Suffolk County Vector Control & Wetlands Management Long Term Plan & Environmental Impact Statement

Task 3b: Early Action Projects
Non-Target Invertebrate Study

Prepared for:

Suffolk County Department of Public Works
Suffolk County Department of Health Services
Suffolk County, New York

Prepared by:

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SUFFOLK COUNTY VECTOR CONTROL AND WETLANDS MANAGEMENT LONG - TERM PLAN AND ENVIRONMENTAL IMPACT STATEMENT

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TABLE OF CONTENTS

TABLES

APPENDIX 1 - SITE MAPS

APPENDIX 2 - DATA TABLES

1. Introduction

Invertebrates are often used as a measure of overall habitat function and health. Melampus snails (family Melampodidae) serve as food for waterfowl. Amphipods (Order Amphipoda) are common inhabitants of tidal marsh vegetation. Fiddler crabs (*Uca spp*.) are not found in all Long Island salt marshes, but may be a keystone species where present. Studies have suggested that the use of vector control larvicides can reduce the number and diversity of invertebrates. Therefore, Cashin Associates, PC (CA) undertook a small study of the potential for impacts to marsh invertebrate populations using these three signature invertebrates.

Five pairs of marshes were sampled for the presence of these invertebrates. Paired marshes were in close physical proximity, morphologically similar, and sampled on the same date, within two hours of the low tide. The intent of the pairing was that one marsh in each pair is treated with larvicides, while the other is not. Due to communication errors, it turned out that only three of the sampled marshes have been treated, and the other seven were not. Although this reduces the power of the sampling, it also allows for greater comparison of between marsh differences.

The marsh pairs were:

- Pair 1: Smith Point North-Hospital Point (South Shore)

  Smith Point North has received larvicide treatments, and Hospital Point did not over the 2001 – 2004 period.

- Pair 2: Smith Point Park-William Floyd Estate (South Shore)

  Smith Point County Park has received only a few larvicide treatments, and the William Floyd Estate was not treated at all over the 2001 – 2004 period.

- Pair 3: Sunken Meadow-Crab Meadow (North Shore)

  Sunken Meadow has received treatments, and Crab Meadow did not over the 2001 – 2004 period.

- Pair 4: Hubbard Creek-Mill Creek (Peconic)

There was miscommunication that led the site selector to understand Mill Creek received larvicide treatments. Neither marsh has been treated over the 2001 – 2004 period.

- Pair 5: Mashomack-Little Northwest Creek (Peconic)

There was miscommunication that implied Mashomack and Little Northwest Creek had received some larvicide applications; it was anticipated that the amount of treatment for each would differ. A records search showed neither marsh has been treated over the 2001 – 2004 period.

All 10 marshes were grid ditched, presumably in the 1930s. The presence of ditches has been noted, by some, to impact invertebrate populations.

A location map of the sites is included in Appendix 1. Appendix 1 also includes aerial photographs of the marshes. The treatment history of the three larvicided marshes is summarized in Table 1.

Table 1. Number of Larvicide Applications

	Smith Point North	Smith Point Park	Sunken Meadow
2001			
Bti	4	3	5
Methoprene	11	0	12
Duplex	3	0	4
2002			
Bti	3	0	3
Methoprene	4	0	9
Duplex	4	0	4
2003			
Bti	3	1	4
Methoprene	7	0	12
Duplex	2	0	2
2004			
Bti	1	0	1
Methoprene	7	0	5
Duplex	5	0	3
Total, 2001-2004	54	4	64

Bacillus thuringiensis israelensis (*Bti*) is a bacterial control agent is consumed by mosquito larvae, and leads to death by disrupting the larval gut. Methoprene is a mimic of a an insect growth regulator. It is absorbed by the larvae, and interferes with the maturation of the larvae so that, in a non-feeding stage, the larvae or pupae starve. *Bti* is only useful against earlier stage larvae. Methoprene is most effective against older larvae. When a mix of larvae are present, or the larvae are developing quickly, a duplex formulation of both pesticides is sometimes applied.

2. Sampling Procedure

Four marsh surface samples were taken on each marsh. Sites were selected by vegetation type and elevation, beginning near a major ditch or tidal creek (low marsh, *Spartina alterniflora*) and moving inland to include a high marsh (*S. patens*) sample and a marsh transition sample (*Iva, Phragmites*). If pools or pannes were present, a sample was taken from its vegetated edge. If not, the fourth sample was taken at a mid marsh elevation containing a variety of species of vegetation.

