Ohio Department of Natural Resources, Division of Wildlife

PROJECT FINAL REPORT
Brook Trout Reintroduction: Lake Erie Drainage, NE Ohio: F3SM02

PROJECT TITLE: Brook Trout Reintroduction: Lake Erie Drainage, NE Ohio
PROJECT CODE: F3SM02
TIME PERIOD: FY97-FY07
PREPARED BY: Andy Burt
DATE PREPARED: 07/1/2007

PROJECT SUMMARY: Brook trout colonized Ohio's Lake Erie tributary streams following the retreat of the Wisconsin glacier some 10,000 years ago. However, Trautman (1981) stated that two branches of the Chagrin River appeared to contain suitable habitat, but by 1945 the habitat had been destroyed and he was not able to document any native brook trout populations in Northeast Ohio. In 1972, Dr. Andrew White, John Carroll University, documented two reproducing populations of brook trout in the headwaters of the Chagrin River near Bass Lake in Geauga County. Subsequent mitochondrial DNA and microsatellite DNA analysis confirmed that these fish were the remnants of the original brook trout populations. Unfortunately, agricultural development followed by residential development has significantly impacted the Chagrin River Watershed, eliminating most of the high quality headwater streams that brook trout require for survival. Due to residential development, one of the two streams documented by Dr. White was lost as a viable population in 1993. This left Spring Brook as the only remaining wild population of the Ohio brook trout. In 1998, the Geauga Park District purchased Spring Brook and most or the surrounding acreage, thus providing protection for this last stronghold of the Ohio brook trout. During the years 1992-2000 the Chagrin River, Grand River, and Rocky River watersheds were surveyed for remnant brook trout populations and habitat. No additional native brook trout populations were found but 15 streams were identified as potential introduction sites for the brook trout. Population expansion efforts began in 1996 and continued until 2004. During the expansion period, growth and survival rates were evaluated, then after several years of stocking each stream, reproductive success was extensively monitored. By the conclusion of the project, 10 streams including Spring Brook contained reproducing populations while six streams failed to support brook trout. Although substantial protection of the brook trout streams has occurred over the past decade, because of the fragile nature of the streams and the brook trout, continued protection and monitoring is needed to preserve this unique heritage species.

NEED: Project F3SM02 was necessary to:

1) determine if any other native Ohio brook trout populations exist;
2) expand, restore, and protect the population of brook trout in Northeast Ohio; and,
3) inform and educate residents, sportsman, and conservation organizations about the unique and fragile species;

Brook trout (*Salvelinus fontinalis*) are the only trout native to much of the eastern United States and Ohio lies on the fringe of the native range (Figure 1). Brook trout colonized Ohio's Lake Erie tributary streams following the retreat of the Wisconsin glacier some 10,000 years ago.

Arguably the most beautiful freshwater fish, brook trout survive in only the coldest and cleanest water. Their intolerance of pollutants makes the brook trout an indicator of the health of the watersheds they inhabit. Strong wild brook trout populations demonstrate that a stream ecosystem is healthy and that water quality is excellent. A decline in brook trout populations can serve as an early warning that the health of an entire system is at risk.

By the 19th century Kirtland (1838), Garlick (1857), and Howe (1908) found these "speckled trout" thriving in only two Ohio stream systems: one was a tributary to Lake Erie near Kingsville, and the other was the Chagrin River. Trautman (1981) stated that the Kingsville stream in 1930 had indications of formerly containing suitable brook trout habitat, though no trout were found. Trautman also stated that two branches of the Chagrin River appeared to contain suitable habitat, but by 1945 the habitat had been destroyed. He did not mention any existing populations within the Chagrin River Watershed.

In 1972, Dr. Andrew White of John Carroll University, found two reproducing populations of brook trout in the headwaters of the Chagrin River near Bass Lake in Geauga County. These two streams, Woodie Brook and Spring Brook, were found to have as many as four age classes of brook trout. Mitochondrial DNA analysis in 1993 and 1998 and microsatellite DNA analysis in 2007 confirmed that these fish were the remnants of the original brook trout populations described by Kirtland, Garlick, Howe, and Trautman. Unfortunately, the Chagrin River Watershed has been significantly impacted: first by deforestation and agricultural development, then within the last few decades by residential development. The Woodie Brook fishery was impacted and lost as a viable population in 1993 due to residential development which left Spring Brook as Ohio's only indigenous brook trout stream.

OBJECTIVE(S): Project F3SM02 was initiated as project F3NM06 utilizing non-federal aid funding, but in Fiscal Year 2004, the project coding changed to take advantage of State Wildlife Grant funding. Throughout the project, the objectives remained the same and included:

1) To identify and protect native brook trout streams and habitat within the Lake Erie drainage in Northeast Ohio.
2) To complete an inventory of potential brook trout habitat and to implement a native brook trout reintroduction program at suitable sites.
3) To increase the number of functioning native brook trout streams to six by the end of this project in 2007.

APPROACH: Plans for rehabilitation and restoration of the Ohio brook trout was a cooperative effort. Meetings and discussions concerning the native brook trout rehabilitation, restoration, and protection included representatives from local Park Systems, trout clubs, conservation organizations, educators, and State and Federal agencies. The first phase was to evaluate whether any other native brook streams existed in the State and to identify streams in Northeast Ohio capable of supporting a brook trout population. The second phase involved propagating and raising brook trout fry for release into streams. The final phase was evaluation and monitoring of introduced populations for viability and sustainability.

<u>Stream Surveys</u>. Optimal brook trout habitat can be characterized by clear, cold spring-fed water, a silt-free rocky substrate in riffles, abundant instream cover, and stable water flows (Raleigh 1981). Spring Brook and Woodie Brook (prior to habitat destruction) possess these characteristics. However, due to geographic isolation of the Ohio brook trout from other Eastern and Great Lakes brook trout populations and their restricted range in Ohio, the stream habitat characteristics of the native Ohio streams were sought to be replicated. One important feature of the Ohio brook trout streams is the presence of the Sharon sandstone/conglomerate. The Sharon bedrock consists of quartz-rich well rounded, well sorted coarse-grained sandstones and conglomerates. The Sharon sandstone/conglomerate is the most important bedrock aquifer in Northeast Ohio and outcroppings of this type of sandstone are typically associated with springs (Foos 2003). Over time, the sandstone erodes away leaving behind the smooth quartz pebbles. The stream substrate in Spring Brook and Woodie Brook is dominated by this smooth gravel and is assumed to provide ideal spawning substrate for the brook trout.

Streams within the Lake Erie watershed in Northeast Ohio were surveyed for existing trout and evaluated for the potential of supporting brook trout. Survey sites were usually near road crossings, but all reports of high quality headwater streams and streams formally containing trout were investigated. Surveys consisted of first taking a water temperature of a stream during mid-summer. If the water temperature was within the temperature range of the brook trout, (<20 degrees Celsius), then stream habitat and the fish community was assessed. Habitat was evaluated using the Qualitative Habitat Evaluation Index (QHEI) developed by the Ohio EPA for Ohio Streams (Rankin 1989). The fish community was usually sampled with seines, but under some circumstances, a backpack electrofisher was used throughout a stream reach. The aquatic insect community was also visually assessed as an indication of water quality and available forage. Only streams with cold water, very good habitat, and presence of headwater fish species were considered as potential release sites for brook trout.

Propagation. The goal of the fish propagation was to produce enough fish to seed a stream where brook trout were not present. The goal was not to maintain a stream population solely by stocking, but to produce a self-sustaining population of brook trout in each stream. Since brook trout become sexually mature by age-3, no more than 4 years of releases would be required to produce a successful population in a stream. If a stream could not maintain a viable population after 4 years, the stream was likely lacking critical habitat characteristics required to support brook trout.

