

Vermont Fish and Wildlife Department Annual Report

State: Vermont

Project No.: F-35-R-16

Grant Title: Lake Champlain Fisheries Restoration and Management

Study No. II

Study Title: Forage Fish Monitoring

Period Covered: July 1, 2013 to June 30, 2014

Summary of Activity:

Lake Champlain forage fish assessment in 2013 was carried out beginning on July 29 and ending on August 20. Smelt catch by trawling was extremely low with three stations recording their lowest CPUE ever. Only the Juniper Island station was above the long-term average. Floating gill nets were utilized to sample alewife. Alewives were captured at all stations with the greatest catch being at the Barber Point station. Results from acoustic sampling agreed with patterns found at five stations where trawling was conducted for rainbow smelt. The acoustic sampling indicated an increase in fish above the thermocline which, based on gillnets and shallow trawls, is likely a combination of alewife and white perch.

INTRODUCTION

In the fall of 1990, an 8-year experimental program for management of sea lamprey (*Petromyzon marinus*) in Lake Champlain began. In conjunction with sea lamprey control measures, several assessment programs were initiated to help determine the overall effect of the program on the lake's fisheries. Rainbow smelt (*Osmerus mordax*) are the primary food for salmonid predators in the lake and also supported an important winter recreational fishery. Lake Champlain fishery managers predicted that as sea lamprey populations were reduced there could be accompanying changes in predator mortality rates and growth and thus increased consumption rates of rainbow smelt by predators. Thus, an 8-year program was initiated to monitor rainbow smelt stocks in several areas of the lake using the technique of stepped-oblique midwater trawling (Kirn and LaBar 1991, LaBar 1999). At the conclusion of the 8-year experimental sea lamprey control program, the Lake Champlain Technical Committee recommended that the smelt monitoring program be continued by the Vermont Department of Fish and Wildlife (VTDFW). This document reports the findings of the forage fish sampling efforts carried out by VTFWD with support from the U.S. Fish and Wildlife Service.

PROCEDURES

Standard Rainbow Smelt Monitoring

Five stations were sampled in 2013 for rainbow smelt in Lake Champlain (Figure 1, Table1). These sites include three main lake stations, one station in Malletts Bay, and one

station in the Inland Sea (also known as the Northeast Arm). All five sites have been sampled historically.

Midwater trawling was carried out at night as described by Kirn and LaBar (1991). The midwater trawl measures 5 meters (m) by 5 m with large mesh near the mouth grading to smaller mesh near the end, and terminating in a cod end with a 0.6 cm square mesh liner. For each trawl, the net was lowered to approximately 35 m depth or to just above the bottom, whichever came first. The net was towed at the maximum depth for 10 minutes allowing it to stabilize. The net was then raised about 3 m and towed for an additional 5 minutes. This step is repeated until the net was 10 m below the surface and then it is hauled back to the boat. Thus, in deep-water sites, each trawl consisted of nine steps and lasted for 55 minutes, and at the shallower sites, 6-7 steps and 40-45 minutes. Four trawls per night were conducted at each site. During each trawl, the net was monitored for depth using a remote transmitter affixed to the head rope on the net. Prior to sampling at each station a temperature profile was taken.

Catch-per-unit-effort (CPUE) is expressed in terms of catch per 55-minutes of trawling (catch X 55 min/actual trawling time). A sample of 50 fish was randomly selected from each haul and frozen for later otolith extraction. In the laboratory, smelt were thawed, measured, weighed, and otoliths were extracted. Otoliths were placed in an ethanol/glycerine mixture (70:30) to help clear them and later aged with a binocular dissecting scope at 10 - 45X magnification.

Young-of-year (YOY) smelt and alewife (*Alosa pseudoharengus*) were saved and later measured to the nearest millimeter in the laboratory. Any adult alewife or cisco (*Coregonus artedii*) collected were also counted and measured on the boat. All other fish species collected were identified and counted.

Alewife Monitoring

Alewives were first discovered in Lake Champlain in 2004. A sampling program is being developed to monitoring their abundance and population characteristics. Floating gill nets were utilized to collect alewife samples for age and growth analysis. One net was set in the early evening at each standard smelt monitoring station prior to midwater trawling and retrieved at the conclusion of the night's sampling. The net measured 6m deep by 21m in length with 7 panels of mesh sizes 6.25, 8, 10, 12, 15, 18 and 25mm.

Catch-per-unit-effort is expressed in terms of catch per 4-hour net set (number of fish /4 hr/net set). All Captured alewives were frozen. In the laboratory, alewife were thawed, measured, weighed, and otoliths were extracted. The otoliths were stored dry in vials and later aged with a binocular dissecting scope at 10 - 45X magnification.

In addition to alewife data collected from the floating gill net surveys, data was also collected from alewife captured during the Lake Champlain community monitoring project (F-35-R-15-Study III). This was done in order to collect larger alewives. As above, adult alewives were frozen for later processing in the laboratory.

Hydro Acoustics

In 2005 a lake wide hydroacoustic survey was added to the forage fish monitoring program. A series of transects were created which cover a large portion of Lake Champlain (Figure 1). The transects are sampled each year with a 120 kHz split beam Biosonics echosounder following the Lake Champlain acoustics SOP which is based on the standard operating procedures for fisheries acoustics surveys in the Great Lakes (Parker-Stetter et al. 2009). The unit was set to log data down to -100 dB with a ping rate of 1 ping per second for main lake transects and 4 pings per second for Malletts Bay and NEA. The pulse width was set to 0.4ms. All hydroacoustic surveys were performed at night (1 hour past sunset until 1 hour before sunrise). During acoustic surveys fish samples were collected to confirm acoustic targets using two different nets. An opening/closing tucker trawl (1m x 1m) with 1000 um mesh was used to collect young of the year fish and the standard 5m x 5m midwater trawl was used for larger fish. During each trawl, the net depth was monitored using a remote transmitter affixed to the head rope on the net. Temperature profiles were collected each night in the areas sampled.

FINDINGS

Standard Rainbow Smelt Monitoring

Midwater Trawling --- A total of 20 midwater trawls were conducted between July 29 and August 12, 2013 (Table 2, Figure 2). Smelt catch was extremely low with three stations recording their lowest CPUE ever. Only the Juniper Island station was above the long-term average. Table 3 compares CPUE long-term mean and median values with values before and after alewife invasion.

Age and Growth --- Mean age of smelt sampled in 2013 ranged from 1.6 to 2.0 years old (Table 4 and Figures 3 and 4). Over 90 percent of all the smelt saved from the main lake stations were age 2 with a mean total length (TL) of 106 mm. This represented an 18 percent decrease in length-at-age for this age (Table 5 and Figures 5-6). Typically, main lake age 2 smelt are about 130 mm TL. Age composition of the samples from each station is illustrated in Figure 8 and compared to previous years in Figures 9-11. Less than half of the usual numbers of smelt were collected from Malletts Bay and the Northeast Arm for age analysis.

Young-of-Year Rainbow Smelt --- It's important to note that the trawl is not designed to effectively sample young-of-year (YOY) smelt and that the YOY data must be viewed cautiously. Larger numbers of YOY smelt were found at main lake stations; were similar in the Northeast Arm, and fell substantially in Malletts Bay in 2013 (Table 6). Smelt YOY lengths had a greater range in the main lake varying from 21 to 63 mm (Table 7). Malletts Bay YOY were slightly smaller than at the other stations and less variable as was YOY in the Northeast Arm (Figure 12).

Hydro Acoustics

Acoustic work was performed lake-wide in 2013 and included the three basins of Lake Champlain (Malletts Bay, Northeast Arm and Main Lake). Over 71.8 km were sampled. The survey sampled 6.2 km in Malletts Bay, 12.8 km in Northeast Arm and 52.8 km in Main Lake.

Shortly after sampling all data files are examined to ensure data integrity. This includes opening each data file in the processing software to confirm readability, plotting GPS positions, examining the echogram for any strange noises or data problems. The data is then back-up on multiple systems. Physical samples were also taken using a Sea Bird CTD (conductivity, temperature, depth, pH) profiler. In 2013 a total of 28 profiles were taken: 17 Main Lake, 6 Inland Sea and 5 Malletts Bay. Samples with various trawls (tucker – young of year, midwater – older) was conducted to identify the species composition of acoustic targets (Table 8a and 8b). A total of 8 tucker trawls and 16 midwater trawls were performed in 2013. Samples have been processed and CPUE calculated. Additionally acoustic sampling was also conducted during the stepped-oblique midwater trawling.

Processed Data --- In both Malletts Bay and Northeast Arm adult smelt numbers (acoustic targets below the thermocline) appear to be lower (2008 – 2013) than seen in earlier years (2005 - 2007) (Figure 16). In the Northeast Arm fish numbers above the thermocline showed a strong increase in 2008 – 2011 and 2013 but 2009 and 2012 was similar to earlier years. Malletts Bay fish numbers above the thermocline were higher in 2008, 2011 and 2013 than earlier years. The Malletts Bay estimate in 2009 is not displayed on the graph due to noise problems. Based on shallow midwater trawls and floating gillnets catches we suspect that most of the fish above the thermocline are a mix of alewife and white perch. All three Main Lake Sections (North Main Lake, Main Lake and South Main Lake) experienced a decrease in adult smelt numbers for the first time. In these three sections the adult smelt numbers below the thermocline for 2013 are some of the lowest seen since the starting of sampling.

Targeted Trawls --- Fish from 2012 and 2013 targeted trawls have been processed and final trawl CPUE calculated (Table 8a and 8b).

Alewife Monitoring

Floating Gill Nets --- Five floating gill nets were set in 2013 (Table 9). Three nets were fished in the main lake with the Barber Point station recording the greatest CPUE of adult alewife at 131 fish for a 4 hour set. Malletts Bay had the lowest CPUE for both young and adult alewife with only 5 YOY per set. However, these numbers should be viewed cautiously as only 38 YOY were recorded per set in the Northeast Arm but more than 17 thousand YOY were estimated captured with the midwater trawl in the Northeast Arm (Table 6).

