Monitor Aquatic Invasive Species in Lake Carl Blackwell Using Remote Sensing Imagery

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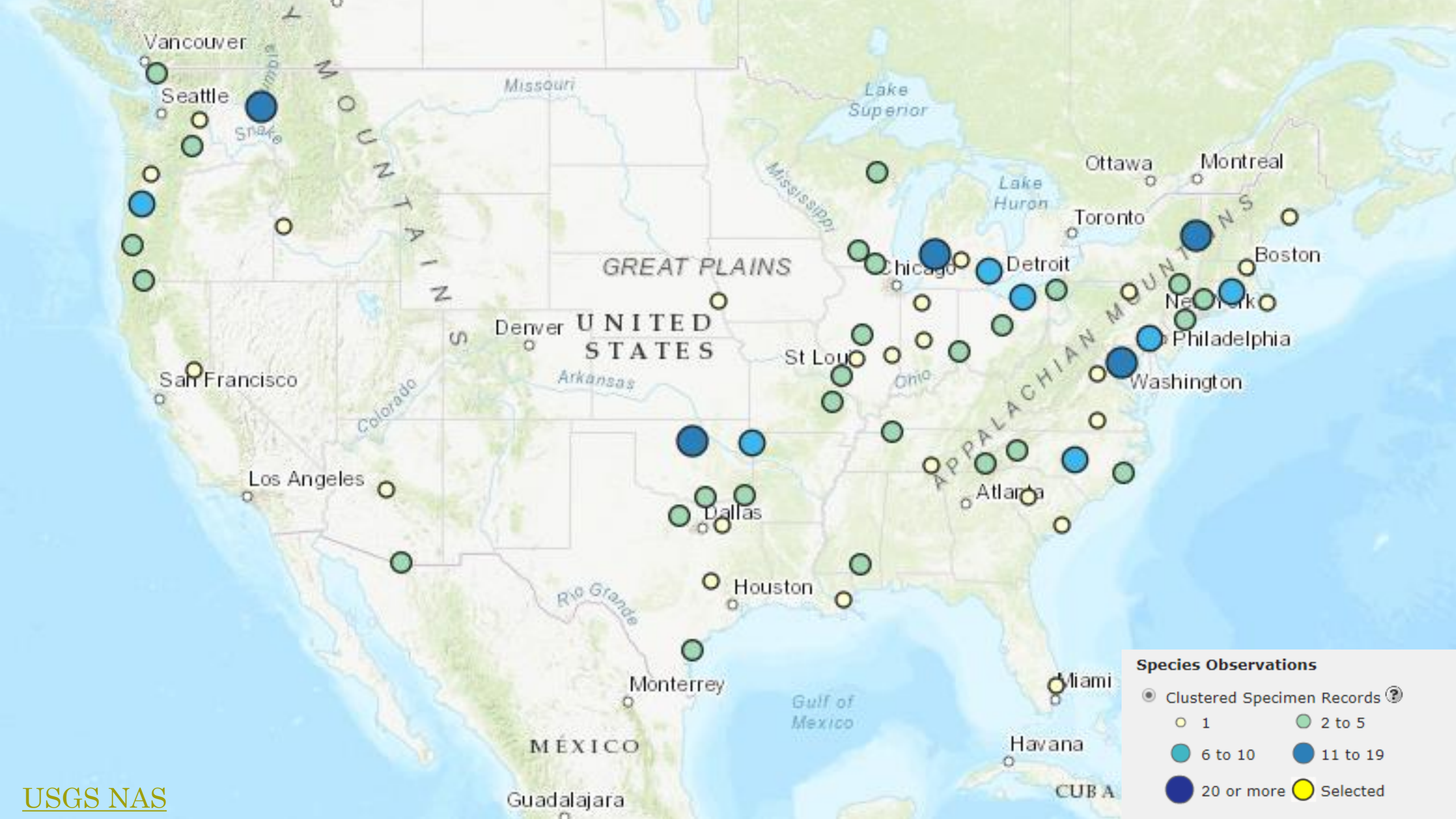
Lake Carl Blackwell