Two strategies for collecting gametes were used to maximize production of fry and to ensure the stream fish populations would not be impacted. Because of the small population of native brook trout, initial efforts focused on taking gametes from fish captured in the stream. The fertilized eggs would then be taken back to a hatchery and raised until the fish were large enough to be released into streams. In addition, a brood stock of brook trout was developed to optimize production. Some of the hatchery raised fry along with stream captured juvenile brook trout were raised in a hatchery to eventually become the sexually mature brood fish. These brood fish as well as the fry produced were tested for diseases following the Great Lakes Fish Disease Control Policy and Model Program (Horner and Eshenroder 1993).

Once a stream was identified as a potential site for release of brook trout it was stocked as fry were available. The projected date for release was usually around the beginning of April when the typical size was 40 mm. Fry were held in the hatchery until the size and number of fry required more space than the hatchery could provide. At that time the fish were transported to each stream site and transferred to buckets that could easily be carried throughout the stream. Brook trout were released into the shallow water riffle and run habitat throughout the entire stream reach to ensure dispersion and to avoid predation by larger fish in the deeper pool habitat.

The survival of the stocked fry was assessed by seining the streams each month throughout the summer. In subsequent years, effort was reduced and only a single late summer survey was used to evaluate the fry survival. Survey protocol was to use an 8 ft. x 4 ft. seine or a 4 ft. by 4 ft. seine with 1/4 in. bar measurement, depending on stream size. All habitats were surveyed from the lowest stream reach to upper most point where brook trout habitat existed. In most streams, the lowest reach was identified by the confluence of a larger body of water and the upper reach was identified by either a physical barrier or intermittent flows. Once a brook trout was captured, it was placed into a bucket of water until all fish could be captured from a habitat type. So as to not recapture fish, an entire riffle, run, pool sequence was surveyed before fish were processed. Seining continued in each habitat until brook trout could no longer be captured. Then all fish were measured and returned to the habitat in which they were removed. Survey results were then entered into the Ohio Fisheries Information System (OFIS).

Population monitoring. While the streams were actively being stocked with brook trout, there was no practical means to distinguish hatchery produced from stream produced young. Fish surveys that evaluated the fry survival could also determine if the stream could support juvenile and adult fish since the older fish were stocked in previous years, but the stocking surveys could not evaluate whether a stream contained the required habitat for brook trout spawning or egg development. To evaluate whether a stream could support the entire life cycle of brook trout, population monitoring surveys were completed in the years following the last release of fish into a stream. When a population of fish is not able to annually produce a successful cohort, the viability of the stream must be questioned. The monitoring of brook trout populations began when either there was evidence of natural reproduction in a stream or when no further releases of brook trout were planned for a stream. The monitoring of populations involved the same protocols as the stream surveys except that only a single late summer survey was used to evaluate the stream.

If a seining survey captured less than 5 total brook trout, an Engineering Technical Services model ABP-2™ backpack electrofisher equipped with Quadrapulse technology was used to verify whether the seining survey was ineffective due to stream habitat or if brook trout were no longer present in the stream at a high level. Quadrapulse is most effective in cold water streams, and draws the fish (electrotaxis) as well as, and typically much better than, conventional pulses, but without the hard stunning or narcosis (Engineering Technical Services 1999). The benefit of light stunning is that the trout should not experience the same morbidity or mortality that is sometimes seen with conventional pulses, particularly at high peak current levels. Settings recommended by Engineering Technical Services and used in the brook trout surveys were 250 peak volts with a frequency of 240 pulses per second at a duty cycle of 25 percent.

Protection. Although the brook trout in Woodie Brook and Spring Brook have likely been in existence since the last glacial retreat in Ohio over 10,000 years ago, they are under the constant threat of extirpation from the state. The county in which the streams are located is one of the fastest growing counties in the State. Housing developers have plans to build adjacent to Spring Brook which can warm the stream through surface run-off and decrease the flow of the stream by removing water from the aquifer for drinking water supplies. Strategies to protect the brook trout streams included education of residents and sportsmen, conservation easements, and land purchases. Habitat restoration was an important consideration for areas of the streams that were severely degraded. None of these strategies could be accomplished solely through the efforts of the Ohio Division of Wildlife. It is only through partnering with organizations that these efforts would make a substantial difference for the brook trout.

To facilitate communication and provide a forum for discussion, the Brook Trout Advisory Committee was formed. This committee was comprised of members from organizations with a stake in protecting the brook trout. The quarterly meetings allowed for sharing of data and for developing a single, focused strategy for protecting the fragile streams.

FINDINGS: The site evaluations, hatchery propagation, and stream surveys were all found to adequately meet the needs of this project and to successfully re-introduce brook trout to Northeast Ohio streams. At the time of this report, Spring Brook has continued to support a strong population of brook trout. In addition, five re-introduction sites including the physically restored Woodie Brook, maintain strong populations of brook trout, and four other re-introduction sites are still supporting low levels of brook trout more than four years since the last release of fish into the stream. Due to the success of this project, brook trout are now present and maintaining population levels in 10 streams across Northeast Ohio (Figure 2).

Stream Surveys. During the project, almost 200 roadside stream surveys were completed, but only a few streams were found suitable for brook trout. Most streams were found to contain water temperatures that exceeded the preferred water temperature of 16 degrees Celsius for brook trout. During these surveys, no other brook trout populations were documented besides the non-native population that existed in Sulfur Springs which was maintained with hatchery produced fish from the University School hatchery as well as through some natural reproduction. Because of the presence of non-native trout, this stream was not considered for native brook trout reintroductions.

Since few streams with suitable habitat were identified in the roadside surveys, local media outlets were used to educate landowners about the native Ohio brook trout and the need for locating suitable streams for reintroduction. With the help of landowners and County Park Districts, 15 streams were eventually identified as potential brook trout habitat (Table 1).

Habitat fragmentation is common for brook trout across its native range and is one of the major reasons brook trout populations are declining along the eastern U.S. (Theiling 2006). Ideally, the project hoped to find a corridor of streams with limited fragmentation that could support brook trout. However, as seen through much of the eastern brook trout range, most streams found suitable for brook trout were fragmented and isolated from other nearby coldwater streams. All 15 streams possessed a barrier at one or both ends of the stream reach which prevented the brook trout from inhabiting a larger area of stream or from migrating between streams. In most instances, the brook trout habitat began at the spring source, but natural falls or a lack of physical habitat also prevented further upstream migration of brook trout. The lower end of the stream reaches usually terminated into a larger body of water such as a marsh, lake, pond, or larger stream. This confluence with a larger body of warm water created a temperature barrier for the brook trout during the summer months, likely restricting migration and habitat use in this area to cooler periods. Of all the streams surveyed, only one contained suitable brook trout habitat over a longer contiguous reach than Spring Brook. Most of the streams only possessed a few hundred meters of suitable stream habitat for the brook trout (Table 1).

