Appendix H: Whittlesey Creek Brook Trout Experiment

AN EXPERIMENT TO ESTABLISH A SELF-SUSTAINING BROOK TROUT POPULATION IN WHITTLESEY CREEK THAT EXHIBITS A MIGRATING LIFE HISTORY (COASTER) BY STOCKING, ENACTING PROTECTIVE REGULATIONS AND IMPLEMENTING HABITAT IMPROVEMENTS

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Fishery Resources Office and Whittlesey
Creek National Wildlife Refuge
&
Wisconsin Department of Natural Resources
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BACKGROUND

Whittlesey Creek is a 5.2-mile tributary to Lake Superior in Bayfield County located at the head of Chequamegon Bay west of Ashland, Wisconsin. There are two named tributaries to Whittlesey Creek, the North Fork of Whittlesey Creek and Little Whittlesey Creek. Whittlesey has a surface drainage watershed of approximately 4900 acres (Johannes et al 1970). The watershed has two main soil regions consisting of mainly sand or clay.

The sand portion of the basin (upstream of the headwaters) is dominated by forest cover, most of which lies within the Chequamegon National Forest. This region consists of a very deep layer of sands (at least a couple of hundred feet deep) where any precipitation that falling here quickly penetrates the ground and enters the deep aquifer of Whittlesey Creek. Faith Fitzpatrick of the United States Geological Survey has estimated that the recharge cycle (estimated time for precipitation that falls in this sand region to reach the stream) is in the neighborhood of 90 years (Faith Fitzpatrick, personal communication, 8505 Research Way, Middleton, Wisconsin 53562). This creates a situation where Whittlesey Creek receives a very stable base flow from this groundwater source (approximately 16 cfs.). The great majority of this water enters the stream reach located from about a quarter mile upstream of the junction of the Mainstem and the North Fork to about a half-mile downstream of the forks.

The second major soil region, consisting of mainly steeply sloping impervious clay soils, encompasses the drained portion of the watershed. The great majority of this region is in private ownership either in field, pasture or forest. The clay soils of this region are very impervious and shed water very quickly to the stream. Precipitation runs off this clay region so quickly that the USGS described surface runoff rates as ‘urban-like’ (Bernard Lenz, personal communication, Northwest Field Office, Rice Lake, Wisconsin 54868). A typical snow-melt or rainfall event can increase volume of flow by 15 to 20 times in a few hours while more severe events in recent years have amplified flows by up to 40 times base flow (USGS, 1999). These peak flood events cause severe bank erosion, destabilizing spawning substrates, and accelerating sedimentation.

Whittlesey Creek provides valuable spawning and rearing habitat for resident and migratory trout and salmon. Whittlesey Creek is listed as having Class I trout water on 4 miles of the main stem from Lake Superior to the junction of North Fork and 1.8 miles on the North Fork from the junction with Whittlesey Creek to Cozy Corner Road (WIDNR 2002). Upstream of Cozy Corner Road there is 1 mile of Class II trout water (WIDNR 2002). Brook trout abundance and distribution was determined during surveys conducted by Wisconsin DNR in 1977 and by Wisconsin DNR and the Service in 2001 and 2002. Comparative data from these surveys indicates that abundance declined 70% from 1977 to 2001. Population estimates from 6 common survey stations were 184 in 1977 and 56 in 2001. In the 2 stations (Stations 4 and 5) for which population estimates were made in 1977, 2001 and 2002 brook trout population estimates were 79, 27, and 11, respectively. The apparent decline in abundance may be a result of in-stream habitat changes caused by floods over the 24-year time period between surveys.

Whittlesey was historically an important brook trout stream whose populations probably declined by the turn of the century. We assume (although there is no documented evidence yet) that at least some of the settlement period (late 1800's) brook trout may have migrated to Chequamegon Bay and exhibited lake growth (coaster). The first official record of brook trout stocking took place in 1916 and stocking continued sporadically until the early 1990's (Table 1).

We presently lack important information regarding the question, 'what creates the coaster phenotype or life history'. We note a few of the numerous explanations of which we are aware, and acknowledge that there are undoubtedly more. All can be supported given our current level of understanding.

Table 1. History of stocking in Whittlesey Creek (compiled by Wisconsin DNR).