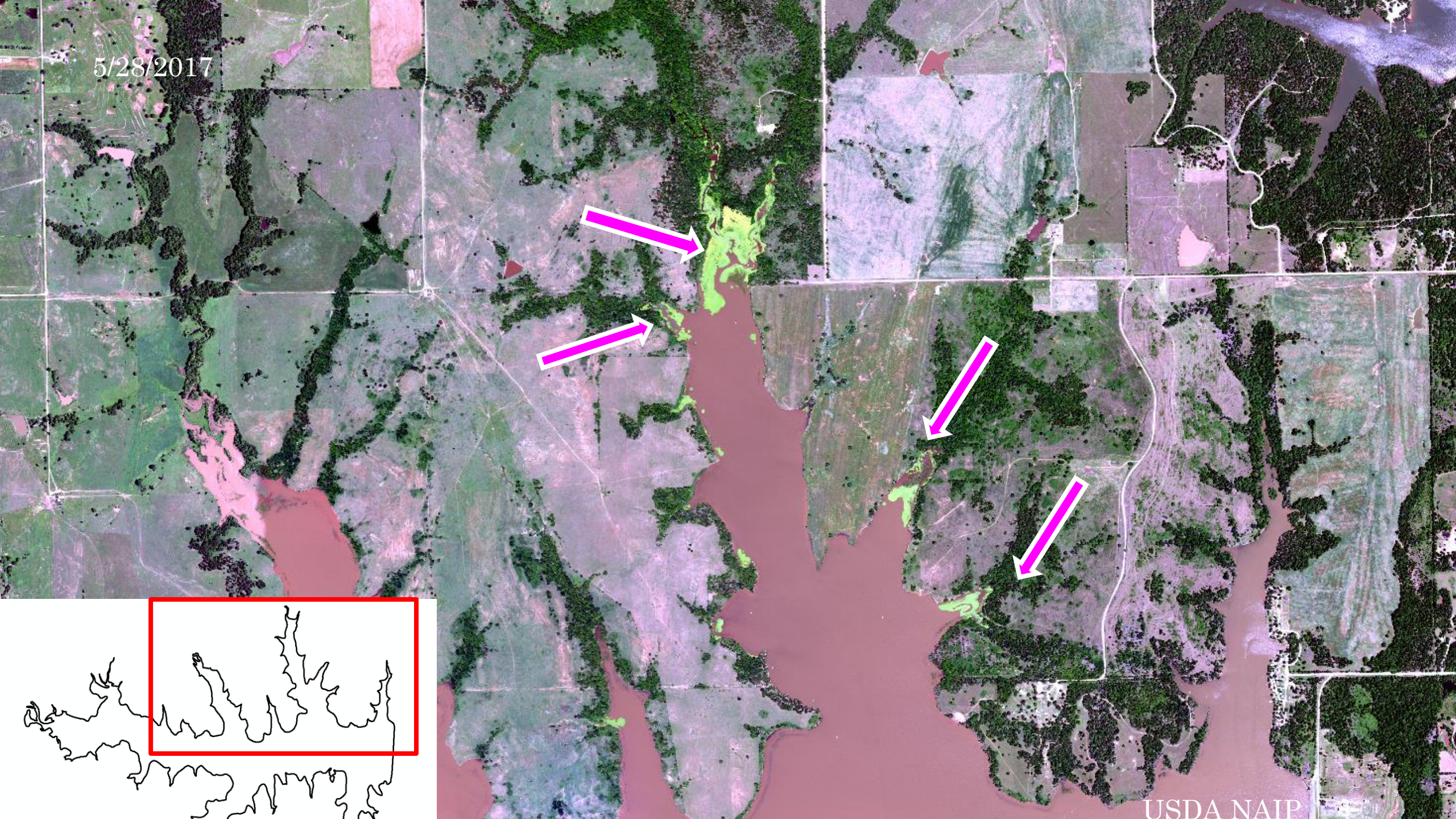

September 2018

Yellow Floating Heart (Nymphoides peltata)

- Native to southeast Asia and Mediterranean
- Occurs in moderately cold temperate area
- U.S. Distribution
- Infestation in OK


Vancouver
Seattle
Missouri
Lake Superior
Lake Huron
Ottawa
Montreal
Toronto
Boston
Detroit
Chicago
GREAT PLAINS
Denver
UNITED STATES
St Louis
Philadelphia
Washington
San Francisco
Arkansas
Ohio
Colorado
Los Angeles
Atlanta
Dallas
Houston
Rio Grande
Monterrey
Miami
Gulf of Mexico
MÉXICO
Havana
CUBA
Guadalajara
Species Observations
Clustered Specimen Records
1
2 to 5
6 to 10
11 to 19
20 or more
Selected

