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Nearshore Fish Community Analysis On Northwestern Lake Champlain

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ABSTRACT

Community surveys are necessary sources of information needed to properly manage fisheries. These surveys detail important historical data concerning past fish assemblages and the previous status of recreational game fish. Historically, Lake Champlain has received little attention with regard to fish community assemblage research. We undertook a beach, seine net survey at four locations along the northwestern shores of Lake Champlain. We surveyed several unique nearshore habitat types and recorded abiotic factors, fishes, and plant communities. Our results revealed 17 different taxa with four being non-native to the basin. Lakeview Park had the highest species richness and abundance, which we believe results from the presence of vegetation at the sampling site. The scope of our survey was limited (i.e., small species or young of the year game fish), thus we recommend future comprehensive surveys that include a variety of fish sampling methods.

Key words: community, seine, substrate, vegetation

INTRODUCTION

Community assemblage structure is an important part of fisheries management. Using community composition data, fisheries managers can assess ecosystem health (Karr et al. 1986). Fish serve as bioindicators and can provide warnings of water degradation or serve as a metric for describing effects of remediation projects (Moore et al. 2000). Community composition can reflect presence and effects of invasive species. In addition, community assessment can assess health of forage species, which helps managers manipulate fisheries to produce trophy animals or large volumes of commercially desirable fish (Kohler and Hubert 1999).

Most knowledge concerning the Lake Champlain fish assemblage focuses on the Vermont side. (Halnon 1963; Facey & Labar 1989; Facey 1991). Moore's (1929) report supplemented the New York Conservation Department's biological survey, which established baseline biotic data from all New York drainages (e.g., Allegheny, Mohawk, Genesee, Champlain, Lower Hudson, Oswego, Ontario and Erie). An annotated description for each fish species, with geographic distribution notes, was included for all drainages (Moore 1929). The next survey resulted in publication of Inland Fishes of New York (Smith 1986). Smith (1986) revisited Moore's (1929) sites and compared assemblages from these two eras. Currently, this book is widely used for fish taxonomy and distribution in New York. Since 1985, there has been no comprehensive survey performed on fish communities in New York; however, there have been reviews (Carlson and Daniels 2004; Marsden and Langdon 2012).

Historically, limited fish community monitoring has been conducted on Lake Champlain. Currently, most monitoring is done by Vermont Department of Fisheries and Wildlife. Because New York DEC manages commercial fisheries on Lakes Ontario and Erie in the north and Long Island Sound in the south, recreational fisheries of Lake Champlain have competed for attention. Because of this lack of attention, key questions cannot be addressed that could have enhanced our current understanding about

the lake and overall community ecology concepts. For example, Mihuc et al. (2012) used long-term monitoring data from 1992 to 2012 to examine patterns in zooplankton abundance in Lake Champlain. They were able to identify changes in abundance that coincided with invasive species introductions. Without that monitoring data, these patterns could not have been examined. Additionally, black bass (*Micropterus* spp.) research on Lake Champlain would have benefited from community analysis assessment from Cumberland Bay. There is a question of how introduction of trophy-sized black bass in Cumberland Bay influences the local fish community (Maynard et al. unpublished data). A long-term fish community dataset could have helped address this question.

Several methods are used to monitor fish communities. Electrofishing is an effective capture method for all fish species and size classes; however, it requires investments in gear, training, and personnel. Gill-, trap-, or trawl-netting is used to assess fish communities in large lakes and impoundments. However, all methods require a boat and a large investment of time and personnel training. Seine-netting, by contrast, is a relatively low-investment sampling method that can be accomplished with less training. Seine net samples must be taken nearshore (i.e., shallow water); thus, fishes that are caught typically are small juvenile game fish, or minnow communities (Murphy and Willis 1996, Kohler and Hubert 1999).

The goal of our study was to survey nearshore fish communities in Northwestern Lake Champlain (Clinton County, NY) using seine-net sampling. Our objectives are to 1) sample sites across the northwest portion of Lake Champlain and 2) document species richness and overall abundance.

METHODS

Study area:

Lake Champlain lies in the northeastern United States, covering an area approximately 201 km long and 23 km wide at its broadest point (Fig. 1a). It borders New York and Vermont along with parts of Quebec Provence, Canada. The lake has an average depth of 19.3 m with max depth of approximately 120.0 m. Lake Champlain drains north via Richelieu River which drains into the St. Lawrence River. We selected four sites to capture a potential difference in habitats with the goal of adequately assessing species richness. Our four sites included Valcour conference center, Lakeview Park, Monty's Bay, and the Great Chazy boat launch (Fig 1a). Valcour conference center is located in a cove across from Valcour, 11.1 km south of Plattsburgh, NY. Lakeview Park is located 1.7 km of the Plattsburgh marina. Monty's Bay is located left of the Monty's Bay marina 17.7 km north of Plattsburgh, NY. The final site, Chazy, located at the mouth of the Great Chazy River 34.0 km from Plattsburgh.

