The sky is not the limit!
-- controlling invasive plants with survey- and spray-drones

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Suisun Resource Conservation District, Leading Edge Aerial Technologies, CASA 2100

Suisun Marsh

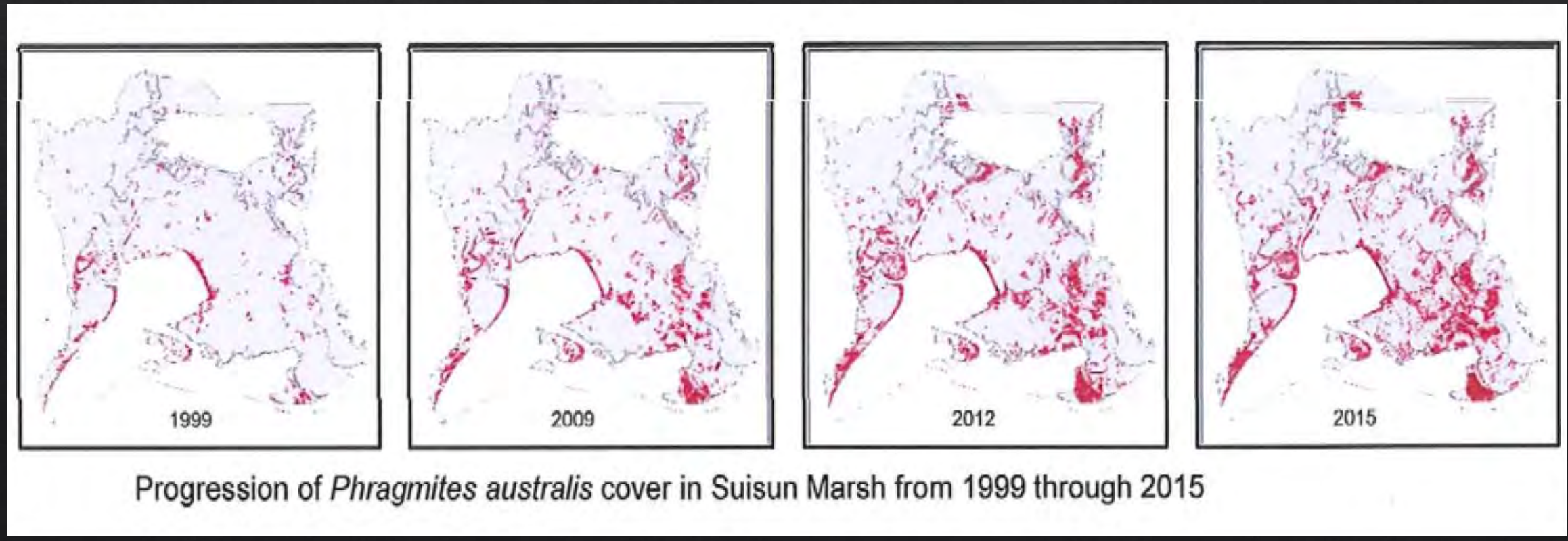
- Largest contiguous brackish marsh in the United States
- Encompasses 10% of California's remaining wetlands
- Acreage Breakdown
  - 52,000 acres managed wetlands
  - 6,300 acres tidal wetlands
  - 30,000 acres of bays and sloughs
  - 27,000 acres of upland grasslands

Invasive Perennial Pepperweed (*Lepidium latifolium*)

- Native to Europe and Asia
- Saline tolerant
- Found in areas of disturbance
- Displaces native plants
- >1000 acres in Suisun Marsh

Invasive Common Reed (Phragmites australis)

Phragmites is the most widespread invasive in Suisun Marsh. From 1999 to 2015, it increased 227% (821 acres) in wetlands and 432% (1433 acres) along levee berms.



