CHAPTER 7: MARSH RESTORATION PROJECT: FISH ASSEMBLAGE STRUCTURE

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MARSH RESTORATION PROJECT: FISH ASSEMBLAGE STRUCTURE

INTRODUCTION

In July 1994, the New Jersey Department of Environmental Protection (NJDEP) issued the Final NJPDES Permit No. NJ0005622 ("Permit") for the Salem Station. In August 2001, the NJDEP renewed PSEG's Permit; with several Custom Requirements that advanced the restoration and monitoring measures required by the 1994 permit. Specific to marsh fish assemblage monitoring, the 2001 Permit required PSEG to develop and implement an Improved Biological Monitoring Work Plan (IBMWP). The IBMWP requires, among other things, the following studies:

> *Studies of habitat utilization by finfish will be conducted in restored wetlands in New Jersey that have not met the final vegetative success criteria, and the results will be compared to those from reference wetlands. The wetland restoration sites and two reference sites will be sampled from late spring through mid-fall in all years of the permit cycle.*
>
> *Two sampling methods will be employed, trawls and block nets. Trawl samples will be collected monthly at three stations within each marsh/adjacent study area:upper tidal creek, lower tidal creek and the mouth of each creek. At each of the three stations, three 2-minute tows will be conducted. Fish sampling in upper tidal creeks will employ block nets fished during daylight ebb tides on a monthly basis. All finfish will be identified to the lowest practical taxon and counted. The length of the target species will be measured in a subsample taken from each collection. Data on water temperature, dissolved oxygen, salinity, and turbidity also will be recorded at each sampling location.*

In addition to the IBMWP required monitoring, PSEG has continued weir monitoring of three habitat types within the Alloway Creek Watershed (ACW) to document changes in fish assemblage resulting from the restoration of *Phragmites*-dominated marsh.

The overall long-term objective of this research is to evaluate the effectiveness of restoration activities on faunal response with emphasis on the patterns and processes that control fish utilization and production for restored wetlands in Delaware Bay. More specifically, fish species composition, life history stage, and size are compared across habitat types (large and small marsh creeks) in restored and reference marshes. The target species are weakfish (*Cynoscion regalis*), white perch (*Morone americana*), spot (*Leiostomus xanthurus*), and bay anchovy (*Anchoa mitchilli*), although all fish species, as well as blue crabs (*Callinectes sapidus*), horseshoe crabs (*Limulus polyphemus*), snapping turtle (*Chelydra serpentina*), and diamondback terrapin turtles (*Malaclemys terrapin*) were included in sampling for a more complete understanding of restoration effects.

These studies of habitat utilization began in 1996 with the initiation of physical marsh restoration efforts, and this is the fourteenth annual report in a long term monitoring project (PSE&G 1997-1999b; PSEG 2000-2009). The outline of this report was re-organized in 2007 to present results with a regional perspective. With this perspective, the fish assemblages, sampled in the restoration and reference sites monitored, can be more clearly described as part of respective

ecological communities within the estuary. Accordingly, results from the Moores Beach Reference Marsh and Commercial Township Restoration Site are summarized in the Lower Bay Region section of this report, reflecting the polyhaline (18-35 ppt) portion of the Delaware Estuary. The Mad Horse Creek Reference Marsh and Alloway Creek Watershed Restoration Site are summarized in the Upper Bay Region section of this report, reflective of the oligohaline (0.5-5 ppt) portion of the Estuary. Sub-sections within site-specific summaries are as they have been in the previous annual reports.

MATERIALS AND METHODS

STUDY SITES AND SAMPLING FREQUENCY

The monitoring area encompasses two restoration and two reference tidal marsh sites arrayed along the New Jersey shore of Delaware Bay (Figure 7-1). These sites were sampled intensively once a month, from May through November, in daylight, and in coincident to the spring tides (Table 7-1). The intensively sampled sites included the Moores Beach Reference Marsh (Figures 7-2a and b), the Commercial Township Restoration Site (Figures 7-3a and b), the Mad Horse Creek Reference Marsh (Figure 7-4), and the ACW Site, which includes the Alloway Creek (Figure 7-5), and Mill Creek (Figure 7-6) Sampling Areas. As previously described, based on their generalized salinity profiles and reference/restoration site characteristics the Moores Beach and Commercial Township sites were grouped into the Lower Bay Region; the Mad Horse Creek, Alloway Creek, and Mill Creek areas were grouped into the Upper Bay Region (Table 7-1). The restoration sites can also be divided broadly into two groups based on the nature of alteration: former salt hay farms adjacent to the lower bay and *Phragmites*-dominated sites adjacent to the upper bay. Restoration of the Commercial Township Site, a former salt hay farm, entailed the creation of higher order marsh creeks and the breaching of earthen dikes to allow a natural tidal inundation cycle to re-establish tidal exchange within the site. Moores Beach, located four miles southeast of the Commercial Township site, was designated as a reference site for the salt hay restoration site. The AWC *Phragmites*-dominated restoration site included the Mill Creek and Alloway Creek areas. At these areas of the ACW site, restoration efforts are ongoing and include a range of measures to remove *Phragmites* and encourage the natural re-vegetation of *S. alterniflora* and other types of vegetation. Mad Horse Creek, located approximately 10 miles south of the ACW site, is the designated reference site for the *Phragmites*-dominated restoration sites. Mad Horse Creek has a minimal disturbance history, and probably represents the more natural marsh condition among the reference sites. Additionally, sampling of the two areas of the ACW site encompassed (within a single salinity/temperature and distance regime) stages of restoration including areas dominated by *Phagmites*, areas undergoing restoration that were treated with herbicide, and reference areas dominated by *S. alterniflora.*

SAMPLING TECHNIQUES

Physical and chemical parameters were measured at the beginning of each sample, for all otter trawl and weir samples. From May to November 2009, temperature, dissolved oxygen concentration and salinity were measured with a calibrated hand-held salinity, temperature and oxygen meter (YSI Model 85), by lowering the probe into the water and recording near-surface

values. Water transparency was measured by lowering a Secchi disc in the water column until it was no longer visible and recording the corresponding depth in 1.0 inch increments.

Large marsh creeks were sampled using a 4.9 m (16 ft.) semi-balloon otter trawl with 6.0 mm (0.25 inch) cod end mesh. At each site, two large marsh creeks were sampled at three locations: upper (U), lower (L), and mouth (M) (e.g., Figure 7-2 a). Sampling took place around high tide, with three two-minute tows per station. The mouth of a creek was defined as its intersection with the next higher order creek. In general, the creek mouth trawling stations are subtidal and the lower and upper stations are shallow subtidal to intertidal. Start and end points for each trawl were recorded using Global Positioning System (GPS) co-ordinates to ensure that identical areas were sampled each month. Tow speed was 1.4 m/s (6 ft/s) and was measured using a Marsh-McBirney, Inc. model 201 flowmeter. All tows were against the current at a constant engine RPM of 1800 (90 hp Honda outboard on 24ft. Carolina Skiff) or 2500 (50 hp Honda outboard on 21ft. Carolina Skiff). Depth was measured at each site using a Hummingbird® Piranha Max 10 depth recorder. The ratio of towline to water depth was maintained at 5:1 with minor adjustments to compensate for current speed and tidal flow. A total of 504 otter trawls were made during the 2009 sampling season (Table 7-1).

The first 20 of each fish species, blue crabs, diamondback terrapins, horseshoe crabs, and snapping turtles in each replicate tow were identified, enumerated, and measured separately to the nearest millimeter. Fork length (FL) was recorded for fish species with forked tails; total lengths (TL) were recorded for all other fish. Carapace width (CW) was measured for blue crabs and horseshoe crabs, and carapace length (CL) was recorded for diamondback terrapins and snapping turtles. Tentative identifications were finalized and fish ages were determined using Wang and Kernehan (1979), Able and Fahay (1998) and PSE&G (1999a). Individual fishes not identifiable to species were preserved in 95% ethanol or 10% formalin and processed in the laboratory. All fish not preserved for laboratory identification and all turtles were returned to the water at the end of all sampling within a creek reach.

Small intertidal marsh creeks were sampled using weirs 1.8 m x 1.2 m x 1.2 m (6 ft. x 4 ft. x 4 ft.), with 4.5 m x 1.8 m (15 ft. x 6 ft.) wings, 0.175 mm (0.125 inch) mesh set at high tide and hauled at low tide when the creek was drained. At each small intertidal creek sampled, a net was stretched across the channel with support poles embedded vertically in the sediment. Wings were extended back onto the marsh surface from each end of the net, forming a funnel-shaped weir. Wing support poles were embedded in the sediment directly upstream and lashed to the net support poles, and the "leaded" net line was buried in the bottom sediment to eliminate gaps in the weir. Local topography occasionally prevented the complete draining of the small marsh creeks, therefore, any fish remaining in standing pools of water immediately in front of the net were seined into the weir. Fish and blue crabs were identified and enumerated, and up to 50 individuals per species per sample were measured, using the same techniques as for the trawl collections. A total of five sites were sampled monthly using weirs deployed during the day totaling 98 sets (Table 7-1).

DATA ANALYSIS

Species composition and abundances were calculated as percent frequency of occurrence (percent of samples containing each species), percent composition (proportion of individual species to the total number of fish collected), and catch-per-unit-effort (CPUE) (mean numbers of individuals collected per sample). Length frequency distributions were used to interpret age distributions for target species.

RESULTS AND DISCUSSION

LOWER BAY REGION

Physical and Chemical Parameters

Temperature

The pattern in mean water temperature observed in 2009 exhibited the typical seasonal pattern found in a temperate climate (Figure 7-7). During the sampling period, mean water temperatures increased from May through August, then declined through November. Values at the two Lower Bay Region sites were similar throughout the sampling season. Moores Beach values ranged from 11.8°C in October to 29.0°C in August; Commercial Township values ranged from 11.5°C in November to 29.4°C in August.

Salinity

The Lower Bay Region sites mean salinity values, as observed during the 2009 "Marsh Fish Assemblage" sampling season, are presented in Figure 7-7. Generally, over the period of sampling the average salinity in the Lower Bay Region stayed constant with a range between 16.0 ppt and 18.7 ppt. There was, however, a spike in salinity of 21.1 ppt at Moore's Beach in November; otherwise, values at Moores Beach ranged from 16.5 ppt in October to 18.7 ppt in September; Commercial Township ranged from 16.0 ppt in June to 17.6 ppt in August. The greatest difference in salinity occurred in November when Moores Beach was 4.0 ppt higher than Commercial Township; in all other months the difference was between 0.1 to 1.4 ppt.

Dissolved Oxygen

Monthly mean dissolved oxygen values for the 2009 sampling season are depicted in Figure 7-7. In general, mean dissolved oxygen decreased from May to the seasonal low in July, and then increased through October. Seasonal lows for the Moores Beach and Commercial Township sites occurred in July, at 2.7 and 4.1 mg/ℓ, respectively. Seasonal highs for the Moores Beach and Commercial Township sites occurred in October at 9.6 and 9.8 mg/ℓ, respectively. When comparing the values of Moores Beach and Commercial Township, their seasonal trends more or less mimic one another.

Moores Beach Reference Site

General Catch Composition

A total of 9,971 fish, representing 23 species and 17 families, was collected in 126 otter trawl collections and 14 weir sets from May through November 2009 in the Moores Beach reference site (Tables 7-1, 7-2 and 7-3). The species collected were composed primarily of transients (70%), i.e. those that spend a portion of their life history outside of the Delaware Bay, and secondarily of residents (30.0%), i.e. those that spend their entire life history in the Bay. In addition, two invertebrates, i.e., blue crab (n=913) and horseshoe crab (n=20), and one reptile, i.e., diamondback terrapin (n=2), were included in the catches.

Large Marsh Creeks

A total of 316 fish, representing 22 species and 16 families, was collected in otter trawl collections during 2009 (Table 7-2 and 7-3). The total CPUE was 2.51. In the aggregate, eight species comprised 85% of the total catch, and in order of decreasing abundance they were; hogchoker (27%), weakfish (17%), summer flounder (9%), striped bass (8%), oyster toadfish (7%), white perch (7%), black drum (5%), and black sea bass (5%). Hogchoker had the highest percentage of occurrence at 16%, with white perch and striped bass both occurring in 14% of the trawl collections. Weakfish occurred in 10% of collections while no other species occurred in more than 8% of the collections. Fish abundance in the large marsh creeks, as expressed by monthly catch-per-unit-effort (CPUE) for all fish collected by otter trawls, was highest in May with a monthly mean CPUE of 6.83, second highest in August with a mean CPUE of 5.22 and CPUE's were $\leq$2.66 during the other months of sampling (Figure 7-8). When viewed from a monthly perspective, species composition and abundance data illustrates a dynamic progression of species utilization underlying the aggregate data (Figure 7-9). May and September were transitional months with no species predominant. However during the remaining months, each of the following species or co-generic aggregates comprised $\geq$50 % of the total catch in their respective months; hogchoker in June (69%) and July (56%), weakfish in August (50%), and moronids (i.e., white perch and striped bass) in October (67%) and November (69%).

Small Marsh Creeks

A total of 9,655 fish, representing 6 species and 6 families, was collected in weir sets during 2009 (Table 7-2 and 7-3). The total CPUE was 689.64. Two species comprised 99% of the total catch, and in order of decreasing abundance they were; mummichog (74%) and Atlantic silverside (25%). Mummichog occurred in all of the weir sets, and Atlantic silverside was taken in 79% of the sets. Sheepshead minnow was taken in 29% of the sets with all other species occurring in $\leq$8% of the collections. Fish abundance in the small marsh creeks, as expressed by monthly catch-per-unit-effort (CPUE) for all fish collected by weir, was highest in August with a monthly mean CPUE of 1,732, and mummichog was the most common species comprising 62% (Figure 7-8 and 7-9). Mummichog was the predominant species during all months of sampling. Atlantic silversides comprised 42% of the catch in July, when it was at its peak in abundance (Figure 7-9).

Commercial Township Restoration Site

General Catch Composition

A total of 8,393 fish, representing 28 species and 21 families, was collected in 126 otter trawl collections and 14 weir sets from May through November 2009 in the Commercial Township restoration site (Tables 7-1, 7-2 and 7-4). The species collected were composed primarily of transients (75%), and secondarily of residents (25%). In addition, two invertebrates, i.e., blue crab (n=1105) and horseshoe crab (n=17), and one reptile, i.e., diamondback terrapin (n=3), were included in the catches.

Large Marsh Creeks

A total of 2,330 fish, representing 26 species and 19 families, was collected in otter trawl collections during 2009 (Table 7-2 and 7-4). The total CPUE was 18.49. Six species comprised 91% of the total catch, and in order of decreasing abundance they were; Atlantic silverside (31%), Atlantic croaker (22%), bay anchovy (19%), hogchoker (7%), black drum (7%), and weakfish (5%). All other species collected individually comprising $\leq$ 4% of the total fish catch. While Atlantic silverside was the most numerically abundant species, bay anchovy and black drum were the species most frequently taken, both occurring in 31% of the trawl collections. Weakfish, hogchoker and white perch were also represented in the catch at relatively high frequencies of 25, 22, and 17%, respectively. No other species occurred in more the 13% of the collections. Atlantic silverside, the numerically abundant species, occurred in 13% of the trawl collections. Fish abundance in the large marsh creeks, decreased from May to June, followed by an increase from June to the seasonal high in August with a monthly mean CPUE of 46.72. CPUE decreased in September and October, then rose slightly in November (Figure 7-10). Like Moores Beach, there was a progression of species composition and predominance in the Commercial Township restoration site. Bay anchovy was the predominant species in May, June, and September comprising 52, 64, and 74% of the catch, respectively. Atlantic silverside was the predominant species in July and August, comprising 67 and 62% of the catch, respectively. In October and November, Atlantic croaker was the predominant species comprising 69 and 81% of the catch, respectively (Figure 7-11).

Small Marsh Creeks

A total of 6,063 fish, representing ten species and seven families, was collected in weir sets during 2009 (Table 7-2 and 7-4). The total CPUE was 433.07. Two species comprised 96% of the total fish catch, and in order of decreasing abundance they were; Atlantic Silverside (60%), and mummichog (36%). Mummichog was taken in 86% of the weir sets, and Atlantic silverside occurred in 79% of the sets. Black drum was taken in 43% of the sets. No other species occurred in more the 15% of the collections. Fish abundance in the small marsh creeks was highest in July with a monthly mean CPUE of 1,589 (Figure 7-10). Abundance was lowest in October, with a monthly mean CPUE of 20.5. Each of the following species comprised $\geq$52% of

the total catch in their respective months; Atlantic menhaden in May, Atlantic silverside in June, July, August, and September, and mummichog in October and November (Figure 7-11).

Target Species Accounts for the Lower Bay Region

Bay anchovy

In the large marsh creeks of the Lower Bay Region, bay anchovy comprised 2 and 19% of the total catch at the Moores Beach Reference and Commercial Township Restoration Sites, respectively. They occurred in 4% of the Moores Beach otter trawl collections and 31% of the Commercial Beach otter trawl collections (Tables 7-3 and 7-4). At Moores Beach, a total of 5 individuals, was collected, and their mean CPUE for the study period was 0.04. At Commercial Township, a total of 444 was taken, and the CPUE was 3.52. Bay anchovy was only collected at Moores Beach during May and November. Bay anchovy abundance in May was 0.16 and in November it was 0.11 (Figure 7-12). At Commercial Township, bay anchovy abundance was highest in September, with a CPUE of 12.05. In all other months of sampling CPUE's were ≤4.00. Individuals collected at Moores Beach ranged from 43 to 58 mm FL (Figure 7-13). All specimens collected in May were age 1+; all specimens collected in November were age 0+. Individuals collected at Commercial Township ranged from 18 to 83 mm FL (Figure 7-14). All specimens measured in May were age 1+. During June and July 97 and 83% of specimens caught were age 1+. During August through November age 0+ were predominant, comprising from 92 to 100% of the specimens measured. During September 97% of the specimens measured were between 28 and 48mm. In the small marsh creeks of the Lower Bay Region, two bay anchovy were collected at the Moores Beach Reference Site and seven were taken at the Commercial Township Restoration Site (Tables 7-3 and 7-4). At the Moores Beach site, the mean CPUE for the study period for bay anchovy was 0.14. The fish were collected in May, the monthly mean CPUE was 1.00, and they were age 1+ at 48 and 53 mm FL (Figures 7-13 and 7-15). At the Commercial Township Restoration Site bay anchovy occurred in 7% of the weir collections. Bay anchovy was collected at Commercial Township only in May with a CPUE of 3.50 (Figure 7-15). All Individuals collected at Commercial Township were 1+ in age and ranged in size from 48 to 58 mm FL, respectively (Figure 7-14).

Spot

In the large marsh creeks of the Lower Bay Region, spot comprised 4 and <1% of the total catch at the Moores Beach Reference and Commercial Township Restoration Sites, respectively, occurring in 6 and 2% of the respective otter trawl collections (Tables 7-3 and 7-4). At Moores Beach, a total of 12 spot was collected, and their mean CPUE for the study period was 0.10. At Commercial Township, a total of 3 was taken, and the CPUE was 0.02. At Moores Beach, spot were only collected in May, August and September (Figure 7-16). Their abundance was highest in May at 0.33 and only marginally lower in August at 0.27. In September the CPUE was 0.06. Spot were only taken in three months at Commercial Township with equal CPUE'S in June, August, and September at 0.06. Individuals collected at Moores Beach ranged from 43 to 188 mm TL , and all were age 0+ (Figure 7-17). The three individuals collected at Commercial Township ranged from 88 to 173 mm TL, and all were age 0+ (Figure 7-18). No spot were taken in the small marsh creeks of the Lower Bay Region.

Weakfish

In the large marsh creeks of the Lower Bay Region, weakfish comprised 17 and 5% of the total catch at the Moores Beach Reference and Commercial Township Restoration Sites, respectively, occurring in 10 and 25% of the respective otter trawl collections (Tables 7-3 and 7-4). At Moores Beach, a total of 55 individuals was collected, and their mean CPUE for the study period was 0.44. While at Commercial Township, a total of 111 was taken, and the CPUE was 0.88. At Moores Beach, weakfish were collected in July through September, with the peak in abundance occurring in August with a CPUE of 2.61 (Figure 7-19). However at Commercial Township, weakfish were collected in June through October with a seasonal peak in abundance in August at 4.16. Individuals collected at Moores Beach ranged from 23 to 303 mm TL, all except one individual caught in September at 303 mm TL, were age 0+ (Figure 7-20). Individuals collected at Commercial Township ranged from 28 to 213 mm TL; all were age 0+ (Figure 7-21). In August individual ranging from 33 to 63 mm TL comprised 81% of the catch.

White perch

In the large marsh creeks of the Lower Bay Region, white perch comprised 7 and 3% of the total catch at the Moores Beach Reference and Commercial Township Restoration Sites, respectively, occurring in 14 and 17% of the respective otter trawl collections (Tables 7-3 and 7-4). At Moores Beach, a total of 21 individuals was collected and their mean CPUE for the study period was 0.17. At Commercial Township, a total of 64 was taken, and the CPUE was 0.51. At Moores Beach, white perch was collected in all months except June (Figure 7-22). The mean monthly CPUE was highest in May at 0.50; abundance in all other months was $\leq$0.22. At Commercial Township, white perch was collected during all months of sampling, except July and August. Their abundance was high and highest during October and November at 1.11 and 1.88, respectively. CPUE in all other months was $\leq$0.27. Individuals collected at Moores Beach ranged from 63 to 283 mm FL; all but three were age 1+ or older (Figure 7-23). Individuals collected at Commercial Township ranged from 133 to 263 mm FL; all were age 1+ or older (Figure 7-24).

In the small marsh creeks of the Lower Bay region, no white perch were caught at the Moores Beach Reference Site. At Commercial Township Restoration Site, one individual was collected, comprising <1% of the total catch, and the mean CPUE for the study period was 0.07 (Table 7-4). The mean monthly CPUE for June, the only month that white perch were collected was 0.50 (Figure 7-25). The individual collected at Commercial Township was 38 mm FL and age 0+ (Figure 7-24).

Effects of Restoration at Lower Bay Salt Hay Farms

Abundance of all species collected in the large marsh creeks of the lower bay was more than seven times greater at the Commercial Township Restoration Site (CPUE = 18.49) than at the Moores Beach Reference Site (2.51) (Tables 7-3 and 7-4; Figure 7-26). This difference was largely the result of the predominance of two non-target species, Atlantic silverside and Atlantic croaker, and one target species, bay anchovy. Atlantic silverside and Atlantic croaker had respective CPUE's of 5.71 and 4.09 with a total of 720 and 515 specimens taken at Commercial Township. Both of these species had CPUE values of 0.01 with only one individual each, taken

from Moore's Beach. Commercial Township had a total of 444 bay anchovy collected with a CPUE of 3.52. This was substantially higher than at Moores Beach where only five bay anchovy were collected, with a CPUE of 0.04. The abundance of weakfish was two times greater at Commercial Township (0.88) than at Moores (0.44), and white perch were three times more abundant, with respective CPUE's of 0.51 and 0.17. Spot were more five times more abundant at Moores Beach than Commercial, with respective CPUE's of 0.10 and 0.02.

Fish species richness in trawls was similar at both sites with 26 species at Commercial Township and 22 at Moores Beach (Figure 7-26). There were 20 species common to both sites, though differing in rank order. Those species taken exclusively at one site or the other were incidental to infrequent captures represented by <20 individuals. The top five most collected species at the two sites only shared one common speices, hogchoker. Hogchoker was ranked first at Moores Beach and fourth at Commercial Township. Weakfish was ranked second at Moores Beach and sixth at Commercial Township. Other species of note include white perch which ranked sixth at Moores Beach and eighth at Commercial Township; Atlantic Silverside which ranked first at Commercial but tied for last at Moores Beach with only one specimen collected; Atlantic croaker which ranked second at Commercial Township but tied for last at Moores Beach with only one specimen collected; and spot which ranked tied for 15th at Moores Beach but ranked 17th at Commercial Township.

Abundance of all species collected in the small marsh creeks of the lower bay was generally similar at the Moores Beach Reference Site (CPUE = 689.64) and at the Commercial Township Restoration Site (433.07) (Tables 7-3 and 7-4; Figure 7-26). Fish species richness was similarly low at both sites, with ten species at Commercial Township and six species at Moores Beach. However, there was a relatively high degree of commonality, with five species common to both sites, though differing somewhat in rank order. Mummichog ranked first at Moores Beach and second at Commercial Township with the highest overall specimens collected with CPUE's of 513.00 and 156.86 respectively. Atlantic Silverside ranked first at Commercial Township and second at Moores Beach with respective CPUE's of 258.21 and 175.00. Atlantic menhaden ranked third at both sites; bay anchovy ranked fifth at both sites; and sheepshead minnow ranked fourth at Moores Beach and tied for seventh at Commercial.

UPPER BAY REGION

Physical And Chemical Parameters

Temperature

The pattern in mean water temperature observed in 2009 exhibited the typical seasonal pattern found in a temperate climate (Figure 7-27). Over the period of sampling, in the upper bay region, mean water temperatures generally increased from May through August, and then declined through November, except at Mad Horse which showed a slight increase from October to November. Monthly differences in mean water temperature among sites during the sampling season ranged from 0.1 °C in September to 3.6°C in May. Mad Horse Creek values ranged from 12.4 to 28.5°C; Alloway Creek ranged from 11.4 to 27.8 °C; Mill Creek ranged from 10.5 to 27.6°C.

Salinity

The upper bay region mean salinity values, as observed during the 2009 "Marsh Fish Assemblage" sampling season, are presented in Figure 7-27. Mean salinity at Mad Horse Creek, a designated upper bay site but geographically intermediate, was always higher than the other two sample areas, ranging from a low of 5.3 ppt in June to a high of 13.2 ppt in October. Over the period of sampling at the Alloway Creek and Mill Creek areas, mean salinity values generally increased from May through July, then decreased in August, increased to the season highs in October, before decreasing again in November. Through the sampling period, mean salinity at Alloway Creek ranged from 1.5 ppt in May to 4.7 ppt in October, and at Mill Creek it ranged from 0.8 ppt in August to 4.5 ppt in October. Observed mean salinities were generally lowest at Mill Creek.

Dissolved Oxygen

Monthly upper bay region sites mean dissolved oxygen values for the 2009 sampling season are depicted in Figure 7-27. During the period of generally increasing water temperature (i.e., May – August), there was no corresponding consistent decrease in dissolved oxygen values within the sampling sites, as is typically expected. However, during the period of decreasing water temperature (September – November), dissolved oxgen values generally increased to seasonal highs in November at all sites. At Mad Horse Creek, dissolved oxygen ranged from 4.6 mg/ℓ in July to 8.9 mg/ℓ in November; at Alloway Creek it ranged from 5.1 mg/ℓ in Aug to 8.7 mg/ℓ in November; and at Mill Creek it ranged from 5.3 mg/ℓ in June to 9.3 mg/ℓ in November.

Mad Horse Creek Reference Site

General Catch Composition

A total of 1,332 fish, representing 21 species and 14 families, was collected in 126 otter trawl collections and 14 weir sets from May through November 2009 in the Mad Horse Creek Reference Site (Tables 7-1, 7-2, and 7-5). Most species collected were transients (76%), i.e. those that spend a portion of their life history outside of the Delaware Bay, and the remaining species were residents (24%), i.e. those that spend their entire life history in the Bay. In addition, one invertebrate, i.e., blue crab (n = 617) was included in the catches.

Large Marsh Creeks

A total of 857 fish, representing 21 species and 14 families, was collected in otter trawl collections during 2009 (Table 7-5). The total CPUE was 6.80. In the aggregate, six species comprised 85% of the total catch. Bay anchovy and white perch comprised nearly half of the catch at 29 and 16%, respectively, and they were commonly taken, occurring in 32 and 40% of the trawl collections, respectively. The other four species of note were, in order of decreasing abundance, Atlantic menhaden (13%), weakfish (9%), hogchoker (9%), and Atlantic silverside (9%). Fish abundance in the large marsh creeks at the Mad Horse Creek site, as expressed by monthly catch-per-unit-effort (CPUE) for all fish collected by otter trawls, was highest in July with a CPUE of 15.66 (Figure 7-28). CPUE in all other months was $\leq$ 8.11. When viewed from a monthly perspective, species composition and abundance data illustrates a dynamic progression of species utilization underlying the aggregate data (Figure 7-29). Each of the following species

were predominant in the total catch during their respective months; Atlantic menhaden in May with 60%, hogchoker in June with 43%, bay anchovy in July and October with 44 and 51%, respectively, hogchoker and weakfish in August with 29 and 22%, respectively, and white perch in November, with 56%.

Small Marsh Creeks

A total of 475 fish, representing seven species and seven families, was collected in weir sets during 2009 (Table 7-5). The total CPUE was 33.93. Three species comprised 96% of the total catch. They were mummichog (77%), Atlantic silverside (10%) and naked goby (9%). Mummichog occurred in 57% of the weir sets, Atlantic silversides occurred in 64% of the weir sets, and naked goby occurred in 36% of the weir sets. Other species occurring in 21% of the collections were bay anchovy and summer flounder. Fish abundance in the small marsh creeks at the Mad Horse Creek site, as expressed by monthly catch-per-unit-effort (CPUE) for all fish collected in weir sets, was highest in August at 89.00 (Figure 7-28). Mummichog was the predominant species during May through August, and in October, comprising from 72 to 100% of the total catch. Naked goby was only species taken in September, and Atlantic silverside was predominant in November, comprising 80% of the catch (Figure 7-29).

Alloway Creek Watershed Restoration Site – Alloway Creek Sampling Area

General Catch Composition

A total of 1,793 fish, representing seven species and seven families, was collected in 42 weir sets from May through November 2009 in the Alloway Creek Sampling Area (Tables 7-1, 7-2 and 7-6). The representation of transient and resident species was three and four, respectively. In addition, one invertebrate, i.e., blue crab (n = 29) was included in the catches. The total CPUE was 42.69. Mummichog comprised 96% of the total catch, and occurred in 86% of the weir sets. Naked goby comprised only 2% of the total catch, but occurred in 19% of the weir sets. All other species were represented by twenty specimens or less, and occurred in no more than 10% of the sets. Fish abundance in the small marsh creeks at the Alloway Creek area, as expressed by monthly catch-per-unit-effort (CPUE) for all fish collected in weir sets, was highest in August, with a CPUE of 148.50, and was secondarily high in July with a CPUE of 101.67 (Figure 7-30). During the other months of sampling, CPUE's were $\leq$16.67. Mummichog was the predominant species for all months except November at the Alloway Creek Sampling Area, comprising from 58 to 100% of the catch (Figure 7-31). In November, gizzard shad comprised 60% of the catch.

Alloway Creek Watershed Restoration Site – Mill Creek Sampling Area

General Catch Composition

A total of 5,819 fish, representing 18 species and 13 families, was collected in 126 otter trawl collections and 14 weir sets from May through November 2009 in the Mill Creek Sampling Area (Tables 7-1, 7-2, and 7-7). Half of the species collected were transients (50%), i.e. those that spend a portion of their life history outside of the Delaware Bay, and the other half of the species were residents (50%), i.e. those that spend their entire life history in the Bay. In addition, one invertebrate, i.e., blue crab (n=222) and two reptiles, i.e., diamondback terrapin (n=7), and common snapping turtle (n=1), were included in the catches.

Catch in Large Marsh Creeks

A total of 3,207 fish, representing 16 species and 11 families, was collected in otter trawl collections during 2009 (Table 7-7). The total CPUE was 25.51. White perch comprised 72% of the total catch, and brown bullhead was the only other species to comprise ≥5% of the catch. White perch, the most numerically abundant species, was also collected most frequently, occurring in 90% of the trawl collections. Brown bullhead was taken in 48% of the collections. All other species occurred in ≤32% of the collections. Fish abundance in the large marsh creeks at the Mill Creek area, as expressed by monthly catch-per-unit-effort (CPUE) for all fish collected by otter trawls, was highest in August at 37.50 and lowest in June at 16.00 (Figure 7-32). White perch was the dominant species in every month of the sampling year comprising from 59 to 83% of the total catch (Figure 7-33).

Catch in Small Marsh Creeks

A total of 2,612 fish, representing 12 species and 12 families, was collected in weir sets during 2009 (Table 7-7). The total CPUE was 186.57. Mummichog comprised 86% of the total catch, and occurred in 100% of the weir sets. All other species individually comprised <5% of the catch. While collected in relatively low numbers, white perch, Atlantic silverside, bay anchovy, and brown bullhead were commonly taken, occurring in 64, 57, 50 and 43%, respectively. Fish abundance in the small marsh creeks at the Mill Creek area was highest in August at 709.00; and it was ≤227.50 in all other months with the lowest value recorded in September at 15.50 (Figure 7-32). Mummichog was the predominant species during all months except October, comprising from 58 to 94% of the total catch in those months (Figure 7-33). Bay anchovy comprised 50% in October.

Target Species Accounts for the Upper Bay Region

Bay Anchovy

In the large marsh creeks of the Upper Bay Region, bay anchovy comprised 29 and 4% of the total catch at the Mad Horse Creek Reference Site and Mill Creek Area of the Alloway Creek Restoration Site, respectively, occurring in 32 and 28% of the respective otter trawl collections (Tables 7-5 and 7-7). At Mad Horse Creek, a total, of 250 individuals, was collected and their mean CPUE for the study period was 1.98. At Mill Creek, a total of 119 was taken, and the CPUE was 0.94. Bay anchovy was collected in all months of sampling except June at Mad Horse, and abundance was highest in July with a CPUE of 6.94 (Figure 7-34). During the other months of sampling CPUE was ≤3.77. At Mill Creek, bay anchovies were collected in all months of sampling. Their abundance was highest at 2.88 during September, and the CPUE was ≤1.44 in the other months of sampling. Individuals collected at Mad Horse Creek ranged from 18 to 83 mm FL (Figure 7-35). All specimens collected in May were age 1+ and older. Bay anchovy, age 0+, were predominant in July, August, and October comprising 72, 83, and 71% of the specimens measured. During September and November age composition was equally divided between ages 0+ and 1+. Individuals collected at Mill Creek ranged from 23 to 78 mm FL (Figure 7-36). All specimens measured in May and June were age 1+ and older. Age 0+ were predominant in July through November, comprising from 84 to 100% of the specimens measured. In September, when abundance was highest at Mill Creek, specimens between 23 and 53 mm FL comprised 97% of the specimens measured and were age 0+.

In the small marsh creeks of the Upper Bay Region, bay anchovy comprised 1, <1 and 2% of the total catch at the Mad Horse Creek Reference Site, the Alloway Creek and the Mill Creek areas of the Alloway Creek Watershed Restoration Site, respectively, occurring in 21, 2, and 50% of the respective weir sets at all locations (Tables 7-5, 7-6 and 7-7). At Mad Horse Creek, a total of seven individuals was collected, and their mean CPUE for the study period was 0.50. At the Mill Creek Area, a total of 60 was collected, and the CPUE was 4.29. At the Alloway Creek Area, a total of 4 was collected, and the CPUE was 0.10. At Mad Horse Creek, bay anchovy were collected only in August and October with CPUE's of 1.00 and 2.50, respectively (Figure 7-37). At Mill Creek, bay anchovy were collected from July through November, with the highest CPUE of 16.50 in October. At Alloway Creek all bay anchovy were caught in September with a CPUE of 0.66. Individuals collected at Mad Horse Creek ranged from 33 to 48 mm FL, those collected at Mill Creek ranged from 28 to 63 mm FL, and those individuals taken at Alloway Creek ranged from 38 to 43 mm FL (Figures 7-35, 7-36 and 7-38). All but one bay anchovy collected in the small marsh creeks of the Upper Bay Region were age 0+. A single age 1+ bay anchovy was collected in the Mill Creek area.

Spot

No spot were caught in the large marsh creeks at the Mill Creek Area of the Alloway Creek Restoration Site. In the large marsh creeks of the Mad Horse Creek Reference Site, a total of 5 specimens was taken, and the CPUE was 0.04. Spot comprised <1% of the total catch, occurring in 2% of the otter trawl collections (Tables 7-5). Individuals were collected during May and June with CPUE's of 0.05 and 0.22 respectively (Figure 7-39). Individuals collected at Mad Horse Creek ranged from 38 to 93 mm FL, and all but one specimen caught in May was age 1+ (Figure 7-40). No spot were collected in the small marsh creeks of the Upper Bay Region during 2009

Weakfish

In the large marsh creeks of the Upper Bay Region, weakfish comprised 9 and 1% of the total catch at the Mad Horse Creek Reference and Mill Creek Area of the Alloway Creek Restoration Site, respectively, occurring in 25 and 19% of the respective otter trawl collections (Tables 7-5 and 7-7). At Mad Horse Creek, a total of 80 weakfish was collected and their mean CPUE for the study period was 0.63. At Mill Creek, a total of 40 was taken, and the CPUE was 0.32. At Mad Horse Creek, weakfish were collected July through September, and the CPUE was highest in July at 2.50 (Figure 7-41). At Mill Creek, weakfish were collected July through October; CPUE was highest in September at 1.00. Individuals collected at Mad Horse Creek ranged from 23 to 163 mm FL (Figure 7-42). Individuals collected at Mill Creek ranged from 28 to 128 mm FL, (Figure 7-43). All weakfish measured were age 0+. No weakfish were taken in the small marsh creeks of the Upper Bay Region.

White perch

In the large marsh creeks of the Upper Bay Region, white perch comprised 16 and 72% of the total catch at the Mad Horse Creek Reference and the Mill Creek Area of the Alloway Creek Restoration Site, respectively, occurring in 40 and 90% of the respective otter trawl collections (Tables 7-5 and 7-7). At Mad Horse Creek, a total of 135 individuals were collected and their mean CPUE for the study period was 1.07. At Mill Creek, a total of 2,321 was taken, and the CPUE was 18.42. White perch were collected in all months of sampling except August at Mad

Horse, and abundance was highest in November with a CPUE of 3.72 (Figure 7-44). At Mill Creek, white perch were collected in all months of sampling. CPUE was 10.55 in May, increasing to its highest value of 31.05 in August, and then decreasing to 14.22 in October. November CPUE was secondarily high at 22.55. Individuals collected at Mad Horse Creek ranged from 38 to 283 mm FL; all but 2 specimens measured were age 1+ or older, possibly including individuals age 8+ (Figure 7-45). During November, when abundance was highest, individuals 143 to 203 mm FL comprised 77% of the specimens measured. Individuals collected at Mill Creek ranged from 28 to 243 mm FL (Figure 7-46). In all months, but August, age 1+ and older were the predominant age classes taken. During August age 0+ represented 62% of the total collection. Specimens that were aged 0+ were commonly taken throughout the sample season.

In the small marsh creeks of the Upper Bay Region, white perch comprised 1, <1 and 3% of the total catch at the Mad Horse Creek Reference Site, Alloway Creek and Mill Creek Areas within the Alloway Creek Restoration Site, respectively; occurring in 14, 5 and 64% of the respective weir sets (Tables 7-5, 7-6 and 7-7). At the Mad Horse Creek Site, a total of 4 white perch was taken, and the CPUE was 0.29. At the Alloway Creek Area, a total of 2 white perch was taken, and the CPUE was 0.05. At the Mill Creek Area, a total of 80 was collected, and the CPUE was 5.71 (Tables 7-5, 7-6, and 7-7). At Mad Horse Creek, white perch were only collected in June and July with monthly CPUE's of 1.50 and 0.50 respectively At Alloway Creek, they were collected only in September and November with the same CPUE of 0.16 (Figure 7-47). At Mill Creek, white perch were collected in every month except October. Their abundance was highest in August with a CPUE of 18.50; abundance was secondarily high in June at 10.50: and CPUE was ≤6.50 in the other months of their occurrence. At Mad Horse Creek all individuals were age 1+ and ranged between 123 and 158 mm FL. Both of the individuals collected at Alloway Creek were most likely age 0+ and measured 68 and 83 mm FL. Those collected at Mill Creek ranged from 33 to 218 mm FL, and were predominantly age 1+ in May, June, and November. In July, August, and September the majority of specimens 83, 70, and 80% were age 0+ (Figures 7-45, 7-46 and 7-48).

Effects of Restoration at Upper Bay *Phragmites*-Dominated Marshes

Abundance of all species collected in the large marsh creeks of the upper bay was almost four times greater at the Mill Creek Sampling Area of the ACW Site (CPUE = 25.51) than at the Mad Horse Creek Reference Site (CPUE = 6.80) (Tables 7-5 and 7-7; Figure 7-49). The difference in overall fish abundance was largely the result of higher absolute abundance of white perch at the Mill Creek area. If the contribution of white perch to the total CPUE is subtracted from both sites, then the resulting aggregate CPUE's for all other species are more similar, i.e., 5.73 at Mad Horse Creek and 7.09 at Mill Creek. The contribution to overall fish abundance at Mill Creek made by the other three target species, i.e., bay anchovy, weakfish and spot, was minimal. While bay anchovy was the predominant species at Mad Horse Creek, with a CPUE of 1.98, its abundance was of minor importance at Mill Creek with a CPUE of 0.94. Even though weakfish was twice as abundant at Mad Horse Creek (0.63) than at Mill Creek (0.32) their overall contribution to the total species abundance was negligible at both sites. Spot was even less influential to the total CPUE with an abundance of 0.04 at Mad Horse Creek and no fish taken at Mill Creek.

Fish species richness in large marsh creeks was higher at Mad Horse Creek than at Mill Creek with 21 and 16 species, respectively (Figure 7-49). There were 12 species common to both sites, though differing in rank order. Those species taken exclusively at one site or the other were incidental captures represented by ≤ 7 individuals, with the exception of summer flounder and gizzard shad. Summer flounder were taken only at Mad Horse where a total of 28 were collected. Gizzard shad were taken only at Mill Creek where a total of 25 were collected. White perch ranked first at Mill Creek and second at Mad Horse; and bay anchovy ranked first at Mad Horse and fifth at Mill Creek. While both sites are located in the "upper bay", they also are in the transitional portion of the estuary where generally freshwater and saltwater assemblages intermingle at the boundaries of their favored distributions. During 2009 this intermingling exhibited similarities and differences of note. The majority of the species caught were common to both sites. However, summer flounder, a species which is typically more associated with the higher salinity waters of the "lower bay", was taken exclusively at Mad Horse Creek. Similarly, carp and eastern silvery minnow, species which are typically more associated with the low salinity waters of the freshwater tidal river, were taken exclusively at Mill Creek.

Abundance of all species collected in the small marsh creeks of the upper bay was higher at both restoration sampling areas than at the Mad Horse Creek Reference Site. At Alloway Creek, the total CPUE (42.69) was marginally greater than that at Mad Horse Creek (33.93), and at Mill Creek (186.57) it was more than five times greater (Tables 7-5, 7-6 and 7-7; Figure 7-49). These differences were driven by the disproportionate predominance of mummichog at both restoration areas. This was particularly notable at both Mill Creek and Alloway Creek where mummichog abundance was 2 and 6 times greater than at Mad Horse Creek. Like abundance, fish species richness was higher at Mill Creek than at the Mad Horse Creek Reference Site, with 12 and 7 species, respectively (Figure 7-49). Species richness at Alloway Creek was seven, the same as Mad Horse Creek. Six of seven species taken at Mad Horse Creek, i.e., mummichog, Atlantic silverside, naked goby, bay anchovy, white perch, and American eel were common to both Alloway and Mill Creek, and all species taken at Alloway Creek were common to Mill Creek. There were six species taken only at Mill Creek, each comprised <1% of the total catch. Regarding species rank order, mummichog was first at all three sites; naked goby was ranked second at Alloways, third at Mad Horse, and eighth at Mill Creek; bay anchovy was ranked fourth at Mad Horse and fifth at Alloways and Mill Creek; and white perch was ranked third at Mill Creek, fifth at Mad Horse, and seventh at Alloways. The other two target species were not collected in the small marsh creeks of the upper bay region.

LITERATURE CITED

Able, K. W. and M. P. Fahay. 1998. The First Year in the Life of Estuarine Fishes in the Middle Atlantic Bight. Rutgers University Press.

Public Service Electric & Gas Co. (PSE&G). 1997. Biological Monitoring Program Annual Report-1996, Chapter 7, Newark, NJ.

____. 1998. Biological Monitoring Program Annual Report-1997, Chapter 7, Newark, NJ.

____. 1999a. Salem Generating Station, NJPDES Permit Renewal Application. Public Service Electric & Gas Co., Newark, NJ.

____. 1999b. Biological Monitoring Program Annual Report-1998, Chapter 7, Newark, NJ.

Public Service Enterprise Group. (PSEG). 2000. Biological Monitoring Program Annual Report-1999, Chapter 7, Newark, NJ.

____. 2001. Biological Monitoring Program Annual Report-2000, Chapter 7, Newark, NJ.

____. 2002. Biological Monitoring Program Annual Report-2001, Chapter 7, Newark, NJ.

____. 2003. Biological Monitoring Program Annual Report-2002, Chapter 7, Newark, NJ.

____. 2004. Biological Monitoring Program Annual Report-2003, Chapter 7, Newark, NJ.

____. 2005. Biological Monitoring Program Annual Report-2004, Chapter 7, Newark, NJ.

____. 2006. Biological Monitoring Program Annual Report-2005, Chapter 7, Newark, NJ.

____. 2007. Biological Monitoring Program Annual Report-2006, Chapter 7, Newark, NJ.

____. 2008. Biological Monitoring Program Annual Report-2007, Chapter 7, Newark, NJ.

____. 2009. Biological Monitoring Program Annual Report-2008, Chapter 7, Newark, NJ.

Wang, J. C. S. and R. J. Kernehan. 1979. Fishes of the Delaware Estuaries: A Guide to the Early Life Histories. Ecological Analysis Communications, Towson, Maryland.

1999 – 2006 Flooding Events in the Delaware River Basin, including June '06, April '05, and Sept '04, 2006 Delaware River Basin Commission, www.state.nj.us.drbc/flood_website/events.html#2006

Table 7-1. Summary of sampling efforts for the 2009 Marsh Fish Assemblage sampling season.

Site	MAY	JUN	JUL	AUG	SEP	OCT	NOV	Site Totals
Lower Bay Moores Beach								
Trawl	18	18	18	18	18	18	18	126
Weir	2	2	2	2	2	2	2	14
Commercial Township								
Trawl	18	18	18	18	18	18	18	126
Weir	2	2	2	2	2	2	2	14
Upper Bay Mad Horse Creek								
Trawl	18	18	18	18	18	18	18	126
Weir	2	2	2	2	2	2	2	14
Mill Creek								
Trawl	18	18	18	18	18	18	18	126
Weir	2	2	2	2	2	2	2	14
Alloway Creek								
Weir	6	6	6	6	6	6	6	42
Monthy Totals								
Trawl	72	72	72	72	72	72	72	504
Weir	14	14	14	14	14	14	14	98
Combined	86	86	86	86	86	86	86	602

Table 7-2 Checklist of Delaware Bay Fauna collected from May 2009 to November 2009.

Key: T = Tansient, R = Resident.

	Species	Common Name	Pattern of Utilizations
Achiridae			
	Trinectes maculatus	Hogchoker	R
Anguillidae			
	Anguilla rostrata	American eel	T
Atherinopsidae			
	Menidia menidia	Atlantic silverside	T
Batrachoididae			
	Opsanus tau	Oyster toadfish	R
Belonidae			
	Strongylura marina	Atlantic needlefish	T
Centrarchidae			
	Lepomis gibbosus	Pumpkinseed	R
Clupeidae			
	Alosa aestivalis	Blueback herring	T
	Alosa mediocris	Hickory shad	T
	Alosa psuedoharengus	Alewife	T
	Alosa sapidissima	American shad	T
	Brevoortia tyrannus	Atlantic menhaden	T
	Dorosoma cepedianum	Gizzard shad	R
Cyprinidae			
	Cyprinus carpio	Common carp	R
	Hybognathus regius	Eastern silvery minnow	R
Cynoglossidae			
	Symphurus plagiusa	Blackcheek tonguefish	T
Cyprinodontidae			
	Cyprinodon variegatus	Sheepshead minnow	R
Diodontidae			
	Chilomycterus schoepfi	Striped burrfish	T
Engraulidae			
	Anchoa mitchilli	Bay anchovy	T
Fundulidae			
	Fundulus heteroclitus	Mummichog	R
Gobiesocidae			
	Gobiesox strumosus	Skilletfish	R
Gobiidae			
	Gobiosoma bosc	Naked goby	R
Ictaluridae			
	Ameiurus nebulosus	Brown bullhead	R
Labridae			
	Tautoga onitis	Tautog	T
Moronidae			
	Morone americana	White perch	R
	Morone saxatilis	Striped bass	T
Ophidiidae			
	Ophidion marginatum	Striped cusk eel	T

Table 7-2 Continued

Paralichthyidae			
	Paralichthys dentatus	Summer flounder	T
Phycidae			
	Uropycis regia	Spotted hake	T
Pomatomidae			
	Pomatomus saltatrix	Bluefish	**T**
Sciaenidae			
	Bairdiella chysoura	Silver perch	T
	Cynoscion regalis	Weakfish	T
	Leiostomus xanthurus	Spot	T
	Mircopogonias undulatus	Atlantic croaker	T
	Pogonias cromis	Black drum	T
	Menticirrhus saxatilis	Northern kingfish	T
Serranidae			
	Centropristis striata	Black sea bass	T
Syngnathidae			
	Syngnathus fuscus	Northern pipefish	T
Triglidae			
	Prionotus evolans	Striped searobin	T
Uranoscopidae			
	Astroscopus guttatus	Northern stargazer	R
Invertebrates			
	Callinectes sapidus	Blue claw crab	R
	Limulus polyphemus	Horseshoe crab	T
Reptilia			
	Malaclemys terrapin	Diamondback terrapin	R
	Chelydra serpentina	Common snapping turtle	R

Table 7-3. Composite species composition, for large marsh creek (otter trawl) and small marsh creek (weir) collections, for Moores Beach from May to November 2009.

	Large Marsh Creeks				Small Marsh Creeks			
Species	**Percent frequency of occurrence**	**Percent composition**	**Catch per unit effort**	**Total collected**	**Percent frequency of occurrence**	**Percent composition**	**Catch per unit effort**	**Total collected**
Alosa sapidissima	1	<1	0.01	1	-	-	-	-
Anchoa mitchilli	4	2	0.04	5	7	<1	0.14	2
Anguilla rostrata	6	3	0.08	10	7	<1	0.07	1
Brevoortia tyrannus	3	2	0.05	6	7	<1	0.79	11
Centropristis striata	6	5	0.13	16	-	-	-	-
Chilomycterus schoepfi	1	<1	0.01	1	-	-	-	-
Cynoscion regalis	10	17	0.44	55	-	-	-	-
Cyprinodon variegatus	-	-	-	-	29	<1	0.64	9
Fundulus heteroclitus	1	<1	0.01	1	100	74	513.00	7182
Gobiesox strumosus	1	<1	0.01	1	-	-	-	-
Gobiosoma bosc	2	1	0.02	2	-	-	-	-
Leiostomus xanthurus	6	4	0.10	12	-	-	-	-
Menidia menidia	1	<1	0.01	1	79	25	175.00	2450
Menticirrhus saxatilis	2	1	0.02	2	-	-	-	-
Micropogonias undulatus	1	<1	0.01	1	-	-	-	-
Morone americana	14	7	0.17	21	-	-	-	-
Morone saxatilis	14	8	0.19	24	-	-	-	-
Ophidion marginatum	1	<1	0.01	1	-	-	-	-
Opsanus tau	5	7	0.18	23	-	-	-	-
Paralichthys dentatus	8	9	0.24	30	-	-	-	-
Pogonias cromis	7	5	0.13	16	-	-	-	-
Trinectes maculatus	16	27	0.68	86	-	-	-	-
Urophycis regia	1	<1	0.01	1	-	-	-	-
Total Fish	-	-	2.51	316	-	-	689.64	9655
Callinectes sapidus	92	71	6.55	825	57	1	6.29	88
Malaclemys terrapin	2	<1	0.02	2	-	-	-	-
Limulus polyphemus	9	2	0.16	20	-	-	-	-
Total all speicies	-	-	9.23	1163	-	-	695.93	9743

Table 7-4. Composite species composition, for large marsh creek (otter trawl) and small marsh creek (weir) collections, for Commercial Township from May to November 2009.

	Large Marsh Creeks				Small Marsh Creeks			
Species	**Percent frequency of occurrence**	**Percent composition**	**Catch per unit effort**	**Total collected**	**Percent frequency of occurrence**	**Percent composition**	**Catch per unit effort**	**Total collected**
Alosa psuedoharengus	1	<1	0.01	1	-	-	-	-
Anchoa mitchilli	31	19	3.52	444	7	<1	0.50	7
Anguilla rostrata	6	<1	0.06	8	-	-	-	-
Astroscopus guttatus	1	<1	0.01	1	-	-	-	-
Bairdiella chrysoura	2	<1	0.03	4	7	<1	0.07	1
Brevoortia tyrannus	6	1	0.13	16	14	3	10.93	153
Chilomycterus schoepfi	1	<1	0.01	1	-	-	-	-
Cynoscion regalis	25	5	0.88	111	-	-	-	-
Cyprinodon variegatus	-	-	-	-	7	<1	0.07	1
Fundulus heteroclitus	1	<1	0.01	1	86	36	156.86	2196
Gobiosoma bosc	2	<1	0.02	3	-	-	-	-
Leiostomus xanthurus	2	<1	0.02	3	-	-	-	-
Menidia menidia	13	31	5.71	720	79	60	258.21	3615
Menticirrhus saxatilis	9	3	0.60	76	-	-	-	-
Micropogonias undulatus	11	22	4.09	515	7	<1	0.14	2
Morone americana	17	3	0.51	64	7	<1	0.07	1
Morone saxatilis	7	<1	0.09	11	-	-	-	-
Ophidion marginatum	4	<1	0.06	8	-	-	-	-
Opsanus tau	1	<1	0.01	1	-	-	-	-
Paralichthys dentatus	6	<1	0.08	10	-	-	-	-
Pogonias cromis	31	7	1.21	152	43	1	6.07	85
Prionotus evolans	1	<1	0.01	1	-	-	-	-
Strongylura marina	-	-	-	-	7	<1	0.14	2
Symphurus plagiusa	1	<1	0.01	1	-	-	-	-
Syngnathus fuscus	4	<1	0.06	7	-	-	-	-
Tautoga onitis	1	<1	0.01	1	-	-	-	-
Trinectes maculatus	22	7	1.33	167	-	-	-	-
Urophycis regia	2	<1	0.02	3	-	-	-	-
Total Fish	-	-	18.49	2330			433.07	6063
Callinectes sapidus	76	27	7.00	882	93	4	15.93	223
Malaclemys terrapin	2	<1	0.02	3	-	-	-	-
Limulus polyphemus	7	1	0.13	17	-	-	-	-
Total all speicies	-	-	25.65	3232	-	-	449.00	6286

Table 7-5. Composite species composition, for large marsh creek (otter trawl) and small marsh creek (weir) collections, for Mad Horse Creek from May to November 2009.

	Large Marsh Creeks				Small Marsh Creeks			
Species	**Percent frequency of occurrence**	**Percent composition**	**Catch per unit effort**	**Total collected**	**Percent frequency of occurrence**	**Percent composition**	**Catch per unit effort**	**Total collected**
Alosa aestivalis	1	<1	0.01	1	-	-	-	-
Alosa sapidissima	3	1	0.04	5	-	-	-	-
Ameiurus nebulosus	1	<1	0.01	1	-	-	-	-
Anchoa mitchilli	32	29	1.98	250	21	1	0.50	7
Anguilla rostrata	6	1	0.06	7	7	<1	0.14	2
Bairdiella chrysoura	1	<1	0.01	1	-	-	-	-
Brevoortia tyrannus	12	13	0.89	112	-	-	-	-
Cynoscion regalis	25	9	0.63	80	-	-	-	-
Fundulus heteroclitus	3	<1	0.03	4	57	77	26.21	367
Gobiosoma bosc	2	<1	0.02	3	36	9	3.00	42
Leiostomus xanthurus	2	1	0.04	5	-	-	-	-
Menidia menidia	6	9	0.58	73	64	10	3.50	49
Micropogonias undulatus	2	1	0.04	5	-	-	-	-
Morone americana	40	16	1.07	135	14	1	0.29	4
Morone saxatilis	25	6	0.39	49	-	-	-	-
Paralichthys dentatus	17	3	0.22	28	21	1	0.29	4
Pogonias cromis	6	1	0.06	8	-	-	-	-
Pomatomus saltatrix	1	<1	0.01	1	-	-	-	-
Symphurus plagiusa	2	1	0.05	6	-	-	-	-
Syngnathus fuscus	2	<1	0.02	3	-	-	-	-
Trinectes maculatus	19	9	0.63	80	-	-	-	-
Total Fish	-	-	6.80	857	-	-	33.93	475
Callinectes sapidus	87	37	3.95	498	79	25	8.50	119
Total all speicies	-	-	10.75	1355	-	-	42.43	594

Table 7-6. Composite species composition, for small marsh creek (weir) collections, for Alloway Creek area during May to November 2009.

	Small Marsh Creeks			
Species	**Percent frequency of occurrence**	**Percent composition**	**Catch per unit effort**	**Total collected**
Anchoa mitchilli	2	<1	0.10	4
Anguilla rostrata	5	<1	0.05	2
Dorosoma cepedianum	5	1	0.48	20
Fundulus heteroclitus	86	96	41.17	1729
Gobiosoma bosc	19	2	0.74	31
Menidia menidia	10	<1	0.12	5
Morone americana	5	<1	0.05	2
Total Fish	-	-	42.69	1793
Callinectes sapidus	26	2	0.69	29
Total all speicies	-	-	43.38	1822

Table 7-7. Composite species composition, for large marsh creek (otter trawl) and small marsh creek (weir) collections, for Mill Creek from May to November 2009.

	Large Marsh Creeks				Small Marsh Creeks			
Species	**Percent frequency of occurrence**	**Percent composition**	**Catch per unit effort**	**Total collected**	**Percent frequency of occurrence**	**Percent composition**	**Catch per unit effort**	**Total collected**
Alosa mediocris	1	<1	0.01	1	-	-	-	-
Ameiurus nebulosus	48	5	1.39	175	43	1	1.14	16
Anchoa mitchilli	28	4	0.94	119	50	2	4.29	60
Anguilla rostrata	7	<1	0.09	11	14	<1	0.14	2
Brevoortia tyrannus	24	5	1.26	159	21	5	8.43	118
Cynoscion regalis	19	1	0.32	40	-	-	-	-
Cyprinis carpio	5	<1	0.06	7	-	-	-	-
Dorosoma cepedianum	13	1	0.20	25	21	<1	0.86	12
Fundulus heteroclitus	1	<1	0.01	1	100	86	159.64	2235
Gobiosoma bosc	-	-	-	-	14	<1	0.57	8
Hybognathus regius	1	<1	0.02	2	14	<1	0.21	3
Lepomis gibbosus	-	-	-	-	7	<1	0.07	1
Menidia menidia	2	<1	0.02	2	57	3	5.43	76
Micropogonias undulatus	27	5	1.16	146	7	<1	0.07	1
Morone americana	90	72	18.42	2321	64	3	5.71	80
Morone saxatilis	32	2	0.58	73	-	-	-	-
Pogonias cromis	6	<1	0.08	10	-	-	-	-
Trinectes maculatus	10	4	0.91	115	-	-	-	-
Total Fish	-	-	25.51	3207	-	-	186.57	2612
Callinectes sapidus	41	6	1.49	188	79	1	2.43	34
Chelydra serpentina	1	<1	0.01	1	-	-	-	-
Malaclemys terrapin	6	<1	0.06	7	-	-	-	-
Total all speicies	-	-	27.01	3403	-	-	189.00	2646

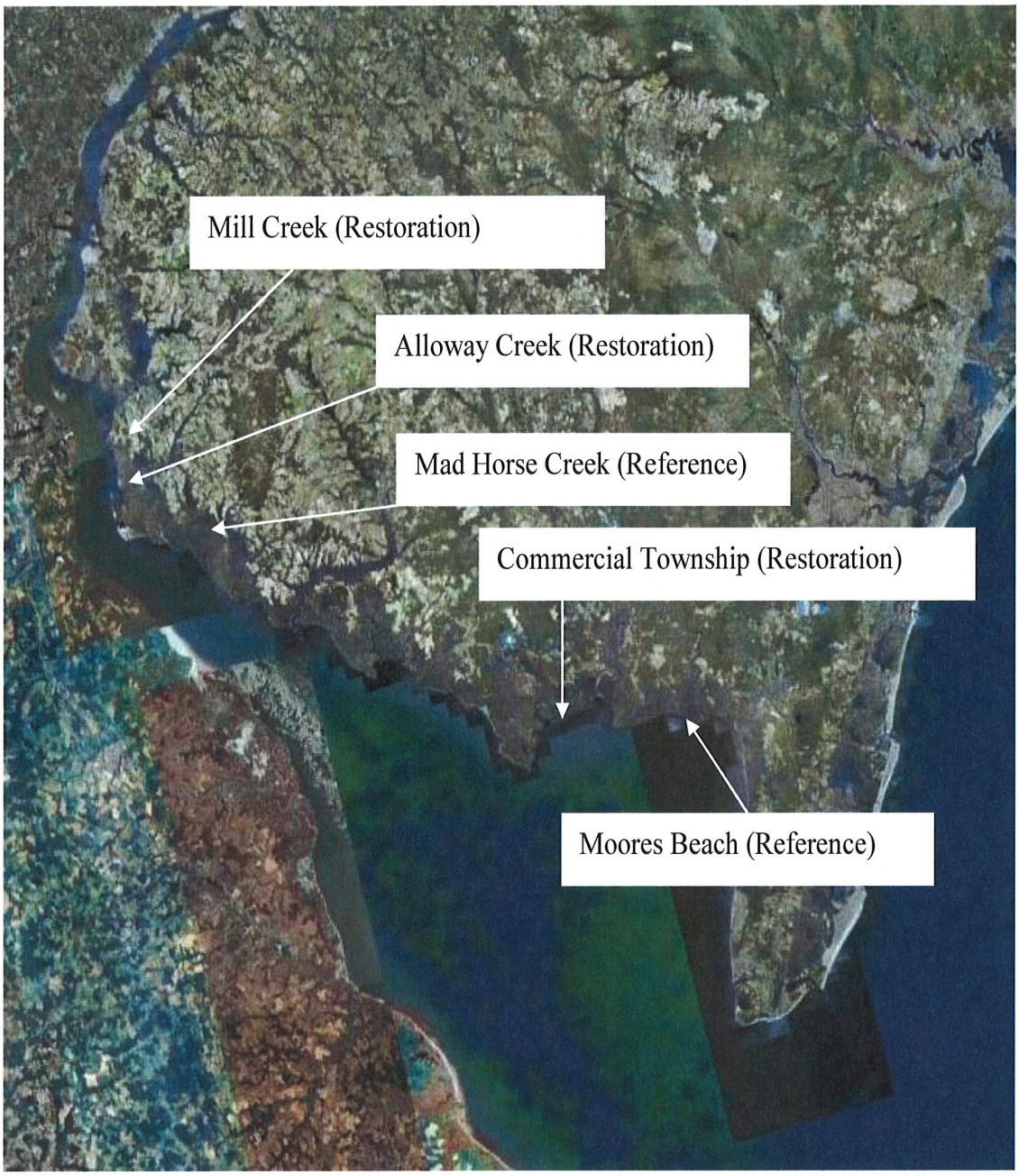


Figure 7-1. Restored and reference marsh study sites in Delaware Bay.

Figure 7-2a. Moores Beach sampling sites (reference) in Delaware Bay during 2009.

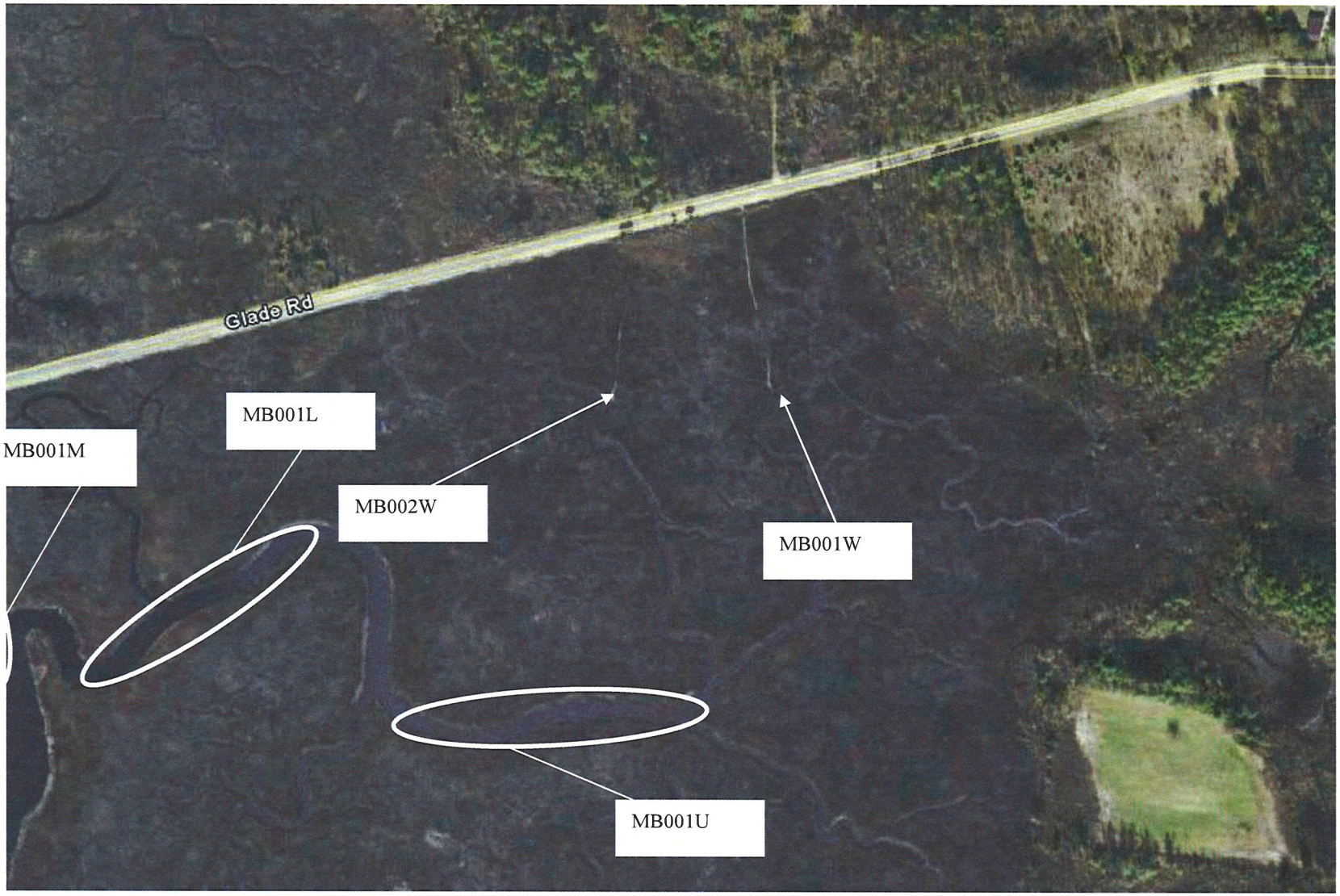


Figure 7-2b. Expanded view of small marsh creeks (weir) at the Moores Beach Reference Site in Delaware Bay during 2009.

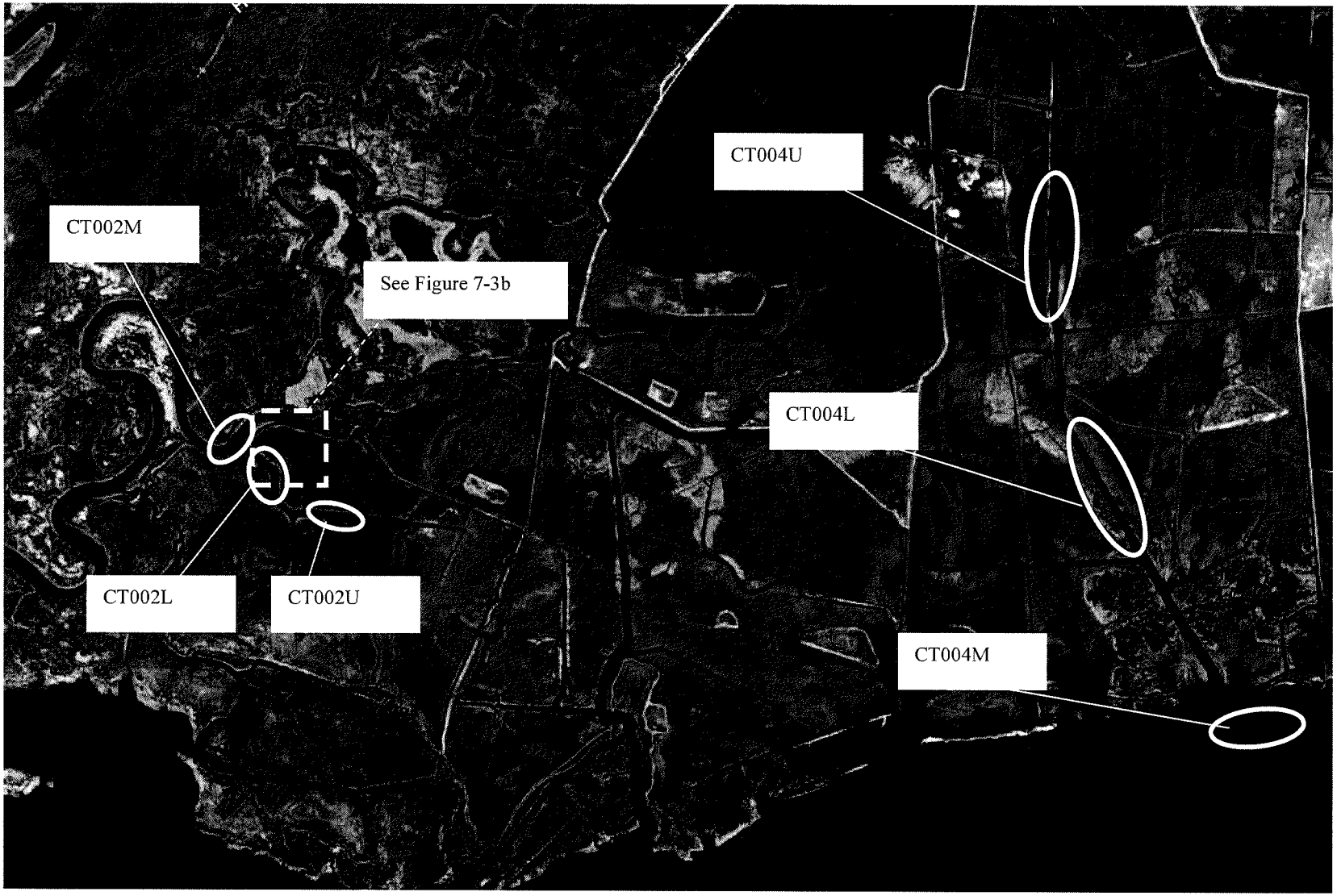


Figure 7-3a. Commercial Township sampling sites (restoration) in Delaware Bay during 2009.

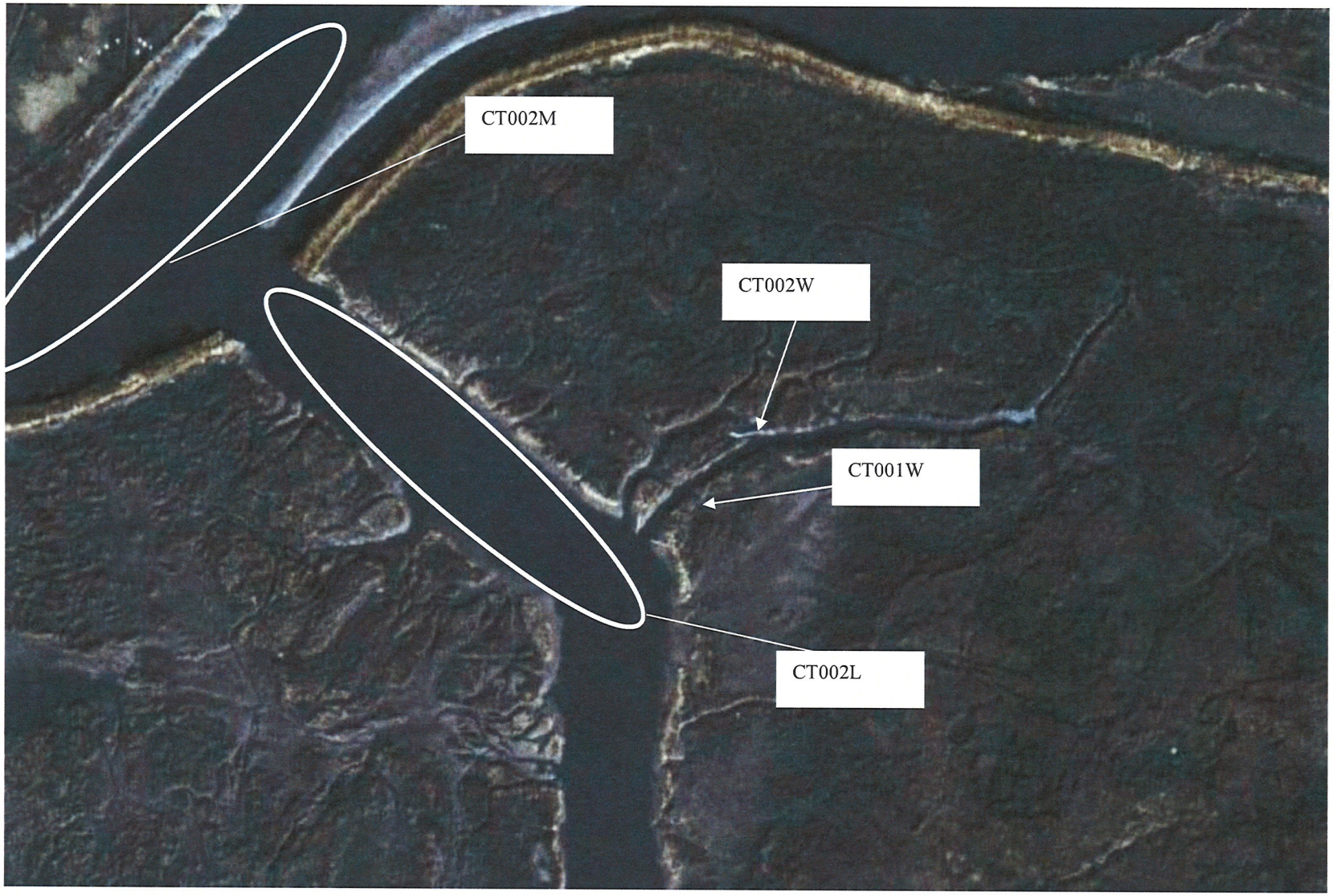


Figure 7-3b. Expanded view of small marsh creeks (weir) at the Commercial Township Restoration Site in Delaware Bay during 2009.

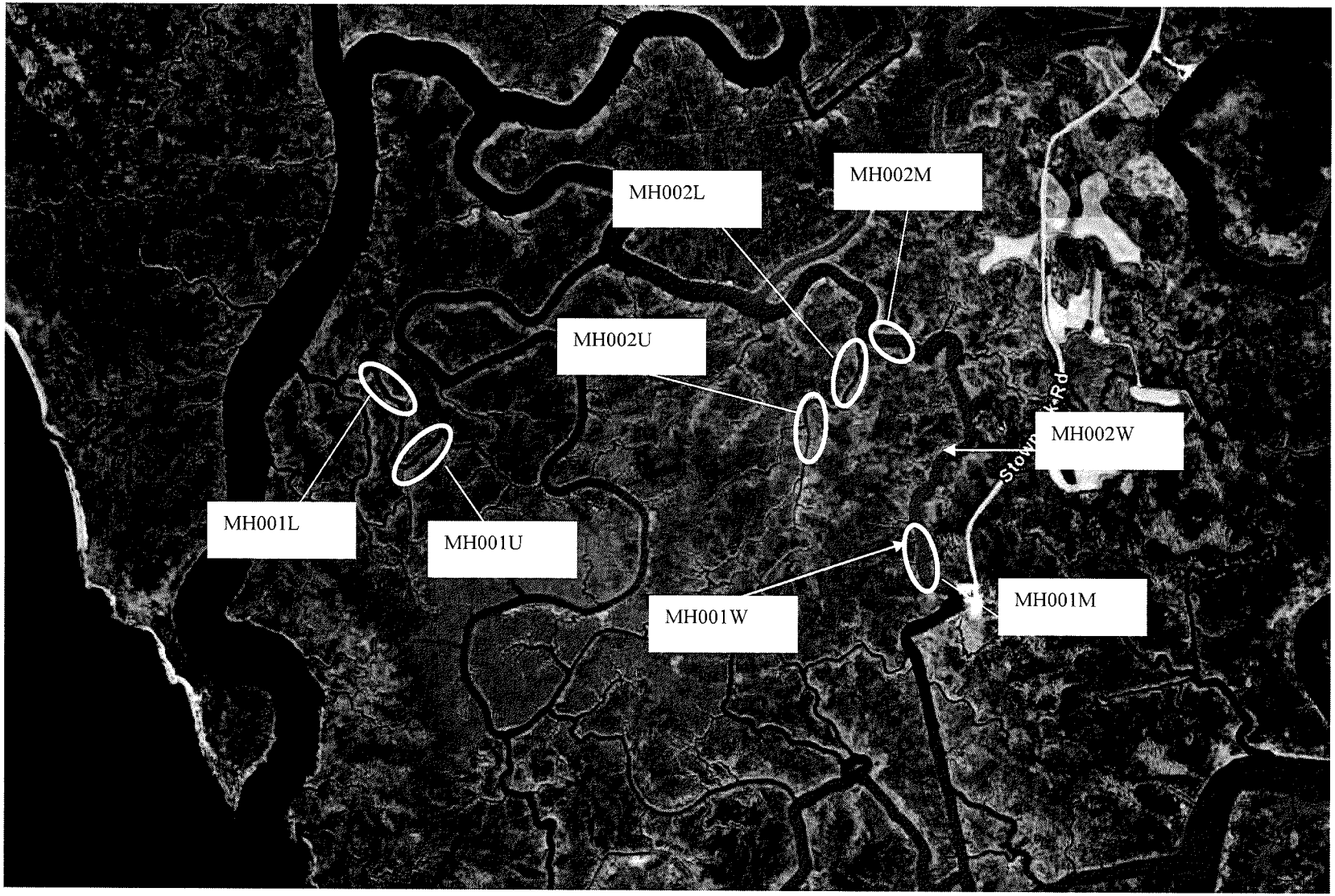


Figure 7-4. Mad Horse Creek sampling sites (reference) in Delaware Bay during 2009.

Figure 7-5. Alloway Creek sampling sites (restoration) in Delaware Bay during 2009.

Figure 7-6. Mill Creek sampling (restoration) sites in Delaware Bay during 2009.

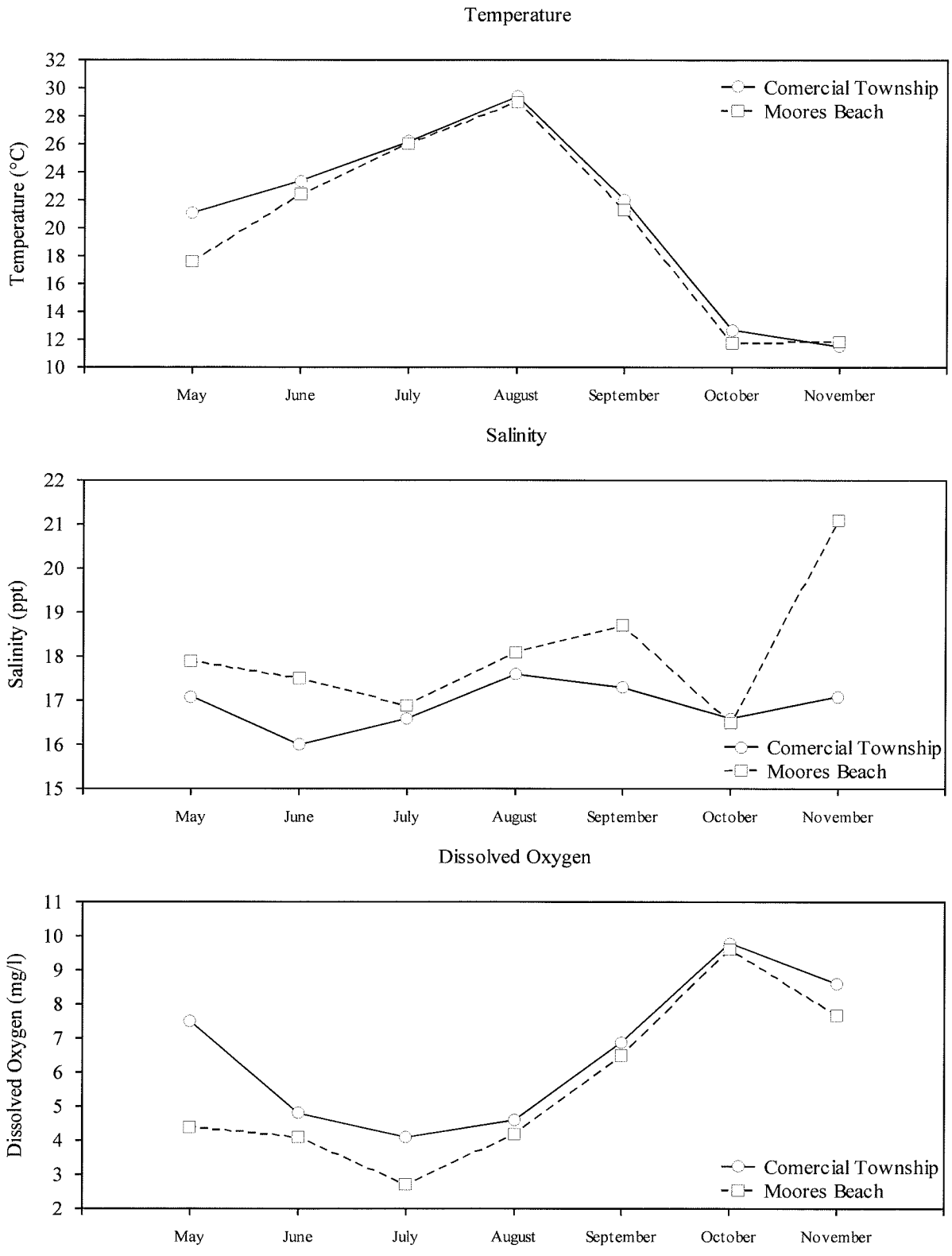


Figure 7-7. Selected physical parameters at regularly sampled sites in the Lower Delaware Bay Region during 2009.

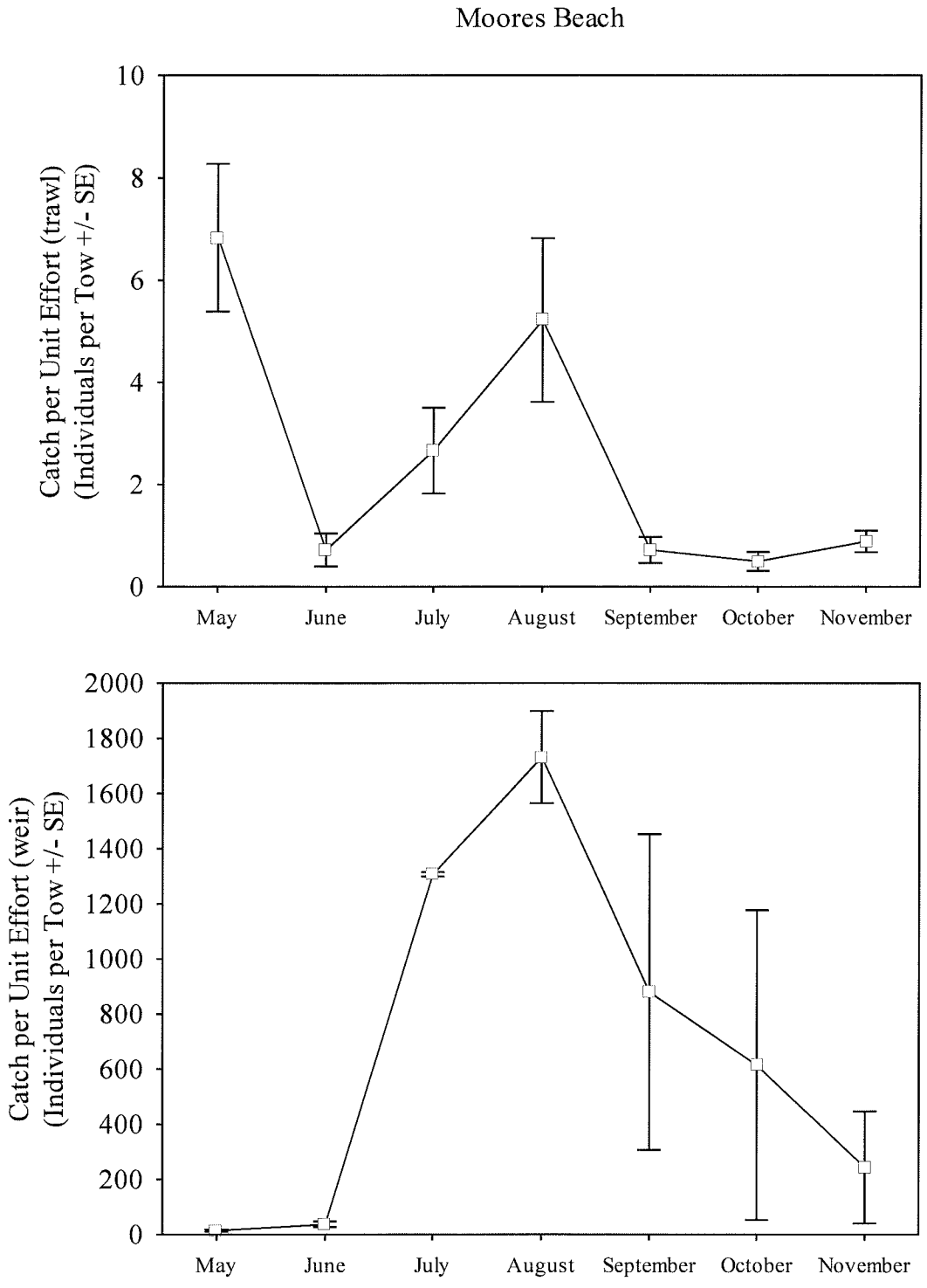


Figure 7-8. Monthly abundance for all fish caught, in large marsh creeks (otter trawl) and small marsh creeks (weir), at Moores Beach during 2009.

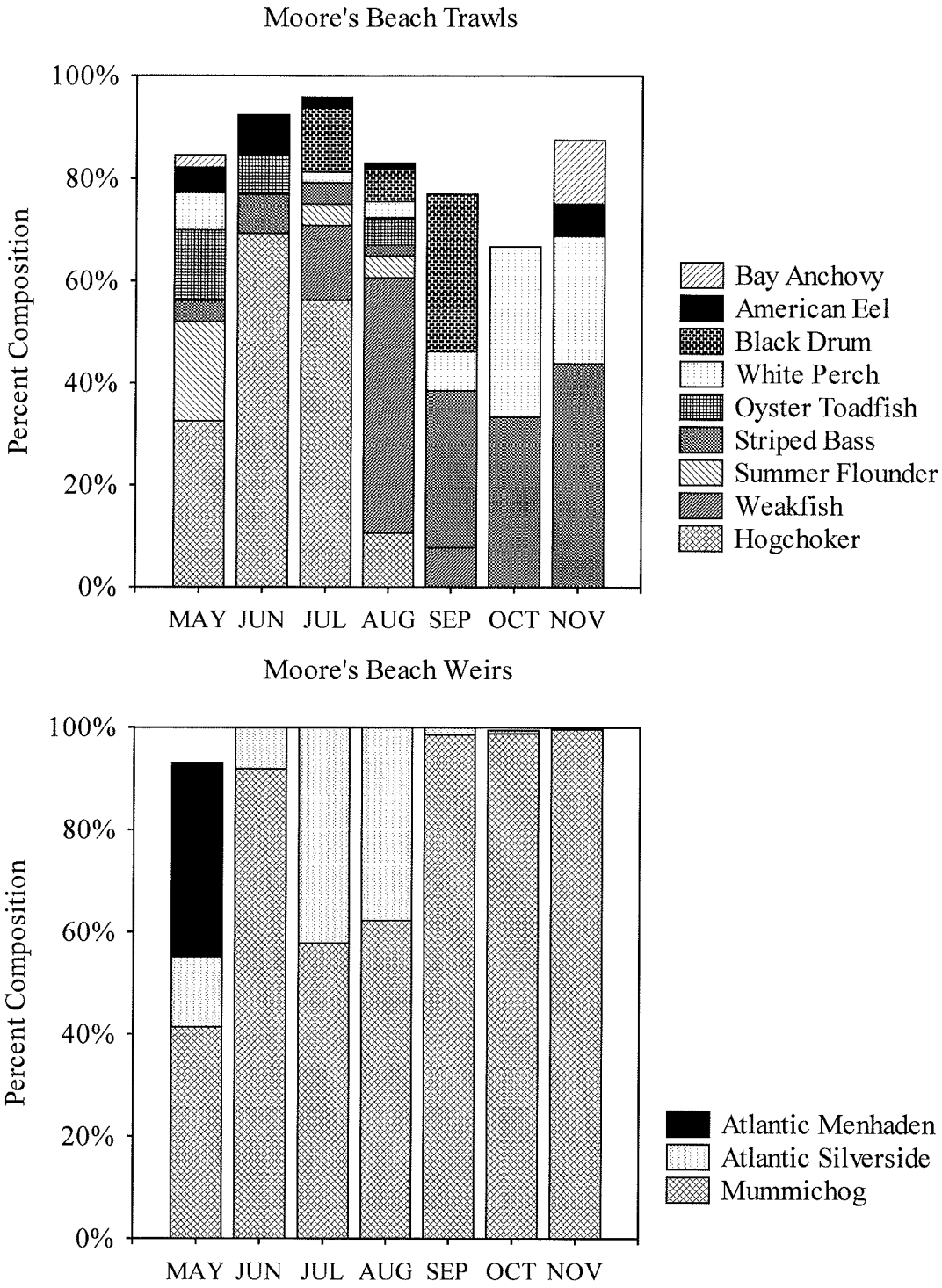


Figure 7-9. Monthly percent composition for fish caught, in large marsh creeks (otter trawl) and small marsh creeks (weir), in Moores Beach during 2009.

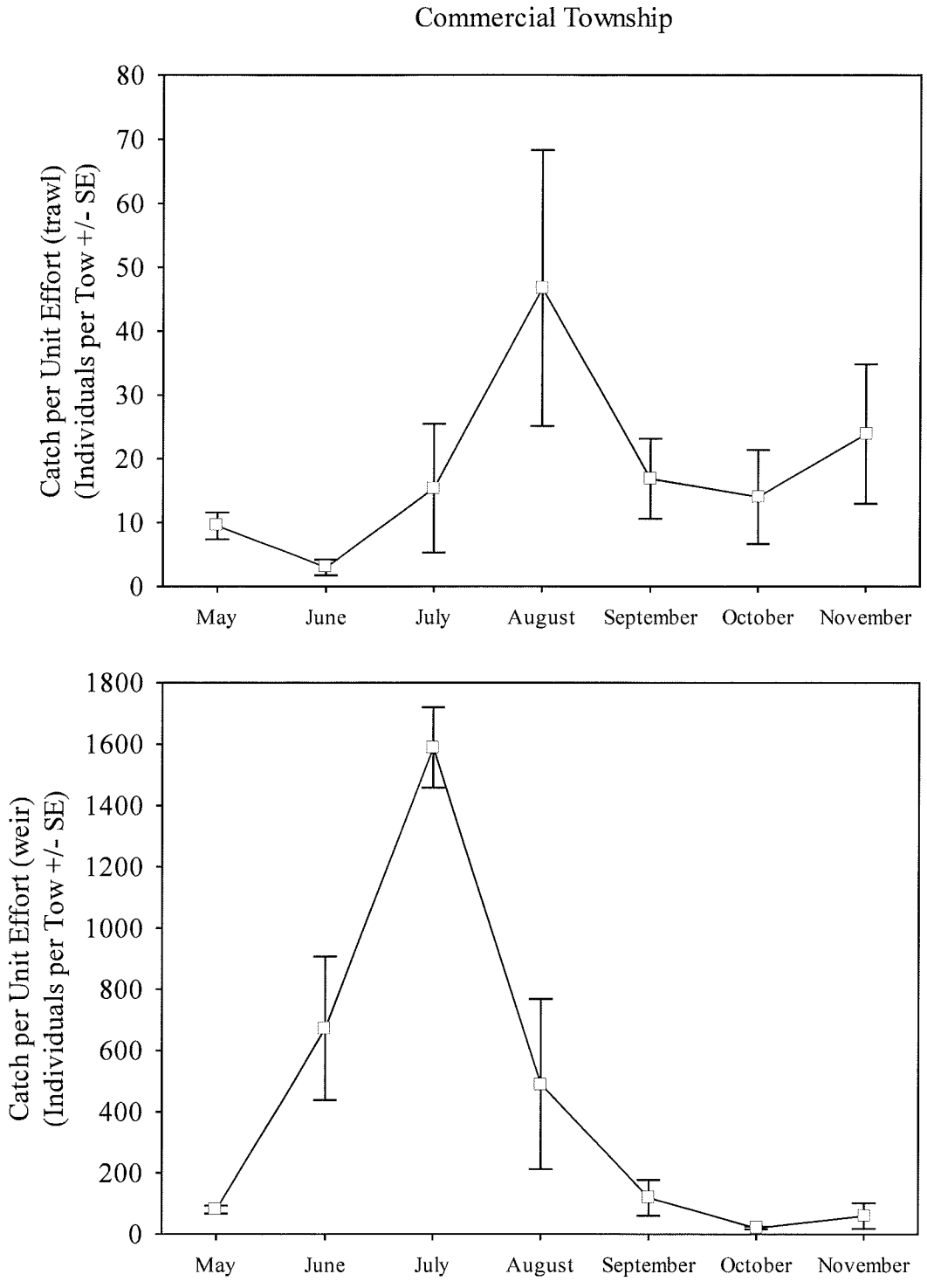


Figure 7-10. Monthly abundance for all fish caught, in large marsh creeks (otter trawl) and small marsh creeks (weir), at Commercial Township during 2009.

