4.0 MACROINVERTEBRATE COLLECTIONS

4.1 METHODS OF COLLECTION AND PROCESSING

Macroinvertebrate sampling station locations have changed with modifications to the NPDES Permit. The upstream stations were eliminated in 2000 and Station 2 was relocated in 2001 (Normandeau Associates 2001 and 2002).

Macroinvertebrate samples were collected in June, August, and October of 2005 at Stations 2 and 3 below Vernon Dam as specified in Vermont Yankee's NPDES permit. Three replicate rock baskets (cage samplers) were deployed at each of the two stations: Station 2 (substation 227) and Station 3 (substation 031, Figure 4-1). Station 2, near the Vermont shore, is the most downstream sampling station and is approximately 10-12ft deep with a substrate of cobble, boulders, and mud. Station 3, near the New Hampshire shore, is the most upstream sampling station and is located in an eddy bordered by a swift-water riffle area approximately 10ft deep with a sandy substrate.

Rock baskets used in 2005 and in previous surveys were made of one-inch square, 14-gauge galvanized wire with a PVC coating. The cylindrical basket measured 6.5in diameter width X 11in long. Each rock basket was filled with clean, cobble-sized rocks (2.5in to 4in diameter) from the Connecticut River.

The three replicate rock baskets were deployed at each station for approximately four weeks. At the end of the sampling period, rock baskets were retrieved from the river and placed into individual 5-gallon buckets. The rocks of each replicate sample were rinsed of attached organisms into a number 30 sieve (600μm mesh openings). The contents of each sample were preserved in 70% ethanol in a sample container labeled with date, time, station, and sample number, and taken to the laboratory for later processing.

Rock baskets were deployed at Stations 2 and 3 on 1 June, 1 August, and 3 October 2005, and retrieved on 5 July, 2 September, and 1 November, respectively.

In the laboratory, the contents of each macroinvertebrate rock basket sample were examined in entirety under low magnification (2x) to separate and sort the organisms from sediment and detritus. Identification of organisms to the lowest possible taxonomic level, given their life stage and condition, was completed using dissecting (45x) and compound (1,000x) microscopes. Dipterans and oligochaetes were separated by subfamily, tribe, or recognizable type prior to identification to the genus/species level. All or representative subsamples from each grouping were prepared by clearing and mounting, and then identified with a compound microscope. Where subsampled, the number of specimens identified to genus/species was used to apportion the remaining individuals from each group into specific taxa. In instances where dipteran or oligochaete specimens could be identified to genus or species without the aid of a compound microscope, no preparation was necessary. Taxonomic keys used to identify all specimens in addition to dipterans and oligochaetes, were: Burks (1953), Hitchcock (1974), Burch (1975), McCafferty (1975), Brown (1976), Simpson and Bode (1980), Wiederholm (1983), Klemm (1985), Roback (1985), Brinkhurst (1986), Peckarsky (1990), Jokinen (1992), Merritt and Cummins (1996), Wiggins (1996).

4.2 RESULTS

From the 18 rock basket samples collected in 2005, 805 macroinvertebrates of 18 orders were collected, identified and enumerated (Table 4-1). A total of 477 benthic macroinvertebrates were collected from rock baskets deployed at Station 2, and 328 benthic macroinvertebrates were collected from rock baskets deployed at Station 3 during the three sampling periods in 2005 (Table 4-1). The majority of the annual collection consisted of mayflies (Ephemeroptera, 54.16%) and true flies (Diptera, 20.37%, Table 4-1). Macroinvertebrates representing 82 identifiable species were collected in 2005. The species collected most often at both stations was *Stenacron interpunctatumm*, a mayfly.

At Station 2, 105 macroinvertebrates were collected in June, 135 in August, and 237 in October, representing 14 orders (Table 4-2). Mayflies (Ephemeroptera, 59.96%) constituted the majority of the collection in all months. However, in August mollusks (Mollusca, 31.11%) were a close second to the dominant mayflies (32.59%). Other macroinverebrates collected at Station 2 during the three sampling periods included mollusks (Mollusca, 12.37%), true flies (Diptera, 9.85%) and caddisflies (Trichoptera, 9.01%, Table 4-2). Macroinvertebrates of 54 species were collected at Station 2 during the three sampling periods.

At Station 3, 43 macroinvertebrates were collected in June, 248 in August, and 37 in October, representing 15 orders. Mayflies (Ephemeroptera, 45.73%) and true flies (Diptera, 35.67%) represented the majority of macroinvertebrates collected as none of the other species comprised over 4% of the total collection. The August collection at Station 3 represented the greatest number of macroinvertebrates collected during the season. Macroinverebrate of 57 species were collected from Station 3.

When comparing collections from the two stations the most obvious difference was the number of macroinvertebrates collected in the October sample. October was the month that the greatest number of maroinvertebrates (237 macroinvertebrates) were collected at Station 2, and the month the smallest number were collected at Station 3 (37 macroinvertebrates). While differences in community composition and abundance exist between these two stations, a number of environmental dissimilarities exist such as substrate size and mobility, and the character of organic matter, which may affect community composition to some degree and help explain the observed differences. Furthermore, high river flows during the October 2005 incubation period (Figure 2-3) resulted in spill conditions at Vernon Dam that may have disturbed the rock basket samplers deployed at Station 3, which is located closer to Vernon Dam than Station 2 (Figure 4-1).

The macroinvertebrate communities found at both Stations 2 and 3 during 2005 exemplify what could be expected from their location in the mainstem of the Connecticut River watershed (Vanote 1980). This community was dominated by Ephemeropterans whose primary mode of foraging is the collection and filtering of particulate detritus. Species of Diptera, also a dominant member of this macroinvertebrate community, represent a diversity of functional feeding groups (collector gatherers, collector filters, herbivores and predators). In addition, benthic periphyton consumers and an assemblage of dominant predatory taxa accompany these taxa.

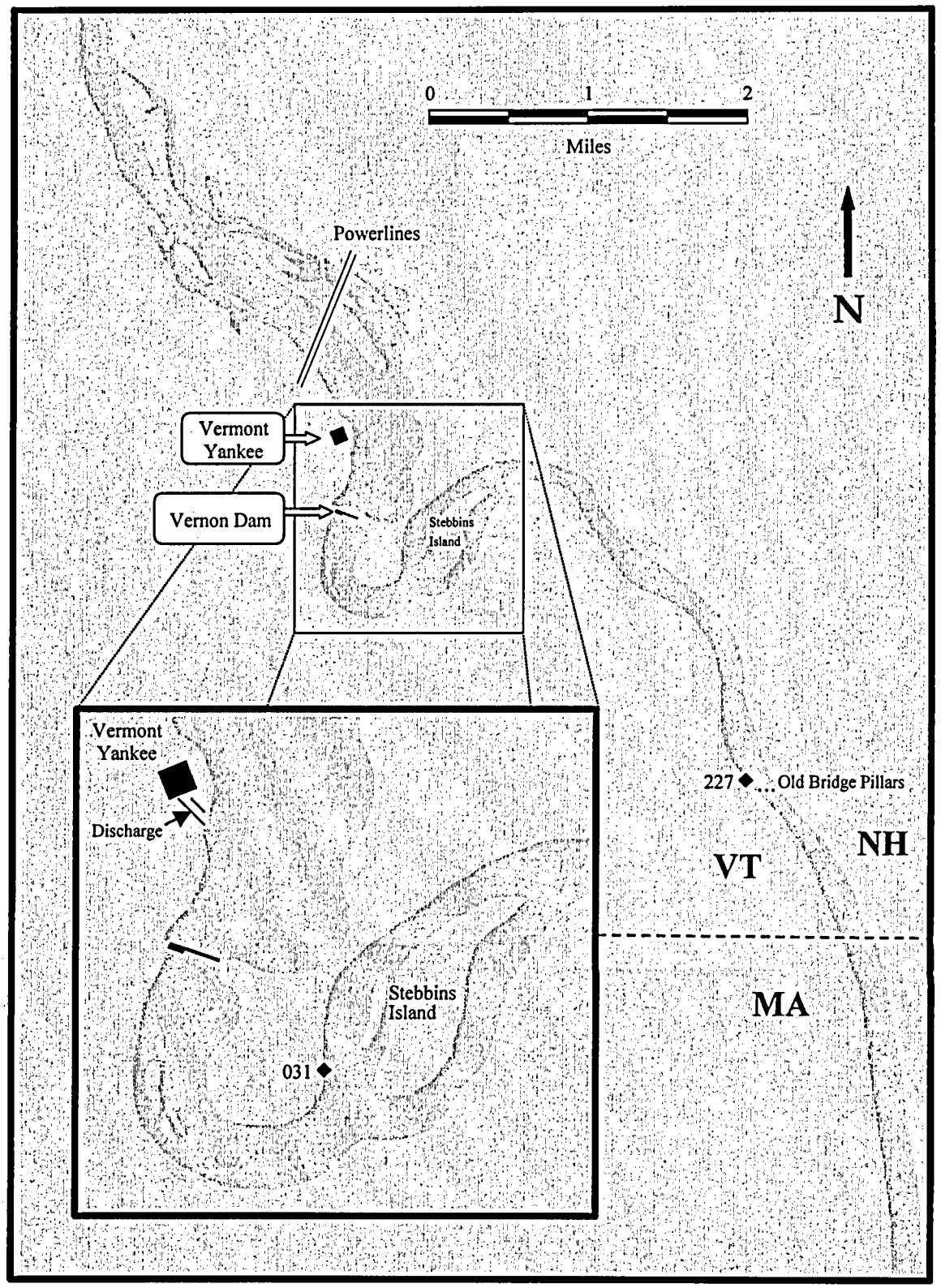

Figure 4-1. NPDES macroinvertebrate rock basket sampling at Stations 227 and 031.