Midwater trawl --- Fifty-seven adult alewives were collected by midwater trawl in 2013 (Table 10). Alewives were collected at all stations. The greatest number was collected in Malletts Bay (27); the least at Juniper Island (3). Barber Point and Valcour Island had similar numbers (9 and 10 alewives respectively). Eight were collected in the Northeast Arm. Alewife YOY were also collected at all stations (Table 6). The largest number of YOY alewife was collected in the Northeast Arm (estimated 17 thousand fish).

Alewives were also collected prior to this forage fish assessment during the annual community monitoring project (F-35-R-16: Study III). These fish were from sampling which occurred between June 24 and July 8, 2013. The greatest number of alewife was collected from the main lake (88) and least from Malletts Bay (7) (Table 10).

Age and Growth --- Both juvenile and adult alewife were collected by floating gillnets in 2013 (Table 11). Most stations were dominated by age 2 alewives. Between 2009 and 2013 the length-at-age for alewife has declined, especially age 2 alewives (Figure 14). The greatest decline of mean length for age 2 alewives was recorded in the main lake where the mean length has dropped from 194 mm to 139 mm. Similarly, age 2 alewives in Malletts Bay declined from 186 mm in 2009 to 152 mm in 2013. Alewives collected by trawl were not saved for age analysis but were measured onboard the boat. Figure 16 compares length frequencies between alewife collected by gillnet (which were aged) and those collected by trawl. The floating gill nets collected larger alewife than the trawl in 2013.

Young-of-Year Alewife --- Alewife YOY were collected by midwater trawl in 2013. It's important to note that the trawl is not designed to effectively sample YOY alewife and that the YOY data must be viewed cautiously. Large numbers of alewife YOY were collected by midwater trawl at all but the Barber Point station (Table 6). It was estimated that the number of alewife YOY collected in the Northeast Arm was in excess of 17 thousand fish. Figure 16 compares lengths of juvenile alewife collected at each station.

Cisco

Only one cisco was collected at the Valcour Island station during the 2013 forage fish sampling effort (Table 12). It should be noted that data prior to 1999 should be viewed cautiously as it's uncertain how well cisco numbers were monitored in earlier years.

Temperature

Figure 19 shows temperature profiles for the sampling period. Temperature profiles varied slightly at different stations. Thermoclines generally were determined to exist below 12 meters in depth.

RECOMMENDATIONS

1. Continue to monitor rainbow smelt populations.
2. Develop means of sampling alewife populations.

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Table 1. Rainbow smelt sampling station locations in Lake Champlain. North and south refer to the approximate location of the northern and southern ends of the trawled transect.

Station name	Depth (meters)	Location (latitude and longitude)	
		North	South
Main Lake			
Barber Point	50 - 60	44 ° 10.85' 73 ° 23.64'	44 ° 08.97' 73 ° 23.74'
Juniper Island	70 - 90	44 ° 28.87' 73 ° 18.33'	44 ° 26.75' 73 ° 18.09'
Valcour Island	56 - 62	44 ° 38.50' 73 ° 23.50'	44 ° 36.50' 73 ° 23.50'
Malletts Bay			
Malletts Bay	22 - 32	44 ° 36.07' 73 ° 16.59'	44 ° 34.65' 73 ° 16.82'
Inland Sea			
Northeast Arm	22 - 40	44 ° 47.02' 73 ° 15.39'	44 ° 45.36' 73 ° 14.69'

Table 2. Mean catch per 55 minute trawl (CPUE with 95% confidence interval) of rainbow smelt in 2013 and comparison to pre- (1990-2004) and post-alewife invasion mean CPUE (2005-2013).

Station	Number of trawls	CPUE	Pre-Alewife Mean	Post-Alewife Mean	N years
Main Lake					
Barber Point	4	12 ± 9	206	357	20
Juniper Island	4	255 ± 83	180	195	24
Valcour Island	4	68 ± 40	423	165	14
Malletts Bay					
Malletts Bay	4	25 ± 6	1124	473	24
Inland Sea					
Northeast Arm	4	20 ± 11	1363	218	24

Table 3. Mean catch per 55 minute trawl of rainbow smelt in 2013 and comparison to long-term mean and median CPUE, pre- and post-alewife invasion.

	Barber Pt.	Juniper Is.	Valcour Is.	Malletts Bay	Northeast Arm
<i>All Years</i>					
Mean	274	186	257	880	934
Median	206	112	138	542	621
N	20	24	14	24	24
<i>1990-2004: Pre-Alewife Invasion</i>					
Mean	206	180	423	1124	1363
Median	138	111	285	654	1103
N	11	15	5	15	15
<i>2005-2013: Post-Alewife Invasion</i>					
Mean	357	195	165	473	218
Median	256	131	77	82	108
N	9	9	9	9	9

Table 4. Mean and maximum age of rainbow smelt sampled by station in 2013. Number in parenthesis is change from previous year.

Station	Mean age	Maximum age
Main Lake		
Barber/Juniper /Valcour	2.0 (+1.0)	3
Malletts Bay		
Malletts Bay	1.6 (-0.4)	3
Inland Sea Station		
Northeast Arm	2.0 (+0.5)	5

Table 5. Mean length and standard deviation in millimeters, by age class of rainbow smelt sampled in 2013. Number of smelt aged in parenthesis.

Station	Age 1	Age 2	Age 3	Age 4	Age 5	Age 6
Main Lake Stations						
Barber Point Juniper Island Valcour Island	98 ± 9 (21)	106 ± 7 (403)	128 ± 24 (13)	---	---	---
Malletts Bay						
Malletts Bay	103 ± 9 (27)	118 ± 7 (23)	145 ± 16 (3)	---	227 (1)	---
Inland Sea						
Northeast Arm	127 ± 6 (8)	138 ± 10 (50)	158 ± 5 (2)	---	200 ± 6 (2)	---

Table 6. Summary of young-of-year rainbow smelt and alewife (in parenthesis) collected during midwater smelt trawls, 1999-2013. Larger numbers are estimated based on weighed and counted subsamples.

Year	Barber	Juniper	Valcour	Malletts Bay	Northeast Arm
1999	4172	2588	830	3095	1690
2000	5667	1350	774	3629	881
2001	7961	13253	7378	103000	6015
2002	29	10	23	65	8
2003	3	109	397	57	230
2004	15	400	NA	102	397
2005	9717 (1)	700	6283	1022	798
2006	31350 (2)	624	561	1529	916
2007	129	109	1447 (1728)	5	392
2008	201 (1)	36	3796 (60)	187 (2308)	796 (244)
2009	0 (0)	450 (0)	349 (91)	485 (383)	35 (57)
2010	6 (75)	39 (74)	202 (659)	0 (0)	0 (est. 1400)
2011	est. 8990 (10)	3078 (15)	1034 (88)	est. 3240 (est. 2258)	986 (290)
2012	5 (23)	0 (43)	4 (26)	223 (1581)	30 (51)
2013	19 (28)	243 (487)	277 (859)	19 (669)	24 (est. 17252)

Table 7. Number, mean length (standard deviation) and range of young-of-year smelt sampled in 2013.

Station	Number Collected	Mean Length	Number Measured	Range
Main Lake				
Barber Point	19	39 ± 7	19	23 - 51
Juniper Island	243	35 ± 6	142	21 - 63
Valcour Island	277	42 ± 6	93	38 - 57
Malletts Bay				
Malletts Bay	19	31 ± 3	19	28 - 36
Inland Sea				
Northeast Arm	24	39 ± 3	24	38 - 57

Table 8a. CPUE of targeted acoustic trawls in 2012. For example sampling number AT120803001 is sample collected on 08/03/12 and is net number 001.

Sample	Gear	Area	Depth (m)	CPUE (10 minutes)							
				Alewife	Smelt	White Perch	Yellow Perch	Cypr Sp.	Centr Sp	Unknown Larval fish	Other
AT12073101	Mid	NEA	4.3	148.8	-	1.9	-	-	-	-	-
AT12073102	Tucker	NEA	8.3	-	-	-	-	-	-	-	-
AT12080101	Mid	NEA	1.6	16.7	-	-	-	-	-	-	-
AT12080102	Mid	NEA	18.8	0.6	2.4	1.8	-	-	-	-	-
AT12080103	Mid	NEA	13.6	1.0	6.0	5.0	-	-	-	-	-
AT12080201	Mid	North Main Lake	3.5	33.0	8.0	-	-	-	-	-	-
AT12080202	Mid	North Main Lake	8.6	23.0	46.0	-	-	-	-	-	-
AT12080203	Mid	North Main Lake	13.9	62.0	11.0	-	-	-	-	-	-
AT12080204	Tucker	North Main Lake	17	-	6.0	-	-	-	-	-	-
AT12080601	Tucker	South Main Lake	10.2	-	5.0	-	-	-	-	-	-
AT12080602	Mid	South Main Lake	27.5	0.5	49.0	-	-	-	-	-	0.5 (cisco)
AT12080603	Mid	South Main Lake	15.4	1.0	30.0	-	-	-	-	-	1 (salmon)
AT12080604	Mid	South Main Lake	13.2	4.3	-	-	-	-	-	-	-
AT12080801	Mid	Main Lake	5.4	37.0	0.5	-	-	-	-	-	-
AT12080802	Mid	Main Lake	14.2	10.0	4.0	-	-	-	-	-	-
AT12080803	Mid	Main Lake	17.7	3.0	63.0	-	-	-	-	-	-
AT12080804	Mid	Main Lake	5.7	54.0	-	-	-	-	-	-	-
AT12081301	Mid	Malletts	3.6	156.0	1.5	-	-	-	-	-	-
AT12081302	Mid	Malletts	12	757.5	14.0	1.0	0.5	-	-	-	-
AT12081303	Mid	Malletts	17.1	98.0	33.3	-	-	-	-	-	-

Table 8b. CPUE of targeted acoustic trawls in 2013. For example sampling number AT130803001 is sample collected on 08/03/13 and is net number 001.

