Fisheries Division Report Series No. 18-4

Chamberlain Lake, Round Pond, and Telos Lake Management

Progress Report No. 3

By: Timothy C. Obrey
Moosehead Lake Region

December 2018
Maine Department of
Inland Fisheries & Wildlife
Fisheries and Hatcheries Division

Funding Acknowledgement

This project was funded primarily through the Wildlife and Sport Fish Restoration Program. We also wish to acknowledge the Maine Outdoor Heritage Fund and Fly Fishing in Maine for their financial support, and the Maine Department of Agriculture, Conservation, and Forestry for providing staff that assisted in fieldwork.

Jobs F-014 and F-011

Chamberlain Lake, Round Pond and Telos Lake Management

Progress Report No. 3

Summary

Clerk surveys and aerial angler counts were conducted in the winters of 2002, 2007, and 2013. Angler participation has declined since a peak in the early 1990s. Lake trout harvest rates are below the maximum sustainable yield for that species. Brook Trout exploitation rates in the winter were estimated to be 8–12% of the population of legal-sized fish in the system.

Food habit studies show that Brook Trout, Lake Trout, and Lake Whitefish are highly dependent on rainbow smelt as forage in the winter. Lake Whitefish abundance may have temporarily increased after more restrictive regulations were implemented in 1988 and 2005 causing a short-term decline in growth for Lake Trout.

Fall trapnetting surveys were conducted in 2001 and 2006 to gather basic age and growth data from wild Brook Trout on three connected oligotrophic waters: Chamberlain Lake, Round Pond, and Telos Lake. Legal-size Brook Trout were fin clipped so these fish could be identified during clerk angler surveys in the winters of 2002 and 2007. Population estimates were calculated based on the number of marked fish observed. The estimated number of Brook Trout $\geq$ 12 inches in the three-lake system was 3,796 fish in 2001. We estimated the fall population of Brook Trout over 14 inches to be 2,280 fish in 2006.

Radio transmitters were implanted in 52 Brook Trout in the fall of 2006. Post-spawning mortality was estimated at 51%. Fish tagged in 2006 exhibited a high rate of homing to spawning sites in 2007.

KEYWORDS: BKT, LKT, LWF, SLT, AGE & GROWTH, ANGLER SURVEY, EXPLOITATION RATE, FOOD HABITS, MIGRATIONS, MOVEMENTS, HOMING, POPULATION ESTIMATES, REGULATIONS, SURVIVAL.

Jobs F-014 and F-011

Chamberlain Lake, Round Pond and Telos Lake Management

Progress Report No. 3

Abstract

Clerk angler surveys have been conducted on Chamberlain Lake, Round Pond, and Telos Lake since the 1960s to monitor popular winter fisheries for wild Brook Trout (*Salvelinus fontilalis*), Lake Trout (*Salvelinus namaycush*), and Lake Whitefish (*Coregonis clupeaformis).* Angler effort peaked in the early 1990s. Surveys conducted in 2001, 2006, and 2013 indicate use has declined to levels similar to the 1970s. Lake trout were harvested at a rate below the maximum sustainable yield predicted by morphoedaphic index. Trapnetting surveys in 2001 and 2006 indicate wild Brook Trout densities in this large oligotrophic system are low compared to smaller wild Brook Trout ponds. Winter exploitation rates for Brook Trout were estimated to be 8–12% of the legal-size population. Tracking via radio telemetry demonstrated a high rate of fidelity to spawning sites by adult Brook Trout and revealed that winter refuge areas, protected from angling, can be an effective conservation measure.

Introduction

This report summarizes findings of routine winter monitoring from clerk creel surveys conducted since the last report published in 1987. We also present information from trapnetting and radio telemetry studies that focused on understanding population dynamics of wild Brook Trout (*Salvelinus fontilalis*), in this system of largely undisturbed lakes.

Chamberlain Lake, Round Pond, and Telos Lake (the three-lake system) are popular destinations for anglers seeking Brook Trout, Lake Trout (*Salvelinus namaycush*), and Lake Whitefish (*Coregonis clupeaformis)* in northwestern Maine. These lakes are in the Allagash Wilderness Waterway which was established by the Maine Legislature in 1966 to preserve, protect, and enhance the natural beauty, character, and habitat of this exceptional area. The lakes provide a unique opportunity to study coldwater sportfish in a system of large interconnected oligotrophic lakes. This is especially true for wild Brook Trout. There have been many studies on Brook Trout in smaller lakes and ponds (<200 acres) and, although these small trout ponds represent 80% of the total number of all Maine waters that support fisheries for Brook Trout, they include only 11% of the total acreage. Much less information is available from wild trout populations in Maine's large oligotrophic lakes, especially those > 1,000 acres in area. Although lakes > 1,000 acres comprise only 6% of the total number of Brook Trout lakes in Maine, they represent 73% of the total surface area of Maine waters that support fisheries for Brook Trout.

Study Area

Chamberlain Lake is located near the headwaters of the Allagash River. It is the largest lake (11,804 acres) in the Allagash River drainage. Round Pond (367 acres) and Telos Lake (1,909 acres) lie just to the southeast of Chamberlain Lake (Figure 1). Prior to the 1840s, Telos Lake drained into Round Pond through a short, shallow thoroughfare, and Round Pond drained into Chamberlain Lake through a slightly longer, shallow thoroughfare. In 1841, a dam now known as Lock Dam was constructed on the natural outlet of Chamberlain Lake. It diverted the flow away from Big Eagle Lake and the Allagash River, and into Round Pond and Telos Lake and then into Webster Lake and the East Branch of the Penobscot River through a man-made canal and another dam constructed at the new outlet of Telos Lake. Today, all three waters remain flowed by Lock Dam and Telos Dam, and most of the water in the 250 square mile drainage area flows into the Penobscot's East Branch. Chamberlain Lake, Round Pond, and Telos Lake were all included in the Allagash Wilderness Waterway (AWW) when it was created in

1966 to prevent further development along their shores, to limit road access to them, and to maintain the natural character of the environment and the wilderness experience. The AWW is a state-managed waterway that is included in the National Wild and Scenic River System. Today the Allagash remains one of Maine's last few undeveloped waterways. Other than the construction and operation of the dams to manage water in the lakes, there have been few other permanent changes to the environment in this area since the last glacial period, which occurred more than 10,000 years ago.

Like all the waters in the AWW, Chamberlain Lake, Round Pond, and Telos Lake provide habitat for wild populations of indigenous fish that have scarcely been influenced through introductions of exotic species. Brook Trout, Lake Trout, Lake Whitefish, and Burbot (*Lota lota*) provide very popular winter and summer recreational fisheries. These waters are some of the easiest to access in the AWW. Current fishing regulations include one Brook Trout per day with a minimum length limit of 14 inches, three Lake Whitefish per day with a minimum length limit of 16 inches, and two Lake Trout per day with a minimum length limit of 18 inches. There are no regulations regarding the number or size of Burbot that can be harvested.

Chamberlain Lake, with 47 miles of shoreline, has a maximum depth of 154 feet, and an average depth of 38 feet. Approximately 4,500 acres (41%) of the total area consists of littoral habitat (depth < 20 feet), primarily along the immediate shore. There are two major tributaries to Chamberlain Lake: Allagash Stream, and Ellis Brook. Allagash Stream, which flows into the northwest end, is the largest tributary. However, due to the barrier created by Little Allagash Falls, only 2 miles of Allagash Stream are accessible to fish from Chamberlain Lake. Ellis Brook, with a drainage area of 24 square miles, is about half the size of Allagash Stream and is devoid of any fish barriers. There are 13 other smaller tributaries to Chamberlain Lake, most of which are unnamed, each with a drainage area of less than 5 square miles. Chamberlain Lake's natural outlet below Lock Dam is accessible, when the lake is full, to fish moving downstream via a 3 ft culvert that runs through the dam. However, there are no provisions for fish passage upstream into Chamberlain Lake through Lock Dam.

Telos Lake and Round Pond, although separated by a thoroughfare, are managed together as one unit. They have a total area of 2,276 acres, 20 miles of shoreline, a maximum depth of 86 feet, and a mean depth of 25 feet. Littoral habitat comprises 1,070 acres, or about 47% of the total surface area. Telos Stream, with a drainage area of 16 square miles, is the only large tributary to both Telos Lake and Round Pond. There are only four other, much smaller tributaries to these two waters. Fish may move downstream out of Telos Lake through a man-made outlet at its eastern end. However, there are no provisions for upstream passage into Telos Lake from the outlet.

The extensive rocky shoreline and shoals found in all three waters provide ample opportunity for spawning Lake Trout. Water management is closely coordinated with AWW staff to maximize spawning success. The numerous brooks and streams provide spawning habitat for Brook Trout and Lake Whitefish. Overall, the physical and biological characteristics in this system are excellent for maintaining these indigenous coldwater game fish species.

Angler access is restricted in the summer and winter. The AWW maintains a boat launching facility on the thoroughfare between Chamberlain Lake and Round Pond. This is the only boat access site during the summer months. The AWW allows winter anglers to park campers in a large parking area to the west of the launch. A snowmobile trail is maintained from the parking area to Chamberlain Lake and to Round Pond. Additionally, the AWW maintains a smaller camping area at the Kellogg Brook Campsite during the winter. Nugent's Camps, a commercial sporting camp, is located about 3.75 miles up the lake from the thoroughfare. There is no road access to the camps; however, recently snowmobile access was created. The camps are very popular with both open water and ice anglers. Nearly all the winter fishing use originates from either Nugent's camps or the two camping/parking areas.