Year	Date	Location	Species (strain)	Size	Number
1916	May 29	Whittlesey	Brook Trout	Advanced Fry	10800
1916	May 29	North Fork	Brook Trout	Advanced Fry	3600
1916	June 23	Whittlesey	Rainbow Trout	Advanced Fry	6400
1916	June 23	North Fork	Rainbow Trout	Advanced Fry	6400
1917	May 30	Whittlesey	Brook Trout	Advanced Fry	3600
1917	May 30	North Fork	Brook Trout	Advanced Fry	3600
1921	April 1	Whittlesey	Brook Trout	Fry	3600
1928	No date	Whittlesey	Brook Trout	Fingerling #3	28000 (Up to)
1929	July 18	Whittlesey	Brook Trout	Fingerling	5600
1933	Sept. 9	Whittlesey	Rainbow Trout	Yearling	3000
1933	June 26	Whittlesey	Brook Trout	Fingerling #3	1600
1935	June 10	Whittlesey	Brook Trout	Fingerling	21250
1935	August 7	Whittlesey	Brook Trout	Fingerling	15000
1936	Sept. 24	Whittlesey	Brook Trout	Fingerling	18000
1938	No date	Whittlesey	Brook Trout	Fingerling	13675
1939	No date	Whittlesey	Brook Trout	Fingerling	20815
1940	No date	Whittlesey	Brook Trout	Fingerling	25060
1941	No date	Whittlesey	Brook Trout	Adults	14
1941	No date	Whittlesey	Brook Trout	Fingerling	15000
1941	No date	Whittlesey	Brook Trout	Yearling	845
1942	No date	Whittlesey	Brook Trout	Fingerling	7650
1942	No date	Whittlesey	Brook Trout	Yearling	300
1943	No date	Whittlesey	Brook Trout	Yearling	682
1944	No date	Whittlesey	Brook Trout	Yearling	1000
1946	No date	Whittlesey	Brook Trout	Fingerling	6500
1947	No date	Whittlesey	Brook Trout	Fingerling	6800

1948	No date	Whittlesey	Brook Trout	Fingerling	7600
1949	No date	Whittlesey	Brook Trout	Fingerling	4800
1950	No date	Whittlesey	Brook Trout	Fingerling	4500
1971	May 17	Whittlesey	Brown Trout	6.8 per pound	20000
1972	May 18	Whittlesey	Brown Trout	6.2 per pound	12500
1972	May 17	Whittlesey	Brown Trout	6.3 per pound	7500
1973	May 16	Whittlesey	Brown Trout	6.7 per pound	20000
1994	No date	Whittlesey	Brown Trout (L. Nipigon)	Yearling (Ad clip)	500
1994	No date	Whittlesey	Brook Trout (L. Nipigon)	Yearling	1000
1995	No date	Whittlesey	Brook Trout (L. Nipigon)	Yearling (Ad clip)	1000

GOALS AND OBJECTIVES

To gain insight into the question of what triggers the lake life history in brook trout, a number of experiments are being developed or are on-going in Wisconsin and other areas around Lake Superior. This experiment is one aspect of the Brook Trout Plan for Wisconsin's Lake Superior Basin. It will attempt to test the whether stocking progeny of Isle Royale strains of brook trout can re-establish a self-sustaining migratory population in Whittlesey Creek.

Hypothesis:

Whittlesey Creek can support a healthy self-sustaining migrating brook trout population by stocking brook trout with a known lake life history, by protective regulations, and by habitat improvements.

Project Goal:

Establish a self-sustaining brook trout population in the Whittlesey Creek watershed that exhibits a migrating life history.

Project Objectives:

Short term: By 2003, describe the current status and abundance of the Whittlesey Creek fish community and identify strategies to establish a self-sustaining migratory brook trout population.

Long term: By 2030, establish a self-sustaining migratory brook trout population. A population is considered self-sustaining when it supports itself for at least two life spans after stocked fish no longer contribute to recruitment.

Strategies:

- Repeat in 2001, the comprehensive fish survey conducted by WIDNR in 1977.
- Establish index stations in the stream and along the lake shoreline and survey these on a regular schedule beginning in 2001.
- Stock Whittlesey Creek for seven years using strains of brook trout from the Lake Superior basin with a known lake life history.