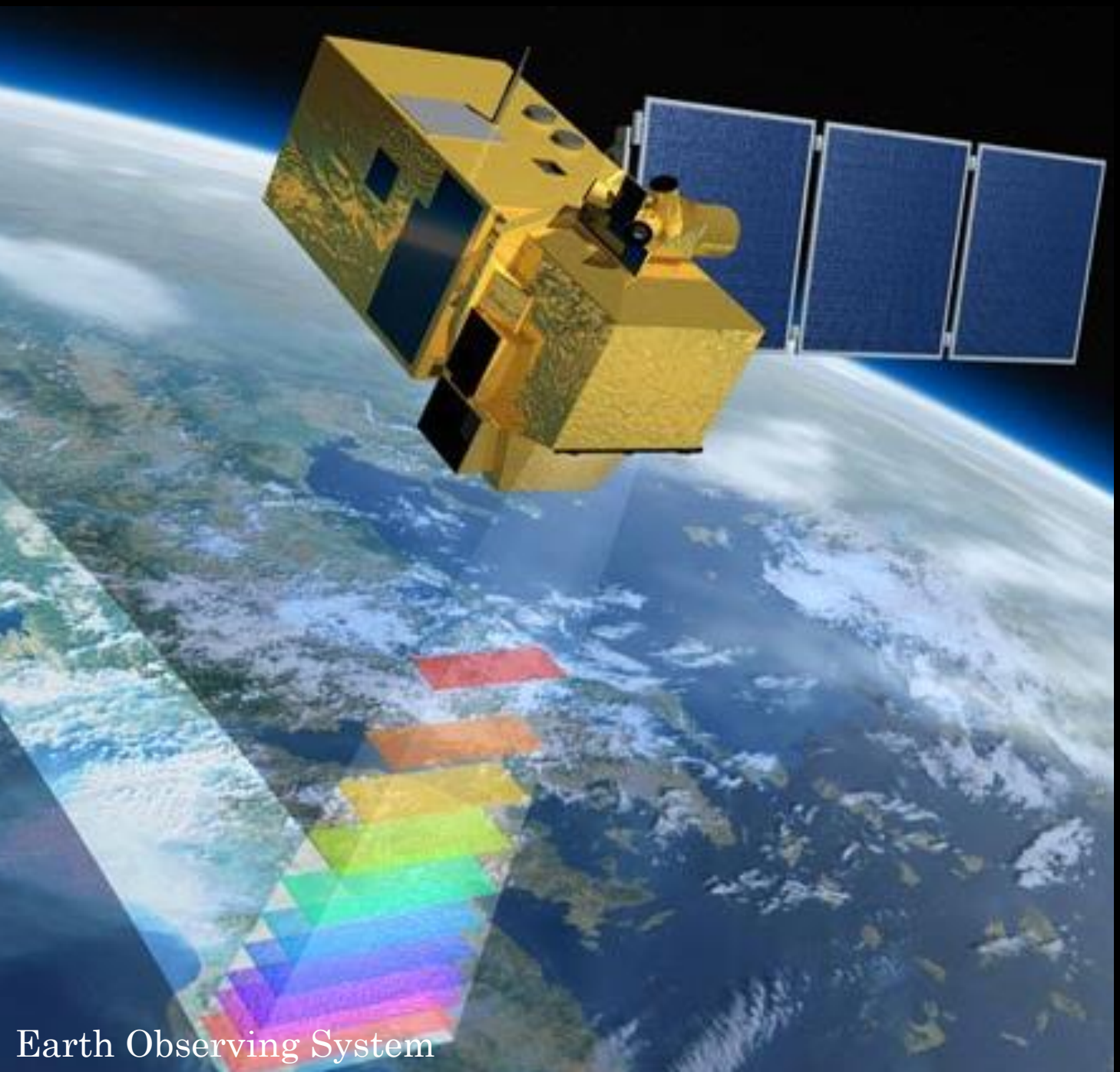
USGS NAS


5/28/2017
USDA NAIP

How can we monitor YFH effectively?

Goal: Develop a Cost-effective modeling method

- How
  - Long Term
  - Low Cost
  - Frequent
- What
  - Presence
  - Coverage
  - Density
  - (Treatment)



Earth Observing System

Band number	Band name	Sentinel-2A		Sentinel-2B		Resolution (nm)
		Central wavelength (nm)	Bandwidth (nm)	Central wavelength (nm)	Bandwidth (nm)	
1	Coastal aerosol	443.9	27	442.3	45	60
2	Blue	496.6	98	492.1	98	10