Table 4-1. Total Number, Mean of Three Replicates, and Percentage of Total Macroinvertebrates Collected at Stations 3 and 2 during the combined sampling periods of June, August, and October 2005.

Taxon		STATION								
		Station 3 NH			Station 2 VT (South)			All		
		Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Nematoda	Nematoda	0	0	0	1	0.1	0.21	1	0.1	0.12
	Subtotal	**0**	**0**	**0**	**1**	**0.1**	**0.21**	**1**	**0.1**	**0.12**
Turbellaria	Dugesia tigrina	9	1	2.74	1	0.1	0.21	10	0.6	1.24
	Subtotal	**9**	**1**	**2.74**	**1**	**0.1**	**0.21**	**10**	**0.6**	**1.24**
Hoplonemertea	Prostoma graescense	1	0.1	0.3	0	0	0	1	0.1	0.12
	Subtotal	**1**	**0.1**	**0.3**	**0**	**0**	**0**	**1**	**0.1**	**0.12**
Oligochaeta	Dero sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Limnodrilus sp.	2	0.2	0.61	0	0	0	2	0.1	0.25
	Lumbriculidae	1	0.1	0.3	0	0	0	1	0.1	0.12
	Subtotal	**4**	**0.4**	**1.22**	**0**	**0**	**0**	**4**	**0.2**	**0.5**
Mollusca	Ferrissia rivularis	4	0.4	1.22	54	6	11.32	58	3.2	7.2
	Helisoma trivolvis gr.	1	0.1	0.3	1	0.1	0.21	2	0.1	0.25
	Physa sp.	7	0.8	2.13	4	0.4	0.84	11	0.6	1.37
	Subtotal	**12**	**1.3**	**3.66**	**59**	**6.6**	**12.37**	**71**	**3.9**	**8.82**
Veneroida	Pisidium sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Subtotal	**1**	**0.1**	**0.3**	**0**	**0**	**0**	**1**	**0.1**	**0.12**
Hydrachnidia	Hydrachnida	0	0	0	3	0.3	0.63	3	0.2	0.37
	Subtotal	**0**	**0**	**0**	**3**	**0.3**	**0.63**	**3**	**0.2**	**0.37**
Isopoda	Caecidotea sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Subtotal	**1**	**0.1**	**0.3**	**0**	**0**	**0**	**1**	**0.1**	**0.12**
Amphipoda	Hyalella azteca	5	0.6	1.52	20	2.2	4.19	25	1.4	3.11
	Subtotal	**5**	**0.6**	**1.52**	**20**	**2.2**	**4.19**	**25**	**1.4**	**3.11**
Decapoda	Crangonyx sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Orconectes rusticus	1	0.1	0.3	0	0	0	1	0.1	0.12
	Subtotal	**1**	**0.1**	**0.3**	**1**	**0.1**	**0.21**	**2**	**0.1**	**0.25**

(continued)

Table 4-1. (Continued)

Taxon		STATION								
		Station 3 NH			Station 2 VT (South)			All		
		Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Ephemeroptera	Caenis sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Centroptilum sp.	1	0.1	0.3	1	0.1	0.21	2	0.1	0.25
	Ephemerella sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Eurylophella sp.	2	0.2	0.61	0	0	0	2	0.1	0.25
	Isonychia sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Leptophlebia sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Leucrocuta sp.	19	2.1	5.79	24	2.7	5.03	43	2.4	5.34
	Stenacron interpunctatum	84	9.3	25.61	132	14.7	27.67	216	12	26.83
	Stenonema mediopunctatum	1	0.1	0.3	0	0	0	1	0.1	0.12
	Stenonema modestum	13	1.4	3.96	32	3.6	6.71	45	2.5	5.59
	Stenonema sp.	27	3	8.23	64	7.1	13.42	91	5.1	11.3
	Stenonema terminatum	3	0.3	0.91	29	3.2	6.08	32	1.8	3.98
	Subtotal	**150**	**16.7**	**45.73**	**286**	**31.8**	**59.96**	**436**	**24.2**	**54.16**
Odonata	Argia sp.	1	0.1	0.3	1	0.1	0.21	2	0.1	0.25
	Argia tibialis	0	0	0	1	0.1	0.21	1	0.1	0.12
	Boyeria vinosa	2	0.2	0.61	1	0.1	0.21	3	0.2	0.37
	Enallagma sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Gomphus sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Neurocordula michaeli	0	0	0	1	0.1	0.21	1	0.1	0.12
	Neurocordulia sp	0	0	0	2	0.2	0.42	2	0.1	0.25
	Subtotal	**5**	**0.6**	**1.52**	**6**	**0.7**	**1.26**	**11**	**0.6**	**1.37**
Plecoptera	Acroneuria lycorias	2	0.2	0.61	0	0	0	2	0.1	0.25
	Agnetina sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Isoperla sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Sweltsa sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Subtotal	**4**	**0.4**	**1.22**	**1**	**0.1**	**0.21**	**5**	**0.3**	**0.62**

(continued)

Table 4-1. (Continued)

Taxon		STATION								
		Station 3 NH			Station 2 VT (South)			All		
		Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Coleoptera	Dineutus sp.	1	0.1	0.3	3	0.3	0.63	4	0.2	0.5
	Dubiraphia sp.	1	0.1	0.3	1	0.1	0.21	2	0.1	0.25
	Haliplus sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Psephenus herricki	2	0.2	0.61	1	0.1	0.21	3	0.2	0.37
	Subtotal	**5**	**0.6**	**1.52**	**5**	**0.6**	**1.05**	**10**	**0.6**	**1.24**
Hydrophiloidea	Agraylea multipunctata	1	0.1	0.3	0	0	0	1	0.1	0.12
	Subtotal	**1**	**0.1**	**0.3**	**0**	**0**	**0**	**1**	**0.1**	**0.12**
Neuroptera	Corydalus cornutus	0	0	0	1	0.1	0.21	1	0.1	0.12
	Sialis sp.	0	0	0	2	0.2	0.42	2	0.1	0.25
	Subtotal	**0**	**0**	**0**	**3**	**0.3**	**0.63**	**3**	**0.2**	**0.37**
Trichoptera	Cheumatopsyche sp.	4	0.4	1.22	8	0.9	1.68	12	0.7	1.49
	Hydropsyche phalerata	0	0	0	4	0.4	0.84	4	0.2	0.5
	Hydropsyche slossonae	1	0.1	0.3	0	0	0	1	0.1	0.12
	Hydroptila sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Neureclipsis sp.	1	0.1	0.3	10	1.1	2.1	11	0.6	1.37
	Nyctiophylax sp.	0	0	0	2	0.2	0.42	2	0.1	0.25
	Oecetis sp.	3	0.3	0.91	6	0.7	1.26	9	0.5	1.12
	Oxyethira sp.	1	0.1	0.3	1	0.1	0.21	2	0.1	0.25
	Polycentropus sp.	0	0	0	10	1.1	2.1	10	0.6	1.24
	Triaenodes sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Subtotal	**10**	**1.1**	**3.05**	**43**	**4.8**	**9.01**	**53**	**2.9**	**6.58**
Tipuloidea	Tipula sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Subtotal	**0**	**0**	**0**	**1**	**0.1**	**0.21**	**1**	**0.1**	**0.12**

(continued)

Table 4-1. (Continued)