Field Sampling:

We sampled fish using beach seine nets (Net length= 7.35 m, width= 1.25 m, Bar: 0.6 mm, Stretch: 1 mm) and conducted 2 drag seine efforts per site. Valcour and Lakeview sites were sampled twice; on September 20th and October 15th respectively. Monty's Bay and Chazy were only sampled once on September 25th and October 4th respectively due to time constraints. To begin sampling, one person walked perpendicular from the shore about 4.5 m into the lake followed by a second person. The first person then walked parallel to the shore which stretched the seine net out. In unison, both people walked

toward the shore until the net was pulled up onto the beach. The total cross sectional area that was sampled was 33 m. We hand-collected fish from the net and placed them in a 20 l bucket with an attached Bubble Box Air Pump™. We identified all fish to lowest possible taxa, then took total length to the nearest mm and mass using a Pesola™ scale to the nearest gram. We recorded physical habitat parameters at each location we took a seine net sample to compare microsite conditions. Total dissolved solids (TDS), temperature, dissolved oxygen (DO) and pH were measured using a YSI multi-probe. Vegetation was identified to lowest taxa possible and classified as emergent, floating or submergent. The substrate was classified as either silt, sand gravel, cobble or boulder.

Analysis

Species collected in this study were grouped into ecological traits (e.g., water class, temperature, trophic class and tolerance) based on parameters defined by Halliwell et al. (1999). Site-specific abundance were presented with a stacked bar graph and site-specific community composition was presented with pie graphs. Species richness was counted for each site and a Shannon-Weiner index was used to calculate community evenness. Abiotic data were the mean of individual seines efforts at each site.

RESULTS

Of the 4 sites only 3 produced fish. Seventeen fish species were collected (Table 1) from all sites combined. Of the 17 species, 10 are invertivores, six are top carnivores and one is a benthic herbivore. Length and weight data from all fish show a large bias toward small species or juveniles (Table 2). Lakeview Park had the greatest diversity with an S of 12, followed by Valcour, Chazy, and Monty's Bay with 7, 5 and 0 respectively (Table 3). Lakeview Park had the greatest evenness (0.75) followed by Valcour (0.68) and Chazy (0.60) sites (Table 3). Lakeview Park had the highest abundance of fish with 88, followed by Valcour, Chazy, and Monty's Bay with 59, 27 and 0 respectively (Figure 2).

At Valcour species richness was 7, where the most abundant fish was yellow perch (*Perca flavescens*) which comprised 57% of the community followed by spottail shiner (*Notropis hudsonius*; 15%), white perch (*Morone Americana*; 12%) and golden shiner (*Notemigonus crysoleucas* ;7%)[Figure 2]). At Lakeview Park species richness was 12, where the most abundant fish was alewife (*Alosa pseudoharengus* ;46%) followed by the shiner genus (*Notropis* spp.; 17%), eastern silvery minnow (*Hybognathus regius* ; 13%) and the golden shiner (*Notemigonus crysoleucas ;*11% [Figure 3]). Species richness at Chazy was 5, where pumpkinseed sunfish (*Lepomis gibbosus;* 70%) dominated the community with rock bass (*Ambloplites rupestris*; 15%) comprising the second most abundant species (Figure 4).

Water temperatures at all sites varied from 13°C at Chazy to 19.4°C at Monty's Bay (Table 4). Conductivity at each site was fairly consistent, varying from 135.8 ìS/cm at Chazy to 177.2 ìS/cm at Valcour (Table 4). Acidity (e.g., pH) ranged from 7.03 at Lakeview Park to 7.59 at Monty's Bay. Total Dissolved Solids (TDS) ranged from 0.17g/L at Chazy to .22g/L at Valcour Island (Table 4). Lakeview Park and Chazy sites both had sandy substrate, while Valcour and Monty's Bay had gravel and silt substrates, respectively (Table 4). *Vallisneria* spp.was found at Lakeview Park and *Vallisneria* spp. and *Sparganium* spp. were found at Chazy (Table 4).

DISCUSSION

The goal of this survey was to establish baseline nearshore fish data for northwestern Lake Champlain. In total, we identified 17 species over our entire study. One taxa was identified to genus (*Notropis*) due to time constraints and identification difficulties. The majority of these species (10) are classified as invertebrates; however, the number of invertivores may increase because some of top carnivores present (e.g., rock bass, largemouth bass, smallmouth bass, white perch and yellow perch) were captured as juveniles. These species may also prey upon invertebrates. The length and weight table shows a large bias towards small or young of year fish. This bias consistent with most seine surveys because of the limitation of sampling from shore (Murphy and Willis 1996).

