Talmadge Creek

Calhoun County, 2S/6W/34,35 and 3S/6W/1,2,12
Kalamazoo River, surveyed 2010 - 2017

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Environment

Talmadge Creek is a small tributary to the Kalamazoo River located on the south side of Marshall, MI. Talmadge Creek is classified as a warm stream by Michigan's Valley Segment Ecological Classification (Seelbach et al. 1997). The watershed is 2,056 acres and the land use is agriculture (36%), urban (27%), wetland (20%) and forest (16%). The creek is 3.6 miles long from the headwaters to the confluence with the Kalamazoo River, and drains in a northwest direction. Talmadge Creek has a low gradient of 0.18 feet per mile and is located in the Southern Michigan and Northern Indiana Drift Plain. The geology of the watershed is coarse-textured glacial outwash sand and gravel and postglacial alluvium. Soils in the watershed include fine sandy loam, sandy loam, and silty loam and are generally well drained. Although the soils are highly permeable, the low slope of the Talmadge Creek watershed results in only moderate groundwater inputs to the creek.

History

Few fisheries surveys were completed on Talmadge Creek before 2010. Initial surveys were conducted in 1953 using a DC electrofisher, but only five Central Stonerollers were collected. In 2000, another electrofishing survey was completed on Talmadge Creek downstream of the 15 ½ Mile Road crossing (Figure 1) as part of the data collection efforts for the Kalamazoo River Assessment (Wesley 2005). A total of 11 species were captured with the most abundant being Central Mudminnow followed by Blacknose Dace, Creek Chub, and Mottled Sculpin. Mottled Sculpin is a coldwater fish species. The presence of sculpins prompted fisheries managers to conclude that this stream could be managed for trout if the creek was more accessible to the public.

On July 26, 2010, a 30-inch diameter pipeline owned by Enbridge, Inc. ruptured, discharging heavy crude oil into a wetland and subsequently into Talmadge Creek. The amount of oil discharged was estimated to be 819,000 to 1,000,000 gallons. The oil flowed down 2.2 miles of Talmadge Creek before entering the Kalamazoo River. The oil migrated approximately 35 miles down the Kalamazoo River to Morrow Pond. In the weeks following the incident, the Michigan Department of Natural Resources-Fisheries Division (DNR) and the Michigan Department of Environmental Quality-Water Resources Division (DEQ) developed a joint work plan to monitor the long-term effects of the oil spill and associated cleanup activities on fish, macroinvertebrates, and fish habitat in the Kalamazoo River and Talmadge Creek (Wesley and Walterhouse 2010).

During September 2010-August 2017, DNR staff conducted fish community and habitat surveys on the Kalamazoo River and Talmadge Creek with assistance from DEQ, the Calhoun Conservation District, and Entrix, Inc. (a consultant of Enbridge). Personnel from DEQ-Surface Water Assessment Section also collected macroinvertebrate and aquatic habitat data using their Procedure 51 protocol (MDEQ 2011; MDEQ 2018). Survey results for sampling on the Kalamazoo River can be found in Status of

the Fishery Resource Report 2017-243 (Diana 2017). This report summarizes results from the fish community and fish habitat sampling on Talmadge Creek from 2010 through 2017.

Current Status

Electrofishing surveys at two sites were initiated shortly after the oil spill on September 16, 2010 and subsequently were completed annually in late August (2011 through 2017). Talmadge Creek at 15 ½ Mile Road represented a heavily impacted site downstream of the spill location and the Zenz property site represented a location just upstream of the spill location (~600 feet; Figure 1). Talmadge Creek at 15 ½ Mile Road was surveyed starting 1,000 feet downstream of the road and was electrofished in the upstream direction for 500 feet. The Zenz property site is located downstream of the 17 Mile Road crossing of Talmadge Creek. The station began 500 feet downstream of a small foot bridge, which is immediately downstream of a private vehicle bridge. Two additional sites were surveyed to assess limitations to fish community recovery due to potential upstream passage barriers resulting from perched culverts at the 15 ½ Mile Road and I-69 crossings of Talmadge Creek. The I-69 site was surveyed from the road crossing at 15 ½ Mile Road proceeding upstream 420 feet to the culvert at the I-69 crossing on August 18, 2014. A site upstream of 16 Mile Road was surveyed on August 22, 2016 and August 30, 2017 to determine if fish populations were recruiting through the culvert under I-69 allowing for recovery at this site. The site was surveyed from the 16 Mile Road crossing proceeding upstream for 500 feet.

During each electrofishing survey, all fish were identified and measured to the nearest inch. Catch per effort (CPE) was calculated for each site as the number of fish captured per 1,000 feet of stream surveyed. Fish population diversity was assessed using species richness and Simpson's Diversity Index Scores (Simpson 1949).

Habitat data were collected using the Status and Trends survey protocol (Wills et al. 2011). Habitat sampling was conducted during each of the 2010 through 2017 surveys. Thirteen cross-sectional transects were evaluated within each sampling station. Stream (wetted) width and general habitat type (run, riffle, or pool) was recorded for each transect. Riparian vegetation class and bank stability rating (1 = <25% bare soil; 2 = 25-50% bare soil; 3 = 51-75% bare soil; 4 = >75% bare soil) was assessed for the left and right banks, and if an undercut was present water depth and undercut length (perpendicular to stream flow) was measured. Water depth, dominant substrate, and percent coverage of wood (within a 1 ft x 1 ft square) were recorded at 2 ft intervals along each transect. Data for lineal and areal counts of woody structure were obtained using the methods outlined by Wills et al. (2011). Water depth and current velocity were measured at 1 foot intervals along a single transect within the sampling station and used to calculate discharge.