Sample	Gear	Area	Depth (m)	CPUE (10 minutes)							
				Alewife	Smelt	White Perch	Yellow Perch	Cypr Sp.	Centr Sp	Unknown Larval fish	Other
AT13073101	Mid	Malletts	5	625	-	-	-	-	-	-	-
AT13073102	Mid	Malletts	6.5	2494.5	1	-	-	-	-	-	-
AT13073103	Tucker	Malletts	8.7	271	-	-	-	-	-	-	-
AT13073104	Tucker	Malletts	5	193	-	-	-	-	-	-	-
AT13080601	Mid	NEA	5.2	578	-	-	-	-	-	-	-
AT13080602	Tucker	NEA	8.1	10	-	-	-	-	-	-	-
AT13080603	Tucker	NEA	12.2	176	-	-	-	-	-	-	-
AT13080604	Tucker	NEA	13.8	8	-	-	-	-	-	-	-
AT13080605	Tucker	NEA	17.4	25.7	8.6	-	-	-	-	-	-
AT13081301	Mid	South Main Lake	3.8	431	-	2	-	-	-	-	-
AT13081302	Mid	South Main Lake	35.7	47.4	2.6	-	-	-	-	-	-
AT13081501	Mid	Main Lake	9.4	85	5	-	-	-	-	-	-
AT13081502	Mid	Main Lake	4.2	31.5	3	-	-	-	-	-	-
AT13081503	Mid	Main Lake	32.9	14.7	29.3	-	-	-	-	-	0.7 (cisco)
AT13081504	Mid	Main Lake	14	476.9	63.1	-	-	-	-	-	-
AT13081901	Mid	Main Lake	8.5	45	-	-	-	-	-	-	-
AT13081902	Mid	Main Lake	14.5	5.5	6	-	-	-	-	-	-
AT13081903	Mid	Main Lake	9.2	4	25	-	-	-	-	-	-
AT13081904	Mid	Main Lake	40.1	0.7	11.3	-	-	-	-	-	-
AT13082001	Mid	North Main Lake	10.8	-	2.5	-	-	-	-	-	-
AT13082002	Mid	North Main Lake	16.1	30.8	1.5	-	-	-	-	-	-
AT13082003	Tucker	North Main Lake	3.6	-	-	-	-	-	-	-	-
AT13082004	Tucker	North Main Lake	7.8	-	1.8	-	-	-	-	-	0.5 (sculpin)
AT13082005	Mid	North Main Lake	38.5	1.5	10.8	-	-	-	-	-	0.4 (sculpin)

Table 9. Floating gill net catch per 4 hour set (expanded from total minutes fished) of alewife in 2008 - 2013. YOY = young of year; YAO = yearling and older.

2008			
Station	Sample No.	YOY	YAO
Main Lake			
Barber Point	FGN08080401	2.5	0
Potash Bay	FGN08080501	16.6	60.7
Juniper Island	FGN08072101	0	101.6
Valcour Island	FGN08081201	305.2	155.2
Malletts Bay			
Malletts Bay	FGN08081101	33.8	2.2
Inland Sea			
Ladd Point	FGN08072801	0	0
Knight Island	FGN08073001	0.7	7.4
2009			
Station	Sample No.	YOY	YAO
Main Lake			
Barber Point	FGN09081001	0	119.1
Barber Point (same location as above)	FGN09081201	0	6.7
Button Bay	FGN09081202	0	2.3
Juniper Island	FGN09081701	17.4	106
Valcour Island	FGN09081801	14	93
Cumberland Head	FGN09080601	4.5	35.6
Malletts Bay			
Malletts Bay	FGN09073001	5.4	47.9
Inland Sea			
Ladd Point	FGN09080301	3.1	30.9
Hyde Point	FGN09080501	20.8	13.2
Savage Island	FGN09080502	4.2	8.9

Table 9. Continued.

2010			
Station	Sample No.	YOY	YAO
Main Lake			
Barber Point	FGN10080901	172.7	193.6
Hunter Bay	FGN10081001	136.3	77.7
Juniper Island	FGN10082301	26.9	7.0
Starr Farm Beach	FGN10081201	28.5	3.2
Valcour Island	FGN10072901	44.7	226.0
Valcour Island	FGN10072902	19.6	279.3
Cumberland Head	FGN10080501	101.7	121.5
Malletts Bay			
Malletts Bay	FGN10072701	8.1	77.0
Inland Sea			
Ladd Point - South	FGN10080201	34.6	74.2
Woods Island	FGN10073001	3.0	40.7

Table 9. Continued.

2011			
Station	Sample No.	YOY	YAO
Main Lake			
Barber Point	FGN11081501	lost	lost
Shelburne Point	FGN11081701	14.9	0
Juniper Island	FGN11082301	31	42.2
Valcour Island	FGN11080101	130.4	87
Martin Point	FGN11081101	53.6	0
Malletts Bay			
Malletts Bay	FGN11080201	12.5	33.7
Malletts Bay	FGN11080301	61.3	58
Inland Sea			
Northeast Arm	FGN11080801	1.1	11.7
Savage Island	FGN11081001	7.5	7.5

Table 9. Continued.

2012			
Station	Sample No.	YOY	YAO
Main Lake			
Barber Point	FGN12080601	3.2	399
Juniper Island	FGN12072501	0	57.9
Valcour Island	FGN12072601	2.6	25.8
Martin Point	FGN12080201	0.9	2.7
Malletts Bay			
Malletts Bay	FGN12081301	68.1	1.9
Malletts Bay	FGN12081401	3.8	0.9
Inland Sea			
Northeast Arm	FGN12073001	91.8	96.3
Savage Island	FGN12073101	16.3	70.6

2013			
Station	Sample No.	YOY	YAO
Main Lake			
Barber Point	FGN13081201	9.1	131.3
Juniper Island	FGN13072901	10.1	20.2
Valcour Island	FGN13081101	145.1	27.2
Malletts Bay			
Malletts Bay	FGN13073001	5.1	11.1
Inland Sea			
Northeast Arm	FGN13080501	38.1	35.6

Table 10. Numbers of adult alewife collected by midwater trawl and during community monitoring in 2013. Community monitoring was conducted June 24-26 utilizing gillnets and bottom trawling.

Lake Basin	Midwater Trawl	Community Monitoring
Main Lake	22	88
Malletts Bay	27	7
Inland Sea	8	66

Table 11. Mean total length and standard deviation in millimeters, by age class of alewife sampled by floating gill net (July 29 – August 12) and during community monitoring (June 24 – 26) in 2013. Number of alewife aged in parenthesis.

Floating Gill Nets				
YOY	Age 1	Age 2	Age 3	Age 4
Main Lake Stations				
56 ± 5 (74)	128 ± 7 (23)	139 ± 8 (89)	---	---
Malletts Bay				
54 ± 2 (5)	118 ± 3 (4)	152 ± 21 (3)	---	---
Inland Sea				
---	---	151 ± 8 (25)	---	---
Community Monitoring				
YOY	Age 1	Age 2	Age 3	Age 4
Main Lake Stations				
---	119 ± 8 (6)	147 ± 23 (47)	190 (1)	225 (1)
Malletts Bay				
---	---	170 ± 6 (3)	---	---
Inland Sea				
---	119 ± 6 (4)	147 ± 16 (46)	167 ± 11 (3)	---

Table 12. Summary of total numbers of cisco collected, 1990-2013. Only one cisco has been collected in the Inland Sea (in 1991). Data prior to 1999 should be viewed cautiously. N/A = no sampling occurred.

Year	Barber Point	Juniper Island	Valcour Island	Malletts Bay
1990	N/A	15	N/A	1
1991	N/A	25	N/A	3
1992	N/A	34	N/A	12
1993	22	0	N/A	0
1994	0	0	N/A	0
1995	30	14	N/A	3
1996	19	15	N/A	4
1997	11	25	N/A	11
1998	N/A	45	N/A	2
1999	122	13	31	7
2000	51	20	31	1
2001	47	26	152	3
2002	26	94	139	1
2003	49	40	7	0
2004	65	37	N/A	0
2005	43	22	31	3
2006	17	10	17	0
2007	7	0	15	0
2008	16	13	10	1
2009	0	9	13	0
2010	4	9	16	0
2011	3	13	29	0
2012	12	8	11	0
2013	0	0	1	0