Vegetation provides refugia for small and/or young of year fishes from predation and harsh environmental conditions (Smith 1985). At Valcour, all vegetation was scoured by Tropical Storm Irene, leaving the sampling site devoid of refugia. In contrast, the vegetation present at Lakeview Park was not disturbed by Irene. We suggest that at the time of sampling, Lakeview Park contained the most suitable habitat for small and young of the year fishes. This claim is supported by the higher abundance and species richness observed at Lakeview Park in contrast to Valcour, Monty's Bay and Chazy. Chazy also contained vegetation; however, because only two seine efforts were performed at the site, we lack the information to draw definitive conclusions about this site. Observations from recent electrofishing surveys show a large littoral fish community located in King's Bay, just beyond the Chazy site (Alejandro Reyes, personal observation). This observed community, along with the presence of many vegetation associated species (pumpkinseed, largemouth bass, northern pike) (Smith 1986) in our data, suggests that Chazy does possess suitable small and young of year fish habitat.

Monty's Bay was the only site that contained no fish in our survey. We infer that the combination of lack of vegetation and a silty substrate led to the absence of any small or young of the year fishes. Substrate type, in lentic systems, influences fish structure, assemblages and distribution. Many fish are intolerant of siltation (Halliwell et al. 1991) and siltation has been linked, in part, to some fish population declines in Lake Champlain (Marsden and Langdon, 2012),

The non-native species we found in this survey were alewife, brook silverside, rudd and white perch. Valcour contained two of these species (alewife, white perch), while Lakeview Park contained all four species. Alewife and white perch both have documented effects on Champlain fisheries (Marsden and Langdon 2012). All four non-native species were not recorded in the original survey of Lake Champlain (Moore 1929) or by Smith (1986). Alewives were introduced by anglers via unauthorized stocking and rudds are believed to have been introduced via a bait bucket. White perch and brook silverside first appeared in the south end of the lake, implying that they have expanded their range north from the Champlain canal (Marsden and Hauser 2009).

Because Lake Champlain contains a diverse fish assemblage and economically important recreational fisheries, there is a strong need to monitor fish communities. Seine netting is a low cost, effective way to accomplish this end. Our survey reported 17 species from only 12 seine drags, which is 55% of all fish species reported by Marsden and Landgon (2012) in the lake proper. An increased and standardized effort, including seasonal sampling, would yield a greater amount of information about the Lake Champlain fish community. As noted before, juvenile stages of recreationally and commercially important fishes were observed in this survey. Understanding the distribution and size structure of that particular life stage is crucial for management practices. Ideally, conducting community monitoring would involve use of a variety of sampling gear to collect fishes from various habitats. However, with limited resources, we believe that seine netting can be a viable alternative.

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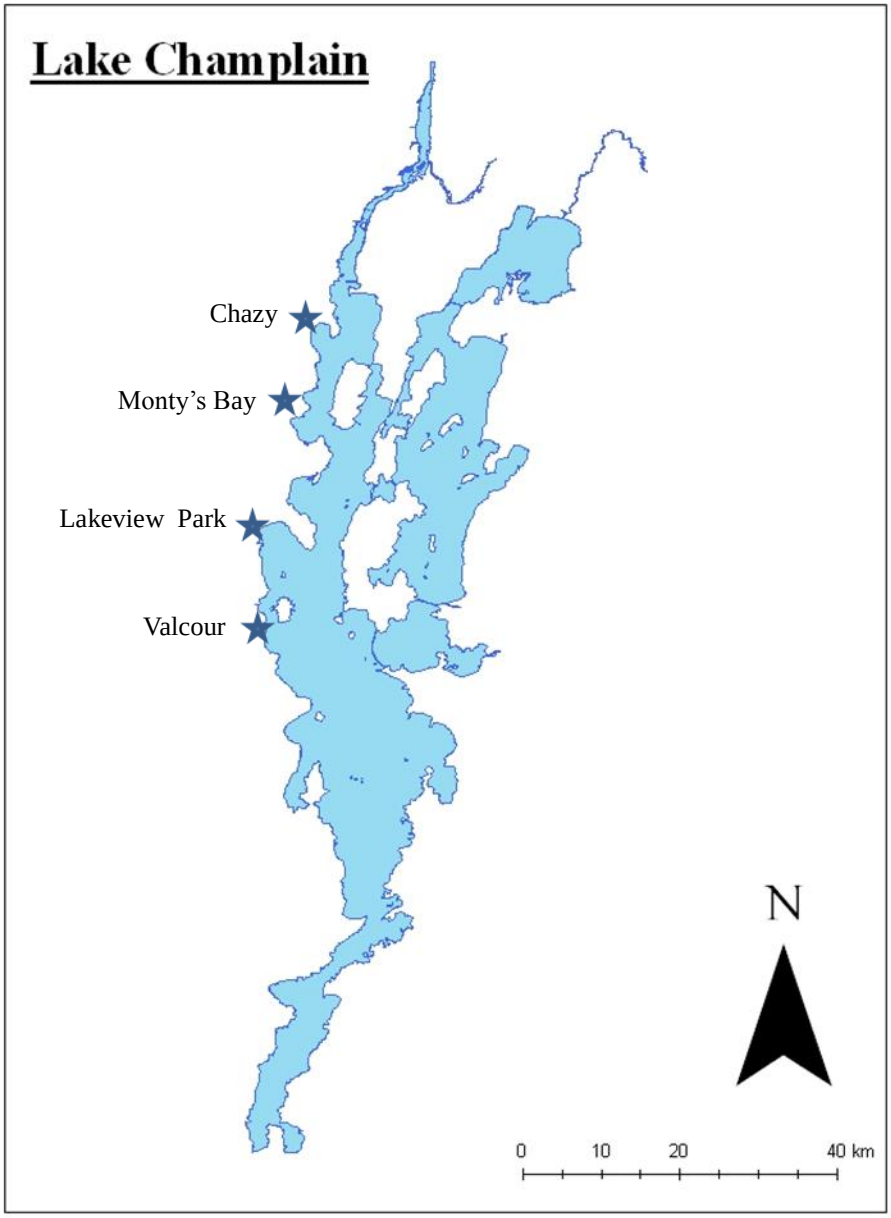

