Operational Performance of Hydrilla Harvesting on Lake Tohopekaliga

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Managing Invasive Plants

Since 2008, the FWC has statutory mandate to manage invasive plants in Florida's public waters (1.25 million acres).

Maintenance control is the coordinated effort to maintain the low-level populations to mitigate risks.

The goals for maintenance control:

- Minimize environmental damage caused by invasive plants
- Conserve the uses and functions of Florida public waters
- Enhance conditions for diverse native plant growth
- Use less herbicide in plant management
- Lower management costs
- Adapt management according to current conditions in each waterbody

Planning Large-Scale Hydrilla Control

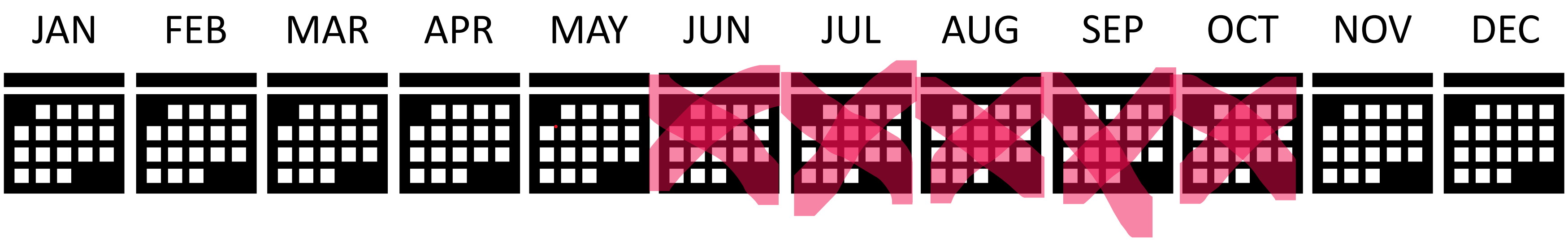
Hydrilla grows year-round in Florida’s sub-tropical climate

JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

https://plants.ifas.ufl.edu/manage/developing-management-plans/large-scale-hydrilla-control-considerations/

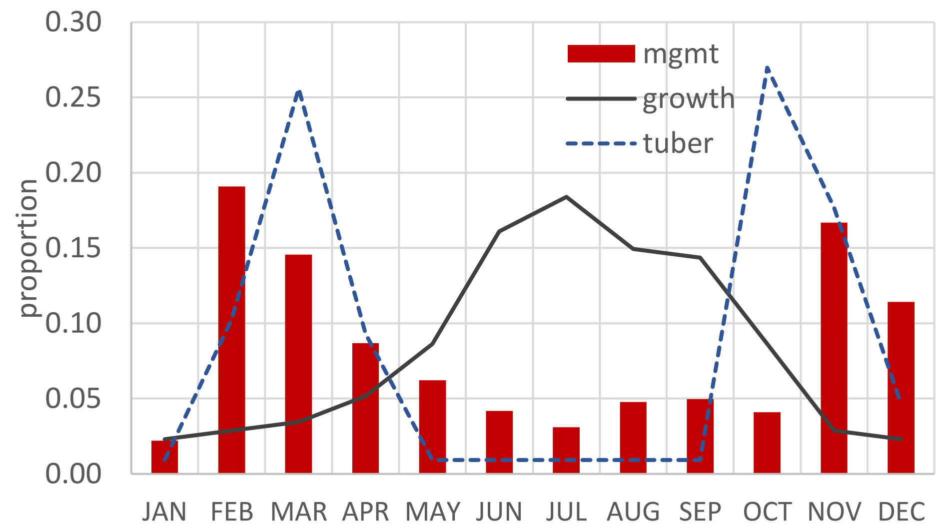
Planning Large-Scale Hydrilla Control

Hydrilla traditionally not managed during the summer



Considerations for Public Lakes:

- High temperatures
- high biomass
- DO crash
- herbicide degradation
- native plant growth
- Hunting seasons
- Fishing tournaments
- Snail kite nesting (year-round)



FWC 2019; Haller 1976

https://plants.ifas.ufl.edu/manage/developing-management-plans/large-scale-hydrilla-control-considerations/

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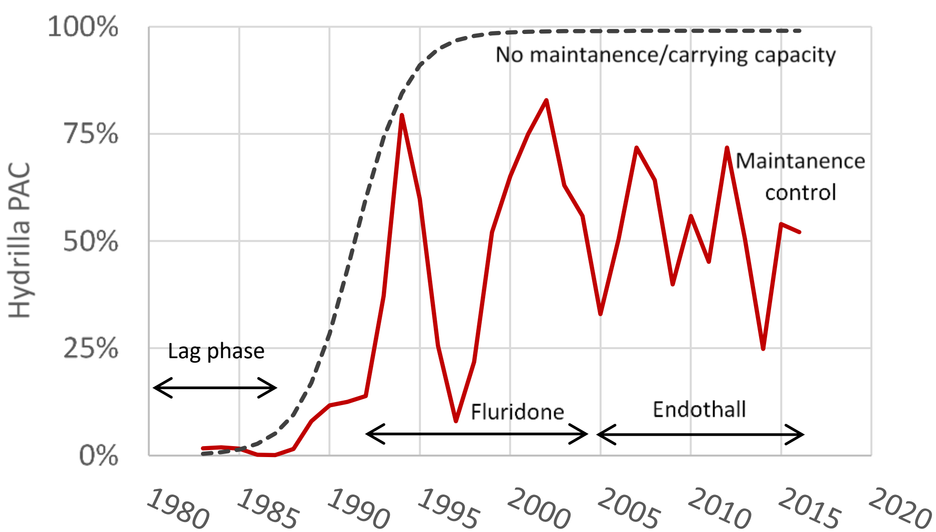
Managing Hydrilla on a Large Lake

Lake Toho (>18,000 acres) has the largest hydrilla infestation in FL, >3500 acres are managed annually to maintain at 50% cover



Percent area cover (PAC) of hydrilla on Lake Toho from 1983-2016 (red) with a simulated invasion curve (black dash) depicting the short lag phase and the carrying capacity of Lake Toho up to 99% of the total area.

