High Definition Stream Surveys of Choccolocco and Cheaha Creeks, AL 2015

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Submitted by:

Brett Connell and James Parham, Ph.D.

TruttaConsulting@gmail.com
www.TruttaConsulting.com

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Introduction

The Choccolocco Creek watershed is located in eastern Alabama and includes portions of Calhoun, Talladega, Cleburne, and Clay counties (Figure 1). Choccolocco Creek flows generally in a southwestern direction to Logan Martin Reservoir, part of the Coosa River drainage. Choccolocco Creek is historically considered to be biologically diverse with numerous rare fish, crayfish, mussels, and snails recorded from the stream (Barbour 2004).

Continuous river corridor surveys facilitate inter-disciplinary collaboration and help to identify vulnerable areas for river condition improvements. Trutta Consulting, LLC (Trutta) surveyed 60 miles of Choccolocco Creek and 8 miles of Cheaha Creek using the High Definition Stream Survey (HDSS) sampling method to gather current, geo-referenced video and to develop spatially continuous maps of bank and stream conditions.

The HDSS approach is an outgrowth of research efforts at the University of Tennessee. The rapid, multi-attribute, geo-referenced techniques have been used for delineation of streambank erosion potential (Connell 2012), development of sediment TMDLs (Hensley 2014), mapping of aquatic habitats (Candlish 2010, McConkey 2010, Connell and Parham 2015), comparing thalweg and cross-sectional transect approaches (Swinson 2012), and prioritizing restoration areas (Connell and Parham 2014). The approach has been used successfully on numerous streams and rivers including Big South Fork River, TN (McConkey 2010), Obed River, TN (Candlish 2010), Beaver Creek and the New River, TN (Connell 2012), Paint Rock Creek, AL (Connell and Parham 2014), Bear Creek, AL (Connell and Parham 2014), and Turkey Creek, AL (Connell and Parham 2015). The results of the HDSS approach are highly valuable for stream channel assessments, water quality and quantity studies, habitat assessments, and community outreach efforts.

This report documents the findings of the Choccolocco Creek survey. The survey data:

1) provides documentation of river bank and habitat conditions in May 2015; and,

2) develops aquatic habitat GIS layers for water depth, left and right bank condition scores, and habitat type (pool, riffle, or run).
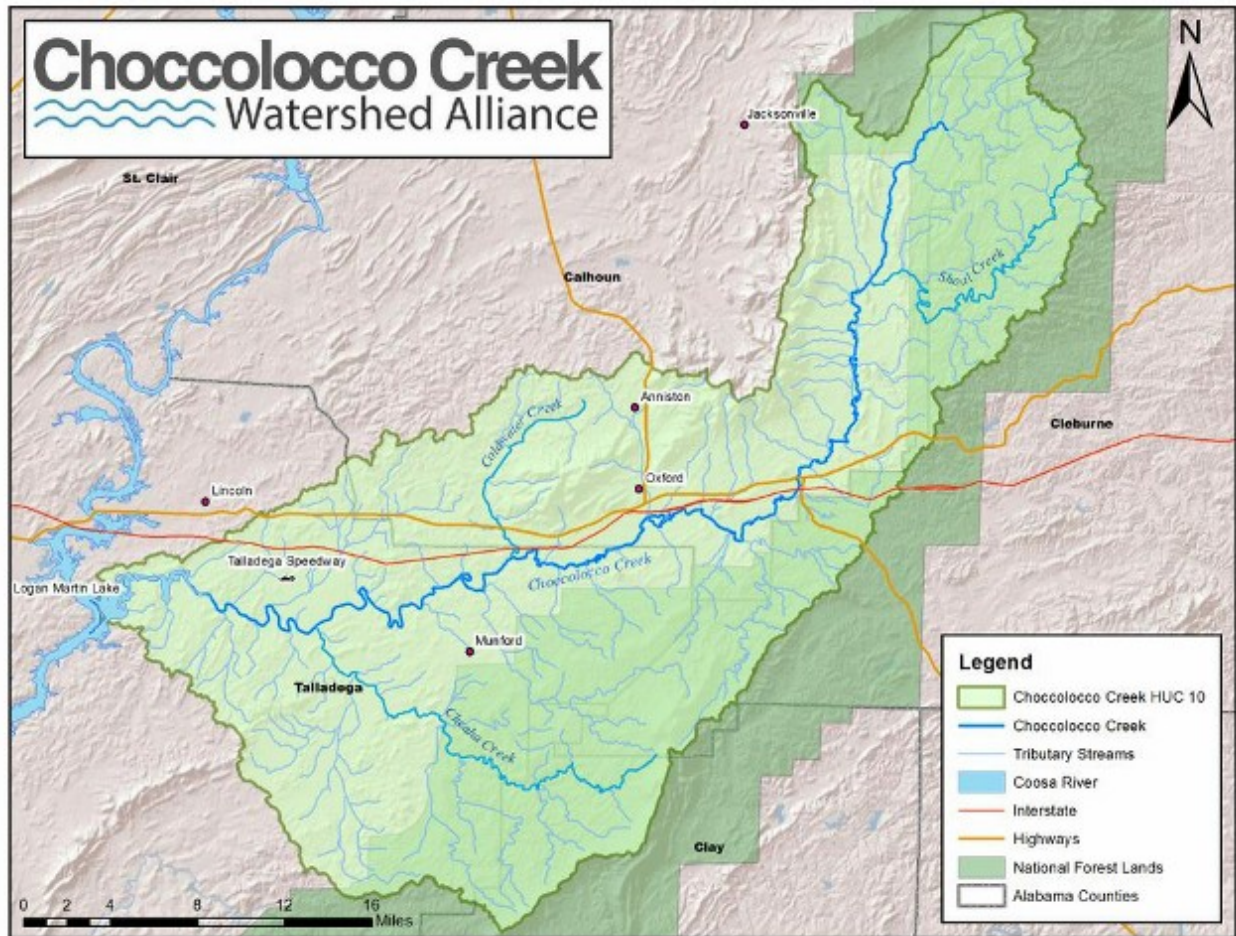

Figure 1:Map of the Choccolocco Creek watershed. Map credit to the Choccolocco Creek Watershed Alliance.