Figure 1a – Map of Lake Champlain showing the four sampling sites (Valcour, Lakeview Park, Monty's Bay and Chazy)

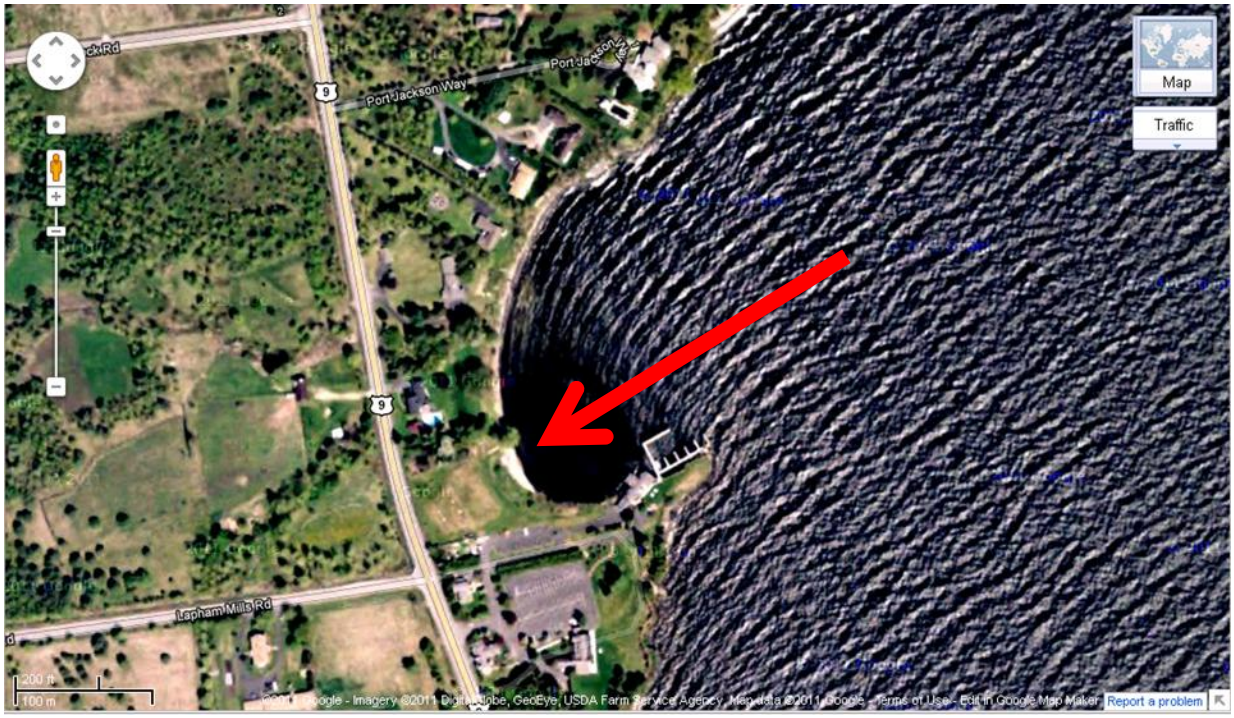

Figure 1b – Aerial photo of Valcour Conference Center (Peru, NY)

Fig 1c – Aerial photo of Lakeview Park (Plattsburgh, NY)

