

# 2009 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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Lake Champlain  
Basin Program



VERMONT

DEPARTMENT OF ENVIRONMENTAL CONSERVATION



The Nature  
Conservancy

SAVING THE LAST GREAT PLACES ON EARTH



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Cover photo: Private off-loading/access site Red Rock Bay, Benson, Vermont

VTDEC Photo

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## **Executive Summary**

### **2009 Water Chestnut Management Program: Lake Champlain and Inland Vermont Waters**

2009 marked the 12th year of a cooperative partnership between the Vermont Department of Environmental Conservation (VTDEC) and The Nature Conservancy (TNC) to manage invasive water chestnut (*Trapa natans* L.) in waters of Vermont and New York. The goal of the partnership has always been to reduce populations of water chestnut and prevent its further spread. In 2009, the partnership continued to reduce large beds of water chestnut in Lake Champlain near Dresden, New York, and continue progress in the marshes associated with the Poultney River, and in other Vermont waters. The Lake Champlain Basin Program has strongly supported this management partnership since 1991.

Contracted firms perform 99% of VTDEC's water chestnut management. Approximately 56% of VTDEC's 2009 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 44% was spent on the Vermont side of the lake from Ferrisburg south to Benson. Mechanical harvesting operations were based out of a private access site developed by VTDEC in Red Rock Bay 4.5 miles south of Benson Landing in Benson, Vermont. 2009 marked year two at this site.

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. TNC's workforce efforts represent both TNC owned and non-owned sites.

A combination of groups including VTDEC-hired contractors, VTDEC staff, TNC staff and volunteers, U.S. Army Corps of Engineers interns, USF&W staff, VYCC crews and private citizens were involved in management efforts. In Lake Champlain, 67 of 69 sites were managed by mechanical harvesting, handpulling or a combination of both methods. Of these, 61 sites were handpulled only; 2 sites were mechanically harvested and handpulled and 4 sites were mechanically harvested only. An additional 21 other Vermont waterbody sites were managed by handpulling alone.

Despite a reduction in mechanical harvesting funds for 2009, a total of 537 loads (1,020.3 tons wet weight) of water chestnut spoils were removed from 6 mechanical harvesting sites in Vermont and New York between Benson Landing, Vermont and Dresden Station, New York in Lake Champlain. All of the 2009 mechanically harvested water chestnut spoils were composted on fields at the Red Rock Bay access site in Benson, Vermont.

Due to reduced funding VTDEC contracted employee's handpulled water chestnut at only 63 sites spending 2,487 hours. Most Lake Champlain sites were handpulled twice during the 2009 season. TNC staff and volunteers pulled water chestnut for approximately 612 hours. The TNC hourly figure includes only actual on the water handpulling hours. Contracted VTDEC handpullers removed an estimated 14.57 tons of water chestnut and an estimated 3 tons were removed by TNC and its volunteers from a total of 75 sites.

One new Lake Champlain water chestnut site was discovered in 2009 in Putnam Creek and associated wetlands in Crown Point, New York. Contracted crews removed over 2,200 rosettes

during 2 workdays. The new 2008 site located in northern Bulwagga Bay, Port Henry, New York continued to be densely populated with water chestnut in 2009 and was surveyed and handpulled prior to mature seed dispersal for the second year in a row. One new “other waterbody” water chestnut site was discovered this year in a small pond in Benson, Vermont. VTDEC staff and contracted handpullers removed 336 rosettes from the site prior to mature seed dispersal.

Successes for the 2009 water chestnut management partnership included: an increase in the number of loads removed via mechanical harvesting as a result of the close proximity of the offloading/access site; mechanical harvesting of the entire water chestnut population in Red Rock Bay, Lake Champlain, a first since 1982; managing most Lake Champlain handpulling sites twice to target regrowth; composting 100% of mechanically harvested water chestnut; and having 16 Lake Champlain sites with no water chestnut in 2009.

For the 12<sup>th</sup> consecutive year, TNC-organized volunteer groups controlled water chestnut infestations in over 800 acres of wetland habitat in the Southern Lake Champlain Valley. Twenty-three sites were visited throughout the season by volunteer groups and TNC staff, and water chestnut harvests were largely similar to previous years, with no unusual spikes in abundance beyond those which have been previously observed.

# 2009 Water Chestnut Management Program: Lake Champlain and Inland Vermont Waters

## Final Report

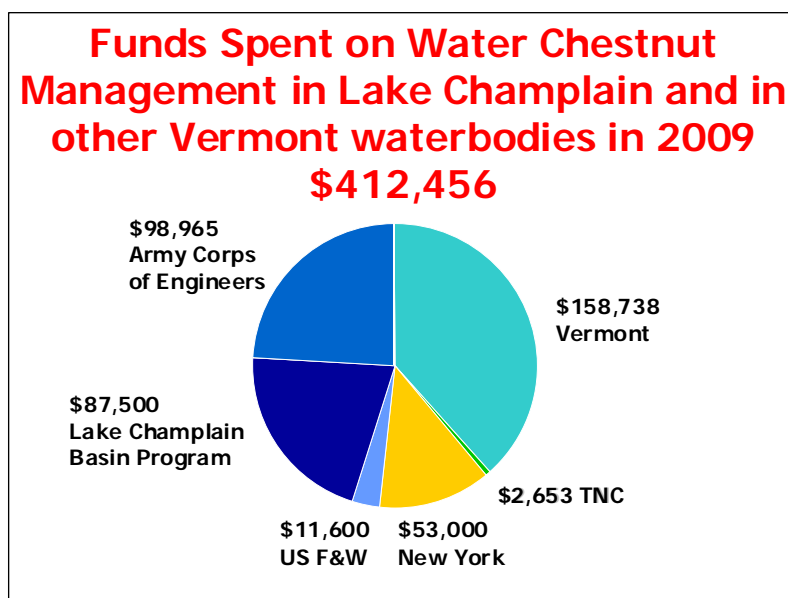
### Introduction

This report describes all aspects of 2009 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 were 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 have been of a non-chemical nature. Handpulling is the best method 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. If possible VTDEC seeks to manage each site twice during the summer season to try and control regrowth. TNC utilizes staff leaders and a voluntary 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 2009 totaled \$412,456 (Figure 1-1). Funds spent on management since 1982, are estimated at \$8.3 million (see Table 1.1).



**Figure 1-1.** Summary of funds spent managing water chestnut in Lake Champlain and other Vermont waterbodies in 2009.

**Table 1-1. Summary of funds spent on water chestnut management, 1982-2009.**

Year	Vermont	New York	USACOE	USF&W ANS	USDA Whip	USF&W Partners	DU	LCBP VTDEC TNC	TNC	Yearly Total	
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		10,000	5,000	50,000	13,000	510,331	
2005	186,919		188,000	13,215		10,000		50,000	13,000	11,917	473,051
2006	150,000	36,298	200,045	2,955	7,650	10,000		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		12,900		69,500	15,000	11,578	549,911
2009	157,049	53,000	98,965			12,000		72,500	15,000	2,653	411,167
<b>TOTAL</b>	<b>2,842,875</b>	<b>735,260</b>	<b>3,321,836</b>	<b>126,696</b>	<b>10,200</b>	<b>54,900</b>	<b>15,000</b>	<b>983,958</b>	<b>182,586</b>	<b>57,749</b>	<b>8,331,060</b>

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

Table 1-2. Water chestnut indicators for 2009 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	2,753.2	Y	VTDEC/NYDEC/TNC/QUEBEC		Annual	Annual
		Number of acres < 25% surface coverage	2,178.5	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	\$355,983*	Y	VTDEC/LC Sea Grant/NYDEC/QUEBEC		Annual	Annual
Mechanical Management	R	Tons of water chestnut removed through mechanical harvesting	1020.3 tons	Y	VTDEC/NYDEC/TNC		Annual	Annual
Hand Pulling Management	R	Tons of water chestnut removed through handpulling	17.61 tons	Y	VTDEC/TNC		Annual	Annual
		Number of handpulling hours in Lake Champlain and tributaries	3,189.6 hrs	Y	VTDEC/TNC		Annual	Annual

\* Figure includes VTDEC supervisor salary, TNC total funds, mechanical harvesting contract amount, handpulling contract amount, composting contract amount, and improvements to the off-loading/access site.

## **Part 1: VTDEC Water Chestnut Management**

The majority of VTDEC water chestnut management is carried out under contract. Three contracts were awarded in 2009: mechanical harvesting, handpulling and composting. The VTDEC field supervisor 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. Other VTDEC staff assist with removal efforts, surveys, searches and 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 only \$269,914 in available funds to implement 2009 water chestnut management. Management contracts awarded in 2009 included \$147,000 for mechanical harvesting, \$100,000 for handpulling, and \$3,640 for water chestnut spoils composting. Approximately 56% 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, as well as 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 USF&W Partners program. Table 2-1 summarizes the distribution of 2009 funds with sources.

**Table 2-1. Allocation of funds for VTDEC 2009 water chestnut management program.**

	<b>USF&amp;W Partners</b>	<b>LCBP</b>	<b>VTDEC</b>	<b>USACOE</b>	<b>Total</b>
<b>Personnel, Fringe and Indirect</b> (estimated): Field supervisor, full-time May through October 2009, part time the rest of the year		\$72,500			\$72,500
<b>Contractual:</b> Handpulling Mechanical harvesting Composting	\$11,600		\$98,084 \$48,035 \$3,640	\$98,965	\$100,000 \$147,000 \$3,640
<b>Other:</b> Administration Grant to TNC Site access improvement		\$15,000	\$25,000 \$15,190	\$25,000	\$50,000 \$15,000 \$15,190
<b>Total</b>	<b>\$11,600</b>	<b>\$87,500</b>	<b>\$189,949</b>	<b>\$123,965</b>	<b>\$403,330</b>

### *Equipment*

Contracted mechanical harvesting equipment used in 2009 included: 2 large mechanical harvesters each with 800 cubic foot storage capacity, a high-speed transport barge, a shore conveyor and two four-wheel-drive one-ton dump trucks. Contracted handpulling activities utilized ten kayaks, two jonboats and a motorized pontoon boat. VTDEC utilizes a variety of motorboats, canoes and kayaks for survey search efforts, handpulling and contractor oversight.

### *Results*

In Lake Champlain, 69 sites are known to support populations of water chestnut including one new site in Putnam Creek and wetland in Crown Point, New York. Of these, 67 sites were managed with mechanical harvesting, handpulling or both methods: 61 sites were handpulled only, 4 sites were mechanically harvested only, and 2 sites were mechanically harvested and handpulled. The southern portion of the lake between Dresden Station, New York, and Whitehall, New York continues to be unmanaged due to a lack of adequate resources. All 21 other waterbody sites in Vermont were managed in 2009 including a new small pond in Benson, Vermont downstream of a previously existing site. Surveying was conducted throughout the management season to assess water chestnut populations, direct contracted crews and search for new infestations. A number of outreach activities were also implemented in 2009. A summary of these efforts in 2009 follows.