<u>Propagation</u>. Substantial effort was expended in adapting procedures to successfully spawn adults and to hatch brook trout eggs. In the fall of 1994, immature brook trout were captured from Spring Brook and relocated to a private hatchery operated by University School. In addition, eggs were stripped from ripe females and fertilized streamside before being taken to the University School hatchery. All fish held at the University School hatchery were initially held and raised as brood stock. In subsequent years, the captive brood was supplemented by fish from both Woodie Brook and Spring Brook. Eventually, all brood stock was maintained at the Castalia State Fish hatchery. Production of fry for stocking efforts ranged from 55 fry in 1997 to almost 40,000 fry. Stocking rates varied and were based upon the number of fry produced and available habitat within a stream. During the initial phase of propagation when fewer fish were available, stocking rates were only a couple hundred fry per quarter mile of stream. As production capabilities increased, so did the stocking rates. By the final year of production, several thousand fry per quarter mile of stream where released. Although it was known that the streams did not require this rate of stocking, the lack of additional brook trout streams necessitated the overstocking of the known stream reaches. It was hypothesized that the extra fry would either be pushed downstream and locate other cold water refugia or they would be a food source to the other brook trout in the stream. In 2003, the brood stock tested positive for infectious pancreatic necrosis (IPN) and were consequently terminated following the Great Lakes Fish Disease Policy. Since most streams had received multiple years of fry stockings and no other suitable streams were available, re-establishment of brood stock was not initiated. This in turn ended the planned fish introduction efforts one year prematurely.

The stocking assessment surveys revealed how variable survival can be in different streams. In some streams, none of the fish stocked were recaptured, while in others, over 20 percent of the fish stocked were captured in the seining surveys (Table 3). Even within the same stream, the percent survival fluctuated by as much as 17 percent. Some of the variation can be attributed to sampling error. However, attempts to standardize technique and sample habitat were made. In general, streams where brook trout introductions were successful had an average minimum survival of at least four percent (Table 4). The streams that had a minimum percent survival less than four percent were typically the largest stream systems and contained the warmest water. Because these systems were larger, they were also more difficult to survey with a seine. Therefore it is possible the fry had a higher survival rate, but they were not sampled effectively.

Because brook trout were not present in streams before the initial stocking of fry, it was possible to determine the growth of brook trout in the first couple years. The brook trout fry averaged 80 mm in size by the end of the first summer of growth (Age-0). In the first year brook trout were stocked into a stream, they generally were more abundant and reached a larger size than those stocked in subsequent years presumably because of the lack of competition with older brook trout in the streams. By the end of the second summer in a stream (Age-1), fish grew to a maximum of 252 mm with an average length of 160 mm. Because of the differences in growth rates of individual fish, it was not possible to estimate the size of brook trout at age-2 and age-3. Only a range of sizes could be provided based upon length frequencies (Figure 4) and growth of individual fish caught in each year of the survey (Table 6).

Because some brook trout fry were placed into pools that were isolated from the rest of the stream except under flood flows, it was possible to capture fish and track their growth through time. These fish were identified for 4 consecutive years from the deepest and highest quality pools in the streams and reached sizes over 300 mm before they either perished or eluded our seines.

<u>Monitoring</u>. Because Spring Brook contained the only wild and native population of Ohio brook trout in the state, monitoring surveys only occurred at the beginning and end of the project period so as to minimize the impact the surveys may have had on the fish and their habitats. In May 1997, a population survey was performed using mark (adipose fin clip) and recapture of brook trout. Age-0 fish were not marked because they were not effectively captured using seines. A modified Schnabel calculation estimated the population size to be 267 fish (95% confidence interval between 185 and 382). An average of 53 juvenile and adult fish were captured in each of the three surveys performed which was interpreted to mean the standardized seining approach captured approximately 20 percent of the fish in the stream on each survey. The 2006 population was estimated to be 646 brook trout (95% confidence interval between 534 and 758) brook trout, but it included age-0 fish since the surveys occurred in the fall and the age-0 fish were larger. Even accounting for the differences in of age-0 fish sampled between surveys, the population of Spring Brook greatly increased over the period of the project and is a stable population.

The monitoring surveys of streams where brook trout were introduced occurred annually. However, if a stream was thought to be devoid of any trout, monitoring surveys were not performed as diligently. The purpose of the stream monitoring was to look for Age-0 brook trout in the stream when fish had not been stocked into the stream. The presence of young fish confirms the presence of suitable spawning habitat as well as confirms the presence of adult fish surviving in the stream regardless of whether they are captured in the surveys. Streams that could not support the stocked brook trout would not be able to sustain a wild population so surveys did not always occur annually.

Monitoring of the brook trout began either after the first observance of wild hatched fish in the stream or when all stockings in the stream were completed. A stream with natural reproduction of brook trout at least three years removed from its last hatchery release was considered a success in this project. Since brook trout typically only live three to four years in a stream, by assessing the stream three years removed from its final stocking, most fry captured are likely second generation wild fish.

Most streams entered into the monitoring phase after 2003 when the stocking phase of the project ended. In 12 of the 15 streams, naturally reproduced brook trout were captured in at least one year post hatchery release. The Leech stream was the first stream to enter the monitoring phase when in 1999, after only two years of releases, wild hatched fry were observed while releasing the hatchery fry into the stream. From the years 2000 to 2006, the numbers of wild hatched age-0 brook trout in the Leech survey were greater than or equal to the number of brook trout captured in years the stream was stocked (Figure 3). The last year the Leech property was surveyed, the stream contained almost twice the number of fish per quarter mile as Spring Brook.

Four of the 15 streams stocked did not show any evidence of wild hatched trout (Eklund, Little Sweetly, Pierson, and Linton Creek). Brook trout were able to successfully spawn in two other streams in low numbers for at least one year since hatchery releases ended (Baldwin and Nature Center). These streams had suitable spawning habitat, but could not support sufficient numbers of sexually mature fish due to other habitat limitations. Baldwin and Pierson are especially of note because there is no indication brook trout will survive in these streams, yet in every survey, wild hatched age-0 and age-1 rainbow trout were captured in low numbers in the stream. Since these rainbow trout were only present in low numbers, it was assumed the rainbows were not abundant enough to exclude the brook trout from the stream. Instead, it reflects the differences in quality of habitat required by each of the species.

In total, nine streams still contained self-sustaining populations of brook trout at the conclusion of the project (Table 4). Five of the populations are considered strong (Hrabak, Leech, Muir Valley, Pebble Brook, and Woodie Brook), and four of them are limited in size or have demonstrated high recruitment and survival variability in the monitoring surveys (Affelder, Pettibone, Palsa, Mt. Glen). The minimum population size required to sustain a population of brook trout in a stream is not known. Lack of brook trout in the surveys should not be interpreted as the brook trout are not in the stream. It simply means the fish are either not present the stream reach sampled or our gear was not effective in sampling them. For instance, the Hrabak stream had been sustaining a small wild population of brook trout for six years at the conclusion of this project. Annual surveys using seining and electrofishing gear have indicated that although less than 14 age-0 brook trout were sampled per year with occasionally zero fish captured in an annual survey, the number of brook trout present is still sufficient to maintain a small population. The adults and juveniles in the stream were seldom captured, so the fish are likely seeking refuge in areas of the stream unable to be sampled. The concern with small population sizes is that one catastrophic event could eliminate the few remaining adults. Even if the adults can survive, the genetic bottleneck and lack of gene flow may slowly degrade the population to the point of extirpation.

<u>Protection</u>. The Ohio brook trout streams are under a constant threat of extirpation due to the small population size and fragmentation of the streams. In the final year of this project alone, a garbage truck overturned into a branch of Woodie Brook and a surfactant (a synthetic polymer formulated to increase detergency and the wetting properties of drilling fluids) was released into the headwaters of Spring Brook. Because of the education and cooperation within the community, quick responses and cleanup prevented any harm to the fish populations in the streams. Education of residents, sportsman groups and conservation groups was an integral part of the success of this project. By making these groups aware of the status and threats to the brook trout, whenever opportunities arose to protect or restore a stream, everyone was willing to contribute to be a part of the effort.

