Conservation Strategies for Protection and Restoration of Native Ohio Brook Trout (*Salvelinus fontinalis*): 2026-2035

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Purpose of this Plan

Native Ohio Brook Trout *(Salvelinus fontinalis*, hereafter NOBT) are found in limited habitat on the fringe of their historical range in North America (Figure 1). The five naturally reproducing populations in Northeast Ohio are at risk from continued habitat loss, attributed to urbanization, climate patterns of increased summer temperatures and precipitation intensity, and other compounding factors. Ohio Brook Trout are currently listed by Ohio Department of Natural Resources, Division of Wildlife (ODOW) as a State Endangered species within what is believed to be their native range of Northeast Ohio's Lake Erie tributaries based on historical documentation (specifically the Ashtabula, Chagrin, Conneaut, and Grand River drainages). The purpose of this plan is to prevent the loss of NOBT.

This plan provides a background and situation analysis that includes an updated overview of conservation efforts including habitat assessments, reintroductions, and fish surveys – then proposes objectives and strategies to secure the future of NOBT. Elements of this plan are anticipated to be included in the next update of the ODOW State Wildlife Action Plan (SWAP) for 2026-2035. The SWAP identifies high priority needs and approaches to restore, improve, and protect species of greatest conservation need in Ohio in cooperation with statewide partners.

Figure 1. Native Ohio Brook Trout, Spring Brook, Geauga County, (Photo credit: Paul Pira, 9/19/2019).

Background and Situation Analysis

Brook Trout are the only trout (char) native to Ohio's interior waters. They have inhabited coldwater streams and lakes ever since the retreat of the continental glaciers across the eastern United States and New England and have thrived in the ancient valleys of the Appalachians for the last several million years (Eastern Brook Trout Joint Venture - EBTJB, easternbrooktrout.org). Nationally, Brook Trout populations have severely declined due to a multitude of threats including sedimentation, warming water temperatures, population fragmentation, non-native species competition, deforestation and urbanization, acid mine drainage, and surface water runoff (EBTJV, easternbrooktrout.org). During the past two decades, Eastern Brook Trout Joint Venture partners (U.S. Fish and Wildlife Service, state wildlife agencies, and NGOs) have spent over $28.5 million on efforts to slow the decline of and restore native Brook Trout populations through efforts such as barrier removals, habitat restoration, riparian protection and restoration, and non-native species control (EBTJB, easternbrooktrout.org). Ohio is at the extreme edge of the eastern Brook Trout range, experiences many of the same stressors that face Brook Trout nationally, and only a few relic populations remain within the known native northeast Ohio range.

Brook Trout colonized Ohio's Lake Erie tributaries following retreat of the Wisconsin glacier ~10,000 years ago and were documented within at least two separate tributary systems in northeast Ohio through the early 1900s (Kirtland 1838; Garlick 1857; Howe 1908). However, subsequent agricultural and industrial practices resulted in drastic land changes and by the mid-1900s these fish were considered extirpated from Ohio (Trautman 1981).

In 1972, Dr. Andrew White, John Carroll University, found reproducing populations of Brook Trout in two headwater streams of the Chagrin River near Bass Lake, Geauga County (White personal communications; Burt 2007). These streams, Woodie Brook and Spring Brook, were found to have at least four age classes of Brook Trout and kindled interest in further investigation. Mitochondrial DNA analysis (Curtis 1998) and microsatellite DNA analysis (King 2007 unpublished data; Kazyak et al. 2022) later confirmed these fish to be wild, native remnants of the Brook Trout populations described by Kirtland (1838), Garlick (1857), Howe (1908), and Trautman (1981). The mitochondrial halotype common to hatchery raised brook Trout populations (BT1) was not present in any samples. Furthermore, these fish possessed genetic markers not seen in any of the other 10,000 wild Brook Trout tested from the eastern US, supporting the conclusion that the Brook Trout found in Ohio headwater streams of Geauga County were native wild trout of historic dispersal origin. These findings shaped perspectives for restoration efforts that would follow.

The Lake Erie drainage in northeast Ohio has been significantly and negatively impacted over the last 200 years due to deforestation, agricultural practices, industrial development, and urbanization. The Brook Trout population in Woodie Brook was no longer viable by 1993 due to residential development and Spring Brook became the only remaining native Brook Trout stream. The perilous state of NOBT prompted the Geauga Park District and other conservation agencies, organizations, and concerned citizens to purchase Spring Brook and most of the surrounding acreage in 1998, thereby protecting the last stronghold of native Brook Trout in Ohio.

Reintroduction to Potential Habitats: 1996-2006

Following confirmation of relic populations of Brook Trout in Spring Brook and Woodie Brook, plans were developed to propagate these native trout and introduce them into nearby Lake Erie drainage headwater streams where they were presumed to once occupy (Figure 2).

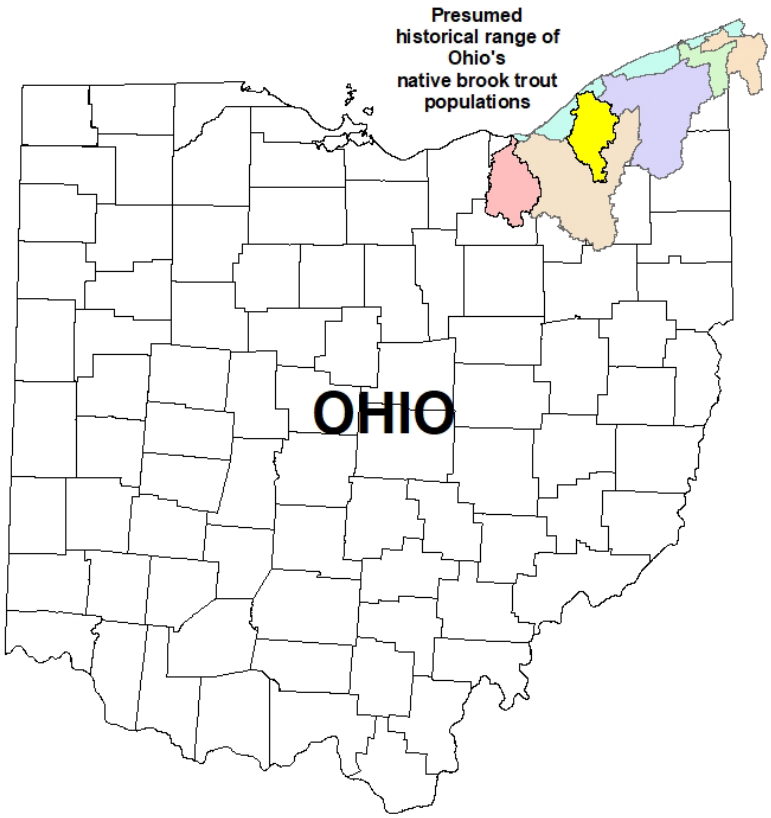


Figure 2. Probable range of NOBT populations inferred from historic literature. Watersheds include the Conneaut, Ashtabula, Grand, Chagrin, Cuyahoga, and Rocky Rivers including adjacent nearshore drainages.

The ODOW served as principal investigator of this northeast Ohio reintroduction project during 1996-2006 (Burt 2007). The project goals were to:

1. Identify and protect native Brook Trout streams and habitat within the Lake Erie drainage in Northeast Ohio;
2. Complete an inventory of potential habitat and implement a reintroduction program;
3. Increase the number of functioning native Brook Trout streams to six by 2007.

More than 100 streams within the presumed native range (Figure 2) were evaluated as possible candidates for reintroduction efforts. Beginning in 1996, 15 streams were stocked with NOBT (Table 1). Stocked trout were progeny of NOBT from Spring Brook and reared at the Castalia State Fish Hatchery. Candidate streams were selected for introductions based on consistent water temperatures less than 16 C, Sharon sandstone conglomerate, few or no other stream fish species, and a diversity of riffle-run-pool

habitats. In total, over 79,000 native Brook Trout fry were released into northeast Ohio streams from 1996 through 2003. Nine of the 15 streams were determined to have adequate fry stocking survival and were categorized as having potential for establishing self-sustaining populations. Brook Trout populations were assessed using seines and backpack electrofishing following stockings to assess survival and success in establishing naturally reproducing populations.

At the conclusion of the reintroduction project, nine streams had either small or large naturally reproducing populations and six streams failed to establish them at any level (Table 1). Although substantial protection of these Brook Trout streams had occurred over the past decade, this work suggests that the fragile nature of these streams and Brook Trout warrant continued protection and monitoring to preserve these native populations.

Table 1. Reintroduction stocking of Brook Trout in the Lake Erie drainage by the ODOW during 1996-2003 (reproduced from Burt 2007).