Taxon		STATION								
		Station 3 NH			Station 2 VT (South)			All		
		Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Diptera	Ablabesmyia janta	1	0.1	0.3	0	0	0	1	0.1	0.12
	Ablabesmyia mallochi	7	0.8	2.13	3	0.3	0.63	10	0.6	1.24
	Ablabesmyia sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Axarus sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Chironomini	0	0	0	1	0.1	0.21	1	0.1	0.12
	Cladotanytarsus sp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Cricotopus bicinctus	4	0.4	1.22	1	0.1	0.21	5	0.3	0.62
	Dicrotendipes neomodestus	19	2.1	5.79	0	0	0	19	1.1	2.36
	Eukiefferiella sp.	14	1.6	4.27	1	0.1	0.21	15	0.8	1.86
	Microtendipes pedellus gp.	0	0	0	1	0.1	0.21	1	0.1	0.12
	Monodiamesa sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Orthocladiinae	1	0.1	0.3	0	0	0	1	0.1	0.12
	Orthocladius sp.	14	1.6	4.27	1	0.1	0.21	15	0.8	1.86
	Paratanytarsus sp.	2	0.2	0.61	0	0	0	2	0.1	0.25
	Phaenopsectra obedians gr.	2	0.2	0.61	2	0.2	0.42	4	0.2	0.5
	Phaenopsectra sp.	2	0.2	0.61	0	0	0	2	0.1	0.25
	Polypedilum flavum	2	0.2	0.61	2	0.2	0.42	4	0.2	0.5
	Polypedilum sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Polypedilum tritum	0	0	0	6	0.7	1.26	6	0.3	0.75
	Procladius sp.	0	0	0	7	0.8	1.47	7	0.4	0.87
	Pseudochironomus sp.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Rheotanytarsus sp.	10	1.1	3.05	6	0.7	1.26	16	0.9	1.99
	Synorthocladius sp.	10	1.1	3.05	6	0.7	1.26	16	0.9	1.99
	Tanytarsus sp.	24	2.7	7.32	8	0.9	1.68	32	1.8	3.98
	Thienemannimyia gr.	1	0.1	0.3	0	0	0	1	0.1	0.12
	Subtotal	**117**	**13**	**35.67**	**47**	**5.2**	**9.85**	**164**	**9.1**	**20.37**
Empidoidea	Hemerodromia sp.	2	0.2	0.61	0	0	0	2	0.1	0.25
	Subtotal	**2**	**0.2**	**0.61**	**0**	**0**	**0**	**2**	**0.1**	**0.25**
	Overall Total	**328**	**36.4**	**100**	**477**	**53**	**100**	**805**	**44.7**	**100**

Table 4-2. Macroinvertebrates Collected at Station 2 During June, August and October of 2005.

Taxon		1 June - 5 July			1 Aug - 2 Sept			3 Oct - 1 Nov			All		
		Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Nematoda	Nematoda	1	0.3	0.95	0	0	0	0	0	0	1	0.1	0.21
	Subtotal	**1**	**0.3**	**0.95**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.1**	**0.21**
Turbellaria	Dugesia tigrina	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.3**	**0.42**	**1**	**0.1**	**0.21**
Mollusca	Ferrissia rivularis	3	1	2.86	37	12.3	27.41	14	4.7	5.91	54	6	11.32
	Helisoma trivolvis gr.	0	0	0	1	0.3	0.74	0	0	0	1	0.1	0.21
	Physa sp.	0	0	0	4	1.3	2.96	0	0	0	4	0.4	0.84
	Subtotal	**3**	**1**	**2.86**	**42**	**14**	**31.11**	**14**	**4.7**	**5.91**	**59**	**6.6**	**12.37**
Hydrachnidia	Hydrachnida	0	0	0	3	1	2.22	0	0	0	3	0.3	0.63
	Subtotal	**0**	**0**	**0**	**3**	**1**	**2.22**	**0**	**0**	**0**	**3**	**0.3**	**0.63**
Amphipoda	Hyalella azteca	3	1	2.86	3	1	2.22	14	4.7	5.91	20	2.2	4.19
	Subtotal	**3**	**1**	**2.86**	**3**	**1**	**2.22**	**14**	**4.7**	**5.91**	**20**	**2.2**	**4.19**
Decapoda	Crangonyx sp.	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.3**	**0.42**	**1**	**0.1**	**0.21**
Ephemeroptera	Caenis sp.	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Centroptilum sp.	0	0	0	1	0.3	0.74	0	0	0	1	0.1	0.21
	Ephemerella sp.	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Isonychia sp.	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Leptophlebia sp.	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Leucrocuta sp.	12	4	11.43	0	0	0	12	4	5.06	24	2.7	5.03
	Stenacron interpunctatum	32	10.7	30.48	22	7.3	16.3	78	26	32.91	132	14.7	27.67
	Stenonema modestum	2	0.7	1.9	5	1.7	3.7	25	8.3	10.55	32	3.6	6.71
	Stenonema sp.	34	11.3	32.38	13	4.3	9.63	17	5.7	7.17	64	7.1	13.42
	Stenonema terminatum	0	0	0	3	1	2.22	26	8.7	10.97	29	3.2	6.08
	Subtotal	**80**	**26.7**	**76.19**	**44**	**14.7**	**32.59**	**162**	**54**	**68.35**	**286**	**31.8**	**59.96**
Odonata	Argia sp.	0	0	0	1	0.3	0.74	0	0	0	1	0.1	0.21
	Argia tibialis	1	0.3	0.95	0	0	0	0	0	0	1	0.1	0.21
	Boyeria vinosa	1	0.3	0.95	0	0	0	0	0	0	1	0.1	0.21
	Neurocordula michaeli	1	0.3	0.95	0	0	0	0	0	0	1	0.1	0.21
	Neurocordulia sp	0	0	0	2	0.7	1.48	0	0	0	2	0.2	0.42
	Subtotal	**3**	**1**	**2.86**	**3**	**1**	**2.22**	**0**	**0**	**0**	**6**	**0.7**	**1.26**
Plecoptera	Sweltsa sp.	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.3**	**0.42**	**1**	**0.1**	**0.21**

(continued)

Table 4-2. (Continued)

Taxon		1 June - 5 July			1 Aug - 2 Sept			3 Oct - 1 Nov			All		
		Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Coleoptera	Dineutus sp.	3	1	2.86	0	0	0	0	0	0	3	0.3	0.63
	Dubiraphia sp.	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Psephenus herricki	0	0	0	1	0.3	0.74	0	0	0	1	0.1	0.21
	Subtotal	**3**	**1**	**2.86**	**1**	**0.3**	**0.74**	**1**	**0.3**	**0.42**	**5**	**0.6**	**1.05**
Neuroptera	Corydalus cornutus	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Sialis sp.	0	0	0	1	0.3	0.74	1	0.3	0.42	2	0.2	0.42
	Subtotal	**0**	**0**	**0**	**1**	**0.3**	**0.74**	**2**	**0.7**	**0.84**	**3**	**0.3**	**0.63**
Trichoptera	Cheumatopsyche sp.	3	1	2.86	0	0	0	5	1.7	2.11	8	0.9	1.68
	Hydropsyche phalerata	0	0	0	0	0	0	4	1.3	1.69	4	0.4	0.84
	Hydroptila sp.	0	0	0	1	0.3	0.74	0	0	0	1	0.1	0.21
	Neureclipsis sp.	2	0.7	1.9	2	0.7	1.48	6	2	2.53	10	1.1	2.1
	Nyctiophylax sp.	0	0	0	1	0.3	0.74	1	0.3	0.42	2	0.2	0.42
	Oecetis sp.	0	0	0	6	2	4.44	0	0	0	6	0.7	1.26
	Oxyethira sp.	0	0	0	1	0.3	0.74	0	0	0	1	0.1	0.21
	Polycentropus sp.	0	0	0	0	0	0	10	3.3	4.22	10	1.1	2.1
	Triaenodes sp.	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Subtotal	**5**	**1.7**	**4.76**	**11**	**3.7**	**8.15**	**27**	**9**	**11.39**	**43**	**4.8**	**9.01**
Tipuloidea	Tipula sp.	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.3**	**0.42**	**1**	**0.1**	**0.21**
Diptera	Ablabesmyia mallochi	0	0	0	3	1	2.22	0	0	0	3	0.3	0.63
	Ablabesmyia sp.	0	0	0	1	0.3	0.74	0	0	0	1	0.1	0.21
	Chironomini	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Cladotanytarsus sp.	0	0	0	1	0.3	0.74	0	0	0	1	0.1	0.21
	Cricotopus bicinctus	1	0.3	0.95	0	0	0	0	0	0	1	0.1	0.21
	Eukiefferiella sp.	0	0	0	1	0.3	0.74	0	0	0	1	0.1	0.21
	Microtendipes pedellus gp.	0	0	0	0	0	0	1	0.3	0.42	1	0.1	0.21
	Orthocladius sp.	0	0	0	1	0.3	0.74	0	0	0	1	0.1	0.21
	Phaenopsectra obedians gr.	0	0	0	0	0	0	2	0.7	0.84	2	0.2	0.42
	Polypedilum flavum	2	0.7	1.9	0	0	0	0	0	0	2	0.2	0.42
	Polypedilum tritum	0	0	0	6	2	4.44	0	0	0	6	0.7	1.26
	Procladius sp.	0	0	0	0	0	0	7	2.3	2.95	7	0.8	1.47
	Rheotanytarsus sp.	3	1	2.86	1	0.3	0.74	2	0.7	0.84	6	0.7	1.26
	Synorthocladius sp.	0	0	0	6	2	4.44	0	0	0	6	0.7	1.26
	Tanytarsus sp.	1	0.3	0.95	7	2.3	5.19	0	0	0	8	0.9	1.68
	Subtotal	**7**	**2.3**	**6.67**	**27**	**9**	**20**	**13**	**4.3**	**5.49**	**47**	**5.2**	**9.85**
	Station Total	**105**	**35**	**100**	**135**	**45**	**100**	**237**	**79**	**100**	**477**	**53**	**100**

Table 4-3. Macroinvertebrates Collected at Station 3 During June, August, and October 2005.