- Identify watershed stressors and instream stressors through hydrologic geomorphologic studies and fishery assessment, identify habitat improvement options, and conduct projects that ultimately improve instream habitat.
- During and post stocking conduct the comprehensive fish survey to monitor changes in the fish community of Whittlesey Creek throughout the experiment.
- Document genetic characteristics of the existing brook trout stock and of the strains proposed to be stocked.
- Establish regulations that protect brook trout from harvest while in the stream.
- Establish regulations that provide greater protection of brook trout while in Lake Superior.

STOCKING PLAN

Stocking Goal
To establish 25 spawning pairs of brook trout exhibiting the migratory life history.

Biological Considerations
<u>Fish Community Effects</u>
In Wisconsin waters of Lake Superior brook trout are the only native salmonine that utilize the riverine environment. Historically, both lake trout and lake dwelling brook trout were present in the lake, with brook trout utilizing the nearshore environment and lake trout occupying deeper waters of the lake.

In addition to brook trout, the current fish community of Whittlesey Creek consists of numerous introduced salmonines including migratory coho salmon, rainbow (steelhead) and brown trout, and resident rainbow and brown trout. These introduced salmonines are considered ‘naturalized’ as their populations are sustained by natural reproduction. In addition, splake are stocked in Chequamegon Bay and are occasionally found in Whittlesey Creek.

As described in the Background section, brook trout numbers in Whittlesey Creek are low and declined by at least 70% over the time period from 1977 to 2001. From recently collected data, it appears that the brook trout population in Whittlesey Creek is small and remaining stable or declining.

Based on WIDNR survey data from 1977, 2001, and 2002, the abundance of coho salmon in Whittlesey Creek has also dropped. Data from 2001 and 2002 suggest that abundance was down by 70-80% from 1977. In common stations, population estimates for all ages were 26,131 in 1977 and 4,877 in 2001. While abundance is much reduced from 1977, coho salmon in Whittlesey Creek have been found to exhibit high survival over-winter, comparable or better than over-winter survival in streams of the Pacific Northwest (Ford 1997). Based on Ford’s (1997) study the decline in abundance is not attributable to poor over-winter survival. We do not expect the stocking of coaster strain brook trout to affect survival of coho salmon in Whittlesey Creek.

Limited data on Lake Superior tributaries suggests that juvenile coho salmon may depress brook and brown trout populations (Stauffer 1977). Peck (1992) speculated that coho salmon might have a negative effect on the restoration of coaster brook trout in Lake Superior by competition in the stream environment. This is unknown, as coho introductions in Lake Superior occurred after coaster brook trout populations in the lake had already declined.

Inherent in the experiment hypothesis is the belief that migratory brook trout can, if the proper strain is present and if protection is adequate, co-exist with non-native naturalized and stocked salmonines in Whittlesey Creek. Groundwater upwellings or springs are abundant in Whittlesey Creek, especially in the area near and upstream from the confluence of the main stem and North Fork. Brook trout, apparently more than any other salmonine, prefer upwellings for spawning habitat (Powers 1980, Curry and Noakes 1995). At the time of spawning, redd site selection is likely to result in some segregation of brook trout and non-indigenous salmonines in Whittlesey Creek.

Brook trout and other salmonines have proven to be rather adaptable at using apparently sub optimum spawning sites (Powers 1980, Curry and Noakes 1995). If upwelling groundwater is present brook trout have spawned on sand, silty-sand, and waterlogged sticks (Powers 1980, Curry and Noakes 1995). Kondolf and Wolman (1993) report that in a particular river system, chum salmon select sites with upwelling currents to prevent freezing of the eggs. They note that these sites are selected despite the need to excavate 30 cm of silt to locate gravel in which to deposit eggs.

Fish Community Objectives

Rehabilitation of lake dwelling coaster brook trout is a priority of the Great Lakes Fishery Commission Lake Superior Committee (Horns et al. 2002). To advance efforts to rehabilitate lake dwelling brook trout in Lake Superior, a multi-agency adhoc committee of the Lake Superior Technical Committee was formed. This committee developed the document, A Brook Trout Rehabilitation Plan for Lake Superior (Newman et al. 1999). The rehabilitation goal for brook trout in Lake Superior to maintain widely distributed, self-sustaining populations in as many of the original, native habitats as is practical (Newman et al. 1999).

The rehabilitation plan provides guidance for population objectives and identifies numerous issues and strategies for consideration. Population objectives that will be adopted for this project include: the population will be self-sustaining and capable of co-existing with populations of naturalized salmonines in the existing fish community, the population will exhibit genetic profiles consistent with those of populations currently existing in the Lake Superior basin, essential habitat will be protected and where necessary, rehabilitated, and that the fully restored population will be comprised of 6 or more age groups, including at least two spawning year classes of females.