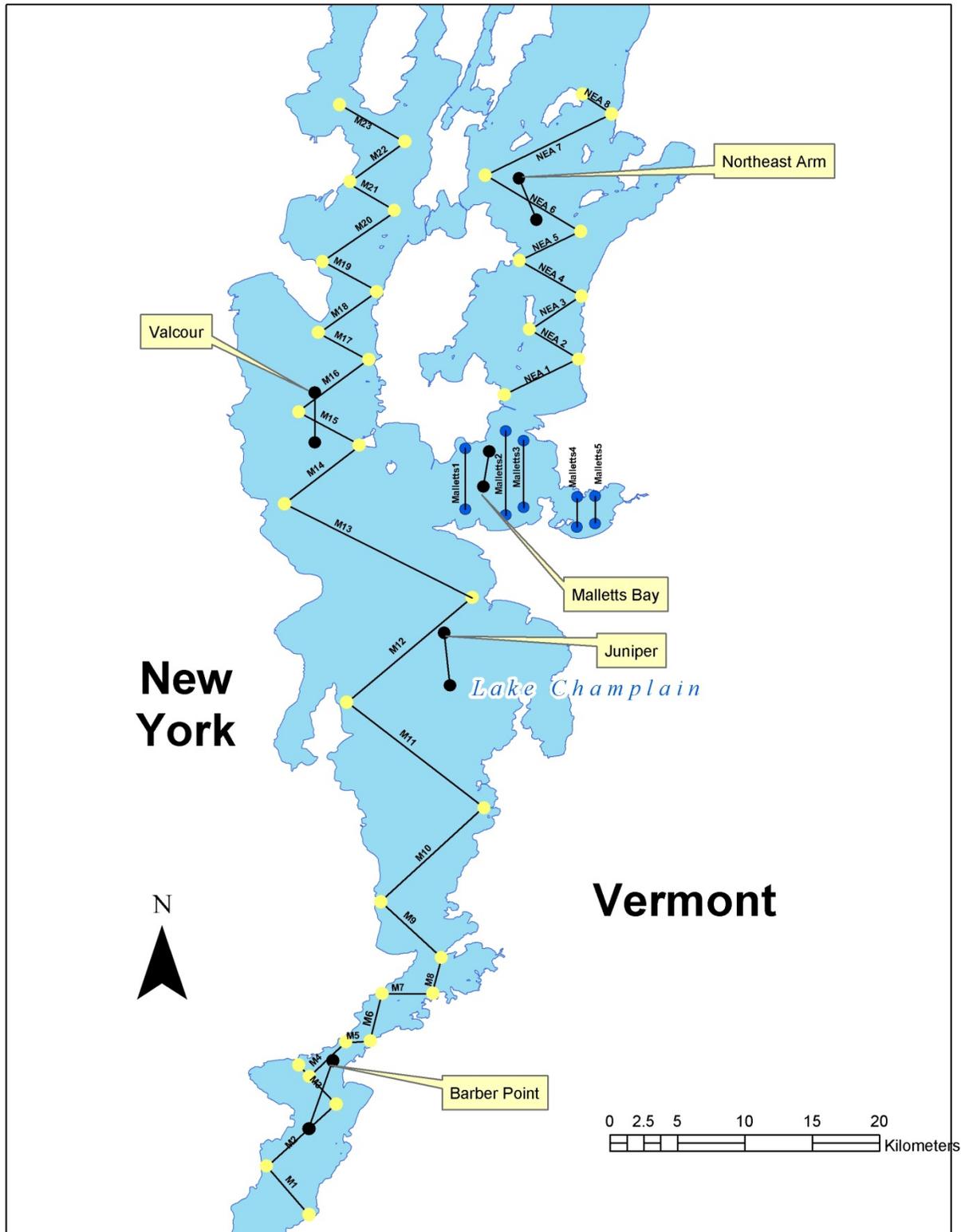


Figure 1. Rainbow smelt sampling stations (text boxes) and acoustic transects with transect name.

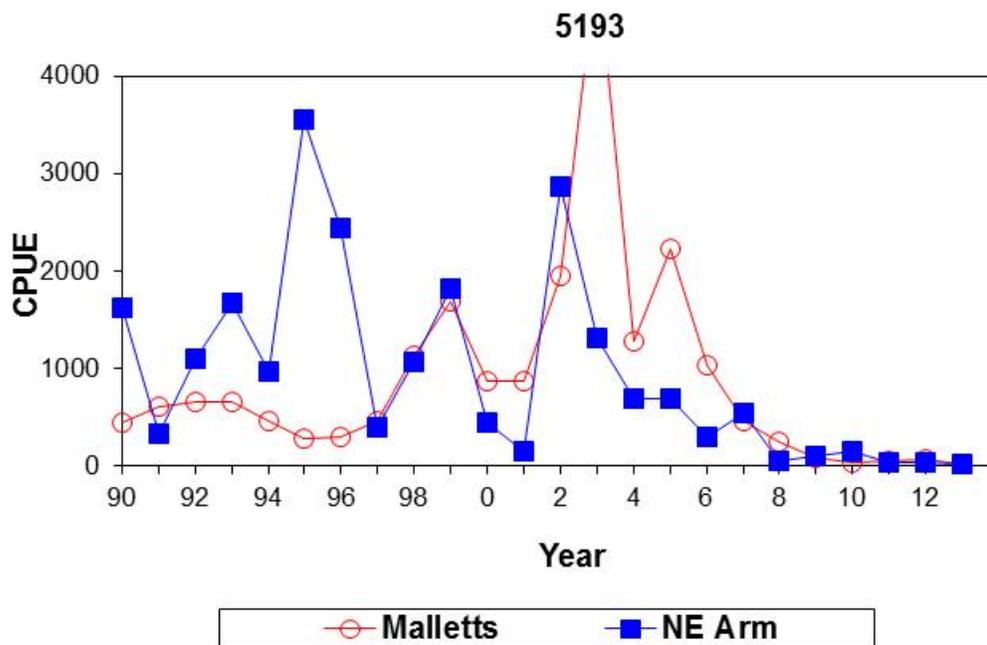
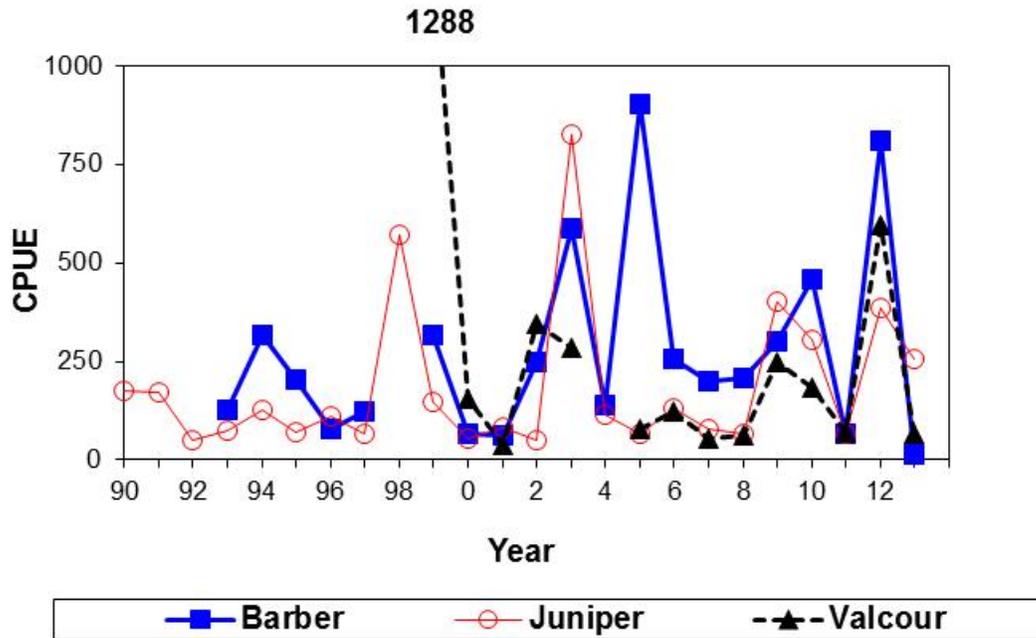


Figure 2. Mean CPUE of smelt for Lake Champlain, 1990-2013.

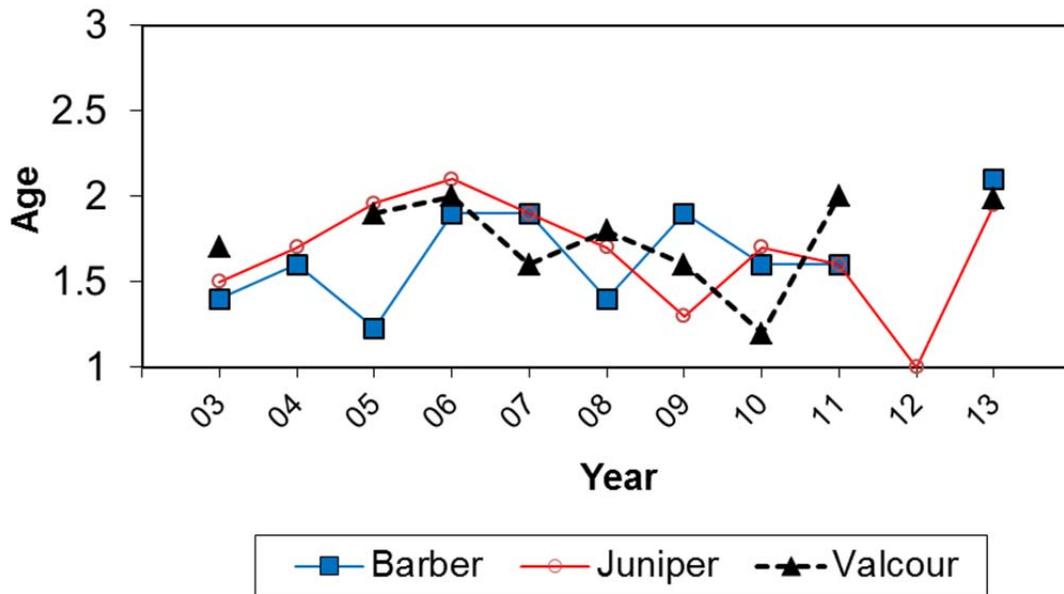


Figure 3. Mean age of rainbow smelt sampled at three main lake stations, 2003-2013.

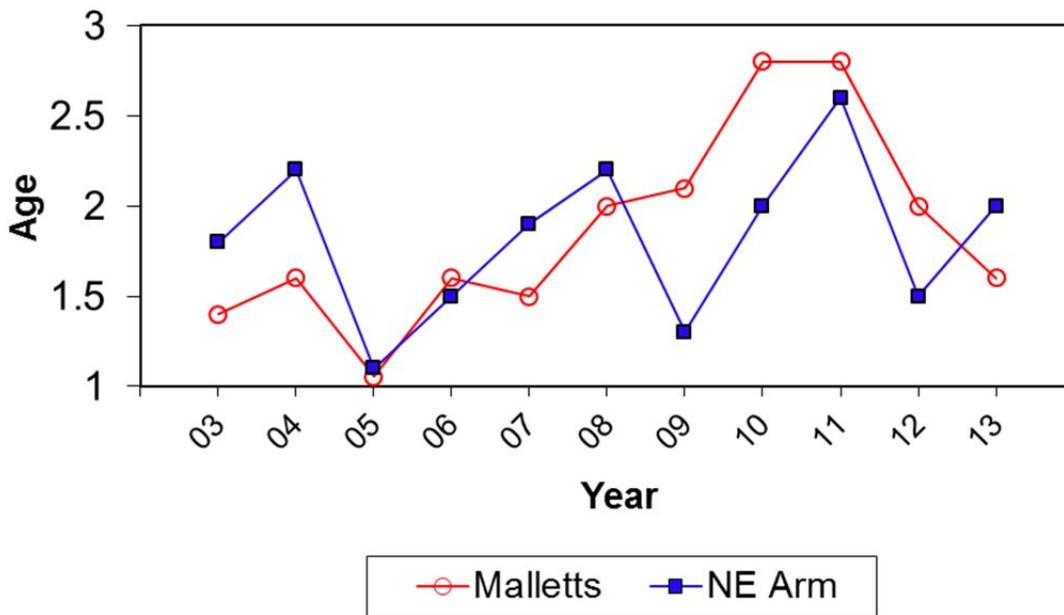


Figure 4. Mean age of rainbow smelt sampled at Malletts Bay and the Northeast Arm stations, 2003-2013.