A total of 23 species were caught in Talmadge Creek across all sites from 2000 through 2017. Mean CPE for the 15 ½ Mile site was 2,161 (Table 1) and was higher than the control site at the Zenz property which had a mean CPE of 792 (Table 2). Total CPE at 15 ½ Mile reached a low in 2010 and increased during 2011 through 2017 (Figure 2). The 2017 CPE was higher than measured in 2000 prior to the oil spill. The number of species decreased at 15 ½ Mile from 11 in 2000 to only 3 in 2010 following the oil spill (Figure 3). The number of species increased from 2010 through 2017, and more species were present in 2015 through 2017 (mean of 12.3) than in 2000. Species that were found in 2000 that were not observed following the oil spill include Bluegill (2 in 2000) and Lake Chubsucker

(5 in 2000). Fish species that were observed from 2010 through 2017 that were not collected in 2000 included Bluntnose Minnow, Brook Stickleback, Blackside Darter, Common Shiner, Golden Shiner, Largemouth Bass, Northern Hog Sucker, Rainbow Darter, Smallmouth Bass, Rock Bass, and Spotfin Shiner.

Fewer fish species were observed at the Zenz site (Table 2). A total of 8 species occurred throughout all surveys at the Zenz site (compared to 23 species at 15 ½ Mile), with 5 to 6 species captured each year. Blacknose Dace, Creek Chub, Central Stoneroller, Central Mudminnow, and Green Sunfish made up 93% of the catch in 2016 and 2017 compared to 79% in the 2000 survey. Central Mudminnow was the most common species prior to the oil spill with a mean CPE of 194 (50% of total catch) and the second most common species in 2016 and 2017 with a mean CPE of 346 (11% of total catch). Blacknose Dace saw the largest increase in CPE from 46 (12% of total) in 2000 to an average of 1,404 (43%) in 2016 and 2017. All of these species had much greater CPE in 2016 and 2017 than in 2000 (Table 1).

Fish diversity at all sites was evaluated from 2010 through 2017 using Simpson's Diversity Index Score. Diversity scores at 15 ½ Mile Road decreased from the 2000 survey (3.3) to a low in the survey following the oil spill in 2010 (1.3; Figure 4). Diversity increased at 15 ½ Mile in 2011 through 2015 (mean 2.2). During 2016 and 2017, the mean index score (3.6) was similar to the pre oil spill score in 2000. The 16 Mile site had a similar diversity score in 2016 and 2017 (2.6 and 3.4 respectively). The Zenz site had lower diversity scores in general than 15 ½ Mile. The Zenz site diversity score also increased from a low in 2010 (1.6) to a high in 2016 and 2017 (3.1 and 2.9 respectively), indicating that fish species at this site may have been impacted by the oil spill even though it occurred downstream. The Zenz site had similar diversity scores in 2016 and 2017 to those observed in the 2000 survey at 15 ½ Mile Road.

Fish community composition was evaluated using MDEQ Great Lakes and Environmental Assessment Section (GLEAS) Procedure 51 for wadable streams (Creel et al. 1998; MDEQ 1997). This procedure uses a multimeric scoring procedure to rank sites from poor to excellent based on the fish species present and their abundance. Ten community metrics are scored from -1 to +1 including number of total taxa, darter taxa, sunfish taxa, sucker taxa, and intolerant taxa and the percent of tolerant, omnivore, insectivore, piscivore, and simple lithospheric spawning fish. Metric scores are summed and scored as poor (< -4), neutral (-4 to +4), or excellent (> +4). Fish index score was -3 at 15 ½ Mile in the 2000 survey (Figure 5). Scores decreased to poor in 2010 and fluctuated from neutral in 2011 and 2012, to poor in 2013 and 2015, and neutral again in 2015 through 2017. Scores in 2015 through 2017 were slightly higher than in 2000 prior to the oil spill. All other sites had poor fish communities present through the duration of the survey period with the exception of the Zenz site in 2017 which was -2.

The I-69 and 16 Mile sites were surveyed to determine if the road crossings at 15 ½ Mile Road and I-69 were preventing fish species from recolonizing upstream reaches. In 2016 and 2017, the mean number of species at 15 ½ Mile was 12, which is higher than the means of 9 species caught at 16 Mile and 8 species caught at I-69 (Table 3). All commonly captured species at 15 ½ Mile also were caught at 16 Mile with the exception of Common Shiner. Common Shiners were collected at the I-69 site in 2014. Other species that were present from 2010 through 2017 at 15 ½ Mile that were not observed at 16 Mile include Bluntnose Minnow, Blackside Dace, Largemouth Bass, Northern Hog Sucker,

Pumpkinseed, Rainbow Darter, and Rock Bass. These species were not consistently caught and only were captured in 2 or less of the surveys from 2010 through 2017 at 15 ½ Mile, and CPUE was less than 10 fish per 1,000 feet. Mottled Sculpin was the last species to recolonize as sculpins were observed in low numbers at 15 ½ Mile in 2011 and 2016 (mean CPE = 8) but increased numbers were observed in 2017 (mean CPE = 88). None were observed at 16 Mile in 2016, however they were observed in 2017 with a CPE of 36.