A sanctuary area was delineated at the north end of Chamberlain Lake to protect Brook Trout which are concentrated in the winter months at the mouth of Allagash Stream. This area north of the Crow's Nest campsite was closed to ice fishing in 2000.

Methods

Winter clerk surveys were conducted in 2002, 2007, and 2013 by regional fisheries staff. Two biologists covered all three lakes on alternate weekends throughout the course of the winter each year, weather and conditions permitting. The ice fishing season on these waters begins on January 1st and ends on March 31st. Only completed angler trip information was recorded during interviews which occurred on the ice, in the Chamberlain Lake and Kellogg Brook camping/parking areas, and at Nugent's Camps. Date, start and stop time, party size, and catch by species were all recorded. Data were also collected from fish observed on the ice during the survey. Biological data were collected from fish observed on the ice during the survey. These data include date captured, length, weight, and scale samples (Brook Trout and Lake Whitefish only). Scale samples were collected from Brook Trout and Lake Whitefish. Brook Trout and Lake Trout were also examined for fin clips that would have been applied during trapnetting operations conducted the previous fall. Stomachs were collected from all species if the fish were not frozen. Stomachs were brought back to the laboratory at the Department of Inland Fisheries and Wildlife (DIFW) Greenville headquarters. Each stomach was dissected and all contents were removed, identified, and measured volumetrically.

Aerial angler counts were conducted in the winters of 2002, 2007, and 2013. Flights were scheduled near the middle of the day, as much as possible, to coincide with peak daily use. A flight was scheduled on one weekday and one weekend day per week. The number of ice fishing parties was counted on each lake. These counts were expanded by mean party size and an activity curve generated from the winter clerk survey as described by AuClair (1982). Complete angler counts for the day were also recorded by IFW staff on days when clerk surveys were conducted and no flights were scheduled.
Trap nets were set along the shore of Chamberlain Lake in September and October in 2001 and 2006. Net sites were selected based on information that the area was noted for good trout catches in the winter and early in the spring, or because of their proximity to tributaries that might be used for spawning. All trout captured were measured, weighed, and examined to determine maturity based on external physical characteristics. Scales were taken from a sample of the catch to estimate the age class

structure of the population. All legal-size trout captured were marked with a fin clip so that these fish could be identified if they appeared in anglers' catch during the 2002 and 2007 ice fishing seasons. After handling, all trout were released.

A radio telemetry project was conducted on the three-lake system in 2006 and 2007. The objectives of the study included determining if Brook Trout were using the current protected area at the northern end of Chamberlain Lake and if expansion of this area is needed. We also wanted to locate other areas that may serve as winter refuge for wild Brook Trout in Chamberlain Lake, Round Pond, and Telos Lake. This study was important to ensure proper law enforcement and fisheries management for the conservation of the wild Brook Trout resource in the three-lake system as well as other large lakes with similar physical and biological characteristics. We also wanted to locate spawning habitats in tributaries and shoreline areas of the Chamberlain Lake system. Most importantly, this study allowed us to estimate the abundance, standing crop, post-spawning survival, and exploitation of adult Brook Trout in the Chamberlain Lake system.

We implanted radio transmitters (Advanced Telemetry Systems (ATS); model F1385 [40 ppm pulse rate, 22 ms pulse width, 15 g, 327 d battery life, 654 d capacity life]) in 52 Brook Trout (39 males, 8 females, 5 immature) in the fall of 2006. These transmitters were also equipped with a mortality switch that would activate after 24 hours of inactivity.

Prior to surgery, fish were anesthetized with a clove oil based anesthesia then placed into a towel-lined fish measuring box. A drip bucket with fresh water kept the fish's gills wet and oxygenated during the surgery. An incision was made along the ventral surface just anterior of the pectoral fins. The transmitter was placed internally along the gut wall and the antenna was pressed through the body cavity. The incision was closed with sutures and cleaned with distilled water. The fish was placed in fresh water to recover and then released.

Brook Trout were tracked utilizing both stationary (ATS; model R4500) and handheld mobile (ATS; model R2000) receivers. Stationary data loggers were installed at a IFW camp on the thoroughfare between Chamberlain Lake and Round Pond, and at an AWW storage building at Telos Dam. No electrical power is available in this remote setting so these units were powered with a 12-volt battery attached to a solar panel. Data were downloaded periodically throughout the study. Handheld receivers were used to locate individual fish using aircraft, boat, and biologists on foot. Sixteen flights were scheduled between September 2006 and March 2008 to track individual fish. Flights covered the entire three lake system as well as tributaries and the outlet including Webster Lake. Numerous other tracking events occurred by boat while we were tending nets in the fall of 2006 on the three-lake system. These may or may not have covered the entire lake.

Table 1. Winter clerk survey data from the three-lake system.

	2002	**2007**	**2013**
Parties	238	197	91
Anglers	766	615	339
Hours	5160	3935	2420
Legal Brook Trout Kept	94	85	51
Legal Brook Trout Released	58	309	206
Sublegal Brook Trout	32	265	172
Legal Lake Trout Kept	93	52	35
Legal Lake Trout Released	60	107	63
Sublegal Lake Trout	2	77	11
Legal Lake Whitefish Kept	226	76	22
Legal Lake Whitefish Released	506	81	72
Sublegal Lake Whitefish		206	82

Results

Creel surveys:

Table 1 summarizes winter clerk surveys completed in 2002, 2007, and 2013 on Chamberlain Lake, Round Pond, and Telos Lake (the three-lake system).

Winter catch rates for the three major sport fisheries are presented in Tables 2-4.

Table 2. Winter CPUE for Brook Trout in the three-lake system.

Year	Legal brook trout/hr	SE	Sublegal brook trout/hr	SE	All brook trout/hr	SE
2002	0.038	0.006	0.007	0.002	0.045	0.006
2007	0.093	0.012	0.073	0.012	0.166	0.013
2013	0.113	0.019	0.095	0.017	0.208	0.029

Table 3. Winter CPUE for Lake Trout on the three-lake system.

Year	Legal lake trout/hr	SE	Sublegal lake trout/hr	SE	All lake trout/hr	SE
2002	0.033	0.004	0.000	0.000	0.033	0.004
2007	0.044	0.008	0.018	0.004	0.062	0.009
2013	0.041	0.009	0.005	0.002	0.046	0.010

Table 4. Winter CPUE for Lake Whitefish in the three-lake system.

Year	Legal lake whitefish/hr	SE	Sublegal lake whitefish/hr	SE	All lake whitefish/hr	SE
2002	0.240	0.039	n/a	n/a	0.240	0.039
2007	0.053	0.014	0.095	0.022	0.148	0.031
2013	0.051	0.026	0.068	0.039	0.119	0.048

Monthly harvest rates for all three lakes were estimated using month specific catch rates and monthly use estimates. These harvest rates were then combined to generate total harvest estimates for the winter seasons in each of the three study years (Table 5).

Table 5. Winter use and harvest estimates for the three-lake system.

		2002	2007	2013
Total Estimate of Angler-days		2,666	2,155	2,299
CI (95%)		423	512	386
Brook Trout	**Number**	418	236	263
	Pounds	533	351	326
Lake Trout	**Number**	341	218	550
	Pounds	1,226	755	1,776
Lake Whitefish	**Number**	1,043	431	179
	Pounds	1,630	767	261
All Species	**Total Pounds**	3,389	1,873	2,363
	Pounds/acre	0.41	0.22	0.40

Food Habits:

Stomach contents from the winter 2002 survey were examined from 56 Brook Trout, 28 Lake Trout, and 57 Lake Whitefish. The percent composition by food item and number of stomachs containing no food are presented in Figures 2-4.

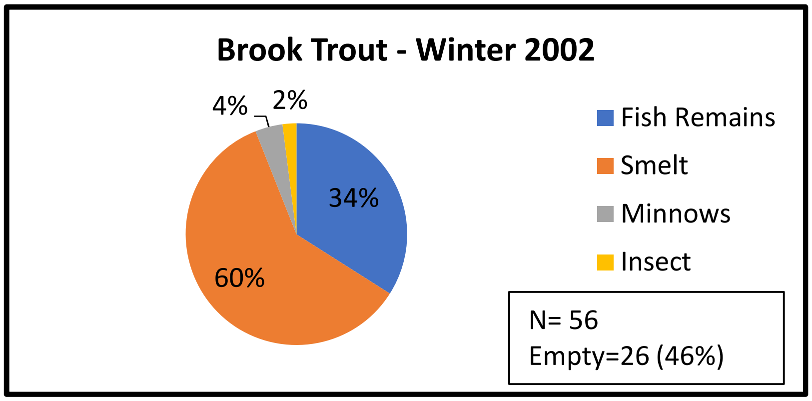

Figure 2. Food habits of Brook Trout from the three-lake system in 2002.

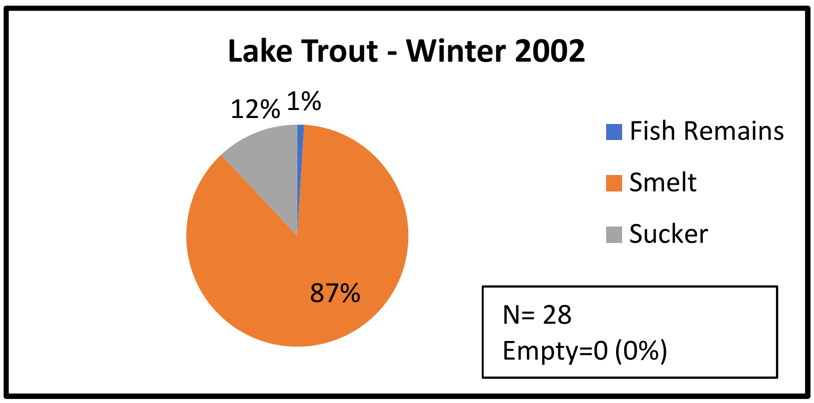

Figure 3. Food habits of Lake Trout from the three-lake system in 2002.

