Bear Creek

Manistee County
Manistee River Watershed

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Environment

Bear Creek is a tributary to the Manistee River in Manistee County, Michigan, near the villages of Copemish, Brethren, and Kaleva (Fig. 1). The Bear Creek watershed encompasses approximately 130,800 acres (Anonymous 2013). Nearly the entire watershed lies in Manistee County, except for two small areas in southern Benzie County and one small area in western Wexford County. Bear Creek is formed as First Creek and Second Creek combine just south of Copemish (Fig. 2). It is quickly joined by Third and Dutchman's Creeks. From there, it flows west for approximately 8 miles before turning south. After flowing south for about 15 miles, it again turns west for its final 4 miles or so before joining the Manistee River. The reach of Bear Creek from the Third Creek confluence down to Nine Mile Road is considered a "Blue Ribbon Trout Stream" by the Michigan Department of Natural Resources (MDNR). Because it joins the Manistee River below Tippy Dam, Bear Creek is open to migratory fish species from Lake Michigan. Bear Creek has one small lowhead dam on it, located at the Spirit of the Woods Conservation Club near Coates Highway. The dam does not impede fish passage for most species. Therefore, migratory fish from Lake Michigan, including sea lamprey, have unimpeded access to most of the Bear Creek watershed.

The Bear Creek watershed has many named and unnamed tributaries (Fig. 2). In addition to First, Second, Third, and Dutchman's Creeks, the primary named tributaries include Lemon, Little Bear, Halls, Horseshoe, Beaver, Little Beaver, Cedar, Podunk, and Boswell Creeks. Most of these streams are coldwater streams that support self-sustaining populations of brook trout and/or brown trout, in addition to migratory steelhead, coho salmon, and Chinook salmon.

There are also a number of lakes within the Bear Creek watershed (Fig. 3). The largest of these is Bear Lake (Fig. 1), a 1,744 acre lake in the northwestern part of the watershed. The Village of Bear Lake is located on its shores. Little Bear Creek flows out of Bear Lake and joins Bear Creek near 13 Mile Road. Bear Lake is regularly stocked with walleye by MDNR and also supports popular fisheries for other species including bluegill, black crappie, largemouth bass, smallmouth bass, and northern pike (Tonello 2000, Seites 2009, Tonello 2010). The other inland lakes in the Bear Creek watershed are all smaller than 50 acres, and include Healy Lake, Lemon Lake, Lake Salma, James Lake, Dickson Lake, and Lake Eleanor.

The highest elevations found in the Bear Creek watershed are glacial moraines near the origins of First and Second Creeks, at approximately 900 feet. Downstream from the point where First and Second Creeks join, Bear Creek drops approximately 175 feet over its 27 miles, for an average gradient of 6.5 feet per mile. This gradient is average for the Manistee River watershed. While the Pine River gradient is much higher at 15 feet per mile, other reaches of the Manistee River have lower gradient (Rozich 1998). Also, according to Rozich (1998), Bear Creek has an average discharge of about 140 cubic feet per second (cfs) near the Village of Brethren (Figure 1).

The landscape that forms the Bear Creek watershed is a mix of agricultural forest (45%), wetland (18%), land (15%), grassland (14%), developed land (6%), and open water (2%; Anonymous 2013). The forests in the Bear Creek watershed are typically a mix of northern hardwoods and conifers. The westward flowing reach near Copemish is very swampy, and primarily flows through state forest land. After Bear Creek turns south, it enters a long stretch of private land consisting of mixed forest and farmland. The lower, westward flowing reach of Bear Creek is very low-gradient, and flows through forested wetlands that are part of the Manistee National Forest, which is administered by the United States Forest Service (USFS). This 6.5 mile reach is designated as a "National Scenic River" under the federal Wild and Scenic Rivers Act. Soils in the watershed tend to be of glacial origin and are typically well-drained and permeable (Anonymous 2013). Oil and gas development is prevalent in the Bear Creek watershed, including numerous oil and natural gas wells, pipelines, and associated infrastructure.

Bear Creek and its tributaries are Designated Trout Streams (Fisheries Order 210). Bear Creek is classified as a top quality trout mainstream, while its tributaries are top quality trout feeder streams (Anonymous 2000). From 13 Mile Road downstream, Bear Creek is regulated as a Type 3 trout stream, which means it can be fished year-round. Minimum size limits are 15 inches for brook and brown trout, and 10 inches for rainbow trout or salmon. All tributaries and Bear Creek upstream from 13 Mile Road are regulated as Type 1 trout streams, which means that they can be fished from the last Saturday in April through September 30. The minimum size limits are 7 inches for brook trout, 8 inches for brown trout, and 10 inches for rainbow trout. For either the Type 3 or Type 1 portions of the watershed, a total of five trout can be kept per day, with no more than three fish over 15 inches.

Public access is poor for much of the Bear Creek watershed, particularly in the prime steelhead and salmon fishing areas downstream from 13 Mile Road. Except for road/stream crossings, there are few places where anglers can legally access the prime middle reaches of Bear Creek. One is a 20-acre parcel of state land on Nine Mile Road, and the other is the 43-acre Spirit of the Woods Conservation Club property. The club allows the public to park and fish on its grounds. Some private landowners do allow the public to park on their land and access the river for a fee. While public access in the prime middle reaches of Bear Creek is poor, there is good access on state forest land in the upper reaches of the watershed, and on USFS land in the lower reaches of the watershed.

History

Although there are few records of the original fish community of Bear Creek, the Arctic grayling was likely the only native salmonid inhabitant of the river. It was likely sometime in the 1880s or early 1890s that the Arctic grayling was extirpated from Bear Creek. No one knows exactly when or why they disappeared, but it was likely from competition with introduced brook, brown, and rainbow trout (steelhead), although overharvest and habitat degradation from Bear Creek log drives also may have played a part. By 1900 or shortly thereafter, arctic grayling were extirpated from all streams in the lower peninsula of Michigan (Vincent 1962).

The first recorded fish stocking on Bear Creek occurred in 1894 when brook trout were stocked (Table 1), likely by the Michigan Fish Commission. Rainbow trout were first recorded as stocked into Bear Creek in 1897. Brook and rainbow trout were then regularly stocked by the Michigan Department of Conservation (MDOC; the precursor to today's MDNR) throughout much of the early and mid-1900s.

Brown trout were first recorded as stocked into Bear Creek in 1928 as part of a trout movement study (Metzelaar 1929), although they were likely already present in the watershed by then. Many tributaries to Bear Creek were regularly stocked with trout from the 1930s through the 1950s. Little Bear Creek in particular was heavily stocked (MDNR file data).

In 1931, MDOC constructed the Bear Creek Trout Rearing Station on Bear Creek. It was located approximately 1½ miles upstream of Thirteen Mile Road (Fig 1). The rearing station was constructed on property that was leased to MDOC from the Arcadia Country Club. All but four acres were eventually sold to the Department. In the early 1960s, budget cuts forced the Department to abandon the rearing station. For several years after, the rearing station was co-operatively managed by the Manistee River Association (MRA). The MDOC provided spring fingerlings which MRA personnel reared to the fall fingerling stage. In the fall, MDOC stocking trucks returned to stock the fish out. After several years of this agreement, the rearing station was once again abandoned.

In 1940, a weir was installed on the mainstem of Bear Creek at the Spirit of the Woods property (MacGregor 1964). For several decades, the weir would be put into place late in the spring steelhead run, to keep the adult steelhead from migrating downstream to Lake Michigan. The purpose of this was to allow anglers extra opportunity to harvest the large rainbow trout (Hazzard 1950). In the early 1960s, the MDOC received complaints regarding this practice, as anglers realized that if the steelhead were allowed to return to Lake Michigan, they would run again in subsequent years. Also, some anglers protested that the weir blocked upstream sucker migrations on Bear Creek. The weir washed out in a flood in the summer of 1963 and was never reconstructed (although the remnants can still be seen on Spirit of the Woods property).

Bear Creek was among the first streams in the state to be stocked with coho salmon in 1966, when 297,000 were stocked (Table 1). An additional 47,020 coho salmon were stocked into Second Creek, and 50,740 were stocked into Third Creek, for a total of 394,760 coho salmon stocked into the Bear Creek watershed in 1966. Nearly 750,000 coho salmon were stocked into the Bear Creek watershed in 1967. Although no further coho salmon stockings occurred, natural reproduction quickly took hold and the species has been self-sustaining in the watershed ever since. Although Chinook salmon were never stocked in Bear Creek, they strayed into Bear Creek from the Manistee River and also established a self-sustaining population.

