European frogbit in the St. Marys River

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Funding provided by:

Research highlights

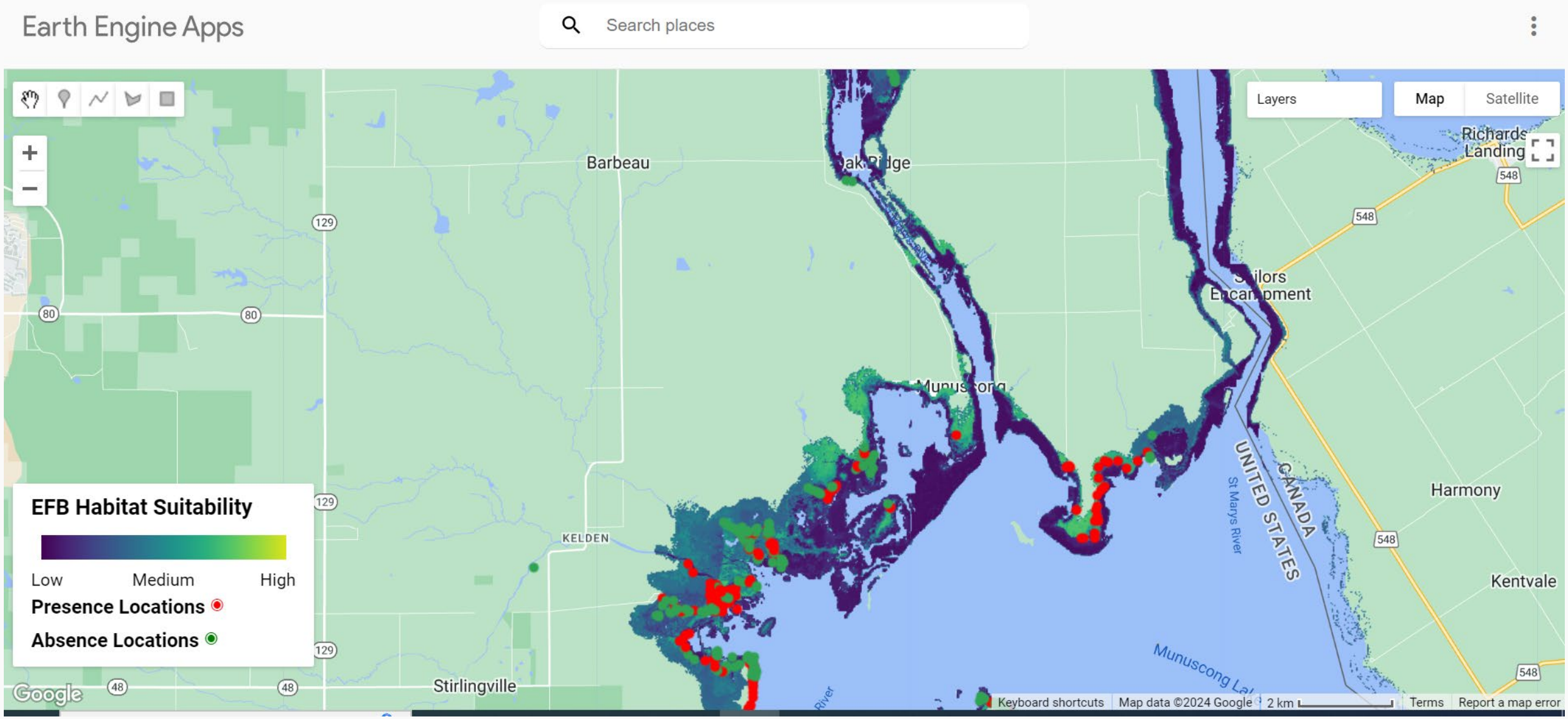
1) **EFB habitat suitability model**
2) **Water level fluctuation and EFB habitat**
3) **Muskrats reduce EFB cover**
4) **Future work**