Methods

Equipment

A HDSS Kayak system was used, consisting of a sit-on-top kayak, multiple GPS sensors, three GPS-enabled video cameras mounted facing forward, left and right (90°), and a flush-mounted depth sensor. The GPS NMEA string from a WAAS-enabled Garmin GPS 18x receiver (typical accuracy < 3 meters 95% of the time) outputted time and location data approximately one each second (1Hz). All bathymetry data was collected by utilizing a sonar-based, kayak-mounted, depth profile system integrated with the GPS. The CruzPro ATU120ST shallow water depth sonar provides 3 mm resolution between the bottom of the stream and bottom of kayak (http://www.cruzpro.co.nz/active.html). Additionally, this sonar transducer has been calibrated specifically for this type of survey and surveys a range of depth from $0.15 - 13$ m (Connell, 2012). The depth sensor provides a 1 Hz output that coincides with the GPS output rate and the resultant data is then combined during post-processing. The primary data collection track focused on traversing the thalweg of the river channel. This track provided continuous data from all sensors and covered both streambanks effectively.

The GPS data string was combined with the depth data string within a NMEA multiplexer and then the combined output was recorded onto a flash drive. A second GPS signal was collected using a Garmin 64C handheld GPS receiver in which the location was recorded for each second in a tracklog. All data including the video and GPS tracklogs were saved to multiple external hard drives at the end of each day in the field. The track log for the GPS signal was exported in GPX format and the data was stored in a Microsoft Access database. The video was further post-processed in Adobe Premiere Pro video editing software to create a single view that encompassed all three video files.

Data Processing and Analysis

The first step in the data classification process was to align all data streams from each field sensor. The HDSS process used a combination of the time stamps and GPS data to accurately pair time and location data with all sensor data. Data alignment was accomplished using custom HDSS data parsing programs in combination with spreadsheet and database software. The GPS time and location information was linked to each second of the left, right, and forward video files. This resulted in the video being referenced to a common location and time. The geo-referenced video was combined with the GPS and depth data such that each data point was associated with Coordinated Universal Time (UTC) and coordinate information. The individual files were assembled to form a continuous tracklog of the survey areas.

The next step was the classification of the data into project-specific categories. The video was classified using HDSS Video Coder software (Figure 3) which allowed an appropriate assessment score to be applied to each second of the video and associated GPS location (Parham 2014).

River condition variables were assessed for Choccolocco Creek to include river left and right bank condition, habitat type (pool, riffle, and run), water depth, presence of large woody debris, and man-made structures. After the data was classified for all video files, the results were displayed in ArcGIS 10.1.

Figure 2: HDSS Video Coder v2.0 software used for systematic classification of video of streambank conditions. The software is easily customizable to allow appropriate classification systems to be used on a project.

Data Classification

Certain issues can affect the feasibility of using HDSS for aquatic habitat assessments. Flows, foliage, weather, stream size, and surveyor error can all be issues during the HDSS process. Years of experience have taught us to watch weather and flow gages for every type of survey. Depending on the size of the stream or type of survey, dense foliage can limit visibility if trying to determine bank height or several other parameters. The USGS flow chart (Figure 9) indicates previous rain events and then a steady declining baseflow which made for ideal survey conditions. A small storm on Monday evening slightly increased flows but not enough to prevent shoreline visibility or dangerous conditions.

Water depth was recorded to the nearest 0.3 cm and then grouped into 1 of 5 depth classes for

visualization based on best professional judgement. Habitat type (pool, riffle, or run) were visually classified from the forward facing geo-video based on best professional judgement. Visual classification of habitat type was performed from the high definition video for the left, center, and right bank views of the river (Connell, 2014).

- *Riffles* are the sections of the bed with the steepest slopes and shallowest depths at flows below bankfull. Riffles typically occur at the cross over locations and have a poorly defined thalweg. Visually, riffles are defined as areas with broken surface flows (whitewater).

- *Runs* differ from riffles in that depth of flow is typically greater and slope of the bed is less than that of riffles. Runs will often have a well-defined thalweg. Visually, runs are areas without broken surface flows but with obvious current present.

- *Pools* are the deepest locations of the reach. Water surface slope of pools at below bankfull flows is near zero. Pools are often located at the outside of meander bends. Visually, pools have smooth surfaces without obvious current present.

- *Other,* additional categories could be added to account for specific conditions such as drops, hydraulic jumps, or man-made constrained channels

Left and right bank condition scores were classified using the video for both the left and right bank of the river. The Bank Condition Score consisted of five bank condition levels ranging from 1 (optimal condition) to 5 (very poor condition). Descriptions and representative images of the different bank condition levels are described in Figure 3 - Figure 7.