A circular metal frame 16cm in diameter was used to define the sampling area. The frame was inserted into the marsh surface to a depth of approximately 5 cm. The soil and root mass within the frame was excavated using a sharp knife, and the sample was collected in a labeled plastic bag. Each marsh sample was processed in a sorting tray. The sample mass was carefully examined for the presence of Melampus and Amphipods.

If *Uca spp*. were present, their abundance was measured by counting the number of burrows within a 30cm ring. Sampling for *Uca spp*. was done parallel to a major ditch or tidal creek edge, by dropping the ring at three meter intervals.

3. Data

Appendix 2 contains the sampling results for each marsh. These sampling results are summarized in Tables 2-4 below.

Table 2. South Shore

	Smith Point North	Hospital Point	Smith Point Park	William Floyd Estate
Fiddler Crabs	**None**	**None**	**None**	**None**
Amphipods				
Low	4	41	8	25
Mix	4			
Panne		49	10	6
High	3	8	14	9
Transition	2	25	14	11
Total	**13**	**123**	**46**	**51**
Melampus				
Low	0	0	1	3
Mix	4			
Panne		0	1	2
High	0	15	4	5
Transition	9	0	1	4
Total	**13**	**15**	**7**	**14**

Table 3. North Shore

	Sunken Meadow	Crab Meadow
Fiddler Crabs	**13**	**5**
Amphipods		
Low	8	9
Mix	17	
Panne		5
High	5	3
Transition	5	3
Total	**35**	**20**
Melampus		
Low	0	0
Mix	0	
Panne		0
High	0	0
Transition	0	0
Total	**0**	**0**

Table 4. Peconic Bay

	Mill Creek	Hubbard Creek	Mashomack	Little Northwest Creek
Fiddler Crabs	**8**	**6**	**11**	**None**
Amphipods				
Low	0	18	0	10
Mix		4		
Panne	3		1	10
High	4	4	2	5
Transition	5	0	7	2
Total	**12**	**26**	**10**	**27**
Melampus				
Low	26	12	0	0
Mix		1		
Panne	68		6	0
High	12	5	3	0
Transition	1	0	2	1
Total	**107**	**18**	**11**	**1**

4. Data Analysis

Amphipod abundance was clearly greatest at Hospital Point, and snail abundance was greatest at Mill Creek. There were more fiddler crabs at Sunken meadow than any other marsh, although the difference between this site and the other four marshes were crabs were detected was much smaller than the differences between the maximum amphipod and snail abundance sites.

Amphipods were detected at all ten marshes. A pattern of greatest abundance in the low marsh-mix-panne areas, with lesser abundances in the high marsh and transition zones can be discerned for all marshes except Smith Point Park, Mill Creek, and Mashomack. Abundance was high at Smith Point Park, despite this lack of conformance. Three sites had lower abundances: Smith Point North, Mill Creek, and Mashomack. Therefore, one of the treated sites had an "unusual" pattern of amphipod detections, and one had lower abundances.

Snails were not detected at the North Shore marshes, and only one was found at Little Northwest Creek. Abundances were very high at Mill Creek, and very low at Little Northwest Creek; otherwise, abundances were somewhat similar at the other six marshes where the snails were found. There were few coherent patterns in terms of ecological settings for the detections. One of the treated sites had lower abundances of snails; no conclusion should be drawn regarding the absence of snails at Sunken meadow, as they were not found at the paired site, either. The variation is snail abundance was greater for the Peconic sites, which suggests environmental factors are a greater control on their overall abundance than treatments with larvicides.

Fiddler crabs were not detected on the south shore, due to a general lack of favored habitat – open beach along a waterway. The treated site had more crab burrows than the untreated sites. The difference between the two north shore sites seemed to be approximately the same as the differences found among the three marshes in the Peconics where crabs were detected. This suggests that larvicide applications do not influence crab abundances.

5. Conclusions

This was a limited sampling effort. The power of the study would have been enhanced if the original design had been applicable. However, the limited data collected here implies that long-term, persistent use of modern larvicides appears to have no impact on these signature invertebrates.

Sampling for invertebrates is labor-intensive. Patchy populations may result in sampling artifacts that control the results. Diversity indices are sometimes preferred to abundance measures. However, studies that reported effects from mosquito larvicides reported tended to report greater changes in abundances than in diversity. This suggests that measuring invertebrate diversities at these marshes in place of the three invertebrate abundances might not have produced different results.

Finding pairs of somewhat similar marshes in the same general area of the estuary systems with different treatment histories proved to be more difficult than originally perceived. The power of any follow-up study might be enhanced by focusing on the treated sites, and using one area control site. However, the how representative the control site actually is would then become very important. This is not an idle concern, given the relatively large variation is results found for the four Peconic sites, and between Hospital Point and William Floyd Estate.

