Management of Fishery Resources and Sea Lamprey in Lake Champlain, 2005

Annual Report from the Lake Champlain Fisheries Technical Committee

Prepared by the Fisheries Technical Committee of the
Lake Champlain Fish and Wildlife Management Cooperative

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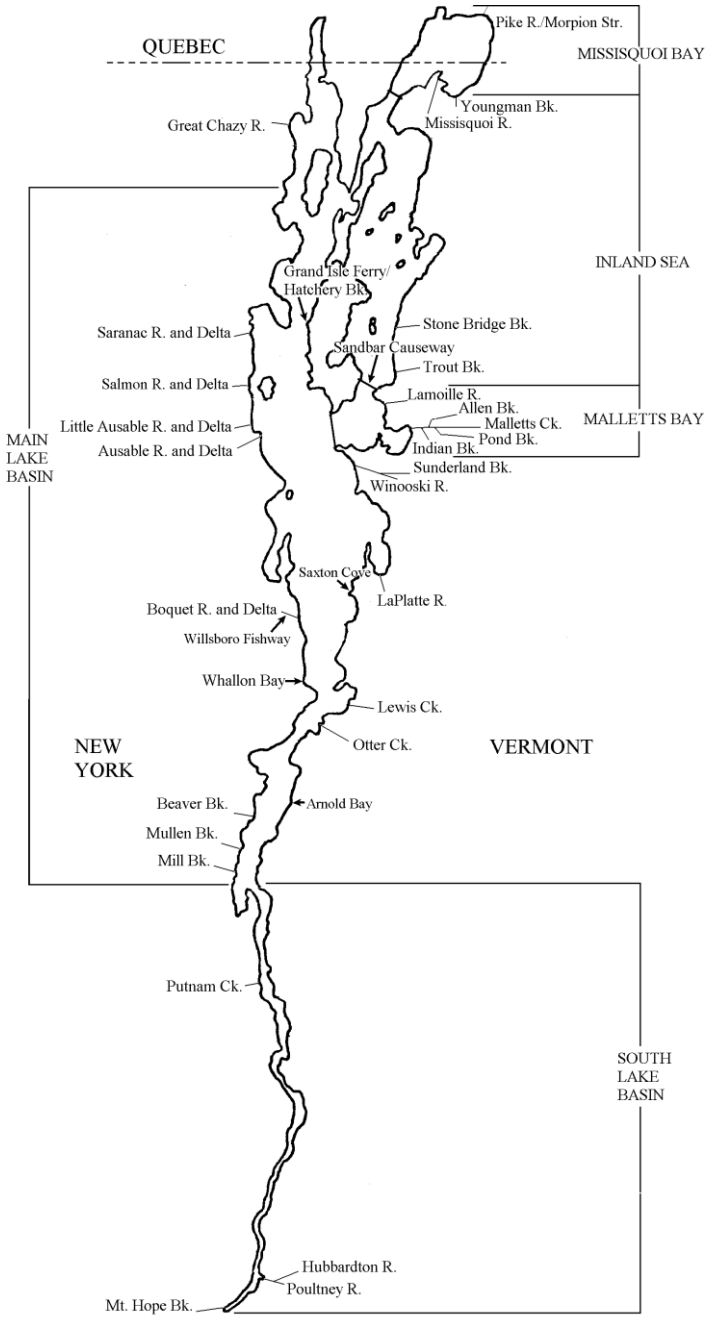
Executive Summary

The Lake Champlain Fisheries Technical Committee manages and conducts research on the fish resources of Lake Champlain. The Committee promotes a unified approach for the conservation of those resources. This report summarizes activities of the Committee in 2005.

A primary focus of the Fisheries Technical Committee has been to reestablish populations of the native landlocked Atlantic salmon and lake trout. Management of sea lamprey in Lake Champlain has become a major activity necessary to achieve those objectives. No treatments were scheduled in 2005. During their spawning run, sea lamprey were trapped on eight streams. Quantitative sampling was conducted to estimate abundances of larval and transformer stage sea lamprey of eight tributaries. A sea lamprey life history model is in the process of being developed. The model will help identify future research needs and the relative effectiveness of various approaches to control. A control alternatives working group is investigating alternatives to lampricides as possible lamprey control procedures.

Salmonid management included stocking about 265,000 landlocked Atlantic salmon, 83,000 lake trout, 76,000 steelhead and 65,000 brown trout. Salmonid abundances were monitored through spring and fall near shore electrofishing, collections at the Willsboro Fishway and Winooski River Fish Lift, and an angler diary cooperator program. A study to compare returns from three strains of salmon was begun with the stocking of differentially fin-clipped study fish in spring, 2003. Attack rates on lake trout and salmon in 2005 were higher than attack rates prior to the eight-year experimental sea lamprey control program, and higher than 2004. Sampling of salmon and lake trout by the Committee indicated that abundance of both species was relatively low, likely an indication of sea lamprey induced mortality. Completion of the Final Supplemental Environmental Impact Statement on long-term sea lamprey control in 2001 allowed a long-term control program to begin in 2002. Expectations were that the renewed control effort would yield improvements to salmonid populations, as well as walleye, lake sturgeon and other fish populations by the completion of the first round of treatments. However, the expected benefits have not yet been achieved. Several factors may be contributing to the continued high attack rates and our failure to achieve target wounding rates: 1) Tributaries known to produce sea lamprey ammocoetes are not yet being treated. The Morpion/Pike river system in Quebec has never been treated for sea lamprey. The Poultney River has not been treated since 1996 and has never been treated at an optimal treatment concentration. 2) Tributaries that did not previously support lamprey spawning and ammocoete production are now producing sea lamprey. Surveys in 2005 documented ammocoete production in the Lamoille River, and a survey in 2003 documented a significant sea lamprey population in the Missisquoi River. 3) There may be significant residual ammocoetes (i.e. ammocoetes that survive a lamprey treatment on a particular tributary or delta). These issues and potential corrective steps are addressed in this document.

FIGURE 1. Map of Lake Champlain showing relevant tributaries and other fishery survey locations.



Introduction

This report summarizes activities conducted by the Lake Champlain Fisheries Technical Committee during 2005. A major focus of the Technical Committee has been to reestablish native landlocked Atlantic salmon and lake trout populations in Lake Champlain. In addition, effort has been directed towards management of walleye, lake sturgeon, smelt and other species. Related activities include fish stocking, control of sea lamprey, research into sea lamprey biology in Lake Champlain, and studies of potential nontarget impacts from lamprey control.

The Lake Champlain Fisheries Technical Committee is part of the Lake Champlain Fish and Wildlife Management Cooperative (Cooperative). The Cooperative and the Fisheries Technical Committee were established in 1973 to promote "a unified approach for the protection and management of the fish and wildlife resources of interstate significance in Lake Champlain" (Lake Champlain Fish and Wildlife Policy Committee, 1977). The Fisheries Technical Committee includes representatives of the US Fish and Wildlife Service (USFWS), the Vermont Department of Fish and Wildlife (VTDFW), the New York State Department of Environmental Conservation (NYSDEC), the University of Vermont, and the Vermont Cooperative Fish and Wildlife Research Unit. In addition, representatives from the Province of Quebec, Sea Grant, and other universities are frequently involved in Technical Committee activities.

The organizations making up the Technical Committee obviously have a broad spectrum of management, regulatory, and research responsibilities. This document primarily discusses activities conducted cooperatively between the organization's members and/or activities that involve resources held in common across the lake's political boundaries.