Research highlights

EFB habitat suitability model

https://louisjochems.users.earthengine.app/view/efbriskmapstmarys2023

Web application
EFB Habitat suitability in the St Marys River



Research highlights

2) Water Level fluctuation and EFB

Manuscript: *Active remote sensing data and dispersal processes improve predictions for an invasive aquatic plant during a climatic extreme in Great Lakes coastal wetlands*. Louis Jochems, Jodi Brandt, Clayton Kingdon, Samuel J. Schurkamp, Andrew Monks, Shane C. Lishawa

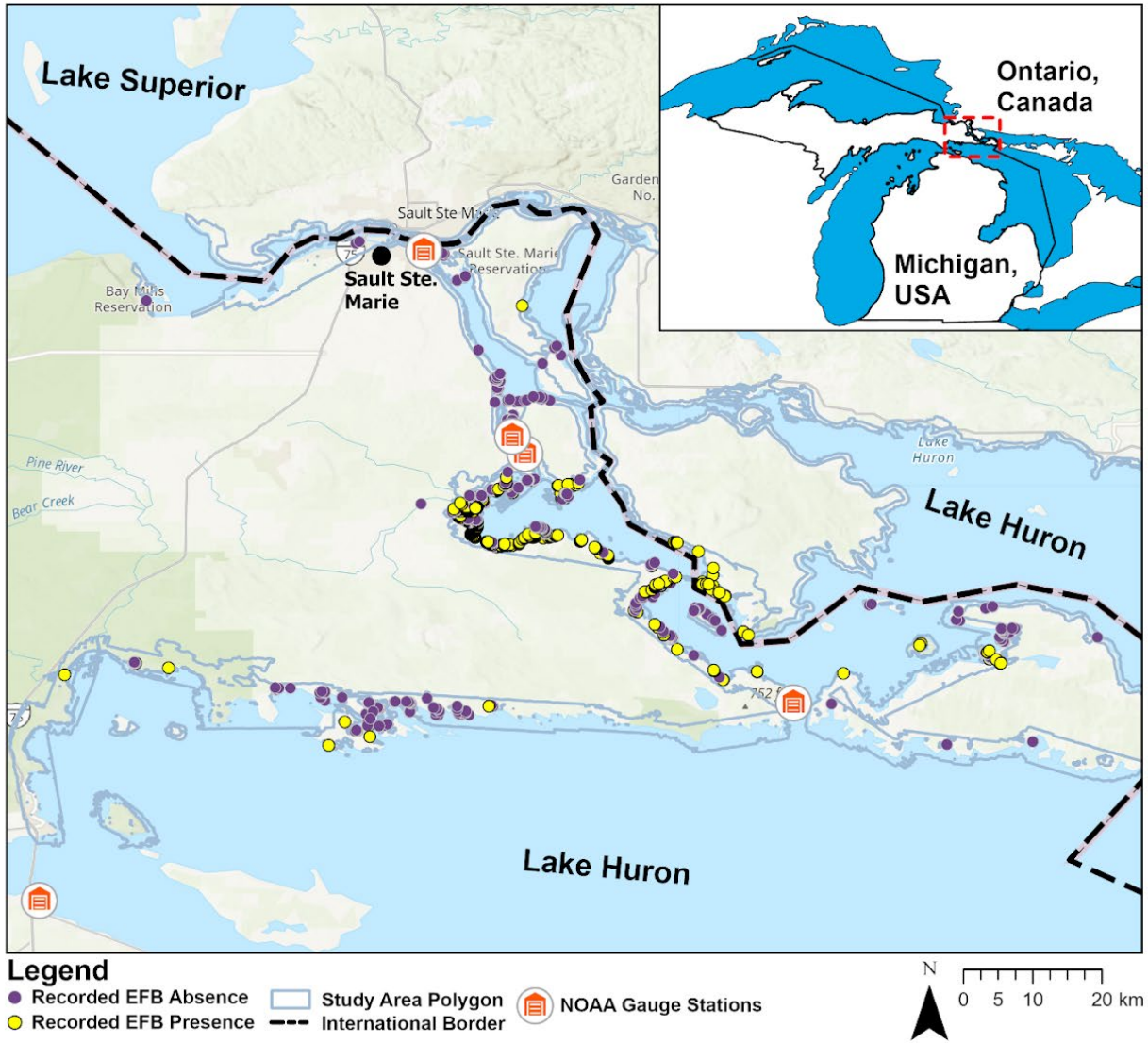


Figure 1. Study area, NOAA gauge stations, and distribution of field data points collected along the St. Marys River and the Eastern Upper Peninsula in Michigan, USA. All points were collected between June and September 2015-2023. The study area polygons were created from merging the coastal wetland delineations, USACE topobathymetry, and USGS DEM extents; and were used to clip all imagery/geospatial data to run SDM predictions. Lake water level data from the NOAA gauge stations were used to generate modeled water depth when differenced with the USACE topobahtymetry layers.