APPENDIX 1

Site Maps

These are contained in a separate file.

APPENDIX 2

Sampling Data

PAIR I
Site : Smith Point County Park North
Date: August 26, 2004 Time: 2:20 p.m.

Moon Phase	3 days before full
Weather	Sunny, 75°, Wind SE @ 10 km
Tide	Low Tide @ 2:35, Mastic Beach

Notes: Extensive ditching, many fish in ditches and pools. No larval mosquitoes noted, adults present. No fiddler crabs. Vegetation mainly S. alterniflora.

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Site	Low marsh. S. alterniflora, ditch edge.	High marsh. S. patens, slight hummocks, 30' from edge of large ditch.	Mix of S. alterniflora and S. patens. 50' inland from ditch, 40' from marsh's upland edge, many invertebrates.	Transition. Iva/S. alterniflora/Phragmites mix, 80' from ditch.
Amphipods	4	3	4	2
Melampus	0	0	4	9

PAIR I
Site: Hospital Point, F.I.N.S.
Date: August 26, 2004 Time: 3:20 p.m.

Notes: Many adult mosquitoes at marsh transition, some on marsh, no larvae noted. No fiddler crabs, even in inland panne areas. Some ditching, poor condition. No fiddler crabs.

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Site	Low marsh. S. alterniflora, 3" from ditch edge, 50' from bay.	High marsh. S. patens with some Salicornia. 80' from ditch edge, 120' from bay.	Panne edge. Salicornia and stunted S. alterniflora.	Transition. Stunted S. alterniflora and Distichlis meets Phragmites, Iva and Baccharis.
Amphipods	41 (nearly all small in size)	8 (many invertebrates, mites, ants,…)	49 (mainly small)	25 (mainly small)
Melampus	0	15	0	0

PAIR II
Site: William Floyd Estate
Date: September 1, 2004 Time: 11:30 a.m.

Moon Phase	3 days after full moon
Weather	Sunny, 75°, wind N at 7 knots
Tide	Low at Mastic Beach at 11:05 a.m.

Note: Marsh surface very wet, less wet near bay. Few adult mosquitoes, no larvae noted. Ditches with fish and high water levels. No fiddler crabs.

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Site	Low marsh. S. alterniflora, ditch edge 100' from bay.	High marsh. S. patens, 100' from bay, 60' from ditch edge.	Panne edge. Stunted S. alterniflora, Salicornia sp. Standing water, 40' from bay.	Transition. Stunted S. alterniflora, Iva, Phragmites. Significant elevation change, dry soil. 450' from bay.
Amphipods	25	9	6	11
Melampus	3	5	2	4

PAIR II
Site: Smith Point Park
Date: September 1, 2004 Time: 12:50 a.m.

Notes: Small marsh area, wet surface. Mainly S. alterniflora, Distichlis and Salicornia. Very many biting flies (Simulidae). No mosquitoes or fiddler crabs noted.

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Site	Low marsh. S. alterniflora. Ditch edge 80' from bay; standing water.	High marsh. Small patch of S. patens, 200' from bay. Very wet. Many invertebrates, notably Isopoda.	Panne edge. Distichlis, 120' from bay, standing water.	Transition. Iva, Phragmites, S. patens and Distichlis. Drier site.
Amphipods	8	14	10	14
Melampus	1	4	1	1

PAIR III
Site: Sunken Meadow State Park
Date: September 2, 2004 Time: 7:30 a.m.

Moon Phase	4 days past full.
Low Tide	8:10 a.m. at Nissequogue River
Weather	Sunny, 70°, NW wind 15 knots

Notes: Vegetative growth not as dense as other marshes that were sampled, Soil well drained, no mosquitoes, no ditches or pools.

Fiddler Crabs: Sampled along lower edge of S. alterniflora. Sand with small stones, ribbed mussels scattered throughout.

R_1: 7 burrows R_2: 2 R_3:4

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Site	Low marsh. Sparse S. alterniflora, fiddler crab burrows. Inundated at high tide, 20' from waters edge at low tide.	High marsh. S. patens, Limonium 100' from water at low tide. No crabs.	Stunted S. alterniflora, Distichlis, Salicornia, no crabs 60' from water.	Transition. S. Patens, Phragmites, Iva. Very sandy, dry.
Amphipods	8	5	17 (most very small)	5
Melampus	0	0	0	0

PAIR III
Site: Crab Meadow
Date: September 2, 2004 Time: 9:15 a.m.