Woodie Brook was one of the two brook trout streams documented by Dr. Andy White in the mid 1970's. However, a developer destroyed most of the habitat by constructing a pond where the stream once flowed. When the opportunity arose several years later to purchase the property, several organizations contributed funds. Using mitigation credits and donations from the local community, Woodie Brook became the first trout stream restoration in the state of Ohio and is once again supporting a strong brook trout population. A few years later, when residential construction on a property adjoining Woodie Brook threatened the recovery efforts, many organizations again contributed funds to purchase a 3-acre parcel to protect critical habitat and to ensure the stream would not be impacted.

The Brook Trout Advisory Committee also has contributed significantly to the restoration efforts. By utilizing organizational expertise, the committee has evaluated the need for habitat improvements in Woodie Brook, developed a plan to improve the Cleveland Metroparks Zoo native brook trout exhibit, and initiated the development of a local habitat suitability index (HSI) for the brook trout. The Ohio native brook trout HSI will classify stream habitat, water quality, and stream community variables to determine which characteristics were essential to the brook trout reintroduction efforts. The HSI will then be used to evaluate and rank other coldwater streams for brook trout suitability in Northeast Ohio.

MANAGEMENT IMPLICATIONS:

This project demonstrated the importance of building relationships and partnering with other organizations, as well as private landowners, in order to build support for a project and to reach goals that would otherwise be unrealistic. Representatives of Federal, State, Local entities, along with nonprofit organizations, sportsman clubs, and individual land owners all contributed to this project ensuring its success.

A prime example of the power of partnerships is in the brook trout stream protection. Prior to this project, virtually all of the brook trout streams were owned by real estate developers and private landowners. By pooling resources, enough money was contributed for the Western Reserve Land Conservancy to purchase a large amount of land surrounding the streams. The Conservancy then transferred title to Geauga Parks for management and protection of the property. Currently, 32-acres of property surrounding Spring Brook are protected and 12-acres encompassing the highest quality habitat at Woodie Brook are managed by the Geauga Park District (Figure 9) with more of the stream protected in easements. Entire streams and in some cases, entire watersheds of the other successful brook trout streams are owned by Park Districts. Barring catastrophic events, this ensures the brook trout will survive in Ohio for a very long time.

The success of F3SM02 reduced the eminent threat of native brook trout extirpation from the state, however, the brook trout should remain on the Ohio threatened and endangered list as a threatened species due to the restricted range and small population size. Future consideration should be given to relocating brook trout from Spring Brook where genetic diversity is high, to other satellite streams that are supporting brook trout, but likely have less genetic diversity due to hatchery propagation. Given the success of this project in expanding the number of brook trout streams to at least 6 and possibly as high as 10 streams, if numerous additional suitable streams are identified the Ohio native brook trout HSI developed by the Brook Trout Advisory Committee, a continuation of this project should be explored to ensure this heritage species will be around for future generations to enjoy.

COST ANALYSIS: Project costs of F3SM02 were entirely personnel based, and as the initial project F3NM06, most of the non-personnel costs were associated with hatchery production which ended in FY03. In FY07, the planned and actual mandays used differed by less than one percent (Figure 10). Complete analysis of annual personnel and non-personnel costs are available in annual progress reports from FY93 through FY07.

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Project report submitted by the following:

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John Navarro, Program Administrator Date
Stream Conservation & Environmental Assessment

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Figure 1. Current range and population status of the eastern brook trout within subwatersheds of the United States (Thieling 2006).

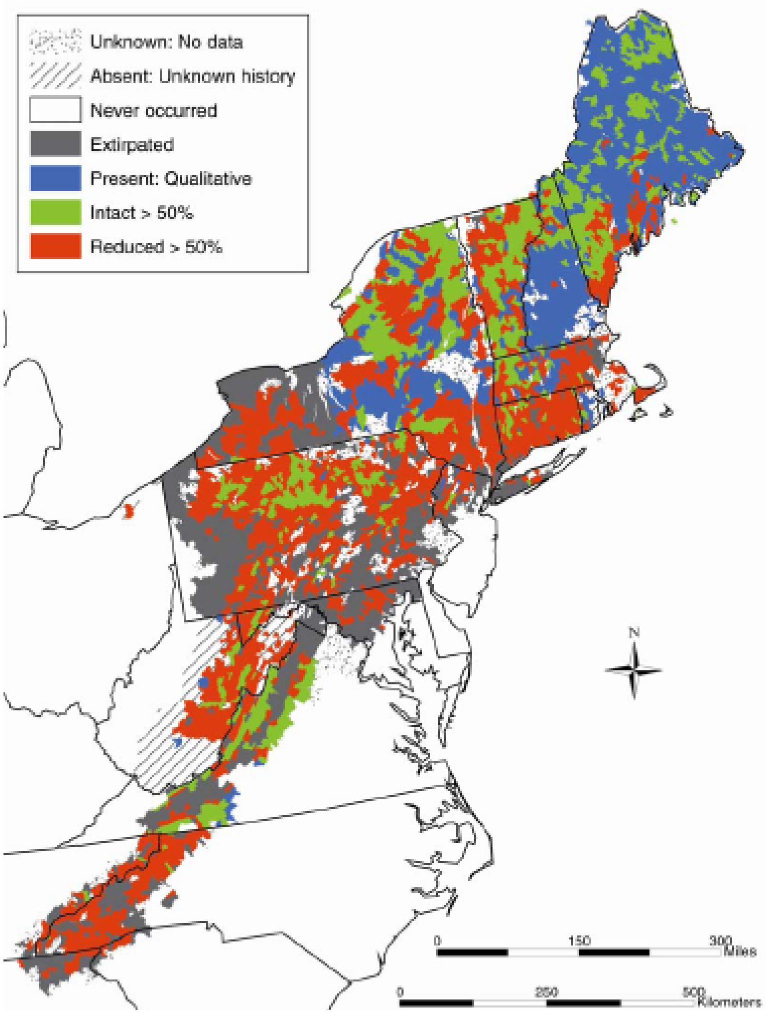

Figure 2. A map of Northeast Ohio showing the locations of streams where Ohio native brook trout were introduced.