Large Woody Debris (LWD) was classified into three groups: (1) trees that fell from the left

bank and primarily influenced the left side of the stream channel, (2) trees that fell from the right

bank and primarily influenced the right side of the stream channel, and (3) trees that fell across

the stream and influenced the whole stream channel. Man-made structures were classified as a

point feature present at a location. The man-made structures included any in-channel structure,

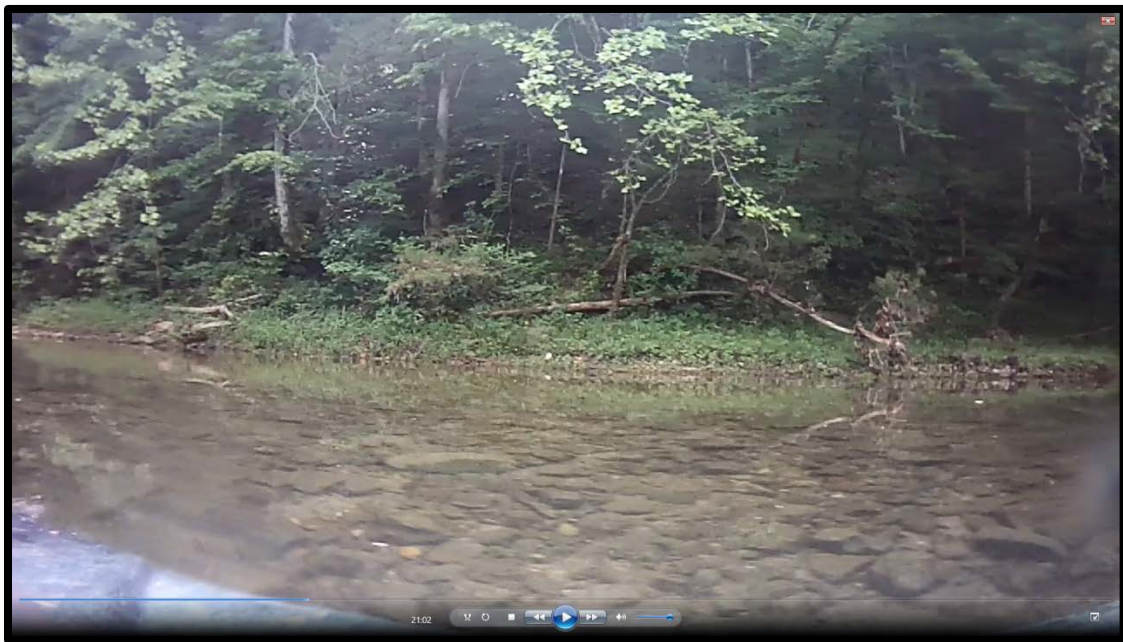such as bridges, culverts or outfall pipes.

Figure 3: Level 1, Optimal Condition: Banks currently in optimal condition with excellent surface
protection and low erosion potential. Includes stabilized areas such as bedrock   outcroppings,
heavily wooded areas, banks with low slopes and with good access to flood plain.

Figure 4: Level 2, Good Condition: Banks currently in good condition with minor impacts present. Includes heavily forested areas with moderate bank angles and adequate access to flood plains.

Figure 5: Level 3, Fair Condition: Banks showing moderate erosion impact with limited access to flood plain and variable surface protection. Potential impacts affecting water quality and aquatic habitat.

Figure 6: Level 4, Poor Condition: Banks with high erosion potential consisting of few trees and grass. Obvious impacts from cattle, agriculture, industry, with minimal connectivity to the flood plain. Source of negative impacts to water quality and aquatic habitat.

Figure 7: Level 5, Very Poor Condition: Banks with the highest erosion potential and steep bank angles. Evidence of active bank failure, with very little stabilization from vegetation. Obvious impacts from cattle, agriculture, and industry with no connectivity to flood plain. Contribution of sediment is very high in these areas.

Results

We surveyed 60 miles of Choccolocco Creek and 8 miles of Cheaha Creek using the High

Definition Stream Survey (HDSS) sampling method to gather current, geo-referenced video and

develop spatially continuous maps of bank and stream conditions from May 11 to May 14,

2015. The weather was generally clear with a few rainstorms occurring in the days prior to the

survey. The stream discharge was near the long-term median (550 cfs) for the site according to

the USGS Choccolocco Creek gage near Lincoln, AL(Figure 8).

Figure 8: USGS Gage 02404400 CHOCCOLOCCO CREEK AT JACKSON SHOAL NR
LINCOLN AL. HDSS surveys were conducted from May 11-14.

Field Observations

From the survey starting location in the headwaters of Choccolocco Creek, instream conditions

showed degraded conditions. Impacts from agriculture and cattle production were visible and

water clarity was low due to the amount of suspended solids in the water. Several areas had

numerous (30+) cows in the water as they were attracted to the cool water and shade from the few remaining trees in the area.

After passing Snow Creek and other tributaries that drain the city of Oxford and Anniston Army Depot, impacts from stormwater events were observed with countless pieces of trash and "very poor" streambank stability. Although no water quality testing was performed, the odor of raw sewage was apparent during day 2 and 3 of the survey where potential discharge locations were observed and noted.

In Cheaha Creek, clear water and highly variable streambank stability was observed. Past streambank stabilization appeared to be effective in the areas where trees and surrounding riparian species were present. The areas without vegetation had lost all of their rip-rap with tall streambank undercut and actively eroding streambanks were observed. It was noted that greater water clarity conditions were observed from the beginning of the survey location (McElderry Rd Bridge) up until the Kelly Creek confluence where turbid water was observed mixing with the clearer water of Cheaha Creek. Despite the highly turbid waters from Kelly Creek, Cheaha Creek was still much clearer than Choccolocco Creek at their confluence.