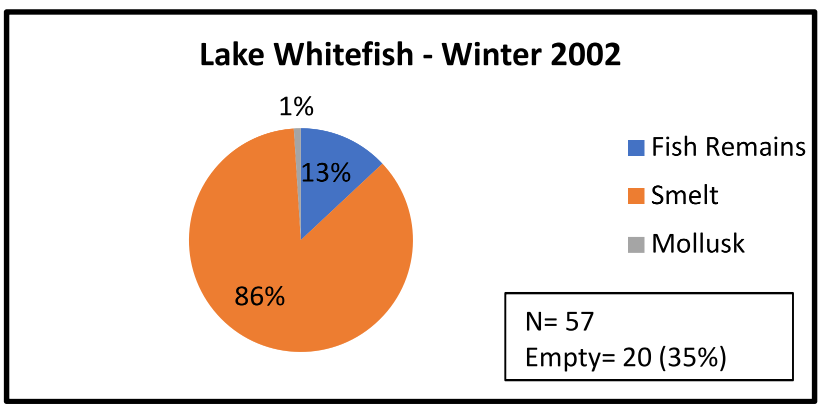

Figure 4. Food habits of Lake Whitefish from the three-lake system in 2002.

Stomach contents were examined from 53 Brook Trout, 48 Lake Trout, and 44 Lake Whitefish in 2007. The percent composition by food item and number of stomachs containing no food are presented in Tables 5-7.

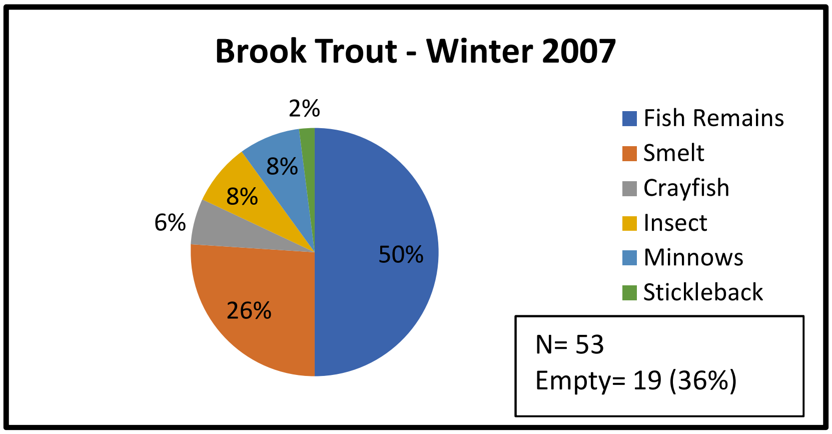

Figure 5. Food habits of Brook Trout from the three-lake system in 2007.

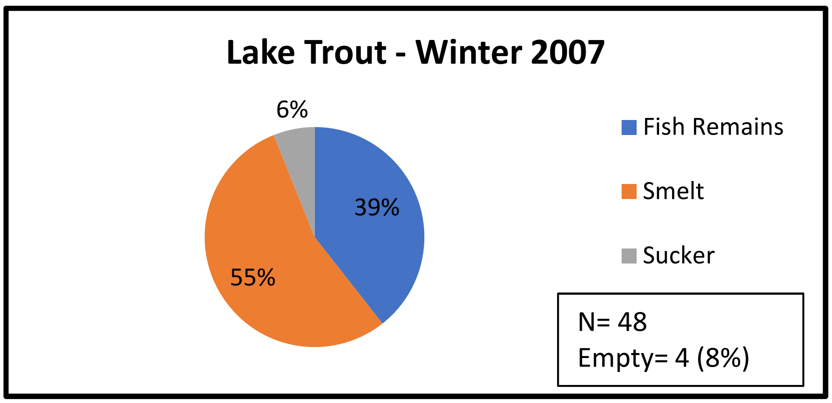

Figure 6. Food habits of Lake Trout from the three-lake system in 2007.

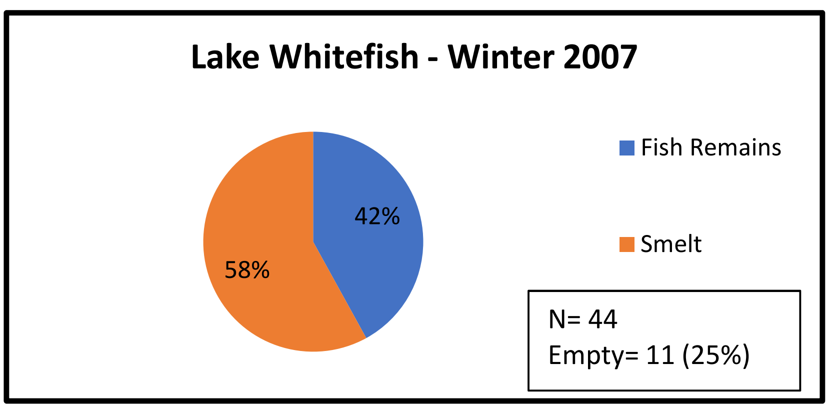

Figure 7. Food habits of Lake Whitefish from the three-lake system in 2007.

Stomach contents were examined from 46 Brook Trout, 28 Lake Trout, and 21 Lake Whitefish in 2013. The percent composition by food item and number of stomachs containing no food are presented in Figures 8-10.

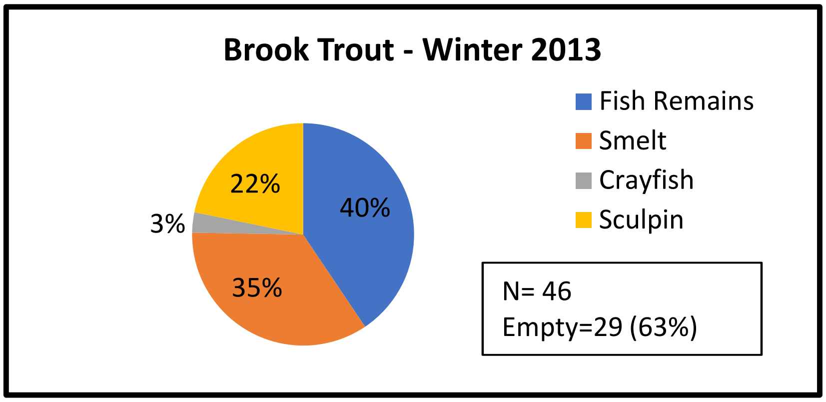

Figure 8. Food habits of Brook Trout from the three-lake system in 2013.

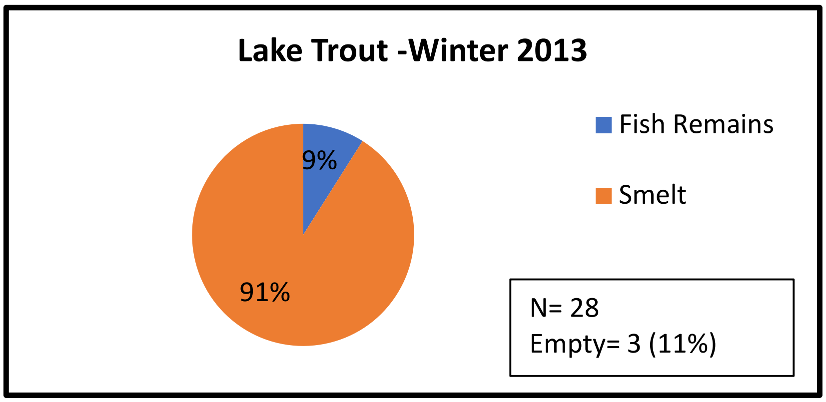

Figure 9. Food habits of Lake Trout from the three-lake system in 2013.

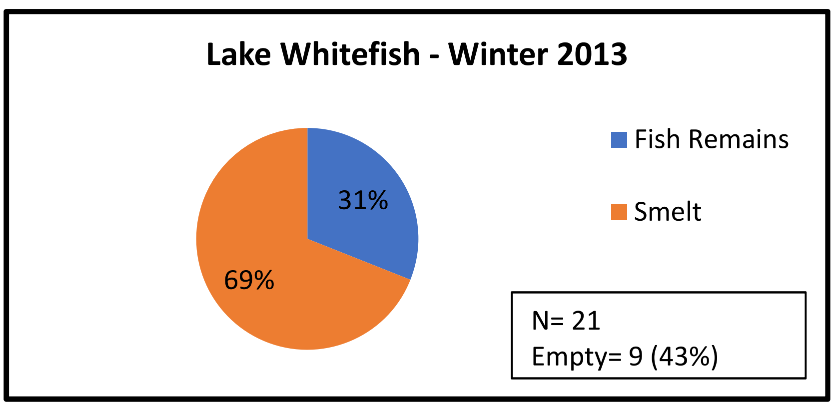

Figure 10. Food habits of Lake Whitefish from the three-lake system in 2013.