By the mid-1970s, illegal salmon harvest on Bear Creek (and other streams around the state) had become rampant. Snagging, spearing, and over-limit catches, as well as trespassing, littering, and streambank erosion caused by overwhelming numbers of anglers had become common. In an attempt to curb the illegal activities and protect Bear Creek, MDNR installed a blocking weir on lower Bear Creek to keep the salmon from migrating into the majority of the watershed. Even before it was constructed, it was extremely controversial, with some folks supporting the weir while others were ardently opposed. According to Ylkanen (1978), the weir was successful in blocking the majority of the fall run in 1977. Thus the previously-experienced upstream problems were solved for that year. However, Ylkanen also reported heavy illegal harvest (snagging) below the weir. The weir was again successfully operated in 1978 (Hay 1979), but snagging remained a problem below the weir, particularly at night. Due to the controversial nature of the project and the issue of having to oversee the weir 24 hours per day, the weir was not installed again after the fall of 1978.

As do many streams throughout the Great Lakes region, Bear Creek hosts a spawning population of sea lamprey. Sea lamprey are an exotic invasive parasitic fish that have the potential to do great harm to Great Lakes fish populations if they are not controlled. Sea lamprey are migratory, as they spawn in streams and spend the first several years of their life cycle as filter feeders living in the stream sediment. Then they migrate downstream to Lake Michigan and transform into the adult parasitic stage. Because of this, The United States Fish and Wildlife Service (USFWS) regularly treats Bear Creek with TFM (3-trifluoromethyl-4-nitrophenol), a chemical compound that selectively kills sea lamprey. Since 1964, Bear Creek has been treated with TFM 16 times; most recently in 2002, 2006, 2009, 2012, and 2013. While TFM is a selective compound that targets sea lamprey, there is still risk to other species. In the September 2002 TFM treatment of Bear Creek, a non-target fish kill occurred in which approximately 500 adult Chinook salmon were killed. Since that time, Bear Creek has been treated four times with no further non-target mortality.

From 1994-2014, a total of 20 exceptional fish caught from Bear Creek have been entered into the DNR Fisheries Division Master Angler program (Table 2). Five different species were represented, including brook trout, coho salmon, Chinook salmon, rainbow trout (steelhead), and redhorse. Of those, Chinook salmon are the most well-represented species, comprising 15 of the 20 entries.

Watershed Planning

The Bear Creek Watershed Council (BCWC) was founded in 1988, mostly by local riparian landowners, private citizens, and elected officials who were concerned about the future of Bear Creek. Since then, the BCWC has continuously provided guidance and leadership regarding many different Bear Creek issues, including road/stream crossing improvements, streambank inventories and erosion control projects, instream habitat improvement projects, dam removals, and management plan development. In 1993, the Bear Creek Partnership Agreement was drafted, with 15 organizations signing on: BCWC, USFS, MDNR, Michigan Department of Environmental Quality (MDEQ), Conservation Resource Alliance (CRA), Pleasanton Township, Manistee County Planning Commission, Arcadia Club, Spirit of the Woods Conservation Club, Manistee County Road Commission, Greater Manistee Fly Fishing Club, Bear Lake Township, Dickson Township, Maple Grove Township, and Marilla Township. It was these partners that helped create the first watershed management plan for Bear Creek. The watershed management plan was completed in 2000 (CRA 2000).

In 2009, another effort began when the Manistee County Community Foundation was awarded a large grant from the Environmental Protection Agency (EPA; Section 319 of the Clean Water Act) to develop a new comprehensive watershed management plan. The effort was completed in December 2013 when the plan was approved by MDEQ Surface Water Quality Division (Anonymous 2013). Prominent partners on the project included the Bear Creek Watershed Council, the Bear Lake Watershed Alliance, and the Bear Creek Property Owners Association, among many others. The development of the 2013 Bear Creek Watershed Management Plan was extremely inclusive, and involved numerous public meetings at which stakeholders were given an opportunity to comment and provide input. Goals and objectives outlined in the plan included water quality monitoring for Bear Creek and Bear Lake, protecting and improving habitat on Bear Creek and Bear Lake, and controlling the spread of invasive species within the watershed, among others.

Habitat Improvement

Habitat improvement has long been a topic of discussion regarding Bear Creek. The watershed was logged off in the late 19th and early 20th centuries. During that process, Bear Creek was used for log drives, resulting in major habitat damage. Since then, most habitat improvement efforts on Bear Creek were attempts to heal that damage, and also to simply make the stream more productive for salmonids. One of the earliest stream improvement efforts on Bear Creek occurred from 1947 to 1953, when stream improvement structures were installed. The efforts took place on the upper portion of Bear Creek, as well as some on Second Creek. Several types of structures were installed, including cover logs, wing deflectors, double wing deflectors, and "digger logs". In all, 1,245 different structures were installed within the watershed (MacGregor 1964).

Many other efforts took place over the years, mostly by MDOC (and later MDNR) personnel. Most of these efforts were implemented on the mainstem of Bear Creek, and included streambank stabilization (with rock rip rap, log terraces, vegetative plantings, etc.) and fish cover (including sod covers, artificial log jams, whole trees, etc.). There was even discussion regarding potential sand traps on Bear Creek, but none were ever constructed.

With the formation of the BCWC in 1988 and the Bear Creek Partnership in 1993, a shift in responsibility for habitat improvement on Bear Creek took place. The BCWC and the Partnership began to take ownership of Bear Creek issues, including habitat improvement. In 1995, the Northwest Michigan RC&D Council (renamed "Conservation Resource Alliance (CRA)" in the late 1990s) became involved, providing professional expertise, particularly with project management and implementation. In the 1990s, a number of eroding streambanks were repaired on both the mainstem of Bear Creek and on Beaver Creek as well. The Beaver Creek project took place over several years and included the installation of woody fish cover and vegetative plantings.

Stream improvement work has continued on Bear Creek since then. Although most major eroding streambanks on the mainstem have long been fixed, high water events in 2008 and 2014 have created new ones. Installing woody structure for fish cover has also been a focal point of efforts on Bear Creek in recent years. Although expensive, fixing poor road/stream crossings is critical, as they can be a major source of anthropogenic sand entry into the steam. The Milks Road crossing was replaced with a new timber bridge with paved approaches in 2006, alleviating major sedimentation concerns from the old crossing. Recent Bear Creek habitat projects have included woody cover installation projects at the Spirit of the Woods Conservation Club and in the vicinity of 9 Mile Road. The eroding streambank inventory for Bear Creek was most recently updated in 2008, and the road stream crossing inventory for the Bear Creek watershed was updated in 2014 (Chris Pierce, CRA; personal communication).

The largest dam in the Bear Creek watershed for many years was the Copemish Dam. The Copemish Dam impounded First Creek just downstream of the village of Copemish. When the dam was originally constructed is unknown, but Copemish Pond, the impoundment created by the dam, was a popular impoundment for fishing and swimming for many decades in the 1900s. The impoundment was even regularly stocked with brook and rainbow trout by the MDOC for many years. However, by the late 1980s, the dam had experienced a partial failure, with the majority of the impoundment being drained (Tonello 2013a). In 1998, the Copemish Village Council passed a resolution supporting removal of the dam. In 2000, all remaining dam boards and remnants of the stack were removed. In 2003, with assistance from the Bear Creek Watershed Council and CRA, the undersized culvert that

continued to impound water was removed and replaced with an adequately sized structure. This returned First Creek to a free-flowing state.

Public Access

One long-standing issue on Bear Creek is the lack of public access on the middle reaches of the stream, which provides the best fishing for salmon and steelhead. In an April 17, 1981 memo, MDNR Fisheries Biologist Ralph Hay identifies the area from Kerry Road upstream to County Road 600 (13 Mile Road; Fig. 1) as an area in need of additional public access. While it is legal to access Bear Creek from county road crossings, parking and safety are problematic. Conflicts between anglers and landowners have long been an issue on Bear Creek, particularly during the fall salmon run. The fall salmon run presents several different issues, the first of which is the sheer number of anglers who pursue the spawning salmon. In addition, fall salmon anglers on Bear Creek tend to be less-law abiding than summer trout anglers or spring steelhead anglers. Landowners report rampant snagging, spearing, trespassing, littering, destruction of property, etc. during the October salmon run. While Conservation Officers ardently patrol the river each fall, the issues have persisted for decades.

