

2008 Water Chestnut Management Program: Lake Champlain and Inland Vermont Waters

FINAL REPORT

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A Report Prepared for the Lake Champlain Basin Program

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Cover photo: Wetland northern end of Lake Bomoseen, Hubbardton, Vermont

VTDEC Photo

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Executive Summary

2008 Water Chestnut Management Program: Lake Champlain and Inland Vermont Waters

2008 marked the 11th year of a cooperative partnership between the Vermont Department of Environmental Conservation (VTDEC) and The Nature Conservancy (TNC) to manage water chestnut (*Trapa natans* L.), an invasive aquatic plant found in Lake Champlain, its associated tributaries, and other inland waterbodies in Vermont and New York. The goal of the partnership is to reduce populations of water chestnut and prevent its further spread. Prior to its formation in 1998, water chestnut was managed solely by VTDEC. As a direct result of the partnership, a significant reduction in large beds of water chestnut in Lake Champlain, in the marshes associated with the Poultney River and in other Vermont waters have been noted.

The majority of VTDEC water chestnut management is carried out under contract. Approximately 42% of VTDEC's 2008 water chestnut contract budget was spent on management at sites located on the New York side of Lake Champlain, from Port Henry south to Dresden and 58% was spent on the Vermont side of the lake from Ferrisburg south to Benson. Mechanical harvesting work was carried out from a new private access site developed in Red Rock Bay 4.5 miles south of Benson Landing in Benson, Vermont.

TNC utilizes an all-volunteer workforce to handpull in ecologically significant wetland areas concentrated primarily near their Southern Lake Champlain Valley Preserve Office in West Haven, Vermont.

A combination of groups including VTDEC-hired contractors, VTDEC staff, TNC volunteers, U.S. Army Corps of Engineers interns, USF&W staff, VYCC crews and private citizens were involved in management efforts. In Lake Champlain, 68 sites were managed by mechanical harvesting, handpulling or a combination of both methods. Of these, 61 sites were handpulled only; 3 sites were mechanically harvested and handpulled and 4 sites were mechanically harvested only. An additional 20 other Vermont waterbody sites were managed by handpulling alone.

Mechanical harvesters removed a total of 525 loads (997.5 tons wet weight) of water chestnut spoils from 7 mechanical harvesting sites in Vermont and New York between Benson Landing and Red Rock Bay (Vermont) in Lake Champlain. All of the 2008 mechanically harvested water chestnut spoils were composted on fields near Red Rock Bay in Benson, Vermont.

Handpulling hours by all involved groups in program sites totaled approximately 4,117.2, of which 2,973.5 were completed by VTDEC contracted handpullers and 734.75 were logged by TNC and its volunteers. The TNC hourly figure includes only actual on the water handpulling hours. TNC hourly rates portrayed in Part 2. of this report includes on shore training hours in their total of 1212.25 hours of handpulling. Contracted handpullers removed an estimated 33 tons of water chestnut and an estimated 3 tons were removed by TNC and its volunteers.

Only one new Lake Champlain water chestnut site was discovered in 2008. The site is located in northern Bulwagga Bay, Port Henry, New York. This site was surveyed and handpulled prior to mature seed dispersal. No new "other waterbody" water chestnut sites were discovered this year.

Successes for the 2008 water chestnut management partnership included: development of a new private access site 4.5 miles south of Benson Landing which increased harvesting efficiency 40%; of 68 Lake Champlain sites targeted for management in 2008, 16 had no water chestnut. One hundred percent of mechanically harvested spoils were composted, and rapid response initiatives at the new Lake Champlain site in Bulwagga Bay insured that there would not be a large seed bank to germinate in 2009.

2008 Water Chestnut Management Program: Lake Champlain and Inland Vermont Waters

Final Report

Introduction

This report describes all aspects of 2008 water chestnut management activities conducted by the Vermont Department of Conservation (VTDEC) [Part 1] and The Nature Conservancy (TNC) [Part 2]. In addition to the VTDEC/TNC partnership, other groups are also involved in water chestnut management efforts in the Lake Champlain Basin. A discussion of these efforts is also provided in this report (Part 3).

The Lake Champlain Basin Program, a funding partner and supporter of this program since 1991, identifies water chestnut control and spread prevention as a top priority in the Lake Champlain Basin. The highest priority action listed in the Nuisance Nonnative Aquatic Plants and Animals section of the Living Natural Resources Chapter of *Opportunities for Action* (April 2003) is *Prevent the Spread and Control the Population of Water Chestnut within Lake Champlain and Elsewhere in the Basin*. Water chestnut management can also be linked to goals and objectives set forth in other *Opportunities for Action* sections: Managing Fish and Wildlife; Protecting and Restoring Wetlands, Streams and Riparian Habitats; Managing Recreation Resources; Informing and Involving the Public; Monitoring and Measuring Success; and Economics in the Lake Champlain Basin.

VTDEC water chestnut management has occurred annually since 1982 and in partnership with TNC since 1998. Management goals are to significantly reduce the negative impacts of this aquatic invasive plant in Lake Champlain and other waters in Vermont, and to prevent further spread. All water chestnut control activities since 1982 have been of a non-chemical nature. Handpulling is employed to control sparse populations of water chestnut or populations inaccessible to mechanical harvesting equipment, while mechanical harvesting is used to control dense mats. VTDEC's program involves control in a north to south direction through handpulling and mechanical harvesting with the majority of the work conducted under contract. TNC utilizes an all-volunteer workforce to handpull in ecologically significant wetland areas concentrated primarily near their Southern Lake Champlain Valley Preserve Office in West Haven, Vermont.

Funds spent on water chestnut management efforts in Lake Champlain and other waters in Vermont in 2008 totaled \$564,911 (Figure 1-1). Funds spent on management since 1982, are estimated at \$7.9 million (see Table 1.1).

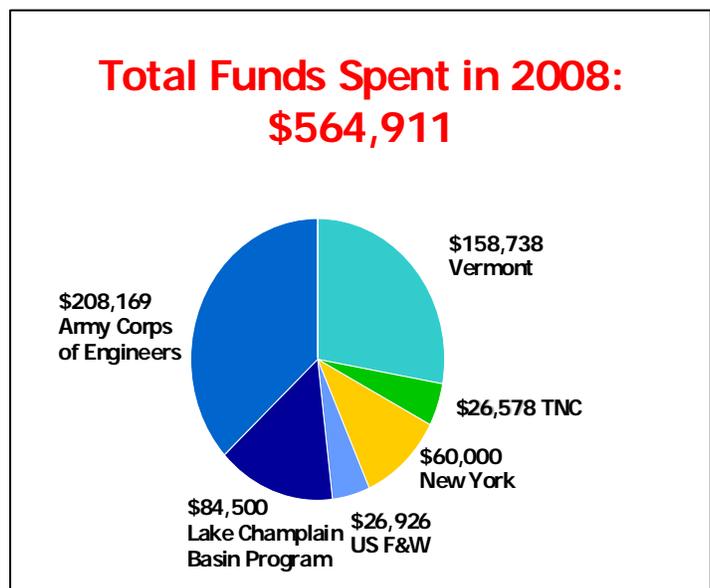


Figure 1-1. Summary of funds spent managing water chestnut in Lake Champlain and other Vermont waterbodies in 2008.

Table 1-1. Summary of funds spent on water chestnut management, 1982-2008.

Year	State		US ACOE	US F&W	USDA	US F&W	DU	LCBP		TNC	Total
	Vermont	New York						VTDEC	TNC		
1982	51,556		120,298								171,854
1983	40,700		95,000								135,700
1984	40,700		95,000								135,700
1985	73,000		170,000								243,000
1986	73,000		170,000								243,000
1987	73,000		170,000								243,000
1988	140,000		140,000								280,000
1989	110,000		110,000								220,000
1990	80,000		80,000								160,000
1991	16,667							50,000			66,667
1992		25,000						50,000			75,000
1993		16,667						50,000			66,667
1994	41,846		19,154					50,000			111,000
1995	21,727	7,000	12,060					50,000			90,787
1996	52,806	7,000	20,972					25,000			105,778
1997	136,000							36,000			172,000
1998	150,640		125,000					6,454	19,546		301,640
1999	141,000							160,504	23,040		324,544
2000	160,000	229,126	212,423	14,497				35,000	18,000		669,046
2001	160,000	112,464	157,000	45,503				33,000	14,000		521,967
2002	150,000	90,554	180,000				3,713	40,000	13,000		477,267
2003	133,854	42,147	220,846	11,000			6,287	50,000	13,000		477,134
2004	156,081		252,250	24,000			5,000	50,000	13,000		510,331
2005	186,919		188,000	13,215				50,000	13,000	11,917	473,051
2006	150,000	36,298	200,045	2,955	7,650			50,000	13,000	19,653	489,601
2007	187,592	56,004	276,654	1,500	2,550			56,000	13,000	11,948	605,248
2008	158,738	60,000	208,169	14,026				69,500	15,000	11,578	564,911
Total	\$2,685,826	\$682,260	\$3,222,871	\$126,696	\$10,200	\$42,900	\$15,000	\$911,458	\$167,586	55,096	\$7,919,893

To support the goals of the Ecological Indicators Task Force, water chestnut indicators were developed and are presented in Table 1-2. on the following page.

Table 1-2. Water chestnut indicators for 2008 management efforts.

Indicator	P S R	Suggested Measures	Values	Currently Collected?	Who Should Collect?	Spatial Resolution	Collection Frequency (minimum)	Reported Frequency (minimum)
Area Infested with Water Chestnut	P	Total number of infested acres	2,747	Y	VTDEC/NYDEC/TNC/QUEBEC		Annual	Annual
		Number of acres < 25% surface coverage	2,175	Y	VTDEC/NYDEC/TNC/QUEBEC		Annual	Annual
		Location of mechanical harvesting: miles north of Whitehall NY	8.5 miles	Y	VTDEC	South Lake	Annual	Annual
		Number of Lake Segments infested	5	Y	VTDEC	Lake Segment	Annual	Annual
Management Resources	R	Dollars spent on management VTDEC/TNC Total	\$480,820*	Y	VTDEC/LC Sea Grant/NYDEC/QUEBEC		Annual	Annual
Mechanical Management	R	Tons of water chestnut removed through mechanical harvesting	997.5 tons	Y	VTDEC/NYDEC/TNC		Annual	Annual
Hand Pulling Management	R	Tons of water chestnut removed through hand-pulling	33.86 tons	Y	VTDEC/TNC		Annual	Annual
		Number of hand-pulling hours in Lake Champlain and tributaries	3,370.2 hrs	Y	VTDEC/TNC		Annual	Annual

* Figure includes VTDEC supervisor salary, TNC total funds, mechanical harvesting contract amount, handpulling contract amount, and the composting contract amount

Part 1: VTDEC Water Chestnut Management

The majority of VTDEC water chestnut management is carried out under contract. Three contracts were awarded in 2008: mechanical harvesting, handpulling and composting. The VTDEC field supervisor, often with other VTDEC staff, provides oversight of the contracts, obtains landowner permission for access and disposal, conducts surveys of existing and searches for new populations and oversees water chestnut education and outreach efforts.

Authorization

Water chestnut mechanical harvesting activities in Vermont waters require an Aquatic Nuisance Control Permit. On June 8, 2005, Aquatic Nuisance Control Permit 2005-H01 was issued to VTDEC and allows mechanical harvesting and cutting activities in Lake Champlain from sites located in the towns of Ferrisburg, Panton, Addison, Bridport, Shoreham, Orwell, Benson, and West Haven. The permit was issued for 10 years. Handpulling activities do not require a permit in Vermont.

In New York, water chestnut control activities in Lake Champlain and associated waters require a permit from the Adirondack Park Agency. Permit 2001-47, issued June 26, 2001 to the New York State Department of Environmental Conservation (NYSDEC) and VTDEC jointly, authorizes mechanical harvesting and handpulling of water chestnut from Lake Champlain in the towns of Dresden, Putnam, Ticonderoga, Crown Point, and Moriah. This permit expires in July 2011.

Budget

VTDEC had \$509,637 in available funds from state general funds, a USFW Partners grant, USFWS ANS plans, and the U.S. Army Corps of Engineers to implement 2008 water chestnut management. Management Contracts awarded by VTDEC in 2008 included \$250,000 for mechanical harvesting, \$127,637 for handpulling, and \$4,500 for water chestnut spoils composting. From the handpulling contract and from the composting contract small amounts of money were left unspent and will be held over for work in 2009. Approximately 42% of VTDEC's total water chestnut contract budget was spent on management at sites located on the New York side of Lake Champlain, from Port Henry south to Dresden. Additional program costs included support of a VTDEC field supervisor position and other administrative costs, and site improvements to the new off-loading site. Funds to support these costs came from LCBP, VTDEC, the U.S. Army Corps of Engineers and the U.S. Fish & Wildlife Service. Table 2-1 summarizes the distribution of 2008 funds with sources.