Stream	County	Site Length (m)	Stream Water Temperature (C)	Years Stocked and Monitored	Total Number Fry Stocked	Avgerage Stocking Rate (# / m)	Average Age-0 Survey (# / m)	Average Survival (%)	F3SM02 Brook Trout Outlook
Affelder	Geauga	365	13.8	2001-2003	10,047	9.2	0.89	9.49%	Successful - Small
Baldwin Creek		500	16.4	2001-2003	6,241	4.2	0.08	1.95%	Fail
Eklund	Geauga	378	18.3	2002-2003	3,625	4.8	0.03	0.44%	Fail
Hrabak	Geauga	261	15.2	1997-2000	1,113	1.1	0.05	6.76%	Successful - Small
Leech	Geauga	146	11.7	1997-1999	1,056	2.4	0.24	12.38%	Successful - Large
Linton Creek		661	19.4	2001, 2003	6,993	5.3	0.06	0.99%	Fail
Little Sweetly Creek		548	19.0	2002	843	1.5	0	0.00%	Fail
Mt. Glen Farms		571	17.3	2001, 2003	9,015	7.9	0.08	0.87%	Successful* - Small
Mirror Valley	Medina	837	17.4	2001-2003	8,950	3.6	0.17	5.90%	Successful - Large
Palsa	Geauga	317	16.5	2001-2003	7,437	7.8	0.37	5.49%	Successful - Small
Pebble Brook (ASM)	Geauga	475	15.8	1996-2001, 2003	6,705	2.0	0.09	4.25%	Successful - Large
Pettibone	Geauga	201	16.3	2001-2003	6,857	11.4	1.19	11.70%	Successful - Small
Pierson Stream		300	17.8	2001	1,949	6.5	0.02	0.36%	Fail
West Woods Nature Center	Geauga	327	13.3	2001-2003	2,013	2.1	0.18	9.49%	Fail*
Woodie Brook	Geauga	529	13.2	2001-2003	6,186	2.9	0.51	9.33%	Successful - Large
Spring Brook	Geauga	821	13.6	None	0	0.0	0.37	N/A	N/A

** as annotated in FSM02 Final Report - professional opinon was applied to outlook status*

Brook Trout Advisory Committee

Insights regarding NOBT genetics, stream inventories, and reintroduction efforts prompted formation of the Brook Trout Advisory Committee in 1999. This committee is comprised of federal and state agencies, local park districts, conservation organizations, and sport fishing groups to promote preservation, reintroduction, and conservation of native Brook Trout in northeast Ohio. This group met quarterly until 2015, then as needed, with attendees primarily involving agencies working on population monitoring.

Population Status Monitoring: 2009 to Present

The reintroduction project concluded with the final stocking in 2003 and the final population assessment in 2006. In 2009, ODOW and partners developed a routine monitoring plan for the newly established native Brook Trout. Streams with successful populations, classified as “large populations”, were to be assessed once every 2-3 years, streams with limited populations, classified as “small populations”, were assessed once every 3 years, and those identified as “failed” in the reintroduction project were assessed in their entirety once to confirm that no Brook Trout remained. These streams were removed from the sampling list if no Brook Trout were confirmed following full stream electrofishing coverage.

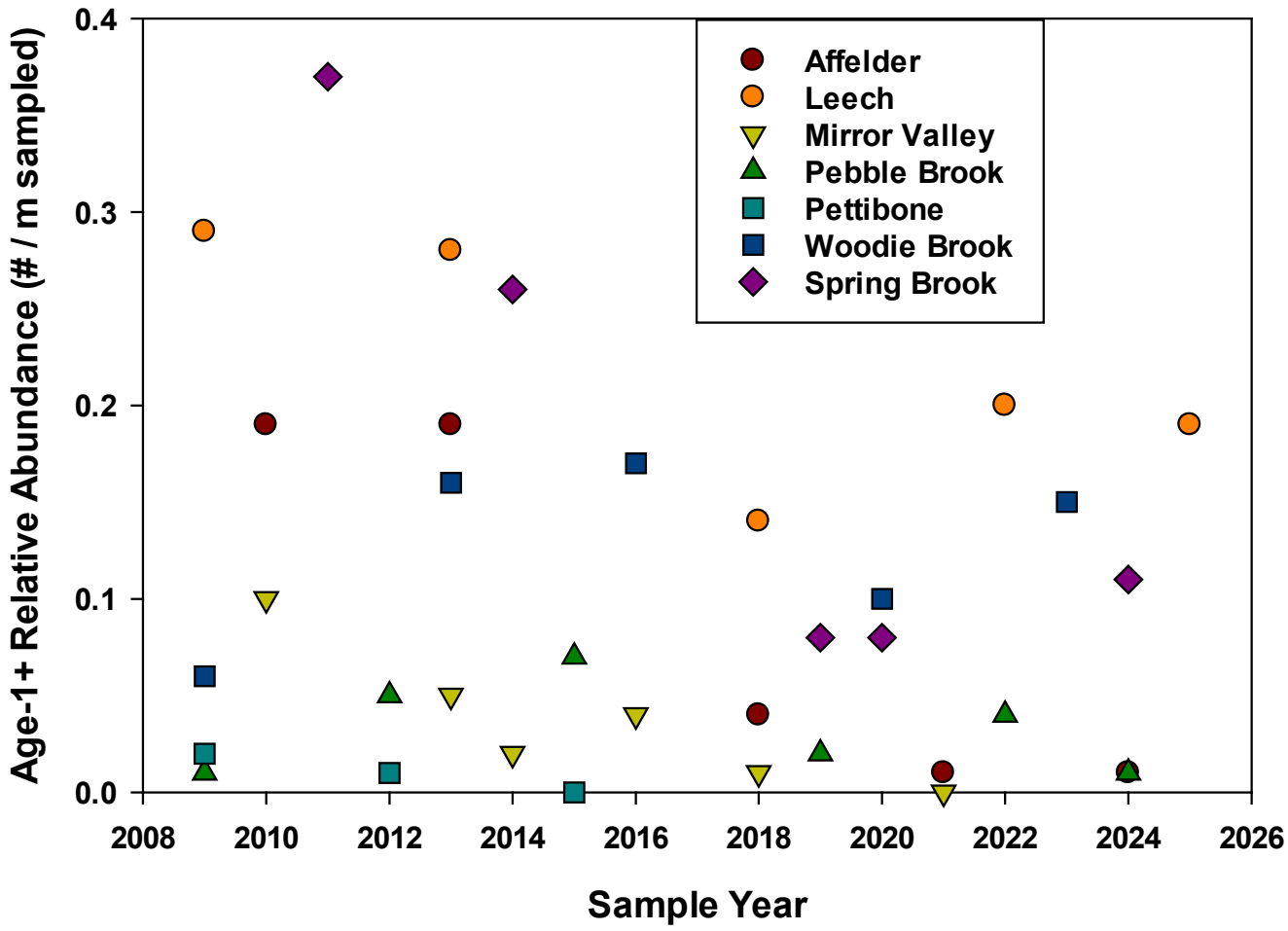
Surveys to assess populations were conducted during August to early-September prior to the Brook Trout spawning. Daytime backpack electrofishing (ETS model ABP-2, DC electrofisher with quadrapulse) was selected as the sampling method and effort was measured in distance (meters of stream electrofished). Electrofishing samples were conducted in the upstream direction, stopping at natural pool-riffle interfaces to process and release fish. In general, 50% or more of the total stream length was assessed. Relative abundance was determined as fish per meter (standard approach) and fish per quarter mile (to align with previously reported results); fish total length was used to classify individuals as age-0/juvenile (TL ≤ 110 mm) or age-1+/reproductive adults (mm > 110 mm) (Burt 2007; age-length key based on Ohio known-age observations). Water temperature at the furthest downstream and furthest upstream electrofished extent was measured during each assessment. Forty-six assessments were completed from 2009 through 2025. Non-zero catch per unit effort estimates from the first 10 years of monitoring (2009-2018) were used to establish qualitative classifications of “low”, “medium”, and “high” for age-0 and age-1+ relative abundances and all data from 2009 through present was assigned a classification (Table 2).

Table 2. Assessment of Brook Trout streams to determine population viability, 2009-2025. Qualitative classifications were derived from the 2009-2018 estimates of catch per unit effort by category. Quartiles of all non-zero estimates were used to create categories.