Biology and Life History

The fecundity of brook trout in Tobin Harbor has been determined for 2 fish. A 16-inch female contained 1,800 eggs (Quinlan 2000), while a 2.5- pound, 18-inch female had 3,373 eggs (Henry Quinlan, personal communication, USFWS Ashland Fishery Resources Office, Ashland, Wisconsin, 54806). Becker (1983) reported that a 14-inch female contained 1,500 eggs. The number of eggs produced by Lake Nipigon strain brook trout at the Ontario Ministry of Natural Resources Dorian Hatchery is typically 1,500 eggs/kg of fish (John Sagar, personal communication, Hatchery Manager, Ontario Ministry of Natural Resources Dorian Fish Culture Station).

There is a dearth of information available on the characteristics of coaster redds. Ten brook trout redds located during surveys conducted by the Service in the Salmon Trout River, had an average diameter of 0.8 m (range 0.6 to 1.1m) (Lee Newman, personal communication, USFWS Ashland Fishery Resources Office, Ashland, Wisconsin, 54806). At Tobin Harbor, a large male and female and several smaller male coasters were observed on one redd in 1997. Substrate material in the redd was a mixture of sand and pea gravel, and water depth was 0.5 m (Henry Quinlan, personal communication, USFWS Ashland Fishery Resources Office, Ashland, Wisconsin, 54806). There is no information on whether or not eggs were deposited, nor whether fry emerged from redds in the Salmon Trout River or in Tobin Harbor. Becker 1983, described typical redd size as having a diameter of 0.3-0.6 m for stream brook trout.

Strain Selection and Genetics

Currently 3 strains of brook trout from the Lake Superior basin that exhibit the lake life history are being maintained in hatcheries as brood stock for rehabilitation stocking efforts. Two Isle Royale strains (Tobin

Harbor and Siskiwit Bay area) are reared by the Service at the Iron River (Iron River NFH) and Genoa National Fish Hatcheries. The Lake Nipigon strain is from a lacustrine population that is within the Lake Superior basin, but due to natural barriers is inaccessible to Lake Superior. The Lake Nipigon strain is reared at the Ontario Ministry of Natural Resources Dorian Fish Culture Station and through a transfer of eggs from Dorian at the Red Cliff Tribal Hatchery.

The Siskiwit Bay area strain originated from brook trout captured in the estuary of the Big and Little Siskiwit rivers, primarily the Big Siskiwit River. This strain has been derived from gametes collected over two years (1995 and 1999). A total of 8 males and 11 females contributed to this brood stock.

The Tobin Harbor strain is derived from gametes collected in three separate years (1996, 1998, and 2001) from a shoreline spawning population. Founding parents for the brood stock consist of 51 males and 48 females.

Tissue samples from Isle Royale stocks have been analyzed genetically using Mitochondrial DNA (MtDNA) (Burnham-Curtis 1996 and 2001). MtDNA analysis indicates that the predominant haplotype found in Lake Superior brook trout populations predominates in the Isle Royale source stocks and populations from Wisconsin (Little Onion and Little Sioux rivers and Oak Island streams numbered 6 and 7) (Burnham-Curtis 2001). The MtDNA analysis suggests that the evolutionary history of these populations have a common pattern of colonization, likely from the Atlantic refugium (Burnham-Curtis 2001). While BT1 is the predominant haplotype in Lake Superior populations, the Big Siskiwit River population also contained haplotypes BT2 and BT4 and therefore can be differentiated from the Tobin Harbor strain in which only BT1 was present. The sample size was rather small, particularly for the Siskiwit Bay area population, which renders the results informative but not statistically significant.

Additionally, recent unpublished microsatellite DNA analysis shows that the Tobin Harbor and Siskitwit Bay (Big and Little Siskiwit rivers) populations exhibit different markers and can be differentiated genetically (Loren Miller, personal communication, Department of Fisheries and Wildlife, University of Minnesota, St. Paul, Minnesota, 55108, and Wendy Lee Stott, U.S. Geological Survey, Great Lakes Science Center, Ann Arbor, Michigan, 48105). Dr. Loren Miller's study will compare wild and hatchery stocks using microsatellite analysis to determine the level of genetic conservation in the hatcheries, to describe parentage relationships, and to provide recommendations for continued maintenance of diverse genetics in the hatchery system. Because genetic and life history differences are evident, and tagging work has shown no movement between populations at Isle Royale, the Service maintains the Tobin Harbor and Siskiwit brood stocks separately.