Table 2-1. Allocation of funds for VTDEC 2008 water chestnut management program.

	USF&W ANS	USF&W Partners	LCBP	VTDEC	US ACOE Corps	Total
Personnel, Fringe and Indirect (estimated): Field supervisor, full-time May through October 2008, part time the rest of the year			\$69,500			\$69,500
Contractual: Handpulling Mechanical harvesting Composting	\$10,468 \$3,558	\$12,900		\$114,737 \$31,363 \$942	\$208,169	\$127,637 \$250,000 \$4,500
Other: Administration Grant to TNC Site access improvement			\$15,000	\$15,000	\$28,000	\$43,000 \$15,000
Total	\$14,026	\$12,900	\$84,500	\$162,042	\$236,169	\$509,637

Equipment

Contracted mechanical control equipment used in 2008 included: 2 large mechanical harvesters each with 800 cubic foot storage capacity, a high-speed transport barge, and a shore conveyor. Two four wheel drive one-ton dump trucks were purchased by the contractor for use at the new Red Rock Bay private access site for spoils removal. Contracted handpulling activities utilized ten kayaks, two boats and a motorized pontoon boat. VTDEC utilizes a variety of motorboats, canoes and kayaks for survey and search efforts, handpulling and contractor oversight.

Results

In Lake Champlain, 69 sites are known to support populations of water chestnut including one new site at Bulwagga Bay Campground in Port Henry, New York. Of these, 68 sites were managed with mechanical harvesting, handpulling or both methods: 61 sites were handpulled only, 4 sites were mechanically harvested only, and 3 sites were mechanically harvested and handpulled. The only area not managed in 2008 was the southern portion of the lake between Red Rock Bay, West Haven, Vermont and Whitehall, New York. Contracted management efforts concluded on September 5 as most available funds were expended. All 20 other water body sites in Vermont were managed in 2008. Surveying was conducted to assess populations, direct contracted crews and search for new populations. No new other waterbody sites were found in 2008. A number of outreach activities were also implemented in 2008. A summary of these efforts in 2008 follows.

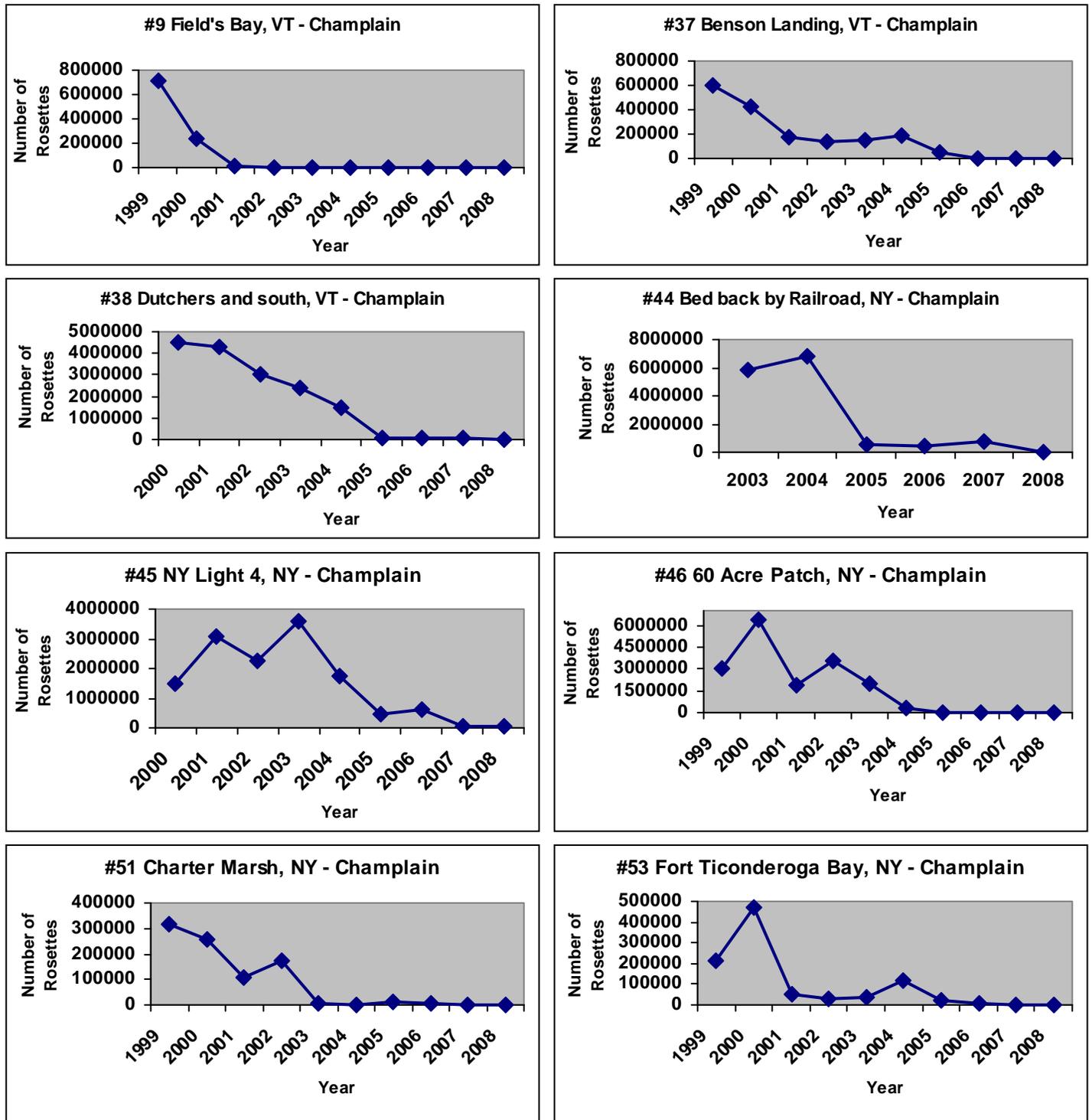
Surveying

- VTDEC staff conducted 14 water chestnut surveys in 2008 between June and October: 6 surveys of water chestnut populations in Lake Champlain and 8 surveys of “other waterbodies.”
- The southern portion of Missisquoi Bay, Lake Champlain was surveyed extensively by airboat on August 8. No water chestnut was discovered during the survey. Water levels in the bay at the time of the survey were three feet above average. VTDEC annual airboat surveys have been conducted in Missisquoi Bay since 2002.
- The 600-acre wetland at the northern end of Lake Bomoseen, Castleton and Hubbardton, Vermont was surveyed for the fourth consecutive year by airboat on August 7. No water chestnut was found during the comprehensive survey.
- Only one new water chestnut site was discovered in 2008 in Lake Champlain at Bulwagga Bay Campground in Port Henry, New York.
- No other waterbodies were discovered with water chestnut in 2008
- A surface water search of Waterbury Reservoir in Waterbury, Vermont was conducted following a report by a local fisherman of water chestnut seed sightings. No water chestnut was discovered.

Mechanical Harvesting

- The contract for 2008 mechanical harvesting was awarded to Aquatic Control Technology, Inc (ACT, Inc.) of Sutton, Massachusetts.
- A new access site was developed in Red Rock Bay on private property at the southern end of Benson, Vermont four miles south of Benson Landing.
- Mechanical harvesting of water chestnut was only conducted in Lake Champlain.
- Mechanical harvesting began on July 8 in Putnam, New York and concluded on August 21 in Red Rock Bay in Benson, Vermont.
- Two mechanical harvesting shifts, utilizing 8 to 10 people each, worked 5 days a week, from 7:00 a.m. to 7:00 p.m.
- A total of seven Lake Champlain sites were mechanically harvested. Figure 2-1 provides historical data for eight mechanical harvesting sites including Fields Bay in Ferrisburg, Vermont where only handpulling has been required since 2001.
- As of 2008, the northernmost mechanical harvesting site in Lake Champlain was at the southern end of the 60 Acre Patch (site #46), Benson, Vermont.
- Total mechanical harvesting hours in 2008 were 655, way lower than in the previous year (816.5, in 2007) due to higher rates and lower funding. Although funds available for mechanical harvesting were less than in 2007, more loads were harvested because of the close proximity of mechanical harvesting sites to the new private access site in Red Rock Bay in Benson, Vermont.
- The 2008 mechanical harvesting operation was 40% more efficient with the new access site than the operation run out of Benson Landing in 2007.
- Approximately 7,350 cubic yards (an estimated 997.5 tons) of water chestnut spoils were removed in 525 harvester loads from 173 acres of the lake.
- One hundred percent of mechanically harvested water chestnut was composted on fields at the Red Rock access site in Benson, Vermont. Chestnut spoils were turned twice in the fall of 2008 and dried bedded cow manure was added to improve the process. .

Figure 2-1. Water chestnut rosettes removed by mechanical harvesting over time at eight Lake Champlain sites.



Handpulling

- The 2008 contract for handpulling was awarded to Lakeside Sports of Fair Haven, Vermont.
- Contracted handpulling commenced in Lake Champlain on July 7 in Ferrisburg, Vermont and ended September 5, removing water chestnut regrowth from Charter Marsh in Ticonderoga, New York.
- Ten contracted handpullers each worked an average of 40 hours per week through out the season.
- At least 65 Lake Champlain and associated tributaries, and “other waterbody” sites were targeted by contracted handpulling crews. These crews spent 2,973.45 hours removing approximately 32.72 tons of water chestnut.
- More than 1,000 acres along 125 shoreline miles of Lake Champlain in Vermont and New York were handpulled by contracted staff.
- Contracted handpulling crews removed water chestnut in areas up to 2.5 miles south of Benson Landing again in 2008 before the season ended.
- Other groups, including VTDEC, TNC, LCBP, US Army Corps of Engineers, US Fish and Wildlife Service, Friends of the Missisquoi Refuge, and private citizens, provided additional handpulling, both in Lake Champlain and in other waters.
- Handpulling hours by all groups totaled 4,117.2.
- Figure 2-3 provides historical handpulling data for eight handpulling sites in Lake Champlain and Figure 2-4 provides historical handpulling data for eight “other waterbody” sites.
- Only one new water chestnut site in the Champlain Basin was discovered in New York in 2008, in northern Bulwagga Bay, Port Henry, New York. Rapid response initiatives at this site prevented any mature seed drop.
- No new “other waterbody” water chestnut sites were found in 2008



Figure 2-2. Handpulling water chestnut in dense Eurasian watermilfoil beds in Lake Champlain. VTDEC Photo

Figure 2-3. Water chestnut rosettes removed by handpulling over time at eight Lake Champlain sites.