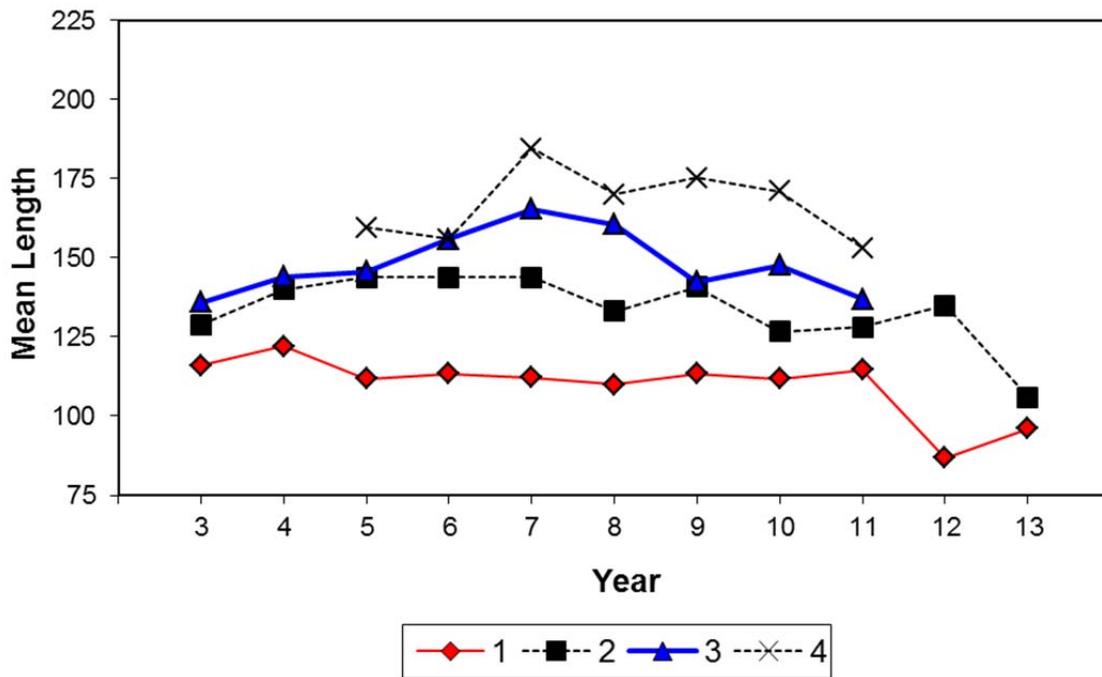


Figure 5. Mean length (mm) at age of rainbow smelt sampled at Juniper Island, 2003 - 2013.

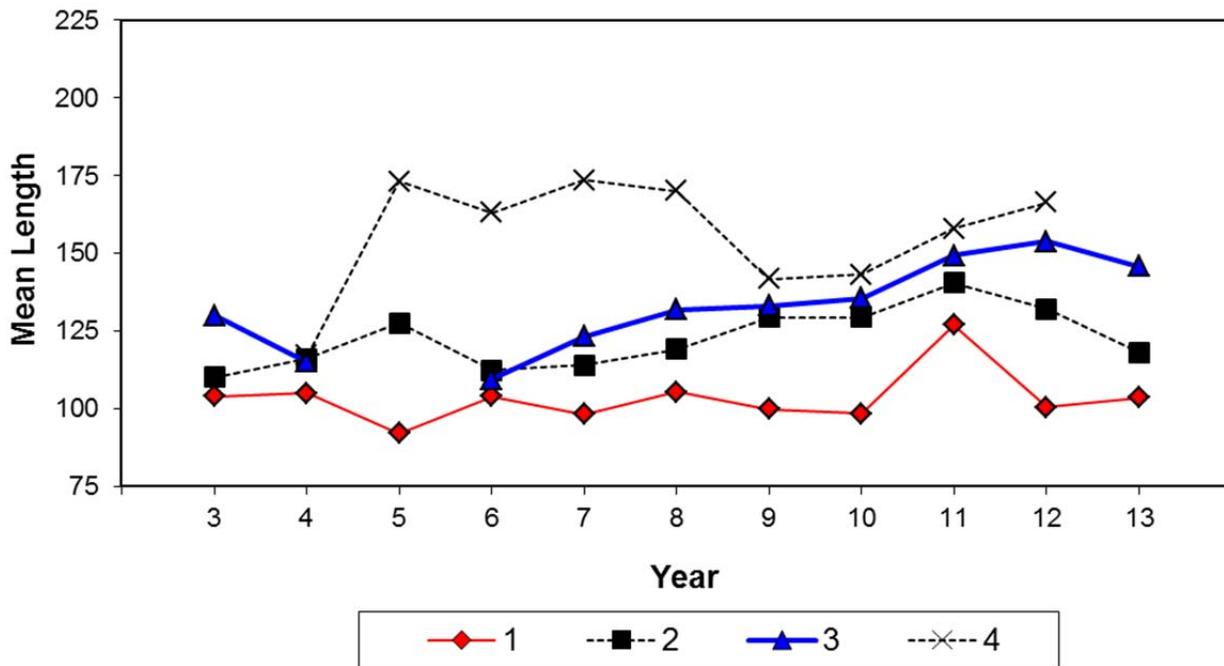


Figure 6. Mean length (mm) at age of rainbow smelt sampled in Malletts Bay, 2003 - 2013.

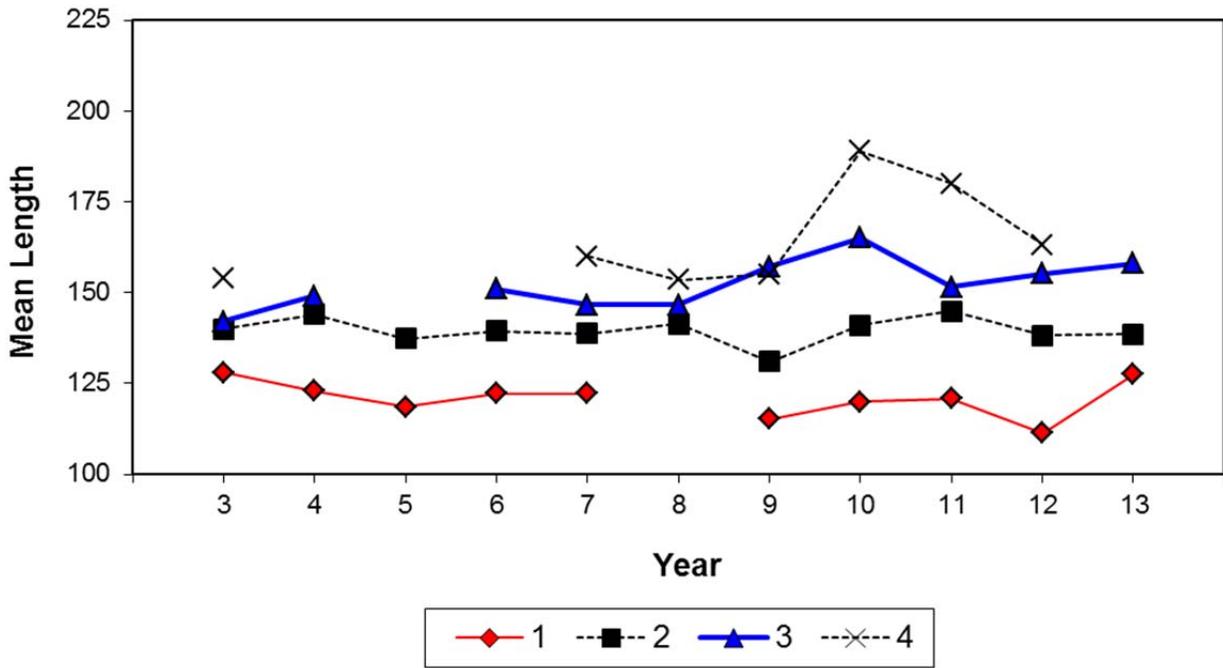


Figure 7. Mean length (mm) at age of rainbow smelt sampled in the Northeast Arm, 2003 - 2013.

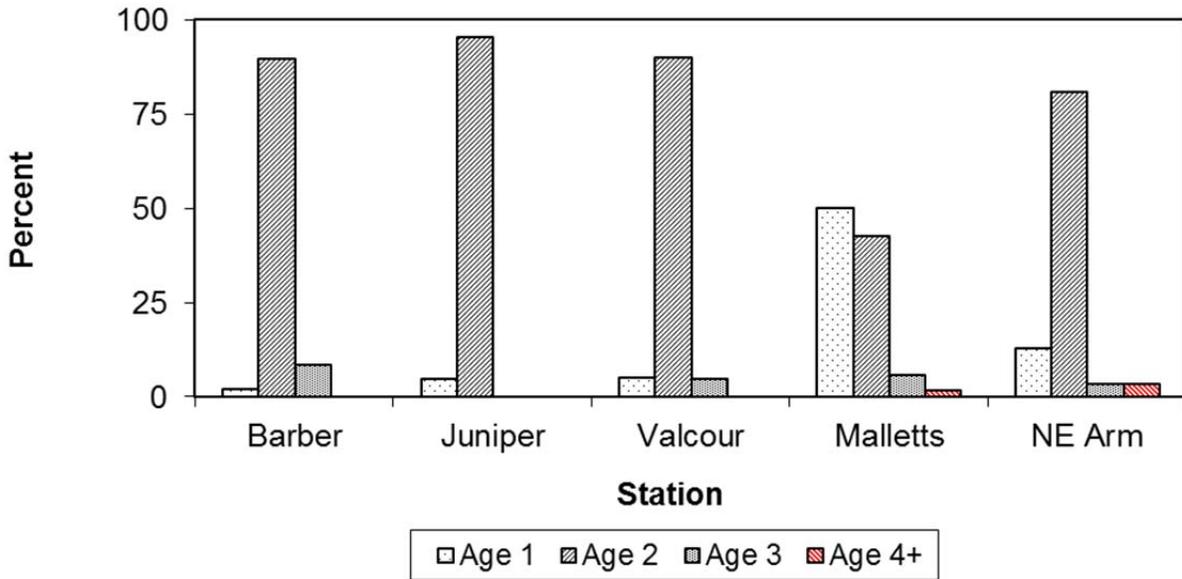


Figure 8. Percent composition by age class of rainbow smelt sampled in Lake Champlain in 2013.