Stream	Date Sampled	Stream Water Temperature (C)	Distance Sampled (m)	Total Brook Trout	Age-0 Survey (#/m)	Age-1+ Survey (#/m)	Age-0 Classification	Age-1+ Classification
Affelder	8/23/2010	15.0	242	71	0.10	0.19	MEDIUM	HIGH
Affelder	8/28/2013	15.0	174	43	0.06	0.19	LOW	MEDIUM
Affelder	9/13/2018	14.0	218	9	0.00	0.04	.	MEDIUM
Affelder	9/16/2021	17.0	273	15	0.04	0.01	LOW	LOW
Affelder	9/12/2024	13.9	211	3	0.01	0.01	LOW	LOW
Baldwin Creek	8/17/2011	15.6	403	0	0.00	0.00	.	.
Eklund	8/24/2010	17.0	288	0	0.00	0.00	.	.
Hrabak	8/23/2010	16.0	312	0	0.00	0.00	.	.
Leech	10/6/2009	7.0	132	115	0.58	0.29	HIGH	HIGH
Leech	8/27/2013	14.0	98	47	0.20	0.28	MEDIUM	HIGH
Leech	9/13/2018	13.0	111	64	0.43	0.14	HIGH	MEDIUM
Leech	9/20/2022	13.1	162	52	0.12	0.20	MEDIUM	HIGH
Leech	9/17/2025	12.5	108	49	0.27	0.19	HIGH	MEDIUM
Linton Creek	Pre-2009	.	.	0	.	.	.	.
Little Sweetly Creek	Pre-2009	.	.	0	.	.	.	.
Mt. Glen Farms	10/5/2009	10.0	297	0	0.00	0.00	.	.
Mirror Valley	8/24/2010	15.0	242	67	0.18	0.10	MEDIUM	MEDIUM
Mirror Valley	8/28/2013	16.5	224	17	0.03	0.05	LOW	MEDIUM
Mirror Valley	8/20/2014	15.0	766	15	0.01	0.02	LOW	LOW
Mirror Valley	9/9/2016	.	820	31	0.00	0.04	.	MEDIUM
Mirror Valley	9/11/2018	14.0	815	8	0.01	0.01	LOW	LOW
Mirror Valley	9/8/2021	16.5	911	0	0.00	0.00	.	.
Palsa	8/19/2011	16.1	296	0	0.00	0.00	.	.
Pebble Brook (ASM)	9/3/2009	11.1	392	109	0.27	0.01	HIGH	LOW
Pebble Brook (ASM)	9/10/2012	10.5	185	37	0.15	0.05	MEDIUM	MEDIUM
Pebble Brook (ASM)	8/20/2015	16.1	343	84	0.18	0.07	MEDIUM	MEDIUM
Pebble Brook (ASM)	9/19/2019	14.0	487	25	0.04	0.02	LOW	LOW
Pebble Brook (ASM)	9/16/2022	12.6	267	10	0.00	0.04	.	MEDIUM
Pebble Brook (ASM)	9/12/2024	13.3	398	4	0.01	0.01	LOW	LOW
Pettibone	10/6/2009	9.4	351	49	0.12	0.02	MEDIUM	MEDIUM
Pettibone	9/10/2012	12.0	329	36	0.10	0.01	MEDIUM	LOW
Pettibone	8/21/2015	13.3	448	0	0.00	0.00	.	.
Pierson Stream	8/17/2011	15.6	229	0	0.00	0.00	.	.
West Woods Nature Center	9/3/2009	8.9	398	4	0.01	0.01	LOW	LOW
West Woods Nature Center	9/6/2016	12.0	199	0	0.00	0.00	.	.
Woodie Brook	10/5/2009	9.0	673	80	0.06	0.06	MEDIUM	MEDIUM
Woodie Brook	8/27/2013	13.5	67	40	0.43	0.16	HIGH	MEDIUM
Woodie Brook	9/6/2016	15.0	190	55	0.12	0.17	MEDIUM	MEDIUM
Woodie Brook	9/24/2020	15.5	285	58	0.10	0.10	MEDIUM	MEDIUM
Woodie Brook	9/7/2023	16.0	268	59	0.07	0.15	MEDIUM	MEDIUM
Spring Brook	8/19/2011	14.7	217	118	0.17	0.37	MEDIUM	HIGH
Spring Brook	8/19/2014	11.7	249	168	0.41	0.26	HIGH	HIGH
Spring Brook	9/19/2019	12.5	180	81	0.37	0.08	HIGH	MEDIUM
Spring Brook	9/24/2020	15.5	187	94	0.43	0.08	HIGH	MEDIUM
Spring Brook	9/7/2022	13.5	369	134	0.10	0.26	MEDIUM	HIGH
Spring Brook	9/11/2024	13.3	375	158	0.31	0.12	HIGH	MEDIUM

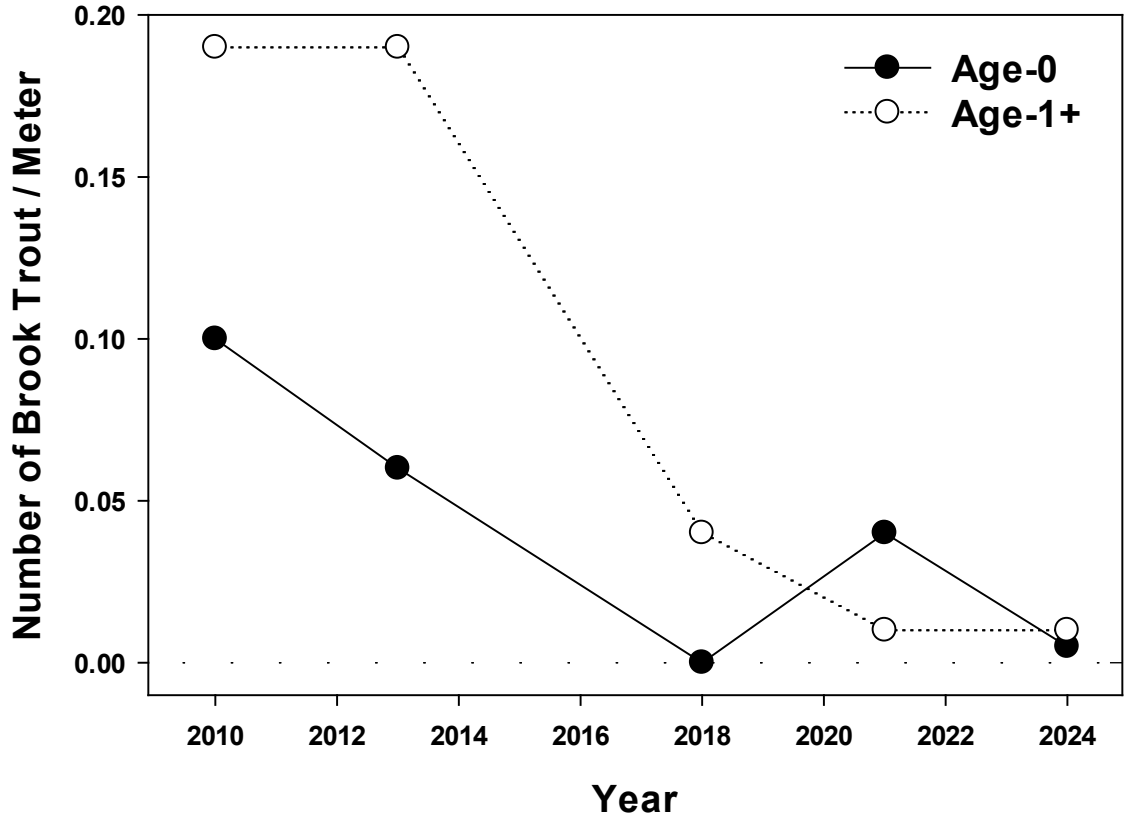
Population monitoring documented continued declines in adult abundance (Figure 3) and resultant age-0 densities from 2015 to 2025. Currently, Brook Trout persists in five streams, two of which have extremely low densities. The decline in viability of streams stocked during the 1996-2003 restoration effort and limited remaining populations prompted the ODOW to list Brook Trout as State Endangered within their native range in 2022. This prompted the ODOW, Geauga Park District, Cleveland Metroparks and other conservation partners to initiate development of this Ohio Brook Trout Conservation Plan to assist in preventing the loss of NOBT.

Figure 3. Adult (age-1+) relative abundance (# sampled per meter) of Ohio Brook Trout as assessed using standardized backpack electrofishing from 2009 – 2025. Colors and shapes delineate individual streams. Pettibon 2015 and Mirror Valley 2021 are true zeros.