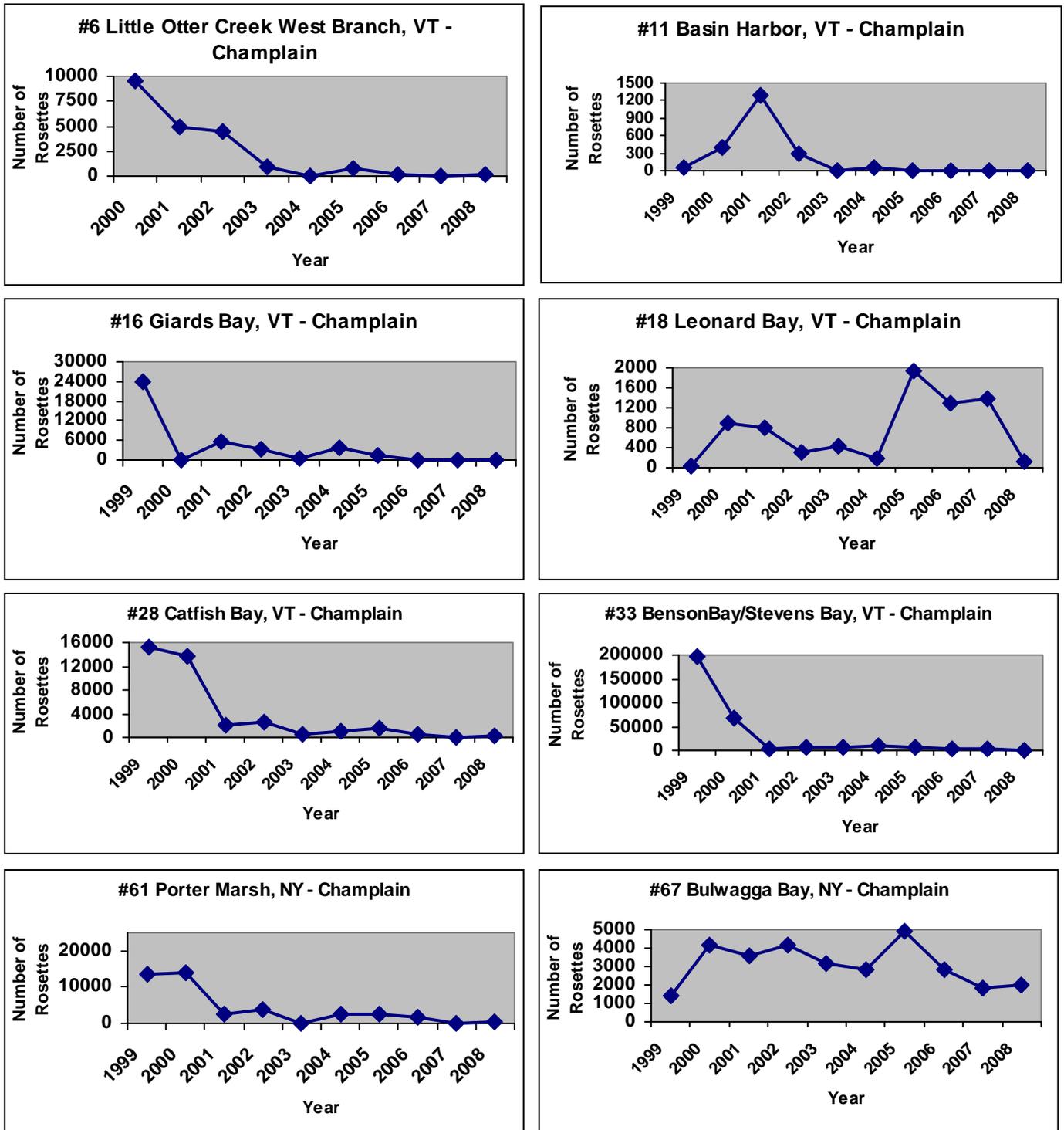
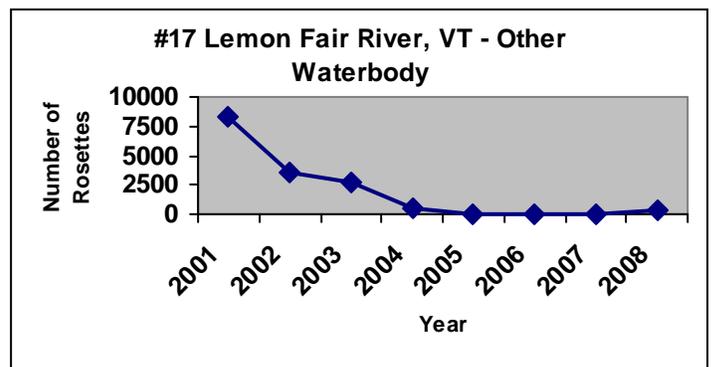
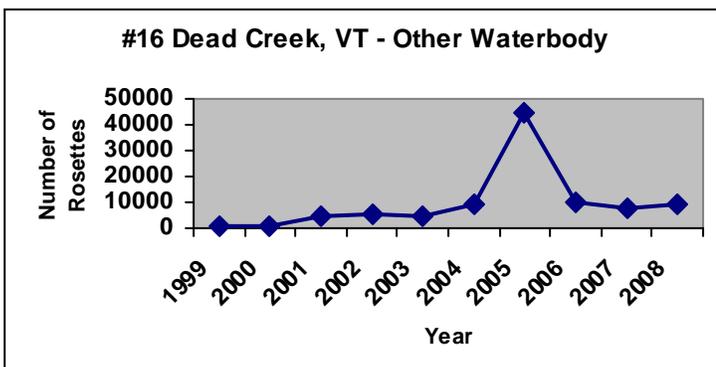
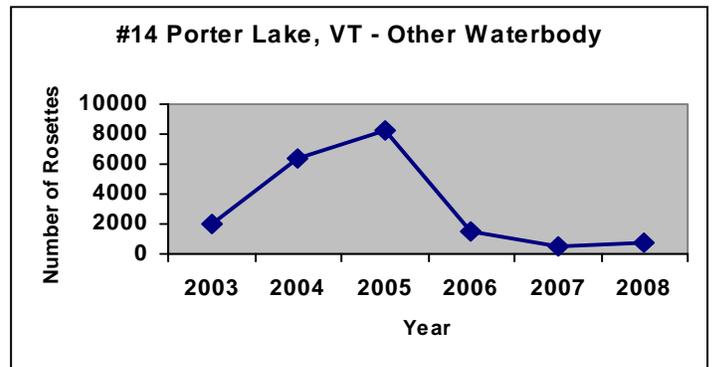
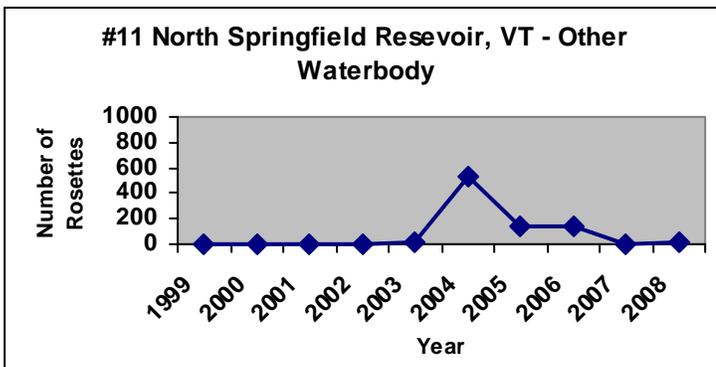
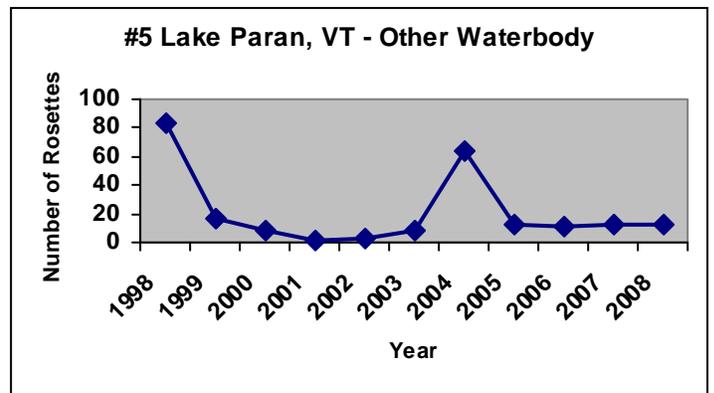
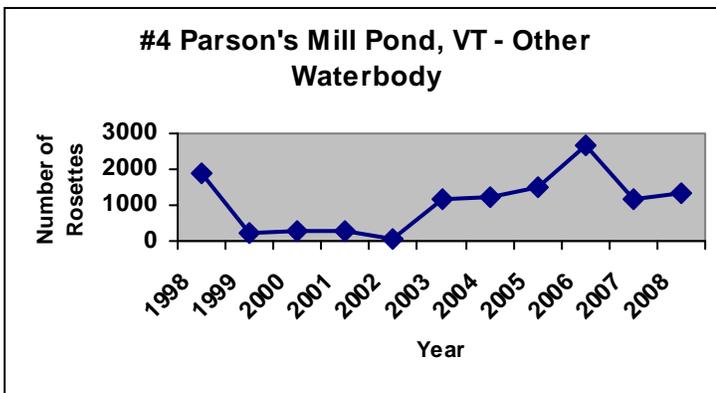
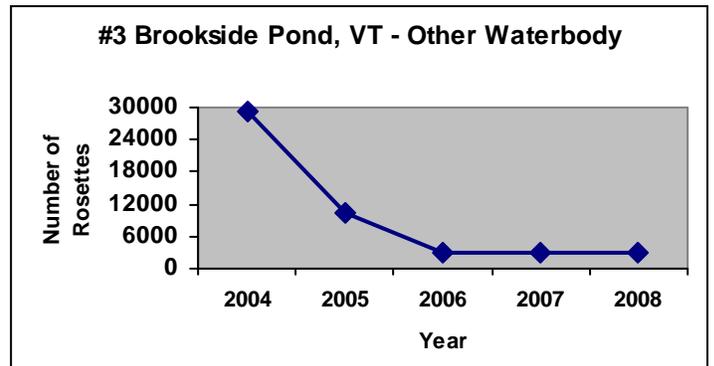
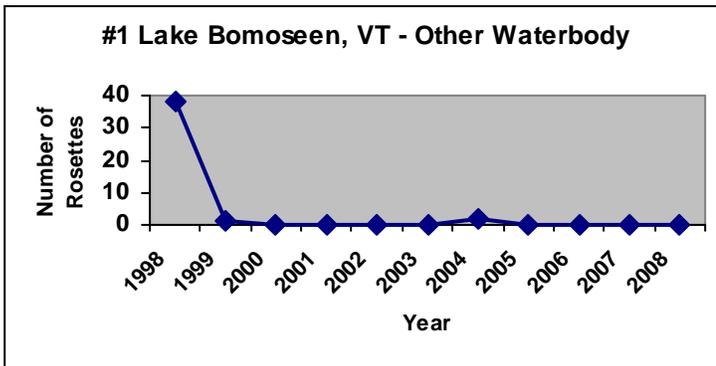


Figure 2-4. Water chestnut rosettes removed by handpulling over time at eight other waterbody sites in Vermont.



Education and Outreach Efforts

- Aquatic invasive species warning signs, with information about water chestnut and Vermont Transport Laws, were checked and repaired throughout the state at Vermont Department of Fish and Wildlife public accesses. Twenty-seven new signs were posted and 4 vandalized signs were repaired or replaced in the Lake Champlain Basin. Aquatic invasive species brochure boxes were installed at 29 accesses.
- VTDEC staff gave several presentations about water chestnut issues around the state.
- AIS Stickers were distributed in 2008. The sticker was developed to raise awareness of aquatic invasive species issues in Vermont, as well as to support the VTDEC Grant-in-Aid Program. The Grant-in-Aid Program provides funds to municipalities managing aquatic nuisance species, including water chestnut.

The estimated total weight of water chestnut removed from Lake Champlain and associated tributaries utilizing both management methods, including TNC and USF&W handpulling efforts in listed sites in 2008 was 1,031.3 tons wet weight. The estimated total weight of water chestnut removed from all other waterbody sites in Vermont was 1.4 tons wet weight. A breakdown of management techniques for all water chestnut sites in 2008 is provided in Appendix 1 and 2. The distribution of water chestnut in Lake Champlain is provided in Appendix 3. All of the other waterbodies infested with water chestnut are also in Appendix 3.