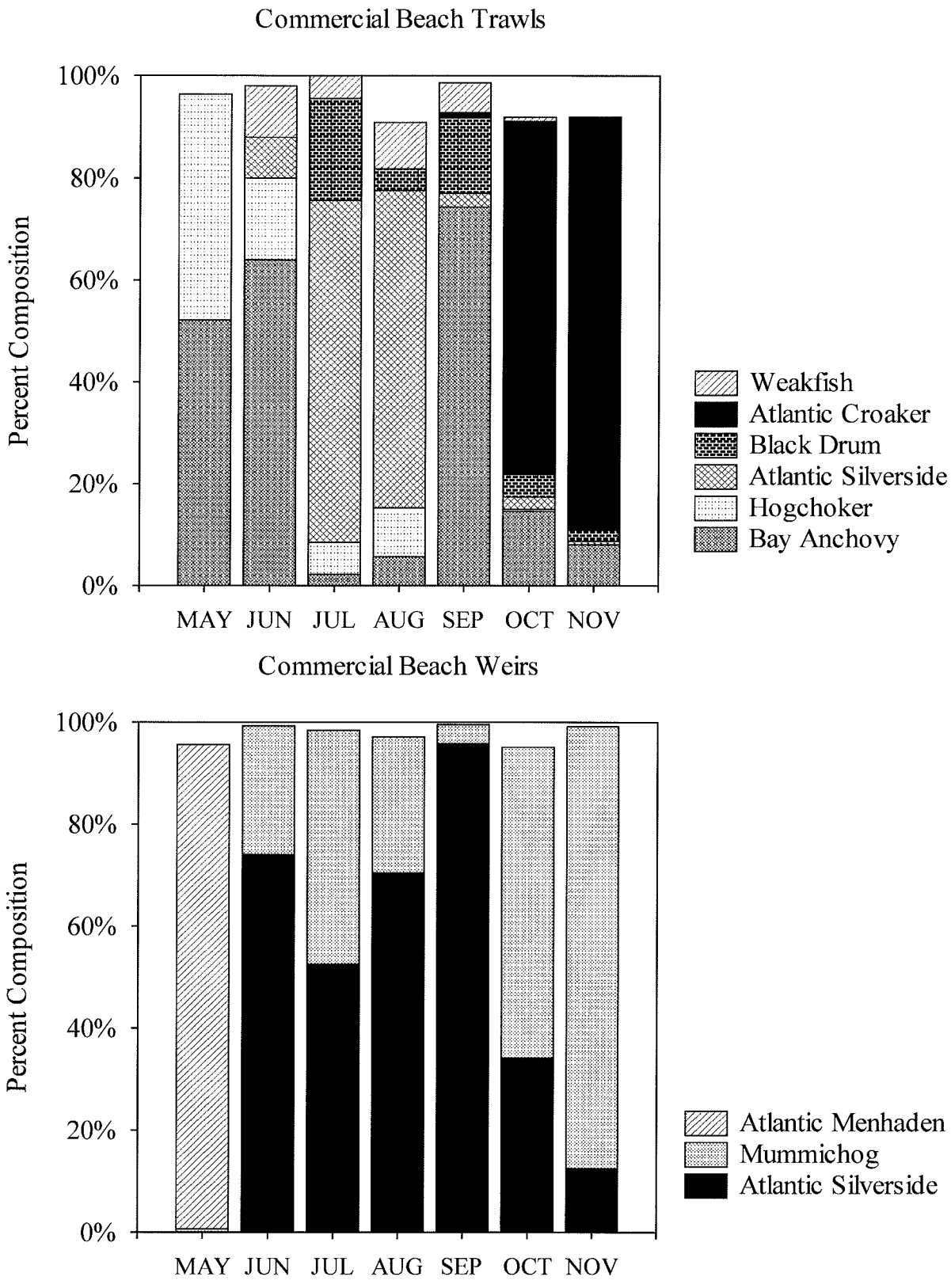


Figure 7-11. Monthly percent composition for fish caught, in large marsh creeks (otter trawl) and small marsh creeks (weir), in Commercial Township during 2009.

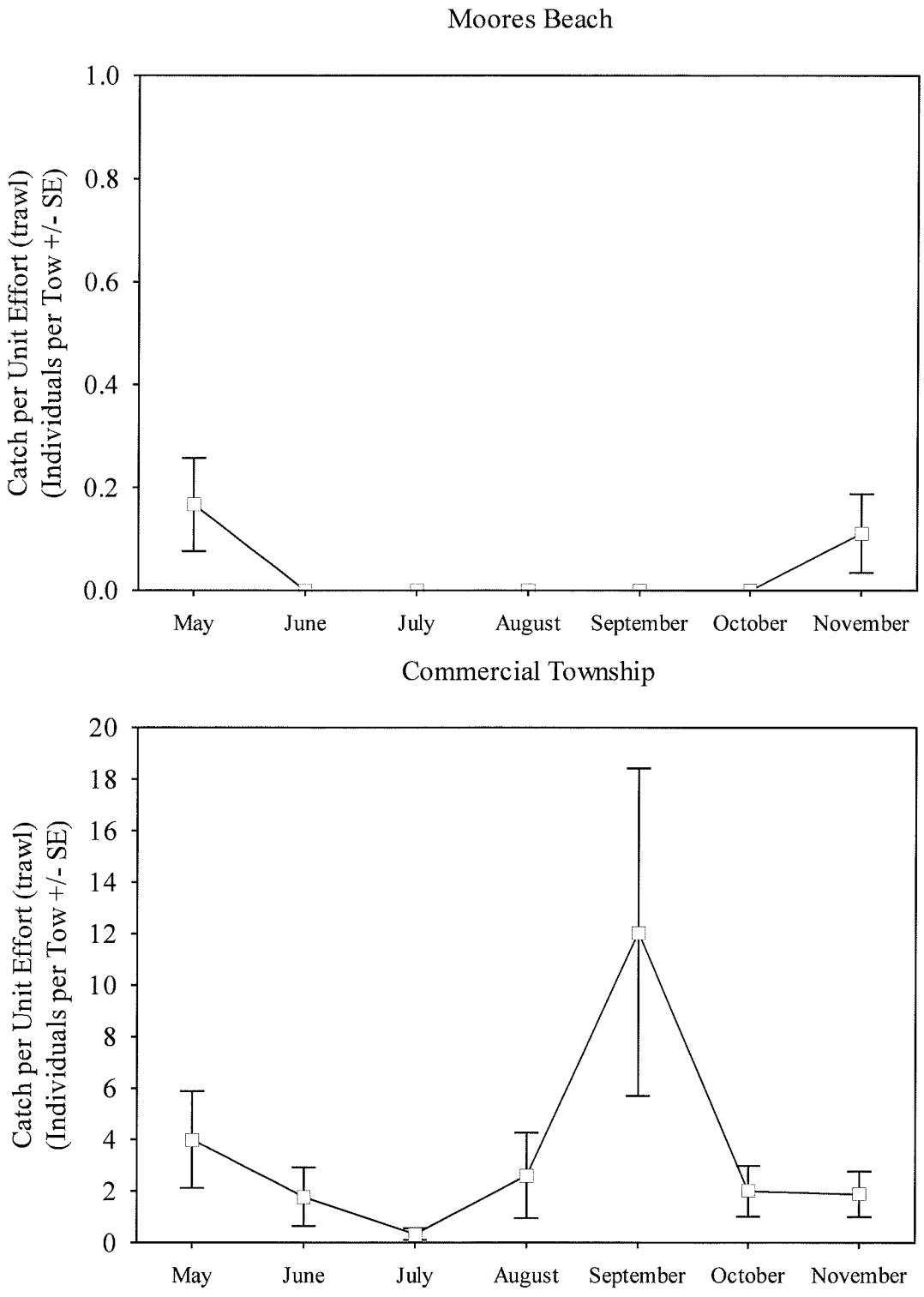


Figure 7-12. Monthly abundance for bay anchovy caught, in large marsh creeks with otter trawls, in the Lower Bay Region during 2009.

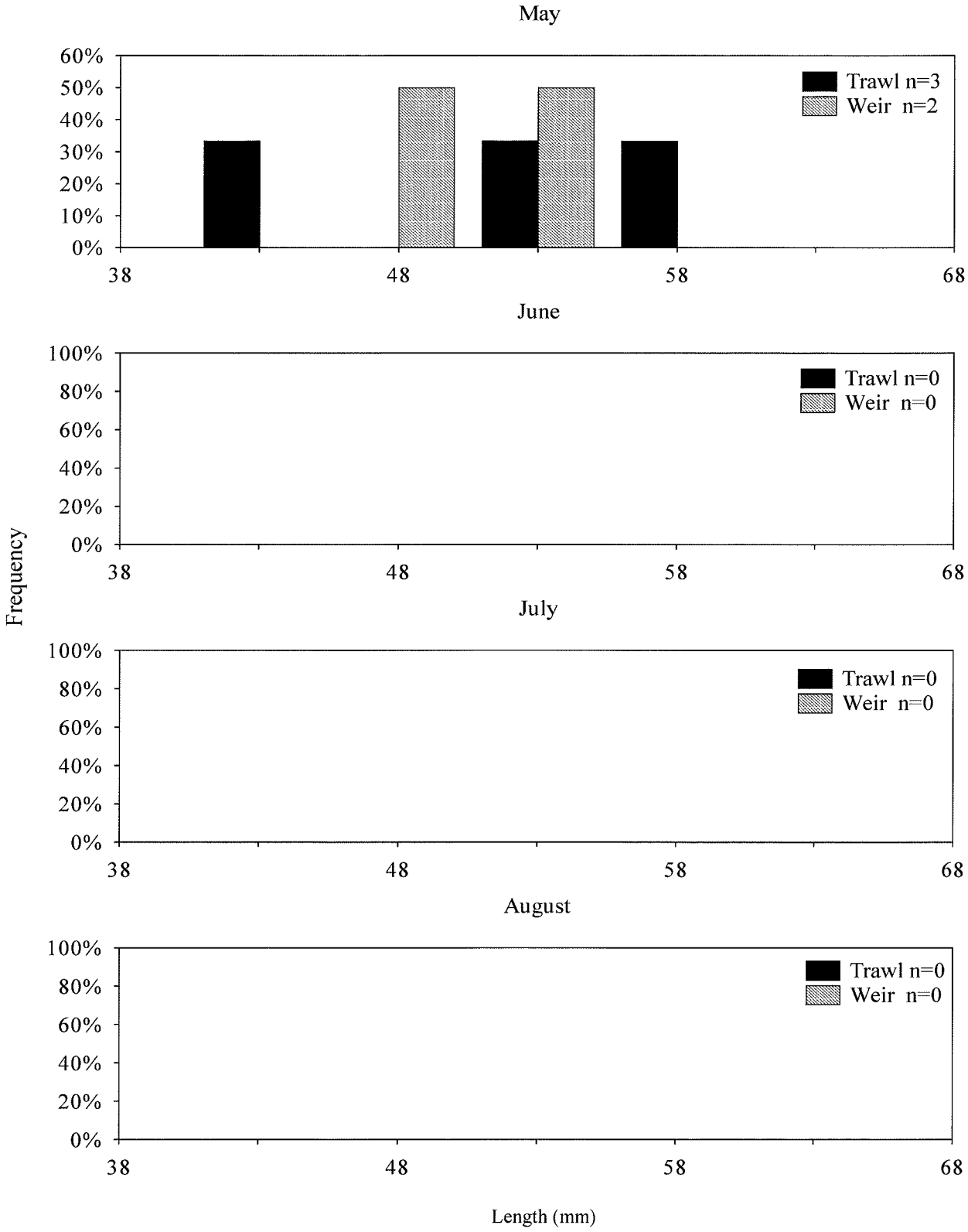


Figure 7-13. Size distribution of bay anchovy, from large marsh creeks (otter trawl) and small marsh creeks (weir), at Moores Beach in 2009.

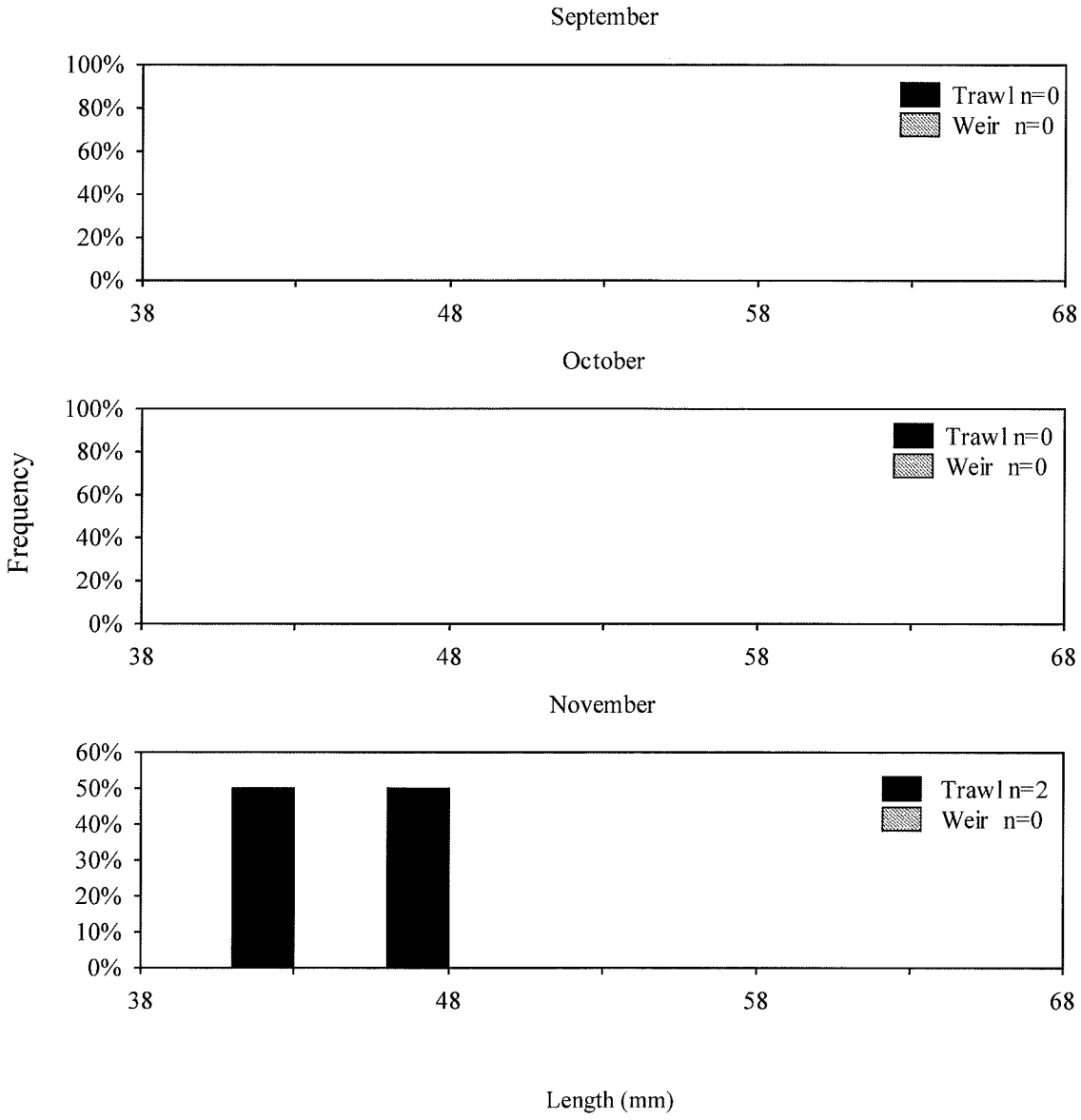


Figure 7-13. Continued.

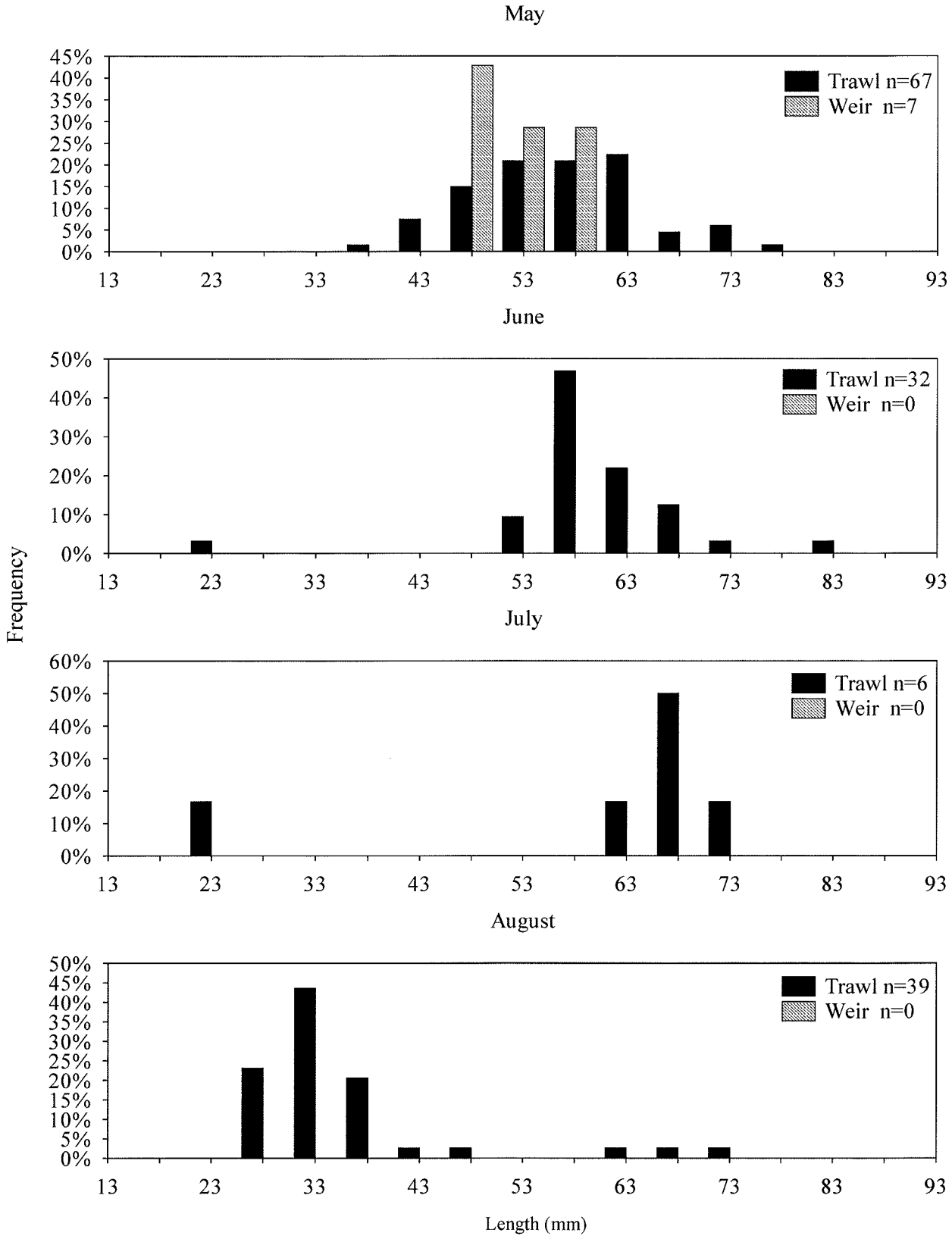


Figure 7-14. Size distribution of bay anchovy, from large marsh creeks (otter trawl) and small marsh creeks (weir), at Commercial Township in 2009.

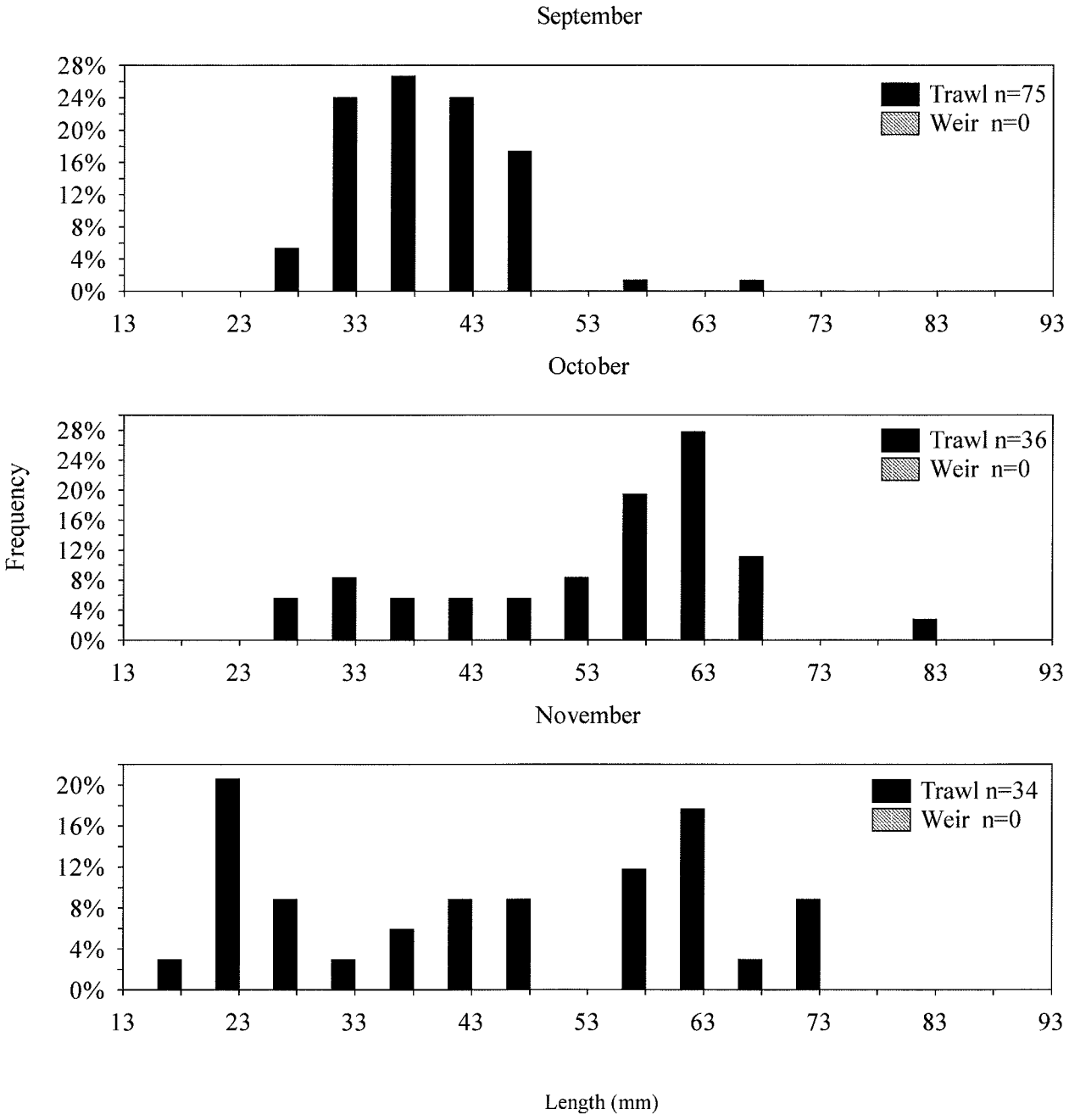


Figure 7-14. Continued.

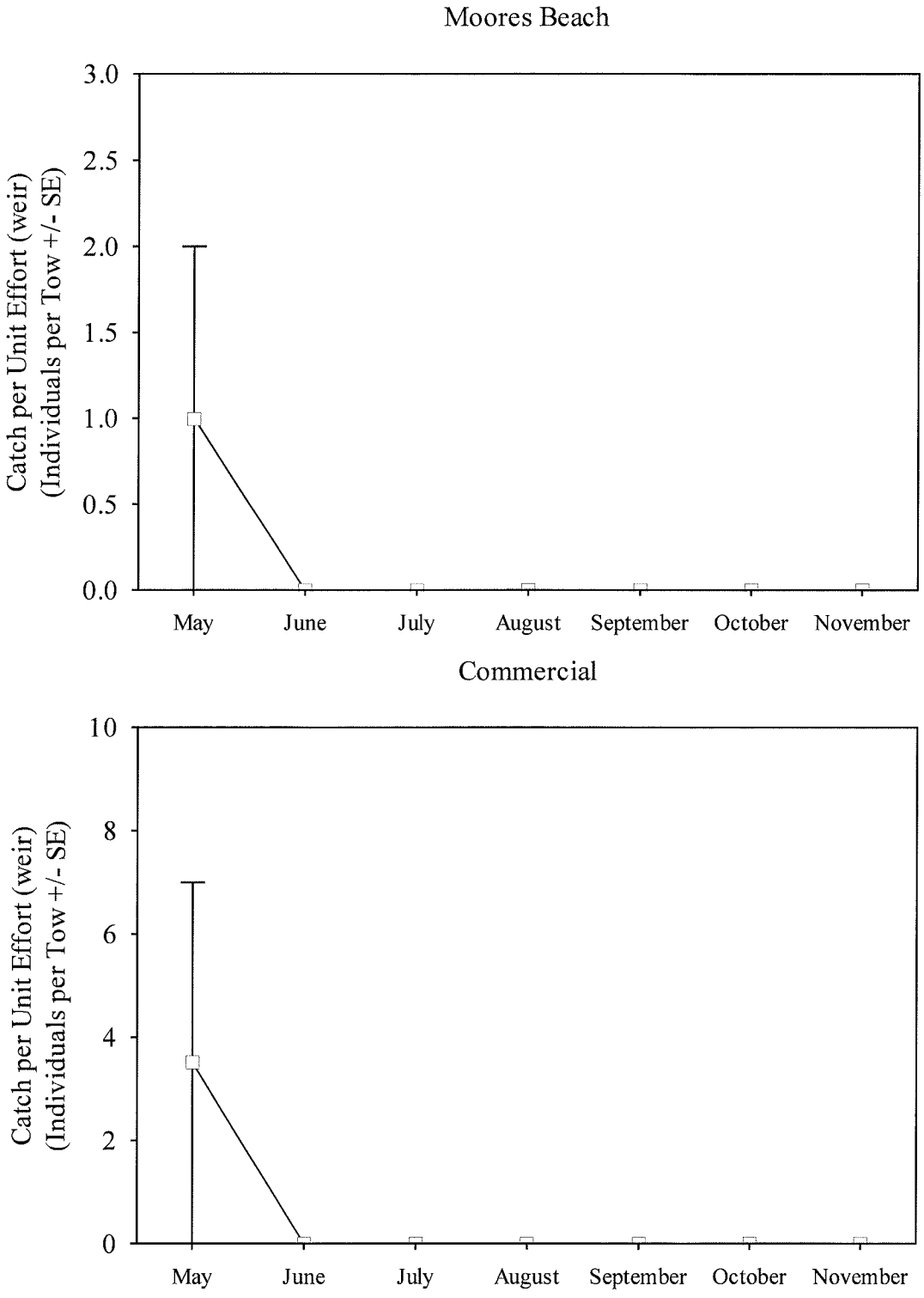


Figure 7-15. Monthly abundance for bay anchovy caught, in small marsh creeks with weirs, in the Lower Bay Region in 2009.

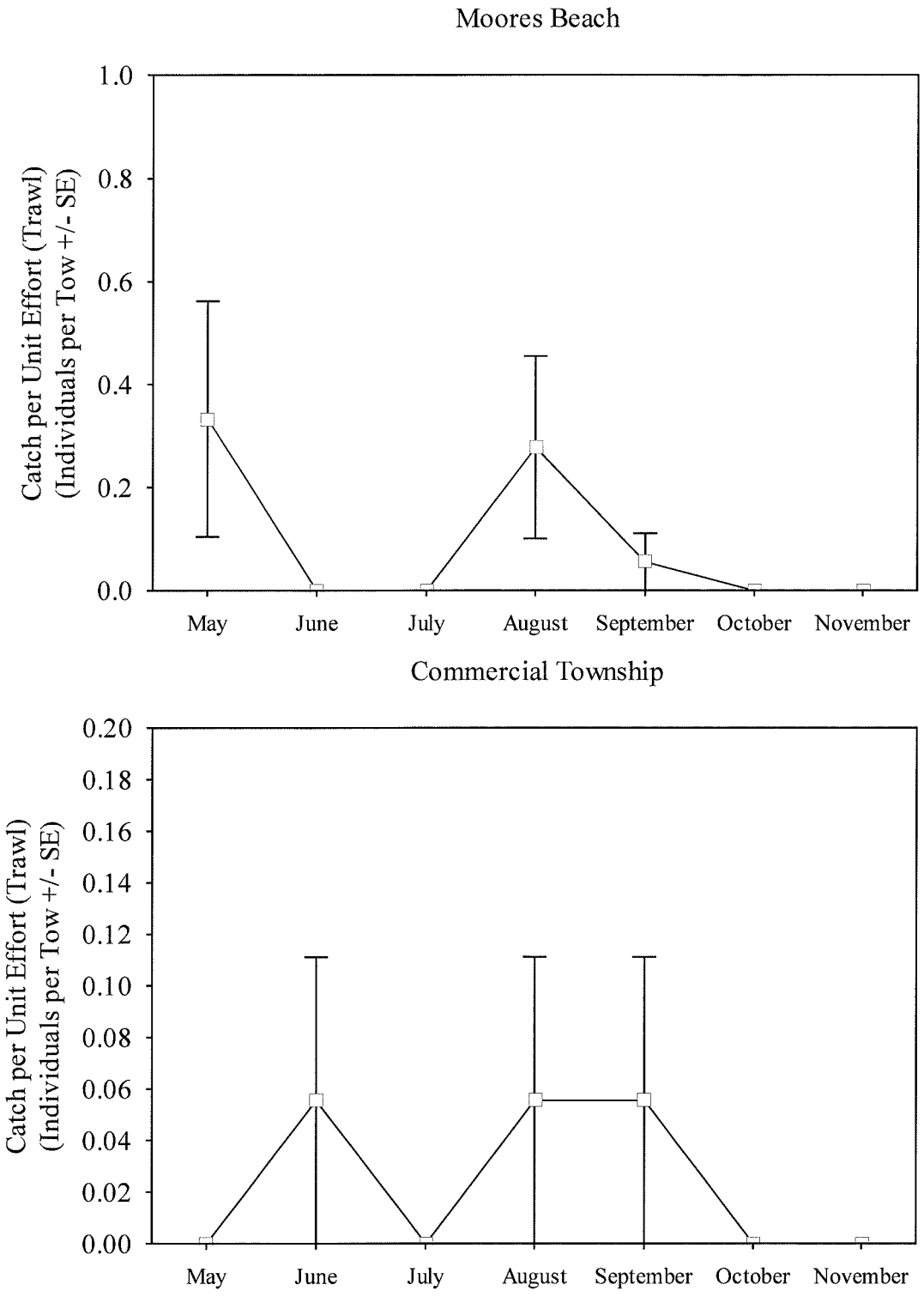


Figure 7-16. Monthly abundance for spot caught, in large marsh creeks with otter trawls, in the Lower Bay Region during 2009.

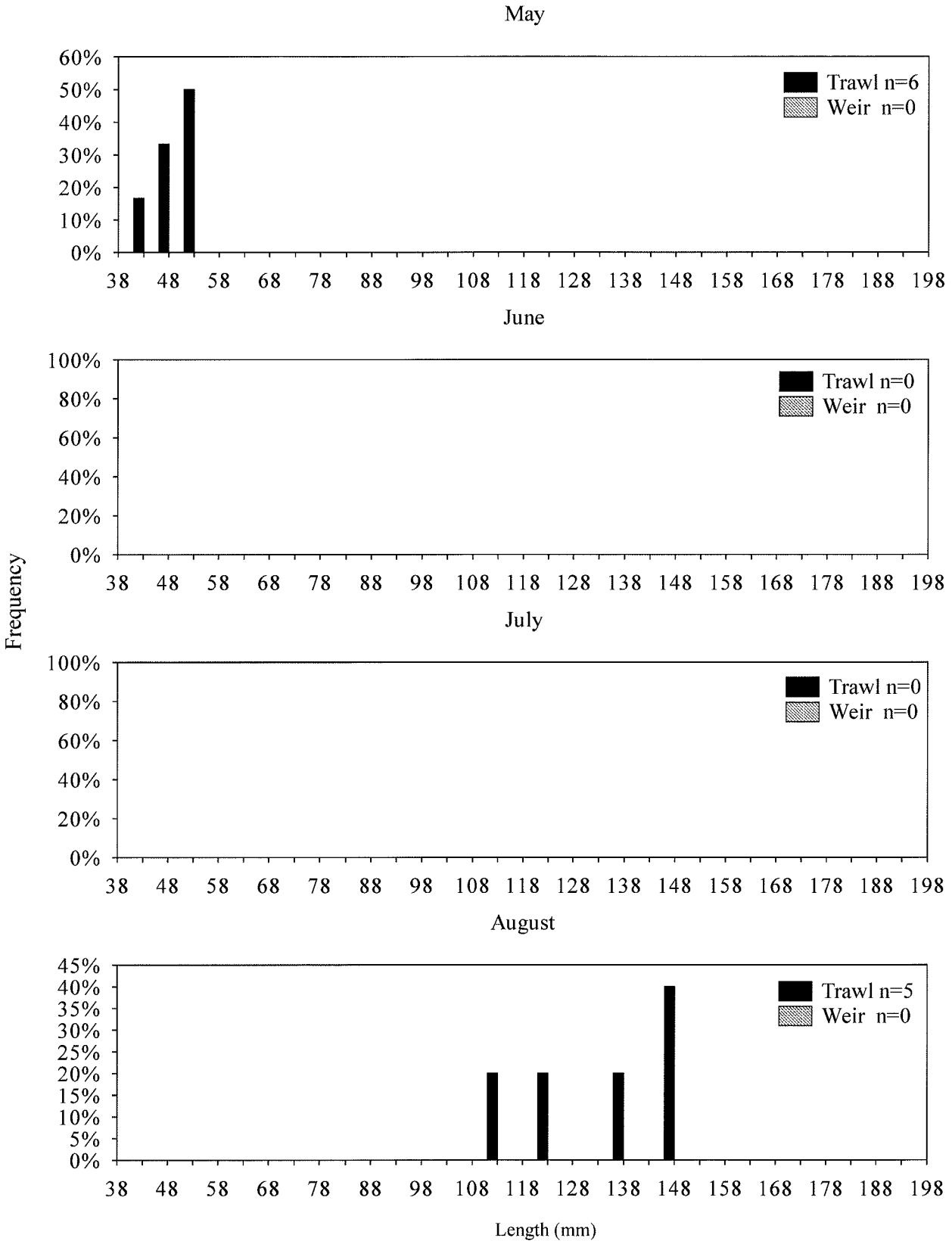


Figure 7-17. Size distribution of spot, from large marsh creeks (otter trawl) and small marsh creeks (weirs), at Moores Beach during 2009.

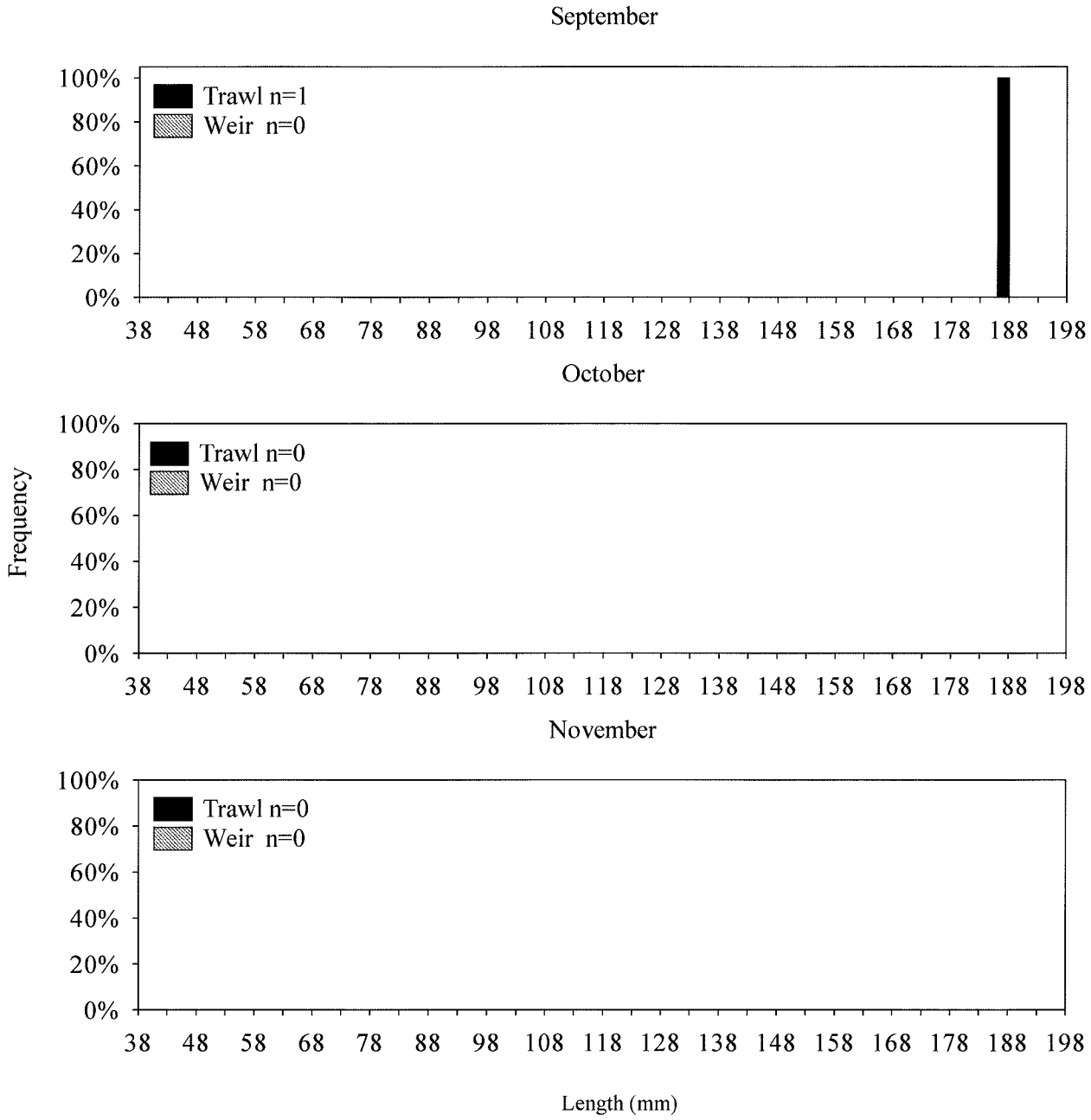


Figure 7-17. Continued.

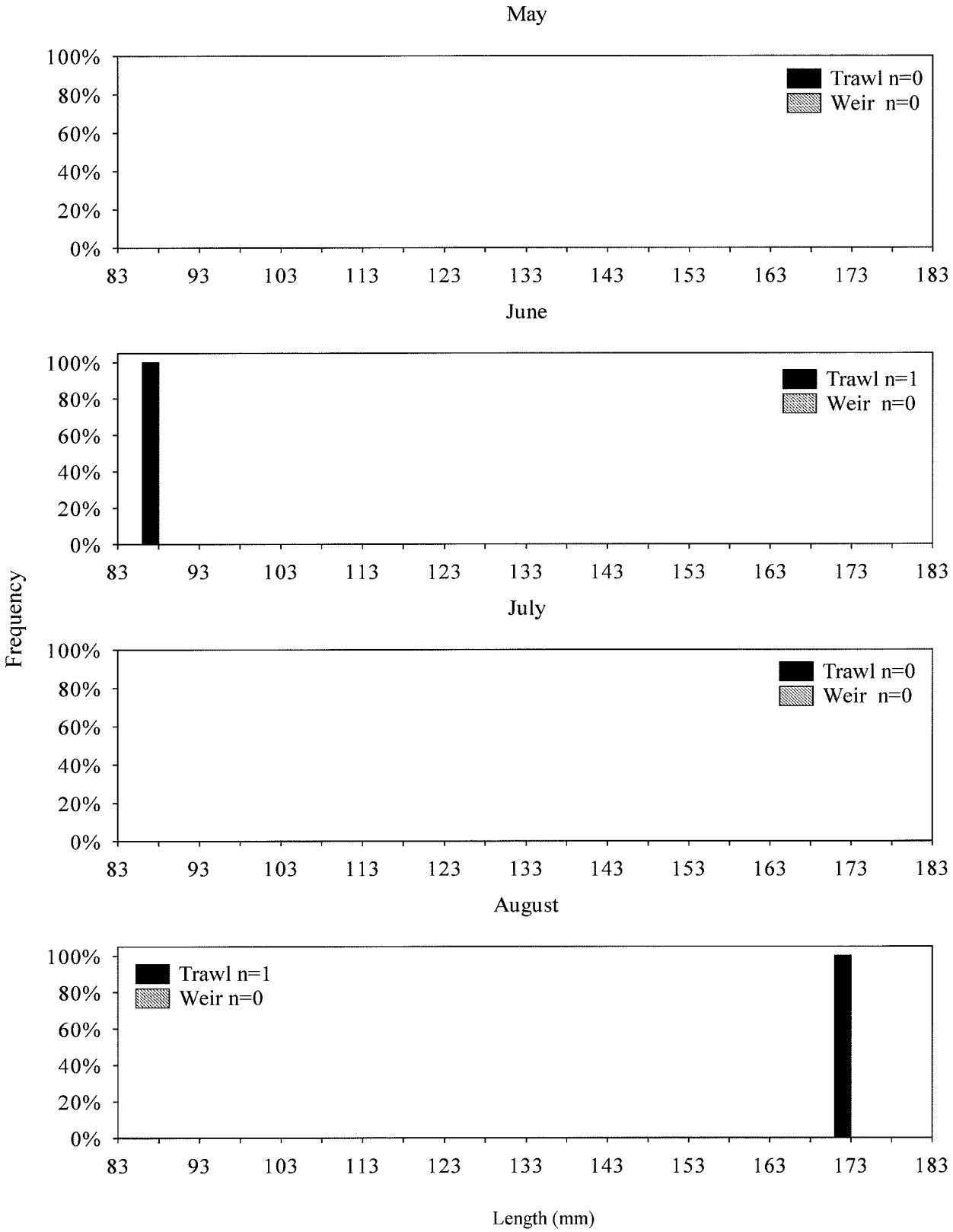


Figure 7-18. Size distribution of spot, from large marsh creeks (otter trawl) and small marsh creeks (weir), at Commercial Township in 2009.

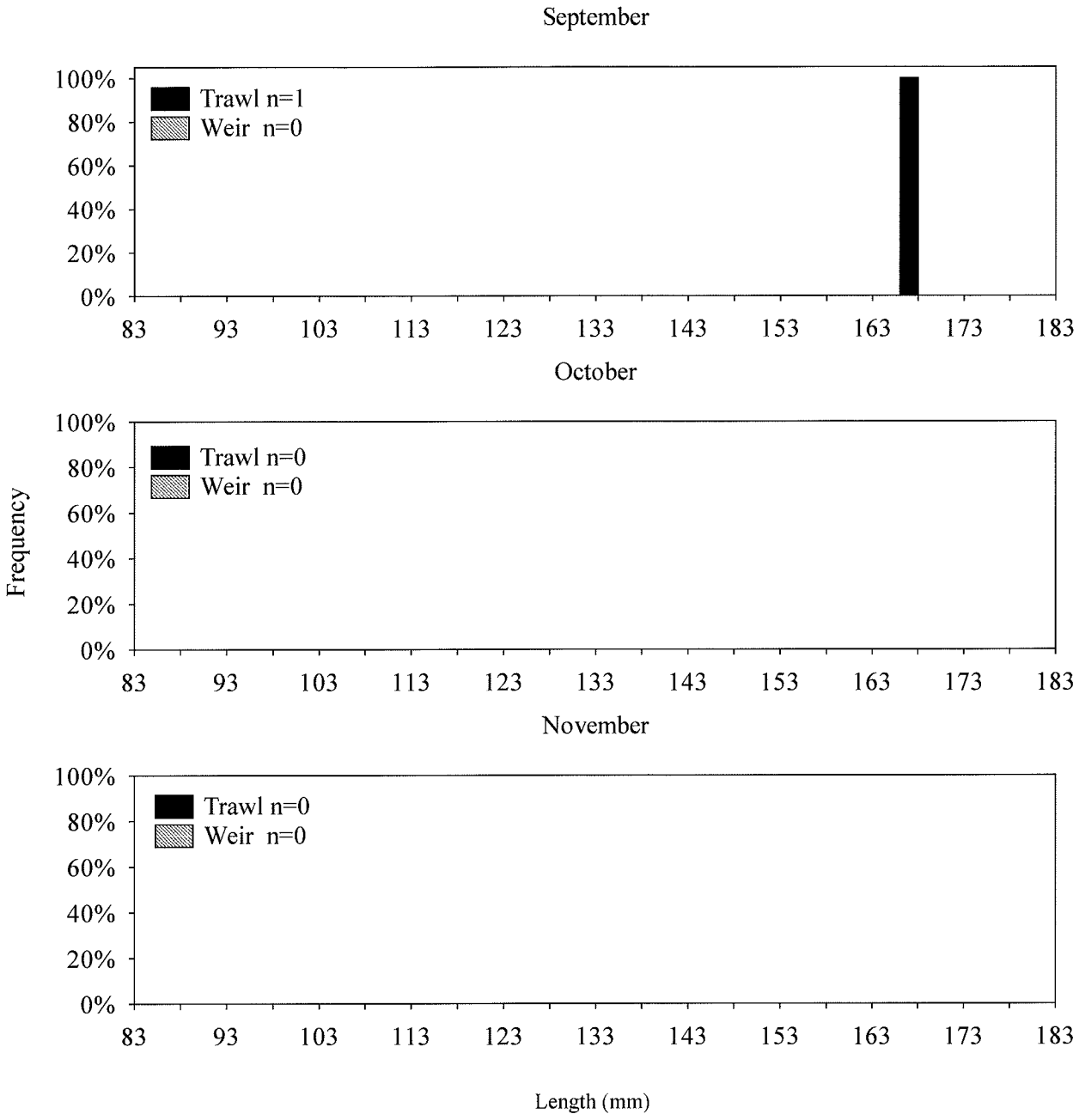


Figure 7-18. Continued.

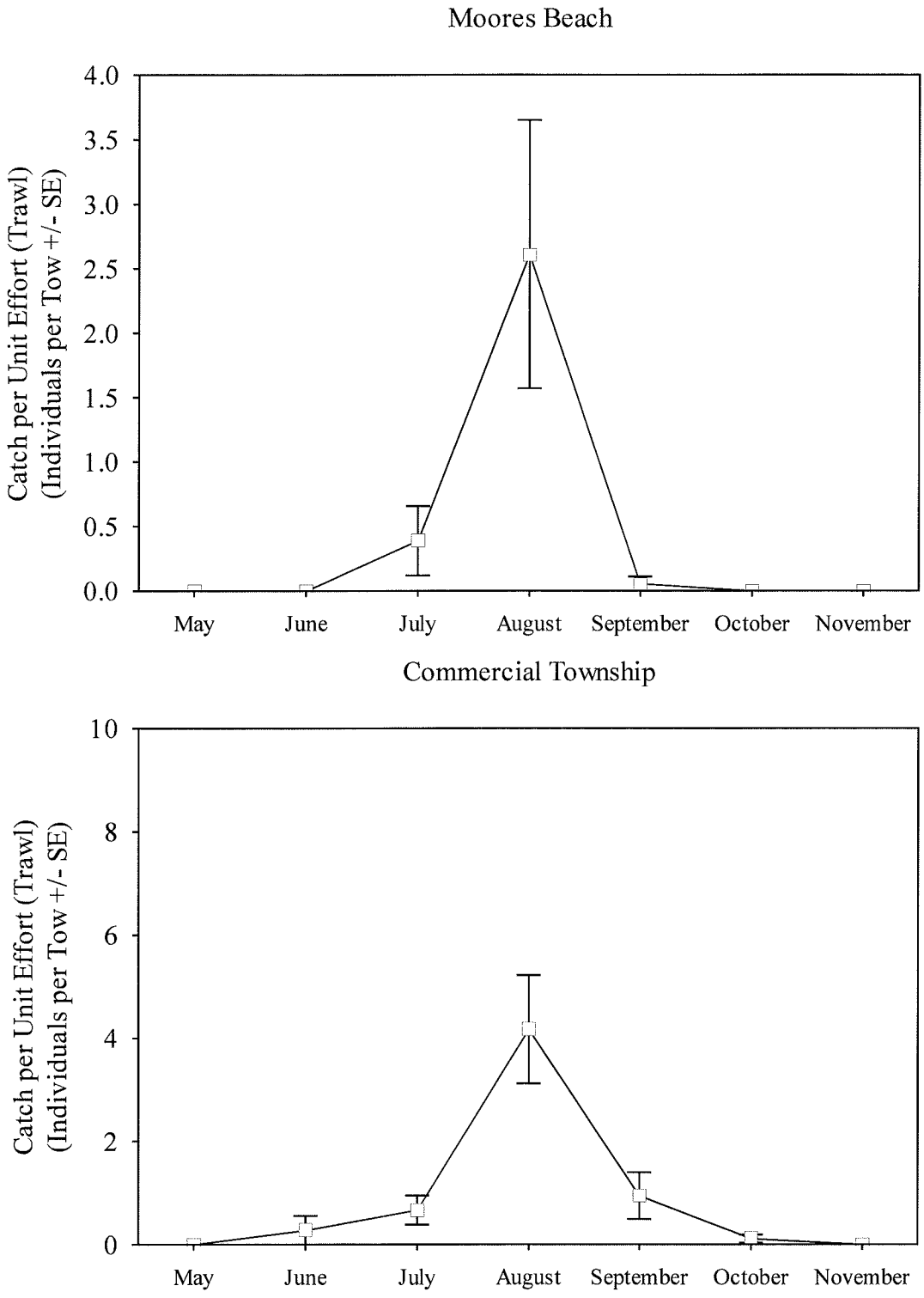


Figure 7-19. Monthly abundance for weakfish caught, in large marsh creeks with otter trawls, in the Lower Bay Region during 2009.

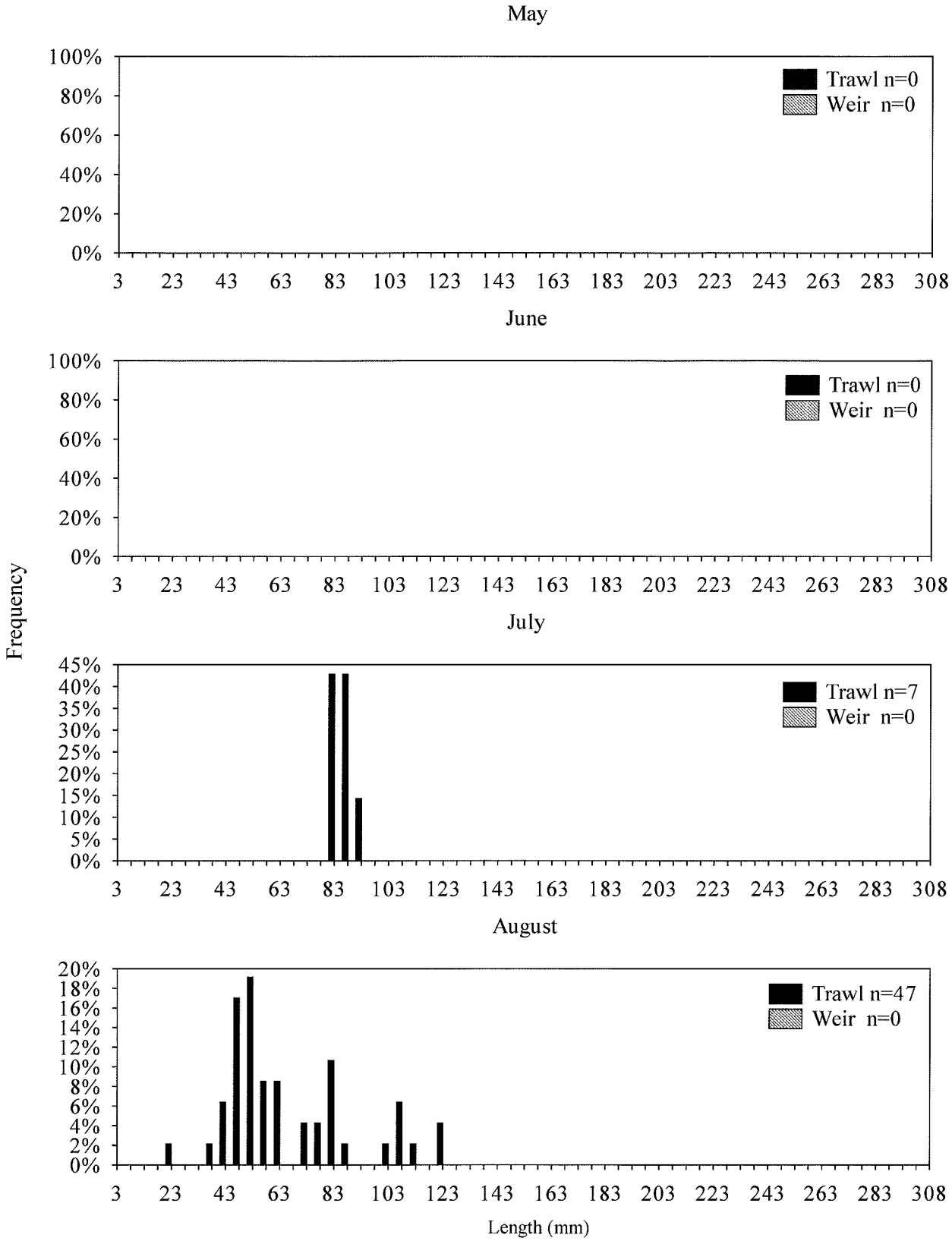


Figure 7-20. Size distribution of weakfish, from large marsh creeks (otter trawl) and small marsh creeks (weir), at Moores Beach during 2009.

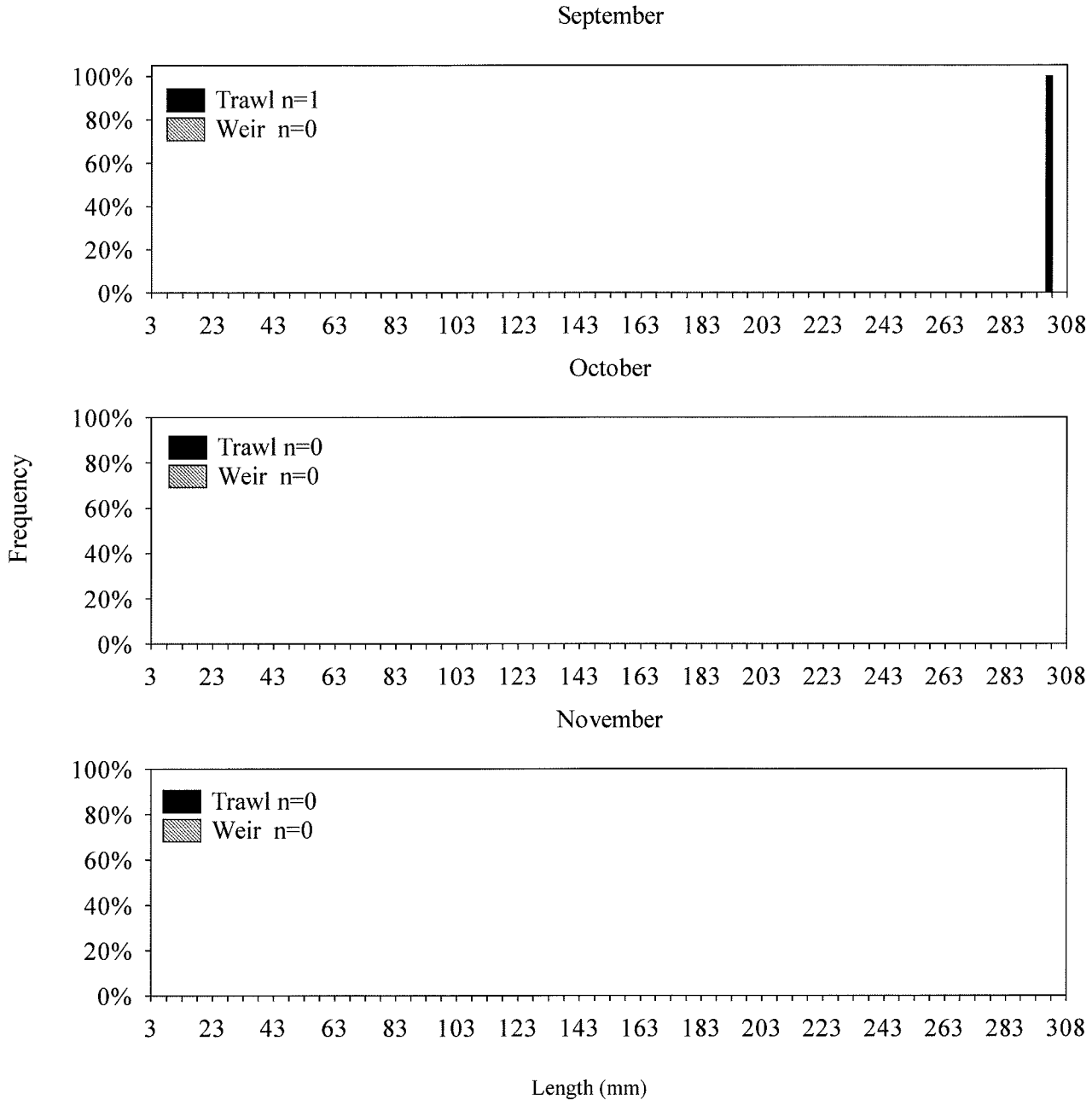


Figure 7-20. Continued.

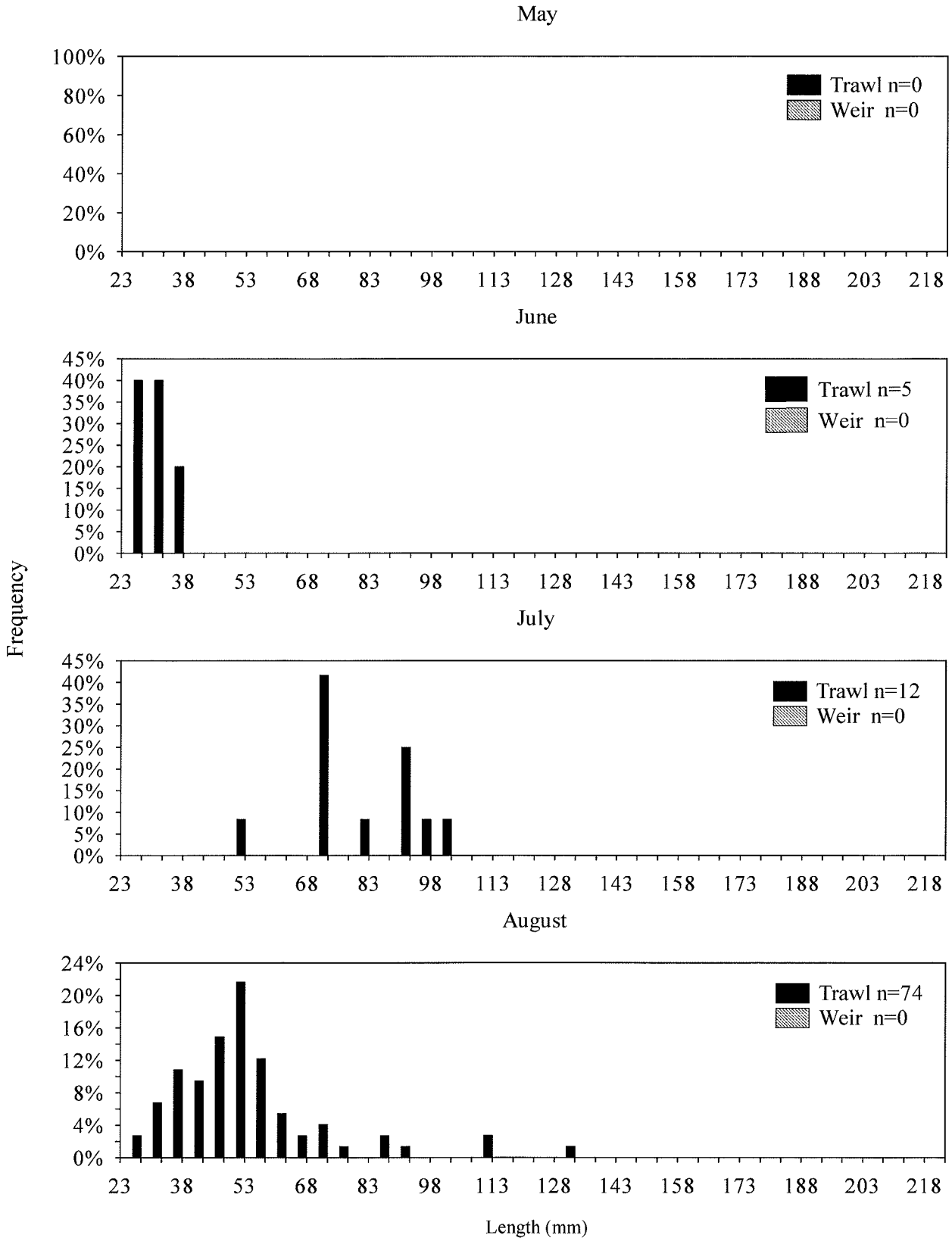


Figure 7-21. Size distribution of weakfish, from large marsh creeks (otter trawl) and small marsh creeks (weir), at Commercial Township during 2009.

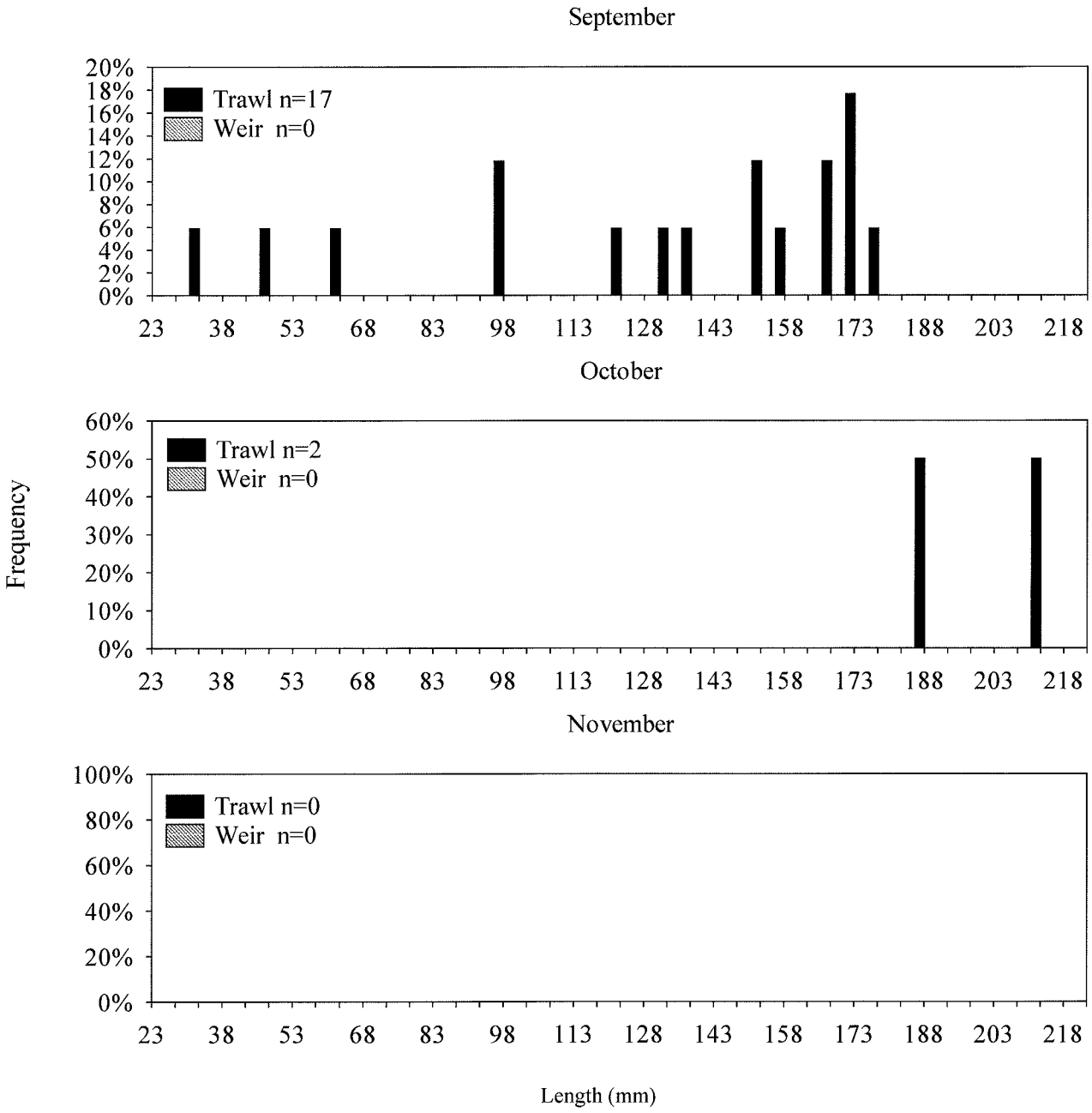


Figure 7-21. Continued.

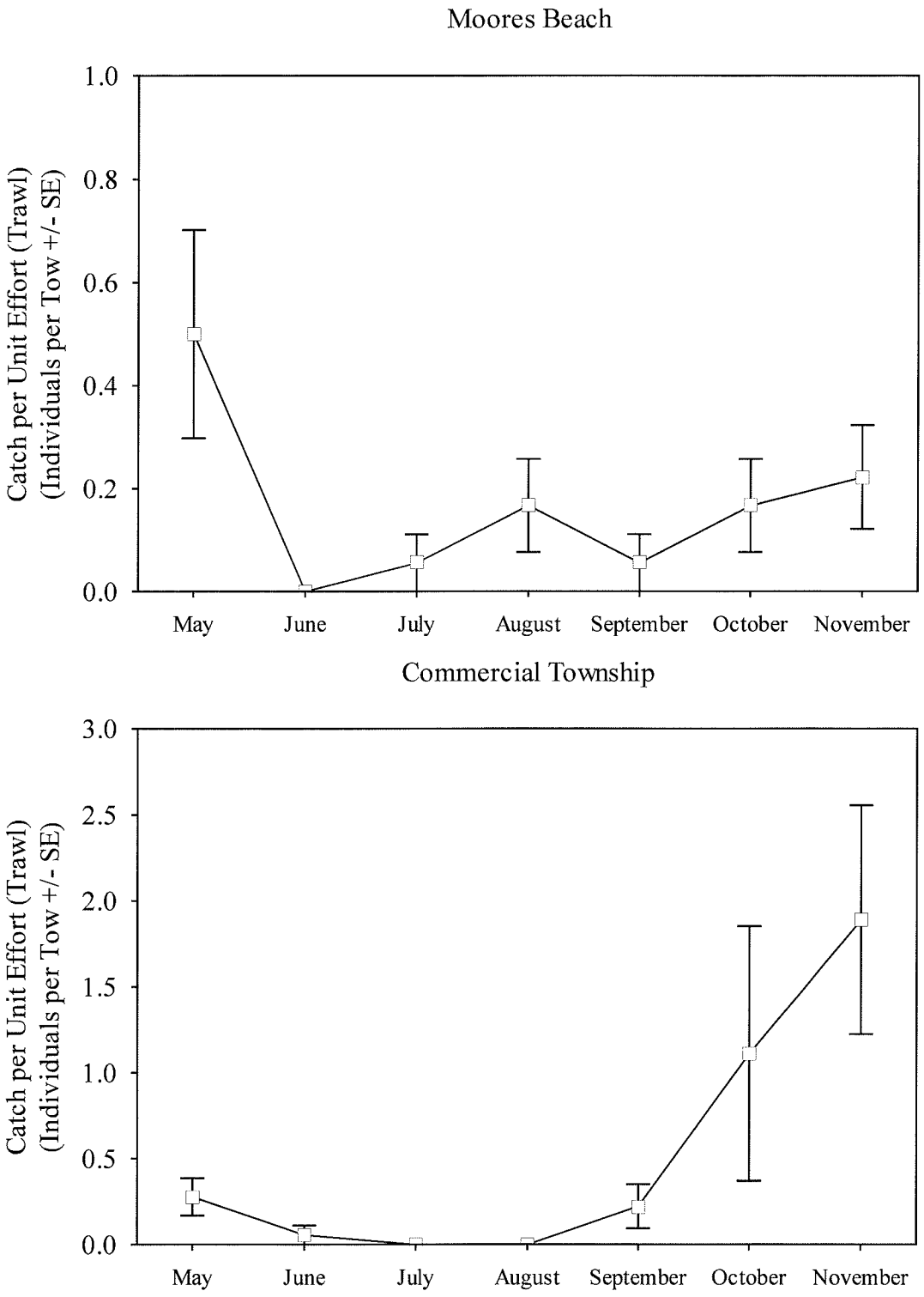


Figure 7-22. Monthly abundance for white perch caught, in large marsh creeks with otter trawls, the Lower Bay Region during 2009.

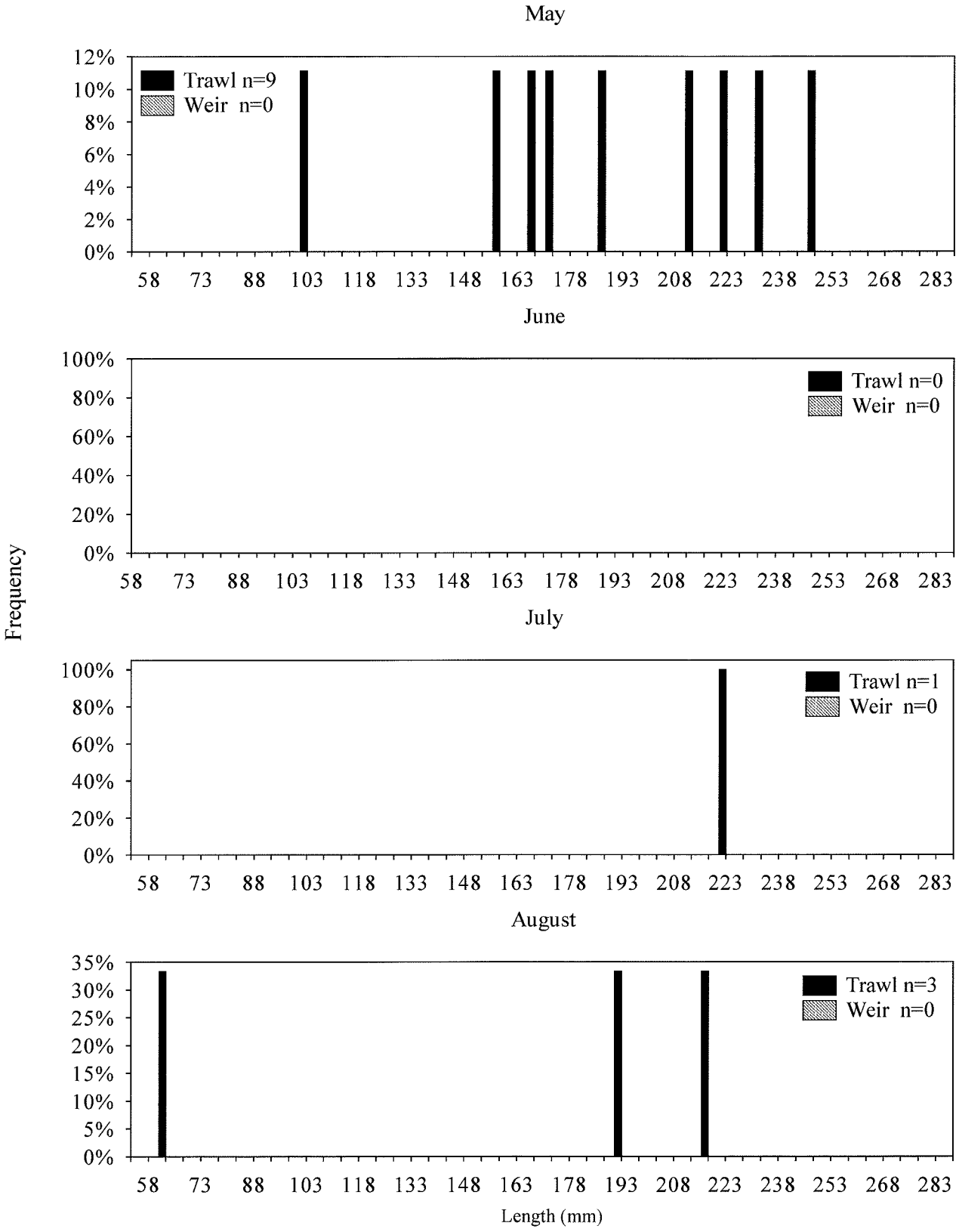


Figure 7-23. Size distribution of white perch, from large marsh creeks (otter trawl) and small marsh creeks (weir), at Moores Beach in 2009.

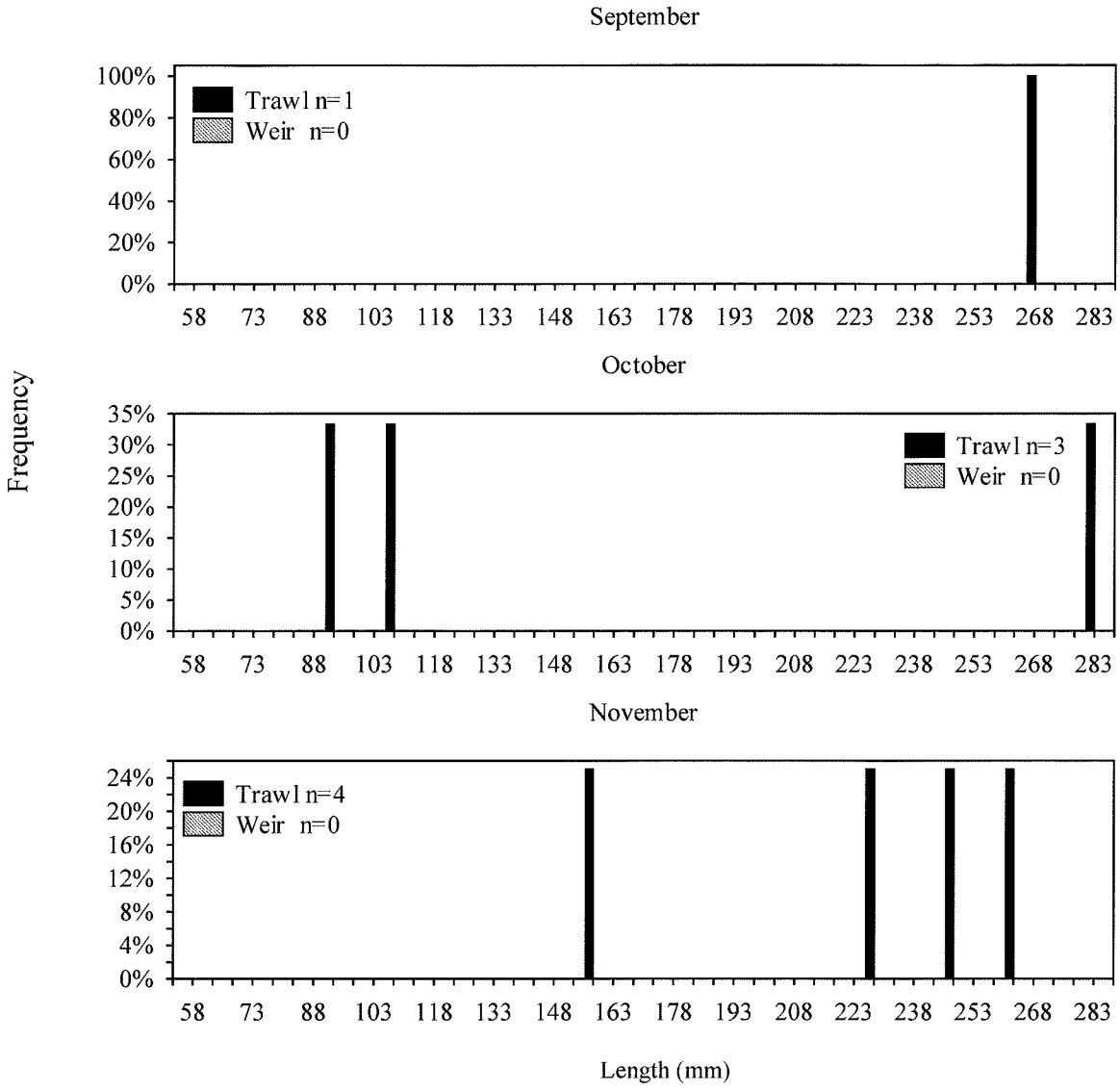


Figure 7-23. Continued.

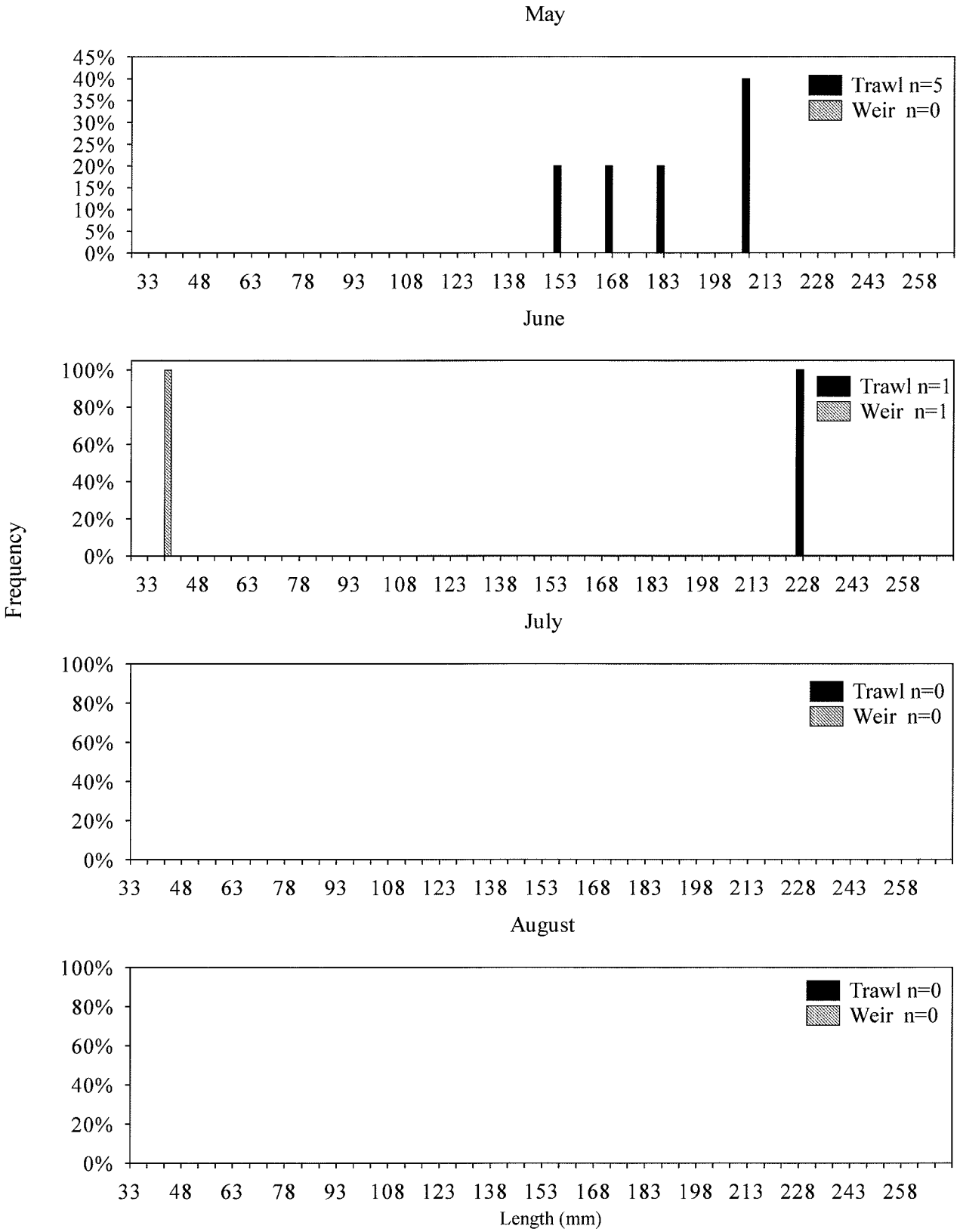


Figure 7-24. Size distribution of white perch, from large marsh creeks (otter trawl) and small marsh creeks (weir), at Commercial Township in 2009.

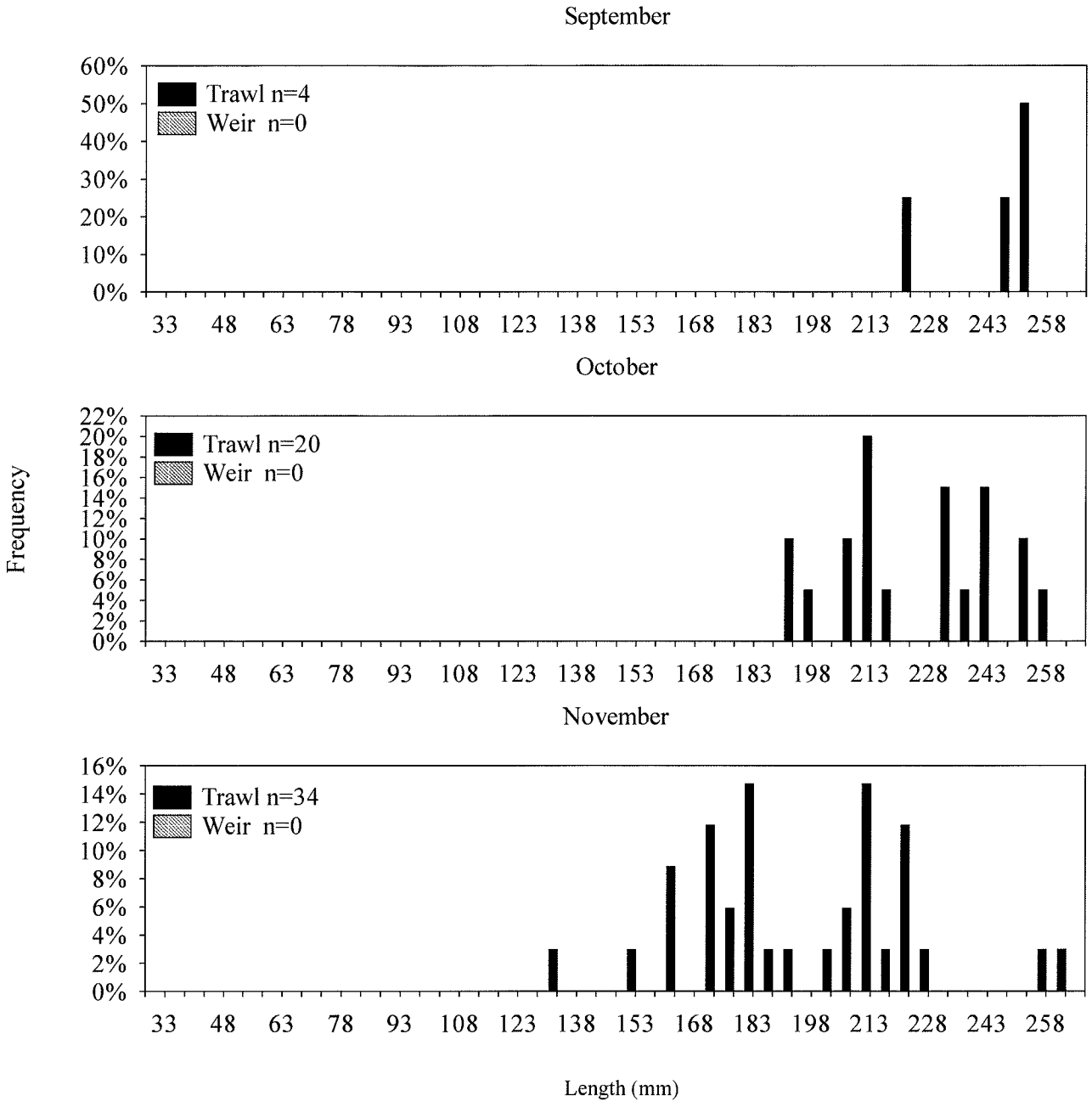


Figure 7-24. Continued.

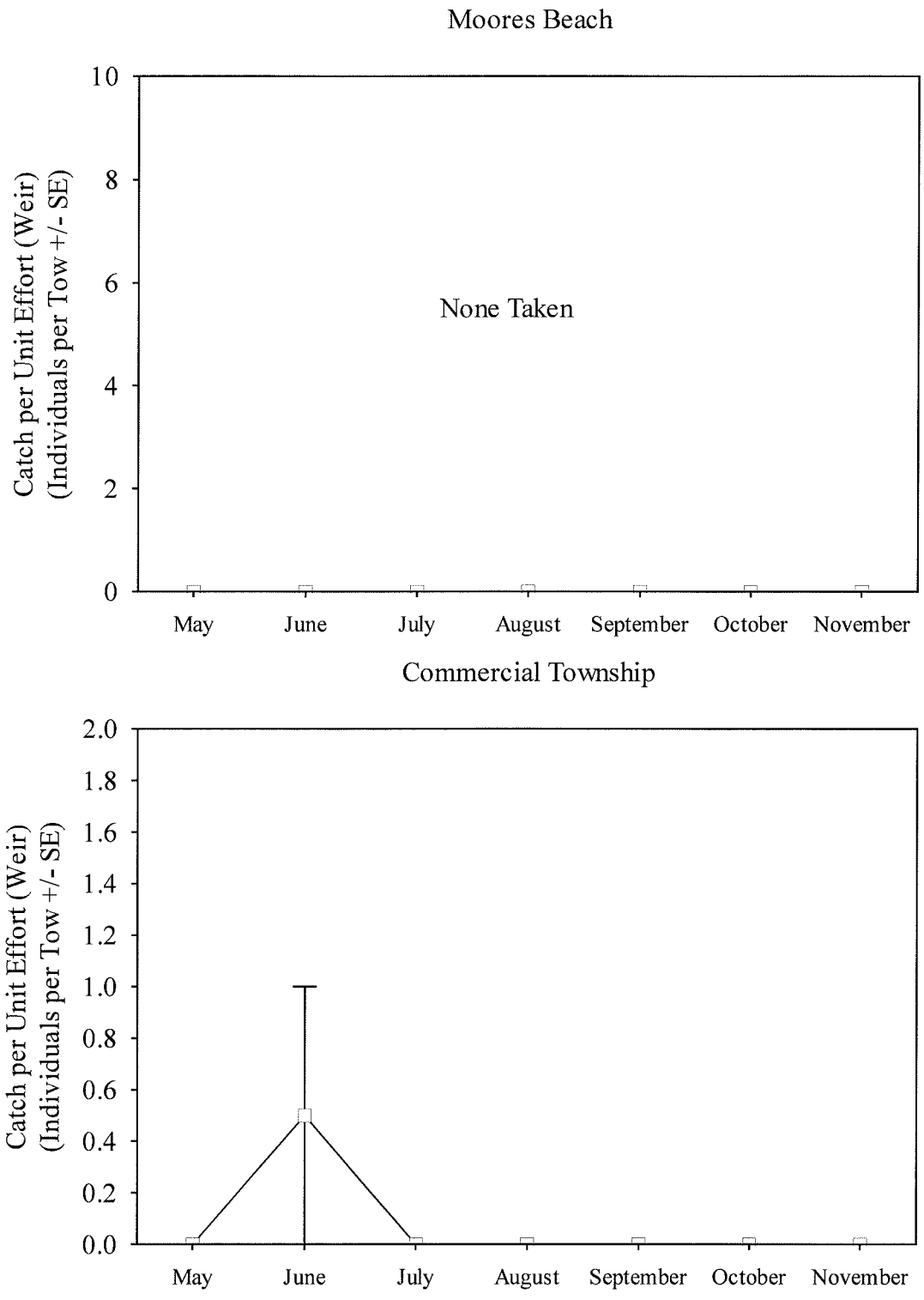


Figure 7-25. Monthly abundance for white perch caught in, small marsh creeks with weirs, in the Lower Bay Region in 2009.

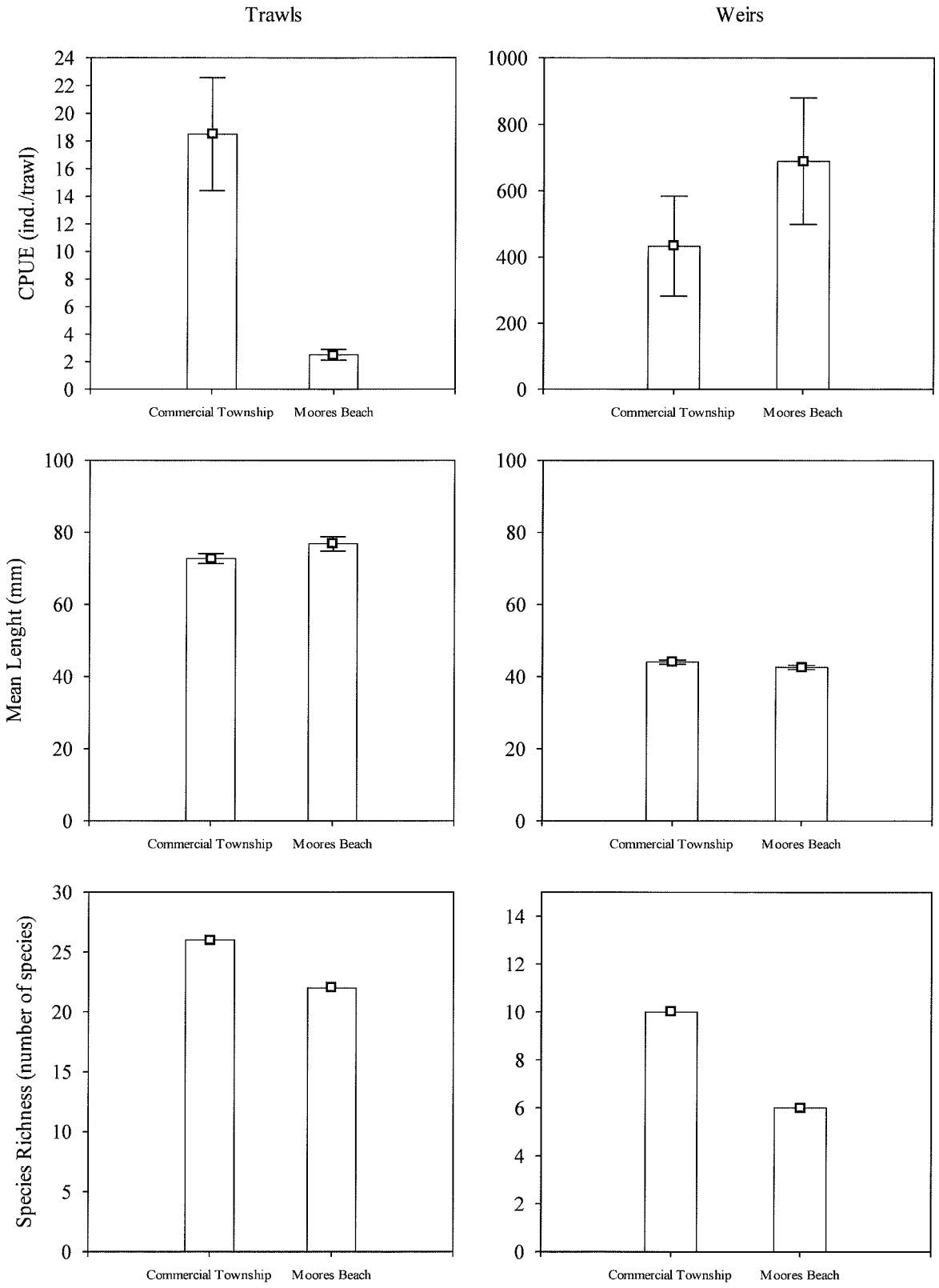


Figure 7-26. Comparisons of abundance, fish length, and species richness among reference (Moores Beach) and restored (Commercial Township) marshes from large and small creeks during 2009.