Refer to the map of Lake Champlain (Figure 1) for locations of tributaries and other areas referred to in this report.

Sea Lamprey Management and Assessment

The Cooperative's current objectives for sea lamprey control in Lake Champlain, as established in the FSEIS for the long-term control program, include:

- *Achieve and maintain lamprey wounding rates at or below:*
  25 wounds per 100 lake trout (ideally 10 wounds per 100 lake trout);
  15 wounds per 100 landlocked salmon (ideally 5 wounds per 100 salmon);
  2 wounds per 100 walleye (ideally less than 1 wound per 100 walleye).

- *Attain target wounding rates within five years of full implementation of the long-term control program.*

Presently, sea lamprey control in the Lake Champlain Basin is achieved through the use of lampricides, barriers, and trapping. Ongoing efforts monitor the status of various life stages of

sea lamprey to better direct those control efforts. Lastly, research efforts are being pursued to assess potential new control methodologies.

Lampricide Control

- There were no scheduled sea lamprey control treatments in 2005.
- A list of past and projected future stream treatments is provided in Appendix 1.

Toxicity Studies

- Lampricide toxicity testing, essential for obtaining necessary treatment permits, was completed on several species in 2005. NYSDEC tested quillback, fluted shell mussels, and pocketbook mussels at the Rome Laboratory and found them to be relatively resistant to the mixture of TFM/Niclosamide, with the lowest observed NOEC (No Observed Effect Concentration) of 1.6 times the MLC (sea lamprey minimum lethal concentration). American brook lamprey and margined madtom were only marginally more resistant to TFM/Niclosamide than sea lamprey.
- High flows and scheduling difficulties forced the postponement of collections of channel darters needed for testing with the TFM/Niclosamide combination.

Trapping and Barriers

- Traps were used to collect migratory-phase sea lamprey in eight streams during the spring of 2005 (Table 1).

TABLE 1. Number of migratory-phase sea lamprey captured during 2005 in Lake Champlain tributaries where traps were deployed. Streams are grouped by watershed where applicable.

Stream	Number of migratory-phase sea lamprey captured	Percent change from 2004
Great Chazy River	192	-77%
Stone Bridge Brook	33	-60%
Trout Brook	37	-81%
Malletts Creek	149	-45%
- Indian Brook	0	0%
- Pond Brook	2	-87%
Winooski River	NA	NA
- Sunderland Brook	2	-87%
Beaver Brook	141	+3%

- On seven of those streams trapping was implemented as the primary method of control. Trapping has been implemented as a control technique in small streams where trapping efficiency is thought to be high, and where suitable trapping sites exist downstream of spawning habitat.

- In the Great Chazy River, trapping is part of an integrated approach to controlling sea lamprey that includes lampricide treatments and a barrier with a trapping facility.

- A trap was set in Beaver Brook, Westport, NY, for a second year, to evaluate the feasibility of using traps to control the larval population there. Beaver Brook has been problematic for lampricide treatments due to low discharge and variable water chemistry. Larval assessment surveys are planned for 2006 in Beaver Brook to determine the effectiveness of trapping at controlling its larval sea lamprey population.

- Youngman Brook, which was also identified as a stream where trapping could be used as a control method was dropped from the list in 2005. One sea lamprey has been caught in the 4 years since trapping has been implemented, leading us to believe that the farm impoundment downstream from our trap site is limiting the upstream migration of sea lamprey.

Sea Lamprey Control in the Pike River System

The Pike River System in Quebec, including its major tributary, Morpion Stream, is one of the most important untreated sea lamprey producers in the Lake Champlain Basin. Surveys conducted in 1999 and 2004 estimated larval sea lamprey populations of approximately 136,000 and 179,000, respectively. It is believed that the majority of sea lamprey reproduction in the Pike

River system occurs in Morpion Stream. The Lake Champlain Fish and Wildlife Management Cooperative is pursuing the construction of a weir in Morpion Stream to prevent migrating sea lamprey from reaching the spawning areas.

- In 2004 the U.S. Fish and Wildlife Service completed the hydrologic modeling, siting analysis, three alternative weir designs, and cost estimates and submitted a final report to the Lake Champlain Basin Program. The final technical report was issued during 2005 (Young and Orvis 2004).

- This report will serve as the foundation for the submittal of necessary permits to the Quebec Ministry of the Environment.

- Current Plans are to fund the remainder of the project using Federal appropriations made to the Cooperative during 2004. This includes contracting a Quebec consultant to shepherd permits through the appropriate Canadian Federal and Provincial agencies and construction costs.

- It is hoped that construction can commence during the summer of 2006. Under this scenario, Morpion Stream will continue to produce parasitic phase sea lamprey through 2010, due to the sea lamprey life cycle.

Alternative Control: Alternatives Workgroup

The Final Supplemental Environmental Impact Statement for long-term sea lamprey control recommends "deferment of lampricide treatment of the Poultney River for five years after [program] initiation to fully assess potential alternatives to lampricides and the effects of the proposed sea lamprey control program on wounding rates." This provides an opportunity to investigate potential alternative control techniques, while currently feasible control activities are implemented elsewhere in the Champlain Basin. An "Alternatives Workgroup" was formed to evaluate sea lamprey control methodologies that do not involve the use of lampricides. The workgroup consists of 30 members from 16 governmental and non-governmental organizations, including representatives from: the U.S. Fish and Wildlife Service; the Vermont Department of Fish and Wildlife; the New York State Department of Environmental Conservation; the Lake Champlain Walleye Association; the Vermont BASS Federation; charter captains; the Lake Champlain Committee; and The Nature Conservancy. The USFWS, as chair of the Alternatives Workgroup for the Cooperative, is chartering the Workgroup as a Federal advisory committee under the Federal Advisory Committee Act (FACA). Chartering the Workgroup under FACA provides an opportunity for stakeholders to give policy and technical advice to the Cooperative about sea lamprey control techniques that may provide useful alternatives to lampricides. Following our June 2003 meeting, meetings were postponed until the Workgroup was formally chartered under FACA. The USFWS expects to charter the workgroup through the Department of Interior in early 2006.

Sea Lamprey Assessment

Sea lamprey assessment activities include monitoring several stages of the sea lamprey life cycle. Abundances of the larval (ammocoete) and transformer stages are estimated using quantitative assessment sampling (QAS) techniques in wadeable stream sections, and deepwater electrofishing surveys in delta areas. The data from those two techniques help the Committee prioritize lamprey treatments on streams and deltas. Lastly, monitoring sea lamprey attack rates on salmonids and walleye yields an indication of impacts of the parasitic stage (attack rates are discussed elsewhere in this document).

Sea Lamprey Assessment - ammocoetes and transformers in tributaries

- QAS surveys were conducted on nine tributaries during the summer of 2005. Five streams were surveyed to verify their larval populations warrant the lampricide treatment scheduled for 2006 (Table 2). While all streams contained substantial numbers of larval sea lamprey, Lewis Creek above Ferrisburg Falls (Reach 2) had a low enough larval population that treatment was not recommended for that reach.

TABLE 2. Summary of larval sea lamprey surveys conducted in 2005 on Lake Champlain tributaries.