Documentation of Stream Corridor Conditions

To show the results of the surveys, we created maps of the full survey segment and three higher resolution images of the surveys (lower, mid, and upper). The following maps show:

- Left Bank Condition (Figure 9)

- Right Bank Condition (Figure 10)

- Habitat Types (Figure 11)

- Water Depth (Figure 12)

- Large Woody Debris (Figure 13)

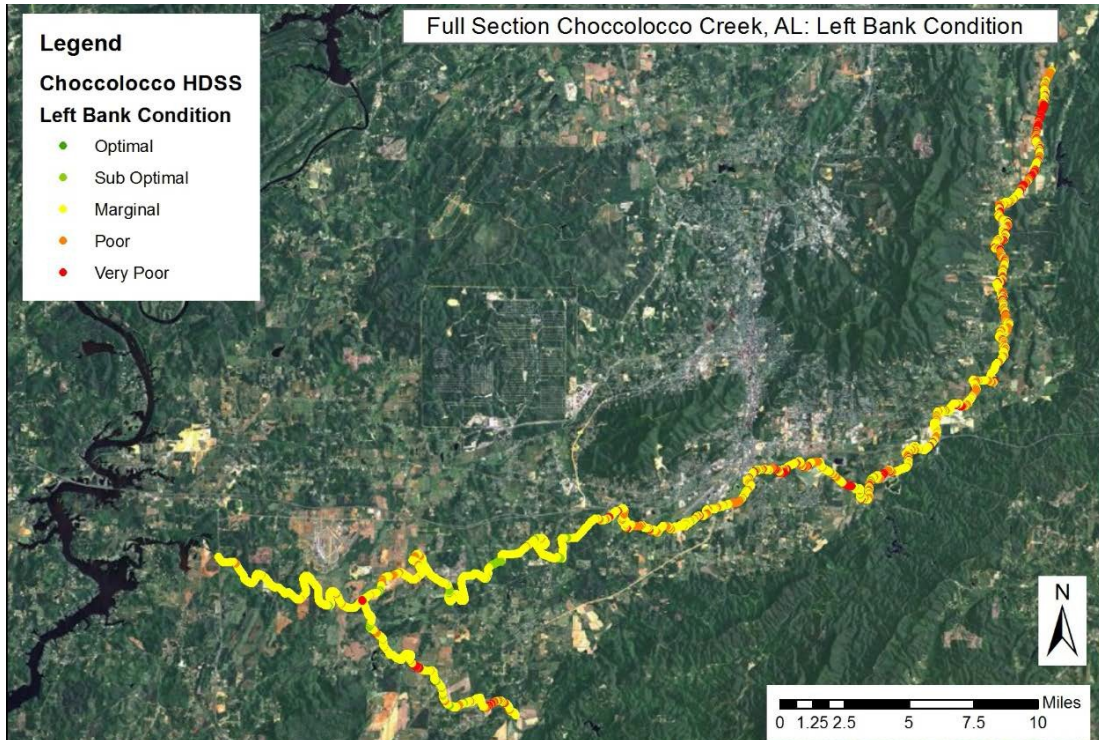- Man-made Structures (Figure 14)