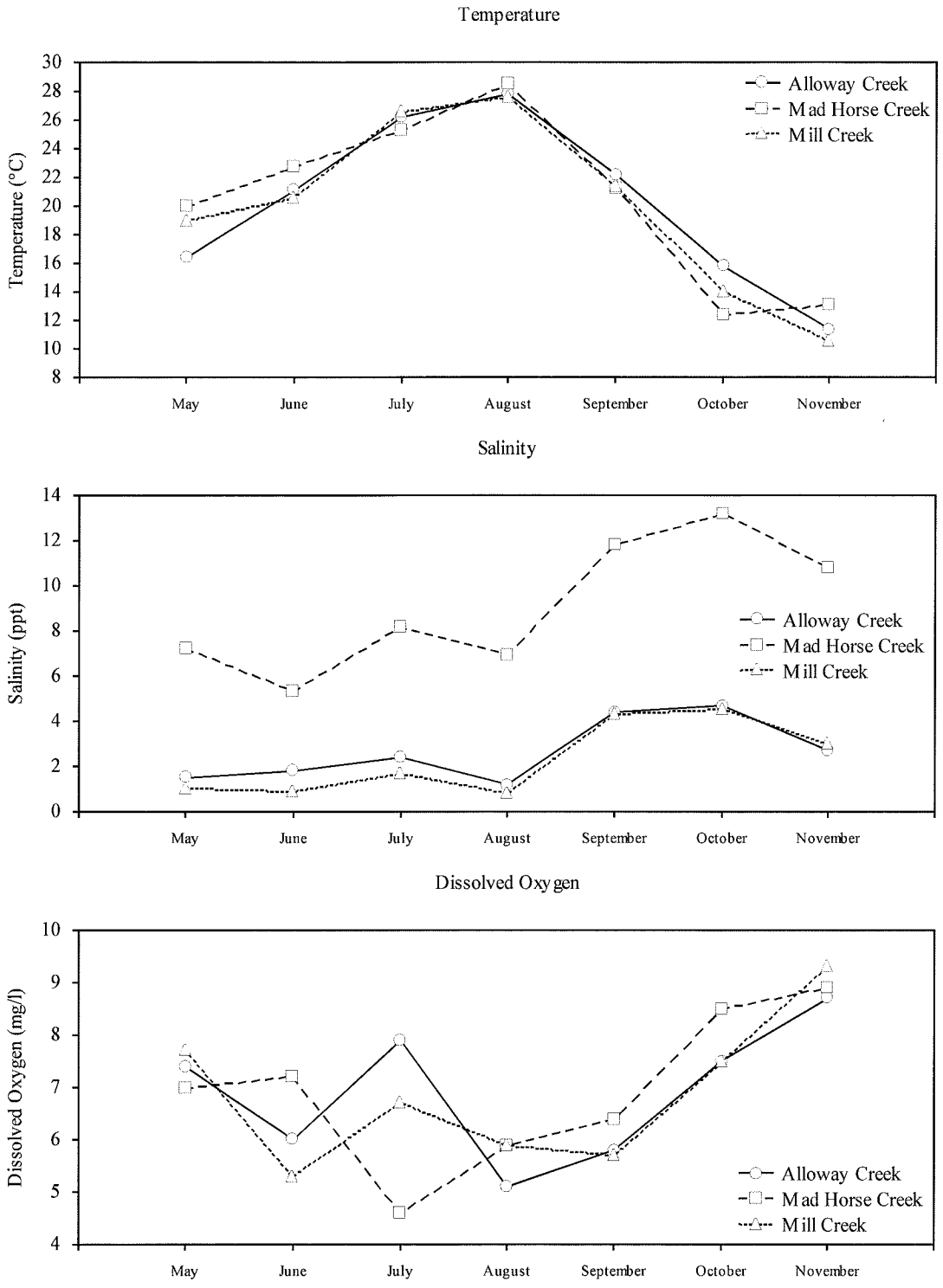


Figure 7-27. Selected physical parameters at regularly sampled sites in the Upper Delaware Bay Region during 2009.

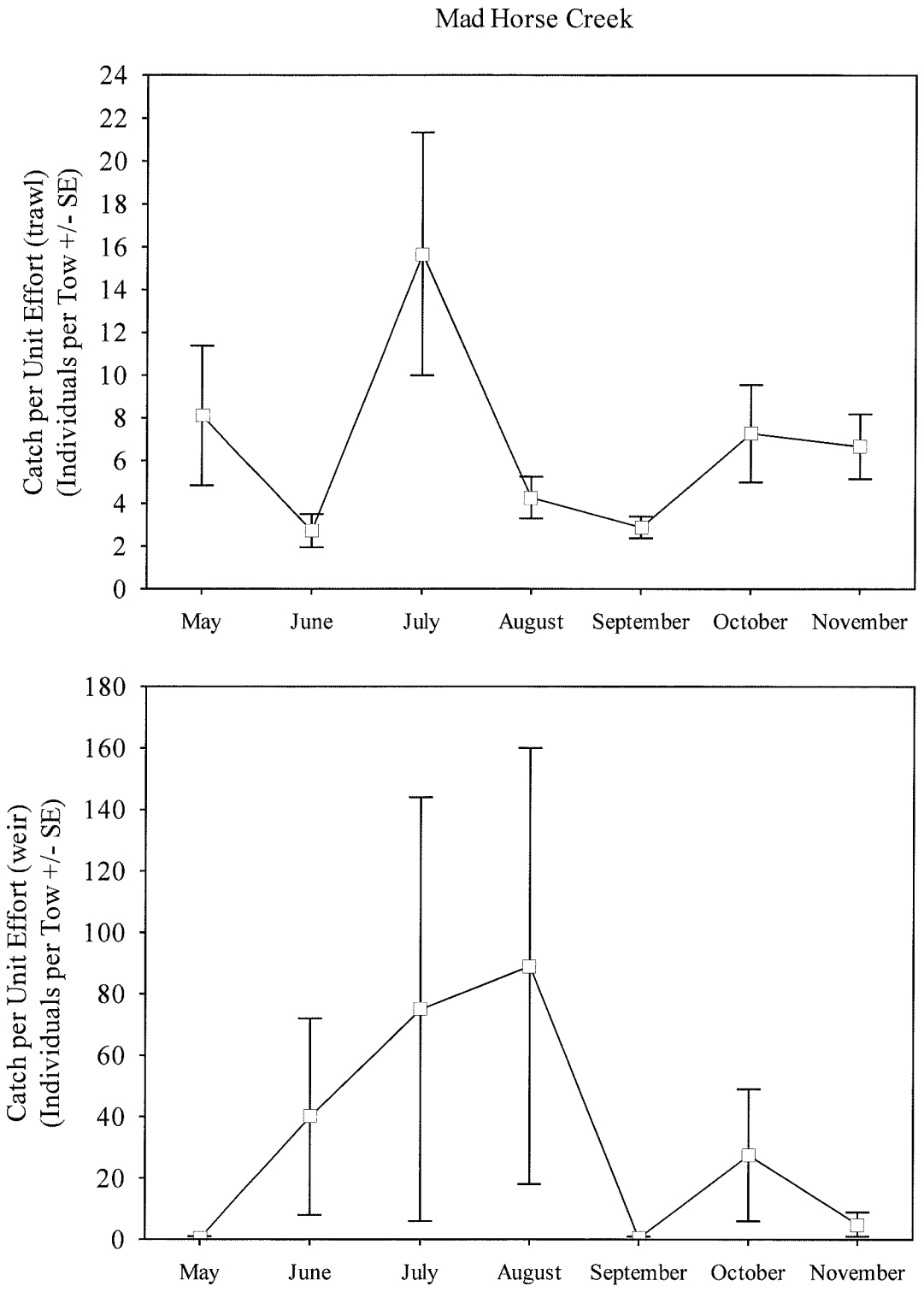


Figure 7-28. Abundance by month for all fish caught, in large marsh creeks (otter trawl) and in small marsh creeks (weir), at Mad Horse Creek during 2009.

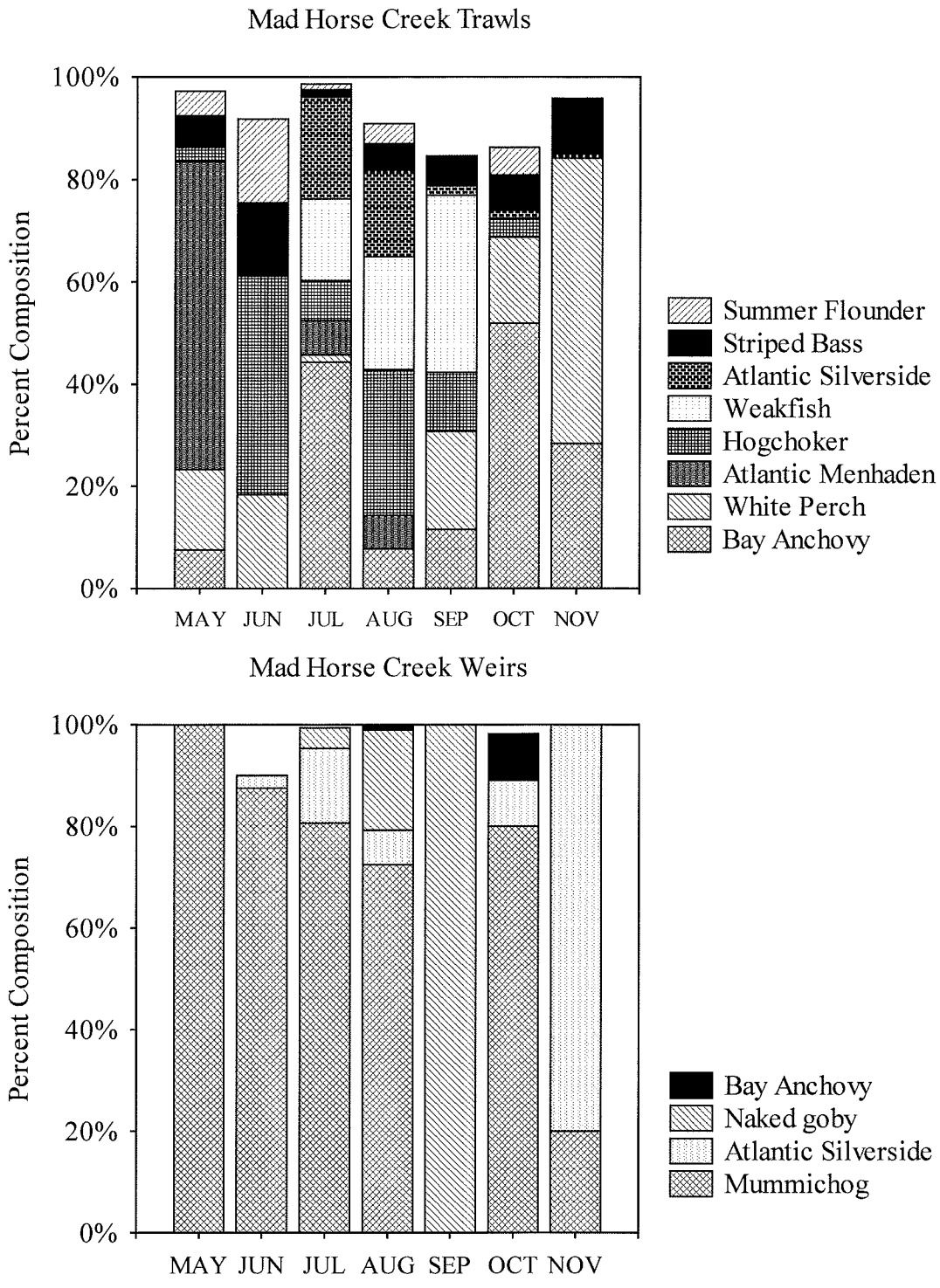


Figure 7-29. Monthly percent composition for fish caught, in large marsh creeks (otter trawl) and small marsh creeks (weir), in Mad Horse Creek during 2009.

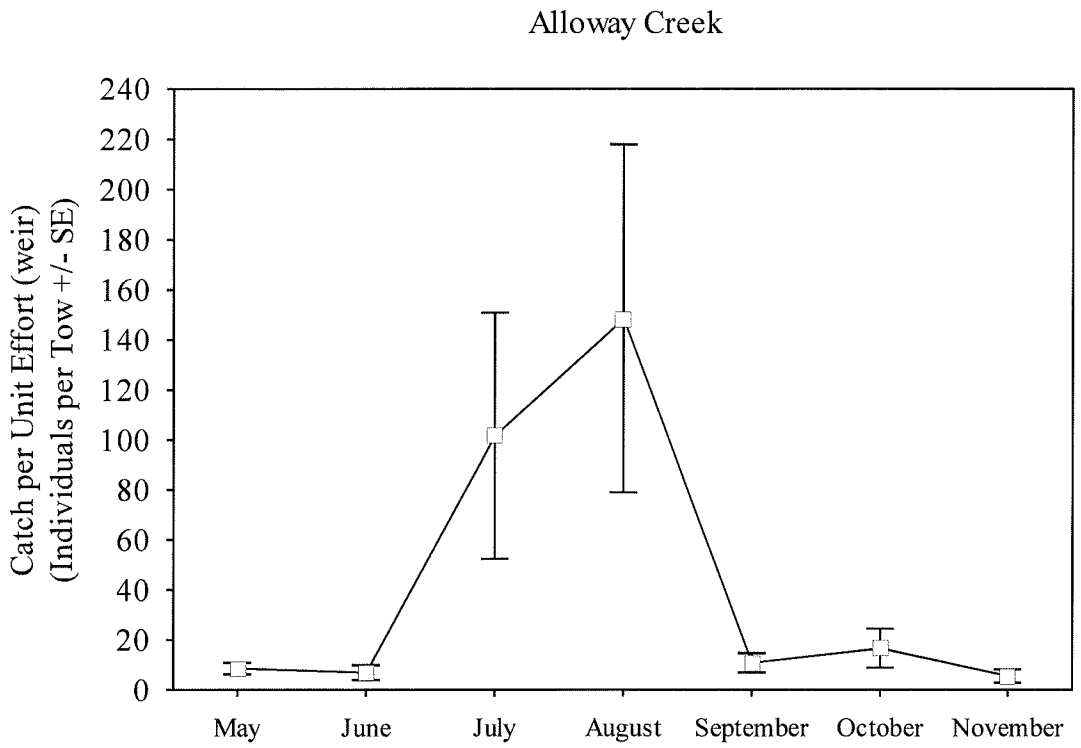


Figure 7-30. Monthly abundance for all fish caught, in small marsh creeks with weirs, at Alloways Creek during 2009.

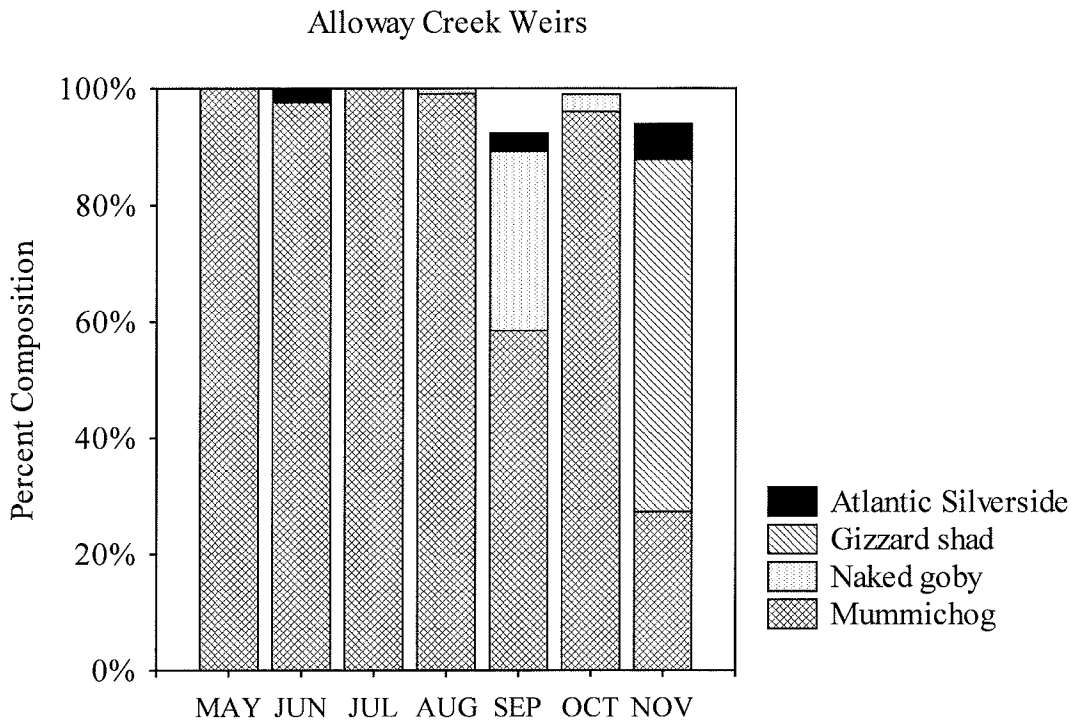


Figure 7-31. Monthly percent composition for fish caught, in small marsh creeks (weir), in Alloway Creek during 2009.

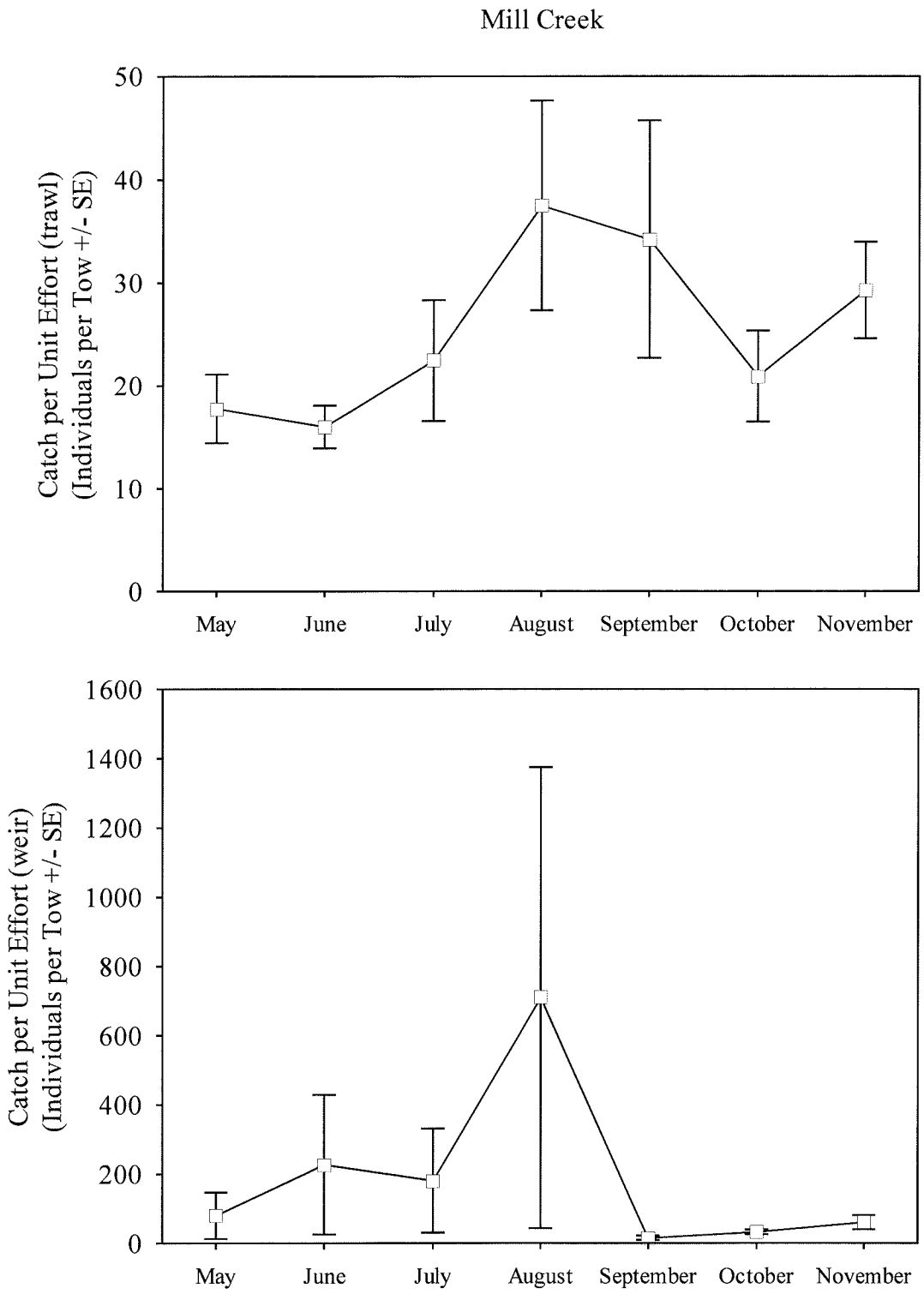


Figure 7-32. Abundance by month for all fish caught, in large marsh creeks (otter trawl) and in small marsh creeks (weir), at Mill Creek during 2009.

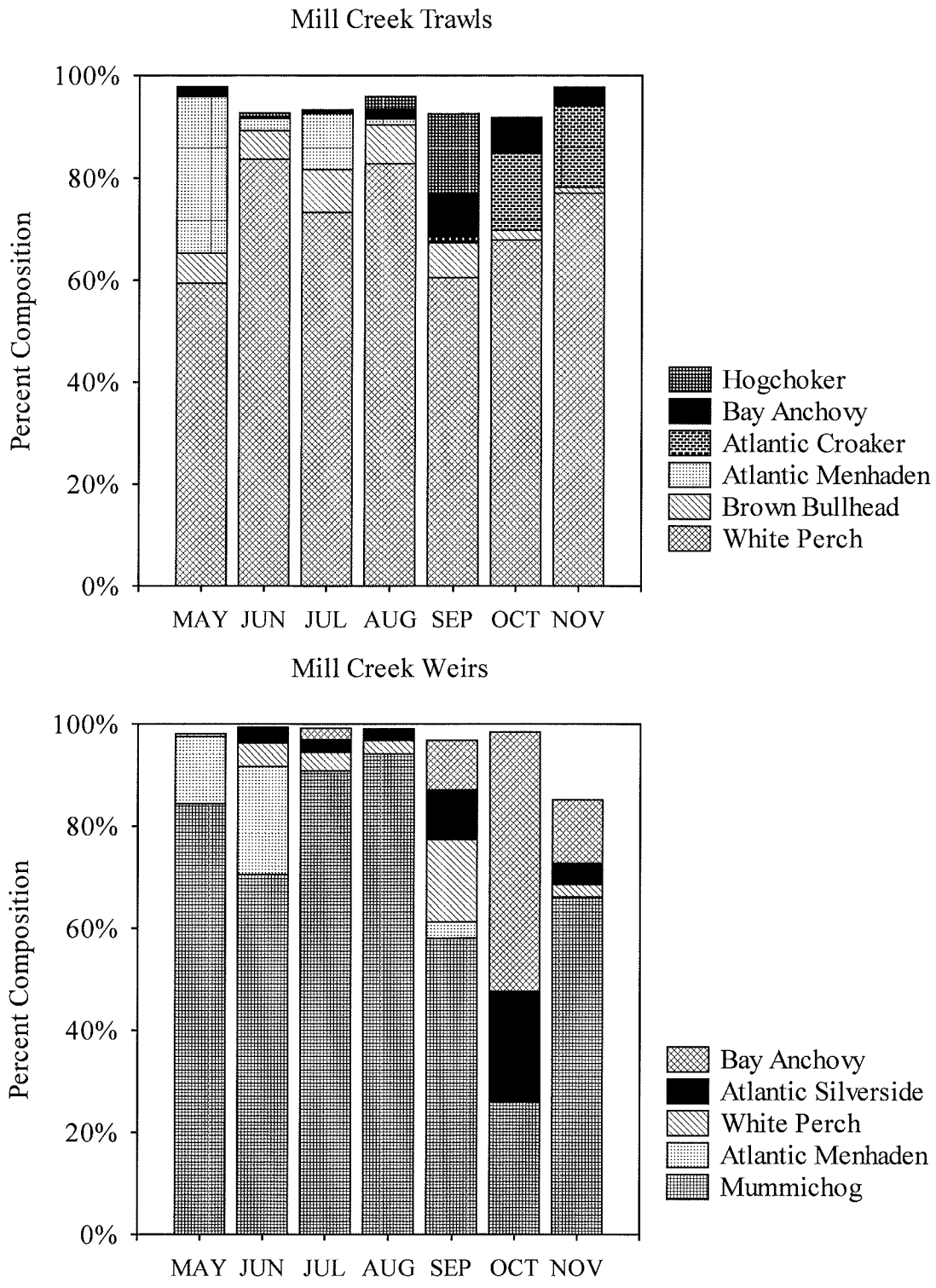


Figure 7-33. Monthly percent composition for fish caught, in large marsh creeks (otter trawl) and small marsh creeks (weir), in Mill Creek during 2009.

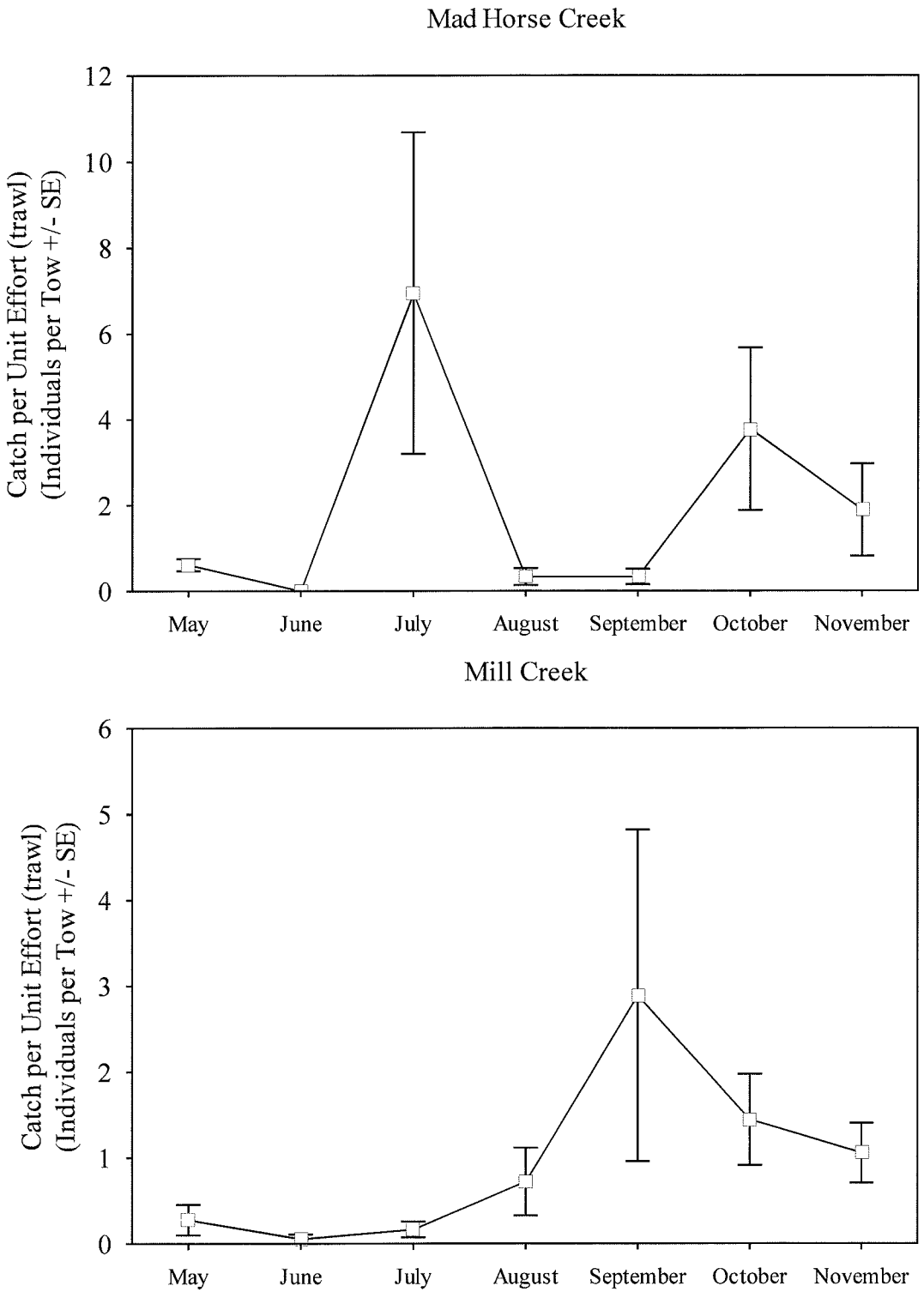


Figure 7-34. Monthly abundance for bay anchovy caught, in large marsh creeks with otter trawls, in the Upper Bay Region during 2009.

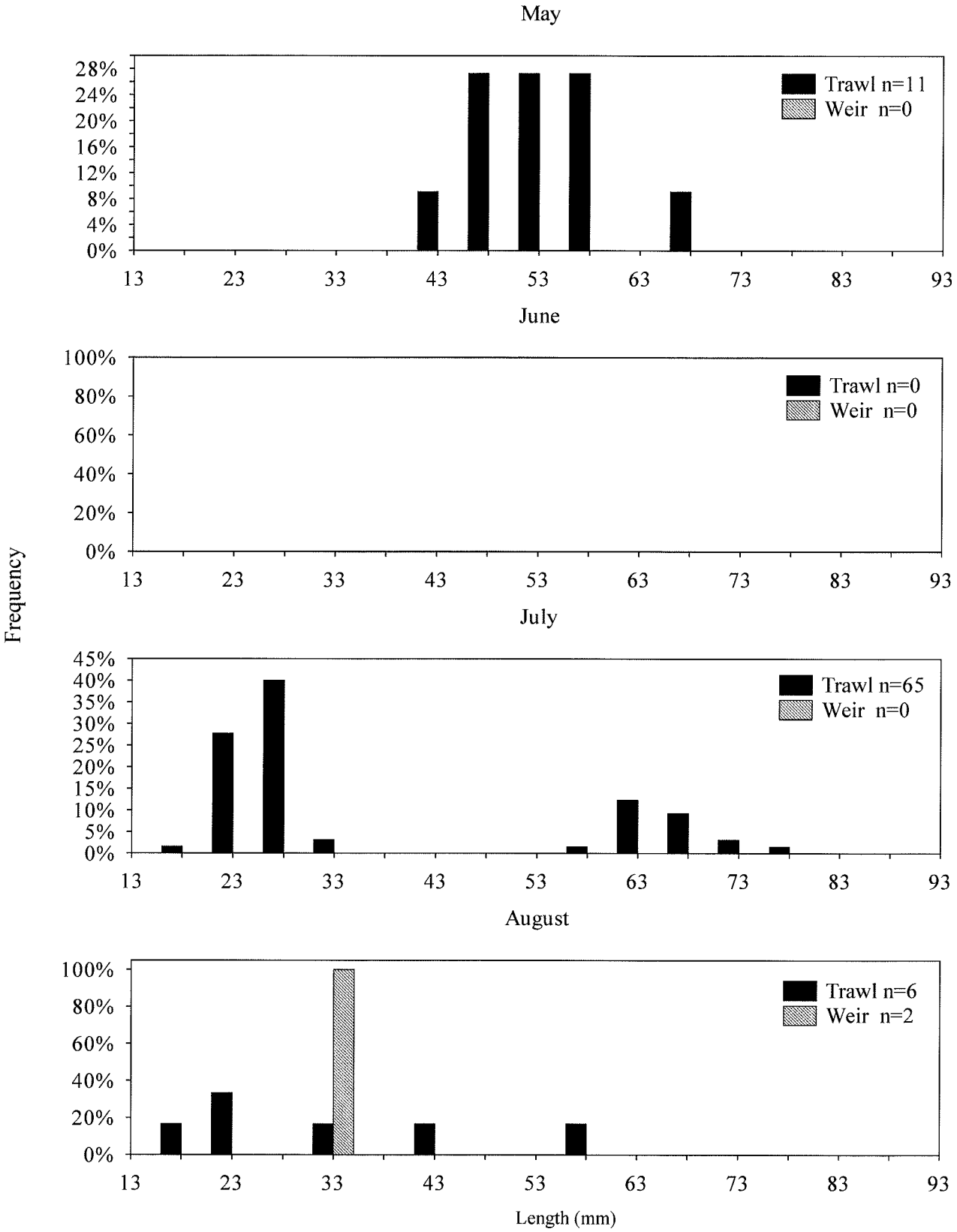
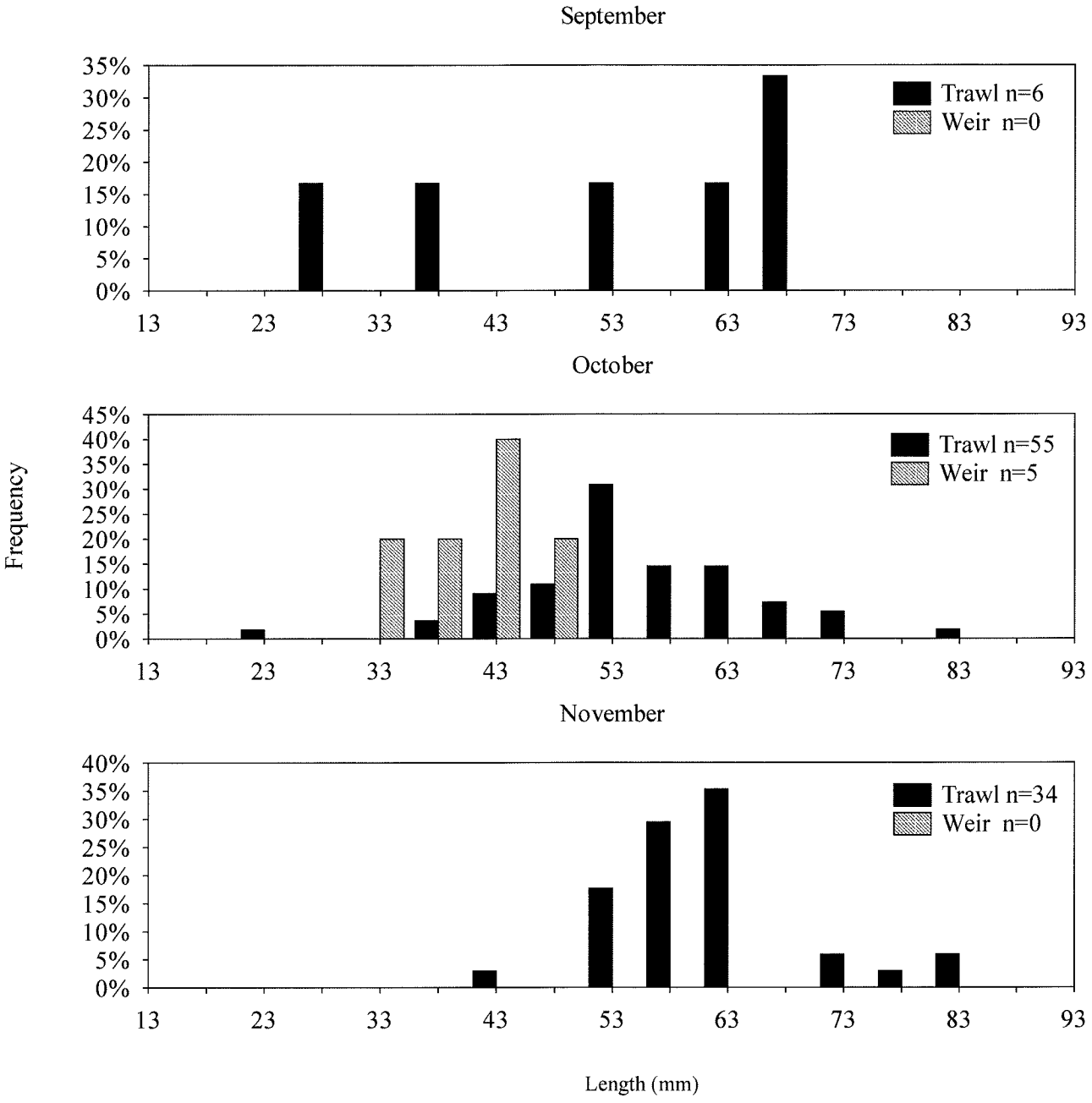


Figure 7-35. Size distribution of bay anchovy, collected in large marsh creeks (otter trawl) and small marsh creeks (weir), at Mad Horse Creek during 2009.



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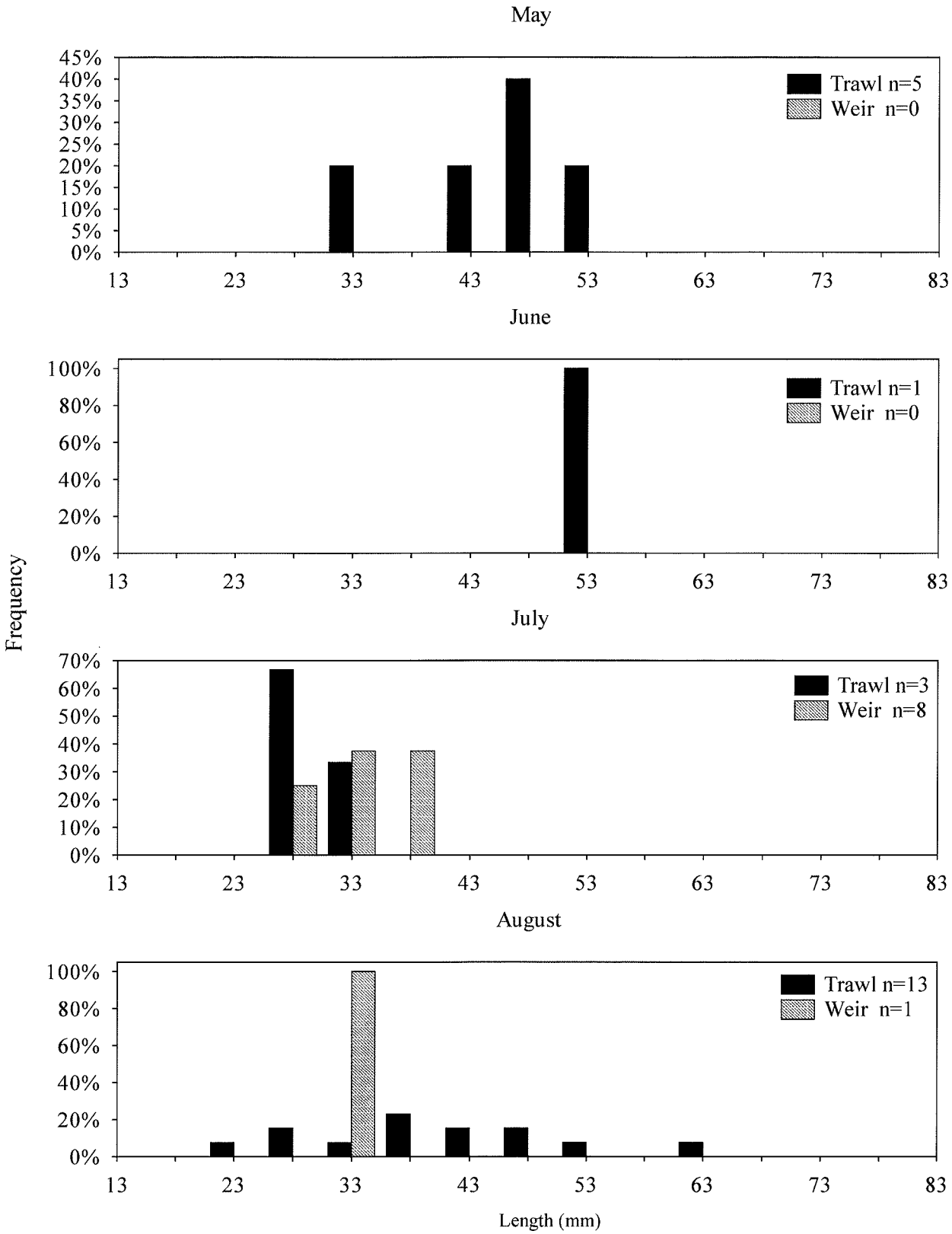
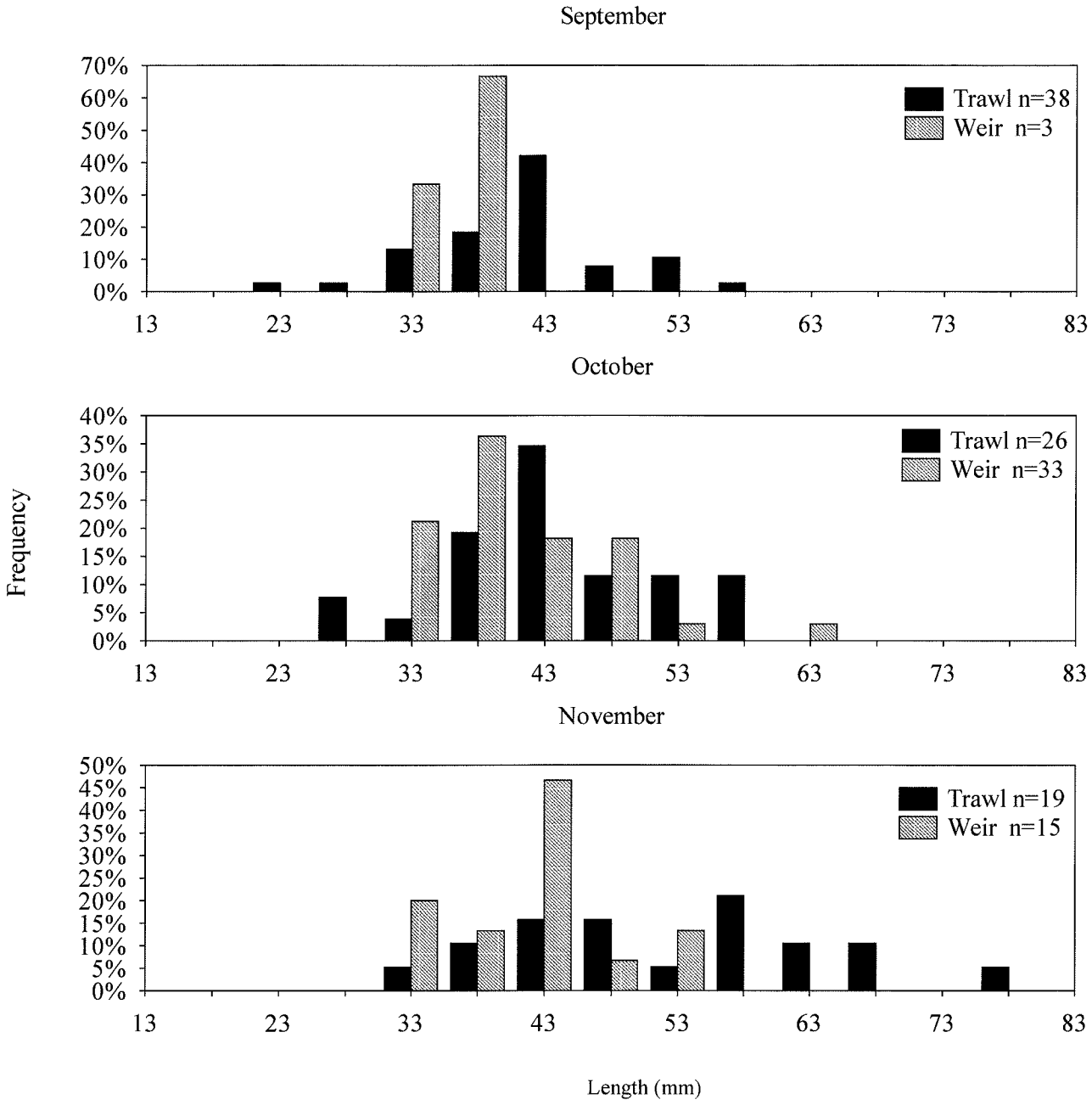


Figure 7-36. Size distribution of bay anchovy, collected in large marsh creeks (otter trawl) and small marsh creeks (weirs), at Mill Creek in 2009.



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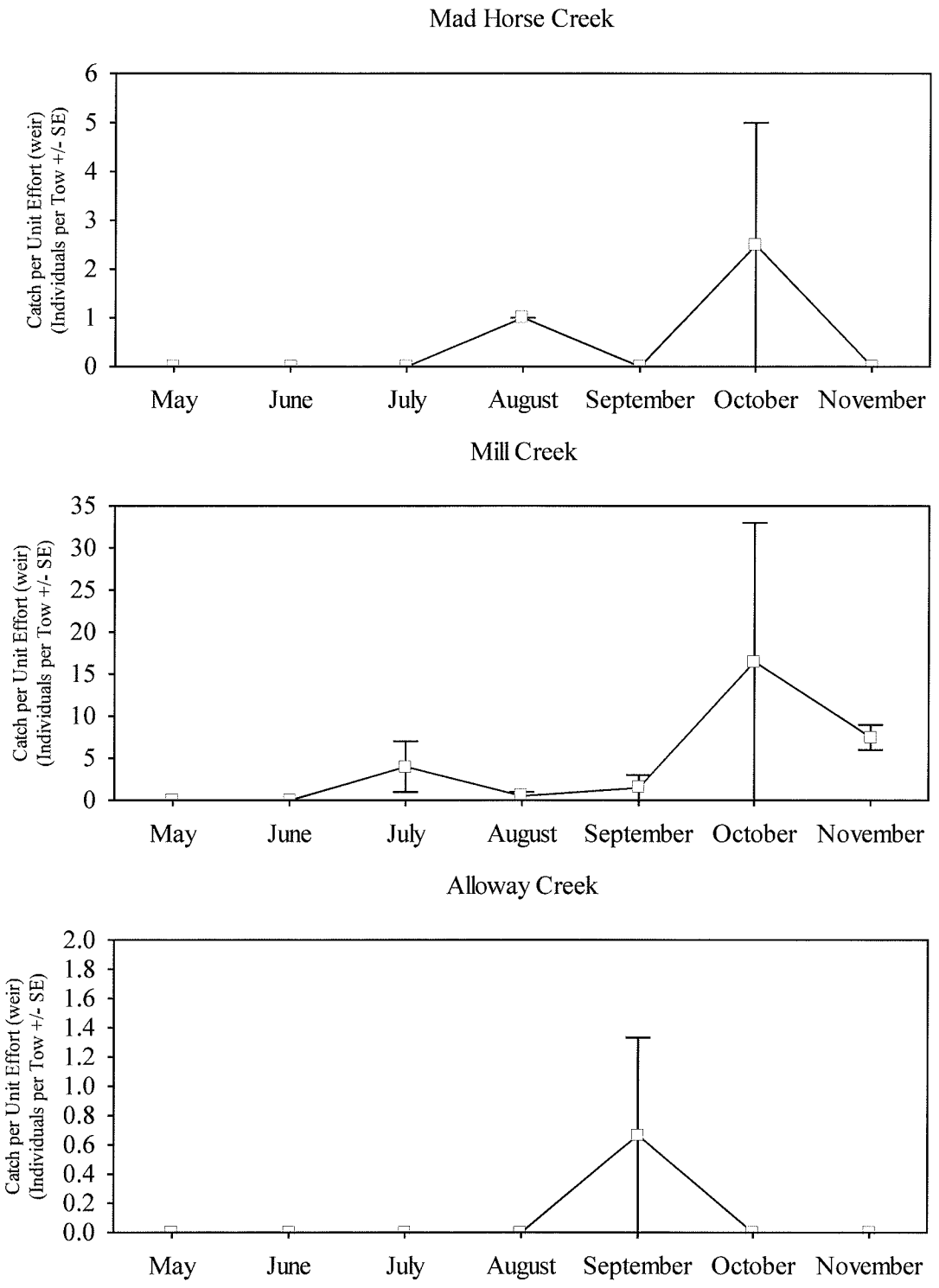


Figure 7-37. Monthly abundance for bay anchovy caught, in small marsh creeks with weirs, in the Upper Bay Region in 2009.

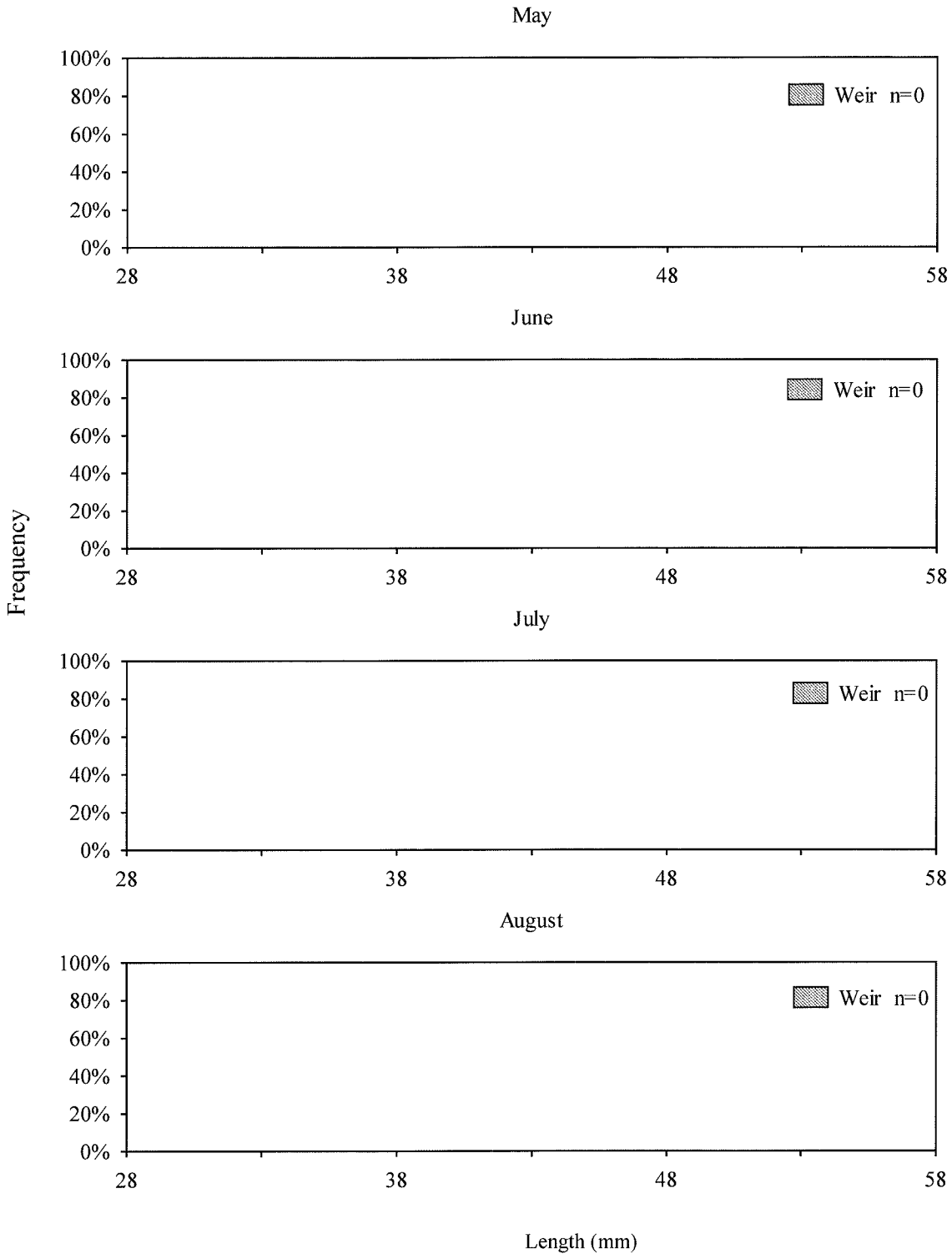
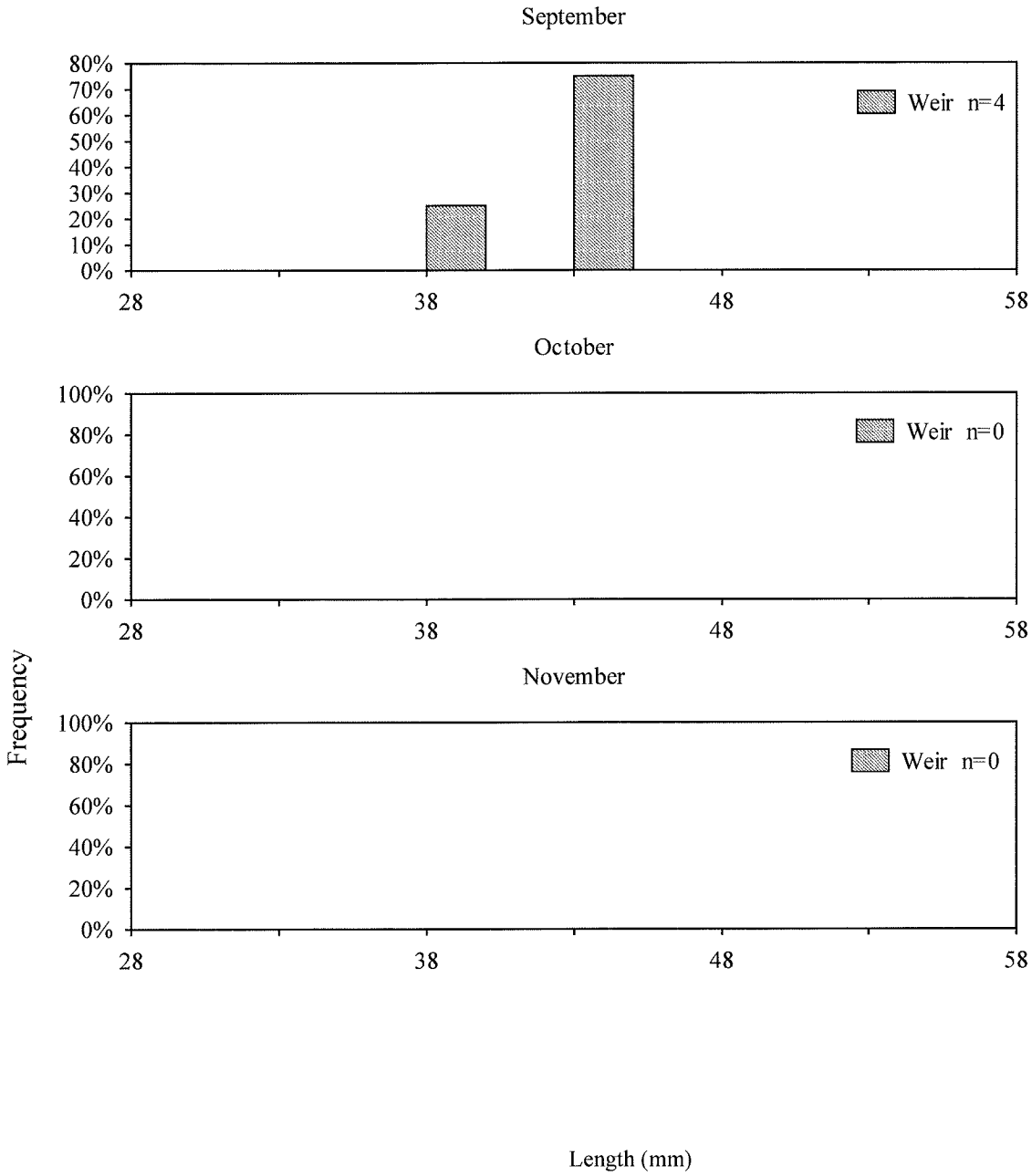


Figure 7-38. Size distribution of bay anchovy, collected in small marsh creeks (weir), at Alloways during 2009.



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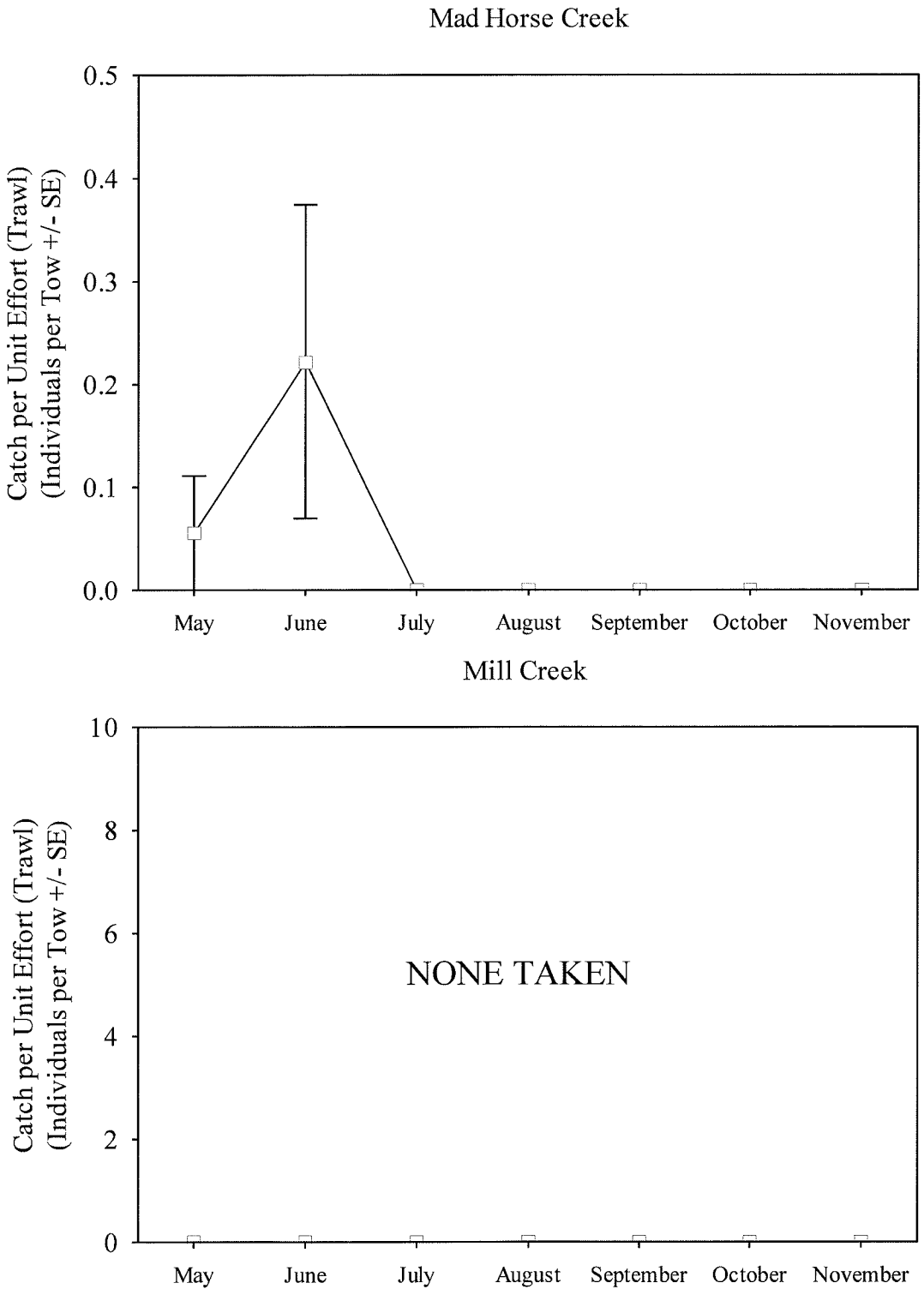


Figure 7-39. Monthly abundance for spot, collected in large marsh creeks with otter trawls, in the Upper Bay Region during 2009.

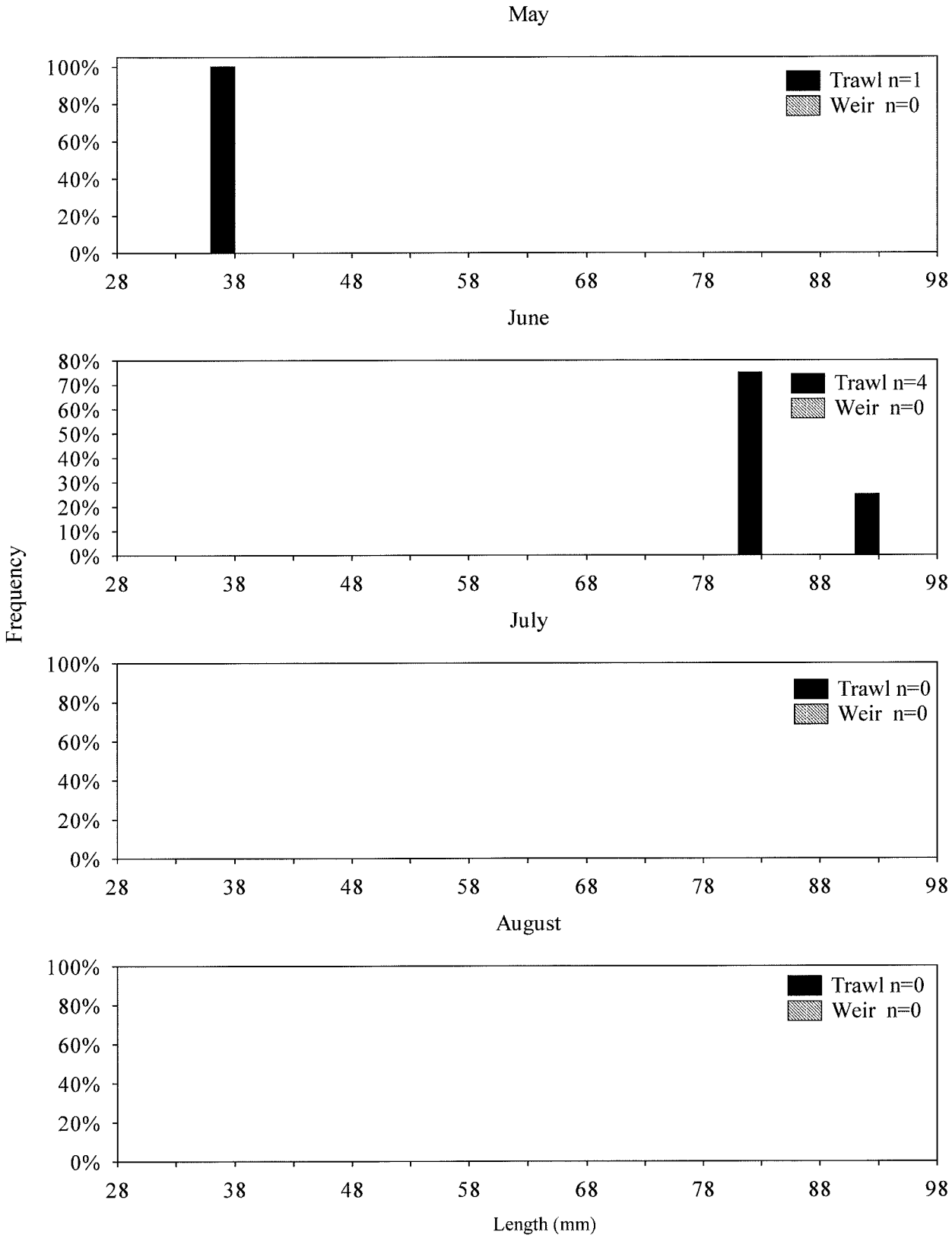
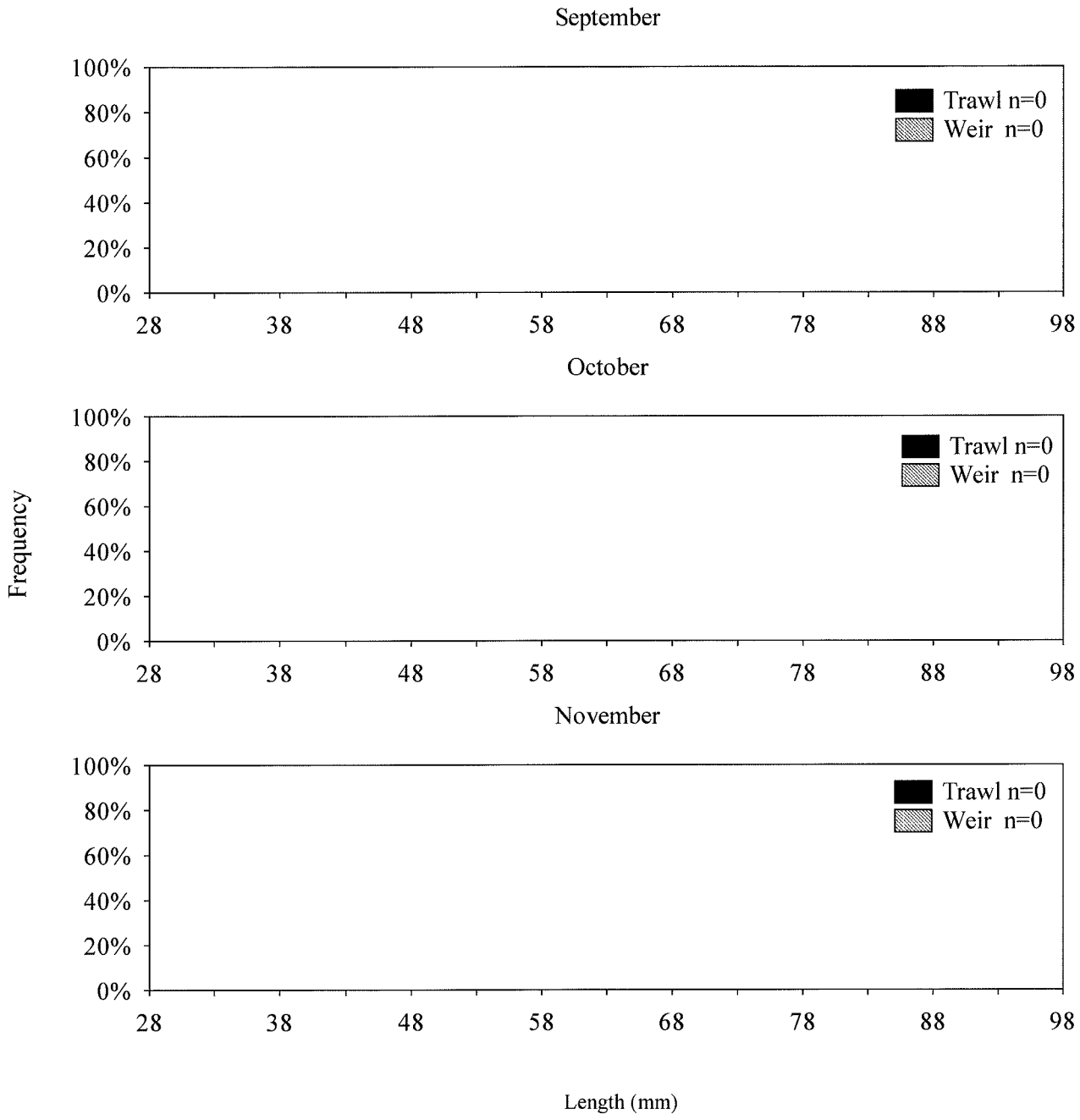


Figure 7-40. Size distribution of spot, collected in large marsh creeks (otter trawl) and small marsh creeks (weir), at Mad Horse Creek during 2009.



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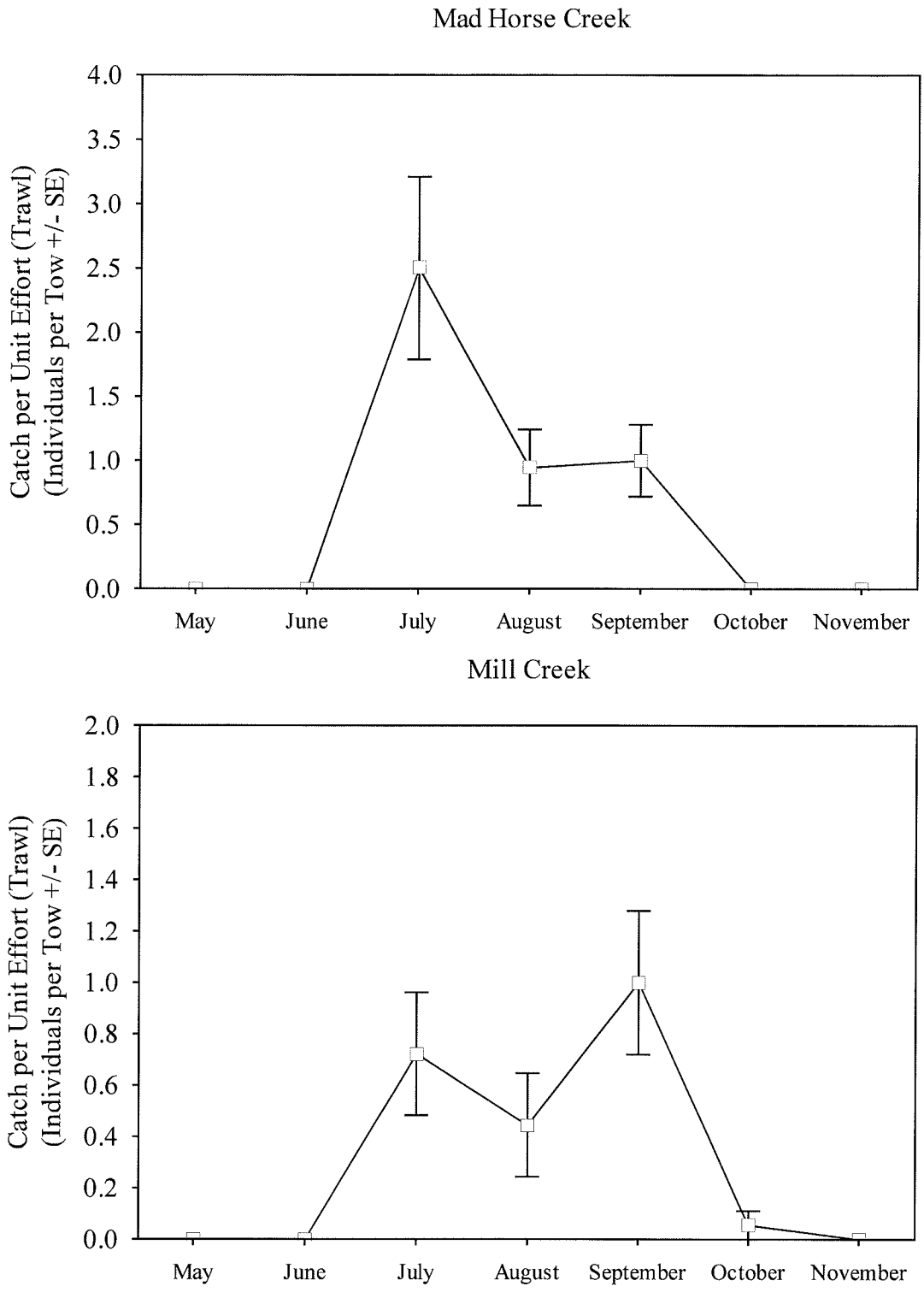


Figure 7-41. Monthly abundance for weakfish, collected in large marsh creeks with otter trawls, in the Upper Bay Region during 2009.

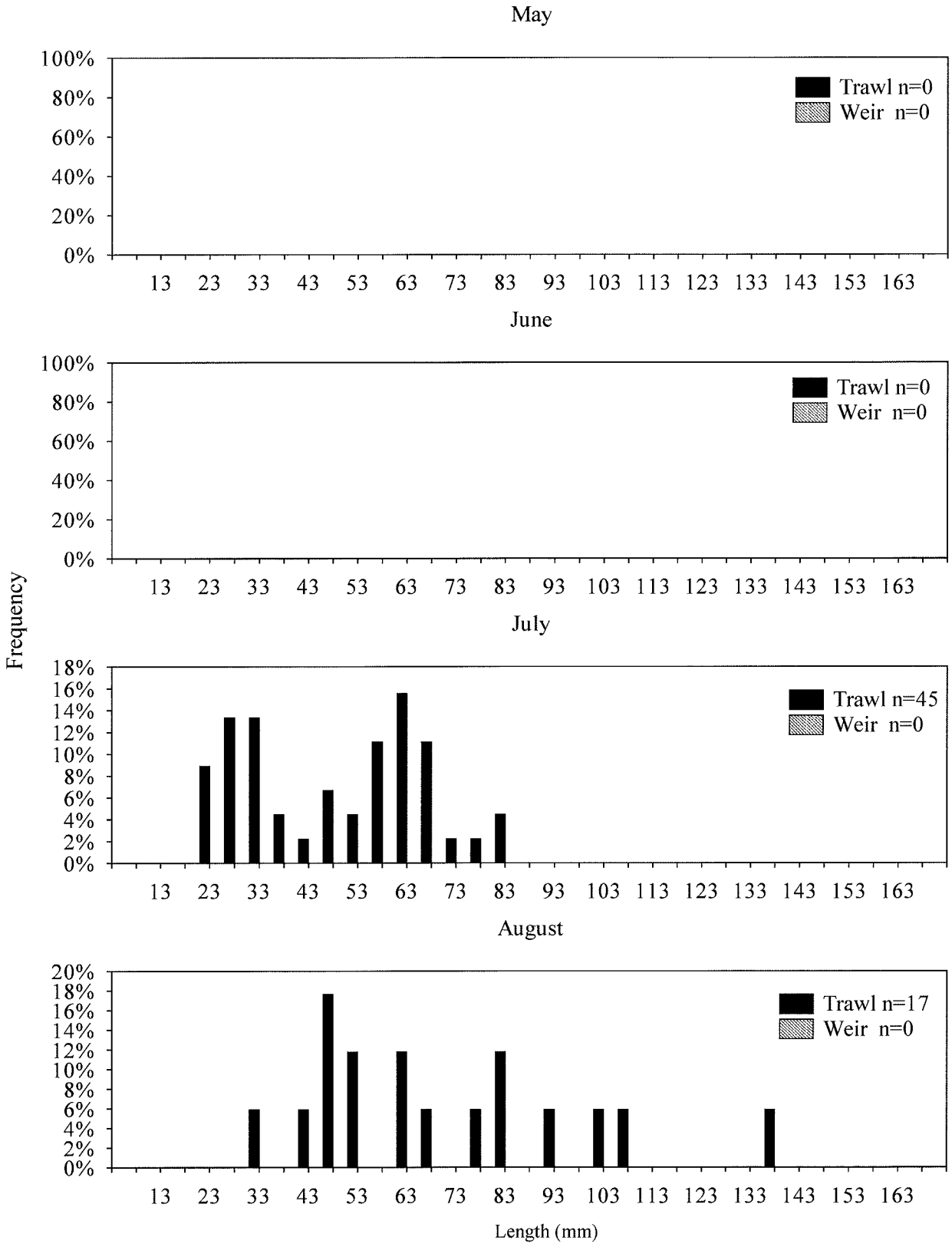
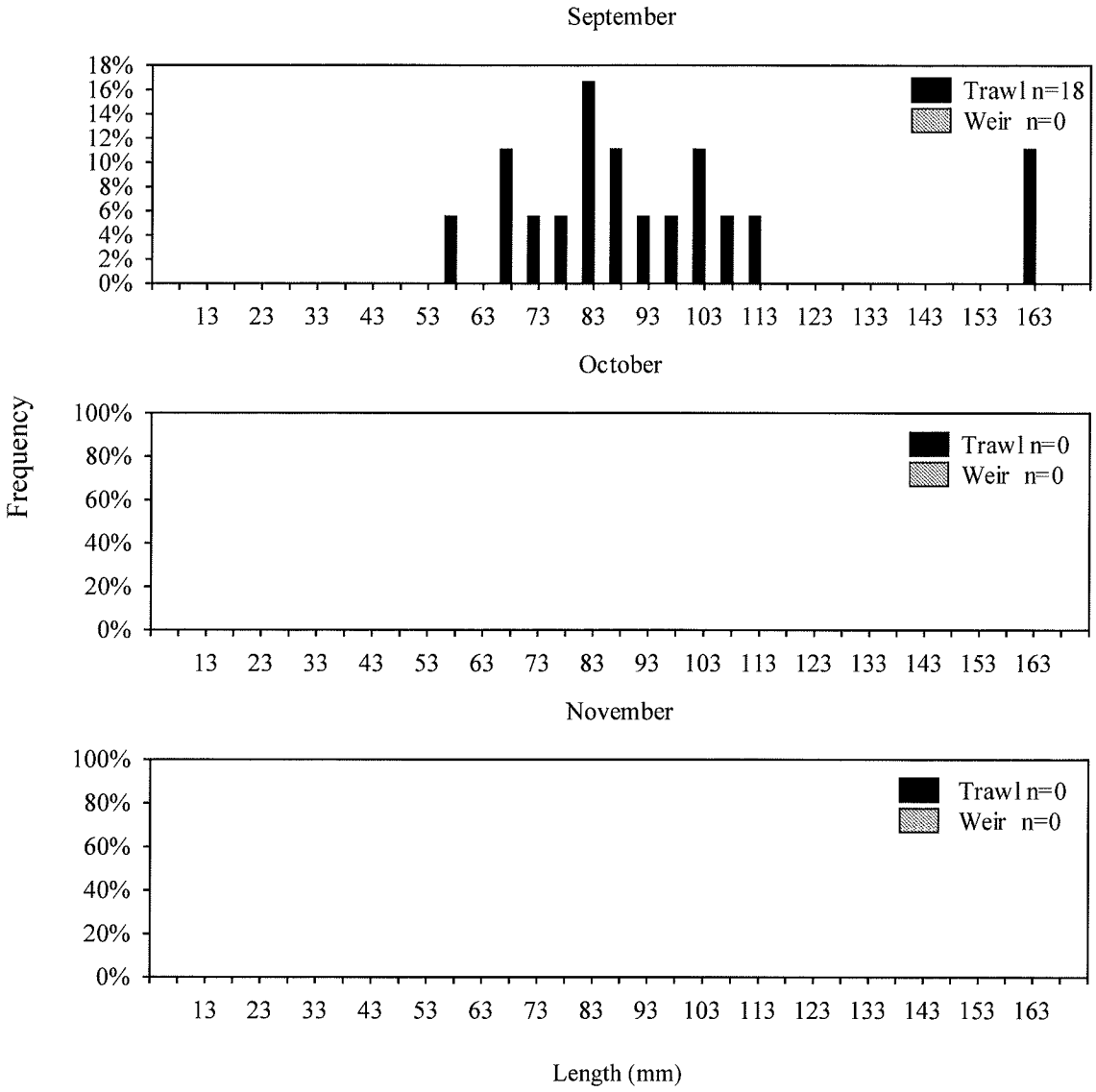


Figure 7-42. Size distribution of weakfish, collected in large marsh creeks (otter trawl) and small marsh creeks (weir), at Mad Horse Creek during 2009.



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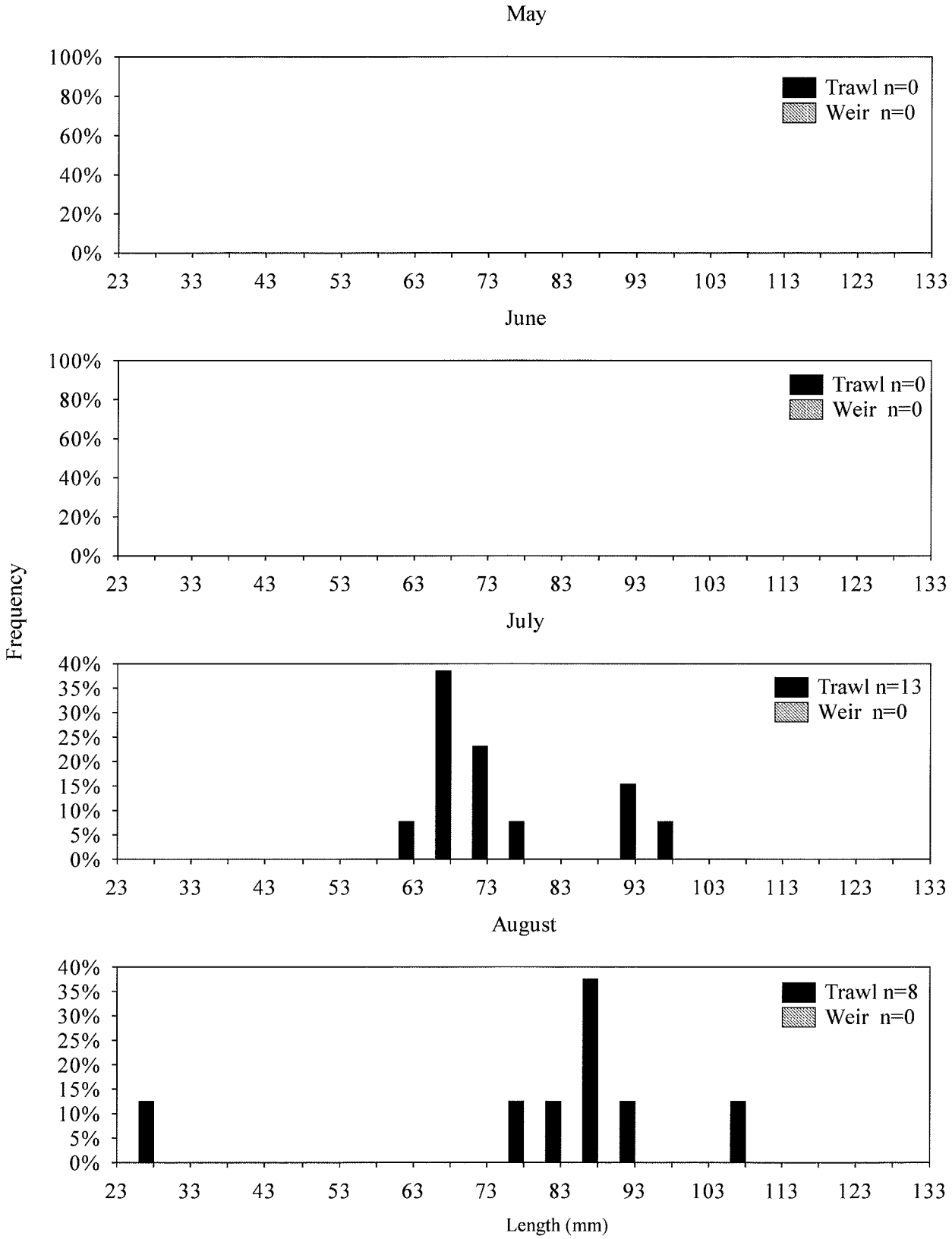
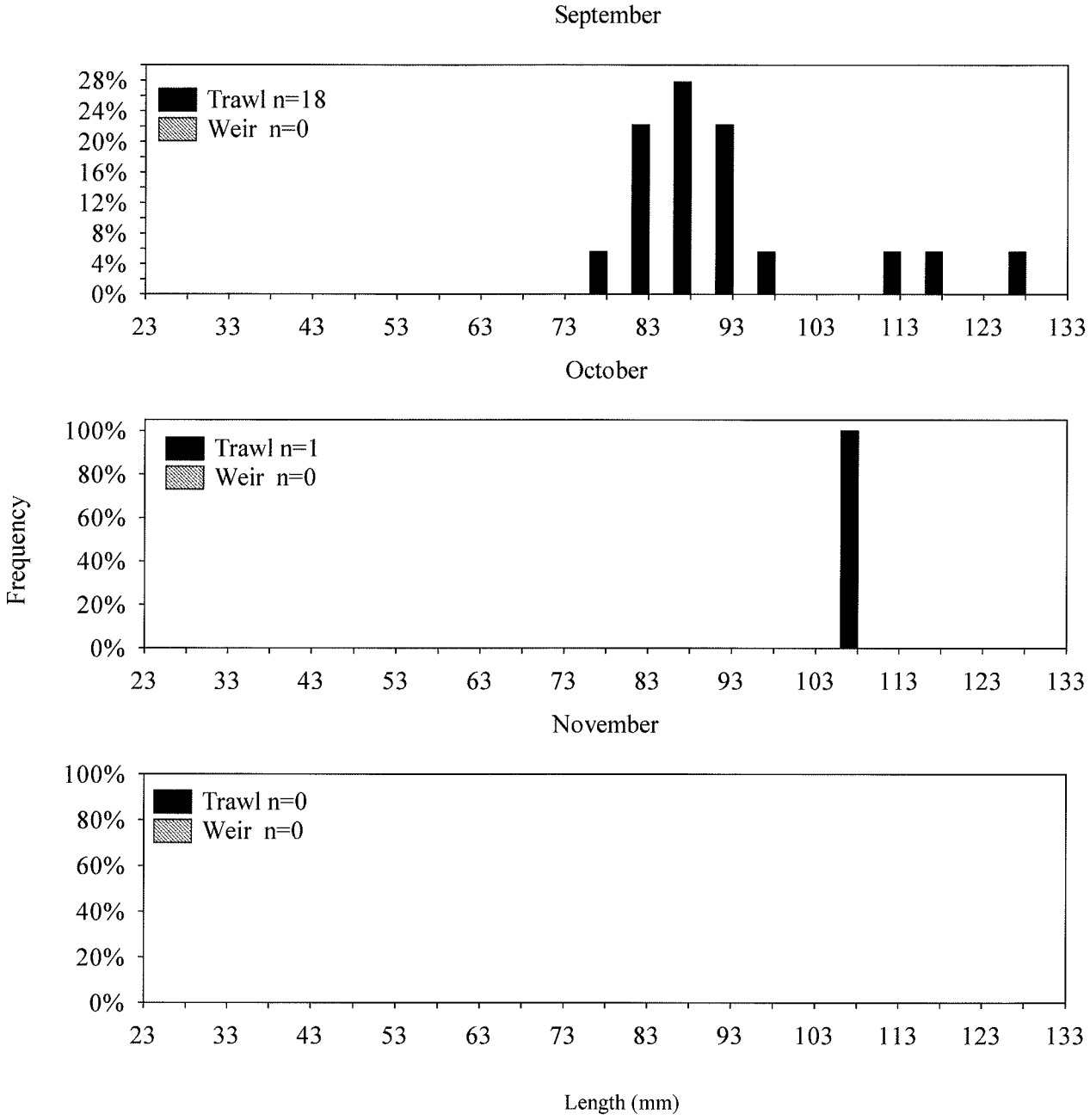


Figure 7-43. Size distribution of weakfish, collected in large marsh creeks (otter trawl) and small marsh creeks (weir), at Mill Creek during 2009.



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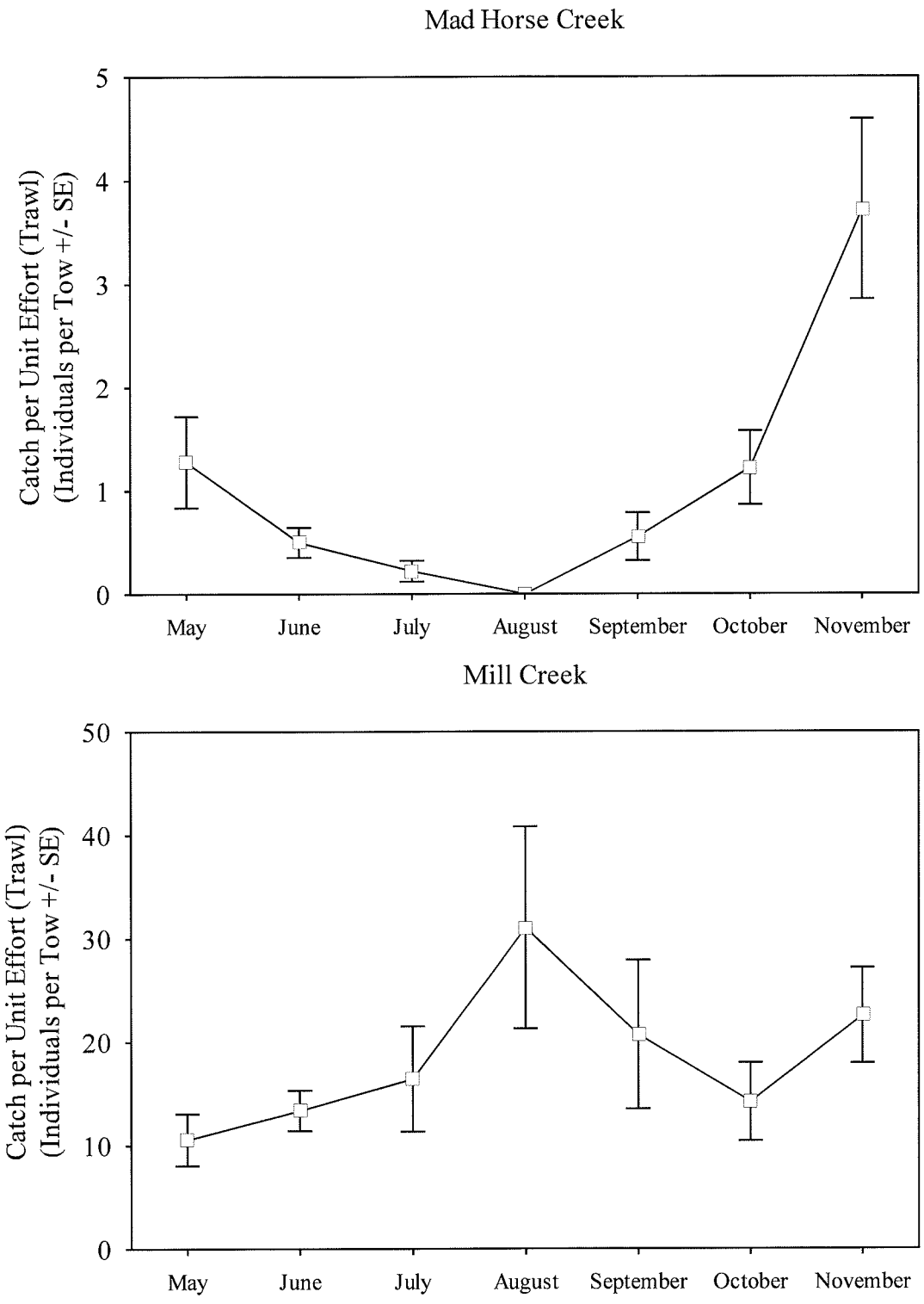


Figure 7-44. Monthly abundance for white perch, collected in large marsh creeks (otter trawl), in the Upper Bay Region during 2009.