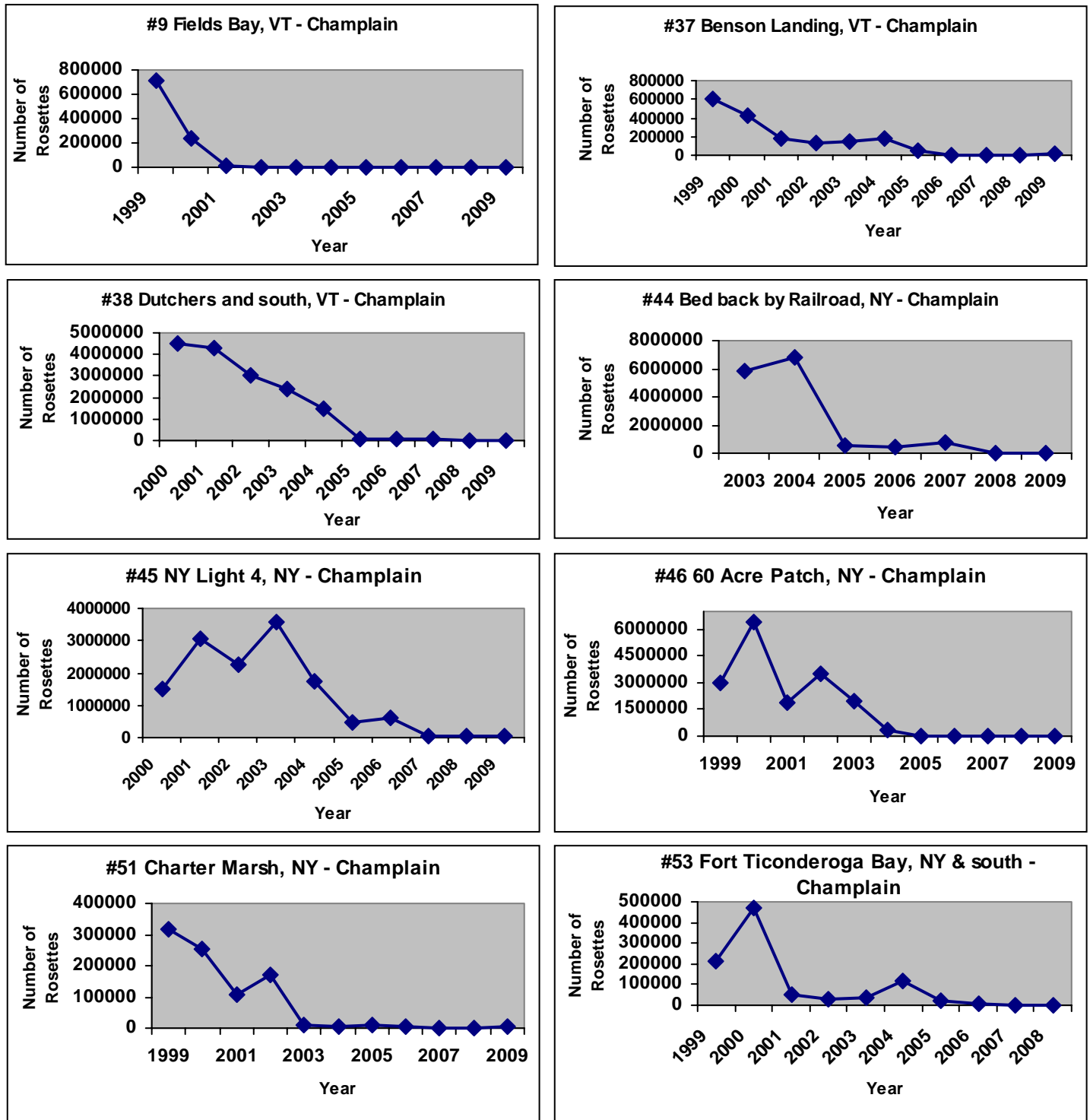
## **Surveying**

- VTDEC staff conducted 12 water chestnut surveys in 2009 between July and September: 5 surveys of water chestnut populations in Lake Champlain and tributaries, and 7 surveys of “other waterbodies.”
- The southern portion of Missisquoi Bay, Lake Champlain was surveyed extensively by airboat on August 12 and 19. Two water chestnut rosettes were found during the second survey day outside the mouth of Big Marsh Slough. Water levels in the bay at the time of the survey were about one foot above average. VTDEC airboat surveys have been conducted in Missisquoi Bay since 2002.
- The southern end of the 600-acre wetland at the northern end of Lake Bomoseen, Castleton and Hubbardton, Vermont was surveyed by kayak instead of airboat due to budget restraints. No water chestnut was found during the survey.
- Only one new Lake Champlain water chestnut site was discovered in 2009 in Putnam Creek a tributary to Lake Champlain in Crown Point, New York.
- One new small “other waterbody” site was discovered with water chestnut in 2009 in Benson, Vermont down stream of an existing site.

## **Mechanical Harvesting**

- The contract for 2009 harvesting was awarded to Aquatic Control Technology, Inc of Sutton, Massachusetts.
- The new offloading/access site developed at Red Rock Bay on private property had roads improved and continued to play a vitally important role in harvesting efficiency in 2009.
- Mechanical harvesting of water chestnut was only conducted in Lake Champlain.
- Mechanical harvesting began on July 9 in Putnam, New York and concluded on August 5 south of Red Rock Bay near Dresden Station, New York.
- 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. throughout the harvesting season.
- A total of six Lake Champlain sites were mechanically harvested. Figure 2-1 provides historical data for eight past and present mechanical harvesting sites including Fields Bay in Ferrisburg, Vermont where only handpulling has been required since 2001.
- As of 2009, the northernmost mechanical harvesting site in Lake Champlain a site by the railroad tracks near New York Light 4 (site #44), Putnam, New York.
- Total mechanical harvesting hours in 2009 were 376, down from 655 in 2008. The decrease in harvesting hours reflects a 48% reduction in USACOE funding to the State of Vermont.
- Despite a reduction in mechanical harvesting hours in 2009, more loads were harvested in 2009 versus in 2008. This was due to the close proximity of sites to the offload/access site at Red Rock Bay in Benson, Vermont resulting in increased mechanical harvesting operation efficiency.
- In 2009 the cost of each harvested load was \$200 less than the cost of a load in 2008.
- Approximately 7,518 cubic yards (an estimated 1,020.3 tons) of water chestnut spoils were removed in 537 harvester loads from an estimated 175 acres of the South Lake.
- All of the mechanically harvested water chestnut was composted. Composting occurred on fields at the Red Rock Bay off-loading/access site. Chestnut spoils were turned twice in the fall of 2009; 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 2009 contract for handpulling was awarded to Lakeside Restoration of Fair Haven, Vermont. Funding was 78% of the 2008 contract at \$100,000 for 2009.
- Contracted handpulling commenced in Lake Champlain on July 7 in Ferrisburg, Vermont and ended September 1 in a newly discovered infestation in a small pond in Benson, Vermont.
- Ten contracted handpullers each worked an average of 40 hours per week through out the season.
- At least 69 Lake Champlain and associated tributaries, and 7 “other waterbody” sites were targeted by contracted handpulling crews. These crews spent 2,487 hours removing approximately 14.57 tons of water chestnut.
- More than an estimated 1,000 acres along 125 shoreline miles of Lake Champlain in Vermont and New York were handpulled by contracted staff, much of it twice during the season.
- Contracted handpulling crews removed water chestnut between Ferrisburg and 2.5 miles south of Benson Landing in 2009 before the season ended. The reduction in funding prevented any further progress south.
- Other groups, including VTDEC, TNC, LCBP, USACOE, USF&W, 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 3,245.
- Figure 2-3 provides historical handpulling data for eight typical long-term handpulling sites in Lake Champlain from Ferrisburg south to Benson and Figure 2-4 provides historical handpulling data for eight long-term “other waterbody” sites. For some of these sites such as #68 Bulwagga Bay the number of rosettes removed is increasing because more wetland area is able to be explored with the high lake level conditions of the last several years.
- Handpulling was deployed at both new water chestnut sites: Putnam Creek, Crown Point, New York and a small pond in Benson, Vermont. Both initiatives occurred before mature seeds dropped.



**Figure 2-2.** Lakeside Restoration’s newly developed water chestnut container system for offloading spoils from a kayak VTDEC