One of the few public access sites on the middle reaches of Bear Creek is provided by the Spirit of the Woods Conservation Club, located off Coates Highway. The Club owns 36 acres of land with over one mile of frontage on both sides of Bear Creek, from which it allows the public to park and access Bear Creek. In addition, the Club has several different hiking trails on the property, including one trail ("Mickey's Trail") that is ¼ mile in length and features universally accessible paved walkways, fishing decks, and resting benches along Bear Creek. Thus the Spirit of the Woods Conservation Club provides the only barrier-free accessible fishing opportunity on Bear Creek for those with mobility challenges.

In 2011, MDNR acquired a 19 acre parcel of land on Bear Creek just upstream of Nine Mile Road, on the east bank of the river. The parcel has 1,445 feet of frontage on Bear Creek and 520 feet of frontage on Beaver Creek. Also, nearly ½ of the parcel consists of coniferous forested wetlands. The parcel was primarily purchased to provide anglers and river recreationists with legal, safe access to Bear Creek. The secondary reason for purchasing the parcel was to protect the Bear Creek ecosystem, as well as the adjacent conifer swamp, which provides excellent habitat for a number of desirable wildlife species. To date, no development has occurred on the site, but there have been ongoing discussions with the Bear Creek Watershed Council about an appropriate development strategy for the site.

Fisheries, Biological, and Temperature Surveys

The first comprehensive fisheries survey of the Bear Creek watershed was conducted by MDOC in 1963 (MacGregor 1964). In the study, 10 different sites in the watershed were surveyed by electrofishing. Brook and brown trout were abundant high in the watershed, but only sparse numbers of trout were found at survey stations anywhere downstream of 13 Mile Road (Fig 1). Catches of non-trout species were also recorded (Table 3). MacGregor (1964) commented that "the trout population in Bear Creek does not compare favorably with that found in other well-known Michigan streams". He attributed this to marginal summer temperatures, inadequate cover, and lack of reproduction. He recommended stabilizing eroding streambanks, planting trees along the stream to provide shade and reduce erosion, installing instream habitat structures to provide cover and channel diversity, and stabilizing eroding road ditches.

Most Bear Creek tributaries were surveyed by MDOC via backpack electrofishing during the summer of 1966 (MDNR files, Cadillac). These surveys were conducted as part of a state-wide effort to determine which streams held trout and which did not. The 1966 surveys led to what is known today as Fisheries Order 210, which lists all of the Designated Trout Streams of Michigan. Since coldwater streams capable of supporting trout are a nationally rare resource, such streams are often afforded extra environmental protection.

Another MDOC fisheries survey of Bear Creek was conducted in the summer of 1968 (Bullen 1968), this one to determine the extent of natural reproduction of coho salmon from the 1967 fall run. Since the coho salmon were first stocked in 1966, the first full adult run took place in the fall of 1967. In the survey, nine stations were surveyed by electrofishing (two on Second Creek, one on Beaver Creek, one on Cedar Creek, and five on the mainstem of Bear Creek itself). Coho salmon reproduction was documented at all sites except for the two lower sites on the Bear Creek mainstem. The heaviest concentrations of juvenile coho salmon were documented in Second Creek and the furthest upstream site on the Bear Creek mainstem. Non-trout species were also noted (Table 3).

The next MDNR fisheries survey of Bear Creek was conducted in 1983 (Hay 1983). In the 1983 survey, five sites were sampled by electrofishing. At the two upstream sites (Leffew Road and Bear Creek Rearing Station; Fig. 1), mark/recapture studies were conducted to provide population estimates for trout species. At the three downstream sites (13 Mile Road, 11 Mile Road, and Milks Road; Fig. 1) only one was pass was completed due to a general lack of trout abundance. At the Leffew Road and Bear Creek Rearing Station sites, excellent populations of brown, brook, and rainbow trout were observed (Tables 4 and 5). While juvenile salmon were observed at both of these stations, they were not counted or identified. For the Leffew Road station, MDNR Fisheries Biologist Ralph Hay noted that the reach had good spawning and rearing habitat. For the Rearing Station, he noted that the survey reach contained "very good spawning habitat and is an ideal nursery area for small fish. Approximately 70% of the station is gravel".

At the other three stations, the salmonid populations and habitat were not nearly as abundant (Hay 1983). At the 13 Mile Road station, only two brown trout, one brook trout, and one rainbow trout were caught. Hay noted that the water velocity was slow and the habitat poor. At the 11 Mile Road station, the trout catch consisted of four brown trout and five rainbow trout. Again, the habitat was rated poor, with most of the stream bottom being sand, and the pools shallow and sandy. The Milks Road station produced two brown trout and 41 rainbow trout. Hay noted some good gravel riffles here, but saw little cover for growing larger fish. The 11 Mile and 13 Mile Road stations each produced a few juvenile salmon, but they were not measured or counted. Non-trout species were also documented in the 1983 surveys (Table 3).

In July of 1992, Surface Water Quality Division (then with MDNR, currently with the Michigan Department of Environmental Quality (MDEQ)) personnel conducted a fisheries, invertebrate, habitat, and water quality survey of three stations in the Bear Creek watershed (Walker 1999). The three stations included one on First Creek just below the Copemish Dam site, and two stations on downstream reaches of Bear Creek at Kerry Road and Coates Highway (Fig. 1). Brown trout were captured at all three sites, and rainbow trout were captured at the two Bear Creek stations; thus all three sites were meeting their coldwater stream designation. The macroinvertebrate community was rated as "acceptable" at all three sites. Habitat was rated as "excellent" at the First Creek station and

"good" at the Coates Highway station; but only "fair" at the Kerry Road station. The Kerry Road station rating was lower due to a wide, open channel and excessive sand with little depth or channel diversity present. The water chemistry data collected at all three stations was within normal, acceptable ranges. Non-trout species were also documented (Table 3).

Two sites on Bear Creek were surveyed by MDNR by electrofishing in the summer of 1997. As in 1983, a mark/recapture study was conducted at the Leffew Road station. At the Leffew Road station, the population estimates for brown trout and brook trout were relatively similar to those from 1983, while the steelhead population estimate was much higher (Table 5). The only other station surveyed in 1997 was 13 Mile Road. At that site, only one pass was conducted due to a general lack of salmonids (as was the case in 1983). Salmon were again noted but not identified or counted. At the 13 Mile Road station the 1997 salmonid catch consisted of one brook trout, six brown trout, and 15 rainbow trout, plus a few unidentified juvenile salmon. Non-trout species were noted (Table 3).

As part of a landmark study of steelhead in the Manistee River below Tippy Dam, Woldt (1998) also conducted several surveys on Bear Creek for the sake of comparison. In the Bear Creek portion of the study, three sites were surveyed in August and October of 1997. While Woldt found fall juvenile steelhead densities on the Manistee River to be very low, those of Bear Creek were much higher, more in line with those found in the Little Manistee River or Pine Creek (another tributary to the Manistee River below Tippy Dam). Woldt attributed the high mortality of juvenile steelhead on the Manistee River to the temperature regime dictated by Tippy Dam, which typically includes high summer temperatures with little diurnal cooling. Conversely, he attributed the higher densities of juvenile steelhead in the Little Manistee River, Bear Creek, and Pine Creek to the cooler summer temperature regimes of those streams.

Another MDEQ Surface Water Quality Division survey of the Bear Creek watershed was conducted in 1999 (Walker 2004). This time, MDEQ only surveyed one site on Bear Creek (although they did survey sites on the following tributaries: Second Creek, Lemon Creek, Little Bear Creek, Little Beaver Creek, Cedar Creek, Podunk Creek, and Boswell Creek). The Bear Creek station was at Kerry Road. Although no fisheries survey was conducted in 1999, another habitat evaluation was conducted, similar to that conducted in the 1992 survey (Walker 1999). While the habitat had been rated as "poor" in 1992, in 1999 it had improved to "good". Walker (2004) reported that sand in the station was greatly reduced, resulting in more exposed gravel. More woody debris was present, and there was also more depth and channel diversity.