Plant	Acres Treated	Expenditures
Hydrilla	20,618.4	$10,040,619.88
Floating Plants	28,676.7	$4,664,194.00
Torpedograss	123.5	$18,429.22
Wild taro	5.7	$1,378.47
Paragrass	692.8	$40,274.90
Hygrophila	13.4	$5,531.94
W. Indian marsh grass	355.3	$58,972.75
Ludwigia grandiflora/hexapetala	1,275.6	$294,367.99
Aquatic soda apple	14.2	$2,164.24
Water spinach	0.5	$165.33
Giant salvinia	16.8	$934.20
Other plants	8,872.3	$703,341.85
Floating islands	867.5	$1,025,508.61
Survey/Admin	n/a	$151,809.59
TOTAL	**61,532.7**	**$17,007,692.97**

FWC Invasive Plant Management Section 2018

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Fluridone Resistance

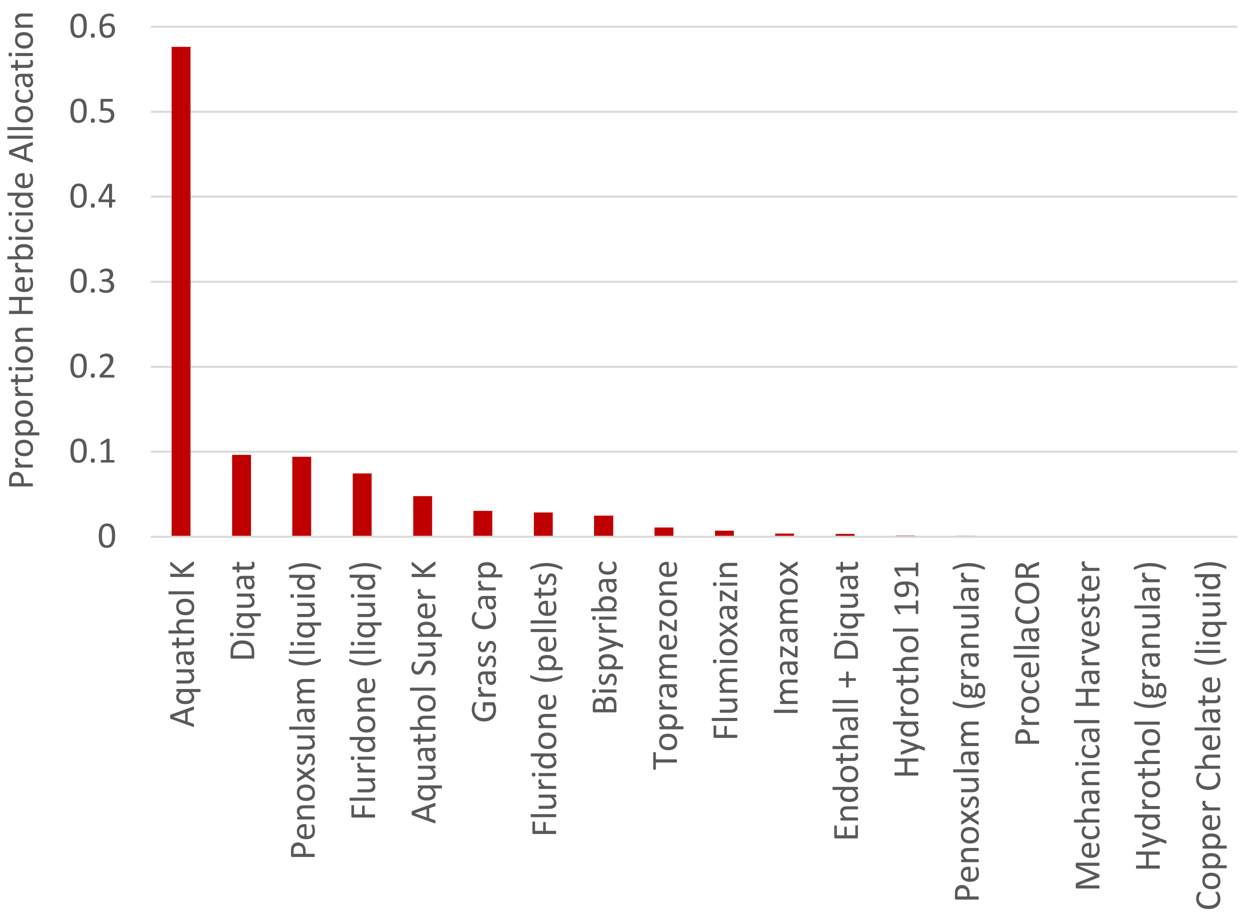
Table 2. History of fluridone applications (kg) on the Kissimmee Chain of Lakes in Florida.

	Fluridone			
Year	Lake Tohopekaliga	Lake Cypress	Lake Hatchineha	Lake Kissimmee
	kg			
1993	544 (1197 lb)	—	—	—
1994	606	—	—	—
1995	1,208	—	—	787
1996	2,505	113	—	—
1997	2,466	113	889	3,123
1998	2,495	544	1,089	2,359
1999	2,486	923	1,746	2,223
2000	3,882	549	1,686	2,486
2001	3,735	1,270	1,016	1,884
2002	5,655	1,207	1,651	1,929
2003	6,160	907	1,094	1,732
2004	4,445	1,219	1,814	1,407
2005–2012	0[a]	0	0	0

Netherland and Jones 2015

Standards in Hydrilla Management

Treatments provide up to 300 days suppression
Disproportionately reliant on endothall
Most other actives in combo to prevent resistance



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FWC Aquatic Plant Management Program Enhancements

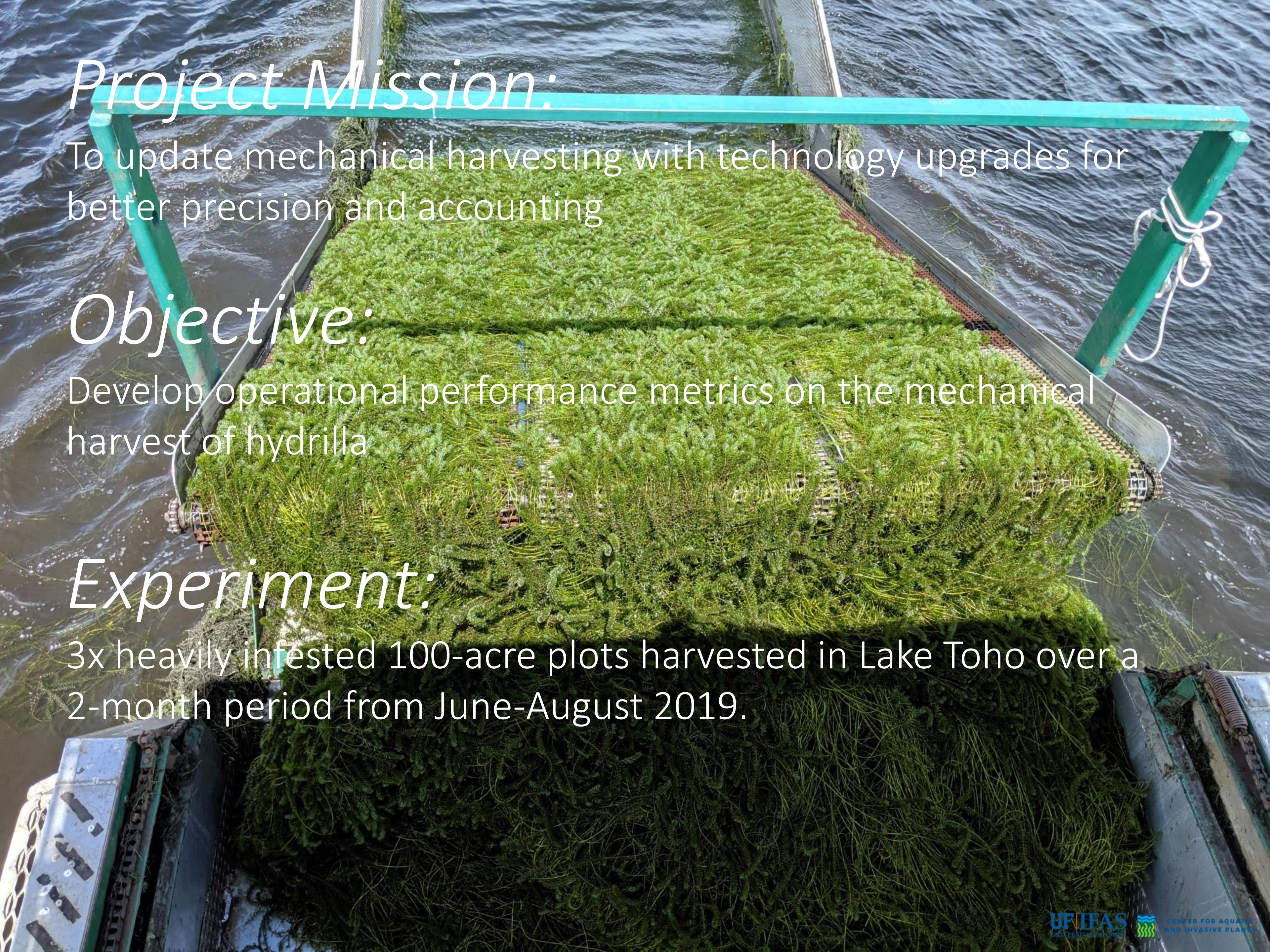
January 2019 the FWC put a 2-month moratorium on the use of herbicides and conducted public stakeholder listening sessions throughout the state.