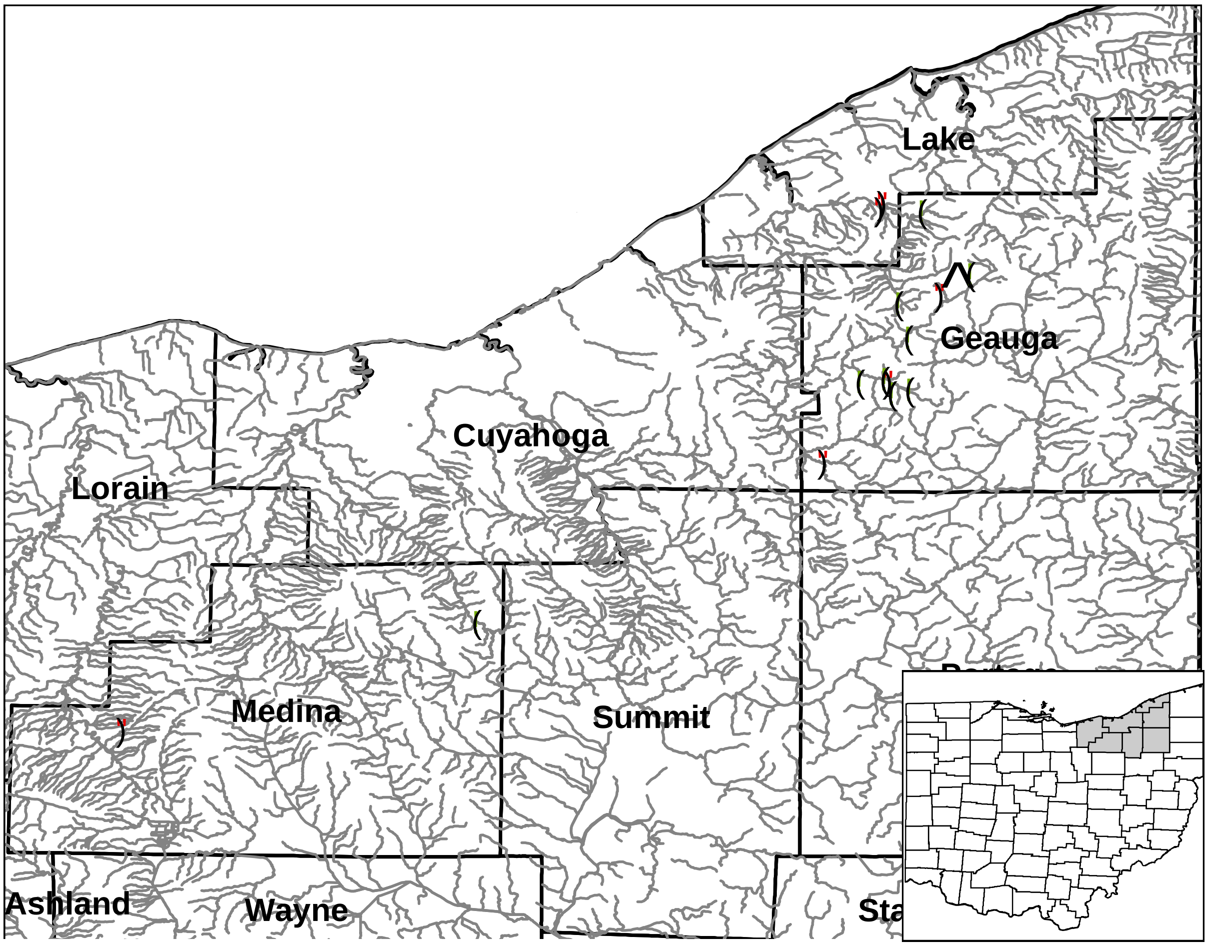

Table 1. Table of the stream metrics from sites determined to be suitable for brook trout reintroduction.

Stream	Site Length (m)	Sharon Sandstone	QHEI score	HMFEI score	Water Temperature (C)
Affelder	365	Yes	83	46	13.8
Baldwin Creek	500	Yes	78	48	16.4
Eklund	378	Yes	68	28	18.3
Hrabak	261	Yes	68.5	45	15.2
Leech	146	Yes	75.5	46	11.7
Linton Creek	661	Yes	87.5	41	19.4
Little Sweetly Creek	548	No	69.5	22	19.0
Mt. Glen Farms	571	No	77.5	35	17.3
Muir Valley	837	Yes	84	43	17.4
Palsa	317	Yes	78.5	44	16.5
Pebble Brook	475	Yes	75.5	55	15.8
Pettibone	201	Yes	80	47	16.3
Pierson Stream	300	No	75.5	64	17.8
West Woods Nature Center	327	Yes	77.5	33	13.3
Woodie Brook	529	Yes	73	60	13.2
Average	**448**		**75.6**	**48.7**	**15.7**
*Spring Brook	821	Yes	84.5	58	13.6

* Spring Brook was used as a reference since it was the only existing brook trout stream at the time of the project.

Table 2. The stocking summary for each year native brook trout were released into Northeast Ohio streams

Year	Number of streams stocked	Number of fry stocked
1996	1	55
1997	3	349
1998	3	1,071
1999	3	3,007
2000	2	300
2001	11	21,097
2002	8	11,858
2003	11	39,968
Grand Total	**15**	**77,700**

Table 3. Yearly stocking rates and associated survey results for each year fry were released.

Stream	Year	Fry Stocking		Age-0 Survey		Percent Survival
		Number	Num per ¼ mile	Number	Num per ¼ mile	
Affelder	2001	4042	4455	375	413.32	9.28%
Affelder	2002	2000	2204	159	175.25	7.95%
Affelder	2003	4005	4414	440	484.96	10.99%
Baldwin Creek	2001	2000	1609	47	37.82	2.35%
Baldwin Creek	2002	1235	994	26	20.92	2.11%
Baldwin Creek	2003	3006	2419	42	33.79	1.40%
Eklund	2002	615	655	2	2.13	0.33%
Eklund	2003	3010	3204	17	18.09	0.56%
Hrabak	1997	130	200	24	36.99	18.46%
Hrabak	1998	401	618	19	29.29	4.74%
Hrabak	1999	407	627	11	16.96	2.70%
Hrabak	2000	175	270	2	3.08	1.14%
Leech Stream	1997	114	314	23	63.38	20.18%
Leech Stream	1998	342	942	29	79.91	8.48%
Leech Stream	1999	600	1653	51	140.53	8.50%
Linton Creek	2001	2751	1674	9	5.48	0.33%
Linton Creek	2003	4242	2582	70	42.60	1.65%
Little Sweetly Creek	2002	843	619	0	0.00	0.00%
Mt. Glen Farms	2001	3000	2114	14	9.86	0.47%
Mt. Glen Farms	2003	6015	4238	76	53.55	1.26%
Muir Valley	2001	1502	722	173	83.15	11.52%
Muir Valley	2002	2016	969	47	22.59	2.33%
Muir Valley	2003	5432	2611	213	102.38	3.92%
Palsa	2001	2002	2541	166	210.67	8.29%
Palsa	2002	1500	1904	82	104.06	5.47%
Palsa	2003	3935	4994	107	135.79	2.72%
Pebble Brook	1996	55	47	2	1.69	3.64%
Pebble Brook	1997	105	89	3	2.54	2.86%
Pebble Brook	1998	328	278	19	16.09	5.79%
Pebble Brook	1999	2000	1694	11	9.32	0.55%
Pebble Brook*	2000	1250	106	5	4.23	4.00%
Pebble Brook*	2001	500	423			
Pebble Brook	2003	2467	2089	214	181.25	8.67%
Pettibone	2001	2007	4017	407	814.61	20.28%
Pettibone	2002	1500	3002	152	304.23	10.13%
Pettibone	2003	3350	6705	157	314.23	4.69%
Pierson Stream	2001	1949	2614	7	9.39	0.36%
West Woods Nature Center*	2001	712	876	46	56.59	5.25%
West Woods Nature Center	2002	500	615	45	55.36	9.00%
West Woods Nature Center	2003	801	985	84	103.34	10.49%
Woodie Brook*	2000	700	532			
Woodie Brook	2001	132	100			
Woodie Brook	2002	1649	1254	118	89.74	7.16%
Woodie Brook	2003	3705	2818	426	323.97	11.50%

* Fish were stocked in part or entirely by University School.

Table 4. Percent survival of brook trout fry averaged over all years.

Stream Name	Average Fry Percent Survival	Brook Trout Outlook
Leech Stream	12.38%	Successful
Pettibone	11.70%	Successful
West Woods Nature Center	9.49%	Fail
Affelder	9.40%	Successful
Woodie Brook	9.33%	Successful
Hrabak	6.76%	Successful
Muir Valley	5.92%	Successful
Palsa	5.49%	Successful
Pebble Brook	4.25%	Successful
Baldwin Creek	1.95%	Fail
Linton Creek	0.99%	Fail
Mt. Glen Farms	0.87%	Successful
Eklund	0.44%	Fail
Pierson Stream	0.36%	Fail
Little Sweetly Creek	0.00%	Fail

Table 5. Reintroduction sites in relation to its major watershed with years the site was stocked and surveyed along with its brook trout population status as of 2006.