In July of 2001, another MDNR fisheries survey was conducted on Bear Creek, with the goal of collecting trout to be sacrificed and tested for Whirling Disease. Two sites were sampled. The first site was at 11 Mile Road, but not enough trout were captured for Whirling Disease testing. In approximately 150 yards of sampling, only five trout were captured- two brown trout, two brook trout, and one rainbow trout. Other species observed included bluegill, green sunfish, white sucker, blacknose dace, bluntnose minnow, fathead minnow, creek chub, and sculpin (Table 3). The second site was at Coates Highway on the Spirit of the Woods Conservation Club property. Here we captured and sacrificed 19 brown trout from 4 to 8 inches and 11 rainbow trout from 5 to 8 inches. We observed but did not capture a number of brown trout from 9 to 20 inches in length. Other species observed included juvenile coho salmon, bluegill, sculpin, blacknose dace, longnose dace, alewife, burbot, white

sucker, redhorse, and rock bass (Table 3). Subsequent testing on the sacrificed trout did not find any evidence of Whirling Disease.

Beginning in 2005, the Leffew Road station was adopted as a Fixed Site in the Fisheries Division's Stream Status and Trends Program (Tonello 2014). Per the protocol of the program (Wills et al. 2011), the station is to be sampled for three consecutive years, and then not sampled for three consecutive years. In the first year of the cycle, habitat evaluation data should also be collected. Temperature data should be recorded in as many years of the cycle as possible, with the use of a continuous recording thermometer. This station was sampled by electrofishing in 2005-2007, and 2011-2013, in addition to the surveys previously conducted in 1983 and 1997 (Table 5). Habitat evaluation data were collected in July 2006 and July 2011 (Table 6). Temperature data for the station were recorded from August 2005 through May of 2007 and then again from June 2011 through August 2013 (Table 7). Also, non-trout species were collected and counted during the marking run in 2005 (Table 3). Age and growth data for trout and juvenile salmon were obtained through scale aging (Tables 8 and 9).

In 2008, MDNR established a new index station on Bear Creek at the Spirit of the Woods Conservation Club (Tonello 2008). Although not an official Status and Trends site, Status and Trends protocols (Wills et al. 2011) were used in establishing the station. A mark/recapture electrofishing survey was conducted on July 23 and 24, 2008. The survey reach is 1,200 feet in length and covers an area of 1.45 acres. In the survey, population estimates for salmonids were established (Table 10). Other species were captured and counted for the first half of the station (Table 3). Age and growth data for trout and juvenile salmon were obtained through scale aging (Table 11). Also in 2008, MDNR collected summer temperature data at four sites in the watershed (Table 12). While the Spirit of the Woods site was not among the sites where temperature data were collected by MDNR in 2008, the Little River Band of Ottawa Indians (LRBOI) collected June and July data from that site in 2007 (Table 12).

Habitat data were also collected at the Spirit of the Woods index station by MDNR in 2008 (Table 13) according to the Status and Trends protocol (Wills et al. 2011). The station averaged 52.6 feet wide, with an average depth of 1.7 feet and a maximum depth of 6.3 feet. Discharge was 160.7 cubic feet per second. The majority of the reach was run (61.5%), with 23.1% riffle and 15.4% pool. Hard substrates of gravel, small cobble, and large cobble dominated the station, although sand was also present. A total of 1,916 square feet of woody cover was measured, along with 864 feet of linear wood. The habitat evaluation data from the Spirit of the Woods station were comparable to other northern Michigan trout streams (Table 13).

Current Status

The most recent MDNR fisheries survey of Bear Creek was conducted on September 16 and 18, 2014, at the Spirit of the Woods index station. As in 2008, population estimates were established for trout and salmon (Table 10). The results of the 2014 survey were quite similar to those from 2008. Brown trout from 2 to 19 inches were caught, as were rainbow trout from 1 to 13 inches. Juvenile Chinook salmon were relatively abundant, and juvenile coho salmon were present but not abundant. Although one brook trout was caught in the 2008 Spirit of the Woods survey, none were caught in 2014. Several adult Chinook and coho salmon were caught during the survey but not included in the population estimates for those respective species. Non-salmonid species were captured and counted during the

marking run (Table 3). Two species that had not been previously observed in Bear Creek were present and relatively abundant: round goby and spotfin shiner. Age and growth for juvenile trout and salmon was obtained through scale aging (Table 11).

Analysis and Discussion

As a self-sustaining trout, salmon, and steelhead stream, Bear Creek is a rare and valuable resource. Bear Creek is extremely popular for fishing, particularly in the fall for salmon and in the spring for steelhead. Bear Creek also sees some pressure from resident brown and brook trout anglers, particularly in its upper reaches. The 2014 MDNR fisheries survey revealed that the Spirit of the Woods reach of Bear Creek continues to support self-sustaining populations of brown trout, steelhead, coho salmon, and Chinook salmon. Age and growth for trout and juvenile salmon from Bear Creek is slightly better than state averages compiled from other Michigan streams (Tables 9 and 11).

However, the 1964 observations of MDOC Fisheries Biologist John MacGregor that "the trout population in Bear Creek does not compare favorably with that found in other well-known Michigan streams" still hold true today. Salmonid densities (particularly for brown trout) in the Spirit of the Woods area of Bear Creek are much lower than those of other streams in the northwest lower peninsula of Michigan, including the Little Manistee and Pere Marquette River (Table 14). The reason for this is somewhat unclear. While it may be temperature related, water temperatures in the Spirit of the Woods reach of Bear Creek seem to be within the acceptable range for salmonids (Tonello 2008). Another potential explanation may be habitat availability. Anecdotally, the station appears to be overly wide and shallow, with a lack of depth, channel diversity, and overhead cover. However, when habitat data from the station are compared to that from other more productive salmonid streams like the Pere Marquette and Little Manistee (Table 10), the Bear Creek habitat is similar to those other streams. Bear Creek even has more depth and more channel diversity than the other streams. Woody cover is present, as is a good amount of hard substrate (gravel and cobble).

One other possible explanation for the lower salmonid abundances in the lower reaches of Bear Creek could be the flashiness of the stream. Streams with stable flows tend to have more healthy salmonid populations than those whose levels fluctuate greatly. Bear Creek is known to rise rapidly and become turbid after rain events, unlike other area salmonid streams. Unfortunately, Bear Creek lacks a streamflow gauge, so the true extent of the flashiness is unknown.

Another curious fact of Bear Creek is the prevalence of brook trout at the Leffew Road station (Table 5). In many other Michigan streams with migratory salmon and steelhead, brook trout are relegated to tiny headwater tributaries with very cold water temperatures. However, in the Leffew Road area of Bear Creek, this is not the case. Despite the presence (and sometimes large abundance) of four other salmonid species (brown trout, rainbow trout, coho salmon, and Chinook salmon), brook trout remain abundant and appear to be thriving. Although they are within the range that allows for salmonids to thrive, July average water temperatures in the Leffew Road reach are not particularly cold (Table 7). Woldt (1998) measured a high rate of daily temperature flux in that area of Bear Creek that was brought about by diurnal cooling. He believed that the diurnal cooling was what allowed Bear Creek steelhead to survive in Bear Creek when they could not in the Manistee River below Tippy Dam.

Public access remains an issue on Bear Creek, particularly in the prime salmon/steelhead fishing reach between 13 Mile Road and Coates Highway. With the exception of road/stream crossings, only the 9

Mile Road parcel that was purchased by MDNR in 2011 allows access. This limited amount of access continues to lead to conflict between anglers and private landowners.

Management Direction

In general, the Bear Creek watershed is relatively intact and healthy. It hosts self-sustaining populations of five different salmonid species and is a very popular fishery. The primary reason that Bear Creek remains a high-quality cold-water stream is a lack of intensive human development adjacent to it and its tributaries. Much of the watershed is in a forested, undeveloped state. Therefore, the primary goal for the Bear Creek watershed should be protection. For the stream reaches in the Pere Marquette and Manistee National Forests, protection should come in the form of timber harvest practices that are considerate of Bear Creek and its tributaries. On the privately-owned reaches of Bear Creek, landowners are encouraged to develop and manage their land in ways that are respectful of Bear Creek and its tributaries. The riparian land/water interface is critical habitat that should remain as natural as possible. With many wetlands in the Bear Creek watershed lost over the years, any remaining wetlands should be protected. Wetlands are critical to the continued health of the watershed. Future riparian development and wetland loss may result in deterioration of the water quality and aquatic habitat. In particular, wetland loss and increasing impervious surfaces in the watershed could lead to more surface runoff, resulting in increased flashiness, increased summer water temperatures, and potentially make the watershed inhospitable for salmonids.

