



# Stream Substrate Mapping in the Calkkiller River

Jon Zetterberg, 2017

Tennessee Tech University, United States Fish and Wildlife Service



## Introduction

The Panama City Field Office of the USFWS had created a guide to low-cost, Side Scan Habitat Mapping using side scan sonar units, known to most as fish finders. Working with the Tennessee Field Office of the USFWS, this guide was followed, modified, and applied to the portions of the Calkkiller River in Middle Tennessee, see Figure 5, with hopes of identifying potential habitat and reintroduction points for endangered and threatened species, including the Blue Masked Darter.

The portion of the river which flows through downtown Sparta, TN contains two low head dams, show in Figure 6. The lower of the dams was at one point in time used to divert the water through a hydroelectric power plant, while the upper and larger was used as the intake for the city water plant. These dams no longer serve a purpose and are in poor condition. They are causing sedimentation build ups, and blocking the natural egress of the river. Side scan sonar data was collected above the lower dam in hopes to identify the former stream bed.

## Methodology

Using the information from the National Hydrography Dataset (NHD) from the United States Geological Survey (USGS), the Calkkiller Watershed was divided into 171 catchment areas and analyzed. Key factors including Temperature, Sinuosity, Steam Gradient, Flow, Temperature, Drainage Area, and Precipitation were compared and combined with potential put in and take out locations along the river to identify the ideal locations for data collection. Four sections of the river were targeted for potential trips with lengths of 4.07, 8.48, 4.82, and 3.43 miles. USGS stream gage 03419800, Calkkiller River at Highway 111, was monitored throughout the planning stages of the project. At different flow levels, the river was checked to identify the ideal flow levels where the water was at a high level, but low enough to navigate safely. The ideal level for data collection in the upper sections of the Calkkiller River is between 500 and 900 cubic feet per second (cfs).

A Hummingbird Onyx SI 8 unit was used to record substrate information for two sections of the river. The unit was custom mounted onto a kayak to allow for data collection in shallow environments. The sonar files were then processed using Reef Master to take the straight line sonar data and fit it to the curving GPS track which was recorded during data collection. The data was then exported as a high resolution image file and georeferenced in ESRI's ArcMap 10.4.1. The patterns throughout the image were broken into 9 categories and digitized. A portion of the resulting polygons are shown in Figure 1.

Figure 4: Limitations of Sonar Data

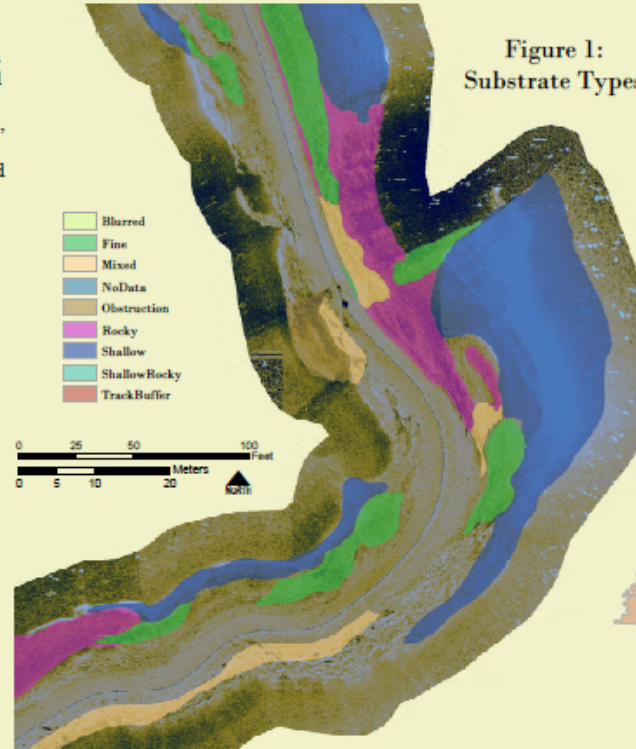
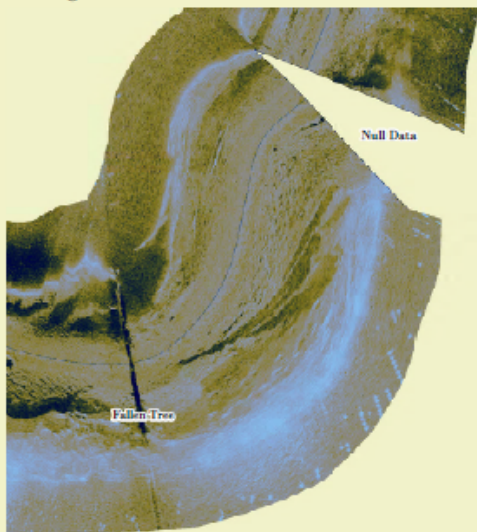