Conclusions

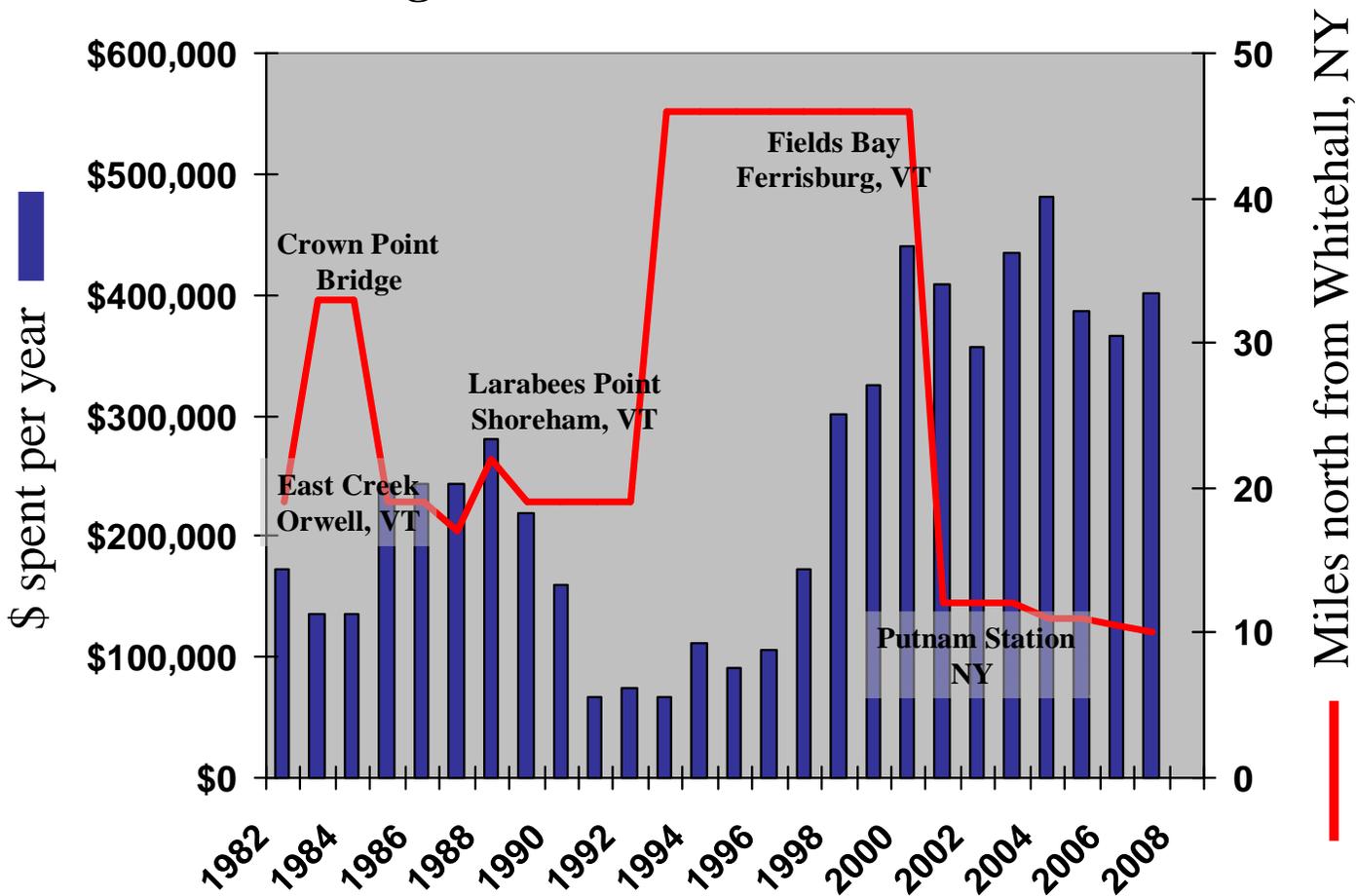
In 2008, continued declines of water chestnut densities at sites where management efforts have been consistent over at least the last five years were again observed. Sixteen Lake Champlain sites and four other waterbody sites had no water chestnut in 2008. Successful ongoing long-term management of water chestnut is imperative due to the presence of viable water chestnut seeds in the sediment, the difficulty of finding all plants at each site, and the possibility of reintroduction. Figure 2-5 illustrates the importance of consistent management of water chestnut in Lake Champlain for successful control.

As the water chestnut population is pushed further south in Lake Champlain, suitable access for off-loading must be obtained to ensure program efficiency and the best use of already limited management funds. The new access site developed at Red Rock Bay in Benson, Vermont in 2008 has greatly enhanced the efficiency of the mechanical harvesting operations and will be utilized for the mechanical harvesting portion of the program in the future.

2008 program successes included: development of a new access site on private property in Red Rock Bay four miles south of Benson Landing, Benson, Vermont, which allowed a 40% increase in mechanical harvesting efficiency based on mechanical harvester loads per hour in 2008 versus 2007. One hundred percent of the water chestnut spoils collected thru the mechanical harvesting process were composted; and rapid response initiatives occurred at the newly confirmed infestation site in Lake Champlain in Bullwagga Bay, Port Henry New York. Also of 68 Lake Champlain sites targeted for management in 2008, 16 had no water chestnut.

Figure 2-5. Annual water chestnut funding vs. northernmost mechanical harvest site in Lake Champlain, 1982-2008.

Lake Champlain Water Chestnut Management: Annual Funding vs. Northernmost Mechanical Harvest Site



Part 2: TNC Water Chestnut Management

Objectives

The Nature Conservancy's mission is to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. Towards this end, one of the goals of the Southern Lake Champlain Valley Program is to protect important natural communities from being degraded by non-native invasive species. Accordingly, TNC's motivation for organizing and conducting water chestnut control efforts is to abate the threats that water chestnut poses to conservation targets in this landscape. TNC has identified eight conservation targets in the Southern Lake Champlain Valley. Two targets: 1) wetland, floodplain, and riparian natural communities; and 2) the southern end of Lake Champlain, are adversely affected by water chestnut.

Management Summary and Changes to Program, 2008

TNC organized 41 volunteer water chestnut workdays and 4 workdays without volunteers in 2008 between June 24 and September 3, harvesting 17,270 pounds of water chestnut. Handpulling and surveying activities were conducted at 24 sites, and volunteers donated a total of 1,212 hours of labor for water chestnut management (Table 3-1). As in past years, focus continued to be on sites considered ecologically significant: East Creek, Poultney River wetlands, and South Bay's southern end. In addition, inland sites continued to be treated: Parson's Mill Pond, Root Pond, and Pelky's Swamp. Due to a surplus of volunteer handpulling capacity, three lesser-priority sites were also addressed: Cook Island, which is adjacent to the Champlain Barge Canal in Whitehall, New York; northern portions of South Bay, where rosettes were pulled after mechanical harvesting of water chestnut mats occurred (results from these areas are described under "South Bay harvester sites"). One workday occurred for the first time in Mill Bay in Putnam, New York, which features a 15 acre mat of water chestnut.

Table 3-1. Volunteer hours and water chestnut harvest summary data by year.

Year	Days	Volunteers	Hours	Sites	Pounds	Rosettes
1998	34	155	1088	11	17730	X
1999	33	282	1554	11	154620	X
2000	46	315	1861.5	15	109170	X
2001	45	259	1463.5	20	87435	X
2002	34	148	724.5	17	14219	X
2003	34	238	941	17	30225	X
2004	42	222	1143	21	17651	X
2005	45	292	1225.5	29	16412	187,568
2006	49	232	1384	22	12864	60,244
2007	49	307	1380	23	9771	47,956
2008	45	253	1212	24	17270	81,462
Total			13,977		487,367	377,230

As in past years, TNC staff was careful to schedule workdays to minimize the probability of inadvertently dispersing zebra mussels to un-infested waters. Crews washed and sun-dried canoes after each workday, and attempted to not schedule any workdays at un-infested sites immediately after a workday at an infested site.

Volunteers

Volunteer involvement continues to be the cornerstone of TNC's management program. Recruiting efforts continued in 2008 via newspaper calendar announcements, bulk mailing to previous years volunteers, flyer postings and handouts. This year, 302 volunteers contributed 1,212 hours, which is slightly fewer hours than were contributed in 2006 (Table 3-2). Similar to previous years, organized groups continued to contribute the bulk of handpulling hours to the program (932 hrs vs. 289 hours contributed by individual volunteers) in 2008.

Thirteen groups returned from previous years to pull water chestnut: Sangamon Camp, Camp Betsey Cox from Pittsford, Vermont, Camp E-Wen-Akee of Benson, Vermont, North Country Camps of Keeseville, New York, Castleton Vermont 4-H club, Green Mountain Peace Corps, Vermont Achievement Center of Rutland Vermont, a Middlebury College Freshman orientation group, Adirondack Wilderness Challenge (a youth correctional camp in Schyler Falls, New York), Fair Haven Vermont Grade School, Castleton State College RA Orientation, an Americorps NCCC work crew, and the Vermont Youth Conservation Corps. Groups participating for the first time in 2008 included a "Concerned Business Associates" group and a Castleton Community Adventures youth group. In addition to volunteer groups, the Lake Champlain Basin Program used one of the volunteer workdays as a staff outing, and interns from the New York City High School of Environmental Studies contributed to water chestnut management efforts. In addition to the volunteer hours, TNC staff provided 417 hours of field labor.

Methods

Since water chestnut is an annual plant, repeated annual harvesting of rosettes before seed drop is an effective way of controlling populations. To manage water chestnut TNC crews searched for and handpulled water chestnut rosettes in targeted wetland sites throughout the growing season (June – August) via visual searches from canoes. Water chestnut plants are distinctive in appearance, and are easily recognizable by supervised volunteers, thereby making the use of volunteers a practical and cost-effective way of managing water chestnut in shallow wetland habitats. The work objective for each site was to search for and handpull all existing water chestnut rosettes. At each site, harvested water chestnut rosettes were placed in Gardeners Supply bags and weighed on a spring scale.

Table 3-2. Volunteer statistics from water chestnut handpulling, 1998 – 2008.

Year	Totals		Group volunteers		Individual Volunteers	
	Total number of volunteers	Total Volunteer hours	Number of volunteers from groups	Hours from group	Number of Individuals	Hours from individuals
1998	155	1,088	91	529	64	559
1999	282	1,554	185	772	97	782
2000	315	1,862	225	974	90	888
2001	259	1,464	176	766	83	698
2002	148	725	106	341	42	384
2003	238	870	144	380.5	84	490
2004	222	1,143	162	663	60	480
2005	292	1,225	242	1012	54	210
2006	232	1,334	194	990	40	344
2007	238	1380	184	1083	54	297
2008	253	1,212	232	932	31	289

Since water chestnut harvests were recorded as numbers of full bags in the initial years of this program (1998-2000), in order to compare harvest data between years, the harvest weight recorded during this period is estimated by multiplying the bags times by the approximate weight of a full bag (90 lbs).

Numbers of rosettes harvested were estimated by weighing and counting a subset of harvested rosettes, and total daily rosette harvest was estimated by extrapolating the rosette/lb ratio to the entire harvest weight.

In order improve our ability to describe existing conditions and trends in water chestnut infestation; sites will continue to be characterized by their infestation intensity. Classification categories will be defined in terms of lbs of harvested water chestnut/acre, and will be done according to the scheme depicted in (Table 3-3).

Table 3-3. Water chestnut infestation intensity classification.

Infestation Intensity	Lbs/acre
Negligible	< 5
Low	5 – 150
Moderate	150 – 600
High	600 – 4000
Mats	> 4000

The upper limits of this classification were defined by looking at lbs/acre estimates from 2005 handpull harvests in the water chestnut mats in the Drowned Lands, which were 150,000 lbs/acre.

Results and Discussion

Water chestnut harvest continues to exhibit an overall pattern of decline or stabilization at all of the sites that were visited in 2008 (Table 3-4; Figure 3-1 a-f). Overall, 19 of the sites are isolated enough from the influx of water chestnut propagules from other areas to be considered responsive to management efforts. Of these sites, one exhibited notable increases in harvest weights (La Chute River Marshes), while the remainder yielded either minor increases or decreases in harvest weights compared to 2007 (Table 3-5). As in previous years, few major changes were observed in harvest weights, no major shifts in infestation intensity were observed.

The summer of 2008 featured historically high levels of rainfall, which in general provided high water conditions that facilitated access to most of our worksites. However, heavy rainfall shortened a number of workdays, and caused work to be deferred until the end of the season at a number of sites, sometimes after plant senescence and mature seed drop. Accordingly, it is probable that increases in water chestnut harvest will be observed next season at these sites. In addition to TNC volunteers, VTDEC-contracted handpulling crews also visited La Chute River, Whitney Creek, and East Creek, and these results are included in our analysis of water chestnut harvest trends. The most noteworthy site-specific results in 2008 were as follows:

La Chute River Marshes, Ticonderoga, NY

2008 marked the third year that TNC volunteer workdays were held at this site, which had been handpulled in years prior to 2006 by VTDEC contractor handpulling crews. Substantially more water chestnut was harvested at this site in 2008 than in previous years (3606 lbs, compared to 334 and 418 in 2007 and 2006, respectively). Most plants were found in high-concentration “hotspots” scattered throughout the south-western most portions of the marsh. Two factors probably contributed to the increase in water chestnut at this site: 1) water levels were unusually high in July and August, due very high levels of rainfall. This facilitated access to portions of the marsh that are usually more difficult to reach because of low water and emergent vegetation. 2) This site is the largest single area of wetland habitat that TNC handpulls with volunteers, and features extensive open areas of water interspersed with floating and emergent vegetation. Untrained volunteers have a very limited ability to perform systematic area-wide searches for water chestnut, so almost inevitably, at such a site, some locations are overlooked on any given year. Despite the increase in water chestnut at this site, infestation intensity at this site remained low.

Billing’s Marsh, West Haven, VT

Water chestnut harvest in 2008 remained relatively low (275 lbs; Table 3-4), declining from a remarkable spike in water chestnut abundance in 2006 (957 lbs). One workday was held at this site in 2008. Infestation intensity at this site was low, but this site was not handpulled until the end of the season, due to weather-related delays. Many seeds fell off of plants as they were pulled from the water this season. Accordingly, an increase in water chestnut harvest at this site is likely in 2009. Infestation intensity at this site was low.