Tributary (and reach)	Estimated 2005 larval population	Estimated 2005 transformer production
Salmon River	62,161	0
Little Ausable River	164,781	0
Ausable River	648,532	1,801
Putnam Creek	101,906	0
Lewis Creek – Reach 1	59,292	237
Lewis Creek – Reach 2	141	0
Trout Brook	2,253	0
Malletts Creek	4,442	342
Lamoille River	38,719	-

- On the Little Ausable and Salmon Rivers in NY, two standard sampling plots (approximately 15m² each) were sampled above the falls on each river thought to be the upstream barrier to sea lamprey migration. This sampling was conducted because limited numbers of sea lamprey adults were seen penetrating upstream of the falls on the Salmon River in 2002. However, no larval sea lamprey were captured above the falls on either river.

- Surveys were conducted on three streams to determine the effect of blocking and trapping of adult sea lamprey on the larval population. On Trout Brook, Vermont, a QAS was conducted along the entire sea lamprey accessible portion of the stream. Trapping operations for control began in Trout Brook during the spring of 2002. The 2005 survey found sea lamprey only in the areas near the mouth. The sizes of larvae captured suggest that there has been successful spawning since the inception of the trapping program on Trout Brook, however the numbers of small larvae were relatively low compared to the numbers of larger larvae that were likely spawned prior to 2002. There is no previous population estimate to compare 2005 results, however the size distribution of larvae captured suggest that there has been a reduction in recruitment coinciding with trapping operations. Additional surveys are recommended in the next few years to determine if there is a change from the population levels documented during the 2005 survey.

- A QAS was conducted on Malletts Creek, Vermont to assess the effects of trapping. Surveys were conducted in the same reach as a previous survey conducted in 2001. The survey reach started at the upstream extent of a large wetland near the mouth of Malletts Creek and extended up to the falls, which is the upstream extent of lamprey migration. The quantitative survey conducted in 2001 produced a population estimate of 21,223 ammocoetes and 6,061 transformers. Results from the 2005 survey indicate a 79% decrease in the abundance of sea lamprey. These results are encouraging and additional surveys are recommended at four-year intervals to further document the effects of trapping on the larval sea lamprey population. Malletts Creek is not currently considered for control with TFM in order to protect the Vermont-listed northern brook lamprey.

- Detection surveys were also conducted on Stone Bridge Brook, Vermont, where trapping has been ongoing since the inception of the experimental program in 1990. Stone Bridge Brook received a lampricide application in 1991 as part of the experimental program. Since then, trapping has prevented the reestablishment of larval sea lamprey populations as documented by repeated sampling efforts. In 2005, a detection survey of all available habitat, 1/4 of the distance to the mouth, immediately downstream of the trapping site, confirmed the continued absence of sea lamprey larvae. Detection surveys should continue to monitor the status of sea lamprey populations in Stone Bridge Brook.

- Sea lamprey were first detected in the Lamoille River during detection surveys in 2002. Prior to that collection, it was believed that sea lamprey did not inhabit the Lamoille River and as a result it was not included in the long-term control program. During the summer of 2005 a quantitative assessment survey was conducted for the first time on the Lamoille River. The sampled reach extended from Peterson dam, in the town of Milton downstream to the lake. The river splits into two channels near the mouth. Sea lamprey were found to be distributed throughout the entire reach sampled, including both branches at the mouth. Although densities of sea lamprey larvae were low (0.12 larvae/m^2), the large size of the river produced a substantial population estimate of 38,719 larvae. The Lamoille River should be considered for inclusion into the long-term sea lamprey control program.

Forage Fish Assessment

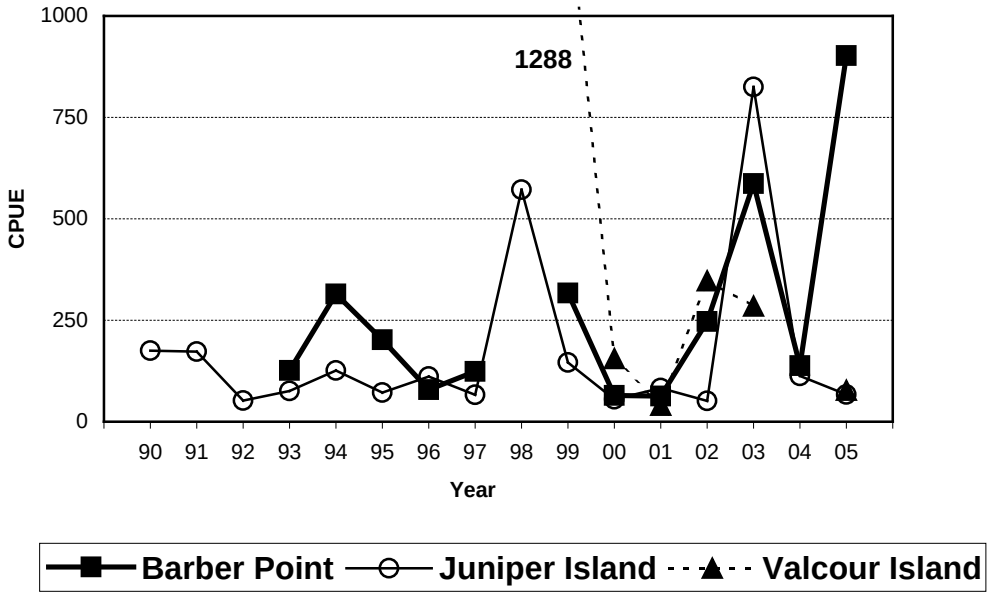
Rainbow smelt are the primary food for walleye and salmonids, and also comprise an important winter sport fishery in Lake Champlain. Predation on rainbow smelt is likely to increase as sea lamprey control yields increased survival of salmonids. Therefore, a program was initiated in 1990 to monitor rainbow smelt stocks annually in several areas of the lake.

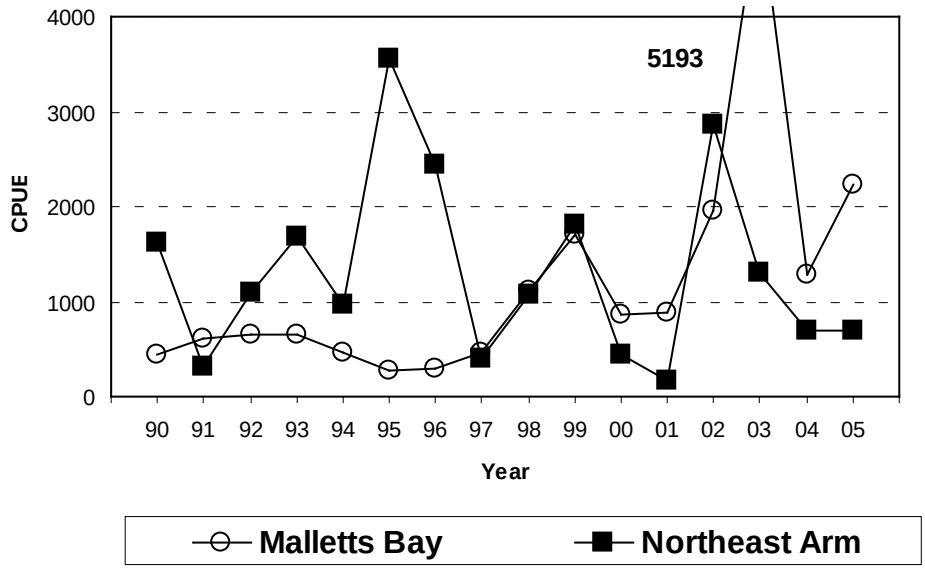
- Twenty midwater trawls were conducted between July 25 and August 15, 2005. Three stations were in Main Lake, one in Malletts Bay and one in Inland Sea.

