Assessment and Mapping of Civilian Conservation Corps Structures on the Maple River in Emmet County, Michigan

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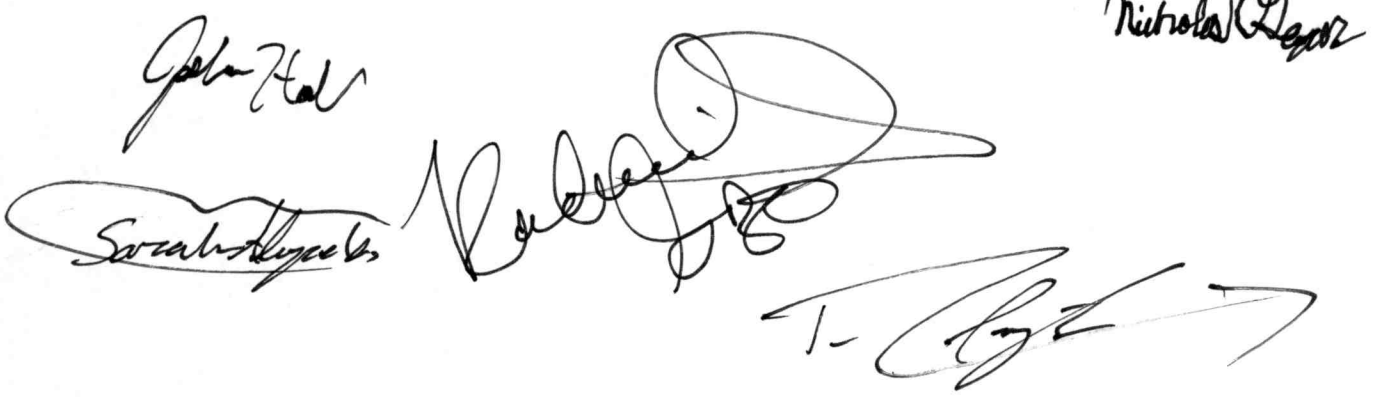
Abstract

The purpose of this survey was to evaluate the condition of in-stream structures created by the Civilian Conservation Corps (CCC) on the Combined Branch of the Maple River in Emmet County, MI. These structures were put in place to create fish habitats and spawning areas for Trout species that are not indigenous to the Maple River. On July 31st and August 3rd of 2013, we traveled down the stretch of the Maple River between Lake Kathleen and Brutus Road to locate and assess the status of the CCC constructed trout habitats. A total of 49 CCC structured were mapped and surveyed. The locations of trout spawning areas provided to us from Trout Unlimited, in addition to our Google map database, allowed us to identify which structures were in close proximity to redds. Also, we identified structures that were in poor in quality due to sediment accumulation from soil erosion. For future assessment of trout habitat we recommend every two years evaluation of the condition of CCC structures. We hope our Google Map database provides the grounds for future surveys to improve trout conditions in the Maple River.



Introduction and Background

Trout are one of the most popular game fish in the world. Not surprisingly, much effort has been taken to create high quality trout fisheries in waters all around the globe. Trout require habitats with cold, clean waters with ample food sources, places to hide from predators, and well oxygenated gravel to lay their eggs in. Many Northern Michigan streams, fed by cold groundwater inflows and running over glacial till and sands provide prime locations for trout to live. There are three species of trout that currently call Michigan streams home; brown trout, rainbow trout, and brook trout. These species were intentionally stocked in these streams for the purpose of the recreational enjoyment of fishermen. Brook trout (*Salvelinus fontinalis*) are a native species to the Upper Peninsula streams and possibly the Northern Lower Peninsula but these populations are now heavily supplemented with stocked fish. Brown Trout (*Salmo trutta*) and Rainbow Trout (*Onchorynchus mykiss*) are completely introduced in all Michigan streams and much of the Great Lakes. In the early days of managing river trout fisheries stocking of trout was seen as the best and only way to keep quality populations (MDNR). When trout populations in Michigan streams began to show significant declines fisheries managers began to reevaluate how to maintain quality trout populations. A study by Clarence Tazwell at the University of Michigan Fisheries Institute in 1931 showed ways trout populations can be enhanced and made healthier by improving the quality of in-stream habitat. It helped to start changes in how trout fisheries were managed through improvement of successful populations by helping the streams in which the trout live and reducing the supplementation of trout by stocking.