Progression of *Phragmites australis* cover in Suisun Marsh from 1999 through 2015

Other Invasive Plants of Concern

- Russian Thistle (Salsola australis)

- Alligatorweed (Alternanthera philoxeroides)

Phragmites treatment efficacy with herbicide is best in controlling small patches

Biol Invasions
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ORIGINAL PAPER

Management of invasive *Phragmites australis* in the Adirondacks: a cautionary tale about prospects of eradication

Brendan Quirion · Zachary Simek · Andrea Dávalos · Bernd Blossey

- Treated patches from 0.36-4,134 m^2
  - monitored each annually to estimate extent and cover
  - considered patch eradicated when absent for 3 consecutive years
- Eradicated Phragmites in 104 of 294 sites
  - best (83%) success occurred in small patches (0.36m^2)
  - worst (2%) success occurred in large patches (3,000 m^2)
- Concluded monitoring was critical to for accountability, and efficacy of managing large populations was questionable

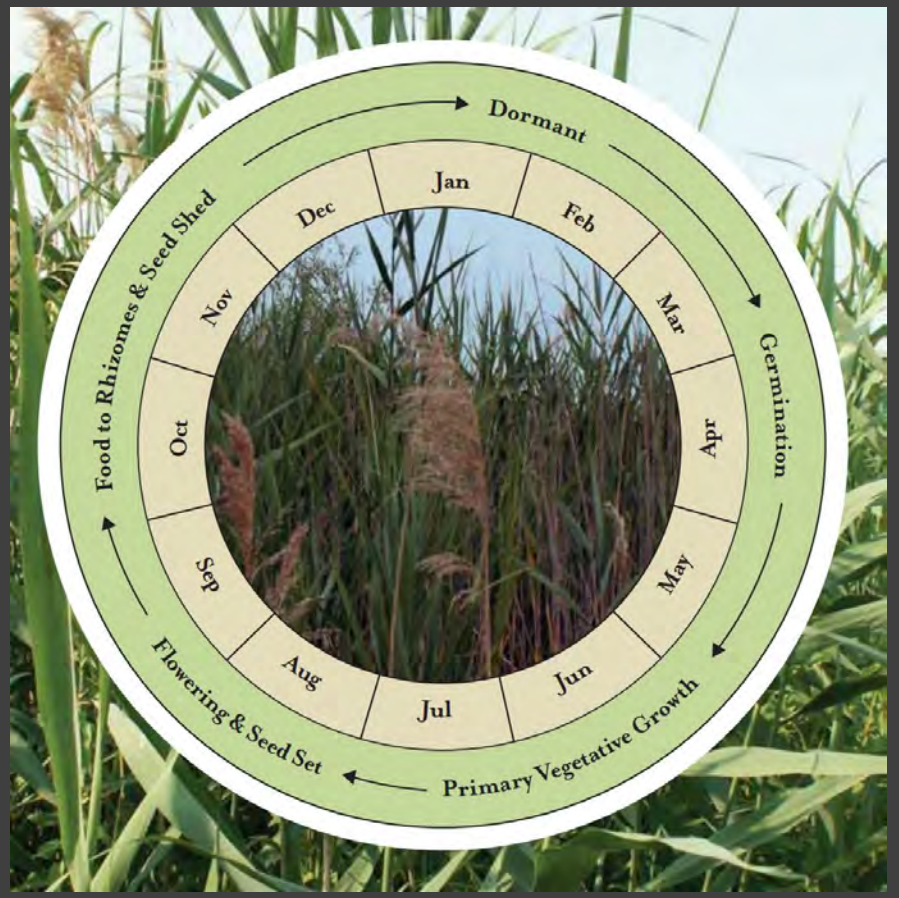
What if we could…

- ❑ control small patches before they become a bigger problem?
- ❑ apply chemical treatments with surgical precision and little overspray?
- ❑ minimize chemical exposure for applicators?

Use of unmanned aerial systems (UAS) for invasive plant control

Currently, we use surveillance drones to 1) take images of areas and 2) provide color bands of possible patches; and spray drones to 3) program possible patches, 4) verify patches by visual observations, and 5) apply herbicide where plants are confirmed

Ideally, spray-drones alone would 1) detect the plants, 2) identify invasive patches, and 3) apply herbicide with high efficacy for control



LELA best treated in the spring before flowering

Surveillance Drone Unmanned Aerial System (UAS)

- DJI M200 Matrix or Phantom 3 Pro quadcopter: 2.9 pounds (small drone class <20 lbs), 15-30 min run time, 4K camera, gimbel, stabilizer, 12.76 megapixel image.

