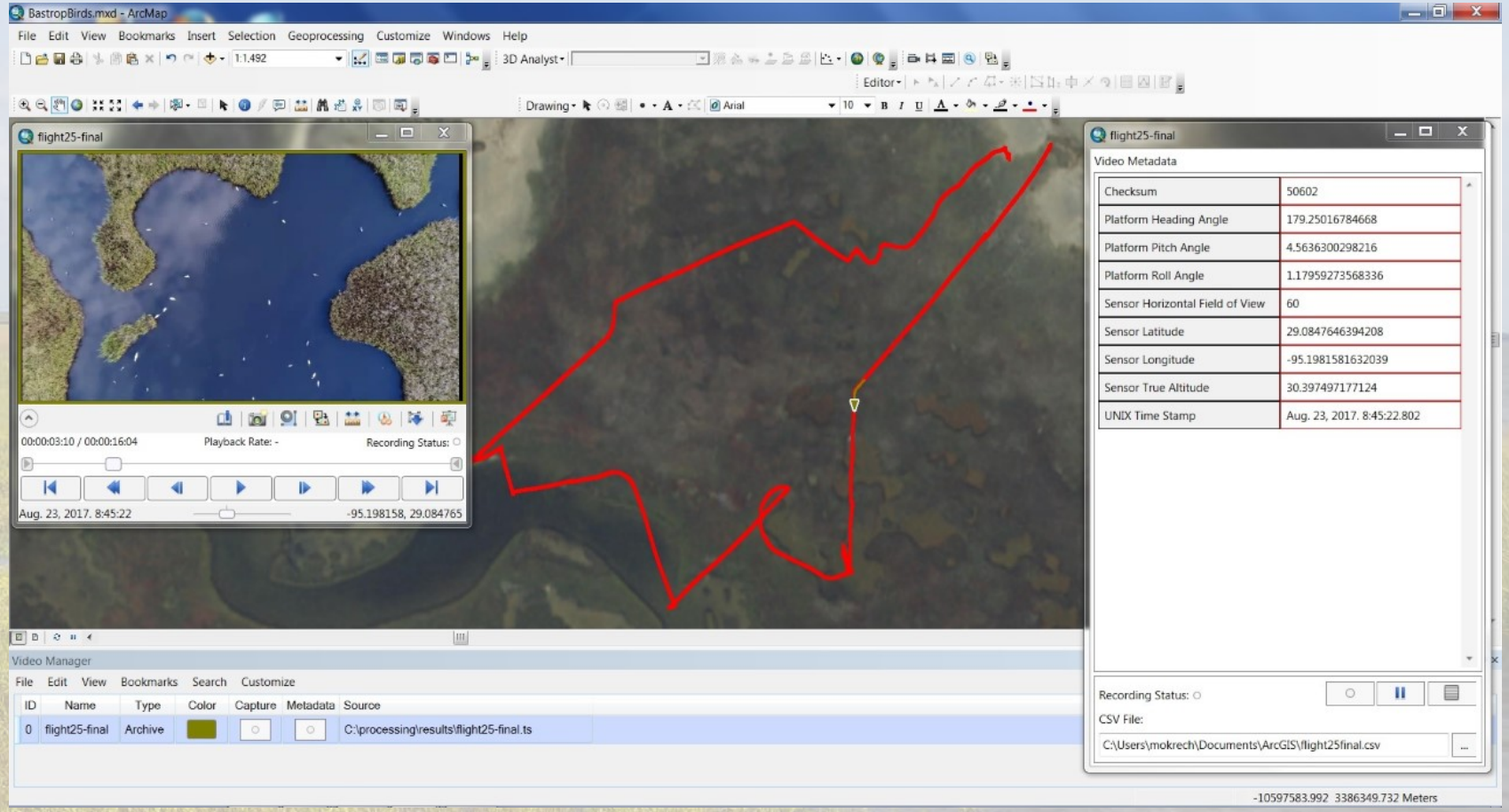
Analysis



- 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?

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