3	Green	560	45	559	46	10
4	Red	664.5	38	665	39	10
5	Vegetation Red Edge	703.9	19	703.8	20	20
6	Vegetation Red Edge	740.2	18	739.1	18	20
7	Vegetation Red Edge	782.5	28	779.7	28	20
8	NIR	835.1	145	833	45	10
8A	Narrow NIR	864.8	33	864	32	20
9	Water vapor	945	26	943.2	27	60
10	SWIR – Cirrus	1373.5	75	1376.9	76	60
11	SWIR	1613.7	143	1610.4	141	20
12	SWIR	2202.4	242	2185.7	238	20

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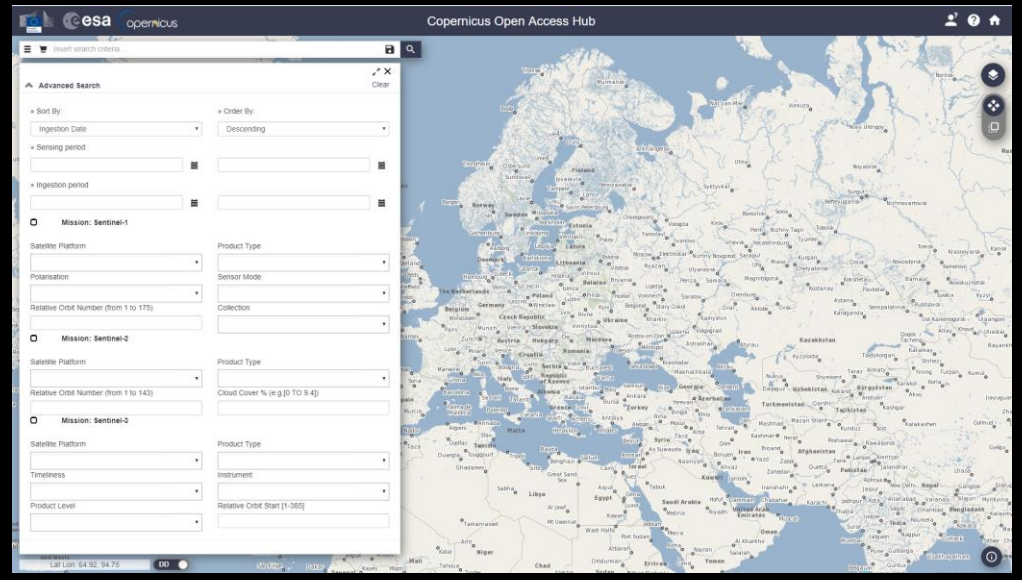
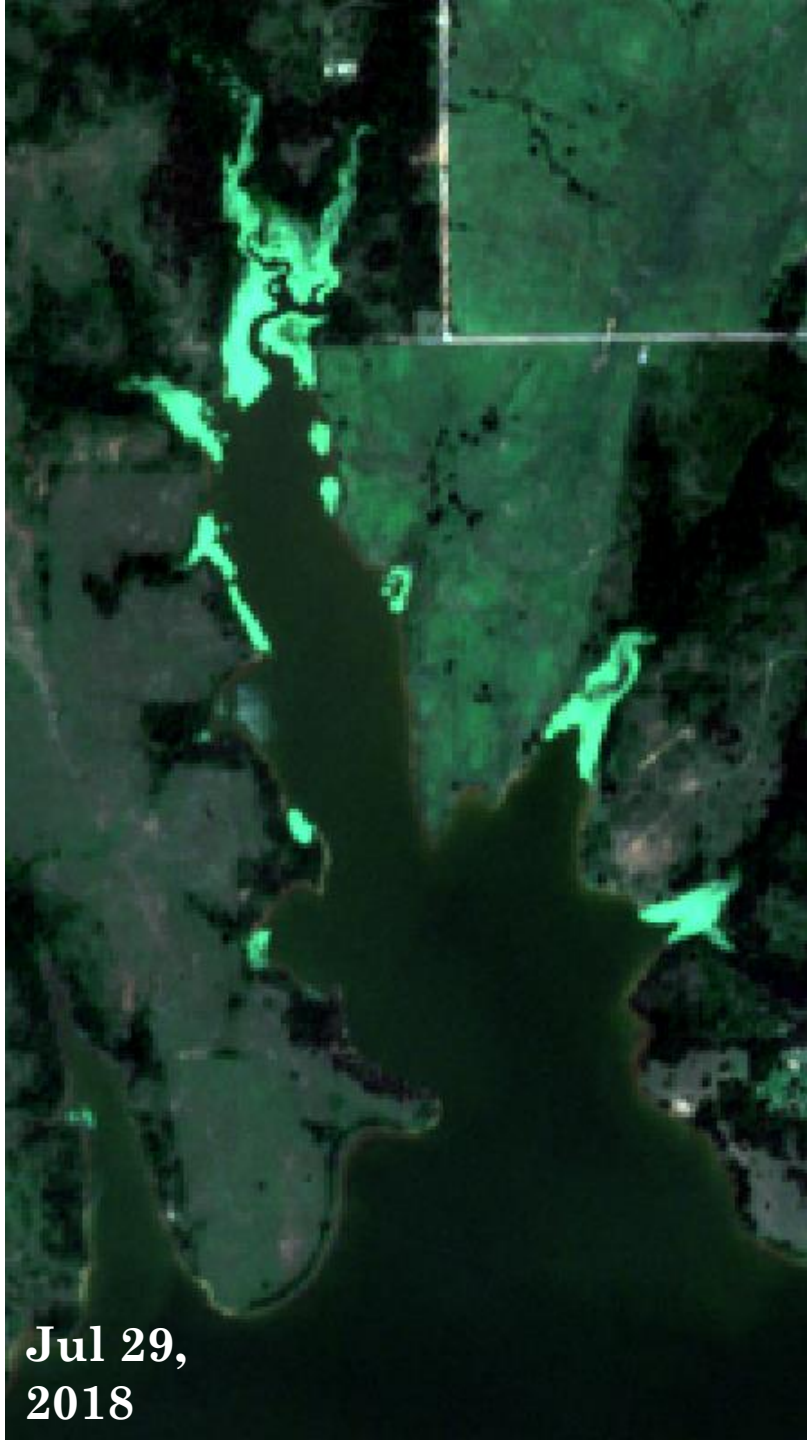
Data