Brookside Pond, Orwell, VT

Two workdays were held at this site in 2008, and 705 lbs of water chestnut was harvested, which is nearly the same as the 693 lbs of water chestnut (Table 3-4) harvested in 2007. High water conditions in 2008 facilitated access to the entire site, and treatment effectiveness was high. This site was first treated by VTDEC contractor crews in 2004, and due to shallow water and deep mud, is a difficult site

to treat. Volunteer groups are not taken to this site on account of the difficult conditions. Infestation intensity at this site was low.

East Creek, Orwell, VT

Six workdays were spent at East Creek in 2008. As in past seasons, more water chestnut was discovered in reaches closest to Lake Champlain. TNC has pulled water chestnut from East Creek since 1996 and there had been a steady decline in the water chestnut population until 2002, after which harvests have varied annually (Table 3-4; Figure 3-1a). Water chestnut harvest in 2008 decreased to 565 lbs from the spike observed in 2006 (2,315 lbs). Accordingly, infestation intensity decreased at this site from low in 2006 to negligible levels in 2008. If this level of water chestnut infestation is maintained, it would represent remarkable progress in management, and may provide insights with respect to the maximum amount of control that is feasible at a site of this size.

Schoolhouse Marsh, West Haven, VT

One workday was held at this site in 2008, and only 7 lbs. of water chestnut were harvested (Table 3-4), which is close to the lowest harvest ever recorded for this site since harvesting began in 1998. Infestation intensity at this site has been negligible since 2007.

South Fork of East Creek, Orwell, VT

Only 17 lbs were harvested from this site in 2008. This is substantially less than the harvest of 134 pounds of water chestnut in 2007 (Table 3-4), and the handpulled total in 2006 of 324 lbs. Workdays were held at this site early in the season. Plans to re-visit the site later were abandoned due to schedule setbacks from inclement weather, so second-growth plants may well have produced un-harvested seeds. An increase in harvest weights in 2009 is anticipated

Southern Lake Champlain, West Haven, VT and Whitehall, NY

A large harvest of 2091 lbs was collected at this site in 2008. This is considerably more than previous years (1042 and 981 lbs in 2007 and 2006, respectively; Table 3-5). This site is subject to the deposit of seeds from plants dislodged from other areas of the lake, so varying harvest trends are not surprising. Increases in this year's harvest may have been attributed to an influx of seeds dropped by floating plants that were dislodged by mechanical harvesting south of the railroad bed in South Bay the previous year. Overall infestation intensity is low.

Whitney Creek, Addison, VT

Two workdays were held at this site in 2008 by TNC. Overall, 1014 lbs of water chestnut were collected, which is substantially less than previous years (440 lbs in 2007, 6,998 lbs in 2006 and 1,333 lbs in 2005). Although infestation remained low within the entire site, the vast majority of plants were concentrated near the outlet to Lake Champlain, and plant abundance at this site remained puzzlingly high given that pulling efforts have been consistently maintained since 1998.

Mill Bay, Putnam, NY

TNC crews spent one day harvesting water chestnuts at this site, which features a 16 acre mat of water chestnut. This was the first time we worked at this site, and the site was the most productive option for working with the Adirondack Wilderness Challenge group this year. The site is inaccessible to mechanical harvesters from Lake Champlain, so hand-harvesting is the only feasible method for this site. This site will remain a low priority for our program, given that we do not have enough resources to make meaningful progress at managing water chestnut at this site.

Table 3-4. Pounds¹ of water chestnut harvested by year per site, 1998 - 2008.

Site Name	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Billings Marsh	1170	1440	247.5	135	48	53	50	132	975	157	275
Brookside Pond	X	X	X	X	X	X	VTDEC	957	412	693	705
Buoy 33 wetlands	X	X	X	X	X	X	X	X	2006	527	868
Cogman Pond	VTDEC	450	135	VTDEC	320	211	87	18	26	39	84
Cook Island West	X	X	X	X	X	X	173	X	X	1839	1109
East Creek	10170	2250	2250	652.5	2865	1034	996 ²	1281	2315	341	565 ⁵
Finch Marsh	990	X	787.5	270	116	55	413	178	124	187	189
Finch Marsh Outlet	X	X	X	X	X	X	490	15	0	0	10
Hubbarton Ponds	X	X	X	X	X	X	X	0	X	X	X
Inman Pond	X	x	X	x	x	X	X	0	X	X	X
La Chute River Marshes	X	X	X	X	X	VTDEC	VTDEC	VTDEC	418	334	3606 ⁵
Nichols Wetland	X	X	X	22.5	46	75	31	203	280	18	44
Mill Bay											3220
Old Marsh Pond	0	X	X	X	0	X	X	0	X	X	0
Parson Mill Pond	292.5	67.5	90	135	18.5	635	365	400	697	181	199
Pelkey Swamp	24 plants	20 plants	2 plants	25 plants	0	0	2 plants	0	1 plant	15	20
Reed Marsh	1800	270	112.5	22.5	75	147	183	264	94	287	236
Rogers Marsh	2160	810	22.5	20 plants	3 plants	0	3 plants	6 plants	2 plants	26 plants	93
Root Pond	X	X	X	X	X	X	10 plants	X	10 plants	6 plants	6
S. Lake Champlain ³	720	X	X	X	540	259	1241	270	981	1042	2091
Saslow Marsh	X	X	X	X	X	X	70	48	76	94	133
Schoolhouse Marsh	180	X	135	X	117	128	57	43	20	4	7
Schoolhouse Marsh North	X	X	X	X	X	587	83	51	43	70	133
South Bay	X	X	3240	8415 ⁴	363	492	173	30	43	91	53
South Bay/Timber Marsh	X	X	X		X	X	X	644	826	153	641
South Bay/Harvester sites										3120	2366
South Fork	202.5	180	45	90	50	421	87	263	324	134	17
The Drowned Lands	X	X	X	X	6660	25479	13006	10359	X	X	X
Whitney Creek	VTDEC	2520	9405	4275	9270 ⁵	886	9282 ⁵	1333 ⁵	6998 ⁵	440	1014

¹ 1998 – 2001 pounds are estimates made from number of bags filled: 1 full bag = 90lbs of water chestnut.

² Additional harvest conducted by VTDEC at the mouth of the creek.

³ From mouth of Poultney River to Buoy 33.

⁴ Includes Timber Marsh area of South Bay

⁵ Combined harvest from VTDEC and TNC

VTDEC – site treated by the Vermont Department of Environmental Conservation

X – Site not visited

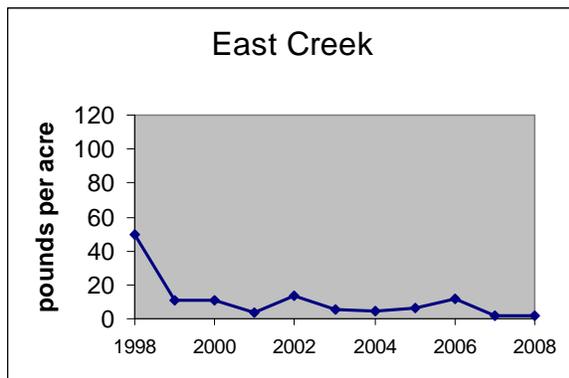
Table 3-5. Area-based harvest statistics for select sites, 2005 - 2008.

Site	2005		2006		2007		2008	
	rosettes/acre	lbs/acre	rosettes/acre	lbs/acre	rosettes/acre	lbs/acre	rosettes/acre	lbs/acre
Billings Marsh	26	8.1	297	59.8	66.4	9.6	74.4	16.9
Brookside Pond	801	76	245	32.7	193.9	55	227.5	56.0
Buoy 33 wetlands	X	X	2033	371.5	449.1	100.6	702.1	159.6
Coggman Pond	3	0.7	6	1	1.5	1.6	16.9	3.4
East Creek	74	8.2	87	14.9	11.3	2.2	21.3*	3.6*
Finch Marsh	76	6.1	25	4.1	1.9	6.2	60.4	6.6
La Chute River Marshes	X	X	31	3.4	12.7	2.1	84.9*	22.2*
Nichols Wetland	530	88.3	608	121.7	27.8	7.8	70.8	19.1
Parson's Mill Pond	38	10.2	67	17.7	29.2	4.6	34.2	5.1
Pelkey Swamp	0	0	0	0	3.1	0.3	2.2	0.4
Reed Marsh	51	16.1	20	5.7	63	17.5	191.4	14.4
Rogers Marsh	2	0.3	1	<1	7	1.4	230.7	25.1
Root Pond	X	X	1	0	0.3	<1	2.8	0.3
S. Lake Champlain	104	7.8	151	25.3	199.1	30.8	208.0	61.9
Saslow Marsh	28	9.4	57	14.9	73.7	18.4	151.3	26.1
Schoolhouse Marsh	38	3.6	2	0.4	0.4	0.1	1.1	0.2
Schoolhouse Marsh North	5	1.1	13	3.6	22.7	5.8	44.2	11.0
South Bay	8	0.3	4	0.4	53.4	0.8	4.2	0.5
South Bay/Timber Marsh	233	11.5	82	14.7	17.2	2.7	91.8	11.4
South Fork (E. Creek)	31	5.9	31	7.2	10.6	3	3.8	0.4
Whitney Creek	75	18.2	166	43.8	33.8	6	255.9*	71.0*

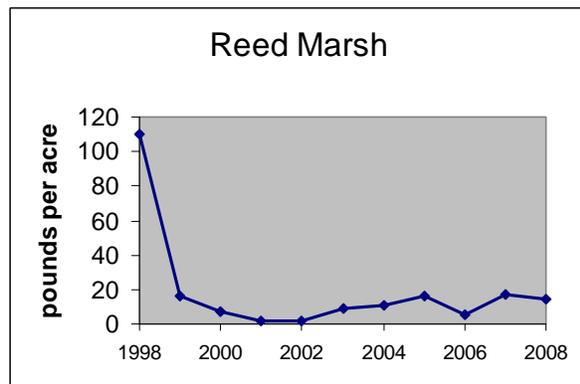
* combined harvest from VT DEC and TNC

Figure 3-1a-f. Water Chestnut harvest trends at six sites in the Southern Lake Champlain Valley, 1998 – 2008.

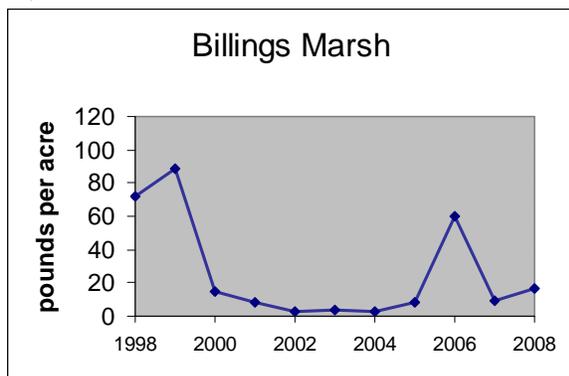
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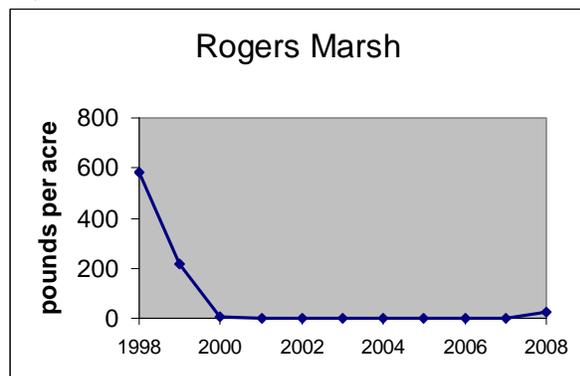
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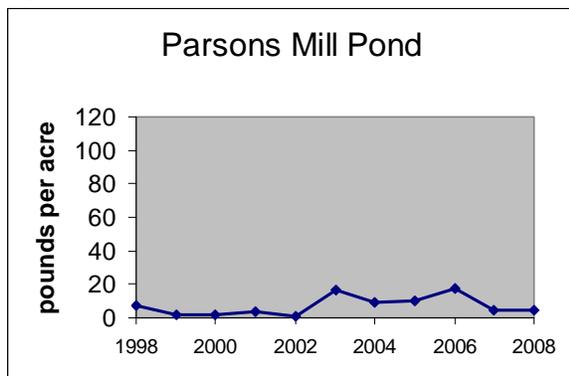
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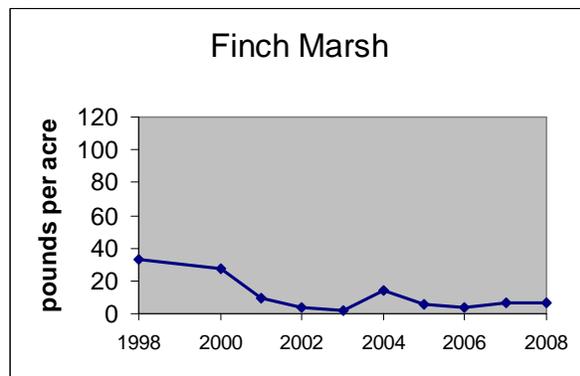
1d)



1e)



1f)



Conclusions

After eleven years of water chestnut control efforts, TNC’s Water Chestnut Management Program continues to be successful at maintaining the diminished levels of water chestnut infestation that were achieved after the initial years of the program. Although some sites have exhibited puzzling variations in water chestnut harvests, in 2008, harvests at all of these sites remain at low levels that might be expected after multiple successive years of treatment. Program-wide

results illustrate that substantial gains in water chestnut management have been achieved via our volunteer-base program on a large proportion of the total area of infested habitat in Lake Champlain: Volunteers handpulled water chestnut in nearly 900 acres of infested habitat, which is approximately 35% of the entire infested habitat that exists in the basin.