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

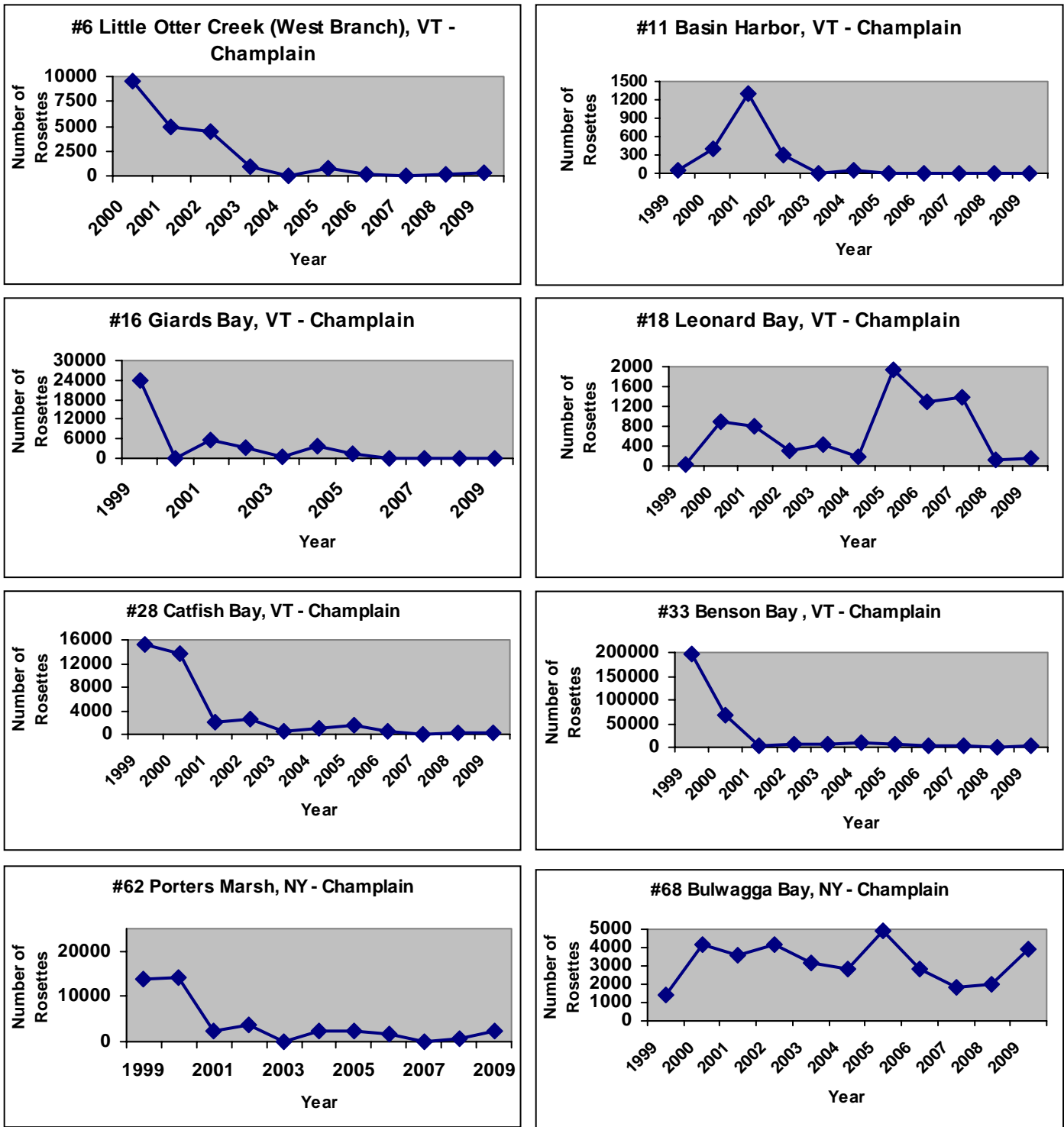
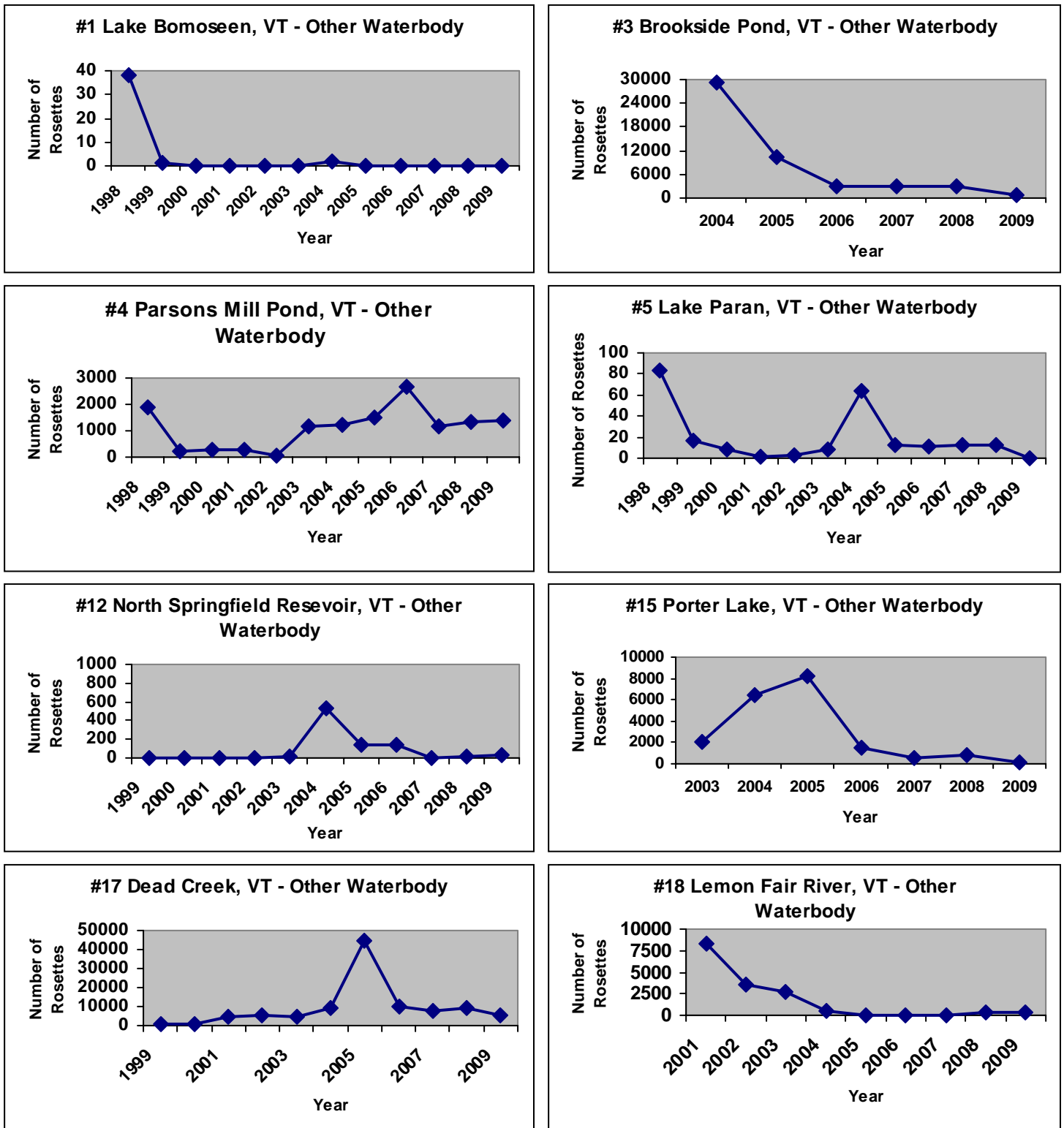


Figure 2-4. Water chestnut rosettes removed by handpulling over time at eight other waterbody sites in Vermont.



## **Education and Outreach Efforts**

- Aquatic invasive species warning signs with information about water chestnut and Vermont transport laws were checked and maintained throughout the state at approximately 95% of all Vermont Department of Fish and Wildlife public accesses. In 2009, 42 new signs were posted and 63 aquatic invasive species brochure boxes were installed at accesses. A record 154 accesses were visited during the season.
- VTDEC staff gave several presentations relating to aquatic invasive species including water chestnut around the state.

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 2009 was 1,038 tons wet weight, up slightly from 2008. The estimated total weight of water chestnut removed from all other waterbody sites in Vermont was 0.6 tons wet weight.

A breakdown of management techniques for all water chestnut sites in 2009 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 included in Appendix 3.

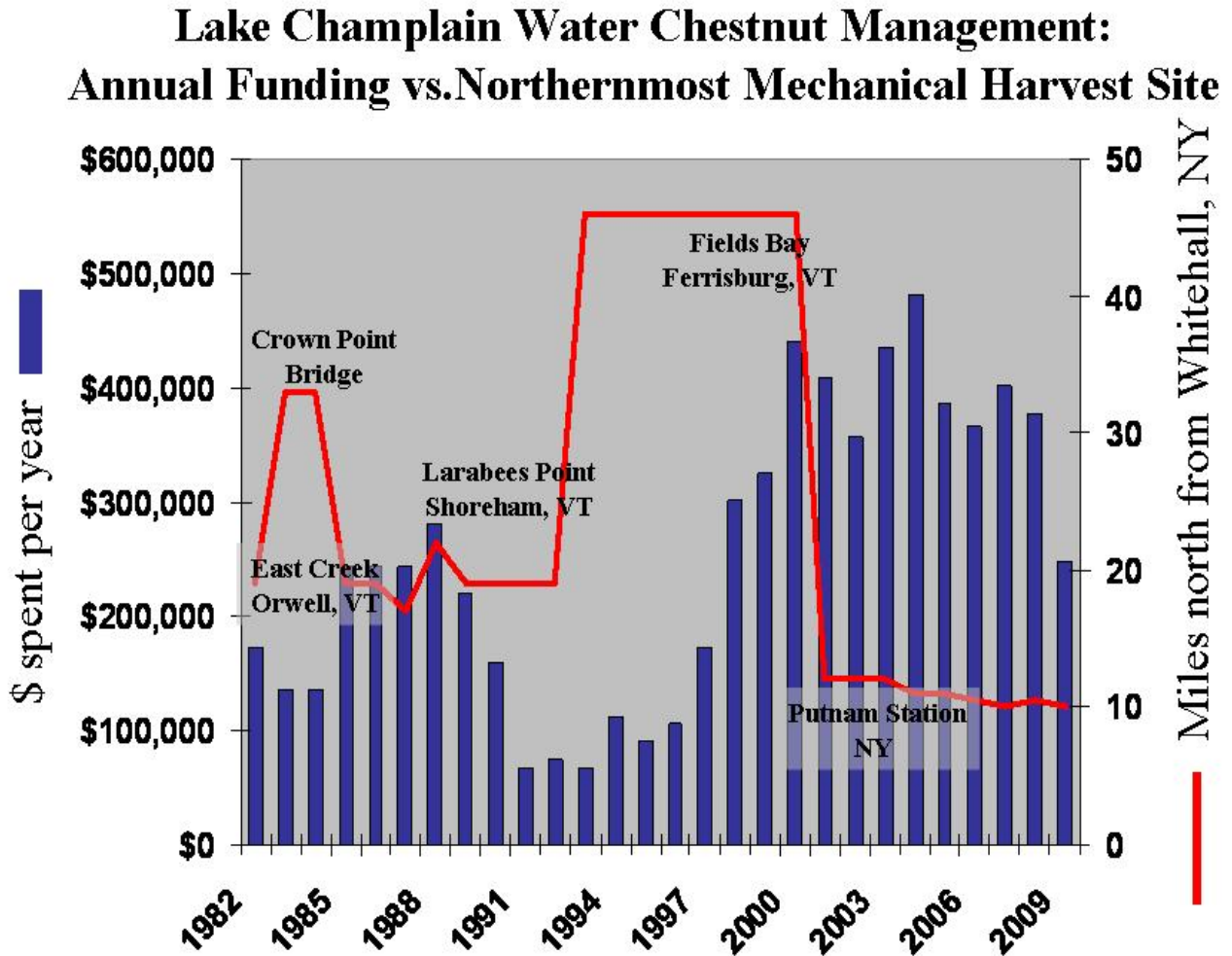
## ***Conclusions***

In 2009, continued declines of water chestnut densities at 68 sites where management efforts have been consistent over at least the last five years were again observed. Fifteen Lake Champlain sites and three other waterbody sites had no water chestnut in 2009. Figure 2-5 illustrates the importance of consistent management of water chestnut in Lake Champlain for successful control.

The importance of the private access at Red Rock Bay for mechanical harvesting spoils removal was again demonstrated this year. In a year of reduced funds the benefits of having an access very close to mechanical harvesting sites was proven when loads of chestnut rose. Cost of harvesting dropped \$200 a load because of increased operational efficiency a result of being near the access/offload site.

**2009 program successes included:** an increase in the number of loads removed via mechanical harvesting as a result of the close proximity of the offloading / access site; mechanical harvesting of the entire water chestnut population in Red Rock Bay, Lake Champlain, a first since 1982; managing most Lake Champlain handpulling sites twice to target regrowth; composting 100% of mechanically harvested water chestnut; and having 16 Lake Champlain sites with no water chestnut in 2009.

Figure 2-5. Annual water chestnut funding vs. northernmost mechanical harvest site in Lake Champlain, 1982-2009.



## 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 their goals 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 their conservation targets in Lake Champlain. The Conservancy 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 in 2009*

Twenty-nine volunteer water chestnut workdays and 10 workdays without volunteers were organized in 2009 between June 24 and August 25, harvesting 6,854 pounds of water chestnut. Handpulling and scouting activities were conducted at 23 sites, and volunteers donated a total of 787 hours of labor to water chestnut management (Table 3-1). TNC staff also scouted for water chestnut at an additional two sites (Hubbardton Ponds). As in past years, the main focus was on sites considered ecologically significant: East Creek, Poultney River wetlands, and South Bay's southern end. In addition, inland sites continued to be treated including Parsons Mill Pond, Root Pond, and Pelky's Swamp.

**Table 3-1. Volunteer hours and water chestnut harvest summary data by 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
2009	39	203	787	23	6854	29,297
<b>Total</b>			<b>13,977</b>		<b>487,367</b>	<b>377,230</b>

X = data unavailable

As in past years, workdays were scheduled to minimize the probability of inadvertently dispersing zebra mussels to uninfested waters. Canoes were washed and dried in the sun after each workday, and attempts were made not to schedule any workdays at uninfested sites immediately after

a workday at an infested site.