From 1925 to 1930 all trout fishing in Michigan streams was closed due to the significant declines in trout populations during the 1920's. In 1933, the Civilian Conservation Corps (CCC) was created to combat the Great Depression by giving unemployed men and women meaningful jobs that improved the nation's infrastructure and environmental resources. Following the new approach to trout stream

improvement through in-stream structure building and restoration the CCC went to work building the structures. Between 1933 and 1935, the CCC built a total of 31,084 in-stream structures in the United States to create trout habitats (Hunter 1990).These in-stream structures were implemented to counteract declining fish populations due to loss of physical habitat, chemical pollution and overfishing (Thompson and Stull 2002). The structures provide cover for trout and downstream pools provide cover for adult trout and an overwintering habitat for adult and juvenile fishes (Hunter 1990). These structures were especially important in helping improve the trout fishery on many Northern Michigan streams including famous waters such as the Au Sable.

In this study we looked at CCC structures constructed on the Maple River, a smaller, lesser known Michigan Trout stream about 80 miles north of Grayling and the famous waters of the Au Sable. The main branch Maple River originates at the confluence of the east and west branches at a dam impoundment at Lake Kathleen. The Maple River continues to flow down into Burt Lake. Our project involved mapping and assessing the integrity of Civilian Conservation Corps in-stream structures along the Combined Branch of the Maple River. The in-stream structures installed by the Civilian Conservation Corps were surveyed to see if repairs, replacements, or removals are needed. The purpose of this study is to evaluate the condition of these structures and whether they are fulfilling their original intention, creating hiding structures and enhancing feeding areas and spawning areas for river Trout populations. The structures also play a role in preventing bank erosion and maintaining stability and this role of the structure was also considered in our assessment.

Major Goals of this Assessment

1) Locate and assess the status of the CCC constructed trout habitats on the Maple River in Emmet County, MI,

2) Compare overall fish totals in these structures and to natural structures on the river, and

3) Offer ways in which these structures can be improved on the Maple River to enhance the populations of trout and other fishes in the river system.

Methods

An observational survey locating and assessing a variety of CCC and natural structures was conducted on the Maple River in Emmet County, MI, on July 31, 2013 from Lake Kathleen to Maple River Road and August 3, 2013 from Maple River Road downstream to Brutus Road.

The survey team consisted of five individuals, who accessed the structures by floating down the Maple River in canoes and kayaks. At each structure the watercrafts were landed on the opposite bank as to not disturb the fish in each structure. Each member then donned masks and snorkels and approached the structure at equal intervals. While maintaining as much stealth as possible each surveyor snorkeled and made counts of fish present in each structure. Fish observed were divided into two categories: trout and other, and into two subcategories: adult (> 7 inches) and small (< 7 inches). The subcategory small was utilized rather than juvenile because not every fish that was counted was positively identified by species. Many species of fish only grow to an adult size equivalent to that of juvenile trout.