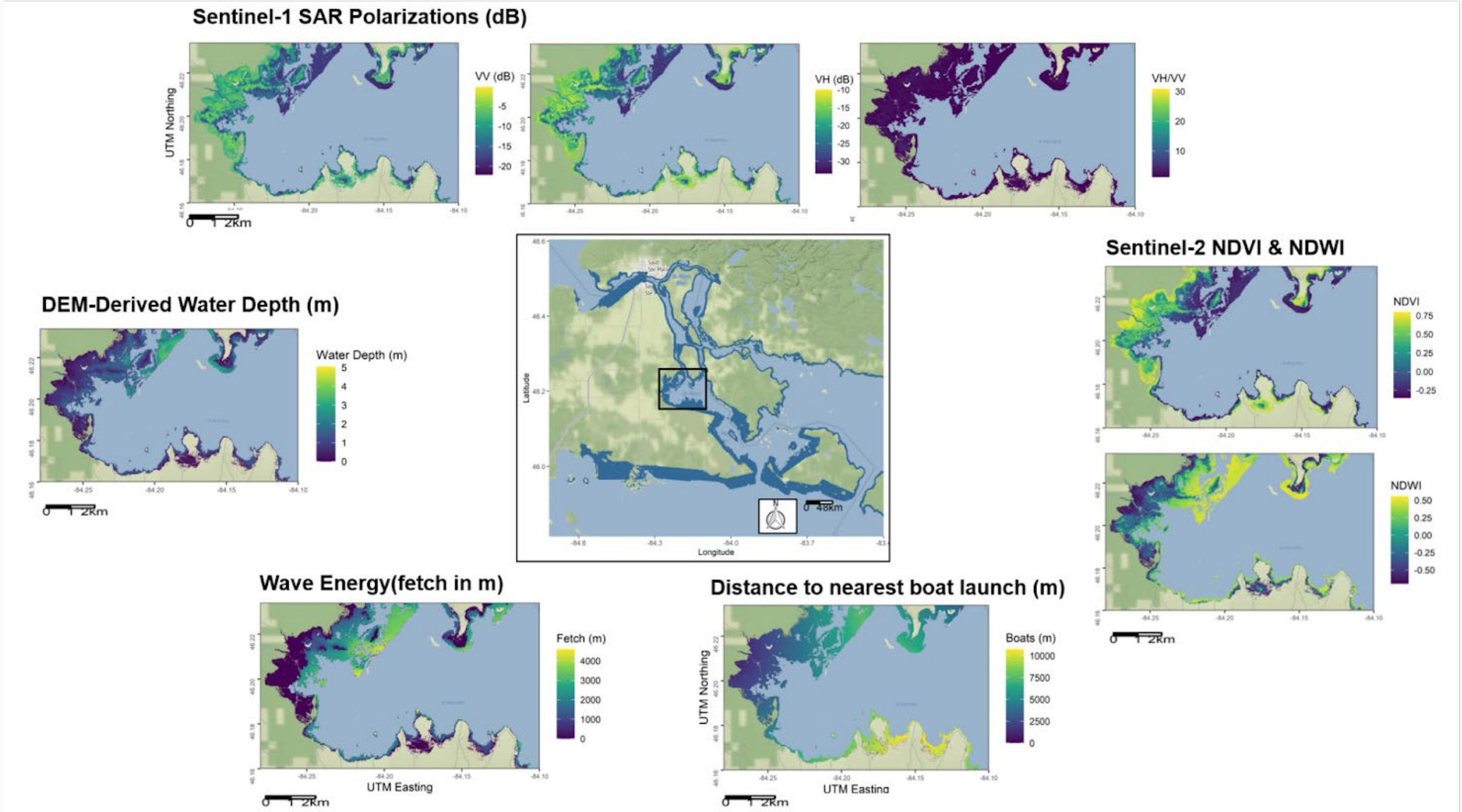


Figure 2. All eight predictor variables used in the SDMs over Munuscong Bay along the St. Marys River. Panels are divided by data source.