Based on public feedback the FWC is improving the Aquatic Plant Management Program:

- Expand habitat management plans for individual lakes.
- Form Technical Assistance Group of staff, partners and stakeholders.
- Improve timing and oversight of herbicide use.
- ***Increase the use of mechanical harvesting to manage aquatic plants.***
- Develop pilot projects to better integrate plant management tools.
- Improve agency communication regarding plant management activities.

Reexamine mechanical harvesting for hydrilla management

- Mechanical harvesters are a century-old technology
- Benefits a lake system by removing biomass from the water column
- Mostly deployed in tussock removal projects



Project Mission:

To update mechanical harvesting with technology upgrades for better precision and accounting

Objective:

Develop operational performance metrics on the mechanical harvest of hydrilla

Experiment:

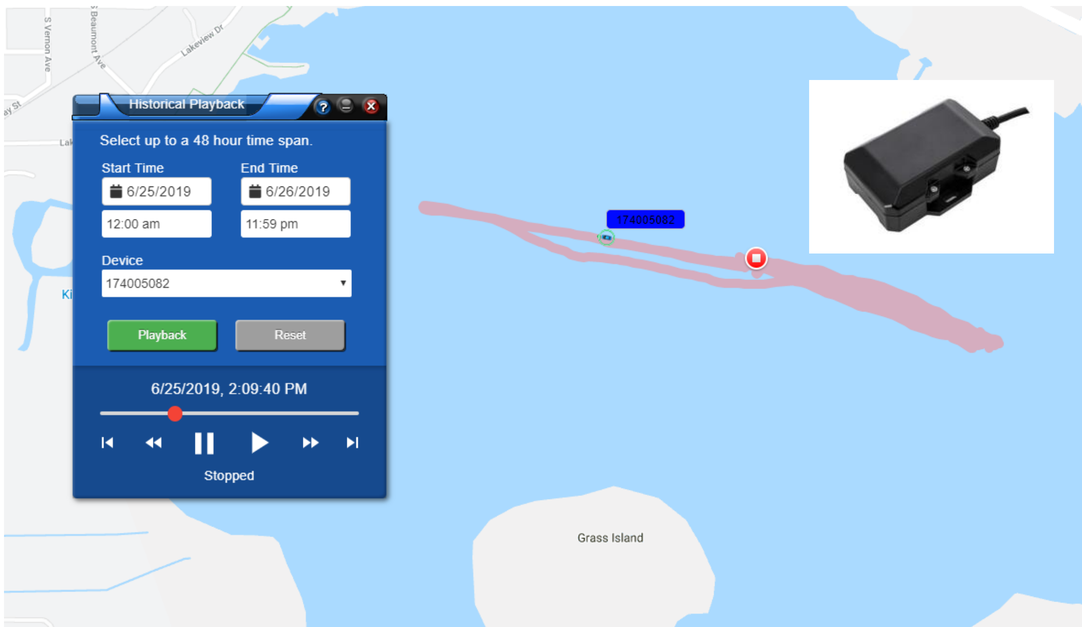
3x heavily infested 100-acre plots harvested in Lake Toho over a 2-month period from June-August 2019.

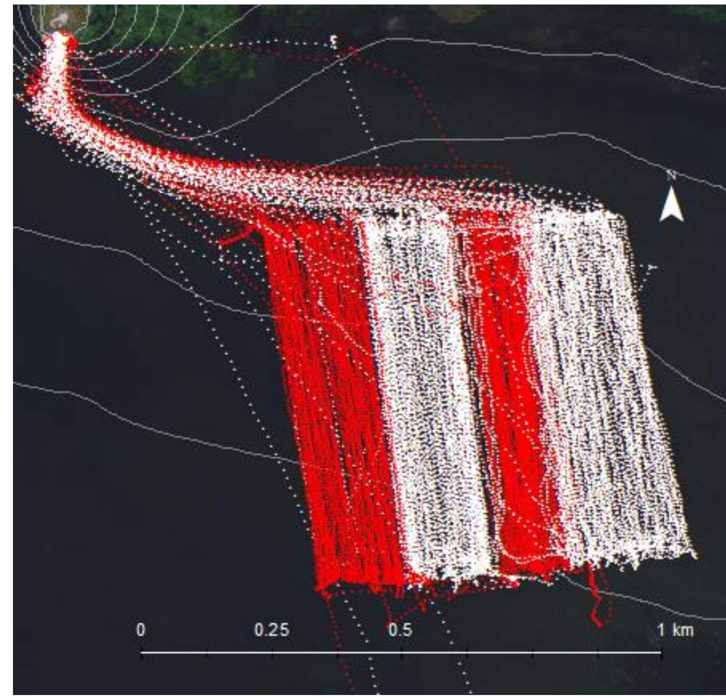
Harvest operations

- Three plots established in the north (shallow)and south (deep) ends of the lake (45 and 64 ha, respectively.
- A total of six Kelpin harvesters with three tug/air boats were deployed for transporting barged material to designated spoil islands
- Deployed from 06/14 to 08/30 (77 days)

