Applications of Remote Sensing Techniques for Conserving Freshwater Mussel Habitat During Periods of Drought

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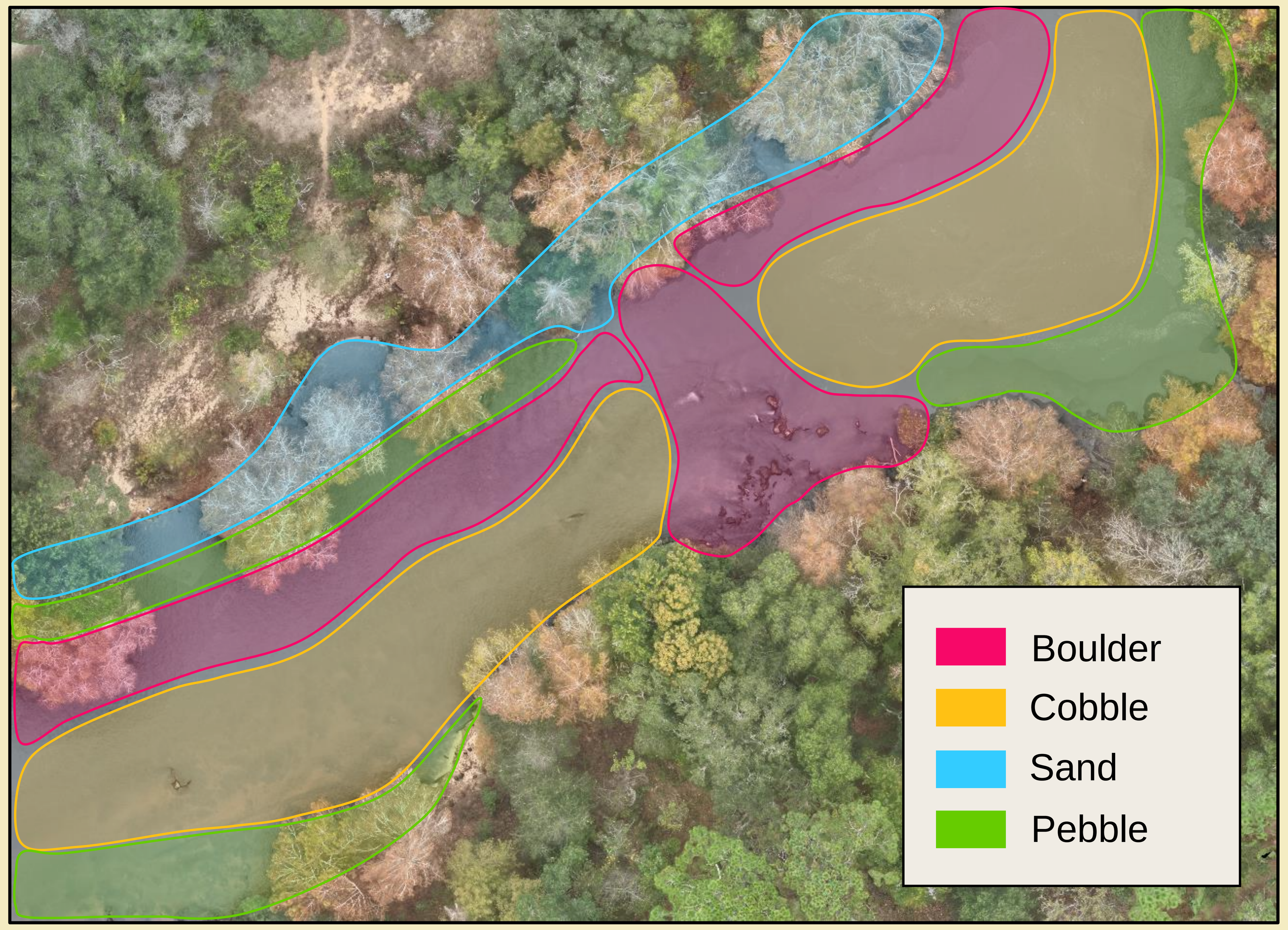


Figure 1. Orthomosaic of Ichawaynotchaway Creek (THE) manually delineated with colored lines signifying different habitat characteristics: boulder, cobble, pebble, and sand