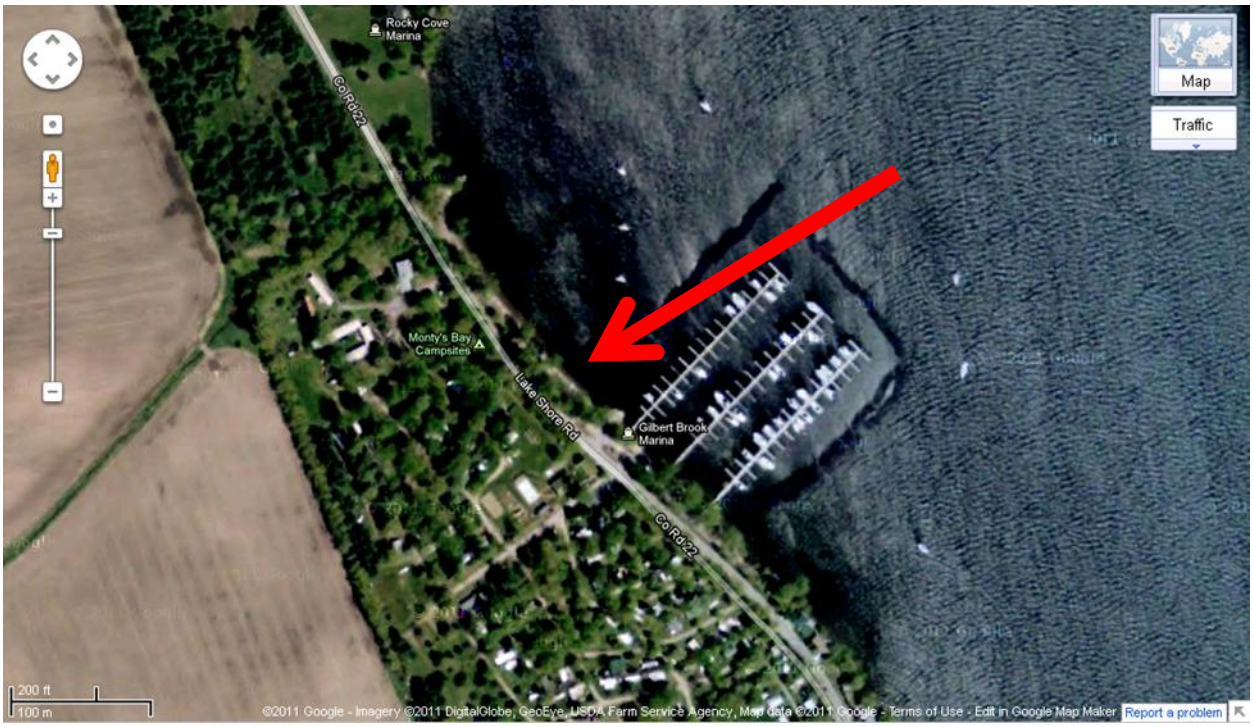

Fig. 1d – Aerial photo of Monty's Bay Marina (Chazy, NY)

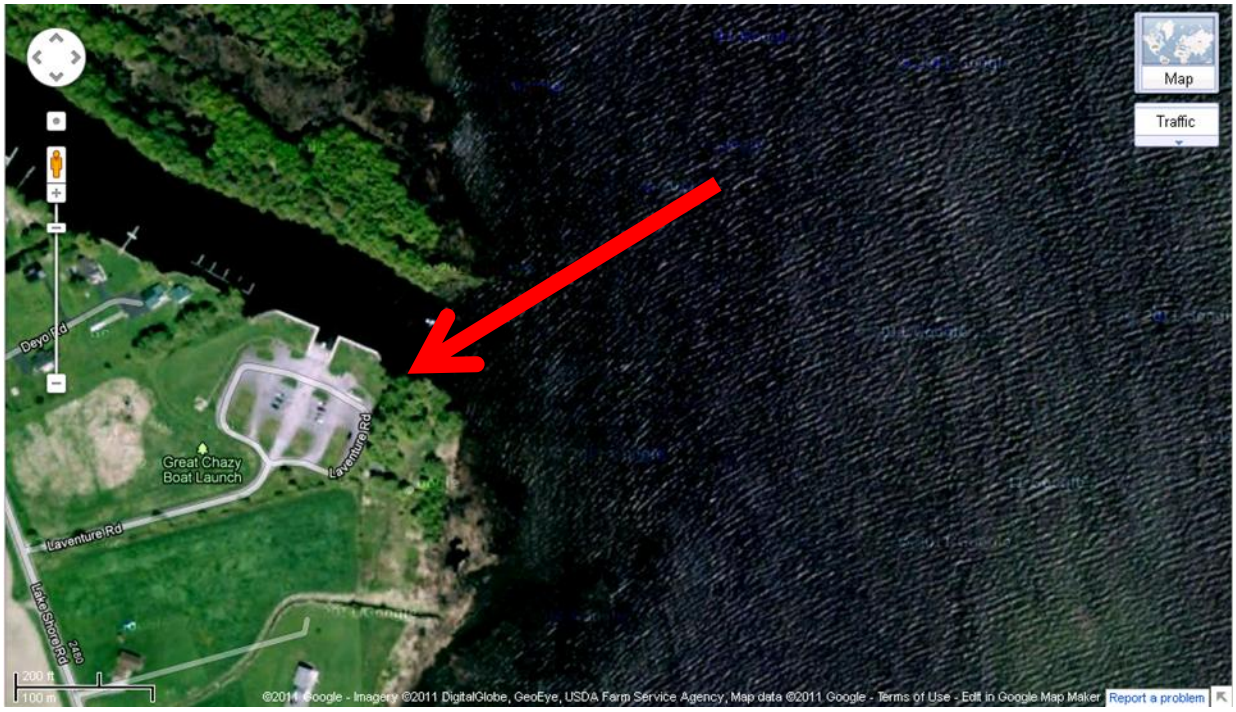

Fig. 1e – Aerial photo of the Great Chazy boat launch (Chazy, NY)

Table 1. List of fish species sampled and ecological traits (n = 17) in this study (after Halliwell et al. 1999).