Notes: Ditches nearly choked off, many pools with fish, pannes with many fiddler crabs. Crab burrows also between S. alterniflora stems. No mosquitoes noted.

Fiddler Crabs: Sampled parallel to lowest edge of S. alterniflora on edge of main channel, 300 yards from Long Island Sound.

R_1: 2 R_2: 2 R_3: 1

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Site	Low marsh. S. alterniflora at top of bluff off main channel, crab burrows, vegetation not dense, sandy well drained soil.	High marsh. S. patens. 20' from high tide line off main channel, moist soil, no crabs.	Pool edge. Distichlis, stunted S. alterniflora. 120' from main channel.	Transition. Iva with Distichlis 150' from main channel. Very many ants with eggs but little other life.
Amphipods	9	3	5	3
Melampus	0	0	0	0

PAIR IV
Site: Mill Creek
Date: September 9, 2004 Time: 12:05

Moon Phase	4 days before new moon
Low Tide	1:45 at Sag Harbor
Weather	Sunny 70°, SW Wind at 15-20 knots

Notes: No ditches, no mosquitoes noted (too windy for flying insects). Fiddler crabs throughout marsh. Creek banks steep with tall S. alterniflora to waters edge, no bare sand, little S. patens present in marsh.
Fiddler crabs: Sampled in tall S. alterniflora along creek bank.

R_1: 4 R_2: 1 R_3: 3

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Site	Low marsh. S. alterniflora 15' from creek, 200' yards from bay. Some fiddlers and ribbed mussels.	High marsh. S. patens mixed with stunted S. alterniflora nearby. Hummocks, some fiddlers and mussels, many small isopods.	Panne edge. Stunted S. alterniflora, Salicornia, dead S. patens. Many Melampus evident on surrounding bare ground. Fiddlers and mussels present.	Transition. S. alterniflora and Distichlis meeting Iva and Baccharis.
Amphipods	0	4	3	5
Melampus	26	12	68	1

PAIR IV
Site: Hubbard Creek
Date: September 9, 2004 Time: 1:10

Notes: Many natural creeks and drains with fish and snails (Littorina sp.). No mosquitoes noted. Fiddler crabs only along creek banks and hummocks in tall S. alterniflora.

Fiddler Crabs: Sampled in tall S. alterniflora along creek bank.

R_1: 3 R_2: 1 R_3: 2

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Site	Low marsh. S. alterniflora 6' off creek edge, many ribbed mussels, no crabs.	High marsh. S. patens. 100' from creek, 30' from treeline.	Wet area with Typha sp, and dead S. patens (no pannes on marsh).	Transition. Juncus at edge of Iva and greenbriar.
Amphipods	18	4	4	0
Melampus	12	5	1	0

PAIR V
Site: Little Northwest Creek
Date: 10/19/04 Time: 8:40

Moon Phase	8 days before full			
Weather	Moderate rain, 60°, wind NE 12 knots			
Tide	Low tide 9:00 a.m @ Sag Harbor			
Notes: Extensive ditching up to marsh border, good tidal invitation, little high marsh. No crabs or fish noted. Too late in season for mosquito larvae, too windy for adults. Many ribbed mussels near waterways, many small pools and salt pannes.				
	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Site	Low marsh. Ditch edge 100' from main creek, S. alterniflora.	High marsh. S. patens with some Distichlis, dry sediment 60' from ditch.	Pool/wet panne edge. Distichlis, Limonium and stunted S. alterniflora.	Transition. Iva, Distichlis edge. Very sandy, moderate elevation change, 20' from end of a ditch.
Amphipods	10	5	10	2
Melampus	0	0	0	1

PAIR V
Site: Mashomack Preserve
Date: October 19, 2004 Time: 10:45

Notes: Extensive ditching, some in poor condition. Good tidal inundation to marsh transition; little high marsh. No fish or mosquitoes noted. Many snails (Littorina sp.) in ditches, many fiddler crabs near ditch and creek edges, many ribbed mussels.

Fiddler Crabs: Sampled parallel to edge of main tidal creek in tall S. alterniflora.

R1: 5 R2: 4 R3: 2

	Sample 1	**Sample 2**	**Sample 3**	**Sample 4**
Site	Low marsh. Edge of tidal creek, tall S. alterniflora.	High marsh. S. patens mixed with Distichlis 30' from ditch.	Pool/wet panne edge. Salicornia, Limonium, stunted alterniflora.	Transition. Iva, Distichlis: Drier sediment 90' from tidal creek.
Amphipods	0	2	1	7
Melampus	0 Note: 7 snails in sample, probably Littorina sp., but not the same species as in the ditches.	3	6	2