- Calculated mean catch-per-unit-effort (CPUE; number of smelt captured per 55 minute trawl) in 2005 varied with some stations posting increases and some decreases (Figure 2). The greatest increase in catches occurred at Barber Point in Main Lake and in Malletts Bay. Long-term CPUE trends continue to appear cyclical in nature.

- In 2005 the hydroacoustic portion of the forage fish assessment took a large step forward. A State Wildlife Grant was used to purchase new equipment and to create a standard operating procedure (SOP) for acoustic forage fish survey in Lake Champlain with a focus on improving the assessment of early life stages (young of the year smelt). All needed equipment was purchased and the project collected a large amount of acoustics data. The data have not been processed yet because the data processing SOP is still under construction. Acoustics were performed in a large portion of Lake Champlain (Malletts Bay, Inland Sea and Main Lake). The sampling resulted in 71.3 miles of acoustic transects in Main Lake, 28.5 miles in Inland Sea and 11.6 miles in Malletts Bay. In addition to the acoustics, targeted trawls were performed in Main Lake (N=23), Inland Sea (N=9) and Malletts Bay (N=3) to confirm the species of acoustic targets. Physical samples (water temperature, dissolved oxygen, conductivity) were taken at 24 locations: 13 Main Lake, 9 Inland Sea and 2 Malletts Bay. Since the procedures to process the data are still to be defined, no processing was performed, but the data were visually examined to ensure data integrity.

FIGURE 2. Total CPUE of smelt from trawls in Lake Champlain, 1990-2005.





Salmonid Management

Salmonid management activities include stocking of landlocked Atlantic salmon (landlocked salmon), lake trout, steelhead, and brown trout. On certain rivers, fish passage is being developed at dams to facilitate spawning migrations of migratory species. A variety of sampling procedures are conducted to monitor the status of the salmonid populations, including evaluations of potential natural reproduction.

Salmonid Stocking Summary

- Salmonid stockings in Lake Champlain during 2005 included about: 265,000 landlocked salmon (smolt equivalents); 83,000 lake trout; 76,000 steelhead (smolt equivalents); and 65,000 brown trout (Table 3). The list includes landlocked salmon and steelhead that were stocked in tributaries to the lake. Also listed in Table 3 are the stocking targets for each species. The stocking numbers are presented as "stocking equivalents." Salmonids are stocked at widely varying sizes, from recently hatched fry that spend two years in the tributaries before migrating to the lake, to smolts and yearlings that are ready to begin life in the lake at the time of stocking. The numbers stocked are adjusted to stocking equivalents to better represent the effective numbers stocked.

TABLE 3. Numbers (in stocking equivalents [a]) of salmonids stocked in Lake Champlain during 2005, and stocking targets for the lake.

Species	Main Lake		Malletts Bay/Inland Sea		Total stocked in 2005
	Target	2005 stocking	Target	2005 stocking	
Landlocked salmon	207,000	206,294	60,000	58,277	264,571
Lake trout	82,000	83,352	0	0	83,352
Steelhead	73,000	70,670	12,000	4,975	75,645
Brown trout	38,000	35,274	40,000	29,999	65,273
Total	400,000	395,590	112,000	93,251	490,846

[a] Salmonids are stocked in a range of sizes which exhibit very different survival rates. The numbers stocked are converted to stocking equivalents based on expected survival rates.

Landlocked Salmon Fry Stocking Evaluations

- The lower Winooski River, including the Huntington River and Mill Brook was stocked with approximately 144,000 fry in 2005. At the time of stocking, fry mean length approximated 41 mm total length. Based on subsequent electrofishing surveys, survival

estimates of fry through their first summer were highest in Mill Brook and the Huntington River at 40 and 35 percent, respectively. Mill Brook had the greatest density of young-of-year salmon at 14.9 fish per salmon unit (100 m^2), while the Huntington River station was next with 11.3 young-of-year per unit. Mean lengths of 0+ and 1+ parr ranged from 87 – 97 mm and 130 – 180 mm, respectively.

- In spring 2004, the first attempt at capturing landlocked salmon smolts planted as fry out-migrating to Lake Champlain was conducted utilizing a rotary screw trap. This trap was placed in the lower Huntington River (a tributary to the Winooski River) and captured a total of 57 salmon. The trap was again deployed in 2005. The objectives of the trapping are to: (1) describe timing and rates of migration, (2) assess in-river migrational factors, (3) evaluate inter-year variability in the magnitude of out-migration.

  The trap was deployed on April 14, 2005 and fished for 49 days until June 9. A total of 126 unmarked salmon smolts were captured in 2005. An additional six salmon were recaptured after being released upstream. Analysis of scale samples determined that 65 percent of the smolts were 2-year olds that originated from the 2003 stocking of 67,800 fry in the Huntington River. Mean length for these salmon was 142 mm with a range from 120 – 170 mm. Three-year old smolts made up 33 percent of the captured fish and ranged in length from 141 – 190 mm with a mean of 170 mm. Two salmon were aged as 1-year olds.

  A trap efficiency of 0.044 was calculated from the recapture of 6 out of 135 marked smolts. About 2,864 salmon smolts passed the trapping site based on the estimated trap efficiency and a total of 126 "wild" smolts captured. Scale analysis suggests that 1,862 (65 %) of these would be 2-year old salmon. Salmon parr sampling in the early fall of 2004 estimated densities of this 2003-year class at 1 parr per salmon-unit and there were 2,100 units of the Huntington River stocked with salmon fry.

- A landlocked salmon parr tagging project began in 2004 and continued in 2005 in the Winooski River watershed to evaluate the success of fry stocking. A total of 879 salmon parr have been tagged with magnetized metal tags in the Huntington River. Mean length of tagged fish was 91.6 mm (sd = 13.5) in 2004 and 95.5 (sd = 8.4) in 2005. The parr are tagged in the nose with magnetized wire tags that can be detected with a portable sampling detector. The parr will eventually out-migrate to Lake Champlain, mature and return to the Winooski River. These adult salmon must be lifted at the Winooski Dam fish passage facility to complete their journey. At the lift, the salmon will be checked for the presence of the tag. This project will provide information about the effectiveness of fry stocking and its contribution to the number of returning adults.

Sea Lamprey Attack Rates on Salmonids

- Wounding rates on lake trout and salmon were unacceptably high during 2005. Table 4

shows that for the size classes selected for monitoring, 2005 wounding rates were much higher than the wounding objectives. Lake trout wounding rates were even higher than prior to the experimental control program, and actually increased from 2004 levels.

TABLE 4. Wounding rates on Lake Champlain lake trout and salmon sampled in Main Lake during 2005.