- Source
  - Copernicus Open Access Hub
  - USGS Earth Explorer
- Dates
  - May-October 2016-2018 (23 images)
- Data Type
  - Level – 1C: Top-of-atmosphere reflectance, radiometrically and geometrically rectified




Jul 24,
2016


True Color
Composite
Jul 19,
2017


Jul 29,
2018

Sentinel-2 Images 2016-2018

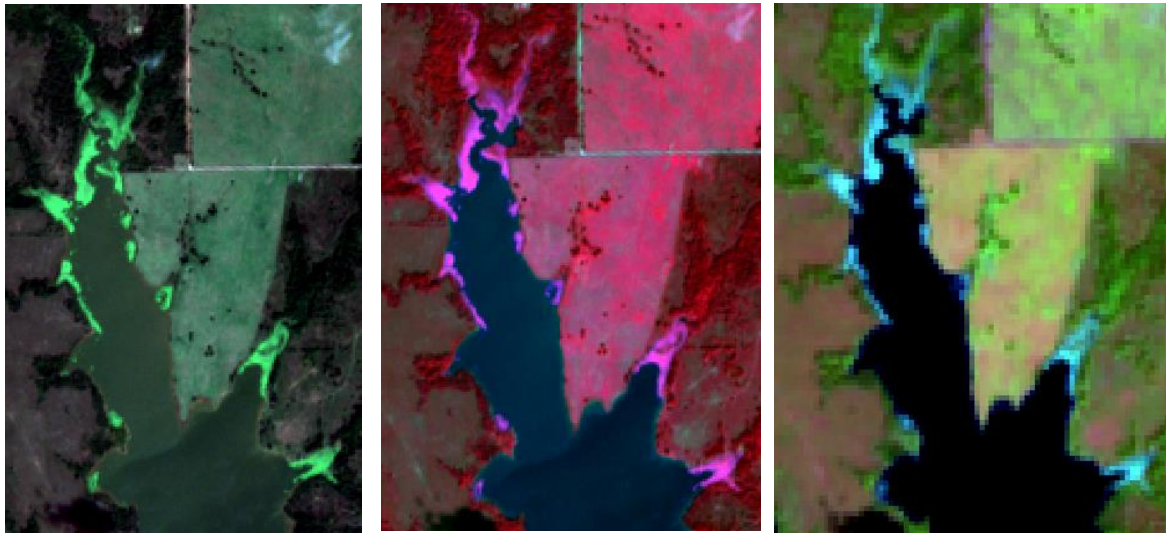
Rectification Digital # to Reflectance

Visualize Presence (Color Composites)

Red (4)
Green (3)
Blue (2)

NIR (8)
Red (4)
Green (3)

SWIR (11)
NNIR (8A)
VRE (5)



Calculate Spatial Coverage

Calculate Vegetation Index

Take out water areas

Calculate Water Body Index

Create Non-Water Mask (Land+AqaPlant)