Habitat was evaluated from 2010 through 2017, but no habitat surveys were conducted prior to the oil spill. The surveys in 2010 were conducted prior to large scale remediation efforts which greatly impacted the habitat of Talmadge Creek as dredging and excavating occurred throughout the channel, banks and flood plain resulting in a greatly altered system. In 2010, the site at 15 ½ Mile was an even mix of riffle (46%) and runs (54%). Pools became more prevalent after 2013 resulting in a mean of 9% pool habitat in 2013 through 2017 surveys. Width averaged 9.3 feet and was the widest during the high flows of 2010 (14.9 feet). Water depth at 15 ½ Mile averaged 0.5 feet and discharge ranged from 0.5 - 2.4 cfs with an average of 1.5 cfs. The riparian vegetation at 15 ½ Mile was 100% tag alders in 2010, but was cleared as part of remediation resulting in 100% grassy vegetation from 2013 through 2017. Banks were rated unstable in 2010, but shifted to high stability in 2013 through 2017 (100% stability class 1) as grasses became more prevalent on the banks. Water temperature in late August during electrofishing surveys ranged from 53 to 76 degrees F and averaged 62 degrees F. Gravel was the predominant substrate (mean percentage of total substrate = 74.5%) from 2010 through 2017. Sand also was common (mean = 13.5%) and the relative substrate composition of sand and gravel did not change through time. Larger substrates were observed in 2010 and 2011 (mean cobble = 7.5%, boulder = 4.4%), but no boulders and only a mean of 1% cobble were observed during 2012 - 2017. Gravel was highly embedded from 2010 - 2015 (83% of gravel sampling points had greater than 50% embedded), but the percentage of embedded gravel decreased to a mean of 49% of gravel sampling points in 2016 and 2017. Wood was nearly absent from the 15 ½ Mile site with a mean of 0.8 linear feet of log across all years of surveying. No brush deposits were observed in 2010 - 2015, but brush increased to 27 ft^2 in 2016 and 58 ft^2 in 2017.

Habitat surveys also were conducted at the Zenz site from 2010 through 2017. Habitat was not disturbed as the cleanup and remediation all occurred downstream of the site. This site was mostly run habitat which averaged 96% of habitat types observed in surveys from 2010-2017. Width averaged 8.5 feet and mean depth was 0.3 feet. Discharge on the survey days averaged 0.48 cfs and ranged from 0.07 to 1.04 cfs. Water temperatures at the Zenz site were colder than at the 15 ½ Mile site and averaged 59.2 degrees F (range = 50 - 67 degrees F). Riparian vegetation was primarily tag alder (mean of 70%) followed by grass (mean of 25%). Banks were very stable with a mean of 93.8% ranked as stability class 1 from 2010 through 2017. Substrate was mostly sand (54%), followed by silt (37%), gravel (4%), and small cobble (3%), and substrate composition did not shift through time. Mean estimates of wood (34.5 linear feet) and brush deposits (229 ft^2) were higher than recorded for the 15 ½ Mile site.

Habitat was surveyed at the 16 Mile site in 2016 and 2017. Width averaged 9.7 feet, depth averaged 0.4 feet, temperature averaged 72.6 degrees F, and discharge averaged 1.5 cfs. This site consisted entirely of run habitat. The riparian vegetation was 100% grass, resulting in a high stability rating in 96% of banks that were evaluated. Substrate at 16 Mile was composed of gravel (mean of 35%), sand (mean of 32%), and silt (33%). No changes in habitat were observed as this site was only surveyed

near the end of the study period. Habitat was similar to the 15 ½ Mile site in 2016 and 2017, except no pools were observed at 16 Mile.

Analysis and Discussion

Fish abundance and diversity in Talmadge Creek were severely impacted by the oil spill. The lowest CPE and diversity scores were observed at the 15 ½ Mile site in the survey conducted shortly after the spill in 2010. In addition, fish diversity was the lowest at the Zenz site in 2010 as well, indicating that sites upstream of the spill also could have been impacted. Recovery gradually occurred at 15 ½ Mile with both CPE and diversity exhibiting increasing trends from 2010 through 2017. CPE began to fluctuate around the same level from 2014 through 2017 at a much higher CPE than was observed in the 2000 survey. Increases in diversity also began to level out in 2015 through 2017 with diversity being slightly higher than observed in 2000. Only two species that were observed in 2000 were not caught following the oil spill (Bluegill and Lake Chubsucker). These species were rare in the 2000 survey, making up approximately 4% of the total catch. Many new fish species were observed in 2010 through 2017 that were not collected during the 2000 survey. Environmentally sensitive species (such as Rainbow Darter and Blackside Darter) were present in Talmadge Creek following the oil spill but catch rates for these species were low. There were large increases in catch rates of more tolerant species throughout the study period as may be expected following an impact to a stream. The four most common species in 2000 (Central Mudminnow, Creek Chub, Green Sunfish, Blacknose Dace) were also the four most common species at the end of the recovery period. Common Shiner was not present in 2000, but is now occurring in high abundance at the 15 ½ Mile site. It is unclear if the increase in catch rates of these five species is due to the ability of the stream to carry more fish, or if catch rates in 2000 underestimated the relative abundance of fish present. There may be a decrease in densities of these common fish species in the future as populations fluctuate to the system's carrying capacity (e.g. decrease in CPE at 15 ½ Mile from 2014 to 2015). These are natural population fluctuations and would not necessarily indicate a decrease in the quality of the stream. Fish community index scores (GLEAS) ranked the 15 ½ Mile Road site as neutral or poor and all other sites as poor. The fish community scoring did decrease at 15 ½ Mile Road following the oil spill, but had returned to slightly higher scores in 2015 through 2017 than observed in the 2000 survey. Talmadge Creek most likely had somewhat depressed fish communities prior to the oil spill as indicated by low scores in the 2000 survey and at the reference site. All indications from fish species present, CPE, and species diversity indicate that the fish population of Talmadge Creek has recovered to pre oil spill conditions. These results concur with MDEQ macroinvertebrate and habitat surveys conducted over the same time period (MDEQ 2018).