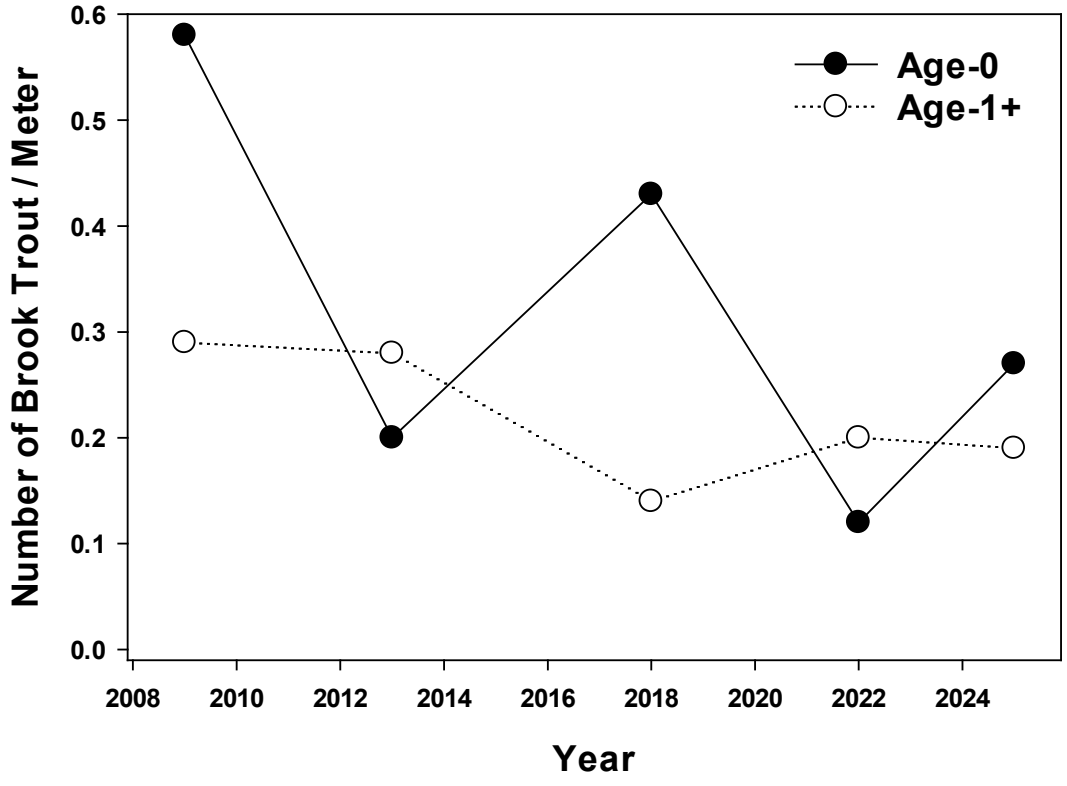


Current Populations

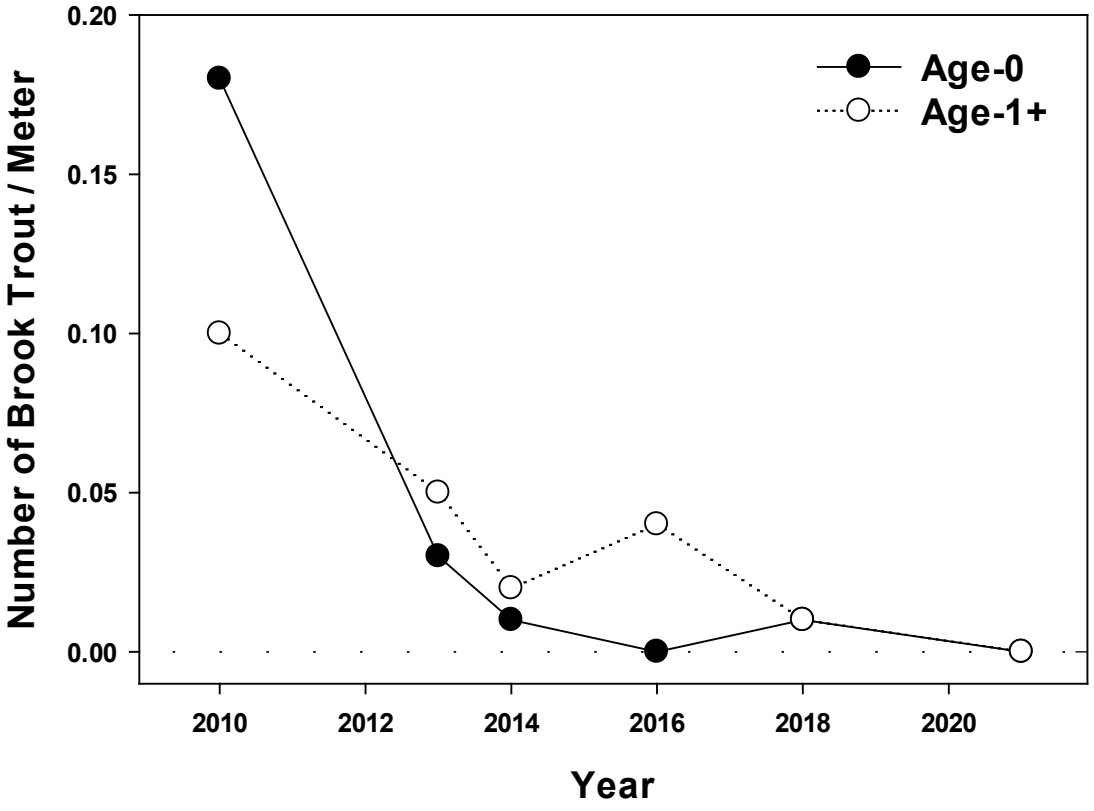
Affelder – Geauga County, Russell Township. Geauga Park District is the primary landowner within the watershed. Affelder stream flows into an unnamed tributary to Silver Creek and then into Silver Creek, of the Chagrin River system. Brook Trout were introduced to this stream from 2001-2003 and the stream did not hold Brook Trout prior to stocking. During the past 20 years, managing biologists have observed increased siltation and evidence of high energy flow pulses eroding stream banks. Habitats once dominated primarily by gravel with favorable interstitial spaces are now shifting to substrates characterized by fine sediment. Water temperatures at the time of electrofishing events have ranged from 13.9 – 17.0 C with no distinct temporal trend. Other species observed in the most recent 2024 electrofishing survey include Central Mudminnow (*Umbra limi*), Johnny Darter (*Etheostoma nigrum*), White Sucker (*Catostomus commersonii*), Blacknose Dace (*Rhinichthys atratulus*), and Creek Chub *(Semotilus atromaculatus)*. The remaining Brook Trout are confined to one deep plunge pool. The waterfall creating this plunge pool represents an absolute upstream barrier to migration. There remain so few individuals that professional speculation is that the population will become extirpated within the next 2-5 years.



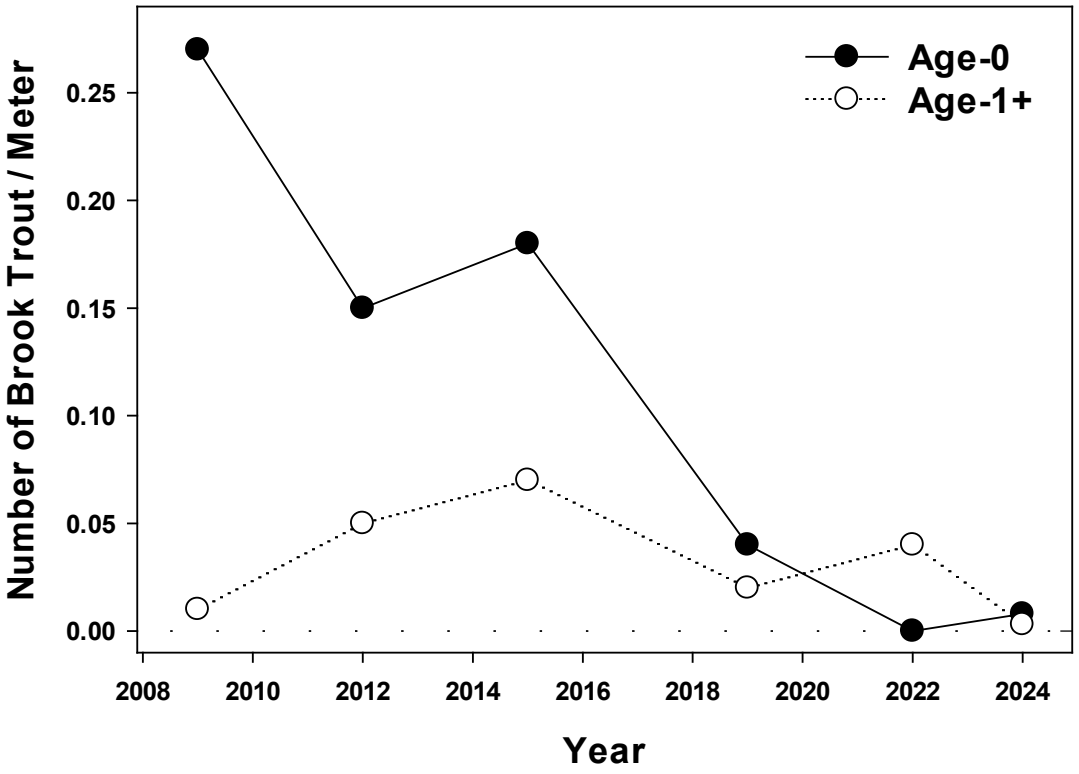
Leech – Geauga County, Munson Township. Located partly on private property nestled within a forested watershed owned primarily by Geauga Park District, the Leech stream flows into a wetland complex that drains directly to the Chagrin River. Brook Trout were introduced to this stream from 1997-1999 and the stream did not hold Brook Trout prior to stocking. During the past 20 years, managing biologists have observed relatively minor changes in the stream and adjacent watershed. Water temperatures at the time of electrofishing events have ranged from 7.0 – 14.0 C with no distinct temporal trend; the most recent 2025 survey documented 12.5 C. Other species observed during the most recent electrofishing survey include Central Mudminnow, Grass Pickerel (*Esox americanus*), and Creek Chub. Although relative abundances of juvenile Brook Trout have fluctuated across time, the inferred density of adult Brook Trout has remained relatively constant, suggesting a stable and self-sustaining population. Professional speculation is that this population will remain viable and intact over the duration of this conservation plan if the private landowners continue their conservation ethic and protection of the stream ecosystem.