Scientific name	Common Name	Water Class	Temperature	Trophic Class	Tolerance
Alosa pseugoharengus	Alewife (ALEW)	S-L	C-W	PI	M
Ambloplites rupestris	Rock bass (RKB)	S-L	C-W	TC	M
Esox lucius	Northern pike (NTP)	R-L	C-W	TC	I
Fundulus diaphanus	Banded killifish (BDK)	S-L	W	WC	T
Hybognathus regius	Eastern silvery minnow (ESM)	R-L	W	BH	I
Labidesthes sicculus	Brook silverside (SILV)	S-L	W	WC	I
Lepomis gibbosus	Pumpkinseed (LEP)	S-L	W	GF	M
Micropterus dolomieu	Smallmouth bass (SMB)	R-L	C-W	TC	M
Micropterus salmoides	Largemouth bass (LMB)	S-L	W	TC	M
Morone americana	White perch (WP)	R-L	C-W	TC	M
Notemigonus crysoleucas	Golden shiner	S-L	W	GF	T

	(GLDS)				
Notropis hudsonius	Spottail shiner (STS)	R-L	W	WC	M
Notropis spp	Shiner (SHIN)	S-L	C-W	GF	M
Perca flavescens	Yellow perch (YLP)	S-L	C-W	TC	M
Pimephales notatus	Bluntnose minnow (BLTN)	S-L	W	GF	T
Rhinichthys cataractae	Longnose dace (LND)	B-S	C-W	BI	M
Scardinius erythophthalmus	Rudd (RUDD)	S-L	W	WC	T

Water class: B = brook = lotic systems with mean width <5m, S = stream = lotic systems with mean width 5-10m, R = Rivers = lotic systems with mean width >10m, L = Lake = ponds and reservoirs included. Temperature: C = cold water, C-W = both cold and warm/cool water, W = warm water. Trophic class: BH = benthic herbivore, BI = benthic insectivore, GF = generalist feeder, PI = planktivorous invertivore, TC = top carnivore, WC = water column insectivore. Tolerance: T = tolerant, M = intermediate, I = intolerant. (note: characteristics in this table apply to adult fish species)

Table 2. Mean and standard deviation (St Dev) for length and mass data for all fish.

Species	N Length	Mean Length	Stdev Length	N Mass	Mean Mass	Stdev Mass
Alewife	24	60.21	8.13	18	3.31	1.64
Rock bass	4	38.75	6.29	4	2.25	0.65
Longnose dace	3	71.67	0.58	3	6.33	0.58
Banded killifish	1	40.00	N/A	0	N/A	N/A
Smallmouth bass	5	49.00	5.83	5	2.30	1.30
Spottail minnow	9	60.56	6.82	8	2.88	1.27
Eastern silvery minnow	11	61.09	4.13	11	3.23	1.13
Pumpkinseed	18	35.11	4.75	18	1.97	0.43
Largemouth bass	1	80.00	N/A	1	4.00	N/A
Northern pike	1	560.00	N/A	1	460.00	N/A
Golden shiner	16	57.50	6.58	16	3.75	2.04
Shiner	10	61.50	2.42	10	3.45	1.04
Yellow perch	24	64.33	7.39	12	4.67	1.83
Bluntnose minnow	3	68.33	2.89	1	4.00	N/A
Rudd	1	65.00	N/A	1	3.00	N/A
Brook silverside	2	70.00	35.36	2	2.75	2.47

Table 3 – Community composition data for beach seines

Location	Species Richness (S)	Hmax	Evenness
Valcour	7	1.94	0.68
Lakeview Park	12	2.48	0.60
Chazy	5	1.60	0.75
Monty's Bay	0	0	N/A