Real-time GPS tracking

https://app.usfleettracking.com/

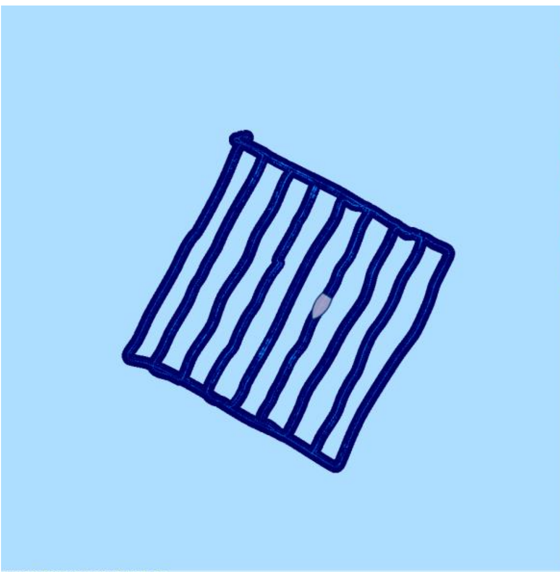


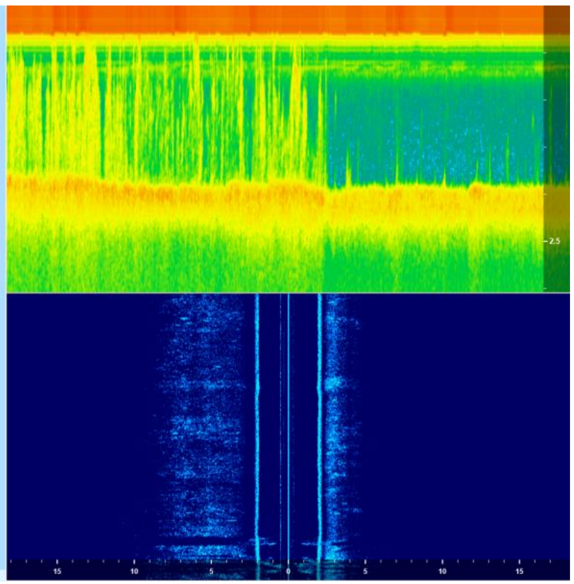


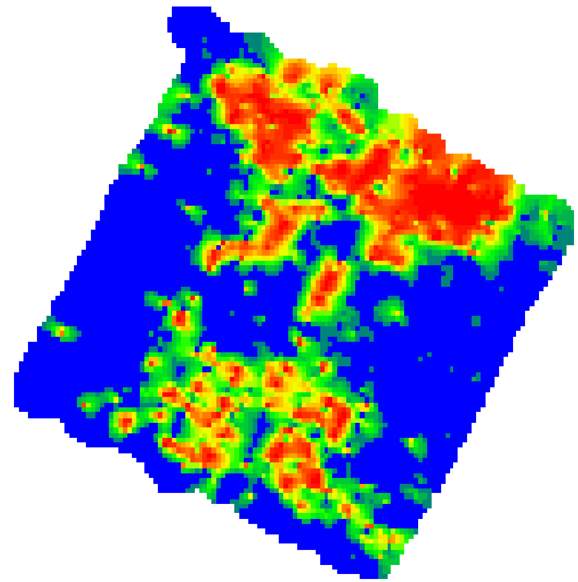
- GPS loggers wired to the ignition; recording on 10s intervals
- GPS track data used to analyze harvester efficiency and precision

Hydro-acoustic surveys

https://www.biobasemaps.com/







- Calculate biovolume of SAV
- A 20° beam transducer integrated with WAAS GPS
- Post-processed in GIS to produce biovolume rasters

Satellite Remote Sensing

https://scihub.copernicus.eu/dhus/#/home

Copernicus Sentinel-2 satellite constellation

- Multi-spectral instrument w/ 13 bands
- 748 km alt_{agl}; 290 km FOV
- 10 m res and high revisit frequency

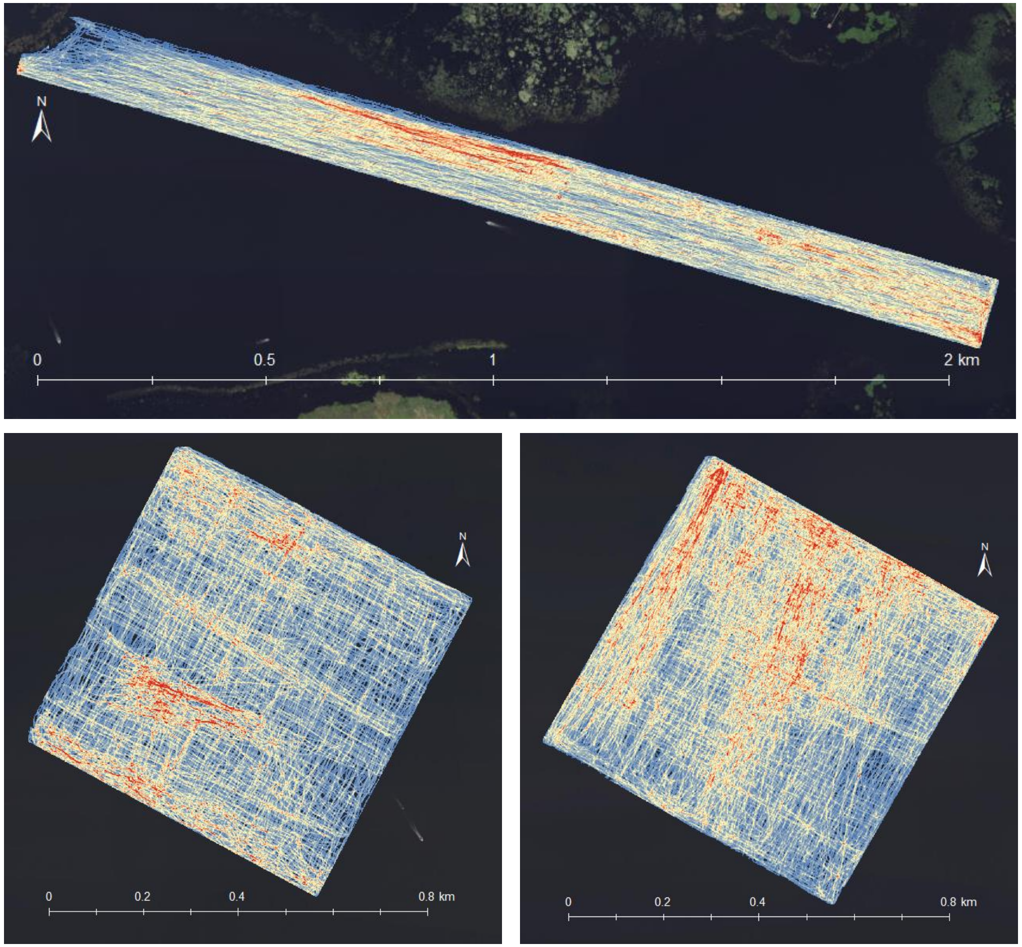
Principles of Normalized Difference vegetation index (NDVI):

- Chlorophyll absorbs visible red light; leaf cellular strongly reflect NIR.
- Water absorbs NIR light more than visible red light.