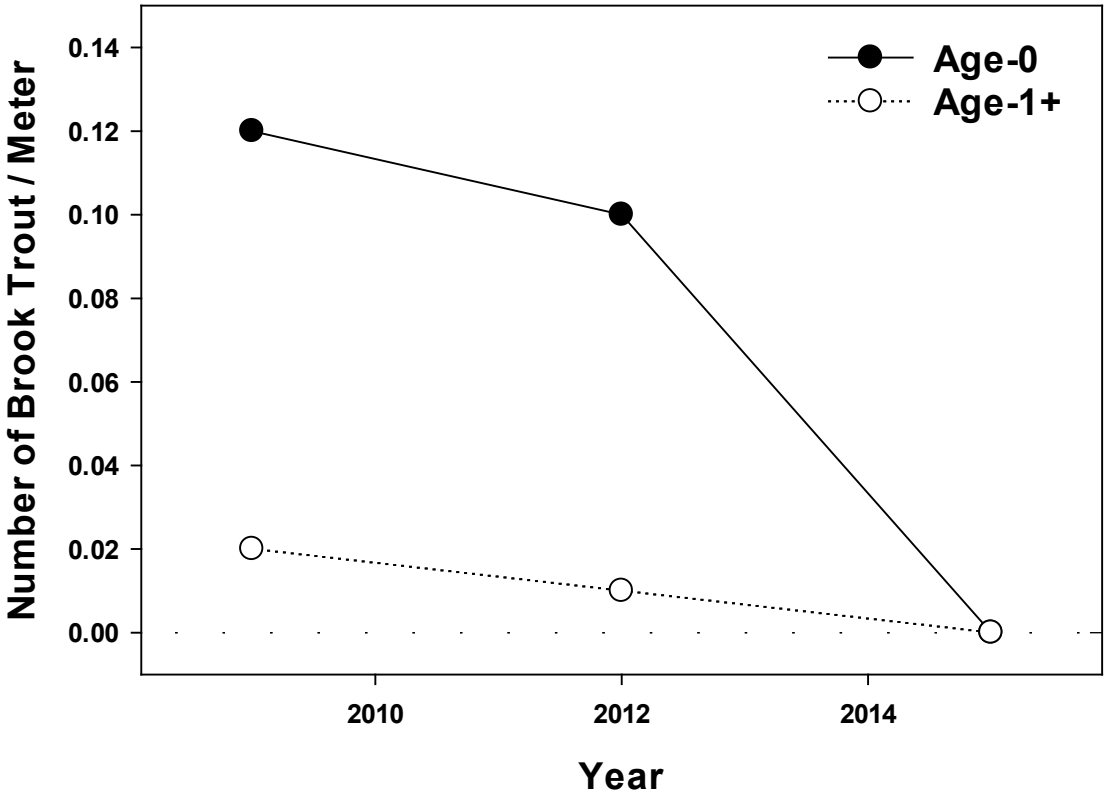
Mirror Valley – Medina County, Hinckley Township. Mirror Valley stream has a 306-acre sub-watershed with the lower 185 acres held in ownership by Cleveland Metroparks. The stream flows directly into the East Branch Rocky River in Cleveland Metroparks Hinckley Reservation. Brook Trout were introduced to the stream from 2001-2003 and the stream did not hold Brook Trout prior to stocking. During the past 20 years, managing biologists have observed a dramatic increase in sedimentation and substrate scouring with notable evidence of increased high energy pulses. In May 2014, the watershed experienced a 500-year storm event that changed the morphology of the channel in many areas. A macroinvertebrate survey in 2014 revealed only 50% of the EPT taxa present compared to a 2008 survey. These taxa did rebound back to 2008 levels by 2016. In March 2016, Hinckley Township undertook a culvert and drainage project on Bellus Road (upstream of Cleveland Metroparks property) that greatly increased sedimentation in the creek with resulting stormwater runoff. Water temperatures at the time of electrofishing events have ranged from 14.0 – 16.5 C with no distinct temporal trend. After the dramatic decline in both adult and juvenile relative abundances between the 2010 and 2012 electrofishing events, the population size remained low, and evidence of natural reproduction ceased by 2018. No individuals were observed in the most recent, 2021 sampling event and the population is considered extirpated.



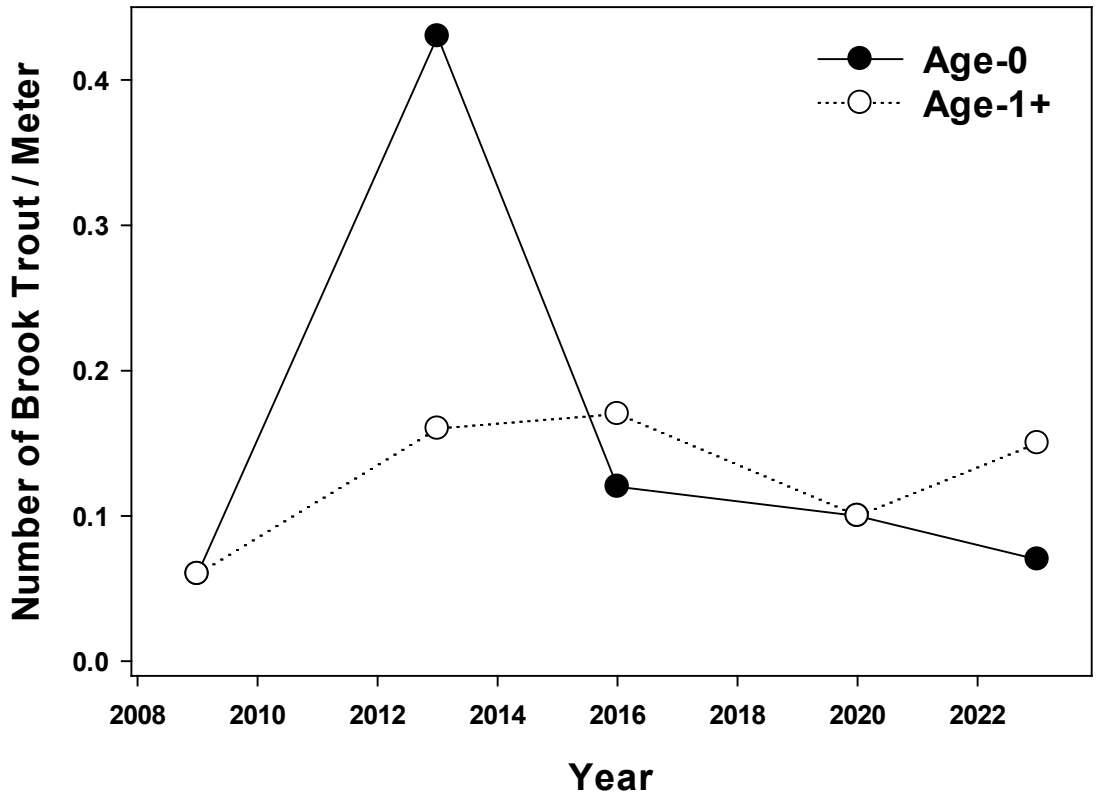
Pebble Brook (ASM) – Geauga County, Russell Township. Originates to the northeast in residential parcels and flows into an 800-acre Geauga Park District West Woods Reservation parcel just bordering the American Society of Metals (ASM) property. Pebble Brook flows into Silver Creek which flows to the northwest, joining the Chagrin River. Despite much of the stream flowing on protected park property, the waterway is highly influenced by residential and road runoff. Water temperatures at the time of electrofishing events have ranged from 10.5 to 16.1 C. Excluding the highest (taken in August in 2015), the data does show a general warming trend across time, suggesting increasing influence from surface runoff. Brook Trout were introduced to this stream from 1996 through 2003. Standardized electrofishing assessments show are steady decline in the relative abundance of both juvenile and adult Brook Trout in this system with the most recent 2024 survey indicating an extremely low population. Professional speculation is that the population will soon become extirpated. Other species observed during the most recent electrofishing survey include Creek Chub, Blacknose Dace, and White Sucker.