Stream or Owner	**Watershed**	**Years Stocked**	**Years Surveyed**	**Population Size**
Spring Brook	Chagrin River	None	1996, 2006	Large
Affelder	Silver Creek, Chagrin River	2001-2003	2001-2006	Small
Baldwin	East Branch, Chagrin River	2001-2003	2001-2006	Fail
Eklund	Chagrin River	2002-2003	2002-2006	Fail
Hrabak	Silver Creek, Chagrin River	1997-2000	1997-2000, 2003-2006	Small
Leech	Chagrin River	1997-1999	1997-2006	Large
Linton Creek	Aurora Branch, Chagrin River	2001, 2003	2001-2006	Fail
Little Sweetly	Black River	2002	2002-2004, 2006	Fail
Mt. Glen Farm	East Branch, Chagrin River	2001, 2003	2001-2006	Small
Muir Valley	East Branch, Rocky River	2001-2003	2001-2006	Large
Nature Center	Silver Creek, Chagrin River	2001-2003	2001-2006	Fail
Palsa	East Branch, Chagrin River	2001-2003	2001-2006	Small
Pebble Brook	Silver Creek, Chagrin River	1996-2001, 2003	1996-2006	Large
Pettibone	Silver Creek, Chagrin River	2001-2003	2001-2006	Small
Pierson Creek	East Branch, Chagrin River	2001	2001-2003, 2005-2006	Fail
Woodie Brook	Chagrin River	2001-2003	2001-2006	Large

Figure 3. Chart of age-0 brook trout collected from the two most successful re-introductions streams and from a Spring Brook survey. The arrows point to the last year hatchery fish were released into the stream.

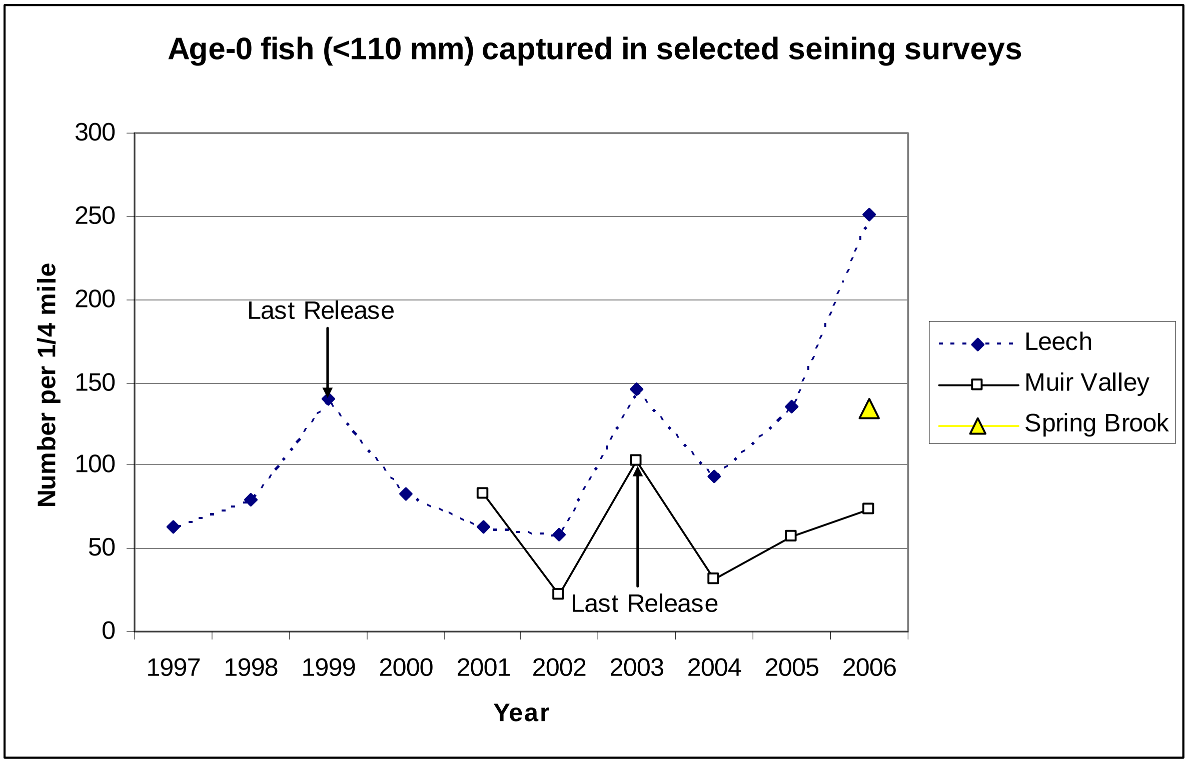

Figure 4. Length frequency of brook trout captured from all surveys between 2002 and 2006.

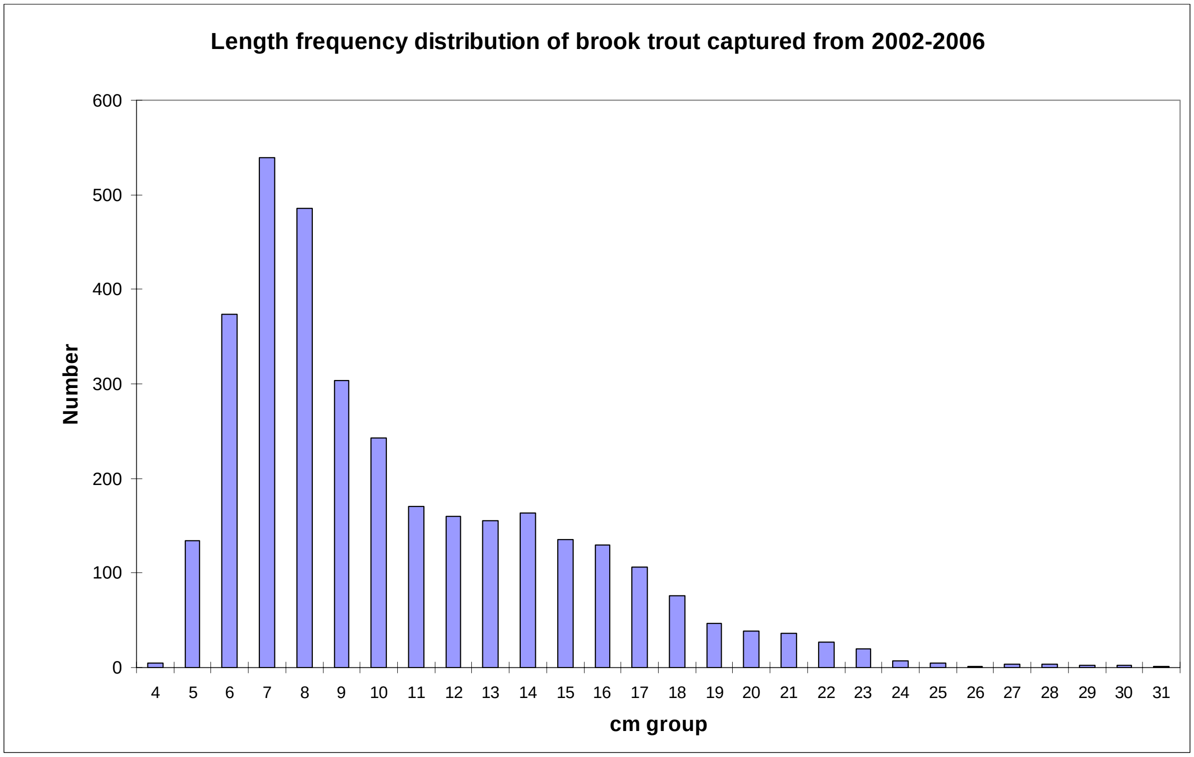

Table 6. Estimated size range of each age class based upon length frequency data and known age of fish from stocking date.