In 2009 TNC acquired their Water Chestnut Field Coordinator through the AmeriCorps Program. TNC's Conservation Ecologist for the Southern Lake Champlain Valley Office, supervised the Field Coordinator; provided administrative, logistical, and field support; and worked on volunteer recruitment as well.

### ***Volunteers***

Volunteer involvement continues to be the cornerstone of this program. Recruiting efforts continued in 2009 via newspaper calendar announcements, bulk mailing to previous years volunteers, flyer postings and handouts. This year, 203 volunteers contributed 787 hours, which is substantially fewer hours than were contributed in previous years (Table 3-2). Similar to previous years, organized groups continued to contribute the bulk of handpulling hours to the program (658 hrs vs. 129 hours contributed by individual volunteers) in 2009.

Ten groups returned from previous years to pull water chestnuts: Camp Betsey Cox from Pittsford, Vermont, Camp E-Wen-Akee of Benson, Vermont, Barn Day Camp of Plymouth, Vermont, Champlain Discovery Camp from the Lake Champlain Maritime Museum, Green Mountain Peace Corps, Orwell Grade School, Fair Haven, Vermont Grade School, and the Zen Affiliate of Vermont. In addition to volunteer groups, the Lake Champlain Basin Program used one of their volunteer workdays as a staff outing, and interns from the New York City High School of Environmental Studies contributed to water chestnut management efforts.

**Table 3-2. Volunteer statistics from water chestnut handpulling, 1998 – 2009\*.**

	<b>Totals</b>		<b>Group volunteers</b>		<b>Individual Volunteers</b>	
	<b>Total number of volunteers</b>	<i>Total Volunteer hours</i>	<b>Number of volunteers from groups</b>	<i>Hours from group</i>	<b>Number of Individuals</b>	<i>Hours from individuals</i>
<b>1998</b>	<b>155</b>	<i>1,088</i>	<b>91</b>	<i>529</i>	<b>64</b>	<i>559</i>
<b>1999</b>	<b>282</b>	<i>1,554</i>	<b>185</b>	<i>772</i>	<b>97</b>	<i>782</i>
<b>2000</b>	<b>315</b>	<i>1,862</i>	<b>225</b>	<i>974</i>	<b>90</b>	<i>888</i>
<b>2001</b>	<b>259</b>	<i>1,464</i>	<b>176</b>	<i>766</i>	<b>83</b>	<i>698</i>
<b>2002</b>	<b>148</b>	<i>725</i>	<b>106</b>	<i>341</i>	<b>42</b>	<i>384</i>
<b>2003</b>	<b>238</b>	<i>870</i>	<b>144</b>	<i>380.5</i>	<b>84</b>	<i>490</i>
<b>2004</b>	<b>222</b>	<i>1,143</i>	<b>162</b>	<i>663</i>	<b>60</b>	<i>480</i>
<b>2005</b>	<b>292</b>	<i>1,225</i>	<b>242</b>	<i>1,012</i>	<b>54</b>	<i>210</i>
<b>2006</b>	<b>232</b>	<i>1,334</i>	<b>194</b>	<i>990</i>	<b>40</b>	<i>344</i>
<b>2007</b>	<b>238</b>	<i>1,380</i>	<b>184</b>	<i>1083</i>	<b>54</b>	<i>297</i>
<b>2008</b>	<b>253</b>	<i>1,212</i>	<b>232</b>	<i>932</i>	<b>31</b>	<i>289</i>
<b>2009</b>	<b>203</b>	<i>787</i>	<b>175</b>	<i>658</i>	<b>28</b>	<i>129</i>

\*In addition to the volunteer hours, TNC staff (AmeriCorps Field Coordinator Stephanie Stahl, Conservation Ecologist Paul Marangelo, TNC AmeriCorps Volunteer Coordinator Calvin Maginel) provided 349 hours of field labor.

## ***Methods***

Since water chestnut is an annual plant, repeated annual harvesting of rosettes before the drop of seeds is an effective way of controlling populations. To manage water chestnuts, TNC staff and volunteers search for and handpull water chestnut rosettes in targeted wetland sites throughout the growing season (June – August) via visual searches from canoes. Water chestnuts 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 chestnuts were placed in Gardeners Supply bags and weighed with a spring scale.

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). TNC staff also estimated the number of rosettes harvested by weighing and counting a subset of harvested rosettes. The total daily rosette harvest was estimated by extrapolating the measured rosette/lb ratio to the entire harvest weight at a given site. In order to improve the ability to describe existing conditions and trends in water chestnut infestation, TNC staff will continue to characterize sites according to their infestation intensity. Classification categories are defined in terms of number of harvested water chestnut rosettes/acre, and are classified according to the scheme depicted in Table 3-3. The upper limits of this classification was defined by looking at lbs/acre estimates from 2005 handpull results in the Drowned Lands, where chestnut densities were up to 400,000 rosettes/acre.

**Table 3-3. Water chestnut infestation intensity classification.**

<b>Infestation intensity</b>	<b>rosettes/acre</b>
Negligible	< 10
Low	10 – 350
Moderate	350 – 800
High	800 – 5,000
Mats	> 5,000

## ***Results and Discussion***

Water chestnut harvest continues to exhibit an overall pattern of decline or stabilization at all sites visited in 2009 (Table 3-4; Figure 3-1 a-f). Overall, 19 sites are isolated enough from the influx of water chestnut propagules from other areas to be considered responsive to management efforts. Of these sites, a number exhibited moderate increases in harvest weights (East Creek), while the remainder yielded either minor increases or decreases in harvest weights compared to 2008 (Table 3-5). As in previous years, few major changes were observed in harvest weights, no and major shifts in infestation intensity were observed.

The early part of the summer of 2009 featured high levels of rainfall, which in general provided high water conditions that facilitated access to most of their worksites. 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 the analysis of water chestnut harvest trends in table 3-1. The most noteworthy site-specific results in 2009 were as follows:

#### **La Chute River Marshes, Ticonderoga, New York**

2009 was the 4<sup>th</sup> year that TNC volunteer workdays were held at this site, which had been pulled in years prior to 2006 by VTDEC contracted handpulling crews. Water chestnut harvests in 2009 were similar to 2008 (3,495 lbs. vs. 3606 lbs, respectively). Most plants were found in high-concentration “hotspots” scattered throughout the south western portions of the marsh. High water later in the season facilitated access to areas that are difficult to enter during ordinary water levels, and a substantial amount of water chestnut was found just south of the riparian trees bordering the river into the southwestern marsh in locations that are often difficult to access. This site is the largest single area of wetland habitat that TNC works in 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. Nevertheless, if sustained over successive years, it is highly unlikely that volunteer-based searches will overlook any “hotspots” that are able to develop from areas that are missed from previous years. Overall, water chestnut infestation intensity at this site remained low.

#### **Brookside Pond, Orwell, Vermont**

Water chestnut harvest in 2009 was only 51 lbs at this site, substantially less than in previous years (705 lbs in 2008, 693 lbs in 2007; Table 3-4). This site was first managed by VTDEC contracted crews in 2004; due to shallow water and deep mud, is difficult control. TNC staff generally avoids taking volunteers to this site on account of the difficult conditions. In 2009, this pond was visited only once early in the season (July 10<sup>th</sup>). Low water later in the season discouraged additional visits, so this site bears watching in 2010 to see if water chestnut rebounds. Infestation intensity at this site was low (34 rosettes/acre).

Table 3-4. Pounds<sup>1</sup> of water chestnut harvested by year per site, 1999 - 2009.

Site Name	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Billings Marsh	1,440	247.5	135	48	53	50	132	975	157	275	149
Brookside Pond	X	X	X	X	X	VTDEC	957	412	693	705	51
Buoy 33 wetlands	X	X	X	X	X	X	X	2,006	527	868	*
Coggman Pond	450	135	VTDEC	320	211	87	18	26	39	84	74
Cook Island West	X	X	X	X	X	173	X	X	1839	1109	105
East Creek	2,250	2,250	652	2,865	1,034	996 <sup>2</sup>	1,281	2,315	341	565 <sup>5</sup>	2,429 <sup>5</sup>
Finch Marsh	X	787.5	270	116	55	413	178	124	187	189	61
Finch Marsh Outlet	X	X	X	X	X	490	15	0	0	10	51
Hubbarton Ponds	X	X	X	X	X	X	0	X	X	X	0
Inman Pond	x	X	x	x	X	X	0	X	X	X	X
La Chute River Marshes	X	X	X	X	VTDEC	VTDEC	VTDEC	418	334	3,606 <sup>5</sup>	3,495 <sup>5</sup>
Nichols Wetland	X	X	22.5	46	75	31	203	280	18	44	5
Mill Bay										3,220	X
Old Marsh Pond	X	X	X	0	X	X	0	X	X	0	X
Parson Mill Pond	67.5	90	135	18.5	635	365	400	697	181	199	198
Pelkey Swamp	20 plants	2 plants	25 plants	0	0	2 plants	0	1 plant	15	20	36
Reed Marsh	270	112	22	75	147	183	264	94	287	236	64
Rogers Marsh	810	22.5	20 plants	3 plants	0	3 plants	6 plants	2 plants	26 plants	93	28
Root Pond	X	X	X	X	X	10 plants	X	10 plants	6 plants	6	2
S. Lake Champlain <sup>3</sup>	X	X	X	540	259	1,241	270	981	1042	2,091	191
Saslow Marsh	X	X	X	X	X	70	48	76	94	133	88
Schoolhouse Marsh	X	135	X	117	128	57	43	20	4	7	5
Schoolhouse Marsh North	X	X	X	X	587	83	51	43	70	133	22
South Bay	X	3,240	8,415 <sup>4</sup>	363	492	173	30	43	91	53	83
South Bay/Timber Marsh	X	X		X	X	X	644	826	153	641	698
South Bay/Harvester sites									3,120	2,366	X
South Fork	180	45	90	50	421	87	263	324	134	17	66
The Drowned Lands	X	X	X	6,660	2,5479	13,006	10,359	X	X	X	X
Whitney Creek	2,520	9,405	4,275	9,270 <sup>5</sup>	886	9,282 <sup>5</sup>	1,333 <sup>5</sup>	6,998 <sup>5</sup>	440	5,246 <sup>5</sup>	1,152 <sup>5</sup>

<sup>1</sup> 1999 – 2001 pounds are estimates made from number of bags filled: 1 full bag = 90lbs of water chestnut.

<sup>2</sup> Additional harvest conducted by VTDEC at the mouth of the creek.

<sup>3</sup> From mouth of Poultney River to Buoy 33.

<sup>4</sup> Includes Timber Marsh area of South Bay

<sup>5</sup> Combined harvest from VTDEC and TNC

VTDEC – site treated by the Vermont Department of Environmental Conservation

X – Site not visited; \* results added with results from S. Lake Champlain site.