Figure 9: Choccolocco Creek Left Bank Condition Scores.
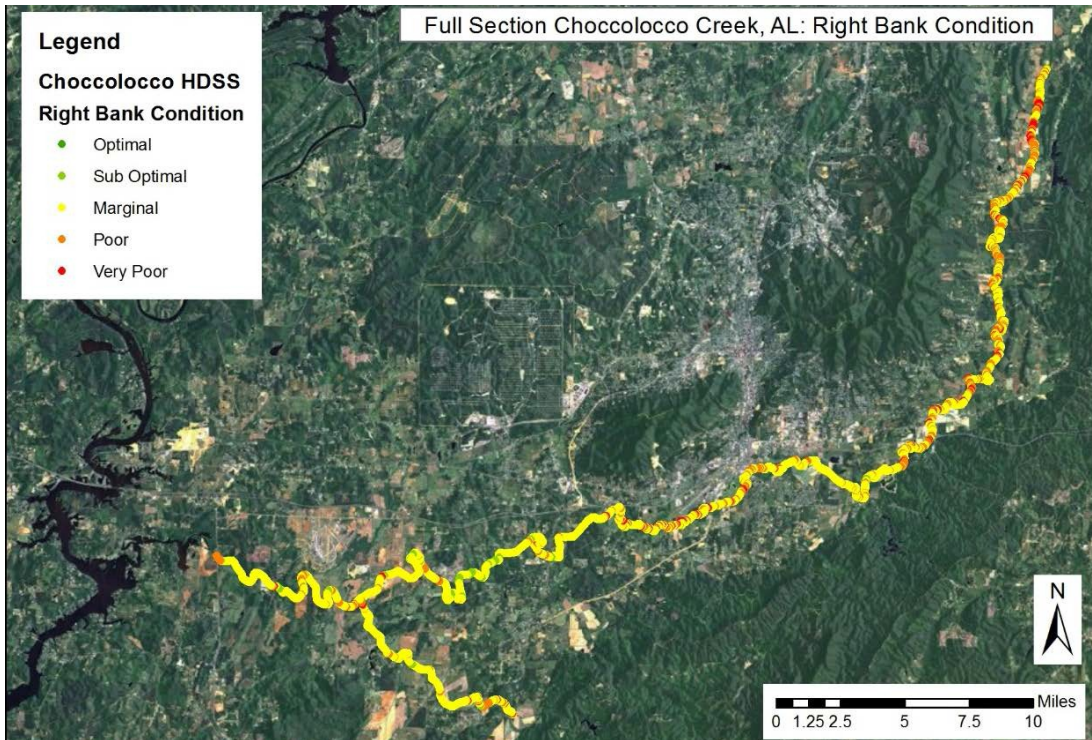
Figure 10: Choccolocco Creek Right Bank Condition Scores.
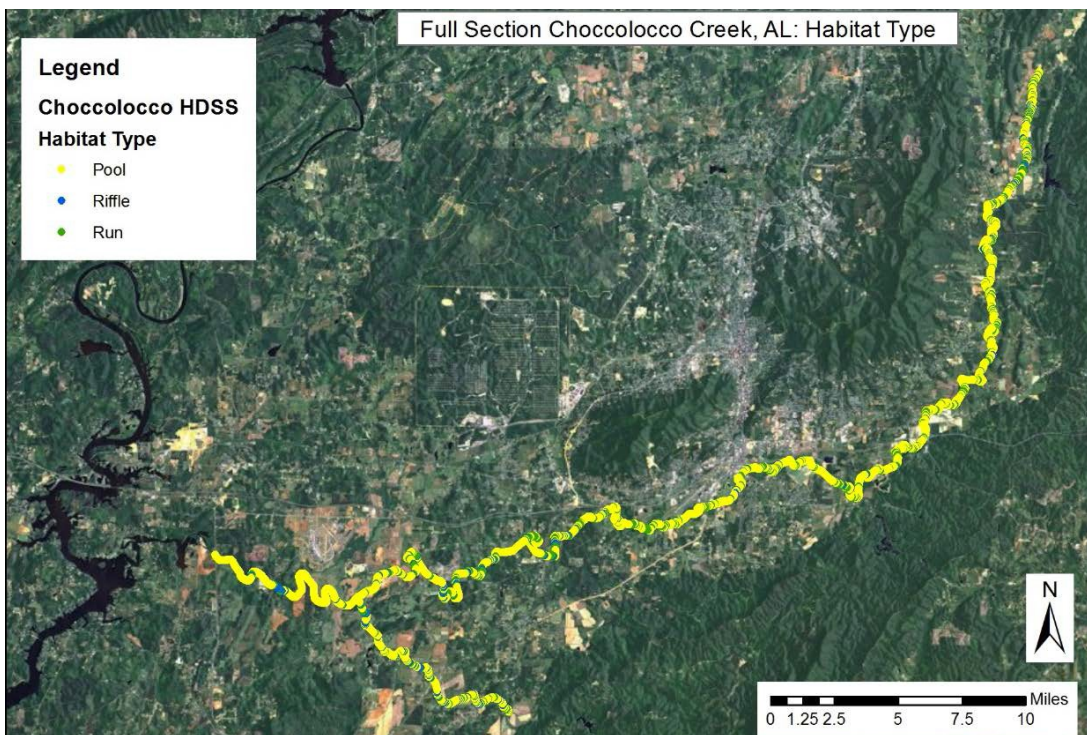