Bear Creek should continue to be managed as a self-sustaining fishery for steelhead, Chinook salmon, coho salmon, brown trout, and brook trout. Bear Creek has not been stocked in many years and that should remain the case. Although the fish populations of Bear Creek have been studied to some degree by MDNR Fisheries Division and others, many questions remain. Future studies should revolve around determining the number of Chinook salmon, coho salmon, and steelhead smolts being produced in Bear Creek. Smolt production contributes to fisheries on Lake Michigan, Manistee Lake, the Manistee River, and Bear Creek itself. These fisheries are important component to Michigan's resource based economy. Enumerating returning adult salmon and steelhead would also provide valuable insight for fisheries managers.

There are several other prominent fisheries management questions related to Bear Creek as well. One is the success of brook trout in the upper watershed despite competition from four other salmonid species. Another is the low salmonid densities present in Bear Creek downstream from 13 Mile Road, despite temperature and habitat data that suggest otherwise. Answering these questions would provide valuable information that might benefit fisheries managers all over Michigan and possibly elsewhere. Establishing a streamflow gauge and flow duration curve for Bear Creek might also be helpful in explaining fisheries issues on Bear Creek.

Although recent surveys have been conducted on First, Second, Dutchman's, and Third Creeks (Tonello 2013a, Tonello 2013b, Tonello 2013c, Tonello 2014b), most other Bear Creek tributaries have not been surveyed by MDNR since 1966. Therefore, backpack electrofishing fisheries surveys should be conducted on all tributaries throughout the watershed. Updated knowledge of the fish communities found in the tributaries will help create a better understanding of the fisheries potential of the Bear Creek watershed.

The Leffew Road index station on Bear Creek should continue to be surveyed on a three year rotation per Status & Trends Fixed Stream protocol (Wills et al. 2011). Salmonid population estimates, habitat, temperature, and non-game fish data should be collected according to the protocol. The Spirit of the Woods index station should be surveyed as frequently as time and personnel issues allow, with population estimates established each time. Also, habitat, temperature, and non-game fish data should be collected each time the station is surveyed.

Although it is well-known that Bear Creek receives heavy fishing pressure at certain times of the year, no creel surveys have ever been done on it. Conducting a creel survey to determine the amount of angling pressure Bear Creek receives would provide information that could be used to determine the economic and socioeconomic value of the Bear Creek fishery. Also, angler catch data would provide insight as to favored species targeted by anglers as well as spatial information as to the most heavily fished reaches of Bear Creek. A creel survey would likely require two clerks- one to float different reaches of Bear Creek in a kayak and the other to spot the vehicle and interview anglers at access points.

Habitat improvement work should continue on Bear Creek. The Bear Creek Partnership should continue to stabilize eroding streambanks, install woody fish cover, and fix poor road/stream crossings as funding becomes available. The Greater Bear Watershed Management Plan should assist with prioritization, as will the CRA streambank and road/stream crossing inventories.

Public access continues to be lacking on Bear Creek, particularly between 13 Mile Road and Coates Highway, which is the most popular reach for salmon and steelhead fishing. While legal access to Bear Creek can be gained from county road crossings, it is neither convenient nor safe for anglers (or motorists on those roads). Therefore efforts to acquire parcels for public access should continue. To keep in character with the surrounding landscape, development at future public access sites on Bear Creek need not be high profile. Providing anglers with convenient and legal access to the stream, a place to safely park, and possibly restroom facilities should be the goal. Potential owners of access parcels could include MDNR, Manistee County, or any of the townships associated with Bear Creek. Manistee County's "Explore the Shores" program might also be helpful in facilitating angler access to Bear Creek.

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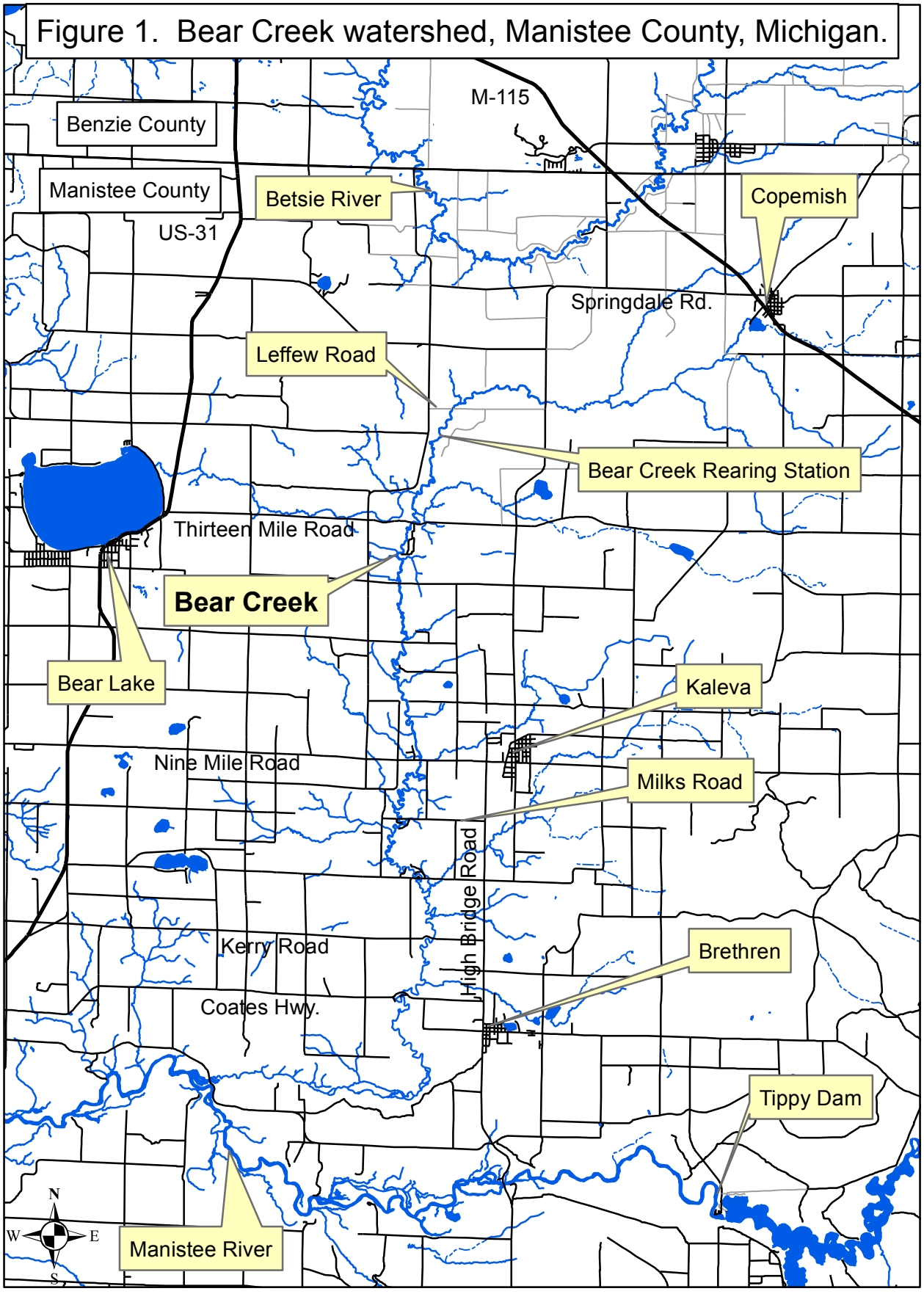
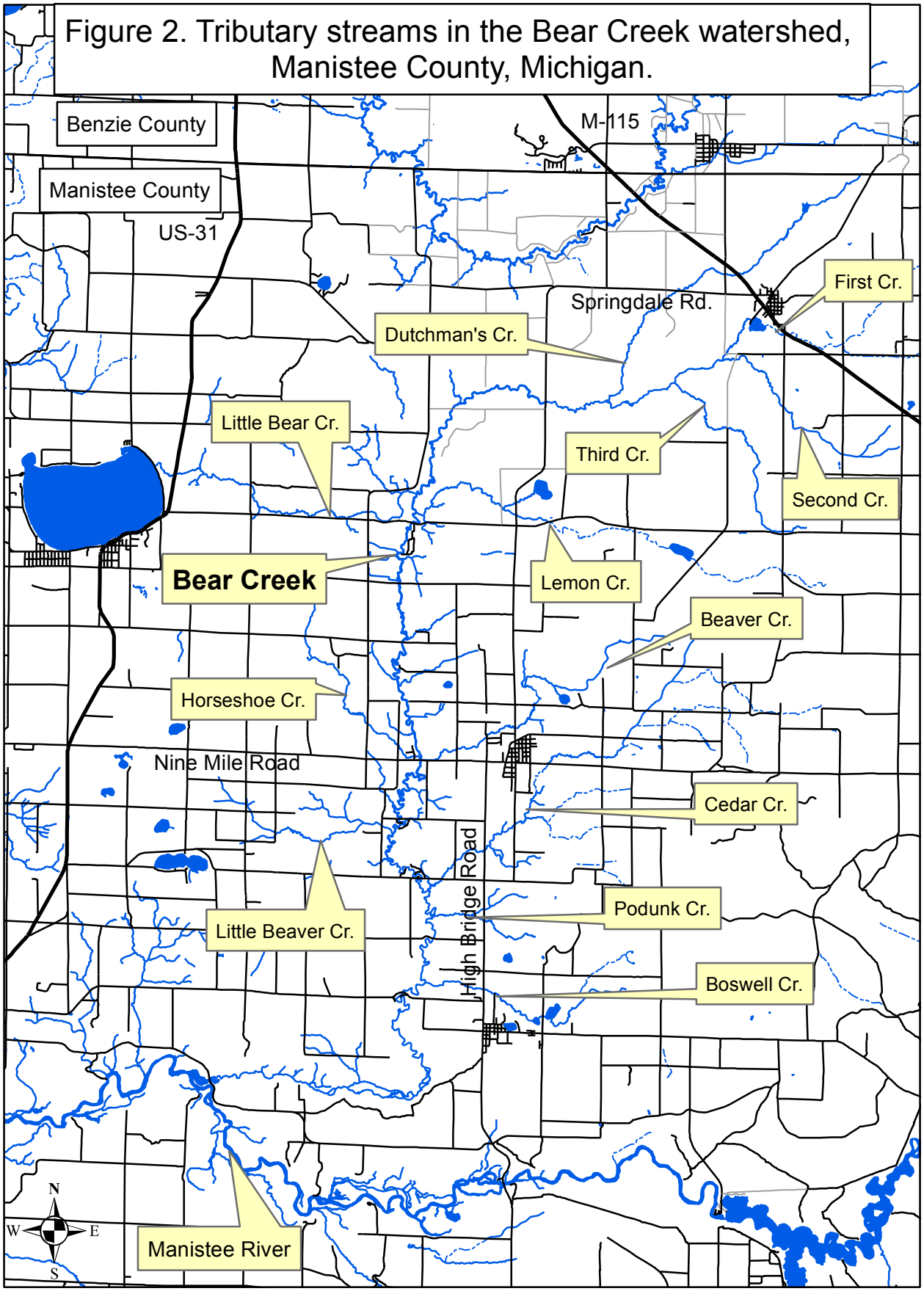