Taxon		1 June - 5 July			1 Aug - 2 Sept			3 Oct - 1 Nov			All		
		Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Turbellaria	Dugesia tigrina	1	0.3	2.33	3	1	1.21	5	1.7	13.51	9	1	2.74
	Subtotal	**1**	**0.3**	**2.33**	**3**	**1**	**1.21**	**5**	**1.7**	**13.51**	**9**	**1**	**2.74**
Hoplonemertea	Prostoma graescense	0	0	0	1	0.3	0.4	0	0	0	1	0.1	0.3
	Subtotal	**0**	**0**	**0**	**1**	**0.3**	**0.4**	**0**	**0**	**0**	**1**	**0.1**	**0.3**
Oligochaeta	Dero sp.	0	0	0	1	0.3	0.4	0	0	0	1	0.1	0.3
	Limnodrilus sp.	0	0	0	0	0	0	2	0.7	5.41	2	0.2	0.61
	Lumbriculidae	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Subtotal	**0**	**0**	**0**	**1**	**0.3**	**0.4**	**3**	**1**	**8.11**	**4**	**0.4**	**1.22**
Mollusca	Ferrissia rivularis	3	1	6.98	0	0	0	1	0.3	2.7	4	0.4	1.22
	Helisoma trivolvis gr.	0	0	0	1	0.3	0.4	0	0	0	1	0.1	0.3
	Physa sp.	0	0	0	6	2	2.42	1	0.3	2.7	7	0.8	2.13
	Subtotal	**3**	**1**	**6.98**	**7**	**2.3**	**2.82**	**2**	**0.7**	**5.41**	**12**	**1.3**	**3.66**
Veneroida	Pisidium sp.	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Subtotal	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
Isopoda	Caecidotea sp.	0	0	0	1	0.3	0.4	0	0	0	1	0.1	0.3
	Subtotal	**0**	**0**	**0**	**1**	**0.3**	**0.4**	**0**	**0**	**0**	**1**	**0.1**	**0.3**
Amphipoda	Hyalella azteca	0	0	0	5	1.7	2.02	0	0	0	5	0.6	1.52
	Subtotal	**0**	**0**	**0**	**5**	**1.7**	**2.02**	**0**	**0**	**0**	**5**	**0.6**	**1.52**
Decapoda	Orconectes rusticus	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.3**	**2.7**	**1**	**0.1**	**0.3**
Ephemeroptera	Centroptilum sp.	0	0	0	1	0.3	0.4	0	0	0	1	0.1	0.3
	Eurylophella sp.	1	0.3	2.33	0	0	0	1	0.3	2.7	2	0.2	0.61
	Leucrocuta sp.	16	5.3	37.21	3	1	1.21	0	0	0	19	2.1	5.79
	Stenacron interpunctatum	2	0.7	4.65	73	24.3	29.44	9	3	24.32	84	9.3	25.61
	Stenonema mediopunctatum	1	0.3	2.33	0	0	0	0	0	0	1	0.1	0.3
	Stenonema modestum	0	0	0	13	4.3	5.24	0	0	0	13	1.4	3.96
	Stenonema sp.	3	1	6.98	24	8	9.68	0	0	0	27	3	8.23
	Stenonema terminatum	0	0	0	3	1	1.21	0	0	0	3	0.3	0.91
	Subtotal	**23**	**7.7**	**53.49**	**117**	**39**	**47.18**	**10**	**3.3**	**27.03**	**150**	**16.7**	**45.73**
Odonata	Argia sp.	0	0	0	1	0.3	0.4	0	0	0	1	0.1	0.3
	Boyeria vinosa	1	0.3	2.33	1	0.3	0.4	0	0	0	2	0.2	0.61
	Enallagma sp.	1	0.3	2.33	0	0	0	0	0	0	1	0.1	0.3
	Gomphus sp.	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Subtotal	**2**	**0.7**	**4.65**	**2**	**0.7**	**0.81**	**1**	**0.3**	**2.7**	**5**	**0.6**	**1.52**

(continued)

Table 4-3. (Continued)

Taxon		1 June - 5 July			1 Aug - 2 Sept			3 Oct - 1 Nov			All		
		Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Plecoptera	Acroneuria lycorias	0	0	0	2	0.7	0.81	0	0	0	2	0.2	0.61
	Agnetina sp.	0	0	0	1	0.3	0.4	0	0	0	1	0.1	0.3
	Isoperla sp.	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Subtotal	**0**	**0**	**0**	**3**	**1**	**1.21**	**1**	**0.3**	**2.7**	**4**	**0.4**	**1.22**
Coleoptera	Dineutus sp.	1	0.3	2.33	0	0	0	0	0	0	1	0.1	0.3
	Dubiraphia sp.	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Haliplus sp.	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Psephenus herricki	1	0.3	2.33	1	0.3	0.4	0	0	0	2	0.2	0.61
	Subtotal	**2**	**0.7**	**4.65**	**1**	**0.3**	**0.4**	**2**	**0.7**	**5.41**	**5**	**0.6**	**1.52**
Hydrophiloidea	Agraylea multipunctata	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Subtotal	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0.3**	**2.7**	**1**	**0.1**	**0.3**
Trichoptera	Cheumatopsyche sp.	0	0	0	2	0.7	0.81	2	0.7	5.41	4	0.4	1.22
	Hydropsyche slossonae	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Neureclipsis sp.	0	0	0	1	0.3	0.4	0	0	0	1	0.1	0.3
	Oecetis sp.	0	0	0	3	1	1.21	0	0	0	3	0.3	0.91
	Oxyethira sp.	1	0.3	2.33	0	0	0	0	0	0	1	0.1	0.3
	Subtotal	**1**	**0.3**	**2.33**	**6**	**2**	**2.42**	**3**	**1**	**8.11**	**10**	**1.1**	**3.05**
Diptera	Ablabesmyia janta	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Ablabesmyia mallochi	0	0	0	7	2.3	2.82	0	0	0	7	0.8	2.13
	Axarus sp.	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Cricotopus bicinctus	0	0	0	4	1.3	1.61	0	0	0	4	0.4	1.22
	Dicrotendipes neomodestus	0	0	0	19	6.3	7.66	0	0	0	19	2.1	5.79
	Eukiefferiella sp.	0	0	0	14	4.7	5.65	0	0	0	14	1.6	4.27
	Monodiamesa sp.	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Orthocladiinae	1	0.3	2.33	0	0	0	0	0	0	1	0.1	0.3
	Orthocladius sp.	0	0	0	14	4.7	5.65	0	0	0	14	1.6	4.27
	Paratanytarsus sp.	0	0	0	2	0.7	0.81	0	0	0	2	0.2	0.61
	Phaenopsectra obedians gr.	0	0	0	0	0	0	2	0.7	5.41	2	0.2	0.61
	Phaenopsectra sp.	1	0.3	2.33	1	0.3	0.4	0	0	0	2	0.2	0.61
	Polypedilum flavum	1	0.3	2.33	1	0.3	0.4	0	0	0	2	0.2	0.61
	Polypedilum sp.	1	0.3	2.33	0	0	0	0	0	0	1	0.1	0.3
	Pseudochironomus sp.	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3

(continued)

Table 4-3. (Continued)

Taxon		1 June - 5 July			1 Aug - 2 Sept			3 Oct - 1 Nov			All		
		Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total	Count	Mean	% of Total
Diptera (continued)	Rheotanytarsus sp.	7	2.3	16.28	3	1	1.21	0	0	0	10	1.1	3.05
	Synorthocladius sp.	0	0	0	10	3.3	4.03	0	0	0	10	1.1	3.05
	Tanytarsus sp.	0	0	0	24	8	9.68	0	0	0	24	2.7	7.32
	Thienemannimyia gr.	0	0	0	0	0	0	1	0.3	2.7	1	0.1	0.3
	Subtotal	**11**	**3.7**	**25.58**	**99**	**33**	**39.92**	**7**	**2.3**	**18.92**	**117**	**13**	**35.67**
Empidoidea	Hemerodromia sp.	0	0	0	2	0.7	0.81	0	0	0	2	0.2	0.61
	Subtotal	**0**	**0**	**0**	**2**	**0.7**	**0.81**	**0**	**0**	**0**	**2**	**0.2**	**0.61**
	Station Total	**43**	**14.3**	**100**	**248**	**82.7**	**100**	**37**	**12.3**	**100**	**328**	**36.4**	**100**

5.0 FISH COLLECTIONS

Fish collections are performed annually as specified in the Vermont Yankee NPDES permit. General fish collection efforts are made monthly in May, June, September, and October via electrofishing at the eight primary stations specified in the NPDES permit (Table 1-1 "general electrofishing," Figure 5-1). Anadromous fish collection efforts are made twice a month from July through October via electrofishing at the three primary stations below Vernon dam specified in the NPDES permit (Table 1-1 "anadromous electrofishing," Figure 5-1). Fish impinged on the circulating water traveling screens are collected weekly from 1 April through 20 June and again from 15 July through 31 October. Larval fish are collected weekly from 1 May through 15 July in the vicinity of the Vermont Yankee circulating water intake structure when the Vermont Yankee cooling water system is in open/hybrid cycle.

