Bathymetry and Habitat Map Production for NEON Aquatic Sites

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National Ecological Observatory Network

What are Bathymetric and Habitat Maps?

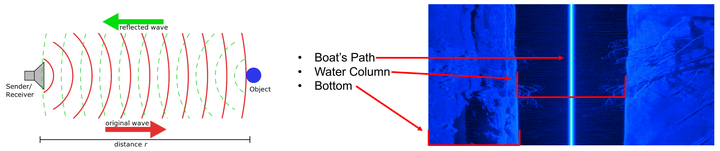
Bathymetric maps are similar to a topographic maps in that spaces are use to represent areas of the same elevation while lines define a change in the elevation.

Habitat maps are conjoined polygons that are georeferenced and represent substrate types found within that system along with major features such as large woody debris.

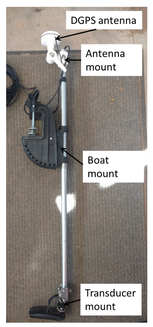
Reasoning for Map Creation
Fish require and utilize habitat for purposes such as foraging, mating, and protection from predators. This means that it's crucial to learn about how these habitats can possibly change from stochastic events, climate change, and human usage. In learning we can better possibly preserve these habitats for aquatic organisms as a whole.

Sight through Sound
Seeing underwater is difficult. Things such as sediment in the water column, deep depths, and water refraction mean that sight by light is not optimal. So sight by means of sound in the form of sonar is the best option. The sonar system works similar in how bats and dolphins use echolocation to interact with their environment.

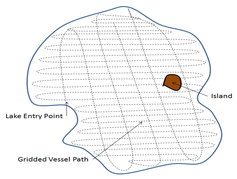
How Sonar Works
The sonar systems work in two different ways. The downscanning sonar takes readings directly underneath the boat's location and is able to determine depth. The side scanning sonar works almost like dragging a wall of sound through the water column that creates high quality images of the bottom. This allows us to create detailed habitat maps.



Methods of Sonar Data Collection



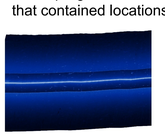
- The survey vessel is mounted with the sonar equipment along with a Differential Global Positioning System.
- The navigational track is followed in a pattern like the figure to the right.
- Data points that include depth and GPS position are recorded simultaneously along with side scanning images.
- Transducer used is dual beam high frequency.
- Water depths are determined by the time it takes the signal produced by the transducer to return.
- To decrease distortion in the data cause by the boat motor's prop, the transducer is mounted to the front of the boat.



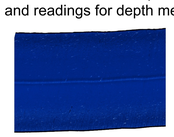
Methods of Map Production

Two programs of software are used to create both the bathymetric and habitat maps. This includes SonarTRX in conjunction with ArcGIS.

SonarTRX was used in order to create mosaic images of the side scanning sonar. Slant range correction is applied in this program to remove the water column representation for easier georeferencing. .CSV files were also created that contained locations and readings for depth measurements.



Before slant range correction

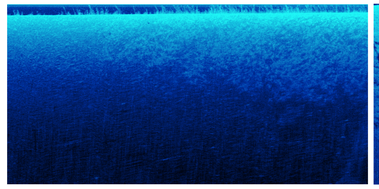


After slant range correction is applied

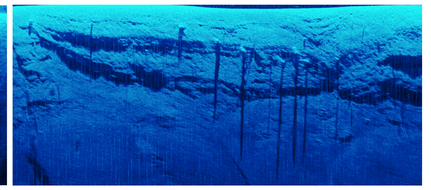
ArcGIS was then used to import both the mosaics and .CSV depth files separately. Mosaics were layered onto the map and polygons were drawn around different substrate types and features such as large woody debris. The end product here was the habitat map. Empirical Bayesian Kriging was applied to interpolate the depth measurements to create a bathymetric map.