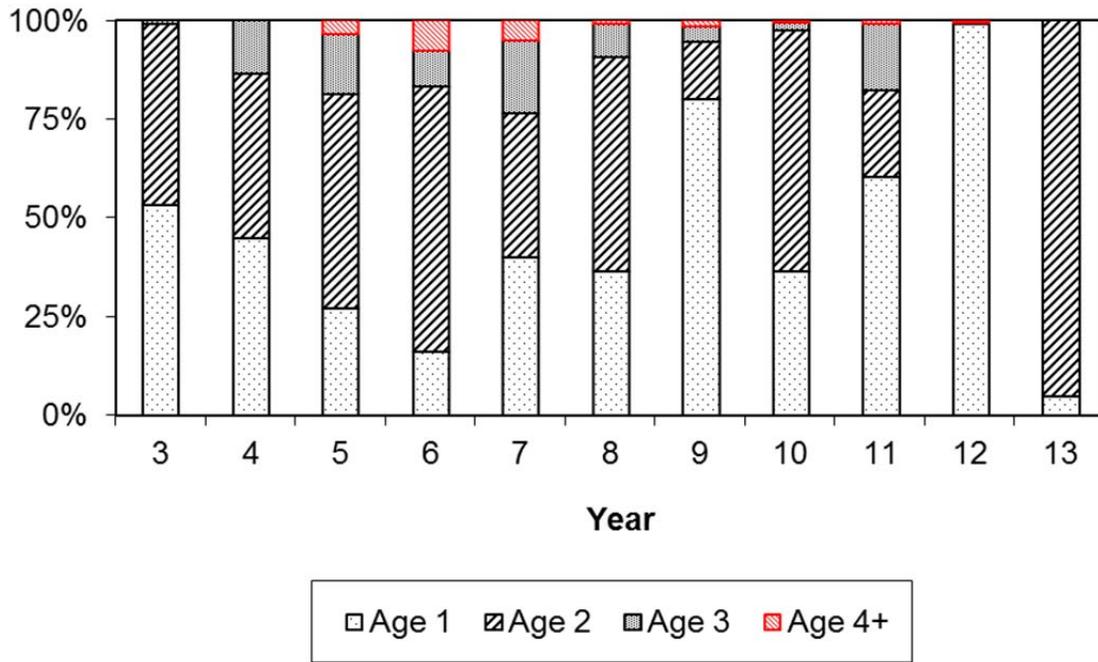


Figure 9. Percent composition by age class for rainbow smelt sampled at Juniper Island, 2003 - 2013.

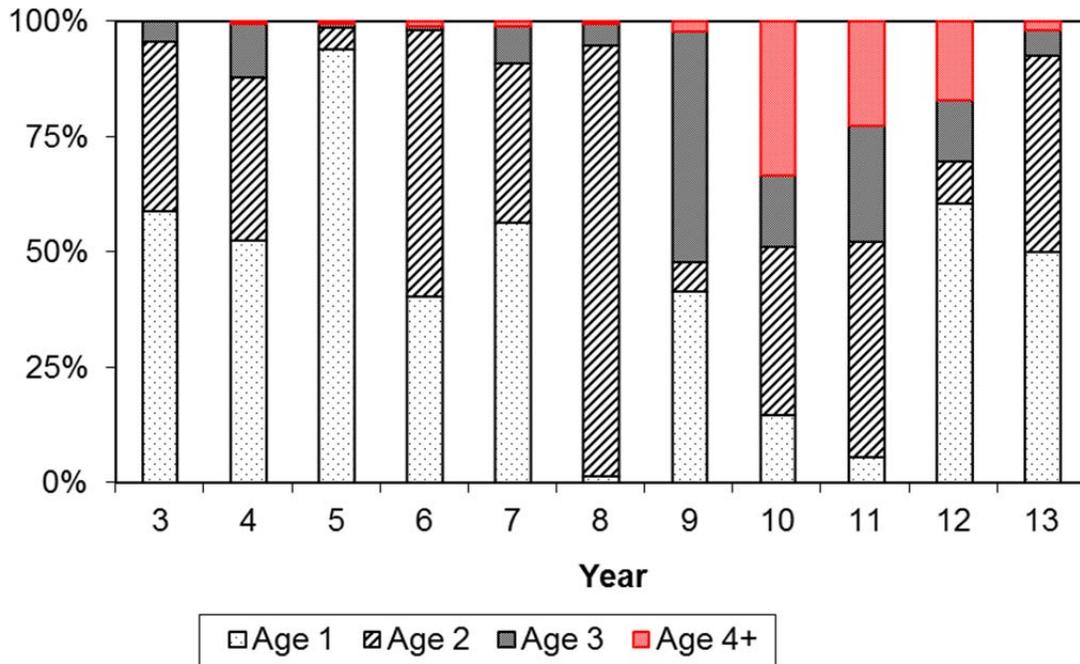


Figure 10. Percent composition by age class for rainbow smelt sampled in Malletts Bay, 2003 - 2013.

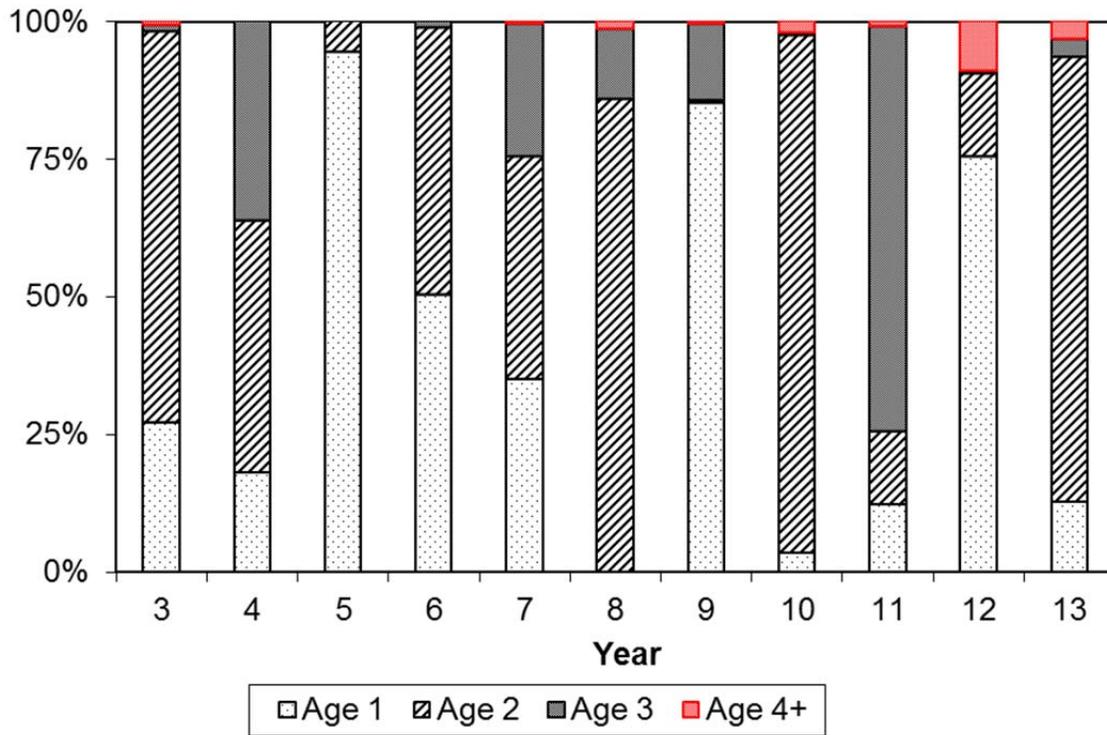


Figure 11. Percent composition by age class for rainbow smelt sampled in the Northeast Arm 2003 - 2013.

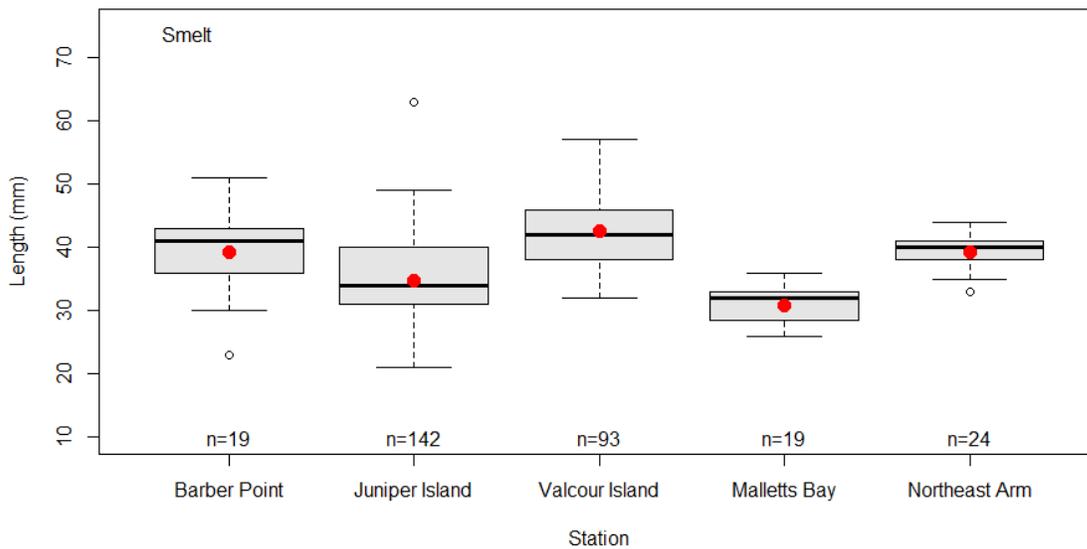


Figure 12. Box plots of length with mean (red dot) of young-of-year rainbow smelt sampled in 2013.