5.1 METHODS OF COLLECTION AND PROCESSING

5.1.1 Electrofishing – General

General electrofishing was performed with a boat-mounted Coffelt Electronics Model VVP-15 electroshocker. All general electrofishing samples were collected in the evening beginning at least 0.5 hour after sunset once per month in May, June and September 2005. General electrofishing was conducted at the following eight primary stations: Rum Point (substation 102), Station 5 (substations 051 and 052), Station 4 (substations 416 and 426), N.H. Setback (substation 091), 0.1 mile south of the Vernon Dam (substation 724), Station 3 (substation 032), Stebbin Island (substation 614) and Station 2 (substation 217) (Table 1-1, Figure 5-1). In October, only the upstream primary stations, Rum Point (substation 102), Station 5 (substations 051 and 052), Station 4 (substations 416 and 426) and N.H. Setback (substation 091) were sampled. All fish collected by general electrofishing were identified to species, weighed to the nearest gram (wet weight), measured to the nearest millimeter (total length) and released alive after processing.

Scheduled October general electrofishing collections were not conducted at the four stations below Vernon dam due to higher than normal precipitation and river flows that began on 8 October and continued through the week of 20 November 2005 (Figure 2-3), the agreed upon cancellation date.

5.1.2 Electrofishing - Anadromous Fish

Anadromous fish electrofishing was performed with a boat-mounted Coffelt Electronics Model VVP-15 electroshocker. All anadromous fish electrofishing samples were collected in the evening beginning approximately 0.5 hour after sunset, twice a month from July through September 2005. Anadromous fish electrofishing collections were conducted at the three primary stations downstream of Vernon Dam: 0.1 mile south of Vernon Dam (substation 725), Station 3 (substation 031), and Stebbin Island (substations 615, 613, 614, and 624) (Table 1-1, Figure 5-1). Fish other than clupeids were not processed if collected during the anadromous fish electrofishing runs. Collected juvenile American shad were weighed to the nearest gram (wet weight), measured to the nearest millimeter (total length), and released alive after processing.

Scheduled October anadromous fish collections were not conducted due to higher than normal precipitation and river flows that began on 8 October and continued through the week of 20 November 2005 (Figure 2-3), the agreed upon cancellation date.

5.1.3 Impingement

Impingement collections consisted of two consecutive daily sampling events per week. Weekly and 24-hour spring and fall impingement samples were collected 29 March through 15 June and 27 July through 23 October 2005.

Weekly anadromous impingement samples were produced from back-washing debris from the traveling and service water screens into the collection bin. The debris from the collection bin was examined for Atlantic salmon and American shad only. This sample collection provided the quantity of Atlantic salmon or American shad impinged during the previous six days. If present, Atlantic salmon and American shad were weighed to the nearest gram (wet weight) and measured to the nearest millimeter (total length). The traveling screens were back-washed approximately 24 hours later and the debris was examined for all impinged fish. This sample collection provided the quantity of all fish impinged on the traveling screens during the previous 24 hours. Fish collected in the 24-hour sample were identified to species, weighed to the nearest gram (wet weight), and measured to the nearest millimeter (total length) as specified in Vermont Yankee's NPDES permit.

Weekly and 24 hour impingement sampling events on 25 October and 26 October were not conducted due to a scheduled plant refueling outage that started on 22 October and ended on 10 November 2005.

The 2005 Atlantic salmon and American shad impingement limits were calculated as 252 and 666 respectively, using the formulas specified in Vermont Yankee's NPDES Permit. In October, seven additional 24hr impingement samples were collected because the American shad 50% annual quota of 333 was surpassed. As stipulated in the NPDES permit, after surpassing the 50% annual quota, the collection of any subsequent American shad during an impingement sampling event caused the impingement sample frequency to increase to daily sampling until three consecutive daily samples not containing American shad were obtained. The additional sampling events occurred on 13 to 15, and 20 to 23 October.

5.1.4 Larval Fish

A 50-cm diameter, 363-µm nitex nylon ichthyoplankton net was towed behind a boat in a semi-circular path at surface (approximately 0.3 m), mid (approximately 1.8 m), and near bottom (approximately 3.7 m) depths. A flume-calibrated, General Oceanics Inc. Model 2030R mechanical flow meter was mounted in the net mouth and used to estimate the volume of water filtered in each tow. Tows were taken at a boat speed of about 1 m/sec, and tow durations were adjusted to provide a tow volume of approximately 100 m^3. The contents of each ichthyoplankton sample were washed into a collection cup fastened to the distal end of the net. Larval fish samples were preserved in 5% formalin, labeled with the date, time, and depth of collection, and taken to the laboratory for processing at a later date.

In the laboratory, the ichthyoplankton in each sample were separated from the debris using an 8x to 80x variable magnification dissecting microscope. Larval fish were identified to the lowest practical taxonomic level utilizing published larval keys (Fish (1930), Lippson and Moran (1974), Jones et al. (1978), and Auer (1982)) and enumerated.

During 2005, larval fish were collected weekly between 2 May and 11 July in the vicinity of the Vermont Yankee circulating water intake structure (Figure 5-1).

5.2 RESULTS

Overall, 25 species of fish and 27 taxa were identified from samples collected in 2005 (Table 5-1). The total number of species and species composition were similar to past years (Aquatec 1993, 1995, and Normandeau Associates 1997- 2005). All fish species collected were typical of the Connecticut River drainage, and no federally listed threatened or endangered species were collected.

5.2.1 Fish – General Electrofishing

During 2005, 376 fish of 17 taxa were collected during general electrofishing. A total of 36 electrofishing sampling events representing 6 hours of effort were completed among the eight primary stations at ten substations (Figure 5-1, Table 5-2). Catch per unit effort (CPUE) as fish per hour (Table 5-3) and grams of fish per hour (Table 5-4), was used to standardize the effort between upstream and downstream collections. The combined upstream and downstream CPUE was 62.7 fish/hour. CPUE was 83.8 fish/hour for 24 samples collected at the six upstream substations, and 20.5 fish/hour for 12 samples collected at the four substations downstream of Vernon Dam (Table 5-2).

There were 335 fish weighing a total of 25,917 grams (wet weight) collected in the Connecticut River upstream from Vernon Dam during the 2005 general electrofishing surveys (Table 5-3). The most numerically abundant fish species upstream from Vernon Dam were yellow perch (159 fish) and bluegill (73 fish, Table 5-3). Yellow perch (9,244 g), bluegill (5,045 g), white sucker (4,115 g), largemouth bass (3,097 g) and pumpkinseed (2,579 g) accounted for a majority of the biomass of fishes collected upstream from Vernon Dam by electrofishing (Table 5-3).

There were 41 fish weighing a total of 6,882 grams (wet weight) collected in the Connecticut River downstream from Vernon Dam. The most numerically abundant fish species below Vernon Dam were smallmouth bass (13 fish), yellow perch (8 fish), and spottail shiner (8 fish, Table 5-3). Smallmouth bass (3,254 g), white sucker (1,550 g), and yellow perch (1,250 g) accounted for the majority of the biomass of fishes collected by general electrofishing downstream from Vernon Dam (Table 5-3).

No Atlantic salmon were collected during general electrofishing events either upstream or downstream from Vernon Dam during 2005 (Table 5-3). No American shad were collected upstream from Vernon Dam, and 1 American shad was caught downstream of Vernon Dam during the 2005 general electrofishing collections (Table 5-3).

Based on catch per unit of effort, yellow perch (39.8 fish/hour) and bluegill (18.3 fish/hour) were the most frequently caught fishes upstream from Vernon Dam (Table 5-4). In terms of biomass (grams wet weight), yellow perch (2,311.0 grams/hour), bluegill (1,261.3 grams/hour), and white sucker (1,028.8 grams/hour) were the most significant species collected via general electrofishing upstream from Vernon Dam (Table 5-4). Downstream from Vernon Dam, smallmouth bass (6.5 fish/hour), yellow perch (4 fish/hour), and spottail shiner (4 fish/hour) were the most frequently caught species. Smallmouth bass (1,627.0 grams/hour), white sucker (775.0 g/hour), and yellow perch (625.0 g/hour) accounted for the majority of the biomass of fishes collected downstream from Vernon Dam (Table 5-4).

5.2.2 Anadromous Fish Electrofishing

Results reported in this section include American shad collected during anadromous fish sampling events, not including American shad (1 fish) reported under general electrofishing, Section 5.2.1.

A total of 59 juvenile American shad were collected in the anadromous electrofishing program performed between July and September 2005 (Table 5-5). The October anadromous fish collections were not conducted due to the higher than normal precipitation and river flows that began on 8 October and continued through the week of 20 November 2005, the agreed upon cancellation date.