Trapnetting:

Nets were set in locations that were suitable from the perspective of depth, substrate, and exposure to prevailing winds. Nets were left in place or moved after tending, depending on their success in catching trout, to maximize the catch

We fished from one to eight trap nets per night in 21 different locations on the three waters from September 10, 2001 through October 25, 2001. Five or six nets were set on most days (35 of 45). Total effort over the 45-day period was 250 net days, or 5,976 net hours.

Trapnets were fished in 13 different locations from September 13, 2006 to October 20, 2006. Total effort over the 37-day period was 250 net days (6,002 net hours), nearly identical to the 2001 effort.

Mean lengths and Fulton's Condition (K) factors from the 2001 and 2006 trapnetting are presented in Tables 6-8.

Table 6. Mean lengths and Fulton's K Factors for Brook Trout in fall trapnetting on the three-lake system.

Brook trout					
	Total sample N	Mean Length	SE	K	SE
2001	350	14.2	0.18	1.01	0.01
2006	276	12.9	0.19	0.95	0.01

Table 7. Mean lengths and Fulton's K Factors for Lake Trout in fall trapnetting on the three-lake system.

Lake trout					
	Total sample N	Mean Length	SE	K	SE
2001	57	21.6	0.21	0.88	0.02
2006	102	22.3	0.18	0.81	0.01

Table 8. Mean lengths and Fulton's K Factors for Lake Whitefish in fall trapnetting on the three-lake system.

Lake whitefish					
	Total sample N	Mean Length	SE	K	SE
2001	151	11.4	0.21	0.73	0.01
2006	N/A	N/A	N/A	N/A	N/A

Length frequencies for Brook Trout and Lake Trout sampled in trapnets in 2001 and 2006 are presented in Figures 11-12.

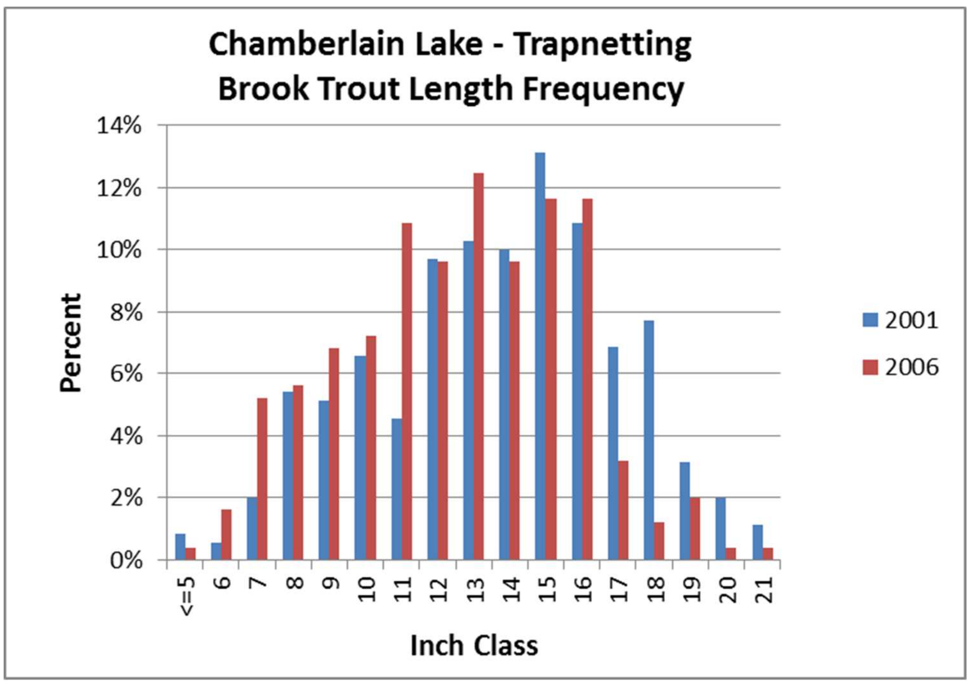

Figure 11. Length frequency for Brook Trout in fall trapnetting on the three-lake system.

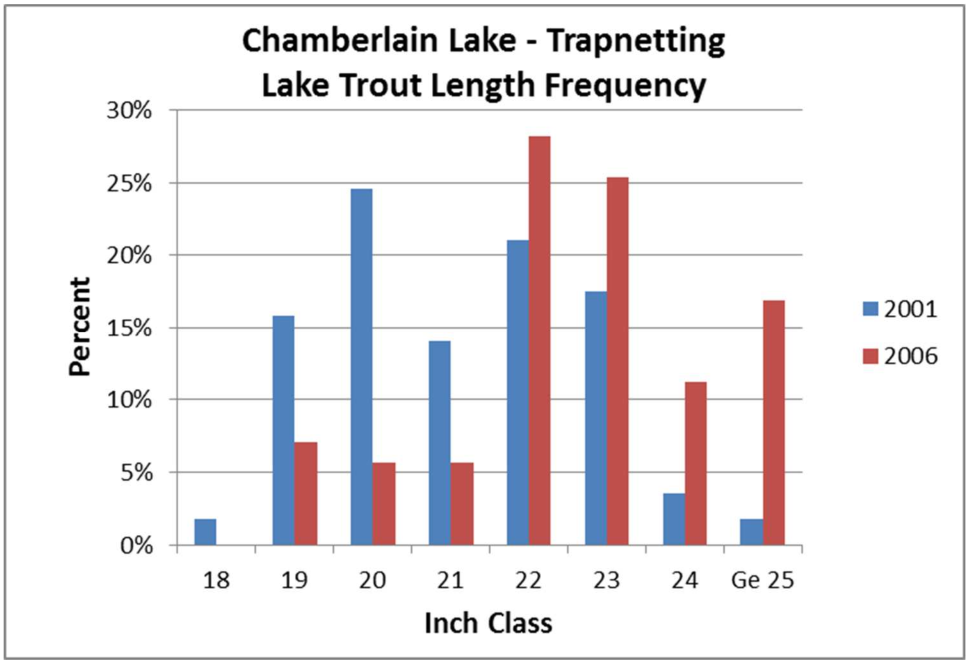

Figure 12. Length frequency for Lake Trout in fall trapnetting on the three-lake system

Returns from 252 legal-size Brook Trout marked in the fall of 2001 provided the basis to estimate the abundance of adult Brook Trout, and their exploitation by winter anglers in 2002. Five of the 91 Brook Trout checked on Chamberlain Lake and three of the 28 trout checked on Telos Lake and Round Pond had been marked with an adipose fin clip in the fall of 2001. Based on the total number of marked trout at large from trapnetting the previous fall, the total number of trout checked during the ice fishing season, and the number of marked trout that appeared in the catch, the Peterson population estimate for Chamberlain Lake, Telos Lake, and Round Pond combined was 3,796 $\pm$ 2,264 (95% CI) Brook Trout $\geq$ 12 inches. When the area of all three waters is combined, this estimate represents an abundance of 0.28 legal-size trout per surface acre ($\pm$ 0.17/acre, 95% CI). The exploitation of adult Brook Trout by ice anglers in 2002 was 11% of the estimated fall population of legal size trout in the lakes based on the total estimated 2002 winter harvest of 418 Brook Trout from the three waters. This estimate does not include Brook Trout that would have been recruited to the fishery during the period of October through the end of the study in March.

A total of 105 Brook Trout ≥ 14 inches had a left ventral fin clip applied during the fall trapnetting in 2006. The legal length limit for Brook Trout increased from 12 inches to 14 inches since 2001, hence the difference in methods. Eighty-five Brook Trout were observed during the creel survey the following winter on all three lakes and just five were fin-clipped. Based on these very limited returns, the Peterson population estimate was 2,280 Brook Trout ≥ 14 inches (± 1,823, 95% CI) or 0.17 legal fish/acre (± 0.14) in the fall of 2006.

We calculated a separate population estimate for 2006 based on returns of radio-tagged Brook Trout. Forty-eight fish > 14 inches received implants, and eight were reported caught by anglers the following winter; seven of the eight were released alive and one was harvested. We correlated tracking data with the angler reports of location and approximate size of released fish to determine that each report was a different individual fish. We used the total number of fish reported in the winter survey as the number of fish examined for this Peterson estimate. Based on these figures, we estimated 2,941 Brook Trout ≥ 14" (± 1,805, 95% CI) were present in the lake in the fall. Therefore, the two Peterson population estimates for 2006 calculated using different methods were similar.

We determined that 44% of the radio-tagged Brook Trout were still alive and in the Chamberlain Lake system and vulnerable to fishing on January 1, 2007. The remaining fish had succumbed to post-spawning mortality, were still up in the tributaries, or had moved downstream to Webster Lake and therefore could not return to the study area because there is no fishway in Telos Dam. All the tagged Brook Trout that remained in the streams throughout the winter were later determined to be mortalities. The survival/mortality information allowed us to generate a population estimate for mature Brook Trout in the system at the beginning of the ice fishing season and measure exploitation by applying this figure to the fall and winter population estimates.

Tagged Brook Trout movements:

Table 9. Fall and subsequent winter population estimates and exploitation for Brook Trout in the three-lake system.