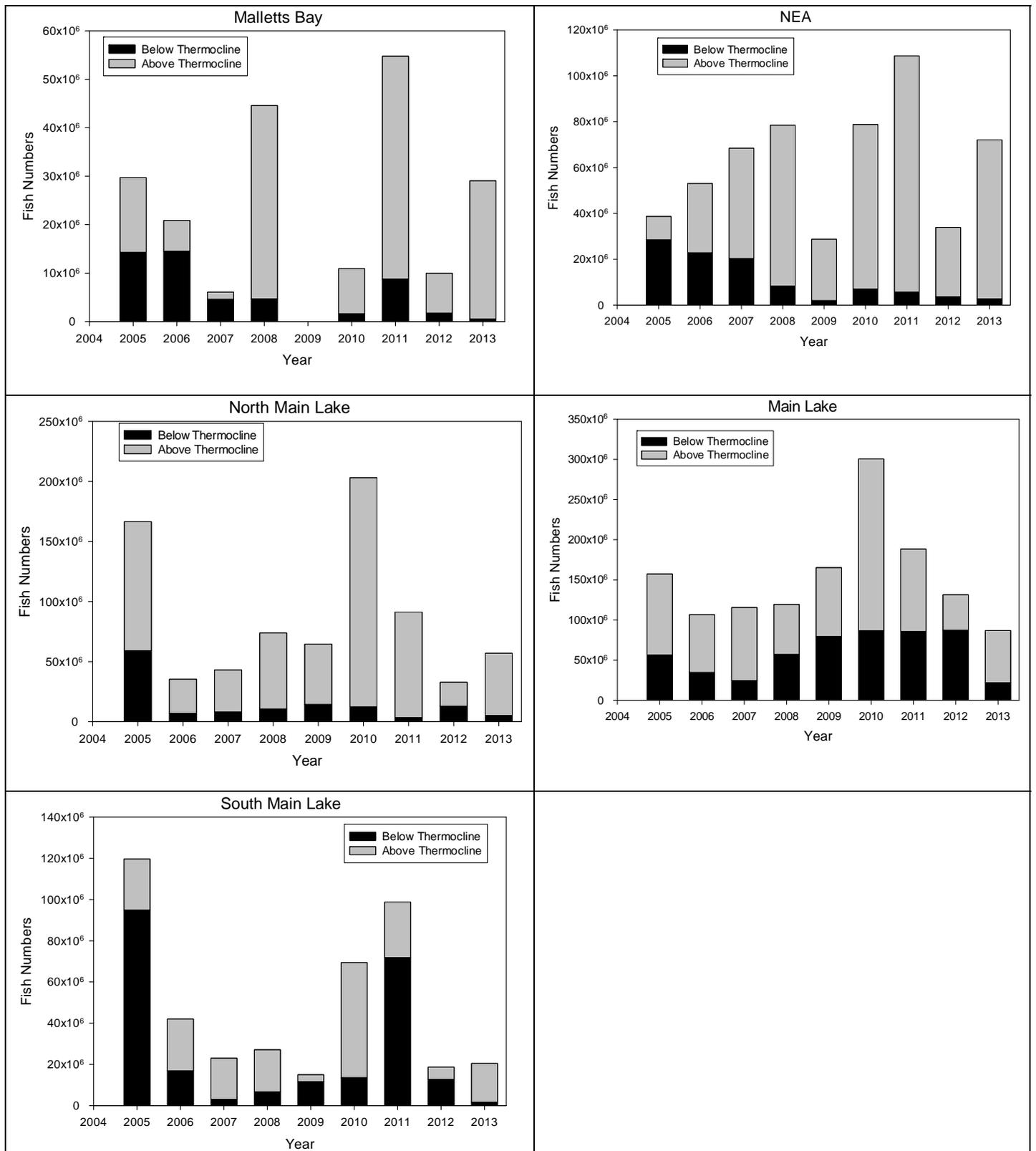


Figure 13. Estimated numbers of yearling and older fish (>-61 dB) in different areas of Lake Champlain from Acoustic data. Rainbow smelt are the primary fish found below the thermocline. Common species found above the thermocline include white perch and alewives.

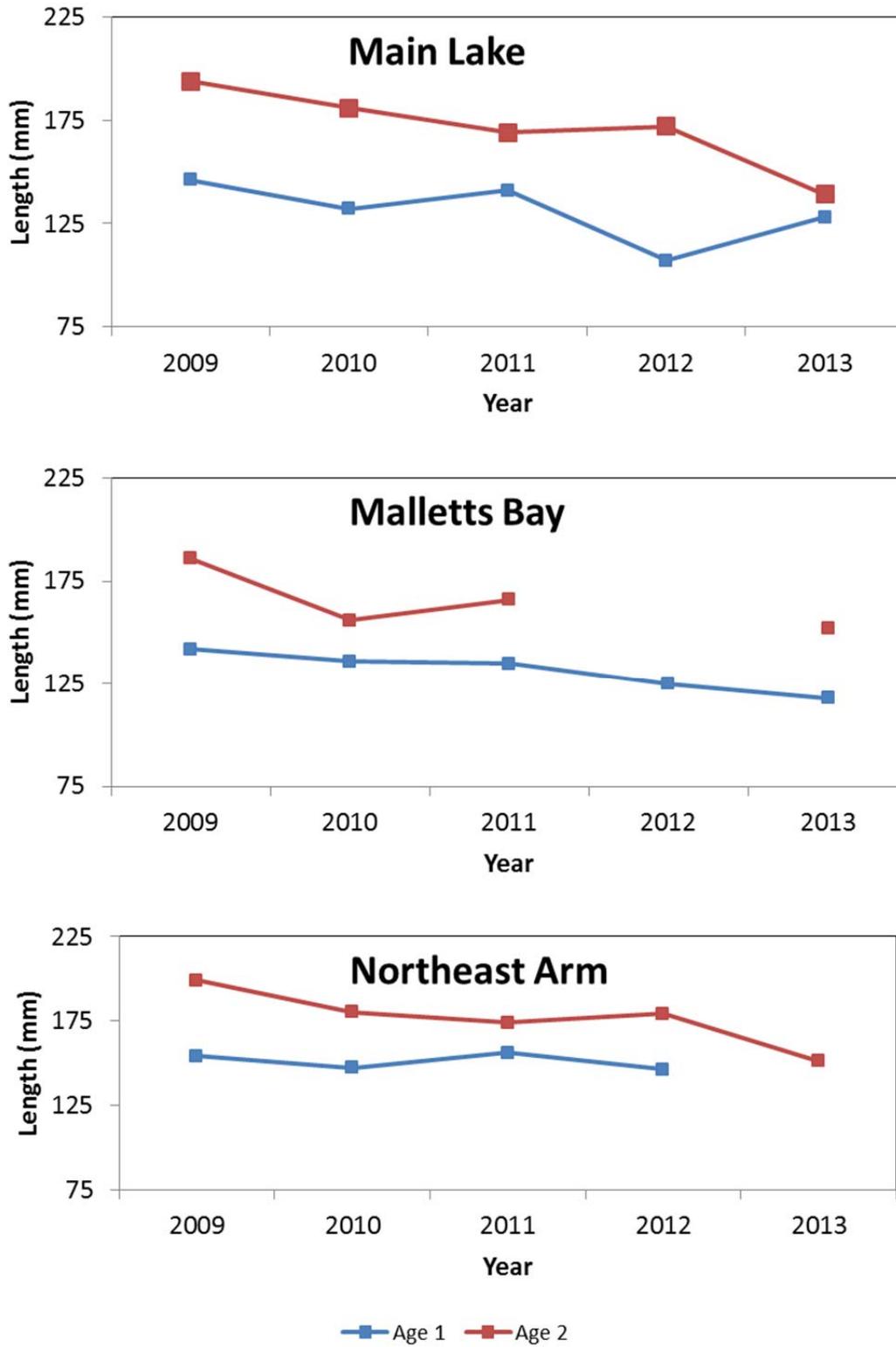


Figure 14. Mean length (mm) at age of alewife sampled by floating gillnet, 2009 – 2013.