NDVI > 0 vegetated
NDVI = 0 rocks and bare soil
NDVI < 0 water

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$

Harvest efficiency and precision



- A total of 1022 harvester-hours
- Avg. 12.7 boat-hrs day^{-1}
- Avg. daily harvest rate 1.4 acres boat-hr^{-1}
- ~25% of boat operations not harvesting

Plot	Boat-hrs day^{-1}	ha day^{-1}	Speed (m s^{-1})
SOUTH 1	12.3	7.3	0.74
SOUTH 2	12.5	6.8	0.68
NORTH	13.1	7.6	0.68

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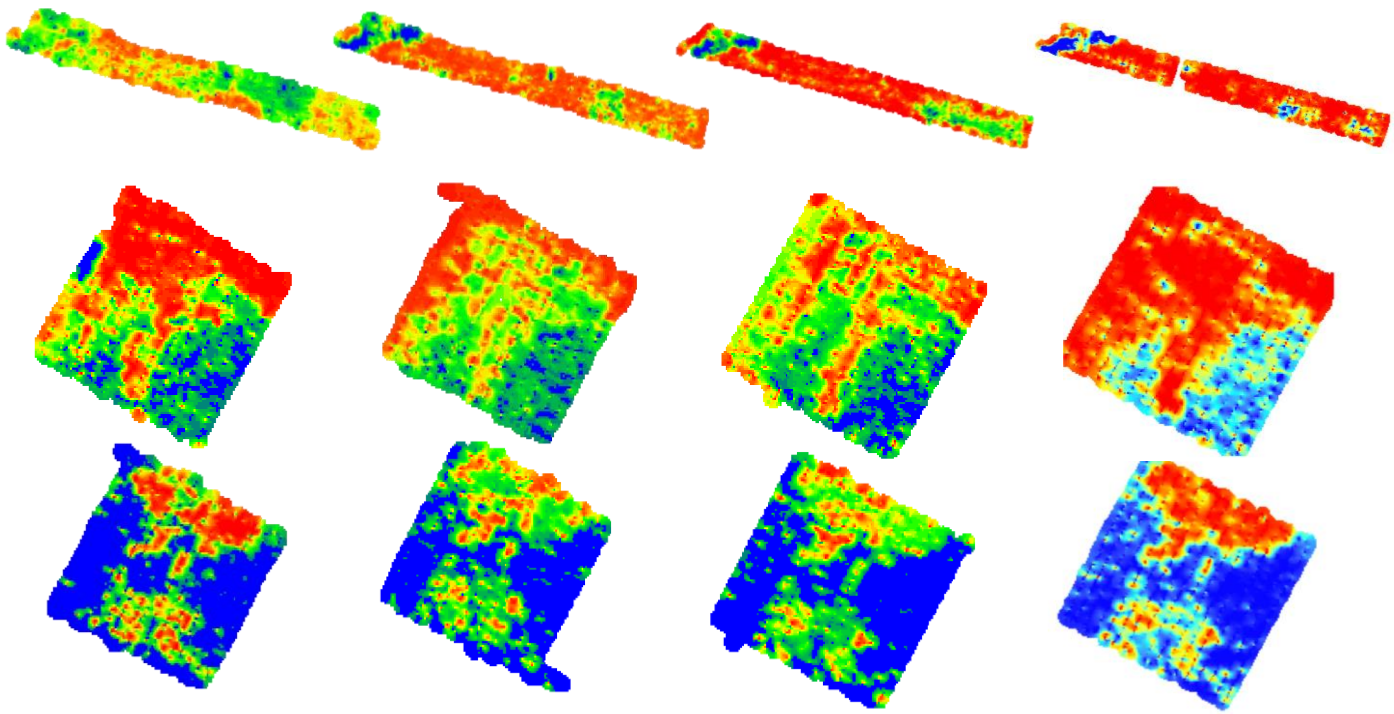
Harvest efficacy and hydrilla suppression

