Tracking Marsh Vegetation Communities Using UAV-Derived NIR Imagery

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Becky Morton, President & CEO, GeoWing Mapping, Inc., Oakland, CA

Sundaran Gillespie, Assoc GIS Analyst, WRA Environmental Consultants of San Rafael, CA

9/14/16
Project Site & Background

REMEDIATION SITE
VEGETATION MONITORING

Project Site: Military Ocean Terminal Concord (MOTCO), Suisun Bay CA

- Long-term Vegetation Mapping
- Special Status Species Habitat Monitoring

Salt Marsh Harvest Mouse  California Black Rail
Project Goals

- **Map Dominant Plant Communities**

- **Document the Composition and Extent of Plants Species.**

- **Compare the results of these mapping efforts to previous monitoring years (2005, 2008, 2011)**

- **Remote Sensing and GIS Spatial Analysis**
Methods

- Ground-level Surveys
- Photograph monitoring
- A low altitude helicopter direct observation
- UAV-derived color (RGB) & color infrared (CIR) Aerial Imagery
- UAV-derived imagery as inputs to Trimble eCognition and Geospatial Information Systems (GIS)
Unmanned Aerial Vehicle

- “Hex” Copter
- Nadir Camera (facing down)
- 15 Minute Battery
- 60 Acres per Flight
- Navigation-grade GNSS
- Autonomous Flight and Camera Trigger
- RTL Failsafes
Multispectral (NIR) Camera

- MicaSense “RedEdge”
- Powered and Triggered by the Drone
- Weight: 5.3 oz

**Capture of discrete wavelengths of light:**

<table>
<thead>
<tr>
<th>BAND</th>
<th>WAVELENGTH</th>
<th>BANDWIDTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Light</td>
<td>475 nm</td>
<td>25 nm</td>
</tr>
<tr>
<td>Green Light</td>
<td>560 nm</td>
<td>20 nm</td>
</tr>
<tr>
<td>Red Light</td>
<td>668 nm</td>
<td>10 nm</td>
</tr>
<tr>
<td>Red Edge</td>
<td>717 nm</td>
<td>10 nm</td>
</tr>
<tr>
<td>Near Infrared</td>
<td>840 nm</td>
<td>40 nm</td>
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</table>
Data Collection

- Limited Access
- Multispectral Aerial Acquisition
- High Resolution Image Data
- One week total schedule
Data Collection

- 200+ Acres
- Flying Height: 400 ft
- 70% Overlap/Sidelap
- 45 Flightlines
- 0.25 ft Pixel Size
- 1100+ Images Collected
Challenges (First Flight)

- Safety
- Mobilization
- Varying Cloud Cover (Data Consistency)
- Battery Life (2 Batteries)
Success! (Second Flight)

- Split to 3 “Blocks”
- Uniform Overcast Sky (Data Consistency)
- Battery Life (3 Batteries)
- 1.5 Hours
- Fly Fixed-Wing in Future
Data Processing

Raw Imagery Issues:
- Vignetting
- Variable brightness
- Co-registration

Problems reduced by:
- Avoiding sun angles >70° and <30°
- Uniform camera exposure and ISO settings
Data Processing

<table>
<thead>
<tr>
<th>Display Colors</th>
<th>Color Image</th>
<th>NIR Image</th>
<th>Red Edge Image</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Band 1</td>
<td>Band 4</td>
<td>Band 5</td>
</tr>
<tr>
<td>Green</td>
<td>Band 2</td>
<td>Band 1</td>
<td>Band 1</td>
</tr>
<tr>
<td>Blue</td>
<td>Band 3</td>
<td>Band 2</td>
<td>Band 2</td>
</tr>
</tbody>
</table>
Resolution
Data Processing Results

- 900+ Images Used for Ortho Mosaic
- 1 Day of Mosaic Processing
- 3 Days of Data Management, QA/QC, Georeference, etc.
- 4-Band Mosaic (RGB + NIR)
- UAV = fast turnaround hi-res data
Remote Sensing Methods

Preliminary Ground-level Surveys:

- Plant Communities Identified to Species
- GPS coordinates: Trimble Geo-7X
- Dominant plant communities (>20% cover)
eCognition Workflow

1. Acquire Aerial Imagery
2. Load Aerial Image
3. Segmentation Process
4. Training Process
5. Classify
6. Re-classify
7. Export to GIS

Trimble eCognition (version 8)

→ eCognition is a remote-sensing software package that allows users to classify different signature outputs of imagery at multiple scales.
Vegetation Mapping

- Dominant Plant Communities
  - open water
  - pickleweed
  - bulrush/tule/cattail
  - perennial pepperweed
  - western goldentop
  - common reed
  - Other

- RGB UAV imagery

- CIR UAV imagery

- ArcGIS → Further Refinement of Plant Communities to Vegetation Alliances and Species
Vegetation Mapped

- Vegetation Alliance
- Plant Community
- Acreage and % of Study Area
- Percent Change (2005-2015)
- Percent Change In the Last Three Years
Results
Impacts to Plant Communities

- **Invasive Species: Phragmites australis, Lepidium latifolium**

- **Salt Marsh Harvest Mouse / California Black Rail Habitat Degradation**
Conclusion

★ Remote Sensing AND Ground-level Surveys

★ Climate, Hydrology, Salinity

★ Adaptive Protocols and Methods
THANK YOU

Becky Morton – becky@geowingmapping.com
geowingmapping.com
510-350-7744

Sundaran Gillespie – gillespie@wra-ca.com
wra-ca.com
415-454-8868