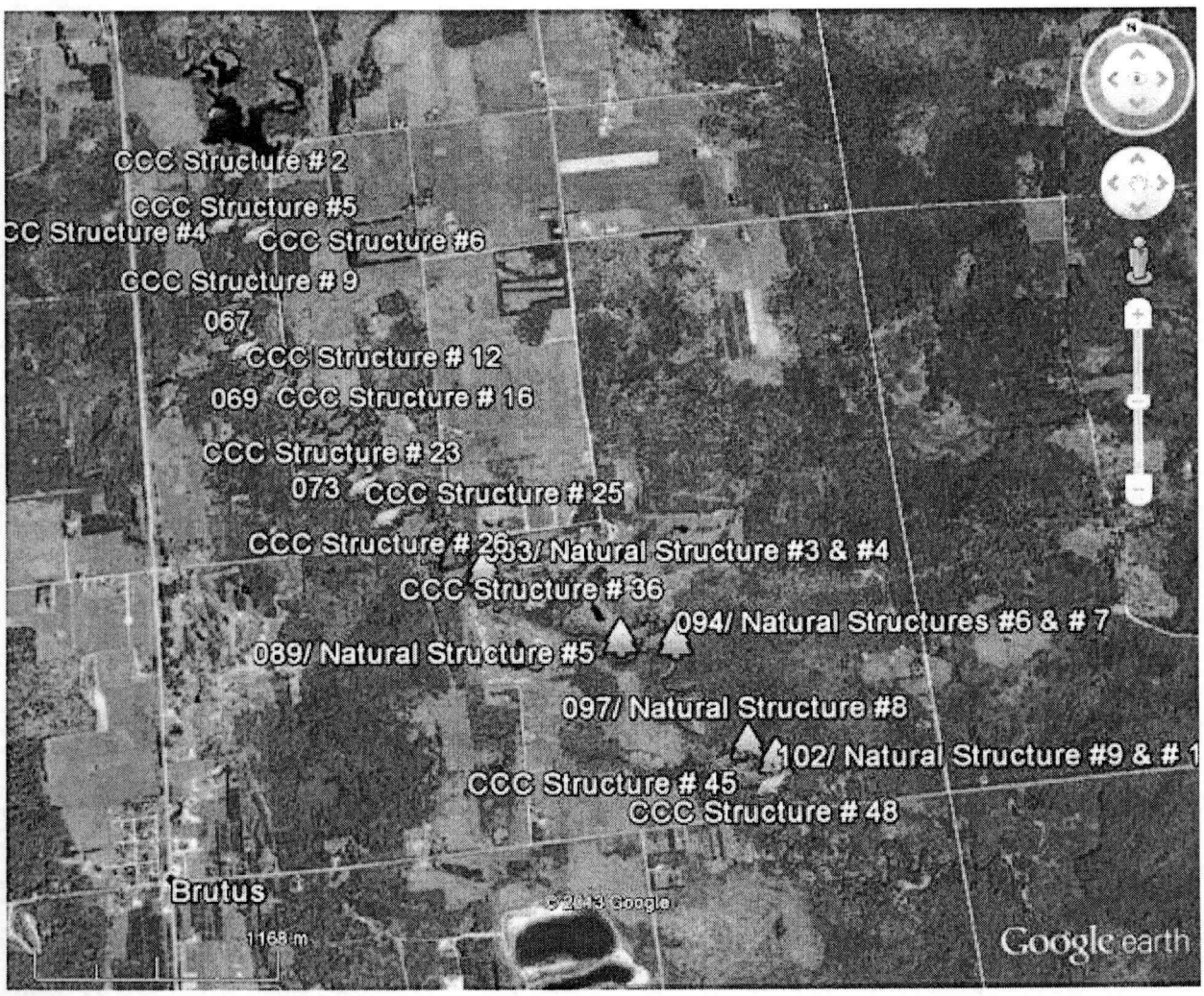
Observations of the physical qualities of each structure were made. Geographic coordinates of each structure were obtained via a Garmin GPS receiver. These data were then mapped out on GIS and compared to locations of trout spawning grounds; the locations of trout spawning redds were gathered by Trout Unlimited in the Fall of 2011 and 2012. Other observations included estimations of depth at structure edge, flow through structure, underwater openness of each structure, amount of sediment and debris gathered by structure, and amount of shade provided by terrestrial tree cover.

In addition to the CCC structures, ten dams/log jams created by natural processes were surveyed to compare fish count with the man-made structures. These were used to make comparisons with the CCC structures in the analysis.

Result

Along the Maple River between Lake Kathleen and Brutus Road, a total of 49 CCC structures were observed. For future surveying of the CCC structures and Trout habitats along the Maple River a Google Map database was created; mapping out the location of each structure as well as locations of spawning areas of brown trout from 2011 and 2012 provided by Trout Unlimited using a Garmin GPS device (Fig.1). This interactive Google map serves as a figure to which future waypoints of CCC structures, images, and new redds may be added.