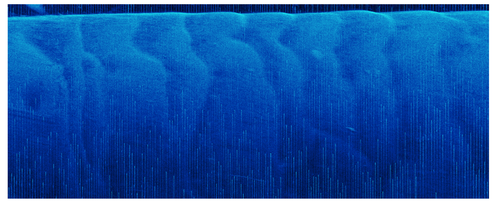
Side Scanning Sonar Substrate Examples

Vegetation with soft substrate

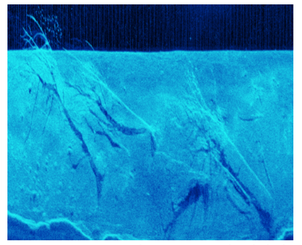


Clay substrate within a river



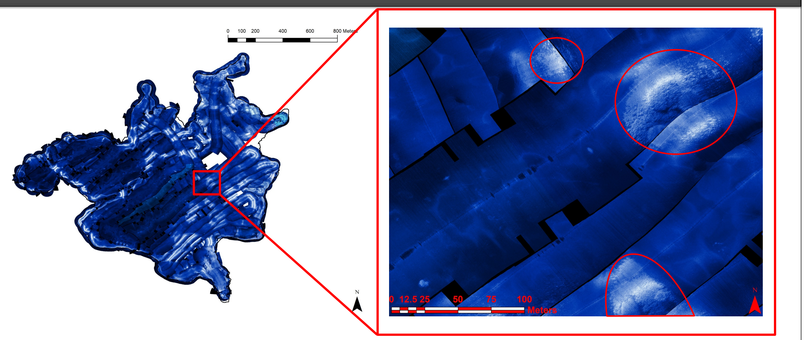


Sand dunes within a river



Large woody debris

Mosaics



Completed mosaic of Toolik Lake on the left with a close up view on the right. Red circles indicate areas classified as vegetation/cobble while the rest of the zoomed in area would be classified as soft substrate.

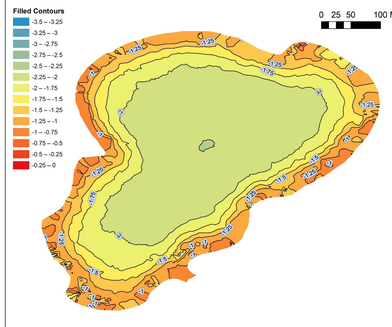
Conclusions

I completed three tasks, which included the creation of: a standard operating procedure created bathymetry maps (7),and habitat maps (2).These completed maps can be utilized by staff and outside researchers alike for research purposes such as finding optimal locations to sample, correlate organismal sampling to specific habitat types/depths, etc. The standard operating procedure also means that these maps can be created for more sites quickly, even by someone with little knowledge of sonar systems or the software used.

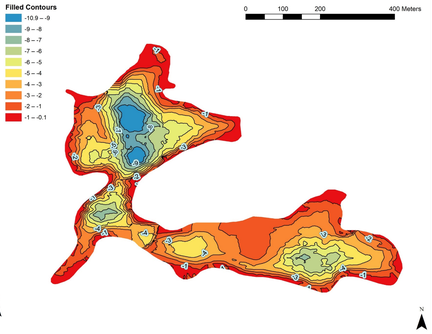
Additional work is still needed to optimize these maps and obtain a more precise habitat map. Methods that involve ground truthing methods in which a ponar or camera are deployed within either random or specified locations to gain a more direct view of the substrate and features rather than just the sonar images themselves.

Bathymetry

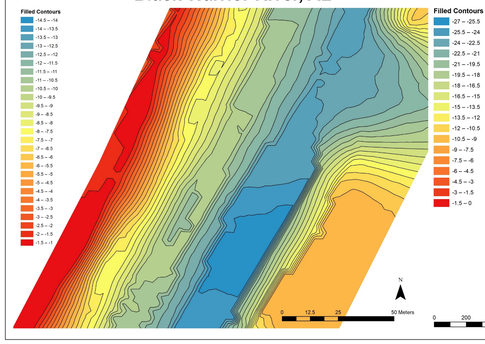
Prairie Pot-hole Lake, ND



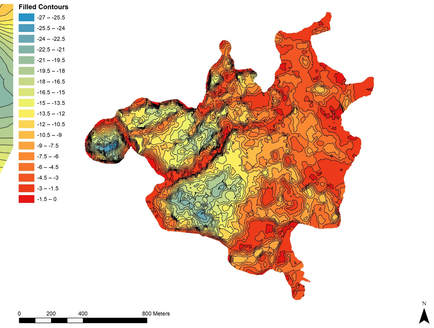
Little Rock Lake, WI



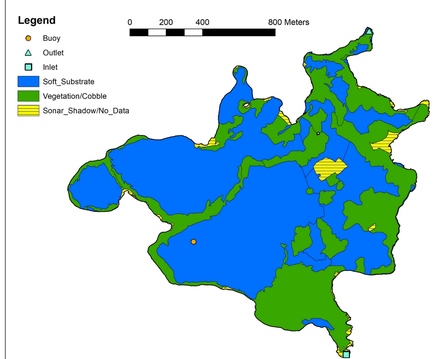
Black Warrior River, AL



Toolik Lake, AK

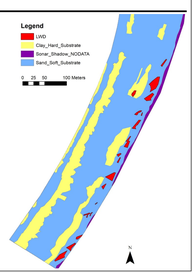


Habitat Map



Habitat map for Toolik Lake (left) with markers showing the inlet, outlet, and NEON buoy locations. Deeper sections of the lake tended to be soft substrate while shallow areas had more cobble with vegetation mixed in.

Habitat map for a section of the Black Warrior River (right). Channel of river lacked harder substrate and was mostly soft sandy substrate instead.



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