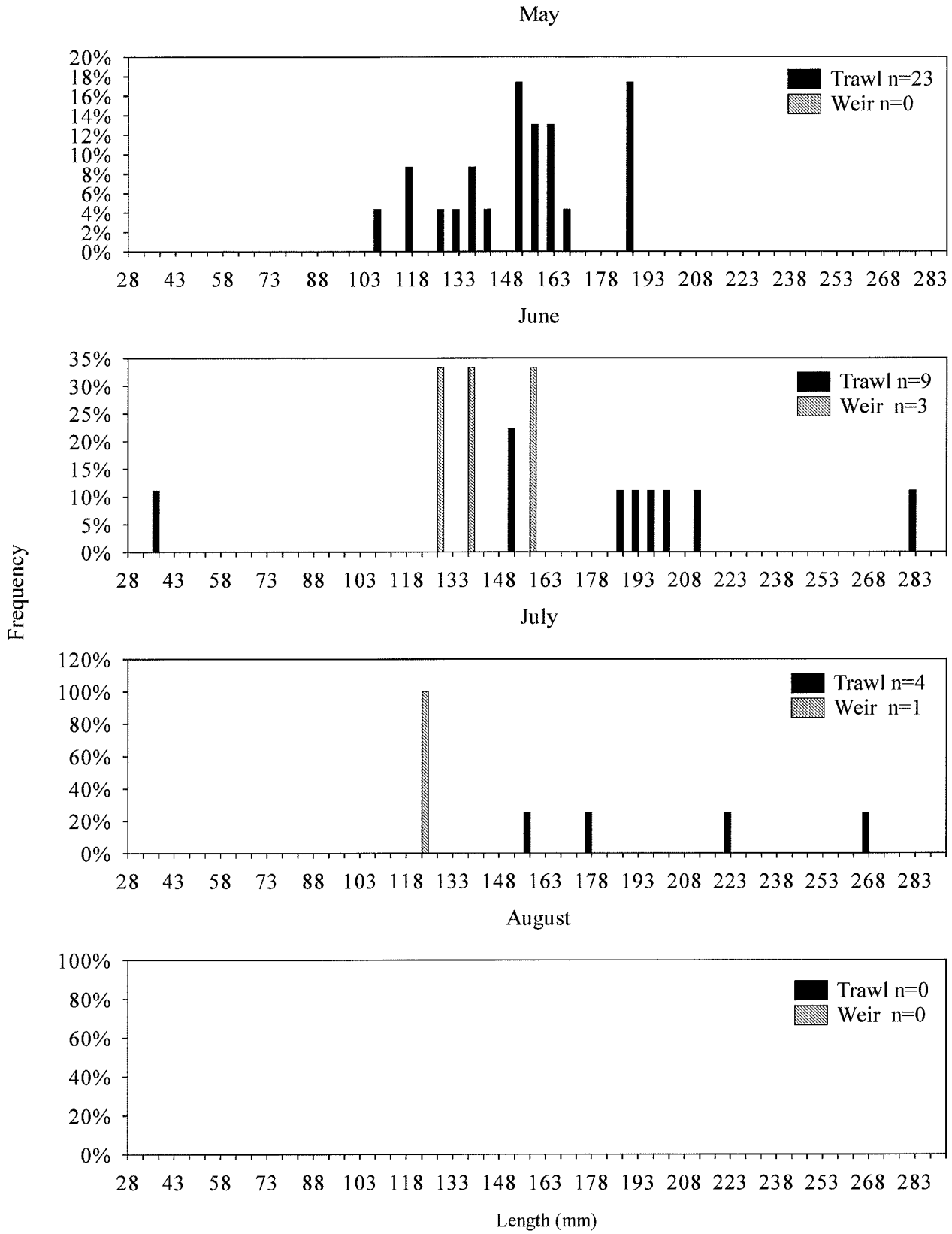
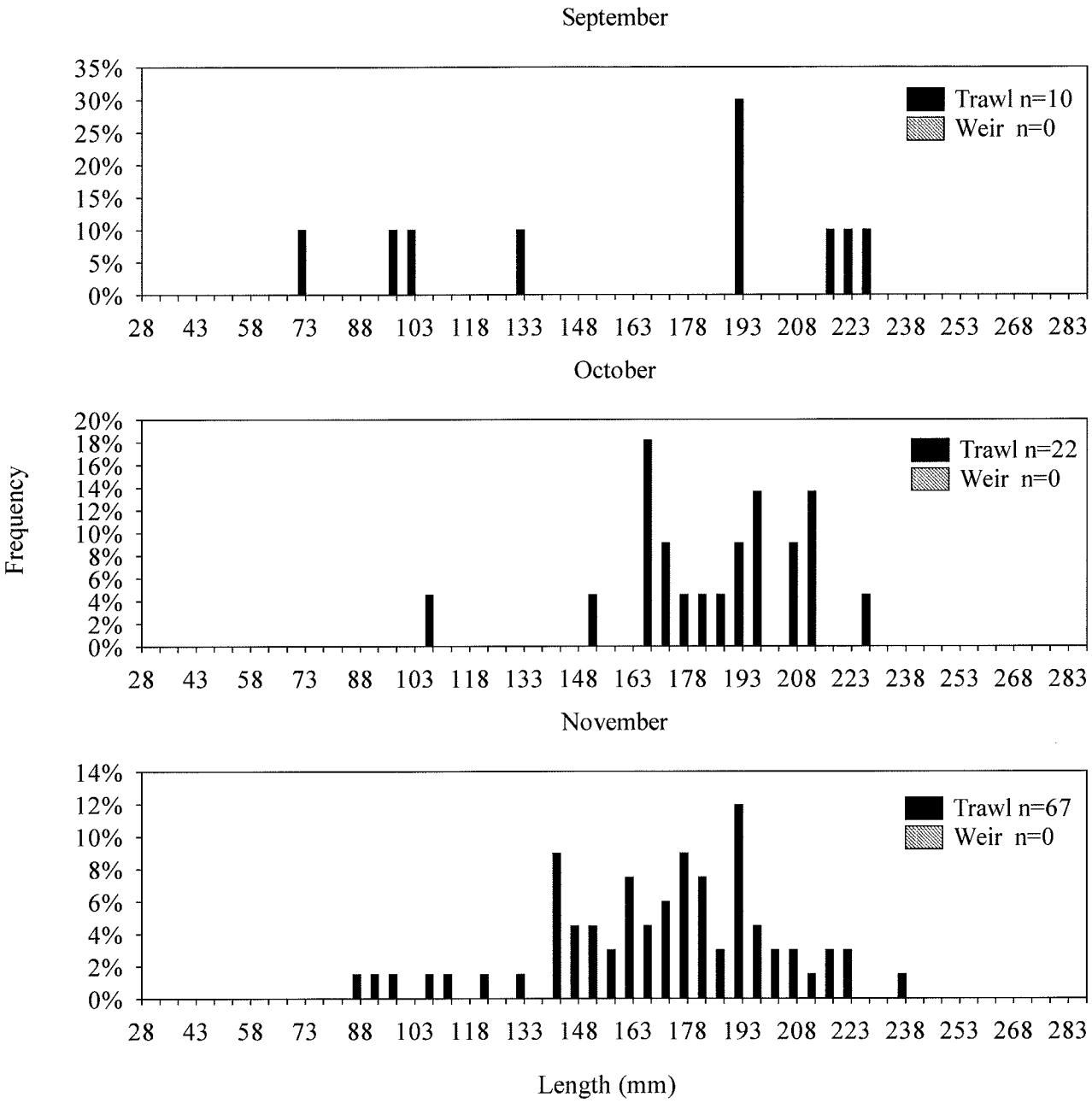


Figure 7-45. Size distribution of white perch, collected in large marsh creeks (otter trawl) and small marsh creeks (weir), at Mad Horse Creek during 2009.



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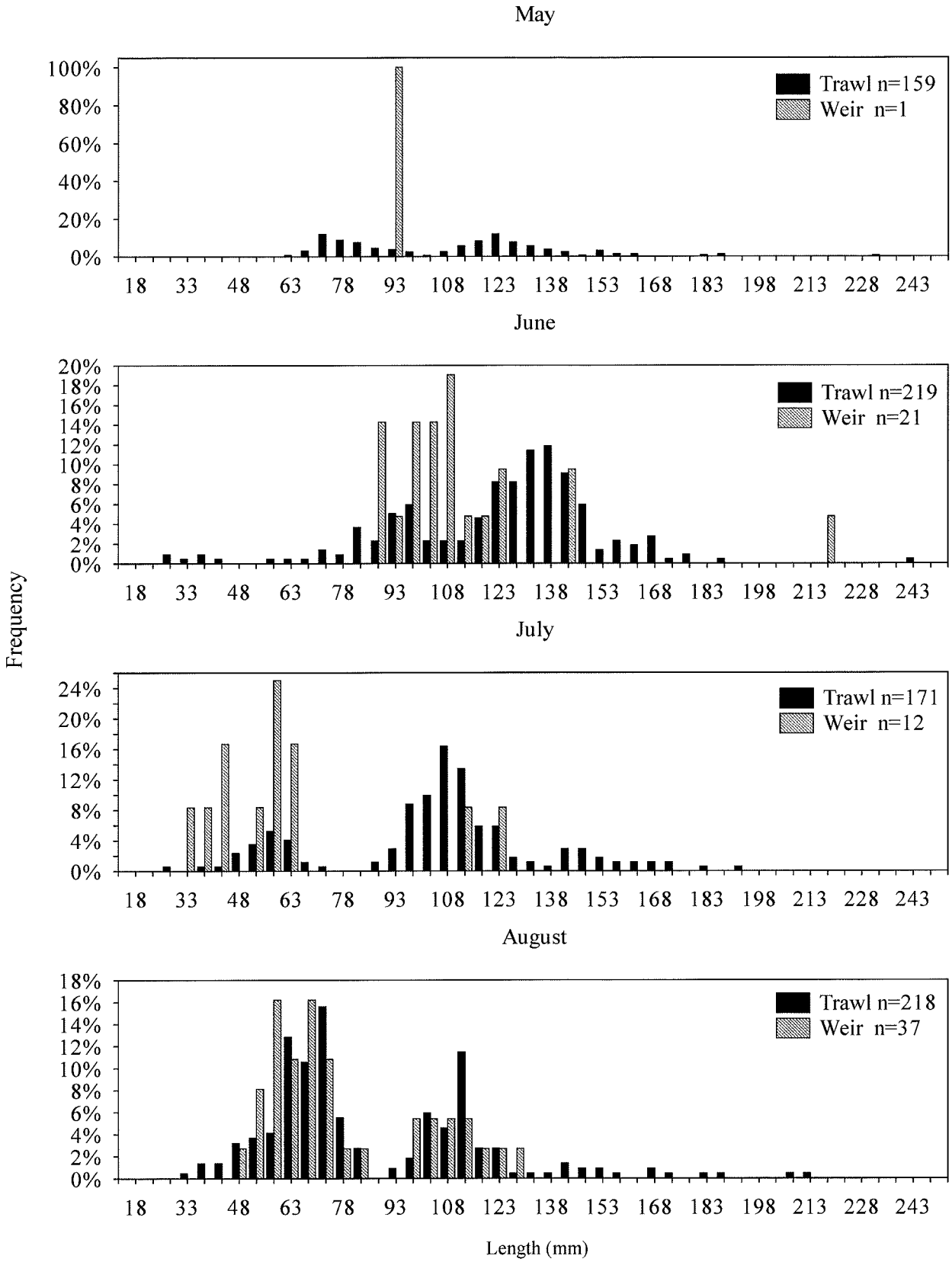
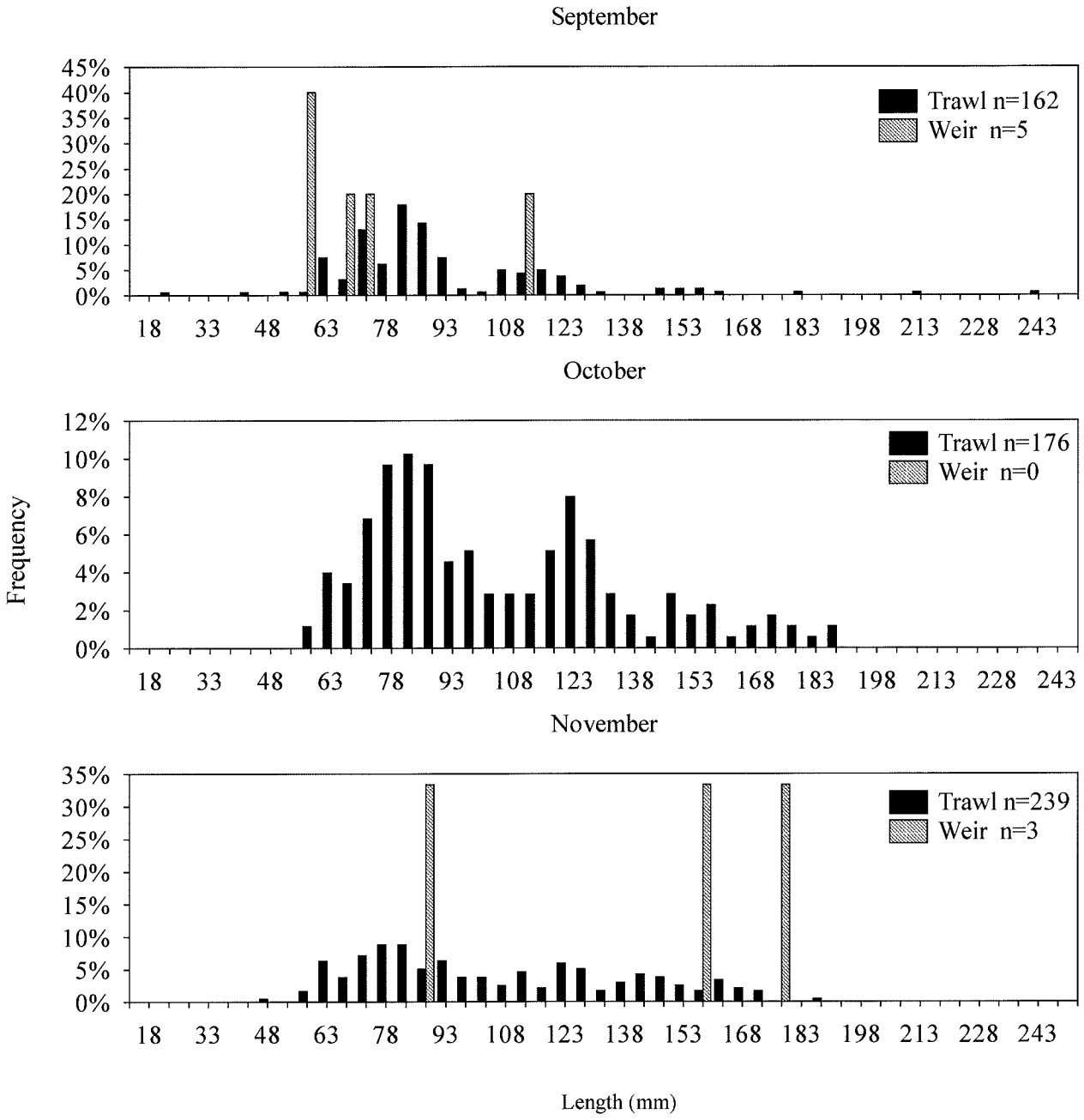


Figure 7-46. Size distribution of white perch, collected in large marsh creeks (otter trawl) and small marsh creeks (weir), at Mill Creek during 2009.



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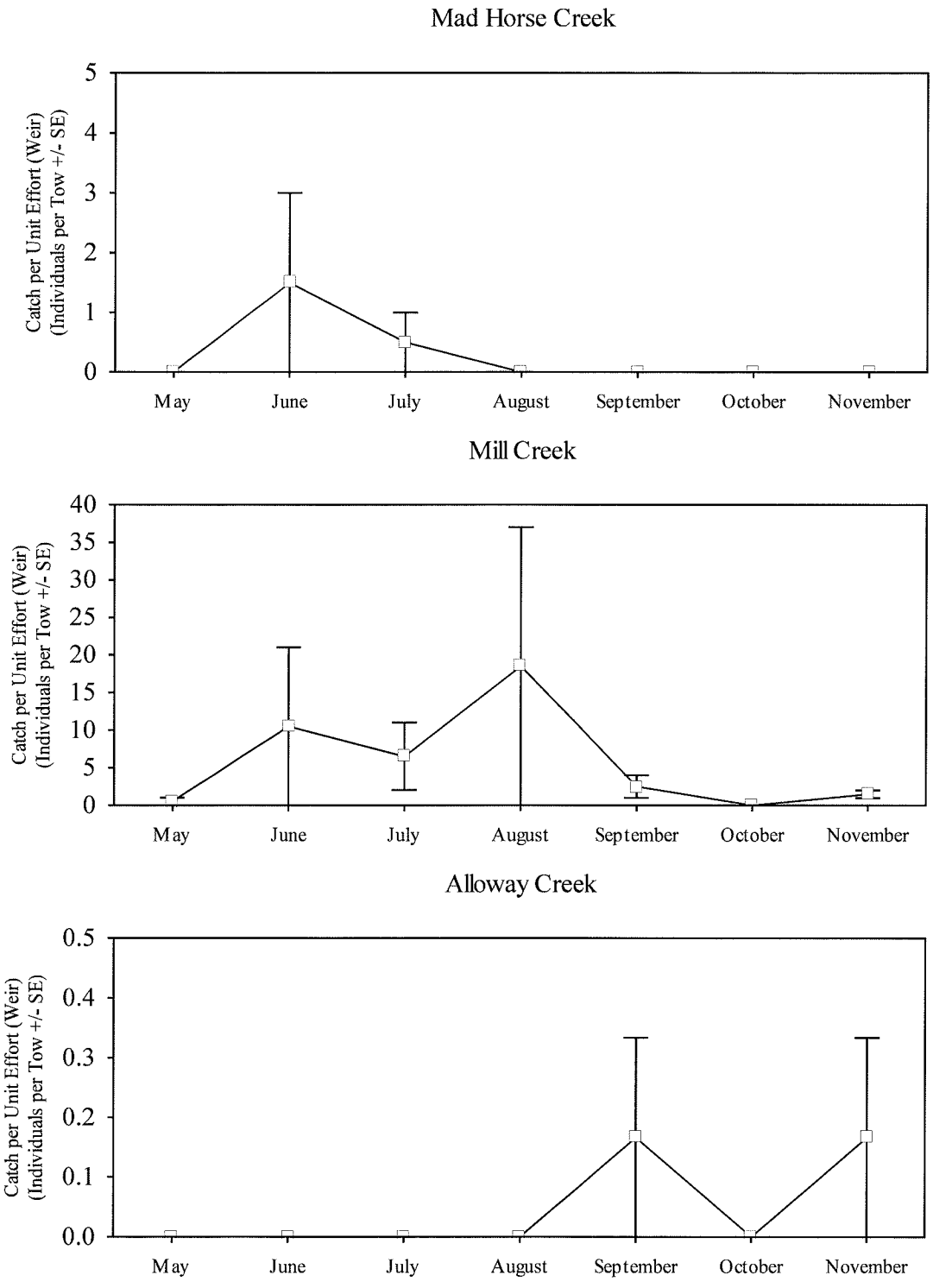


Figure 7-47. Monthly abundance for white perch, collected in small marsh creeks (weir), in the Upper Bay Region during 2009.

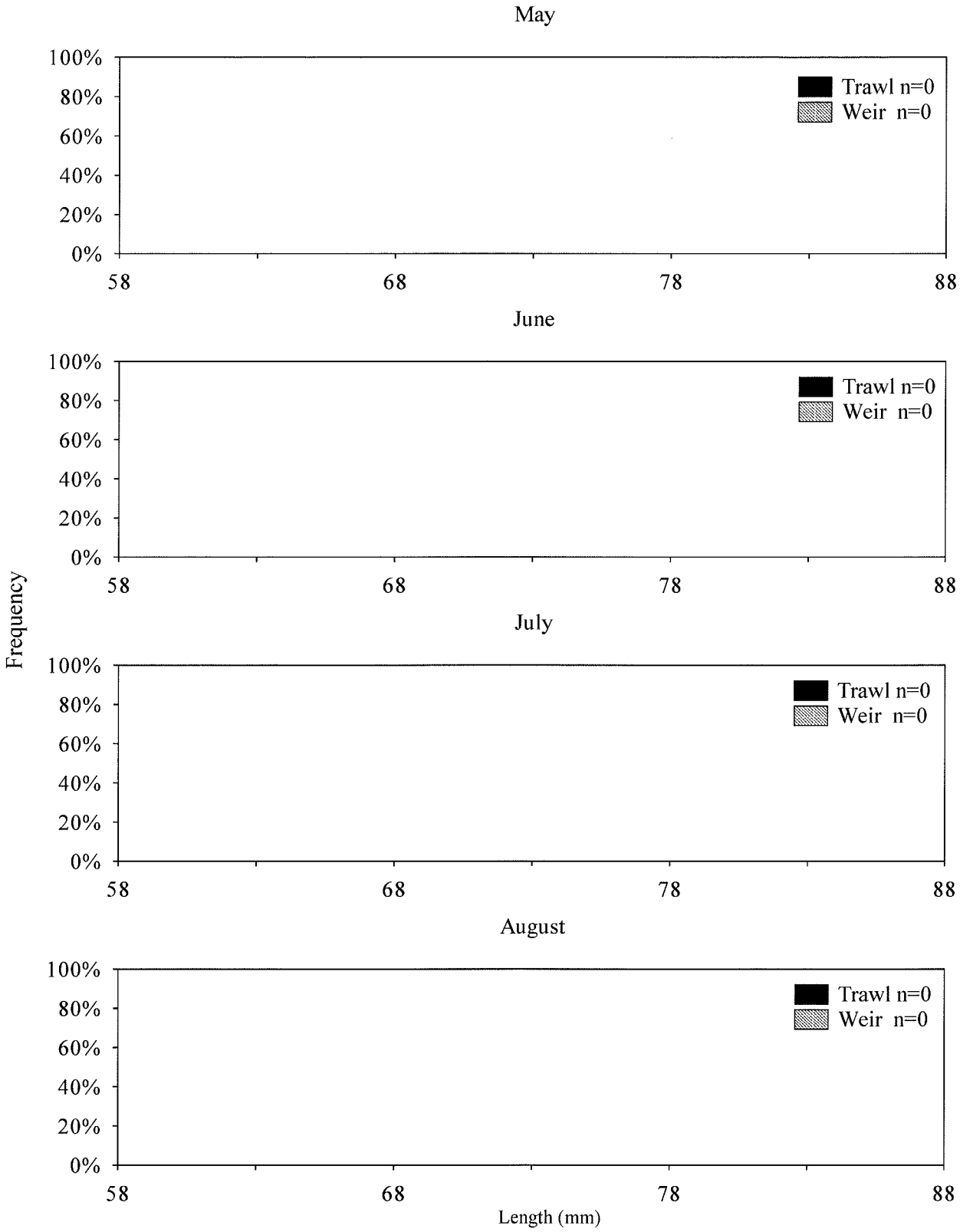
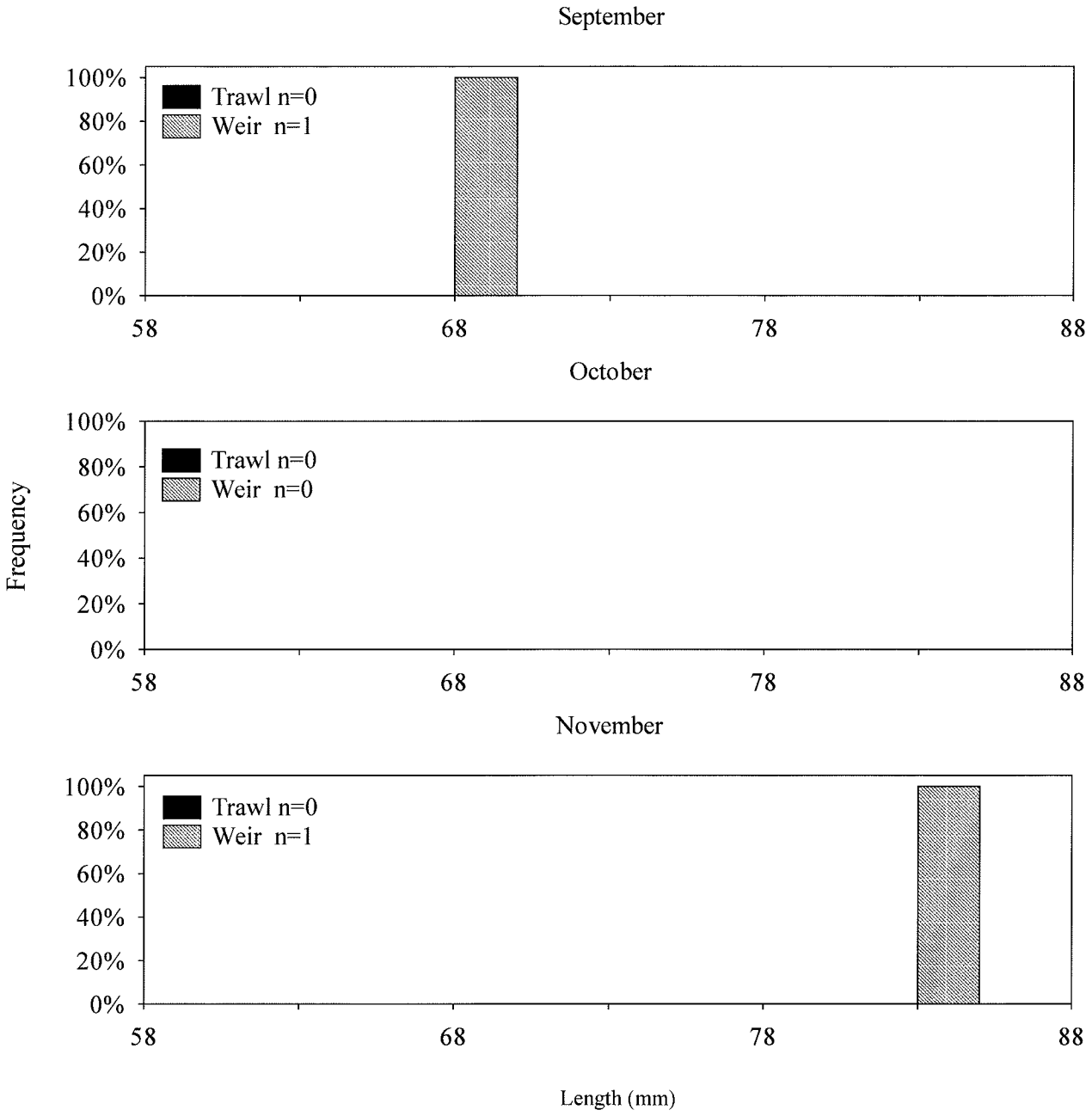


Figure 7-48. Size distribution of white perch, collected in small marsh creeks (weir) at Alloway Creek during 2009.



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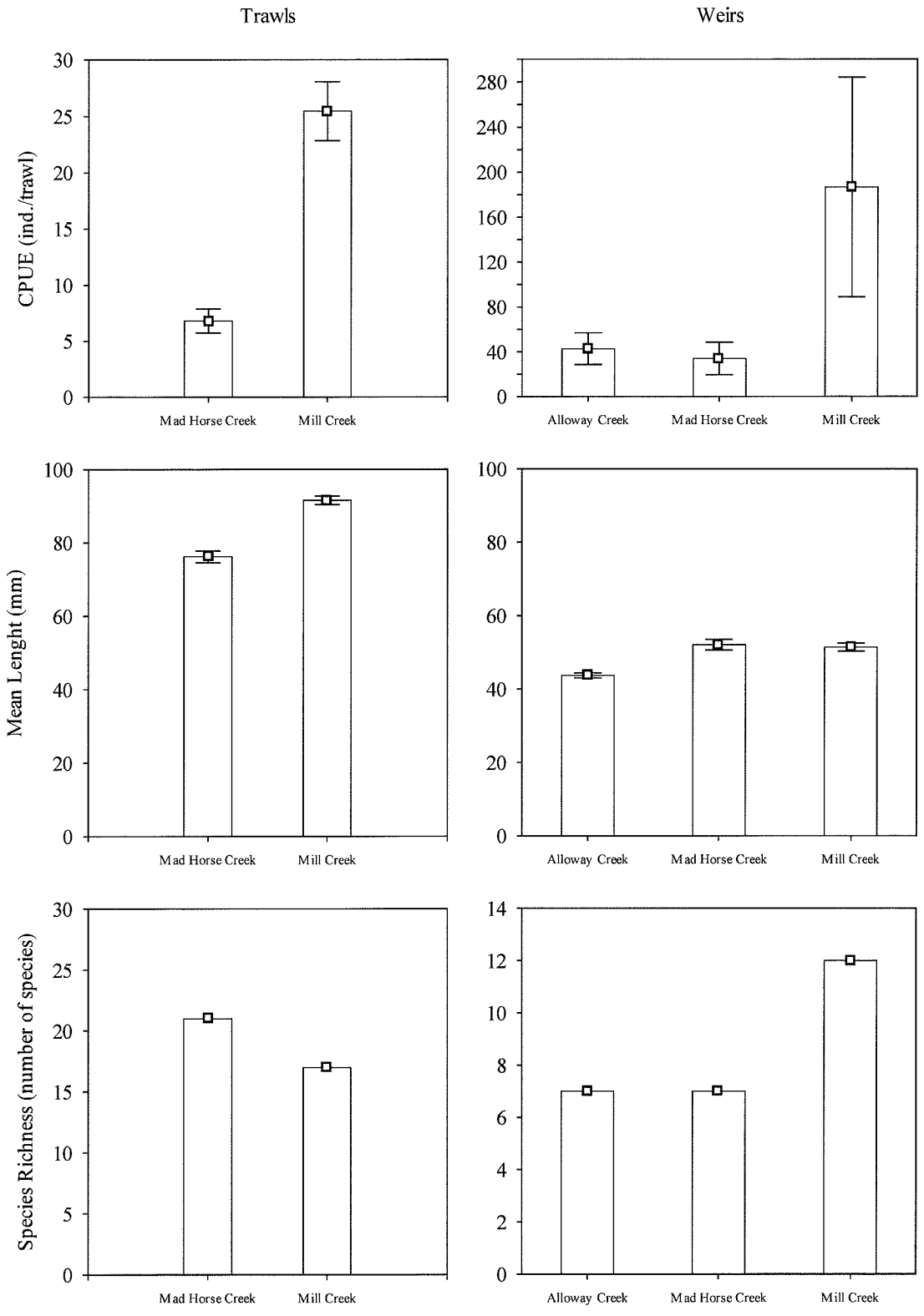

Figure 7-49. Comparisons of abundance, fish length, and species richness among restored (Alloway Creek and Mill Creek) and reference (Mad Horse Creek) marshes from large and small marsh creeks during 2009.

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INTRODUCTION

As a component of its Estuary Enhancement Program (EEP), Public Service Enterprise Group (PSEG) has initiated an Improved Biological Monitoring Work Plan (IBMWP) for the Delaware Estuary pursuant to Special Condition Section G.6 of the 2001 NJPDES Permit (No. NJ0005622) for the Salem Generating Station. The IBMWP was prepared and amended by PSEG, reviewed by the Estuary Enhancement Program Advisory Committee and approved by the New Jersey Department of Environmental Protection (NJDEP).

In accordance with the IBMWP, vegetative and hydrogeomorphic monitoring was conducted in 2009 by PSEG. This monitoring included peak growing season (August) sampling at two reference marshes in New Jersey and four wetland restoration sites in New Jersey and Delaware. False color infrared (CIR) and true color aerial photographs were also acquired of the reference marshes and wetland restoration sites on September 28, 2009 and September 14, 2009; respectively. These photographs were utilized to map the extent of the various vegetation cover types present on each of these sites.

MATERIALS AND METHODS

This section describes the materials and methods used in the collection of detrital production data in 2009 and subsequent data analysis. Elements of the 2009 work scope included:

- Collection of percent coverage, height and flowering status data within quadrats located along transects and within plots;
- Collection of macrophyte and litter samples;
- Processing (i.e., weighing) of macrophyte samples in the laboratory;
- Data analysis (e.g., mean, standard deviation, standard error) of percent cover, height and biomass data;
- Acquisition and interpretation of CIR and true color aerial photography.

SITE LOCATIONS

The locations of the EEP restoration sites and reference marshes are shown in Figure 8-1. CIR or true color aerial photography was acquired at all sites for the purpose of mapping the extent of the vegetation communities present. Field data collection in 2009 occurred in New Jersey at four sites: the Mad Horse Creek (MHC Reference Marsh) and Moores Beach West (MBW Reference Marsh) reference marshes; the Commercial Township Salt Hay Farm Wetland Restoration Site (CT Site); and the Alloway Creek Watersehd Wetland Restoration Site (ACW Site). Field data collection also occurred at two wetland restoration sites in Delaware: The Rocks and Cedar Swamp. A brief description of each site is provided in the following paragraphs.

Reference Marshes

The two reference marshes selected in accordance with the IBMWP were MHC Reference Marsh and MBW Reference Marsh. MHC Reference Marsh is an oligohaline (salinity 0-5 ppt) marsh, most of which had not been previously used for salt hay farming operations. The 3,942-acre portion of the marsh selected as a reference site is considered to represent a good example of natural hydrology and drainage patterns, and represents a mature vegetative marsh community.

MBW Reference Marsh is a mesohaline (salinity 5-18 ppt) marsh that "naturally restored" following storm damage to its berms in 1972. By 1992, most of the areas that were in salt hay production in 1960 had been converted to low marsh dominated by *Spartina alterniflora.* The low marsh succession was accomplished by natural processes. The marsh area designated as the reference site encompasses approximately 1,264 acres.

Salt Hay Farm Wetland Restoration Sites

Three New Jersey salt hay farms, located in Commercial Township, Maurice River Township and Dennis Township, have been restored to normal daily tidal flow by PSEG under the EEP. The Dennis Township and Maurice River Township salt hay farm sites have reached their targeted coverage of *Spartina alterniflora* and other desirable marsh species, and are not included in this chapter of the 2009 Annual Report. Detrital production monitoring has continued at the CT Site, which is located in Cumberland County and contains 2,894 acres within the restoration boundary.

The CT Site is bounded to the east by the Village of Bivalve and the Maurice River, to the south by the Delaware Estuary, to the west by Dividing, Indian, and Hansey Creeks and to the north by rural properties and the Village of Port Norris. The restoration site is situated along the southern New Jersey shoreline of the Delaware Estuary at the northern margin of the Maurice River Cove, approximately 18 miles northwest of Cape May Point. For at least three generations, the area between Dividing Creek and the Maurice River had been farmed commercially; earthen dikes had been constructed to enhance the production of salt hay *(Spartina patens* and *Distichlis spicata).* As a result of storms during early 1996, a number of breaches in the perimeter dike occurred; despite attempts to repair these, much of the salt hay farming area was inundated during the 1996 growing season. However, salt hay farming was continued on some areas in the

western portion of the site. The construction phase (dredging, dike breaching, etc.) of the wetland restoration was completed in the fall of 1997, returning daily tidal flows to the wetland restoration area of the site.

New Jersey *Phragmites* Dominated Sites

Two *Phragmites*-dominated sites in New Jersey, the ACW Site and the Cohansey River Watershed Wetland Restoration Site (CRW Site), have undergone restoration by PSEG under the EEP. The CRW Site has reached its targeted coverage of *Spartina alterniflora* and other desirable marsh species, and is not included in this chapter of the 2009 Annual Report. The ACW Site is a *Phragmites*-dominated site that had been historically diked and farmed. Based on a review of historical aerial photography, *Phragmites* originally became established on dike areas and then spread to the adjacent marshes. The ACW Site is located in Elsinboro and Lower Alloways Creek Townships, Salem County, NJ. The ACW Site encompasses approximately 3,096 acres that include the wetland restoration area and adjacent buffer. The wetland restoration area is comprised of approximately 1600 acres; *Phragmites* covered approximately 58.7 percent of the wetland restoration area in 1996, prior to initial restoration activities. The wetland restoration area is subject to tidal influence from the Delaware River, via Alloways Creek, Straight Ditch and Mill Creek. The ACW Site is bounded to the east by the Salem-Hancocks Bridge Road, to the north by the Fort Elfsborg-Hancocks Bridge Rd, tidal marsh and agricultural fields, to the west by the Delaware River, and to the south primarily by the Alloways Creek.

Delaware *Phragmites* Dominated Sites

Prior to 1999, five restoration sites were monitored in Delaware. PSEG selected to continue restoration activities at two of these sites, The Rocks and Cedar Swamp. Wetland restoration activities were initiated at these two Delaware *Phragmites*-dominated sites by the Delaware Department of Natural Resources and Environmental Control (DNREC) in 1995. A brief description of the pre-restoration conditions at each site based on interpretations of 1993 aerial photography is provided in the following paragraphs.

The restoration area at The Rocks is comprised of 736 acres and is located approximately 2.3 miles south of Silver Run and 4.0 miles southeast of Odessa in Appoquinimink Hundred, New Castle County, Delaware. This site is part of a continuous tidal marsh community, referred to as the Appoquinimink River-Blackbird Creek System, which extends north and south for several miles. The site is bounded to the east by the Delaware River, to the north by Appoquinimink River, to the west by Stave Landing Road and to the south by Blackbird Creek. Stave Landing Road provides access to The Rocks from the west. *Phragmites* covered 86.9 percent of the vegetated marsh plain in 1993 prior to the initiation of restoration activities by DNREC.

The restoration area at Cedar Swamp is comprised of 1,863 acres and is located approximately 2.6 miles south of The Rocks in Blackbird Hundred, New Castle County, Delaware. This site is bounded to the east by the Delaware Bay. To the north, the site is bounded by farmland and Cedar Swamp Road, and to the west and south the site is bounded by farmland, woodland, and contiguous tidal marsh. The boundary between the Delaware River and the Delaware Bay is

located at the northeast side of the site, at Liston Point. Collins Beach Road provides access to a public boat ramp and parking area in the southeast corner of the site. Public access to the northern side of the site is available via Cedar Swamp Road. In addition to public hunting and wildlife observation, Cedar Swamp is used as an anchorage for commercial and recreational crabbing and fishing boats. Historically, the site was used for hunting and included a coastal recreation resort. *Phragmites* covered 71.3 percent of the wetland restoration area prior to the initiation of wetland restoration activities by DNREC.

AERIAL MAPPING

Aerial photography was acquired for all reference and restoration sites in New Jersey and Delaware on September 14 and 28, 2009. True color photographs were acquired of the MHC Reference Marsh, ACW Site, Cedar Swamp and The Rocks. CIR photographs were acquired of the MBW Reference Marsh and the CT Site. This photography was acquired at a nominal scale of 1:9600 (i.e., 1 in = 800 ft). The time of acquisition was selected to provide images of the sites at the end of the growing season during the mid-day period and at low tide.

Camera, Aircraft, and Film Type

To obtain the aerial photography, a Wild-RC30 camera with a Wild Universal Aviogon/4-S lens and a nominal focal length of 153 mm was flown in a Cessna Piper aircraft. Kodak Aerochrome III Infrared Film 1443, an infrared-sensitive, false color reversal film, was used for the CIR aerial photography. CIR photographic film is comprised of three layers (cyan, yellow and magenta) that are exposed in response to the characteristics of the light reflected from the earth's surface. Plant leaves reflect a significant amount of green energy and partially expose the yellow layer in addition to almost complete exposure of the cyan layer by the infrared - leaving the magenta layer and varying parts of the yellow layer with an image color ranging from magenta to red. The more green energy that is reflected by a given vegetation cover, the less yellow layer remains and the more magenta the images of that type appears. Because of species differences in leaf structure and chlorophyll content, separation of species dominated areas on CIR photography often can be based on this variation in red to magenta color. Since wet soil and water reflect little in the wavelengths that CIR film is sensitive to, these areas appear dark (unexposed) on the image. As a result, CIR aerial photography is particularly useful in mapping vegetative coverage on sites that are not fully vegetated.

Agfa AVIPHOT Color X100 PEI, a color negative film without color mask that is suitable for electronic image scanning for the reproduction of clean and saturated colors without additional color correction, was used for the true color aerial photography. This film is particularly useful for mapping vegetation types that are visually different during the peak growing season (e.g., *Spartina alterniflora* and *Phragmites australis*).

The aerial photography was acquired following standard specifications for stereo coverage. The forward overlap (overlap in the direction of flight) was 60 percent. The sidelap between overlapping parallel flight lines of vertical photography was 30 percent. Any series of two or more consecutive photographs within a flight line were not to be crabbed in excess of three (3) degrees relative to the plotted line of flight, and the differential crab between any two

consecutive exposures within a flight line did not exceed three (3) degrees. The tilt within a single frame did not exceed three (3) degrees nor did the difference in tilt between two consecutive frames within flight lines exceed four (4) degrees. The average tilt for all negatives of the same nominal scale did not exceed one (1) degree.

Once the aerial photography was secured, the original photographic negatives were developed through automated processing equipment and RC paper contact prints (9in x 9in) and diapositives of each negative were produced. One set of film diapositives was printed from the original aerial photography using an automatic dodging printer having a flat platen on cut sheets of Kodak Aerographic Duplicating (ESTAR Thick Base) Film No. 4421. This set was used for the vegetation mapping photo interpretation process.

To allow for quick referencing of the aerial flight, an aerial photographic line index of the photography was produced utilizing minifications of each exposure and referencing photographs to each other using Adobe® Photoshop® software. The index references each flight line and exposure on the index map by site.

Geodetic Control

Available existing horizontal and vertical controls, as well as controls acquired in 1996, were used to establish geodetic control for the mapping. All external control (used to control the final network adjustment) was based entirely on first order stations as published by the National Geodetic Survey. Stations were located for photo-identifiability (e.g., targets were painted, where surfaces allow, with high visibility traffic paint). Where surfaces did not permit painting, targets consisted of weather-proof plastic material. Target legs measured 12 inches in width and seven feet in length.

GPS survey techniques were used for establishing photo control at these sites using ground-based rapid static procedures. Rapid static GPS uses dual-frequency receivers to occupy the stations for 8-15 minutes compared to 30-45 minutes using dual frequency receivers in a static mode and 60-75 minutes using single-frequency static methods. The accuracy of the GPS-derived orthometric heights is enhanced by occupying a number of existing benchmarks throughout the project area, and using *Geoid93*—geoidal height interpolation and modeling software from the National Geodetic Survey (NGS)—to model the undulations, or the separation of the modeled sea level surface (the geoid) from the idealized mathematical representation of the earth as an ellipsoid of revolution.

All GPS surveys were performed to exceed the first order horizontal specification (0.01 m + 10 ppm). A sufficient number of existing National Geodetic Reference System (NGRS) stations was used as external control. When the vertical control was done using static mode GPS, a sufficient number (at least 6) of well-distributed benchmarks was included in the network. These known orthometric heights were used along with geoid heights derived from *Geoid93* to obtain orthometric heights of all stations in the network. The network was designed so that loop closures may be analyzed for verification.

GPS data collected in the field were downloaded from the receivers to a computer and processed using the GP Survey® software package from Trimble Navigation, Ltd. The baseline processor is known as WAVE (Weighted Ambiguity and Vector Estimation), which is optimized for dual frequency data. This program checks the data as it is downloaded, allowing editing of items such as station name, height of instrument, and so forth. The data was processed in batch mode, with no operator interaction required. Only integer biased fixed solutions were used. The results were examined to identify suspect lines. When a baseline had a low ratio and/or a high reference variance, it was checked by loop closures. The network was designed to enable the verification of all lines. The results were sent by high-speed modem link for analysis by an experienced geodetic engineer. If any re-observations were required, theses were performed before the GPS crew left the site. Office processing consisted of analyzing the results to determine if any manual reprocessing was necessary. Results deemed acceptable were combined to form a network. This network was then adjusted by TRIMNET, a least squares adjustment package from Trimble Navigation, Ltd.

Aerotriangulation

Analytical aerotriangulation was performed for the CIR and true color aerial photography obtained in September 2009. The aerial film negatives were digitally scanned at 22.5 microns and the scanned images were used in the analytical aerotriangulation process on Socet Set® softcopy workstations utilizing Socet Set® Multi-Sensor Triangulation System (MST) software. Data capture was performed with the Automation Point Measurement program (APM). The identification and numbering of pass points and tie points between contiguous strips, was performed by the APM program. This data was then edited with the Interactive Point Measurement program (IPM). The editing process reduces the point residual error, point placement and the addition of ground control. The data was corrected for radial lens distortion and film deformation, and a non-airborne simultaneous adjustment was performed. The data was then exported into the program system BLUH to perform the data reduction and final adjustment. BLUH performs the automatic elimination of systematic image effects through the use of additional parameters. Simultaneous Adjustment was carried out and the data was exported into Socet Set® software for the stereo compilation process.

Stereo compilation

Stereo compilation was accomplished by the stereo digitizing of map elements, extracted from the 2009 CIR and true color aerial photography using precision analytical stereo plotting instruments. The aerial photographs were arranged in overlapping pairs, (commonly referred to as a stereo model) and were then mounted in a stereoplotter for compilation. The analytical

solutions, aerial calibration, and geodetic control data, developed in the previous steps of the mapping process, were downloaded into the photogrammetric device and accurately registered to the photography. This process involves mathematically orienting the stereo model with the instrument to create a stereoscopic three dimensional image that the photogrammetrist interprets and compiles to build a vector land base of the mapping features as seen through the optics of the instrument. Such map features include:

- Center lines of channels between one and five feet in width;
- Edges of channels greater than five feet in width;
- Ponded areas;
- Dikes, dike breaches and internal berms; and
- Miscellaneous roadways.

Digital Elevation Models (DEM) were also developed to support the production of digital orthophotographs by taking a file containing break lines (digitized points that are connected by a line) which have been placed at all breaks in terrain, and mass points placed at strategic locations (tops, depressions, road intersections, and so forth) and linking them together to form the triangulated irregular network, or TIN. Generally, break lines will be shown at all terrain breaks, drains, tops of banks, ridges, valleys, bases of hills, edges of plateaus, road edges, and so forth. All vector information (map data) was tiled to match PSEG's existing tiling scheme (4,000 ft x 8,000 ft).

Digital Orthophotography

An Intergraph Digital Ortho Production System was used for generating digital orthophotography of the reference and restoration sites. The system includes the Zeiss/Intergraph PhotoScan PS1 digital transmissive scanner, six Intergraph workstations with JPEG Compression boards, and more than 40 gigabytes of disk storage capacity. The following steps comprise the general digital orthophoto workflow:

Scanning. Each diapositive was scanned three times using red, green, and blue filters. Each scan pass detects the film's emulsion layers that are sensitive to a corresponding spectral bandwidth. Scanning is performed in a manner that duplicates the film as it is exposed to maintain the relationships between the individual colors in the film.

DEM Production. Mass point and break lines were merged into blocks and the coordinate system, global origin and working units were set using Intergraph's MGE Terrain Modeler software package. A TIN surface model was developed for each site and, from that surface representation, a grid model was created at an appropriate interval to support orthorectification.

Image Orientations. After an exposure was scanned, the fiducial marks were measured using Image Station Digital Orientation (ISDO) software to determine the Interior Orientation (IO) of the image. This step relates the scanned image to the USGS camera calibration report and determines the geometric relationship between the two. Residual errors are normally less than 10 microns for a diapositive. If the Root Mean Square Error (RMSE) was excessive, the exposure was re-scanned. If the error was repeated, the diapositive was rejected and remade.

The Exterior Orientation (EO) was performed by relating measured pug mark positions with the corresponding ground coordinates to determine the exact location of the camera at the time of exposure. Known as the space resection, this position consists of the X, Y, and Z coordinates of the camera and the three rotation angles that describe the tip, tilt, and yaw of the aircraft. Convergence statistics should not exceed National Map Accuracy Standards (NMAS) standards for the scale of photography.

Digital Orthorectification. Digital orthophoto processing is a reiterative process that combines input from photography, analytics, and a DEM. The Intergraph Image Station Rectifier (IISR) software mathematically calculates the true orthogonal position and brightness value for each pixel within the digital orthophoto. This is accomplished by differentially resampling the input data both spatially and radiometrically to calculate a new rectified pixel.

The central portion of every exposure from the stereo model was scanned and rectified. Using only the central portion of each exposure reduces the effect of vignetting (uneven exposure that results in darker margins around the diapositives). This is especially important with color infrared photography as it is very susceptible to change in exposure level. Following rectification, the coordinates of photo-identifiable points within the rectified image were compared to the actual ground coordinate of that point. The distance between the observed point and the true coordinate is used to quantify the accuracy of the orthophoto in terms of the NMAS for the mapping scale. These values were included with the result of the interior and exterior orientation analysis. The ortho image was also viewed against the vectorized break lines and other planimetric features to ensure correlation with the DEM file. Compiled features such as stream edges and road center lines are readily identifiable and were used to assess the overall accuracy of the orthophoto.

Mapsheet Generation and Output

Automated procedures were used to merge two or more overlapping images together and generate a specified mapsheet (4,000 ft in a north-south direction and 8,000ft in an east-west direction). Using the AutoOrtho (ISAO) software developed by Intergraph and TRIFID Corporation, digital imagery can be mosaiced, tone-matched, and feathered into a single continuous seam-free image that can be edge matched against the adjacent sheets to check for continuity of features and contrast. All digital orthophoto files were produced as Intergraph type 28 RGB 24-bit files with a standard color table attached to it so that plotting and display characteristics are consistent among the files.

Vegetation Mapping

Mapping of marsh vegetation types on the wetland restoration and reference sites utilized the 2009 CIR and true color aerial photography acquired for vector mapping and digital orthophotograph production. CIR photography is a three layer (cyan, yellow and magenta) film that has been widely used for crop and natural vegetation studies because image color formation is dependent upon reflected energy in the red and green portion of the visible spectrum as well as the near-infrared. An object that reflects only infrared energy will expose the cyan layer of the film, leaving the yellow and magenta layers that combine in a subtractive mixture to form a red image when viewed by transmitted light.

A team of scientists familiar with the vegetation and physical features of the reference and restoration sites interpreted the CIR and true color aerial photography by identifying color/texture characteristics (i.e., signatures) of the various cover types present. The various areas of species-dominated polygons or other site features (e.g., mud flats) identified on the CIR aerial photography were delineated digitally while viewing the orthophotograph on the computer monitor. On-screen digitizing of cover type boundaries was performed using AutoCAD LT 2005™. Each polygon mapped in this way was assigned an identifying code consisting of the year, cover type designation, and a sequential polygon number for that cover type. Thus, each polygon was given a unique alphanumeric identification that linked the polygon to an external Microsoft Access™ database. AutoCAD Map 2® Release 14.0 software was utilized to further process the data. The minimum mapping unit (MMU) employed for the digitizing effort was one acre. In order to be identified as a given cover type, it is generally necessary that the vegetative cover of the polygon exceed 30 percent. Thus areas mapped as "mud flat" may support vegetation below the 30 percent mapping threshold. This is consistent with the approach utilized by the USFWS in the preparation of NWI maps, where areas supporting less than 30 percent cover are identified as unvegetated (Tiner 1998).

Quantitative Geomorphologic Evaluation

A quantitative evaluation of the geomorphologic features was conducted based on the geomorphological mapping compiled from the September 2009 CIR and true color photography. The following parameters were determined as part of the quantitative geomorphologic evaluation:

- Channel classification (order)
- Determination of the total number of channels in each order
- Calculation of bifurcation ratio
- Channel frequency
- Total length (sinuous length)
- Total linear length
- Average channel length
- Channel length ratio
- Percent of total channel length
- Average channel sinuosity
- Drainage density

An approach to geomorphological classification of stream channels was developed by Horton (1945), who emphasized topographic characteristics of the drainage area and gave a hierarchical order to every channel in the drainage basin in his stream-ordering technique. The Horton method utilizes a "top-down" approach to determine the order of the drainage channels, where the smaller streams have lower-order numbers and the central channel is assigned the highest-order number.

Strahler (1957) modified the Horton system by starting the next highest order at the confluence of two tributaries of lower order. Strahler's method is based on the premise that, for a sufficiently large sample size, order number is directly proportional to relative watershed dimensions, channel size, and volume of stream discharge. Also, because the order number is a dimensionless value, two drainage basins of different sizes can be compared at corresponding points through the use of order numbers.

The analytical channel geomorphology tools of Horton (1945) and Strahler (1957), as referenced in Chow (1964, 1988) (order analysis) were developed for evaluating mature stream systems and to aid in the design of stream restoration projects. An implicit assumption of order analysis is that the evaluation is done for sites with comparable channel orders. While this technique is appropriate for mature stream systems, it is not as effective for rapidly developing (i.e., recently restored) salt marsh tidal channel systems in which the number and order of channels can change dramatically over a short time period.

The development of small channels through natural restoration processes dramatically changes the order number of the largest channels. The change in order number with channel development makes it extremely difficult to relate channel dimension with channel order. Because the number of small channels at a restoration site increases as the site matures, the classical channel ordering method makes it appear as if the number of large inlet channels also varies over time. This is because the increase in small channels causes the order number assigned to the largest channels to increase as well.

This increase in order number for the largest channels made comparison between years and among sites extremely difficult at the PSEG restoration sites. In some instances it was not possible to match channel size (dimensions) with channel order, since each channel system changed independently of other systems at a site, and among sites. As a result, it was impossible to track what was happening over time in the smaller channels. Knowing what was happening in the smaller channels was critical, since these small marsh channels provide pathways for tidal waters to access the marsh plain. Additionally, these small marsh channels provide conduits for fish access and detrital export. Therefore, analyzing changes of these small tidal channels is one of the most critical aspects for assessing restoration success.

To address the difficulties associated with application of the "top-down" channel order approach, the hydrogeomorphic analysis technique utilized for this project was modified to be more useful with a dynamic system. Using this hydrogeomorphic class technique ensures that the largest channels are always the lowest number (first class), and that increasing order numbers are assigned to the rapidly changing smaller channels.

Using the "bottom-up" approach, the main inlet from the Delaware Bay or other major water body (e.g. West Creek, Riggins Ditch) was designated a first-class channel. The procedures outlined below were then followed to determine the class designations of channels to be analyzed at each site.

(1) A second-class channel begins where a first-class channel splits into two separate, comparably sized double-lined channels (double-lined channels are greater than five ft wide). If one of these two channels is less than half the size of the other channel, the smaller channel becomes a second-class channel and the other remains a first-class channel.

(2) When a second-class channel splits, the above-stated procedure is applied to identify these branches as third class, fourth class, etc. This rule is only applicable to double-lined channels (i.e., greater than 5 ft wide).

(3) Any single-lined channel (i.e., less than 5 ft wide) coming off a double-lined channel is a third-class channel. However, if that double-lined channel is already a third-class channel or greater, then that single-lined channel will be one class higher than the double-lined channel it branches from.

(4) With any split of a single-lined channel, those two channels will be one class higher than the channel they are splitting from.

The method used to derive the geomorphological analysis of the reference marshes and wetland restoration sites utilizes the attributes of both AutoCAD® and Arc View® software. This software quantifies the number of channels of each order that occur on a site as well as derive the various length measurements that are utilized to characterize the channel systems on the sites, as described below:

Bifurcation Ratio (R_B). The bifurcation ratio, or R_B, is the ratio of the number of channels of one class to the number of channels of the next lower class.

$$R_B = N_n / N_{n-1}$$

Channel Frequency (F_C). The channel frequency, or F_C, is the number of channels for all classes (N_T) per unit area.

Total length (sinuous length) (L). The total sinuous length, or L, for channels in each class is the centerline length along the channel course from the start of a channel of one class to the beginning of the channel of next lower class.

Total linear length (straight line length) (SL). The straight line length, or SL, is the length for channels in each class measured as the straight line distance from the start of the channel of one class to the beginning of the channel of next lower class.

Average channel length ($L_{n\ avg}$). The average channel length, or $L_{n\ avg}$, is the total length of channels of a given class divided by the number of channels in that class.

$$L_{n\,avg} = L_n / N_n$$

Channel length ratio (R_L). The channel length ratio, or R_L, is the ratio of the average length of channels in one class to the average length of channels in the next higher class.

$$R_L = L_n / L_{n+1}$$

Percent of total channel length (%CL). The percent of total channel length, or %CL, provides information on the proportion of each channel class in the site. This value is calculated by dividing the total length of channels in one class (Ln) by the total length of channels of all classes (LT) and multiplying by 100%.

$$\%CL = L_n / L_T \times 100\%$$

Average channel sinuosity (S_{avg}). The average channel sinuosity, or S_{avg}, is the ratio of the average length of channels of a given class to the average straight line length for channels in that class.

$$S_{avg} = L_{n\,avg} / SL_{n\,avg}$$

Drainage density (D). The drainage density, or D, is the total length of channels of all classes divided by the area of the site.

VEGETATION TRANSECTS

Detrital production data were collected in August 2009 along transects located in New Jersey at the MHC Reference Marsh and MBW Reference Marsh (Figures 8-2 and 8-3, respectively); the CT Site (Figure 8-4); the ACW Site (Figure 8-5); and The Rocks and Cedar Swamp Sites in Delaware (Figures 8-6 and 8-7). Random quadrats (0.25 m^2) were located as described below along each of the transect alignments shown in these figures. Macrophyte production data were collected within these quadrats as described in the following sections. The original transects at the restoration sites and the reference marshes were established as part of the 1995 detrital production monitoring effort. Two of the reference site transects were relocated in 1996, MHC Reference Marsh Transect 3 (shown as MHT3A in Figure 8-2) and MBW Reference Marsh Transect 1 (shown as MBT1A in Figure 8-3). The former was relocated for a property access purpose; the latter to eliminate the excessive edge habitat that the original alignment traversed. The Rocks and Cedar Swamp transects were established for the 1999 sampling effort.

Each transect sampled in 2009 was divided into community segments, with each segment traversing a portion of the total transect length dominated by a given species. In the event that two or more species were determined to be co-dominants, the community segment was identified as such. This method is further discussed in the following section.

The collection of field data (e.g., percent aerial cover) and clipping of samples of macrophytes for laboratory processing occurred within the randomly selected quadrats located along the community segments of each transect. Each quadrat was identified by an alpha-numeric code

designating its associated transect and sampling event, the type of data collected at the quadrat and its position along the transect. As an example, MHT1-09-OQ18 indicates that the quadrat was sampled along MHC Reference Marsh Transect 1 during 2009 (MHT1-09). The data collected was an ocular estimate of percent cover within the quadrat area (O), and the quadrat was the eighteenth sampled along the transect (Q18). Similarly, MHT1-09-CQ1 indicates that the quadrat was sampled along MHC Reference Marsh Transect 1 during 2009 (MHT1-09). In this instance, percent cover data were collected and the quadrat area was clipped for standing crop determinations (C). The quadrat was the first sampled along the transect (Q1).

The method for establishing the random location of the quadrats is as follows:

The transects at the wetland restoration sites were walked, recording the type, length and number of plant communities (i.e., community segments) and open water and mudflat areas crossed on an appropriate data sheet (Appendix A, Exhibit A-1). A Magellan Meridian® global position system (GPS) unit was utilized to determine the lengths of each plant community traversed and the locations of channels and other geomorphic features. The community designations determined as a result of this effort served as the basis for the selection of quadrat locations.

The appropriate number and location of quadrats sampled utilizing the appropriate data form (Appendix A, Exhibits A-2 and A-3) was determined as follows:

1. Two quadrats per dominant species type traversed along the transect (e.g., *Spartina patens* dominated, *Spartina alterniflora* dominated) were randomly located. Within these quadrats, standing crop collections ("clips") were made. To locate these clip quadrat locations, two community segments of the transect dominated by the same species were randomly selected from the total number of similarly dominated segments[1]. A quadrat location was then randomly selected within each segment.

2. Additional quadrats were randomly located along the transect length within which only ocular estimates of percent cover were made (i.e., "ocular" quadrats). The number of ocular quadrats was determined by multiplying three by the total number of biomass clip quadrats (maximum 22).

Clip and/or ocular quadrats were located one meter to the side of the transect alignment so as to avoid sampling areas that were previously walked over. The side (right/left) of the transect to which the quadrat was placed was alternated between sample points.

At the reference marshes, community data collected during the 1996 sampling effort were used to determine the appropriate number and location of quadrats to be sampled (according to the procedures outlined above) during the 2009 effort.

[1]In the event that only one transect segment was dominated by a given species, both clip quadrats were randomly located within that segment.

QUADRAT SAMPLING

Sampling within the 0.25 m^2 quadrats located along the transects as described above was conducted utilizing the field procedures described below:

Percent Aerial Coverage

Within each 0.25 m^2 quadrat, the percent of plant foliar and stem aerial coverage (as viewed from above by an observer standing at a point adjacent to the quadrat) was visually estimated using the following percent coverage categories:

0% = open water or bare sediment
<1% = plants sparsely or very sparsely present
5% = plants covering from 1 to 10% of the area
15% = plants covering from 11 to 20% of the area
25% = plants covering from 21 to 30% of the area
35% = plants covering from 31 to 40% of the area
45% = plants covering from 41 to 50% of the area
55% = plants covering from 51 to 60% of the area
65% = plants covering from 61 to 70% of the area
75% = plants covering from 71 to 80% of the area
85% = plants covering from 81 to 90% of the area
95% = plants covering from 91 to 100% of the area

The process of determining the percent coverage for each species occurring in a quadrat first involved estimating of the total percent coverage of all plants within the 0.25 m^2 quadrat area. This total was then subdivided into individual percentages for each species within the quadrat and entered onto an appropriate data sheet (Appendix A - Exhibit 2 for clip quadrats; Exhibit 3 for ocular quadrats).

Canopy Height

Canopy height was determined for each species by measuring the height of a mid-sized plant occurring within the quadrat. These data were entered onto an appropriate data sheet (Appendix A - Exhibit 2 for clip quadrats; Exhibit 3 for ocular quadrats).

Flowering status

During each sampling event, plant species occurring within each quadrat were noted as being either flowering or non-flowering at the time of sampling. The flowering status was recorded on the appropriate data sheet (Appendix A - Exhibit 2 for clip quadrats; Exhibit 3 for ocular quadrats).

Above-ground Biomass Collection

A vertical photograph was taken of each clip quadrat area and all living and standing non-living vegetation within the quadrat was cut within 1 cm of the sediment, separated by species and placed in labeled paper bags. Unattached surface litter from within the quadrat area was also collected and placed in labeled paper bags. Samples were then transported to and processed in the laboratory as described below.

VEGETATION PLOTS

To supplement the collection of field data within quadrats along transects in 2009, additional 0.25 m^2 quadrat sampling was conducted within previously established 60 m x 60 m (3,600 m^2) "plots". These plots were located at each site during the initial years of restoration to collect macrophyte productivity data from areas appearing to be of relatively uniform species composition, coverage and height at the time of selection. The primary purpose of this supplemental sampling was to determine the peak live standing crop in areas that could be located on the peak growing season CIR and true color photography, since a 3,600 m^2 area appears as an approximately 0.2 cm^2 area (0.4 cm x 0.4 cm) on a 2X enlargement (1:4,800) of the 1:9,600 scale aerial photography. The number of plots located at each site and the dates these plots were established are as follows:

Site	Number of Plots	Date Established
MHC Reference Marsh	3	1996
MBW Reference Marsh	3	1996
Cedar Swamp Site	1	1997
The Rocks Site	1	1997
ACW Site	3	1999
CT Site	4	1999

The corners of these plots were marked with PVC pipes and located using Global Positioning System (GPS) methods to provide a permanent record of the sampling location. The locations of these plots at each site are shown in Figures 8-2 (MHC Reference Marsh), 8-3 (MBW Reference Marsh), 8-4 (CT Site), 8-5 (ACW Site), 8-6 (The Rocks Site), and 8-7 (Cedar Swamp Site).

Quadrat Locations

Each of the fifteen 3,600 m^2 plots listed above was stratified into nine 20 m x 20 m (400 m^2) sub-areas. One 0.25 m^2 quadrat was randomly located within each sub-area, for a total of 9 quadrats per plot. Each quadrat was identified by an alpha-numeric code designating the site, plot number and quadrat number. As an example, MHP1-09-CQ5 indicates that the quadrat was sampled within MHC Reference Marsh Plot 1 (MHP1) during 2009 (09). The quadrat area was clipped for standing crop determination (CQ) and it was the fifth sampled within the plot (5).

Quadrat Sampling

Percent coverage, height and flowering status data were collected in each quadrat as described previously and recorded on the appropriate data sheet (Appendix A – Exhibit A-4). Above ground biomass collection was performed as described previously. Samples were then transported to and processed in the laboratory as described below.

MACROPHYTE LABORATORY PROCESSING

In the laboratory, each sample was dried to a constant weight at 60° C. Following drying, the plant materials collected from each quadrat were weighed to the nearest 0.01g and entered onto the laboratory data sheet (Appendix A – Exhibit A-5). The data was then entered into a Microsoft ® EXCEL spreadsheet for subsequent statistical analysis.

RESULTS

COVER TYPE MAPPING

Cover Type Descriptions

The CIR and true color aerial photography acquired on September 14 and 28, 2009 was interpreted to map the extent of the various cover types present on the wetland restoration and reference sites at the time of peak standing crop. The cover types identified at the various sites were delineated by mapped polygons[2] representing areas of each site that are either dominated by listed species (i.e., vegetation community types) or represent identifiable land/water features (e.g., developed land, agricultural land, open water, mud flat). In areas where two or more species dominate a vegetation community, multiple species were listed.

The acreage and percent coverage of each individual cover type (e.g., species or group of species) for the reference marshes and the "wetland restoration area" of each wetland restoration site is provided in Tables 8-1 through 8-4. The wetland restoration area generally occurs within the overall "site boundary" and was determined based on the mapping of the tidal wetland/upland edges. These tables group the cover types under the following categories:

- *Spartina*/other desirable marsh vegetation;
- *Phragmites*-dominated vegetation;
- Non-vegetated marsh plain;
- Internal water areas;
- Open water; and
- Upland vegetation/miscellaneous cover categories

The extent of each cover category at each of the reference marshes and wetland restoration sites is shown in Appendix B, Figures B-1 to B-6. These figures also show the wetland restoration area boundaries for each site. General descriptions of the various cover categories that appear on these figures and the individual cover types that they represent are provided in the following paragraphs.

***Spartina spp.* and Other Desirable Marsh Vegetation**

While restoration of *Spartina alterniflora* as a dominant species is desirable, there are numerous other species that contribute to estuarine productivity and are indicative of a fully functional marsh ecosystem. Such species include, but are not limited to: *Spartina cynosuroides, Spartina patens, Distichlis spicata, Scirpus robustus, Scirpus olneyi, Typha latifolia, Pluchea purpurascens, Acorus calamus, Eleocharis parvula,* and *Echinochloa walteri*. Areas that are predominated by *Spartina alterniflora* or another desirable marsh species are included in this category. Where other species are co-dominants with *Spartina alterniflora*, these species are also indicated in the type designation (e.g., *Spartina alterniflora/Amaranthus cannabinus*).

[2] The minimum polygon area for vegetation stands is approximately 1 acre.

Where sparse clumps of *Spartina alterniflora* occur in mud flat areas, these areas are designated in a similar manner (e.g., *Spartina alterniflora*/Mud flat). In the event that mud flat predominates an area, the order of the type name is reversed (i.e., Mud flat/*Spartina alterniflora*).

Spartina alterniflora

The *Spartina alterniflora* cover type represents areas that have developed "complete" coverage by this species. The percent coverage of the marsh plain by *Spartina alterniflora* in these areas generally ranges between 80 and 90 percent. This cover type represents both tall and short forms. The tall form reaches heights of between 120 and 200 cm and occurs along the margins of creeks, guts, channels, and in other areas that are subject to daily tidal inundation. Short form plants are generally 30 to 60 cm high and occur either in areas of higher marsh surface elevation or on the normally flooded marsh plain inland from the creek channels. In some cases other species, including *Spartina cynosuroides, Scirpus robustus*, and *Amaranthus cannabinus*, also occur as co-dominants in this community.

Salt Hay

The salt hay cover type represents areas of the Commercial Township Site vegetated with *Spartina patens, Distichlis spicata*, and *Juncus gerardii.* This cover type was present prior to the restoration of tidal flows to this site. These areas were actively managed for salt hay production, which involved, among other things, periodic inundation and mowing.

Spartina patens

The *Spartina patens* cover type is typically found in natural high-marsh areas that are at an elevation between mean high and mean higher high water (MHW and MHHW, respectively). These areas are usually dominated by *Spartina patens*.

High Marsh

The high marsh cover type includes a variety of coastal species that are generally found at an elevation above MHW. Depending on the particular location, it may contain *Spartina patens, Distichlis spicata, Iva frutescens, Baccharis halimifolia, Panicum virgatum*, and *Phragmites australis*.

Typha spp.

The *Typha* spp. cover type includes areas dominated by *Typha latifolia* and *Typha angustifolia.* These species generally occur in the lower-salinity areas of the estuary and have become established over large areas of the *Phragmites*-dominated sites following the application of a glyphosate-based herbicide with a surfactant.

Recovering Desirable Species Area

These areas, historically, were dominated by desirable marsh vegetation, (i.e., *Spartina alterniflora, Spartina cynosuroides*). In recent years, these areas have been severely damaged by foraging snow geese and muskrats, turning them primarily to mud flat.

Desirable Marsh Vegetation and *Phragmites*

Desirable Marsh Vegetation/*Phragmites* represents portions of each site that are dominated by a variety of desirable marsh species, and include *Phragmites* as a subdominant species. *Phragmites* may occur sparsely throughout the mapped area (Mixed Marsh) or as small isolated colonies that are below the mapping threshold. These areas are primarily within the *Phragmites*-dominated wetland restoration sites and usually represent areas that, prior to initial restoration activities, were monotypic stands of *Phragmites*.

***Phragmites*-Dominated Vegetation**

This cover category includes larger areas (>1 acre) dominated by living monotypic stands of *Phragmites* and areas treated with a glyphosate-based herbicide with a surfactant that have remaining dead culms present (e.g., areas that have not been burned).

Phragmites australis

Stands of *Phragmites* occur at both the reference marshes and the wetland restoration sites. At the reference marshes and salt hay farm restoration sites, this community is usually found as an isolated cover type in disturbed areas such as dikes, ditch and road edges, and on natural creek levees. At the *Phragmites*-dominated sites, the cover type had occurred over large areas of the marsh plain prior to the initiation of the restoration activities. Although *Phragmites* usually forms monotypic stands, species such as *Iva frutescens*, *Baccharis halimifolia*, and *Atriplex patula* may also be present in this community, especially along the upland edge.

Dead *Phragmites australis*

Monotypic stands of *Phragmites* that have been either treated with a glyphosate-based herbicide with a surfactant or subjected to salt water inundation are delineated as the dead *Phragmites australis* cover type. This type is included in the *Phragmites*-dominated vegetation category because the dead culms mask the underlying vegetation; therefore, the establishment of desirable marsh vegetation cannot be interpreted from the aerial photography. As these culms are removed by natural processes (e.g., storm tides, ice flows) or by mechanical means through continued restoration activities, the marsh plain will be exposed and these areas will likely become vegetated with *Spartina alterniflora* or other desirable naturally occurring marsh vegetation.

Non-Vegetated Marsh Plain

Various cover types within the marsh plain that are not vegetated[3] by macrophytes are included in this category.

Mud Flat

At the restoration sites, mud flat is primarily a transitional cover type that precedes the establishment of desirable vegetation. Mud flat areas that were exposed (i.e., not covered by water) at the time of the CIR and true color aerial photography were delineated as this cover type. During many high tides these areas are inundated. Sparse (< 30 percent cover) vegetation may be present that cannot be detected on the CIR or true color aerial photography. This vegetation may be dominated by *Phragmites* or *Spartina* spp. and other desirable naturally occurring marsh vegetation. Algal mats may also be present over much of the mud flat areas.

Algal Mat

Mud flats covered by cohesive mats of filamentous algae or a filamentous or gelatinous mat of cyanobacteria have been categorized as algal mat. This cover type is present over many areas, but is not always identifiable on the CIR or true color aerial photography because of differences in the sun's reflection off the marsh surface and sediment deposition onto the algal mat.

Wrack

In some areas, the marsh plain is covered by accumulated dead stems of marsh vegetation that that have been deposited by the tides, obscuring the marsh surface. These areas are delineated as the wrack cover type.

Internal Water Areas

Areas that were covered by surface water at the time of the aerial photography (low tide) were designated as open water. Open water includes the subtidal areas of tidal creeks, guts, channels, ditches, and areas of ponded water within the marsh. These areas generally do not support any significant vegetation.

Interior Channels

This cover type consists of interior channels greater than five feet wide and includes water areas within channels at the time of the aerial photography (low tide) as well as exposed channel mudflat areas between the low tide water line and the adjacent marsh plain.

[3] Areas considered to be non-vegetated may support sparse vegetative cover. To be mapped as vegetated, it is generally necessary that greater than 30 percent of the marsh surface be covered by macrophytes.

Ponded Water

The ponded water cover type represents areas within the reference marsh and wetland restoration sites that are hydrologically isolated and remain inundated at low tide.

Open Water

The open water category includes small portions of major water bodies (e.g., Delaware Bay, Alloways Creek) adjacent to the various restoration sites or reference marshes that occur within the site boundaries.

Upland Vegetation/Miscellaneous Cover Categories

Relatively small areas of upland vegetation and other non-marsh cover categories occur within the restoration area boundary at some sites. While the area of each of these is provided in the tables, they are generally mapped on the Figures in Appendix B as upland "buffer" areas.

Site Descriptions

Discussions of the cover type composition in 2009 at each of the reference marshes and wetland restoration sites are provided in this section. Reference marshes are discussed first, followed by the CT Site, the ACW Site and the Delaware *Phragmites*-dominated restoration sites.

Detailed information on cover type areas for the 2009 monitoring year are presented in Tables 8-1 through 8-4. The percentage of the total marsh area[4] for applicable cover types has been calculated and is included in these tables. Maps showing the 2009 vegetative cover of each reference marsh and wetland restoration site are provided in Appendix B. These maps correspond to the reference marsh and wetland restoration area cover type data presented in Tables 8-1 through 8-4 and show the areas of each site that are vegetated as per the categories below.

Reference Marshes

The extent of each cover category at the reference marshes was based on the interpretation of the 2009 CIR and true color aerial photography as shown in Figures B-1 (MHC Reference Marsh) and B-2 (MBW Reference Marsh) in Appendix B. The acreage of the vegetation cover categories and cover types mapped in 2009 within each of the reference marshes and the relative percent of the total marsh area that each type represents are summarized in Table 8-1.

[4] The total marsh area excludes: 1) areas of each reference marsh and wetland restoration site that are above MHHW, as defined by vegetation interpretation; and 2) tidal wetland areas that were not affected by PSEG's wetland restoration activities at a given site. The latter includes areas that were outside of the salt hay farming dikes at the time of PSEG's acquisition of the site and areas landward of upland dikes that were constructed by PSEG as part of the wetland restoration designs for the sites.

A total of 72.2 percent of the MHC Reference Marsh was covered by *Spartina spp.* and Other Desirable Marsh Vegetation in 2009. Desirable mixed Marsh as the single dominant comprised 34.2 percent of the total marsh area. *Phragmites australis* dominated over areas representing 11.7 percent of the marsh plain in 2009. Interior Water Areas, primarily Channels, made up 14.8 percent.

A total of 84.4 percent of the MBW Reference Marsh was covered by *Spartina spp.* and Other Desirable Marsh Vegetation in 2009. *Spartina alterniflora* as the single dominant comprised 75.2 percent of the total marsh area. *Phragmites australis* dominated areas covered 4.6 percent of the marsh plain. Non-vegetated Marsh Plain and Internal Water Areas made up 2.8 percent and 7.2 percent, respectively, of this reference marsh.

Commercial Township Salt Hay Farm Restoration Site

The extent of each cover category and cover type at the CT Site based on the interpretation of the 2009 CIR aerial photography is shown in Figure B-3 in Appendix B. The acreage of the vegetation cover categories and cover types mapped within the CT Site and the relative percent of the total marsh area that each type represents are summarized in Table 8-2.

Spartina spp./Other Desirable Marsh Vegetation (57.4%) and Non-vegetated Marsh Plain (28.4%) were the dominant cover categories at the CT Site in 2009. Areas dominated by *Spartina alterniflora* represented the most extensive vegetated cover type (occurring over 51.8% of the restoration area). Mud Flat (18.7%) and Mud Flat/*Spartina alterniflora* (9.5%) were the most prevalent non-vegetated cover types. *Phragmites* Dominated Vegetation comprised 2.6 percent of the total marsh area and was also present within areas mapped as *Spartina* spp./Other Desirable Marsh Vegetation with *Phragmites* cover category (0.2%). Internal Water Areas were primarily Channels (8.8%) and Ponded Water (1.5%).

Alloway Creek Watershed *Phragmites* Dominated Wetland Restoration Site

The extent of each cover category at the ACW Site based on the interpretation of the 2009 true color aerial photography is shown in Figure B-4 in Appendix B. The acreage of the vegetation cover categories, cover types mapped and the relative percent of the total marsh area that each type represents are summarized in the Table 8-3.

Spartina spp./Other Desirable Marsh Vegetation comprised 71.4 percent of the total marsh area at the ACW Site in 2009. Individual cover types present within this cover category included: *Spartina alterniflora*/Desirable Mixed Marsh (31.2%), Desirable Mixed Marsh (34.4%), and Mixed Marsh (3.2%). The *Phragmites* Dominated Vegetation cover category represented 14.0 percent of the total marsh area, with monotypic *Phragmites australis* stands representing 8.6 percent, and *Phragmites australis* dominating with other vegetation types representing 3.9 percent. Also included in this cover category are areas of the ACW Site dominated by Dead *Phragmites australis,* representing 1.4 percent of the total marsh area. Non-vegetated Marsh Plain comprised 0.7 percent of the total marsh area. Areas covered by mudflat accounted for most (0.3%) of these areas. Channels represent 13.8 percent of the ACW Site.

Delaware *Phragmites* Dominated Wetland Restoration Sites

The extent of each cover category at the Delaware *Phragmites* dominated wetland restoration sites based on the interpretation of the 2009 true color aerial photography is shown in Figures B-5 (The Rocks) and B-6 (Cedar Swamp) in Appendix B. The acreage of the vegetation cover categories and cover types mapped within each restoration site and the relative percent of the total marsh area that each type represents are summarized in Table 8-4.

The Rocks. *Spartina spp.*/Other Desirable Marsh Vegetation (86.8%) was the most extensive cover category at The Rocks Site in 2009. Individual cover types present within this cover category included: *Spartina alterniflora* (1.3%), Desirable Mixed Marsh (78.8%), and Mixed Marsh (4.1%). The *Phragmites* Dominated Vegetation cover category represented 8.3 percent of the total marsh area, with monotypic *Phragmites australis* stands representing 5.5 percent, and *Phragmites australis* dominating with other types representing 2.6 percent. Also included in this cover category are areas dominated by Dead *Phragmites australis,* representing 0.1 percent of the total marsh area. Non-vegetated Marsh Plain comprised 0.3 percent of the total marsh area. Areas covered by wrack accounted for most (0.1%) of these areas. Internal Water Areas represent 4.1 percent of The Rocks Site, represented primarily by Channels (4.0%).

Cedar Swamp. *Spartina spp.*/Other Desirable Marsh Vegetation (82.5%) was the most extensive cover category at the Cedar Swamp Site in 2009. Individual cover types present within this cover category included: Desirable Mixed Marsh (59.2%), *Spartina alterniflora/Spartina cynosuroides* (10.1%), *Spartina cynosuroides/Spartina alterniflora* (3.7%), and High Marsh Shrubs (1.4%). In addition, *Spartina* spp. /Other Desirable Marsh Vegetation with *Phragmites* represented 6.1 percent of this category, represented primarily by Mixed Marsh areas (4.8%). The *Phragmites* Dominated Vegetation cover category represented 6.3 percent of the total marsh area, with monotypic *Phragmites australis* stands representing 2.8 percent, and *Phragmites australis* dominating with other types representing 2.3 percent. Also included in this cover category are areas dominated by Dead *Phragmites australis,* representing 1.2 percent of the total marsh area. Non-vegetated Marsh Plain comprised 1.1 percent of the total marsh area. Internal Water Areas represent 9.8 percent of the Cedar Swamp Site, represented primarily by Channels (9.8%).

GEOMORPHOLOGIC MAPPING

Maps showing existing hydraulic features on the restoration sites as interpreted from the September 2009 CIR and true color aerial photography of the reference marshes and wetland restoration sites are provided in Appendix C. Mapped features include:

- Center lines of channels between one and five feet in width;
- Edges of channels greater than five feet in width;
- Ponded areas;
- Dikes, dike breaches and internal berms; and
- Miscellaneous roadways.

These maps present the extent of channel systems and other water areas (e.g., ponded areas) as interpreted from the above-referenced photography for these sites. Comments regarding the mapping of the sites are provided in the following paragraphs.

Reference Marshes

The channel systems at the MHC and MBW Reference Marshes based on 2005 CIR and true color aerial photography are shown on Figures C-1 and C-2 in Appendix C. Data representing the 2005 geomorphological characteristics of these reference marshes are presented in Table 8-5.

Commercial Township Salt Hay Farm Wetland Restoration Site

The channel systems at the CT Site in 2009 are shown on Figure C-3 in Appendix C. Data representing the geomorphological characteristics of the CT Site are presented in Table 8-5.

Alloway Creek Watershed *Phragmites* Dominated Wetland Restoration Site

The channel systems at the ACW Site in 2009 are shown on Figure C-4 in Appendix C. Data representing the geomorphological characteristics of the ACW Site are presented in Table 8-5.

Delaware *Phragmites* Dominated Wetland Restoration Sites

The channel systems at The Rocks and Cedar Swamp sites in 2009 are shown on Figures C-5 and C-6 in Appendix C. Data representing the geomorphological characteristics of The Rocks and Cedar Swamp are presented in Table 8-5.

REFERENCE MARSH TRANSECT SAMPLING

Quadrat sampling was conducted during the peak (August) 2009 growing season at the MHC Reference Marsh and MBW Reference Marsh. Percent cover, species identification, flowering status, and height data were collected from both clip and ocular quadrats. Standing crop data (live standing and dead standing) and litter were collected from clip quadrats only.

The field and lab data representing the clip and ocular quadrats along the reference marsh transects during the peak season 2009 macrophyte sampling events are presented in Appendix D. The individual 2009 quadrat data, as well as the means, for percent cover, height (*Spartina alterniflora* and *Spartina cynosuroides*), live standing crop, dead standing crop, and litter for each transect and for all transects at each reference marsh are presented in Appendix D, Tables D-1 and D-2. For each site these means were calculated for: 1) *Spartina alterniflora* dominated[5] (S-d) quadrats, 2) non-*Spartina alterniflora* dominated (e.g., *Phragmites* dominated) quadrats, and 3) for all quadrats.

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[5] *Spartina alterniflora* dominated quadrats include those dominated by *Spartina cynosuroides*.

While the tables in Appendix D present all macrophyte field and laboratory data in detail, several tables have been prepared which summarize the reference marsh transect data collected during the peak growing season. Table 8-6 presents a summary of percent cover by dominance type (*Spartina alterniflora* dominated, non-*Spartina alterniflora* dominated, and all species) for all quadrats (clip and ocular). A summary of percent cover and standing crop data, from clip quadrats only is presented in Table 8-7. The mean percent cover (and mean standing crop), standard error of the mean, standard deviation, minimum, maximum, and number of quadrats for each dominance type are provided in both tables. In addition to the summaries by site, summaries by transect also have been prepared. Table 8-8 presents the means and measures of dispersion (standard error of the mean and standard deviation) by transect for percent cover, height, and standing crop. Data from both clip and ocular quadrats, as applicable, have been used in the calculations in Table 8-8.

Species Composition. *Spartina alterniflora* was the dominant species sampled along transects at the MHC Reference Marsh and MBW Reference Marsh in 2009, recorded in 88 and 96 percent of the quadrats sampled at each site, respectively. Additional species found to be present in the quadrats at the reference marshes are presented in Table 8-9.

Percent Cover. Peak season 2009 percent cover was estimated within all (ocular and clip) quadrats sampled at each reference marsh during the peak season sampling event. The total number of quadrats sampled and number of *Spartina* dominated (S-d) quadrats were as follows:

Site	Peak Season (#)
MHC Reference Marsh	72 (58 S-d)
MBW Reference Marsh	24 (22 S-d)

The mean percent coverage (± SE) for all quadrats in the 2009 sampling event at each reference marsh is graphically shown in Figure 8-8 and was as follows:

Site	Peak Season (%)
MHC Reference Marsh	43 (±2)
MBW Reference Marsh	40 (±4)

The mean percent cover for *Spartina alterniflora* dominated and non-*Spartina alterniflora* dominated quadrats is shown in Figure 8-8. Histograms illustrating the distribution of percent cover determinations for all *Spartina alterniflora* dominated quadrats sampled at the reference marshes are presented in Figures 8-9 and 8-10.

Vegetation Height. The average height of each plant species present was measured for all (ocular and clip) quadrats sampled at each reference marsh during the 2009 peak season sampling event. For *Spartina alterniflora* dominated quadrats (which include *Spartina alterniflora* and *Spartina cynosuroides),* the mean height (±SE) for the 2009 sampling event at each reference marsh was as follows:

Site	Peak Season (cm)
MHC Reference Marsh	118 (±4)
MBW Reference Marsh	117 (±6)

Heights of other species measured within quadrats during the 2009 peak season are presented in Tables D-1 and D-2 (Appendix D).

Flowering Status. Flowering *Spartina alterniflora* was present in 18 percent of the quadrats in which this species occurred along transects at the MHC Reference Marsh during the 2009 peak season sampling event. In comparison, flowering *Spartina alterniflora* was not present in any of the quadrats in which this species occurred at the MBW Reference Marsh. The flowering status for plants within each quadrat sampled is provided in Tables D-1 and D-2 (Appendix D).

Live Standing Crop. Peak season 2009 live standing crop was determined for each reference marsh based on collections of standing living plant materials from clip quadrats along transects. The total number of clip quadrats as well as *Spartina* dominated (S-d) clip quadrats at each reference site were as follows:

Site	Peak Season (#)
MHC Reference Marsh	18 (11 S-d)
MBW Reference Marsh	6 (6 S-d)

The mean values (±SE) for live standing crop in *Spartina alterniflora* dominated quadrats, non-*Spartina alterniflora* dominated quadrats, and all quadrats sampled at each reference marsh in 2009 are presented in Table 8-7 and shown in Figure 8-11. The mean live standing crop for all quadrats was as follows:

Site	Peak Season (gdw/m^2)
MHC Reference Marsh	826 (±145)
MBW Reference Marsh	811 (±79)

Dead Standing Crop. Dead standing crop was determined for each reference marsh based on collections of standing dead plant materials from clip quadrats along transects. The mean values (±SE) for dead standing crop in *Spartina alterniflora* dominated quadrats, non-*Spartina alterniflora* dominated quadrats, and all quadrats sampled at each reference marsh in 2009 are presented in Table 8-7. The mean values (±SE) for dead standing crop for all quadrats at each reference marsh were as follows:

Site	Peak Season (gdw/m^2)
MHC Reference Marsh	50 (±26)
MBW Reference Marsh	43 (±20)

Litter. Plant litter biomass present on the marsh surface was determined based on collection of unattached dead plant materials within clip quadrats along transects at the reference marshes. The mean values (±SE) for litter in *Spartina alterniflora* dominated quadrats, non-*Spartina alterniflora* dominated quadrats, and all quadrats sampled at each reference marsh in 2009 are presented in Table 8-7. The mean values (±SE) for litter biomass in all quadrats at each reference marsh were as follows:

Site	Peak Season (gdw/m^2)
MHC Reference Marsh	65 (±24)
MBW Reference Marsh	18 (±11)

The above tabulations are based on the pooled data for all quadrats *(Spartina alterniflora* dominated and non-*Spartina alterniflora* dominated) in all transects at the reference marshes during the peak-growing season. The following sections present a summary of data from Tables D-1 and D-2 (Appendix D) for quadrats along transects at each reference marsh.

Mad Horse Creek Reference Marsh - Transects

The field and laboratory data representing the clip and ocular quadrats along the MHC Reference Marsh transects during the peak season 2009 macrophyte sampling events are presented in Table D-1, in Appendix D. The means for percent cover, species height (*Spartina alterniflora* dominated only), live standing crop, dead standing crop and litter for each transect are also presented on this table. These means were calculated independently for 1) *Spartina alterniflora* dominated quadrats along each transect, 2) other (e.g., *Phragmites* dominated) quadrats along each transect, and 3) for all quadrats along each transect. Means of each type also were calculated for the site as a whole (i.e., means of all quadrats along all transects). Tables 8-6, 8-7 and 8-8 provide summary information for percent cover, height, live standing crop, dead standing crop and litter biomass as previously described.

Species Composition. *Spartina alterniflora* was the dominant species present in quadrats sampled along transects at MHC Reference Marsh, occurring in 88 percent of the quadrats sampled. The percentage of quadrats in which *Spartina alterniflora* occurred along each transect was as follows: MHT1 (79 percent), MHT2 (100 percent), and MHT3 (78 percent). Additional species found to be present in the quadrats at MHC Reference Marsh were *Amaranthus cannabinus*, *Distichlis spicata*, *Scirpus robustus*, *Spartina patens* and *Spartina cynosuroides*.

Percent Cover. The mean percent aerial cover, as well as measures of dispersion (standard error of the mean, standard deviation), for quadrats along each transect at MHC Reference Marsh during the 2009 peak growing season are presented in Table 8-8. Field data for each quadrat are presented in Table D-1 (Appendix D). The total number of quadrats (clip and ocular) along each transect was as follows:

Transect	Peak Season (#)
MHT1	24 (19 S-d)
MHT2	8 (8 S-d)
MHT3	40 (31 S-d)

The mean percent cover (± SE) for all quadrats along each transect in 2009, and for *Spartina alterniflora* dominated quadrats (shown graphically in Figure 8-12) only were as follows:

Transect	All Quadrats (%)	S-d Quadrats (%)
MHT1	41 (±3)	43(±3)
MHT2	44 (±5)	44 (±5)
MHT3	45 (±3)	43 (±3)

Vegetation Height. The average height of each plant species present was measured for all (ocular and clip) quadrats sampled at MHC Reference Marsh during the 2009 peak season sampling event. For *Spartina* dominated quadrats, the mean height (±SE) of *Spartina alterniflora* and/or *Spartina cynosuroides* was as follows:

Transect	Peak Season (cm)
MHT1	122 (±4)
MHT2	153 (±6)
MHT3	107 (±5)

Heights for all species of vegetation present in the quadrats in 2009 are presented in Table D-1.

Live Standing Crop. Live standing crop was determined for each transect at MHC Reference Marsh based on collections of living standing plant materials from clip quadrats along each transect. The number of clip quadrats along each transect was as follows:

Transect	Peak Season (#)
MHT1	6 (5 S-d)
MHT2	2 (2 S-d)
MHT3	10 (4 S-d)

The mean values (±SE) for live standing crop in all clip quadrats during the 2009 peak season sampling of MHC Reference Marsh transects, and for all *Spartina alterniflora* dominated clip quadrats, were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (gdw/m^2)
MHT1	1109 (±411)	1310 (±438)
MHT2	1005 (±67)	1005 (±67)
MHT3	620 (±68)	474 (±83)

Mean live standing crop determinations for *Spartina alterniflora* dominated quadrats only sampled during the 2009 peak season are shown graphically in Figure 8-13.

Dead Standing Crop. The mean values (±SE) for dead standing crop in all clip quadrats during the 2009 peak season sampling of MHC Reference Marsh transects were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (gdw/m^2)
MHT1	136 (±68)	135 (±83)
MHT2	0 (±0)	0 (±0)
MHT3	9 (±9)	0 (±0)

Litter. The mean values (±SE) for litter biomass in clip quadrats during the 2009 peak season sampling of MHC Reference Marsh transects were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (gdw/m^2)
MHT1	158 (±53)	112 (±33)
MHT2	59 (±59)	59 (±59)
MHT3	10 (±10)	25 (±25)

Moores Beach West Reference Marsh - Transects

The field and laboratory data representing clip and ocular quadrats along MBW Reference Marsh transects during the 2009 peak season macrophyte sampling events are presented in Table D-2, in Appendix D. The means for percent cover, species height (*Spartina alterniflora* dominated only), live standing crop, dead standing crop and litter biomass for each transect are also presented on this table. The means were calculated independently for: 1) *Spartina alterniflora* dominated quadrats along each transect, 2) other (e.g., *Phragmites* dominated) quadrats along each transect, and 3) for all quadrats along each transect. Means of each type also were calculated for the site as a whole (i.e., means of all quadrats along all transects). Tables 8-6, 8-7 and 8-8 provide summary information for percent cover, height, live standing crop, dead standing crop and litter biomass as previously described.

Species Composition. *Spartina alterniflora* was the dominant species present in quadrats sampled along transects at MBW Reference Marsh, occurring in 96 percent of the quadrats sampled in 2009. The percentage of quadrats in which *Spartina alterniflora* occurred along each transect was as follows: MBT1 (88 percent), MBT2 (100 percent), and MBT3 (100 percent). *Spartina paten* was also found in MBT1.

Percent Cover. The mean percent aerial cover, as well as measures of dispersion (standard error of the mean, standard deviation), for quadrats along each transect at MBW Reference Marsh during the 2009 peak growing season are presented in Table 8-8. Field data for each quadrat are presented in Table D-2. The total number of quadrats (clip and ocular) from which percent cover data were collected along each transect was as follows:

Transect	Peak Season (#)
MBT1	8 (7 S-d)
MBT2	8 (7 S-d)
MBT3	8 (8 S-d)

The mean percent cover (±SE) for all quadrats along each transect, and for all *Spartina alterniflora* dominated quadrats (shown graphically in Figure 8-12) were as follows:

Transect	All Quadrats (%)	S-d Quadrats (%)
MBT1	59 (±8)	53 (±6)
MBT2	25 (±3)	27 (±2)
MBT3	38 (±3)	38 (±3)

Vegetation Height. The average height of each plant species present was measured for all (ocular and clip) quadrats sampled at MBW Reference Marsh during the 2009 peak season sampling event. The mean height (±SE) for *Spartina* dominated quadrats (which included *Spartina alterniflora* and *Spartina cynosuroides*) at MBW Reference Marsh was as follows:

Transect	Peak Season (cm)
MBT1	96 (±2)
MBT2	132 (±15)
MBT3	121 (±4)

Live Standing Crop. Live standing crop was determined for each transect at MBW Reference Marsh based on collections of living standing plant materials from clip quadrats along each transect. The number of clip quadrats sampled along each transect in 2009 was as follows:

Transect	Peak Season (#)
MBT1	2 (2 S-d)
MBT2	2 (2 S-d)
MBT3	2 (2 S-d)

The mean values (±SE) for live standing crop in all clip quadrats during the 2009 peak season sampling of MBW Reference Marsh transects, and for all *Spartina alterniflora* dominated clip quadrats, were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (gdw/m^2)
MBT1	656 (±22)	656 (±22)
MBT2	956 (±176)	956 (±176)
MBT3	822 (±133)	822 (±133)

Live standing crop determinations for the 2009 peak season are shown graphically in Figure 8-13.