While no records of strain exist, it is believed that many different strains of brook trout have been stocked in Whittlesey Creek (Table 1). Additionally, brook trout have been stocked in Fish Creek located ½ mile from Whittlesey Creek, in other tributaries within 10 miles of Whittlesey Creek, and in Chequamegon Bay.

Genetic analysis of the resident brook trout in Whittlesey Creek is in progress. Samples collected in 2001 and 2002 are being analyzed by UW-Stevens Point in cooperation with Wisconsin DNR. The genetic characterization of resident brook trout will be conducted using the same genetic markers used to describe the Isle Royale strains and Lake Nipigon strain fish from the Red Cliff Tribal Hatchery.

The brook trout population in Whittlesey Creek is not a "heritage" population (remnant population with no documentation and/or likelihood of having mixed with stocked or transferred fish). As shown in Table 1, stocking of brook trout in Whittlesey Creek has occurred frequently over the last 100 years. Unfortunately, there is no record of the various strains that have been used, however, it is generally understood that until the 1990's, the source fish were not from the Lake Superior basin. Stocking brook trout that originated from the Lake Superior basin in Whittlesey Creek is consistent with the Brook Trout Rehabilitation Plan for Lake Superior (Newman et al. 1999).

Fish Health

The U.S. Fish and Wildlife Service Fish Health Laboratory in La Crosse, Wisconsin, conducts fish health testing at the Iron River National Fish Hatchery semi-annually. At present the classification for the Iron River NFH is Rs. This classification indicates that *Renibacterium salmonarium* bacteria (causative agent for Bacterial Kidney Disease), were present in samples tested. The Service will follow guidelines of the Great Lakes Fish Health Policy which state that efforts should be made not to stock fish with overt signs of the disease (Hnath et al. 1993). None of the brook trout or lake trout at Iron River NFH shows overt signs of BKD or any other fish health diseases. Prior to stocking a complete Fish-Disease Inspection Report will be provided to WIDNR. However, due to the small size (<1 inch) of advanced fry planned for stocking, bacterial disease testing cannot readily be conducted on these fish.

Stocking Details

In determining the number of coasters to be stocked at various life stages we considered coaster biology (egg production) and information on the size of remnant and re-established coaster populations at Isle Royale, in the Salmon Trout River, Michigan, and at Grand Portage, Minnesota.

There is no definitive information available from which to determine which of the two Isle Royale strains would be most suited to Whittlesey Creek and provide the greatest chance of meeting the goal of this project. Therefore, we plan to stock various life stages of both strains and evaluate their performance in situ, through assessment surveys and genetic analysis.

Annually throughout the stocking period (2003-2009) we plan to stock multiple life stages of both the Tobin Harbor and Siskiwit strains of brook trout. The number of eggs to be stocked is based on estimated production by the target population and the availability of eggs from Iron River NFH. The number of eggs stocked will be evaluated throughout the project. Observations from surveys conducted in fall and winter on use of spawning sites by fall run salmonines will be used to provide information on the amount of available spawning habitat. This may provide additional information to better determine the number of eggs to stock.

The number of fingerlings, yearlings and adults to stock will be determined by the target population size, estimates of survival (including straying), and hatchery availability. Fingerlings, yearlings and adults will be scatter stocked throughout the stream. Areas of suitable spawning and nursery habitat will be a priority.

The stocking of Tobin Harbor spring fingerlings was determined to be more successful than fall fingerlings in an ongoing experimental stocking project in several streams at Pictured Rocks National Lakeshore (Lora Loope, personal communication, Pictured Rocks National Lakeshore, Munising, Michigan, 49862). However, the source hatchery for the fish differed, with the spring fish being reared at Genoa NFH and the fall fingerlings being reared at Iron River NFH. As a result of water temperature differences at these two hatcheries, the spring fish from Genoa NFH were equal in size (3.0-3.5 inches) to the fall fingerlings at Iron River NFH.

At the time that stocking is discontinued, we expect that 3-4 year classes of stocked fish will be mature and capable of reproducing naturally. To allow adequate evaluation of this experiment, WDNR has enacted regulations that protect brook trout in Whittlesey Creek and in the lake environment.