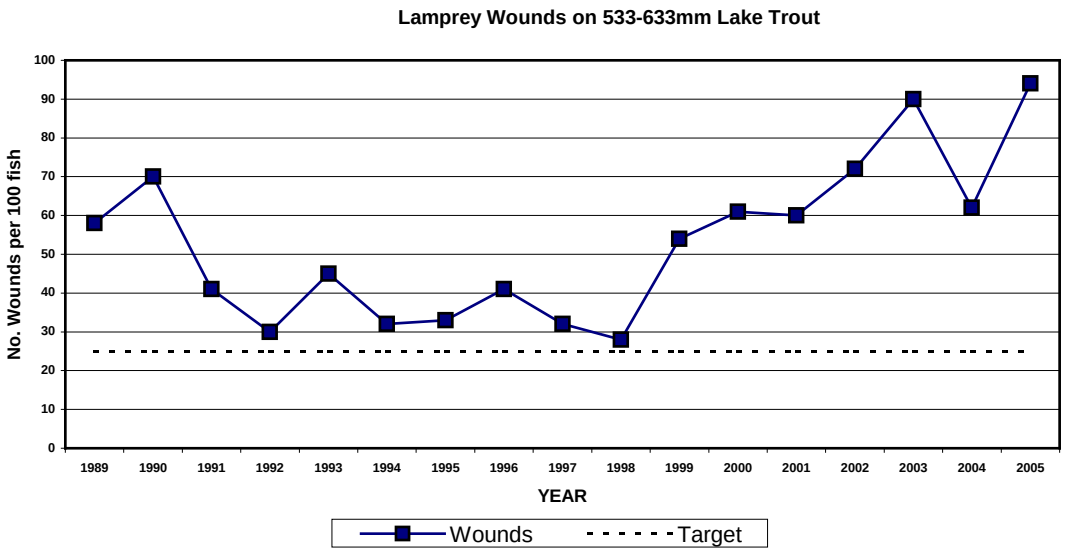
Species	Number of lamprey wounds per 100 fish			
	Objective	Pre-control	Eight-year control	2005
Lake trout[a]	25	55	38	94
Landlocked salmon[b]	15	51	22	54

[a] Lake trout in the 533-633 mm (21.0-24.9 in) length interval. Pre-control included 1982-92, while eight-year control includes 1993-97.

[b] Salmon in the 432-533 mm (17.0-21.0 in) length interval. Pre-control included 1985-92, while eight-year control includes 1993-98.

- Annual wounding rates for lake trout from 1989 through 2005 show a substantial reduction in wounding during the experimental control program, a rebound from 1999 through 2003, a slight drop in 2004 followed by another increase (Figure 3).

FIGURE 3. Sea lamprey wounds (fresh and healing) per 100 lake trout, 533–633 mm total length, sampled in Main Lake by electrofishing, 1989–2005.



- A similar pattern of high wounding rates occurred for three size classes of landlocked

salmon returning to the Willsboro Fishway, Lamoille River, Sandbar Causeway, Winooski River Fish Lift and Hatchery Brook (Table 5). Wounding rates for the intermediate size class in 2005 are roughly as high as wounding rates for the period before control began.

TABLE 5. Sea lamprey wounding rates by size group for adult landlocked salmon captured at various locations during various phases of sea lamprey control.

	Pre-control (1985–1992)		Experimental control (1993–1998)		Interim Control (1999–2002)		2005	
Location / size group (mm)	N	Wounds per 100 salmon	N	Wounds per 100 salmon	N	Wounds per 100 salmon	N	Wounds per 100 salmon
Willsboro Fishway								
432-533	43	51	101	22	34	65	2	100
534-634	80	73	157	44	46	80	5	80
635-736	32	156	30	40	12	12	2	200
Lamoille River								
432-533	200	32	335	43	81	56	2	100
534-634	116	83	237	58	26	69	1	100
635-736	31	77	44	82	6	33	1	200
Sandbar Causeway								
432-533	191	42	241	37	50	60	39	97
534-634	114	59	156	69	18	89	12	58
635-736	47	104	29	84	3	67	1	400
Winooski River Fish Lift								
432-533	n/a	-	160	21	31	64	7	157
534-634	n/a	-	165	28	46	63	8	38
635-736	n/a	-	18	61	9	278	0	0
Hatchery Brook								
432-533	n/a	-	196	33	416	35	42	50
534-634	n/a	-	100	45	254	68	23	39
635-736	n/a	-	20	85	34	65	1	0

- With the exception of the Poultney River, the major lamprey producing tributaries and

delta areas that were treated during the experimental program have also been treated during the initial round of treatments for the long-term program. In addition, the Winooski River was added to the lampricide control program, and adult trapping was initiated on Malletts Creek. Yet wounding rates continue to be unacceptably high. Density compensatory mechanisms, partially ineffective treatments and adult trapping, and/or increased lamprey production from other locations are likely explanations for that trend. Regardless of the cause, it is obvious that sea lamprey control must be expanded substantially from current levels to achieve the desired fishery resource benefits.

- Tributaries with documented but currently uncontrolled sea lamprey populations include the Pike River and its tributary Morpion Stream, the Missisquoi River, the Lamoille River, the LaPlatte River and the Poultney River.

Fish Passage

Winooski River Fish Lift

The Winooski One hydroelectric station in Winooski, Vermont, is the first upstream barrier on the Winooski River. More than 33 km of suitable salmonid habitat exist upstream of the dam. The Winooski One fish "trap and truck" project has allowed fisheries managers the opportunity to restore wild migratory salmonid populations and fisheries in the lower Winooski River that have been restricted by barriers built on the river. The goals of the project are: To create quality stream fisheries for lake-run steelhead rainbow trout and landlocked salmon in the Winooski River; and to encourage natural reproduction of landlocked salmon and steelhead rainbow trout in the Winooski River watershed.

- The fish lift operated from March 22 thru May 13 and from September 15 thru November 21, 2005. Only 4 steelhead were lifted in the spring and 15 salmon and 5 steelhead were recorded in the fall (Table 6). Of the salmon processed in the fall, 7 were male and 7 female. All salmon aged (11) had spent one year in the lake. Mean lengths of the salmon were 554 and 529 mm for male and female salmon, respectively.

TABLE 6. Summary of landlocked salmon and rainbow steelhead trout lifted at the Winooski One fish passage facility, 1993–2005.

Year	Spring		Fall	
	Salmon	Steelhead	Salmon	Steelhead
1993	NA	0	36	7
1994	179	0	32	15
1995	38	0	12	9
1996	45	0	45	3
1997	8	0	115	24
1998	23	0	85	80
1999	54	0	53	13
2000	22	0	29	3
2001	7	0	6	0
2002	5	1	21	3
2003	4	2	14	3
2004	0	3	10	1
2005	0	4	15	5

Willsboro Fishway

The Willsboro Fishway is located on the Boquet River in the Town of Willsboro, Essex County, New York. The fishway provides fish passage upstream, over the most downstream dam on the Boquet River.

- Nine adult salmon were collected in the Willsboro Fishway during 2005.

Imperial Mill Dam fish passage

The Imperial Mill dam is located on the Saranac River in the City of Plattsburgh, Clinton County, New York. The dam is located approximately 5.3 km from the river mouth, and is the first upstream barrier to fish passage on the Saranac River. Efforts continued to develop fish passage at the Imperial Mill Dam.

- Dam safety deficiencies were identified and must be corrected prior to, or concurrent with, installation of fish passage. Lowering the elevation of the dam crest would be the

least expensive option for correcting the deficiencies.

- A sediment survey of the Imperial Mill Dam reservoir was conducted in 2004. The sediment study will help predict potential impacts from lowering the crest elevation or dam removal.

- Conceptual agreement was reached with the former owner of the dam to lower the crest. However, the mill and dam were sold in 2003 and the mill was converted into an industrial park with multiple tenants. The new owner has expressed an interest in maintaining the present crest elevation to generate hydropower to supply the industrial park tenants with electricity. Discussions were initiated, and will continue, with the new owner to reach a mutually agreeable solution to the dam's deficiencies and potential fish passage.

- NYDEC Real Property staff in Albany is researching deeds far back in time to determine whether the state owns the river bottom. If the state is owner, then the state could assume ownership of the dam and more easily remove or lower its crest to accommodate fish passage installation.

