Mapping waterhyacinth dispersal with GPS trackers

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Intro

Figure 1. Waterhyacinth mats floating in the Sacramento-San Joaquin Delta, CA.

Figure 2. Waterhyacinth monoculture in the Sacramento-San Joaquin Delta, CA.

Water hyacinth

(*Eichhornia crassipes* (Mart.) Solms))

- Perennial free-floating aquatic plant species
- Native to the Amazon region of South America
- Introduced to US in late 19th century
- Very fast growth rate; spreads vegetatively through rhizomes
- Intertwined roots and leaves form plant mats
- Widespread in the Sacramento-San Joaquin Delta

Objective:

- Determine to what extent wind, tidal movement, and mass flow drove the dispersal of water hyacinth mats in the Delta

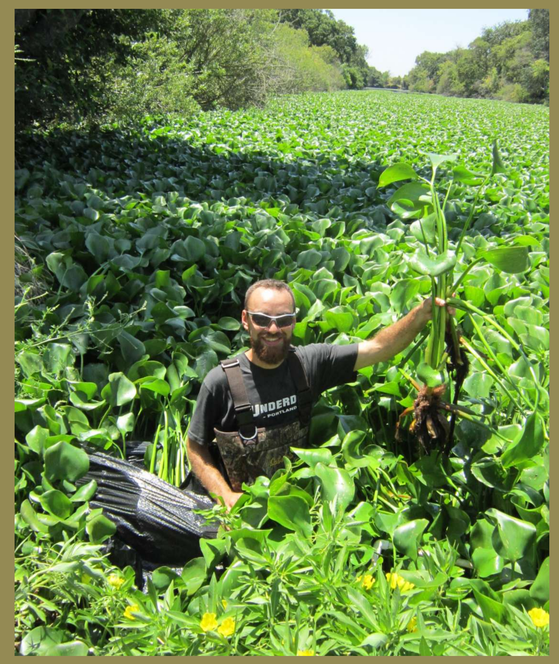

Figure 3. Monthly phenology sampling in the Sacramento-San Joaquin Delta, CA.

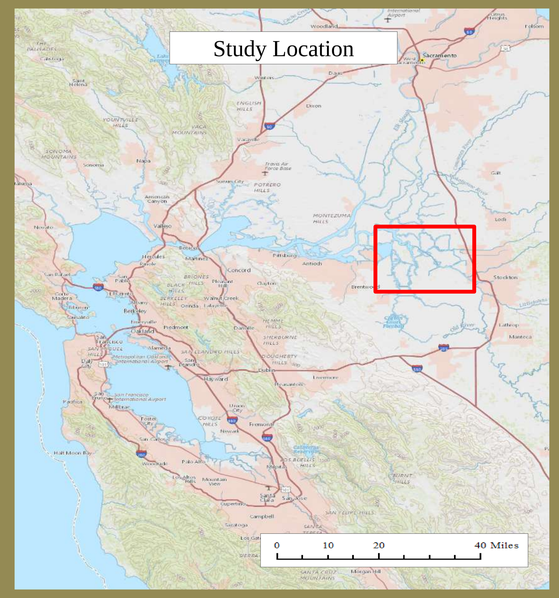

Figure 4. Study location in the Sacramento-San Joaquin Delta, CA, 2016-2018.

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Methods

- **Drogue:** 2000 mL Nalgene bottle released into floating water hyacinth mats

- Bottle contained:
  - Trackstick GPS tracker
  - Sportdog TEK 1.0

- Each drogue drifted 2-4 hours before being collected and the Trackstick downloaded

- Trackstick recorded:
  - location
  - direction
  - speed of the plant mat

- Drogues recovered and downloaded 79 times from June 2016 - February 2018

Figure 5. Setting up a bottle with radio collar and GPS recording device. The receiver for the radio collar is on the left.

Figure 6. Deploying a bottle on July 20, 2017. Sacramento-San Joaquin Delta, CA.