Fish populations surveyed at the Zenz site had lower diversity and CPE than the 15 ½ Mile site. Differences in fish communities are most likely due to differences in habitat at the two sites. The Zenz site is further towards the headwaters with smaller width, discharge, and depth than 15 ½ Mile. The average water temperature was 2.9 degrees F cooler at the Zenz site compared to 15 ½ Mile. The fish community at the Zenz site was dominated by Mottled Sculpin and was more similar to fish communities found in small coldwater streams. Species diversity and density usually are low in the relatively cold headwaters of a stream and increase in downstream reaches with increasing stream size and water temperatures. The impacted site at 15 ½ Mile has recovered to have higher CPE and diversity than the control site on the Zenz property. There is no evidence that the lower species diversity and abundance at the Zenz site is related to the oil spill.

The culverts at the road crossings of 15 ½ Mile Road and I-69 most likely restrict fish passage to some extent. Both culverts must allow fish passage in certain conditions as demonstrated by the recolonization of species at the 16 Mile site. Some species that were not found in the Zenz site upstream were collected at the 16 Mile site and most likely colonized from downstream. There were a few less abundant fish species that were observed in the 15 ½ Mile site that were not collected upstream, but most of these species were not present in the 2000 survey at 15 ½ Mile or are not species that we would expect to find in a small coolwater stream like Talmadge Creek (e.g. Largemouth Bass, Pumpkinseed, and Rock Bass). Some species only were detected in low numbers at the 15 ½ Mile site, and if densities increase they should be able to colonize the upstream sites in the future. It is unlikely that the culvert at I-69 is preventing recovery of the 16 Mile site.

Changes in habitat were observed at the 15 ½ Mile site. Most changes resulted directly from intense cleanup and remediation work. All sediments, banks and riparian areas that were covered in oil were dredged or excavated and the stream channel was rebuilt, stabilized and planted. This resulted in a very different stream than existed prior to the oil spill. Initially the riparian zone was dominated by shrubs and small trees which were removed after 2010. Grasses were replanted and have improved stability of the banks, but very little woody habitat remains in the stream and there will be no wood available to recruit to the stream for some time. Brush was beginning to establish in the riparian zone, and there was some recruitment of brush into the stream by 2016 and 2017. The new channel has greater habitat diversity with pools being more prevalent, and a large number of fish were collected from these pools. Although we could not document changes in habitat at the 16 Mile site, the habitat was similar to conditions at the 15 ½ Mile site. The lack of habitat diversity at 16 Mile (no pools or riffles) could account for the small differences in fish populations observed compared to 15 ½ Mile.

Management Direction

The fish populations in Talmadge Creek have recovered to pre oil spill conditions. Estimates of abundance (CPE), species richness (number of species), and species diversity (Simpson's) at 15 ½ Mile have recovered to levels similar to or above what was observed in the 2000 survey conducted prior to the oil spill. Substrate and instream habitat is not limiting fish populations. Some changes were observed in riparian vegetation and instream wood, but these are expected to improve as vegetation continues to grow and wood recruits to the stream. Although the culverts at I-69 do limit fish passage under certain flows, fish have been able to recolonize areas upstream of the crossing. Fish populations continue to maintain themselves through natural reproduction and migration into the stream. No further management actions are required for Talmadge Creek.

References

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Table 1. CPE (#/1,000 feet) of fish collected in electrofishing surveys at the 15 ½ Mile site during 2000 through 2017. Bolded species were not found in the 2000 survey, but were captured following the oil spill in 2010. Italicized species were found in the 2000 survey, but were not captured after the oil spill.