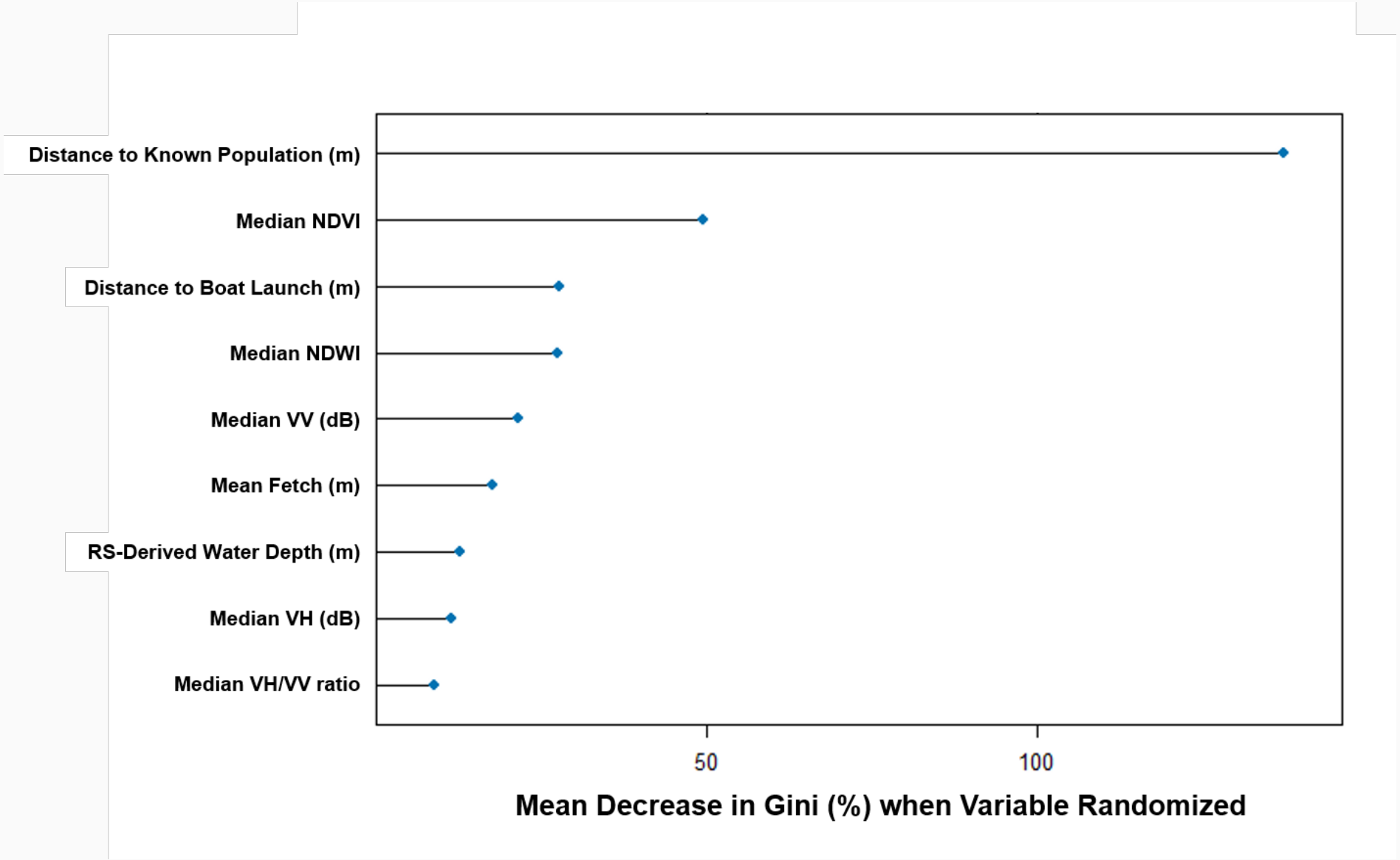


Figure 5. Variable importance, or the mean percentage decrease