Figure 7. Waterhyacinth mat with GPS tracker after drifting for 3 hours Sacramento-San Joaquin Delta, CA. April 26, 2017.

Figure 8. 4ft^2 waterhyacinth mat with GPS tracker after drifting for 3 hours Sacramento-San Joaquin Delta, CA.

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Results

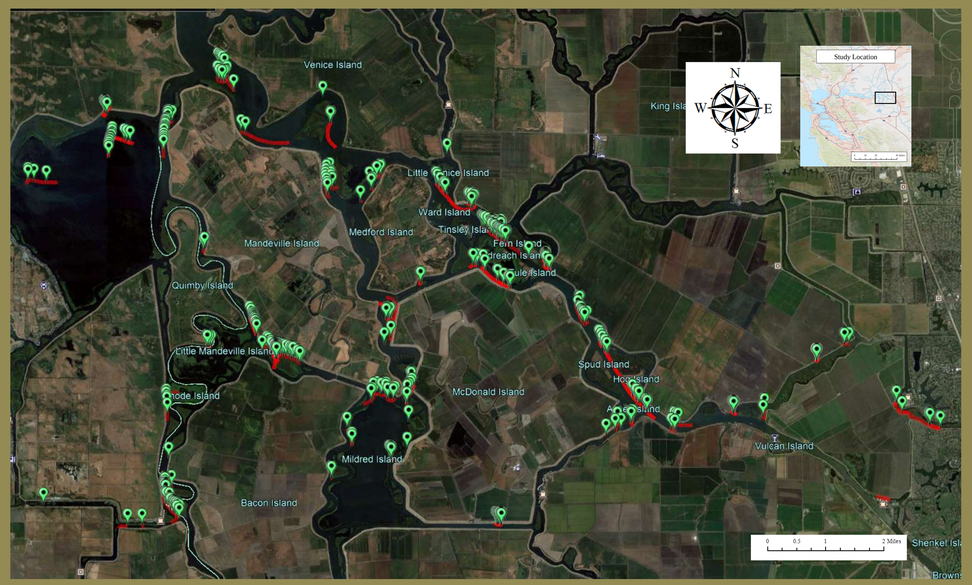

Figure 9. Plant mat paths recorded in the Sacramento-San Joaquin Delta, CA, 2016-2018.

- Direction of each tracker was compared to the water direction and wind direction during the period the tracker was deployed
  - ANOVA ($P < 0.05$)
  - Simple linear regression
- Water movement, including tidal fluctuation, had a much greater effect on plant movement than wind

Table 1. ANOVA results for waterhyacinth mat direction compared with water direction.

	Water Direction				
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	631997	631997	355.07	<.0001
Error	77	137053	1779.90414		
Corrected Total	78	769050			

Table 2. ANOVA results for waterhyacinth mat direction compared with wind direction.

	Wind Direction				
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	12560	12560	1.28	0.2617
Error	77	756490	9824.54158		
Corrected Total	78	769050			

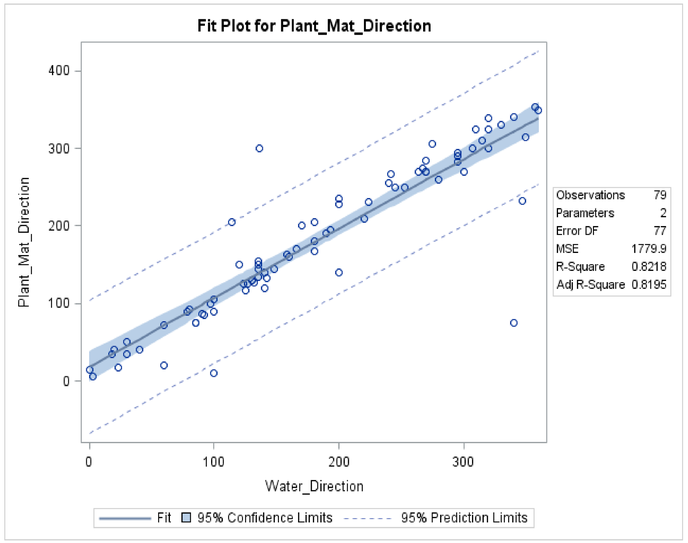

Figure 8. Fit plot from simple linear regression for waterhyacinth plant direction of travel with water movement.