Figure 1. Bear Creek watershed, Manistee County, Michigan.
M-115
Benzie County
Manistee County
Betsie River
Copemish
US-31
Springdale Rd.
Leffew Road
Bear Creek Rearing Station
Thirteen Mile Road
Bear Creek
Bear Lake
Kaleva
Nine Mile Road
Milks Road
High Bridge Road
Kerry Road
Brethren
Coates Hwy.
Tippy Dam
Manistee River
N
W
E
S

Figure 2. Tributary streams in the Bear Creek watershed, Manistee County, Michigan.



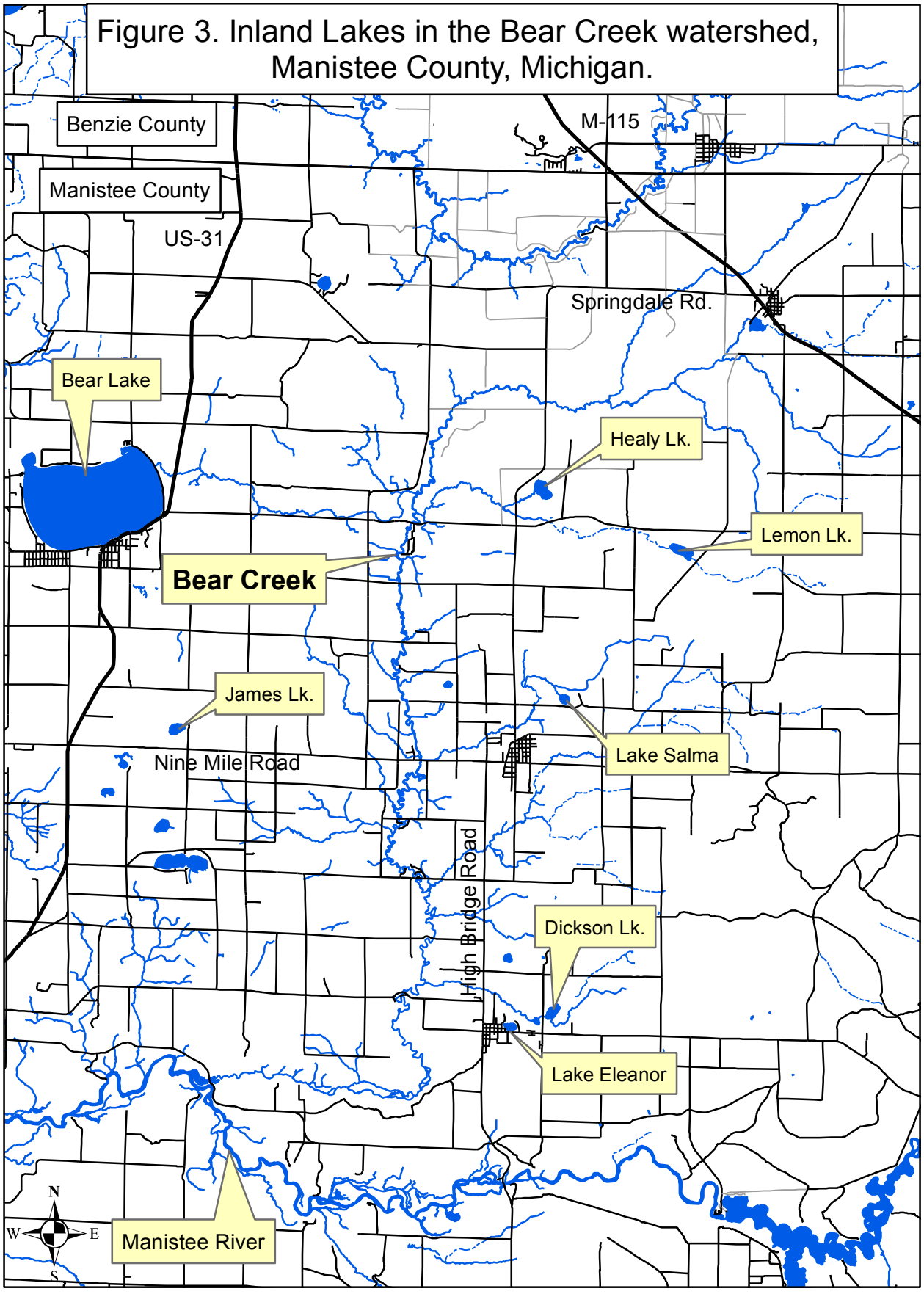


Figure 3. Inland Lakes in the Bear Creek watershed, Manistee County, Michigan.
Benzie County
Manistee County
M-115
US-31
Springdale Rd.
Bear Lake
Healy Lk.
Lemon Lk.
Bear Creek
James Lk.
Lake Salma
Nine Mile Road
High Bridge Road
Dickson Lk.
Lake Eleanor
Manistee River
N
W
E
S

Table 1. Fish stocked in Bear Creek, Manistee County.