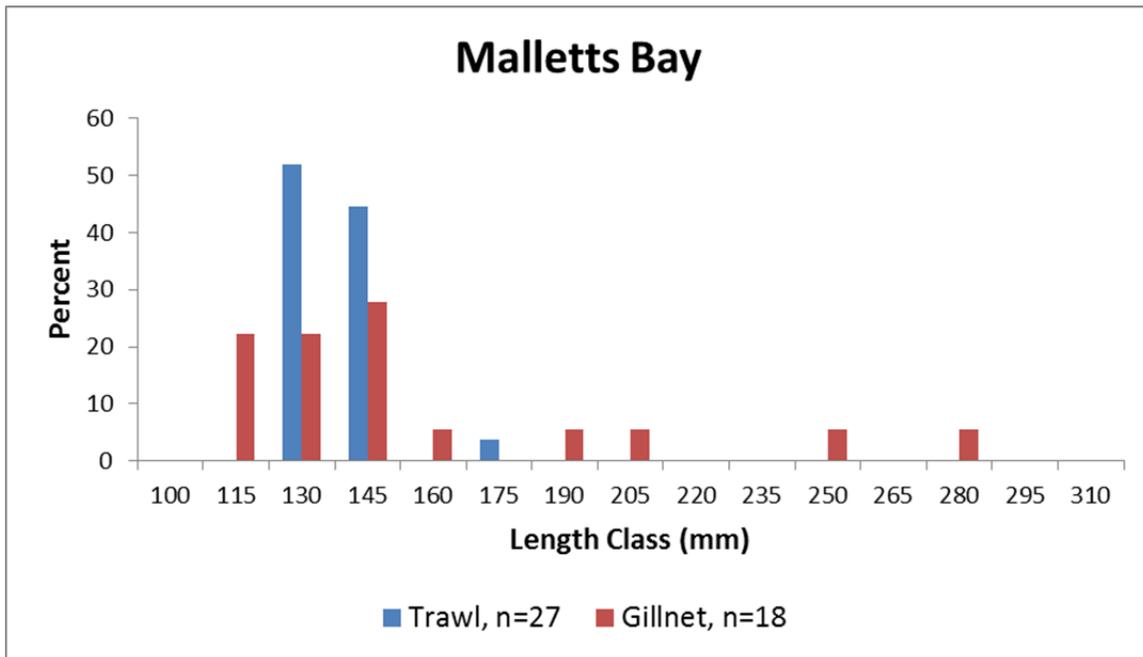
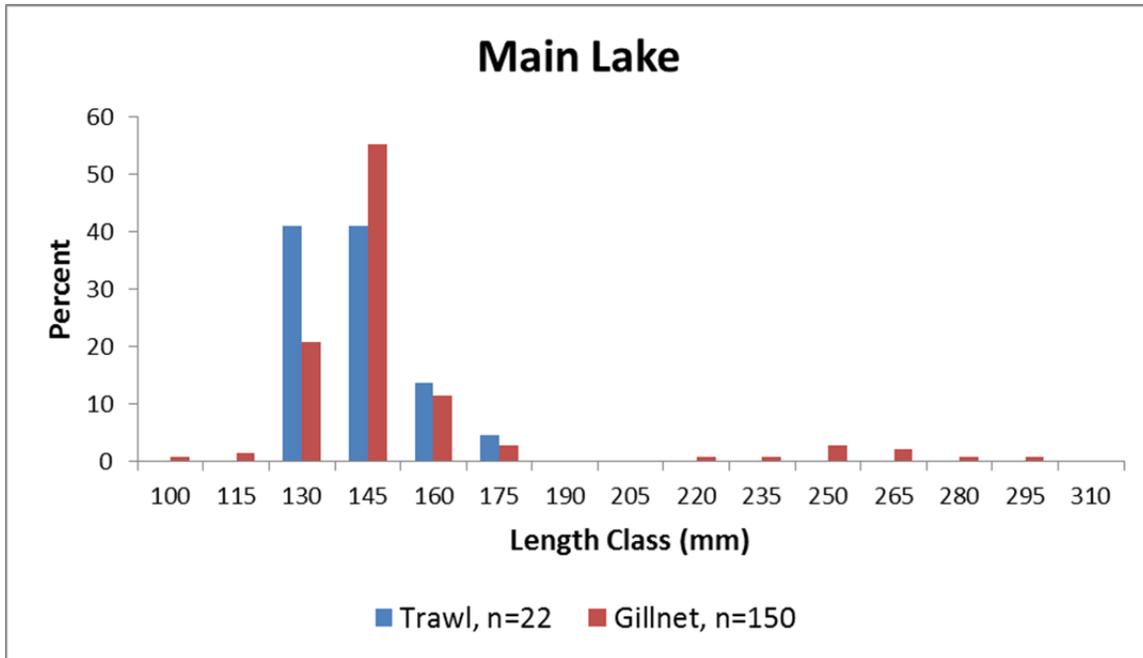


Figure 15. Length frequency charts comparing alewife collected in the main lake and Malletts Bay by midwater trawls and floating gill net.

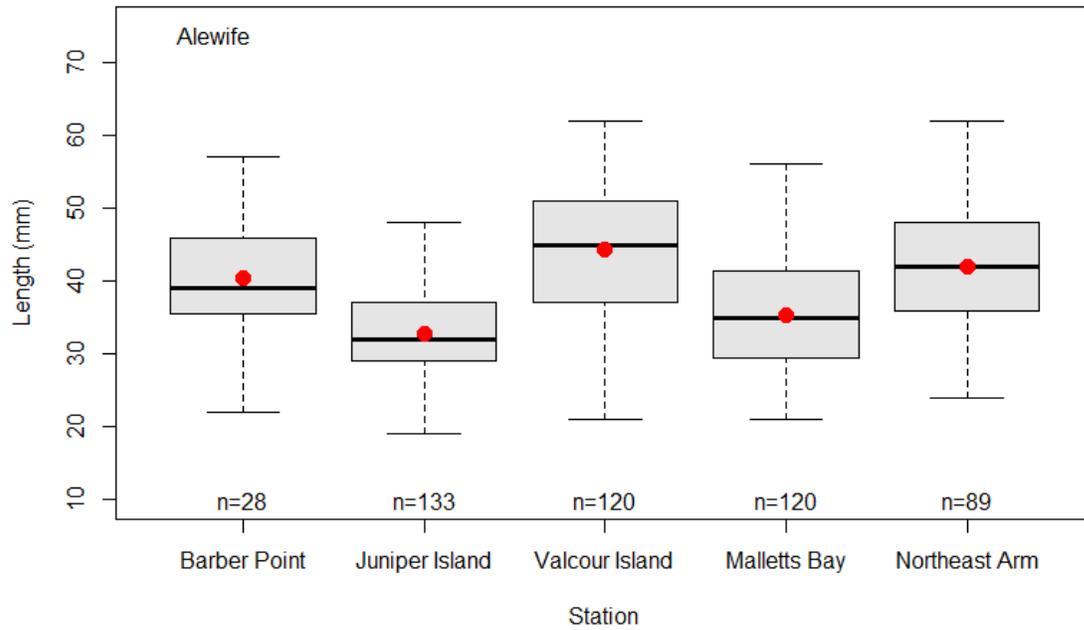


Figure 16. Box plots of length with mean (red dot) of young-of-year Alewife sampled in 2013.

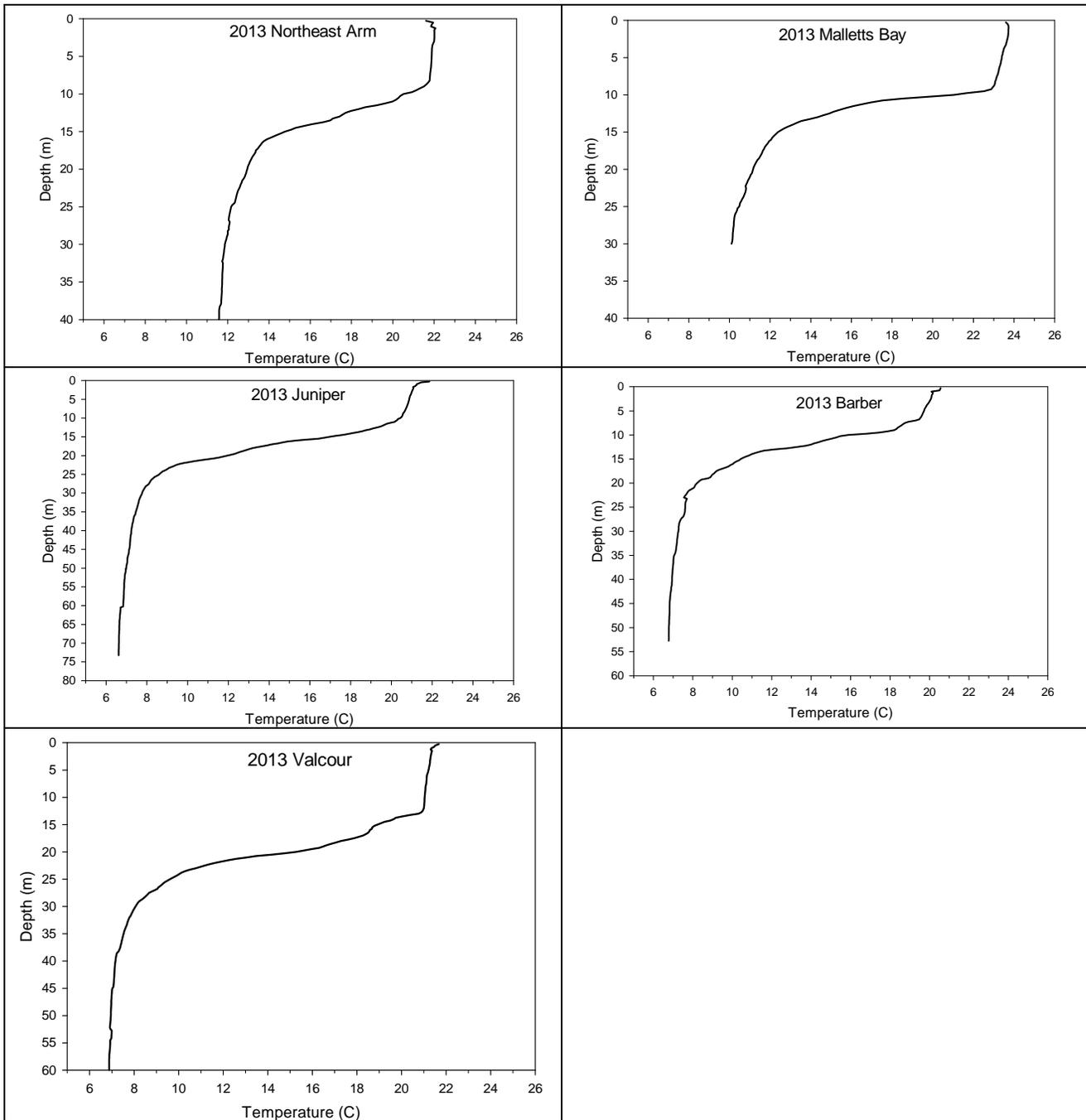


Figure 17. Temperature profiles collected in 2013 at the five standard trawling stations: Northeast Arm, Malletts Bay, Juniper, Barber Point, and Valcour.