Boundary .shp

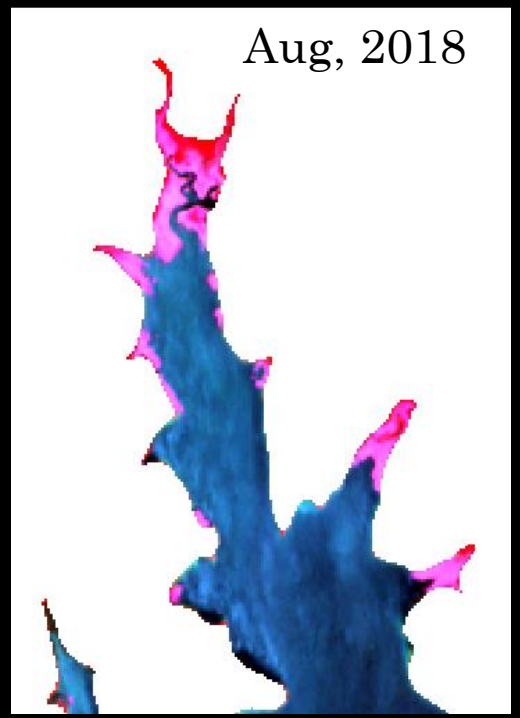
Find Aquatic Vegetation

Calculate YSH Density


May, 2018


Jun, 2018


Jul, 2018


Aug, 2018


Sep, 2018


Oct, 2018

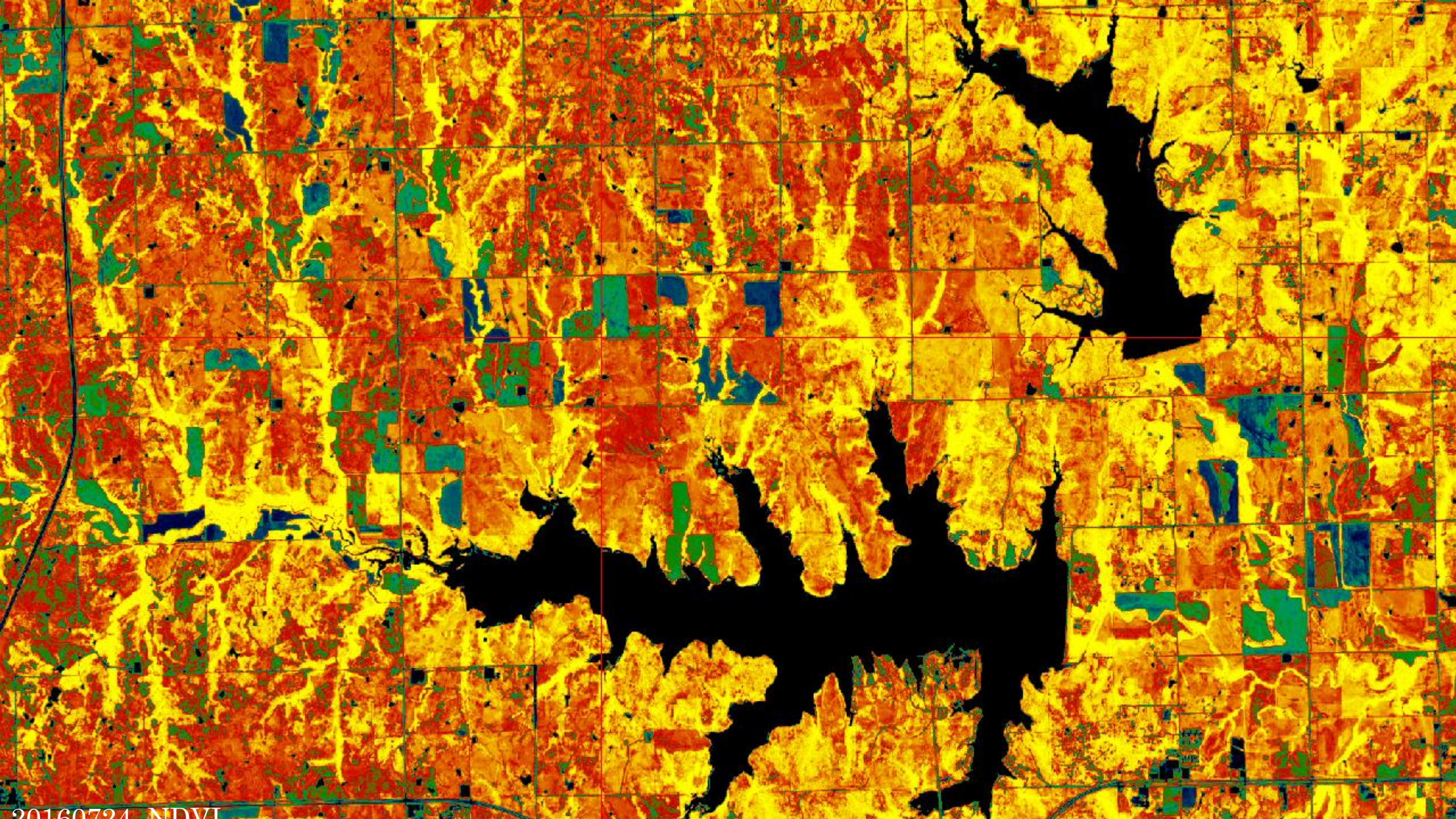
Identify Aquatic Vegetation

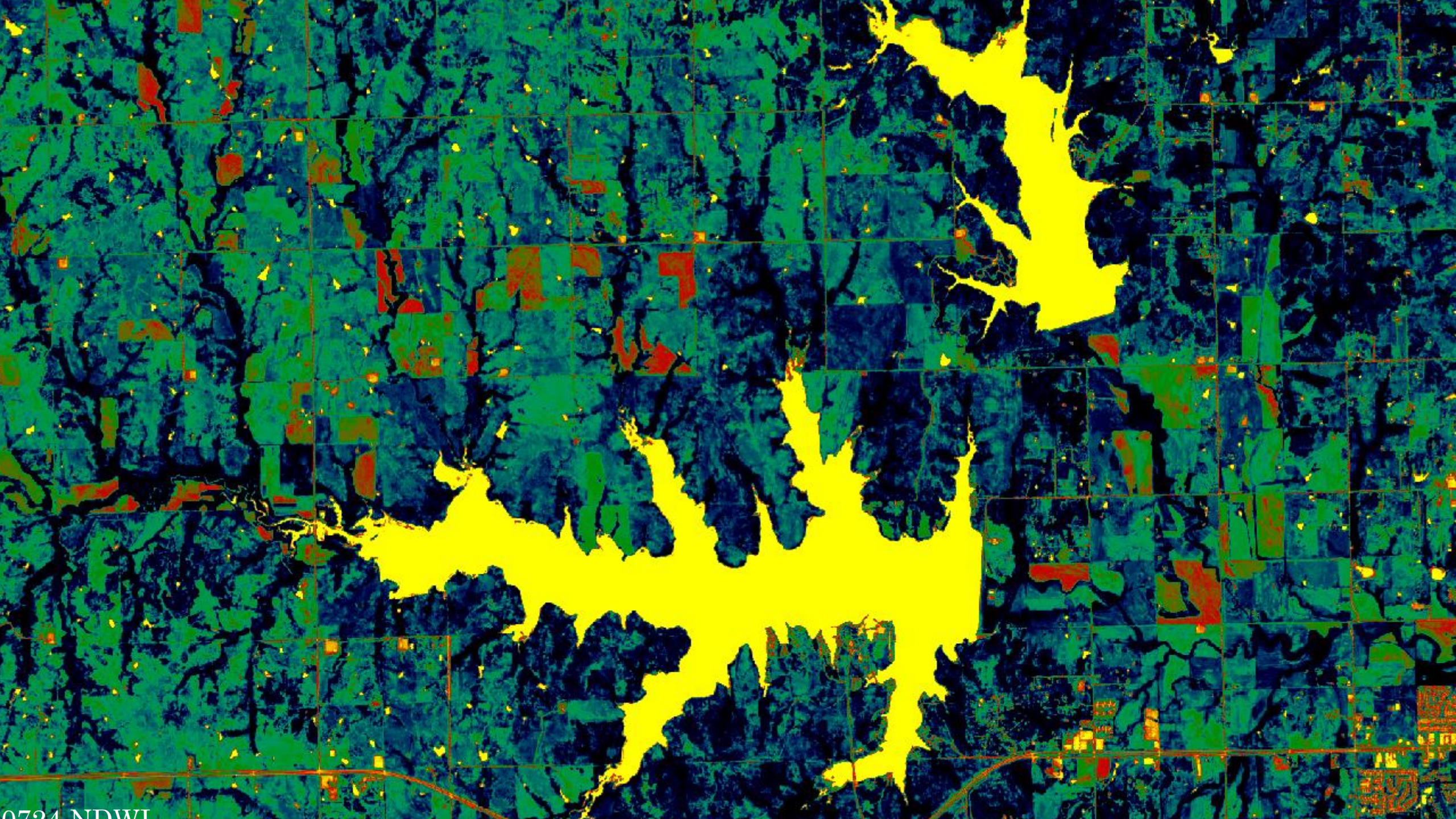
Normalized Difference Vegetation Index (NDVI)