Year	Species	Number	Life stage	Strain
1894	Brook trout	5,000	none indicated	
1895	Brook trout	3,000	none indicated	
1897	Rainbow trout	5,000	none indicated	
1905	Brook trout	20,000	fry	
1909	Brook trout	22,500	fry	
1910	Brook trout	20,000	fry	
1928	Brook trout	172	yearlings; adults	
	Brown trout	99	yearlings, adults	
1933	Brook trout	87,000	6-8 mo.	
	Rainbow trout	30,000	6-8 mo.	
1934	Brook trout	24,000	5 mo.	
	Rainbow trout	46,000	2-8 mo.	
1935	Brook trout	25,000	7 mo.	
	Rainbow trout	46,000	3-7 mo.	
1936	Brook trout	7,500	8 mo.	
	Rainbow trout	53,000	fry; 5 mo.	
1937	Brook trout	35,000	8 mo.	
	Rainbow trout	70,500	5 mo.	
1938	Brown trout	16,000	9 mo.	
	Rainbow trout	42,000	6 mo.	
1939	Brook trout	5,500	10 mo.	
	Rainbow trout	3,000	yearlings	
1940	Brook trout	8,200	7 mo.-yearlings	
	Rainbow trout	19,500	7 mo.-yearlings	
1941	Brook trout	6,400	yearlings	
	Rainbow trout	16,217	8 mo.-yearlings	
1942	Brook trout	3,075	yearlings	
	Rainbow trout	13,650	7 mo.-adults	
1943	Brook trout	5,000	yearlings	
	Rainbow trout	1,208	adults	
1944	Brook trout	1,200	yearlings, adults	
	Rainbow trout	2,577	adults	
1945	Brook trout	4,050	adults	
	Rainbow trout	5,000	18-19 mo.	
1946	Brook trout	1,350	adults	
	Rainbow trout	3,100	adults	
1947	Brook trout	450	adults	
	Brown trout	4,000	adults	
	Rainbow trout	1,040	yearlings, adults	

Table 1 continued. Fish stocked in Bear Creek, Manistee County.

Year	Species	Number	Life stage	Strain
1948	Brook trout	800	legal	
	Brown trout	3,600	legal	
	Rainbow trout	100	adults	
1949	Brook trout	350	legal	
	Brown trout	9,500	legal	
	Rainbow trout	42	legal	
1950	Brook trout	2,600	legal	
	Brown trout	3,800	legal	
	Rainbow trout	48	legal	
1951	Brook trout	2,750	legal	
	Brown trout	7,250	legal	
	Rainbow trout	33	legal	
1952	Brook trout	1,650	legal	
	Brown trout	6,900	legal	
	Rainbow trout	1,000	legal	
1953	Brown trout	2,400	legal	
	Rainbow trout	2,400	legal	
1954	Brook trout	1,700	legal	
	Rainbow trout	7,100	legal	
1955	Rainbow trout	14,300	legal	
1956	Rainbow trout	22,500	legal	
1957	Rainbow trout	10,500	legal	
1958	Rainbow trout	7,650	legal	
1959	Rainbow trout	9,800	legal	
1960	Rainbow trout	5,400	legal	
1961	Rainbow trout	2,400	legal	
1962	Rainbow trout	2,400	legal	
1963	Brook trout	1,045	legal	
	Rainbow trout	1,600	legal	
1965	Rainbow trout	400	legal	
1966	Coho salmon	297,000	yearlings	
1967	Coho salmon	749,983	yearlings	
1970	Rainbow trout	7,200	yearlings	
1971	Rainbow trout	7,108	yearlings	
1975	Rainbow trout	5,000	fall fingerlings	
1976	Steelhead	33,600	yearlings	

Table 2. Michigan DNR Master Angler awards issued for fish caught from Bear Creek, Manistee County, 1994-2014.

Species	Number of Master Angler awards issued
Brook trout	1
Chinook salmon	15
Coho salmon	1
Rainbow trout	2
Redhorse	1
Total:	20

Table 3. Presence/absence of fish species in historical fisheries surveys at various locations on the mainstem of Bear Creek.

Species	1963	1968	1983	1992 (DEQ)	1997	2001	2005	2008	2014
Alewife						x			
Blacknose dace	x	x	x	x	x	x	x	x	x
Blacksided darter				x					
Bluegill	x			x		x		x	x
Bluntnose minnow						x			
Brook stickleback	x				x				
Brook trout	x	x	x		x	x	x	x	
Brown trout	x	x	x	x	x	x	x	x	x
Burbot	x	x	x	x		x		x	x
Central mudminnow	x				x			x	
Chinook salmon			x		x		x	x	x
Coho salmon		x				x	x	x	x
Common shiner	x	x			x			x	
Creek chub	x	x	x	x	x	x	x	x	x
Fathead minnow						x			
Golden shiner	x								
Green sunfish	x				x	x		x	
Johnny darter	x	x	x	x	x		x	x	x
Longnose dace		x		x		x		x	x
Mottled sculpin		x	x	x	x	x	x	x	x
Slimy sculpin	x								
Northern redbelly dace							x		
Pumpkinseed sunfish				x				x	
Rainbow trout	x	x	x	x	x	x	x	x	x
Rock bass						x			x
Round goby									x
Golden redhorse				x					
Shorthead redhorse				x				x	
Redhorse spp.						x			
Spotfin shiner									x
White sucker	x	x	x	x	x	x	x		x

Table 4. Fish population estimates for Bear Creek from the Bear Creek Rearing Station survey site, 1983.

	Brown trout		Rainbow trout		Brook trout		Coho salmon		Chinook salmon	
Year	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre
1983	102	21.26	1,137	43.62	376	17.15	*	*	*	*

Station length in 1983 = 682 feet

Station average width for 1983 = 34.6 feet

Station area for 1983 = .68 acres

* Field notes indicate that some salmon (species unknown) were observed but not counted.

Table 5. Fish population estimates for Bear Creek from the Leffew Road Index Station, 1983-2013.

	Brown trout		Rainbow trout		Brook trout		Coho salmon		Chinook salmon	
Year	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre
1983	71	39.96	938	49.45	609	24.87	*	*	*	*
1997	38	22.26	2,021	48.68	789	34.28	*	*	*	*
2005	50	17.02	1,770	17.42	1,508	43.1	220	1.46	21	0.26
2006	31	7.21	1,494	19.55	1,122	26.52	109	0.89	49	0.81
2007	78	11.11	1,513	23.02	1,473	29.45	197	1.48	197	2.55
2011	62	22.54	1,488	19.06	761	26.33	667	4.47	188	2.44
2012	34	17.92	1,881	24.40	471	20.16	234	1.69	139	1.87
2013	28	22.95	1,513	32.02	777	16.54	282	3.78	256	6.29

Station length in 1983 and 1997 = 595 feet

Station average width for 1983 and 1997 = 39.0 feet

Station area for 1983 and 1997 = .53 acres

* Field notes indicate that some salmon (species unknown) were observed but not counted.

Station length for 2005-2011 = 1,000 feet

Station area for 2005-2007 = .84 acres

Station area for 2011-2013 = .85 acres

Table 6. Habitat evaluation from Bear Creek at the Leffew Road index station, 2006 and 2011.

	2006	2011
% Riffle	7.7%	15.4%
% Run	92.3%	69.2%
% Pool	0.0%	15.4%
Average width	36.8 ft	37.1 ft
Average depth	1.1 ft	1.55 ft
Max depth	2.2 ft	3.2 ft
Discharge	29.7 cfs	31.3 cfs
Logjam cover	1,944 sqft	0 sqft
Linear wood	300 ft	552 ft
Substrate		
clay	4.0%	4.0%
detritus/silt	20.4%	15.0%
sand	43.4%	36.2%
gravel	23.7%	33.6%
small cobble	6.6%	11.2%
large cobble	0.0%	0.0%
wood	2.0%	0.0%
island	0.0%	0.0%

Table 7. MDNR Bear Creek temperature data from the Leffew Road Index Station, 2005-2007 and 2011-2013.