American shad collections of August (31 fish) and September (28 fish) constituted 100% of the anadromous electrofishing catch of 2005. No American shad were collected in July. American shad total lengths recorded in August 2005 ranged from 61-93 mm and weight ranged from 3-5 g (Table 5-5). The CPUE in August was highest at Station 3 (18.0 fish/hour) and averaged 16 fish/hour at all stations (Table 5-5). American shad total lengths recorded in September 2005 ranged from 87-100 mm and weight ranged from 6-10 g (Table 5-5). The CPUE in September was highest at the Stebbin Island stations (16 fish/hour) and averaged 9.33 fish/hour at all stations.

5.2.3 Fish – Impingement

In 2005, 2,076 fish of 24 taxa were collected from the permit-required impingement sampling program. American shad (577 fish), yellow perch (483 fish) and bluegill (352 fish) were the most numerically abundant species in the impingement samples during the six months of sampling in 2005 (Table 5-3). Bluegill (17,018 g), yellow perch (13,813 g), and rock bass (11,380 g) comprised the majority of fish biomass impinged during 2005 (Table 5-3).

The months of May and October 2005 brought in the greatest number and biomass of impinged fish. In May, 397 fish weighing 20,687g were collected, and in October 1,259 fish weighing 27,440g were collected (Table 5-6).

A total of 577 American shad were collected from the traveling screens at the Vermont Yankee intake structure in 2005 from the combined total of 6-day and 24-hour sampling events (Table 5-3). The American shad annual impingement limit of 666 was not exceeded during 2005; however, the 50% annual limit of 333 American shad was exceeded. Most of the American shad impingement occurred between 13 September and 11 October, when 509 American shad were collected from the impingement bin. This coincided with a heavy precipitation event that dropped 10 inches of rain between 8-10 October, as recorded near Vermont Yankee. In accordance with permit requirements, after 50% of the annual limit was collected, impingement sampling frequency increased to daily, and concluded when no American shad were collected over three consecutive sampling days. The cumulative total counts of impinged juvenile American shad first became greater than 50% of the annual limit on 11 October required seven additional shad related 24hr impingement sampling events. The day after the 50% quota was exceeded (12 October), 12 shad were collected. The following three days, no shad were collected and daily sampling ended on 15 October. During the next regularly scheduled 6-day sample (18 October), 45 American shad were collected, again prompting daily collections. On 19 and 20 October, 10 and 1 American shad were collected, respectively. No American shad were collected between 21 and 23 October, when Vermont Yankee ceased cooling water withdrawal due to a scheduled refueling outage.

A total of 17 Atlantic salmon (smolts) were impinged between 4 April and 24 May in 2005. Three Atlantic salmon smolts were collected during 6-day samples and 14 Atlantic salmon smolts were

collected during 24hr samples. The Atlantic salmon limit of 252, calculated using the formula specified in Vermont Yankee's NPDES permit, was not surpassed in 2005.

5.2.4 Ichthyoplankton

Thirty-three ichthyoplankton samples representing six taxa were collected in the Connecticut River in close proximity to Vermont Yankee's circulating water intake structure between 2 May and 11 July 2005 (Table 5-7). A total of 536 ichthyoplankters were identified and enumerated (Table 5-8). *Cyprinidae* sp. (carp and minnows) made up 67.91% of the ichthyoplankton collected and exhibited the highest mean density-per-tow during the weeks of 13 June (54.4/100 m^3) and 20 June 2005 (36.3/100m^3, Table 5-9). White perch, *Centrarchidae* sp, yellow perch, common carp, and walleye eggs and larvae made up the remaining 32.09% of the collection (Table 5-8). Surface tows (0.3m deep) produced the highest total and average catch of larval fish.

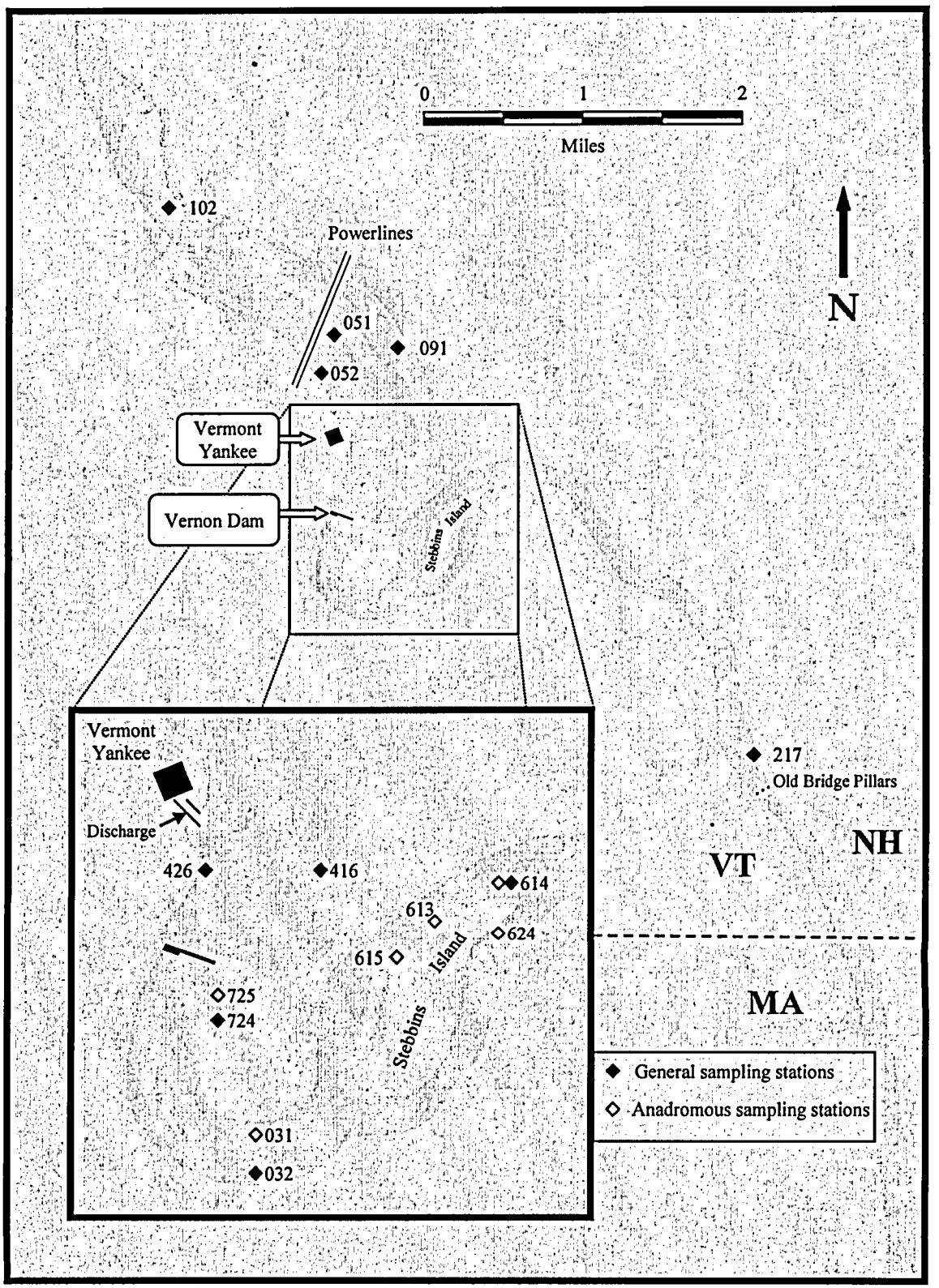

Figure 5-1. General and anadromous fish electrofishing sampling stations.

Table 5-1. Check List of Fishes (Nelson et al. 2004) Collected in the Connecticut River near Vernon, Vermont in each NPDES Sampling Program During 2005.

Class	Order	Family	Scientific name	Common Name	Program			
					Impingement	Anadromous Electrofishing[1]	General Electrofishing	Ichthyo-plankton
Cephalaspidomorphi	Petromyzontiformes	Petromyzontidae	Petromyzon marinus	Sea lamprey	X			
Actinopterygii	Anguilliformes	Anguillidae	Anguilla rostrata	American eel	X			
	Clupeiformes	Clupeidae	Alosa sapidissima	American shad	X	X	X	
	Cypriniformes	Cyprinidae	Cyprinidae	Carps and minnows				X
			Cyprinus carpio	Common carp	X		X	X
			Notemigonus crysoleucas	Golden shiner	X		X	
			Notropis hudsonius	Spottail shiner	X		X	
			Semotilus corporalis	Fallfish	X		X	
		Catostomidae	Catostomus commersoni	White sucker	X		X	
	Siluriformes	Ictaluridae	Ameiurus nebulosus	Brown bullhead	X			
	Esociformes	Esocidae	Esox niger	Chain pickerel	X		X	
	Salmoniformes	Osmeridae	Osmerus mordax	Rainbow smelt	X			
		Salmonidae	Salmo salar	Atlantic salmon	X			
			Salmo trutta	Brown trout	X			
			Salvelinus fontinalis	Brook Trout	X		X	
	Cyprinodontiformes	Fundulidae	Fundulus diaphanus	Banded Killifish			X	
	Perciformes	Moronidae	Morone americana	White perch	X			X
		Centrarchidae	Centrarchidae	Centrarchidae				X
			Ambloplites rupestris	Rock bass	X		X	
			Lepomis gibbosus	Pumpkinseed	X		X	
			Lepomis macrochirus	Bluegill	X		X	
			Micropterus dolomieu	Smallmouth bass	X		X	
			Micropterus salmoides	Largemouth bass	X		X	
			Pomoxis nigromaculatus	Black crappie	X		X	
		Percidae	Etheostoma olmstedi	Tessellated darter	X			
			Perca flavescens	Yellow perch	X		X	X
			Sander vitreus	Walleye	X		X	X

[1] Only American shad were processed from these samples.