	2001/2002			2006/2007	2006/2007 (ATS)
Number Marked - ≥ **12 inches**	252		Number Marked- ≥ **14 inches**	105	48
Total Number examined	119		Total Number examined	85	479
Number Recaptures	8		Number Recaptures	5	8
Population Estimate(fall)	3,796		Population Estimate(fall)	2,280	2,941
CI(95%)	2264 (60%)		CI(95%)	1823(79%)	1806(61%)
Upper Range	6,059		Upper Range	4,051	4,747
Lower Range	1,533		Lower Range	509	1,135
Number of BKT ≥ **12 inches** per acre	0.28		Number of BKT ≥ **14 inches** per acre	0.17	0.22
Population Estimate(winter)	1,670		Population Estimate(winter)	1,003	1,294
Number of BKT ≥ **12 inches** per acre	0.13		Number of BKT ≥ **14 inches** per acre	0.08	0.10
Number of BKT ≥ **12 inches** harvested in winter 2002	418		Number of BKT ≥ **14 inches** harvested in winter 2007	236	236
Exploitation	25%		Exploitation	24%	18%

Tracking information varied among the 52 tagged fish. We will present two examples that typified the sample and demonstrated important information.

Fish #084 was a 14.6 inch mature male Brook Trout captured in a trapnet on the west side of Chamberlain Lake on 10/13/06. Three days later the fish had entered Allagash Stream, the main spawning tributary for the system. In early November, the fish left Allagash Stream and settled on the east side of Chamberlain Lake for most of the winter. The fish was never detected on the stationary receivers set up at the thoroughfare or Telos Dam. This fish spent the entire 2007 open water season in Chamberlain Lake. On 9/25/07, the fish was detected on the east side of the lake near Nugent's Camps. At some point over the next 21 days, the fish returned to Allagash Stream during the spawning run and was located there on an aerial flight on 10/16/07 (Figure 13). In the fall of 2007, we located 13 tagged Brook Trout that had also spawned in 2006. All 13 were in the same stream where they were located in 2006.

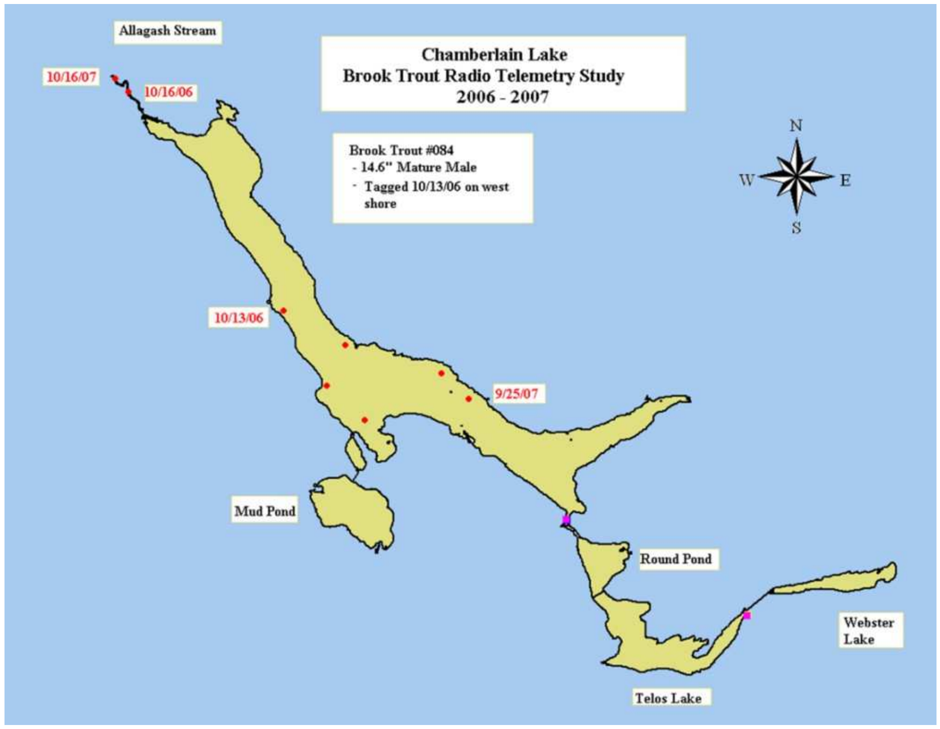

Figure 13. Brook Trout movements in the three-lake system (Fish #084).

Fish #893 was 15.4 inches and sexually immature at the time it was tagged at Telos Landing on 10/11/06. The fish was found multiple times from the date of tagging through the fall of 2007. Each time, the fish was in either Telos Lake or Round Pond. The fish never left these two smaller basins until the fall of 2007 when it presumably matured and moved into Chamberlain Lake, passing by our stationary receiver at the

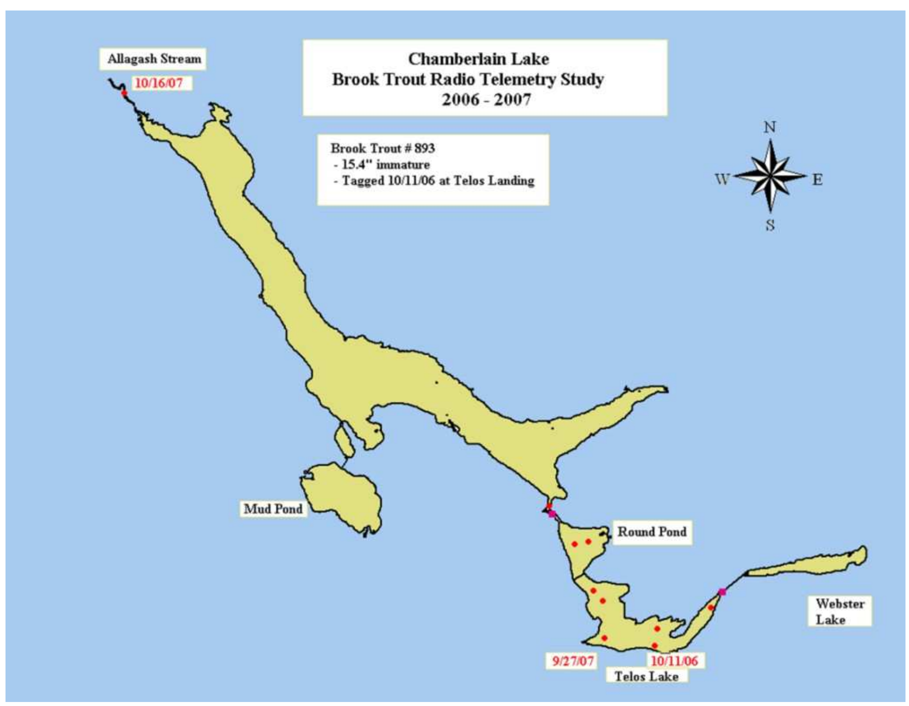

Figure 14. Brook Trout movements in the three-lake system (Fish #893).

thoroughfare. On 10/16/07, this fish was located in Allagash Stream, about 14 miles from where it was tagged a year prior (Figure 14).

Discussion

The AWW diligently protects the area around all the lakes and rivers within the Waterway. Timber harvesting and road construction are not allowed, except for special circumstances, within the Restricted Zone which varies from 400–880 feet from the high-water mark around the watercourse. The AWW receives notification and reviews management plans for timber harvesting within a 1/4-mile zone around the waterway, and any new construction in this zone requires prior approval. Forestry operations in areas visible from the watercourse require prior approval. The AWW staff also maintain and manage water level control structures at Lock Dam and Telos Dam with input from the IFW. The habitat and aesthetics are well protected within the three-lake system. However, many of the spawning Brook Trout tributaries and important sources for cool water extend beyond the boundaries of the watercourse and are not as well protected. It may be beneficial in the future to increase protection in terms of fishing restrictions, increased riparian buffers, and development restrictions to Ellis Brook, Telos Stream, and other smaller tributaries.

The current water management plan helps to sustain the coldwater fish populations in the lakes. The dam at the outlet of Telos Lake ultimately controls lake levels in all three waters and maintains the fishery downstream in the outlet. In general terms, the AWW staff attempt to maintain a “full” water level in the Chamberlain Lake system during the summer recreation season. The lake is drawn down in September to ensure the Lake Trout spawn at an artificially low lake elevation in mid/late October to increase the chance their eggs remain underwater during subsequent natural/artificial drawdowns. Fishing flows are also released to provide fall fishing below Telos Dam. Lock Dam provides flow in Martin Stream and into Eagle Lake. This section of stream provides canoe access to the remainder of the Allagash River system. Summer flows are adequate for boating, however, the culvert which provides flow through the dam is dewatered after the lake is drawn down more than four feet from the mean high water mark. We hypothesize that the elimination of flow into Martin Stream during the fall and winter months has contributed to the decline of the Lake Whitefish population in Big Eagle Lake. We have multiple reliable reports of historical spawning runs of Lake Whitefish in Martin Stream downstream of Lock Dam. Recent observations indicate the run is no longer present. If Lock Dam is ever reconstructed, a high priority should be placed on providing year-round flow into Martin Stream.

Winter angler use patterns at Chamberlain Lake mimic statewide trends; use was generally between 1,000 and 2,000 angler-days in the 1970s then increased dramatically in the mid-1980s and early 1990s to nearly 5,000 angler-days and subsequently declined. The closure of the Great Northern paper mills in Millinocket and subsequent loss of employment opportunities undoubtedly contributed to the decline in fishing pressure that we have documented not only at Chamberlain Lake (Figure 15), but also Chesuncook Lake and other waters in northern Piscataquis County since 1998.