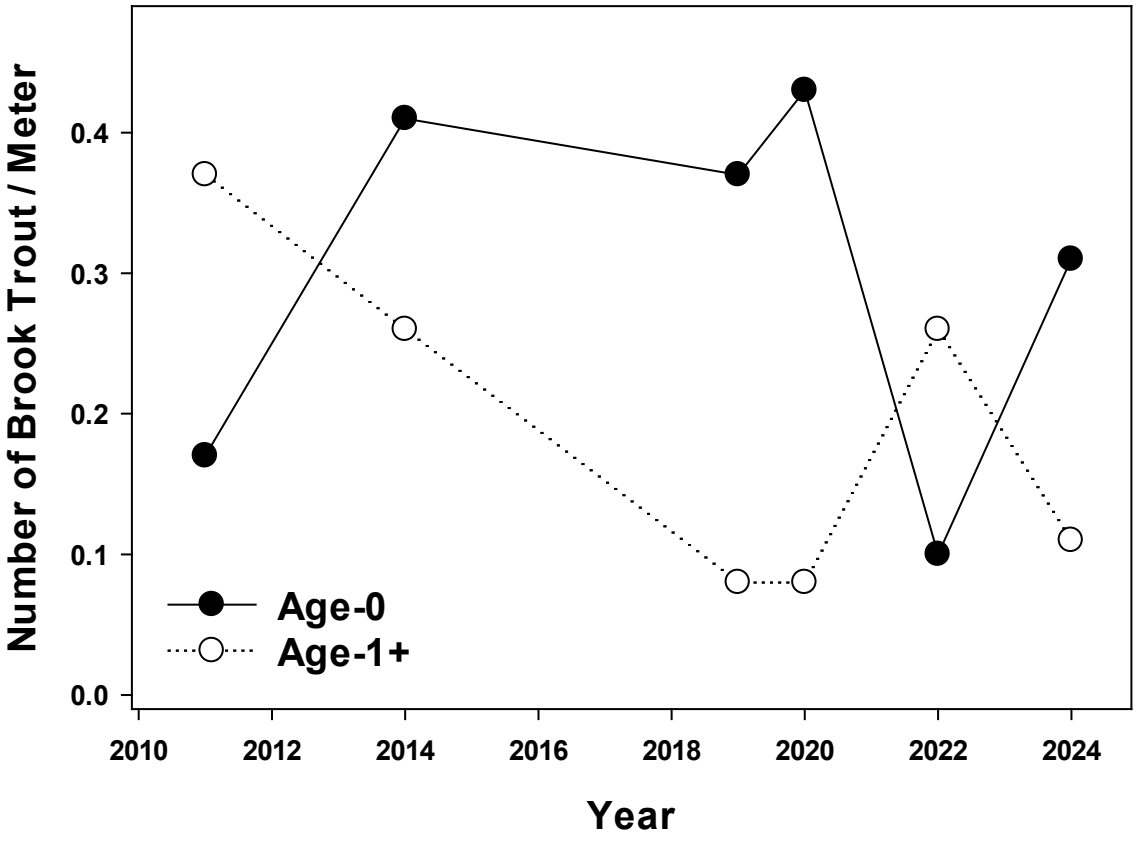
Pettibone – Geauga County, Newbury Township. Flowing entirely through private properties from its origin 0.5 km south of Silver Creek – a direct tributary to the Chagrin River, the Brook Trout persisted downstream of a pond and upstream of an open field, in a small, 24-acre wooded parcel. Water temperatures at the time of electrofishing events ranged from 9.4 to 13.3 C, consistently increasing over time. During the summer of 2015, the immediate area received two separate 100-year precipitation events that caused severe, localized flooding and damage in the region. A site visit after these rains revealed a stream that had no resemblance to the pre-storm system and was completely scoured with all pebbles and gravel substrate washed away. No Brook Trout were observed during the 2015 electrofishing sample, and the population is considered extirpated.



Woodie Brook – Text here. Geauga County, Munson Township. Woodie Brook is a small tributary to the Chagrin River headwaters and Bass Lake. The tributary enters a wetland complex upstream of the north shore of Bass Lake, flowing through a mix of private parcels and Geauga Park District property along the ~1 km extent. 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, one of these being Woodie Brook. Genetic analyses subsequently confirmed that these fish were indeed NOBT – likely the populations described by earlier naturalists such as Kirtland, Garlick, Howe, and Trautman. Significant impacts from deforestation and residential development caused Woodie Brook to be lost as a viable population by 1993. Stream restoration/reconstruction work was implemented in the early 2000s, and Brook Trout were reintroduced into Woodie Brook from 2001 through 2003, with the majority being introduced in 2002 and 2003 fully post-stream restoration. Water temperatures at the time of electrofishing events do show some signs for concern. From 2009 through 2023 (5 sampling events), water temperatures have steadily increased from 9.0 to 16.0 C, with increases at each time-step. Other fish species encountered during the most recent electrofishing event included Green Sunfish, Grass Pickerel, Blacknose Dace, Creek Chub, and Central Mudminnow. Current data suggests the population of NOBT is stable.



Spring Brook – Text here. Geauga County, Munson Township. Spring Brook flows into Bass Lake after traversing through primarily protected nature preserve property. An elevated culvert within 150 m of Bass Lake prevents lake/warmwater species from advancing upstream in Spring Brook. The extreme headwaters lie on private property north of Wilson Mills Road. Spring Brook is the only identified stream in Ohio that has continuously been inhabited by NOBT. Discovered by Dr. Andrew White in 1972, the Brook Trout in Spring Brook were confirmed genetically to be non-hatchery origin and presumed native from the post-glacial era. Spring Brook served as the source population for the propagation component of the 1996-2006 reintroduction project. No hatchery-reared NOBT were stocked back into Spring Brook during the reintroduction project. Water temperatures at the time of electrofishing events have ranged from 11.7 to 14.7 C with no distinct temporal trend. The three most recent events had only 1 C range (12.5-13.5 C). Receiving drainage from Wilson Mills Road, Spring Brook has experienced roadway runoff pollution events, and this remains the most notable threat. Associated with road runoff is increased energy and erosion during high precipitation events. Consequently, a stream renovation project was completed in 2021 restored ~800 linear feet of cold-water stream using natural channel design and bioengineering including riffle-pool complexes, placement of boulder, woody debris, and log revetments, and riparian invasive species treatment. Although the population has shown notable variable in age-0 and age-1+ relative abundances, the population remains sustainable. No additional fish species were detected during the most recent electrofishing survey.



Current Population Threats

NOBT face persistent threats from land use changes, increased surface water inputs, changes in habitat associated with increased summer temperatures and precipitation frequency, and other factors. Watersheds of NOBT are primarily forested. However, residential and commercial development continues to increase and change the landscape. Future planning should strive to raise awareness of the sensitivity of these watersheds to increased impervious surface creation and deforestation. Development should include steps to protect critical riparian areas and groundwater sources in these and other cold-water streams within the vicinity of native Brook Trout as part of comprehensive conservation priorities.

Surface water inputs and intensity of precipitation also appear to be increasing in watersheds of native Brook Trout streams. Increased surface water inputs have resulted from newly installed culvert pipes and from the regrading of county ditches that direct and concentrate surface waters into these streams. Several alarming incidents have occurred in which point-source run-off has been a direct and immediate threat to NOBT. These effects are compounded by increased frequency and intensity of storm events anticipated with climate change. In one recent case (Pettibone stream, 2015), several inches of precipitation fell within only a few hours and much of the stream's substrates was washed downstream. Subsequent fish surveys have since failed to detect any Brook Trout where once there was a viable population.