Methods

All life stages to be stocked, except eggs, will receive a mark for later identification. We anticipate being able to utilize genetic analysis to differentiate fish stocked as eggs (no external mark) versus naturally reproduced fish as a result of ongoing genetic analysis being conducted at the University of Minnesota and U.S. Geological Survey in Ann Arbor, Michigan.

All fish reared at Iron River NFH are marked with oxytetracycline. The oxytetracycline mark will be used to differentiate stocked advanced fry from wild fish since they are too small for an external tag or fin clip (the capability to assess / read oxytetracycline marked fish needs to be secured for this project). All yearlings will be marked with an adipose fin clip and receive a coded-wire tag in the snout. Adults will be marked with Floy tags and will retain fin clips used to manage brood stock in the hatchery. Additional stocking of adult coasters in 2005 and 2007 will be conducted if excess brood stock is available. The intent of the adult transfer is to stimulate natural reproduction by all means possible.

Lacking information, we made several assumptions on survival of stocked eggs/fish to aid planning efforts. The first is that roughly 5% of the stocked eggs will survive to the advanced fry stage (i.e. 2,500 advanced fry will survive from 50,000 eggs). Advanced fry will survive to yearlings at a rate of 10%, and yearlings to age 2 at 10% per year. Beyond age 2 we estimate that survival will be 50%, similar to the rate of survival (0.56) at Tobin Harbor, Isle Royale, Michigan (Quinlan 1999).

A telemetry study conducted on Tobin Harbor brook trout found that fish remain within the harbor year round (Newman 2000). Therefore, survival rate may be quite different for fish that migrate to and from Lake Superior. We expect the return rate of fish out-migrating to be low but have no figure to use as an estimate. The number of eggs and fish to be stocked and the number projected to survive to subsequent years are shown in Table 2.

The number of fish, particularly females, of age 3 and greater may be critical to successful reproduction. At Tobin Harbor, 80% of female coasters were found to be mature by age 3, while less than 20% of age 2 or younger females were mature (Quinlan 1999). Using the predicted survival rates as a guide, the total number of fish projected to survive to age 3 or greater is shown at the bottom of Table 2. We acknowledge that these totals result in more than the 25 pair goal for this experiment. However, due to uncertainties in our survival estimates, straying and return rates, and lack of understanding of fish survival during migration, the projected number of fish was used simply as a guide to help determine a reasonable number of eggs and fish to stock. We also note that after 2004, the number of mature fish could be greater than the projected number of fish $\geq$ age 3 shown in Table 2, as males may mature at younger ages.

At each eyed egg stocking site a minimum of 50 eggs will be placed in egg trays to estimate percent hatch. Eggs will be stocked in manually created redds in areas of suitable habitat and where brook trout are observed spawning. Care will be taken to avoid disruption of any redds created naturally by salmonines.

Advanced fry will be scatter stocked near areas of suitable spawning substrate or where brook trout are observed spawning. Yearlings and adults will be scatter stocked throughout the stream. Some yearlings and adults will be stocked in areas of suitable spawning habitat. Enclosures such as pens or temporary block nets will be used to retain stocked yearlings and adults in the stream for 3-7 days post stocking. The intent of the enclosures is to provide some degree of imprinting and reduce the likelihood of immediate departure from the stream.

Table 2. Stocking by year and number of fish present over time at assumed survival rates described in text (stocking events are shown in bold and the estimated number of fish equal to or greater than age 3 are shown in italics).

Lifestage	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
2003										
Adults	***75***	*33*	*16*	*8*						
2004										
Eggs		**50,000**	250	25	*13*	*6*	*3*			
Yrlngs*		**2,000**	200	*100*	*50*	*25*	*12*			
2005										
Ad Fry**			**20,000**	2,000	200	*100*	*50*	*25*	*12*	
Adults			***50***	*25*	*12*	*6*				
2006										
Eggs				**50,000**	250	25	*13*	*6*	*3*	
Yrlngs*				**2,000**	200	*100*	*50*	*25*	*12*	
2007										
Ad Fry**					**20,000**	2,000	200	*100*	*50*	*25*
Adults					***50***	*25*	*12*	*6*		
2008										
Eggs						**50,000**	250	25	*13*	*6*
Yrlngs*						**2,000**	200	*100*	*50*	*25*
2009										
Ad Fry**							**20,000**	2,000	200	*100*
Adults							***50***	*25*	*12*	*6*
≥ Age 3	75	33	66	133	125	262	190	287	152	162

* Yearlings will be approximately 4 inches for a spring release.
** Advanced Fry - Fish will be approximately 1.25 inches for a spring release.