Spring and Fall Salmonid Assessments

Spring and fall boat electrofishing surveys for salmonids are conducted annually in addition to the sampling discussed above on the Boquet and Winooski fish passage facilities. This sampling allows for the collection of biological data including length, sex and age information as well as lamprey wounding data. The data are utilized in hatchery product/strain evaluations and to monitor sea lamprey control progress through time.

- Spring sampling consisted of a single day of electrofishing in the mouth of the Saranac River. Thirty-seven landlocked salmon were captured, none older than 1 lake-year in age. Scale interpretations determined that 4 of 37 fish captured were of fry origin (either fry-stocked or the result of natural reproduction, not stocked as yearlings).

- Fall sampling occurred at various Main Lake areas. Electrofishing operations occurred after dark in shallow water regions of Willsboro Bay, Willsboro Point, Whallon Bay and in the Boquet River. A total of 264 landlocked salmon, 2 rainbow trout and 4 brown trout were captured. Only 19 of the salmon were determined to be older than 1 lake-year in age. Based on scale interpretations, 8 of 264 salmon captured were of fry origin. Sea lamprey wounding among fall 2005 landlocked salmon 432 – 533 mm in total length, was 53.7, A1-A3 wounds per 100 fish. New York and Vermont fall assessment data were combined to establish the wounding index for the main-lake region of Lake Champlain.

- Landlocked salmon strain evaluation data were collected from fin-clipped salmon stocked in equal numbers and at the same locations to evaluate their comparative performance in

Lake Champlain. Fin-clipped, strain study salmon captured in 2005 were 21 Sebago strain, 17 Memphremagog strain, and 8 Adirondack strain. Total strain study salmon captures to date (2003 to present) are 67 Sebago: 29 Memphremagog: 26 Adirondack.

- Vermont conducted fall electrofishing surveys on Whallon Bay, Grand Isle Ferry breakwater and adjacent Ed Weed Fish Culture Station discharge stream, Lamoille River and Sandbar Causeway from late September through early December, 2005. Selected data from salmonids sampled in these surveys are summarized in Table 7. Sixty-four of the captured lake trout were within the slot size (432-533 mm) selected for evaluation of lamprey wounding rates.

TABLE 7. Number and average total length (TL) of salmonids collected by Vermont in 2005 fall electrofishing surveys.

	Lake trout		Salmon		Steelhead		Brown trout	
Area	N	TL (mm)	N	TL (mm)	N	TL (mm)	N	TL (mm)
Whallon Bay	111	686	10	481	0	-	0	-
Grand Isle[a]	219	667	76	510	19	384	21	410
Lamoille River	0	-	4	560	1	365	3	338
Sandbar Causeway	0	-	55	505	1	397	0	-

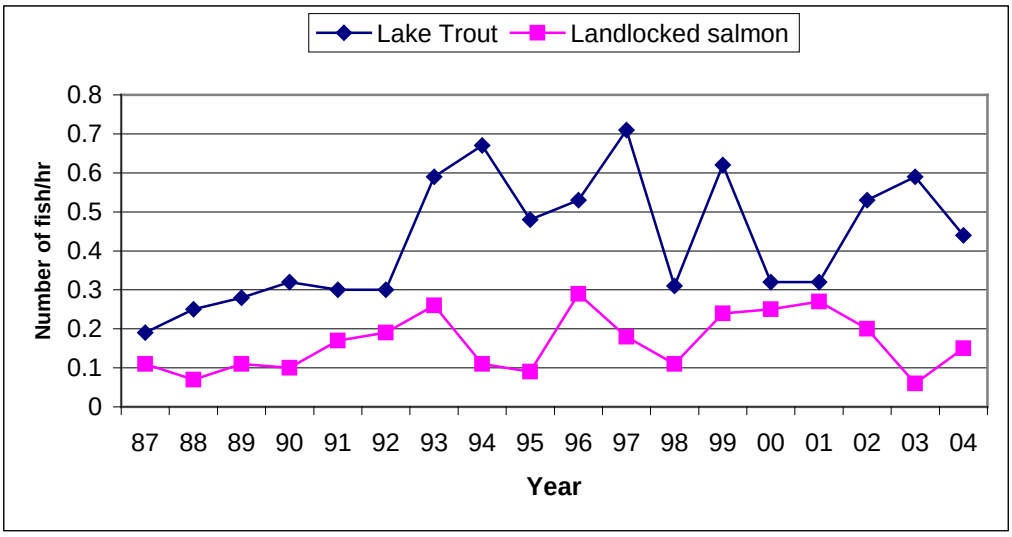
[a] Includes Grand Isle ferry breakwater, Hatchery Brook and surrounding shoreline

Lake Champlain Salmonid Angler Diary Program

- During the 2004 open-water fishing season, 33 cooperators recorded information from 461 fishing trips.

- For lake fishermen, the catch rate for lake trout anglers was 0.44 legal-sized lake trout per hour, and 0.15 legal-sized landlocked salmon per hour for landlocked salmon anglers (Figure 4).

FIGURE 4. Main lake catch rates (number of fish per angler hour) for legal-sized lake trout and landlocked salmon, 1987–2004.

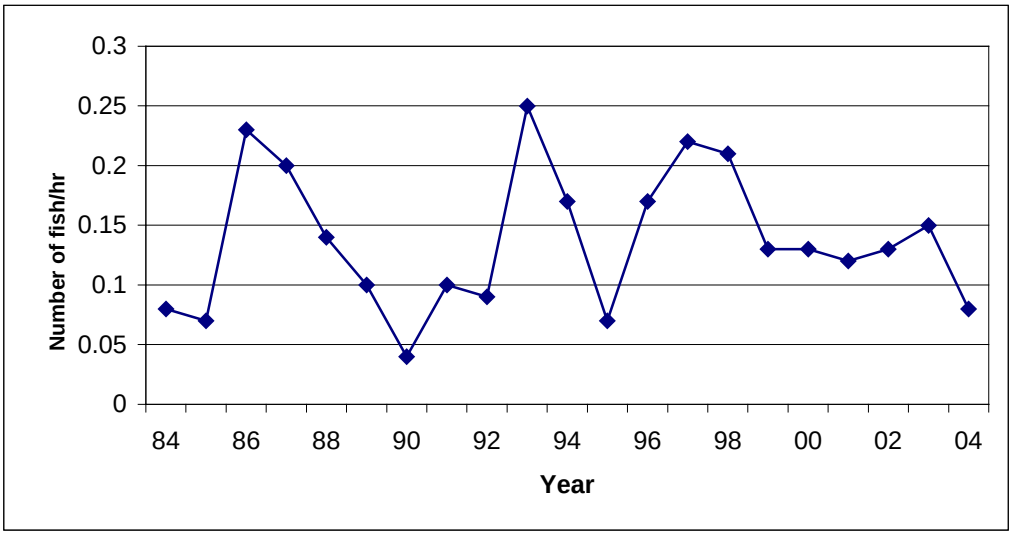


- Catch rates for legal-sized lake trout (≥ 381 mm) decreased slightly in 2004, however, catch rates for landlocked salmon improved from 2003.

- Cooperators reported 11 lake-caught brown trout and 2 steelhead, and no lake trips solely targeting these two species were made during 2004.

- In contrast to lake fishing for landlocked salmon, tributary fishing worsened slightly in 2004 from 2003 (Figure 5). Cooperators reported catching 69 landlocked salmon in tributaries, compared with 97 landlocked salmon in 2003.

FIGURE 5. Tributary catch rates (number of fish per angler hour) for legal-sized landlocked salmon, 1984–2004. These include trips where salmon alone or in combination with another salmonid were listed as the angler's target.