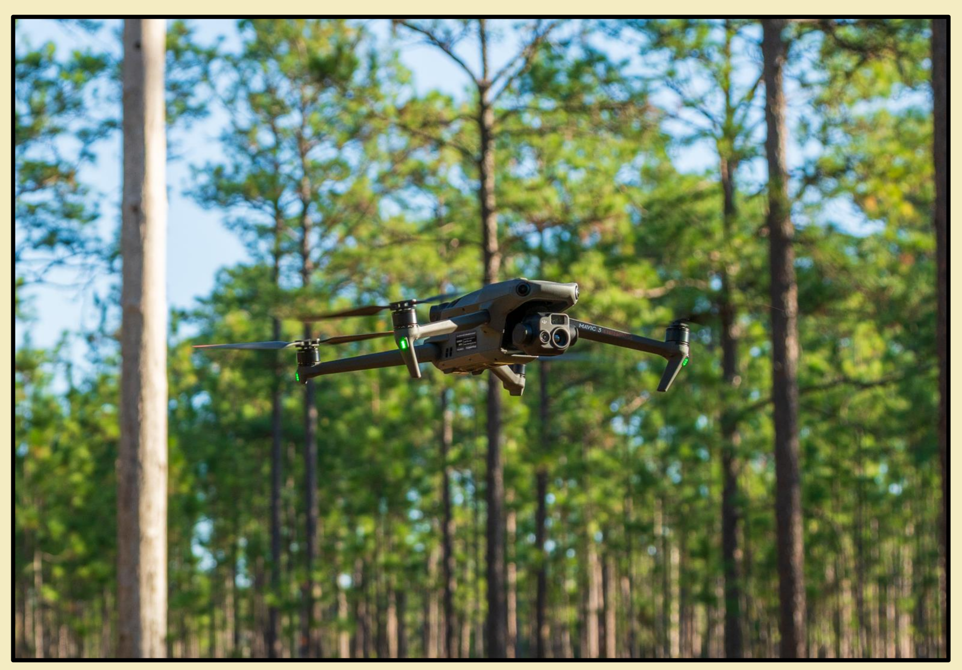


Figure 2. Drone used for remote sensing

Figure 3. LiDAR scanner used for remote sensing

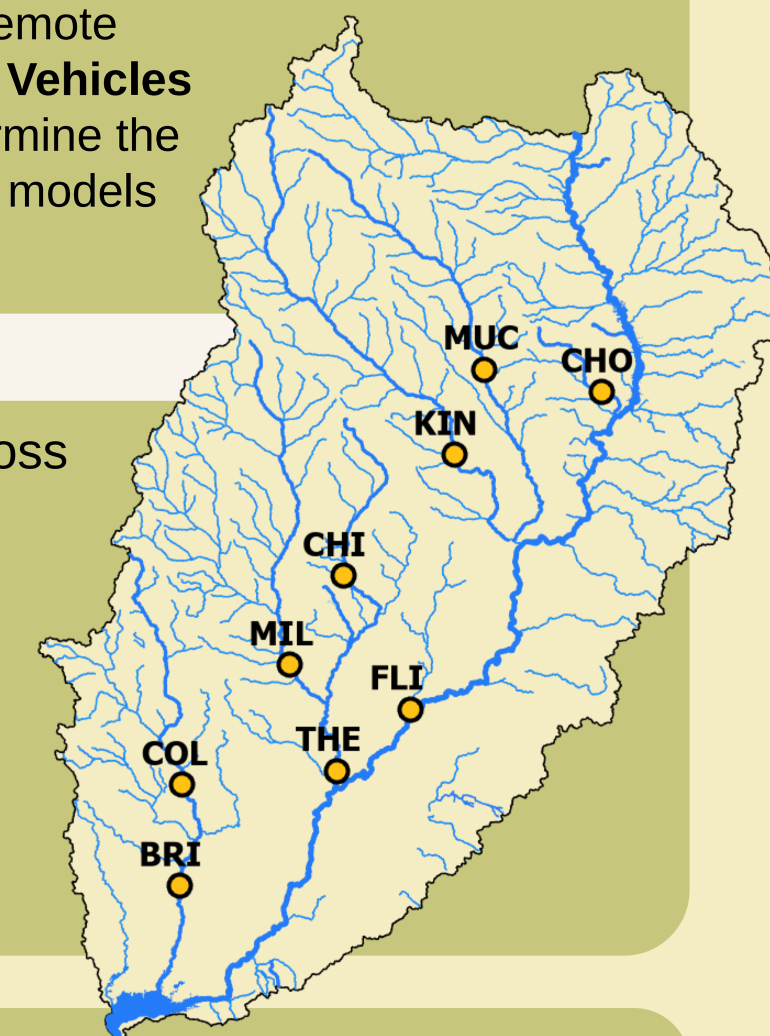
Figure 4. 3D point cloud generated from terrestrial LiDAR scans of Chokee Creek (CHO)