Measurable Objectives

- ***First Generation Target (2014):*** Do enough stocked fish migrate and survive to maturity?
    - *Migration Target*: If stocked fish survive in sufficient numbers to achieve 25 migratory spawning pair target by 2014 - Target achieved and experiment succeeds to this stage and continues.
    - *Reproduction Target*: That migratory brook trout successfully recruit enough to support next generation targets. - Target achieved and experiment succeeds to this stage and continues.
    - If fewer than 25 migrating spawning pairs survive to spawning age or if natural recruitment does not achieve self-supporting goal – Target not achieved, but assessment continues.

- ***Second Generation Target 2019:*** Does spawning stock generate sufficient juvenile production to migrate and support next generations' recruitment?
    - If spawning produces sufficient fall fingerlings that normal survival would allow population to survive and reach 25 spawning pair in the next generation, about 2019 – Target achieved and experiment succeeds to this stage and continues.
    - If fall fingerling population is insufficient to achieve next generation spawner target of 25 pair – Target not achieved, but assessment continues.

- ***Third Generation Target 2024 to 2030:*** Does experiment achieve target rehabilitation goal?
    - If spawning population is sustained at or near 25 pair for at least two generations beyond the end of stocking, about 2030 - Target achieved and experiment is a success.
    - If self-sustaining spawning population stabilizes at less than 25 pair, but assessments indicated carrying capacity reached at lower level than target – Target not achieved but rehabilitation successful at lower level.
    - If spawning population is not sustained at or near 25 pair for at least two generations beyond the end of stocking - Target not achieved.

ASSESSMENT AND HABITAT RESTORATION ACTIVITIES

Post Stocking Evaluation Period (2010 – 2030)

Assessment of stocked fish and monitoring of changes to the fish community will occur for the duration of the stocking period or until stocked fish are no longer encountered. All standardized index stations described below will be conducted for the duration of the project. These assessments will provide information to evaluate stocking success, the abundance of brook trout and other salmonines, population status, habitat use, and other life history traits of the developing migratory ‘coaster’ brook trout population.

Stream Electrofishing

Comprehensive Fishery Survey - In 2001, WDNR and Service staff conducted a comprehensive fishery survey repeating a similar survey done by WDNR in 1977. Tissue samples were collected in both 2001 and 2002 for genetic analysis of the existing stock (lab workup has not been done yet). We propose to repeat the comprehensive survey between 2005 and 2009, and again 3-5 years post stocking to provide a comparison of the fish community pre, during, and post stocking.

Index Stations - Three stream reaches were selected as index stations to be sampled annually (mid-September) throughout the experiment. These index stations were chosen to encompass the majority of the existing spawning habitat located in the watersheds transitional zone. Results of surveying these index stations will allow documentation of changes in brook trout recruitment success. A USFWS-DNR crew sampled the three index stations in 2002. These surveys will be conducted during the 2nd week of September.

Fall Index Station - A stream reach in the depositional zone (between STH 13 and Ondassagon Road) has been sampled by WDNR annually each fall, since 1971. This station will continue to be sampled annually throughout the experiment.

Lake Shore Electrofishing

In 2001, an index electrofishing station was established and sampled along a portion of the Chequamegon Bay shoreline (a 5 km section from the mouth of Whittlesey Creek north along the shoreline to Bono Creek). This station was selected to determine presence, abundance and habitat use by lake-dwelling migratory brook trout. This station was re-sampled during 2002 and will be sampled two to three times annually (spring and fall) throughout the experiment.