Age	Range
0	44 mm - 110 mm
1	110 mm - 250 mm
2	180 mm – 280 mm
3	240 mm -310 mm

Figure 5. Box plot of the number of wild hatched age-0 (<120 mm) brook trout captured per quarter mile from each stream.

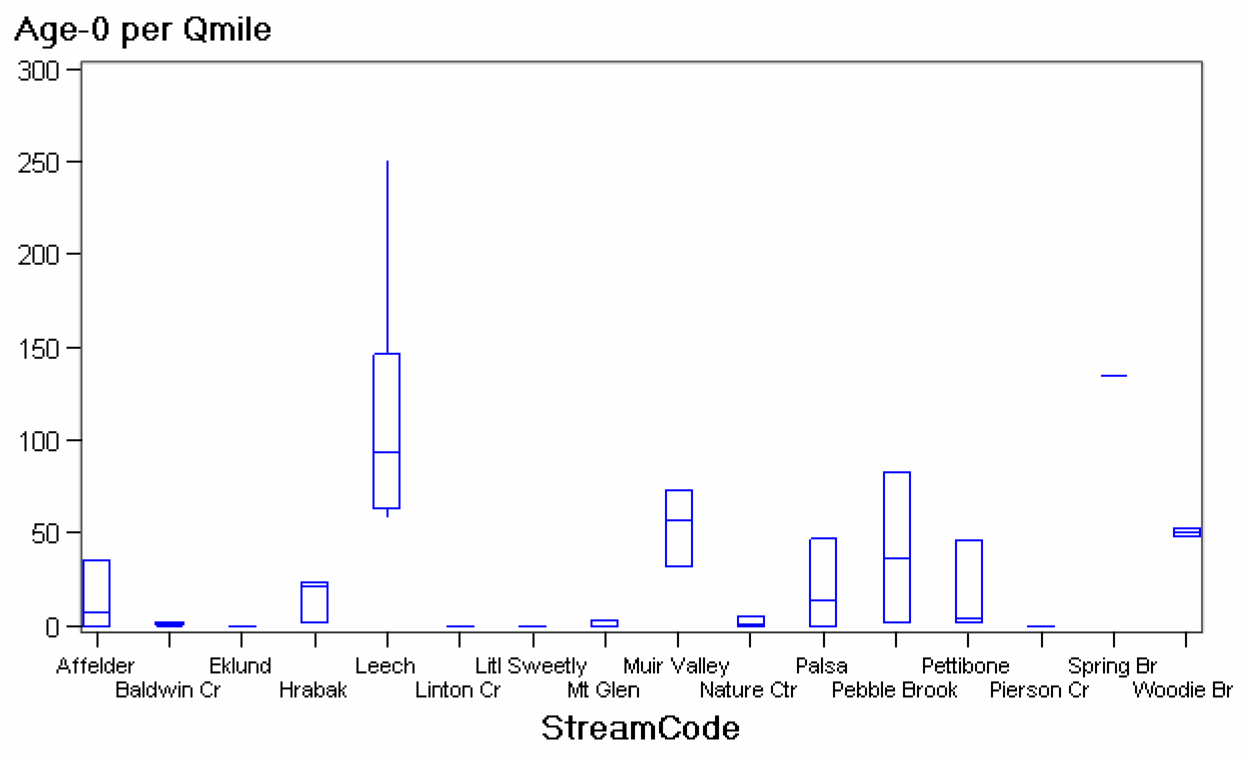

Figure 6. Box plots of the number of hatchery produced age-0 brook trout (<120 mm) captured per quarter mile in each stream.

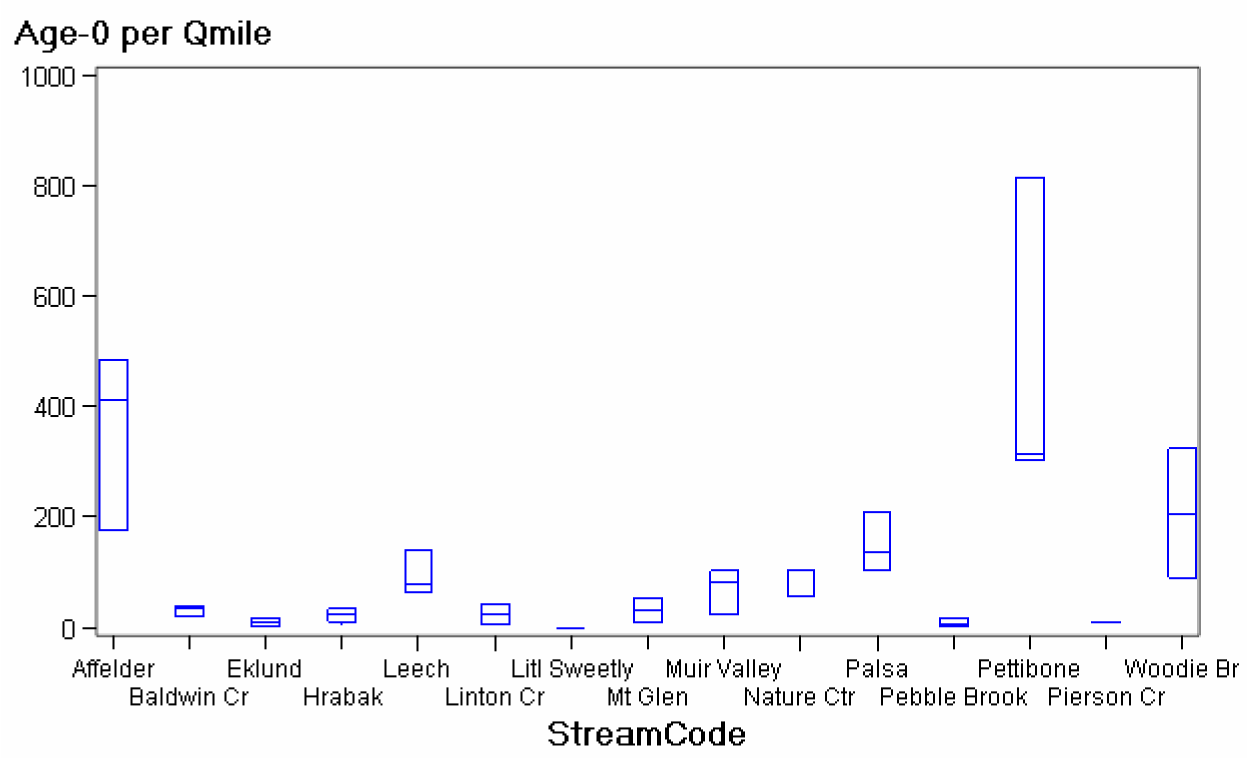

Figure 7. Box plots of the number of juvenile and adult brook trout (>120 mm) captured per quarter mile in each stream regardless of whether stockings occurred.

