Use of Drone to Detect Distribution of the Invasive Plant *Ludwigia* in the Laguna de Santa Rosa

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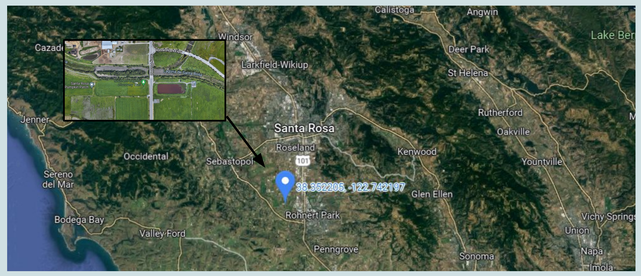
Abstract

The invasive aquatic plant *Ludwigia* has become an increasing problem within the Russian River watershed, and particularly in the Laguna de Santa Rosa. It outcompetes native plant species, hinders flood control, serves as prime habitat for mosquitos, and impedes the migration of anadromous fish, such as salmon and steelhead trout. The purpose of this project is to establish a method for using drone imagery to map the distribution of *Ludwigia* in a section of the Laguna de Santa Rosa near Stony Point Road in Rohnert Park, CA. We will compare mapping of *Ludwigia* distribution using drone imagery to traditional on-the-ground *Ludwigia* mapping.



Methods

- Drone used: DJI Mavic Pro (10 megapixels)
  - Comparison flight (8 Phantom) was flown by Eric McDermott using a DJI Phantom drone (20 megapixels)

Pix4D Settings

- Center and Ignore Homepoint = both no
- Optimal white balance = auto
- Optimal camera angle to ground = 80°
- Other settings varied per table below

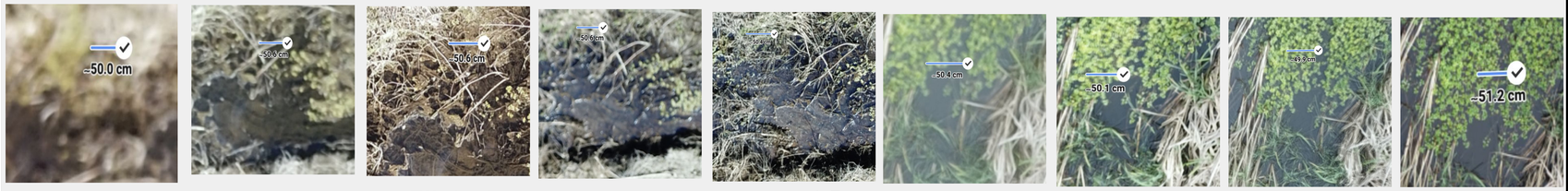
- Imaging Software used: Pix4D Cloud
  - Optimal settings: 3D model; quality
- Ground truthing conducted through ArcGIS Collector App

	Flight 1	Flight 2	Flight 3	Flight 4	Flight 5	Flight 6	Flight 7	Flight 8	Flight 8 Phantom
# images	26	36	70	138	138	204	89	201	
Flight time	2 min	2 min	6 min	5.5 min	10 min	~ 10 min	9 min	19 min	~5 min
Elevation(ft)	100	100	50	50	50	50	50	50	50
Drone speed	fast	fast	normal	fast	normal	normal +	normal +	normal +	normal +
Front overlap	20	45	45	60	60	75	75	75	75
Side overlap	20	45	45	60	60	75	75	75	75
Grid type	grid	grid	grid	grid	grid	double grid	grid	double grid	double grid
Pic trigger	fast	fast	fast	fast	fast	fast	safe	safe	NA

How Does Drone Flight Elevation Impact Photo Quality?

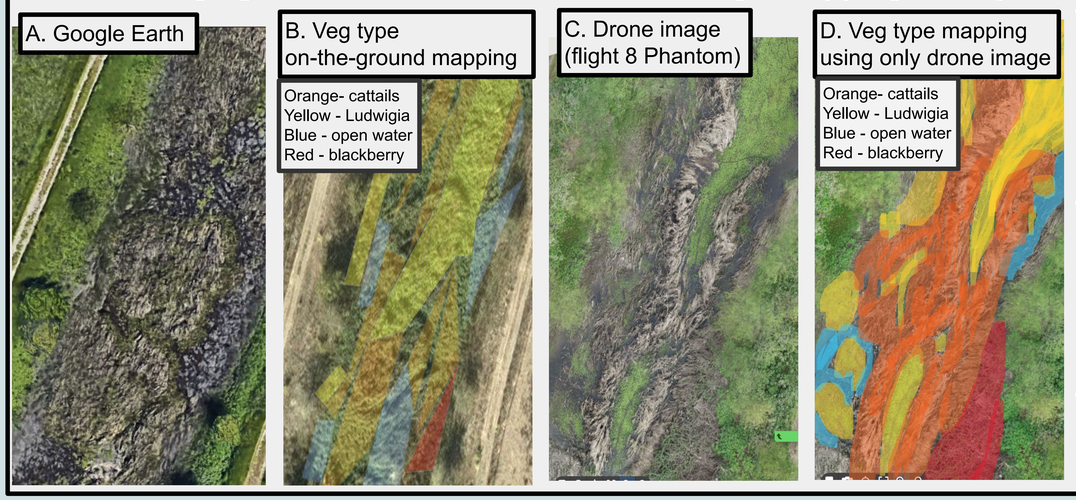
- Flying a drone *too low* limits how much area can be imaged per flight
- Flying a drone *too high* limits the resolution of the images captured
- *Ludwigia* leaves were clearly identifiable at a height of 7 feet. Picture resolution decreased as drone elevation increased

What are Optimal Pix4D Settings for Identification of Ludwigia Using the DJI Mavic Pro?



Flight 1 → **Flight 2** increased photo overlap: 20% to 45% → **Flight 3** decreased elevation: 100' to 50' → **Flight 4** increased photo overlap: 45% to 60% → **Flight 5** Decreased speed: fast to normal → **Flight 6** Increased photo overlap: 60% to 75% → **Flight 7** Changed photo capture: fast (moving) to safe (still) → **Flight 8** Double grid pattern → **8 Phantom** Same as flight #8 but with better drone (for quality comparison)

Is Drone Imaging as Good as on the Ground Ludwigia Mapping Surveys?



- In 2012, the Laguna Foundation hired a team of interns to walk around with GPS units and record where Ludwigia is present in the Laguna de Santa Rosa and its tributaries. The project took an entire summer and has not been updated due to its cost.
- We compared the on-the-ground vegetation mapping method (panel B, using ArcGIS Collector app) to how well Ludwigia distribution could be mapped based on the drone image of the same area that we had from Flight 8 Phantom (panel D).
- With practice and optimization of the ArcGIS Collector app, we believe that we would have better alignment between the color overlays shown in Panels B and D.

Conclusions

We have shown proof of concept that the invasive plant *Ludwigia* can be identified using an image created from a drone flight using the Pix4D software. Through a series of drone flights, we have optimized the settings needed to quickly image a 200 foot long stretch of the Laguna de Santa Rosa channel at a height of 50 feet using an inexpensive drone. With further optimization, we believe that our method of Ludwigia mapping can be as accurate as ground mapping, with the additional benefits of requiring fewer people, faster time, and lower cost.

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