Figure 1: Substrate Types

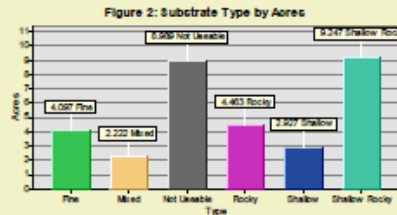


Figure 2: Substrate Type by Acres

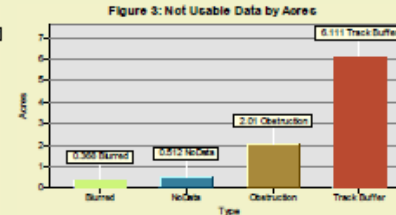


Figure 3: Not Usable Data by Acres

## Discussion

The data that has been collected and created will be left with the Blue Masked Darter Technical Working Group of the USFWS. They are working to identify potential locations to reintroduce the species into the river. Due to the specific substrate types of sand or fine grained sediment substrates required for the Blue Masked Darter to be successful in multiplying itself, this data layer is a key factor in determining appropriate sites.

The workflow from this project has been documented completely, including the mistakes and errors encountered. This documentation will be left with the fore mentioned organization and the Earth Science Department of Tennessee Tech University.

## References

- Kaesler, Adam J and Thom L Litts. "An Illustrated Guide to Low-cost, Side Scan Habitat Mapping." Presentation. April 2013. Document.
- Layman, Steven R and Richard L Mayden. "A New Species of the Darter Subgenus Doration (Percidae: Etheostoma) from the Caney Fork River System, Tennessee." Copeia (2009): 157-170.
- USGS. USGS 03419800 Calkkiller River at Hwy 111 Below Sparta, TN. 2017. [http://waterdata.usgs.gov/tm/nwis/uv?site\\_no=03419800](http://waterdata.usgs.gov/tm/nwis/uv?site_no=03419800).

Figure 5: Calkkiller Watershed Location



## Acknowledgements

- USFWS Cookeville Field Office
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- Kevin Turner

Figure 6: Key Locations in the Calkkiller Watershed



## Results

Within the upper section of the river, 5 substrate types were identified from the sonar data: shallow, coarse, fine, shallow and coarse, and mixed. The occurrences and locations of these different substrate types were mapped tied to specific locations in the Calkkiller River. The acreage from each substrate type was found using NAD 1983 (2011) Tennessee State Plane and are compared in Figure 2. Approximately 9 out of 32 acres of the collected data within the streambed was unusable due to gaps in the bends of the river, blurring, and obstructions. The acreage for these types are compared in Figure 3 and examples are highlighted in Figure 4. The largest reason for unusable data was that it fell below the sensor. With side scan sonar, the stream directly below and immediately to the sides of the sensor contains no descriptive data. The lower, impounded section of the river is mostly organic debris and fine grained sediment. The original streambed was hoped to be identified from the data collected, but a strong head wind at the time of collection caused a slow speed of collection. This resulted in the data being mostly blurred and unusable.

## Conclusions

The key findings from carrying out this project are that side stream sonar can be a low cost method for mapping the substrates for smaller sized rivers, such as the Calkkiller River, and that the Calkkiller River has suitable habitat for the breeding and reproduction of the Blue Masked Darter. Future work similar to this project would be to collect data for the entire length of the Calkkiller River, and use the documented workflow to identify substrate types. This workflow could also be applied to other rivers and waterbodies around the world.