## A robotic future for Great Lakes habitat and species monitoring

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https://eoimages.gsfc.nasa.gov/

#### US Geological Survey in the Great Lakes















RV Kiyi (107')







#### **Current capabilities**

**CTD** chlorophyll



Acoustic backscatter

#### Current vs. [potential] future capabilities



**Tethys Chlorophyll** 

5

Δ

3

2



longitude

longitude

N=140,000

#### N=3,000





#### **Robot-assisted computer vision**



#### **Robot-assisted computer vision**

<u>Computer vision</u> – the practice of automatic extraction, analysis and understanding of useful information from acquired imagery

Computers now outperform humans in common image recognition tasks





### **Robot-assisted computer vision**

#### Iver3 AUV

- 4.6 km/hr for ~6 hrs
- Onboard cameras and lights
- Inertial navigation
- 200 m depth rating









Presence Body size (pixel area) Biomass density (g/m<sup>2</sup>) Numeric density (#/m<sup>2</sup>)



Presence Volumetric occupancy Biomass



Class Topographic variation



Presence Size structure Aerial extent (m<sup>2</sup> or %) Biomass density (g/m<sup>2</sup>)



#### Food available at the bottom helps determine food available at the top







Madenjian et al. 2015

Rowe et al. 2015

- 1000 km transect over 19 days
- <u>Sensors</u>: chlorophyll a, DO, temperature, light, depth, acoustic backscatter





#### Rendezvous with vessel





Bennion, Warner, & Esselman (in prep)



## Robotic assessment of preyfish

- Wave-gliders with towed acoustics
  - Persistent presence on the lakes at a reasonable cost
  - High reliability, large geographic scope, low taxonomic resolution







### Thank you!!

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