July 1 | Aug 8 | Aug 29 | Sep 26

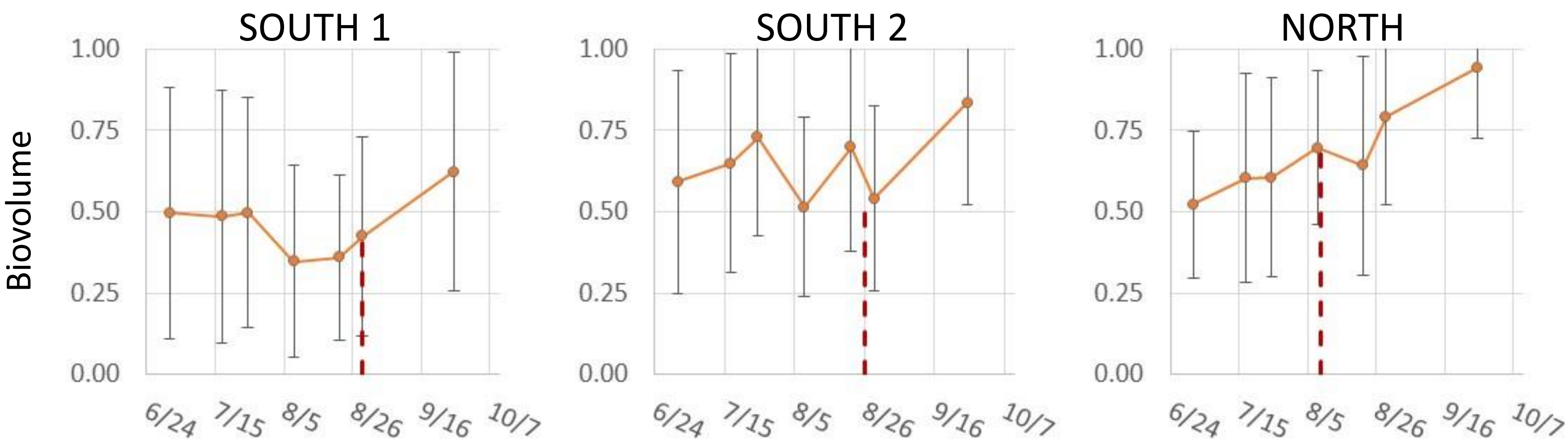
NORTH
PAC >; BV >

SOUTH 2
PAC >; BV >

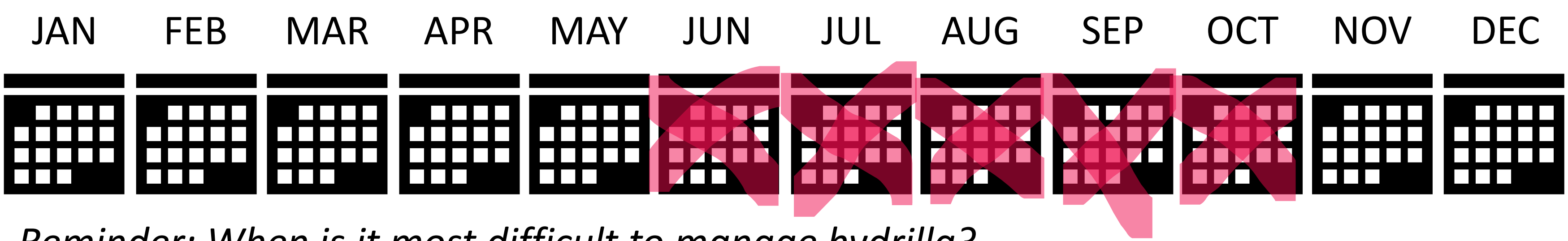
SOUTH 1
PAC >; BV >



Hydrilla suppression

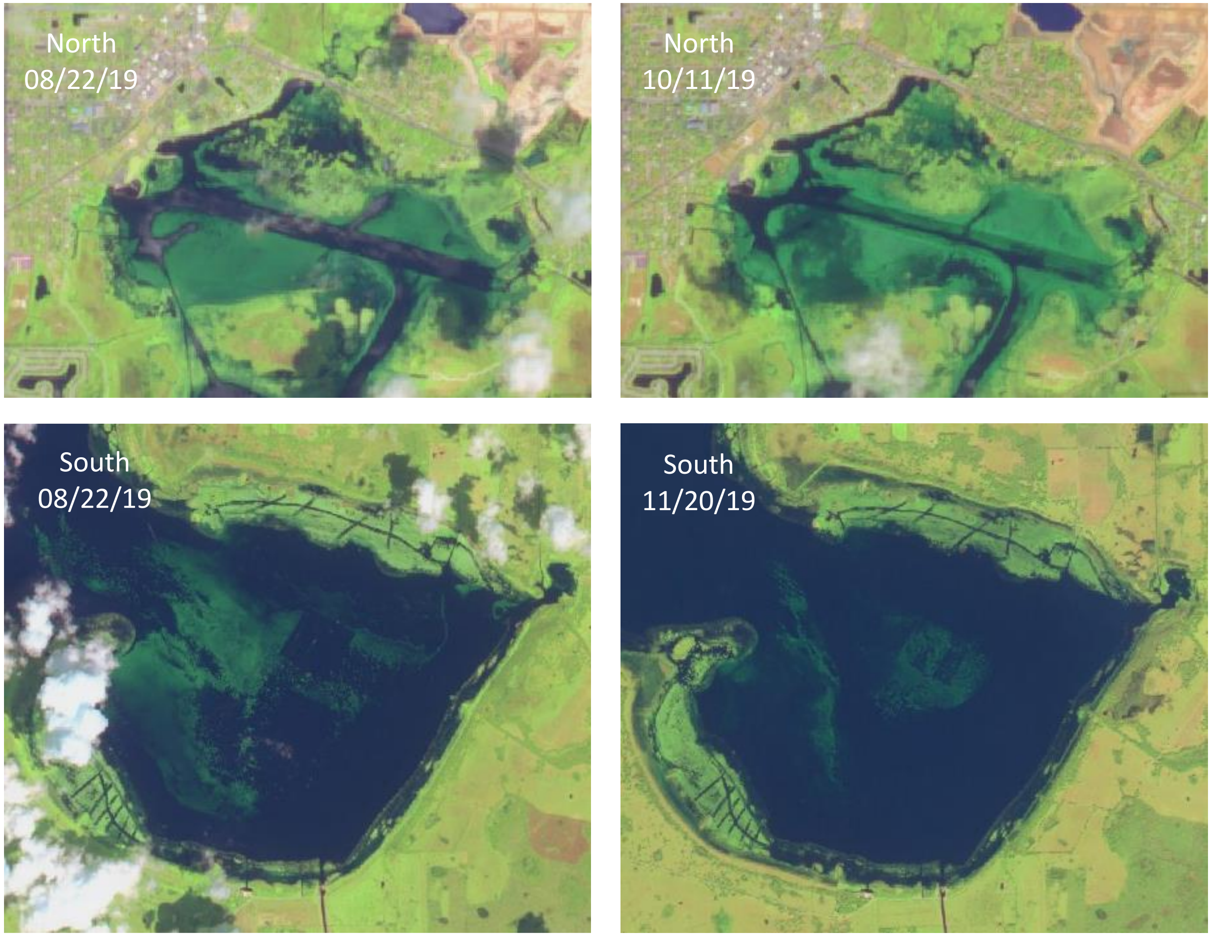


- South (deep) plots harvesting removal matched regrowth
- North (shallow) plot regrowth outpaced harvest operations
- All plots increased in biovolume within 30 days post-harvest



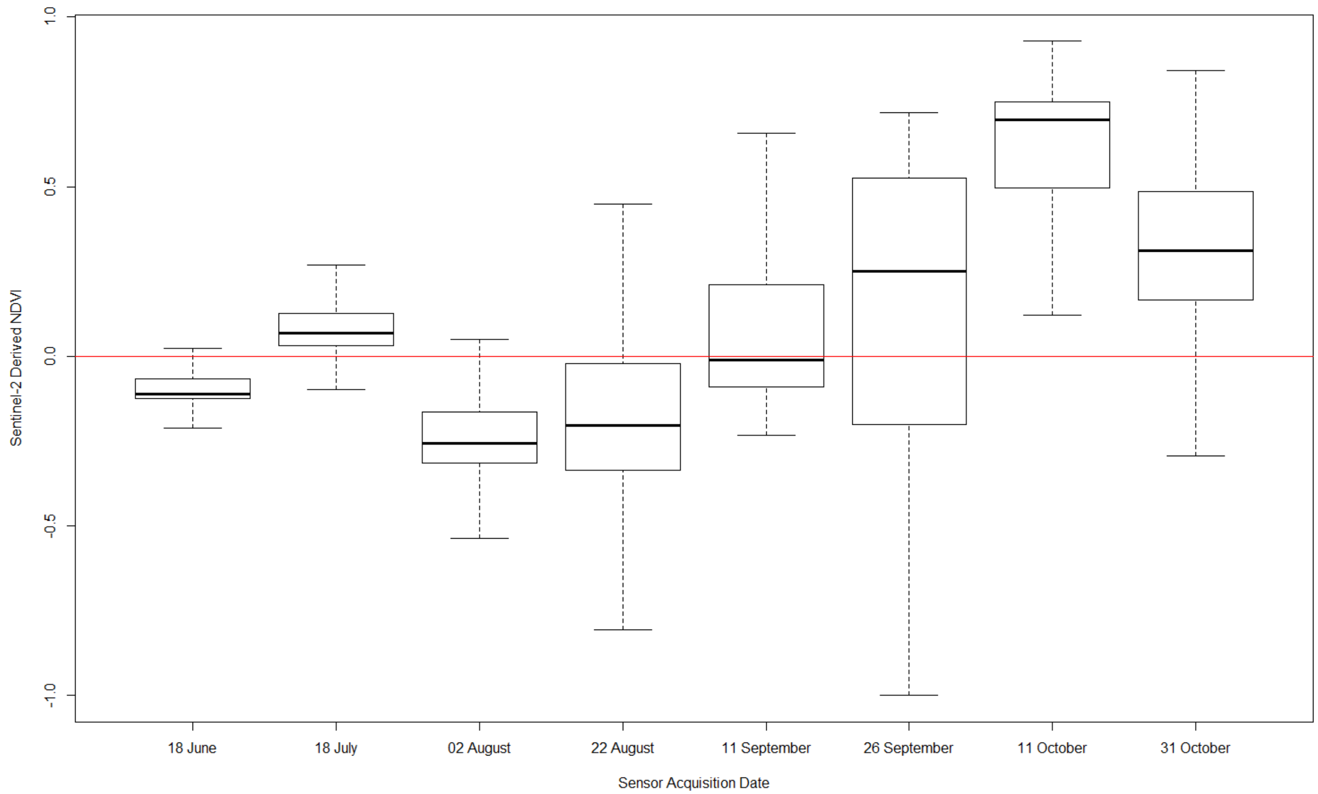
Reminder: When is it most difficult to manage hydrilla?