Figure 1: Google Map of CCC and Natural structure locations on the Maple River, Emmet Co. MI



Within the CCC structures, 236 fish, both adult and small, were counted and 67 fish were counted in the naturally-formed structures. A comparison of the mean values (table 1) shows that the natural structures contained significantly more small fish which include both juveniles and minnows ($\alpha=0.05$; $p<0.001$)(Fig. 2). However, the CCC structures had significantly more adult trout ($\alpha=0.05$; $p<0.001$)(Fig. 2).

Figure 2: Average Fish Count comparisons between types of fish and types of structure

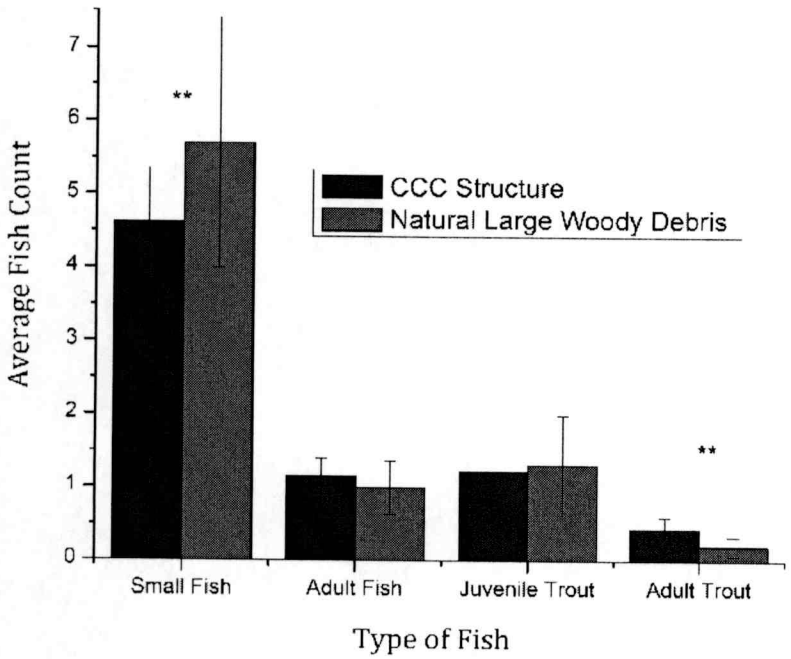


Table 1: Average Fish Count by Structure Type

	Fish Averages					
	Small	Adult	Total	Juvenile Trout	Adult Trout	Total Trout
Natural Structures	5.7	1	6.7	1.3	0.2	1.5
CCC Structures	3.9	1	4.8	1	0.4	1.4

Table 2: Sediment accumulations at CCC structures sites with heavy sediment are those are concern.

Sediment Load		
	Heavy	Light
Structures	1, 2, 3, 4, 5, 6, 7, 19, 20, 21, 23, 25, 32, 33, 37, 39, 40, 41, 43, 44	12, 14, 17, 18, 24, 31, 36, 38, 42, 45, 46, 47, 48, 49
*Structures with neither heavy or light sediment loads were not included		

Conclusions

A major threat to trout populations is sand and sediment buildup, which causes pools to fill up and submerges trout spawning areas. Many CCC structures have accumulated sediments and have lost the ability to store water (Table 2). Sediment reduction techniques include erosion control via stream-bank stabilization and vegetation of eroding river banks (Hansen 1983). Sediment basins can remove large amounts of the stream bed load and can also be used alongside the erosion control measures to remove non-point sources of sedimentation (Hansen 1983). Alexander et al. (1983) found that removal of sand from a stream bed with the installation of an in-stream sediment basin increased brown and rainbow trout production. The authors hypothesized that removal of sand exposed rough substrate such as gravel, cobble, sticks and hypothesized that the rough exposure likely enhanced cover for small fish and reduced territorial competition within the trout population. Furthermore, increased roughness likely produced areas of low water velocity, providing rest areas in which fish could conserve energy (Alexander et al. 1983). Had monitoring of this restoration project taken place in the years following the CCC structure installation, ineffective structures could have been identified, repaired, or removed. The literature shows that only 15-30% of in-stream restoration projects have included post-project monitoring (Bernhardt et al. 2005; Miller et al. 2009).