**Table 3-5. Area-based harvest statistics (number of rosettes/acre) for select sites, 2005 - 2009.**

Site	2005	2006	2007	2008	2009
Billings Marsh	26	297	66	75	35
Brookside Pond	801	245	194	227	34
Buoy 33 wetlands	X	2033	449	702	XX
Coggman Pond	3	6	2	17	9
East Creek	74	87	11	21*	38*
Finch Marsh	76	25	2	60	23
La Chute River Marshes	X	31	13	85*	64*
Nichols Wetland	530	608	28	71	4
Parson's Mill Pond	38	67	30	34	35
Pelkey Swamp	0	0	3	2	2
Reed Marsh	51	20	63	191	12
Rogers Marsh	2	1	7	231	17
Root Pond	X	1	>1	3	1
S. Lake Champlain	104	151	199	208	24
Saslow Marsh	28	57	74	151	165
Schoolhouse Marsh	38	2	>1	1	1
Schoolhouse Marsh North	5	13	23	44	19
South Bay	8	4	53	4	7
South Bay/Timber Marsh	233	82	17	92	66
South Fork (E. Creek)	31	31	11	4	7
Whitney Creek	75	166	34	256*	30*

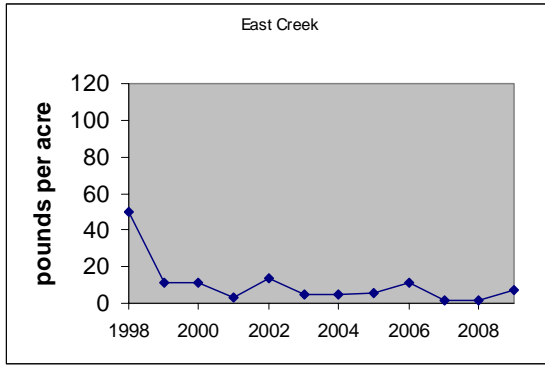
\* combined harvest from VTDEC and TNC

X: no data

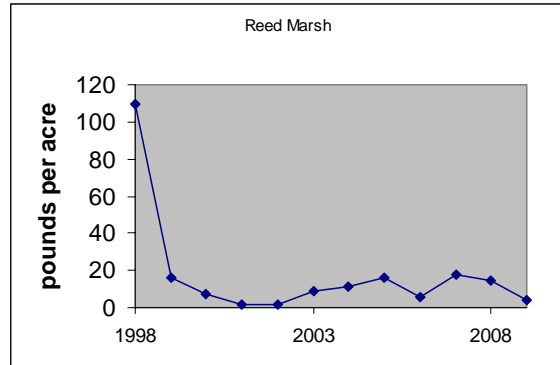
XX: results merged into S. Lake Champlain site in 2009

**Figure 3-1a-f. Water Chestnut harvest trends at six sites in the Southern Lake Champlain Valley, 1998 – 2009.**

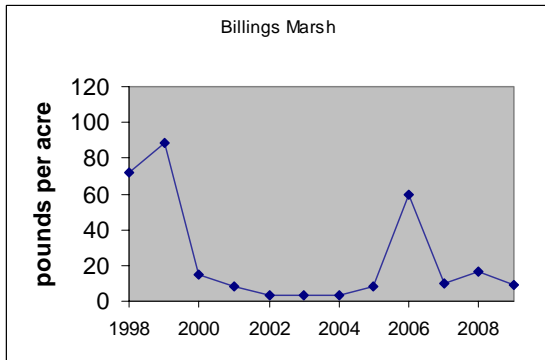
1a)



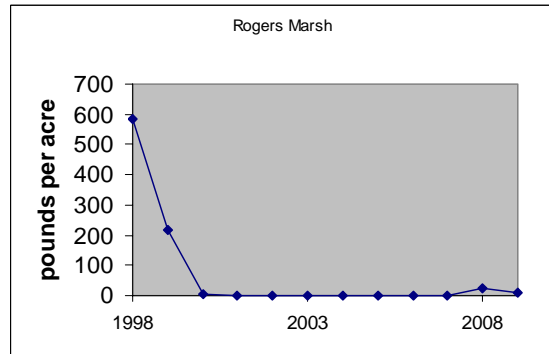
1b)



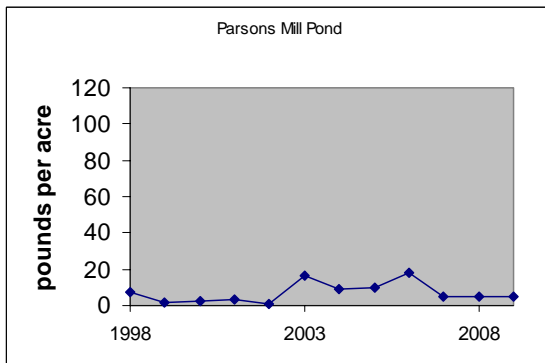
1c)



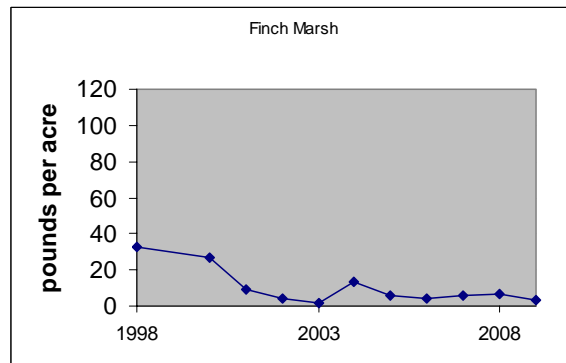
1d)



1e)



1f)



### **East Creek, Orwell, Vermont**

Ten workdays were spent at East Creek in 2009, which is four more than in 2008. The increase in workdays was due to higher abundance of water chestnut. As in past seasons, more water chestnut was found in reaches closest to Lake Champlain. The Conservancy 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 2009 increased to 2,429 lbs from 565 lbs harvested in 2008. Other spikes in abundance were previously observed in 2002 and 2006. With this year's harvest, infestation intensity (38 rosettes/acre) increased back up into the "low" category from 2008. Contributing to this year's increase in harvests was the discovery of pockets of water chestnut hidden in secluded parts of the marsh by VTDEC handpulling crews near the mouth of the creek.

### **Schoolhouse Marsh, West Haven, Vermont**

One workday was held at this site in 2009, and only 5 lbs. of water chestnut were harvested (Table 3-4), which is almost the lowest harvest recorded for this site since management began in 1998. For the third straight year, infestation intensity at this site has been negligible, and harvest weights have been below 10 lbs.

### **South Fork of East Creek, Orwell, Vermont**

An increase in harvest weight was anticipated at this site in 2009; as in 2008, workdays were held early in the season. Despite this expectation, only 66 lbs were harvested from this site in 2009. While this is larger than in 2008 (17 lbs), it is still substantially less than 134 pounds harvested in 2006 (Table 3-4).

### **Southern Lake Champlain, West Haven, Vermont and Whitehall, New York**

Substantially less water chestnut was harvested at this site in 2009 (191 lbs, Table 3-4) than in 2008 when 2,091 lbs were collected. 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. This year, results of the "Buoy 33 wetlands" site were combined into this site's results.

### **Whitney Creek, Addison, Vermont**

This site has been the focus of a substantial amount of handpulling effort since 1998. This year, significantly fewer water chestnut plants were found than in previous years (1,152 lbs in 2009 vs. 5,246 lbs in 2008). However, concentrations of plants were found in locations that had not previously supported high number of water chestnut plants. Two workdays were held at this site in 2009 by TNC, and infestation intensity remains low.

### **Mill Pond / Mill Bay, Putnam, New York**

While TNC did not conduct any work in Mill Bay in 2009, as a result of losing the volunteer group which was best suited to work at this site, they did visit a small pond upstream of the bay, where small numbers of water chestnut were found in the small open water area of the site that is otherwise dominated by a cattails. Unfortunately, large numbers of water chestnut plants were observed back in dense cattail stands in the ponds, which were essentially inaccessible to handpulling. Accordingly, management of water chestnut at this site will pose a substantial challenge that needs to be tackled as soon as possible.

## *Conclusions*

After 12 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 2009, 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 the 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 – the data clearly indicate that water chestnut populations are either reduced or have been prevented from becoming more severe at all sites treated. A number of successive years of results free of excessive fluctuation in harvest weights will be needed to fully support any assertion that TNC's program has reached the highest reduction of water chestnut possible at this particular site, but current year results remain encouraging. It is unlikely that water chestnut can be completely eradicated, even at sites that exhibit substantial progress in water chestnut management, so ongoing maintenance treatments will be needed for the foreseeable future.

TNC's program's reliance on the effort of volunteers continues to be a successful formula for the control of water chestnut in a large group of ecologically significant sites in the Southern Lake Champlain Valley region. TNC volunteer hours, however, sharply declined in 2009 compared to previous years. Over the last few years, the amount of volunteer recruitment effort expended had been calibrated to maintain volunteer hours at levels that were neither excessive nor insufficient to achieve water chestnut management goals. TNC volunteer recruitment strategy therefore relied more on groups returning from previous years rather than the active recruitment of new groups. Last year however, 9 groups from 2008, for various reasons, did not return to contribute hours in 2009. A large number of groups did not return because of personnel changes that resulted in camp organizers that were less interested than their predecessors in participating. While volunteer hours in 2009 were still sufficient to achieve program goals, it is clear that TNC staff was close to the lower limit of volunteer hours needed. Next year, more effort will be devoted in the spring toward recruiting new groups to participate in 2010.

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 2009, 203 volunteers contributed 787 hours and removed approximately 8.5 tons of water chestnuts. This is the equivalent of \$7,870 of donated labor, calculated at the going rate of compensation for contractor handpulling crews. Overall, since the establishment of this program, volunteers have donated 14,764 hours to handpull 247 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, and the Wildlife Habitat Improvement Program (USDA, NRCS).

### Part 3: Other Basin Water Chestnut Management Efforts

#### ***New York\****

In 2009, 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 (\$53,000) and help from NYSDEC staff. Four sites were harvested in the Dresden, New York and West Haven, Vermont region. A total of 1,381 loads of water chestnut spoils were removed from the sites or an estimated 11,324 cubic yards. Harvested material was disposed of in a gravel pit in Dresden.

\*Summary provided by NYDEC staff

#### ***Québec\*\****

In 2009, \$80,000 (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. Only hand pulling was necessary to collect all the rosettes during the season. For the entire territory, water chestnut was 90% less abundant in 2009 than in 2008. One new colony was detected in the Richelieu River and there was an increase of 32% in rosette abundance in that river. Populations of water chestnut in the Pike River decreased by 97 % in 2009. No rosettes were found in the Châteauguay River, but five rooted rosettes were found in the Deux-Montagnes Lake near Montreal probably coming from the infested area on the Ottawa River, just upstream of the Québec border.

\*\*Summary provided by Quebec Ministère du Développement durable, de l'Environnement et des Parcs

#### ***U.S. Fish & Wildlife Service2\*\*\****

During the 2009 field season, Missisquoi National Wildlife Refuge staff utilized a shallow-water Go-Devil Boat for water chestnut removal. Initial search efforts using canoes proved to be fruitless due to thick emergent vegetation and shallow water. Most of the search and removal efforts occurred during July and August, with rosettes being pulled from Cranberry Pool and Big Marsh Slough (the two sites previously identified). No rosettes were found in other (new) areas of the refuge. Additionally, the Refuge Manager and two employees of the Vermont Department of Environmental Conservation (Aquatic Nuisance Species), searched for rosettes using an air boat; this effort resulted in the removal of 2 rosettes in Missisquoi Bay (near Dead Creek and the mouth of Big Marsh Slough) outside of the Refuge boundary.