In addition to changes in watershed land use and shifts in weather patterns, more than 20 years of monitoring native Brook Trout streams has indicated noticeable increases in the presence and abundance of warmwater fishes in these waters. Aggressive and potentially competitive species such as Creek Chub and Green Sunfish (*Lepomis cyanellus*) have increased in certain streams in which Brook Trout have declined. In addition, juvenile Steelhead Trout (*Oncorhynchus mykiss*) may also have potential to compete with Brook Trout for resources if they become established in native Brook Trout headwater streams. Invasive earthworms may also affect forest ecosystems as they compact riparian forest soils and change water permeability, increasing impervious surfaces. This effect, combined with more intense rainfall events, could exacerbate unfavorable conditions for Brook Trout.

Conservation of Native Ohio Brook Trout: 2026-2035

Preventing the loss of Ohio Brook Trout from their native range is paramount. To this end, the Brook Trout Advisory Committee seeks to: 1) protect, restore, and create new habitat for NOBT; 2) maintain and expand Brook Trout populations within their native range; and 3) expand educational outreach. These efforts are best facilitated through an agreed-upon organizational structure, private and public partnerships, grants to support programs, and leverage of the statutory authority and responsibilities of resource agencies and park districts. Given these interests, collaborative partnerships that focus on the strength of those engaged will allow us to better achieve our common goal through ideas proposed over the next 10 years (2026-2035).

Habitat Protection and Restoration. Habitat is paramount to preventing the loss of NOBT. The Ohio population persists on the fringe of the historical range of eastern Brook Trout in North America and anticipated habitat changes are essential considerations. The desired outcome, or goal, necessary to allow Brook Trout to persist in the face of continued development in Northeast Ohio and concerns regarding trends in climate is the foundation for the future of these populations.

Outcome 1: Sufficient habitat is available to support self-sustaining Brook Trout within their native range.

Objective 1.1: Restore or improve habitat in streams with existing populations by 2035.

Strategy 1.1: Improve stream habitat in those streams with existing populations by removing as many surface water inputs/influences as possible, deepening and creating better pool habitat, incorporating more woody debris cover, creating more complex habitat for fry and juvenile fish (e.g., riffles and runs).

Objective 1.2: Identify at least three new opportunities (streams) to protect, restore, or construct cold-water habitat by 2035.

Strategy 1.2: Use cold-water sources to create new or improve existing stream reaches that were previously unsuitable for Brook Trout and task the Advisory Committee to maintain an up-to-date list of locations and maps with potential projects.

Objective 1.3: Identify high-priority areas where specific land use threats exist and seek grants to mitigate these threats by 2030.

Strategy 1.3: Mitigate increased surface water influences, re-route or remove direct surface water influences (e.g., ditches, culvert pipes, etc.) within key areas, minimize development of new impervious surface creation, and pursue grant funding for management of stormwater influences.

Objective 1.4: Acquire or protect through conservation easements or riparian setback zoning, lands in the immediate watersheds where each of the existing populations of Brook Trout are currently found (Affelder, Leech, Pebble Brook, Woodie Brook, Spring Brook).

Strategy 1.4 A: Future planning should strive to raise awareness of the sensitivity of forested watersheds to impervious surface creation and deforestation through steps to assure protection

of riparian areas and groundwater sources, prioritized as follows:

- Proximity to known protected Brook Trout streams.
- Fully protecting known (current or historic) Brook Trout watersheds
- Potential connectivity between Brook Trout streams or other cold-water systems.
- Other known cold-water streams within the vicinity of native Brook Trout populations (should become future conservation priorities).

Strategy 1.4 B: Maintain accurate records of previously assessed streams and develop an up-to-date database to aid in guidance/updates on regional opportunities for land protection.

Objective 1.5: Identify partnerships for stream monitoring and habitat improvements on each of the streams with viable populations by 2030.

Strategy 1.5: Take advantage of opportunities for volunteer organizations to help with stream monitoring and habitat restoration projects. Local schools, sportsman and conservation clubs, local citizen scientists, and other interested entities should be considered as potential valuable resources to aid in assessing and improving Brook Trout populations and habitats.

Objective 1.6: Develop a science-based prospectus on the potential impacts of climate change on NOBT populations by 2035.

Strategy 1.6 A: Future climate change models suggest that native Brook Trout are at high risk of deleterious impacts; therefore, a rigorous literature review of stressors could include:

- Length of low-flow seasons will be extended (drier seasons).
- Increases in peak flows (more extreme weather events) that accelerate stream erosion and scouring. Especially during critical months.
- Increases in winter high-discharge events are predicted to lead to higher frequency of recruitment failures for fall spawning Brook Trout.
- Increases in stream temperatures.
- Negative land use changes (riparian forest loss, increased direct stormwater inputs, new impervious surface creation, development, etc.).
- Potential interruptions of avenues for connectivity
- Competition and impacts from other species.

Strategy 1.6 B: Develop a white paper(s) of potential climate adaptation strategies:

- Land protection/acquisition/conservation easements that protect cold-water habitat and most especially for known native Brook Trout streams.
- Conservation and protection of entire watersheds that protect known native Brook Trout populations to the greatest extent possible.
- Key groundwater inventory and protection.
- Protect headwater streams as potential climate change refugia.
- Prioritize restoration projects and land management that improve stream resilience (e.g., increase forest-shaded habitat, restore natural floodplains, increase capacity to absorb and dissipate flows, and recharge aquifers).
- Identify areas of increased resilience where native Brook Trout are most likely to persist over time. This will promote focused and effective land conservation efforts and habitat enhancement projects.

- Charge the Advisory Committee with determining which management actions may be most beneficial to native Brook Trout so efforts can be tailored to maximize persistence and resiliency.

Population Monitoring and Assessment. Population monitoring and assessment is an essential means to track trends in populations and determine the success of management actions; therefore, routine fish and habitat surveys are considered important on streams with existing populations and adjacent waters.

Outcome 2: Population trends and associated metrics of native Brook Trout are up to date on all streams with established populations.

Objective 2.1.: Populations of native Brook Trout are surveyed bi-annually in streams with self-sustaining populations to monitor success of natural reproduction and recruitment.

Strategy 2.1 A: Document a standardized protocol for Brook Trout population assessment and stream habitat monitoring. Consider assessment of stream habitat (e.g. HHEI/QHEI) each time the Brook Trout population is monitored.

Strategy 2.1 B: Monitoring existing populations will help prioritize where active management or augmentation of fish should be considered. Routine monitoring will improve understanding of stream reaches and watersheds with viable populations and provide insights about how to best manage those areas. These results may also allow biologists to understand which stream sections are not being used, track trends in degradation, and provide insight into impediments to recovery. Methods to continue to monitor populations may include:

- Electrofishing surveys during August and September;
- Identifying individuals or cohorts using marking techniques (tagging);
- Explore the use of telemetry equipment for tracking movement and habitat use.

Strategy 2.1 C: Develop gear comparison methodologies to determine the relationship between catch metrics obtained using the established ETS model ABP-2 backpack electrofisher purchased new in 2000 and the newer ETS ABP-4-MR Pulsed DC electrofisher purchased by the Ohio Division of Wildlife in 2025 to allow continuation of standardized dataset through gear transition.

- Use juvenile Rainbow Trout (*Oncorhynchus mykiss*) in Lake Erie tributaries as a surrogate species to obtain comparison data without submitting ONBT to undue sampling pressure.

Objective 2.2.: Databases of existing Brook Trout population assessment data and reintroduction candidate stream investigations are maintained by cooperating partners within the native range of Ohio Brook Trout to provide data repository and surveillance records of potential restoration streams.

Strategy 2.2 A: Standardized Brook Trout electrofishing assessment data are to be stored in the Ohio Division of Wildlife's Ohio Fisheries Information System (OFIS) database and available to all partners.

Strategy 2.2 B: Many Northeast Ohio streams within the native range of Brook Trout were assessed as potential candidates for introductions during prior years. A database of fish,

habitat, or temperature surveys conducted regionally should be updated and maintained using a Geographic Information System (GIS) and regularly reviewed and updated among conservation organizations to identify and assess potential new Brook Trout streams for restoration.

Site-specific Management Plans. Habitat considerations, potential management actions, and routine data collections can be leveraged to develop site-specific management plans for high-priority streams. Such plans could be reviewed on a regular basis by the Advisory Committee to facilitate grant opportunities and collaborative work.

Outcome 3: Site-specific management plans are maintained for each self-sustaining population.

Objective 3.1: Management plans are developed for each stream with a self-sustaining population by 2030.