Figure 11: Choccolocco Creek Pool, Riffle, Run Locations.
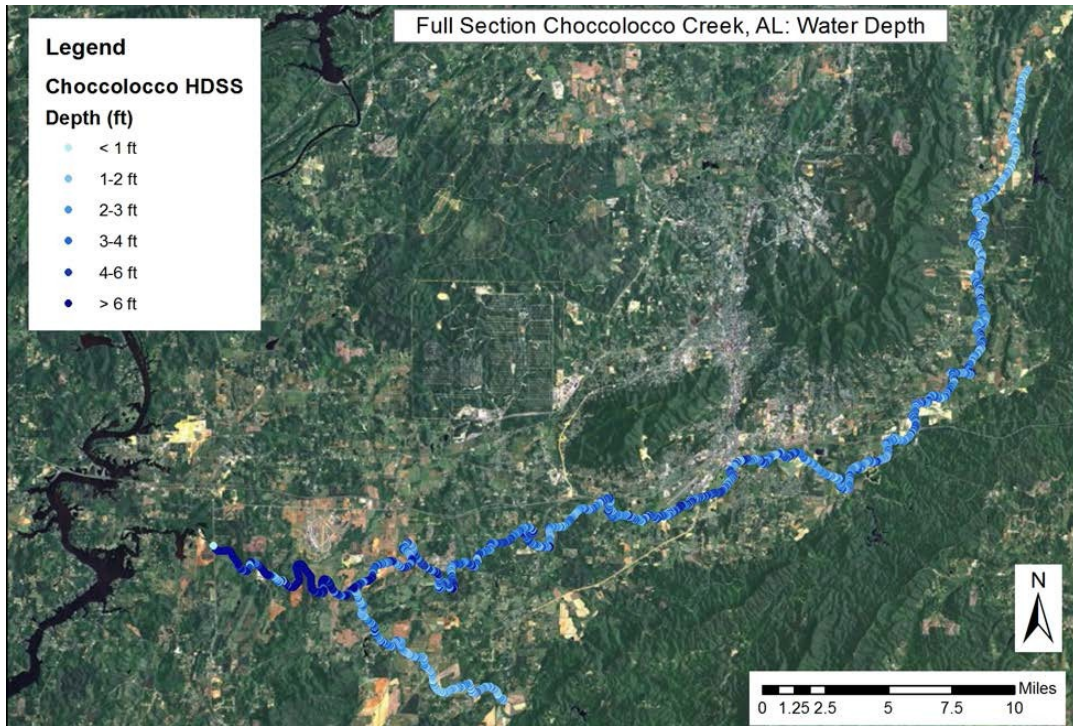
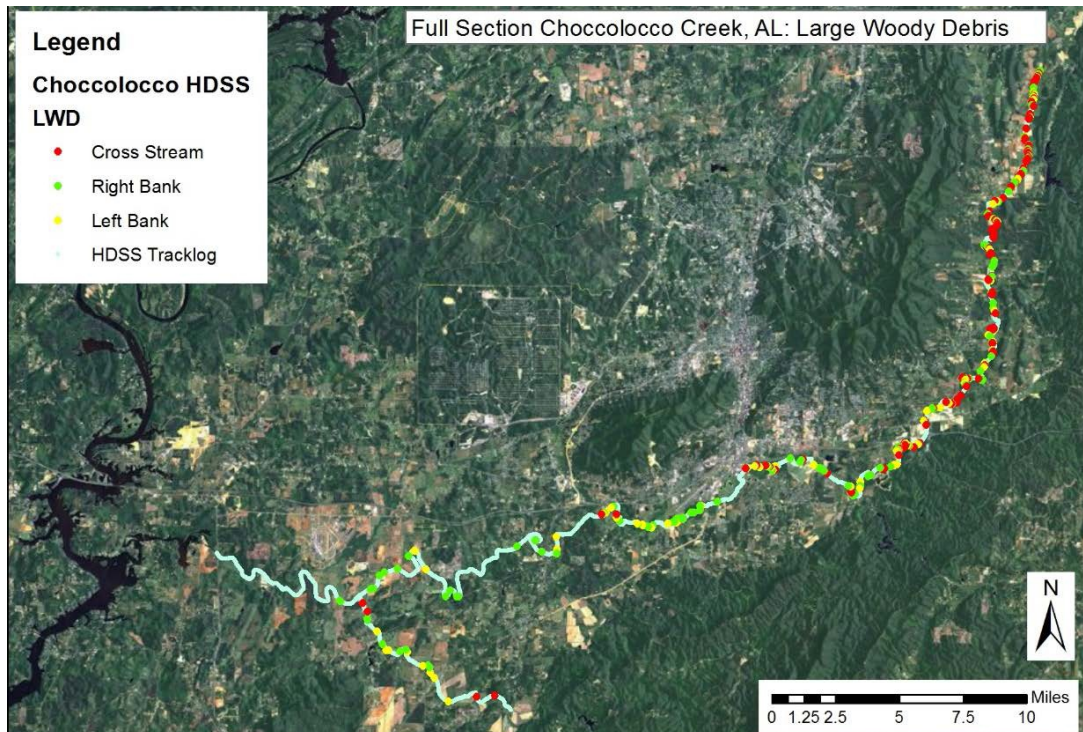Figure 12: Choccolocco Creek Depth Measurements.

Figure 13: Choccolocco Creek Large Woody Debris locations.
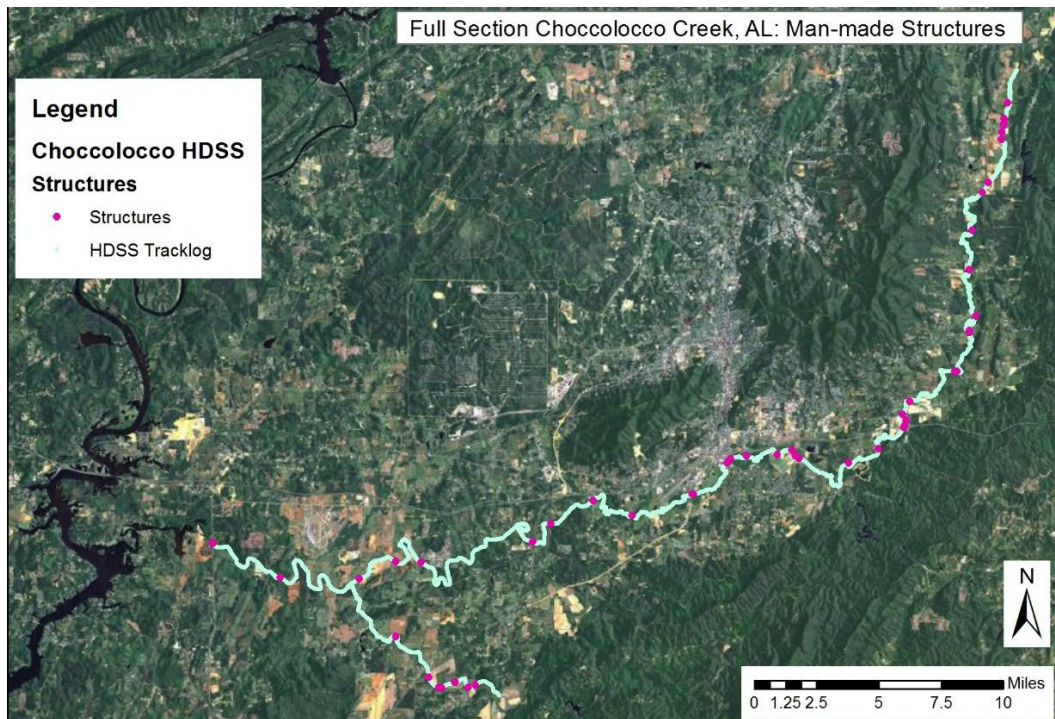
Figure 14: Choccolocco Creek Structure Locations.