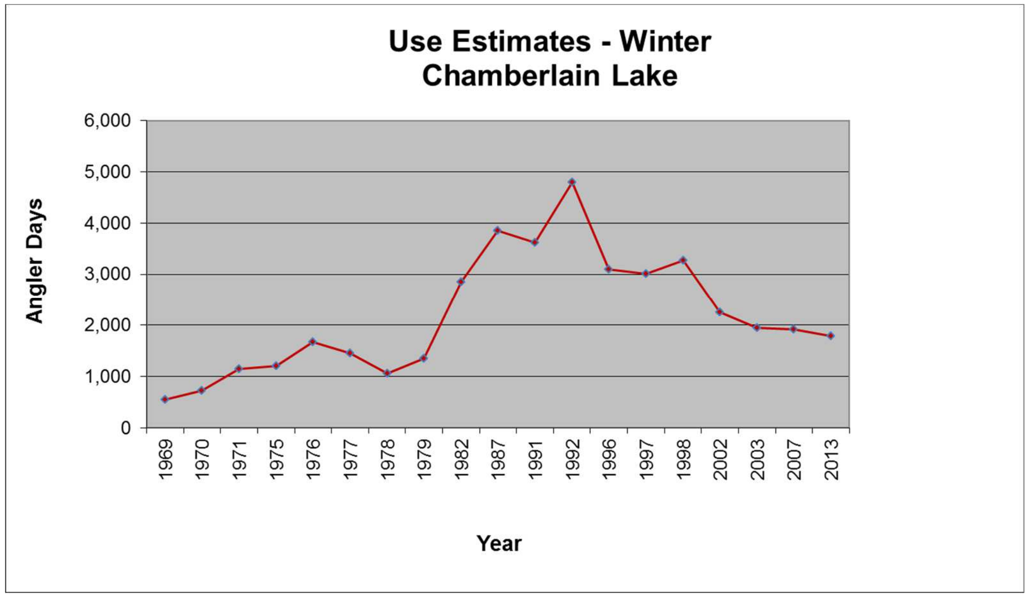

Figure 15. Winter angler use trend on the three-lake system.

Lake Whitefish harvest on Chamberlain Lake peaked during the 1987 winter creel survey under the 8-fish limit when we estimated 2,039 Lake Whitefish (3,431 lbs) were harvested in 3,860 angler days (Figure 16). The daily bag limit on Lake Whitefish changed from eight fish to three fish in 1988 on all the major lakes in the AWW. Harvest declined to 769 Lake Whitefish (1,477 lbs)

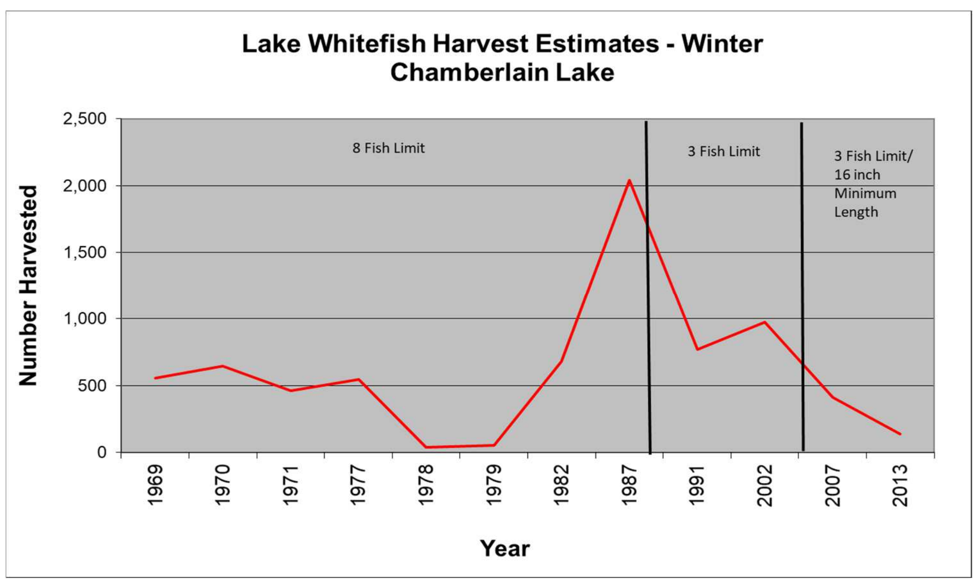

Figure 16. Estimated harvest of Lake Whitefish during the winter fishing season on the three-lake system.

during our 1991 winter creel survey, even though use was comparable (3,620 angler days) to the previous estimate in 1987. A 16- inch minimum length limit was adopted in 2005 to further protect Lake Whitefish throughout Maine. It has also become apparent that anglers who once flocked to Chamberlain Lake primarily to target Lake Whitefish are no longer making the trip. We did not record target species during our winter clerk surveys, but there was a core contingent of anglers who fished exclusively for Lake Whitefish, and in recent years we have not seen those anglers. It is unclear if the lack of fishing effort is a general reflection of declining interest in ice fishing or a reaction to the more restrictive regulations. Catch rates are still very good; we estimated 138 Lake Whitefish were harvested on Chamberlain Lake in 2013. Care needs to be taken regarding over-protecting this fishery in Chamberlain Lake. Food habits demonstrate that these fish feed heavily on smelt which are also the most important forage for Lake Trout. We have learned in other places, such as First Roach Pond (Frenchtown TWP), that severely reducing harvest on predators can result in an over-population of predators and a reduction of the forage base. The very restrictive regulations on Lake Whitefish in the face of drastically lower winter fishing use has resulted in a sharp decline in harvest. Mean length at age, since the implementation of the three fish daily bag limit in 1988 (Figure 17), does show a declining trend for the major age groups represented in the winter harvest which could be an indication of stunting.

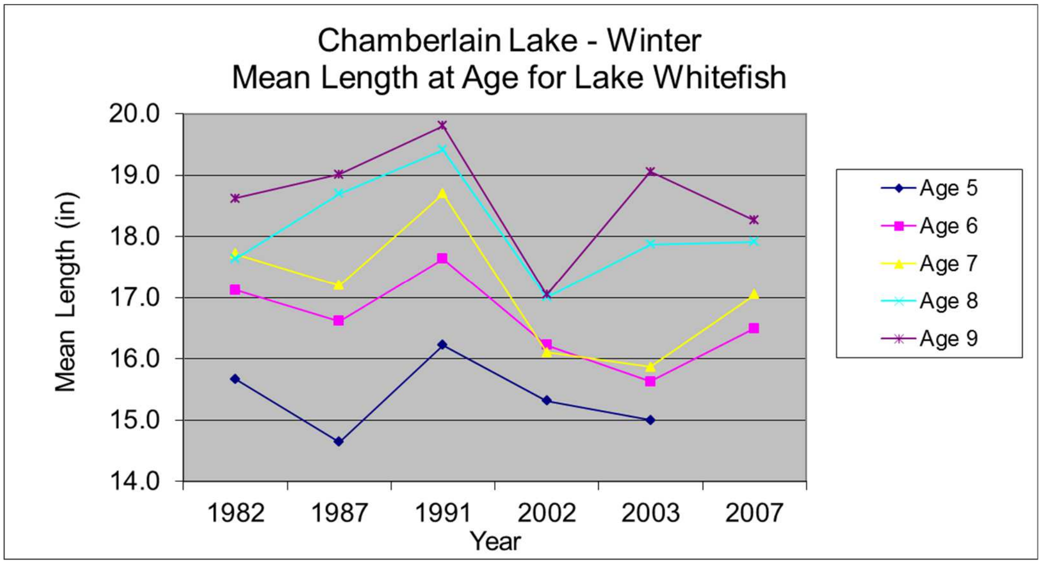

Figure 17. Mean length at age for Lake Whitefish on the three-lake system.

The Lake Trout fishery in the Chamberlain Lake system has been remarkably stable unlike many other Lake Trout waters in the region over the same period. Catch rates for legal Lake Trout have been very close to 0.05 fish/hr since the implementation of the 18-inch minimum length limit in 1979 (Figure 18). The sublegal catch rate has ranged from < 0.01 to 0.28 over that period. In addition, an average of 21% of all Lake Trout reported (legals kept, legals released, and sublegals) exceeded 24 inches over each of these survey years which indicates the quality of the fishery.

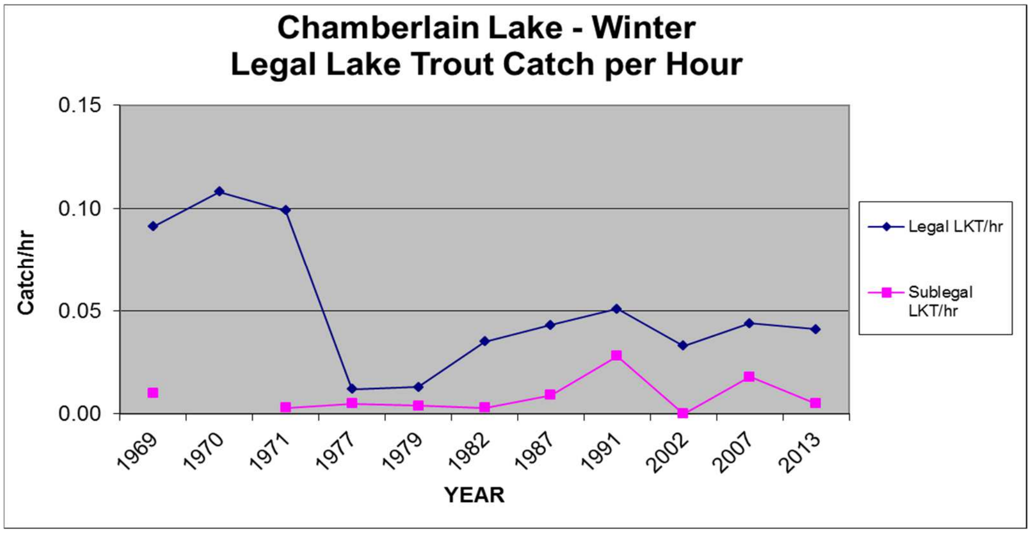

Figure 18. Catch rates for Lake Trout during the winter fishing season on the three-lake system.