The overall effectiveness of TNC handpulling efforts is remarkable: data clearly indicate that water chestnut populations are either reduced or have been prevented from becoming more severe at all sites treated. Future results from two sites in particular bear watching as potentially representative of the degree of control of water chestnut that can be achieved after successive years of handpulling effort. Both Schoolhouse Marsh and East Creek have had two successive years of exceptionally low harvests (1.1 and 17 rosettes/acre, respectively, in 2008). Harvesting efforts at East Creek commenced in the mid-1990's and predated the volunteer handpulling program by at least 4 years, so the results represent the cumulative efforts of 15 years of hand pulling at this site. A number of successive years of results free of excessive fluctuation in harvest weights will be needed to fully support any assertion that the management program has reached the highest threshold possible at these sites, but current year results are certainly encouraging. Still, it is unlikely that water chestnut can be completely eradicated at most of these sites, and some level of maintenance treatments will be needed for the foreseeable future.

This program's reliance on the effort of volunteers continues to be a successful formula for the control of water chestnut at a large set of ecologically significant sites in the Southern Lake Champlain Valley region. Since 1998, the recruitment and management of volunteers for TNC's Water Chestnut Management Program has proven to be both effective and cost-efficient. In 2008, 232 volunteers contributed 1212 hours and removed approximately 8.5 tons of water chestnuts. This is the equivalent of \$12,120 of donated labor, calculated at the going rate of compensation for contractor handpulling crews. Overall, since the establishment of this program, volunteers have donated 13,977 hours to handpull 243 tons of water chestnuts. The program also continues to be a valuable source of education/information on the water chestnut issue for volunteers and local residents.

Acknowledgements

Funds for this program were provided by the Lake Champlain Basin Program, the Waterwheel Foundation of VT, and the Wildlife Habitat Improvement Program (USDA, NRCS).

Part 3: Other Basin Water Chestnut Management Efforts

New York

In 2008, NYSDEC funds were available to operate New York State Canal Corps mechanical harvesting equipment for water chestnut removal in southern Lake Champlain. The Town of Dresden, New York oversaw the harvesting program with financial support (\$60,000) and help from NYSDEC staff. Four sites were harvested in the Dresden, New York and West Haven, Vermont region. A total of 1,431 loads of water chestnut spoils were removed from the sites or an estimated 11,448 cubic yards. Harvested material was disposed of in a gravel pit in Dresden.



Québec*

In 2008, \$89,900 (Canadian dollars) was spent managing water chestnut in Québec. The Richelieu River, Pike River, South River, John Pond in Venise-en-Québec, Deux-Montagnes Lake and the Châteauguay River and vicinity were surveyed and targeted for control. Handpulling and the rake equipped Biocaptor boat were heavily used during the season. For the entire territory, water chestnut was 47% less abundant in 2008 than in 2007. Eight colonies were controlled on the Richelieu River; however new sites were also identified, principally due to seeds spreading from South River. Populations of water chestnut in the Pike River increased by 22 % in 2008. No rosettes were found in the Châteauguay River, but one detached rosette was found on the Deux-Montagnes Lake probably coming from the infested area on the Ottawa River, just upstream of the Québec border.

Control efforts will continue in 2009, with the expectation of a sharper decline in water chestnut populations overall.

*Summary written by Quebec ministry staff

U.S. Fish & Wildlife Service**

Missisquoi National Wildlife Refuge staff utilized crews from the Vermont Youth Conservation Corps (VYCC) for most of the water chestnut management that occurred in the Refuge in 2008. VYCC crews spent four weeks between July and August searching for and removing water chestnut. Less than half as many rosettes were pulled in 2008 (2,523) as had been found and handpulled in 2007 (5,963). Although many areas of the Refuge were searched in 2008, water chestnut plants were only found in two of the sites previously identified, Cranberry Pool and Big Marsh Slough. No water chestnut was found in sites in Long Marsh Channel or at the mouth of big marsh Slough. Emergent vegetation was prevalent and well-developed in refuge marshes and made searching for water chestnut difficult.

**Summary written by USF&W Staff

LCBP Water Chestnut Workgroup

The LCBP Water Chestnut Workgroup formed in 2004 continued to bring guidance to water chestnut management in the Basin. Comprised of representatives from LCBP, TNC, VTDEC, NYSDEC, New York Sea Grant, New York State Canal Corporation and Missisquoi National Wildlife Refuge, the Workgroup assisted with the Vermont, New York mechanical harvesting efforts in southern Lake Champlain in 2008 and acted as an important outlet for basin communication on water chestnut management.

Appendix 1. Water Chestnut Management Program Summary: 2008 Lake Champlain and associated tributary sites.

Site Number and Name	Town	Control Implemented	Date Targeted	Number of HP or MH Hours	Estimated# of pounds removed	Estimated # of Harvester Loads or # of Rosettes Pulled
VERMONT SITES						
MISSISQUOI BAY						
1.	Missisquoi Bay 45°00'33 N / 73°07'54 W	Highgate Springs	HP-DEC	8/8	0.5	0
			USF&W	8/16	1	0
2.	Missisquoi Refuge Long Marsh Channel 44°59'34.38"N 73°09'20.88"W	Highgate Springs	USF&W	7/24, 8/16	5	0
			HP- DEC	8/8	0.5	0
3.	Outside entrance to Big marsh Slough NEW 44°58'32 N / 73°08'03 W	Highgate Springs	HP-DEC	8/8	0.5	0
			USF&W	8/16	0.5	0
MAIN LAKE						
	McNeil Cove 44°18'03N / 73°17'47W	Charlotte	HP-DEC	6/25	1	0
4.	Converse Bay F&W Access & Bay South 44°17'19N / 73°16'01W	Charlotte	HP-DEC	6/25	2	0
OTTER CREEK						
5.	Town Farm Bay/Kimball Brook 44°16'60N / 73°16'01W	Charlotte	HP-DEC	6/25	2	0
6.	Little Otter Creek (West Branch) 44°13'28N / 73°01'38W	Ferrisburg	HP	7/8	20	15.4
7.	Porter Bay 44°13'37N / 73°18'58N	Ferrisburgh	HP	7/7	18	0
8.	Mouth of Otter Creek to Fort Cassin Access 44°13'31N / 73°19'27W	Ferrisburgh	HP	7/7	2	0
9.	Fields Bay 44°13'15N / 73°19'09W	Ferrisburgh	HP	7/7, 8/13	54	132.4
			HP-DEC	6/16	2	2

* Key: HP = handpulling
 MH = mechanical harvesting
 DEC = VT Department of Environmental Conservation
 USF&W = US Fish & Wildlife Service
 TNC = The Nature Conservancy
 1 MH load = 14 cubic yards
 L= Lakeside

Site Number and Name		Town	Control Implemented	Date Targeted	Number of HP or MH Hours	Estimated# of pounds removed	Estimated # of Harvester Loads or # of Rosettes Pulled
10.	Otter Creek Fort Cassin Access South to Dead Creek 44°12'23N / 73°19'16W	Ferrisburgh	HP	7/8	0.5	0.25	4
PORT HENRY							
11.	Basin Harbor 44°11'46N / 73°21'52W	Panton	HP	7/10	1	0	0
SOUTH LAKE							
12.	Hospital Creek a. 44°02'32N/73°25'06W (L)	Addison	HP	7/10	24	16.2	387
	b. 44°02'20N/73°24'40W			7/10	6	23	544
13.	Whitney Creek a. 44°01'40N / 73°24'05W (lakeside)	Addison	HP	a. 7/21, 8/12, 8/28	30	444.4	1,445
	b. 44°02'50N / 73°24'40W			b. 8/13, 8/28	31.5	4,376	14,813
				HP-TNC	b.7/24, 8/2	74.5	1,014
14.	McCuen Slang VT 44°01'28N / 73°23'67W	Addison	HP	7/21, 8/28	29	91.6	588
15.	Bridport Town Beach 43°59'55N / 73°24'04W	Bridport	HP	7/21	1	0	0
16.	Giards Bay 43°58'44N / 73°24'01W	Bridport	HP	7/21, 9/3	20	20.4	134
17.	North of W. Bridport 43°57'34N / 73°24'21W	Bridport	HP	7/21	1	0	0
18.	Leonard Bay 43°56'16N / 73°24'00W	Bridport	HP	7/21, 9/3	21	12.1	131
19.	Lapham Bay 43°55'33N / 73°23'37W	Shoreham	HP	7/22	15	12.4	113
20.	South of Lapham Bay 43°54'52N / 73°23'40W	Shoreham	HP	7/24	7.5	0.25	4
21.	North of Fivemile Point 43°54'32N / 73°23'40W	Shoreham	HP	7/23	7.5	0	0

* Key: HP = handpulling
 MH = mechanical harvesting
 DEC = VT Department of Environmental Conservation
 USF&W = US Fish & Wildlife Service
 TNC = The Nature Conservancy
 1 MH load = 14 cubic yards
 L= Lakeside

Site Number and Name		Town	Control Implemented	Date Targeted	Number of HP or MH Hours	Estimated# of pounds removed	Estimated # of Harvester Loads or # of Rosettes Pulled
22.	Bays on Lake Street South of Five-Mile Point 43°54'06N / 73°22'35W	Shoreham	HP	7/23	5	0	0
	Stony Cove 43°54'15N / 73°22'56W	Shoreham					
23.	Access by C. Farr Ranch 43°53'54N/73°22'30W	Shoreham	HP	7/23, 9/3	12.5	26.4	313
	Watch Point 43°53'7N / 73°22'31W	Shoreham					
24.	N of Larrabees Point 43°51'56N / 73°22'11W	Shoreham	HP	7/24, 9/4	50	295.8	1,779
25.	Beadles Cove and South 43°51'1N / 73°22'15W	Shoreham	HP	7/24, 9/4	19.5	156.2	530
26.	East Creek a. 43°51'50N / 73°22'37W (mouth)	Orwell	HP	7/29, 9/4	32	199.8	668
	b. 43°49'38N/73°21'59W		HP-TNC	6/30, 7/3-7/29, 8/7	232.3	375	2,642
27.	Shoreline between East Creek & Catfish Bay 43°49'52N / 73°23'06W	Orwell	HP	7/30	5	0	0
28.	Catfish Bay 43°49'40N / 73°23'09W	Orwell	HP	7/30	10	39	142
29.	Buoy 39 Marina 43°49'21N / 73°23'25W	Orwell	HP	7/30	0.5	0	0
30.	Dock at Curly Audette Farm 43°48'38N / 73°22'41W	Orwell	HP	7/30, 9/5	4	104	323
31.	North shore Chipmans Point 43°48'7N / 73°22'32W	Orwell	HP	7/31, 9/5	14.5	223.2	1,067
32.	Shoreline between Chipmans Point and Benson Bay 43°47'07N / 73°21'10W	Orwell, Benson	HP	7/31, 8/1	62.5	523.6	4,239
33.	Benson Bay 43°45'50N / 73°20'41W	Benson	HP	8/1, 8/4, 9/5	34	159.6	1,589