Dead Standing Crop. The mean values (±SE) for dead standing crop in all clip quadrats during the 2009 peak season sampling of MBW Reference Marsh transects, and for all *Spartina alterniflora* dominated clip quadrats, were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (gdw/m^2)
MBT1	34 (±34)	34 (±34)
MBT2	52 (±52)	52 (±52)
MBT3	44 (±44)	44 (±44)

Litter. The mean values (±SE) for litter biomass in all clip quadrats during the 2009 peak season sampling of MBW Reference Marsh transects, and for all *Spartina alterniflora* dominated clip quadrats, were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (gdw/m^2)
MBT1	28 (±28)	28 (±28)
MBT2	0 (±0)	0 (±0)
MBT3	26 (±26)	26 (±26)

REFERENCE MARSH PLOT SAMPLING

The field and laboratory data representing clip quadrats within 60 m x 60 m plots during the peak season 2009 macrophyte sampling event are presented in Appendix E. The individual

quadrat data as well as means for percent cover and live standing crop are presented in Tables E-1 (MHC Reference Marsh) and E-2 (MBW Reference Marsh). Summary data for each plot, and for each reference marsh are presented in Table 8-10. The summary data includes mean percent cover, live standing crop and dead standing crop as well as measures of dispersion (standard deviation, standard error of the mean, minimum and maximum). Because the plots were located to provide representative data for selected *Spartina alterniflora* dominated areas of each site, means and measures of dispersion have not been calculated for *Spartina alterniflora* dominated quadrats separately.

The percent cover and standing crop data for the MHC Reference Marsh and MBW Reference Marsh plots as a whole are presented here, followed by a discussion of individual plots within each location.

Percent Cover. Peak season 2009 percent cover was estimated within randomly sampled quadrats in three 60 m x 60 m plots located at each reference marsh. Since each plot contained nine (9) randomly located quadrats, the total number of percent cover estimates for each reference marsh was twenty-seven (27). The mean percent coverage (±SE) for all quadrats at each reference marsh was as follows:

Site	Peak Season (%)
MHC Reference Marsh	34 (±2)
MBW Reference Marsh	39 (±3)

Live Standing Crop. Peak season 2009 live standing crop was determined for each reference marsh based on collections of standing living plant materials from the 27 quadrats within each of the 60 m x 60 m plots at each of the reference marshes. The mean live standing crop (±SE) for all quadrats at each reference marsh was as follows:

Site	Peak Season (gdw/m^2)
MHC Reference Marsh	771 (±57)
MBW Reference Marsh	698 (±53)

The following sections present data for individual 60 m x 60 m plots at each reference marsh in 2009.

Mad Horse Creek Reference Marsh - Plots

Three 60 m x 60 m plots were sampled at MHC Reference Marsh in August 2009. Nine (9) quadrats were sampled within each plot for percent cover and live standing crop. Individual quadrat data are presented in Table E-1.

Species Composition. *Spartina alterniflora* was the dominant species present in quadrats sampled in plots at MHC Reference Marsh, occurring in 96 percent of the quadrats sampled in 2009. The percentage of quadrats in which *Spartina alterniflora* occurred within each plot was as follows: MHP1 (100 percent), MHP2 (100 percent), and MHP3 (89 percent). Additional species found to be present in the quadrats at MHC Reference Marsh were *Spartina cynosuroides*, *Scirpus robustus*, *Spartina patens* and *Distichlis spicata*..

Percent Cover. The peak season 2009 mean percent aerial cover, as well as measures of dispersion (standard error of the mean, standard deviation, minimum and maximum), for each plot are presented in Table 8-10. The mean percent cover (±SE) for each plot is graphically shown in Figure 8-14 and was as follows:

Plot	Peak Season (%)
MHP1	29 (±3)
MHP2	47 (±3)
MHP3	24 (±2)

Live Standing Crop. The peak season 2009 mean live standing crop as well as measures of distribution around the mean for each plot is presented in Table 8-10. The mean live standing crop (±SE) for each plot is graphically shown in Figure 8-15 and was as follows:

Plot	Peak Season (gdw/m^2)
MHP1	836 (±104)
MHP2	866 (±109)
MHP3	612 (±64)

Moores Beach West Reference Marsh - Plots

Three 60 m x 60 m plots were sampled at MBW Reference Marsh in August 2009. Nine (9) quadrats were sampled within each plot for percent cover and live standing crop. Individual quadrat data are presented in Table E-2.

Species Composition. *Spartina alterniflora* was the dominant species present in quadrats sampled in plots at MBW Reference Marsh, occurring in 93 percent of the quadrats sampled in 2009. The percentage of quadrats in which *Spartina alterniflora* occurred within each plot was as follows: MBP1 (89 percent), MBP2 (89 percent), and MBP3 (100 percent).

Percent cover. The peak season 2009 mean percent aerial cover, as well as measures of dispersion (standard error of the mean, standard deviation, minimum and maximum), for each plot are presented in Table 8-10. The mean percent cover (±SE) for each plot is graphically shown in Figure 8-14 and was as follows:

Plot	Peak Season (%)
MBP1	35 (±4)
MBP2	34 (±7)
MBP3	47 (±4)

Live standing crop. The peak season 2009 mean live standing crop as well as measures of dispersion for each plot are presented in Table 8-10. The mean live standing crop (±SE) for each plot is graphically shown in Figure 8-15 and were as follows:

Plot	Peak Season (gdw/m^2)
MBP1	692 (±90)
MBP2	512 (±60)
MBP3	869 (±81)

COMMERCIAL TOWNSHIP SALT HAY FARM WETLAND RESTORATION SITE TRANSECT SAMPLING

The field and laboratory data representing the clip and ocular quadrats along transects at the CT Site during the 2009 peak season macrophyte sampling event are presented in Table D-3 in Appendix D. The individual quadrat data, as well as the means for percent cover, height (*Spartina alterniflora* and *Spartina cynosuroides*), live standing crop, dead standing crop and litter biomass for each transect are also presented on this table. For each transect, these means were calculated independently for: 1) *Spartina alterniflora* dominated (S-d) quadrats, 2) other (e.g., *Phragmites* dominated) quadrats, and 3) the site as a whole. Tables 8-6, 8-7, and 8-8 provide summary information for percent cover, height, live standing crop, dead standing crop, and litter biomass as previously described. The mean percent cover and live standing crop for the 2009 peak growing season also are presented graphically in Figures 8-16 and 8-21, respectively.

Data were collected from both clip and ocular quadrats. Percent cover, species identification, flowering status and height data were collected from both clip and ocular quadrats; live standing crop, dead standing crop, and litter biomass were collected from clip quadrats only.

Species Composition. *Spartina alterniflora* was present in 69 percent of the quadrats sampled at the CT Site in 2009. The other quadrats sampled were located in mudflat areas of the marsh plain.

Percent Cover. Percent cover was estimated within all (ocular and clip) quadrats sampled at the

sites during the 2009 peak season sampling event. A total of 22 quadrats were sampled along transects at the CT Site. The mean percent cover (±SE) for all quadrats during the 2009 peak season sampling event at the salt hay farm wetland restoration site (graphically shown in Figure 8-16) was 30% (±3%). Figure 8-17 shows the percent cover groupings for *Spartina alterniflora* dominated quadrats at the CT Site.

Vegetation Height. The average height of each plant species present was measured for all (ocular and clip) quadrats sampled at the site during the 2009 peak growing season sampling event. For *Spartina alterniflora* dominated quadrats (which include *Spartina alterniflora* and *Spartina cynosuroides),* the mean heights (±SE) at the CT Site in 2009 was 164cm (±14 cm). Heights for other species of vegetation present in the quadrats are presented in Table D-4.

Flowering Status. Flowering *Spartina alterniflora* was present in zero percent of the quadrats in which this species occurred along transects at the CT Site during the 2009 peak season sampling event. The flowering status for plants within each quadrat sampled is provided in Table D-3.

Live Standing Crop. Peak season 2009 live standing crop was determined for the site based on collections of standing living plant materials from clip quadrats along the transects. The number of clip quadrats sampled along transects in 2009 was eight (8), seven (7) of which were *Spartina alterniflora* dominated. The mean value (±SE) for live standing crop at the CT Site is shown in Figure 8-21 and was 835 gdw/m^2 (±171 gdw/m^2).

Dead Standing Crop. Dead standing crop was determined for the site based on collections of standing dead plant materials from clip quadrats along transects. The mean values (±SE) for dead standing crop in *Spartina alterniflora* dominated quadrats, non-*Spartina alterniflora* dominated quadrats, and all quadrats sampled at the site in 2009 are presented in Table 8-7. There was no dead standing crop present during the 2009 sampling event.

Litter. The plant litter biomass present on the marsh surface was determined based on collection of unattached dead plant materials within clip quadrats along transects at the restoration site in 2009. The mean value (±SE) for litter biomass at the site was 14 gdw/m^2 (±9 gdw/m^2).

The above discussions are based on the pooled data for all quadrats at the CT Site during the peak growing season. The following sections present a summary of data from Appendix D, Table D-3 for quadrats along individual transects at the site.

CT Site - Transects

The field and laboratory data representing the clip and ocular quadrats along the Commercial Township Wetland Restoration Site transects during the peak season 2009 macrophyte sampling event are presented in Table D-3, in Appendix D. The means for percent cover, species height (*Spartina alterniflora* dominated only), live standing crop, dead standing crop and litter biomass for each transect are also presented on this table. These means were calculated independently for: 1) *Spartina alterniflora* dominated quadrats along each transect, 2) other (e.g., *Phragmites* dominated) quadrats along each transect, and 3) for all quadrats along each transect. Means of

each type also were calculated for the site as a whole (i.e., means of all quadrats along all transects). Tables 8-6, 8-7 and 8-8 provide summary information for percent cover, height, live standing crop, dead standing crop and litter biomass as previously described.

Species Composition. *Spartina alterniflora* was present in 69 percent of the quadrats sampled along transects at the CT Site in 2009. The percentage of quadrats in which *Spartina alterniflora* occurred along each transect was as follows: CTT1 (88 percent), CTT2 (75 percent), CTT3 (63 percent) and CTT4 (50 percent).

Percent Cover. The mean percent aerial cover, as well as measures of dispersion (standard error of the mean, standard deviation), for quadrats along each transect at the CT Site during the 2009 peak growing season are presented in Table 8-8. Field data for each quadrat are presented in Table D-3. The number of quadrats (clip and ocular) along each transect was as follows:

Transect	Peak Season (#)
CTT1	7 (7 S-d)
CTT2	6 (4 S-d)
CTT3	5 (3 S-d)
CTT4	4 (3 S-d)

The mean percent cover (±SE) for all quadrats along each transect, and for *Spartina alterniflora* dominated quadrats (shown graphically in Figure 8-22) were as follows:

Transect	All Quadrats (%)	S-d Quadrats (%)
CTT1	41 (±3)	41 (±3)
CTT2	19 (±4)	25 (±2)
CTT3	30 (±7)	42 (±3)
CTT4	28 (±9)	35 (±6)

Vegetation Height. The average height of each plant species present was measured for all (ocular and clip) quadrats sampled at the CT Site during the 2009 peak season sampling event. For *Spartina* dominated quadrats, the mean height (±SE) of *Spartina alterniflora* and *Spartina cynosuroides* were as follows:

Transect	Peak Season (cm)
CTT1	108 (±16)
CTT2	167 (±13)
CTT3	93 (±6)
CTT4	126 (±8)

Live Standing Crop. Peak season 2009 live standing crop was determined for each transect at the site based on collections of living standing plant materials from clip quadrats along each transect. The number of clip quadrats along each transect was as follows:

Transect	Peak Season (#)
CTT1	2 (2 S-d)
CTT2	2 (2 S-d)
CTT3	2 (1 S-d)
CTT4	2 (2 S-d)

The mean values (±SE) for live standing crop in all clip quadrats during the peak season sampling of the CT Site transects, and for *Spartina alterniflora*-dominated quadrats only (shown graphically in Figure 8-24), were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (gdw/m^2)
CTT1	1,068 (±294)	1,068 (±294)
CTT2	580 (±151)	580 (±151)
CTT3	551 (±400)	951 (±n/a)
CTT4	1,140 (±506)	1,140 (±506)

Dead Standing Crop. The mean values (±SE) for dead standing crop in all clip quadrats during the 2009 peak season sampling of the CT Site transects, and for *Spartina alterniflora*-dominated quadrats only, were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (gdw/m^2)
CTT1	0 (±0)	0 (±0)
CTT2	0 (±0)	0 (±0)
CTT3	0 (±0)	0 (±n/a)
CTT4	0 (±0)	0 (±0)

Litter. The mean values (±SE) for litter biomass in all clip quadrats during the 2009 peak season sampling of the CT Site transects, and for *Spartina alterniflora*-dominated quadrats only, were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (gdw/m^2)
CTT1	0 (±0)	0 (±0)
CTT2	0 (±0)	0 (±0)
CTT3	54 (±11)	43 (±n/a)
CTT4	0 (±0)	0 (±0)

COMMERCIAL TOWNSHIP SALT HAY FARM WETLAND RESTORATION SITE PLOT SAMPLING

Four 60 m x 60 m plots were sampled at the CT Site in August 2009. Nine (9) quadrats were sampled within each plot for percent cover and live standing crop. Individual quadrat data are presented in Appendix E, Table E-3.

Species Composition. *Spartina alterniflora* was present in 70 percent of the quadrats sampled within plots at the CT Site in 2009. The percentage of quadrats in which *Spartina alterniflora* occurred in each plot was as follows: CTP1 (44 percent), CTP2 (89 percent), and CTP3 (78 percent).

Percent Cover. The 2009 peak season mean percent aerial cover, as well as measures of dispersion (standard error of the mean, standard deviation, minimum and maximum), for the plots at each site are presented in Table 8-10. The mean percent cover for the plots at the CT Site (graphically shown in Figure 8-26) were as follows:

Transect	Peak Season (%)
CTP1	49 (±5)
CTP2	41 (±5)
CTP3	35 (±4)

Live Standing Crop. The 2009 peak season mean live standing crop as well as measures of dispersion (standard error of the mean, standard deviation, minimum and maximum), for the plots at each site are presented in Table 8-10. The mean live standing crop for the plots at the CT Site (graphically shown in Figure 8-27) were as follows:

Transect	Peak Season (gdw/m^2)
CTP1	611 (±277)
CTP2	1,108 (±142)
CTP3	1,088 (±158)

ALLOWAY CREEK WATERSHED *PHRAGMITES* DOMINATED WETLAND RESTORATION SITE TRANSECT SAMPLING

The field and laboratory data representing the clip and ocular quadrats along transects at the ACW Site during the 2009 peak season macrophyte sampling event is presented in Table D-4, in Appendix D. The individual quadrat data, as well as the means for percent cover, height (*Spartina alterniflora* and *Spartina cynosuroides*), live standing crop, dead standing crop and litter biomass for each transect are also presented on this table. For each transect, these means were calculated independently for: 1) *Spartina alterniflora*-dominated (S-d) quadrats, 2) other (e.g., *Phragmites* dominated) quadrats, and 3) the site as a whole. Tables 8-6, 8-7, and 8-8

provide summary information for percent cover, height, live standing crop, dead standing crop, and litter biomass as previously described. The average percent cover and live standing crop for the peak growing season also are presented graphically in Figures 8-16 and 8-21, respectively.

Data were collected from both clip and ocular quadrats. Percent cover, species identification, flowering status and height data were collected from both clip and ocular quadrats; live standing crop, dead standing crop, and litter biomass were collected from clip quadrats only.

Species Composition. *Spartina alterniflora* was the most common dominant species present in quadrats sampled along transects at the ACW Site, occurring in 80 percent of the quadrats sampled. *Phragmites australis* was present in 17 percent of the quadrats. Other species occurring within quadrats included *Spartina cynosuroides*, *Echinochloa walteri, Amaranthus cannabinus, Spartina cynosuroides, Scirpus robustus, Scirpus validus, Polygonum punctatum*, and *Peltandra virginica.*

Percent Cover. Percent cover was estimated within all (ocular and clip) quadrats sampled at the sites during the 2009 peak season sampling event. A total of 62 quadrats were sampled along transects at the ACW Site. The mean percent cover (±SE) for all quadrats (graphically shown in Figure 8-16) were 37% (±2%). Figure 8-18 shows the percent cover groupings for *Spartina alterniflora* dominated quadrats at the ACW Site.

Vegetation Height. The average height of each plant species present was measured for all (ocular and clip) quadrats sampled at the site during the 2009 peak growing season sampling event. For *Spartina alterniflora* dominated quadrats (which include *Spartina alterniflora* and *Spartina cynosuroides),* the mean heights (±SE) at the ACW Site were 136 (±5). Heights for other species of vegetation present in the quadrats are presented in Table D-4.

Flowering Status. Flowering *Spartina alterniflora* was present in 56 percent of the quadrats in which this species occurred along transects at the ACW Site during the 2009 peak season sampling event. The flowering status for species within each quadrat at the ACW Site in 2009 is provided in Table D-4 (Appendix D).

Live Standing Crop. Peak season 2009 live standing crop was determined for the ACW Site based on collections of standing living plant materials from clip quadrats along transects. The total number of clip quadrats for all transects was 16 (10 S-d). The mean value (±SE) for live standing crop for all quadrats is shown in Figure 8-21 and was 1030 (±160) (gdw/m^2).

In addition to the mean live standing crop for all quadrats in the restoration sites, the mean live standing crop values for *Spartina alterniflora* dominated and non-*Spartina alterniflora* dominated quadrats were calculated and are presented in Table 8-7.

Dead Standing Crop. Peak season 2009 dead standing crop was determined based on collections of standing dead plant materials from clip quadrats along transects at the restoration sites. The mean value (±SE) for dead standing crop at the site was 45 (±32) (gdw/m^2).

Litter. The plant litter biomass present on the marsh surface in 2009 was determined based on

collection of unattached dead plant materials within clip quadrats along transects at the restoration sites. The mean value (±SE) for litter biomass at the site was 47 (±14) (gdw/m^2).

The above discussions are based on the pooled data for all quadrats at the ACW Site during the peak growing season. The following sections present a summary of data from Appendix D, Table D-4 for quadrats along individual transects at the site.

ACW Site - Transects

The field and laboratory data representing the clip and ocular quadrats along the ACW Site transects during the peak season 2009 macrophyte sampling event are presented in Table D-4, in Appendix D. The means for percent cover, species height (*Spartina alterniflora* dominated only), live standing crop, dead standing crop and litter biomass for each transect are also presented on this table. These means were calculated independently for: 1) *Spartina alterniflora* dominated quadrats along each transect, 2) other (e.g., *Phragmites* dominated) quadrats along each transect, and 3) for all quadrats along each transect. Means of each type also were calculated for the site as a whole (i.e., means of all quadrats along all transects). Tables 8-6, 8-7 and 8-8 provide summary information for percent cover, height, live standing crop, dead standing crop and litter biomass as previously described.

Species Composition. *Spartina alterniflora* was present in 80 percent of the quadrats sampled along transects at the ACW Site in 2009. The percentage of quadrats in which *Spartina alterniflora* occurred along each transect was as follows: ACWT1 (100 percent), ACWT2 (79 percent), ACWT3 (69 percent) and ACWT4 (81 percent).

Percent Cover. The peak season 2009 mean percent aerial cover, as well as measures of dispersion (standard error of the mean, standard deviation), for quadrats along each transect at the ACW Site are presented in Table 8-8. Field data for each quadrat are presented in Table D-4. The number of quadrats (clip and ocular) along each transect was as follows:

Transect	Peak Season (#)
ACWT1	8 (8 S-d)
ACWT2	22 (20 S-d)
ACWT3	16 (9 S-d)
ACWT4	16 (9 S-d)

The mean percent cover (±SE) for all quadrats along each transect, and for *Spartina alterniflora*-dominated quadrats only (shown graphically in Figure 8-22), were as follows:

Transect	All Quadrats (%)	S-d Quadrats (%)
ACWT1	35 (±5)	35 (±5)
ACWT2	33 (±3)	33 (±4)
ACWT3	36 (±4)	40 (±5)

ACWT4	43 (±6)	53 (±7)

Vegetation Height. The average height of each plant species present was measured for all (ocular and clip) quadrats sampled at the ACW Site during the 2009 peak season sampling event. For *Spartina* dominated quadrats, the mean height (±SE) of *Spartina alterniflora* and *Spartina cynosuroides* for each transect at the site was as follows:

Transect	Peak Season (cm)
ACWT1	110 (±5)
ACWT2	158 (±8)
ACWT3	121 (±4)
ACWT4	141 (±6)

Heights for other species of vegetation present in the quadrats are presented in Table D-4.

Live Standing Crop. Peak season 2009 live standing crop was determined for each transect at the site based on collections of living standing plant materials from clip quadrats along each transect. The number of clip quadrats along each transect was as follows:

Transect	Peak Season (#)
ACWT1	2 (2 S-d)
ACWT2	6 (4 S-d)
ACWT3	4 (2 S-d)
ACWT4	4 (2 S-d)

The mean values (±SE) for live standing crop in all clip quadrats during the 2009 peak season sampling of the ACW Site transects, and for *Spartina alterniflora*-dominated quadrats only (shown graphically in Figure 8-24), were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (%)
ACWT1	909 (±203)	909 (±203)
ACWT2	1,684 (±143)	1,743 (±216)
ACWT3	296 (±137)	501 (±164)
ACWT4	843 (±169)	703 (±224)

Dead Standing Crop. The mean values (±SE) for dead standing crop in all clip quadrats during the 2009 peak season sampling of the ACW Site transects were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (%)
ACWT1	0 (±0)	0 (±0)
ACWT2	0 (±0)	0 (±0)
ACWT3	157 (±123)	0 (±0)
ACWT4	23 (±15)	32 (±32)

Litter. The mean values (±SE) for litter biomass in all clip quadrats during the 2009 peak season sampling of the ACW Site transects were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (%)
ACWT1	0 (±0)	0(±0)
ACWT2	68 (±22)	46 (±28)
ACWT3	57 (±33)	0 (±0)
ACWT4	31(±31)	62 (±62)

ALLOWAY CREEK WATERSHED *PHRAGMITES* DOMINATED WETLAND RESTORATION SITE PLOT SAMPLING

Three 60 m x 60 m plots were sampled at the ACW Site in August 2009. Nine (9) quadrats were sampled within each plot for percent cover and live standing crop. Individual quadrat data are presented in Appendix E, Table E-4.

Species Composition. *Spartina alterniflora* was the most common dominant species present in quadrats sampled within plots at the ACW Site, occurring in 74 percent of the quadrats sampled. The percentage of quadrats in which *Spartina alterniflora* occurred within each plot was as follows: ACWP1 (33 percent), ACWP2 (89 percent), and ACWP3 (100 percent).

Percent Cover. The peak season 2009 mean percent aerial cover, as well as measures of dispersion (standard error of the mean, standard deviation, minimum and maximum), for the plots at each site are presented in Table 8-10. The mean percent cover for the plots at the ACW Site (graphically shown in Figure 8-26) was as follows:

Plot	Peak Season (%)
ACWP1	32 (±10)
ACWP2	30 (±3)
ACWP3	45 (±7)

Live Standing Crop. The peak season 2009 mean live standing crop as well as measures of dispersion for the plots at each site are presented in Table 8-10. The mean live standing crop for the plots at the ACW Site (graphically shown in Figure 8-27) were as follows:

Plot	Peak Season (gdw/m^2)
ACWP1	435 (±168)
ACWP2	691 (±78)
ACWP3	799 (±97)

DELAWARE *PHRAGMITES* DOMINATED WETLAND RESTORATION SITES TRANSECT SAMPLING

The field and laboratory data representing the clip and ocular quadrats along transects at The Rocks and Cedar Swamp Sites in Delaware during the 2009 peak season macrophyte sampling event are presented in Tables D-5 and D-6, in Appendix D. The individual quadrat data, as well as the means for percent cover, height (*Spartina alterniflora* and *Spartina cynosuroides*), live standing crop, dead standing crop and litter biomass for each transect are also presented on this table. For each transect, these means were calculated independently for: 1) *Spartina alterniflora*-dominated (S-d) quadrats, 2) other (e.g., *Phragmites* dominated) quadrats, and 3) the site as a whole. Tables 8-6, 8-7, and 8-8 provide summary information for percent cover, height, live standing crop, dead standing crop, and litter biomass as previously described. The average percent cover and live standing crop for the peak-growing season also are presented graphically in Figures 8-16 and 8-21, respectively.

Data were collected from both clip and ocular quadrats. Percent cover, species identification, flowering status and height data were collected from both clip and ocular quadrats; live standing crop, dead standing crop, and litter biomass were collected from clip quadrats only.

Species Composition. *Spartina alterniflora* and/or *Spartina cynosuroides* occurred within 85 percent of the quadrats sampled along transects at The Rocks Site in 2009. *Phragmites australis* was present in 18 percent of the quadrats. The vegetation cover at The Rocks Site is diverse, with nine other species occurring within the quadrats sampled.

Spartina alterniflora and/or *Spartina cynosuroides* occurred within 99 percent of the quadrats sampled along transects at the Cedar Swamp Site in 2009. *Phragmites australis* was present in 1 percent of the quadrats. Other species present at Cedar Swamp included *Pluchea purpurascens, Iva frutescens, Echinchloa walteri, Spartina patens,* and *Scirpus olneyi.*

Percent Cover. Percent cover was estimated within all (ocular and clip) quadrats sampled at the sites during the 2009 peak season sampling event. A total of 78 quadrats were sampled along transects at The Rocks Site and 79 quadrats were sampled at the Cedar Swamp Site. The mean percent cover (±SE) for all quadrats during the 2009 peak season sampling event at the Delaware *Phragmites* dominated wetland restoration sites (graphically shown in Figure 8-16) were as follows:

Site	Peak Season (%)
The Rocks	41 (±2)
Cedar Swamp	44 (±2)

Figures 8-19 and 8-20 show the percent cover groupings for *Spartina alterniflora* dominated quadrats at The Rocks and Cedar Swamp Sites, respectively.

Vegetation Height. The average height of each plant species present was measured for all (ocular and clip) quadrats sampled at the site during the peak growing season sampling event. For *Spartina alterniflora* dominated quadrats (which include *Spartina alterniflora* and *Spartina cynosuroides),* the mean height (±SE) for the 2009 sampling event at each Delaware *Phragmites* dominated restoration site was as follows:

Site	Peak Season (cm)
The Rocks	125 (±6)
Cedar Swamp	122 (±5)

Heights for all species of vegetation present in the quadrats are presented in Tables D-5 and D-6.

Flowering Status. Flowering *Spartina alterniflora* was present in 18 percent of the quadrats in which this species occurred along transects at The Rocks Site during the 2009 peak season sampling event. The flowering status for species within each quadrat at The Rocks Site in 2009 is provided in Table D-5 (Appendix D).

Flowering *Spartina alterniflora* was present in 4 percent of the quadrats in which this species occurred along transects at the Cedar Swamp Site during the 2009 peak season sampling event. The flowering status for species within each quadrat at the Cedar Swamp Site in 2009 is provided in Table D-6 (Appendix D).

Live Standing Crop. Peak season 2009 live standing crop was determined for each site based on collections of standing living plant materials from clip quadrats along transects. The number of clip quadrats along each transect was as follows:

Site	Peak Season (#)
The Rocks	20 (14 S-d)
Cedar Swamp	19 (13 S-d)

The mean value (±SE) for live standing crop at each site is shown in Figure 8-21 and was as follows:

Site	Peak Season (gdw/m^2)
The Rocks	824 (±81)
Cedar Swamp	655 (±91)

In addition to the mean live standing crop for all quadrats in the restoration site, the mean live standing crop values for *Spartina alterniflora* dominated and non-*Spartina alterniflora* dominated quadrats were calculated and are presented in Table 8-7.

Dead Standing Crop. Peak season 2009 dead standing crop was determined based on collections of standing dead plant materials from clip quadrats along transects at the restoration sites. The mean values (±SE) for dead standing crop were as follows:

Site	Peak Season (gdw/m^2)
The Rocks	46 (±22)
Cedar Swamp	138 (±41)

Litter. The peak season 2009 plant litter biomass present on the marsh surface was determined based on collection of unattached dead plant materials within clip quadrats along transects at the restoration sites. The mean value (±SE) for litter biomass at the sites was as follows:

Site	Peak Season (gdw/m^2)
The Rocks	118 (±42)
Cedar Swamp	74 (±21)

The above discussions are based on the pooled data for all quadrats at The Rocks and Cedar Swamp Sites during the peak growing season. The following sections present a summary of data from Appendix D, Tables D-5 and D-6 for quadrats along individual transects at each site.

The Rocks Site – Transects

The field and laboratory data representing the clip and ocular quadrats along The Rocks Site transects during the peak season 2009 macrophyte sampling event are presented in Table D-5, in Appendix D. The means for percent cover, species height (*Spartina alterniflora* dominated only), live standing crop, dead standing crop and litter biomass for each transect are also presented on this table. These means were calculated independently for: 1) *Spartina alterniflora* dominated quadrats along each transect, 2) other (e.g., *Phragmites* dominated) quadrats along each transect, and 3) for all quadrats along each transect. Means of each type also were calculated for the site as a whole (i.e., means of all quadrats along all transects). Tables 8-6, 8-7 and 8-8 provide summary information for percent cover, height, live standing crop, dead standing crop and litter biomass as previously described.

Species Composition. *Spartina alterniflora* and/or *Spartina cynosuroides* was present in 85 percent of the quadrats sampled along transects at The Rocks Site in 2009. The percentage of quadrats in which one or both of these species occurred along each transect was as follows: TRT1 (81 percent), TRT2 (94 percent), TRT3 (73 percent) and TRT4 (100 percent). Some of the quadrats sampled along TRT3 are dominated by *Spartina patens* and/or *Scirpus olneyi*. *Phragmites australis* occurred in 1 percent of the quadrats sampled along the transects.

Percent Cover. The mean percent aerial cover, as well as measures of dispersion (standard error of the mean, standard deviation), for quadrats along each transect at The Rocks Site during the 2009 peak growing season are presented in Table 8-8. Field data for each quadrat are presented in Table D-5. The number of quadrats (clip and ocular) along each transect was as follows:

Transect	Peak Season (#)
TRT1	16 (12 S-d)
TRT2	16 (16 S-d)
TRT3	30 (8 S-d)
TRT4	16 (14 S-d)

The mean percent cover (±SE) for all quadrats along each transect, and for *Spartina alterniflora*-dominated quadrats only (shown graphically in Figure 8-23), were as follows:

Transect	All Quadrats (%)	S-d Quadrats (%)
TRT1	31 (±2)	31 (±2)
TRT2	40(±2)	40 (±2)
TRT3	45 (±3)	45 (±4)
TRT4	48 (±3)	47 (±4)

Vegetation Height. The average height of each plant species present was measured for all (ocular and clip) quadrats sampled at The Rocks Site during the 2009 peak season sampling event. For *Spartina* dominated quadrats, the mean height (±SE) of *Spartina alterniflora* and *Spartina cynosuroides* for each transect at the site was as follows:

Transect	Peak Season (cm)
TRT1	95 (±5)
TRT2	123 (±15)
TRT3	141 (±18)
TRT4	143 (±7)

Heights for other species of vegetation present in the quadrats are presented in Table D-5.

Live Standing Crop. Peak season 2009 live standing crop was determined for each transect at the site based on collections of living standing plant materials from clip quadrats along each transect. The number of clip quadrats along each transect was as follows:

Transect	Peak Season (#)
TRT1	4 (2 S-d)
TRT2	4 (4 S-d)
TRT3	8 (4 S-d)
TRT4	4 (4 S-d)

The mean values (±SE) for live standing crop in all clip quadrats during the peak season sampling of The Rocks Site transects, and for *Spartina alterniflora*-dominated quadrats only (shown graphically in Figure 8-25), were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (%)
TRT1	1076 (±145)	1060(±341)
TRT2	1056 (±156)	1056 (±156)
TRT3	535 (±54)	579 (±94)
TRT4	919 (±229)	919 (±229)

Dead Standing Crop. The peak season 2009 mean values (±SE) for dead standing crop in all clip quadrats during the peak season sampling of The Rocks Site transects were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (%)
TRT1	0 (±0)	0 (±0)
TRT2	0 (±0)	0 (±0)
TRT3	108 (±49)	178 (±80)
TRT4	15 (±15)	15 (±15)

Litter. The mean values (±SE) for litter biomass in all clip quadrats during the 2009 peak season sampling of The Rocks Site transects were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (%)
TRT1	0 (±0)	0 (±0)
TRT2	230 (±109)	230 (±109)
TRT3	98 (±80)	160 (±160)
TRT4	162 (±68)	162 (±68)

Cedar Swamp Site - Transects

The field and laboratory data representing the clip and ocular quadrats along the Cedar Swamp Site transects during the peak season 2009 macrophyte sampling event are presented in Table D-6, in Appendix D. The means for percent cover, species height (*Spartina alterniflora* dominated only), live standing crop, dead standing crop and litter biomass for each transect are also presented on this table. These means were calculated independently for: 1) *Spartina alterniflora* dominated quadrats along each transect, 2) other (e.g., *Phragmites* dominated) quadrats along each transect, and 3) for all quadrats along each transect. Means of each type also were calculated for the site as a whole (i.e., means of all quadrats along all transects). Tables 8-6, 8-7 and 8-8 provide summary information for percent cover, height, live standing crop, dead standing crop and litter biomass as previously described.

Species Composition. *Spartina alterniflora* and/or *Spartina cynosuroides* was present in 99 percent of the quadrats sampled along transects at the Cedar Swamp Site in 2009. The percentage of quadrats in which one or both of these species occurred along each transect was as follows: CST1 (100 percent), CST2 (96 percent), CST3 (100 percent) and CST4 (100 percent). The single occurrence of *Phragmites australis* was within a quadrat along CST2.

Percent Cover. The mean percent aerial cover, as well as measures of dispersion (standard error of the mean, standard deviation), for quadrats along each transect at the Cedar Swamp Site during the 2009 peak growing season are presented in Table 8-8. Field data for each quadrat are presented in Table D-6. The number of quadrats (clip and ocular) along each transect was as follows:

Transect	Peak Season (#)
CST1	16 (16 S-d)
CST2	23 (18 S-d)
CST3	24 (21 S-d)
CST4	16 (13 S-d)

The mean percent cover (±SE) for all quadrats along each transect, and for *Spartina alterniflora*-dominated quadrats only (shown graphically in Figure 8-23), were as follows:

Transect	All Quadrats (%)	S-d Quadrats (%)
CST1	54 (±3)	54 (±3)
CST2	52 (±7)	60 (±7)
CST3	35 (±2)	34 (±3)
CST4	38 (±2)	38 (±2)

Vegetation Height. The average height of each plant species present was measured for all (ocular and clip) quadrats sampled at the Cedar Swamp Site during the 2009 peak season sampling event. For *Spartina* dominated quadrats, the mean height (±SE) of *Spartina alterniflora* and *Spartina cynosuroides* for each transect at the site was as follows:

Transect	Peak Season (cm)
CST1	126 (±4)
CST2	114 (±5)
CST3	132 (±13)
CST4	112 (±9)

Heights for other species of vegetation present in the quadrats are presented in Table D-6.

Live Standing Crop. Peak season 2009 live standing crop was determined for each transect at the site based on collections of living standing plant materials from clip quadrats along each transect. The number of clip quadrats along each transect was as follows:

Transect	Peak Season (#)
CST1	4 (4 S-d)
CST2	5 (3 S-d)
CST3	6 (4 S-d)
CST4	4 (2 S-d)

The mean values (±SE) for live standing crop in all clip quadrats during the 2009 peak season sampling of the Cedar Swamp Site transects, and for *Spartina alterniflora*-dominated quadrats only (shown graphically in Figure 8-25), were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (%)
CST1	930 (±188)	930 (±188)
CST2	566 (±204)	713 (±334)
CST3	692 (±135)	807 (±179)
CST4	433 (±202)	632 (±391)

Dead Standing Crop. The mean values (±SE) for dead standing crop in all clip quadrats during the 2009 peak season sampling of the Cedar Swamp Site transects were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (%)
CST1	165 (±81)	165 (±81)
CST2	218 (±124)	83 (±45)
CST3	124 (±56)	134 (±88)
CST4	31 (±22)	0 (±0)

Litter. The mean values (±SE) for litter biomass in all clip quadrats during the 2009 peak season sampling of the Cedar Swamp Site transects were as follows:

Transect	All Quadrats (gdw/m^2)	S-d Quadrats (%)
CST1	160 (±34)	160 (±34)
CST2	96 (±48)	53 (±53)
CST3	0 (±0)	0 (±0)
CST4	73 (±43)	18 (±4)

DELAWARE *PHRAGMITES* DOMINATED WETLAND RESTORATION SITES PLOT SAMPLING

One 60 m x 60 m plot was sampled at both The Rocks and Cedar Swamp Sites in August 2009. Nine (9) quadrats were sampled within each plot for percent cover and live standing crop. Individual quadrat data are presented in Appendix E, Tables E-5 and E-6.

Species Composition. *Spartina alterniflora* was the most common dominant species present in quadrats sampled within the plot at The Rocks Site, occurring in 56 percent of the quadrats sampled. Other species present were *Spartina patens, Spartina cynosuroides, Polygonum punctatum, Scirpus robustus, Scirpus pungens, Typha angustifolia* and *Amaranthus cannabinus.*

Spartina alterniflora was the most common dominant species present in quadrats sampled within the plot at the Cedar Swamp Site, occurring in all (78 percent) of the quadrats sampled. Other species present were *Spartina cynosuroides, Pluchea purpuresence,* and *Polygonum punctatum.*

Percent Cover. The peak season 2009 mean percent aerial cover as well as measures of dispersion (standard error of the mean, standard deviation, minimum and maximum) for the plots at each site are presented in Table 8-10. The mean percent cover values for the plots at each site (graphically shown in Figure 8-26) were as follows:

Site	Peak Season (%)
The Rocks (TRP1)	47 (±9)
Cedar Swamp (CSP1)	46 (±6)

Live Standing Crop. The peak season 2009 mean live standing crop as well as measures of dispersion for the plots at each site are presented in Table 8-10. The mean live standing crop values for the plots at each site (graphically shown in Figure 8-27) were as follows:

Site	Peak Season (gdw/m^2)
The Rocks (TRP1)	618 (±90)
Cedar Swamp (CSP1)	747 (±97)

DISCUSSION

COVER TYPE MAPPING

Cover category and cover type mapping and area determinations were completed for two reference marshes and four wetland restoration sites in 2009. This mapping is presented as a series of six maps within Appendix B and detailed listings of the areas of the various cover types within the mapped cover categories are provided in Tables 8-1 through 8-4. The mapping represents wetland systems ranging from relatively stable reference marshes to sites at various phases of post-restoration development. The completion of the restoration of normal tidal inundation and drainage of the marsh at the CT Site has promoted the spread of the *Spartina alterniflora* communities at that site. Glyphosate-based herbicide with a surfactant applications at the ACW Site in New Jersey and Cedar Swamp and The Rocks in Delaware have maintained progress in controlling *Phragmites australis* at these sites and resulted in the expansion of *Spartina alterniflora* and other desirable marsh species as dominant species at these sites in 2009.

GEOMORPHOLOGIC MAPPING

Evidence of successful wetland restoration at the CT Site is provided by the quantitative analysis of 2009 geomorphology mapping. The drainage density in 2009 (1,219 ft/acre) was higher than found for the MBW Reference Marsh in 2005 (438 ft/acre). This drainage density is evidence of progress in the development of a natural channel systems since 2002, when the drainage density was 374 ft/acre. The channel frequency at the CT Site in 2009 (26.3 channels/acre) was also higher than that found in MBW Reference Marsh in 2005 (4.8 channels/acre). The drainage frequency data are a further indication of the progress in channel development that occurred since 2002, when the channel frequency was 3.7 channels/acre.

The drainage density at the MHC Reference Marsh in 2005 was 708 ft/acre. The drainage density value for the ACW Site in 2009 was 749 ft/acre. Drainage densities for the *Phragmites* dominated sites in Delaware ranged from 586 ft/acre at The Rocks to 634 ft/acre at Cedar Swamp. The drainage density for the ACW Site is above that of the MHC Reference Marsh. The Rocks Site and Cedar Swamp Site are below that of MHC Reference Marsh.

The channel frequency for the MHC Reference Marsh in 2005 was 8.9 channels/acre. The channel frequency value for the ACW Site in 2009 was 12.6 channels/acre. The Rocks and Cedar Swamp 2009 channel frequencies were 10.6 channels/acre and 9.8 channels/acre, respectively.

ABOVE-GROUND NET PRIMARY PRODUCTION

Extensive studies of the net primary production of *Spartina alterniflora* have been conducted along the Atlantic and Gulf coasts of the United States. Mitsch and Gosselink (1993) provide a comparison of many of the measured values, ranging from 330 gdw/m^2/yr to 3,700 gdw/m^2/yr. Higher above-ground productivity is generally found in southern coastal plain marshes than

those in northern latitudes. Turner (1976) states that this higher production is related to a greater influx of solar energy and a longer growing season. The relatively high productivity of some southern marshes may also be associated with higher nutrient import associated with sediments deposited by rivers of that region (White et al. 1978).

One of the methods that has been utilized to measure net primary production in tidal marshes is the Peak Standing Crop (PSC) Method. In the PSC Method, the average peak living standing crop over 2 or more consecutive years is used to represent annual net primary productivity (Hsieh 1997). Hsieh lists the following four assumptions relating to the use of the PSC Method:

1. There is no carry-over in living standing crop from one year to another.
2. There is no significant mortality during the growing season.
3. There is no significant growth after the peak of living standing crop.
4. There is no significant grazing.

Since the PSC Method does not account for growing season mortality or loss of live standing crop biomass due to tidal flux and decomposition, the estimates derived from the method are minimum production values. Mitsch and Gosselink (1993) list several primary production determinations for *Spartina alterniflora* marshes derived utilizing the PSC Method as follows:

	Kaswadji et al. (1990)	Kirby and Gosselink (1976)	Hopkinson et al (1980)	Shew et al (1981)
Peak Standing Crop ($gdw/m^2/yr$)	831 ± 41	903	754	242

White et al. (1978) list two additional peak above-ground biomass determinations in North Carolina and New Jersey as 1,320 gdw/m^2 and 1,592 gdw/m^2, respectively. Gross et al. (1991) sampled monthly in both short-form and tall-form *Spartina alterniflora* stands near Lewes, Delaware. They found live aboveground *Spartina alterniflora* during September to range from approximately 500 gdw/m^2 to 1,500 gdw/m^2 in short form and tall form stands, respectively.

Annual production estimates (gdw/m^2) were determined at both reference marshes and wetland restoration sites using the PSC Method. These estimates were derived utilizing data for all clip quadrats sampled along transects at each site in 2009 and from all quadrats sampled within permanent plots at each site in 2009.

MACROPHYTE PRODUCTION AT THE REFERENCE MARSHES

The MHC Reference Marsh and MBW Reference Marsh are both *Spartina alterniflora* dominated tidal wetland systems. At the end of the 2009 growing season, 72.2 percent of MHC and 84.4 percent of MBW was vegetated by *Spartina* spp. and other desirable marsh vegetation. Marsh production in terms of the mean dry weight of live standing macrophytes collected from *Spartina alterniflora*-dominated quadrats sampled along transects during the peak season of 2009 was 951 ±223 gdw/m^2 at MHC Reference Marsh and 811 ±79 gdw/m^2 at MBW Reference

Marsh. Values for quadrats sampled within the permanent plots established at each site were 771 ±57 gdw/m^2 at the MHC Reference Marsh and 698 ±53 gdw/m^2 at the MBW Reference Marsh. These production values are within the published ranges that are summarized above.

MACROPHYTE PRODUCTION AT COMMERCIAL TOWNSHIP SITE

At the end of the 2009 growing season, 57.4 percent of the CT Site was vegetated by *Spartina* spp. and other desirable marsh vegetation. Marsh production in terms of the mean dry weight of live standing macrophytes collected from *Spartina alterniflora* dominated quadrats along transects at the CT Site was 932 ±162 gdw/m^2. Mean dry weight of live standing macrophytes collected at the permanent plots throughout the site was 996 ±106 gdw/m^2. These production values are within the published ranges that are summarized above and are comparable to the production at the MBW Reference Marsh in 2009.

MACROPHYTE PRODUCTION AT ALLOWAY CREEK SITE

At the end of the 2009 growing season, 71.4 percent of the ACW Site was vegetated by *Spartina* spp. and other desirable marsh vegetation. Marsh production in terms of the mean dry weight of live standing macrophytes collected from *Spartina alterniflora* dominated quadrats along transects at the ACW Site was 1,120 ±199 gdw/m^2. Mean dry weight of live standing macrophytes collected at the permanent plots throughout the site was 678 ±65 gdw/m^2. These production values are within the published ranges that are summarized above and are comparable to the production at the MHC Reference Marsh in 2009.

MACROPHYTE PRODUCTION AT THE ROCKS AND CEDAR SWAMP SITES

At the end of the 2009 growing season, 86.8 percent of The Rocks Site was vegetated by *Spartina* spp. and other desirable marsh vegetation. Marsh production in terms of the mean dry weight of live standing macrophytes collected from *Spartina alterniflora* dominated quadrats along transects at The Rocks Site was 824 ± 81 gdw/m^2. Mean dry weight of live standing macrophytes collected at the permanent plots throughout the site was 618 ±90 gdw/m^2. These production values are within the published ranges that are summarized above, and comparable to the production at the MHC Reference Marsh in 2009.

At the end of the 2009 growing season, 82.5 percent of the Cedar Swamp Site was vegetated by *Spartina* spp. and other desirable marsh vegetation. Marsh production in terms of the mean dry weight of live standing macrophytes collected from *Spartina alterniflora* dominated quadrats along transects at the Cedar Swamp Site was 655 ±91 gdw/m^2. Mean dry weight of live standing macrophytes collected at the permanent plots throughout the site was 747 ±97 gdw/m^2. These production values are within the published ranges that are summarized above, and comparable to the production at the MHC Reference Marsh in 2009.

LITERATURE CITED

Blanchard, G.F., J.M. Guarini, P. Richard, P. Gros and F. Mornet. 1996. Quantifying the short-term temperature effect.

Canfield, D.D. and D.J. Des Marais. 1993. Biogeochemical cycles of carbon, sulfur and free oxygen in a microbial mat. Geochimica et Cosmochimica Acta 57:3971-3984.

Chow, V. 1964. Handbook of Applied Hydrology. McGraw-Hill Book Company, New York, NY, pp 43-45.

Chow, V., D. R. Maidment and L.W. Mays. 1988. Applied Hydrology. McGraw-Hill, Inc. Publishers, New York, NY. pp. 166-170.

Gross, M.F., M.A. Hardisky, P.L. Wolf, and V. Klemas. 1991. Relationship between aboveground and below ground biomass of *Spartina alterniflora* (smooth cordgrass).Estuaries 14(2):180-191

Hopkinson, C.S., J.G. Gosselink, and R.T. Parrondo. 1980. Production of coastal Louisiana marsh plants calculated from phenometric techniques. Ecology 61(5):1091-1098

Horton, R.E. 1945. Erosional development of streams and their drainage basins: Hydrophysical approach to quantitative morphology. Reprinted from Geological Society of America Bulletin 56: 275-370.

Hsieh, Y-P. 1997. Aboveground net primary productivity of vascular plants. In: Coultas and Hsieh, Eds., Ecology and Management of Tidal Marshes. St. Lucie Press, Delray Beach, Florida pp. 111-130

Joye, S.B., M.L. Mazzotta and J.T. Hollibaugh. 1996. Community metabolism in microbial mats: the occurrence of biologically-mediated iron and manganese reduction. Estuarine and Coastal Shelf Science 43:747-766.

Kaswadji, R.F., J.G. Gosselink, and R.E. Turner. 1990. Estimation of primary production using five different methods in a *Spartina alterniflora* marsh. Wetlands Ecology and Management 1(2):57-64.

Kirby, C.J., and J.G. Gosselink. 1976. Primary production in a Louisiana gulf coast *Spartina alterniflora* marsh. Ecology (57):1052-1059.

McIntyre, H.L. and J.J. Cullen. 1995. Fine-scale vertical resolution of chlorophyll and photosynthetic parameters in shallow-water benthos. Marine Ecology Progress Series 122:227-237.

Mitsch, W.J. and J.G. Gosselink, 1993. Wetlands. Second Edition. Van Nostrand Reinhold

Company, New York.

Public Service & Electric Gas Company 1995. Detrital Production Monitoring Report - Delaware Bay Estuary, Prepared for PSEG by EA Engineering, Science, and Technology, Inc.

Round, F.E. 1979. Occurrence and rhythmic behavior of *Tropodoneis lepidoptera* in the epipelon of Barnstable, Harbor Massachusetts, USA. Marine Biology 54: 215-217.

Shew, D.M., R.A. Linthurst, and E.D. Seneca. 1981. Comparison of production computation methods in a southeastern North Carolina *Spartina alterniflora* marsh. Estuaries 4:97-109

Squires, E.R. and R.E. Good. 1974. Seasonal changes in the productivity, caloric content and chemical composition of a population of saltmarsh cordgrass (*Spartina alterniflora*). Chesapeake Science 15(2):63-71.

Steel, T.J. and K. Pye. 1997. The Development of Saltmarsh Tidal Creek Networks: Evidence from the UK. Proceedings of the 1997 Canadian Coastal Conference - Abstracts.

Strahler, A.N. 1957. Quantitative analysis of watershed geomorphology. Transactions of the American Geophysical Union 38: 913-920.

Strickland, J.D. and T.R. Parsons. 1972. A practical handbook of seawater analysis, 2nd ed. Bulletin of the Fisheries Research Board of Canada 167.

Stroud, L.M. and A.W. Cooper. 1968. Color-infrared aerial photographic interpretation and net primary productivity of a regularly flooded North Carolina salt marsh. Water Resource Institute, University of North Carolina. Report Number 14.

Sundback, K., P. Nilsson, C. Nilsson and B. Jonsson. 1996. Balance between autotrophic and heterotrophic components and processes in microbenthic communities of sandy sediments: a field study. Estuarine, Coastal and Shelf Science 43:689-706.

Tiner, R.W. 1987. A field guide to coastal wetland plants of the northeastern United States. The University of Amherst Press. Amherst, Massachusetts.

Turner, R.E. 1976. Geographic variation in salt marsh macrophytic production: a review. Contributions in Marine Science 20:47-68.

Valiela, Ivan. 1995. Marine Ecological Processes. Second Edition. Springer, NY 686pp.

White, D.A., T.E. Weiss, J.M. Trapani, and L.B. Thien. 1978. Productivity and decomposition of the dominant salt marsh plants in Louisiana. Ecology 59(4):751-759.

Chapter 8 Tables

Table 8-1
2009 Reference Marsh Cover Category Summary
PSEG Detrital Production Monitoring

Cover Category / Cover Type	Mad Horse Creek		Moores Beach West	
	Acres	Percent of Total Marsh (a)	Acres	Percent of Total Marsh (a)
Spartina* spp./ Other Desirable Marsh Vegetation *w/o Phragmites				
Spartina alterniflora	818	21.3%	954	75.2%
S. alterniflora / A. cannabinus	16	0.4%		0.0%
S. alterniflora / Beach	2	0.1%	1	0.1%
S. alterniflora / Beach / Mud Flat		0.0%	0	0.0%
S. alterniflora / Desirable Mixed Marsh	9	0.2%	4	0.3%
S. alterniflora / High Marsh		0.0%	0	0.0%
S. alterniflora / Mud Flat	116	3.0%	52	4.1%
S. alterniflora / Salt Hay	0	0.0%	4	0.3%
S. alterniflora / S. cynosuroides	94	2.4%		0.0%
S. alterniflora / S. patens	1	0.0%		0.0%
S. alterniflora / Wrack	0	0.0%	0	0.0%
S. alterniflora / Wrack / Mud Flat	0	0.0%		0.0%
Salt Hay *(S. patens;D.spicata; J. gerardii)*		0.0%	4	0.3%
Salt Hay / High Marsh		0.0%	3	0.2%
Salt Hay / Mud Flat		0.0%	0	0.0%
Salt Hay / *S. alterniflora*	0	0.0%	10	0.8%
S. cynosuroides	3	0.1%		0.0%
S. cynosuroides / S. alterniflora	239	6.2%		0.0%
S. cynosuroides / S. patens	0	0.0%		0.0%
S. cynosuroides / Mud Flat	0	0.0%		0.0%
S. patens	0	0.0%		0.0%
S. patens / S. alterniflora	2	0.1%		0.0%
Desirable Mixed Marsh	1314	34.2%	2	0.2%
Desirable Mixed Marsh / Mud Flat	7	0.2%	0	0.0%
Desirable Mixed Marsh / Wrack	0	0.0%		0.0%
High Marsh Shrubs	22	0.6%		0.0%
High Marsh	1	0.0%	3	0.2%
High Marsh / Deciduous Forest	1	0.0%	1	0.1%
High Marsh / Dead Trees		0.0%	1	0.1%
High Marsh / Salt Hay		0.0%	1	0.1%
High Marsh / *S. alterniflora*		0.0%	1	0.1%
subtotal w/o Phragmites	2648	68.9%	1041	82.1%

Table 8-1
2009 Reference Marsh Cover Category Summary
PSEG Detrital Production Monitoring

Cover Category / Cover Type	Mad Horse Creek		Moores Beach West	
	Acres	Percent of Total Marsh (a)	Acres	Percent of Total Marsh (a)
w/ Phragmites				
Desriable mixed marsh / P. australis	1	0.0%		0.0%
S. alterniflora / Mixed Marsh		0.0%	0	0.0%
S. alterniflora / P. australis	15	0.4%		0.0%
S. alterniflora / S. patens / P. australis	1	0.0%		0.0%
Salt Hay / *P. australis*		0.0%	1	0.1%
S. cynosuroides / P. australis	9	0.2%		0.0%
S. cynosuroides / P. australis / Wrack	0	0.0%		0.0%
S. cynosuroides / P. australis / S. alterniflora	0	0.0%		0.0%
S. cynosuroides / Dead *P. australis*	0	0.0%		0.0%
S. cynosuroides / S. alternoflora / P. australis	1	0.0%		0.0%
Mixed Marsh	94	2.4%	7	0.5%
Mixed Marsh / Beach		0.0%	1	0.1%
Mixed Marsh / Dead *P. australis*	0	0.0%		0.0%
Mixed Marsh / Mud Flat	2	0.1%		0.0%
Mixed Marsh / Wrack	0	0.0%		0.0%
High Marsh / *P. australis*	5	0.1%	20	1.6%
High Marsh Shrubs / Mixed Marsh	1	0.0%	0	0.0%
subtotal w/ Phragmites	129	3.3%	29	2.3%
Subtotal	**2777**	**72.2%**	**1070**	**84.4%**
***Phragmites* Dominated Vegetation**				
Dead P. australis Dominant				
Dead *P. australis*	1	0.0%		0.0%
Dead *P. australis / P. australis*	1	0.0%		0.0%
Dead *P. australis / S. cynosuroides*	0	0.0%		0.0%
Subtotal	***2***	***0.1%***	***0***	***0.0%***
P. australis Dominant				
Phragmites australis	352	9.2%	8	0.6%
P. australis / Deciduous Forest	0		1	0.1%
P. australis / Salt Hay		0.0%	0	0.0%
P. australis / High Marsh		0.0%	47	3.7%
P. australis / Dead *P. australis*	3	0.1%		0.0%
P. australis / Dead Trees		0.0%	3	0.2%
P. australis / Desirable Mixed Marsh	33	0.8%		0.0%
P. australis / High Marsh Shrubs	3	0.1%		0.0%
P. australis / Mud Flat	1	0.0%		0.0%
P. australis / Mixed Marsh	0	0.0%		0.0%
P. australis / S. alterniflora	23	0.6%	0	0.0%
P. australis / S. cynosuroides	33	0.9%		0.0%
P. australis / S. cynosuroides / S. alterniflora	0	0.0%		0.0%
P. australis / Wrack	1	0.0%		0.0%
Subtotal	**449**	**11.7%**	**59**	**4.6%**

Table 8-1
2009 Reference Marsh Cover Category Summary
PSEG Detrital Production Monitoring

Cover Category / Cover Type	Mad Horse Creek		Moores Beach West	
	Acres	Percent of Total Marsh [a]	Acres	Percent of Total Marsh [a]
Non-vegetated Marsh Plain				
Mud Flat	8	0.2%	5	0.4%
Mud Flat / Desirable Mixed marsh	1	0.0%	0	0.0%
Mud Flat / High Marsh			0	0.0%
Mud Flat / Mixed Marsh	1	0.0%	0	0.0%
Mud Flat / *P. australis*	0	0.0%	0	0.0%
Mud Flat / Salt Hay			0	0.0%
Mud Flat / *S. alterniflora*	15	0.4%	6	0.5%
Mud Flat / *S. cynosuroides*	0	0.0%		0.0%
Mud Flat / Beach		0.0%	9	0.7%
Mud Flat / Wrack	1	0.0%	0	0.0%
Mud Flat / Wrack / *S. alterniflora*	0	0.0%		0.0%
Mud Flat / Wrack / *P. australis*	0	0.0%		0.0%
Beach	1	0.0%	11	0.9%
Beach / High Marsh			1	0.1%
Beach / Mud Flat		0.0%	1	0.1%
Beach / Mud Flat / *S. alternifora*			0	0.0%
Beach / *S. alterniflora*		0.0%	0	0.0%
Wrack	0	0.0%	0	0.0%
Wrack / Desirable Mixed Marsh		0.0%	0	0.0%
Wrack / Mixed Marsh	0	0.0%	0	0.0%
Wrack / Mud Flat	1	0.0%	0	0.0%
Wrack / Mud Flat / *S. alterniflora*	1	0.0%		0.0%
Wrack / *S. alterniflora*	0	0.0%	1	0.0%
Subtotal	**29**	**0.8%**	**35**	**2.8%**
Internal Water Areas				
Channels	566	14.7%	85	6.7%
Ponded Water	3	0.1%	6	0.5%
Subtotal	**569**	**14.8%**	**92**	**7.2%**
Open Water				
Delaware Bay	18	0.5%	12	1.0%
Upland Vegetation / Miscellaneous Cover Categories				
Agricultural Land	25	--	15	--
Old Field	2	--	13	--
Old Field/Deciduous Forest		--	2	--
Deciduous Forest	61	--	34	--
Deciduous Forest / High Marsh		--	17	--
Deciduous Forest / High Marsh Shrubs	4	--		--
Developed Land	2	--	8	--
Developed Land / Mixed Marsh	0	--		--
Dike	1	--		--
Road	2	--	2	--
Subtotal [b]	**98**	--	**91**	--
Total Marsh Area	**3844**	**100.0%**	**1268**	**100.0%**
Total Site Area	**3942**	--	**1359**	--

[a] Includes water areas, but does not include upland developed land on the site.

[b] Cover category subtotals may not reflect sum of individual cover type acreages due to rounding

Table 8-2
2009 Commercial Township Salt Hay Farm Wetland Restoration Site -
Cover Category Summary
PSEG Detrital Production Monitoring

Cover Category / Cover Type	Commercial Township	
	Acres	**Percent of Total Marsh**
***Spartina spp.*/Other Desirable Marsh Vegetation**		
w/o P. australis		
Desirable Mixed Marsh	6	0.2%
Desirable Mixed Marsh / Mud Flat	2	0.1%
High Marsh Shrubs	2	0.1%
High Marsh	14	0.5%
High Marsh / Mud Flat	1	0.0%
Salt Hay (*S. patens* ; *D. spicata* ; *J .gerardii*)	1	0.0%
Salt Hay / Desirable Mixed Marsh	0	0.0%
Salt Hay / *S. alterniflora*	2	0.1%
Spartina alterniflora	1498	51.8%
S. alterniflora / Dead Trees	0	0.0%
S. alterniflora / Desirable Mixed Marsh	20	0.7%
S. alterniflora / Mud Flat	112	3.9%
S. alterniflora / Wrack	0	0.0%
Spartina patens	0	0.0%
subtotal w/o P. australis	*1657*	*57.2%*
w/ P. australis		
Mixed Marsh	2	0.1%
S. alterniflora / *P. australis*	3	0.1%
subtotal w/ P. australis	*5*	*0.2%*
Subtotal	**1662**	**57.4%**
***P. australis* Dominated Vegetation**		
Dead *P. australis*	0	0.0%
subtotal - Dead *P. australis*	*0*	*0.0%*
P. australis Dominant		
Phragmites australis	49	1.7%
P. australis / Dike	9	0.3%
P. australis / High Marsh	0	0.0%
P. australis / Mud Flat	2	0.1%
P. australis / *S. alterniflora*	13	0.5%
P. australis / Salt Hay	1	0.0%
subtotal - P. australis	*74*	*2.6%*
Subtotal	**74**	**2.6%**

Table 8-2
2009 Commercial Township Salt Hay Farm Wetland Restoration Site -
Cover Category Summary
PSEG Detrital Production Monitoring

Cover Category / Cover Type	Commercial Township	
	Acres	**Percent of Total Marsh**
Non-Vegetated Marsh Plain		
Beach / *S. alterniflora*	0	0.0%
Mud Flat	540	18.7%
Mud Flat / *P. australis*	0	0.0%
Mud Flat / Pond	6	0.2%
Mud Flat/ *S. alterniflora*	275	9.5%
Mud Flat / Wrack	0	0.0%
Wrack	0	0.0%
Wrack / Mud Flat	0	0.0%
Wrack / *S. alterniflora*	0	0.0%
Subtotal	**823**	**28.4%**
Internal Water Areas		
Channels (>5 ft. wide at low tide)	255	8.8%
Ponded Water	43	1.5%
Ponded Water / *S. alterniflora*	4	0.1%
Subtotal	**302**	**10.4%**
Open Water		
Delaware Bay	33	1.1%
Upland Vegetation / Miscellaneous Cover Categories [b]		
Dike / *Phragmites australis*	0	0.0%
Subtotal [c]	**0**	**0.0%**
Total Site Area	**2894**	**100%**

[a] Areas listed are for portions of the site within the Wetland Restoration Area Boundary, as shown in Appendix B, Figures B-3 and B-4.

[b] Areas of upland / developed land listed, are in most cases due to annual variability in the mapping of the upland edge cover types and should not be interpreted as an effect of wetland restoration.

[c] Cover category subtotals may not reflect sum of individual cover type acreages due to rounding.

Table 8-3
2009 Alloway Creek Watershed Phragmites Dominated Wetland Restoration Site -
Cover Category Summary
PSEG Detrital Production Monitoring

Cover Category / Cover Type	Alloway Creek Watershed [a]	
	Acres	**Percent of Total Marsh**
***Spartina* spp./ Other Desirable Marsh Vegetation**		
Desirable Mixed Marsh	551	34.4%
Desirable Mixed Marsh / Mud Flat	1	0.1%
Echinochloa walteri	2	0.2%
E. walteri / S. alterniflora	0	0.0%
High Marsh	2	0.1%
High Marsh Shurbs	4	0.2%
Spartina alterniflora	18	1.1%
S. alterniflora / Desirable Mixed Marsh	499	31.2%
S. alterniflora / Mud Flat	9	0.6%
Typha spp.	2	0.1%
subtotal w/o P. australis	*1088*	*68.0%*
w/ P. australis		
Desirable Mixed Marsh / *P. australis*	0	0.0%
E. walteri / P. australis	1	0.0%
Mixed Marsh	52	3.2%
Mixed Marsh / Mud Flat	0	0.0%
S. alterniflora / P. australis	1	0.0%
subtotal w/ P. australis	53	3.3%
Subtotal [a]	**1142**	**71.4%**
***P. australis* Dominated Vegetation**		
Dead P. australis Dominant		
Dead *P. australis*	3	0.2%
Dead *P. australis* / Desirable Mixed Marsh	18	1.1%
Dead *P. australis / P. australis*	2	0.1%
Subtotal	***23***	***1.4%***
P. australis Dominant		
Phragmites australis	137	8.6%
P. australis / Dead *P. australis*	0	0.0%
P. australis / Desirable Mixed Marsh	47	3.0%
P. australis / High Marsh Shrubs	0	0.0%
P. australis / Mud Flat	1	0.1%
P. australis / S. alterniflora	15	0.9%
Subtotal	***201***	***12.5%***
Subtotal [a]	**224**	**14.0%**

Table 8-3
2009 Alloway Creek Watershed Phragmites Dominated Wetland Restoration Site -
Cover Category Summary
PSEG Detrital Production Monitoring

Cover Category / Cover Type	Alloway Creek Watershed [a]	
	Acres	**Percent of Total Marsh**
Non-Vegetated Marsh Plain		
Mud Flat	5	0.3%
Mud Flat / Desirable Mixed Marsh	1	0.1%
Mud Flat / Mixed Marsh	2	0.1%
Mud Flat / *P. australis*	0	0.0%
Mud Flat / *S. alterniflora*	3	0.2%
Wrack / Mud Flat	0	0.0%
Subtotal	**12**	**0.7%**
Internal Water Areas		
Channels	221	13.8%
Ponds	0	0.0%
Subtotal	**221**	**13.8%**
Upland Vegetation / Miscellaneous Cover Categories		
Agricultural	0	0.0%
Deciduous Forest	0	0.0%
Developed	0	0.0%
Road	0	0.0%
Upland Island	1	0.1%
Subtotal	**2**	**0.1%**
Total Area	**1600**	**100.0%**

[a] Cover category subtotals may not reflect sum of individual acreages due to rounding.

Table 8-4
2009 Delaware Phragmites Dominated Wetland Restoration Sites - Cover Category Summary
PSEG Detrital Production Monitoring

Cover Category / Cover Type	The Rocks		Cedar Swamp	
	Acres	Percent of Total Marsh[a]	Acres	Percent of Total Marsh[a]
***Spartina spp.* / Other Desirable Vegetation**				
w/o P. australis				
Desirable Mixed Marsh	580	78.8%	1103	59.2%
Desirable Mixed Marsh / Mud Flat	0	0.0%	6	0.3%
Desirable Mixed Marsh / Wrack	0	0.0%	0	0.0%
High Marsh	2	0.3%	0	0.0%
High Marsh Shrubs	4	0.5%	26	1.4%
High Marsh Shrubs / Desirable Mixed Marsh	0	0.0%	0	0.0%
High Marsh Shrubs / *S. alterniflora*	0	0.0%	1	0.1%
Salt Hay (*Spartina patens, Distichlis spicata, Juncus gerardii)*	4	0.6%	0	0.0%
Salt Hay / Desirable Mixed Marsh	5	0.7%	0	0.0%
Spartina alterniflora	10	1.3%	12	0.6%
S. alterniflora / Beach	0	0.0%	2	0.1%
S. alterniflora / Desirable Mixed Marsh	0	0.0%	6	0.3%
S. alterniflora / High Marsh Shrubs	0	0.0%	1	0.0%
S. alterniflora / Mud Flat	1	0.2%	5	0.3%
S. alterniflora / *S. cynosuroides*	0	0.0%	188	10.1%
S. alterniflora / Wrack	1	0.1%	0	0.0%
Spartina cynosuroides	0	0.0%	3	0.2%
S. cynosuroides / *S. alterniflora*	0	0.0%	69	3.7%
Spartina patens	0	0.0%	2	0.1%
Spartina patens / Desirable Mixed Marsh	1	0.1%	0	0.0%
subtotal w/o P. australis	*607*	*82.5%*	*1424*	*76.5%*
w/ P. australis				
Desirable Mixed Marsh / *P. australis*	0	0.0%	3	0.2%
Desirable Mixed Marsh / Dead *P. australis*	0	0.0%	0	0.0%
High Marsh Shrubs / *P. australis*	0	0.0%	1	0.1%
High Marsh Shrubs / Dead *P. australis*	0	0.0%	0	0.0%
High Marsh Shrubs / Mixed Marsh	0	0.0%	1	0.0%
Mixed Marsh	30	4.1%	89	4.8%
Mixed Marsh / Dead *P. australis*	0	0.0%	7	0.4%
Mixed Marsh / High Marsh Shrubs	0	0.0%	1	0.1%
Mixed Marsh / Mud Flat	0	0.0%	3	0.1%
Mixed Marsh / *S. alterniflora*	0	0.0%	0	0.0%
S. alterniflora / *P. australis*	2	0.2%	1	0.1%
S. cynosuroides / *P. australis*		0.0%	6	0.3%
subtotal w/ P. australis	*32*	*4.3%*	*113*	*6.1%*
Subtotal	**639**	**86.8%**	**1537**	**82.5%**

Table 8-4
2009 Delaware Phragmites Dominated Wetland Restoration Sites - Cover Category Summary
PSEG Detrital Production Monitoring

Cover Category / Cover Type	The Rocks		Cedar Swamp	
	Acres	Percent of Total Marsh[(a)]	Acres	Percent of Total Marsh[(a)]
***P. australis* Dominated Vegetation**				
Dead P. australis Dominant				
Dead *P. australis*	1	0.1%	4	0.2%
Dead *P. australis* / Desirable Mixed Marsh	0	0.0%	3	0.2%
Dead *P. australis* / Mixed Marsh	0	0.0%	7	0.4%
Dead *P. australis* / Mud Flat	0	0.0%	0	0.0%
Dead *P. australis* / *P. australis*	0	0.0%	9	0.5%
subtotal - Dead P. australis	*1*	*0.1%*	*23*	*1.2%*
P. australis Dominant				
Phragmites australis	41	5.5%	52	2.8%
P. australis / Dead *P. australis*	0	0.0%	8	0.4%
P. australis / Desirable Mixed Marsh	16	2.2%	13	0.7%
P. australis / High Marsh Shrubs	0	0.0%	0	0.0%
P. australis / Mixed Marsh	0	0.0%	1	0.0%
P. australis / Mud Flat	0	0.0%	1	0.1%
P. australis / *S. alterniflora*	2	0.2%	3	0.1%
P. australis / *S. cynosuroides*	1	0.2%	16	0.9%
P. australis / Wrack	0	0.0%	0	0.0%
subtotal - P. australis	*60*	*8.2%*	*95*	*5.1%*
Subtotal	**61**	**8.3%**	**118**	**6.3%**
Non-vegetated Marsh Plain				
Beach	0	0.0%	3	0.2%
Beach / *S. alterniflora*	0	0.0%	0	0.0%
Mud Flat	0	0.1%	2	0.1%
Mud Flat / Dead *P. australis*	0	0.0%	0	0.0%
Mud Flat / Desirable Mixed Marsh	0	0.0%	2	0.1%
Mud Flat / Mixed Marsh	0	0.0%	5	0.2%
Mud Flat / *P. australis*	0	0.0%	1	0.0%
Mud Flat / *S. alterniflora*	0	0.0%	2	0.1%
Mud Flat / *S. cynosuroides*	0	0.0%	0	0.0%
Mud Flat / Wrack	0	0.1%	0	0.0%
Wrack	1	0.1%	1	0.1%
Wrack / Desirable Mixed Marsh	0	0.0%	3	0.1%
Wrack / Mixed Marsh	0	0.0%	1	0.1%
Wrack / *S. alterniflora*	0	0.0%	0	0.0%
Wrack / Mud Flat	0	0.0%	1	0.0%
Subtotal	**2**	**0.3%**	**20**	**1.1%**

Table 8-4
2009 Delaware Phragmites Dominated Wetland Restoration Sites - Cover Category Summary
PSEG Detrital Production Monitoring

Cover Category / Cover Type	The Rocks		Cedar Swamp	
	Acres	Percent of Total Marsh[a]	Acres	Percent of Total Marsh[a]
Internal Water Areas				
Channels	29	4.0%	182	9.8%
Ponded Water	1	0.1%	1	0.0%
Subtotal	**30**	**4.1%**	**183**	**9.8%**
Open Water				
Appoquinimink River	4	0.5%	4	0.2%
Subtotal	**4**	**0.5%**	**4**	**0.2%**
Upland Vegetation / Miscellaneous Cover Categories				
Deciduous Forest		0.0%	1	0.0%
Deciduous Forest / High Marsh Shrubs	0	0.0%	0	0.0%
Subtotal[b]	**0**	**0.0%**	**1**	**0.0%**
Total Marsh Area	**736**	**100%**	**1863**	**100%**

[a] Includes water areas, but does not include upland developed land on the site.

[b] Cover category subtotals may not reflect sum of individual cover type acreages due to rounding

TABLE 8-5
Channel Geomorphology for Reference Marshes and Restoration Sites

Site	Channel Class	Number of Channels	Sinuous Length (feet)	Average Length (feet)	Site Area (acres)	Drainage Density (ft/acre)	Channel Frequency	% of Total Channel Length	Length Ratio	Bifurcation Ratio	Average Channel Sinuosity
Mad Horse 2005	18	2	79	40			0.003	0.0%	1.2	--	1.0
	17	4	130	33			0.006	0.0%	0.8	2.0	1.1
	16	22	910	41			0.030	0.2%	0.9	5.5	1.1
	15	36	1597	44			0.050	0.3%	1.1	1.6	1.1
	14	57	2246	39			0.079	0.4%	0.9	1.6	1.1
	13	86	3962	46			0.119	0.8%	1.0	1.5	1.1
	12	91	4194	46			0.126	0.8%	0.9	1.1	1.2
	11	155	8340	54			0.215	1.6%	1.0	1.7	1.1
	10	236	12829	54			0.327	2.5%	1.0	1.5	1.2
	9	349	19793	57			0.484	3.9%	1.0	1.5	1.1
	8	601	34438	57			0.833	6.7%	0.9	1.7	1.1
	7	916	58897	64			1.270	11.5%	1.0	1.5	1.2
	6	1,175	75738	64			1.629	14.8%	0.9	1.3	1.2
	5	1,174	86941	74			1.627	17.0%	0.8	1.0	1.2
	4	954	86042	90			1.322	16.8%	0.6	0.8	1.2
	3	501	73952	148			0.694	14.5%	0.1	0.5	1.2
	2	27	28659	1061			0.037	5.6%	0.7	0.1	1.3
	1	8	12180	1523			0.011	2.4%	--	0.3	1.3
	Total	6,394	510926		721	708	8.863	100.0%			
Moore's Beach 2005	23	5	320	64			0.004	0.1%	1.6	--	1.1
	22	4	163	41			0.003	0.0%	0.6	0.8	1.1
	21	4	258	65			0.003	0.0%	0.9	1.0	1.0
	20	4	303	76			0.003	0.1%	1.2	1.0	1.2
	19	14	860	61			0.010	0.1%	1.2	3.5	1.1
	18	19	1006	53			0.014	0.2%	0.9	1.4	1.1
	17	35	2054	59			0.026	0.3%	0.9	1.8	1.1
	16	48	3000	63			0.035	0.5%	1.1	1.4	1.1
	15	72	3934	55			0.053	0.7%	0.9	1.5	1.1
	14	118	7542	64			0.087	1.3%	1.0	1.6	1.1
	13	145	8878	61			0.107	1.5%	0.9	1.2	1.1
	12	219	14237	65			0.161	2.4%	1.0	1.5	1.1
	11	323	21641	67			0.238	3.6%	1.0	1.5	1.1
	10	470	33097	70			0.346	5.6%	1.0	1.5	1.1
	9	577	41238	71			0.425	6.9%	0.9	1.2	1.1
	8	738	56707	77			0.543	9.5%	0.9	1.3	1.1
	7	857	69901	82			0.631	11.7%	0.9	1.2	1.1
	6	920	79205	86			0.677	13.3%	0.9	1.1	1.1
	5	848	77738	92			0.624	13.1%	0.8	0.9	1.1
	4	670	72863	109			0.493	12.2%	0.6	0.8	1.1
	3	353	67362	191			0.260	11.3%	0.2	0.5	1.1
	2	17	17517	1030			0.013	2.9%	0.5	0.0	1.3
	1	8	15413	1927			0.006	2.6%	--	0.5	1.2
	Total	6,468	595237		1359	438	4.760	100.0%			

TABLE 8-5
Channel Geomorphology for Reference Marshes and Restoration Sites

Site	Channel Class	Number of Channels	Sinuous Length (feet)	Average Length (feet)	Site Area (acres)	Drainage Density (ft/acre)	Channel Frequency	% of Total Channel Length	Length Ratio	Bifurcation Ratio	Average Channel Sinuosity
Commercial Township 2009	44	4	308	77			0.001	0.0%	--	1.5	1.05
	43	6	268	45			0.002	0.0%	0.9	1.0	1.03
	42	6	295	49			0.002	0.0%	1.1	1.0	1.06
	41	6	265	44			0.002	0.0%	0.9	1.0	1.02
	40	6	469	78			0.002	0.0%	1.8	1.2	1.08
	39	7	303	43			0.002	0.0%	0.6	0.9	1.04
	38	6	214	36			0.002	0.0%	0.7	2.0	1.03
	37	12	807	67			0.004	0.0%	3.8	1.4	1.09
	36	17	723	43			0.006	0.0%	0.9	0.9	1.06
	35	15	608	41			0.005	0.0%	0.8	1.2	1.04
	34	18	723	40			0.006	0.0%	1.2	1.1	1.07
	33	19	943	50			0.007	0.0%	1.3	1.1	1.06
	32	20	1137	57			0.007	0.0%	1.2	1.9	1.04
	31	38	1591	42			0.013	0.0%	1.4	1.7	1.04
	30	64	2224	35			0.022	0.1%	1.4	1.2	1.04
	29	78	3032	39			0.027	0.1%	1.4	1.2	1.03
	28	92	4952	54			0.032	0.1%	1.6	1.4	1.04
	27	129	5686	44			0.044	0.2%	1.1	1.1	1.05
	26	143	6580	46			0.049	0.2%	1.2	1.3	1.06
	25	181	6797	38			0.062	0.2%	1.0	1.5	1.04
	24	264	10042	38			0.091	0.3%	1.5	1.3	1.03
	23	349	13857	40			0.120	0.4%	1.4	1.3	1.04
	22	460	18116	39			0.159	0.5%	1.3	1.4	1.04
	21	652	26562	41			0.225	0.8%	1.5	1.4	1.04
	20	896	37019	41			0.309	1.0%	1.4	1.3	1.04
	19	1198	50822	42			0.413	1.4%	1.4	1.2	1.05
	18	1447	61148	42			0.499	1.7%	1.2	1.3	1.04
	17	1841	80494	44			0.635	2.3%	1.3	1.2	1.04
	16	2282	102897	45			0.787	2.9%	1.3	1.2	1.05
	15	2839	124052	44			0.979	3.5%	1.2	1.2	1.05
	14	3382	143817	43			1.166	4.1%	1.2	1.2	1.04
	13	3906	167772	43			1.346	4.7%	1.2	1.2	1.04
	12	4630	195134	42			1.596	5.5%	1.2	1.1	1.05
	11	5211	217577	42			1.796	6.2%	1.1	1.1	1.04
	10	5725	243727	43			1.973	6.9%	1.1	1.1	1.04
	9	6291	268614	43			2.169	7.6%	1.1	1.1	1.05
	8	6805	296175	44			2.346	8.4%	1.1	1.0	1.05
	7	6980	305797	44			2.406	8.6%	1.0	1.0	1.05
	6	6725	299393	45			2.318	8.5%	1.0	0.9	1.05
	5	6026	288511	48			2.077	8.2%	1.0	0.0	1.05
	4	4916	261199	53			1.695	7.4%	0.9	0.5	1.09
	3	2425	204992	85			0.836	5.8%	0.8	0.0	1.07
	2	41	47702	1163			0.014	1.3%	0.2	0.1	1.13
	1	9	32378	3598			0.003	0.9%	0.1	--	1.16
	Total	76,167	3535724		2901	1219	26.256	100.0%			

TABLE 8-5
Channel Geomorphology for Reference Marshes and Restoration Sites

Site	Channel Class	Number of Channels	Sinuous Length (feet)	Average Length (feet)	Site Area (acres)	Drainage Density (ft/acre)	Channel Frequency	% of Total Channel Length	Length Ratio	Bifurcation Ratio	Average Channel Sinuosity
ALLOWAY CREEK WATERSHED 2009	30	2	116	58			0.001	0.0%	--	0.5	1.05
	29	4	134	34			0.002	0.0%	1.2	2.0	1.10
	28	2	118	59			0.001	0.0%	0.9	0.5	1.13
	27	4	169	42			0.002	0.0%	1.4	0.6	1.03
	26	7	230	33			0.004	0.0%	1.4	1.2	1.06
	25	6	199	33			0.004	0.0%	0.9	1.5	1.04
	24	4	270	67			0.002	0.0%	1.4	0.7	1.08
	23	6	490	82			0.004	0.0%	1.8	1.0	1.12
	22	6	278	46			0.004	0.0%	0.6	0.5	1.03
	21	11	865	79			0.007	0.1%	3.1	0.7	1.07
	20	16	852	53			0.010	0.1%	1.0	0.5	1.07
	19	33	1507	46			0.021	0.1%	1.8	0.6	1.08
	18	60	2503	42			0.037	0.2%	1.7	0.7	1.06
	17	86	3780	44			0.054	0.3%	1.5	0.7	1.10
	16	129	5837	45			0.081	0.5%	1.5	0.7	1.07
	15	188	7970	42			0.117	0.7%	1.4	0.7	1.09
	14	252	11545	46			0.157	1.0%	1.4	0.7	1.08
	13	338	15149	45			0.211	1.3%	1.3	0.8	1.09
	12	444	20741	47			0.277	1.7%	1.4	0.7	1.09
	11	672	30809	46			0.420	2.6%	1.5	0.7	1.08
	10	989	42948	43			0.618	3.6%	1.4	0.7	1.09
	9	1433	63028	44			0.895	5.3%	1.5	0.7	1.10
	8	1926	91885	48			1.203	7.7%	1.5	0.8	1.08
	7	2446	121697	50			1.528	10.1%	1.3	0.9	1.09
	6	2820	143912	51			1.761	12.0%	1.2	0.9	1.10
	5	2977	163649	55			1.859	13.6%	1.1	1.0	1.10
	4	2889	177806	62			1.804	14.8%	1.1	1.3	1.10
	3	2211	185073	84			1.381	15.4%	1.0	27.3	1.15
	2	81	46414	573			0.051	3.9%	0.3	0.9	1.16
	1	93	59943	645			0.058	5.0%	1.3	--	1.18
	Total	20,135	1199919		1601	749	12.577	100.0%			
The Rocks 2009	24	4	183	46			0.005	0.0%	---	1.0	1.0
	23	4	179	45			0.005	0.0%	1.0	0.7	1.0
	22	6	137	23			0.008	0.0%	0.5	0.8	1.0
	21	8	246	31			0.011	0.1%	1.4	1.0	1.0
	20	8	321	40			0.011	0.1%	1.3	0.9	1.0
	19	9	308	34			0.012	0.1%	0.9	0.5	1.0
	18	20	771	39			0.027	0.2%	1.1	0.7	1.0
	17	28	1159	41			0.038	0.3%	1.1	0.7	1.0
	16	38	1671	44			0.052	0.4%	1.1	0.4	1.0
	15	87	3696	42			0.118	0.9%	1.0	0.9	1.0
	14	99	4199	42			0.134	1.0%	1.0	0.7	1.1
	13	136	5077	37			0.134	1.2%	0.9	0.6	1.1
	12	221	9486	43			0.185	2.2%	1.1	0.7	1.1
	11	327	13709	42			0.300	3.2%	1.0	0.7	1.1
	10	499	20306	41			0.444	4.7%	1.0	0.8	1.1
	9	643	26493	41			0.677	6.1%	1.0	0.8	1.1
	8	788	33793	43			0.872	7.8%	1.0	0.9	1.1
	7	924	40884	44			1.069	9.5%	1.0	0.9	1.1
	6	1014	45781	45			1.254	10.6%	1.0	0.9	1.1
	5	1078	53302	49			1.376	12.4%	1.1	1.0	1.1
	4	1063	63920	60			1.463	14.8%	1.2	1.6	1.1
	3	672	73367	109			1.442	17.0%	1.8	39.5	1.1
	2	17	13974	822			0.912	3.2%	7.5	1.1	1.3
	1	15	18603	1240			0.023	4.3%	1.5	--	1.4
	Total	7,708	431565		737	586	10.573	100.0%			

TABLE 8-5
Channel Geomorphology for Reference Marshes and Restoration Sites

Site	Channel Class	Number of Channels	Sinuous Length (feet)	Average Length (feet)	Site Area (acres)	Drainage Density (ft/acre)	Channel Frequency	% of Total Channel Length	Length Ratio	Bifurcation Ratio	Average Channel Sinuosity
Cedar Swamp 2009	35	13	393	30			0.008	0.0%	--	1.2	1.0565
	34	11	271	25			0.006	0.0%	0.8	0.7	0.9557
	33	15	842	56			0.009	0.1%	2.3	0.9	1.1024
	32	16	601	38			0.009	0.1%	0.7	0.8	1.0350
	31	21	772	37			0.012	0.1%	1.0	0.9	1.0349
	30	23	1,107	48			0.013	0.1%	1.3	0.9	1.0962
	29	25	1,652	66			0.014	0.2%	1.4	0.9	1.1275
	28	29	1,577	54			0.017	0.1%	0.8	0.7	1.0599
	27	43	1,923	45			0.025	0.2%	0.8	1.0	1.0577
	26	44	2,329	53			0.025	0.2%	1.2	0.9	1.0706
	25	47	2,402	51			0.027	0.2%	1.0	0.7	1.0609
	24	70	3,920	56			0.040	0.4%	1.1	0.7	1.0618
	23	95	5,699	60			0.055	0.5%	1.1	0.8	1.0705
	22	122	7,131	58			0.070	0.6%	1.0	0.8	1.0629
	21	154	8,713	57			0.089	0.8%	1.0	0.6	1.0841
	20	245	13,311	54			0.141	1.2%	1.0	0.8	1.0809
	19	326	17,059	52			0.188	1.6%	1.0	0.8	1.0691
	18	402	19,994	50			0.232	1.8%	1.0	0.8	1.0793
	17	521	26,273	50			0.301	2.4%	1.0	0.7	1.0755
	16	737	38,149	52			0.426	3.5%	1.0	0.8	1.0759
	15	937	45,679	49			0.541	4.2%	0.9	0.8	1.0766
	14	1,154	56,940	49			0.666	5.2%	1.0	0.9	1.0755
	13	1,338	69,322	52			0.773	6.3%	1.1	1.0	1.0774
	12	1,400	72,980	52			0.809	6.6%	1.0	1.0	1.0826
	11	1,387	75,037	54			0.801	6.8%	1.0	1.0	1.0890
	10	1,355	75,459	56			0.783	6.9%	1.0	1.0	1.0804
	9	1,336	76,385	57			0.772	7.0%	1.0	1.0	1.0720
	8	1,292	80,995	63			0.746	7.4%	1.1	1.1	1.0802
	7	1,204	79,316	66			0.695	7.2%	1.1	1.2	1.0763
	6	1,035	80,204	77			0.598	7.3%	1.2	1.2	1.0783
	5	882	78,322	89			0.509	7.1%	1.1	1.5	1.0757
	4	577	84,099	146			0.333	7.7%	1.6	3.5	1.1514
	3	165	53,266	323			0.095	4.9%	2.2	55.0	1.1514
	2	3	14,510	4,837			0.002	1.3%	15.0	3.0	1.0160
	1	1	865	865			0.001	0.1%	0.2	--	1.0018
	Total	17,025	1097497		1732	634	9.832	100.0%			

TABLE 8-6
AERIAL COVER SUMMARY
2009 CLIP AND OCULAR QUADRAT TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

	Peak Season Percent Cover
Commercial Township Site	
***Spartina alterniflora* dominated Quadrats Only (a)**	
Mean	36%
Standard Error of Mean	2%
Standard Deviation	10%
Minimum	20%
Maximum	55%
Count (n)	17
Non-*Spartina alterniflora* dominated Quadrats Only (b)	
Mean	9%
Standard Error of Mean	2%
Standard Deviation	4%
Minimum	5%
Maximum	15%
Count (n)	5
All Quadrats	
Mean	30%
Standard Error of Mean	3%
Standard Deviation	15%
Minimum	5%
Maximum	55%
Count (n)	22
Alloway Creek Site	
***Spartina alterniflora* dominated Quadrats Only (a)**	
Mean	39%
Standard Error of Mean	3%
Standard Deviation	18%
Minimum	20%
Maximum	85%
Count (n)	46
Non-*Spartina alterniflora* dominated Quadrats Only (b)	
Mean	31%
Standard Error of Mean	4%
Standard Deviation	17%
Minimum	10%
Maximum	65%
Count (n)	16
All Quadrats	
Mean	37%
Standard Error of Mean	2%
Standard Deviation	18%
Minimum	10%
Maximum	85%
Count (n)	62

TABLE 8-6
AERIAL COVER SUMMARY
2009 CLIP AND OCULAR QUADRAT TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

	Peak Season Percent Cover
Mad Horse Creek Reference Marsh	
***Spartina alterniflora* dominated Quadrats Only (a)**	
Mean	43%
Standard Error of Mean	2%
Standard Deviation	13%
Minimum	25%
Maximum	80%
Count (n)	58
Non-*Spartina alterniflora* dominated Quadrats Only (b)	
Mean	44%
Standard Error of Mean	7%
Standard Deviation	27%
Minimum	5%
Maximum	90%
Count (n)	14
All Quadrats	
Mean	43%
Standard Error of Mean	2%
Standard Deviation	17%
Minimum	5%
Maximum	90%
Count (n)	72
Moores Beach West Reference Marsh	
***Spartina alterniflora* dominated Quadrats Only (a)**	
Mean	39%
Standard Error of Mean	3%
Standard Deviation	15%
Minimum	20%
Maximum	75%
Count (n)	22
Non-*Spartina alterniflora* dominated Quadrats Only (b)	
Mean	55%
Standard Error of Mean	45%
Standard Deviation	64%
Minimum	10%
Maximum	100%
Count (n)	2
All Quadrats	
Mean	40%
Standard Error of Mean	4%
Standard Deviation	20%
Minimum	10%
Maximum	100%
Count (n)	24

TABLE 8-6
AERIAL COVER SUMMARY
2009 CLIP AND OCULAR QUADRAT TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

	Peak Season Percent Cover
The Rocks Site	
***Spartina alterniflora* dominated Quadrats Only (a)**	
Mean	40%
Standard Error of Mean	2%
Standard Deviation	12%
Minimum	20%
Maximum	76%
Count (n)	50
Non-*Spartina alterniflora* dominated Quadrats Only (b)	
Mean	43%
Standard Error of Mean	4%
Standard Deviation	19%
Minimum	15%
Maximum	80%
Count (n)	28
All Quadrats	
Mean	41%
Standard Error of Mean	2%
Standard Deviation	15%
Minimum	15%
Maximum	80%
Count (n)[(c)]	78
Cedar Swamp Site	
***Spartina alterniflora* dominated Quadrats Only (a)**	
Mean	47%
Standard Error of Mean	3%
Standard Deviation	21%
Minimum	6%
Maximum	100%
Count (n)	68
Non-*Spartina alterniflora* dominated Quadrats Only (b)	
Mean	30%
Standard Error of Mean	3%
Standard Deviation	11%
Minimum	6%
Maximum	45%
Count (n)	11
All Quadrats	
Mean	44%
Standard Error of Mean	2%
Standard Deviation	21%
Minimum	6%
Maximum	100%
Count (n)	79

(a) Also includes *Spartina cynosuroides* dominated quadrats, when present.
(b) Includes quadrats dominated by *Spartina patens.*

TABLE 8-7
SUMMARY OF 2009 CLIP QUADRAT TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