We did document a substantial decline in Lake Trout condition during the winter 2007 creel survey. Catch rates for Lake Whitefish were peaking prior to the decline in Lake Trout condition. The increase in abundance of smelt-eating Lake Whitefish likely reduced forage for several years in the Chamberlain Lake system. Catch rates for Lake Trout were also relatively high in 2007 indicating they too were experiencing higher than normal densities. Higher densities of these major predators likely had a negative impact on Lake Trout condition, but catch rates subsided by 2013 and condition improved.

Based on the morphoedaphic index (MEI) (Ryder 1965), we estimate the total annual production of fish to be 16,714 pounds in Chamberlain Lake and 4,278 pounds in Round Pond and Telos Lake. Healey (1978) determined that Lake Trout harvest rates over 0.5 pounds/acre/year were excessive. We use 25% of the total annual production as a safe guideline (maximum sustainable harvest) for annual Lake Trout harvest in the Moosehead Lake Region (AuClair 1982).

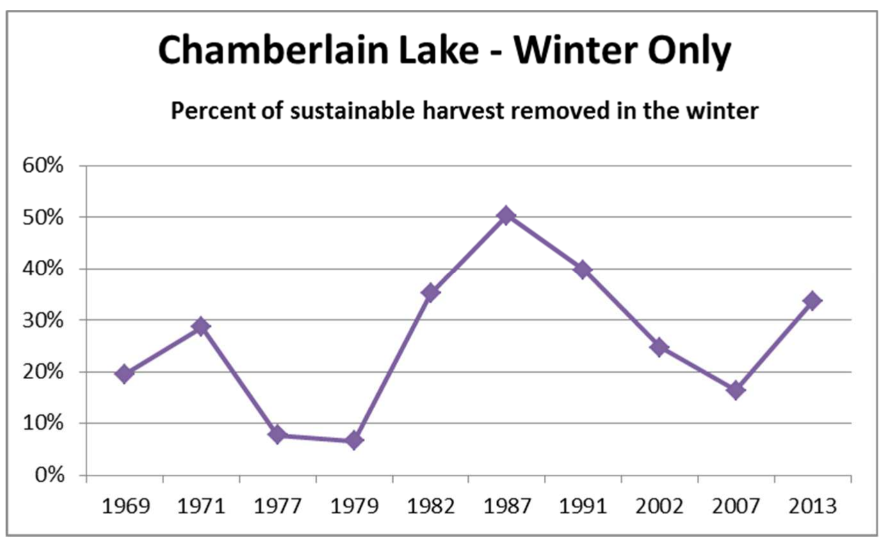

Figure 19. The estimated percent of sustainable harvest removed from Chamberlain Lake in the winter.

Anglers harvested less than 50% of the maximum sustainable yield in the winter months since 1969. Summer harvest is not accounted for in these estimates, but the summer fishery is likely small compared to winter. The total annual harvest of Lake Trout at Chamberlain Lake is probably 35-50% of the maximum sustainable yield. For comparison, recent studies on First Roach Pond indicate that anglers removed 95-106% of the annual maximum sustainable yield when the open water harvest was combined with an experimental opening of the pond to ice fishing (MDIFW, unpublished data). Moosehead Lake has been studied extensively and Lake Trout harvest generally ranges from 55-60% of the maximum sustainable yield annually (MDIFW, unpublished data). Therefore, the harvest of Lake Trout in the Chamberlain Lake system is below the recommended regional guideline and lower than several other wild Lake Trout waters in the area. Theoretically, this should improve the size quality of the Lake Trout fishery. The percentage of harvested Lake Trout ≥ 24 inches examined in winter clerk surveys since 1979 (the implementation of the 18-inch minimum length limit) was 18% in the three-lake system, compared to just 2% at Moosehead Lake and 7% at First Roach Pond (Figure 20).

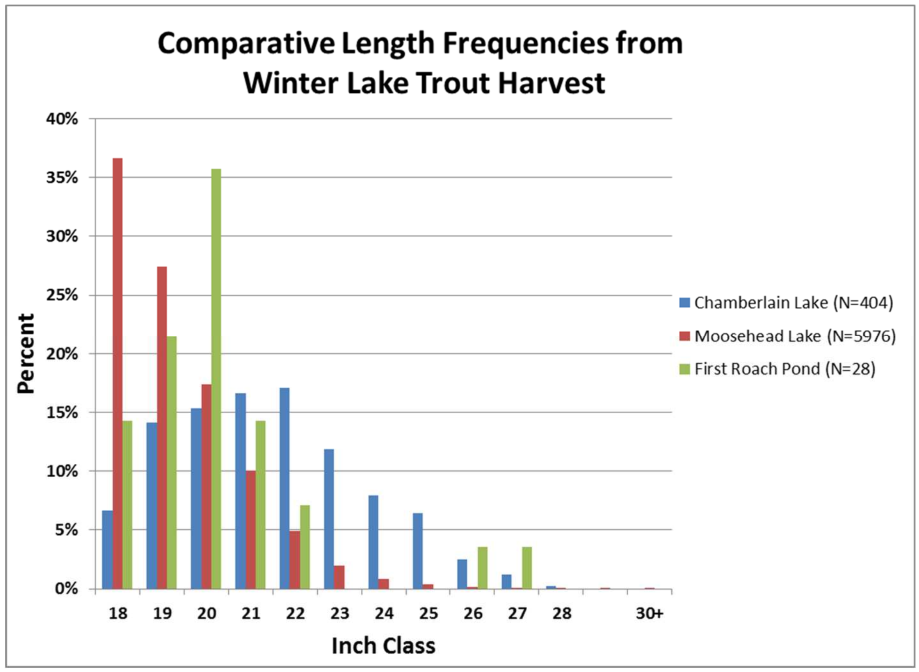

Figure 20. Comparative length frequencies for Lake Trout in the winter harvest.

These data also suggest that maintaining larger fish in the population may help control the recruitment of smaller fish and provide a stable environment for growth and a quality fishery.

Brook Trout trapnetting in 2001 was a major effort to gather information on population density and exploitation in a large oligotrophic system. The results inspired the expanded study in 2006 which included radio telemetry to track fish, estimate post-spawning mortality, and evaluate/identify over-winter refuge areas on Chamberlain Lake. For example, an area of roughly 500 acres at the northern tip of Chamberlain Lake at the mouth of Allagash Stream was closed to ice fishing in 2000 because anglers had located what appeared to be a concentration of vulnerable adult Brook Trout. This is similar to Moosehead Lake where large areas near the mouth of the Roach River and Socatean Stream were closed to ice fishing to protect post-spawning concentrations of Brook Trout. We considered expansion of the refuge area on Chamberlain Lake in 2002; however, the proposal was not implemented due to lack of data and the recent adoption of the original protection zone. We used radio telemetry in 2007 to accurately determine the number of tagged Brook Trout in the current refuge area as well as the number of tagged Brook Trout in the proposed adjacent refuge area. There were 23 active radio transmitters in the entire Chamberlain Lake system in the winter of 2007. We located six (26%) of these tagged Brook Trout in the proposed expanded refuge area and only one (4%) remained in the currently protected area. We had angler reports of two tagged fish caught and released in the proposed protected area, and by the end of the ice fishing season there were two mortality signals in that area. Therefore, a significant number of Brook Trout could be protected from winter harvest and hooking mortality by adopting the proposed expansion of the refuge area at the northern end of Chamberlain Lake, if additional protection is needed to reduce winter exploitation of Brook Trout.

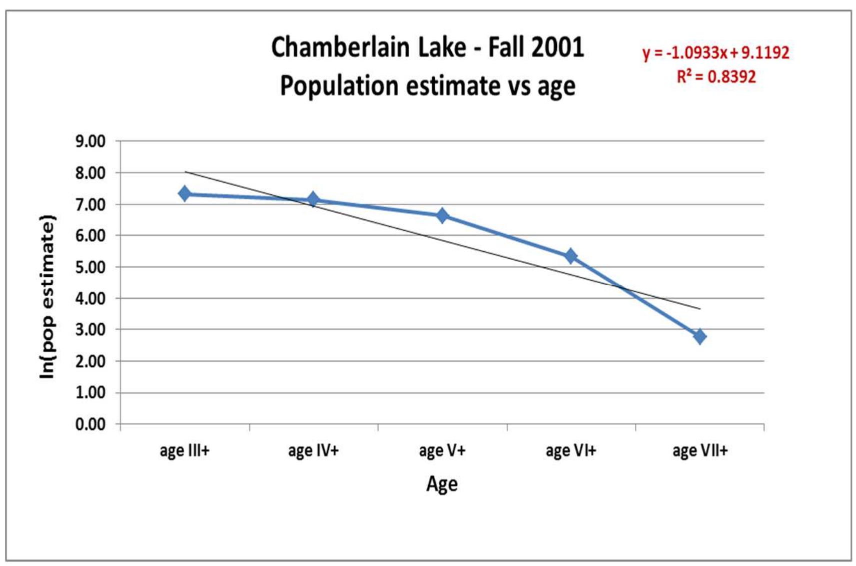

Figure 21. Linear regression of population estimates by cohort for 2001.