- Flight altitude at 275 feet (84 m), range 0.5 miles, roughly mapping 30 acres in 15 minutes, uploaded to Pix4Dmapper 4.5 on iphone.

- Photo mosaic with 80% overlap, digital surface model and 3D mesh, used green and red reflectance bands with control ground images taken each day to correct for light conditions. LiDAR digital elevation map used for correcting for relative elevation.

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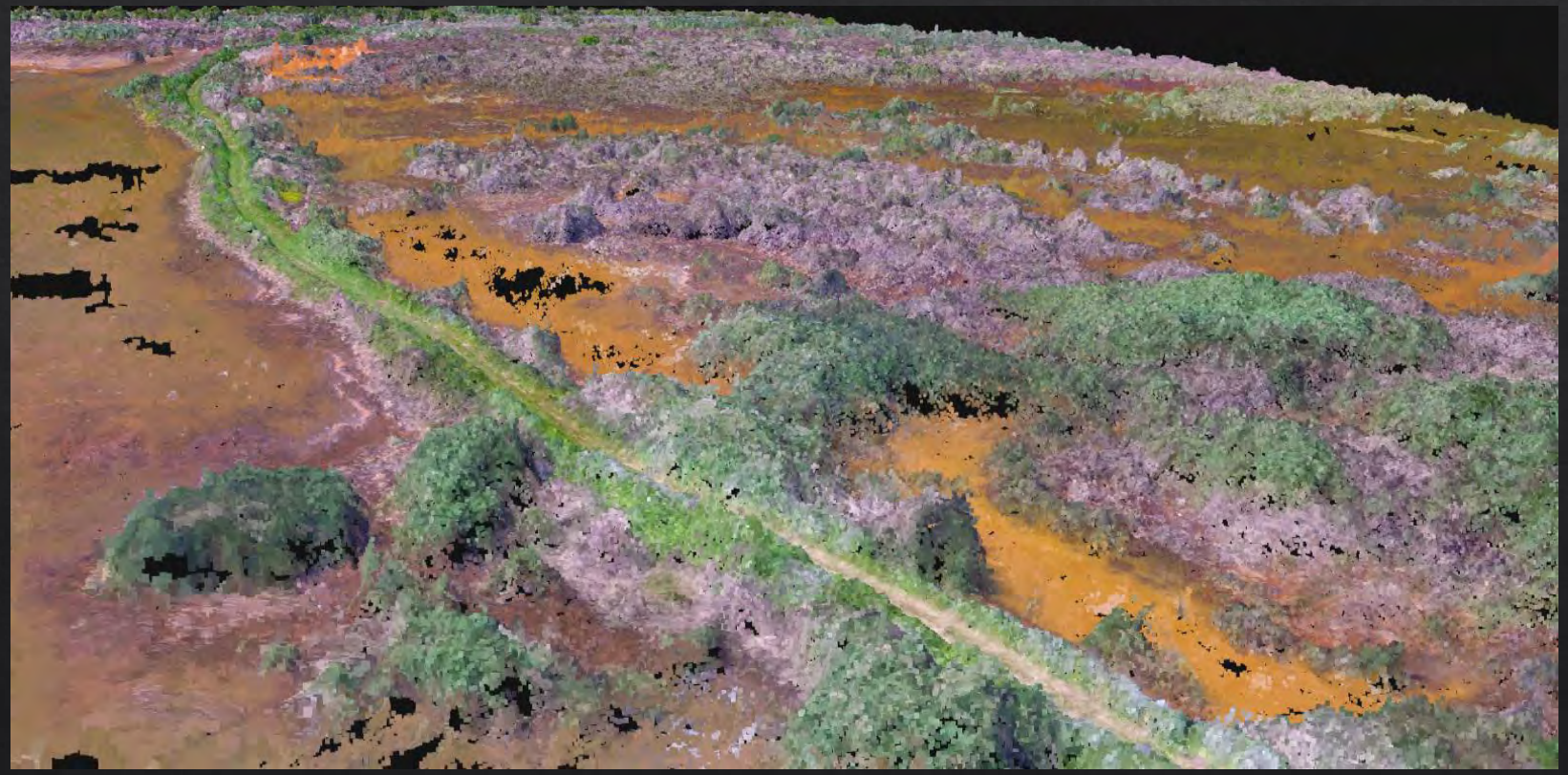
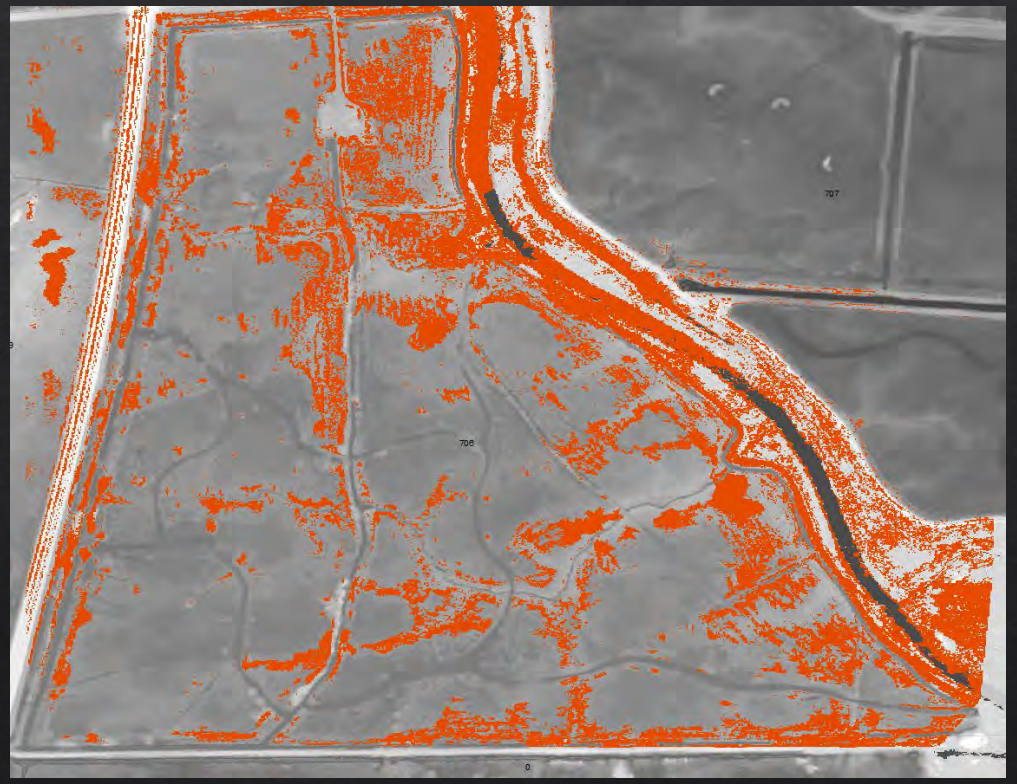
Acquiring Imagery