Significantly more small fish were found in the natural structures as opposed to the CCC structures (Figure 2). This may be due to the fact that CCC structures consist of large logs that are nailed together in a

crosshatch pattern. This type of construction creates large holes that provide large fish a habitat in which to hide. In contrast the natural structures consist of deadfall and small debris which can becomes more tightly packed in the structure and provides a shelter against predation for the smaller fish.

Recommendations

The removal of the dam at Lake Kathleen would drastically alter trout habitats and CCC structure conditions along the Combined Branch Maple River, thus the conclusions drawn from our preliminary work would no longer be applicable and a survey would need to be redone if the removal were to occur. A Dam removal would cause the sediment buildup behind the dam to flow downstream and alter geophysical features of the river. For these reasons we would suggest delaying assessments of the trout habitats until the fate of Lake Kathleen is determined.

Assessing the sediment load is a necessary step towards improving trout habitat in the Maple River. One solution is to dredge the impoundments of sediment created by the CCC structures need to remove sediment buildup to improve trout habitat conditions; however this is not an economically viable option. Instead, we recommend preserving the high quality CCC structures that have not yet filled with sediment, especially those structures with redds in close proximity. The structures can be preserved using erosion control via stream-bank stabilization, and vegetation of eroding river banks (Hansen 1983).

Long-term monitoring of the quality of in-stream structures on the Maple River will ensure that the fish population is healthy and bring economic benefits to Emmet County. We recommend an assessment of the CCC structures every 2 years to determine which are at risk of sediment buildup. It is with hope, that this preliminary work provides the means to improving trout habitat in the future.

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Literature Cited

Alexander, G. R., E. A. Hansen. (1983). Sand Sediment in a Michigan Trout Stream, Part II. Effects of Reducing Sand, Bedload on a Trout Population, North American Journal of Fisheries Management 3: 365-372.

Ayllon, D., A. Almodovar, G.G. Nicola, and B. Elvira. (2010) Ontogenetic and Spatial Variations in Brown Trout Habitat Selection. Ecology of Freshwater Fish 19: 420-432.

Bernhardt, E.S., M. A. Palmer, J. D. Allan, G. Alexander, K. Barnas, S. Brooks *et al.* (2005). Synthesizing U.S. river restoration efforts. Science 308:636-637.

Hansen, E. A., G. R. Alexander, and W. H. Dunn. (1983). Sand Sediment in a Michigan Trout Stream Part I. A Technique for Removing Sand Bedload from Streams. North American Journal of Fisheries Management 3: 355-364.

Hunter, C. J. (1990). Better Trout Habitat: A Guide to Stream Restoration and Management. Island Press. Washington, DC, USA.

Miller, S.W., P. Budy, and J.C. Schmidt. (2009). Quantifying Macroinvertebrate Responses to In-Stream Habitat Restoration: Applications of Meta-Analysis to River Restoration.

Thompson, D.M. (2006). Did the Pre-1980 Use of In-Stream Structures Improve Streams? A Reanlysis of Historical Data. Ecological Applications 16: 784-796.

White, S.L., C. Gowan, K.D. Fausch, J.G. Harris, and W.C. Saunders. (2011). Response of Trout Populations in Five Colorado Streams Two Decades After Habitat Manipulation. Canadian Journal of Fisheries and Aquatic Science 68: 2057-2063.

Tarzwell, C.M. 1931. Trout Stream Improvement in Michigan. Transactions of the American Fisheries Society 61.1: 48-57

http://www.michigan.gov/dnr/0,4570,7-153-10364_52259_10951_11302-22530--,00.html