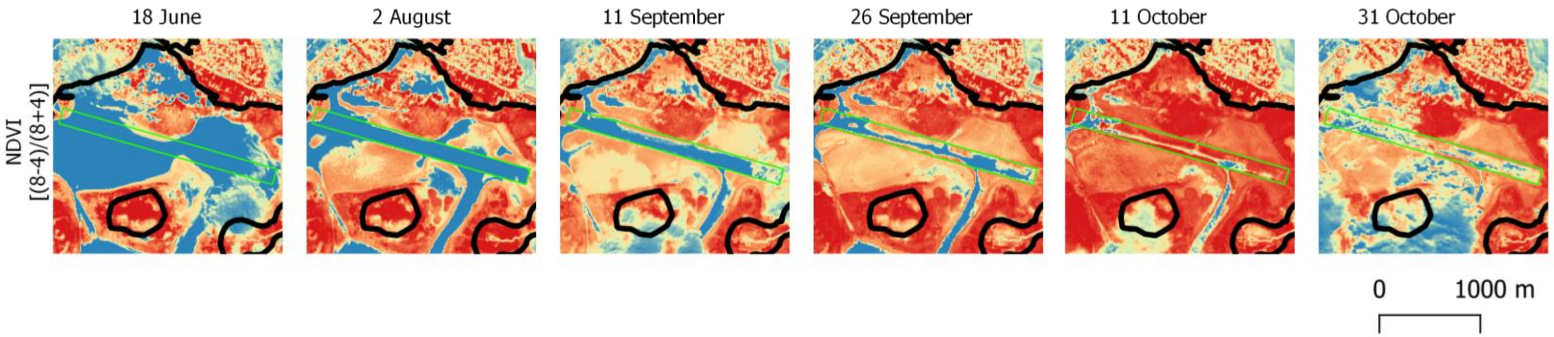
Post-treatment recovery



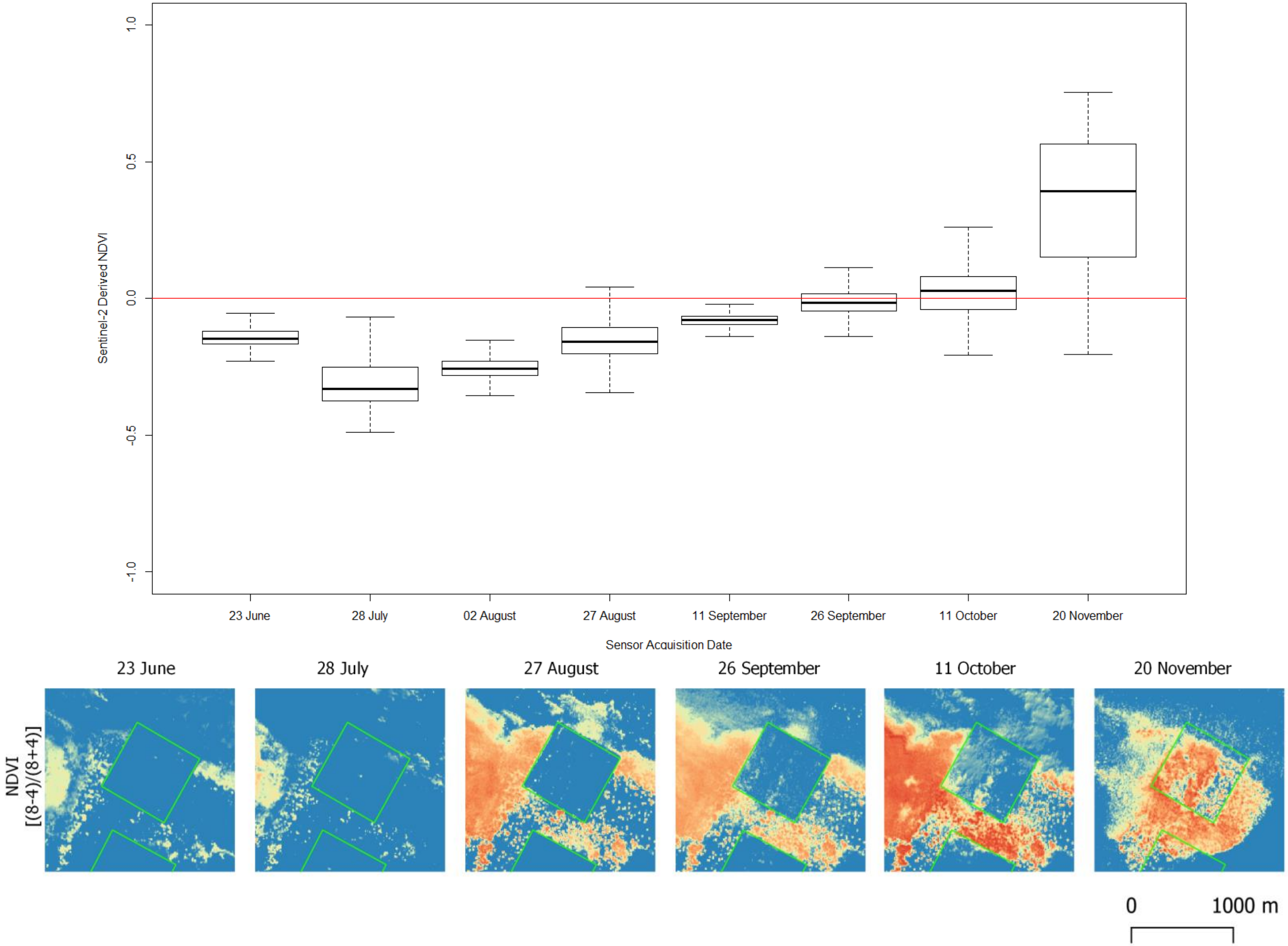
North and South coves just before contract termination (0 weeks after treatment; WAT) and reciprocal recovery expressed post treatment at 6 and 12 WAT, respectively. Note rising wate levels in November due to East Lake Toho drawdown. Images provided by Sentinel-2 satellite from European Space Agency (ESA)

Post-treatment recovery (North)





Post-treatment recovery (South 2)