- Extremely high resolution images with 5x5 cm pixels for detailed image analysis



Mapping Potential Lepidium Patches

- Establishing the areas of treatment



Pixels with possible LELA after red-green analysis

Pixels with possible LELA after elevation adjustment

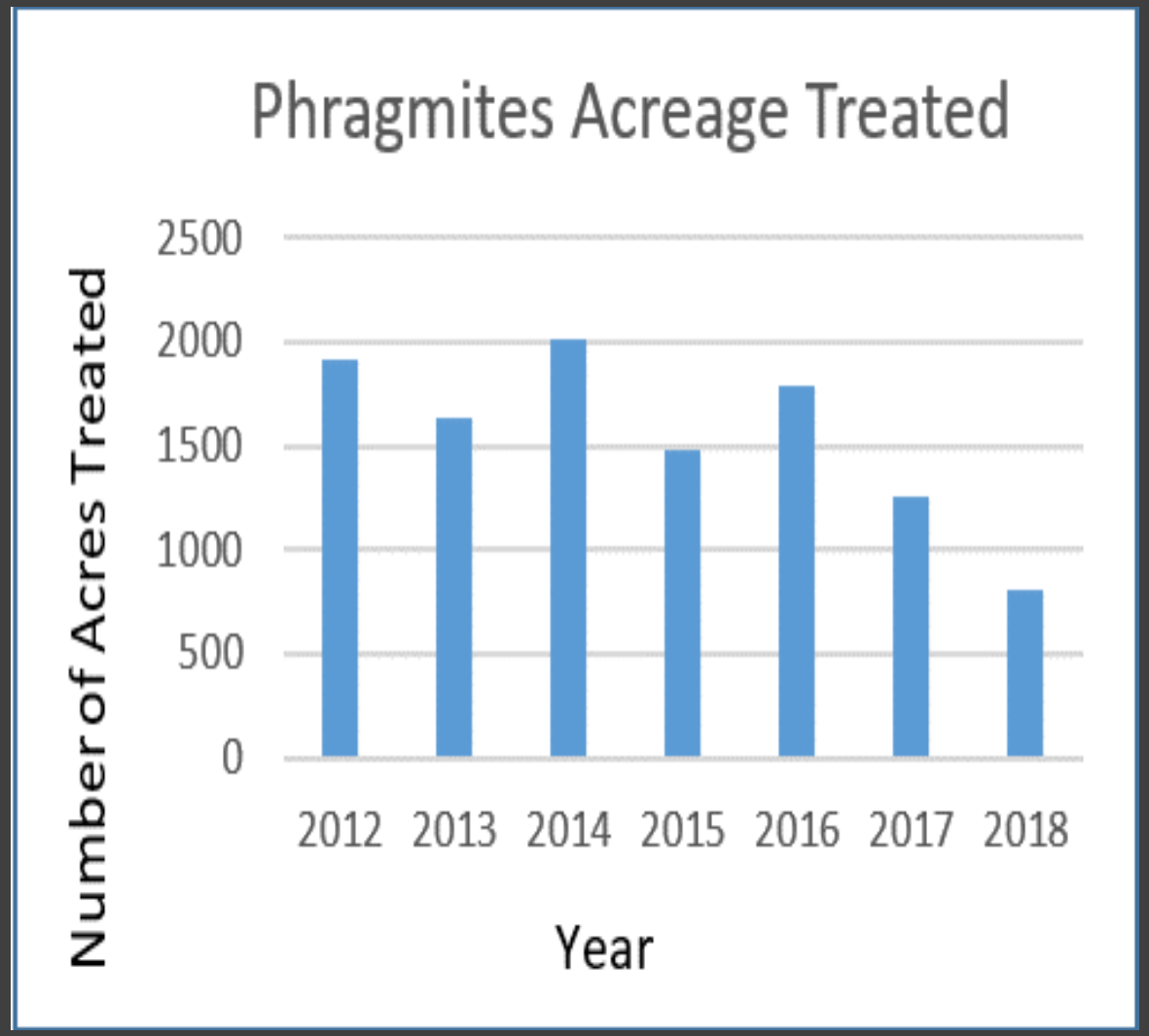
Spray-Drone Unmanned Aerial System (UAS)

- Leading Edge Aerial Technologies (LEAT), Precisionvision 35 hexacopter, 78 pounds (Large Drone class), 3.5 gallon tank, 2 large batteries, 12-14 min run time, front-looking stabilized camera.

- Spray boom 11.8 feet wide, spray area 17.5 feet, mission planning PrecisionVision IOS, flight altitude 10-12 feet.

Equipment and Supplies

- 25-50 gallon mixing tank and pump:
  - Bayer Telar XP broad-leaf (5 gal/ac) or Bayer Roundup Custom (4 gal/ac);
  - Adjust for water hardness and pH
  - Loveland Spreader 90 Surfactant;
  - Liquid Harvest Lazer Dye
- 8000 Amp Generator
- DJI battery charger
- PrecisionVision battery charger
- Ipads and chargers