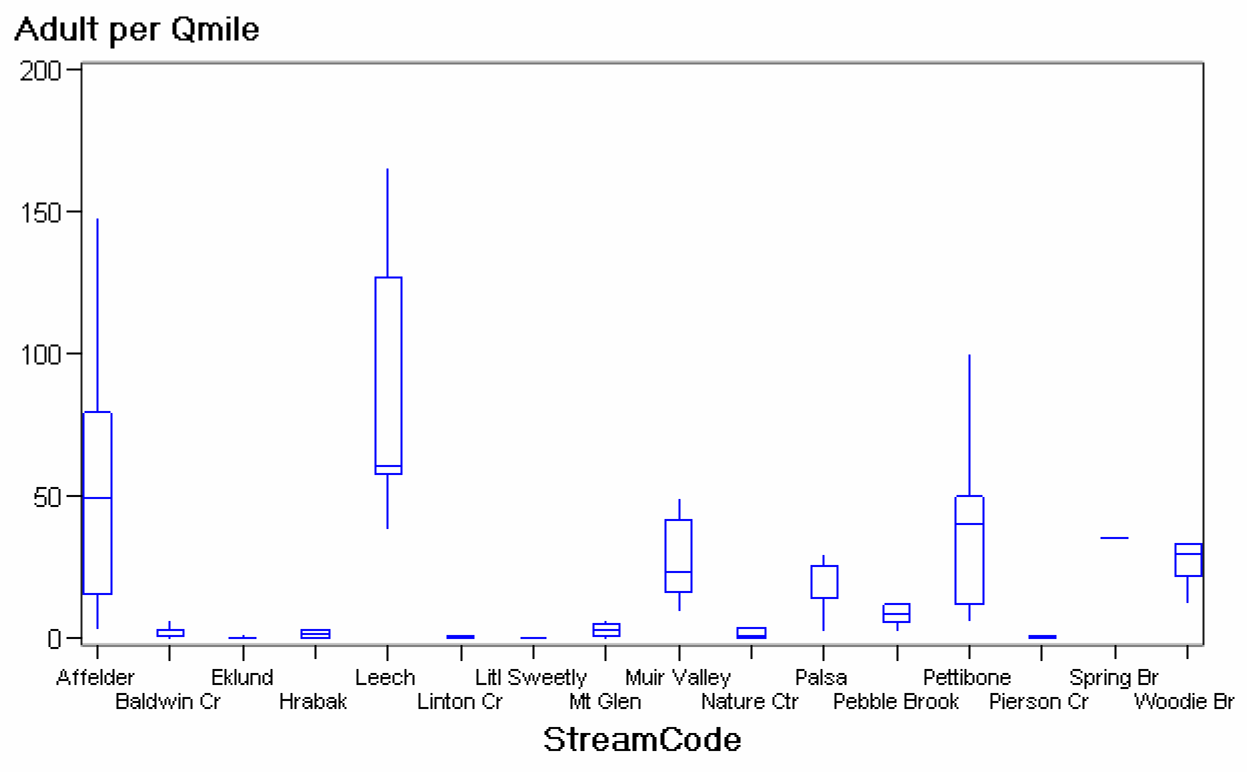

Figure 8. Box plots of the total number of brook trout captured per quarter mile in each stream after it entered the monitoring phase when no brook trout were released.

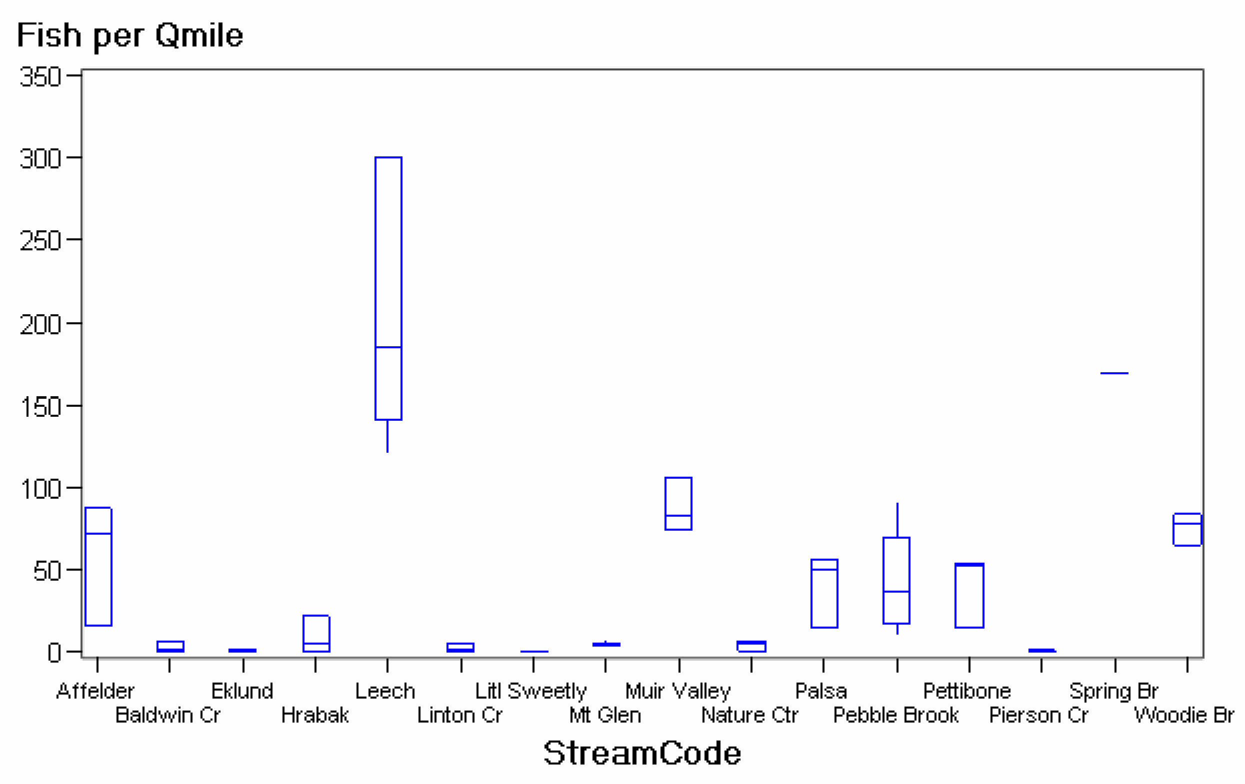
Fish per Qmile
350
300
250
200
150
100
50
0
Affelder
Baldwin Cr
Eklund
Hrabak
Leech
Linton Cr
Litl Sweetly
Mt Glen
Muir Valley
Nature Ctr
Palsa
Pebble Brook
Pettibone
Pierson Cr
Spring Br
Woodie Br
StreamCode

Figure 9. Location and protected property surrounding Spring Brook and Woodie Brook. The green color (lightly shaded) represents property holdings by the Geauga Park District

Data: Geauga County Auditor and
Chagrin River Land Conservancy
State Plane 1983, Ohio North
November 25, 2003

Figure 10. FY07 personnel and non-personnel expenditures.

Prepared On 26-Oct-07

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TIME AND ACTIVITY REPORTING SYSTEM
Performance Report Information
Project Summary
Fiscal Year 2007

				Planned				*Actual*			
Org Unit	**Project**	**Fund**	**SAC**	**Regular Mandays**	**Overtime Mandays**	**Personnel Budget**	**NonPersonnel Budget**	**TARS Mandays**	**TARS Expenditures**	**CAS Expenditures**	**CAS Obligations**
		015 Totals		*70*	*0*	*$12,785.00*		*68.3*	*$10,226.60*		
	F3SM02 - Brook Trout Reintroduction: Lake Erie Drainage, Ne Ohio	*Totals.................*		*70*	*0*	*$12,785.00*		*68.3*	*$10,226.60*		
FMD3 Totals				*70*	*0*	*$12,785.00*		*68.3*	*$10,226.60*		
Grand Totals				***70***	***0***	***$12,785.00***		***68.3***	***$10,226.60***		