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Site Number and Name		Town	Control Implemented	Date Targeted	Number of HP or MH Hours	Estimated# of pounds removed	Estimated # of Harvester Loads or # of Rosettes Pulled
34.	Shoreline between Benson Bay & Stony Point 43°45'24N / 73°21'16W	Benson	HP	8/4	10.5	31.4	218
35.	Stony Point 43°44'37N / 73°21'57W	Benson	HP	8/4	8	110.8	488
36.	Shoreline between Stony Point & Benson Landing 43°44'16N / 73°22'05W	Benson	HP	8/4	8	228.2	2,210
37.	Benson Landing 43°43'45N / 73°22'03W	Benson	HP	8/4, 8/11, 8/25	29	494.2	2,510
38.	Dutchers and South 43°43'01N / 73°22'33W	Benson	HP	8/5, 8/6, 8/7, 8/25, 8/26	170.5	5,344	12,692
39.	Peters Bay 43°38'12N / 73°25'37W	Benson	MH	7/16-8/20	437	1,390,800	366
40.	Red Rock Bay and North 43°40'57 N / 73°25'37 W	Benson	MH	7/10-8/21	45.5	228,000	60
41.	Poultney River and associated sites						
	a. Mouth of the Poultney and region 43°34'08N/ 73°24'06W	West Haven	HP-TNC	6/26	68	2,091	7,030
	b. Rogers Marsh 43°34'06N/73°23'52W	West Haven	HP-TNC	6/26	4	93	854
	c. Shaw Mtn Wetlands 43°41'02N/73°21'23W						
	d. Reed Marsh 43°36'52N/73°22'42W	West Haven	HP-TNC	7/12	31.5	236	3,139
	e. Schoolhouse Marsh 43°35'33N/73°23'12W	West Haven	HP-TNC	7/17, 8/8	16	140	585
	f. Billings Marsh 43°36'17N/73°22'39W	West Haven	HP-TNC	8/14, 9/2	9.5	275	1,213
	g. Galick Road Wetlands 43°34'36N/73°24'48W						
h. Finch Marsh 43°34'36N/73°22'49W	West Haven	HP-TNC	6/24, 6/27, 8/19	28.5	199	1,811	

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Site Number and Name		Town	Control Implemented	Date Targeted	Number of HP or MH Hours	Estimated# of pounds removed	Estimated # of Harvester Loads or # of Rosettes Pulled
	i. Nichols Wetland 43°37'03N/73°22'30W	West Haven	HP-TNC	8/14	8	44	163
NEW YORK SITES							
	j. Saslow Marsh 43°36'50N/73°22'26W	Whitehall	HP-TNC	8/28	7	133	771
SOUTH LAKE							
42.	New York Light 14 and south 43°40'45 N / 73°24'43W	Dresden	MH	7/30-8/21	12	26,600	7
43.	Pulpit Point 43°42'45N / 73°23'43W	Putnam	MH	7/17-8/4	60.5	152,000	40
44.	Bed Back by Railroad NY 43°42'45N / 73°23'26W	Putnam	MH	7/8-7/15	70	129,200	34
			HP	8/11, 8/19, 8/20, 8/21, 8/22, 8/25, 8/27, 8/29, 8/30, 9/1, 9/2	481	19,968	53,404
45.	NY Light 4 43°42'48N / 73°23'09W	Putnam	MH	7/25-8/20	16	49,400	13
			HP	8/12, 8/13, 8/14, 8/15, 8/18, 8/26, 8/27	354.5	23,232	53,419
46.	60 Acre Patch 43°43'21N / 73°22'26W	Putnam	HP	8/11	48	384	936
			MH	8/11-8/14	14	19,000	5
47.	Sixmile Point and South 43°45'26N / 73°22'00W	Putnam	HP	8/1, 8/4, 8/5, 8/6, 9/5	143.5	2,271.1	15,484
48.	South of Gourlie Point 43°46'45N / 73°21'50W	Ticonderoga	HP	8/1	10	47.6	486
49.	Gourlie Point Bay 43°47'38N / 73°22'25W	Ticonderoga	HP	7/31	4.5	0.01	3
50.	North of Gourlie Point 43°47'47N / 73°22'42W	Ticonderoga	HP	7/31	9	80.6	296

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Site Number and Name		Town	Control Implemented	Date Targeted	Number of HP or MH Hours	Estimated# of pounds removed	Estimated # of Harvester Loads or # of Rosettes Pulled
51.	Charter Marsh 43°48'16N / 73°23'5W	Ticonderoga	HP	7/31, 9/5	39.5	288.4	904
52.	North of Charter Marsh 43°48'33N / 73°23'11W	Ticonderoga	HP	7/30	35	110.2	558
53.	Fort Ticonderoga Bay & South 43°50'17N / 73°23'52W	Ticonderoga	HP	7/30	30	264	1,512
54.	LaChute River 43°50'42.18N/73°24'08.82W	Ticonderoga	HP	8/31, 9/4	14.5	336	785
			HP-TNC	7/16, 7/24, 8/11, 8/17	179	3,382	12,964
55.	North of Fort Ticonderoga 43°51'29N / 73°23'20W	Ticonderoga	HP	7/28, 7/29, 9/4	103	3,516.2	10,123
56.	North of Kirby Point 43°52'42N / 73°23'22W	Ticonderoga	HP	7/28, 9/3	45	89.2	562
57.	South of IPCO 43°53'21N / 73°23'24W	Ticonderoga	HP	7/25, 9/3	16.5	45.8	301
58.	IPCO Bay 43°53'42N / 73°23'50W	Ticonderoga	HP	7/25, 9/3	28.5	176.4	624
59.	Bay North of Five Mile Point Light 43°54'17N / 73°24'45W	Ticonderoga	HP	7/22, 7/25, 9/3	60	264	2,747
60.	North of Crown Point 43°57'15N / 73°24'49W	Crown Point	HP	7/22, 9/3	26	43	278
61.	Porters Marsh 43°58'13N / 73°24'58W	Crown Point	HP	7/22, 9/3	27.5	50	564
62.	Bay south of Burdick Crossing 43°59'4N / 73°25'14W	Crown Point	HP	7/21	2	0	0
63.	Bay at Burdick Crossing 43°59'10N / 73°25'13W	Crown Point	HP	7/21	2	0	0
64.	South of Lapstone Point 44°00'10N / 73°25'02W	Crown Point	HP	7/21	8	306	3,345
				8/28	4	126	1,337
65.	Shoreline between Lapstone Pt & Bay South of Crown Point Bridge 44°00'55N / 73°25'03W	Crown Point	HP	7/21, 8/28	7	23	200

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Site Number and Name		Town	Control Implemented	Date Targeted	Number of HP or MH Hours	Estimated# of pounds removed	Estimated # of Harvester Loads or # of Rosettes Pulled
66.	Bay south of Crown Point Bridge 44°01'30N / 73°25'06W	Crown Point	HP	7/10, 7/17	29	146.6	2,034
<i>PORT HENRY</i>							
67.	Bulwagga Bay 44°00'17N / 73°26'51W	Crown Point, Moriah	HP	7/10, 7/11	120	131.8	1,998
68.	Bulwagga Bay Campground 44°02'02.76N / 73°27'36.76W	Crown Point, Moriah	HP	7/14, 7/15, 7/16, 7/18, 8/12	333.5	14,870	159,697

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 MH = mechanical harvesting
 DEC = VT Department of Environmental Conservation
 USF&W = US Fish & Wildlife Service
 TNC = The Nature Conservancy
 1 MH load = 14 cubic yards
 L= Lakeside

Appendix 2. Water Chestnut Management Program Summary: 2008 other waterbody sites.

	Site	Control Implemented*	Date Targeted	Hours	Estimated # of Pounds removed	Rosettes Removed
Lakes and Ponds						
1.	Lake Bomoseen, VT 43°41'18N / 73°11'57W	HP-DEC	8/7	6	0	0
2.	Coggman Pond, VT 43°37'14N / 73°22'30W	HP-TNC	7/30	24	84	420
3.	Brookside Pond, VT 43°46'58N / 73°18'34W	HP-TNC	7/23, 8/1, 8/6	21.5	705	2,867
		HP	8/7, 8/8	3	16.6	105
4.	Parsons Mill Pond, VT 43°42'20 N / 73°17'04W	HP-TNC	8/15	22.5	199	1,343
5.	Lake Paran, VT 42°55'58N / 73°13'13W	HP-DEC	8/13	6	2	12
6.	Small pond, Benson, VT (Horton) 42°42'46N/73°15'20W	HP-owner	June, Aug., Sept.	4	1	6
7.	Small pond, North Bennington, VT (Allen) 42°53'46N / 73°15'20 W	HP-DEC	8/13	8	3	23
8.	Small pond, Bennington, VT (Glanzenberg) 42°53'28N / 73°15'9W	HP-owner	June, July, August	3	0	0
9.	Small pond at Benson Landing, VT 43°43'39N/ 73°21'57W	Checked by VTDEC and contract staff		1	0	0
10.	Root Pond, VT 43°40'46N / 73°20'59W	HP-TNC	7/8	6	6	53
11.	North Springfield Reservoir, VT 44°20'55 N / 72°30'20W	HP-CORPS	6/25, 8/14, 10/8	97.5	1.5	10
12.	Pelkeys Swamp, VT 43°42'33N/ 73°19'18W	HP-TNC	6/27	2.5	20	101
13.	Lily Pond, Lake St Catherine VT 43°29'32N / 73°12'23W	HP-DEC	8/4	4	0	0
		HP- private	June/July	4?	0	0
14.	Porter Lake, VT 44°12'38N / 73°19'09W	HP	7/7, 8/13	24	97.4	790

* Key: HP = handpulling
 DEC = VT Department of Environmental Conservation
 USF&W = US Fish & Wildlife Service
 TNC = The Nature Conservancy
 CORPS = US Army Corps
 VYCC= Vermont Youth Conservation Corp

	Site	Control Implemented*	Date Targeted	Hours	Estimated # of Pounds removed	Rosettes Removed
15.	Bullis Pond, VT 44°57'58N / 72°57'58W	HP DEC	7/14	10	75	930
		HP	7/17, 8/16	67	196.2	2,123
Rivers, marshes, Wetlands VT and New York						
16.	Dead Creek, VT a. 44°11'01N / 73°18'53W b. 44°10'55N / 73°18'44W c. 44°09'11N / 73°19'14W d. Holcomb Slang 44°08'53N / 73°19'01W e. 44°07'53N / 73°19'42W f. 44°07'35N / 73°19'50W g. 44°05'12N / 73°20'50W	HP	7/8, 7/9, 8/13	124.5	976	8,396
		HP	7/9, 8/16	30	106.8	821
17.	Lemon Fair River, VT 43°59'27N / 73°15'00 W	HP	7/12, 8/31	15.5	5.6	262
18.	Richville Pond/Lemon Fair River 43°51'33N / 73°15'26W	HP	7/12, 8/31	12	2.5	38
Missisquoi Refuge Sites, Highgate VT						
19.	Missisquoi Refuge Cranberry Pool 44°57'16.59N 73°08'56.91"W	USF&W	8/7, 8/12 8/13, 8/14	56	150	1,352
		VYCC	7/8, 7/9, 7/31, 8/1	72	40	300
20.	Missisquoi Refuge Big Marsh Slough 44°58'23"N 73°08'24"W	USF&W	8/7, 8/11, 8/12	44	90	692
		VYCC	7/10, 7/11, 8/8	84	27	179

* Key: HP = handpulling
 DEC = VT Department of Environmental Conservation
 USF&W = US Fish & Wildlife Service
 TNC = The Nature Conservancy
 CORPS = US Army Corps
 VYCC = Vermont Youth Conservation Corp