Strategy 3.1: Management plans developed by the Advisory Committee for each stream with self-sustaining populations will include:

- Site history and background with the first record, type of site, and ownership.
- Site description will include watershed drainage and groundwater maps, habitat types, and water chemistry descriptions.
- Survey and demographic summaries including the surveys completed (e.g., specific sampling type, years), time of year, level of effort to complete the survey, annual population estimates, sex ratios (if available), age and stage histograms, genetic information (if available), and survey plans going forward.
- Conservation issues such as the current level of watershed protection, known watershed degradation, habitat fragmentation, inter-specific species competition, pollution, diseases, and other issues.
- Current management, implementations, recommendations for continued conservation efforts, updates to current and future habitat protection needs, habitat management, competitive species management, collection, poaching education, management, population augmentation, and other items.

Augmenting and Establishing Populations. Establishing new populations within the native range by translocating fish from existing self-sustaining populations, developing in-situ propagation methods, or stocking hatchery produced fish of this genetic linage may afford additional protection to existing populations. These approaches would expedite the development of new sustainable populations.

Outcome 4: Increase the number of self-sustaining Brook Trout populations within the native range.

Objective 4.1: Establish one new self-sustaining population (maintaining 6 total) of native Brook Trout within the native range by 2035.

Strategy 4.1: Potential candidate stream sites would have the following data prior to consideration for reintroduction:

- Water temperature data profiles will be acquired during the summer months under an established and consistent protocol.
- HHEI/QHEI assessment (OEPA protocol and score);
- An electrofishing assessment will be performed to document the fish community

following established protocols such as headwater IBI or similar.

When a particular stream is determined to be a good candidate then managers will determine:

- Timeline;
- Source stock(s), numbers /ages needed;
- Key agencies involved and logistics;
- Monitoring program to determine success/failure.

Objective 4.2: Develop a source of native Brook Trout for stocking through reliable trap-and-transfer, in-situ propagation, or by developing production capacity in a hatchery environment by 2030.

Strategy 4.2: Investigate production capacity within an established aquaculture facility through one or more approaches, including:

- Identify current specific projects and anticipate future needs (e.g., stocking numbers and sizes) for new NOBT and explore new stocking opportunities.
- Determine the suitability of existing populations to provide sufficient fish for a trap-and-transfer stocking program.
- Explore the aquaculture production potential to determine the feasibility of rearing fish in a private or public facility following state aquacultural guidelines.
- Develop long-term plans for sustainable trap-and-transfer from wild streams or production in an aquaculture facility.

Genetic Integrity of Native Ohio Brook Trout. NOBT are genetically unique and worthy of conservation efforts (Curtis 1998; Kazyak et al. 2022; King, unpublished data), with genetic profiles for this species at Brook Trout Explorer: http://bte.ecosheds.org/ . Ideally, this lineage is maintained through local conservation efforts, but this may become more challenging over time. Considerations may be necessary to proceed by means that facilitate potential for adaptation to anticipated environmental changes.

Outcome 5: The genetic integrity of NOBT is preserved within its native range.

Objective 5.1: Outcomes 3 and 4, above, are engaged with strategies focused on a full appreciation of maintaining the genetic integrity of NOBT during every step taken in developing management plans and implementing stocking through fish transfer or hatchery production.

Strategy 5.1 A: Fish used to augment or introduce populations for restoration within the native range are obtained from existing, naturally reproducing populations.

Strategy 5.1 B: Hatchery produced fish stocked to augment or introduce populations for restoration within the native range must be sourced from native Ohio broodstock.

Objective 5.2: Conduct research to evaluate the genetic composition of Brook Trout populations from northeast Ohio as compared to other regions and determine best conservation strategies to encourage genetically diverse populations representing Ohio's endemic lineage by 2035.

Strategy 5.2 A: Engage geneticists to identify techniques for preserving the genetics of the Ohio

lineage, specifically:

- What is necessary to preserve the Ohio lineage?
- What might be the genetic composition of new, if necessary, founder populations?
- Which streams might best serve as sources of genetic material?
- Explore species survival programs (SSPs) among other imperiled fishes.

Strategy 5.2 B: Identify any other institutions that would be interested in participating in breeding of Brook Trout and moving identified founder animals to those institutions for said purposes. Individual trout would need to then be tested for infectious diseases, maintained in isolation from other animals, and follow all ODNR approved biosecurity measures.

Organizational Structure (The Ohio Brook Trout Advisory Committee). The Brook Trout Advisory Committee (OBTAC) should be maintained as a working group to facilitate partnership efforts, the acquisition of grants, and public outreach. The strength of the Advisory Committee has been the passion of the individuals involved with NOBT conservation. For more than 20 years, these individuals have developed partnerships that have resulted in cooperation between their respective individual agencies and conservation organizations towards a shared goal. This has resulted in continued collaboration to protect native Brook Trout in Northeast Ohio and educate the public about their imperiled status using educational exhibits, articles, and lectures by multiple members. A key role of this group should also be the implementation and monitoring of this plan through the partnership.

Outcome 6: The OBTAC is fully engaged in preventing the loss of Ohio Brook Trout from their native range.

Objective 6.1: Identification of leadership, a formal committee charter, identification of responsibilities and roles of membership, and roles in plan implementation and monitoring are established for the OBTAC by 12/31/2027.

Strategy 6.1: OBTAC strategies may include the following:

- The OBTAC will meet a minimum of two times per year.
- Members will include governmental management/regulatory agencies and other conservation organizations.
- This committee will provide technical expertise and guidance for future NOBT projects and other coldwater conservation aimed at Brook Trout conservation.
- Continue to build partnerships among landowners/managers, academia, *ex- situ* conservation organizations (e.g., zoos), and others in the conservation community to address conservation issues specific to NOBT.
- One or more OBTAC representatives regularly attend meetings of The Lake Erie Allegheny Partnership for Biodiversity (L.E.A.P.).

Objective 6.2: Information from the Eastern Brook Trout Joint Venture is provided to the OBTAC on an annual basis by an OBTAC participant in the EBTJV.

Strategy 6.2: Select one or more members of the OBTAC to participate in the EBTJV and assume responsibilities for active participation and communication.

Objective 6.3: OBTAC attends at least 3 club, organization, or local governance meetings (e.g., native

fish conservation organizations, conservation clubs, local schools, township trustees) and organizes at least one field trip each year for community groups and interested citizenry to provide education and outreach regarding Brook Trout in Ohio.

Strategy 6.3 A: Identify key contacts for clubs and organizations and begin annual engagements including presentations and field activities.

Strategy 6.3 B: Engage local municipality governance (e.g. township and county officials)

Objective 6.4: An OBTAC sub-committee is established by 2027 to seek funding opportunities to support restoration, education, and outreach needs identified in this plan.

Strategy 6.4: Organize a sub-committee that initially focuses on securing competitive (e.g. NGO and governmental grants) and partnership (e.g. private donors and foundations) Brook Trout focused funding for:

- Land protection, acquisition, and conservation easements that protect coldwater habitat.
- Restoration projects on coldwater habitat streams.
- Fish production within an aquaculture (e.g., fish hatchery) environment.

Objective 6.5: A OBTAC sub-committee completes a literature review of NOBT by 2029.

Strategy 6.5: Organize an OBTAC sub-committee to focus solely on developing a thorough literature review on NOBT or contract a review through a sponsored research partner with OBTAC oversight.

Objective 6.6: Representatives of the OBTAC review and update this Brook Trout Conservation Plan document.

Strategy 6.6: A sub-committee of the OBTAC starts a review and edit of this document in 2033 with a completion date of 12/31/2035. The review should include an evaluation of accomplishments, new and renewed Outcomes and Objectives, and other inclusions that respond to adaptive management and conservation. The revised plan should cover 2036-2045.

Citizen Science: Education, Outreach and Engagement. Educating the public about the important role of native Brook Trout in Ohio may be facilitated by citizen science programs and partnership engagement.

Outcome 7: The local community is informed about the importance of NOBT and actively involved in projects to protect or reintroduce Ohio Brook Trout into local streams within the native range and monitor their success.

Objective 7.1: Steps of this plan are used to build the foundation of a citizen science-based project focused on Brook Trout conservation within their native range by 2035.

Strategy 7.1: A citizen science project can involve water quality monitoring and biological data collection to contribute to Brook Trout conservation efforts.

Objective 7.2: An educational exhibit creating awareness of NOBT is established at one or multiple

zoos, aquaria, or nature centers within the presumed native range by 2030.

Strategy 7.2: Work within existing relationships to explore the potential for creating and maintaining a NOBT exhibit.

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