Site Ranking and Prioritization

To better understand the spatial distribution of bank condition scores and to rank areas with

respect to their bank conditions, additional analysis was performed. The overall survey area was

divided into sections of approximately 200 meters. Then combination scores (left + right bank

condition score/) were averaged for each 200 m section. For example, if the left bank condition

score was Level 1 (Optimal Condition) and the right bank was Level 3 (Fair Condition), the

combination score for that section was Level 2 (Good Condition). From the site ranking

analysis, a total of 656 segments were created and ranked from optimal to very poor condition.

For visualization purposes, the top 50 worst 200 meter survey segments with the lowest bank

conditions scores were mapped (Figure 15).

To better highlight how the results of the HDSS effort may be used, we located the two sites out

of the original 656 with the worst average bank condition scores. For example, two sites,

segment 15 (Figure 16 Figure 18) and segment 23 (Figure 19Figure 20), were tied for the lowest

bank condition score during the survey and each segment had very poor overall scores. Both of

these sites were located in the upper survey section. When looking more closely at each site from

both the aerial imagery and HDSS video for Segment 15 and Segment 23, it was apparent that

stream degradation was caused by allowing cattle direct access to the stream (Figure 20).
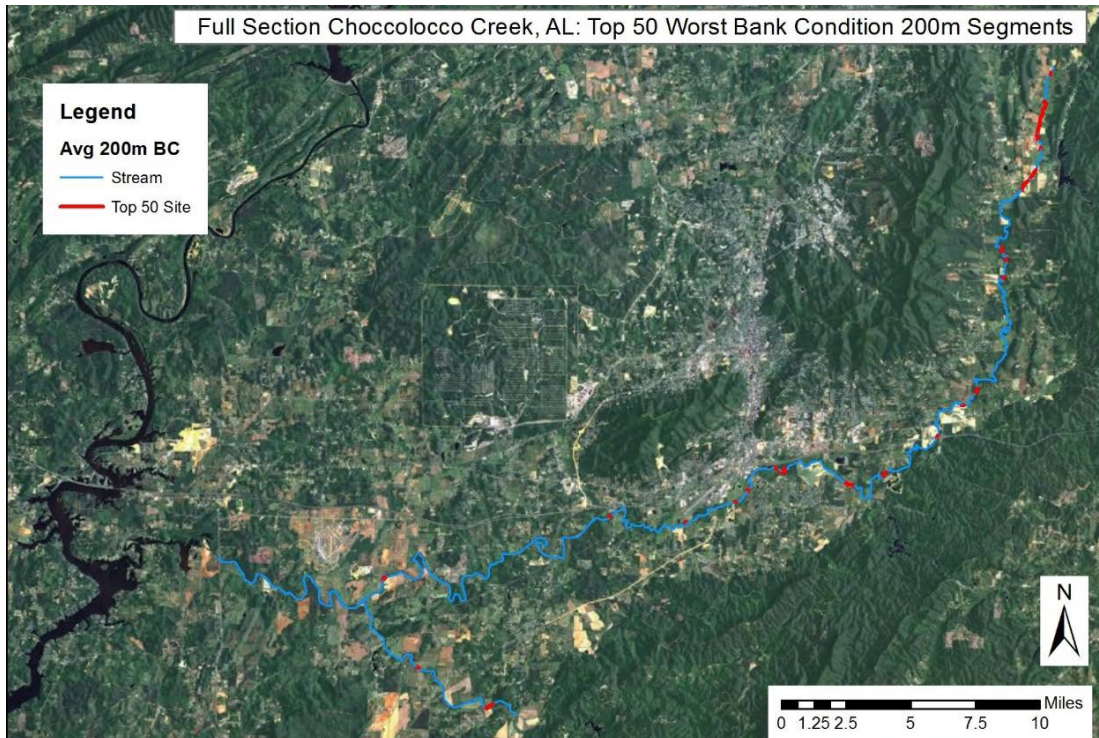

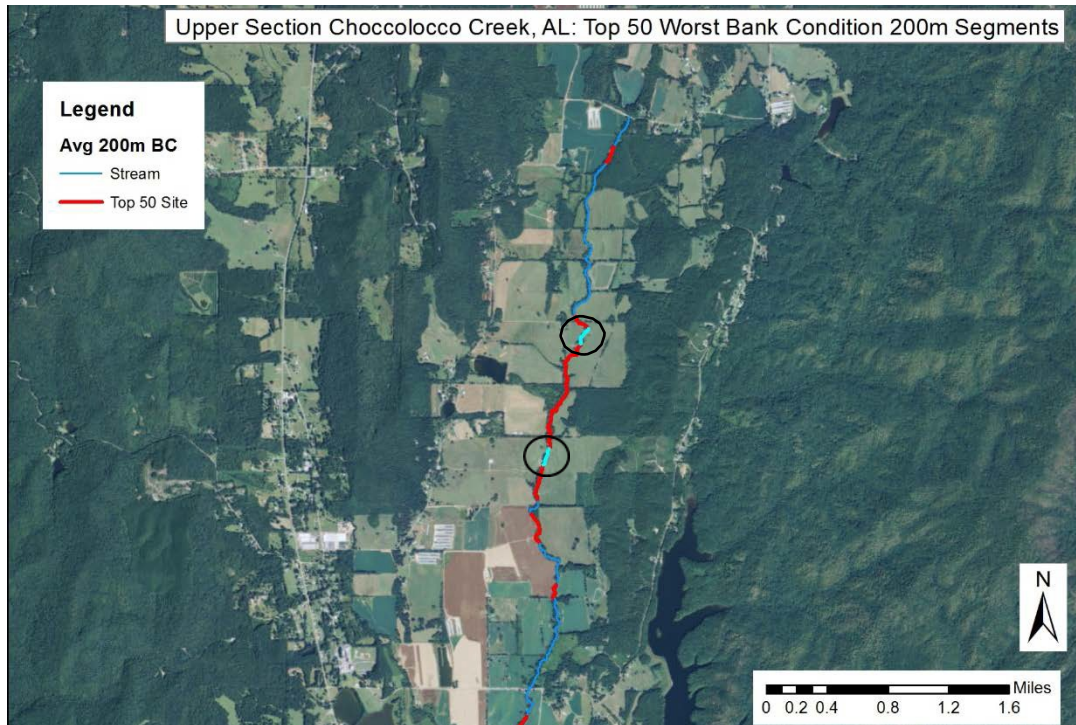Figure 15: Choccolocco Creek locations of top 50 worst 200 m reaches.