Table 5-2. Catch Per Unit of Effort (CPUE) as Fish per Hour for General Electrofishing Collections in the Connecticut River in the Vicinity of Vernon, Vermont during 2005.

		Number of Collections	Hours	Fish	CPUE
Upstream	Rum Point (102)	4	0.667	52	78
	Station 5 - New Hampshire (051)	4	0.667	59	88.5
	Station 5 - Vermont (052)	4	0.667	60	90
	New Hampshire Setback (091)	4	0.667	62	93
	Station 4 - New Hampshire (416)	4	0.667	69	103.5
	Station 4 - Vermont (426)	4	0.667	33	49.5
	Total	**24**	**4**	**335**	**83.8**
Downstream	0.1 Miles south of Vernon Dam (724)	3	0.5	9	18
	Station 3 - Vermont (032)	3	0.5	6	12
	Stebbin Island - New Hampshire Side (614)	3	0.5	7	14
	Station 2 - New Hampshire (217)	3	0.5	19	38
	Total	**12**	**2**	**41**	**20.5**
	Overall Total	**36**	**6**	**376**	**62.7**

Table 5-3. Number, Weight, and Species of Fish Collected During Impingement and General Electrofishing Upstream and Downstream of Vernon Dam in 2005.

	Impingement		Electrofishing				Total Number (No.)	Relative Number (%)	Total Weight (g)	Relative Weight (%)
	CWTS		Downstream		Upstream					
	Number	Weight (g)	Number	Weight (g)	Number	Weight (g)				
Sea lamprey	24	108					24	1	108	0.1
American eel	12	22					12	0.5	22	0
American shad	577	4740	1	4			578	23.6	4744	4.8
Common carp	1	630			1	690	2	0.1	1320	1.3
Golden shiner	17	265			21	477	38	1.5	742	0.8
Spottail shiner	14	65	8	50	10	129	32	1.3	244	0.2
Fallfish	1	19	3	104			4	0.2	123	0.1
White sucker	9	1482	2	1550	4	4115	15	0.6	7147	7.3
Brown bullhead	93	3329					93	3.8	3329	3.4
Chain pickerel	1	130			2	135	3	0.1	265	0.3
Rainbow smelt	3	15					3	0.1	15	0
Atlantic salmon	17	911					17	0.7	911	0.9
Brown trout	2	9					2	0.1	9	0
Brook Trout	2	295	1	17			3	0.1	312	0.3
Banded Killifish					1	7	1	0	7	0
White perch	3	355					3	0.1	355	0.4
Rock bass	175	11380	1	25	1	170	177	7.2	11575	11.8
Pumpkinseed	118	3281			39	2579	157	6.4	5860	6
Bluegill	352	17018	4	628	73	5045	429	17.5	22691	23.2
Smallmouth bass	19	1632	13	3254	2	147	34	1.4	5033	5.1
Largemouth bass	17	1941			20	3097	37	1.5	5038	5.1
Black crappie	127	2291			1	14	128	5.2	2305	2.4
Tessellated darter	4	18					4	0.2	18	0
Yellow perch	483	13813	8	1250	159	9244	650	26.5	24307	24.8
Walleye	5	1368			1	68	6	0.2	1436	1.5
Total	**2076**	**65117**	**41**	**6882**	**335**	**25917**	**2452**	**100**	**97916**	**100**

Table 5-4. CPUE as Fish per Hour and Weight (g) per Hour by Fish Species and Relative (%) CPUE as Fish per Hour and Weight (g) per Hour by Fish Species Collected by General Electrofishing Upstream and Downstream of Vernon, Vermont in 2005

	Upstream				Downstream				Total			
	By Number		By Weight		By Number		By Weight		By Number		By Weight	
Species	CPUE	%	CPUE	%	CPUE	%	CPUE	%	CPUE	%	CPUE	%
American shad					0.5	2.4	2.0	0.1	0.2	0.3	0.7	0.0
Common carp	0.3	0.3	172.5	2.7					0.2	0.3	115.0	2.1
Golden shiner	5.3	6.3	119.3	1.8					3.5	5.6	79.5	1.5
Spottail shiner	2.5	3.0	32.3	0.5	4.0	19.5	25.0	0.7	3.0	4.8	29.8	0.5
Fallfish					1.5	7.3	52.0	1.5	0.5	0.8	17.3	0.3
White sucker	1.0	1.2	1028.8	15.9	1.0	4.9	775.0	22.5	1.0	1.6	944.2	17.3
Chain pickerel	0.5	0.6	33.8	0.5					0.3	0.5	22.5	0.4
Brook Trout					0.5	2.4	8.5	0.2	0.2	0.3	2.8	0.1
Banded Killifish	0.3	0.3	1.8	0.0					0.2	0.3	1.2	0.0
Rock bass	0.3	0.3	42.5	0.7	0.5	2.4	12.5	0.4	0.3	0.5	32.5	0.6
Pumpkinseed	9.8	11.6	644.8	10.0					6.5	10.4	429.8	7.9
Bluegill	18.3	21.8	1261.3	19.5	2.0	9.8	314.0	9.1	12.8	20.5	945.5	17.3
Smallmouth bass	0.5	0.6	36.8	0.6	6.5	31.7	1627.0	47.3	2.5	4.0	566.8	10.4
Largemouth bass	5.0	6.0	774.3	11.9					3.3	5.3	516.2	9.4
Black crappie	0.3	0.3	3.5	0.1					0.2	0.3	2.3	0.0
Yellow perch	39.8	47.5	2311.0	35.7	4.0	19.5	625.0	18.2	27.8	44.4	1749.0	32.0
Walleye	0.3	0.3	17.0	0.3					0.2	0.3	11.3	0.2
Totals	**83.8**	**100.0**	**6479.3**	**100.0**	**20.5**	**100.0**	**3441.0**	**100.0**	**62.7**	**100.0**	**5466.5**	**100.0**

Table 5-5. Monthly Impingement of Fish on Entergy Nuclear Vermont Yankee Circulating Water Traveling Screens in 2005.

Species	April		May		June		August		September		October		Total	
	No.	Wt (g)	No.	Wt (g)	No.	Wt (g)	No.	Wt (g)	No.	Wt (g)	No.	Wt (g)	No.	Wt (g)
American eel					2	6					10	16	12	22
American shad									2	16	575	4724	577	4740
Atlantic salmon	4	132	13	779									17	911
Black crappie	3	130	1	5	2	9	2	7	1	5	118	2135	127	2291
Bluegill	37	1622	66	4864	19	1837	16	1996	3	219	211	6480	352	17018
Brook Trout			1	225							1	70	2	295
Brown bullhead	1	5	1	74	2	60			1	212	88	2978	93	3329
Brown trout											2	9	2	9
Chain pickerel	1	130											1	130
Common carp											1	630	1	630
Fallfish											1	19	1	19
Golden shiner	6	37	2	10	1	20					8	198	17	265
Largemouth bass			1	560			4	42	1	4	11	1335	17	1941
Pumpkinseed	2	32	14	1188	5	343	2	13			95	1705	118	3281
Rainbow smelt	1	2	2	13									3	15
Rock bass	28	1472	71	5039	25	1573	4	115	1	7	46	3174	175	11380
Sea lamprey											24	108	24	108
Smallmouth bass	5	22	6	761	3	194			1	36	4	619	19	1632
Spottail shiner			1	5	1	7	2	11			10	42	14	65
Tessellated darter			3	14							1	4	4	18
Walleye	1	195	2	810							2	363	5	1368
White perch			1	5	1	160	1	190					3	355
White sucker	4	42	2	22	1	170	1	1156			1	92	9	1482
Yellow perch	198	3819	210	6313	23	860	2	82			50	2739	483	13813
Total	**291**	**7640**	**397**	**20687**	**85**	**5239**	**34**	**3612**	**10**	**499**	**1259**	**27440**	**2076**	**65117**

Table 5-6. Summary of 2005 Anadromous Electrofishing Fish Collections of American shad at Stebbin Island, Station 3, and 0.1 Mile Below Vernon Dam.