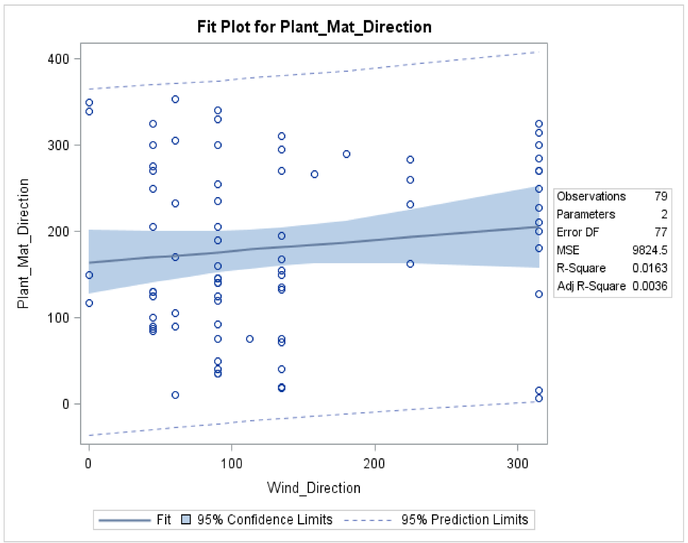

Figure 9. Fit plot from simple linear regression for waterhyacinth plant direction of travel with wind direction.

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Conclusions

- 50 miles inland from the Pacific Ocean
- Tides have a strong influence on the water there
- Rather than long distance travel over days, plant mats move back and forth with the tide
- Plant mats become **entrained** by riprap, other plants, tree branches, etc. during the time they were being tracked (74% were entrained when recovered), are moved by the water a short distance, then get caught again