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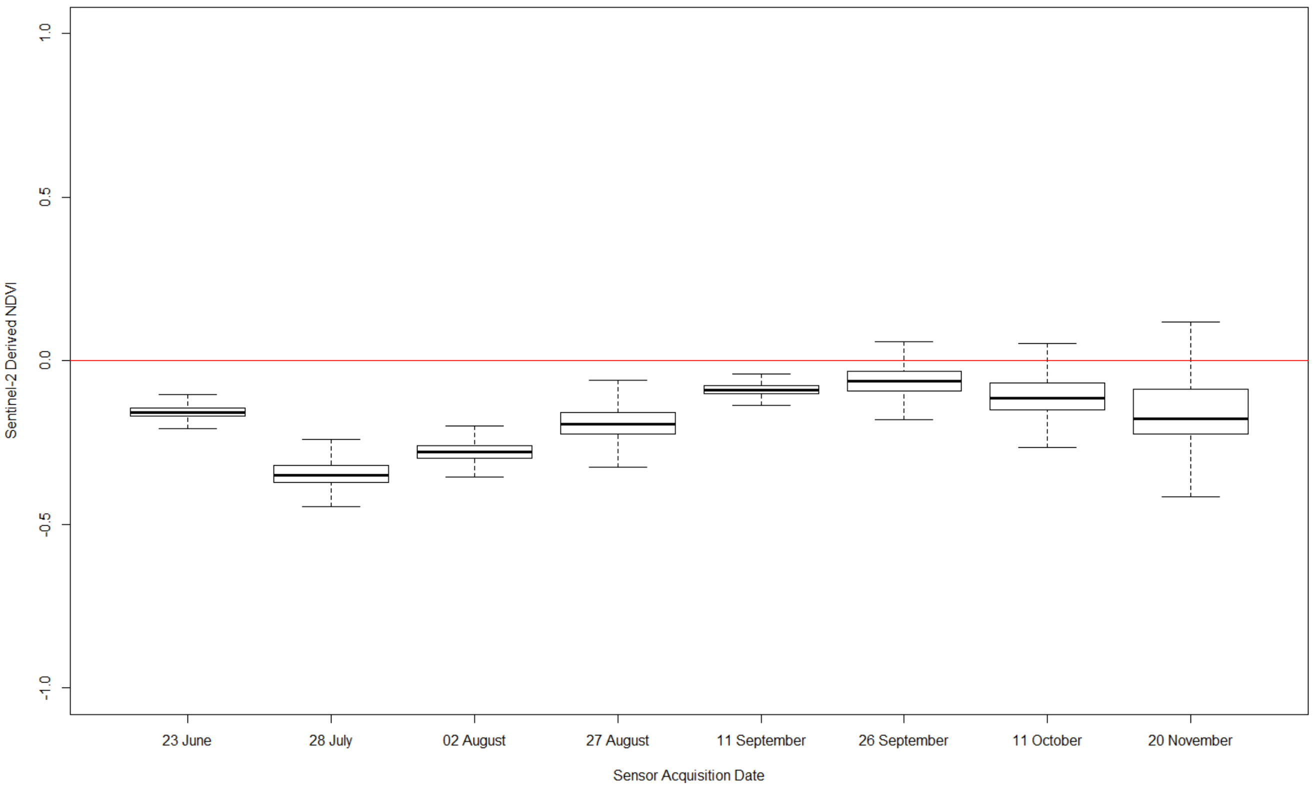
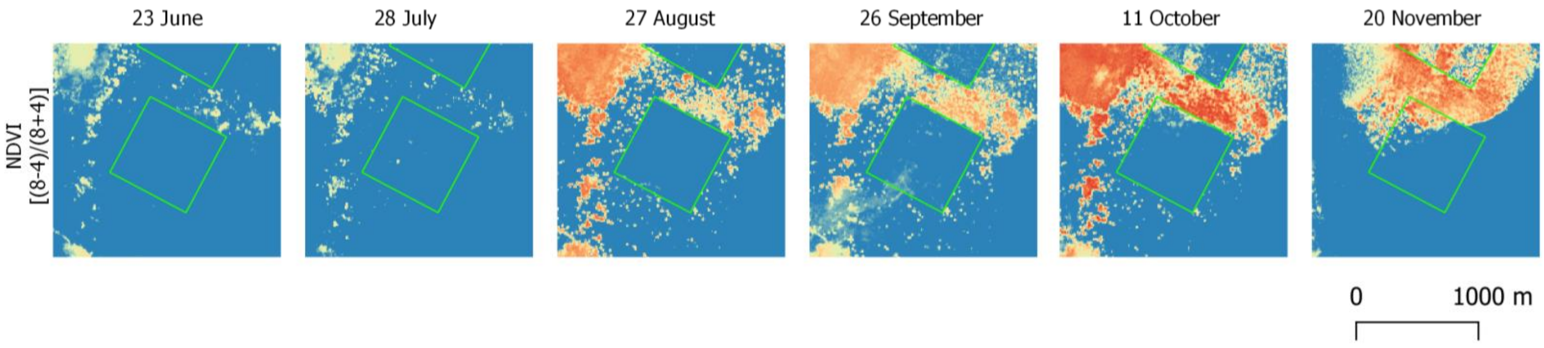
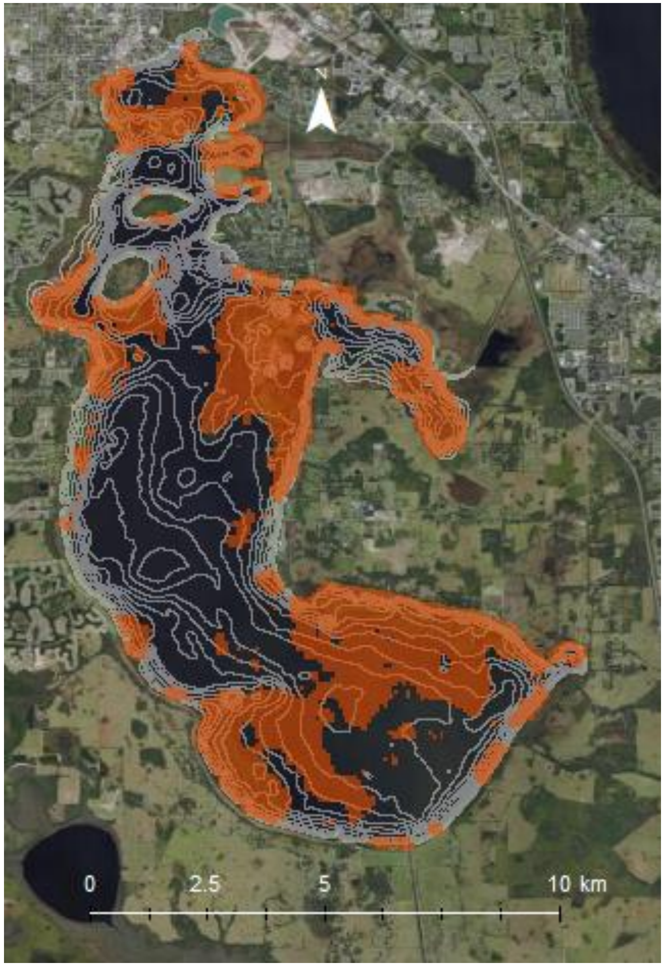
Post-treatment recovery (South 1)





Integrating Mechanical Maintenance

- Herbicide treatments cost \$400-1000 $acre^{-1}$
- Mechanical harvest can be 2-3 times higher at >\$1900 $acre^{-1}$ or \$1400 hr^{-1}
- Summer growth from June-Nov (i.e., 183 days).
- Each acre would require 5-9 boat-hrs for complete summer maintenance.
- It would take 17-30k boat-hrs to manage 3500 acres on Lake Toho
- One boat can manage ~168 acres
- Lake Toho maintenance would require a fleet of 21 Kelpin 800s six months a year



Questions?

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