Species	2000	2010	2011	2012	2013	2014	2015	2016	2017
Black Bullhead	0	0	2	0	0	0	10	7	52
Blacknose Dace	46	0	327	202	548	897	1,425	1,093	1,715
Blackside Darter	**0**	**0**	**5**	**2**	**0**	**0**	**0**	**0**	**0**
Bluegill	*4*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Bluntnose Minnow	**0**	**0**	**0**	**3**	**2**	**0**	**0**	**0**	**0**
Brook Stickleback	**0**	**12**	**5**	**0**	**2**	**0**	**5**	**0**	**5**
Central Mudminnow	194	106	1,117	48	36	283	133	457	235
Central Stoneroller	**0**	**0**	**0**	**0**	**82**	**88**	**123**	**135**	**292**
Common Shiner	2	0	0	0	22	10	13	0	23
Creek Chub	46	0	377	1,440	1,166	2,572	1,033	803	817
Golden Shiner	**0**	**0**	**0**	**0**	**0**	**0**	**10**	**8**	**38**
Grass Pickerel	2	2	0	0	0	0	0	0	0
Green Sunfish	18	0	0	0	18	7	5	83	445
Lake Chubsucker	*10*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Largemouth Bass	**0**	**0**	**0**	**0**	**16**	**0**	**3**	**0**	**0**
Mottled Sculpin	46	0	2	0	0	0	0	15	88
Northern Hog Sucker	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**7**	**0**
Pumpkinseed	6	0	0	0	0	0	3	0	8
Rainbow Darter	**0**	**0**	**0**	**2**	**0**	**0**	**8**	**0**	**0**
Rock Bass	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**
Smallmouth Bass	**0**	**0**	**3**	**25**	**6**	**0**	**0**	**17**	**0**
Spotfin Shiner	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**132**	**0**
White Sucker	10	0	115	168	8	10	25	15	40
Number of Species	11	3	10	9	11	7	13	12	12
Total CPUE	384	120	1,953	1,892	1,906	3,867	2,798	2,772	3,758

Table 2. CPE (#/1,000 feet) of fish collected in electrofishing surveys at the Zenz property site during 2010 through 2017. Bolded species were caught at the Zenz site and italicized species were captured at other sites, but not the Zenz site.

Species	2010	2011	2012	2013	2014	2015	2016	2017
Black Bullhead	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Blacknose Dace	**0**	**0**	**0**	**0**	**0**	**0**	**6**	**8**
Blackside Darter	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Bluegill	**4**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Bluntnose Minnow	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Brook Stickleback	**2**	**42**	**2**	**0**	**10**	**48**	**2**	**28**
Central Mudminnow	**966**	**642**	**196**	**230**	**638**	**546**	**160**	**262**
Central Stoneroller	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Common Shiner	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Creek Chub	**0**	**10**	**102**	**212**	**116**	**202**	**212**	**190**
Golden Shiner	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Grass Pickerel	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Green Sunfish	**2**	**0**	**0**	**12**	**4**	**12**	**2**	**32**
Lake Chubsucker	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Largemouth Bass	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Mottled Sculpin	**246**	**156**	**12**	**80**	**192**	**30**	**158**	**512**
Northern Hog Sucker	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Pumpkinseed	**46**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Rainbow Darter	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Rock Bass	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Smallmouth Bass	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Spotfin Shiner	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
White Sucker	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Number of Species	6	4	4	4	5	5	6	6
Total CPUE	1,266	850	312	534	960	838	540	1,032

Table 3. CPE (#/1,000 feet) of fish collected in electrofishing surveys conducted at the I-69 Site and the 16 Mile site during 2010 through 2017. Bolded species were caught at I-69 or 16 Mile sites and italicized species were captured only at other sites.

Species	I-69	16 Mile	
	2014	2016	2017
Black Bullhead	**0**	**0**	**2**
Blacknose Dace	**43**	**104**	**480**
Blackside Darter	*0*	*0*	*0*
Bluegill	*0*	*0*	*0*
Bluntnose Minnow	*0*	*0*	*0*
Brook Stickleback	**2**	**0**	**44**
Central Mudminnow	**1,955**	**332**	**748**
Central Stoneroller	**26**	**16**	**14**
Common Shiner	**21**	**0**	**0**
Creek Chub	**776**	**558**	**878**
Golden Shiner	**0**	**0**	**2**
Grass Pickerel	*0*	*0*	*0*
Green Sunfish	**19**	**28**	**126**
Lake Chubsucker	*0*	*0*	*0*
Largemouth Bass	*0*	*0*	*0*
Mottled Sculpin	**0**	**0**	**36**
Northern Hog Sucker	*0*	*0*	*0*
Pumpkinseed	*0*	*0*	*0*
Rainbow Darter	*0*	*0*	*0*
Rock Bass	*0*	*0*	*0*
Smallmouth Bass	**0**	**2**	**0**
Spotfin Shiner	**0**	**4**	**0**
White Sucker	**10**	**10**	**2**
Number of Species	8	8	10
Total CPUE	2,852	1,054	2,332