$$NDVI = (NIR-Red)/(NIR+Red)$$

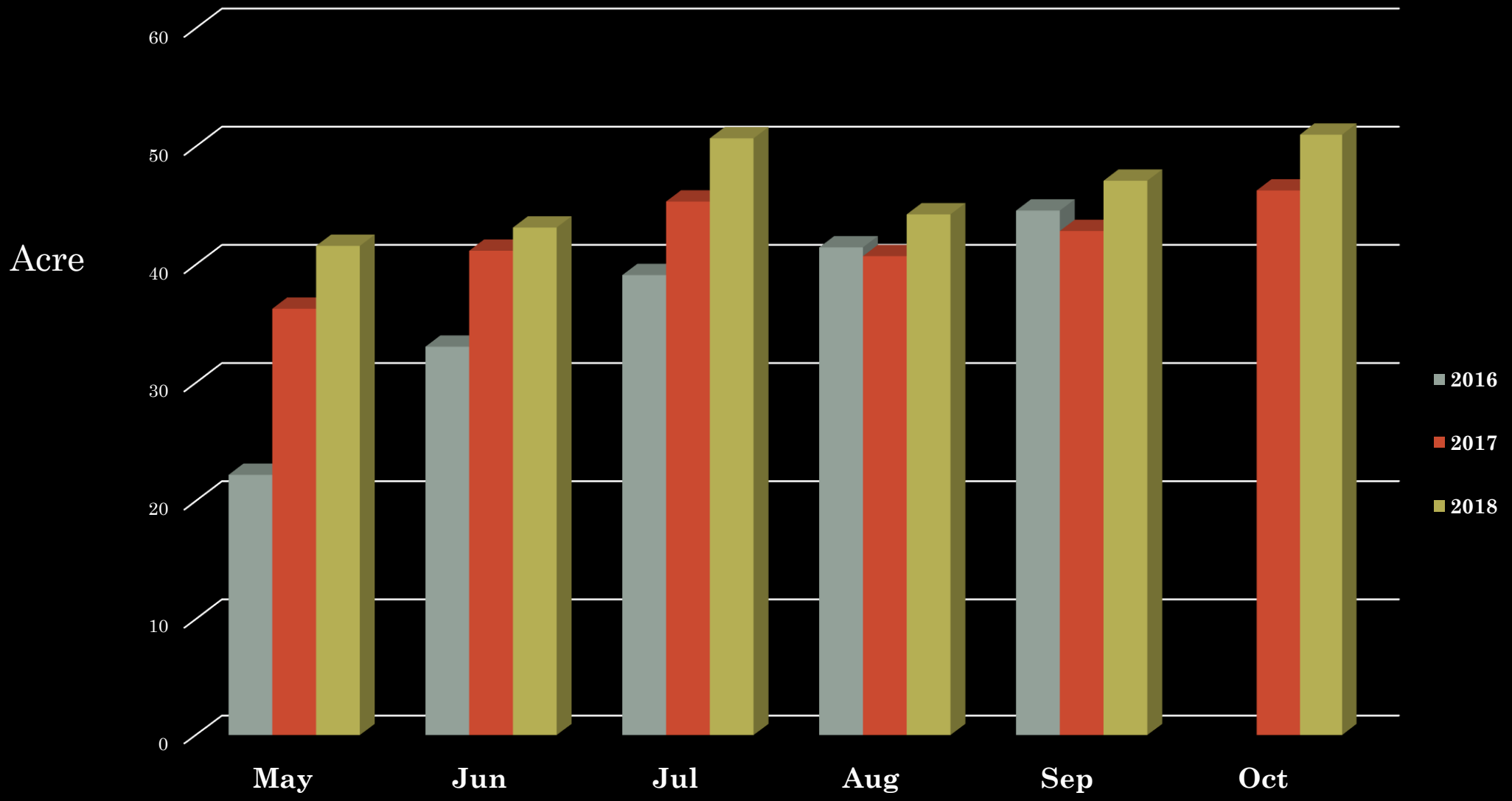
Normalized Difference Water Index

$$NDWI = (Green-NIR)/(Green+NIR)$$


20160724_NDVI


0784 NDWI

YFH Monthly Coverage 2016-2018



Calculating YFH Density

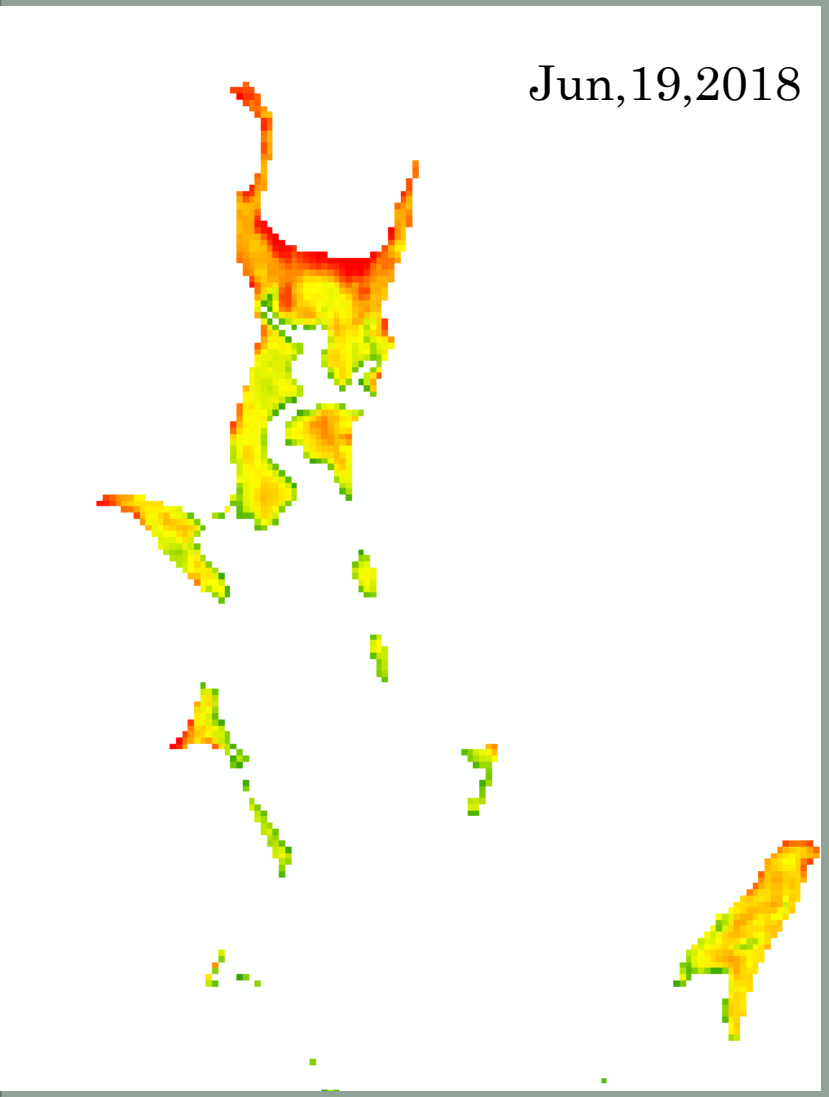
Fractional Vegetation Cover (FVC)