- Cooperators also reported catching 29 brown trout and 84 steelhead during fishing trips on tributaries. Both showed substantial increases from 2003.

Lake Champlain Landlocked Salmon Strain Evaluation

The Cooperative initiated a landlocked salmon strain evaluation in 2002. The study will assess the relative performance of Sebago, Memphremagog, and Little Clear (Adirondack) strain salmon. The Memphremagog, and Little Clear strains are both primarily West Grand Lake progeny and have a long stocking history in Lake Champlain. Sebago strain salmon have been stocked in Lake Champlain in recent years, and monitoring at the Ed Weed Fish Culture Station discharge stream indicates favorable returns from those stockings. In their native lakes, West Grand Lake salmon tend to utilize the outlet for spawning, while Sebago Lake salmon orientate to the inlet. Limited evidence indicates some salmon have out-migrated from Lake Champlain to the St Lawrence River. Such behavioral differences, or other differences between strains, could result in one strain yielding better returns in Lake Champlain than the others. Expectations are to raise 15,000 yearlings of each strain for each year of the study. Prior to stocking, each strain will receive a different mark for future identification. Initial stockings occurred in spring 2003 with evaluations beginning that fall using river mouth and stream electrofishing techniques. Relative returns to the sample, sea lamprey wounding, and biological data will be collected for strain comparisons. The strain stockings will occur for at least three brood years and their performance

will be evaluated through 2007.

- By fall 2005, sampling over a three-year period had resulted in 67 Sebago strain salmon returns, compared to 29 of Memphremagog and 26 of Little Clear heritage. These fish resulted from equal Boquet River yearling stocking efforts in 2003, 2004 and 2005. While returns favor Sebago strain salmon, there is no indication any strain is more resistant to sea lamprey attack, as older age salmon were conspicuously absent from all strains.

Walleye, Sturgeon, and Alewives

Walleye Spawning Run Assessments

- Adult walleye were collected by electro-fishing during the spawning runs in the Poultney, Lamoille, and Missisquoi Rivers in April of 2005. Two hundred and eighty five walleye were collected in the Poultney, 451 walleye in the Missisquoi River and 103 walleye were handled on Lamoille River.

- Trap nets were set overnight in the Missisquoi River spawning area on five different days and a total of 13 walleye were captured.

- Seining in Missisquoi Bay was scheduled to begin on April 9th but ice cover and permitting issues delayed the start date until April 19. Between April 19 and May 7, 2005 a total of 21 seine hauls were performed. Seining was scheduled to continue through May 14 but the hydraulic winch failed, forcing the seining to end early. The seining operation collected seven walleye on four different dates.

- Walleye in the 534-634 mm (21.0-25.0 in) size class collected from the Lamoille River had lamprey wounding rates of about 9 wounds per 100 fish, exceeding the Lake Champlain lamprey wounding rate objective of less than 2 wounds per 100 walleye. The Missisquoi and Poultney River spawning populations met the wounding rate objective in 2005.

South Bay Walleye/Sauger Sampling

- In early April trap netting was undertaken in South Bay to collect walleye eggs for the Lake Champlain Walleye Association and to assess the walleye and sauger populations. A total of 24 overnight Oneida trap net sets yielded catches of 26 fish species. A total of 149 walleye were sampled but no sauger were captured. Walleye eggs were provided to the Lake Champlain Walleye Association for rearing to the fry stage.

- The netting failed to capture a single sauger, and walleye numbers were low compared to similar trap netting conducted during the 1980s. The reasons for the decline in the catch of these two species are unknown, but recent South Bay surveys have produced high numbers of white perch and white crappie. Enquiries to Lake Champlain biologists and anglers also suggest sauger catches have been dwindling. Further investigations might explain whether the increase of non-native white perch and white crappie could be factors in the apparent decline of walleye and sauger.

Walleye Stocking

Recent stocking efforts began in 1986 in cooperation with the Lake Champlain Walleye Association (LCWA). Eggs were collected from the spawning run in South Bay, NY, reared at the Essex County Hatchery in Crown Point, NY and stocked in the South Lake. In 1988, the Salisbury Fish Culture facility in Salisbury, VT began rearing eggs collected from the Poultney River. In 1991, walleye fish culture efforts were moved to the Bald Hill Fish Culture Station in Newark, VT. Annual stocking ranged from 1 to 4 million fry and 12.5 to 70 thousand fingerlings prior to the completion of the Lake Champlain Walleye Restoration Plan adopted by the Vermont Department of Fish & Wildlife in 1999. The restoration plan objective is to collect 12 million eggs and produce 8 million fry for Lake Champlain, annually. Since 1999, 9 to 12.5 million eggs have been collected annually resulting in 6.1 to 8.3 million fry and 45 to 95 thousand fingerlings being stocked into Lake Champlain each year.

- A total of 12,953,800 eggs were collected from the Poultney and Missisquoi River spawning runs in 2005. Fry and fingerlings stocked into Lake Champlain totaled 8,084,500 and 181,575, respectively. This includes the 120,000 fry and 63,175 fingerlings reared cooperatively with the LCWA. All fry and fingerlings were marked with OTC prior to stocking.

Walleye Stocking Evaluation

A priority need identified in the Walleye Restoration Plan was to evaluate the contribution of stocked fry and fingerlings to the Lake Champlain walleye population. Experimentation with OTC marking techniques began in 1998. The OTC technique involves exposing fry or fingerlings to oxytetracycline prior to stocking. The exposure leaves a permanent mark in bony tissue that fluoresces under ultraviolet light and allows identification of stocked walleye years after stocking. OTC techniques were developed by 2000 that allowed the mass marking of all fry and fingerlings stocked into Lake Champlain.

- Sampling for OTC-marked walleye was once again focused on the Missisquoi River in 2005, and targeted age-3 fish. A total of 29 walleye ranging in length from 325 mm to 440 mm (12.8 to 17.3 in) were collected for OTC analysis. Sixteen (55%) of the 29 walleye had OTC marks indicating they were of hatchery origin.

Sturgeon

Lake Champlain once supported a small commercial fishery for lake sturgeon that harvested from 50 to 200 fish annually in the late 1800's and early 1900's. Annual harvest declined rapidly in the late 1940's, and the fishery was closed in 1967. Lake sturgeon are currently listed as endangered by the state of Vermont. In 1998, sampling began in tributaries near historic spawning locations to determine if adult sturgeon were still present and their relative abundance. The Missisquoi, Lamoille, and Winooski Rivers, and Otter Creek are the four tributaries where sturgeon spawning activity had been noted in the past.

Gillnets were used to sample for adult sturgeon during the spawning runs in the Lamoille and Winooski rivers from 1998 thru 2002. Three to eleven individual sturgeon were captured each year. Several sturgeon were captured in more than one year and more than once in a year. The total number of individual sturgeon captured and tagged during the 5 years of gillnetting was 15 in the Winooski and 9 in the Lamoille. Sampling with gillnets near spawning sites on the Missisquoi River in 2001 and 2003 was unsuccessful.

Sturgeon ranged in size from 965 to 1,854 mm, weighing from 5 to 33 kilograms. All captured sturgeon were identified as males with the exception of two small sturgeon that could not be sexed. Lake sturgeon were weighed, tagged with PIT tags (small metal tags placed under the skin, just behind the skull) and measured for fork and total length. A small section of the first pectoral spine was removed from the left pectoral fin for aging and tissue samples were collected and archived for future genetic analysis.