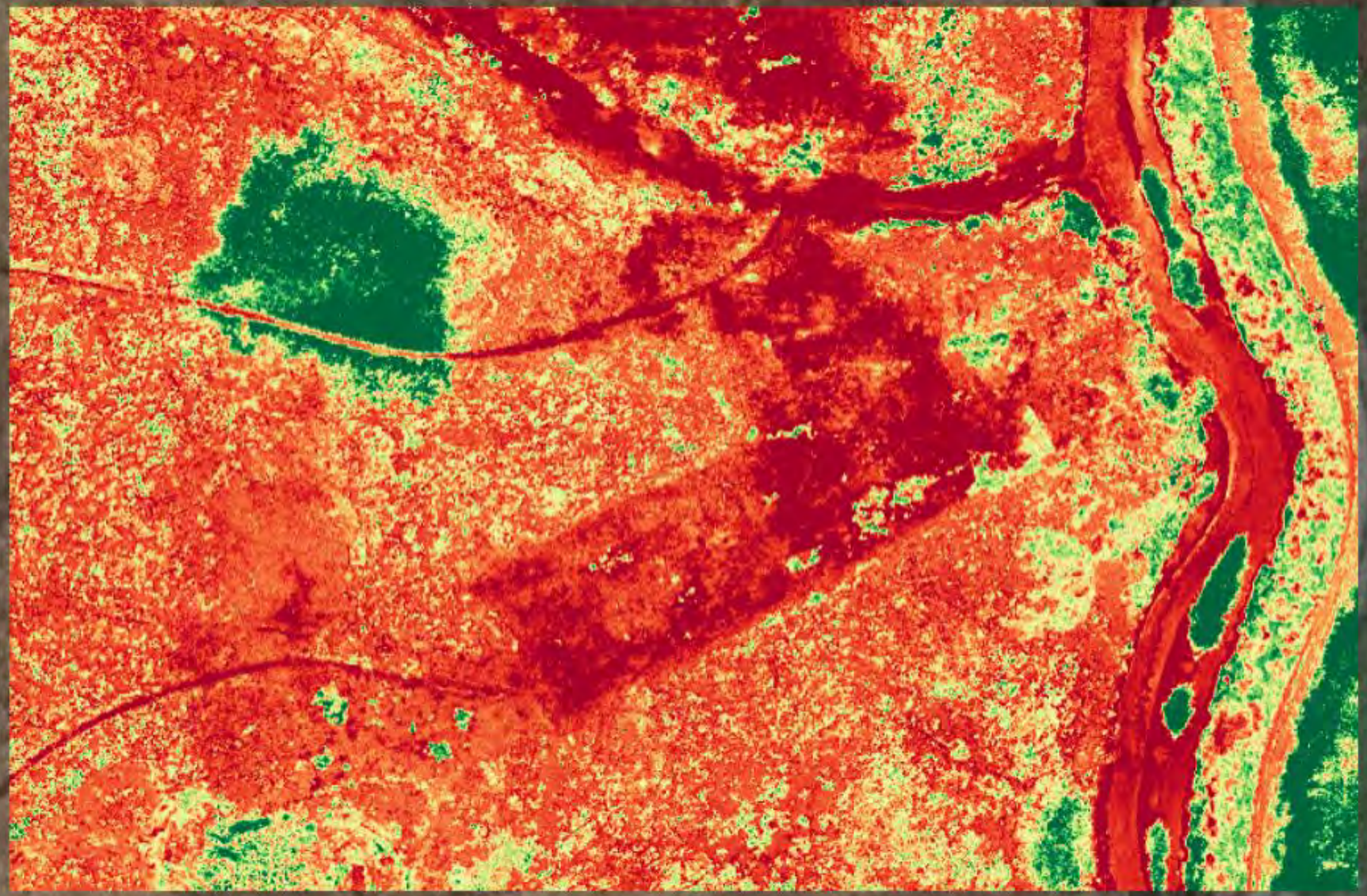
SRCD Phragmites Control Program

Phragmites Control Program in Suisun Marsh led by SRCD for 19 years.

Supported by one-time grant from the Sorenson Foundation to offset costs. Funding ended in 2018.

Recent support by Cal Dept Food and Ag Noxious Weed Grant, 2019-2021.