Monitoring In and Out Migration

A method to monitor in and out migration has not yet been identified. Discussion has focused on upstream and downstream nets such as the modified fyke nets used on the Salmon Trout River by Michigan Technological University, or weirs and video equipment. WDNR experience with numerous in-stream devices (weirs and or nets and traps on the Bois Brule, Iron, Sioux, and Pikes) to monitor and quantify in and out migration on local streams has proven to be impractical. Devices typically become non-functional during flood events, the autumn leaf period and during winter conditions. Structures that have been tried typically block fish runs, cause fish damage or latent mortality, or due to blowout, lose the capability of enumerating movement numbers (major peaks in both upstream and downstream fish movement typically occur during the turbid water period on the declining water volume side of the flood event). Use of underwater cameras to enumerate movement will continue to be explored, however, turbidity is a concern for effective viewing with underwater cameras. In order to enumerate ascending runs on the Bois Brule River, salmonids are crowded within two to three inches of the fish-way window during turbid water conditions. Radio telemetry will be investigated for use on larger fish, generally those greater than one pound. A stationary data logging station set up near the mouth and active tracking by foot and boat would be utilized to monitor movement of fish outfitted with radio transmitters. These and other options will be further explored in the future.

Monitor Migratory Adult Spawning Activity

Visual counts and/or electrofishing gear will be used to monitor migratory spawning aggregations to verify spawning sites. Walking the stream a number of times during the spawning period can be used to observe large fish, indicative of the migrating life history. Electrofishing gear may be used to capture and tag individuals.

Monitor Fry Emergence

Upon identification of spawning locations attempts will be made to assess fry emergence success. This will be done during the late winter/early spring fry emergence period prior to the first significant runoff event, by walking the stream.

Table 3. Assessment activities related to brook trout in Whittlesey Creek.

Purpose of Survey	Season	Waterbody	Gear
Determine presence, abundance, and habitat use	Spring/Fall	Lakeshore	EF boat
Assess YOY and juvenile year class strength	Early Fall	Stream	Barge/Backpack EF
Assess spawning adults and describe habitat used for redds	Fall	Stream	Visual and/or backpack EF
Assess fry emergence	Winter	Stream	Visual

Monitor Water Volume and Temperature

Flow and temperature data will be collected for the duration assessment period. The USGS gauging station will be maintained to provide data on daily mean and peak flow for the duration of the study. WDNR has been monitoring fall to spring water temperatures since 1994-95 at the bridge at Wickstrum

Road and this effort will continue. At least two temperature loggers will be set in the stream in areas where eggs are stocked to describe winter water conditions. Two temperature loggers will also be set in Chequamegon Bay annually from spring through early winter. One will be set within the lakeshore electrofishing index station and the other near Houghton Point to describe the thermal regime in those areas of the bay.

Monitor Stream Channel Morphology Changes

In 1999, the Service conducted an assessment of instream and riparian habitat in Whittlesey Creek. Surveys were conducted on 20 stream reaches in Whittlesey Creek, Little Whittlesey Creek, and North Fork Whittlesey Creek. The surveys identified channel type using the Rosgen Classification system (including dimension, pattern and profile) and quantity and quality of habitat (woody debris, undercut banks, sediment, riparian condition) that contribute to spawning, nursery and refuge for salmonines. This baseline information (a snapshot in time of the condition of these three streams) will assist evaluation of future watershed and instream habitat restoration activities.

The Service will select five to ten of the sites that were sampled in 1999 to serve as reference reaches. Channel morphology and substrate data will be taken annually at each site after the spring snow-melt period and after other major (100 year) flood events to monitor changes to salmonid habitat throughout the experiment. Additionally, photos will be taken at each station to visually record changes in channel structure and instream habitat.

In 2002, the U.S. Geological Survey completed field work on a hydrologic study to determine how changes in land cover affect surface water and base flow in Whittlesey Creek. Upon completion of the written report, the results and recommendations will used to evaluate future watershed, riparian, and instream habitat restoration efforts.

Watershed Improvements

Concurrent with fish assessments and management actions, the Service will conduct watershed and stream corridor restoration treatments with landowners, partner agencies and non- governmental organizations (e.g. Trout Unlimited). The actions will include but not be limited to conservation easements, land acquisition from willing sellers, educational outreach, planning, physical alterations, and streamside litter clean up. We anticipate the USGS hydrologic study on Whittlesey Creek will help identify priority actions. Initial attention will focus on the North Fork of Whittlesey Creek and contributing watershed. Instream habitat improvements have yet to be determined. Information gained from hydrologic and geomorphologic studies will be used to evaluate the suitability and location of instream habitat projects.

Angling Regulations

Angling regulations were changed in 2003 to provide greater protection for brook trout during this experiment. Stream harvest was eliminated with a ‘no kill’ regulation throughout the fishing season and lake harvest is limited by establishing a twenty-inch minimum size limit. These regulations are intended to continue for the length of the experiment.

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