in model accuracy (Gini index) when each given variable is randomly permuted in the random forest from the *All Predictors* Model.

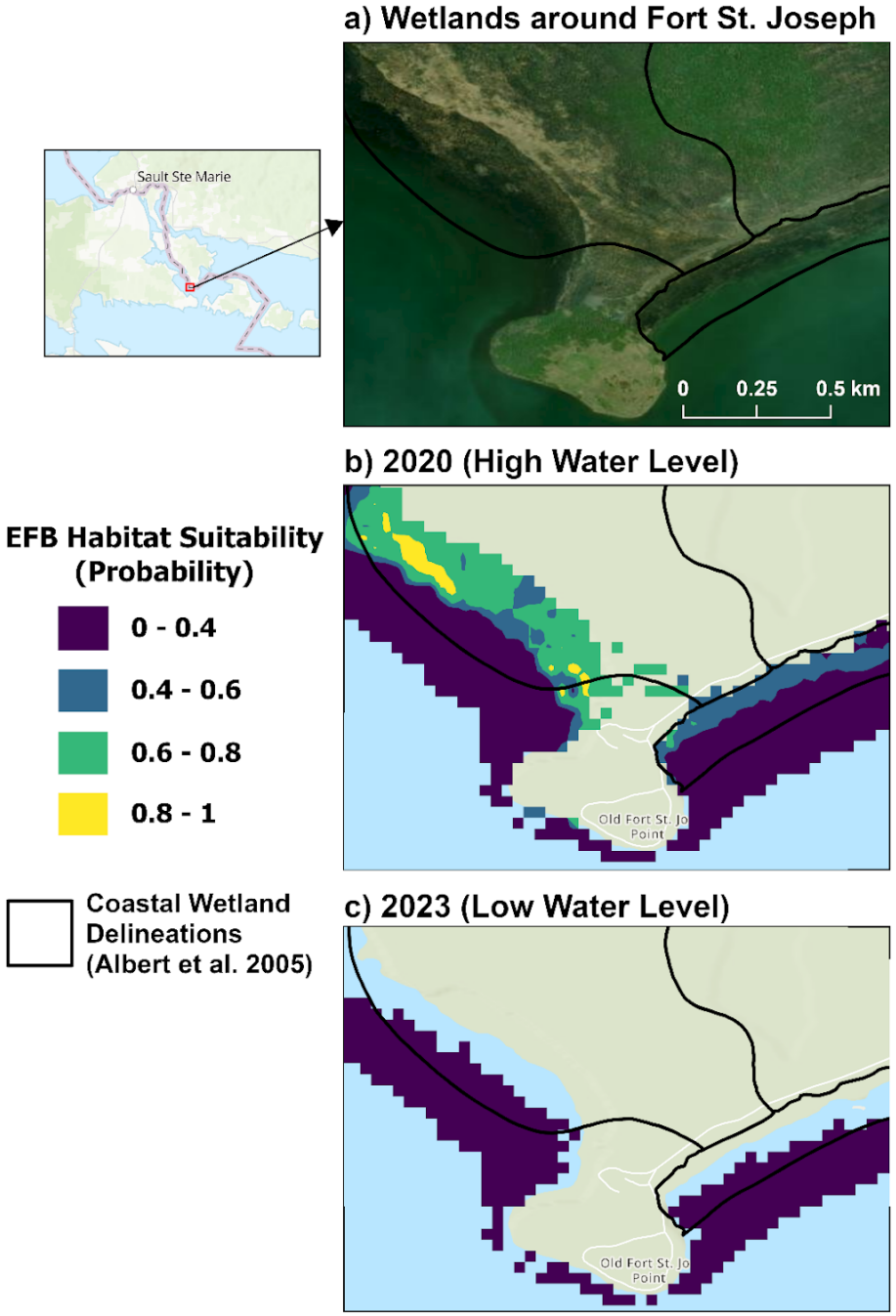
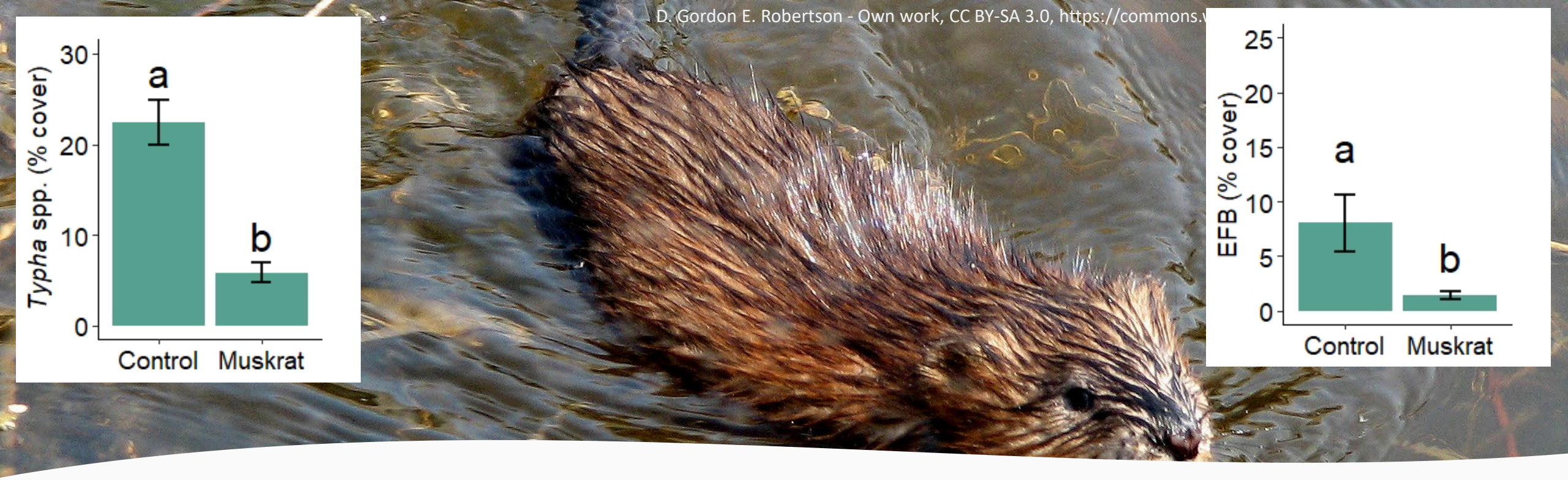