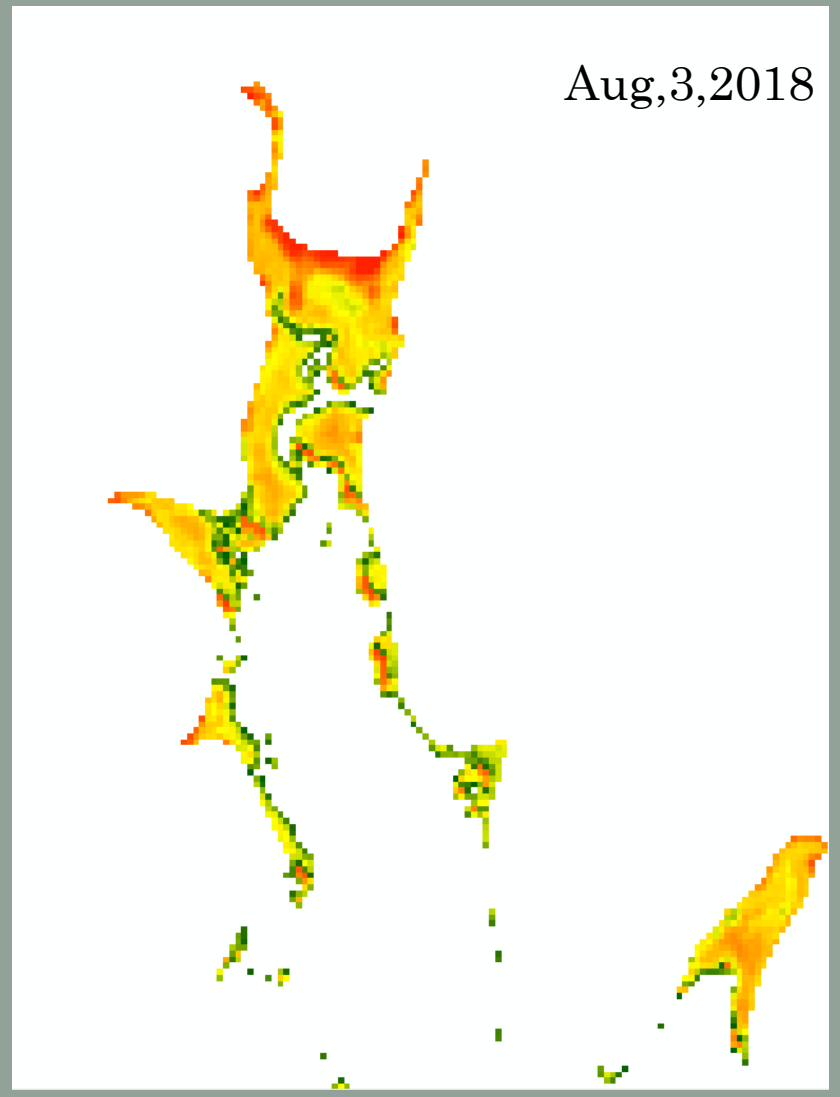
$$FVC = (NDVI-NDVI_{min})*100/ (NDVI_{max}-NDVI_{min})$$

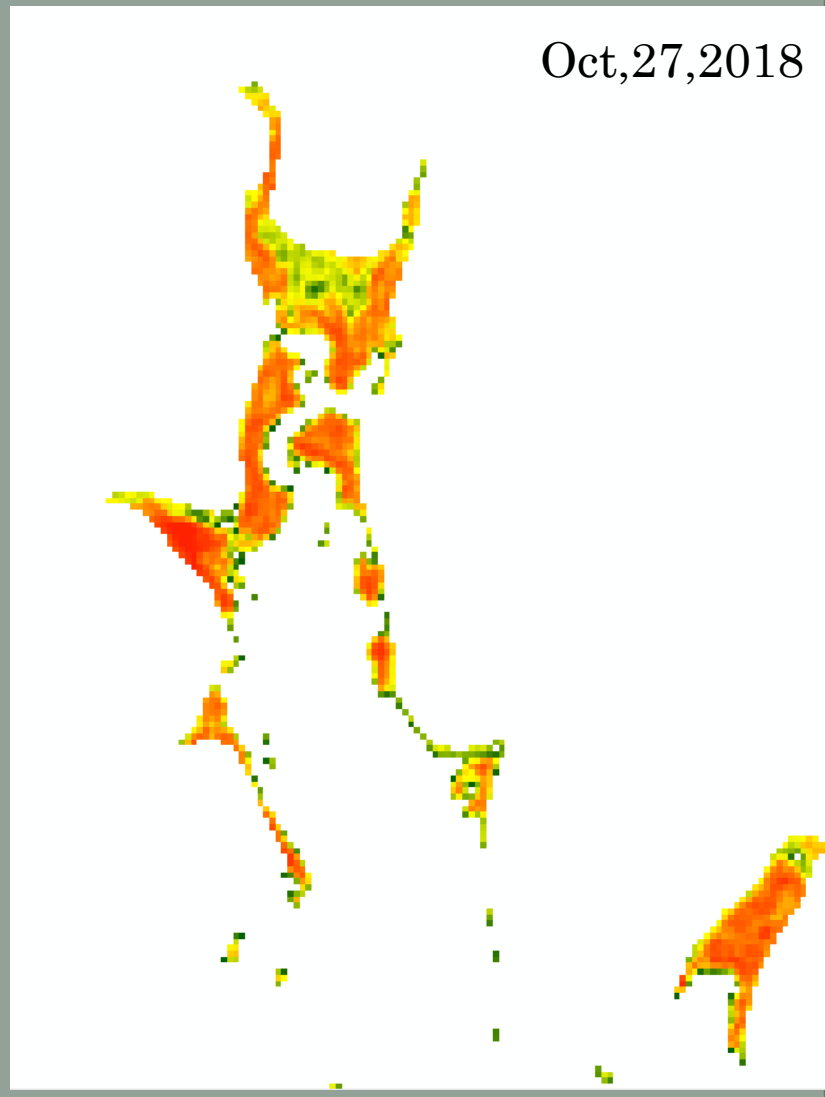
Design treatment options

Monitor treatment efficacy over time

Density







Future steps

- Classification vs. Index Validation
- UAS + RedEdge Sensor
- Treatment efficacy report
- Applications in other areas

Acknowledgement

- Dr Ranjeet John
- Abby McCrea