In addition to the sturgeon captured in the Lamoille and Winooski rivers, a large dead sturgeon was found in Otter Creek in June, 2000. Two additional adult sturgeon were captured in the Winooski River while electrofishing for walleye in 2003, and seining in the Winooski River captured one young sturgeon (170 mm) in August 2001.

- Sampling for sturgeon eggs was conducted in the Winooski, Lamoille, and Missisquoi rivers and Otter Creek in May 2005. A total of 279 eggs were collected from the Winooski (59), Lamoille (165), and Missisquoi (55) rivers.

- Drift nets were used to sample for drifting sturgeon larvae on a limited number of nights in Otter Creek and the Lamoille and Winooski Rivers between May 31 and June 7. One lake sturgeon larva was collected in the Winooski River on June 2, and 30 larvae were collected in the Lamoille River on the morning of June 7. No lake sturgeon larvae were collected in Otter Creek.

Alewives

Alewives are not native to the Lake Champlain Basin. Their potential establishment in Lake Champlain and other area waters could have serious ecological impacts. Alewives were discovered in Lake St. Catherine, Vermont (a tributary to Lake Champlain) in July 1997. It is thought that the Lake St. Catherine population was established through a purposeful, illegal stocking. Alewife first appeared in Lake Champlain's Missisquoi Bay in 2003, when seven young-of-year were collected. A subsequent collection of an adult was made in Main Lake's Isle LaMotte Passage in 2004.

- In 2005, an adult and four young-of-year alewives were collected as by-catches in trawls and beach seining. The young-of-year alewives were collected at three South Lake sites and in Inland Sea, and the adult was collected in Inland Sea. The source of these alewives is not known.

- Because of their wide geographic distribution and the presence of multiple age classes, it appears alewives are established in Lake Champlain. As such, investigations regarding potential reclamation of Lake St. Catherine have been suspended.

- The Lake Champlain Basin Program is sponsoring a workshop in 2006, organized by Lake Champlain Sea Grant staff. The purpose of the workshop is to utilize outside experts with extensive alewife experience to understand potential changes in the lake's ecology should alewife populations reach nuisance levels in Lake Champlain.

Unfortunately, there is no straightforward answer to the current alewife problem. It is very rare when an invasive exotic species can be eradicated in a lake the size of Lake Champlain. More often than not, managers must find ways to cope with the invasive species.

Prospects for 2006

The management and research activities discussed above will generally continue in 2006. Vermont Senator Leahy and other area congressional representatives secured a congressional appropriation for sea lamprey control on Lake Champlain in 2005. The new congressional appropriation will allow the program to continue for at least two more years. A brief synopsis of expectations for 2006 include:

- Sea lamprey control treatments scheduled for 2006 include Putnam and Lewis creeks as well as the Ausable, Little Ausable and Salmon rivers.

- Trap adult spawning-phase sea lamprey on selected streams during 2006.

- Conduct QAS surveys on Beaver Brook and the Boquet River, and deepwater delta sampling on the Salmon, Little Ausable, and Ausable river deltas for information on the

distribution and status of their respective larval sea lamprey populations, relative to their planned treatments in 2007.

- Conduct deepwater larval sea lamprey sampling on previously un-sampled deltas in NY to verify the presence or absence of sea lamprey. Areas to be sampled, if time allows, will include deltas off the mouths of Beaver Brook, Mullen Brook, and Mill Brook.

- NYSDEC will conduct several toxicity tests to evaluate impacts of TFM/Niclosamide combination treatments to nontarget organisms. Combination treatments offer the potential to reduce the cost of treatments and possibly reduce nontarget impacts. However, toxicity tests must be conducted on several species before permits will be issued for combination treatments. Species to be tested include eastern sand darter, channel darter and cylindrical papershell. Collecting test animals, conducting the tests, and analyzing the results make these activities a substantial commitment of staff and time.

- Pursue required permits and construction of a barrier for Morpion Stream in Quebec.

- Pursue New York and Vermont permits and permit modifications as needed for lamprey control activities. In New York, lampricide treatments require Wetlands permits from the NYSDEC and/or the Adirondack Park Agency. In addition, pesticides permits are required from the DEC. Current NY permits are valid thru 2009. In Vermont, Aquatic Nuisance Control and Endangered and Threatened Species permits are required prior to conducting each lamprey treatment. For both states the permitting process has required a substantial commitment of staff time.

- Begin preparation of permit applications in both states so that a Poultney River treatment could proceed in fall, 2007, if program wounding rate objectives are not met and no feasible control alternatives exist.

- The Cooperative and the Alternatives Workgroup will continue to evaluate potential alternatives to lampricides. Staff will maintain communication with the Great Lakes Fishery Commission on related research conducted by that organization.

- Continue activities related to sea lamprey assessment, salmonid assessment and sea lamprey/salmonid interactions. Procedures will be similar to those described above for 2006.

- Continue to update the 1977 document “A Strategic Plan for the Development of Salmonid Fisheries in Lake Champlain” to better reflect the multi-species work pursued by the Cooperative.

- Conduct walleye spawning run assessments, walleye egg collection, walleye stocking (including marked fingerlings and marked and unmarked fry), and walleye stocking evaluations.

- Continue lake sturgeon spawning assessment.

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Appendix 1: Schedule of completed Lake Champlain lamprey treatments through 2005, and projected treatments for 2006 and beyond.

1990: Salmon River
Little Ausable River
Ausable River (and Dry Mill Brook)
Boquet River
Beaver Brook
Putnam Creek
Lewis Creek

1991: Mount Hope Brook (and Greenland Brook)
Stone Bridge Brook
Ausable Delta
Saranac Delta
Little Ausable Delta
Salmon Delta
Boquet Delta

1992: Great Chazy River
Saranac River
Poultney River
Hubbardton River

1993: no treatments

1994: Salmon River
Little Ausable River
Ausable River (and Dry Mill)
Boquet River
Putnam Creek
Lewis Creek

1995: Mount Hope Brook (and Greenland)
Trout Brook
Ausable Delta
Salmon Delta
Boquet Delta
Saranac Delta

1996: Great Chazy River
Poultney River
Hubbardton River

1997: no treatments

1998: Little Ausable River
Salmon River
Putnam Creek
Beaver Brook

1999: Mount Hope Brook (and Greenland)
Boquet River
Ausable River (and Dry Mill)

2000: Great Chazy

2001: no treatments

2002: Little Ausable River
Ausable River (and Dry Mill)
Salmon River
Putnam Creek
Beaver Brook - postponed
Lewis Creek

2003: Mount hope Brook – postponed
Beaver Brook
Boquet River
Ausable Delta
Salmon Delta - no treatment required
Little Ausable Delta - no treatment required
Winooski River - postponed

2004: Great Chazy River
Saranac Delta
Boquet Delta – no treatment required
Mount Hope Brook
Winooski River

2005: no treatments

2006: Little Ausable River
Ausable River (and Dry Mill)
Salmon River
Putnam Creek
Lewis Creek

2007: Beaver Brook
Boquet River
Ausable Delta
Little Ausable Delta
Salmon Delta
Poultney River[1]
Hubbardton River[1]

2008: Great Chazy River
Mount Hope Brook
Saranac Delta
Boquet Delta
Winooski River

2009: no treatments

2010 and beyond: Repeat the cycle listed above for 2006 through 2009. Other rivers such as the Pike, Missisquoi and Lamoille may be added at any time as appropriate.

[1] If program wounding rate objectives are not met and no feasible control alternatives exist.

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