Figure 16: Choccolocco Creek with the worst 200 m reaches being highlighted.

Figure 17: Segment 15, one of two worst locations in the Choccolocco Creek Survey. This site begins at N -85.66378 and W 33.77287.
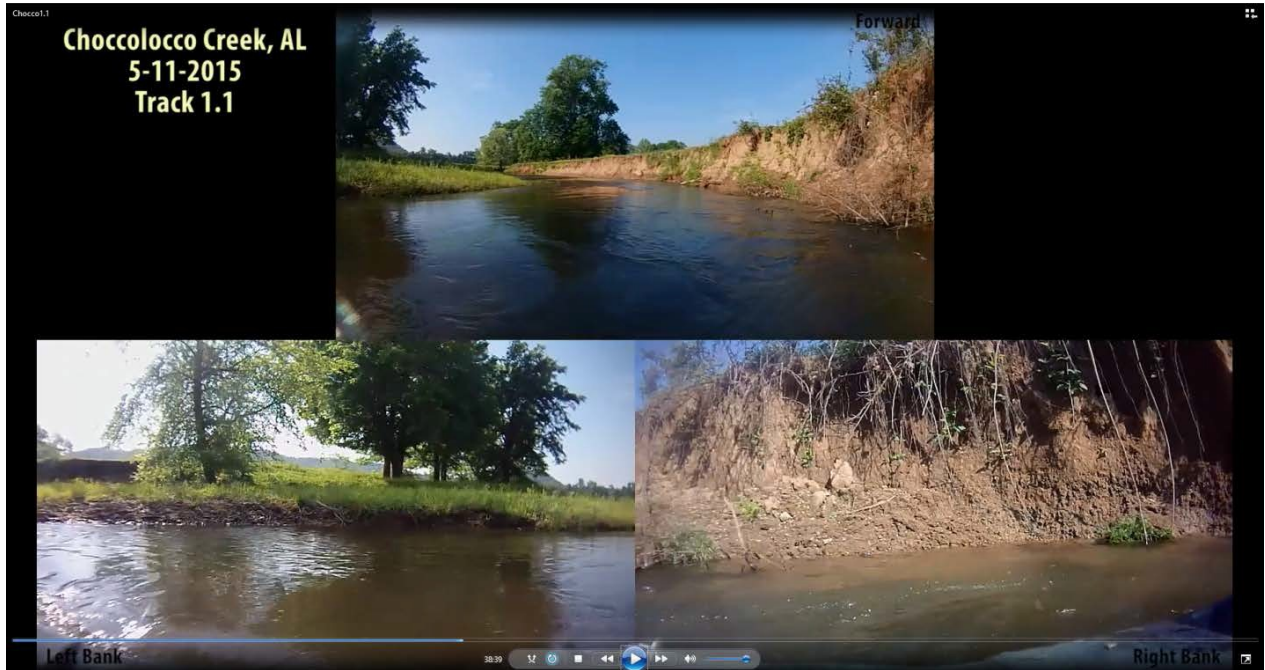
Figure 18: HDSS video imagery for Segment 15, one of two worst locations in the Choccolocco Creek Survey. Note the large failing stream bank and lack of riparian vegetation.

Figure 19: Segment 23, one of two worst locations in the Choccolocco Creek Survey. The site begins at N -85.66753 and W 33.76340.

Figure 20: HDSS video imagery for Segment 23, one of two worst locations in the Choccolocco Creek Survey. Note the cows present in the stream during the survey.

Conclusions

Trutta collected HDSS data for portions of Choccolocco Creek (60 miles) and Cheaha Creek (8 miles) on May 11-14, 2015 to provide documentation and a video archive of river bank conditions and habitat types. In addition, aquatic habitat GIS layers were developed to document left and right bank condition scores, habitat types and depth utilizing the HDSS field data. In addition, we conducted video assessment to locate manmade structure locations and large woody debris (LWD). Structures included culverts, pipes, irrigation pumps, bridges, hardened cattle access points and other man-made structures that may have been present. Large woody debris was separated into Left Bank LWD, Right Bank LWD, and Cross Stream LWD. With the high number of downed trees preventing passage, either portaging or dragging the kayak over log jams was a regular occurrence. Following the classification of the data using our HDSS Video Coder software, we created a corresponding seamless video file and a data file and then created shapefiles for the data within ArcGIS. One of the strengths of the HDSS approach is the ability to

create additional custom classification that can be applied in the future using the video archive of Choccolocco Creek. By applying ranking criteria to the HDSS results, we located stream segments with poor bank condition scores. This may be useful for prioritizing portions of the creek that may benefit from restoration.

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