	2005	**2006**	**2007**	**2011**	**2012**	**2013**
January Average		36.3	35.4		34.6	33.9
January Minimum		32.0	31.9		32.0	32.0
January Maximum		40.6	43.9		39.4	39.5
February Average		34.4	33.1		35.8	33.4
February Minimum		32.0	31.9		31.9	32.0
February Maximum		39.0	40.2		40.0	37.4
June Average		60.9		60.7	62.3	60.1
June Minimum		50.9		52.7	49.6	49.0
June Maximum		74.0		72.9	75.9	70.6
July Average		65.0		65.4	67.3	62.9
July Minimum		55.8		57.2	58.2	53.9
July Maximum		75.1		75.6	75.9	76.1
August Average	63.1	63.1		63.0	63.0	61.2
August Minimum	54.4	55.4		55.6	54.7	52.5
August Maximum	74.4	78.1		72.5	72.0	70.3
December Average	35.0	36.6		37.1	37.4	
December Minimum	32.0	31.9		32.4	32.5	
December Maximum	39.2	41.0		42.5	47.2	

Table 8. Weighted average total length (inches) at age, and growth relative to the state average, for fish sampled from Bear Creek at the Leffew Road index station by electrofishing, 2005-2007. Number of fish aged is given in parenthesis.

Year	Month	Species	Age 0	I	II	III	IV	V	VI	Mean Growth Index
2005	July	Brook trout	2.4 (30)	6.8 (58)	10.8 (10)					+1.4
2006	August	Brook trout	2.7 (23)	6.3 (43)	11.0 (2)					+0.2
2007	July	Brook trout	2.5 (30)	6.0 (45)	10.7 (7)					+1.2
2005	July	Brown trout	2.8 (2)	6.3 (9)	8.8 (18)		16.3 (3)			+0.5
2006	August	Brown trout		6.5 (6)	8.8 (15)					-0.1
2007	July	Brown trout	2.8 (14)	6.0 (11)	9.0 (20)	13.9 (1)				+0.2
2005	July	Chinook	3.2 (18)							-
2006	August	Chinook	4.0 (18)							-
2007	July	Chinook	3.7 (27)							-
2005	July	Coho	3.0 (20)							-
2006	August	Coho	3.8 (16)							-
2007	July	Coho	3.7 (17)							-
2005	July	Rainbow trout	2.8 (30)	6.3 (29)						+1.0
2006	August	Rainbow trout	2.4 (30)	6.5 (35)						+0.3
2007	July	Rainbow trout	2.3 (26)	5.9 (48)						+0.5

Table 9. Weighted average total length (inches) at age, and growth relative to the state average, for fish sampled from Bear Creek at the Leffew Road index station by electrofishing, 2011-2013. Number of fish aged is given in parenthesis.

Year	Month	Species	Age 0	I	II	III	IV	V	VI	Mean Growth Index
2011	July	Brook trout	2.6 (25)	5.7 (35)	9.1 (23)	12.3 (1)				+0.6
2012	July	Brook trout	2.8 (21)	5.8 (29)	9.7 (21)	13.3 (1)				+0.9
2013	Sept.	Brook trout	2.9 (20)	6.0 (41)	11.4 (3)					+0.3
2011	July	Brown trout	2.4 (3)	6.2 (18)	8.7 (19)	14.1 (5)	17.6 (1)	23.3 (1)		+0.9
2012	July	Brown trout		6.1 (3)	9.1 (16)	12.2 (6)	14.9 (3)		19.7 (1)	+0.4
2013	Sept.	Brown trout		6.6 (4)	9.2 (11)	13.1 (5)	18.1 (2)		21.5 (2)	+0.9
2011	July	Chinook	3.7 (19)							-
2012	July	Chinook	3.5 (11)							-
2013	Sept.	Chinook	4.0 (21)							-
2011	July	Coho	3.4 (31)							-
2012	July	Coho	3.4 (13)							-
2013	Sept.	Coho	4.0 (20)							-
2011	July	Rainbow trout	1.9 (20)	6.2 (36)	6.4 (1)					+0.5
2012	July	Rainbow trout	2.4 (30)	5.9 (38)	8.7 (2)					+0.6
2013	Sept.	Rainbow trout	2.5 (33)	6.5 (45)	8.6 (3)					+0.3

Table 10. MDNR salmonid population estimates for Bear Creek at the Spirit of the Woods Conservation Club index station, 2008 and 2014.

	Brown trout		Rainbow trout		Brook trout		Coho salmon		Chinook salmon	
Year	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre
2008	46	11.06	619	15.17	1	0.15	1	0	110	1.27
2014	61	11.44	587	21.06	0	0	3	0.06	117	2.93

Station length = 1200 feet
Station average width = 52.62 feet
Station area = 1.45 acres

Table 11. Weighted average total length (inches) at age, and growth relative to the state average, for fish sampled from Bear Creek at the Spirit of the Woods index station by electrofishing, July 23 and 24, 2008, and September 16 and 18, 2014. Number of fish aged is given in parenthesis.

2008	Age						Mean Growth
Species	0	I	II	III	IV	V	Index
Brook trout		8.3 (1)					-
Brown trout	2.9 (3)	6.3 (25)	11.4 (6)	13.1 (2)	18.6 (2)		+1.6
Chinook salmon	3.0 (20)						-
Coho salmon	2.7 (2)						-
Rainbow trout	2.1 (23)	6.4 (30)	12.6 (1)				+0.7

2014	Age						Mean Growth
Species	0	I	II	III	IV	V	Index
Brook trout							
Brown trout	4.2 (10)	6.4 (17)	10.8 (13)		18.0 (2)	18.8 (1)	+0.9
Chinook salmon	4.3 (11)						-
Coho salmon	4.3 (6)	12.9 (2)					-
Rainbow trout	4.3 (11)	6.9 (38)	11.6 (3)				+1.4

Table 12. 2008 MDNR Bear Creek temperature data from four different stations and 2007 Little River Band Odawa Indians data from one station.

	RR Grade, 24N 14W Sec. 27	13 Mile Road	11 Mile Road	9 Mile Road	Spirit of the Woods Club (LRBOI 2007)
June Average	61.3	62.9	63.1	62.7	64.0
June Maximum	72.3	74.3	73.4	75.3	72.7
June Minimum	53.1	55.4	55.9	56.0	52.2
July Average	62.2	64.4	64.7	64.1	64.6
July Maximum	68.6	70.4	69.9	69.1	73.3
July Minimum	53.6	56.3	56.9	56.9	57.1
August Average	60.5	62.7	63.2	62.8	
August Maximum	67.7	70.2	69.9	69.2	
August Minimum	52.9	55.3	56.30	56.4	

Table 13. MDNR habitat data collected from fisheries index stations on Bear Creek, the Little Manistee River, and the Pere Marquette River.

	Bear Creek Spirit of the Woods	Little Manistee Johnson's Bridge	Pere Marquette Mouth of the Baldwin
	2008	2008	2009
% Riffle	23.1	0	15.38
% Run	61.5	100	84.62
% Pool	15.4	0	0
Average width	52.6 feet	36.4 feet	58.02 feet
Average depth	1.7 feet	1.95 feet	1.66 feet
Max depth	6.3 feet	4.1 feet	3.9 feet
Discharge	160.66 cfs	96.6 cfs	126.4 cfs
Woody cover	1,916 sq. feet	1,663 sq. feet	2,829 sq. feet
Linear wood	864 feet	336 feet	618 feet
Substrate			
clay	1.65%	0.00%	0.83%
detritus/silt	1.24%	25.66%	13.75%
sand	22.73%	21.71%	4.58%
gravel	36.78%	25.66%	60.00%
small cobble	21.07%	20.39%	18.75%
large cobble	12.40%	1.97%	1.25%
boulder	0.00%	3.95%	0.83%
wood	4.13%	0.66%	0.00%

Table 14. 2014 salmonid population estimates from Bear Creek (Spirit of the Woods Conservation Club index station) and two other rivers in the northwestern lower peninsula of Michigan.

	Brown trout		Rainbow trout		Coho salmon		Chinook salmon	
	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre	#/acre	lbs/acre
Bear Creek (Spirit of the Woods)	61	11.44	587	21.06	3	0.06	117	2.93
Little Manistee (Johnson's Bridge)	682	71.98	2,690	18.33	2,217	7.31	31	0.39
Pere Marquette (Mouth of the Baldwin River)	261	156.74	1,422	30.85	224	1.6	238	3.01