**Figure 4-1.** UF&W staff and volunteers pull water chestnut in Cranberry Pool  
VTDEC Photo

Overall, water chestnut management efforts at Missisquoi National Wildlife Refuge appear to be successful, since fewer rosettes were handpulled during 2009 (1,804) than in 2008 (2,523) or

2007 (5,963). Nonetheless, in Big Marsh Slough this year, 453 rosettes, of the 1,222 total rosettes pulled, were found in a relatively small (30' x 60') area, suggesting that despite diligent control efforts, rosettes in that area were probably overlooked during the past few years..

\*\*\*Summary provided 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 2009 and acted as an important outlet for Basin communication on water chestnut management.

**Appendix 1. Water Chestnut Management Program Summary: 2009 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
<b>Vermont Sites</b>						
<b>MISSISQUOI BAY</b>						
1.	<b>Missisquoi Bay</b> 45°00'33 N / 73°07'54 W	<b>Highgate Springs</b>	<b>HP-DEC USF&amp;W</b>	8/12, 8/19	8	0
2.	<b>Missisquoi Refuge Long Marsh Channel</b> 44°59'34.38"N 73°09'20.88"W	<b>Highgate Springs</b>	<b>USF&amp;W</b>	7/30	2	0
3.	<b>Outside entrance to Big Marsh Slough</b> 44°58'32 N / 73°08'03 W	<b>Highgate Springs</b>	<b>HP-DEC USF&amp;W</b>	8/12, 8/19	2	.5
<b>MAIN LAKE</b>						
	<b>McNeil Cove</b> 44°18'03N / 73°17'47W	<b>Charlotte</b>	<b>HP-DEC</b>	Not surveyed in 2009/ alternate year checks		
4.	<b>Converse Bay F&amp;W Access &amp; Bay south</b> 44°17'19N / 73°16'01W	<b>Charlotte</b>	<b>HP-DEC</b>	Not surveyed in 2009/ alternate year checks		
<b>OTTER CREEK</b>						
5.	<b>Town Farm Bay/Kimball Brook</b> 44°16'60N / 73°16'01W	<b>Charlotte</b>	<b>HP-DEC</b>	Not surveyed in 2009/ alternate year checks		
6.	<b>Little Otter Creek (West Branch)</b> 44°13'28N / 73°01'38W	<b>Ferrisburg</b>	<b>HP</b>	7/07, 8/18	55	21.6
7.	<b>Porter Bay</b> 44°13'37N / 73°18'58N	<b>Ferrisburgh</b>	<b>HP</b>	7/7	13	1
8.	<b>Mouth of Otter Creek to Fort Cassin Access</b> 44°13'31N / 73°19'27W	<b>Ferrisburgh</b>	<b>HP</b>	7/7	6.5	0
9.	<b>Fields Bay</b> 44°13'15N / 73°19'09W	<b>Ferrisburgh</b>	<b>HP</b>	7/7, 8/18	36	31.2
10.	<b>Otter Creek Fort Cassin Access south to Dead Creek</b> 44°12'23N / 73°19'16W	<b>Ferrisburgh</b>	<b>HP</b>	7/8	1	0
<b>PORT HENRY</b>						

\* Key: HP = handpulling  
 MH = mechanical harvesting  
 DEC = VT Department of Environmental Conservation  
 USF&W = U.S. 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
11.	<b>Basin Harbor</b> 44°11'46N / 73°21'52W	<b>Panton</b>	<b>HP</b>	Not surveyed in 2009/ alternate year checks			
<i><b>SOUTH LAKE</b></i>							
12.	<b>Hospital Creek</b> a. 44°02'32N/73°25'06W (L)	<b>Addison</b>	<b>HP</b>	7/9, 8/20	21	36.8	350
	b. 44°02'20N/73°24'40W		.	7/9, 8/20	21.5	0	0
13.	<b>Whitney Creek</b> a.44°01'40N / 73°24'05W (L)	<b>Addison</b>	<b>HP</b>	7/9, 8/20	16	15.5	76
	b. 44°02'50N / 73°24'40W		<b>HP</b>	8/20, 8/21	21.5	240.1	663
			<b>HP-TNC</b>	7/25, 8/8	45	908	2,173
14.	<b>McCuen Slang</b> 44°01'28N / 73°23'67W	<b>Addison</b>	<b>HP</b>	7/9, 8/21	25.5	22.7	192
15.	<b>Bridport Town Beach</b> 43°59'55N / 73°24'04W	<b>Bridport</b>	<b>HP</b>	7/13	1	0	0
16.	<b>Giards Bay</b> 43°58'44N / 73°24'01W	<b>Bridport</b>	<b>HP</b>	7/13, 7/21	22.5	9.8	41
17.	<b>North of W. Bridport</b> 43°57'34N / 73°24'21W	<b>Bridport</b>	<b>HP</b>	7/14	1	0	0
18.	<b>Leonard Bay</b> 43°56'16N / 73°24'00W	<b>Bridport</b>	<b>HP</b>	7/14, 8/17	22.5	17.5	145
19.	<b>Lapham Bay</b> 43°55'33N / 73°23'37W	<b>Shoreham</b>	<b>HP</b>	7/14, 8/17	11	1	15
20.	<b>South of Lapham Bay</b> 43°54'52N / 73°23'40W	<b>Shoreham</b>	<b>HP</b>	7/14, 8/17	10	0	0
21.	<b>North of Fivemile Point</b> 43°54'32N / 73°23'40W	<b>Shoreham</b>	<b>HP</b>	7/15, 8/17	5	0	0
22.	<b>Bays on Lake Street south of Five-Mile Point</b> 43°54'06N / 73°22'35W	<b>Shoreham</b>	<b>HP</b>	7/15, 8/18	7.5	23.6	298
	<b>Stony Cove</b> 43°54'15N / 73°22'56W	<b>Shoreham</b>					
23.	<b>Access by C. Farr Ranch</b> 43°53'54N/73°22'30W	<b>Shoreham</b>	<b>HP</b>	7/15, 8/19	11	24	242

\* Key: HP = handpulling  
 MH = mechanical harvesting  
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 USF&W = U.S. 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
<b>Watch Point</b> 43°53'7N / 73°22'31W	<b>Shoreham</b>					
24. <b>North of Larrabees Point</b> 43°51'56N / 73°22'11W	<b>Shoreham</b>	<b>HP</b>	7/15, 7/16, 8/19	12	91.8	825
25. <b>Beadles Cove and South</b> 43°51'1N / 73°22'15W	<b>Shoreham</b>	<b>HP</b>	7/16, 8/19	23	122.2	797
26. <b>East Creek</b> a. 43°51'50N / 73°22'37W (mouth)	<b>Orwell</b>	<b>HP</b>	7/16, 8/20	39.5	413	924
b. 43°49'38N/73°21'59W			8/28	32	1,020.6	4,293
		<b>HP-TNC</b>	6/22-8/20	312	1475	6,336
27. <b>Shoreline between East Creek &amp; Catfish Bay</b> 43°49'52N / 73°23'06W	<b>Orwell</b>	<b>HP</b>	7/25	1	0	0
28. <b>Catfish Bay</b> 43°49'40N / 73°23'09W	<b>Orwell</b>	<b>HP</b>	7/25, 8/26	5	74.6	248
29. <b>Buoy 39 Marina</b> 43°49'21N / 73°23'25W	<b>Orwell</b>	<b>HP</b>	7/25	1	0	0
30. <b>Dock at Curly Audette Farm</b> 43°48'38N / 73°22'41W	<b>Orwell</b>	<b>HP</b>	7/21, 8/26	4.6	13.6	113
31. <b>North shore Chipmans Point</b> 43°48'7N / 73°22'32W	<b>Orwell</b>	<b>HP</b>	7/21, 8/26	4.6	9.3	82
32. <b>Shoreline between Chipmans Point and Benson Bay</b> 43°47'07N / 73°21'10W	<b>Orwell, Benson</b>	<b>HP</b>	7/21, 8/26	31.5	200	1,640
33. <b>Benson Bay</b> 43°45'50N / 73°20'41W	<b>Benson</b>	<b>HP</b>	7/21, 8/26	40	525.6	4,700
34. <b>Shoreline between Benson Bay &amp; Stony Point</b> 43°45'24N / 73°21'16W	<b>Benson</b>	<b>HP</b>	7/24, 8/26	9.5	44.8	310
35. <b>Stony Point</b> 43°44'37N / 73°21'57W	<b>Benson</b>	<b>HP</b>	7/24	1	6	96
36. <b>Shoreline between Stony Point &amp; Benson Landing</b> 43°44'16N / 73°22'05W	<b>Benson</b>	<b>HP</b>	7/24	1	6	96

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 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				
37.	<b>Benson Landing</b> 43°43'45N / 73°22'03W	Benson	HP	7/13	39	561	8,954				
38.	<b>Dutchers and south</b> 43°43'01N / 73°22'33W	Benson	HP	7/13-7/15 7/24, 8/27	177	1,880.8	26,956				
39.	<b>Peters Bay</b> 43°38'12N / 73°25'37W	Benson/ West Haven	MH	7/13-7/16		235,600	62				
40.	<b>Red Rock Bay and north</b> 43°40'57 N / 73°25'37 W	West Haven	MH	7/9 - 8/5		1,155,200	304				
41.	<b>Poultney River and associated sites</b>	West Haven	HP-TNC								
	a. <b>Mouth of the Poultney and region</b> 43°34'08N/ 73°24'06W							7/1, 7/2, 8/13	98	191	944
	b. <b>Rogers Marsh</b> 43°34'06N/73°23'52W							7/22	4	2	16
	c. <b>Shaw Mtn Wetlands</b> 43°41'02N/73°21'23W										
	d. <b>Reed Marsh</b> 43°36'52N/73°22'42W							7/28	20	64	192
	e. <b>Schoolhouse Marsh north &amp; south</b> 43°35'33N/73°23'12W							7/7, 8/7	7	27	263
	f. <b>Billings Marsh</b> 43°36'17N/73°22'39W							7/27	24	149	575
	g. <b>Galick Road Wetlands</b> 43°34'36N/73°24'48W										
	h. <b>Finch Marsh</b> 43°34'36N/73°22'49W							6/23, 7/16, 8/4	25.5	112	696
i. <b>Nichols Wetland</b> 43°37'03N/73°22'30W	7/14	2.5	5	10							
<b>New York Sites</b>											
	<b>j. Saslow Marsh</b>	<b>Whitehall</b>	<b>HP-TNC</b>	7/17	6	88	840				