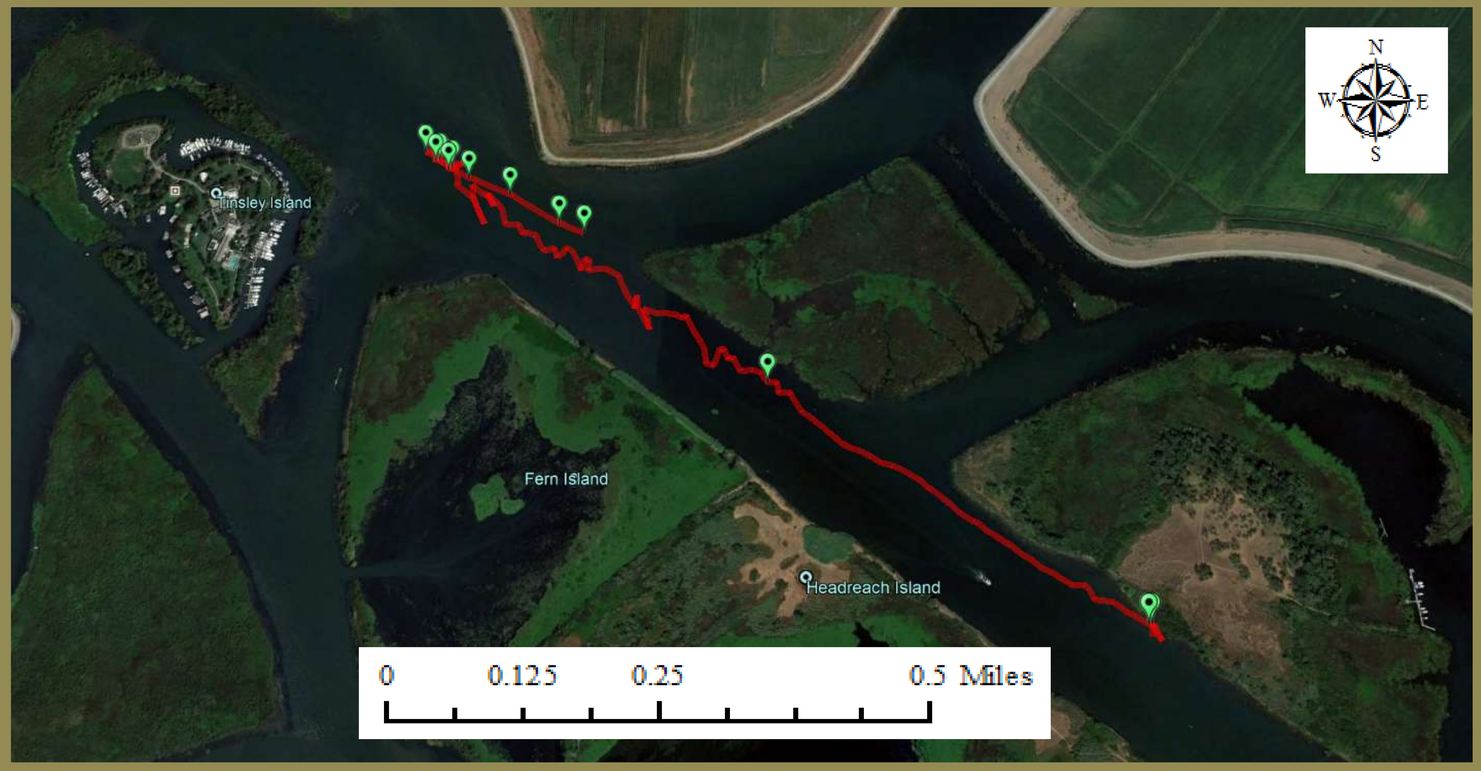

Figure 10. An example of a plant mat changing course as the tide changed. The red line records the track of the GPS in a water hyacinth mat. San Joaquin main channel. November 16, 2017.

Figure 11. An example of a plant mat changing course as the tide changed. The red line records the track of the GPS in a water hyacinth mat. Adjacent to Mandeville Island, Sacramento-San Joaquin Delta. February 7, 2018.

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Thanks

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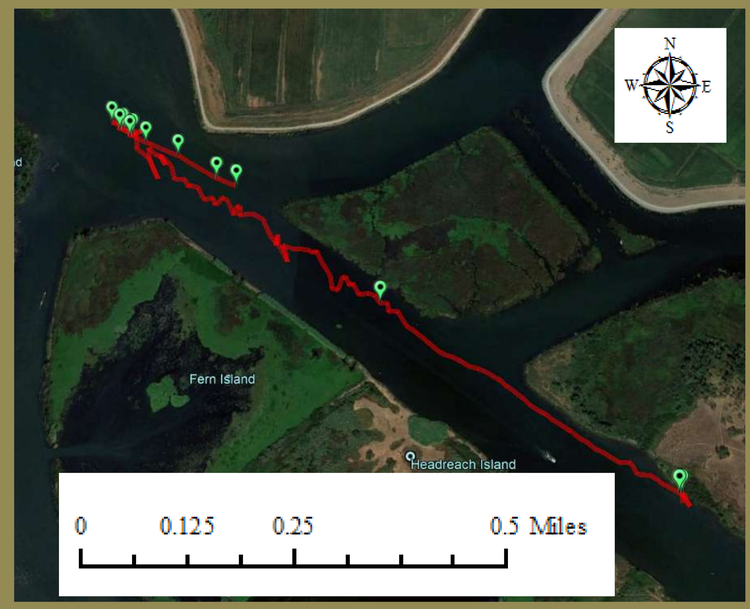

Research performed as part of the Delta Regional Areawide Aquatic Weed Program (DRAAWP). Mention of a product does not constitute an endorsement by the US Department of Agriculture.