Background

- Freshwater mussels are important indicator species strongly affected by drought
  - There are five listed freshwater mussel species and one proposed for listing in the Lower Flint River Basin (LFRB) in Georgia, USA
- A **Habitat Conservation Plan (HCP)** is in development to **reduce the probability of critical low flows** in mussel habitat throughout the LFRB
- A goal of the HCP is to **develop hydrologic models to evaluate inundated habitat** under different modeled conservation scenarios
  - ➢ We are testing the applications of two remote sensing techniques, **Unmanned Aerial Vehicles (UAVs) and terrestrial LiDAR**, to determine the capability and practicality of developing models with each method

Study Area:

- ➢ **9 representative reaches** selected across several tributaries within the LFRB
  - Chokee Creek (CHO)
  - Ichawaynotchaway Creek (THE & MIL)
  - Kinchafoonee Creek (KIN)
  - Muckalee Creek (MUC)
  - Chickasawhatchee Creek (CHI)
  - Flint River (FLI)
  - Spring Creek (BRI & COL)



Methods

- ✓ **Apply two different remote sensing techniques:**
  - **UAV Imagery – DJI Mavic 3T Series (Figure 2)**
    - ✓ Complete two flights per representative reach at ~150 and 300 ft, taking photos every 2 seconds with 90% overlap between images
    - ✓ Use Pix4D software to orient and stitch together imagery to generate high-resolution orthomosaics of each site (Figure 1)
  - **Terrestrial LiDAR – RIEGL VZ–400i (Figure 3)**
    - ✓ Scan along the banks of each representative reach with ~20m spacing in between scan locations
    - ✓ Use RiSCAN Pro software to generate three-dimensional point clouds of each site (Figure 4)
- ✓ **Manually delineate substrate types** using ground-truthing data and UAV imagery (Figure 1)
- **Compare with acoustic Doppler current profiler (ADCP)** bathymetry data
- **Combine LiDAR output with hydrologic models** to evaluate habitat impact levels

Terrestrial LiDAR vs. UAV Imagery

	Terrestrial LiDAR	UAV Imagery
PROS	• Provides high-resolution digital surface models of bank habitat • Captures topography and forest composition beneath tree canopy	• Inexpensive and accessible • Able to capture changes in substrate beneath the water's surface
CONS	• Very expensive and, therefore, not always accessible for research • Does not capture topography beneath the water's surface	• Visibility can be impeded by tree canopies and water turbidity • Quality of product is extremely dependent on weather conditions

Discussion

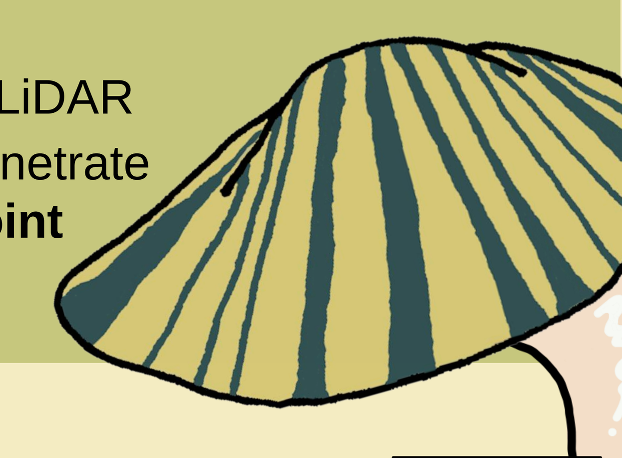
- While both remote sensing methods have their own unique challenges, they **both serve a purpose for achieving goals of the HCP**

  LiDAR is useful for **evaluating the output of hydrologic modeling scenarios**

  UAV is useful for **habitat classification**
- Another goal is to **develop automated habitat classification** using machine learning
- **Alternative remote sensing techniques to consider:**

  Side-scan sonar
  - Uses a transducer to send and receive acoustic pulses to **characterize features of streambeds**

  Green LiDAR
  - Also referred to as topobathymetric LiDAR
  - Uses short green wavelengths to penetrate the water column and **create 3D point clouds of streambeds**



Check this out!