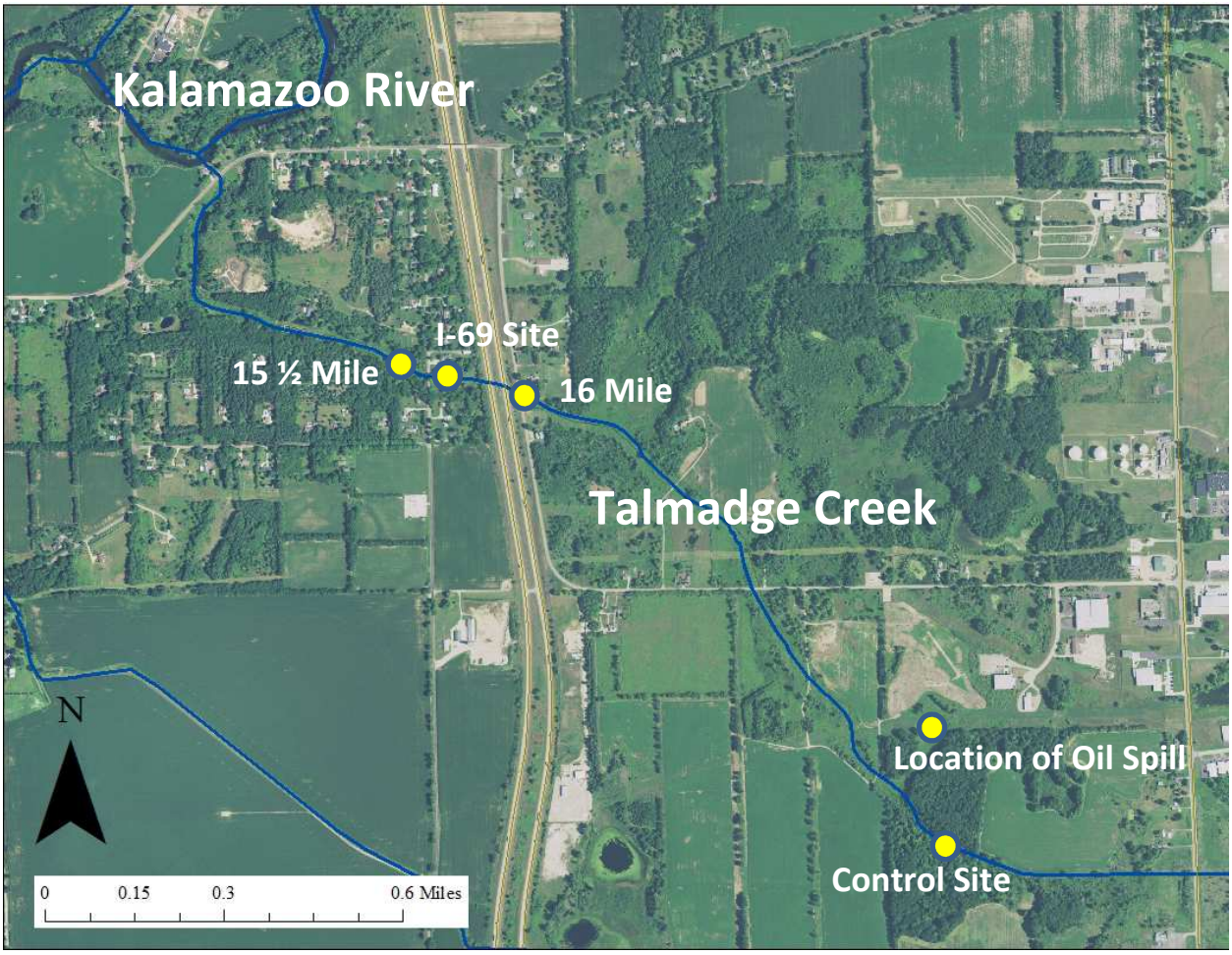

Figure 1. Satellite image of sampling locations relative to the oil spill.

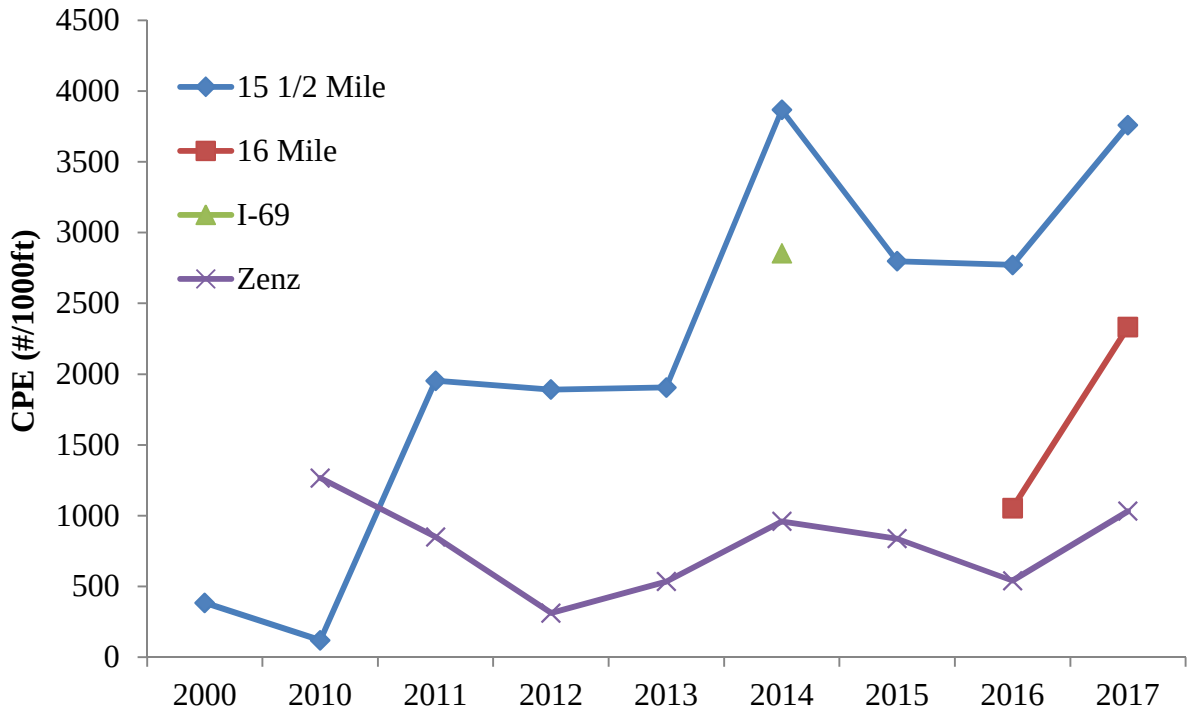

Figure 2: CPE from electrofishing surveys of four sites on Talmadge Creek during 2000 through 2017.