		Biomass					
	Percent Cover	Live Standing		Dead Standing	Litter	Total Standing	Total Biomass
		gdw/m^2	lb/acre	gdw/m^2	gdw/m^2	gdw/m^2	gdw/m^2
Mad Horse Creek Reference Marsh							
***Spartina alterniflora* dominated Quadrats Only (a)**							
Mean	48%	951	8,483	61	71	1,012	1,083
Standard Error of Mean	3%	223	1,994	41	22		
Standard Deviation	9%	741	6,612	136	73		
Minimum	30%	308	2,744	0	0		
Maximum	62%	3038	27,107	357	206		
Count (n)	11	11	11	11	11		
Non-*Spartina alterniflora* dominated Quadrats Only (b)							
Mean	44%	629	5,496	33	55	662	717
Standard Error of Mean	6%	38	342	0	0		
Standard Deviation	24%	293	2,614	59	146		
Minimum	16%	101	904	0	0		
Maximum	86%	922	8,229	145	386		
Count (n)	7	7	7	7	7		
All Quadrats							
Mean	47%	826	7,365	50	65	876	941
Standard Error of Mean	4%	145	1,295	26	24		
Standard Deviation	16%	616	5,496	111	103		
Minimum	16%	101	904	0	0		
Maximum	86%	3,038	161	357	386		
Count (n)	18	18	18	18	18		
Moores Beach West Reference Marsh							
***Spartina alterniflora* dominated Quadrats Only (a)**							
Mean	41%	811	7,239	43	18	855	872
Standard Error of Mean	8%	79	706	20	11		
Standard Deviation	20%	194	1,728	49	28		
Minimum	20%	634	5,660	0	0		
Maximum	75%	1131	10,092	105	56		
Count (n)	6	6	6	6	6		
Non-*Spartina alterniflora* dominated Quadrats Only							
Mean	--	--	--	--	--	--	--
Standard Error of Mean	--	--	--	--	--		
Standard Deviation	--	--	--	--	--		
Minimum	--	--	--	--	--		
Maximum	--	--	--	--	--		
Count (n)	0	0	0	0	0		
All Quadrats							
Mean	41%	811	7,239	43	18	855	872
Standard Error of Mean	8%	79	706	20	11		
Standard Deviation	20%	194	1,728	49	28		
Minimum	20%	634	5,660	0	0		
Maximum	75%	1,131	54	105	56		
Count (n)	6	6	6	6	6		

TABLE 8-7
SUMMARY OF 2009 CLIP QUADRAT TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

		Biomass					
	Percent Cover	Live Standing		Dead Standing	Litter	Total Standing	Total Biomass
		gdw/m^2	lb/acre	gdw/m^2	gdw/m^2	gdw/m^2	gdw/m^2
Commercial Township Site							
***Spartina alterniflora* dominated Quadrats Only (a)**							
Mean	39%	932	8,319	0	6	932	939
Standard Error of Mean	4%	162	1,444	0	6		
Standard Deviation	11%	428	3,822	0	16		
Minimum	25%	429	3,832	0	0		
Maximum	55%	1645	14,681	0	43		
Count (n)	7	7	7	7	7		
Non-*Spartina alterniflora* dominated Quadrats Only							
Mean	15%	150	4,313	0	66	150	216
Standard Error of Mean	15%	150	1,341	0	66		
Standard Deviation	--	--	--	--	--		
Minimum	15%	150	1,341	0	66		
Maximum	15%	150	1,341	0	66		
Count (n)	1	1	1	1	1		
All Quadrats							
Mean	36%	835	7,447	0	14	835	848
Standard Error of Mean	5%	171	1,525	0	9		
Standard Deviation	14%	483	4,313	0	26		
Minimum	15%	150	1,341	0	0		
Maximum	55%	1,645	71	0	66		
Count	8	8	8	8	8		
Alloway Creek Site							
***Spartina alterniflora* dominated Quadrats Only (a)**							
Mean	39%	1120	9,989	6	31	1,126	1,157
Standard Error of Mean	6%	199	1,771	6	16		
Standard Deviation	19%	628	5,602	21	51		
Minimum	20%	337	3,011	0	0		
Maximum	78%	2159	19,265	65	124		
Count (n)	10	10	10	10	10		
Non-*Spartina alterniflora* dominated Quadrats Only (b)							
Mean	29%	880	5,715	109	75	990	1,064
Standard Error of Mean	8%	21	183	0	0		
Standard Deviation	11%	692	6,171	204	59		
Minimum	20%	50	449	0	0		
Maximum	46%	1,641	14,641	516	124		
Count (n)	6	6	6	6	6		
All Quadrats							
Mean	35%	1,030	9,189	45	47	1,075	1,122
Standard Error of Mean	4%	160	1,429	32	14		
Standard Deviation	17%	641	5,715	129	56		
Minimum	20%	50	449	0	0		
Maximum	78%	2,159	143	516	124		
Count	16	16	16	16	16		

TABLE 8-7
SUMMARY OF 2009 CLIP QUADRAT TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

		Biomass					
	Percent Cover	Live Standing		Dead Standing	Litter	Total Standing	Total Biomass
		gdw/m^2	lb/acre	gdw/m^2	gdw/m^2	gdw/m^2	gdw/m^2
The Rocks Site							
***Spartina alterniflora* dominated Quadrats Only (a)**							
Mean	46%	881	7,863	55	158	936	1,094
Standard Error of Mean	3%	100	892	30	56		
Standard Deviation	13%	374	3,339	112	210		
Minimum	25%	406	3,618	0	0		
Maximum	76%	1521	13,573	388	640		
Count (n)	14	14	14	14	14		
Non-*Spartina alterniflora* dominated Quadrats Only (b)							
Mean	45%	691	3,247	26	25	717	741
Standard Error of Mean	12%	129	1,155	0	0		
Standard Deviation	13%	330	2,943	63	60		
Minimum	30%	317	2,829	0	0		
Maximum	61%	1,190	10,621	153	147		
Count (n)	6	6	6	6	6		
All Quadrats							
Mean	45%	824	7,354	46	118	871	988
Standard Error of Mean	3%	81	726	22	42		
Standard Deviation	12%	364	3,247	99	188		
Minimum	25%	317	2,829	0	0		
Maximum	76%	1,521	178	388	640		
Count	20	20	20	20	20		
Cedar Swamp Site							
***Spartina alterniflora* dominated Quadrats Only (a)**							
Mean	45%	796	7,103	111	64	907	972
Standard Error of Mean	7%	111	992	38	24		
Standard Deviation	25%	401	3,578	137	86		
Minimum	6%	48	429	0	0		
Maximum	100%	1350	12,045	376	223		
Count (n)	13	13	13	13	13		
Non-*Spartina alterniflora* dominated Quadrats Only (b)							
Mean	34%	348	3,541	195	95	543	638
Standard Error of Mean	4%	52	463	103	43		
Standard Deviation	10%	127	1,133	251	105		
Minimum	16%	119	1,066	29	0		
Maximum	45%	492	4,386	702	250		
Count (n)	6	6	6	6	6		
All Quadrats							
Mean	42%	655	5,840	138	74	792	866
Standard Error of Mean	5%	91	812	41	21		
Standard Deviation	22%	397	3,541	178	90		
Minimum	6%	48	429	0	0		
Maximum	100%	1,350	170	702	250		
Count	19	19	19	19	19		

(a) Also includes *Spartina cynosuroides* dominated quadrats, when present
(b) Includes quadrats dominated by *Spartina patens.*

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
Mad Horse Creek Reference Marsh - Transect 1					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	43%	122	1310	135	112
Standard Error of Mean	3%	4	438	83	33
Standard Deviation	12%	18	980	185	73
Count (*n*)	19	18	5	5	5
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	32%	--	101	145	386
Standard Error of Mean	13%	--	--	--	--
Standard Deviation	30%	--	--	--	--
Count (*n*)	5	--	1	1	1
All Quadrats					
Mean	41%	--	1109	136	158
Standard Error of Mean	3%	--	411	68	53
Standard Deviation	17%	--	1006	165	129
Count (*n*)	24	--	6	6	6
Mad Horse Creek Reference Marsh - Transect 2					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	44%	153	1005	0	59
Standard Error of Mean	5%	6	67	0	59
Standard Deviation	13%	17	95	0	84
Count (*n*)	8	8	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (d)					
Mean	--	--	--	--	--
Standard Error of Mean	--	--	--	--	--
Standard Deviation	--	--	--	--	--
Count (*n*)	0	--	0	0	0
All Quadrats					
Mean	44%	--	1005	0	59
Standard Error of Mean	5%	--	67	0	59
Standard Deviation	13%	--	95	0	84
Count (n)	8	--	2	2	2

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
Mad Horse Creek Reference Marsh - Transect 3					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	43%	107	474	0	25
Standard Error of Mean	3%	5	83	0	25
Standard Deviation	14%	27	166	0	50
Count (*n*)	31	32	4	4	4
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	50%	--	717	15	0
Standard Error of Mean	9%	--	80	15	0
Standard Deviation	26%	--	195	36	0
Count (*n*)	9	--	6	6	6
All Quadrats					
Mean	45%	--	620	9	10
Standard Error of Mean	3%	--	68	9	10
Standard Deviation	17%	--	215	28	32
Count (n)	40	--	10	10	10
Moores Beach West Reference Marsh - Transect 1					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	53%	96	656	34	28
Standard Error of Mean	6%	2	22	34	28
Standard Deviation	16%	5	31	48	39
Count (*n*)	7	7	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (d)					
Mean	100%	--	--	--	--
Standard Error of Mean	--	--	--	--	--
Standard Deviation	--	--	--	--	--
Count (*n*)	1	--	0	0	0
All Quadrats					
Mean	59%	--	656	34	28
Standard Error of Mean	8%	--	22	34	28
Standard Deviation	22%	--	31	48	39
Count (*n*)	8	--	2	2	2

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
Moores Beach West Reference Marsh - Transect 2					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	27%	132	956	52	0
Standard Error of Mean	2%	15	176	52	0
Standard Deviation	5%	40	248	74	0
Count (*n*)	7	7	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (d)					
Mean	10%	--	--	--	--
Standard Error of Mean	--	--	--	--	--
Standard Deviation	--	--	--	--	--
Count (*n*)	1	--	0	0	0
All Quadrats					
Mean	25%	--	956	52	0
Standard Error of Mean	3%	--	176	52	0
Standard Deviation	7%	--	248	74	0
Count (*n*)	8	--	2	2	2
Moores Beach West Reference Marsh - Transect 3					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	38%	121	822	44	26
Standard Error of Mean	3%	4	133	44	26
Standard Deviation	7%	12	188	62	36
Count (*n*)	8	8	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (d)					
Mean	--	--	--	--	--
Standard Error of Mean	--	--	--	--	--
Standard Deviation	--	--	--	--	--
Count (*n*)	0	--	0	0	0
All Quadrats					
Mean	38%	--	822	44	26
Standard Error of Mean	3%	--	133	44	26
Standard Deviation	7%	--	188	62	36
Count(n)	8	--	2	2	2

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
Commercial Township Site - Transect 1					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	41%	108	1068	0	0
Standard Error of Mean	3%	16	294	0	0
Standard Deviation	8%	43	416	0	0
Count (*n*)	7	7	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (d)					
Mean	--	--	--	--	--
Standard Error of Mean	--	--	--	--	--
Standard Deviation	--	--	--	--	--
Count (*n*)	0	--	0	0	0
All Quadrats					
Mean	41%	--	1068	0	0
Standard Error of Mean	3%	--	294	0	0
Standard Deviation	8%	--	416	0	0
Count (*n*)	7	--	2	2	2
Commercial Township Site - Transect 2					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	25%	167	580	0	0
Standard Error of Mean	2%	13	151	0	0
Standard Deviation	4%	25	213	0	0
Count (*n*)	4	4	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	8%	--	--	--	--
Standard Error of Mean	3%	--	--	--	--
Standard Deviation	4%	--	--	--	--
Count (*n*)	2	--	0	0	0
All Quadrats					
Mean	19%	--	580	0	0
Standard Error of Mean	4%	--	151	0	0
Standard Deviation	10%	--	213	0	0
Count (*n*)	6	--	2	2	2

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
Commercial Township Site - Transect 3					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	42%	93	951	0	43
Standard Error of Mean	3%	6	--	--	--
Standard Deviation	6%	10	--	--	--
Count (*n*)	3	3	1	1	1
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	13%	--	150	0	66
Standard Error of Mean	3%	--	--	--	--
Standard Deviation	4%	--	--	--	--
Count (*n*)	2	--	1	1	1
All Quadrats					
Mean	30%	--	551	0	54
Standard Error of Mean	7%	--	400	0	11
Standard Deviation	17%	--	566	0	16
Count (*n*)	5	--	2	2	2
Commercial Township Site - Transect 4					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	35%	126	1140	0	0
Standard Error of Mean	6%	8	506	0	0
Standard Deviation	10%	15	715	0	0
Count (*n*)	3	3	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	5%	--	--	--	--
Standard Error of Mean	--	--	--	--	--
Standard Deviation	--	--	--	--	--
Count (*n*)	1	--	0	0	0
All Quadrats					
Mean	28%	--	1140	0	0
Standard Error of Mean	9%	--	506	0	0
Standard Deviation	17%	--	715	0	0
Count (*n*)	4	--	2	2	2

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
Alloway Creek Watershed Site - Transect 1					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	35%	110	909	0	0
Standard Error of Mean	5%	5	203	0	0
Standard Deviation	14%	15	288	0	0
Count (*n*)	8	8	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	--	--	--	--	--
Standard Error of Mean	--	--	--	--	--
Standard Deviation	--	--	--	--	--
Count (*n*)	0	--	0	0	0
All Quadrats					
Mean	35%	--	909	0	0
Standard Error of Mean	5%	--	203	0	0
Standard Deviation	14%	--	288	0	0
Count (*n*)	8	--	2	2	2
Alloway Creek Watershed Site - Transect 2					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	33%	158	1743	0	46
Standard Error of Mean	4%	8	216	0	28
Standard Deviation	16%	37	431	0	55
Count (*n*)	20	20	4	4	4
Non-*Spartina alterniflora* dominated Quadrats Only (d)					
Mean	34%	--	1568	0	111
Standard Error of Mean	13%	--	73	0	12
Standard Deviation	18%	--	104	0	17
Count (*n*)	2	--	2	2	2
All Quadrats					
Mean	33%	--	1684	0	68
Standard Error of Mean	3%	--	143	0	22
Standard Deviation	16%	--	349	0	55
Count (*n*)	22	--	6	6	6

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
Alloway Creek Watershed Site - Transect 3					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	40%	121	501	0	0
Standard Error of Mean	5%	4	164	0	0
Standard Deviation	15%	11	231	0	0
Count (*n*)	9	9	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	31%	--	90	314	113
Standard Error of Mean	6%	--	40	202	11
Standard Deviation	16%	--	56	286	15
Count (*n*)	7	--	2	2	2
All Quadrats					
Mean	36%	--	296	157	57
Standard Error of Mean	4%	--	137	123	33
Standard Deviation	16%	--	274	245	66
Count (*n*)	16	--	4	4	4
Alloway Creek Watershed Site - Transect 4					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	53%	141	703	32	62
Standard Error of Mean	7%	6	224	32	62
Standard Deviation	22%	19	317	46	88
Count (*n*)	9	11	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	30%	--	983	14	0
Standard Error of Mean	7%	--	285	14	0
Standard Deviation	19%	--	404	20	0
Count (*n*)	7	--	2	2	2
All Quadrats					
Mean	43%	--	843	23	31
Standard Error of Mean	6%	--	169	15	31
Standard Deviation	23%	--	337	31	62
Count (*n*)	16	--	4	4	4

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
The Rocks Site - Transect 1					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	31%	95	1060	0	0
Standard Error of Mean	2%	5	341	0	0
Standard Deviation	7%	19	482	0	0
Count (*n*)	12	13	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	30%	--	1092	0	0
Standard Error of Mean	2%	--	99	0	0
Standard Deviation	4%	--	139	0	0
Count (*n*)	4	--	2	2	2
All Quadrats					
Mean	31%	--	1076	0	0
Standard Error of Mean	2%	--	145	0	0
Standard Deviation	6%	--	290	0	0
Count (*n*)	16	--	4	4	4
The Rocks Site - Transect 2					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	40%	123	1056	0	230
Standard Error of Mean	2%	15	156	0	109
Standard Deviation	8%	59	313	0	218
Count (*n*)	16	16	4	4	4
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	--	--	--	--	--
Standard Error of Mean	--	--	--	--	--
Standard Deviation	--	--	--	--	--
Count (*n*)	0	--	0	0	0
All Quadrats					
Mean	40%	--	1056	0	230
Standard Error of Mean	2%	--	156	0	109
Standard Deviation	8%	--	313	0	218
Count (*n*)	16	--	4	4	4

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
The Rocks Site - Transect 3					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	45%	141	579	178	160
Standard Error of Mean	4%	18	94	80	160
Standard Deviation	12%	50	188	160	320
Count (*n*)	8	8	4	4	4
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	45%	--	491	38	37
Standard Error of Mean	4%	--	60	38	37
Standard Deviation	20%	--	120	77	74
Count (*n*)	22	--	4	4	4
All Quadrats					
Mean	45%	--	535	108	98
Standard Error of Mean	3%	--	54	49	80
Standard Deviation	18%	--	154	138	225
Count (*n*)	30	--	8	8	8
The Rocks Site - Transect 4					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	47%	143	919	15	162
Standard Error of Mean	4%	7	229	15	68
Standard Deviation	14%	28	459	29	135
Count (*n*)	14	17	4	4	4
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	53%	--	--	--	--
Standard Error of Mean	2%	--	--	--	--
Standard Deviation	3%	--	--	--	--
Count (*n*)	2	--	0	0	0
All Quadrats					
Mean	48%	--	919	15	162
Standard Error of Mean	3%	--	229	15	68
Standard Deviation	13%	--	459	29	135
Count (*n*)	16	--	4	4	4

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
Cedar Swamp Site - Transect 1					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	54%	126	930	165	160
Standard Error of Mean	3%	4	188	81	34
Standard Deviation	14%	17	376	163	68
Count (*n*)	16	18	4	4	4
Non-*Spartina alterniflora* dominated Quadrats Only (d)					
Mean	--	--	--	--	--
Standard Error of Mean	--	--	--	--	--
Standard Deviation	--	--	--	--	--
Count (*n*)	0	--	0	0	0
All Quadrats					
Mean	54%	--	930	165	160
Standard Error of Mean	3%	--	188	81	34
Standard Deviation	14%	--	376	163	68
Count (*n*)	16	--	4	4	4
Cedar Swamp Site - Transect 2					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	60%	114	713	83	53
Standard Error of Mean	7%	5	334	45	53
Standard Deviation	30%	22	579	77	92
Count (*n*)	18	18	3	3	3
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	21%	--	346	421	159
Standard Error of Mean	4%	--	17	281	90
Standard Deviation	10%	--	24	397	128
Count (*n*)	5	--	2	2	2
All Quadrats					
Mean	52%	--	566	218	96
Standard Error of Mean	7%	--	204	124	48
Standard Deviation	31%	--	456	277	108
Count (*n*)	23	--	5	5	5

TABLE 8-8
SUMMARY OF 2009 CLIP and OCULAR QUADRAT DATA
PSEG EEP DETRITAL MONITORING PROGRAM

	Peak Season				
			Biomass		
	Percent Cover	Height (a) (cm)	Live Standing gdw/m^2	Dead Standing gdw/m^2	Litter gdw/m^2
Cedar Swamp Site - Transect 3					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	34%	132	807	134	0
Standard Error of Mean	3%	13	179	88	0
Standard Deviation	13%	62	358	176	0
Count (*n*)	21	23	4	4	4
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	37%	--	462	103	0
Standard Error of Mean	2%	--	29	24	0
Standard Deviation	4%	--	41	34	0
Count (*n*)	3	--	2	2	2
All Quadrats					
Mean	35%	--	692	124	0
Standard Error of Mean	2%	--	135	56	0
Standard Deviation	12%	--	330	138	0
Count (*n*)	24	--	6	6	6
Cedar Swamp Site - Transect 4					
Spartina alterniflora dominated Quadrats Only (b)					
Mean	38%	112	632	0	18
Standard Error of Mean	2%	9	391	0	4
Standard Deviation	9%	33	552	0	6
Count (*n*)	13	14	2	2	2
Non-*Spartina alterniflora* dominated Quadrats Only (c)					
Mean	37%	--	235	61	127
Standard Error of Mean	4%	--	115	32	70
Standard Deviation	8%	--	163	46	100
Count (*n*)	3	--	2	2	2
All Quadrats					
Mean	38%	--	433	31	73
Standard Error of Mean	2%	--	202	22	43
Standard Deviation	8%	--	404	44	85
Count (*n*)	16	--	4	4	4

(a) Height calculations include values for *S. alterniflora* and *S. cynosuriodes* from Spartina-dominated quadrats only.

(b) Also includes *Spartina cynosuroides* dominated quadrats, when present.

(c) Includes quadrats dominated by *Spartina patens.*

(d) All quadrats in this transect were *Spartina* -dominated.

Table 8-9
2009 Species Occurrence At Reference Marshes
PSEG Detrital Production Monitoring

Species [a]	Reference Marsh	
	Mad Horse Creek	Moores Beach West
Amaranthus cannabinus	X*	
Distichlis spicata	X*	
Phragmites australis	X*	
Scirpus robustus	X*	
Spartina alterniflora	X*	X*
Spartina cynosuroides	X*	
Spartina patens	X*	

[a] Species listed were present within quadrats along sampling transects.
* Present as a dominant (>20 percent relative cover) in some quadrats.

TABLE 8-10
SUMMARY OF 2009 PLOT DATA
PSEG EEP VEGETATION MONITORING

	Percent Cover	Live Standing Biomass	
		gdw/m2	lb/acre
Mad Horse Creek Reference Marsh			
Plot 1 (MHP1)			
Mean	29%	836	7,456
Standard Error of Mean	3%	104	927
Standard Deviation	8%	312	2,781
Minimum	20%	155	1,379
Maximum	45%	1,277	11,398
Count (n)	9	9	
Plot 2 (MHP2)			
Mean	47%	866	7,731
Standard Error of Mean	3%	109	975
Standard Deviation	9%	328	2,925
Minimum	35%	522	4,659
Maximum	55%	1,414	12,619
Count (n)	9	9	
Plot 3 (MHP3)			
Mean	24%	612	5,462
Standard Error of Mean	2%	64	575
Standard Deviation	5%	193	1,724
Minimum	20%	238	2,119
Maximum	30%	911	8,132
Count (n)	9	9	
All Plots			
Mean	34%	771	6,883
Standard Error of Mean	2%	57	509
Standard Deviation	12%	296	2,643
Minimum	20%	155	1,379
Maximum	55%	1,414	12,619
Count (n)	27	27	

TABLE 8-10
SUMMARY OF 2009 PLOT DATA
PSEG EEP VEGETATION MONITORING

	Percent Cover	Live Standing Biomass	
		gdw/m2	lb/acre
Moores Beach West Reference Marsh			
Plot 1 (MBP1)			
Mean	35%	692	6,172
Standard Error of Mean	4%	90	800
Standard Deviation	12%	254	2,263
Minimum	15%	252	2,245
Maximum	50%	928	8,275
Count (n)	8	8	
Plot 2 (MBP2)			
Mean	34%	512	4,572
Standard Error of Mean	7%	60	539
Standard Deviation	21%	171	1,525
Minimum	15%	248	2,212
Maximum	75%	730	6,510
Count (n)	8	8	
Plot 3 (MBP3)			
Mean	47%	869	7,751
Standard Error of Mean	4%	81	719
Standard Deviation	12%	242	2,156
Minimum	35%	519	4,632
Maximum	70%	1,212	10,816
Count (n)	9	9	
All Plots			
Mean	39%	698	4,632
Standard Error of Mean	3%	53	469
Standard Deviation	16%	263	2,347
Minimum	15%	248	2,212
Maximum	75%	1,212	10,816
Count (n)	25	25	

TABLE 8-10
SUMMARY OF 2009 PLOT DATA
PSEG EEP VEGETATION MONITORING

	Percent Cover	Live Standing Biomass	
		gdw/m2	lb/acre
Commercial Township Site			
Plot 1 (CTP1)			
Mean	49%	611	5,447
Standard Error of Mean	5%	277	2,473
Standard Deviation	10%	554	4,947
Minimum	35%	14	125
Maximum	60%	1,355	12,094
Count (n)	4	4	
Plot 2 (CTP2)			
Mean	41%	1,108	9,885
Standard Error of Mean	5%	142	1,268
Standard Deviation	13%	402	3,585
Minimum	20%	630	5,619
Maximum	60%	1,961	17,492
Count (n)	8	8	
Plot 3 (CTP3)			
Mean	35%	1,088	9,709
Standard Error of Mean	4%	158	1,411
Standard Deviation	12%	418	3,733
Minimum	20%	476	4,251
Maximum	56%	1,536	13,706
Count (n)	7	7	
All Plots			
Mean	40%	996	8,886
Standard Error of Mean	3%	106	947
Standard Deviation	13%	463	4,130
Minimum	20%	14	125
Maximum	60%	1,961	17,492
Count (n)	19	19	

TABLE 8-10
SUMMARY OF 2009 PLOT DATA
PSEG EEP VEGETATION MONITORING

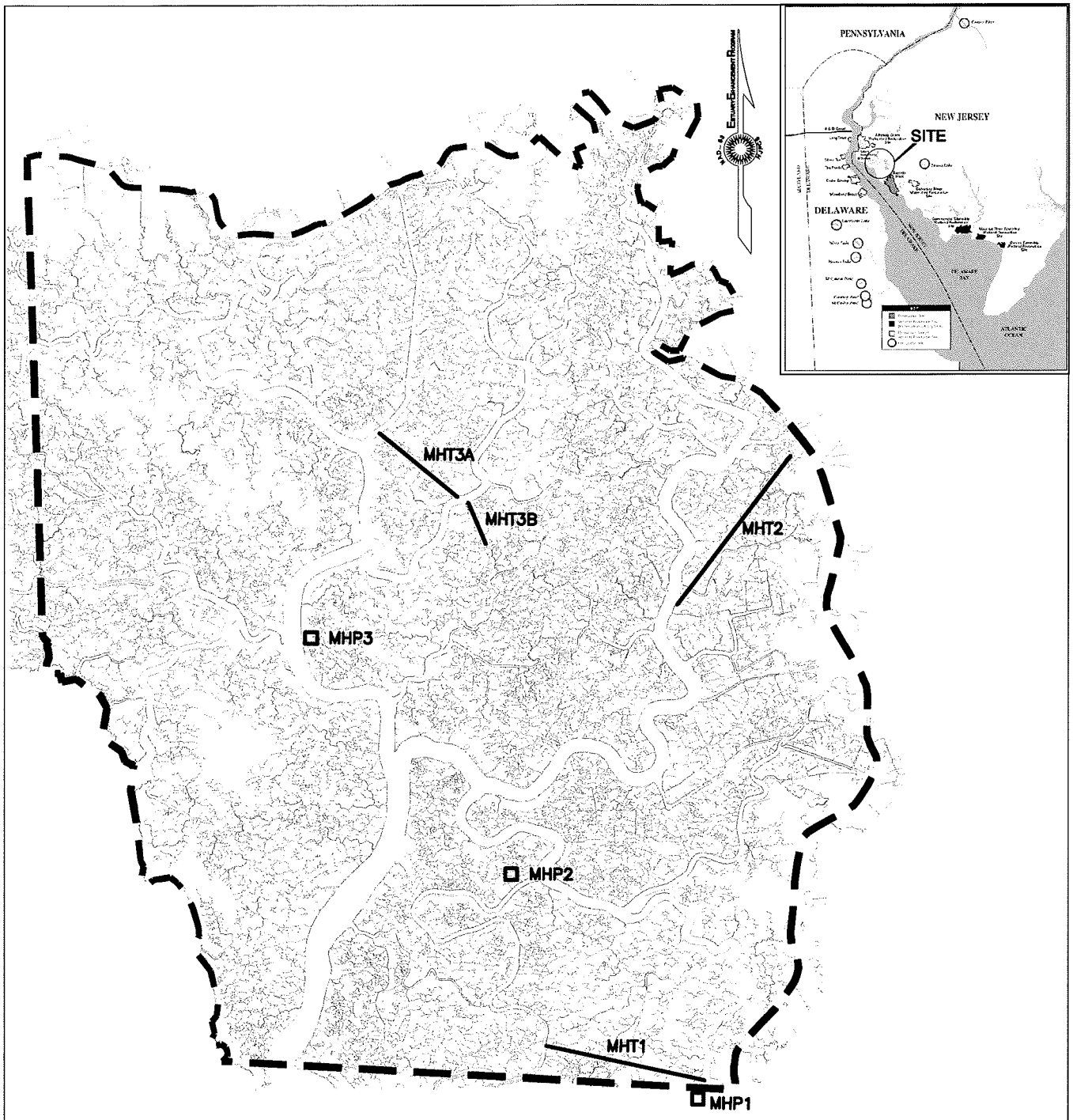
	Percent Cover	Live Standing Biomass	
		gdw/m2	lb/acre
Alloway Creek Watershed Site			
Plot 1 (ACWP1)			
Mean	32%	435	3,881
Standard Error of Mean	10%	168	1,499
Standard Deviation	23%	376	3,351
Minimum	5%	157	1,397
Maximum	60%	964	8,605
Count (n)	5	5	
Plot 2 (ACWP2)			
Mean	30%	691	6,168
Standard Error of Mean	3%	78	698
Standard Deviation	10%	235	2,094
Minimum	15%	304	2,710
Maximum	46%	951	8,485
Count (n)	9	9	
Plot 3 (ACWP3)			
Mean	45%	799	7,131
Standard Error of Mean	7%	97	868
Standard Deviation	21%	292	2,604
Minimum	20%	453	4,040
Maximum	85%	1,291	11,516
Count (n)	9	9	
All Plots			
Mean	36%	678	6,048
Standard Error of Mean	4%	65	577
Standard Deviation	18%	310	2,767
Minimum	5%	157	1,397
Maximum	85%	1,291	11,516
Count (n)	23	23	

TABLE 8-10
SUMMARY OF 2009 PLOT DATA
PSEG EEP VEGETATION MONITORING

	Percent Cover	Live Standing Biomass	
		gdw/m2	lb/acre
The Rocks Site			
Plot 1 (TRP1)			
Mean	47%	618	5,510
Standard Error of Mean	9%	90	802
Standard Deviation	28%	270	2,405
Minimum	15%	242	2,161
Maximum	84%	1,172	10,460
Count (n)	9	9	
Cedar Swamp Site			
Plot 1 (CSP1)			
Mean	46%	747	6,665
Standard Error of Mean	6%	97	869
Standard Deviation	17%	292	2,607
Minimum	30%	404	3,602
Maximum	85%	1,247	11,127
Count (n)	9	9	

Chapter 8 Figures

Figure 8-1
Site Location Map



NOTE:

MHT1 MAD HORSE CREEK VEGETATION TRANSECT 1
MHT2 MAD HORSE CREEK VEGETATION TRANSECT 2
MHT3 MAD HORSE CREEK VEGETATION TRANSECT 3
MHP1 MAD HORSE CREEK VEGETATION PLOT 1
MHP2 MAD HORSE CREEK VEGETATION PLOT 2
MHP3 MAD HORSE CREEK VEGETATION PLOT 3

LEGEND

- SITE BOUNDARY
- EXISTING SURFACE WATER FEATURE
- TRANSECT
- 60m x 60m PLOT

FEET 0 1200 2400 3600
METERS 0 600 1200

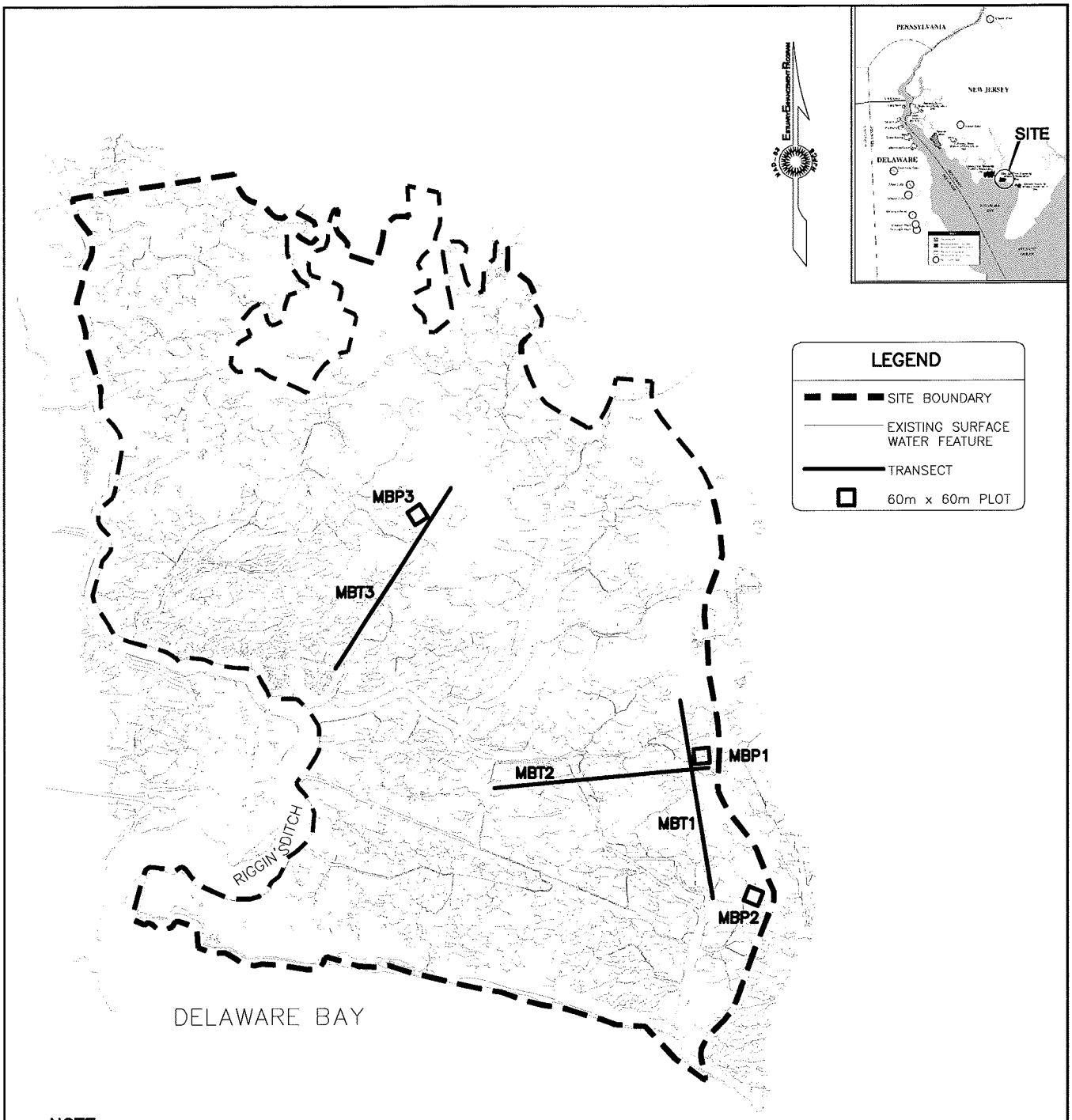
URS

PSEG
ESTUARY ENHANCEMENT PROGRAM

Figure 8-2

MADHORSE CREEK REFERENCE MARSH
2009 VEGETATION MONITORING
TRANSECTS AND PLOTS
LOWER ALLOWAYS CREEK TOWNSHIP
SALEM COUNTY, NEW JERSEY

CADD JL DATE MAY 17, 2010 SCALE AS SHOWN
FILE 09_MH_TRA CHECKED RLH EXAMINED RLH



NOTE:

MBT1 MOORES BEACH VEGETATION TRANSECT 1

MBT2 MOORES BEACH VEGETATION TRANSECT 2

MBT3 MOORES BEACH VEGETATION TRANSECT 3

MBP1 MOORES BEACH VEGETATION PLOT 1

MBP2 MOORES BEACH VEGETATION PLOT 2

MBP3 MOORES BEACH VEGETATION PLOT 3

FEET 0 900 1800 2700

METERS 0 400 800

URS

PSEG

ESTUARY ENHANCEMENT PROGRAM

Figure 8-3

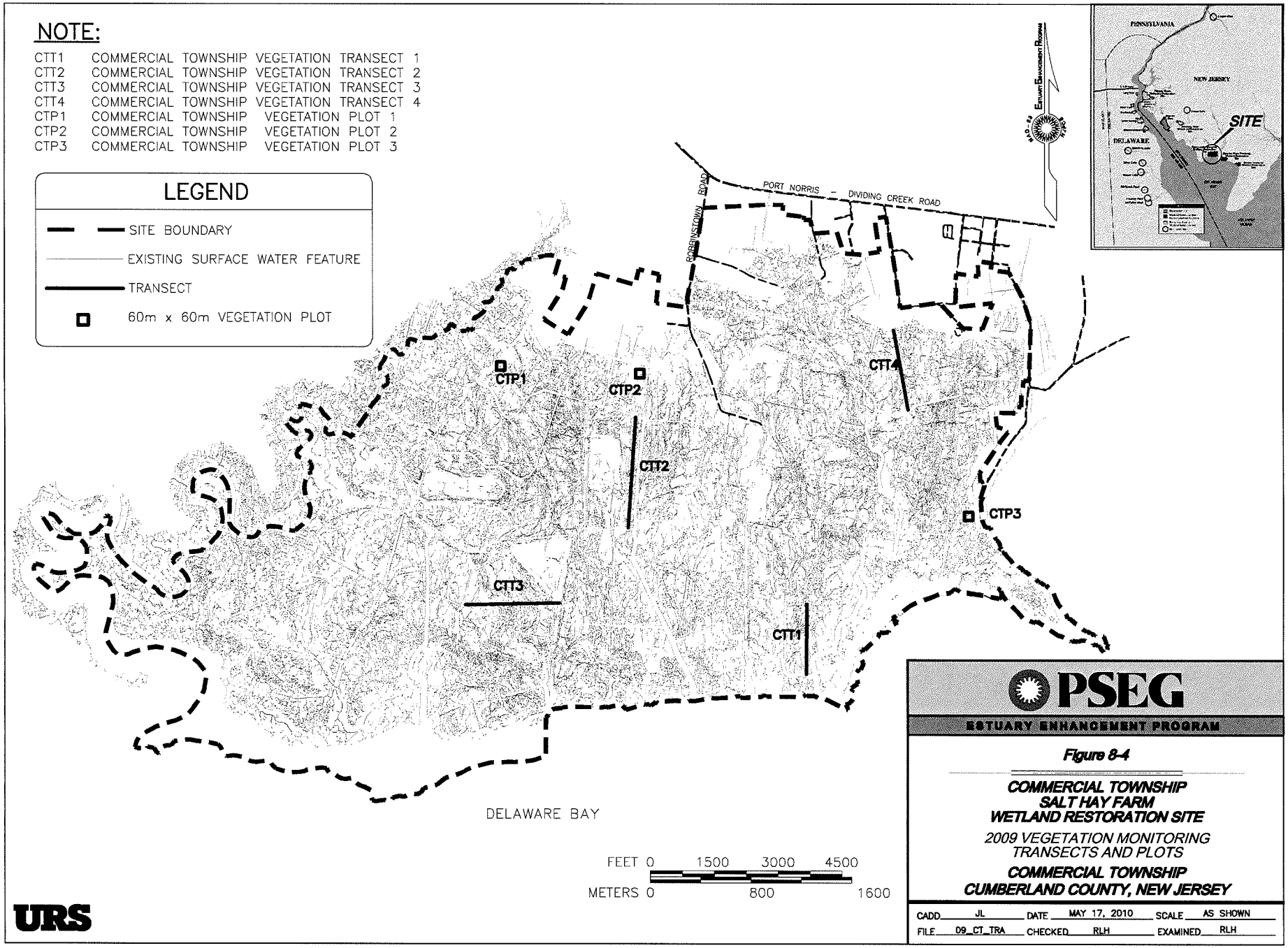
MOORES BEACH REFERENCE MARSH

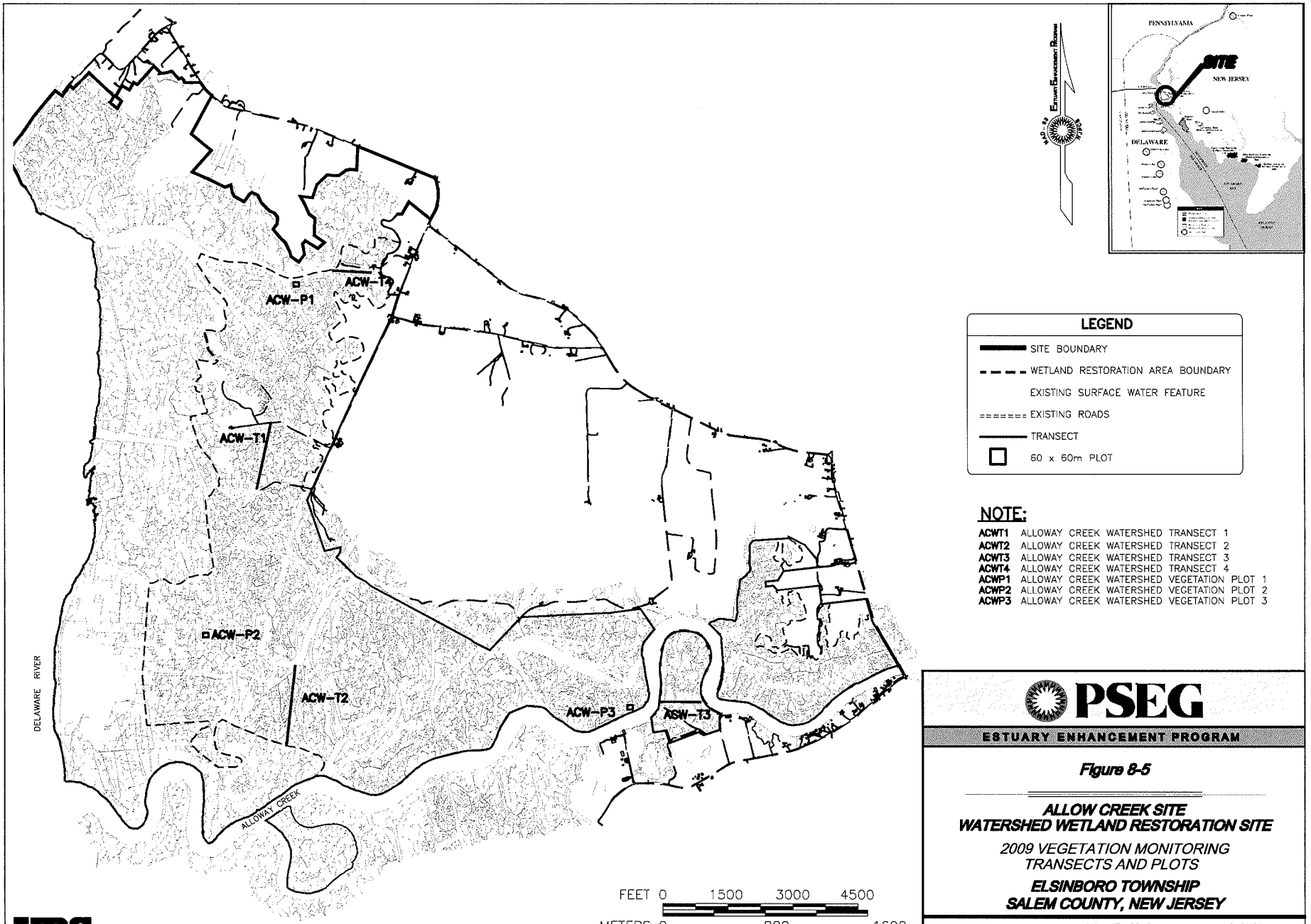
2009 VEGETATION MONITORING TRANSECTS AND PLOTS

MAURICE RIVER TOWNSHIP

CUMBERLAND COUNTY, NEW JERSEY

CADD	JL	DATE	MAY 17, 2010	SCALE	AS SHOWN
FILE	09_MB_TRA	CHECKED	RLH	EXAMINED	RLH


NOTE:
CTT1 COMMERCIAL TOWNSHIP VEGETATION TRANSECT 1
CTT2 COMMERCIAL TOWNSHIP VEGETATION TRANSECT 2
CTT3 COMMERCIAL TOWNSHIP VEGETATION TRANSECT 3
CTT4 COMMERCIAL TOWNSHIP VEGETATION TRANSECT 4
CTP1 COMMERCIAL TOWNSHIP VEGETATION PLOT 1
CTP2 COMMERCIAL TOWNSHIP VEGETATION PLOT 2
CTP3 COMMERCIAL TOWNSHIP VEGETATION PLOT 3
LEGEND
SITE BOUNDARY
EXISTING SURFACE WATER FEATURE
TRANSECT
60m x 60m VEGETATION PLOT
PORT NORRIS - DIVIDING CREEK ROAD
ROBBINSTOWN ROAD
ESTUARY ENHANCEMENT PROGRAM
PENNSYLVANIA
NEW JERSEY
DELAWARE
SITE
CTP1
CTP2
CTP3
CTT1
CTT2
CTT3
CTT4
DELAWARE BAY
FEET 0 1500 3000 4500
METERS 0 800 1600
URS
PSEG
ESTUARY ENHANCEMENT PROGRAM
Figure 8-4
COMMERCIAL TOWNSHIP
SALT HAY FARM
WETLAND RESTORATION SITE
2009 VEGETATION MONITORING
TRANSECTS AND PLOTS
COMMERCIAL TOWNSHIP
CUMBERLAND COUNTY, NEW JERSEY
CADD JL DATE MAY 17, 2010 SCALE AS SHOWN
FILE 09_CT_TRA CHECKED RLH EXAMINED RLH



NOTE:

ACWT1	ALLOWAY CREEK WATERSHED TRANSECT 1
ACWT2	ALLOWAY CREEK WATERSHED TRANSECT 2
ACWT3	ALLOWAY CREEK WATERSHED TRANSECT 3
ACWT4	ALLOWAY CREEK WATERSHED TRANSECT 4
ACWP1	ALLOWAY CREEK WATERSHED VEGETATION PLOT 1
ACWP2	ALLOWAY CREEK WATERSHED VEGETATION PLOT 2
ACWP3	ALLOWAY CREEK WATERSHED VEGETATION PLOT 3

URS

PSEG

ESTUARY ENHANCEMENT PROGRAM

Figure 8-5

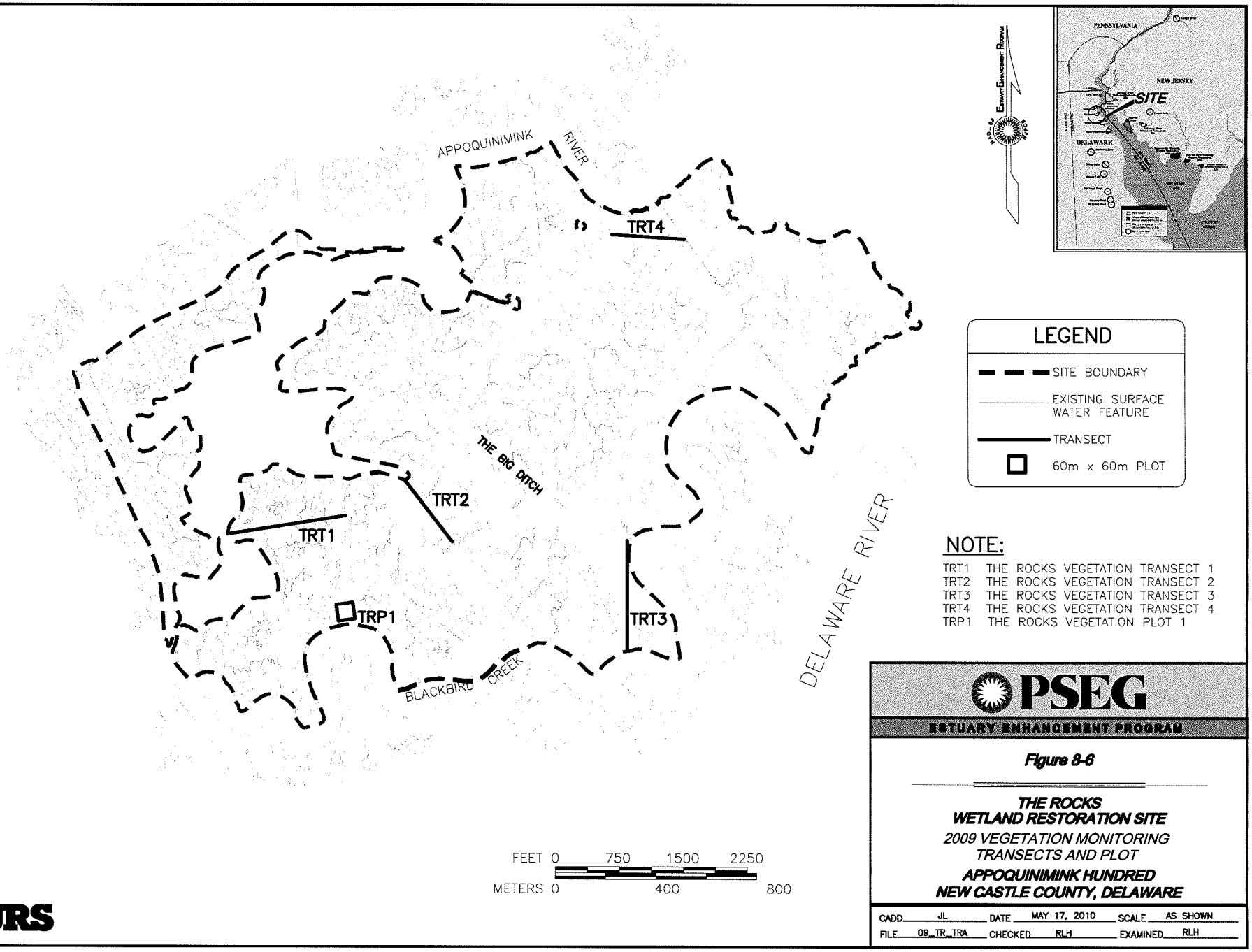
ALLOW CREEK SITE WATERSHED WETLAND RESTORATION SITE

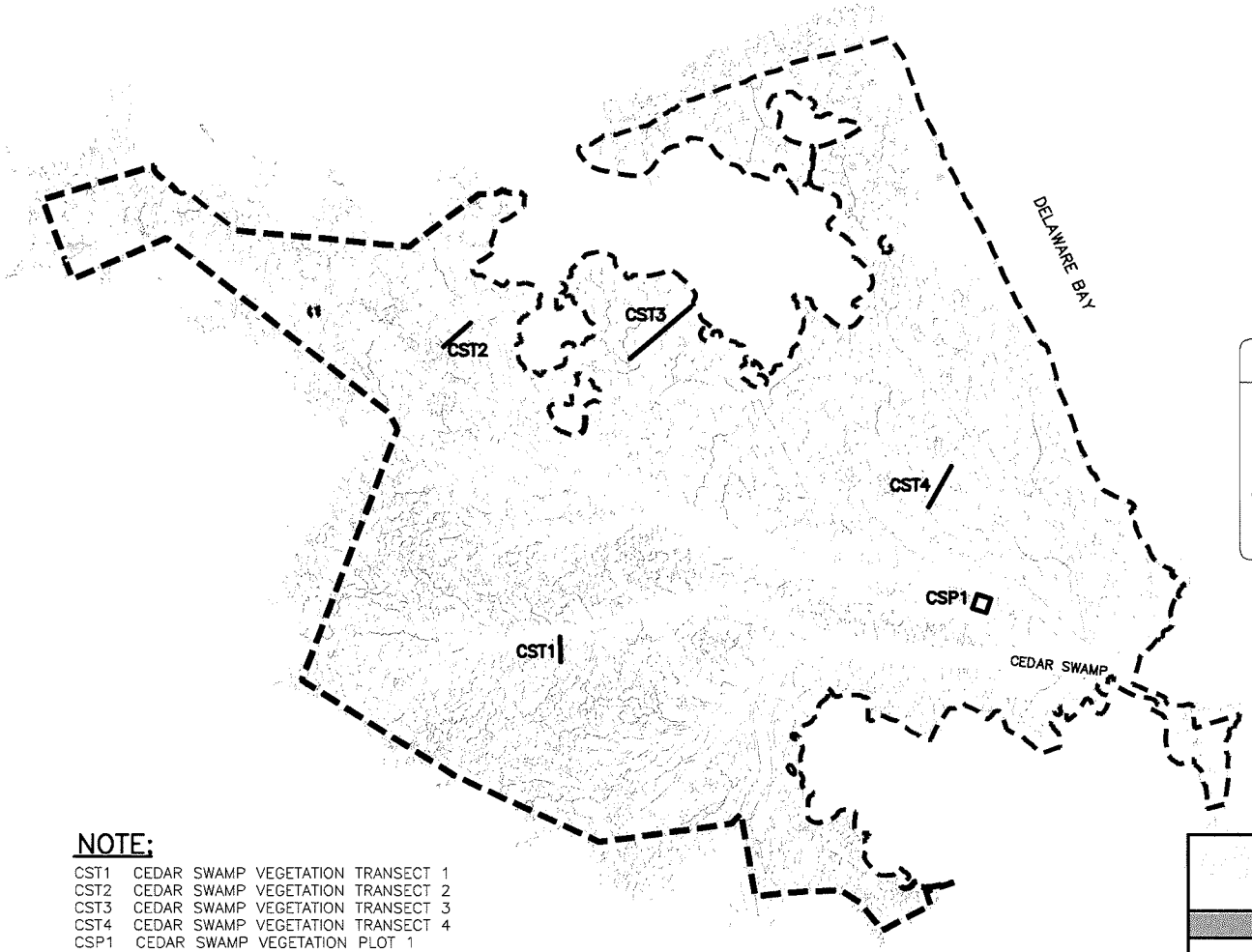
2009 VEGETATION MONITORING TRANSECTS AND PLOTS

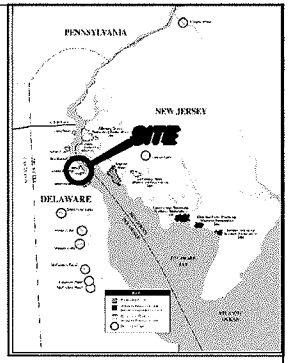
ELSINBORO TOWNSHIP SALEM COUNTY, NEW JERSEY

CADD JL DATE MAY 17, 2010 SCALE AS SHOWN

FILE 09 ACW TRA CHECKED RLH EXAMINED RLH


APPOQUINIMINK RIVER
TRT4
THE BIG DITCH
TRT2
TRT1
TRP1
TRT3
DELAWARE RIVER
BLACKBIRD CREEK
LEGEND
SITE BOUNDARY
EXISTING SURFACE WATER FEATURE
TRANSECT
60m x 60m PLOT
NOTE:
TRT1 THE ROCKS VEGETATION TRANSECT 1
TRT2 THE ROCKS VEGETATION TRANSECT 2
TRT3 THE ROCKS VEGETATION TRANSECT 3
TRT4 THE ROCKS VEGETATION TRANSECT 4
TRP1 THE ROCKS VEGETATION PLOT 1
PENNSYLVANIA
NEW JERSEY
SITE
DELAWARE
FEET 0 750 1500 2250
METERS 0 400 800
URS
PSEG
ESTUARY ENHANCEMENT PROGRAM
Figure 8-6
THE ROCKS
WETLAND RESTORATION SITE
2009 VEGETATION MONITORING
TRANSECTS AND PLOT
APPOQUINIMINK HUNDRED
NEW CASTLE COUNTY, DELAWARE
CADD JL DATE MAY 17, 2010 SCALE AS SHOWN
FILE 09_TR_TRA CHECKED RLH EXAMINED RLH





LEGEND

- SITE BOUNDARY
- EXISTING SURFACE WATER FEATURE
- TRANSECT
- 60m x 60m PLOT

NOTE:

CST1 CEDAR SWAMP VEGETATION TRANSECT 1
CST2 CEDAR SWAMP VEGETATION TRANSECT 2
CST3 CEDAR SWAMP VEGETATION TRANSECT 3
CST4 CEDAR SWAMP VEGETATION TRANSECT 4
CSP1 CEDAR SWAMP VEGETATION PLOT 1

FEET 0 1200 2400 3600
METERS 0 600 1200

URS

PSEG

ESTUARY ENHANCEMENT PROGRAM

Figure 8-7

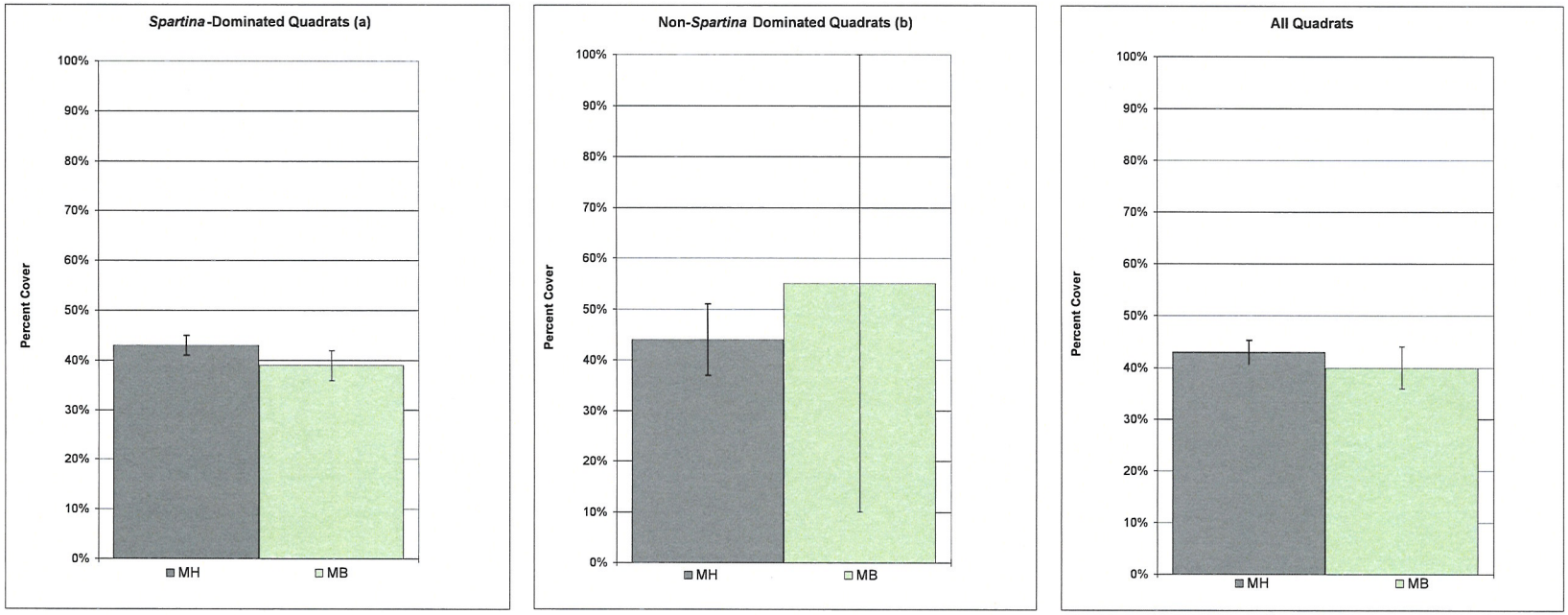
CEDAR SWAMP WETLAND RESTORATION SITE

2009 VEGETATION MONITORING TRANSECTS AND PLOT

BLACKBIRD HUNDRED NEW CASTLE COUNTY, DELAWARE

CADD JL DATE MAY 17, 2010 SCALE AS SHOWN
FILE 09_CS-TRA CHECKED RLH EXAMINED RLH

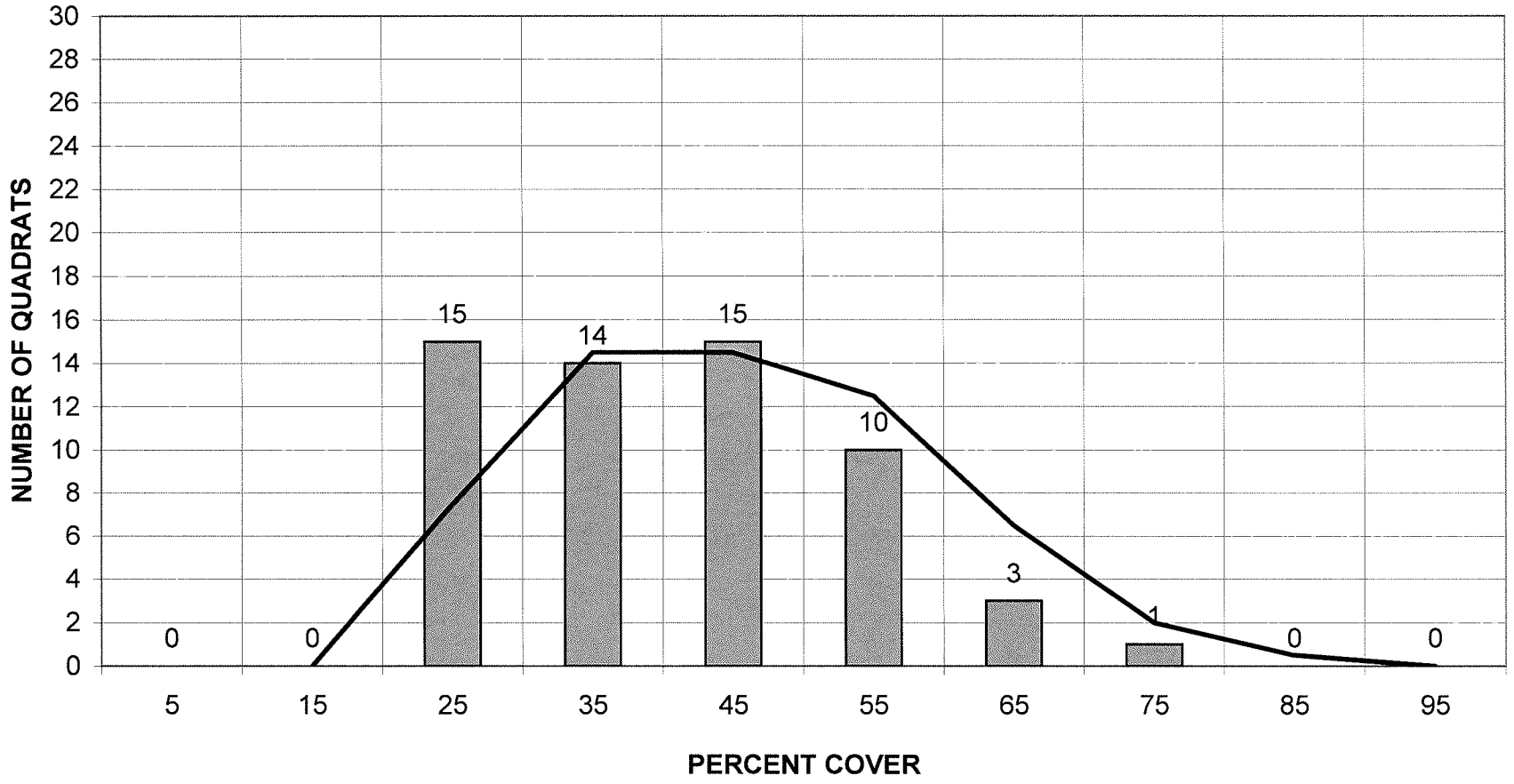
FIGURE 8-8
MEAN PERCENT COVER
2009 REFERENCE MARSH TRANSECT DATA



(a) Also includes *Spartina cynosuroides* dominated quadrats, when present.
(b) Includes quadrats dominated by *Spartina patens* , if present.
Error bar represents +/- one Standard Error of the Mean.

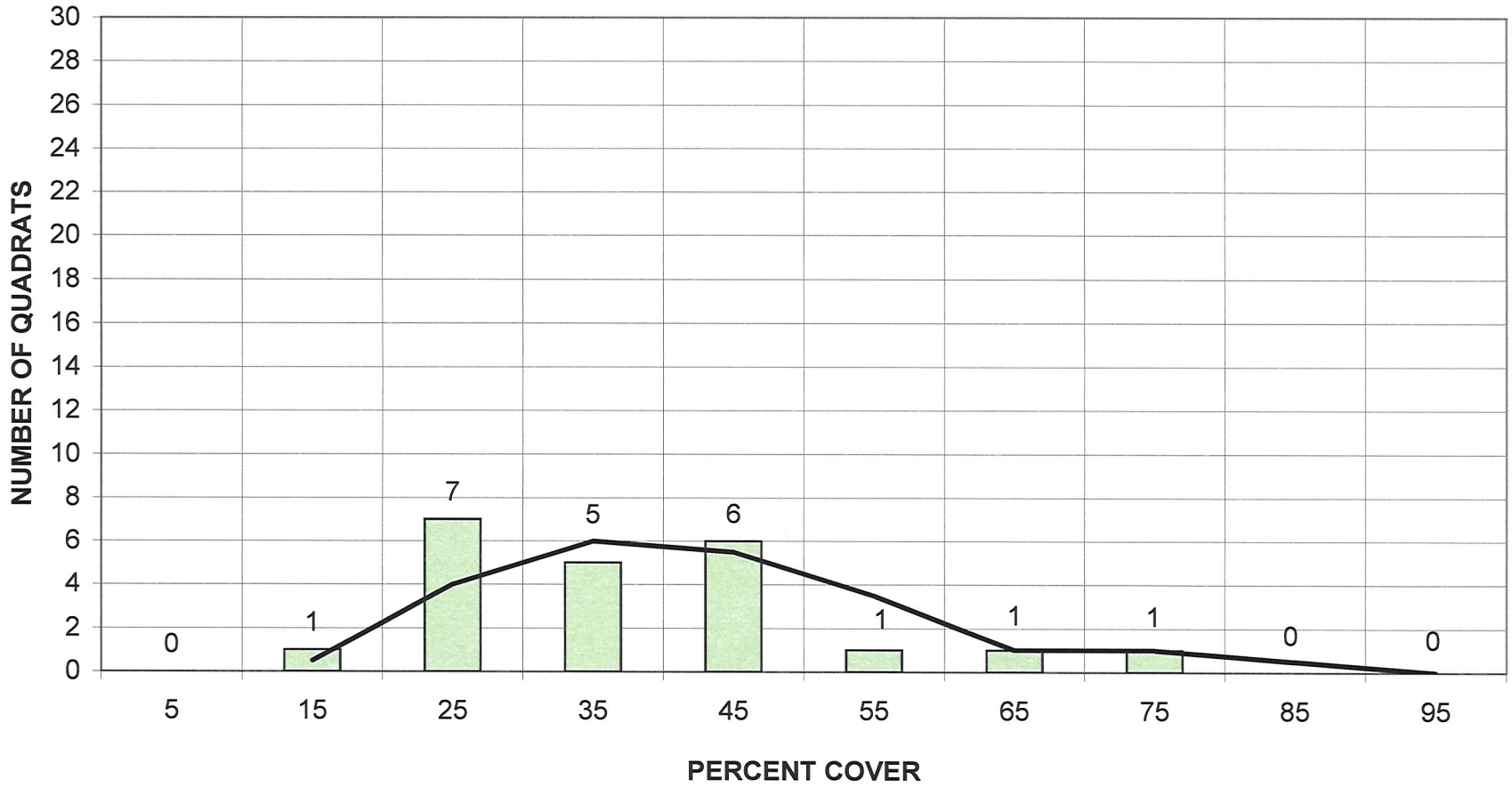
MH = Mad Horse Creek Reference Marsh
MB = Moores Beach West Reference Marsh

FIGURE 8-9
2009 PERCENT COVER GROUPINGS
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
MAD HORSE CREEK REFERENCE MARSH TRANSECTS



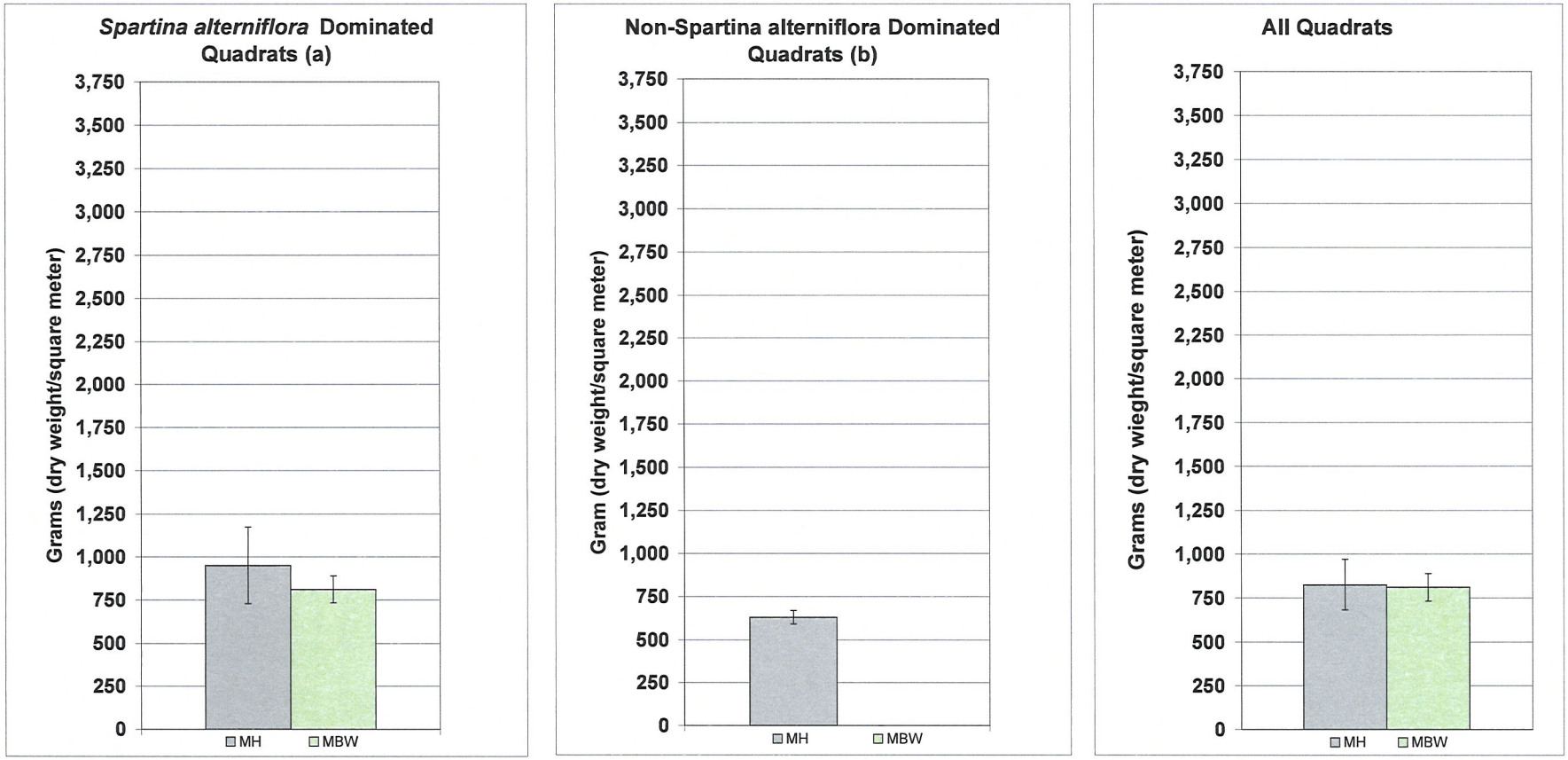
(a) Includes *S. cynosuroides* dominated quadrats, when present.

FIGURE 8-10
2009 PERCENT COVER GROUPINGS
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
MOORES BEACH WEST REFERENCE MARSH TRANSECTS



(a) Includes *S. cynosuroides* dominated

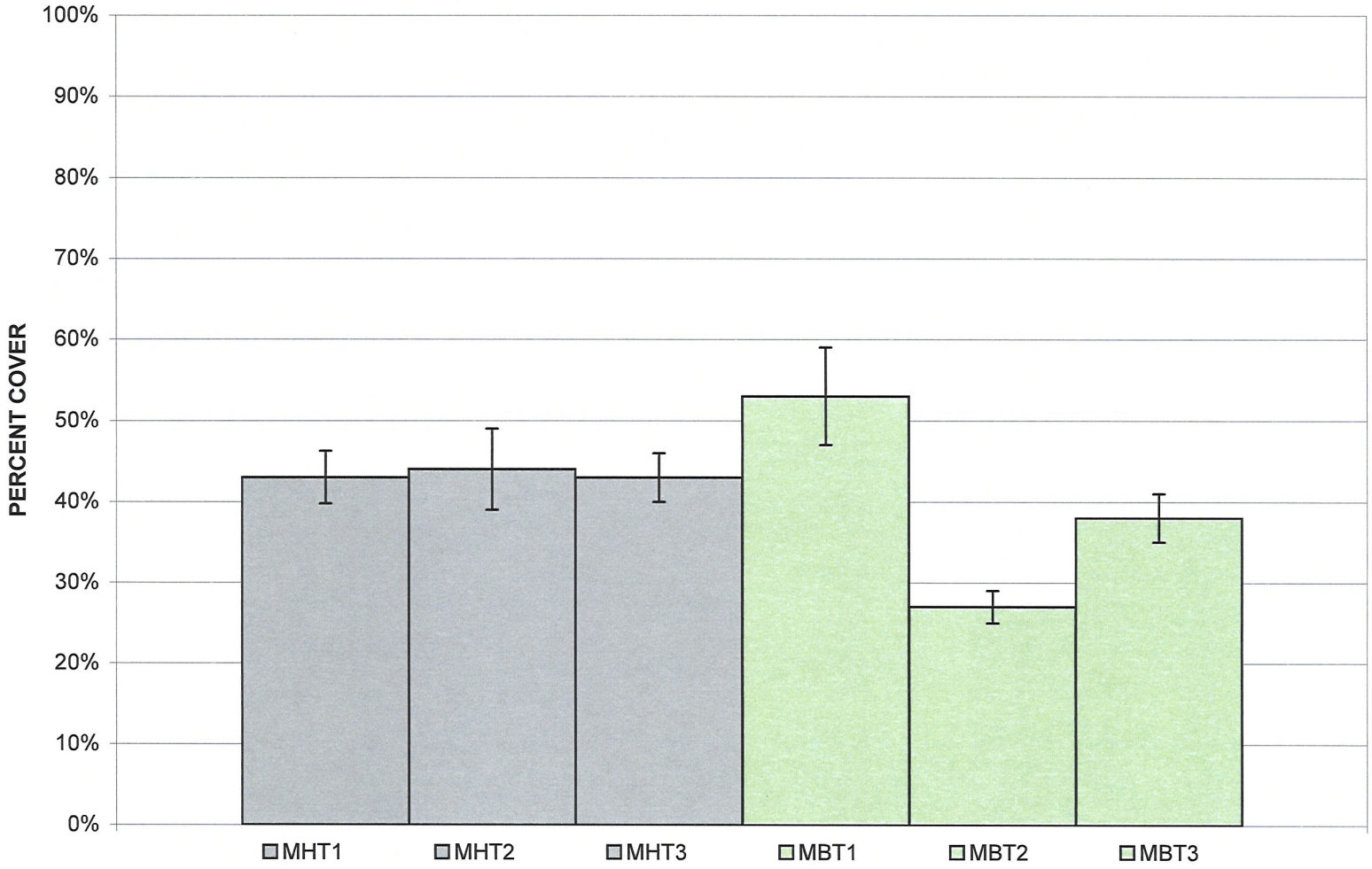
Figure 8-11
Mean Live Standing Crop
2009 Reference Marsh Transect Data



(a) Also includes *Spartina cynosuroides* dominated quadrats, when present.
(b) Includes quadrats dominated by *Spartina patens*, if present.
Error bar represents +/- one Standard Error of the Mean.

MH = Mad Horse Creek Reference Marsh
MBW = Moores Beach West Reference Marsh

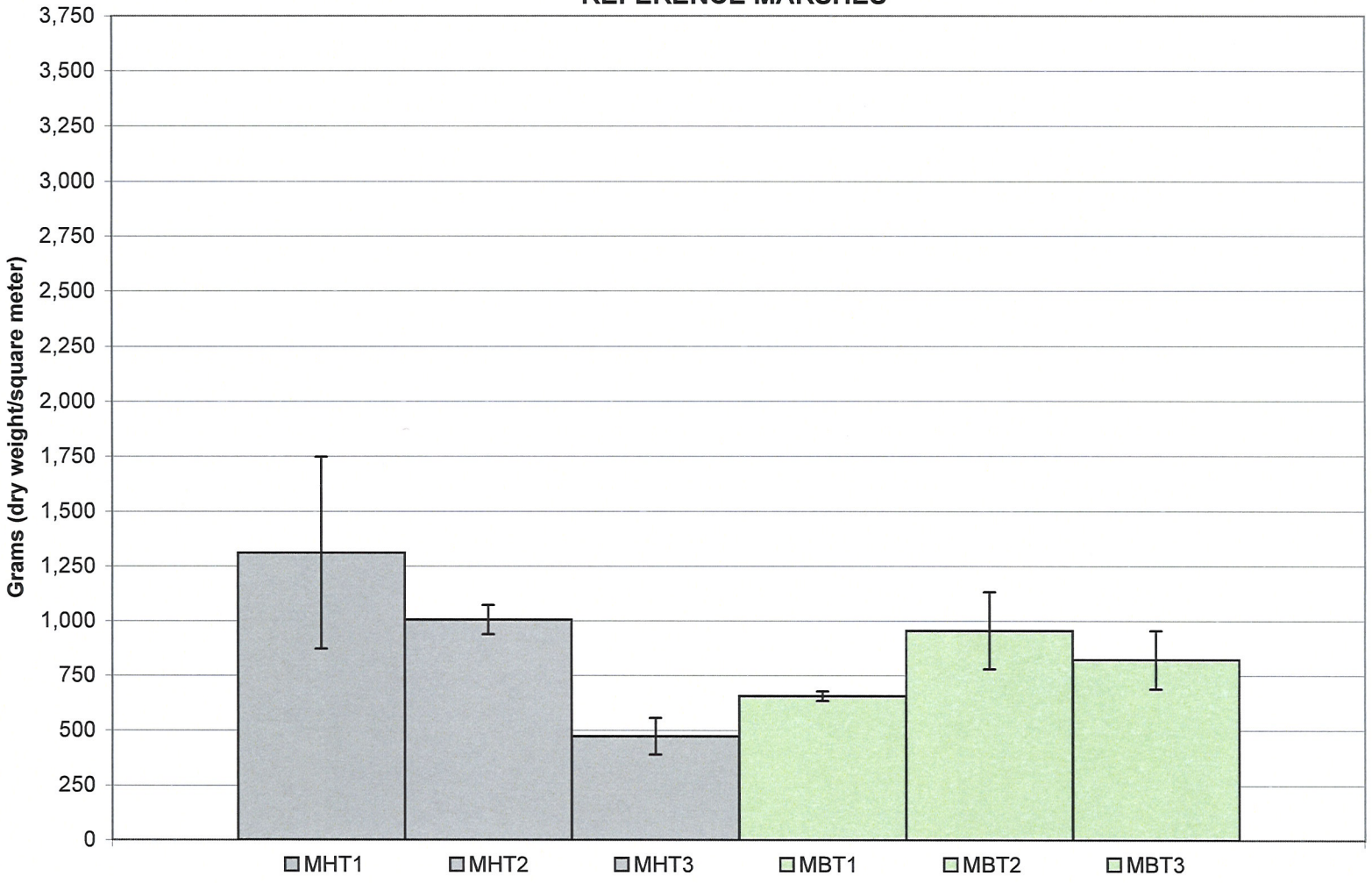
FIGURE 8-12
2009 MEAN PERCENT COVER by TRANSECT
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
REFERENCE MARSHES



(a) Includes *S. cynosuroides* dominated quadrats.
Error bar represents +/- one Standard Error of the Mean.

MH = Mad Horse
MB = Moores Beach West
T1 = Transect 1

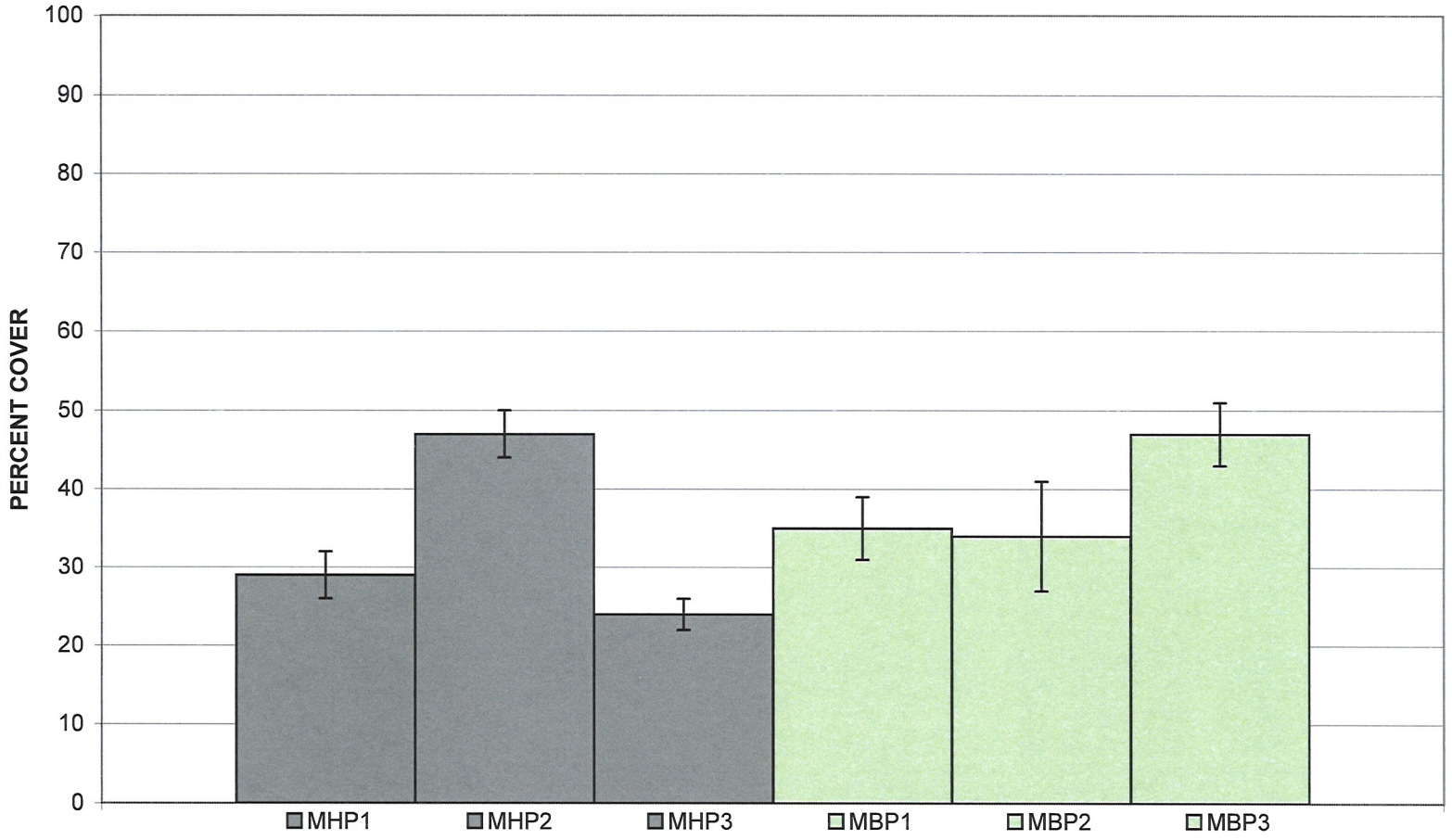
FIGURE 8-13
2009 MEAN LIVE STANDING CROP by TRANSECT
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
REFERENCE MARSHES



(a) Includes *S. cynosuroides* dominated quadrats.
Error bar represents +/- one Standard Error of the Mean.

MH = Mad Horse
MB = Moores Beach West
T1 = Transect 1

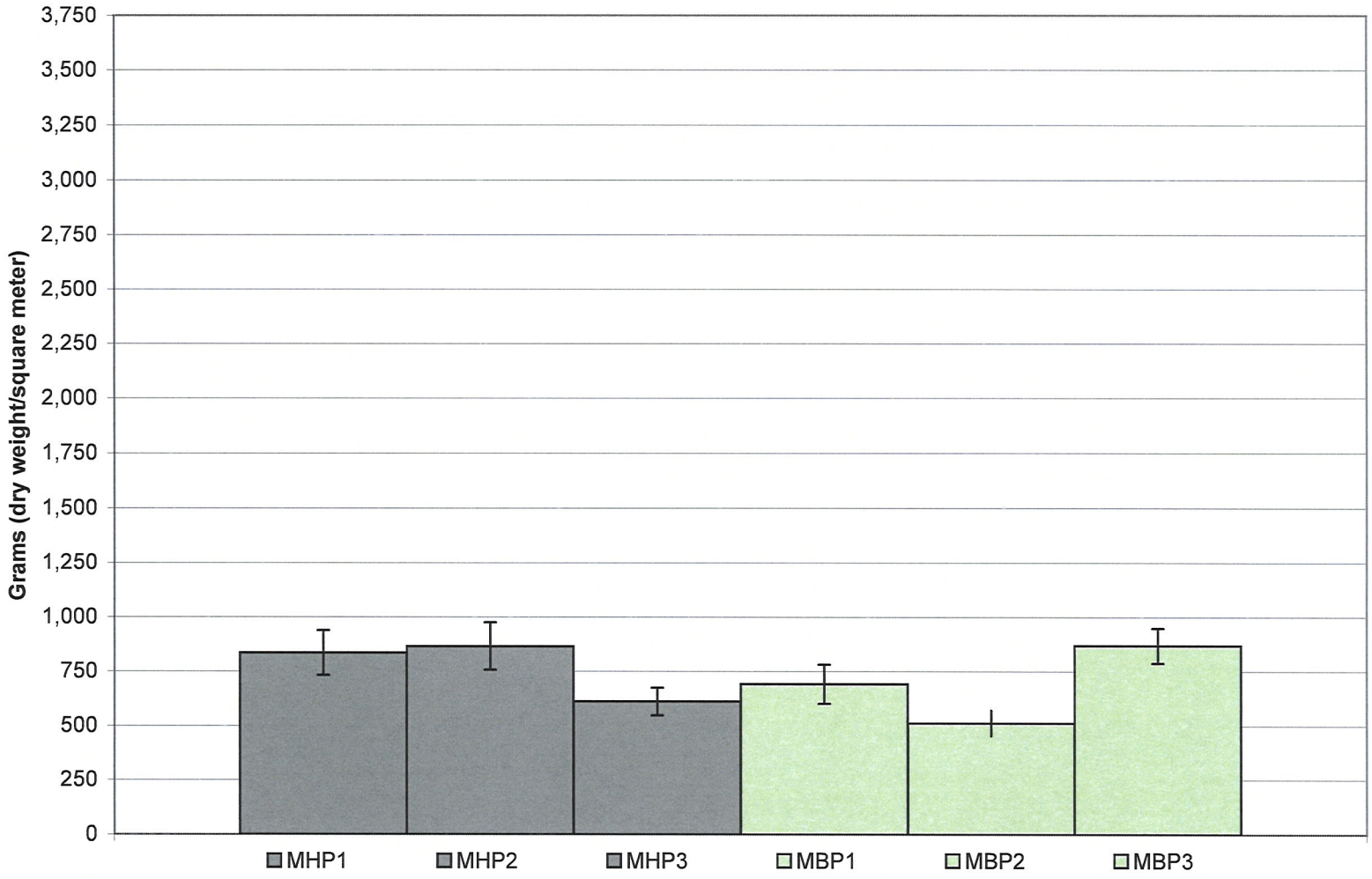
FIGURE 8-14
2009 MEAN PERCENT COVER 60x60 METER PLOTS
REFERENCE MARSHES



MH = Mad Horse P1 = Plot 1
MB = Moores Beach West

Error bar represents +/- one Standard Error of the Mean.

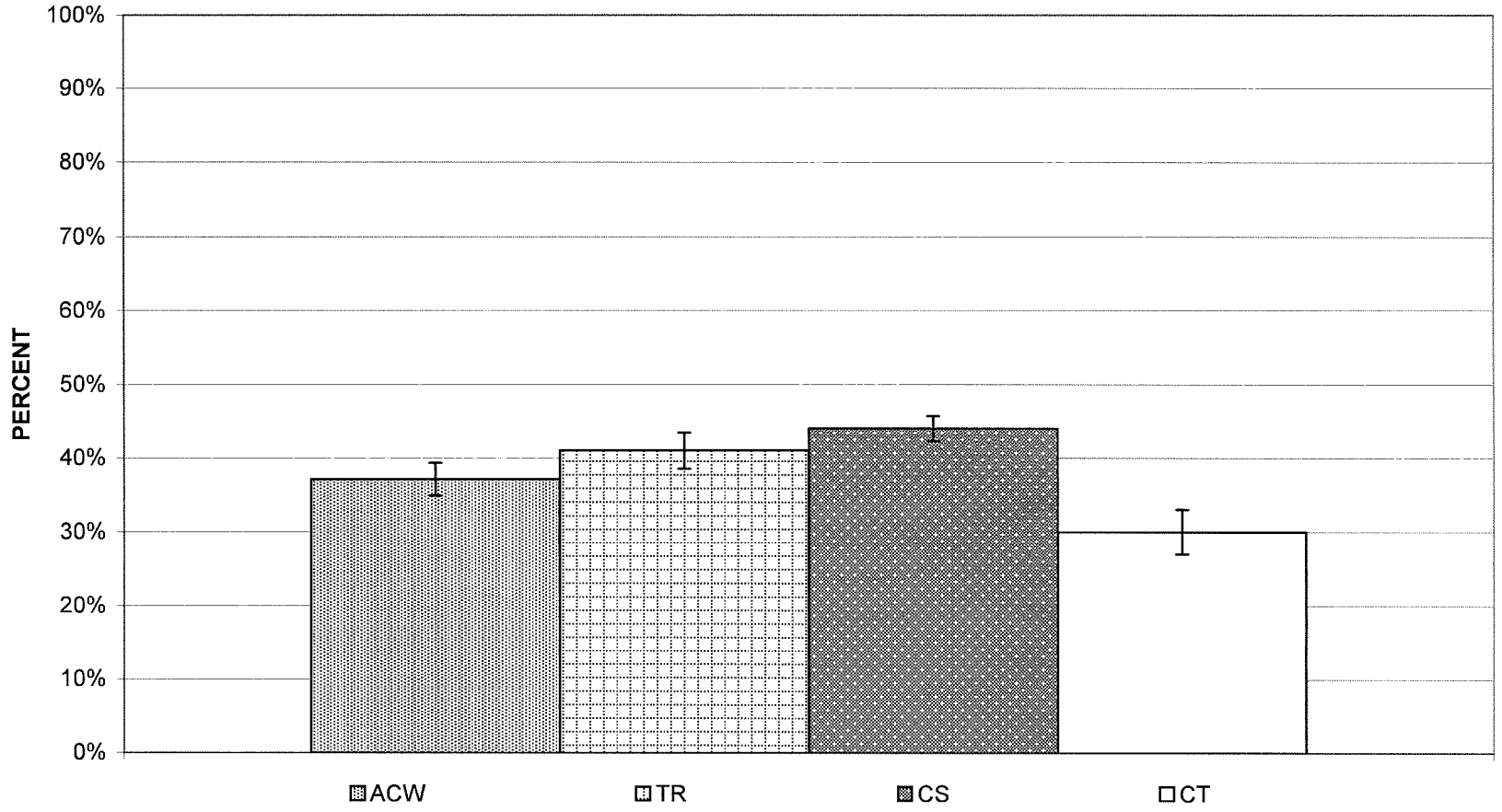
FIGURE 8-15
2009 MEAN LIVE STANDING CROP 60x60 METER PLOTS
REFERENCE MARSHES



Error bar represents +/- one Standard Error of the Mean.