Figure **6a.** Coastal wetlands around Old Fort St. Joseph, Canada (1 m imagery from Maxar Technologies ©2019). Panels 6b & 6c depict predicted EFB habitat suitability (0 to 1 on probability scale) during **b)** the highest annual mean water level recorded (2020) and **c)** a subsequent low annual mean water level (2023), respectively. Elevations used for water levels in each map were 177.43 m and 176.69 m, respectively, to mask all predictor variables to those inundated extents. The black lines portray manually delineated coastal wetlands by Albert et al. 2005.

Year	***Mean Water Level (m)***	***Total Area Predicted (# ~30 x 30 m Pixels)***	***Area of "High" Probability of EFB Suitable Habitat (0.8 - 1)***
2020	177.43	308.36 km^2 (296,254 pixels)	0.810 km^2
2023	176.69	230.10 km^2 (220,049 pixels)	0.213 km^2

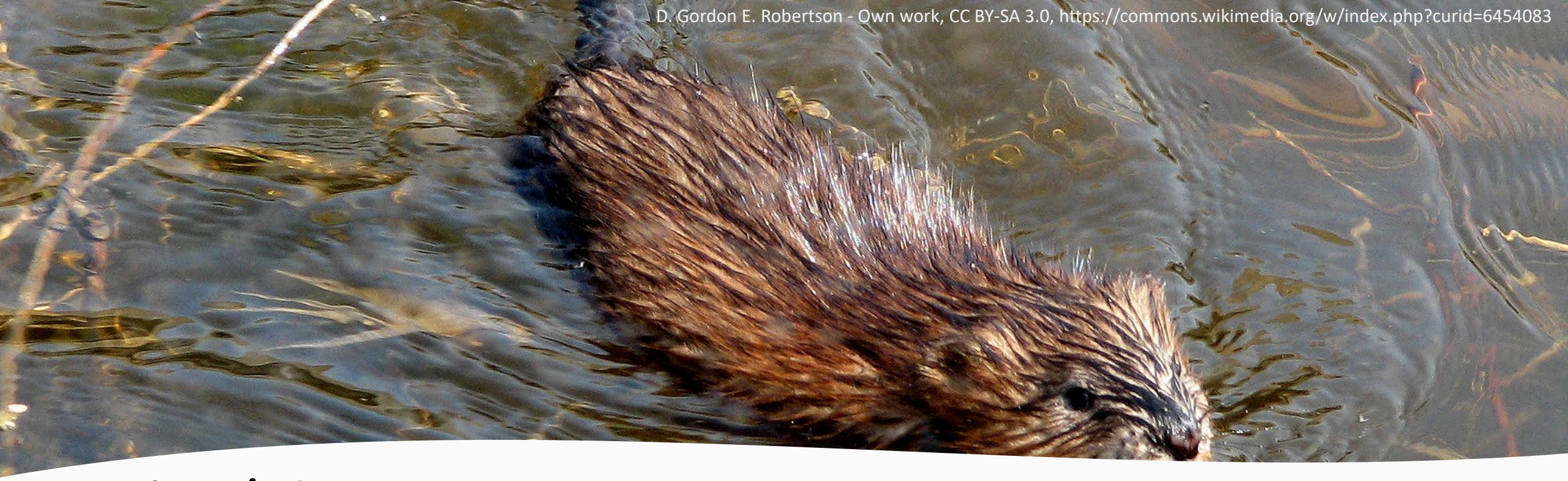
Research highlights

Muskrats reduce EFB cover



Results

Variable	Treatment $\bar{X}$ ± SE		t-value	p-value
Plant metrics	Typha	Muskrat		
***Typha* biomass (g / m²)**	**2032.40 ± 200.37**	**281.15 ± 48.63**	**7.142**	**< 0.001**
***Typha* cover (%)**	**22.39 ± 1.96**	**5.89 ± 0.88**	**6.709**	**< 0.001**
Typha height (m)	2.59 ± 0.03	1.79 ± 0.15	4.791	< 0.001
Typha density (stems / m²)	27.06 ± 2.17	9.50 ± 1.29	5.787	< 0.001
EFB cover (%)	**8.03 ± 2.02**	**1.44 ± 0.28**	**3.869**	**< 0.001**



Results / discussion

Muskrat disturbances

- Increase the complexity of *Typha* and EFB dominated wetland
- Reduction of detritus likely mechanism for increased plant diversity
- First (to our knowledge) documentation of reduction of EFB by native herbivores in general and by muskrats in particular.
- Muskrats are probably eating EFB, but this needs to be verified

Conclusions

- Muskrats are vital components of wetland ecosystems
- Introduce heterogeneity to otherwise homogeneous *Typha* / EFB dominated sites
- Our study suggests that they are capable of dramatically reducing the dominance of ecologically problematic invasive plants
- Muskrats should be considered native biocontrol agents
- Managers should implement measures to increase muskrat populations to the benefit of wetland ecosystems in the in the Great Lakes region

Research highlights

Future work

a. Running additional inland model for target watershed
b. Ground-truthing inland system habitat suitability model in the Thunder Bay Watershed and second inland system
c. Ground-truthing dynamic model in eastern Upper Peninsula