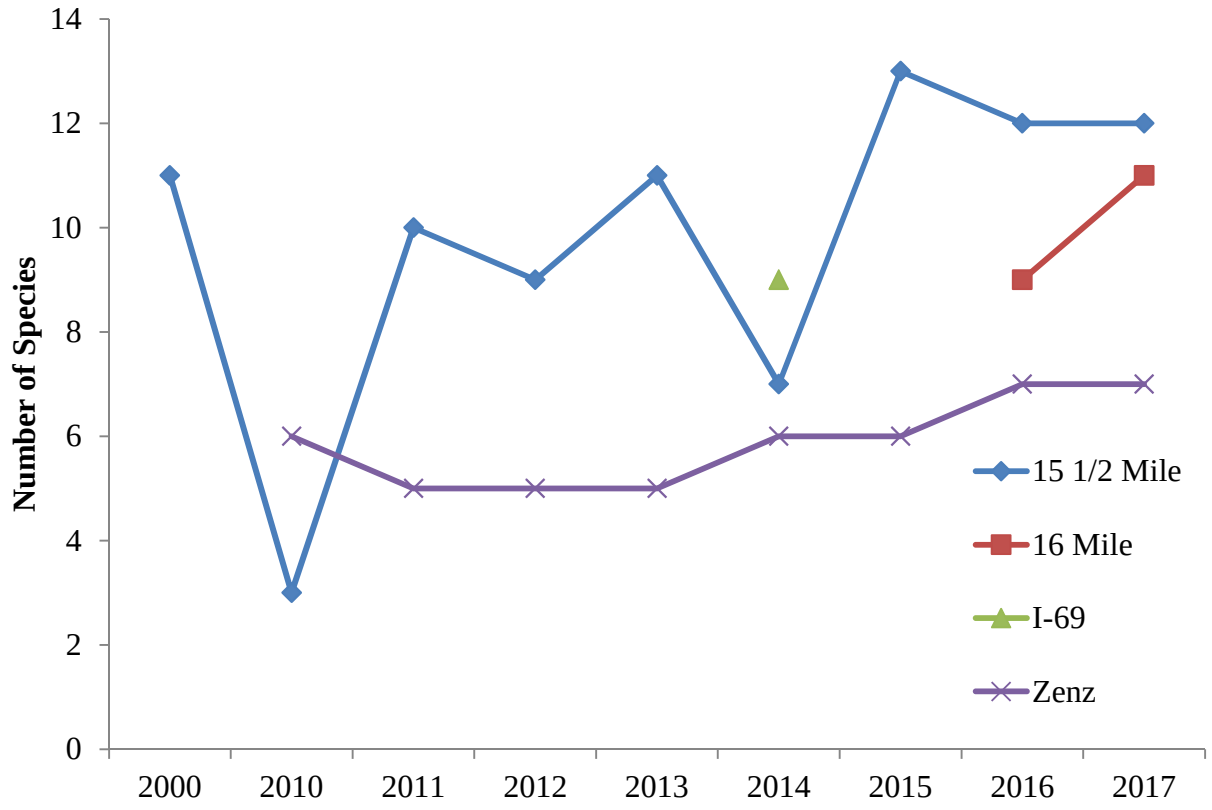

Figure 3. Number of fish species present in surveys at four sites on Talmadge Creek from 2000 through 2017.