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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
43°36'50N/73°22'26W						
<i>SOUTH LAKE</i>						
42. <b>New York Light 14 and south</b> 43°40'45 N / 73°24'43W	<b>Dresden</b>	<b>MH</b>	7/17 – 8/5		528,200	139
43. <b>Pulpit Point</b> 43°42'45N / 73°23'43W	<b>Putnam</b>	<b>MH</b>	7/20		26,600	7
44. <b>Bed Back by Railroad</b> 43°42'45N / 73°23'26W	<b>Putnam</b>	<b>MH</b>	7/10 – 7/13		49,400	13
		<b>HP</b>	7/23, 7/28, 7/29, 7/30	340	5,190.8	53,127
45. <b>NY Light 4</b> 43°42'48N / 73°23'09W	<b>Putnam</b>	<b>MH</b>	7/9, 7/10		45,600	12
		<b>HP</b>	7/16, 7/22 7/23, 7/27	224.5	4,285	37,965
46. <b>60 Acre Patch</b> 43°43'21N / 73°22'26W	<b>Putnam</b>	<b>HP</b>	7/16, 7/17 7/24	64.5	3,511.2	42,176
47. <b>Sixmile Point and south</b> 43°45'26N / 73°22'00W	<b>Putnam</b>	<b>HP</b>	7/20, 7/21 8/16, 8/27	97.5	2,078.7	25,479
48. <b>South of Gourlie Point</b> 43°46'45N / 73°21'50W	<b>Ticonderoga</b>	<b>HP</b>	7/21	2.6	16.2	270
49. <b>Gourlie Point Bay</b> 43°47'38N / 73°22'25W	<b>Ticonderoga</b>	<b>HP</b>	7/21	2.6	7.8	123
50. <b>North of Gourlie Point</b> 43°47'47N / 73°22'42W	<b>Ticonderoga</b>	<b>HP</b>	7/21	2.6	5.8	89
51. <b>Charter Marsh</b> 43°48'16N / 73°23'5W	<b>Ticonderoga</b>	<b>HP</b>	7/21, 8/25	49	588.8	3,848
52. <b>North of Charter Marsh</b> 43°48'33N / 73°23'11W	<b>Ticonderoga</b>	<b>HP</b>	7/21, 8/25	13	24.2	104
53. <b>Fort Ticonderoga Bay &amp; south</b> 43°50'17N / 73°23'52W	<b>Ticonderoga</b>	<b>HP</b>	7/20, 8/21 8/25, 8/26	85	697	5,870
54. <b>LaChute River</b> 43°50'42.18N/73°24'08.82W	<b>Ticonderoga</b>	<b>HP</b>	8/21, 8/259 8/26	30	949.2	4,965

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 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
55.	North of Fort Ticonderoga 43°51'29N / 73°23'20W	Ticonderoga	HP	7/15, 7/16 8/19	48	358.8	2,878
56	North of Kirby Point 43°52'42N / 73°23'22W	Ticonderoga	HP	7/15, 8/19	19.5	32.6	163
57.	South of IPCO 43°53'21N / 73°23'24W	Ticonderoga	HP	7/15, 8/18	17.5	4.5	75
58.	IPCO Bay 43°53'42N / 73°23'50W	Ticonderoga	HP	7/15, 8/18	30.5	237	2,003
59.	Bay north of Five Mile Point Light 43°54'17N / 73°24'45W	Ticonderoga	HP	7/10, 7/14 8/17	50	304.8	2,934
60.	North of Crown Point 43°57'15N / 73°24'49W	Crown Point	HP	7/10, 8/24 7/10, 8/24	51.3	266.2	2,247
61.	Putnam Creek <b>NEW</b> 43°57'22.2N / 73°24'55.5W	Crown Point	HP	7/10, 8/24	25	265.2	2,235
62.	Porters Marsh 43°58'13N / 73°24'58W	Crown Point	HP	7/10, 8/24	12.8	11.3	41
63.	Bay south of Burdick Crossing 43°59'4N / 73°25'14W	Crown Point	HP	7/10	2.3	0	0
64.	Bay at Burdick Crossing 43°59'10N / 73°25'13W	Crown Point	HP	7/10	2.3	0	0
65.	South of Lapstone Point 44°00'10N / 73°25'02W	Crown Point	HP	7/10, 8/24	40.3	189.6	1,773
66.	Shoreline between Lapstone Pt & Bay South of Crown Point Bridge 44°00'55N / 73°25'03W	Crown Point	HP	7/10	13.3	51.8	514
				8/24	12	31.4	231
67.	Bay south of Crown Point Bridge 44°01'30N / 73°25'06W	Crown Point	HP	7/10	18.8	29.8	308
				8/24	4	1	7
<b>PORT HENRY</b>							
68.	Bulwagga Bay 44°00'17N / 73°26'51W	Crown Point, Moriah	HP	07/13, 8/17	58.5	133.8	3,918

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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
69.	<b>Bulwagga Bay Campground</b> 44°02'02.76N / 73°27'36.76W	<b>Crown Point, Moriah</b>	<b>HP</b>	7/06, 8/17	132	3,810.2	45,288

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 USF&W = U.S. Fish & Wildlife Service  
 TNC = The Nature Conservancy  
 1 MH load = 14 cubic yards  
 L= Lakeside

**Appendix 2. Water Chestnut Management Program Summary: 2009 other waterbody sites.**

	Site	Control Implemented*	Date Targeted	Hours	Estimated # of Pounds Removed	Rosettes Removed
<b>Lakes and Ponds</b>						
1.	Lake Bomoseen, VT 43°41'18N / 73°11'57W	HP-DEC	7/27	4	0	0
2.	Coggman Pond, VT 43°37'14N / 73°22'30W	HP-TNC	7/29	24	74	222
3.	Brookside Pond, VT 43°46'58N / 73°18'34W	HP-TNC	7/8	5	51	428
		HP	08/29	3.5	41.4	248
4.	Parsons Mill Pond, VT 43°42'20 N / 73°17'04W	HP-TNC	8/5, 8/6	22.5	198	1,362
5.	Lake Paran, VT 42°55'58N / 73°13'13W	HP-DEC	7/14	4	0	0
6.	Small pond, Benson, VT (Horton) 42°42'46N/73°15'20W	HP-owner	June	2	3	15
		HP-DEC	8/31, 9/1	10	47	337
7.	Small pond, Benson, VT <b>NEW</b> (Phillips)	HP-DEC HP	9/1	8	45	336
8.	Small pond, North Bennington, VT (Allen) 42°53'46N / 73°15'20 W	HP-DEC	7/14	4	1	2
8.	Small pond, Bennington, VT (Glanzenberg) 42°53'28N / 73°15'9W	HP-owner	6/7, 6/20, 7/12	1.5	0	0
10.	Small pond at Benson Landing, VT 43°43'39N/ 73°21'57W	HP	No water chestnut observed by HP contractors or DEC staff			
11.	Root Pond, VT 43°40'46N / 73°20'59W	HP-TNC	7/15	6	2	16
12.	North Springfield Reservoir, VT 44°20'55 N / 72°30'20W	HP-CORPS	July/August	50?	4	30
13.	Pelkeys Swamp, VT 43°42'33N/ 73°19'18W	HP-TNC	6/30	10	36	104
14.	Lily Pond, Lake St Catherine VT 43°29'32N / 73°12'23W	HP-DEC	7/15	3	.5	1
15.	Porter Lake, VT 44°12'38N / 73°19'09W	HP	7/07, 8/18	25.5	19.2	188

\* Key: HP = handpulling  
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 USF&W = U.S. Fish & Wildlife Service  
 TNC = The Nature Conservancy  
 USACOE = US Army Corps

	Site	Control Implemented*	Date Targeted	Hours	Estimated # of Pounds Removed	Rosettes Removed
16.	Bullis Pond, VT 44°57'58N / 72°57'58W	HP	7/17	48	120	1,692
		HP-DEC	8/4	6	24	230
<b>Rivers, marshes, Wetlands Vermont and New York</b>						
17.	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	7/08	111.5	217	3,836
			8/19	48	164.4	870
	h. Route 17 north and south	HP	7/09, 8/20	64.5	56.6	387
18.	Lemon Fair River, VT 43°59'27N / 73°15'00 W	HP	7/18, 8/29	7	17.5	273
19.	Richville Pond/Lemon Fair River, VT 43°51'33N / 73°15'26W	HP	7/18, 8/29	5.5	3	35
<b>Missisquoi Refuge Sites, Highgate Vermont</b>						
20.	Missisquoi Refuge Cranberry Pool 44°57'16.59N 73°08'56.91"W	USF&W	7/9-8/19	46	62	582
21.	Missisquoi Refuge Big Marsh Slough 44°58'23"N 73°08'24"W	USF&W	6/10-9/3	46	125	1,222

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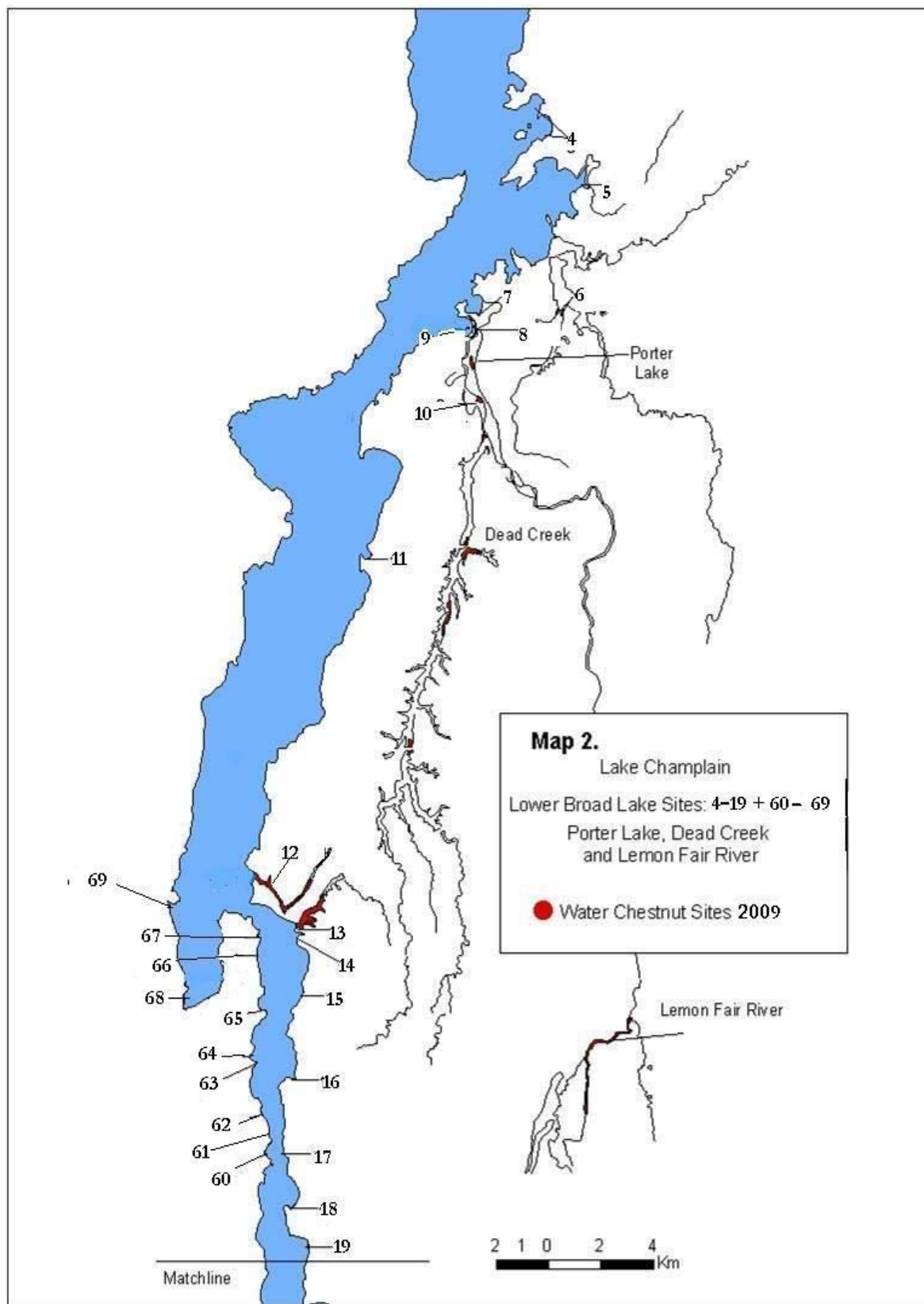
### Appendix 3. 2009 water chestnut management program site maps.