All the population estimates made from mark and recapture studies had wide confidence intervals which is to be expected from a large lake system with low use and relatively few fish tagged. However, all three point estimates were similar. We estimated a population of 3,796 Brook Trout ≥ 12 inches for the fall of 2001. In 2006, two separate estimates were made; one using the returns of fin clipped fish and the other with radio tagged fish. The point estimates were 2,280 and 2,941 respectively. The 2006 estimates were for Brook Trout ≥ 14 inches because the minimum length limit had increased since the 2001 work. Therefore, we would expect the 2006 estimates to be lower than 2001. For comparison purposes, we estimated the number of Brook Trout present by age class and inch class. The population estimate for Brook Trout ≥ 14 inches in 2001 was 2,557 fish, which is within the range estimated in 2006. We expanded this analysis to gain a better understanding of age structure and exploitation. The winter population estimates derived from mark and recapture of fish marked in the previous fall do not account for recruitment to the fishery for Brook Trout that might have been just sublegal in the fall but could have attained legal length sometime between October and the end of the winter survey in March. We estimated survival (S) based on the linear regression of the population estimates for the ages fully recruited to fall trapnetting (Figure 21). In 2001, this include ages III+ and older. Survival is calculated as the inverse natural log of the slope (z) of the regression (Seber 1982). We were then able to use the mean survival to back-calculate year class estimates for younger ages and then a total population estimate for the fall. We estimated a total population of nearly 22,000 Brook Trout age I+ and older in the fall of 2001, and a harvest of 342 Brook Trout ≥ 12 inches in the winter of 2002. This represents a winter exploitation rate of 12% of the legal trout available in the winter. We applied the 56% mortality/dropdown rate to mature Brook Trout in the recruited ages; however, survival is probably higher for immature fish so it is not possible to estimate the total number of immature (age II and some age III) Brook Trout in the winter. Regardless, based on these calculations, the proportion of fish harvested from the entire population in 2002 was certainly low (Table 10).

We repeated the same exercise for the data collected in 2006/2007 and estimated an exploitation rate of 8% for Brook Trout ≥ 14 inches. Also, the fall population estimate for age I+ and II+ fish was higher in 2006 than in 2001 indicating that increasing the minimum length limit to 14 inches may have helped increase the overall population density and decreased exploitation. Based on length-at-age, 100 % of the age III Brook Trout and nearly all of the age IV fish are now protected from winter harvest (allowed 1 fish ≥ 14 in) which should increase production and survival to older ages under the current level of use.

These data, along with those from nearby Big Eagle Lake, provide a useful examination of wild Brook Trout population structure in large lake systems. In 1991 and 1996, Big Eagle Lake was estimated to have 0.13–0.30 Brook Trout ≥ 12 inches per surface acre (Dave Basley, personal communication). Chamberlain Lake estimates ranged from 0.24 to 0.28 Brook Trout ≥ 12 inches per surface acre. Bonney (2006) reported that 48 individual mark-recapture studies have been conducted thus far on a total of 24 Maine lakes, all less than 200 acres. Population estimates for Brook Trout ≥ 6 inches ranged from 0.62 to 60.93 fish per surface acre. These smaller shallow ponds are more productive than larger oligotrophic systems like Chamberlain Lake and Big Eagle Lake. We can compare the total Brook Trout population in the smaller ponds to the Chamberlain Lake system on a per littoral acre basis. The three lakes have roughly 5,570 acres of habitat less than 20 feet deep. Therefore, we estimated a total density of 3.93 fish per littoral-acre in 2001 and 8.80 fish per littoral-acre in 2006.

Table 10. Comparison of fall and subsequent winter population estimates and winter exploitation of Brook Trout in the three-lake system.

Fall 2001-cohort	**Fall Pop est**	**Winter Pop est**	**Winter 2002 - cohort**	**Winter Harvest**	**Exploitation (u)**
age I+	13,587	n/a	age II	0	0%
age II+	4,552	1,229	age III	163	13%
age III+	1,525	671	age IV	115	17%
age IV+	1,255	552	age V	60	11%
age V+	762	335	age VI	4	1%
age VI+	206	91	age VII	0	0%
age VII+	16	7	age VIII	0	0
All ages	21,902			342	**12%**
Ages IV-VII		1,656			
Brook trout >= 12 inches	3,796	2,885			

We estimated post spawning mortality to be 51% for mature Brook Trout in Chamberlain Lake based on the radio transmitters with mortality switches (Table 11). This is within the range for several other studies conducted in the area concerning Brook Trout survival on large oligotrophic systems.

Table 11. Post-spawning mortality rates for wild Brook Trout in the three-lake system and studies on Moosehead Lake.

Study Site and Year	**Chamberlain Lake 2006**	**Socatean Stream 1957**	**Socatean Stream 2010**	**Socatean Stream 2010**	**Roach River 2010**	**Roach River 2010**
Tagging Method	Radio Tags	Jaw Tags	Radio Tags	PIT Tags	PIT Tags	Radio Tags
Post Spawning Mortality	51%	64%	60%	57%	51%	55%
Annual Mortality	64%	75%	70%	n/a	n/a	n/a

Based on our results, spawning activity is the major source of mortality within the year, and the annual figures correspond with the estimated winter exploitation in combination with post spawning mortality. Each of these tagging studies occurred in open systems, devoid of any artificial barriers that may have negatively impacted survival. Therefore, it is difficult to imagine management techniques that would lower natural mortality associated with spawning. It does exemplify the fragile state these fish must be in during the spawning process and shortly after. Fishing over wild spawning Brook Trout could only exacerbate the situation. Spawning runs of wild Brook Trout began on the first rain event in mid- to late-August in all of the tagging studies on these free-flowing waters, and continued until the first week of October. Movement peaked with rain events and slowed to a trickle during dry periods. This lends credence to the past law that closed most streams in Maine to fishing after August 15th. The old law provided additional protection for Brook Trout, especially in the early fall when air temperatures may be high and fish can become stressed and congregated in the limited refuge areas where groundwater is present in the spawning tributaries.

All post-spawning mortalities occurred before the opening of the ice fishing season. However, developing winter sanctuary areas where post spawning fish are concentrated will reduce removal rates and hooking mortality associated with releasing Brook Trout, especially those that are between 12 and 14 inches and are sexually mature.

Recommendations

1. Continue to monitor use and harvest during the winter months every 4–5 years.
2. Conduct one summer clerk survey and use estimate in the next 10 years in the same year as a winter survey.
3. Closely monitor the Lake Whitefish population with respect to the new restrictive regulations and potential impacts on Lake Whitefish and Lake Trout growth.
4. Work with the AWW staff to develop a water management plan along with any new water control structures. Any changes should:
    i. Maintain the water control structures at Lock Dam and Telos Dam.
    ii. Maintain summer recreational lake elevations.
    iii. Provide year-round flow below Lock Dam into Martin Stream at a level to encourage Brook Trout and Lake Whitefish reproduction and support summer canoe passage in Martin Stream.
    iv. Provide flows appropriate to maintain the aquatic community below Telos Dam to Webster Lake and, when possible, appropriate fishing flows.
    v. Maintain the ability to draw the lakes down in the fall to optimize Lake Trout spawning success and reduce the risk of downstream flooding in the spring.
5. Work with the AWW and adjacent landowners to develop a long-term plan to protect the remaining smaller tributaries to the Chamberlain Lake system.
6. Consider management strategies that will maintain, protect, and improve the quality of the wild Brook Trout fishery such as expanding the winter sanctuary area and closing all tributaries to fishing after August 15^{th}.

Literature Cited

AuClair, R. 1982. Moosehead Lake Fishery Management. Fisheries Research Bulletin 11. Maine Department of Inland Fisheries and Wildlife. 175p.

Bonney, F. 2006. Maine Brook Trout – Biology, Conservation, and Management. Maine Department of Inland Fisheries and Wildlife. 153p.

Healey, M.C. 1978. The dynamics of exploited Lake Trout populations and implications for management. J. Wild. Manage. 42(2):307-328.

Ryder, R.A. 1965. A method for estimating fish production in lakes. Trans. Am. Fish. Soc. 94(3): 214-218.

Seber, G.A. F. 1982. The estimation of animal abundance and related parameters. Macmillan publishing Co., New York, NY. 654p.

COOPERATIVE

STATE FEDERAL

PROJECT

This report has been funded in part by the Federal Aid in Sport Fish Restoration Program. This is a cooperative effort involving federal and state government agencies. The program is designed to increase sport fishing and boating opportunities through the wise investment of angler's and boater's tax dollars in state sport fishery projects. This program which was founded in 1950 was named the Dingell-Johnson Act in recognition of the congressmen who spearheaded this effort. In 1984 this act was amended through the Wallop Breaux Amendment (also named for the congressional sponsors) and provided a threefold increase in Federal monies for sportfish restoration, aquatic education and motorboat access.

The program is an outstanding example of a "user pays-user benefits" or "user fee" program. In this case, anglers and boaters are the users. Briefly, anglers and boaters are responsible for payment of fishing tackle, excise taxes, motorboat fuel taxes, and import duties on tackle and boats. These monies are collected by the sport fishing industry, deposited in the Department of Treasury, and are allocated the year following collection to state fishery agencies for sport fisheries and boating access projects. Generally, each project must be evaluated and approved by the U.S. Fish and Wildlife Service (USFWS). The benefits provided by these projects to users complete the cycle between "user pays – user benefits."

Maine Department of Inland Fisheries and Wildlife

284 State Street, 41 SHS, Augusta, ME 04333-0041