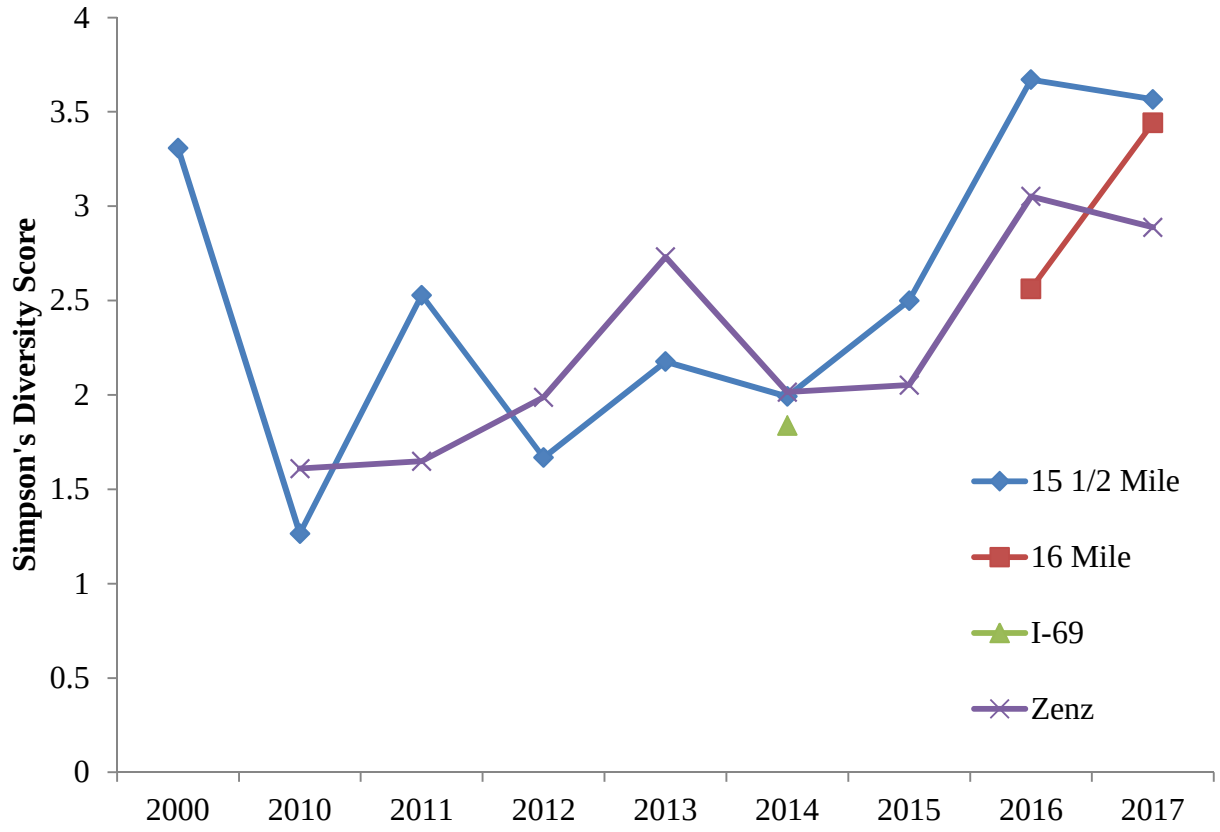

Figure 4. Simpson's Diversity Index scores for four sites surveyed with backpack electrofishing gear on Talmadge Creek during 2000 through 2017.

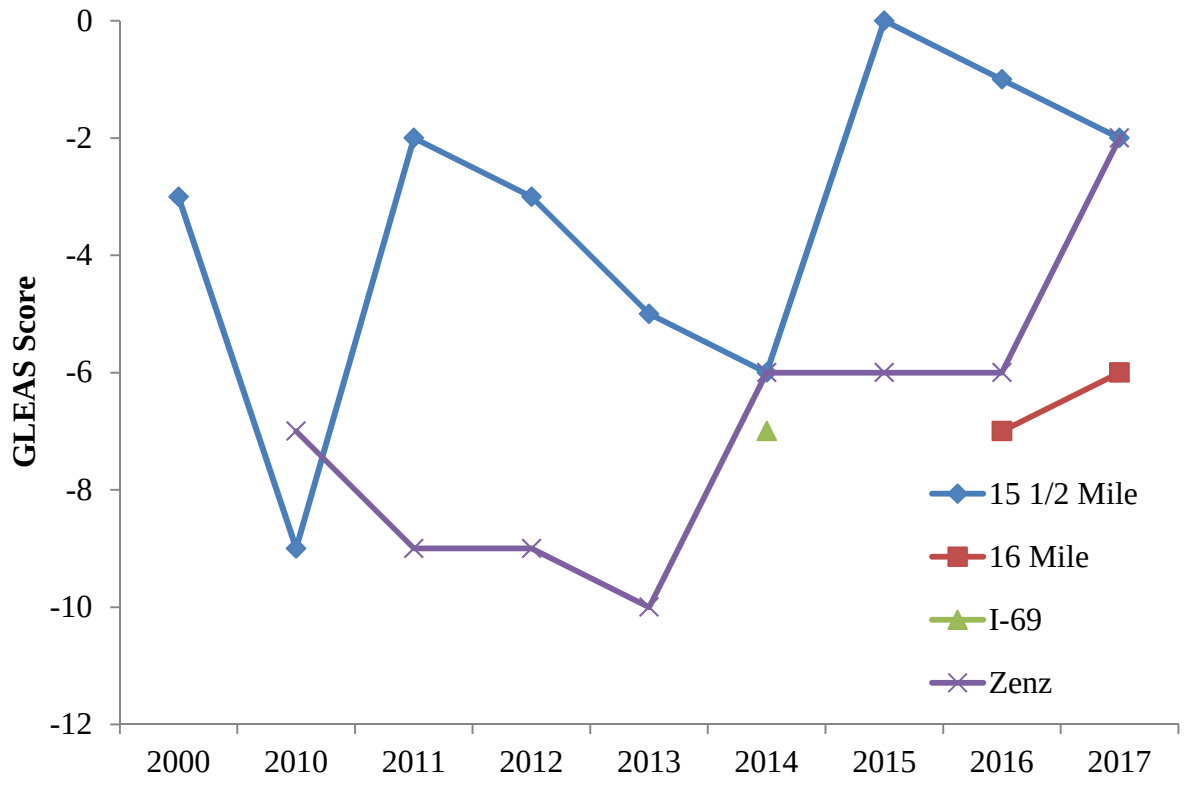

Figure 5. Fish community index scores calculated from the MDEQ GLEAS Procedure 51 for four sites surveyed with backpack electrofishing gear on Talmadge Creek during 2000 through 2017. Fish communities that score from -4 to +4 are considered neutral and scores < -4 are considered poor.