Burning and Spray-drone treatment at Lower Joice Island for Phragmites

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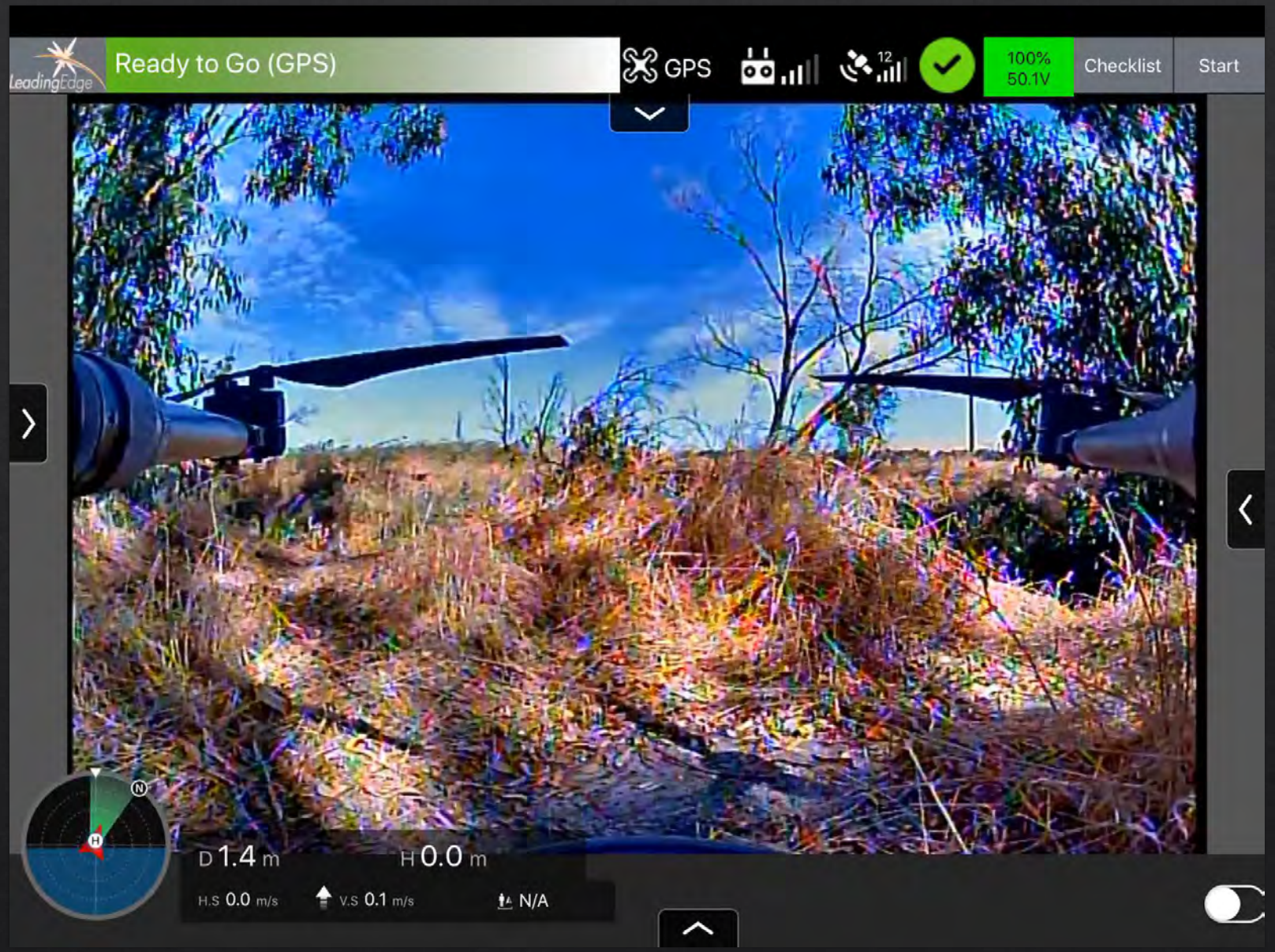
JOYCE ISLAND

Between a tree and a powerline….