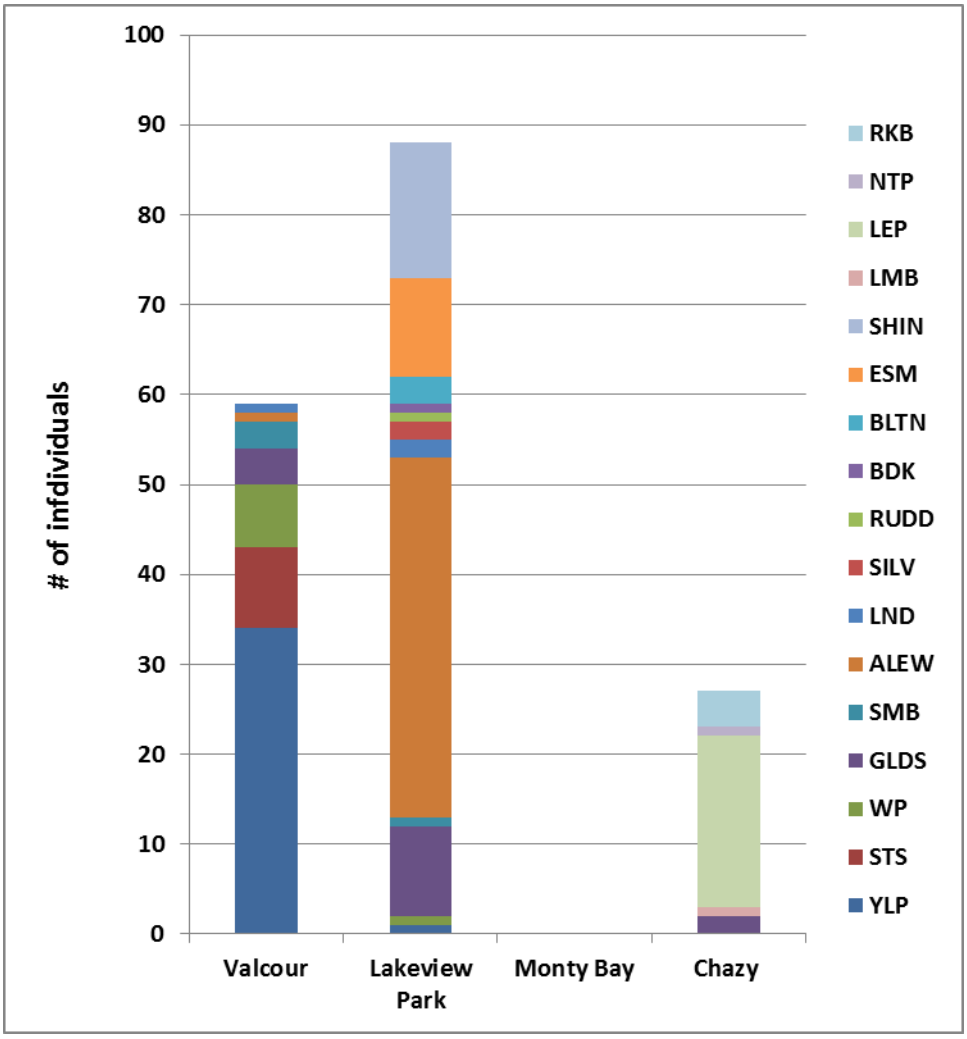

Figure 2. Site-specific community abundance and composition

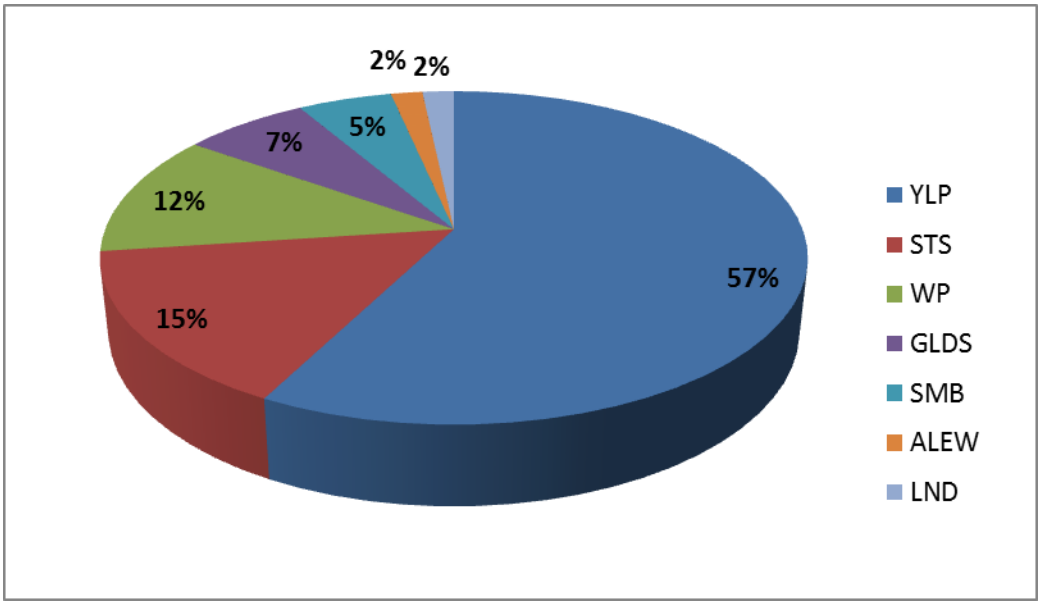

Figure 3. Percent abundance of fish species at Valcour

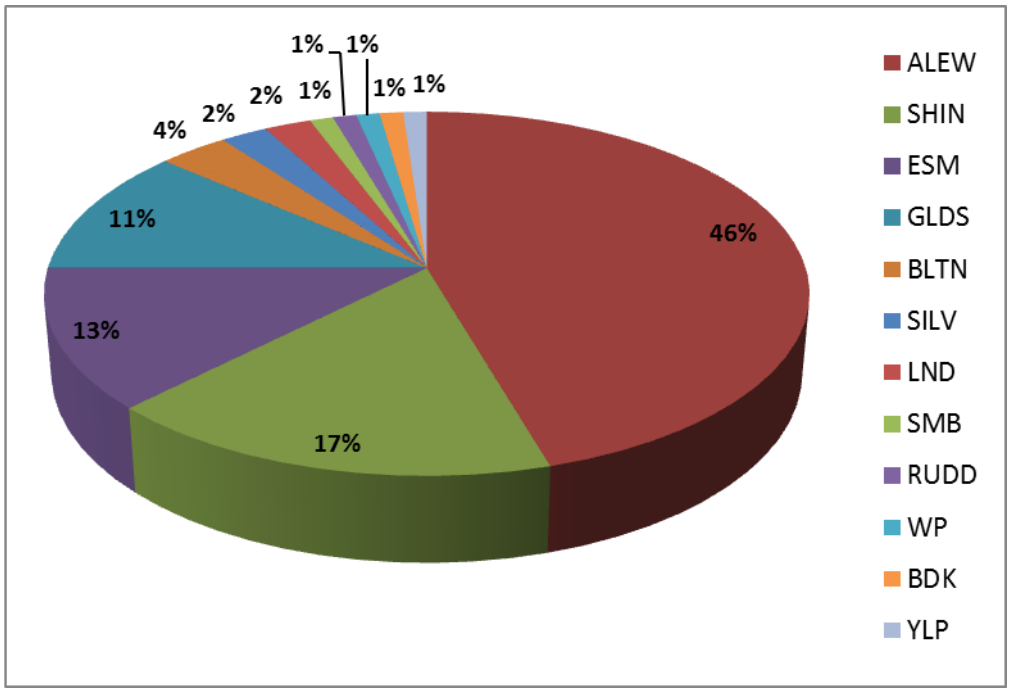

Figure 4. Percent abundance of fish species at Lakeview Park.

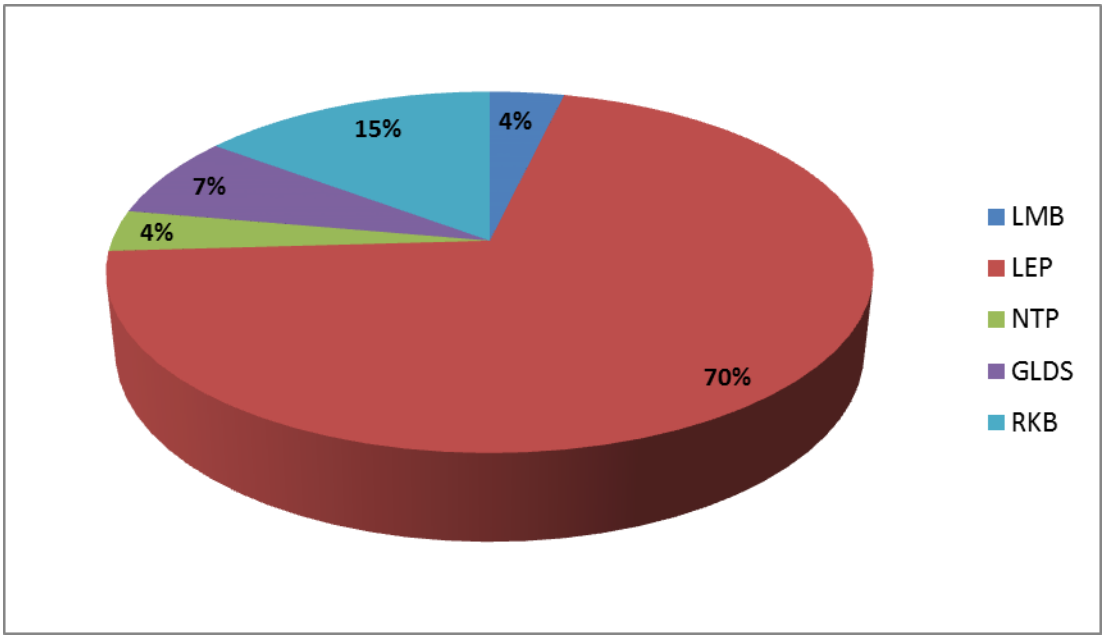

Figure 5. Percent abundance of fish species at Chazy.

Table 4. Site-specific abiotic and habitat parameters.

Location	Water Temp (^{o}C)	Ambient Temp (^{o}C)	Conductivity (µs)	pH	Total Dissolved Solids (g/L)	Substrate	Vegetation
Valcour	16.45	15.6	177.22	7.23	0.22	Gravel	none
Lakeview Park	16.72	15.32	144.52	7.03	0.16	Sand	*Vallisneria* spp.
Monty's Bay	19.4	19.00	143.1	7.59	0.16	Silt	none
Chazy	13.00	14.10	135.8	7.07	0.17	Sand	*Vallisneria/Sparganium*