Month and Station		No. of Fish	Hours	CPUE	Minimum Length (mm)	Maximum Length (mm)	Minimum Weight (g)	Maximum Weight (g)
July	Station 3 (031)	0	0.33	0	-	-	-	-
	Stebbin Island (613,614,615,624)	0	1.33	0	-	-	-	-
	0.1 Miles south of Vernon Dam (724)	0	0.33	0	-	-	-	-
August	Station 3 (031)	6	0.33	18	61	84	3	3
	Stebbin Island (613,614,615,624)	20	1.33	15	80	93	-	-
	0.1 Miles south of Vernon Dam (724)	5	0.33	15	64	84	4	5
September	Station 3 (031)	2	0.33	6	95	97	8	10
	Stebbin Island (613,614,615,624)	24	1.5	16	87	100	6	10
	0.1 Miles south of Vernon Dam (724)	2	0.33	6	87	93	8	9

Table 5-7. Entergy Nuclear Vermont Yankee Ichthyoplankton Sample Effort and Volumes (m^3) in the Connecticut River near the Vermont Yankee Intake Structure during 2005

	Depth (ft)						Mean	
	1		6		12			
Date	N	Volume	N	Volume	N	Volume	N	Volume
2-May-05	1	95.63	1	94.62	1	89.58	3	93.28
9-May-05	1	95.79	1	92.26	1	94.83	3	94.3
16-May-05	1	104.76	1	116.25	1	97.6	3	106.21
23-May-05	1	83.87	1	81.75	1	96.96	3	87.53
31-May-05	1	101.97	1	93.52	1	101.64	3	99.04
6-Jun-05	1	94.94	1	91.2	1	92.46	3	92.86
13-Jun-05	1	84.48	1	87.68	1	87.89	3	86.69
20-Jun-05	1	94.36	1	86.62	1	87.79	3	89.59
27-Jun-05	1	91.12	1	100.44	1	85.28	3	92.28
5-Jul-05	1	103.03	1	103.15	1	104.92	3	103.7
11-Jul-05	1	106.49	1	92.92	1	107.95	3	102.45
Total	**11**	**1056.44**	**11**	**1040.41**	**11**	**1046.9**	**33**	**1047.93**

Table 5-8. Earliest and Latest Collection Dates, Total Number and Relative Percentage by Taxon of Ichthyoplankton Collected Near the Vermont Yankee Circulating Water Intake Structure in 2005.

Species	Earliest Capture	Latest Capture	Number	Percent
Carps and minnows	13-Jun-05	11-Jul-05	364	67.91
Common carp	13-Jun-05	20-Jun-05	3	0.56
White perch	16-May-05	27-Jun-05	75	13.993
Centrarchidae	23-May-05	11-Jul-05	68	12.687
Yellow perch	2-May-05	23-May-05	23	4.291
Walleye	16-May-05	20-Jun-05	3	0.56
Total			**536**	**100**

Table 5-9. Density per 100 cubic meters of Ichthyoplankton Collected at Three Depths in the Vicinity of the Vermont Yankee Circulating Water Intake Structure during 2005

Week	Species	0.3 m	1.8 m	3.7 m	Mean Density
5/2/2005	Yellow perch	0.0	3.2	1.1	1.4
5/9/2005	Yellow perch	3.1	6.5	4.2	4.6
5/16/2005	Walleye	0.0	0.0	1.0	0.3
5/16/2005	White perch	0.0	0.9	1.0	0.6
5/16/2005	Yellow perch	1.0	0.0	0.0	0.3
5/23/2005	Centrarchidae	0.0	0.0	1.0	0.3
5/23/2005	Walleye	0.0	0.0	1.0	0.3
5/23/2005	White perch	4.8	3.7	5.2	4.5
5/23/2005	Yellow perch	1.2	1.2	3.1	1.8
5/31/2005	White perch	7.8	13.9	15.7	12.5
6/6/2005	White perch	0.0	8.8	14.1	7.6
6/13/2005	Carps and minnows	98.2	65.0	0.0	54.4
6/13/2005	Common carp	0.0	1.1	0.0	0.4
6/13/2005	White perch	0.0	2.3	0.0	0.8
6/20/2005	Carps and minnows	73.1	27.7	8.0	36.3
6/20/2005	Centrarchidae	6.4	8.1	3.4	6.0
6/20/2005	Common carp	0.0	1.2	1.1	0.8
6/20/2005	Walleye	1.1	0.0	0.0	0.4
6/27/2005	Carps and minnows	30.7	1.0	0.0	10.6
6/27/2005	Centrarchidae	3.3	4.0	3.5	3.6
6/27/2005	White perch	0.0	0.0	1.2	0.4
7/5/2005	Carps and minnows	39.8	7.8	10.5	19.3
7/5/2005	Centrarchidae	3.9	11.6	21.0	12.2
7/11/2005	Carps and minnows	1.9	33.4	1.9	12.4
7/11/2005	Centrarchidae	0.9	0.0	1.9	0.9

6.0 2005 ZEBRA MUSSEL AND ASIATIC CLAM MONITORING

6.1 METHODS OF COLLECTION AND PROCESSING

Larval (veliger) zebra mussel sampling was conducted bi-weekly between 17 May and 24 October 2005. Collections were made at quarter point stations (at 25, 50 and 75% of the rivers width) at Stations 4 and 5. Station 4 is composed of sub-stations 416 on the New Hampshire shore, 436 at mid-river and 426 on the Vermont shore. Station 5 is composed of sub-stations 051 on the New Hampshire shore, 053 at mid-river and 052 on the Vermont shore (Figure 6-1). At each sample station, 1,000 liters of river water were pumped through a 64-micron plankton net. Samples were preserved in 70% ethanol, and later examined in the laboratory for the presence of the microscopic veligers. A total of 70 pumped veliger samples were collected in 2005.

During the end of a pump sample at station 416 on 24 October a seam on the plankton net opened allowing a majority of the pumped river water to exit the net without going into the collection cup. Subsequent pump samples at stations 436 and 426 were not obtained on this date.

Juvenile/adult (settling stage) zebra mussel (*Dreissena polymorpha*) sampling was conducted between 17 May and 24 October 2005 at Stations 4 and 5 (Figure 6-1). One settlement plate sampler was deployed at each near shore quarter point station (416,426, 051 & 052) for a total of four samplers. Settlement plates were made of six, 6-inch by 6-inch, plates of 1/4 inch hardboard threaded laterally onto a rope with approximately 1.25in between plates. The sampler was suspended in the water column at 1-2 m below the surface. Approximately every two weeks, the plate sampler at each station was lifted out of the water and one plate was randomly selected and cleaned into a 64-micron sieve. The sample was then preserved in 70% ethanol for examination in the laboratory. A total of 46 veliger plate samples were collected and processed during 2005.

One plate sampler deployed at station 52 could not be located when retrieval was attempted on 28 June 2005. A new plate sampler was deployed at Station 52 on 21 July 05.

Asiatic clam (*Corbicula fluminea*) samples were collected with a 9-inch Ponar dredge on 15 June, 15 August, and 10 October 2005 at Station 4 (substations 416, 426, and 436) and Station 5 (substations 051, 052, and 053) (Figure 6-1). Dredge samples were collected at all six locations for a total of 18 dredges. At each station three dredges were combined into a single sample and sieved through a number 30-sieve in the field, prior to being preserved in 70% ethanol for laboratory examination.

6.1.1 Laboratory Identification Procedures

Each of the 116 zebra mussel veliger and settling stage samples were emptied into a petri dish and examined in entirety with cross-polarized light on a dissecting microscope beginning at 40x magnification. The use of cross polarized light allows zebra mussel veligers to be distinguished from other planktonic organisms that are also collected in the samples. *D. Polymorpha* exhibit a dark 'Maltese cross' as a result of the bifringment of light under cross polarization. The larval shells stand out as bright spots against a dark background (Johnson 1996).

In the laboratory, the 18 ponar dredge samples were examined in entirety under low magnification (2x) for the presence of *Corbicula fluminea*. *C. fluminea* also refract cross polarized light and exhibit the associated 'Maltese cross'.

6.2 RESULTS

Eight larval zebra mussel pump samples and 3 plate samples contained mollusks exhibiting characteristics analogous to *D. polymorpha*. These 11 samples were sent to aquatic biologists with the Vermont Department of Environmental Conservation for definitive identification. Of the pump samples 5 were identified as Ostracods, a type of common zooplankton and 3 were identified as glochidia, a parasitic phase of native unionoidean life history in which fish are hosts. Ostracods and glochidia exhibit morphological features similar to *D. polymorpha* including refraction of cross polarized light due to the crystalline calcite structure of the shell, the resultant 'Maltese cross' pattern, size, and a D- shape.

Four samples of mollusks with similar morphological features as *C. fluminea* were sent to the Vermont Department of Environmental Conservation for definitive identification. These 4 samples were identified as the native fingernail clam, *Pisidium* sp.

No Asiatic clams or any life stage of zebra mussels were found in the samples collected during the 2005 Vermont Yankee monitoring program.