Monitoring Effectiveness

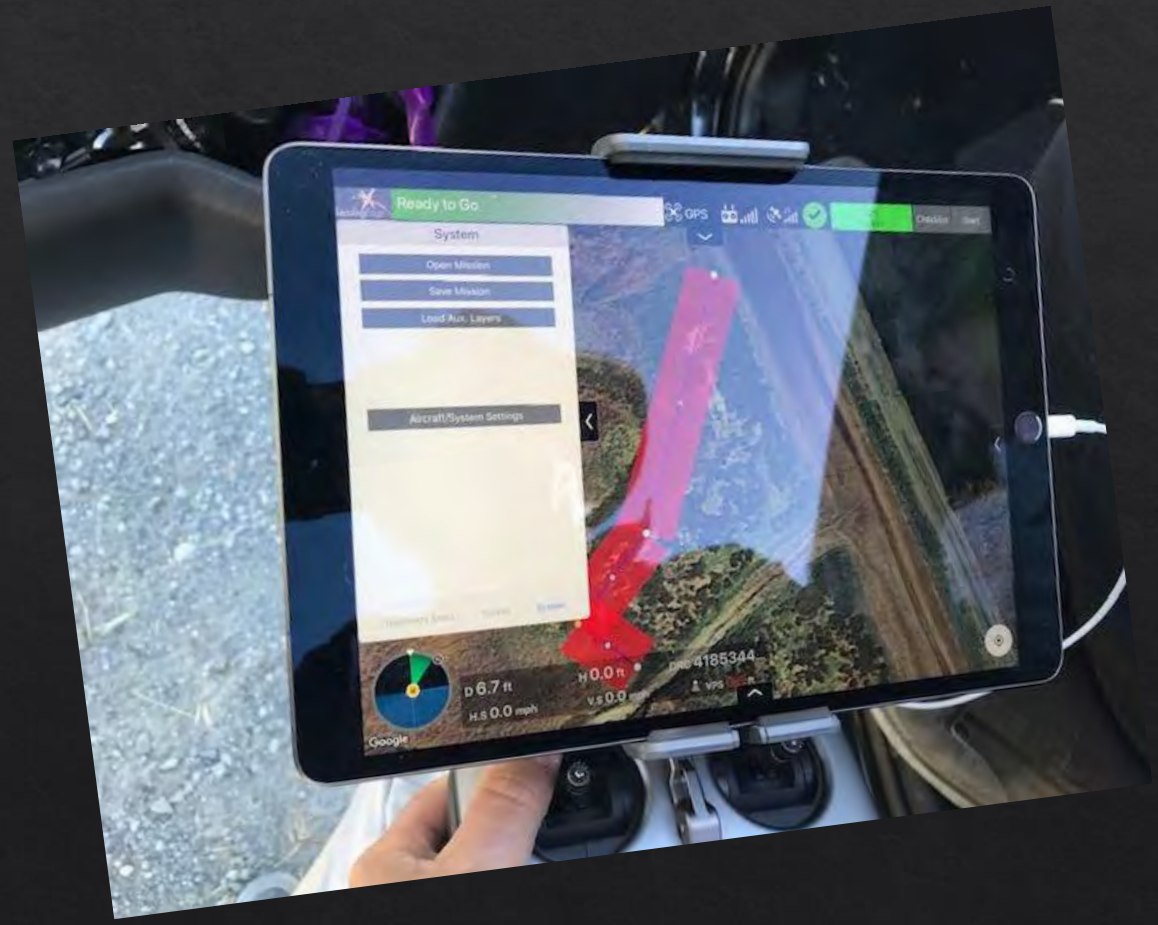
- Measure overspray
- Determine droplet coverage
- Examine treatment through entire patch
- Treat sparse and dispersed patches

Question 1: “UAS” stands for:

A. Unusual Aerial Shots

B. Uniform Automated Services

C. Unmanned Aircraft Systems



Question 2: A “Large” Drone is:

A. Less than 249 grams

B. Greater than 55 pounds

C. Greater than 5 tons

Question 3: Advantage of a spray drone is:

A. More chemical overspray than manned aircraft

B. Less chemical overspray than manned aircraft

C. Same chemical overspray as manned aircraft

Other Questions? Contact me at:

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