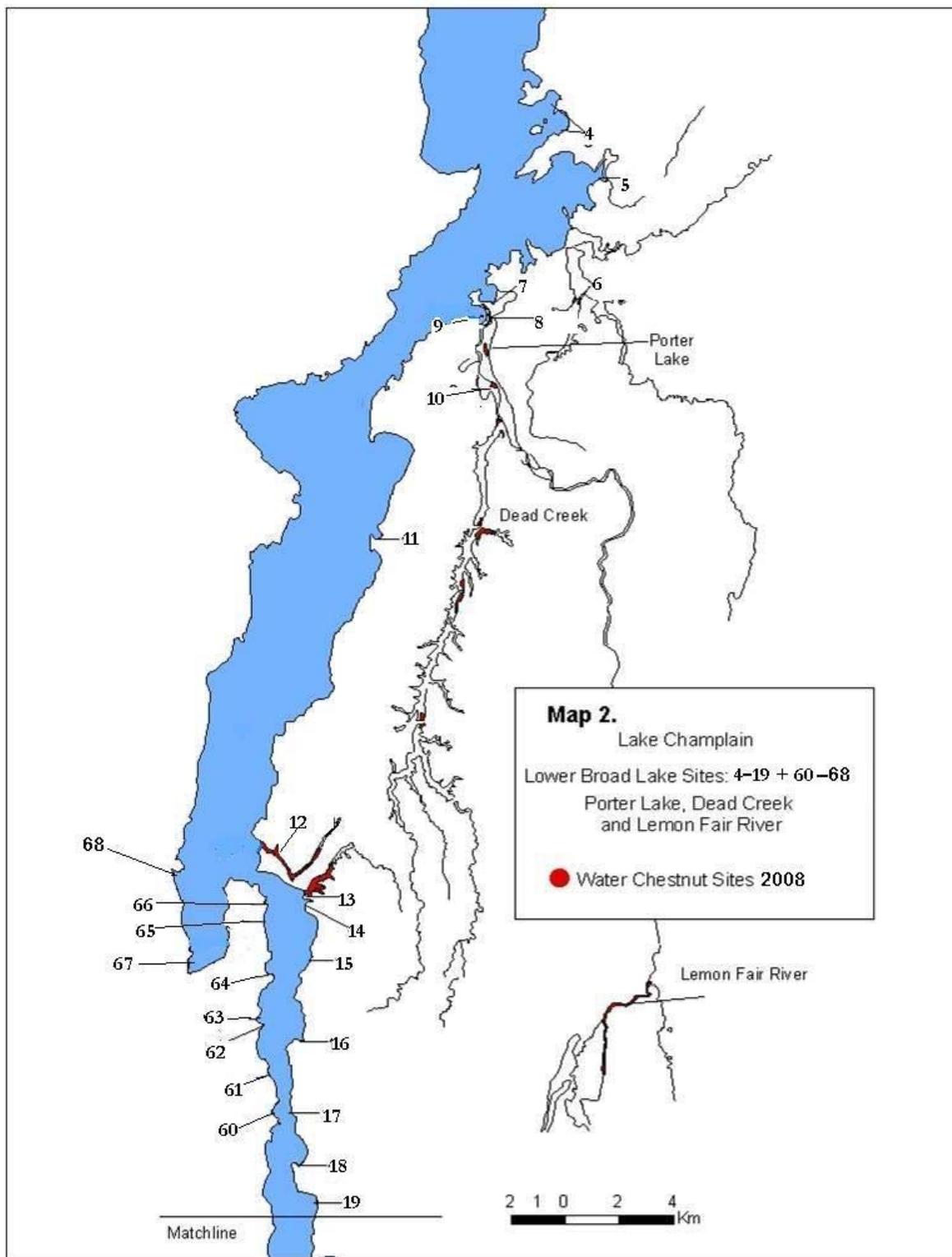
Appendix 3. 2008 water chestnut management program site maps.

Map 1. Northern Lake Champlain sites: Missisquoi Bay.

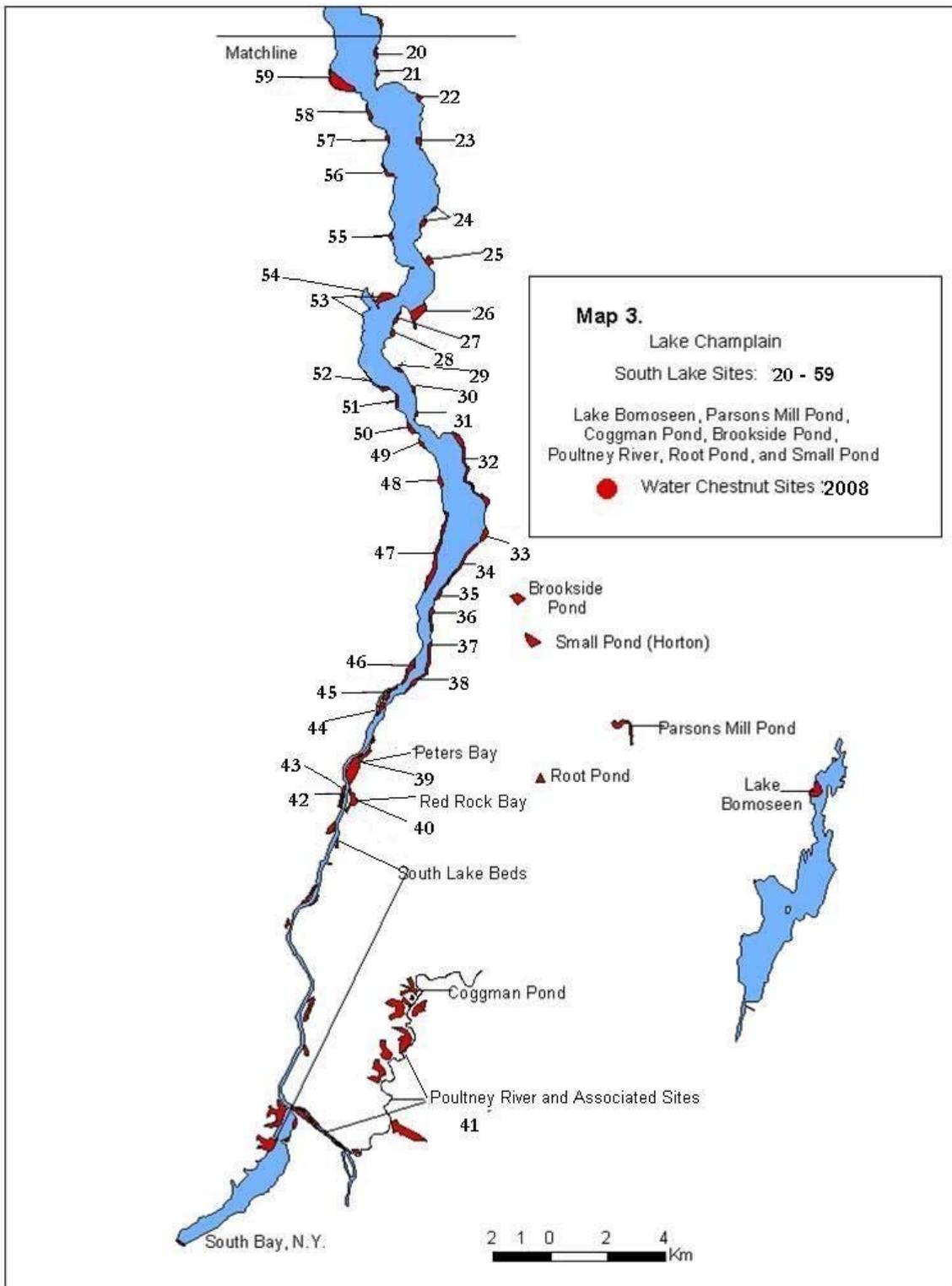


Key: pink = water chestnut site found in 2007, none found 2008
light blue = airboat search area
dark blue = previously known water chestnut sites

Map 2. Lake Champlain: Lower Broad Lake and South Lake, Porter Lake, Dead Creek sites and the Lemon Fair River.



Map 3. Lake Champlain: South Lake Sites, Lake Bomoseen, Parsons Mill Pond, Coggman Pond, Brookside Pond, Poultney River, Root Pond, and small pond in Benson.



Appendix 4. TNC water Chestnut Site Summary Statistics, 2008.

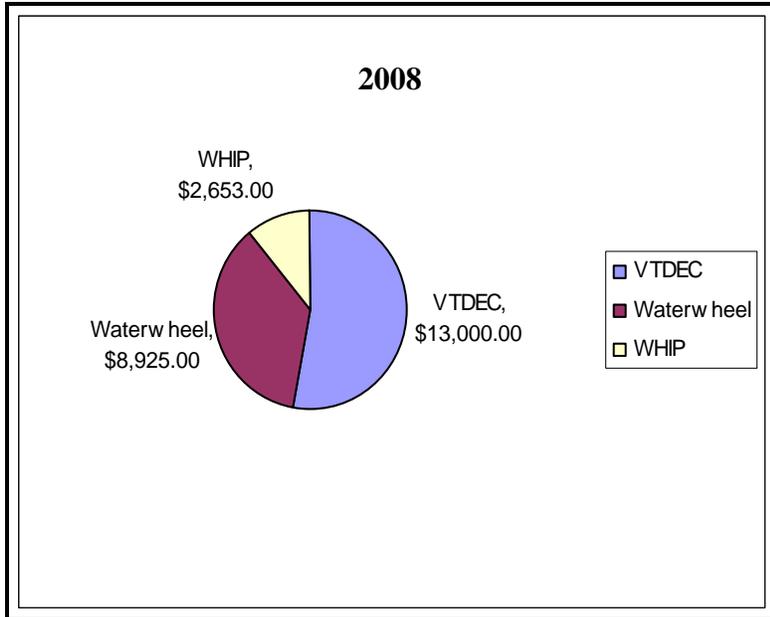
Site	Date	Pulling hours	Volunteer hours	Pounds	Rosettes
Billings Marsh	8/14/2008	6	4	119	464
	9/2/2008	3.5	0	156	749
Billings Marsh totals		9.5	4	275	1,213
Brookside Pond	7/23/2008	3	0	74	467
	8/1/2008	10.5	4.5	203	812
	8/6/2008	8	0	428	1,588
Brookside Pond totals		21.5	4.5	705	2,867
Buoy 33 wetlands	8/13/2008	28	28	868	3,819
Coggman Pond	7/30/2008	24	27.5	84	420
Cook Island	7/26/2008	30	49.5	508	2,520
	8/20/2008	20	22.5	601	2,354
Cook Island totals		50	72	1,109	4,874
East Creek	6/30/2008	20	27	24	161
	7/3/2008	30	104	165	1,186
	7/14/2008	75	74	79	616
	7/22/2008	56.25	20	79	435
	7/29/2008	33	40	26	234
	8/7/2008	18	20.25	2	10
East Creek totals		232.25	285.25	375	2,642
Finch Marsh	6/24/2008	2.5	22.5	10	1,283
	6/27/2008	21	0	109	138
	8/19/2008	5	3.5	80	390
Finch Marsh totals		28.5	26	199	1,811
LaChute River	7/16/2008	77	72	381	2,286
	7/24/2008	33	30.5	332	1,826
	8/11/2008	48	45	2,640	8,712
	8/17/2008	21	21	29	140
LaChute River totals		179	168.5	3,382	12,964
Mill Bay	8/18/2008	21	20	3,220	13,627
Nichol's Wetland	8/14/2008	8	2.5	44	163
Parson Mill Pond	8/15/2008	22.5	24	199	1,343

2008 TNC water Chestnut Site Summary Statistics (continued)

Site	Date	Pulling hours	Volunteer hours	Pounds	Rosettes
Pelky Swamp	6/27/2008	2.5	3	20	101
Reed Marsh	7/12/2008	31.5	33.5	236	3,139
Roger's Marsh	6/26/2008	4	4	93	854
Root Pond	7/8/2008	6	3.5	6	53
S. Lake Champlain	6/26/2008	8	8	22	202
	7/31/2008	60	62	2,069	6,828
S. Lake Champlain totals		68	70	2,091	7,030
Saslow Marsh	8/28/2008	7	4.5	133	771
Schoolhouse Marsh totals	7/17/2008	5	2.5	7	50
Schoolhouse Marsh North	7/17/2008	7	8	97	340
	8/8/2008	4	2.5	36	195
Schoolhouse Marsh North totals		11	10.5	133	535
South Bay	7/1/2008	10.5	5	15	173
	7/18/2008	45.5	60	38	315
South Bay totals		56	65	53	487
South Bay harvester sites	8/25/2008	26	30	838	3,981
	8/26/2008	24	25	1,001	6,287
	9/3/2008	30	28	527	3,173
South Bay harvester site total		80	83	2,366	13,441
South Fork (E. Creek)	7/2/2008	37.5	54	15	150
	7/7/2008	33	35	2	18
South Fork (E. Creek) totals		70.5	89	17	168
Timber Marsh	7/25/2008	27	51	280	2,260
	7/28/2008	36	51	361	2,888
Timber Marsh totals		63	102	641	5,148
Whitney Creek	7/24/2008	42	47.5	405	2,117
	8/2/2008	32.5	36	609	1,827
Whitney Creek Totals		74.5	83.5	1,014	3,944
Grand Total		1,103.25	1,212.25	17,270	81,462

Appendix 5. TNC Program Funding Sources, 2005-2008

Program Funding, 2008



Funding Sources, 2005-2008

Year	VTDEC	USFWS (Partners for F&W program)	Waterwheel Foundation	South Lake Champlain Trust	USDA NRCS WHIP	Totals
2005	\$13,000.00	\$3,000.00	\$6,578.00	\$1,000.00	\$1,339.00	\$24,917.00
2006	\$13,000.00	\$2,000.00	\$15,000.00 ¹	\$0.00	\$2,653.00	\$32,653.00
2007	\$13,000.00	\$0.00	\$9,295.00	\$0.00	\$2,653.00	\$24,948.00
2008	\$15,000.00	\$0.00	\$8,925.00	\$0.00	\$2,653.00	\$26,578.00

¹Funds were used to purchase a replacement truck for program use in 2006.

Appendix 6. 2008 TNC Site maps.