MH = Mad Horse
MB = Moores Beach West
P1 = Plot 1

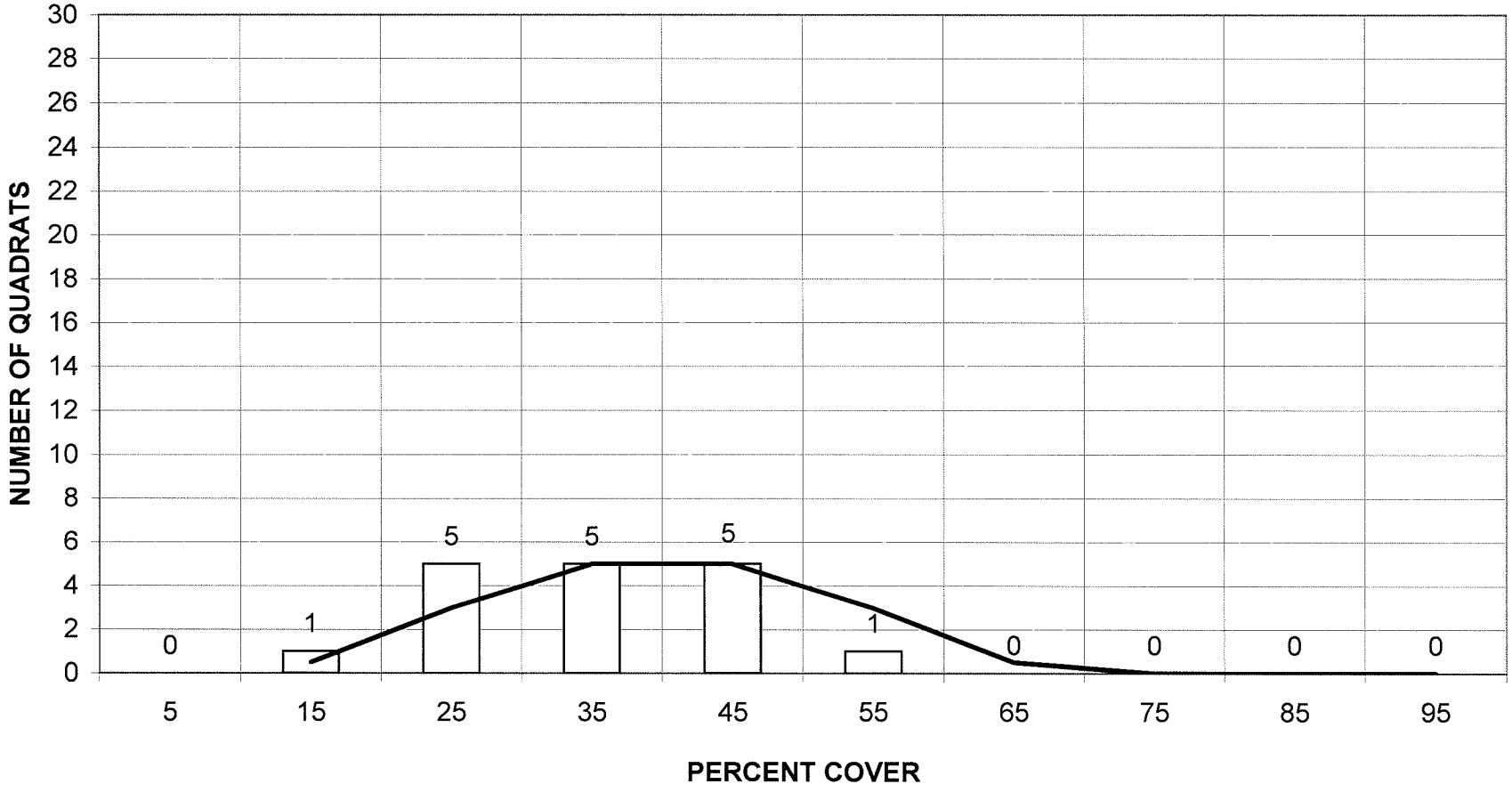
FIGURE 8-16
MEAN PERCENT COVER
2009 RESTORATION SITE TRANSECT DATA



- Error bar represents +/- one Standard Error of the Mean.

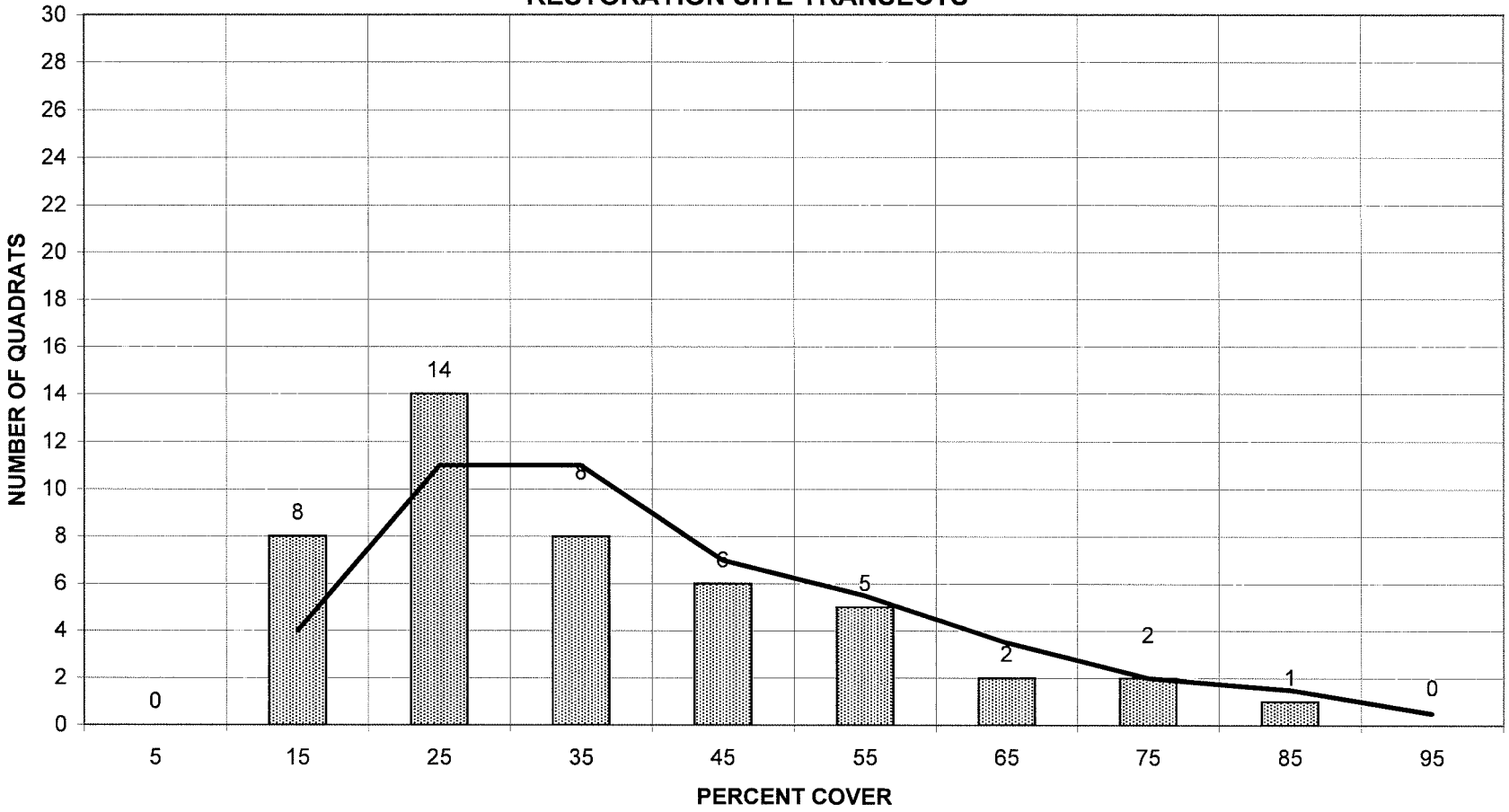
CT = Commercial Township Site
TR = The Rocks
CS = Cedar Swamp
ACW = Alloway Creek Site

FIGURE 8-17
2009 PERCENT COVER GROUPINGS
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
COMMERCIAL TOWNSHIP SALT HAY FARM WETLAND RESTORATION SITE TRANSECTS



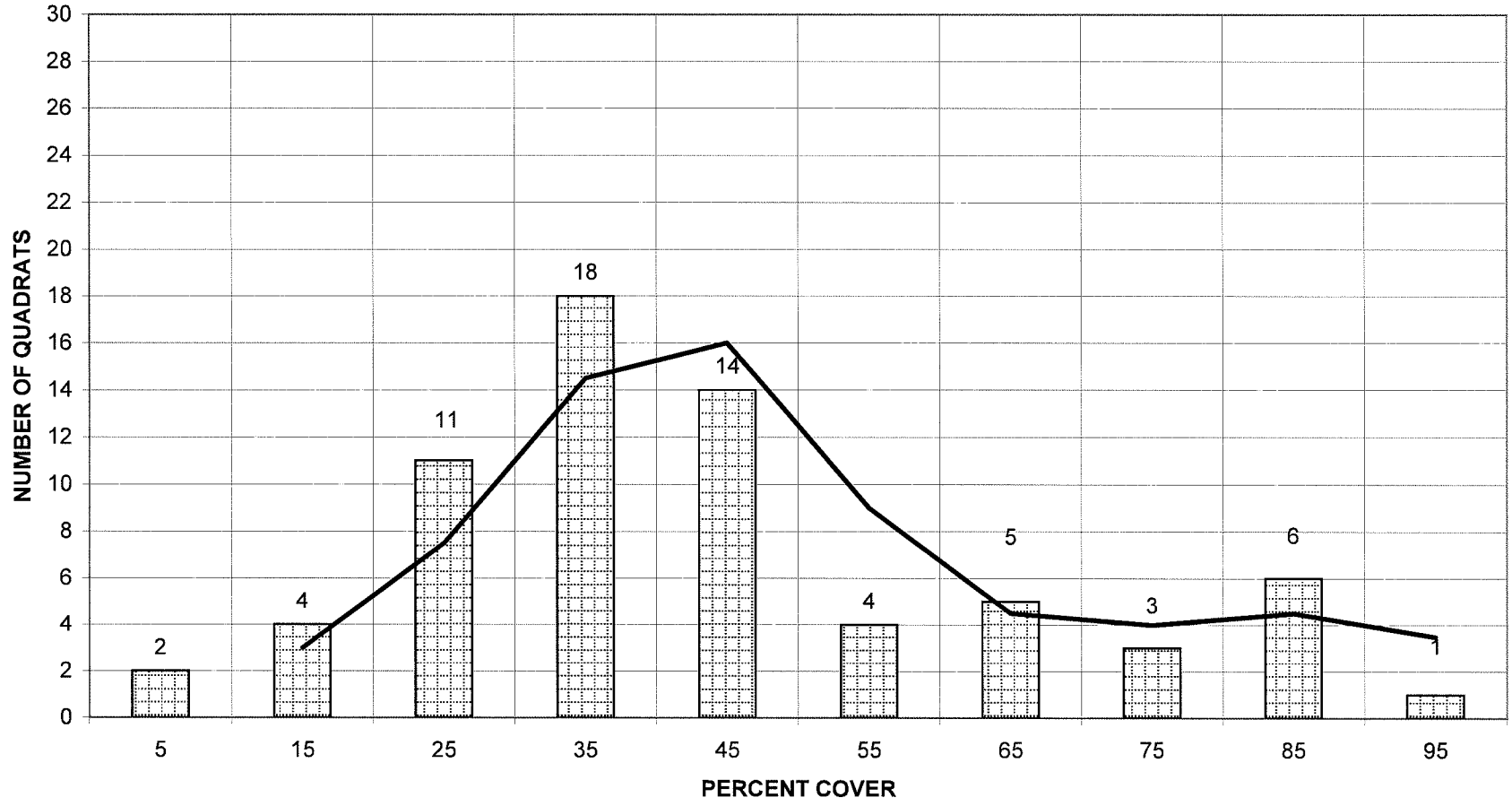
(a) Includes *S. cynosuroides* dominated quadrats, when present.

FIGURE 8-18
2009 PERCENT COVER GROUPINGS
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
ALLOWAY CREEK WATERSHED PHRAGMITES DOMINATED WETLAND
RESTORATION SITE TRANSECTS



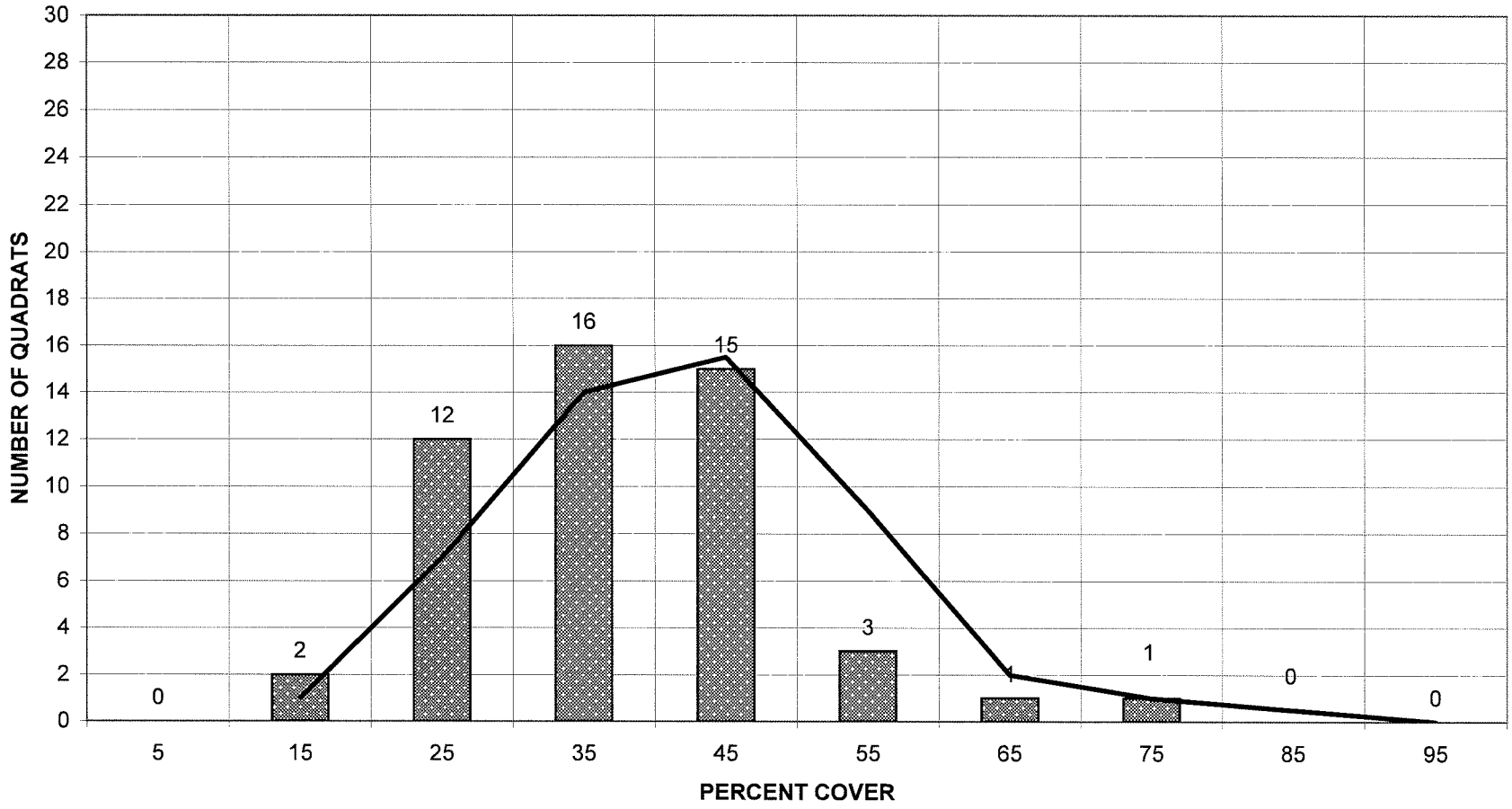
(a) Includes *S. cynosuroides* dominated quadrats, when present.

FIGURE 8-19
2009 PERCENT COVER GROUPINGS
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
THE ROCKS PHRAGMITES DOMINATED WETLAND RESTORATION SITE TRANSECTS



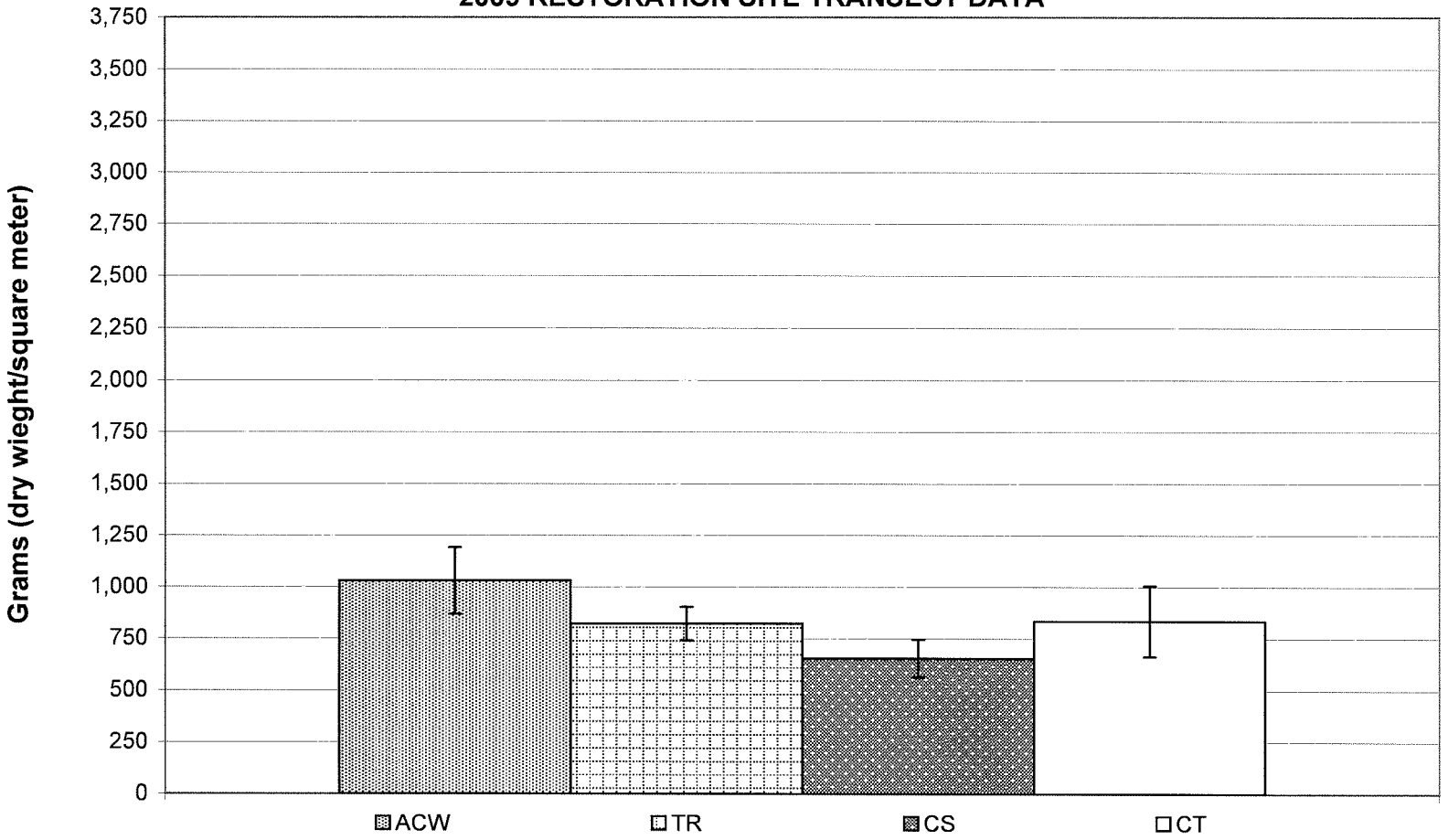
(a) Includes *S. cynosuroides* dominated quadrats, when present.

FIGURE 8-20
2009 PERCENT COVER GROUPINGS
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
CEDAR SWAMP PHRAGMITES DOMINATED WETLAND RESTORATION SITE TRANSECTS



(a) Includes *S. cynosuroides* dominated quadrats, when present.

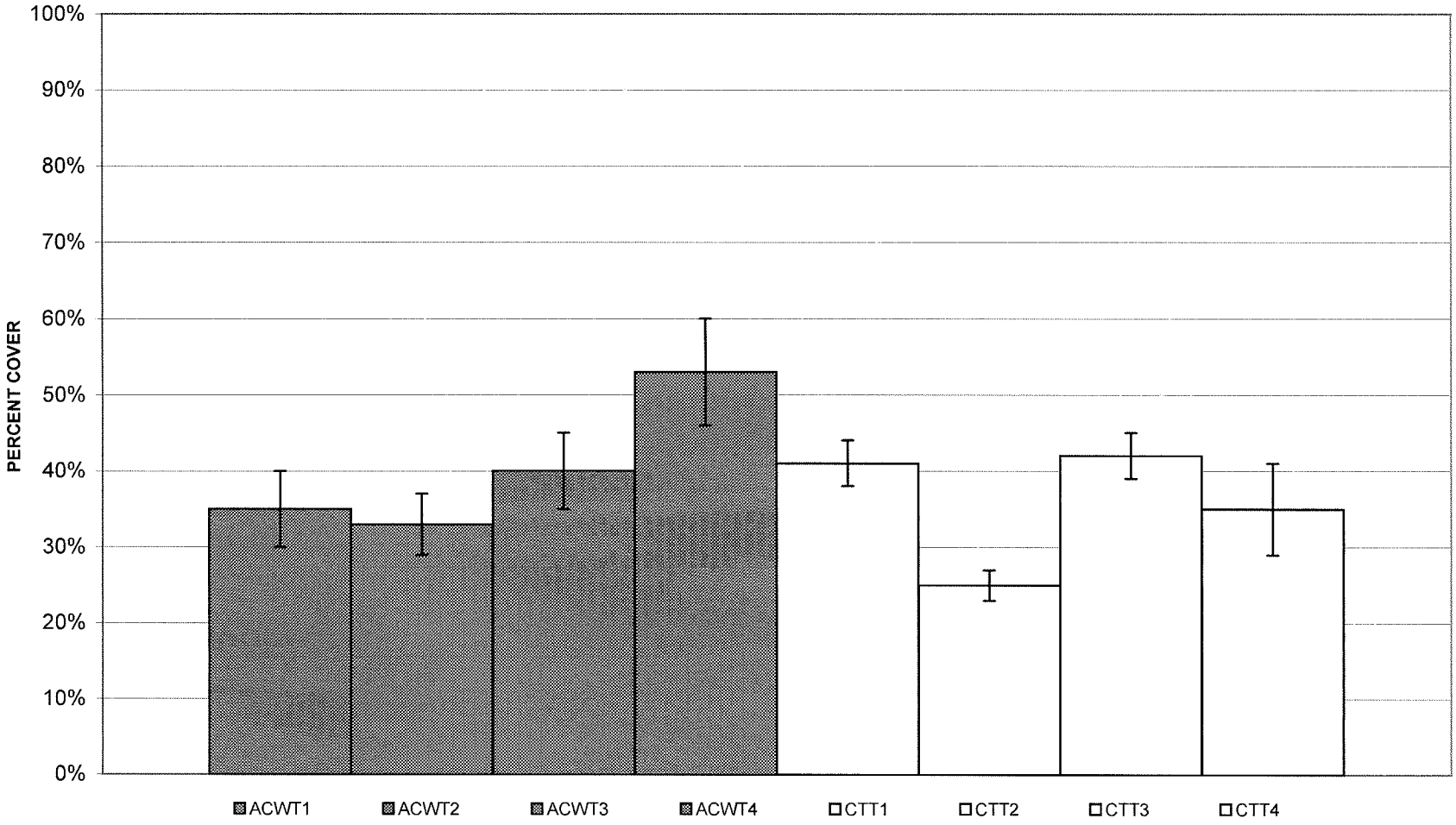
FIGURE 8-21
MEAN LIVE STANDING CROP
2009 RESTORATION SITE TRANSECT DATA



CT = Commercial Township Site
TR = The Rocks
CS = Cedar Swamp
ACW = Alloway Creek Site

- Error bar represents +/- one Standard Error of the Mean.

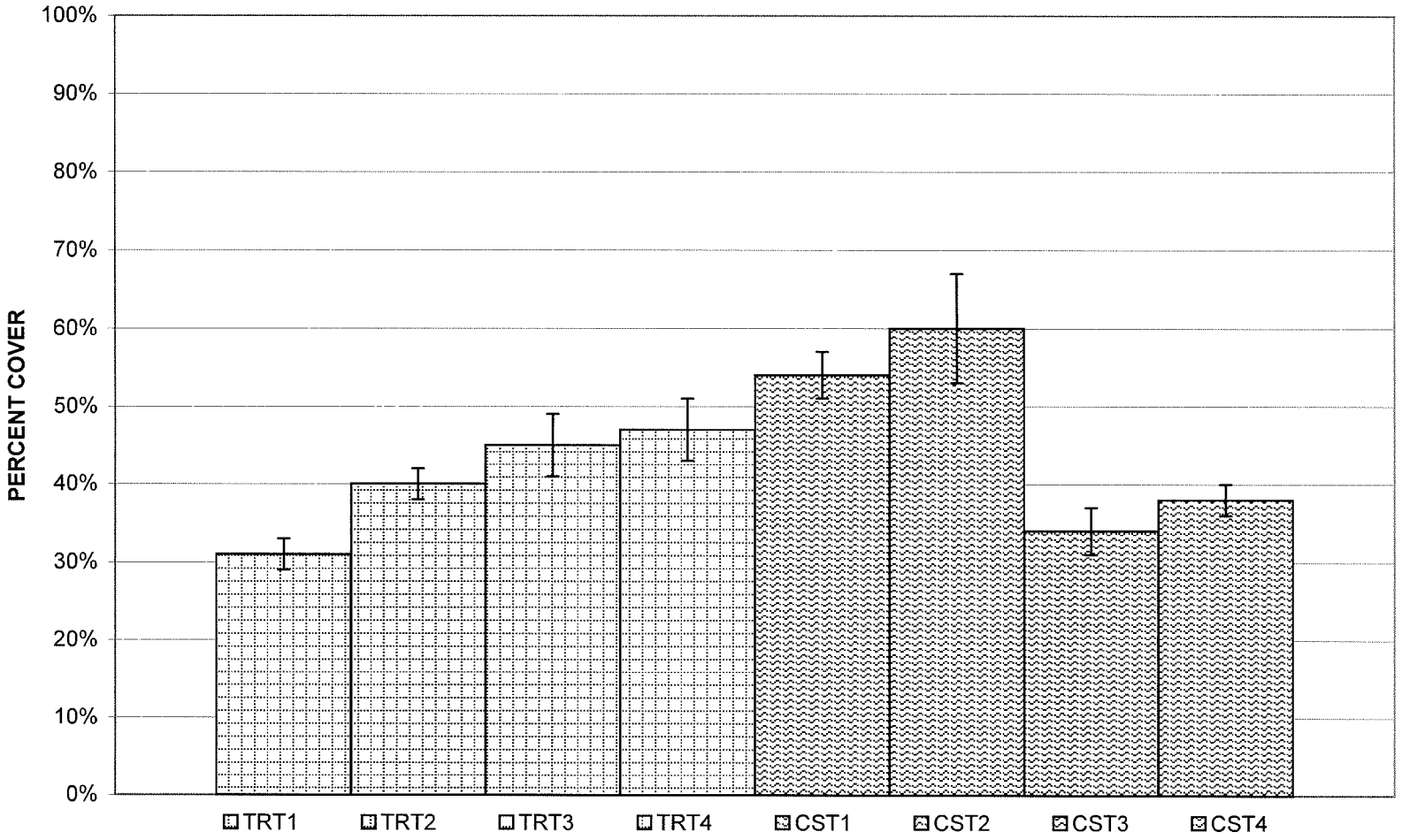
FIGURE 8-22
2009 MEAN PERCENT COVER by TRANSECT
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
NEW JERSEY WETLAND RESTORATION SITES



CT=Commercial Township
ACW = Alloway Creek
T1 = Transect

(a) Includes *S. cynosuroides* dominated quadrats.
- Error bar represents +/- one Standard Error of the Mean.

FIGURE 8-23
2009 MEAN PERCENT COVER by TRANSECT
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
DELAWARE WETLAND RESTORATION SITES

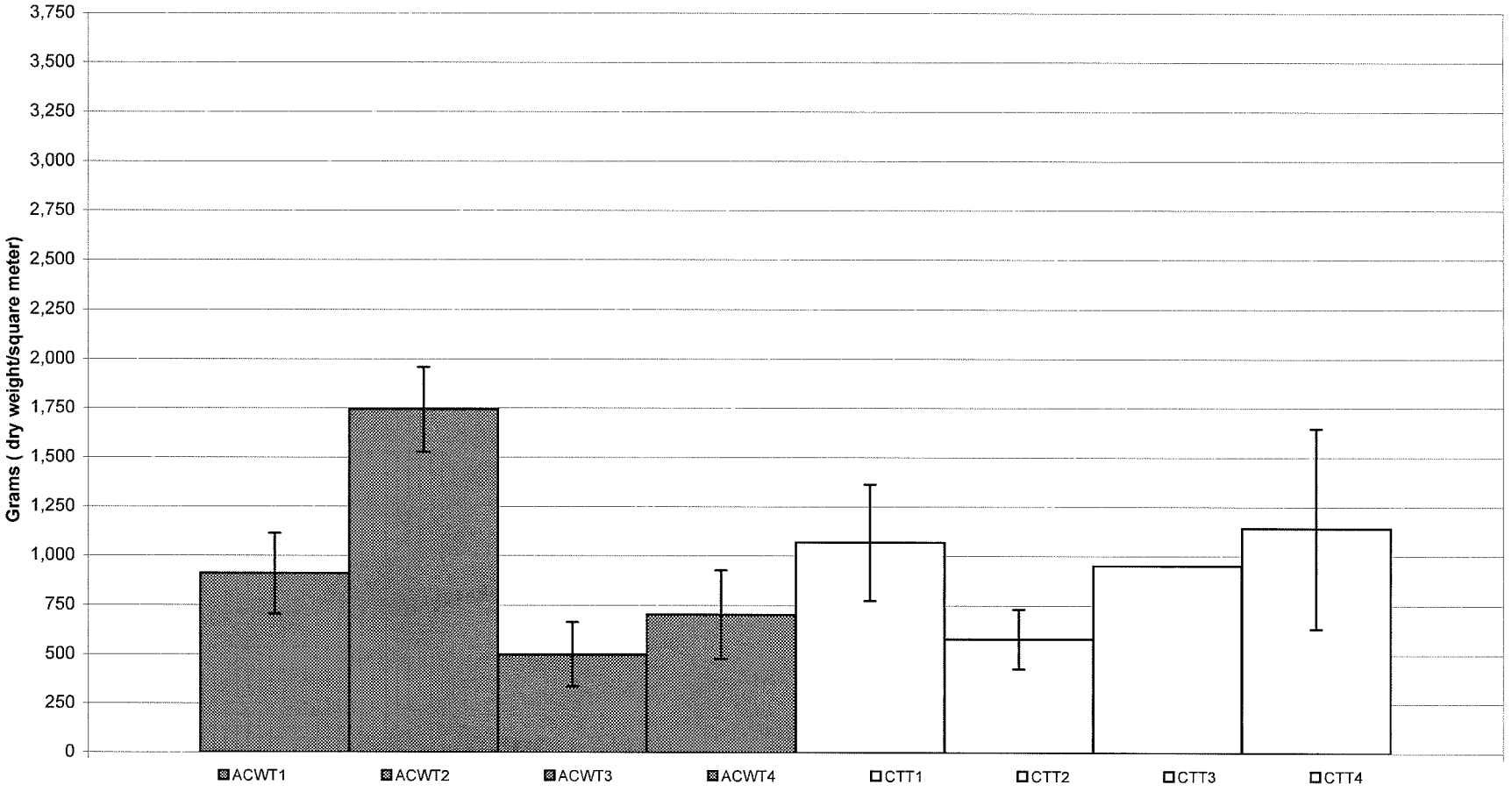


(a) Includes S. cynosuroides dominated quadrats.
Error bar represents +/- one Standard Error of the Mean.

TR = The Rocks
CS = Cedar Swamp

T1 =Transect 1

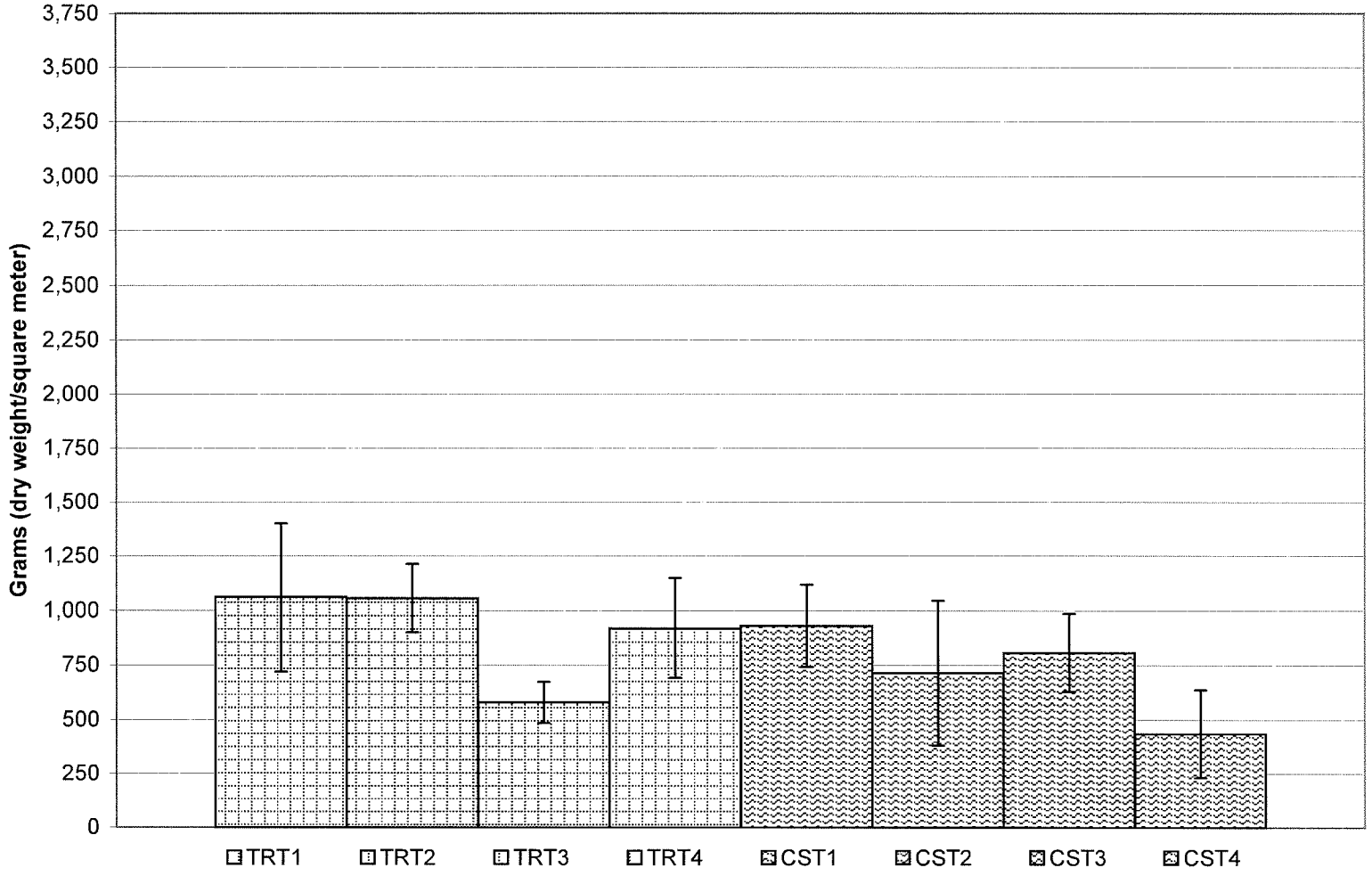
FIGURE 8-24
2009 MEAN LIVE STANDING CROP by TRANSECT
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
NEW JERSEY WETLAND RESTORATION SITES



(a) Includes *S. cynosuroides* dominated quadrats.
Error bar represents +/- one Standard Error of the Mean.

CT=Commercial Township
ACW = Alloway Creek
T1 = Transect

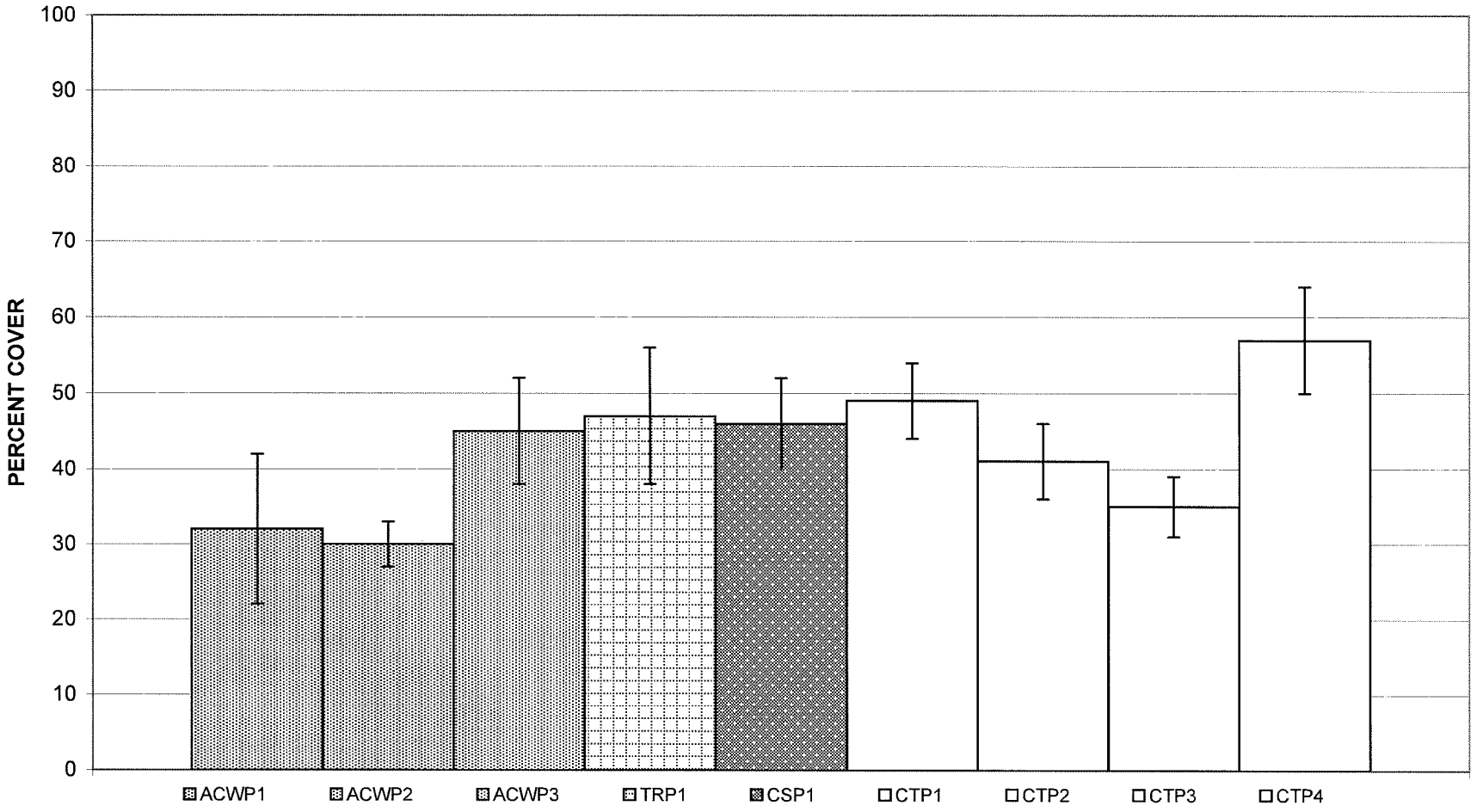
FIGURE 8-25
2009 MEAN LIVE STANDING CROP by TRANSECT
***SPARTINA ALTERNIFLORA* DOMINATED QUADRATS (a)**
DELAWARE WETLAND RESTORATION SITES



(a) Includes S. cynosuroides dominated quadrats.
Error bar represents +/- one Standard Error of the Mean.

TR = The Rocks
CS = Cedar Swamp
T1 =Transect 1

FIGURE 8-26
2009 MEAN PERCENT COVER 60x60 METER PLOTS
WETLAND RESTORATION SITES

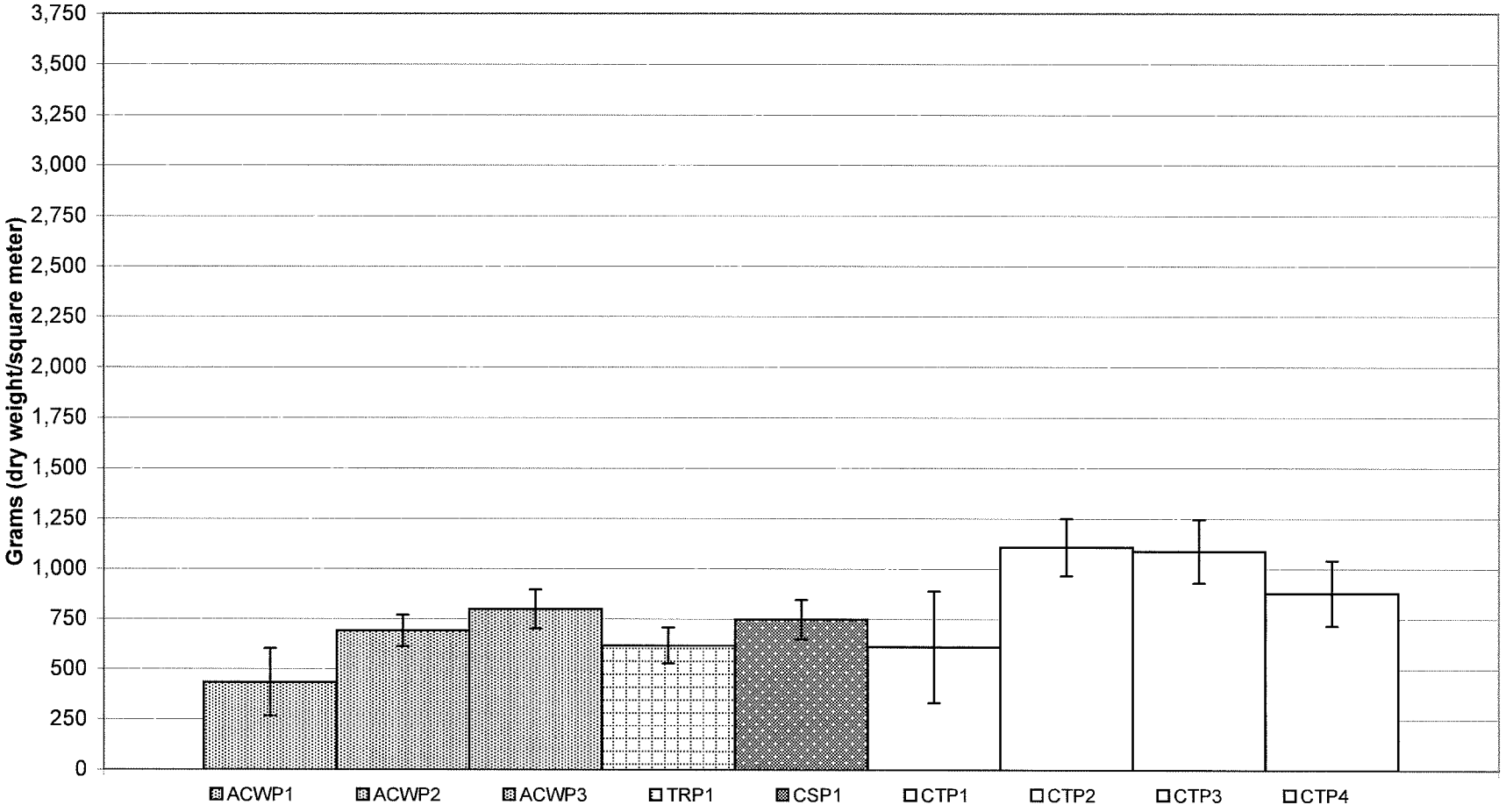


CT=Commercial Township
CS = Cedar Swamp
ACW = Alloway Creek Site
TR = The Rocks

P1 = Plot 1

Error bar represents +/- one Standard Error of the Mean.

FIGURE 8-27
2009 MEAN LIVE STANDING CROP 60x60 METER PLOTS
WETLAND RESTORATION SITES



CT=Commercial Township P1 = Plot 1
CS = Cedar Swamp
ACW = Alloway Creek Site
TR = The Rocks

Error bar represents +/- one Standard Error of the Mean.

Appendix A
Macrophyte Field Data Sampling Data Sheets

EXHIBIT A-1
VEGETATION TRANSECT DATA SHEET
PSEG EEP DETRITAL MONITORING

Site:_____ _____ **Transect:** _____ **Date:** _____

Investigators: _____ **Compass Reading:** _____

Weather Conditions: _____ **Pole #1**

Notes: **Pole #2**

Pole #3

Pole #4

Pole #5

Community type (No.) / Segment No.	Start - End (m)	Length (m)	Return Start - End (m)	Selected Clip Plots (dist from segment) / Selected Ocular Plots (dist from end)

Total number of vegetation communities = _____

Total number of 0.25 m^2 clip plots (number of vegetation communities X 2) = _____

Total number of 0.25 m^2 ocular quadrats (number of clip plots X 3; up to 22) = _____

Total transect length = _____ meters

Dominant Plant Community	No. Community Segments	Selected Community Segment / length (m)		Segment No. / Distance to quadrat (m)	

EXHIBIT A-2
CLIP QUADRAT DATA SHEET
PSEG EEP DETRITAL MONITORING

Site:_____ _____ **Photo No.:**_____ **Date:**_____

Investigators: _____ Weather Conditions: _____

Transect:_____ **Quadrat:** _____ **Distance (m):** _____

Side of transect (L or R):_____ Water Depth (cm): _____

Notes:

Species	Percent Cover	Height (cm)	Flowering (Y/N)	Number of Bags			
				Live	Dead	Litter	Sort
Total Percent Cover							

EXHIBIT A-3

OCULAR QUADRAT DATA SHEET
PSEG EEP VEGETATION MONITORING

Date: _____ **Site:** _____ **Transect:** _____ **Investigators:** _____

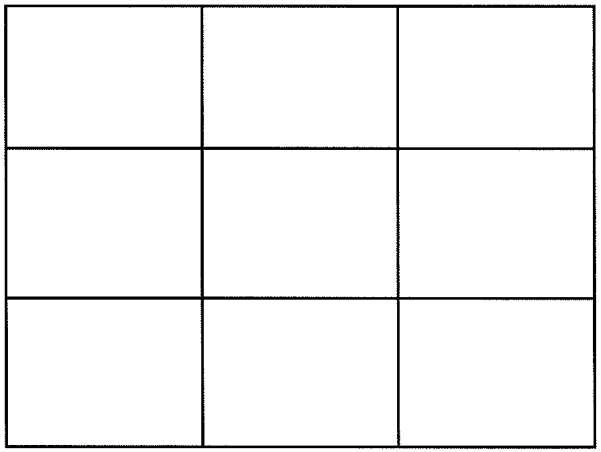
Quadrat No.	Distance from end (m)	Total % Cover	Species {% cover / height (cm) / flowering (y/n)}															
			% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__	% / ht. /__

Note: Locate odd number quadrats on the left side of the transect and even number quadrats on the right side.

EXHIBIT A-4

VEGETATION PLOT DATA SHEET

PSEG EEP VEGETATION MONITORING



Site:_____ **Date:**_____

Investigators:_____ Weather Conditions:_____

Plot:_____

Notes:

Quadrat ID	Distance north (m)	Distance east (m)	Species {% cover / height (cm) / flowering (y/n)}													Number of Bags			
			% / ht ./__	% / ht ./__	% / ht ./__	% / ht ./__	% / ht ./__	% / ht ./__	% / ht ./__	% / ht ./__	% / ht ./__	% / ht ./__	% / ht ./__	% / ht ./__	% / ht ./__	Live	Dead	Litter	Sort

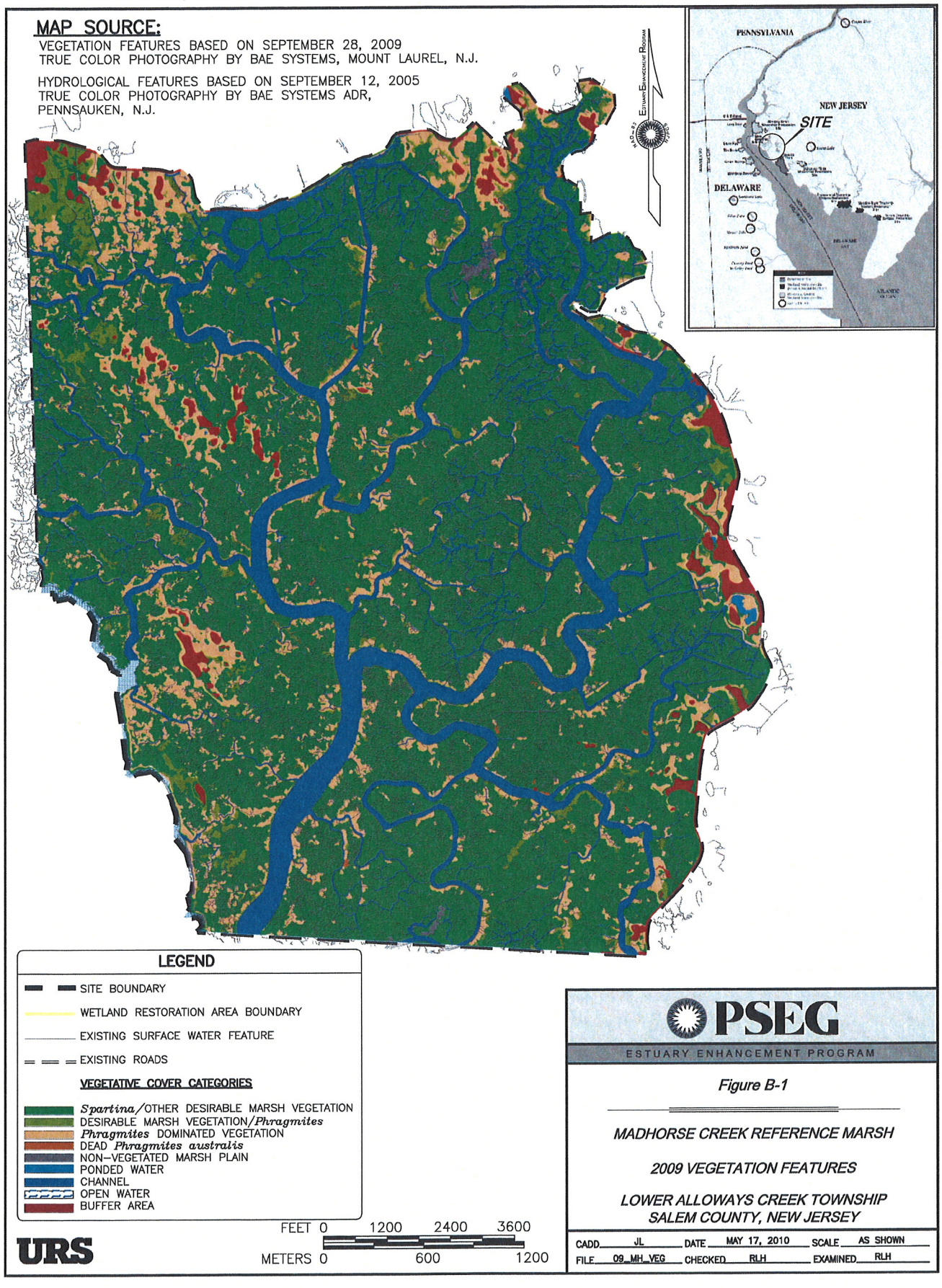
EXHIBIT A-5
LAB DATA SHEET FOR CLIP QUADRAT VEGETATION
PSEG EEP VEGETATION MONITORING

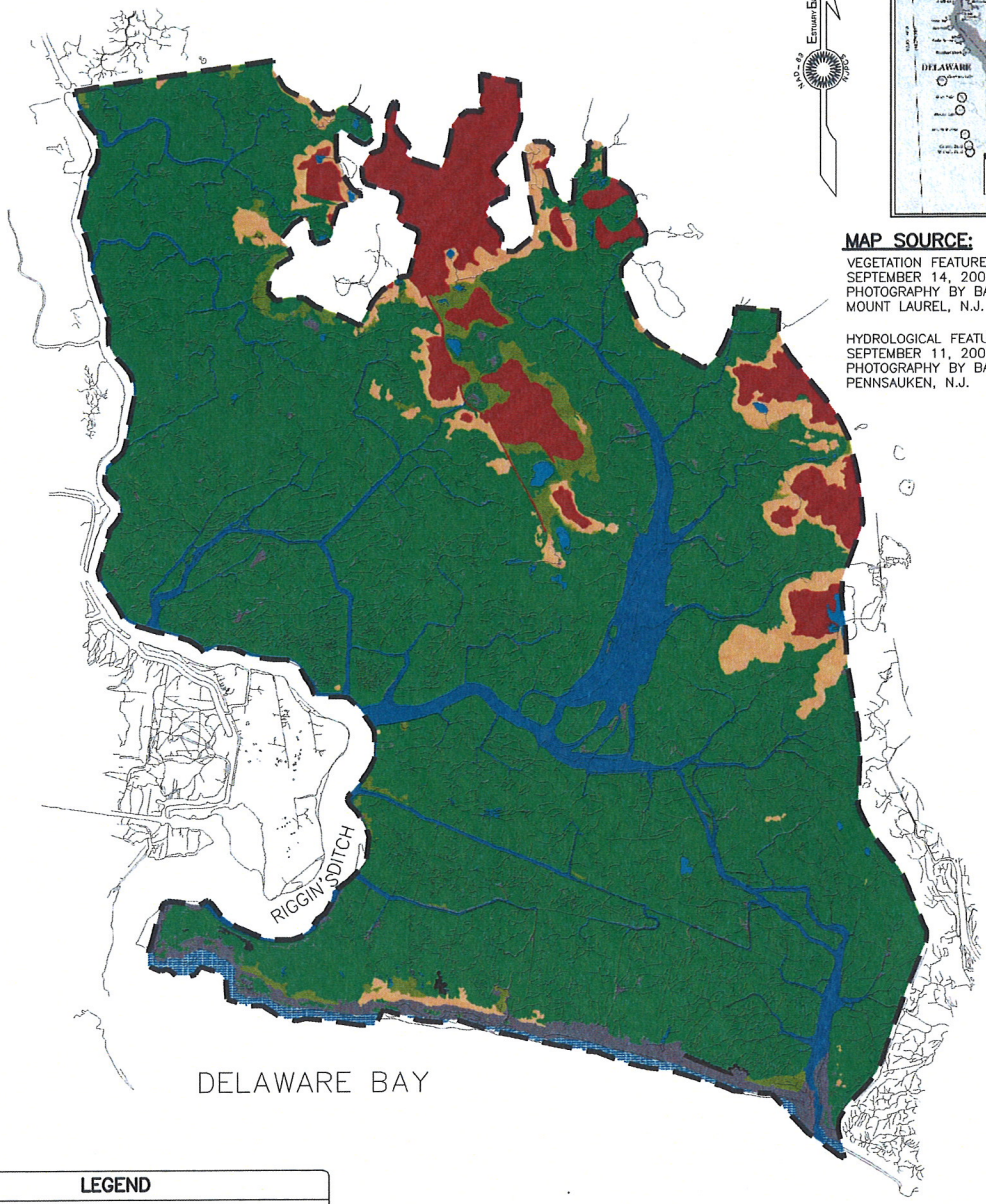
Quadrat ID	Date	Species	Live (g)	Dead Standing (g)	Litter (g)

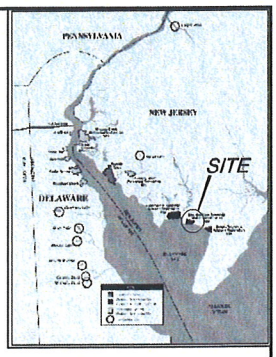
Species abbreviations

AA = arrow arum - *Pelatandra virginica*
AC = water hemp - *Amaranthus cannabinus*
BJ = Blue joint - *Calamagrostis canadenis*
DS = spike grass - *Distichlis spicata*
JG = black grass - *Juncus gerardii*
PA = common reed - *Phragmites australis*
PP = salt marsh fleabane - *Pluchea purpurascens*
PUNC = dotted smartweed - *Polygonum punctatum*
PV = Switch grass - *Panicum virgatum*
SA = smooth cordgrass - *Spartina alterniflora*
SC = big cordgrass - *Spartina cynosuroides*
SO = Three square - *Scirpus olneyi*
SP = salt hay grass - *Spartina patens*
SR = salt marsh bulrush - *Scirpus robustus*
SS = seaside goldenrod - *Solidago sempervirens*
SV = soft stem bulrush - *Scirpus validus*
TA = narrow-leaf cattail - *Typha angustifolia*
TL = broad leaf cattail - *Typha latifolia*
WM = walter's millet - *Echinochloa walteri*

Appendix B
Vegetation Cover Category Maps


MAP SOURCE:
VEGETATION FEATURES BASED ON SEPTEMBER 28, 2009
TRUE COLOR PHOTOGRAPHY BY BAE SYSTEMS, MOUNT LAUREL, N.J.
HYDROLOGICAL FEATURES BASED ON SEPTEMBER 12, 2005
TRUE COLOR PHOTOGRAPHY BY BAE SYSTEMS ADR,
PENNSAUKEN, N.J.
NAD 83
ESTUARY ENHANCEMENT PROGRAM
PENNSYLVANIA
NEW JERSEY
SITE
DELAWARE
ATLANTIC
LEGEND
SITE BOUNDARY
WETLAND RESTORATION AREA BOUNDARY
EXISTING SURFACE WATER FEATURE
EXISTING ROADS
VEGETATIVE COVER CATEGORIES
Spartina/OTHER DESIRABLE MARSH VEGETATION
DESIRABLE MARSH VEGETATION/Phragmites
Phragmites DOMINATED VEGETATION
DEAD Phragmites australis
NON-VEGETATED MARSH PLAIN
PONDED WATER
CHANNEL
OPEN WATER
BUFFER AREA
FEET 0 1200 2400 3600
METERS 0 600 1200
URS
PSEG
ESTUARY ENHANCEMENT PROGRAM
Figure B-1
MADHORSE CREEK REFERENCE MARSH
2009 VEGETATION FEATURES
LOWER ALLOWAYS CREEK TOWNSHIP
SALEM COUNTY, NEW JERSEY
CADD JL DATE MAY 17, 2010 SCALE AS SHOWN
FILE 09_MH_VEG CHECKED RLH EXAMINED RLH





NORTH
ESTUARY ENHANCEMENT PROGRAM

MAP SOURCE:

VEGETATION FEATURES BASED ON SEPTEMBER 14, 2009 CIR AERIAL PHOTOGRAPHY BY BAE SYSTEMS, MOUNT LAUREL, N.J.

HYDROLOGICAL FEATURES BASED ON SEPTEMBER 11, 2005. CIR AERIAL PHOTOGRAPHY BY BAE SYSTEMS ADR, PENNSAUKEN, N.J.

LEGEND

- SITE BOUNDARY
- WETLAND RESTORATION AREA BOUNDARY
- EXISTING SURFACE WATER FEATURE
- EXISTING ROADS

VEGETATIVE COVER CATEGORIES

- *Spartina*/OTHER DESIRABLE MARSH VEGETATION
- DESIRABLE MARSH VEGETATION/*Phragmites*
- *Phragmites* DOMINATED VEGETATION
- Dead *Phragmites australis*
- NON-VEGETATED MARSH PLAIN
- PONDED WATER
- CHANNEL
- OPEN WATER
- BUFFER AREA
- RECOVERING DESIRABLE SPECIES AREA

FEET 0 900 1800 2700

METERS 0 400 800

URS

PSEG

ESTUARY ENHANCEMENT PROGRAM

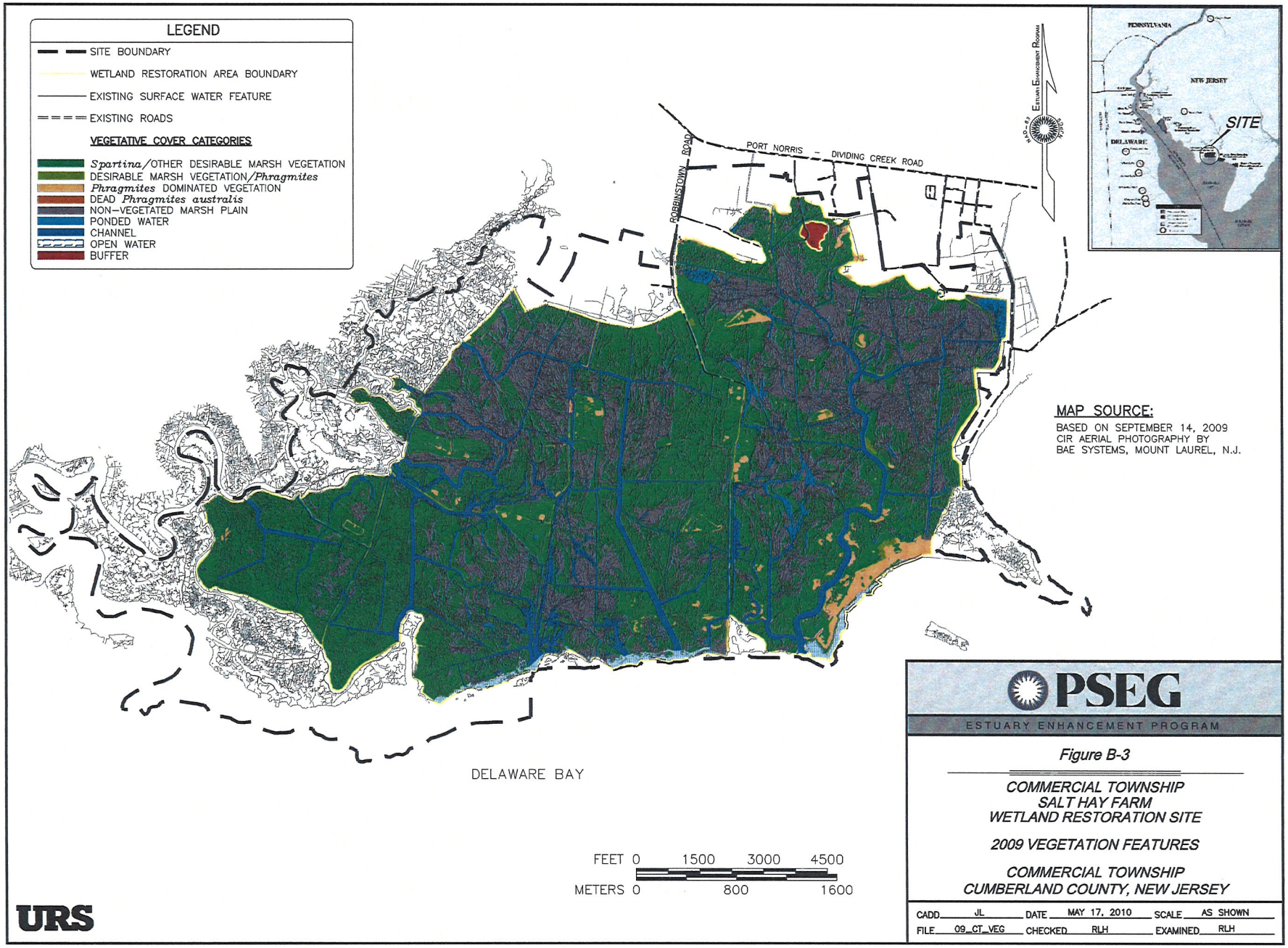
Figure B-2

MOORES BEACH REFERENCE MARSH

2009 VEGETATION FEATURES

MAURICE RIVER TOWNSHIP
CUMBERLAND COUNTY, NEW JERSEY

CADD	JL	DATE	MAY 17, 2010	SCALE	AS SHOWN
FILE	09_MB_VEG	CHECKED	RLH	EXAMINED	RLH



MAP SOURCE:

BASED ON SEPTEMBER 14, 2009
CIR AERIAL PHOTOGRAPHY BY
BAE SYSTEMS, MOUNT LAUREL, N.J.

PSEG
ESTUARY ENHANCEMENT PROGRAM

Figure B-3

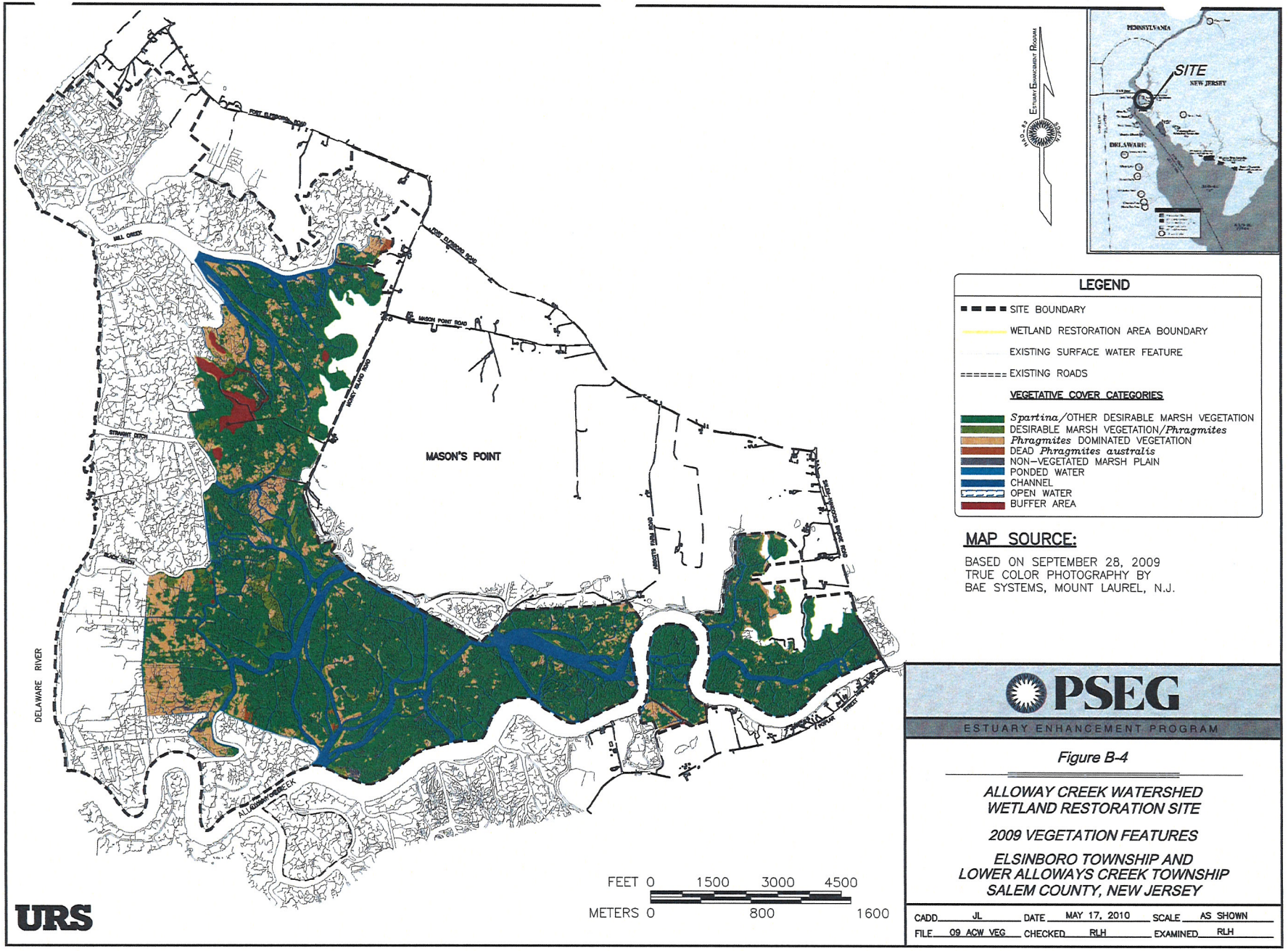
COMMERCIAL TOWNSHIP
SALT HAY FARM
WETLAND RESTORATION SITE

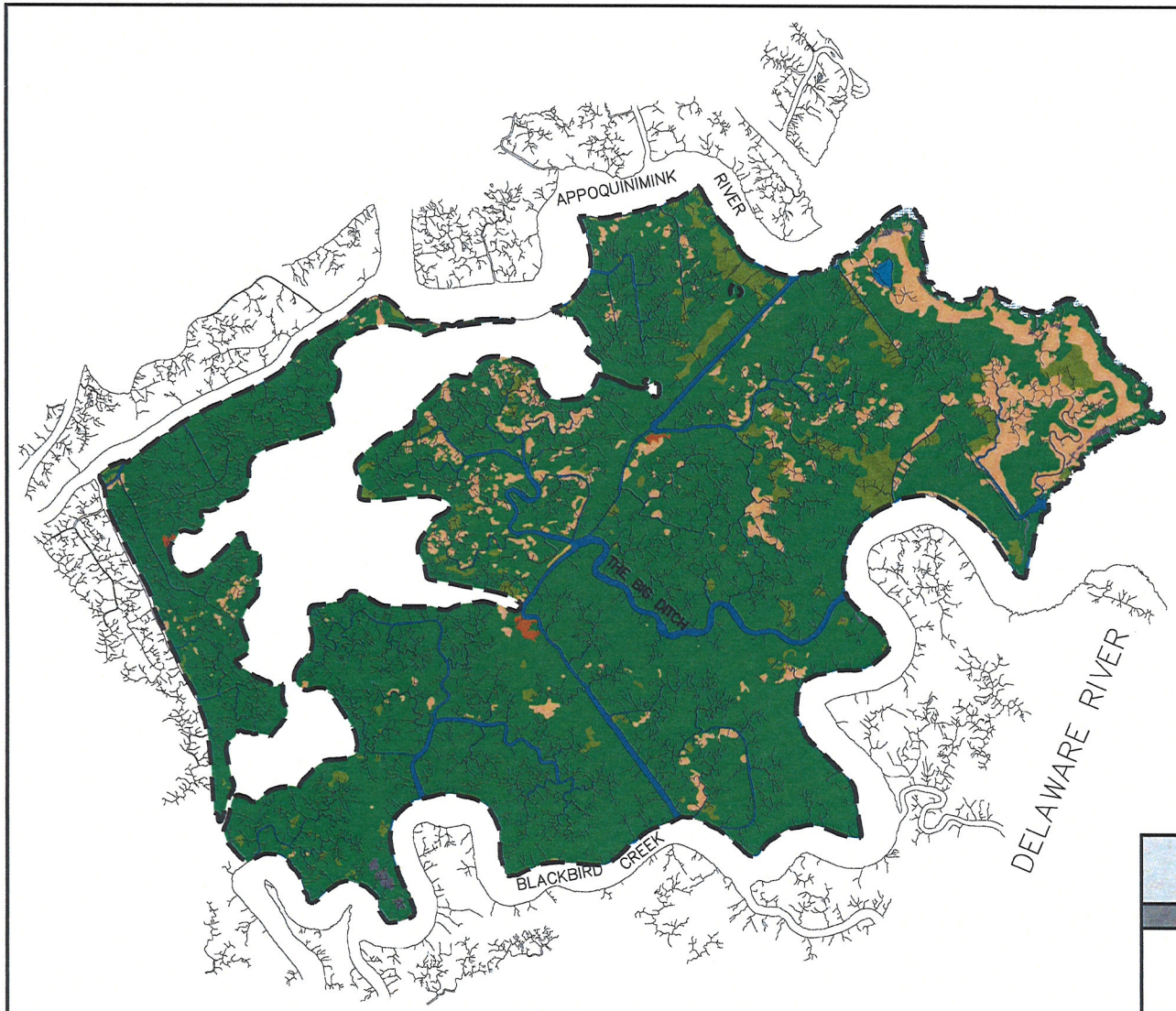
2009 VEGETATION FEATURES

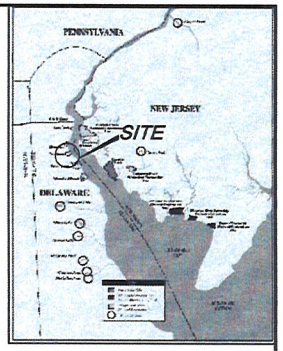
COMMERCIAL TOWNSHIP
CUMBERLAND COUNTY, NEW JERSEY

CADD	JL	DATE	MAY 17, 2010	SCALE	AS SHOWN
FILE	09_CT_VEG	CHECKED	RLH	EXAMINED	RLH

URS


MASON'S POINT
FORT ELFRETH ROAD
MASON POINT ROAD
HILL CREEK
STRAWHAT DITCH
BLACK DITCH
ALLOWAY CREEK
DELAWARE RIVER
ESTUARY ENHANCEMENT PROGRAM
PENNSYLVANIA
NEW JERSEY
DELAWARE
SITE
LEGEND
SITE BOUNDARY
WETLAND RESTORATION AREA BOUNDARY
EXISTING SURFACE WATER FEATURE
EXISTING ROADS
VEGETATIVE COVER CATEGORIES
Spartina/OTHER DESIRABLE MARSH VEGETATION
DESIRABLE MARSH VEGETATION/Phragmites
Phragmites DOMINATED VEGETATION
DEAD Phragmites australis
NON-VEGETATED MARSH PLAIN
PONDED WATER
CHANNEL
OPEN WATER
BUFFER AREA
MAP SOURCE:
BASED ON SEPTEMBER 28, 2009
TRUE COLOR PHOTOGRAPHY BY
BAE SYSTEMS, MOUNT LAUREL, N.J.
FEET 0 1500 3000 4500
METERS 0 800 1600
URS
PSEG
ESTUARY ENHANCEMENT PROGRAM
Figure B-4
ALLOWAY CREEK WATERSHED
WETLAND RESTORATION SITE
2009 VEGETATION FEATURES
ELSINBORO TOWNSHIP AND
LOWER ALLOWAYS CREEK TOWNSHIP
SALEM COUNTY, NEW JERSEY
CADD JL DATE MAY 17, 2010 SCALE AS SHOWN
FILE 09 ACW VEG CHECKED RLH EXAMINED RLH





LEGEND

- WETLAND RESTORATION AREA BOUNDARY
- EXISTING SURFACE WATER FEATURE
- EXISTING ROADS

VEGETATIVE COVER CATEGORIES

- *Spartina*/OTHER DESIRABLE MARSH VEGETATION
- DESIRABLE MARSH VEGETATION/*Phragmites*
- *Phragmites* DOMINATED VEGETATION
- DEAD *Phragmites australis*
- NON-VEGETATED MARSH PLAIN
- PONDED WATER
- CHANNEL
- OPEN WATER
- BUFFER AREA

MAP SOURCE:

BASED ON SEPTEMBER 28, 2009
TRUE COLOR PHOTOGRAPHY BY
BAE SYSTEMS, MOUNT LAUREL, N.J.

FEET 0 750 1500 2250
METERS 0 400 800

URS

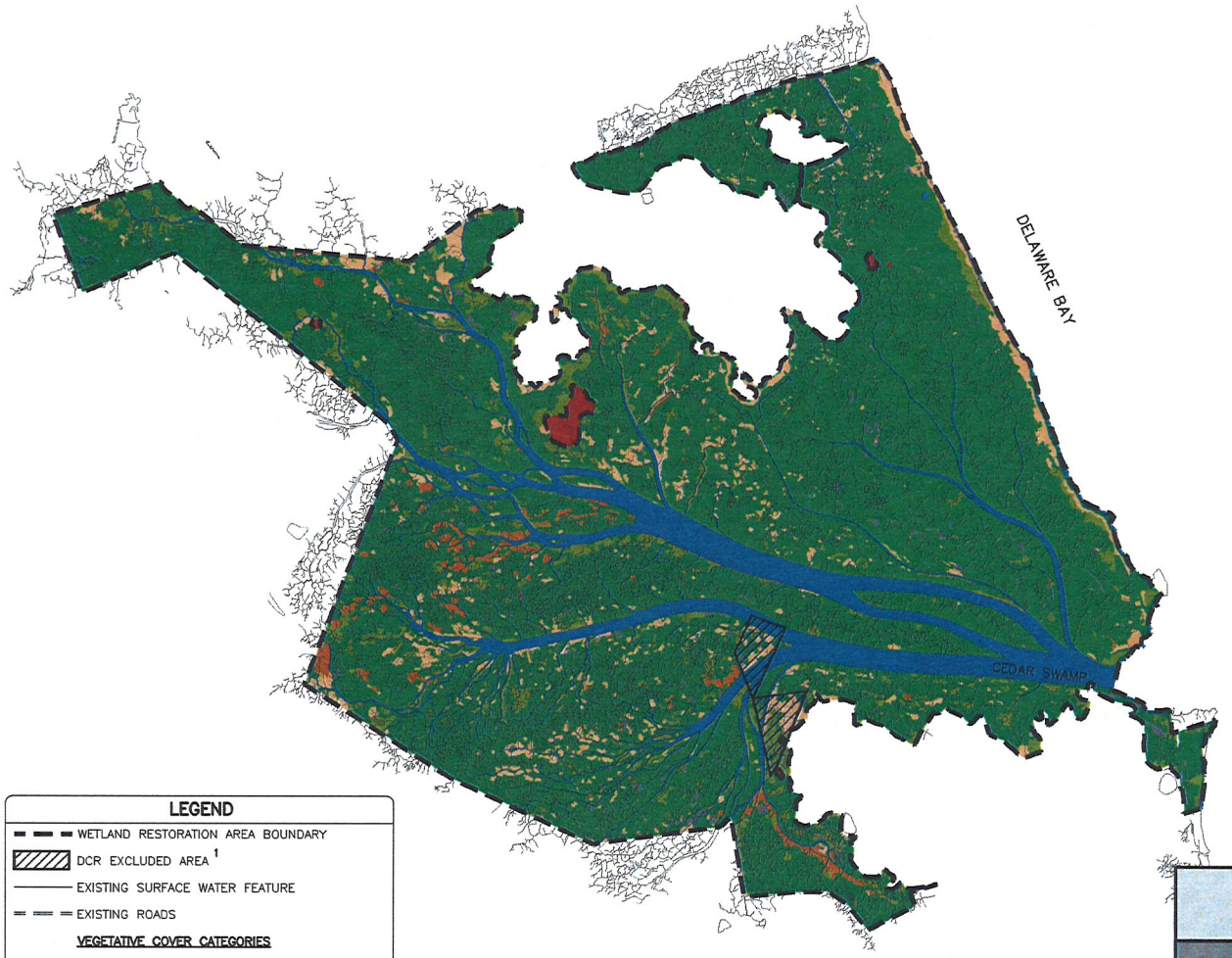
PSEG
ESTUARY ENHANCEMENT PROGRAM

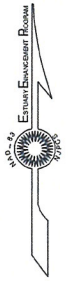
Figure B-5

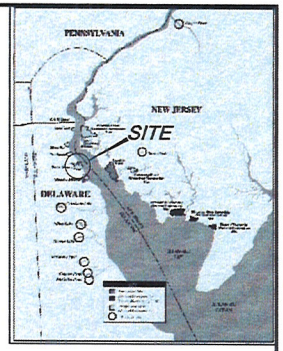
THE ROCKS
WETLAND RESTORATION SITE

2009 VEGETATION FEATURES
APPOQUINIMINK HUNDRED
NEW CASTLE COUNTY, DELAWARE

CADD	JL	DATE	MAY 17, 2010	SCALE	AS SHOWN
FILE	09_TR_VEG	CHECKED	RLH	EXAMINED	RLH







NOTE:

1. CROSS–HATCHED AREA NOT SUBJECT TO DECLARATIONS OF RESTRICTIONS AND COVENANTS.

MAP SOURCE:

BASED ON SEPTEMBER 28, 2009 TRUE COLOR PHOTOGRAPHY BY BAE SYSTEMS, MOUNT LAUREL, N.J.

LEGEND

- WETLAND RESTORATION AREA BOUNDARY
- DCR EXCLUDED AREA [1]
- EXISTING SURFACE WATER FEATURE
- EXISTING ROADS

VEGETATIVE COVER CATEGORIES

- *Spartina*/OTHER DESIRABLE MARSH VEGETATION
- DESIRABLE MARSH VEGETATION/*Phragmites*
- *Phragmites* DOMINATED VEGETATION
- Dead *Phragmites australis*
- NON–VEGETATED MARSH PLAIN
- PONDED WATER
- CHANNEL
- OPEN WATER
- BUFFER AREA

FEET 0 1200 2400 3600

METERS 0 600 1200

URS

PSEG

ESTUARY ENHANCEMENT PROGRAM

Figure B-6

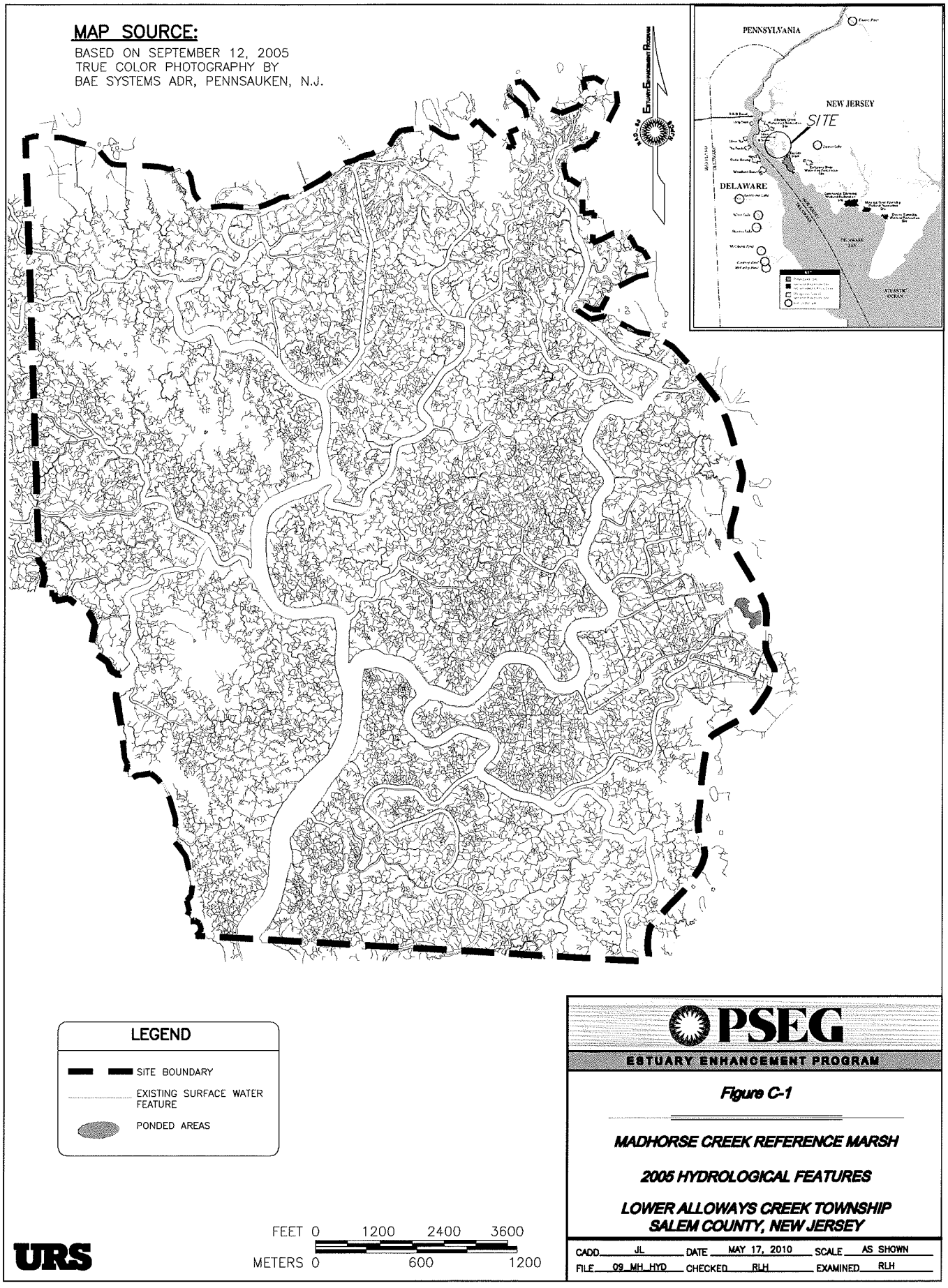
CEDAR SWAMP WETLAND RESTORATION SITE

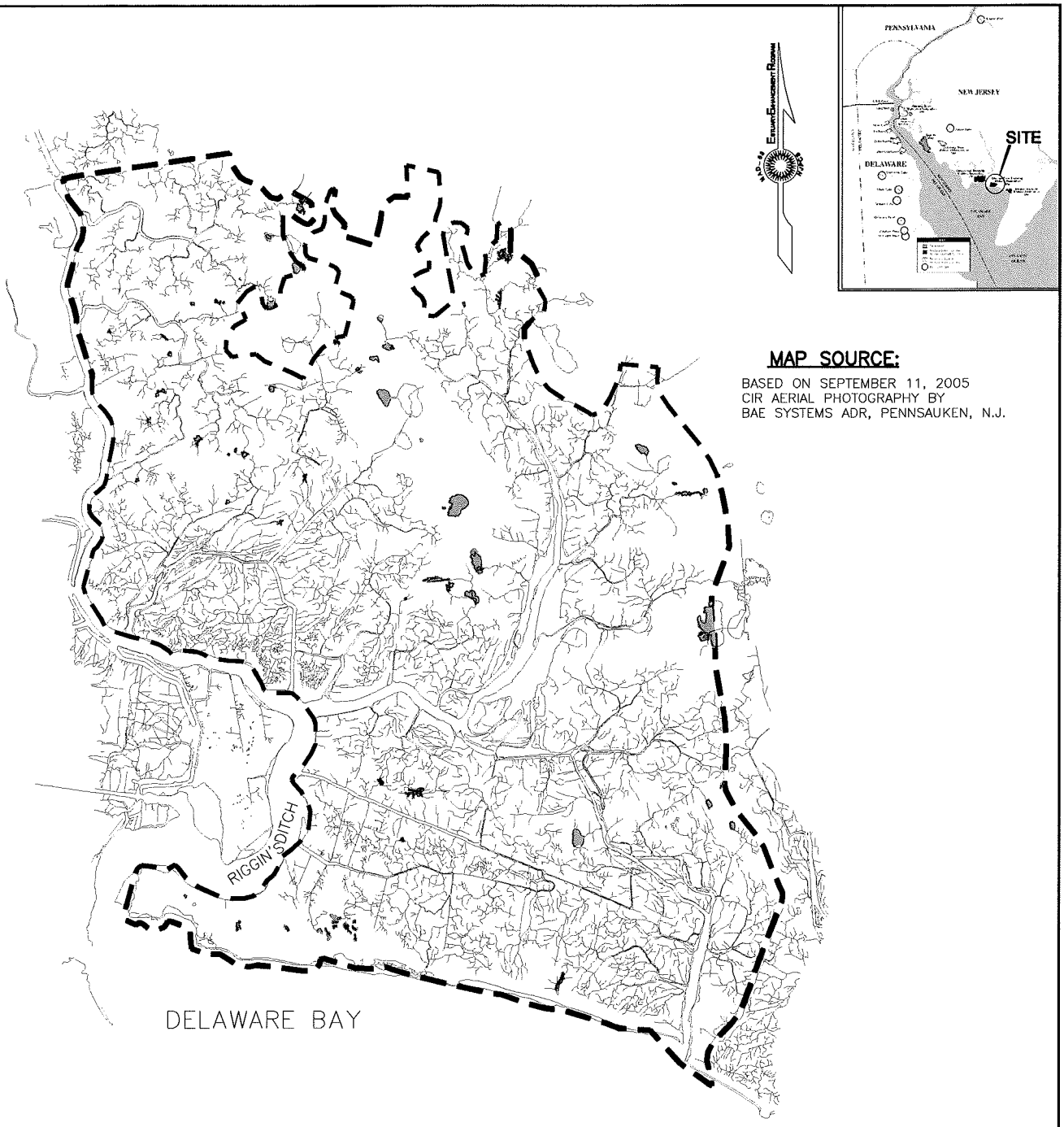
2009 VEGETATION FEATURES

BLACKBIRD HUNDRED NEW CASTLE COUNTY, DELAWARE

CADD	JL	DATE	MAY 17, 2010	SCALE	AS SHOWN
FILE	09_CS–VEG	CHECKED	RLH	EXAMINED	RLH

Appendix C
Geomorphologic Maps


MAP SOURCE:
BASED ON SEPTEMBER 12, 2005
TRUE COLOR PHOTOGRAPHY BY
BAE SYSTEMS ADR, PENNSAUKEN, N.J.
PENNSYLVANIA
NEW JERSEY
SITE
DELAWARE
ATLANTIC OCEAN
LEGEND
SITE BOUNDARY
EXISTING SURFACE WATER FEATURE
PONDED AREAS
FEET 0 1200 2400 3600
METERS 0 600 1200
URS
PSEG
ESTUARY ENHANCEMENT PROGRAM
Figure C-1
MADHORSE CREEK REFERENCE MARSH
2005 HYDROLOGICAL FEATURES
LOWER ALLOWAYS CREEK TOWNSHIP
SALEM COUNTY, NEW JERSEY
CADD JL DATE MAY 17, 2010 SCALE AS SHOWN
FILE 09_MH_HYD CHECKED RLH EXAMINED RLH



MAP SOURCE:

BASED ON SEPTEMBER 11, 2005
CIR AERIAL PHOTOGRAPHY BY
BAE SYSTEMS ADR, PENNSAUKEN, N.J.

LEGEND

- SITE BOUNDARY
- EXISTING SURFACE WATER FEATURE
- PONDED AREAS

FEET 0 900 1800 2700
METERS 0 400 800

URS

PSEG
ESTUARY ENHANCEMENT PROGRAM

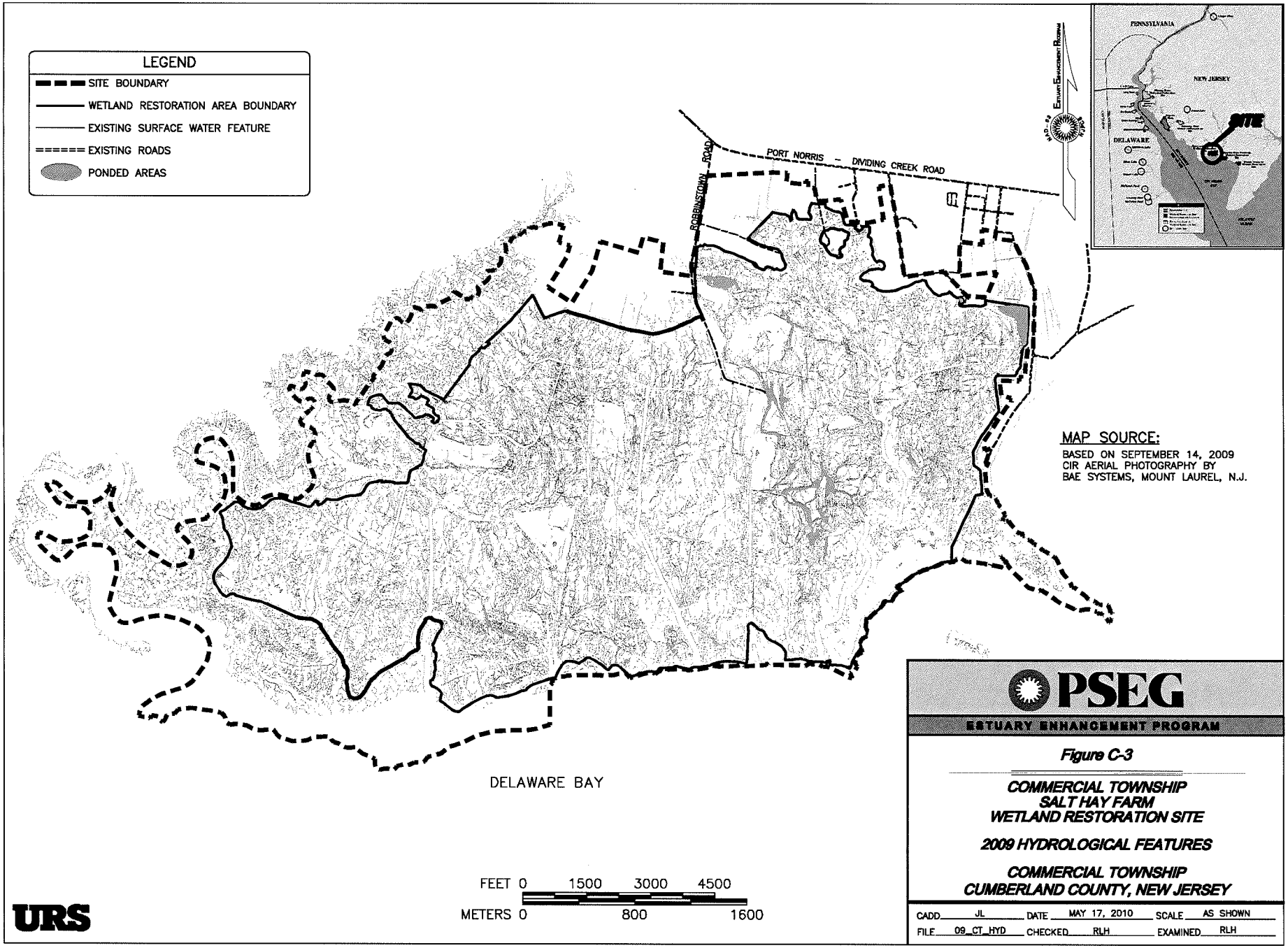
Figure C-2

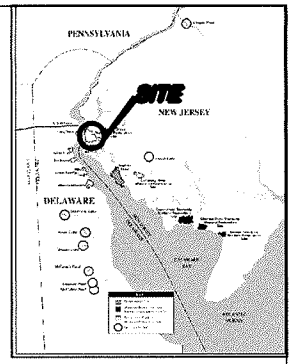
MOORES BEACH REFERENCE MARSH

2005 HYDROLOGICAL FEATURES

MAURICE RIVER TOWNSHIP
CUMBERLAND COUNTY, NEW JERSEY

CADD JL DATE MAY 17, 2010 SCALE AS SHOWN
FILE 09_MB_HYD CHECKED RLH EXAMINED RLH


LEGEND
SITE BOUNDARY
WETLAND RESTORATION AREA BOUNDARY
EXISTING SURFACE WATER FEATURE
EXISTING ROADS
PONDED AREAS
PORT NORRIS - DIVIDING CREEK ROAD
ROBBINSTOWN ROAD
ESTUARY ENHANCEMENT PROGRAM
PENNSYLVANIA
NEW JERSEY
DELAWARE
SITE
MAP SOURCE:
BASED ON SEPTEMBER 14, 2009
CIR AERIAL PHOTOGRAPHY BY
BAE SYSTEMS, MOUNT LAUREL, N.J.
DELAWARE BAY
FEET 0 1500 3000 4500
METERS 0 800 1600
URS
PSEG
ESTUARY ENHANCEMENT PROGRAM
Figure C-3
COMMERCIAL TOWNSHIP
SALT HAY FARM
WETLAND RESTORATION SITE
2009 HYDROLOGICAL FEATURES
COMMERCIAL TOWNSHIP
CUMBERLAND COUNTY, NEW JERSEY
CADD JL DATE MAY 17, 2010 SCALE AS SHOWN
FILE 09_CT_HYD CHECKED RLH EXAMINED RLH



LEGEND

- SITE BOUNDARY
- WETLAND RESTORATION AREA BOUNDARY
- EXISTING SURFACE WATER FEATURE
- EXISTING ROADS
- PONDED AREA

MAP SOURCE:

BASED ON SEPTEMBER 14, 2009
TRUE COLOR PHOTOGRAPHY BY
BAE SYSTEMS, MOUNT LAUREL, N.J.