Map 1. Northern Lake Champlain sites: Missisquoi Bay.

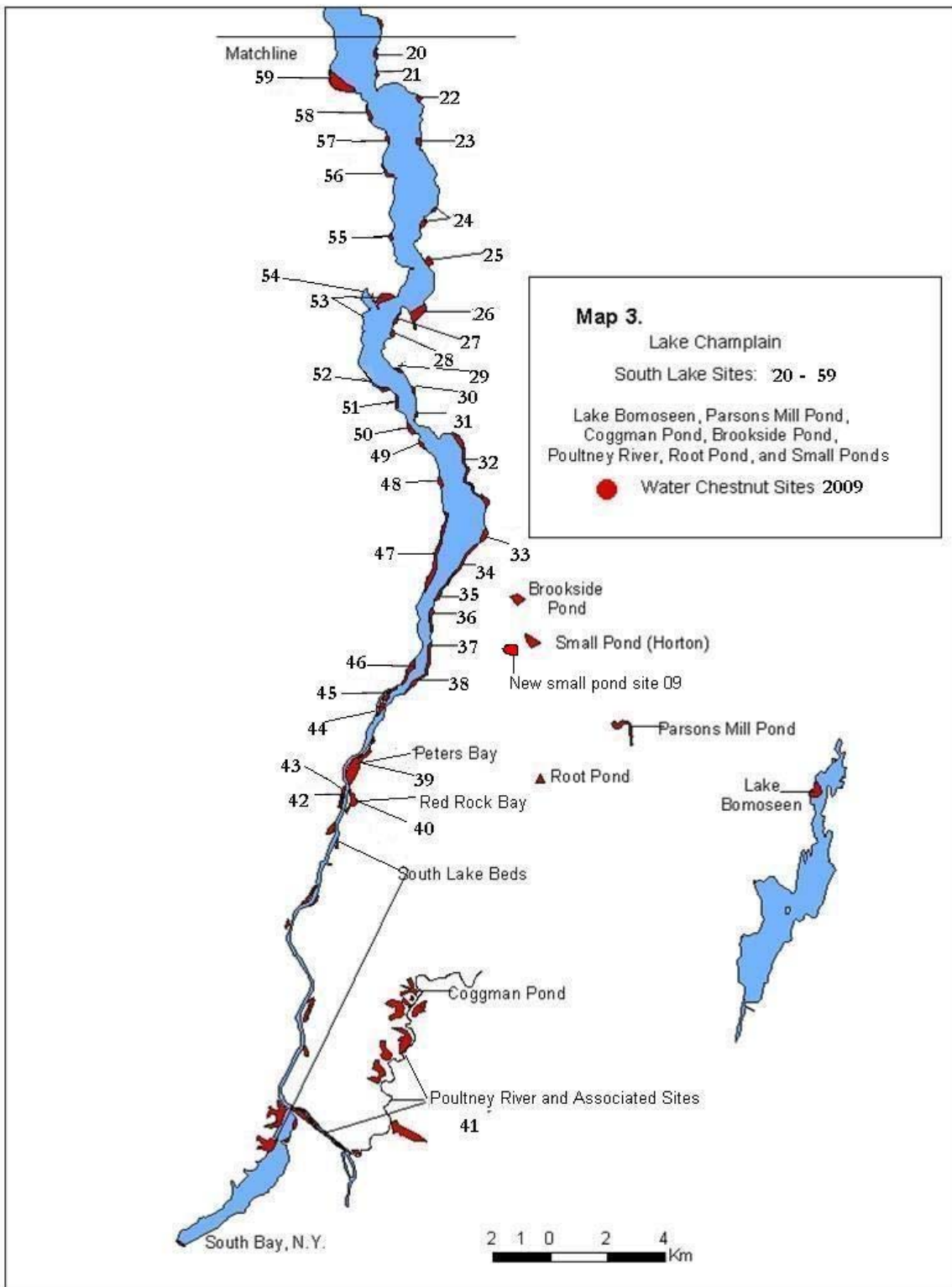


Key: pink = two water chestnut rosettes found in 2009, none found 2008  
light blue = airboat search area  
dark blue = currently known and managed water chestnut sites

Map 2. Lake Champlain: Lower Broad 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, 2009.

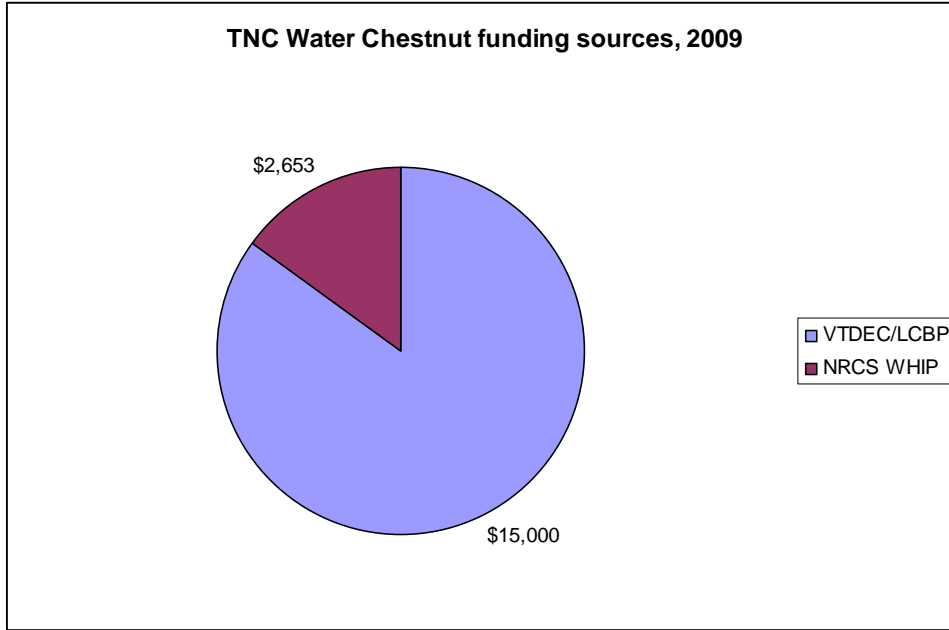
Site	Date	Pulling hours	Volunteer hours	Pounds	Rosettes
<b>Billings Marsh</b>	<b>7/27/2009</b>	<b>24</b>	<b>20</b>	<b>149</b>	<b>575</b>
<b>Brookside Pond</b>	<b>7/8/2009</b>	<b>5</b>	<b>0</b>	<b>51</b>	<b>428</b>
<b>Coggman Pond</b>	<b>7/29/2009</b>	<b>24</b>	<b>22</b>	<b>74</b>	<b>222</b>
<b>Cook Island totals</b>	<b>7/22/2009</b>	<b>4</b>	<b>0</b>	<b>109</b>	<b>251</b>
East Creek	6/22/2009	6	0	7	155
	6/24/2009	73.5	75	151	302
	6/26/2009	24	20	26	153
	7/6/2009	36	41	91	465
	7/13/2009	22.5	23	357	1,367
	7/19/2009	40	32	106	212
	7/30/2009	17.5	24	245	1,113
	8/3/2009	48	44	269	1,248
	8/19/2009	8	6	20	67
	8/20/2009	12	10	137	877
<b>East Creek totals</b>		<b>288</b>	<b>275</b>	<b>1409</b>	<b>5,959</b>
Finch Marsh	6/23/2009	19.5	18	55	397
	7/16/2009	4	4	51	287
	8/4/2009	2	0	6	12
<b>Finch Marsh totals</b>		<b>25.5</b>	<b>22</b>	<b>112</b>	<b>696</b>
LaChute River	7/24/2009	36	31	791	4,208
	8/11/2009	44	49.5	1,756	6,072
<b>LaChute River totals</b>		<b>80</b>	<b>80.5</b>	<b>2,547</b>	<b>10,280</b>
<b>Mill Pond</b>	<b>8/13/2009</b>	<b>2</b>	<b>0</b>	<b>9</b>	<b>32</b>
<b>Nichol's Wetland</b>	<b>7/14/2009</b>	<b>2.5</b>	<b>0</b>	<b>5</b>	<b>10</b>
Parsons Mill Pond	8/5/2009	19.5	24	133	1,027
	8/6/2009	3	0	65	335
<b>Parsons Mill Pond totals</b>		<b>22.5</b>	<b>24</b>	<b>198</b>	<b>1,362</b>

2009 TNC water Chestnut Site Summary Statistics (continued)

Site	Date	Pulling hours	Volunteer hours	Pounds	Rosettes
Pelky Swamp	6/30/2009	10	9	36	104
Reed Marsh	7/28/2009	20	14	64	192
Roger's Marsh	7/22/2009	4	0	28	64
Root Pond	7/15/2009	6	4	2	16
S. Lake Champlain	7/1/2009	60	70	110	565
	7/2/2009	36	49.5	74	350
	8/13/2009	2	0	7	29
<b>S. Lake Champlain totals</b>		<b>98</b>	<b>119.5</b>	<b>191</b>	<b>944</b>
Saslow Marsh	7/17/2009	6	0	88	840
Schoolhouse Marsh	8/7/2009	3	0	5	32
Schoolhouse Marsh North	7/7/2009	4	0	22	231
South Bay	6/25/2009	32	32	46	242
	7/9/2009	10.5	10	37	611
<b>South Bay totals</b>		<b>43</b>	<b>42</b>	<b>83</b>	<b>853</b>
South Fork (E. Creek)	7/17/2009	3	0	5	13
	8/25/2009	21	20	61	324
<b>South Fork (E. Creek) totals</b>		<b>24</b>	<b>20</b>	<b>66</b>	<b>337</b>
Timber Marsh	8/14/2009	24	26	224	1,581
	8/10/2009	26	25	309	1,205
	8/18/2009	36	35	165	910
<b>Timber Marsh totals</b>		<b>86</b>	<b>86</b>	<b>698</b>	<b>3,696</b>
Whitney Creek	7/25/2009	24	29.5	94	188
	8/8/2009	21	20	814	1,985
<b>Whitney Creek Totals</b>		<b>45</b>	<b>49.5</b>	<b>908</b>	<b>2,173</b>
<b>Grand Total</b>		<b>825.5</b>	<b>787.5</b>	<b>6854.0</b>	<b>29,297</b>

**Appendix 5. TNC Program Funding Sources, 2005-2009**

**Program Funding, 2009**



**Funding sources, 2005 – 2009.**

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 <sup>1</sup>	\$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
2009	\$15,000.00	\$0.00	\$0.00	\$0.00	\$2,653.00	\$17,653.00

<sup>1</sup>Funds were used to purchase a replacement truck for program use in 2006.

**Appendix 6. 2009 TNC Site maps.**