FEET 0 1500 3000 4500
METERS 0 800 1600

URS

PSEG

ESTUARY ENHANCEMENT PROGRAM

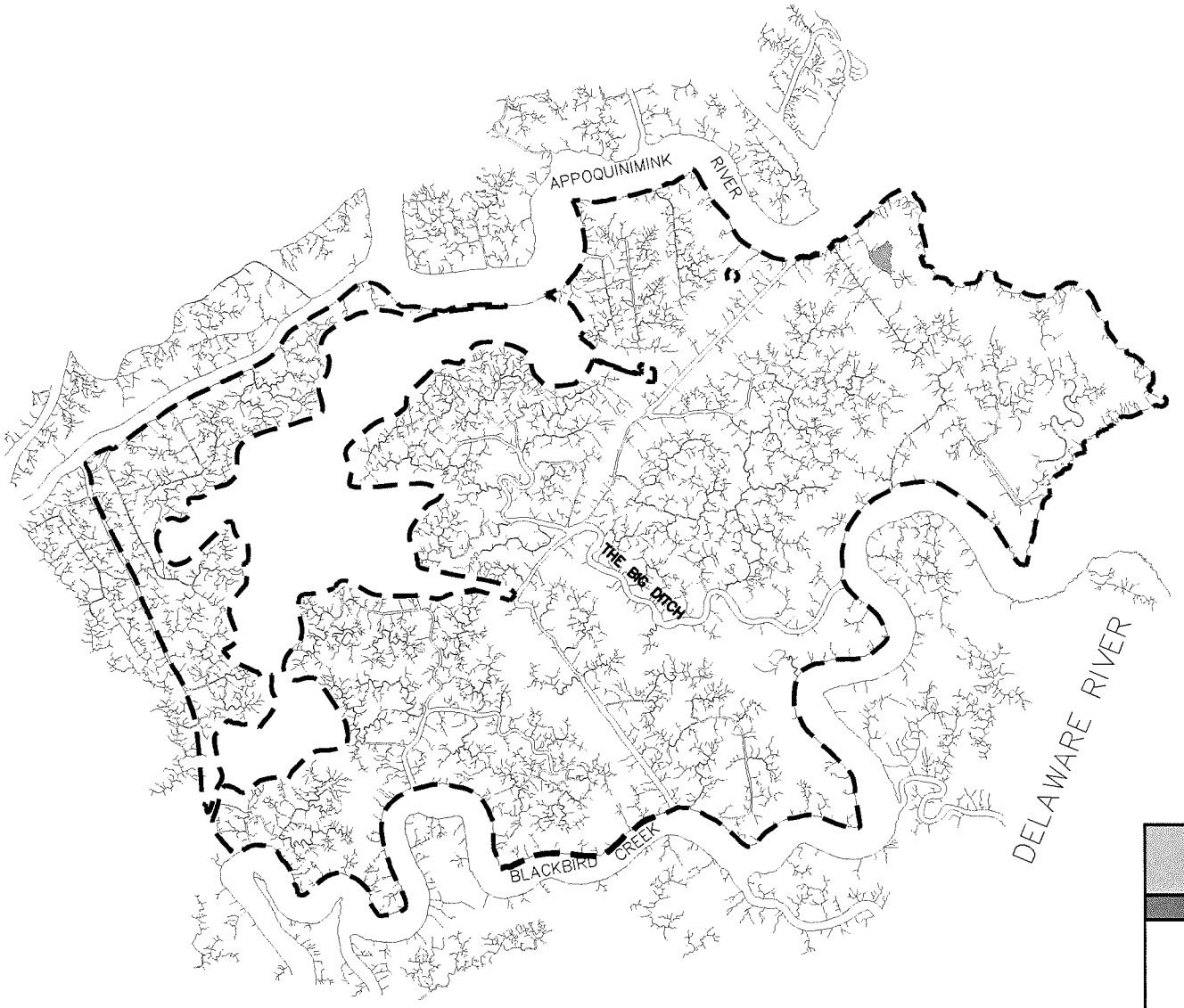
Figure C-4

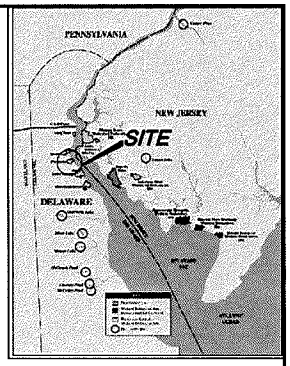
ALLOWAY CREEK SITE WATERSHED WETLAND RESTORATION SITE

2009 HYDROLOGICAL FEATURES

ELSINBORO TOWNSHIP SALEM COUNTY, NEW JERSEY

CADD JL DATE MAY 17, 2010 SCALE AS SHOWN
FILE 09 ACW HYD CHECKED RLH EXAMINED RLH





LEGEND

- WETLAND RESTORATION AREA BOUNDARY
- EXISTING SURFACE WATER FEATURE
- EXISTING ROADS
- PONDED AREAS

MAP SOURCE:

BASED ON SEPTEMBER 14, 2009
TRUE COLOR PHOTOGRAPHY BY
BAE SYSTEMS, MOUNT LAUREL, N.J.

FEET 0 750 1500 2250
METERS 0 400 800

URS

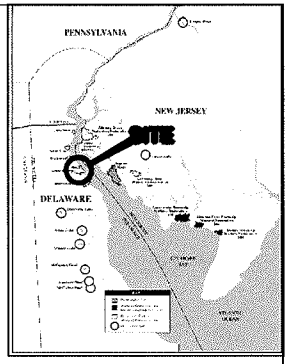
PSEG
ESTUARY ENHANCEMENT PROGRAM

Figure C-5

THE ROCKS
WETLAND RESTORATION SITE

2009 HYDROLOGICAL FEATURES
APPOQUINIMINK HUNDRED
NEW CASTLE COUNTY, DELAWARE

CADD	JL	DATE	MAY 17, 2010	SCALE	AS SHOWN
FILE	09_TR_HYD	CHECKED	RLH	EXAMINED	RLH



NOTE:

1. CROSS-HATCHED AREA NOT SUBJECT TO DECLARATIONS OF RESTRICTIONS AND COVENANTS.

MAP SOURCE:

BASED ON SEPTEMBER 14, 2009 TRUE COLOR PHOTOGRAPHY BY BAE SYSTEMS, MOUNT LAUREL, N.J.

LEGEND

- WETLAND RESTORATION AREA BOUNDARY
- DCR EXCLUDED AREA[1]
- EXISTING SURFACE WATER FEATURE
- EXISTING ROADS
- PONDED AREAS

FEET 0 1200 2400 3600

METERS 0 600 1200

URS

PSEG

ESTUARY ENHANCEMENT PROGRAM

Figure C-6

CEDAR SWAMP WETLAND RESTORATION SITE

2009 HYDROLOGICAL FEATURES

BLACKBIRD HUNDRED NEW CASTLE COUNTY, DELAWARE

CADD	JL	DATE	MAY 17, 2010	SCALE	AS SHOWN
FILE	09_CS-HYD	CHECKED	RLH	EXAMINED	RLH

Appendix D
Macrophyte Quadrat Data - Transects

Table D-1
MAD HORSE CREEK REFERENCE MARSH
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre		
Mad Horse Creek-09- Transect 1 8/14/09										
MHT1-09-OQ1	683	*S. alterniflora*	35%	88%	102	N				
MHT1-09-OQ1	683	*D. spicata*	5%	13%	64	Y				
MHT1-09-OQ2	663	*S. alterniflora*	45%	100%	94	N				
MHT1-09-OQ3	657	*S. alterniflora*	25%	100%	95	N				
MHT1-09-OQ4	642	*S. alterniflora*	35%	100%	120	N				
MHT1-09-OQ5	585	*S. alterniflora*	35%	100%	105	Y				
MHT1-09-OQ6	508	*S. alterniflora*	25%	83%	103	Y				
MHT1-09-OQ6	508	*A. cannanbinus*	5%	17%	102	Y				
MHT1-09-OQ7	465	*S. alterniflora*	45%	90%	151	N				
MHT1-09-OQ7	465	*A. cannanbinus*	5%	10%	133	Y				
MHT1-09-OQ8	433	*S. alterniflora*	35%	88%	130	N				
MHT1-09-OQ8	433	*A. cannanbinus*	5%	13%	98	Y				
MHT1-09-OQ9	381	*S. alterniflora*	25%	100%	129	Y				
MHT1-09-OQ10	370	*S. alterniflora*	35%	100%	127	Y				
MHT1-09-CQ1	361	*S. alterniflora*	55%	100%	119	N	1161	10361	0	61
MHT1-09-OQ11	351	*S. alterniflora*	45%	100%	128	N				
MHT1-09-OQ12	303	*S. alterniflora*	5%	100%	47	N				
MHT1-09-CQ2	300	*P. australis*	45%	100%	301	Y	3038	27107	0	54
MHT1-09-CQ3	270	*S. cynosuroides*	35%	88%	144	N	815	7273	0	206
MHT1-09-CQ3	270	Dead *S. cynosuroides*	5%	13%	107	N	0	0	357	0
MHT1-09-OQ13	255	*S. cynosuroides*	10%	50%	102	N				
MHT1-09-OQ13	255	*S. patens*	10%	50%	85	N				
MHT1-09-CQ4	250	*S. cynosuroides*	35%	70%	135	N	757	6756	0	176
MHT1-09-CQ4	250	Dead *S. cynosuroides*	25%	50%	71	N	0	0	230	0
MHT1-09-CQ4	250	*S. robustus*	1%	2%	90	N	21	183	0	0
MHT1-09-CQ4	250	Dead *S. robustus*	1%	2%	103	N	0	0	86	0
MHT1-09-OQ14	218	*S. cynosuroides*	30%	86%	150	N				
MHT1-09-OQ14	218	Dead *S. cynosuroides*	5%	14%	87	N				
MHT1-09-OQ15	203	*P. australis*	40%	100%	388	Y				
MHT1-09-CQ5	190	*P. australis*	15%	94%	120	N	101	904	0	386
MHT1-09-CQ5	190	Dead *P. australis*	1%	6%	105	N	0	0	145	0
MHT1-09-OQ16	160	*D. spicata*	45%	56%	55	Y				
MHT1-09-OQ16	160	*S. robustus*	35%	44%	105	Y				
MHT1-09-OQ17	124	*S. alterniflora*	55%	100%	131	N				
MHT1-09-CQ6	95	*S. alterniflora*	55%	98%	107	N	743	6626	0	0
MHT1-09-CQ6	95	*P. australis*	1%	2%	150	N	16	139	0	65
MHT1-09-OQ18	80	*S. alterniflora*	45%	69%	127	N				
MHT1-09-OQ18	80	*A. cannanbinus*	15%	23%	145	Y				
MHT1-09-OQ18	80	*S. patens*	5%	8%	103	N				
MHT1 -09- Mean Spartina dominated Quadrats (b)			43%		122		1310	11689	135	112
MHT1 -09- Mean Non-Spartina dominated Quadrats (b)			32%		--		101	904	145	386
MHT1 -09- Mean All Quadrats			41%		--		1109	9892	136	158
Mad Horse Creek-09- Transect 2 8/14/09										
MHT2-09-OQ1	195	*S. alterniflora*	30%	100%	170	N				
MHT2-09-OQ2	203	*S. alterniflora*	30%	97%	165	N				
MHT2-09-OQ2	203	*A. cannanbinus*	1%	3%	106	Y				
MHT2-09-OQ3	328	*S. alterniflora*	40%	98%	150	N				
MHT2-09-OQ3	328	*A. cannanbinus*	1%	2%	140	Y				
MHT2-09-OQ4	499	*S. alterniflora*	20%	67%	128	N				
MHT2-09-OQ4	499	*S. robustus*	10%	33%	122	Y				
MHT2-09-CQ1	527	*S. alterniflora*	45%	100%	136	N	938	8367	0	0
MHT2-09-OQ5	652	*S. alterniflora*	60%	100%	180	N				
MHT2-09-OQ6	732	*S. alterniflora*	60%	98%	150	N				
MHT2-09-OQ6	732	*A. cannanbinus*	1%	2%	100	Y				
MHT2-09-CQ2	783	*S. alterniflora*	50%	100%	148	N	1072	9566	0	118
MHT2 -09- Mean Spartina dominated Quadrats (b)			44%		153		1005	8966	0	59
MHT2 -09- Mean Non-Spartina dominated Quadrats (b)			0%		--		0	0	0	0
MHT2-09- Mean All Quadrats			44%		--		1005	8966	0	59

Table D-1
MAD HORSE CREEK REFERENCE MARSH
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Mad Horse Creek-09- Transect 3A 8/17/09										
MHT3A-09-OQ1	569	*S. alterniflora*	35%	88%	105	N				
MHT3A-09-OQ1	569	*D. spicata*	5%	13%	25	N				
MHT3A-09-OQ2	518	*S. alterniflora*	45%	100%	114	N				
MHT3A-09-OQ3	514	*S. alterniflora*	45%	100%	119	N				
MHT3A-09-OQ4	482	*S. alterniflora*	55%	92%	142	N				
MHT3A-09-OQ4	482	*S. robustus*	5%	8%	138	Y				
MHT3A-09-OQ5	477	*S. alterniflora*	10%	20%	143	N				
MHT3A-09-OQ5	477	*S. robustus*	35%	70%	137	Y				
MHT3A-09-OQ5	477	*S. cynosuroides*	5%	10%	175	Y				
MHT3A-09-OQ6	405	*S. alterniflora*	35%	70%	122	N				
MHT3A-09-OQ6	405	*S. patens*	15%	30%	79	N				
MHT3A-09-OQ7	403	*S. alterniflora*	25%	100%	157	Y				
MHT3A-09-OQ8	348	*S. alterniflora*	45%	100%	112	N				
MHT3A-09-CQ1	343	*S. alterniflora*	35%	70%	104	N	361	3219	0	0
MHT3A-09-CQ1	343	*S. patens*	15%	30%	69	Y	337	3006	0	0
MHT3A-09-OQ9	338	*S. alterniflora*	15%	17%	105	N				
MHT3A-09-OQ9	338	*D. spicata*	75%	83%	40	Y				
MHT3A-09-CQ2	322	*S. alterniflora*	1%	1%	95	N	17	155	0	0
MHT3A-09-CQ2	322	*D. spicata*	85%	99%	40	Y	762	6794	0	0
MHT3A-09-OQ10	279	*S. alterniflora*	15%	100%	60	N				
MHT3A-09-OQ11	264	*S. alterniflora*	55%	100%	129	N				
MHT3A-09-CQ3	258	*S. alterniflora*	15%	75%	110	N	368	3285	0	0
MHT3A-09-CQ3	258	*D. spicata*	5%	25%	55	Y	49	438	0	0
MHT3A-09-OQ12	257	*S. alterniflora*	35%	78%	100	N				
MHT3A-09-OQ12	257	*D. spicata*	5%	11%	51	Y				
MHT3A-09-OQ12	257	*S. patens*	5%	11%	42	Y				
MHT3A-09-OQ13	231	*S. alterniflora*	25%	100%	125	N				
MHT3A-09-OQ14	229	*S. alterniflora*	45%	100%	117	N				
MHT3A-09-CQ4	203	*S. alterniflora*	15%	29%	139	N	489	4366	0	0
MHT3A-09-CQ4	203	*P. australis*	1%	2%	124	Y	76	675	0	0
MHT3A-09-CQ4	203	*D. spicata*	35%	69%	70	Y	192	1715	0	0
MHT3A-09-CQ5	199	*P. australis*	55%	98%	174	Y	549	4899	0	0
MHT3A-09-CQ5	199	Dead *P. australis*	1%	2%	165	N	0	0	88	0
MHT3A-09-OQ15	133	*S. alterniflora*	5%	7%	50	N				
MHT3A-09-OQ15	133	*S. cynosuroides*	65%	93%	172	N				
MHT3A-09-OQ16	116	*S. alterniflora*	35%	44%	15	N				
MHT3A-09-OQ16	116	*S. patens*	45%	56%	65	Y				
MHT3A-09-OQ17	93	*S. alterniflora*	35%	54%	120	N				
MHT3A-09-OQ17	93	*D. spicata*	5%	8%	62	Y				
MHT3A-09-OQ17	93	*S. patens*	25%	38%	60	Y				
MHT3A-09-OQ18	74	*S. alterniflora*	45%	100%	131	N				
MHT3A-09-CQ6	25	*S. alterniflora*	55%	100%	75	N	308	2744	0	0
MHT3A -09- Mean Spartina dominated Quadrats (b)			50%		115		503	4485	0	0
MHT3A-09- Mean Non-Spartina dominated Quadrats (b)			53%		--		626	5582	22	0
MHT3A-09- Mean All Quadrats			51%		--		585	5216	15	0

Table D-1
MAD HORSE CREEK REFERENCE MARSH
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Mad Horse Creek-09- Transect 3B 8/17/09										
MHT3B-09-OQ1	299	*S. alterniflora*	30%	86%	109	Y				
MHT3B-09-OQ1	299	*A. cannanbinus*	5%	14%	187	Y				
MHT3B-09-OQ2	284	*S. alterniflora*	35%	88%	93	Y				
MHT3B-09-OQ2	284	*A. cannanbinus*	5%	13%	156	Y				
MHT3B-09-OQ3	268	*S. alterniflora*	20%	67%	108	Y				
MHT3B-09-OQ3	268	*A. cannanbinus*	10%	33%	132	Y				
MHT3B-09-OQ4	217	*S. alterniflora*	20%	80%	94	Y				
MHT3B-09-OQ4	217	*A. cannanbinus*	5%	20%	137	Y				
MHT3B-09-CQ1	198	*S. alterniflora*	20%	67%	101	Y	328	2924	0	0
MHT3B-09-CQ1	198	*P. australis*	10%	33%	84	Y	160	1429	0	100
MHT3B-09-CQ2	184	*S. alterniflora*	15%	33%	86	Y	425	3791	0	0
MHT3B-09-CQ2	184	*A. cannanbinus*	20%	44%	143	Y	401	3577	0	0
MHT3B-09-CQ2	184	*P. australis*	10%	22%	72	Y	50	442	0	0
MHT3B-09-CQ3	173	*S. alterniflora*	10%	29%	78	N	278	2478	0	0
MHT3B-09-CQ3	173	*A. cannanbinus*	20%	57%	193	Y	636	5673	0	0
MHT3B-09-CQ3	173	*P. australis*	5%	14%	67	N	9	78	0	0
MHT3B-09-OQ5	153	*S. alterniflora*	20%	67%	110	N				
MHT3B-09-OQ5	153	*A. cannanbinus*	5%	17%	109	Y				
MHT3B-09-OQ5	153	*S. patens*	5%	17%	83	N				
MHT3B-09-OQ6	140	*S. alterniflora*	35%	88%	112	Y				
MHT3B-09-OQ6	140	*A. cannanbinus*	5%	13%	99	Y				
MHT3B-09-OQ7	117	*S. alterniflora*	40%	80%	86	Y				
MHT3B-09-OQ7	117	*A. cannanbinus*	10%	20%	95	Y				
MHT3B-09-OQ8	108	*S. alterniflora*	35%	58%	102	Y				
MHT3B-09-OQ8	108	*A. cannanbinus*	10%	17%	82	Y				
MHT3B-09-OQ8	108	*S. patens*	15%	25%	63	N				
MHT3B-09-OQ9	89	*S. alterniflora*	25%	83%	97	N				
MHT3B-09-OQ9	89	*A. cannanbinus*	5%	17%	71	Y				
MHT3B-09-CQ4	61	*S. alterniflora*	35%	88%	102	N	378	3375	0	0
MHT3B-09-CQ4	61	*S. robustus*	5%	13%	96	N	26	233	0	0
MHT3B-09-OQ10	50	*S. alterniflora*	20%	57%	92	N				
MHT3B-09-OQ10	50	*S. patens*	10%	29%	83	N				
MHT3B-09-OQ10	50	*S. robustus*	5%	14%	72	Y				
MHT3B-09-OQ11	35	*S. alterniflora*	30%	100%	85	N				
MHT3B-09-OQ12	19	*S. alterniflora*	20%	80%	72	N				
MHT3B-09-OQ12	19	*A. cannanbinus*	5%	20%	94	Y				
MHT3B -09- Mean Spartina dominated Quadrats (b)			36%		97		446	3980	0	50
MHT3B -09- Mean Non-Spartina dominated Quadrats (b)			40%		--		899	8020	0	0
MHT3B-09- Mean All Quadrats			36%		--		672	6000	0	25
Site Mean Spartina dominated Quadrats (b)			43%		118		951	8483	61	71
Site Mean Non-Spartina dominated Quadrats (b)			44%		--		629	5610	33	55
Site Mean All Quadrats			43%		--		826	7365	50	65

Table D-2
MOORES BEACH REFERENCE MARSH
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Moores Beach-09- Transect 1 8/15/09										
MBT1-09-OQ1	618	*S. alterniflora*	60%	100%	85	N				
MBT1-09-OQ2	488	*S. alterniflora*	40%	89%	100	N				
MBT1-09-OQ2	488	Dead *S. alterniflora*	5%	11%	105					
MBT1-09-OQ3	350	*S. alterniflora*	25%	83%	95	N				
MBT1-09-OQ3	350	Dead *S. alterniflora*	5%	17%	60					
MBT1-09-OQ4	214	*S. patens*	100%	100%	45	Y				
MBT1-09-OQ5	111	*S. alterniflora*	60%	86%	95	N				
MBT1-09-OQ5	111	Dead *S. alterniflora*	10%	14%	95					
MBT1-09-OQ6	4	*S. alterniflora*	45%	98%	95	N				
MBT1-09-OQ6	4	Dead *S. alterniflora*	1%	2%	50					
MBT1-09-CQ1	336	*S. alterniflora*	45%	100%	100	N	679	6054	0	0
MBT1-09-CQ2	42	*S. alterniflora*	60%	80%	100	N	634	5660	0	56
MBT1-09-CQ2	42	Dead *S. alterniflora*	15%	20%	50	N	0	0	68	0
MBT1-09- Mean Spartina dominated Quadrats (b)			53%		96		656	5857	34	28
MBT1-09- Mean Non-Spartina dominated Quadrats (b)			100%		--		0	0	0	0
MBT1-09- Mean All Quadrats			59%		--		656	5857	34	28
Moores Beach-09- Transect 2 8/15/09										
MBT2-09-OQ1	793	*S. alterniflora*	20%	80%	160	N				
MBT2-09-OQ1	793	Dead *S. alterniflora*	5%	20%	70	N				
MBT2-09-OQ2	615	*S. alterniflora*	25%	83%	120	N				
MBT2-09-OQ2	615	Dead *S. alterniflora*	5%	17%	60	N				
MBT2-09-OQ3	518	*S. alterniflora*	25%	100%	48	N				
MBT2-09-CQ1	497	*S. alterniflora*	20%	80%	135	N	1131	10092	0	0
MBT2-09-CQ1	497	Dead *S. alterniflora*	5%	20%	116	N	0	0	105	0
MBT2-09-OQ4	317	*S. alterniflora*	35%	100%	141	N				
MBT2-09-OQ5	286	*S. alterniflora*	10%	100%	142	Y				
MBT2-09-OQ6	197	*S. alterniflora*	25%	96%	161	N				
MBT2-09-OQ6	197	Dead *S. alterniflora*	1%	4%	90	N				
MBT2-09-CQ2	185	*S. alterniflora*	20%	100%	160	N	780	6958	0	0
MBT2-09- Mean Spartina dominated Quadrats (b)			27%		132		956	8525	52	0
MBT2-09-Mean Non-Spartina dominated Quadrats (b)			10%		--		0	0	0	0
MBT2-09- Mean All Quadrats			25%		--		956	8525	52	0
Moores Beach-09- Transect 3 8/15/09										
MBT3-09-OQ1	540	*S. alterniflora*	45%	100%	106	N				
MBT3-09-CQ1	469	*S. alterniflora*	45%	98%	112	N	955	8517	0	51
MBT3-09-CQ1	469	Dead *S. alterniflora*	1%	2%	95	N	0	0	87	0
MBT3-09-OQ2	448	*S. alterniflora*	45%	100%	108	N				
MBT3-09-OQ3	357	*S. alterniflora*	35%	100%	117	N				
MBT3-09-OQ4	343	*S. alterniflora*	25%	100%	133	N				
MBT3-09-OQ5	289	*S. alterniflora*	35%	100%	130	N				
MBT3-09-OQ6	230	*S. alterniflora*	35%	100%	140	N				
MBT3-09-CQ2	200	*S. alterniflora*	35%	100%	122	N	689	6151	0	0
MBT3-09- Mean Spartina dominated Quadrats (b)			38%		121		822	7334	44	26
MBT3-09-09 -09- Mean Non-Spartina dominated Quadrats (b)			0%		--		0	0	0	0
MBT3-09- Mean All Quadrats			38%		--		822	7334	44	26
Site Mean Spartina dominated Quadrats (b)			39%		117		811	7239	43	18
Site Mean Non-Spartina dominated Quadrats (b)			55%		--		0	0	0	0
Site Mean All Quadrats			40%		--		811	7239	43	18

Table D-3
COMMERCIAL TOWNSHIP SALT HAY FARM WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Commercial Township-09- Transect 1 8/16/09										
CTT1-09-CQ1	413	*S. alterniflora*	55%	100%	101	N	1362	12152	0	0
CTT1-09-OQ1	338	*S. alterniflora*	35%	100%	68	N				
CTT1-09-OQ2	329	*S. alterniflora*	45%	100%	111	N				
CTT1-09-OQ3	316	Mud Flat	--	100%	--	--				
CTT1-09-OQ4	211	*S. alterniflora*	30%	100%	59	N				
CTT1-09-CQ2	144	*S. alterniflora*	45%	100%	159	Y	774	6905	0	0
CTT1-09-OQ5	102	*S. alterniflora*	40%	100%	89	N				
CTT1-09-OQ6	98	*S. alterniflora*	40%	100%	170	Y				
CTT1-09- Mean Spartina dominated Quadrats (b)			41%		108		1068	9528	0	0
CTT1-09- Mean Non-Spartina dominated Quadrats (b)			0%		--		0	0	0	0
CTT1-09- Mean All Quadrats			41%		--		1068	9528	0	0
Commercial Township-09- Transect 2 8/17/09										
CTT2-09-OQ1	592	*S. alterniflora*	10%	100%	142	Y				
CTT2-09-OQ2	499	Mud Flat	--	100%	--	--				
CTT2-09-OQ3	319	*S. alterniflora*	20%	100%	170	Y				
CTT2-09-CQ1	278	*S. alterniflora*	25%	100%	130	Y	429	3832	0	0
CTT2-09-CQ2	265	*S. alterniflora*	25%	100%	184	Y	731	6524	0	0
CTT2-09-OQ4	225	Mud Flat	--	100%	--	--				
CTT2-09-OQ5	125	*S. alterniflora*	5%	100%	97	Y				
CTT2-09-OQ6	0	*S. alterniflora*	30%	100%	183	Y				
CTT2-09- Mean Spartina dominated Quadrats (b)			25%		167		580	5178	0	0
CTT2-09- Mean Non-Spartina dominated Quadrats (b)			8%		--		0	0	0	0
CTT2-09- Mean All Quadrats			19%		--		580	5178	0	0
Commercial Township-09- Transect 3 8/15/09										
CTT3-09-OQ1	334	Mud Flat	--	100%	--	--				
CTT3-09-OQ2	305	*S. alterniflora*	10%	100%	69	N				
CTT3-09-CQ2	244	*S. alterniflora*	15%	100%	80	N	150	1341	0	66
CTT3-09-OQ3	229	Mud Flat	--	100%	--	--				
CTT3-09-OQ4	153	Mud Flat	--	100%	--	--				
CTT3-09-OQ5	65	*S. alterniflora*	35%	100%	100	Y				
CTT3-09-OQ6	10	*S. alterniflora*	45%	100%	82	Y				
CTT3-09-CQ1	9	*S. alterniflora*	45%	100%	98	Y	951	8484	0	43
CTT3-09- Mean Spartina dominated Quadrats (b)			42%		93		951	8484	0	43
CTT3-09- Mean Non-Spartina dominated Quadrats (b)			13%		--		150	1341	0	66
CTT3-09- Mean All Quadrats			30%		--		551	4912	0	54
Commercial Township-09- Transect 4 8/17/09										
CTT4-09-OQ1	250	Mud Flat	--	100%	--	--				
CTT4-09-CQ1	196	*S. alterniflora*	45%	100%	143	N	1645	14681	0	0
CTT4-09-OQ2	183	Mud Flat	--	100%	--	--				
CTT4-09-OQ3	177	Mud Flat	--	100%	--	--				
CTT4-09-OQ4	154	Mud Flat	--	100%	--	--				
CTT4-09-OQ5	135	*S. alterniflora*	5%	100%	124	N				
CTT4-09-CQ2	28	*S. alterniflora*	35%	100%	120	Y	634	5657	0	0
CTT4-09-OQ6	20	*S. alterniflora*	25%	100%	116	Y				
CTT4-09- Mean Spartina dominated Quadrats (b)			35%		126		1140	10169	0	0
CTT4-09- Mean Non-Spartina dominated Quadrats (b)			5%		--		0	0	0	0
CTT4-09- Mean All Quadrats			28%		--		1140	10169	0	0
Site Mean Spartina dominated Quadrats (b)			36%		123		932	8319	0	6
Site Mean Non-Spartina dominated Quadrats (b)			9%		--		150	1341	0	66
Site Mean All Quadrats			30%		--		835	7447	0	14

Table D-4
ALLOWAY CREEK WATERSHED PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Alloway Creek Watershed-09- Transect 1 8/19/09										
ACWT1-09-OQ1	440	*S. alterniflora*	20%	67%	112	Y				
ACWT1-09-OQ1	440	*E. walteri*	5%	17%	106	Y				
ACWT1-09-OQ1	440	*A. cannanbinus*	5%	17%	122	Y				
ACWT1-09-OQ2	428	*S. alterniflora*	35%	78%	121	Y				
ACWT1-09-OQ2	428	*A. cannanbinus*	10%	22%	127	Y				
ACWT1-09-OQ3	343	*S. alterniflora*	45%	69%	119	Y				
ACWT1-09-OQ3	343	*A. cannanbinus*	15%	23%	132	Y				
ACWT1-09-OQ3	343	*S. robustus*	5%	8%	63	Y				
ACWT1-09-OQ4	317	*S. alterniflora*	25%	83%	103	Y				
ACWT1-09-OQ4	317	*A. cannanbinus*	5%	17%	101	Y				
ACWT1-09-CQ1	297	*S. alterniflora*	20%	100%	127	Y	1112	9921	0	0
ACWT1-09-OQ5	254	*S. alterniflora*	25%	83%	117	Y				
ACWT1-09-OQ5	254	*P. virginica*	5%	17%	72	N				
ACWT1-09-OQ6	227	*S. alterniflora*	25%	100%	98	Y				
ACWT1-09-CQ2	212	*S. alterniflora*	30%	86%	82	Y	671	5989	0	0
ACWT1-09-CQ2	212	*S. robustus*	5%	14%	80	Y	34	304	0	0
ACWT1-09- Mean Spartina dominated Quadrats (b)			35%		110		909	8107	0	0
ACWT1-09- Mean Non-Spartina dominated Quadrats (b)			0%		--		0	0	0	0
ACWT1-09- Mean All Quadrats			35%		--		909	8107	0	0
Alloway Creek Watershed-09- Transect 2 8/11/09										
ACWT2-09-CQ6	548	*S. cynosuroides*	20%	100%	253	Y	2063	18407	0	0
ACWT2-09-CQ5	544	*S. cynosuroides*	25%	100%	235	Y	2159	19265	0	77
ACWT2-09-OQ1	539	*S. alterniflora*	20%	100%	82	N				
ACWT2-09-OQ2	531	*S. alterniflora*	20%	95%	160	Y				
ACWT2-09-OQ2	531	*S. robustus*	1%	5%	142	Y				
ACWT2-09-OQ3	522	*S. alterniflora*	20%	95%	168	Y				
ACWT2-09-OQ3	522	*S. robustus*	1%	5%	100	Y				
ACWT2-09-OQ4	519	*S. alterniflora*	25%	100%	169	Y				
ACWT2-09-OQ5	516	*S. alterniflora*	35%	100%	185	Y				
ACWT2-09-OQ6	474	*S. alterniflora*	25%	100%	153	Y				
ACWT2-09-OQ17	398	*S. alterniflora*	20%	100%	140	Y				
ACWT2-09-OQ7	359	*S. alterniflora*	35%	100%	144	Y				
ACWT2-09-OQ8	335	*S. alterniflora*	40%	100%	150	Y				
ACWT2-09-CQ4	283	*S. alterniflora*	40%	100%	130	Y	1303	11627	0	0
ACWT2-09-OQ9	269	*Wrack*	0%							
ACWT2-09-CQ3	259	*S. alterniflora*	1%	5%	142	Y	52	468	0	123
ACWT2-09-CQ3	259	*P. australis*	20%	95%	250	Y	1442	12866	0	0
ACWT2-09-OQ10	252	*S. alterniflora*	45%	100%	154	Y				
ACWT2-09-OQ11	240	*Wrack*	0%							
ACWT2-09-OQ12	206	*S. alterniflora*	20%	100%	165	N				
ACWT2-09-OQ13	189	*S. alterniflora*	20%	100%	158	Y				
ACWT2-09-CQ2	165	*S. alterniflora*	50%	100%	150	Y	1445	12890	0	108
ACWT2-09-OQ14	150	*S. alterniflora*	60%	98%	138	Y				
ACWT2-09-OQ14	150	*P. punctatum*	1%	2%	83	Y				
ACWT2-09-OQ15	146	*S. alterniflora*	80%	100%	128	N				
ACWT2-09-OQ16	132	*S. alterniflora*	25%	100%	173	Y				
ACWT2-09-OQ18	51	*S. alterniflora*	40%	100%	120	N				
ACWT2-09-CQ1	11	*S. robustus*	1%	2%	154	Y	33	293	0	99
ACWT2-09-CQ1	11	*P. australis*	45%	98%	173	Y	1608	14347	0	0
ACWT2-09- Mean Spartina dominated Quadrats (b)			33%		158		1743	15547	0	46
ACWT2-09- Mean Non-Spartina dominated Quadrats (b)			34%		--		1568	13987	0	111
ACWT2-09- Mean All Quadrats			33%		--		1684	15027	0	68

Table D-4
ALLOWAY CREEK WATERSHED PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Alloway Creek Watershed-09- Transect 3 8/18/09										
ACWT3-09-OQ1	275	*S. alterniflora*	25%	83%	125	Y				
ACWT3-09-OQ1	275	*P. australis*	5%	17%	171	N				
ACWT3-09-OQ2	257	*S. alterniflora*	25%	100%	131	Y				
ACWT3-09-OQ3	248	*S. alterniflora*	15%	30%	125	Y				
ACWT3-09-OQ3	248	*P. punctatum*	15%	30%	82	Y				
ACWT3-09-OQ3	248	*A. cannanbinus*	1%	2%	188	Y				
ACWT3-09-OQ4	248	Dead *P. australis*	5%	10%	188	N				
ACWT3-09-OQ4	215	*A. cannanbinus*	5%	24%	153	Y				
ACWT3-09-OQ4	215	Dead *P. australis*	15%	71%	176	N				
ACWT3-09-OQ4	215	*S. robustus*	1%	5%	153	Y				
ACWT3-09-OQ5	182	*P. punctatum*	35%	54%	70	Y				
ACWT3-09-OQ5	182	Dead *P. australis*	15%	23%	151	N				
ACWT3-09-OQ5	182	*S. robustus*	15%	23%	101	N				
ACWT3-09-OQ6	179	*P. punctatum*	1%	2%	70	Y				
ACWT3-09-OQ6	179	*A. cannanbinus*	1%	2%	90	Y				
ACWT3-09-OQ6	179	Dead *P. australis*	10%	20%	159	N				
ACWT3-09-OQ6	179	*S. robustus*	10%	20%	139	N				
ACWT3-09-CQ1	169	*P. australis*	5%	25%	103	N	50	449	0	124
ACWT3-09-CQ1	169	Dead *P. australis*	15%	75%	140	N	0	0	516	0
ACWT3-09-CQ2	161	*P. australis*	15%	75%	140	N	130	1159	0	102
ACWT3-09-CQ2	161	Dead *P. australis*	5%	25%	124	N	0	0	112	0
ACWT3-09-CQ3	147	*S. alterniflora*	25%	96%	114	Y	334	2977	0	0
ACWT3-09-CQ3	147	*P. punctatum*	1%	4%	78	Y	4	34	0	0
ACWT3-09-CQ4	105	*S. alterniflora*	45%	75%	112	Y	636	5673	0	0
ACWT3-09-CQ4	105	*P. punctatum*	15%	25%	100	Y	29	258	0	0
ACWT3-09-OQ7	104	*S. alterniflora*	45%	75%	112	Y				
ACWT3-09-OQ7	104	*P. punctatum*	15%	25%	100	Y				
ACWT3-09-OQ8	81	*S. alterniflora*	45%	90%	120	Y				
ACWT3-09-OQ8	81	Dead *P. australis*	5%	10%	137	N				
ACWT3-09-OQ9	70	*S. alterniflora*	35%	97%	145	Y				
ACWT3-09-OQ9	70	Dead *P. australis*	1%	3%	180	N				
ACWT3-09-OQ10	69	*S. alterniflora*	15%	50%	145	Y				
ACWT3-09-OQ10	69	*P. australis*	15%	50%	158	Y				
ACWT3-09-OQ11	24	*S. alterniflora*	35%	70%	118	Y				
ACWT3-09-OQ11	24	*P. virginica*	15%	30%	80	N				
ACWT3-09-OQ12	3	*S. alterniflora*	25%	100%	109	N				
ACWT3-09- Mean Spartina dominated Quadrats (b)			40%		121		501	4471	0	0
ACWT3-09- Mean Non-Spartina dominated Quadrats (b)			31%		--		90	804	314	113
ACWT3-09- Mean All Quadrats			36%		--		296	2637	157	57

Table D-4
ALLOWAY CREEK WATERSHED PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Alloway Creek Watershed-09- Transect 4 8/18/09										
ACWT4-09-OQ1	213	*P. virginica*	5%	6%	82	N				
ACWT4-09-OQ1	213	*S. cynosuroides*	65%	76%	134	Y				
ACWT4-09-OQ1	213	*S. alterniflora*	15%	18%	125	N				
ACWT4-09-CQ1	194	*S. alterniflora*	35%	100%	130	Y	479	4273	0	124
ACWT4-09-OQ2	192	*S. alterniflora*	55%	100%	132	N				
ACWT4-09-OQ3	186	*S. cynosuroides*	1%	9%	102	N				
ACWT4-09-OQ3	186	*S. alterniflora*	5%	45%	125	N				
ACWT4-09-OQ3	186	*S. robustus*	5%	45%	122	Y				
ACWT4-09-OQ4	161	*S. alterniflora*	5%	8%	94	N				
ACWT4-09-OQ4	161	*S. validus*	5%	8%	131	Y				
ACWT4-09-OQ4	161	*E. walteri*	55%	85%	107	Y				
ACWT4-09-OQ5	149	*S. alterniflora*	25%	100%	107	N				
ACWT4-09-OQ6	146	*S. alterniflora*	5%	50%	89	N				
ACWT4-09-OQ6	146	Dead *S. alterniflora*	5%	50%	21	N				
ACWT4-09-OQ7	143	*S. alterniflora*	65%	93%	160	Y				
ACWT4-09-OQ7	143	Dead *S. alterniflora*	5%	7%	84	N				
ACWT4-09-OQ8	127	*P. virginica*	1%	2%	23	N				
ACWT4-09-OQ8	127	*S. alterniflora*	55%	96%	142	Y				
ACWT4-09-OQ8	127	*P. punctatum*	1%	2%	48	Y				
ACWT4-09-OQ9	111	*S. alterniflora*	25%	96%	145	Y				
ACWT4-09-OQ9	111	Dead *S. alterniflora*	1%	4%	43	N				
ACWT4-09-CQ2	92	*S. alterniflora*	15%	60%	124	Y	685	6113	0	0
ACWT4-09-CQ2	92	Dead *S. alterniflora*	5%	20%	57	N	0	0	28	0
ACWT4-09-CQ2	92	*P. virginica*	5%	20%	7	N	13	112	0	0
ACWT4-09-OQ10	67	*S. cynosuroides*	5%	10%	172	Y				
ACWT4-09-OQ10	67	*S. alterniflora*	45%	90%	145	Y				
ACWT4-09-CQ3	32	*S. alterniflora*	75%	96%	163	Y	826	7368	0	0
ACWT4-09-CQ3	32	Dead *S. alterniflora*	1%	1%	55	N	0	0	65	0
ACWT4-09-CQ3	32	*S. robustus*	1%	1%	113	N	10	92	0	0
ACWT4-09-CQ3	32	*P. australis*	1%	1%	194	N	91	816	0	0
ACWT4-09-CQ4	24	*S. robustus*	5%	13%	165	Y	111	989	0	0
ACWT4-09-CQ4	24	*P. australis*	35%	88%	240	Y	1158	10328	0	0
ACWT4-09-OQ11	21	*P. australis*	35%	100%	204	Y				
ACWT4-09-OQ12	4	*P. virginica*	5%	24%	76	N				
ACWT4-09-OQ12	4	*E. walteri*	1%	5%	80	Y				
ACWT4-09-OQ12	4	*P. australis*	15%	71%	187	Y				
ACWT4-09- Mean Spartina dominated Quadrats (b)			53%		141		703	6274	32	62
ACWT4-09- Mean Non-Spartina dominated Quadrats (b)			30%		--		983	8771	14	0
ACWT4-09- Mean All Quadrats			43%		--		843	7522	23	31
Site Mean Spartina dominated Quadrats (b)			39%		136		1120	9989	6	31
Site Mean Non-Spartina dominated Quadrats (b)			31%		--		880	7854	109	75
Site Mean All Quadrats			37%		--		1030	9189	45	47

Table D-5
THE ROCKS PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
The Rocks-09- Transect 1 8/20/09										
TRT1-09-OQ1	405	*S. alterniflora*	25%	71%	92	Y				
TRT1-09-OQ1	405	*S. cynosuroides*	5%	14%	113	Y				
TRT1-09-OQ1	405	*A. patula*	5%	14%	62	Y				
TRT1-09-OQ2	371	*S. alterniflora*	20%	57%	94	N				
TRT1-09-OQ2	371	*S. robustus*	10%	29%	87	Y				
TRT1-09-OQ2	371	*P. punctatum*	5%	14%	61	Y				
TRT1-09-OQ3	338	*S. alterniflora*	20%	67%	82	N				
TRT1-09-OQ3	338	*A. cannanbinus*	10%	33%	68	Y				
TRT1-09-OQ4	313	*S. alterniflora*	20%	67%	78	Y				
TRT1-09-OQ4	313	*A. cannanbinus*	5%	17%	62	Y				
TRT1-09-OQ4	313	*T. angustifolia*	5%	17%	113	N				
TRT1-09-OQ5	293	*S. alterniflora*	20%	100%	96	Y				
TRT1-09-OQ6	247	*S. alterniflora*	25%	63%	62	N				
TRT1-09-OQ6	247	*A. cannanbinus*	15%	38%	117	Y				
TRT1-09-CQ1	235	*S. alterniflora*	35%	88%	111	Y	1374	12259	0	0
TRT1-09-CQ1	235	*A. cannanbinus*	5%	13%	86	Y	27	241	0	0
TRT1-09-OQ7	211	*S. alterniflora*	30%	100%	112	Y				
TRT1-09-OQ8	186	*S. alterniflora*	20%	67%	92	Y				
TRT1-09-OQ8	186	*A. cannanbinus*	5%	17%	98	Y				
TRT1-09-OQ8	186	*S. robustus*	5%	17%	107	Y				
TRT1-09-OQ9	142	*S. alterniflora*	20%	100%	117	Y				
TRT1-09-CQ2	123	*S. alterniflora*	20%	80%	67	Y	711	6345	0	0
TRT1-09-CQ2	123	*A. cannanbinus*	5%	20%	52	Y	9	77	0	0
TRT1-09-OQ10	63	*S. alterniflora*	30%	86%	117	Y				
TRT1-09-OQ10	63	*A. cannanbinus*	5%	14%	78	Y				
TRT1-09-OQ11	20	*A. cannanbinus*	5%	17%	45	Y				
TRT1-09-OQ11	20	*T. angustifolia*	25%	83%	139	Y				
TRT1-09-CQ3	13	*T. angustifolia*	30%	86%	162	Y	1173	10463	0	0
TRT1-09-CQ3	13	*A. cannanbinus*	5%	14%	53	Y	18	158	0	0
TRT1-09-CQ4	5	*T. angustifolia*	20%	67%	160	Y	932	8316	0	0
TRT1-09-CQ4	5	*S. patens*	10%	33%	38	N	61	546	0	0
TRT1-09-OQ12	1	*T. angustifolia*	20%	80%	152	Y				
TRT1-09-OQ12	1	*A. patula*	5%	20%	68	Y				
TRT1-09- Mean Spartina dominated Quadrats (b)			31%		95		1060	9461	0	0
TRT1-09- Mean Non-Spartina dominated Quadrats (b)			30%		--		1092	9742	0	0
TRT1-09- Mean All Quadrats			31%		--		1076	9601	0	0
The Rocks-09- Transect 2 8/16/09										
TRT2-09-CQ1	303	*S. cynosuroides*	40%	100%	193	N	1398	12472	0	187
TRT2-09-OQ1	297	*S. cynosuroides*	35%	88%	211	Y				
TRT2-09-OQ1	297	*P. purpurascens*	5%	13%	42	Y				
TRT2-09-OQ2	263	*S. cynosuroides*	40%	100%	183	Y				
TRT2-09-OQ3	253	*S. cynosuroides*	45%	90%	217	Y				
TRT2-09-OQ3	253	*T. latifolia*	5%	10%	124	Y				
TRT2-09-CQ2	227	*S. cynosuroides*	35%	88%	138	N	1048	9353	0	73
TRT2-09-CQ2	227	*T. latifolia*	5%	13%	130	Y	179	1598	0	0
TRT2-09-OQ4	212	*S. cynosuroides*	20%	57%	198	Y				
TRT2-09-OQ4	212	*P. australis*	15%	43%	225	Y				
TRT2-09-OQ5	154	*P. purpurascens*	5%	10%	37	Y				
TRT2-09-OQ5	154	*S. alterniflora*	45%	90%	96	N				
TRT2-09-OQ6	117	*S. alterniflora*	25%	100%	47	N				
TRT2-09-OQ7	105	*S. alterniflora*	50%	100%	97	N				
TRT2-09-CQ3	99	*S. alterniflora*	40%	100%	94	N	888	7925	0	549
TRT2-09-OQ8	48	*S. alterniflora*	35%	100%	73	Y				
TRT2-09-OQ9	37	*S. alterniflora*	30%	100%	62	N				
TRT2-09-OQ10	25	*S. alterniflora*	20%	67%	61	N				
TRT2-09-OQ10	25	*S. robustus*	10%	33%	83	N				
TRT2-09-OQ11	17	*S. alterniflora*	45%	100%	111	N				
TRT2-09-CQ4	12	*S. alterniflora*	45%	100%	83	Y	710	6338	0	111
TRT2-09-OQ12	9	*S. alterniflora*	40%	89%	97	N				
TRT2-09-OQ12	9	*S. robustus*	5%	11%	101	N				
TRT2-09- Mean Spartina dominated Quadrats (b)			40%		123		1056	9421	0	230
TRT2-09- Mean Non-Spartina dominated Quadrats (b)			0%		--		0	0	0	0
TRT2-09- Mean All Quadrats			40%		--		1056	9421	0	230

Table D-5
THE ROCKS PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
The Rocks-09- Transect 3 8/16/09										
TRT3-09-OQ1	358	*S. cynosuroides*	15%	50%	140	N				
TRT3-09-OQ1	358	*P. australis*	5%	17%	185	N				
TRT3-09-OQ1	358	Dead *P. australis*	10%	33%	125	N				
TRT3-09-OQ2	357	*S. cynosuroides*	20%	80%	138	N				
TRT3-09-OQ2	357	*P. australis*	5%	20%	180	N				
TRT3-09-OQ3	332	*S. olneyi*	15%	25%	116	N				
TRT3-09-OQ3	332	*S. patens*	45%	74%	53	Y				
TRT3-09-OQ3	332	*P. punctatum*	1%	2%	40	Y				
TRT3-09-OQ4	326	*S. olneyi*	35%	44%	103	N				
TRT3-09-OQ4	326	*S. patens*	45%	56%	77	N				
TRT3-09-CQ1	318	*S. olneyi*	25%	41%	130	N	293	2611	0	0
TRT3-09-CQ1	318	*S. patens*	35%	57%	100	N	246	2193	0	0
TRT3-09-CQ1	318	*P. punctatum*	1%	2%	58	N	1	12	0	0
TRT3-09-OQ5	295	*P. australis*	25%	71%	206	Y				
TRT3-09-OQ5	295	*S. olneyi*	10%	29%	130	N				
TRT3-09-OQ6	292	*S. cynosuroides*	5%	20%	185	N				
TRT3-09-OQ6	292	*P. australis*	10%	40%	204	Y				
TRT3-09-OQ6	292	*S. alterniflora*	10%	40%	130	Y				
TRT3-09-OQ7	286	*S. patens*	45%	90%	55	N				
TRT3-09-OQ7	286	*S. alterniflora*	5%	10%	92	N				
TRT3-09-OQ8	278	*S. olneyi*	15%	20%	92	N				
TRT3-09-OQ8	278	*S. patens*	45%	60%	62	N				
TRT3-09-OQ8	278	*P. punctatum*	15%	20%	60	Y				
TRT3-09-OQ9	272	*S. olneyi*	1%	2%	110	N				
TRT3-09-OQ9	272	*S. patens*	5%	10%	58	Y				
TRT3-09-OQ9	272	*P. punctatum*	10%	20%	50	Y				
TRT3-09-OQ9	272	*S. alterniflora*	10%	20%	105	N				
TRT3-09-CQ2	257	*S. cynosuroides*	35%	58%	160	N	434	3875	0	0
TRT3-09-CQ2	257	Dead *S. cynosuroides*	15%	25%	80	N	0	0	174	0
TRT3-09-CQ2	257	*S. olneyi*	5%	8%	140	N	50	442	0	0
TRT3-09-CQ2	257	*S. patens*	5%	8%	62	Y	21	191	0	0
TRT3-09-OQ10	252	*S. cynosuroides*	10%	40%	160	N				
TRT3-09-OQ10	252	Dead *S. cynosuroides*	15%	60%	95	N				
TRT3-09-OQ11	246	*S. cynosuroides*	15%	50%	130	N				
TRT3-09-OQ11	246	Dead *S. cynosuroides*	15%	50%	95	N				
TRT3-09-CQ3	243	*S. cynosuroides*	5%	10%	140	N	411	3664	0	0
TRT3-09-CQ3	243	*S. robustus*	1%	2%	124	N	44	390	0	0
TRT3-09-CQ3	243	*P. australis*	15%	30%	197	Y	135	1204	0	0
TRT3-09-CQ3	243	Dead *P. australis*	15%	30%	117	N	0	0	153	0
TRT3-09-CQ4	227	*S. patens*	35%	78%	80	N	256	2285	0	0
TRT3-09-CQ4	227	*S. olneyi*	10%	22%	100	N	61	545	0	0
TRT3-09-OQ12	205	*S. olneyi*	20%	31%	110	N				
TRT3-09-OQ12	205	*S. patens*	45%	69%	55	N				
TRT3-09-OQ13	202	*S. olneyi*	35%	50%	108	N				
TRT3-09-OQ13	202	*S. patens*	35%	50%	50	N				
TRT3-09-OQ14	180	*S. cynosuroides*	15%	21%	138	Y				
TRT3-09-OQ14	180	*S. olneyi*	20%	29%	135	Y				
TRT3-09-OQ14	180	*S. patens*	35%	50%	75	N				

Table D-5
THE ROCKS PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
The Rocks-09- Transect 3 continued 8/16/09										
TRT3-09-CQ5	168	*S. patens*	35%	70%	45	N	155	1379	0	147
TRT3-09-CQ5	168	*S. olneyi*	10%	20%	110	N	159	1420	0	0
TRT3-09-CQ5	168	*S. cynosuroides*	10%	20%	110	Y	98	873	0	0
TRT3-09-CQ5	168	*P. australis*	5%	10%	130	N	106	943	0	0
TRT3-09-OQ15	150	*S. cynosuroides*	25%	93%	170	N				
TRT3-09-OQ15	150	*S. olneyi*	1%	4%	100	N				
TRT3-09-OQ15	150	Dead *S. cynosuroides*	1%	4%	90	N				
TRT3-09-OQ16	111	*S. alterniflora*	15%	71%	150	Y				
TRT3-09-OQ16	111	*P. australis*	1%	5%	180	Y				
TRT3-09-OQ16	111	Dead *S. cynosuroides*	5%	24%	180	N				
TRT3-09-OQ17	110	*S. cynosuroides*	15%	60%	151	N				
TRT3-09-OQ17	110	Dead *S. cynosuroides*	10%	40%	130	N				
TRT3-09-OQ18	98	*S. cynosuroides*	5%	33%	110	N				
TRT3-09-OQ18	98	*P. australis*	5%	33%	180	Y				
TRT3-09-OQ18	98	*S. alterniflora*	5%	33%	100	N				
TRT3-09-CQ6	91	*S. cynosuroides*	25%	49%	130	N	267	2383	0	0
TRT3-09-CQ6	91	Dead *S. cynosuroides*	15%	29%	80	N	0	0	363	0
TRT3-09-CQ6	91	*P. australis*	10%	20%	190	Y	138	1235	0	0
TRT3-09-CQ6	91	Dead *P. australis*	1%	2%	110	N	0	0	24	0
TRT3-09-OQ19	70	*S. alterniflora*	35%	70%	110	N				
TRT3-09-OQ19	70	Dead *S. alterniflora*	15%	30%	90	N				
TRT3-09-OQ20	64	*S. cynosuroides*	15%	50%	98	Y				
TRT3-09-OQ20	64	*P. australis*	15%	50%	109	Y				
TRT3-09-CQ7	34	*S. alterniflora*	35%	78%	100	N	845	7536	0	0
TRT3-09-CQ7	34	Dead *S. alterniflora*	10%	22%	70	N	0	0	151	0
TRT3-09-OQ21	25	*P. australis*	35%	70%	165	Y				
TRT3-09-OQ21	25	Dead *P. australis*	15%	30%	98	N				
TRT3-09-OQ22	14	*S. cynosuroides*	35%	70%	210	Y				
TRT3-09-OQ22	14	*P. australis*	15%	30%	130	N				
TRT3-09-CQ8	4	*S. cynosuroides*	35%	70%	211	Y	506	4517	0	0
TRT3-09-CQ8	4	*P. australis*	15%	30%	130	Y	55	493	0	640
TRT3-09- Mean Spartina dominated Quadrats (b)			45%		141		579	5168	178	160
TRT3-09- Mean Non-Spartina dominated Quadrats (b)			45%		--		491	4380	38	37
TRT3-09- Mean All Quadrats			45%		--		535	4774	108	98

Table D-5
THE ROCKS PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
The Rocks-09- Transect 4 8/16/09										
TRT4-09-CQ1	246	*S. alterniflora*	75%	99%	147	Y	1521	13573	0	0
TRT4-09-CQ1	246	Dead *S. alterniflora*	1%	1%	144	N	0	0	59	0
TRT4-09-CQ2	245	*S. alterniflora*	45%	100%	152	Y	1033	9219	0	221
TRT4-09-OQ1	237	*S. cynosuroides*	25%	42%	117	N				
TRT4-09-OQ1	237	*S. alterniflora*	35%	58%	132	N				
TRT4-09-OQ2	211	*S. cynosuroides*	50%	100%	188	Y				
TRT4-09-OQ3	203	Dead *S. cynosuroides*	50%	98%	171	Y				
TRT4-09-OQ3	203	*S. cynosuroides*	1%	2%	189	N				
TRT4-09-OQ4	178	*S. patens*	55%	100%	159	N				
TRT4-09-CQ3	173	*S. cynosuroides*	55%	100%	159	N	565	5044	0	313
TRT4-09-OQ5	167	*S. cynosuroides*	55%	85%	168	N				
TRT4-09-OQ5	167	*S. patens*	10%	15%	52	N				
TRT4-09-OQ6	156	*S. cynosuroides*	40%	80%	155	Y				
TRT4-09-OQ6	156	*S. patens*	10%	20%	98	N				
TRT4-09-OQ7	129	*S. cynosuroides*	40%	98%	174	Y				
TRT4-09-OQ7	129	*S. robustus*	1%	2%	140	Y				
TRT4-09-OQ8	114	*S. cynosuroides*	35%	100%	174	N				
TRT4-09-CQ4	111	*S. cynosuroides*	30%	100%	151	N	557	4971	0	112
TRT4-09-OQ9	67	*S. cynosuroides*	40%	98%	153	Y				
TRT4-09-OQ9	67	*P. purpurascens*	1%	2%	66	Y				
TRT4-09-OQ10	38	*S. cynosuroides*	20%	57%	115	N				
TRT4-09-OQ10	38	*S. alterniflora*	15%	43%	98	N				
TRT4-09-OQ11	32	*S. cynosuroides*	20%	77%	115	Y				
TRT4-09-OQ11	32	*S. alterniflora*	5%	19%	88	N				
TRT4-09-OQ11	32	Dead *S. cynosuroides*	1%	4%	103	N				
TRT4-09-OQ12	10	*S. cynosuroides*	30%	65%	153	Y				
TRT4-09-OQ12	10	*E. walteri*	1%	2%	143	Y				
TRT4-09-OQ12	10	*P. punctatum*	15%	33%	97	Y				
TRT4-09- Mean Spartina dominated Quadrats (b)			47%		143		919	8202	15	162
TRT4-09- Mean Non-Spartina dominated Quadrats (b)			53%		--		0	0	0	0
TRT4-09- Mean All Quadrats			48%		--		919	8202	15	162
Site Mean Spartina dominated Quadrats (b)			40%		125		881	7863	55	158
Site Mean Non-Spartina dominated Quadrats (b)			43%		--		691	6167	26	25
Site Mean All Quadrats			41%		--		824	7354	46	118

Table D-6
CEDAR SWAMP PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Cedar Swamp-09- Transect 1 8/15/09										
CST1-09-OQ1	95	*S. alterniflora*	85%	100%	120	N				
CST1-09-OQ2	78	*S. alterniflora*	55%	100%	117	N				
CST1-09-CQ1	75	*S. alterniflora*	55%	92%	107	N	441	3939	0	162
CST1-09-CQ1	75	Dead *S. alterniflora*	5%	8%	66	N	0	0	84	0
CST1-09-OQ3	72	*S. alterniflora*	65%	100%	115	N				
CST1-09-OQ4	68	*S. alterniflora*	65%	100%	115	N				
CST1-09-CQ2	67	*S. alterniflora*	45%	100%	117	N	1021	9111	0	66
CST1-09-OQ5	59	*S. alterniflora*	35%	70%	120	N				
CST1-09-OQ5	59	*S. cynosuroides*	15%	30%	113	Y				
CST1-09-OQ6	57	*S. alterniflora*	75%	100%	127	N				
CST1-09-OQ7	47	*S. alterniflora*	45%	100%	130	N				
CST1-09-OQ8	46	*S. alterniflora*	35%	97%	123	N				
CST1-09-OQ8	46	Dead *S. alterniflora*	1%	3%	62	N				
CST1-09-OQ9	38	*S. alterniflora*	45%	100%	114	Y				
CST1-09-OQ10	32	*S. alterniflora*	45%	100%	115	N				
CST1-09-OQ11	29	*S. alterniflora*	1%	3%	114	N				
CST1-09-OQ11	29	*S. cynosuroides*	35%	97%	153	Y				
CST1-09-CQ3	24	*S. cynosuroides*	45%	88%	167	Y	1350	12045	0	191
CST1-09-CQ3	24	Dead *S. cynosuroides*	5%	10%	95	N	0	0	326	0
CST1-09-CQ3	24	Dead *S. robustus*	1%	2%	55	N	0	0	50	0
CST1-09-OQ12	11	*S. cynosuroides*	55%	98%	150	Y				
CST1-09-OQ12	11	Dead *S. cynosuroides*	1%	2%	134	N				
CST1-09-CQ4	2	*S. cynosuroides*	45%	98%	142	N	907	8091	0	223
CST1-09-CQ4	2	Dead *S. cynosuroides*	1%	2%	98	N	0	0	199	0
CST1-09- Mean Spartina dominated Quadrats (b)			54%		126		930	8296	165	160
CST1-09- Mean Non-Spartina dominated Quadrats (b)			0%		--		0	0	0	0
CST1-09- Mean All Quadrats			54%		--		930	8296	165	160

Table D-6
CEDAR SWAMP PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Cedar Swamp-09- Transect 2 8/13/09										
CST2-09-OQ1	118	*S. alterniflora*	90%	99%	91	N				
CST2-09-OQ1	118	*P. purpurascens*	1%	1%	13	N				
CST2-09-OQ2	113	*S. alterniflora*	45%	88%	99	N				
CST2-09-OQ2	113	*P. purpurascens*	5%	10%	37	Y				
CST2-09-OQ2	113	Dead *S. olneyi*	1%	2%	76	--				
CST2-09-OQ3	109	*S. alterniflora*	80%	93%	95	N				
CST2-09-OQ3	109	*P. purpurascens*	5%	6%	30	Y				
CST2-09-OQ3	109	Dead *S. olneyi*	1%	1%	70	--				
CST2-09-OQ4	88	*P. purpurascens*	1%	3%	38	Y				
CST2-09-OQ4	88	Dead *P. australis*	1%	3%	59	--				
CST2-09-OQ4	88	*S. cynosuroides*	35%	92%	119	N				
CST2-09-OQ4	88	*S. olneyi*	1%	3%	97	Y				
CST2-09-OQ5	75	*S. cynosuroides*	70%	86%	139	Y				
CST2-09-OQ5	75	*S. olneyi*	1%	1%	95	Y				
CST2-09-OQ5	75	Dead *S. cynosuroides*	10%	12%	104	--				
CST2-09-OQ6	69	*S. cynosuroides*	5%	83%	148	Y				
CST2-09-OQ6	69	Dead *S. cynosuroides*	1%	17%	70	--				
CST2-09-CQ1	67	*S. cynosuroides*	70%	99%	162	Y	1105	9859	0	0
CST2-09-CQ1	67	Dead *S. cynosuroides*	1%	1%	97	--	0	0	98	0
CST2-09-CQ2	59	*S. cynosuroides*	15%	94%	136	Y	329	2938	0	250
CST2-09-CQ2	59	Dead *S. cynosuroides*	1%	6%	83	--	0	0	140	0
CST2-09-OQ7	56	*S. cynosuroides*	65%	98%	144	Y				
CST2-09-OQ7	56	Dead *S. cynosuroides*	1%	2%	83	--				
CST2-09-OQ8	53	*S. cynosuroides*	75%	99%	132	Y				
CST2-09-OQ8	53	Dead *S. cynosuroides*	1%	1%	78	--				
CST2-09-CQ3	47	Mud Flat/Wrack				--				
CST2-09-OQ9	46	*S. cynosuroides*	25%	83%	113	N				
CST2-09-OQ9	46	Dead *S. cynosuroides*	5%	17%	129	--				
CST2-09-OQ10	41	*S. cynosuroides*	35%	85%	127	N				
CST2-09-OQ10	41	*S. olneyi*	1%	2%	112	Y				
CST2-09-OQ10	41	Dead *S. cynosuroides*	5%	12%	83	--				
CST2-09-OQ11	35	*S. alterniflora*	85%	100%	122	N				
CST2-09-OQ12	31	*P. purpurascens*	5%	20%	40	Y				
CST2-09-OQ12	31	Dead *P. australis*	5%	20%	161	--				
CST2-09-OQ12	31	*S. cynosuroides*	15%	60%	125	N				
CST2-09-OQ13	27	*P. purpurascens*	15%	30%	48	Y				
CST2-09-OQ13	27	Dead *P. australis*	5%	10%	99	--				
CST2-09-OQ13	27	*S. cynosuroides*	1%	2%	81	N				
CST2-09-OQ13	27	*P. australis*	5%	10%	81	N				
CST2-09-CQ4	26	*S. cynosuroides*	1%	17%	77	Y	48	429	0	160
CST2-09-CQ4	26	Dead *P. australis*	5%	83%	115	--	0	0	152	0
CST2-09-OQ14	22	*P. purpurascens*	5%	13%	43	Y				
CST2-09-OQ14	22	Dead *P. australis*	10%	25%	145	--				
CST2-09-OQ14	22	*S. cynosuroides*	25%	63%	112	Y				
CST2-09-CQ5	21	*S. cynosuroides*	15%	50%	126	N	363	3239	0	69
CST2-09-CQ5	21	Dead *P. australis*	15%	50%	136	--	0	0	702	0
CST2-09-OQ15	18	Dead *P. australis*	15%	38%	15	--				
CST2-09-OQ15	18	*S. cynosuroides*	25%	63%	98	N				
CST2-09-OQ16	9	*S. alterniflora*	70%	78%	118	N				
CST2-09-OQ16	9	*P. purpurascens*	20%	22%	34	Y				
CST2-09-CQ6	4	*S. alterniflora*	95%	95%	91	Y	977	8714	0	0
CST2-09-CQ6	4	*I. frutescens*	5%	5%	43	N	9	80	0	0
CST2-09-OQ17	3	*S. alterniflora*	75%	83%	95	N				
CST2-09-OQ17	3	*I. frutescens*	15%	17%	35	N				
CST2-09-OQ18	1	*S. alterniflora*	5%	83%	112	N				
CST2-09-OQ18	1	Dead *P. australis*	1%	17%	77	--				
CST2-09- Mean Spartina dominated Quadrats (b)			60%		114		713	6360	83	53
CST2-09- Mean Non-Spartina dominated Quadrats (b)			21%		--		0	0	0	0
CST2-09- Mean All Quadrats			52%		--		566	5052	218	96

Table D-6
CEDAR SWAMP PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Cedar Swamp-09- Transect 3 8/18/09										
CST3-09-OQ1	355	*S. alterniflora*	45%	100%	109	N				
CST3-09-CQ1	345	*S. alterniflora*	65%	100%	120	N	1338	11942	0	0
CST3-09-OQ2	298	*S. alterniflora*	50%	100%	100	N				
CST3-09-OQ3	267	*S. alterniflora*	20%	95%	70	N				
CST3-09-OQ3	267	*P. purpurascens*	1%	5%	58	Y				
CST3-09-OQ4	258	*S. alterniflora*	35%	97%	65	N				
CST3-09-OQ4	258	*P. purpurascens*	1%	3%	36	Y				
CST3-09-CQ2	238	*S. alterniflora*	20%	80%	90	N	330	2942	0	0
CST3-09-CQ2	238	*S. cynosuroides*	5%	20%	200	Y	372	3315	0	0
CST3-09-OQ5	195	*S. alterniflora*	55%	92%	80	N				
CST3-09-OQ5	195	*P. purpurascens*	5%	8%	60	Y				
CST3-09-OQ6	170	*S. alterniflora*	30%	100%	100	N				
CST3-09-OQ7	159	*S. alterniflora*	5%	16%	100	N				
CST3-09-OQ7	159	*P. purpurascens*	1%	3%	50	Y				
CST3-09-OQ7	159	*S. cynosuroides*	25%	81%	160	Y				
CST3-09-OQ8	138	*S. alterniflora*	40%	98%	80	N				
CST3-09-OQ8	138	*P. purpurascens*	1%	2%	46	Y				
CST3-09-OQ9	120	*S. alterniflora*	20%	80%	80	N				
CST3-09-OQ9	120	*P. purpurascens*	5%	20%	38	Y				
CST3-09-OQ10	117	*P. purpurascens*	5%	17%	40	Y				
CST3-09-OQ10	117	*S. cynosuroides*	25%	83%	190	N				
CST3-09-CQ3	113	*S. cynosuroides*	20%	57%	166	Y	591	5271	0	0
CST3-09-CQ3	113	Dead *S. cynosuroides*	10%	29%	135	N	0	0	370	0
CST3-09-CQ3	113	*P. purpurascens*	5%	14%	46	Y	10	90	0	0
CST3-09-OQ11	110	*S. alterniflora*	35%	100%	82	N				
CST3-09-CQ4	99	*S. alterniflora*	1%	2%	70	N	137	1225	0	0
CST3-09-CQ4	99	*S. patens*	30%	60%	60	Y	293	2616	0	0
CST3-09-CQ4	99	Dead *S. patens*	10%	20%		--	0	0	127	0
CST3-09-CQ4	99	*P. purpurascens*	1%	2%	79	N	3	24	0	0
CST3-09-OQ12	95	*S. alterniflora*	5%	14%	70	N				
CST3-09-OQ12	95	Dead *S. patens*	10%	29%		N				
CST3-09-OQ12	95	*S. patens*	20%	57%	60	Y				
CST3-09-CQ5	95	*S. alterniflora*	5%	14%	20	Y	202	1805	0	0
CST3-09-CQ5	95	*S. patens*	20%	57%	60	Y	289	2582	0	0
CST3-09-CQ5	95	Dead *S. patens*	10%	29%		--	0	0	79	0
CST3-09-OQ13	74	*S. alterniflora*	25%	100%	70	N				
CST3-09-CQ6	70	*S. cynosuroides*	20%	80%	140	N	587	5237	0	0
CST3-09-CQ6	70	Dead *S. cynosuroides*	5%	20%	110	N	0	0	164	0
CST3-09-OQ14	61	*S. cynosuroides*	35%	100%	125	N				
CST3-09-OQ15	48	*P. purpurascens*	1%	5%	50	Y				
CST3-09-OQ15	48	*S. cynosuroides*	20%	91%	150	N				
CST3-09-OQ15	48	Dead *P. australis*	1%	5%	200	N				
CST3-09-OQ16	20	*S. cynosuroides*	20%	100%	240	Y				
CST3-09-OQ17	16	*S. cynosuroides*	45%	100%	240	Y				
CST3-09-OQ18	3	*S. cynosuroides*	20%	100%	280	Y				
CST3-09- Mean Spartina dominated Quadrats (b)			34%		132		807	7199	134	0
CST3-09- Mean Non-Spartina dominated Quadrats (b)			37%		--		462	4126	103	0
CST3-09- Mean All Quadrats			35%		--		692	6175	124	0

Table D-6
CEDAR SWAMP PHRAGMITES DOMINATED WETLAND RESTORATION SITE
PEAK SEASON 2009 TRANSECT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Distance From Start	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing gdw/m^2	Litter gdw/m^2
			Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Cedar Swamp-09- Transect 4 8/15/09										
CST4-09-OQ1	2	*S. alterniflora*	20%	67%	90	N				
CST4-09-OQ1	2	*P. purpurascens*	10%	33%	35	Y				
CST4-09-OQ2	7	*S. alterniflora*	20%	80%	103	N				
CST4-09-OQ2	7	*P. purpurascens*	5%	20%	15	N				
CST4-09-OQ3	26	*S. alterniflora*	30%	83%	123	Y				
CST4-09-OQ3	26	*P. purpurascens*	5%	14%	52	Y				
CST4-09-OQ3	26	*S. cynosuroides*	1%	3%	115	N				
CST4-09-CQ1	38	*S. alterniflora*	30%	86%	156	N	1017	9078	0	22
CST4-09-CQ1	38	*P. purpurascens*	5%	14%	52	Y	5	44	0	0
CST4-09-OQ4	44	*P. purpurascens*	10%	20%	33	Y				
CST4-09-OQ4	44	*S. cynosuroides*	40%	80%	185	Y				
CST4-09-CQ2	50	*S. cynosuroides*	10%	29%	87	N	49	436	0	0
CST4-09-CQ2	50	Dead *S. cynosuroides*	5%	14%	79	N	0	0	29	0
CST4-09-CQ2	50	*P. purpurascens*	20%	57%	43	Y	71	630	0	197
CST4-09-CQ3	56	*S. cynosuroides*	10%	22%	158	Y	245	2189	0	57
CST4-09-CQ3	56	Dead *S. cynosuroides*	5%	11%	77		0	0	94	0
CST4-09-CQ3	56	*P. purpurascens*	30%	67%	53	Y	105	938	0	0
CST4-09-OQ5	57	*P. purpurascens*	20%	67%	47	Y				
CST4-09-OQ5	57	*S. cynosuroides*	5%	17%	117	N				
CST4-09-OQ5	57	Dead *S. cynosuroides*	5%	17%	82	N				
CST4-09-OQ6	96	*S. alterniflora*	20%	57%	102	N				
CST4-09-OQ6	96	*P. purpurascens*	15%	43%	50	Y				
CST4-09-OQ7	103	*S. alterniflora*	40%	100%	93	N				
CST4-09-OQ8	146	*S. alterniflora*	35%	88%	101	N				
CST4-09-OQ8	146	*P. purpurascens*	5%	13%	19	Y				
CST4-09-OQ9	157	*S. alterniflora*	40%	100%	73	N				
CST4-09-OQ10	170	*S. alterniflora*	50%	100%	88	N				
CST4-09-OQ11	175	*S. alterniflora*	50%	100%	95	N				
CST4-09-OQ12	183	*S. alterniflora*	40%	100%	83	N				
CST4-09-CQ4	199	*S. alterniflora*	20%	80%	165	N	192	1715	0	15
CST4-09-CQ4	199	*E. walteri*	5%	20%	93	Y	49	439	0	0
CST4-09- Mean Spartina dominated Quadrats (b)			38%		112		632	5638	0	18
CST4-09- Mean Non-Spartina dominated Quadrats (b)			37%		--		235	2096	61	127
CST4-09- Mean All Quadrats			38%		--		433	3867	31	73
Site Mean Spartina dominated Quadrats (b)			47%		122		796	7103	111	64
Site Mean Non-Spartina dominated Quadrats (b)			30%		--		348	3104	195	95
Site Mean All Quadrats			44%		--		655	5840	138	74

(a) Quadrat numbers ending in "OQ##" indicate ocular quadrats, those ending in "CQ##" indicate clip quadrats.
(b) Spartina dominated quadrats include those dominated by S. alterniflora and/or S. cynosuroides.

Appendix E
Macrophyte Quadrat Data - Plots

Table E-1
MAD HORSE CREEK REFERENCE MARSH
PEAK SEASON 2009 60 X 60 M PLOT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing	Litter
		Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m2
Mad Horse Creek - Plot 1 8/14/09									
MHP1-VP1	*S. alterniflora*	20%	80%	112	Y	612	5464	0	0
	P. australis	5%	20%	123	N	103	920	0	0
MHP1-VP2	*S. alterniflora*	20%	90%	62	N	979	8734	0	0
	S. robustus	5%	10%	78	N	33	291	0	0
MHP1-VP3	*S. alterniflora*	15%	43%	94	N	613	5469	0	0
	P. australis	20%	57%	198	N	665	5929	0	0
MHP1-VP4	*S. alterniflora*	20%	67%	98	N	689	6148	0	0
	S. patens	10%	33%	70	N	280	2499	0	0
MHP1-VP5	*S. alterniflora*	20%	100%	83	N	155	1379	0	0
MHP1-VP6	*S. alterniflora*	20%	100%	112	N	823	7341	0	0
MHP1-VP7	*S. alterniflora*	35%	100%	111	N	1043	9305	0	0
MHP1-VP8	*S. alterniflora*	45%	100%	147	N	734	6553	0	0
MHP1-VP9	*S. alterniflora*	30%	100%	196	N	793	7072	0	0
Mean for Plot		29%		115		836	7456	0	0
Mad Horse Creek - Plot 2 8/20/09									
MHP2-VP1	*S. alterniflora*	5%	13%	130	N	143	1277	0	0
	S. robustus	35%	88%	150	Y	486	4332	0	0
MHP2-VP2	*S. alterniflora*	35%	100%	135	N	522	4659	0	0
MHP2-VP3	*S. alterniflora*	45%	100%	168	Y	1380	12316	0	0
MHP2-VP4	*S. alterniflora*	35%	100%	150	Y	1414	12619	0	0
MHP2-VP5	*S. alterniflora*	50%	100%	120	Y	916	8169	0	0
MHP2-VP6	*S. alterniflora*	55%	100%	120	Y	794	7088	0	0
MHP2-VP7	*S. alterniflora*	55%	100%	150	N	668	5958	0	0
MHP2-VP8	*S. alterniflora*	55%	100%	106	N	878	7836	0	0
MHP2-VP9	*S. alterniflora*	55%	100%	106	N	596	5322	0	0
Mean for Plot		47%		132		866	7731	0	0
Mad Horse Creek - Plot 3 8/14/09									
MHP3-VP1	*S. patens*	10%	33%	72	N	181	1616	0	0
	S. alterniflora	20%	67%	96	N	276	2461	0	0
MHP3-VP2	*S. alterniflora*	20%	100%	94	N	238	2119	0	0
MHP3-VP3	*S. alterniflora*	20%	100%	88	N	667	5947	0	0
MHP3-VP4	*S. alterniflora*	10%	33%	86	N	218	1949	0	121
	S. patens	20%	67%	69	N	321	2863	0	0
MHP3-VP5	*S. alterniflora*	20%	100%	118	N	773	6896	0	0
MHP3-VP6	*S. alterniflora*	25%	100%	127	N	648	5785	0	0
MHP3-VP7	*S. cynosuroides*	20%	80%	193	N	701	6257	0	0
	Dead S. cynosuroides	5%	20%	160	N	0	0	119	0
MHP3-VP8	*S. patens*	10%	33%	72	N	42	378	0	0
	S. alterniflora	20%	67%	150	N	869	7754	0	0
MHP3-VP9	*S. alterniflora*	20%	100%	109	N	575	5131	0	0
Mean for Plot		24%		122		612	5462	15	13
Mean for Site		34%		123		771	6883	5	4

Table E-2
MOORES BEACH REFERENCE MARSH
PEAK SEASON 2009 60 X 60 M PLOT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing	Litter
		Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Moores Beach - Plot 1 8/15/09									
MBP1-VP1	Wrack					0	0	0	0
MBP1-VP2	*S. alterniflora*	30%	86%	120	N	496	4421	0	0
	Dead S. alterniflora	5%	14%	57	N	0	0	63	0
MBP1-VP3	*S. alterniflora*	20%	100%	100	N	252	2245	0	171
MBP1-VP4	*S. alterniflora*	50%	100%	110	N	874	7802	0	0
MBP1-VP5	*S. alterniflora*	15%	100%	108	N	515	4592	0	113
MBP1-VP6	*S. alterniflora*	45%	100%	108	N	928	8275	0	0
MBP1-VP7	*S. alterniflora*	40%	100%	100	N	904	8066	0	0
MBP1-VP8	*S. alterniflora*	35%	88%	97	N	649	5789	0	0
	Dead S. alterniflora	5%	13%	48	N	0	0	72	0
MBP1-VP9	*S. alterniflora*	35%	100%	143	N	917	8184	0	0
Mean for Plot		35%		111		692	6172	15	35
Moores Beach - Plot 2 8/15/09									
MBP2-VP1	*S. alterniflora*	15%	94%	100	N	556	4959	0	0
	Dead S. alterniflora	1%	6%	40		0	0	23	0
MBP2-VP2	*S. alterniflora*	15%	100%	130	N	381	3403	0	51
MBP2-VP3	*S. alterniflora*	45%	100%	105	N	603	5383	0	0
MBP2-VP4	*S. alterniflora*	10%	67%	90	N	248	2212	0	92
	Dead S. alterniflora	5%	33%	35	N	0	0	53	0
MBP2-VP5	*S. alterniflora*	25%	96%	93	N	438	3908	0	43
	Dead S. alterniflora	1%	4%	45		0	0	49	0
MBP2-VP6	*S. alterniflora*	40%	89%	89	N	418	3728	0	47
	Dead S. alterniflora	5%	11%	53		0	0	46	0
MBP2-VP7	*S. alterniflora*	30%	97%	130	N	730	6510	0	17
	Dead S. alterniflora	1%	3%	53		0	0	21	0
MBP2-VP8	Mud Flat					0	0	0	0
MBP2-VP9	*S. alterniflora*	75%	100%	92	N	726	6476	0	44
Mean for Plot		34%		102		512	4572	24	37
Moores Beach - Plot 3 8/15/09									
MBP3-VP1	*S. alterniflora*	45%	100%	106	N	997	8895	0	10
MBP3-VP2	*S. alterniflora*	35%	100%	140	N	1212	10816	0	116
MBP3-VP3	*S. alterniflora*	45%	100%	145	N	1143	10194	0	187
MBP3-VP4	*S. alterniflora*	45%	100%	107	N	914	8154	0	46
MBP3-VP5	*S. alterniflora*	25%	36%	103	N	402	3585	0	0
	S. patens	45%	64%	67	N	496	4426	0	0
MBP3-VP6	*S. alterniflora*	55%	100%	88	N	700	6246	0	0
MBP3-VP7	*L. nashii*	15%	25%	55	N	80	717	0	0
	S. alterniflora	45%	75%	52	Y	439	3915	0	49
MBP3-VP8	*S. alterniflora*	35%	100%	105	N	890	7937	0	0
MBP3-VP9	*S. alterniflora*	35%	100%	95	N	547	4878	0	36
Mean for Plot		47%		105		869	7751	0	49
Mean for Site		39%		106		698	6229	13	41

Table E-3
COMMERCIAL TOWNSHIP SALT HAY FARM WETLAND RESTORATION SITE
PEAK SEASON 2009 60 X 60 M PLOT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing	Litter
		Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Commercial Township - Plot 1 8/16/09									
CTP1-VP1	Mud Flat					0	0	0	0
CTP1-VP2	Mud Flat					0	0	0	0
CTP1-VP3	Mud Flat					0	0	0	0
CTP1-VP4	*S. alterniflora*	30%	86%	113	N	522	4658	0	0
	Dead S. alterniflora	5%	14%	93	N	0	0	75	0
CTP1-VP5	*S. alterniflora*	45%	90%	143	N	1355	12094	0	0
	Dead S. alterniflora	5%	10%	108	N	0	0	121	0
CTP1-VP6	Mud Flat					0	0	0	0
CTP1-VP7	*S. alterniflora*	35%	70%	140	N	551	4913	0	0
	Dead S. alterniflora	15%	30%	96	N	0	0	136	0
CTP1-VP8	*Dead S. alterniflora*	55%	92%	140	Y	0	0	758	0
	S. alterniflora	5%	8%	87	N	14	125	0	0
CTP1-VP9	Mud Flat					0	0	0	0
Mean for Plot		49%		132		611	5447	273	0
Commercial Township - Plot 2 8/16/09									
CTP2-VP1	*S. alterniflora*	30%	100%	145	N	1018	9081	0	157
CTP2-VP2	*S. alterniflora*	45%	90%	139	N	972	8676	0	120
	Dead S. alterniflora	5%	10%	76	N	0	0	203	0
CTP2-VP3	*S. alterniflora*	35%	100%	160	N	1961	17492	0	127
CTP2-VP4	*S. alterniflora*	35%	100%	145	N	1229	10967	0	291
CTP2-VP5	*S. alterniflora*	20%	100%	128	N	630	5619	0	11
CTP2-VP6	*S. alterniflora*	45%	75%	158	N	1180	10528	0	89
	Dead S. alterniflora	15%	25%	112	N	0	0	77	0
CTP2-VP7	Mud Flat					0	0	0	0
CTP2-VP8	*S. alterniflora*	55%	100%	162	N	750	6693	0	661
CTP2-VP9	*S. alterniflora*	40%	100%	134	N	1124	10027	0	69
Mean for Plot		41%		146		1108	9885	35	191
Commercial Township - Plot 3 8/16/09									
CTP3-VP1	*S. alterniflora*	30%	100%	136	N	1124	10026	0	105
CTP3-VP2	*S. alterniflora*	20%	100%	152	N	1296	11559	0	0
CTP3-VP3	Mud Flat					0	0	0	0
CTP3-VP4	*S. alterniflora*	30%	100%	150	N	476	4251	0	120
CTP3-VP5	*S. alterniflora*	35%	97%	147	N	1167	10415	0	239
	Dead S. alterniflora	1%	3%	86	N	0	0	59	0
CTP3-VP6	*S. alterniflora*	55%	98%	150	N	1536	13706	0	278
	Dead S. alterniflora	1%	2%	85	N	0	0	34	0
CTP3-VP7	*S. alterniflora*	45%	100%	162	N	555	4954	0	54
CTP3-VP8	*S. alterniflora*	30%	100%	147	N	1463	13054	0	159
CTP3-VP9	Mud Flat					0	0	0	0
Mean for Plot		35%		149		1088	9709	12	136
Mean for Site		40%		145		996	8886	73	130

Table E-4
ALLOWAY CREEK WATERSHED WETLAND RESTORATION SITE
PEAK SEASON 2009 60 X 60 M PLOT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing	Litter
		Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Alloway Creek Watershed - Plot 1 8/11/09									
ACWP1-VP1	Mud Flat/Wrack					0	0	0	0
ACWP1-VP2	*S. alterniflora*	40%	98%	56	Y	690	6153	0	164
	P. punctatum	1%	2%	17	Y	13	116	0	0
ACWP1-VP3	Mud Flat/Wrack					0	0	0	0
ACWP1-VP4	*P. australis*	5%	100%	252	N	188	1678	0	141
ACWP1-VP5	*S. cynosuroides*	5%	45%	101	N	80	714	0	379
	P. australis	1%	9%	60	N	83	743	0	0
	Dead P. australis	5%	45%	35	N	0	0	55	0
ACWP1-VP6	*S. alterniflora*	60%	100%	43	N	157	1397	0	0
ACWP1-VP7	Mud Flat/Wrack					0	0	0	0
ACWP1-VP8	Mud Flat/Wrack					0	0	0	0
ACWP1-VP9	*S. alterniflora*	5%	12%	55	N	81	727	0	185
	P. australis	15%	37%	178	Y	437	3895	0	0
	P. virginica	15%	37%	111	N	364	3249	0	0
	E. walteri	1%	2%	45	Y	22	200	0	0
	S. cynosuroides	5%	12%	83	N	60	534	0	0
Mean for Plot		32%		50		435	3881	14	102
Alloway Creek Watershed - Plot 2 8/11/09									
ACWP2-VP1	*A. cannabinus*	10%	40%	130	Y	332	2965	0	0
	S. robustus	5%	20%	120	Y	49	437	0	0
	S. alterniflora	10%	40%	100	N	300	2679	0	0
ACWP2-VP2	*A. cannabinus*	20%	67%	170	Y	392	3494	0	0
	S. alterniflora	10%	33%	105	N	355	3171	0	66
ACWP2-VP3	*A. cannabinus*	15%	41%	180	Y	259	2310	0	0
	P. australis	20%	54%	200	Y	550	4907	0	0
	S. robustus	1%	3%	130	Y	28	248	0	0
	P. punctatum	1%	3%	100	Y	68	606	0	0
ACWP2-VP4	*A. cannabinus*	15%	33%	140	Y	172	1533	0	0
	P. australis	5%	11%	135	N	26	230	0	0
	S. alterniflora	20%	43%	120	Y	531	4740	0	0
	E. walteri	1%	2%	110	Y	4	36	0	0
	P. punctatum	5%	11%	60	Y	3	25	0	0
ACWP2-VP5	*A. cannabinus*	15%	38%	160	Y	372	3315	0	0
	S. alterniflora	20%	50%	110	N	578	5153	0	0
	P. punctatum	5%	13%	65	Y	2	17	0	0
ACWP2-VP6	*A. cannabinus*	15%	43%	130	Y	2	22	0	0
	S. alterniflora	20%	57%	90	N	336	2996	0	0
ACWP2-VP7	*A. cannabinus*	10%	50%	102	Y	85	759	0	0
	S. robustus	5%	25%	100	N	20	182	0	0
	S. alterniflora	5%	25%	86	N	198	1769	0	0
ACWP2-VP8	*S. alterniflora*	20%	80%	110	Y	610	5440	0	0
	A. cannabinus	5%	20%	108	Y	43	388	0	0
ACWP2-VP9	*S. alterniflora*	15%	100%	146	Y	906	8087	0	0
Mean for Plot		30%		108		691	6168	0	22
Alloway Creek Watershed - Plot 3 8/18/09									
ACWP3-VP1	*S. alterniflora*	50%	100%	130	Y	1148	10242	0	0
ACWP3-VP2	*S. alterniflora*	40%	100%	127	Y	808	7207	0	0
ACWP3-VP3	*S. alterniflora*	45%	100%	120	Y	453	4040	0	0
ACWP3-VP4	*S. alterniflora*	70%	100%	109	Y	1291	11516	0	0
ACWP3-VP5	*S. alterniflora*	20%	100%	129	Y	797	7112	0	0
ACWP3-VP6	*S. alterniflora*	30%	100%	178	Y	512	4570	0	0
ACWP3-VP7	*S. alterniflora*	85%	100%	141	Y	986	8801	0	0
ACWP3-VP8	*S. alterniflora*	30%	100%	121	Y	582	5192	0	0
ACWP3-VP9	*S. robustus*	15%	43%	137	N	51	451	0	0
	S. alterniflora	20%	57%	107	Y	566	5048	0	0
Mean for Plot		45%		129		799	7131	0	0
Mean for Site		36%		113		678	6048	3	25

Table E-5
THE ROCKS WETLAND RESTORATION SITE
PEAK SEASON 2009 60 X 60 M PLOT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing	Litter
		Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
The Rocks - Plot 1 8/20/09									
TRP1-VP1	*S. olneyi*	5%	6%	82	N	52	466	0	0
	S. patens	79%	94%	45	N	589	5256	0	0
TRP1-VP2	*S. alterniflora*	5%	17%	137	N	274	2443	0	94
	T. latifolia	25%	83%	194	Y	899	8017	0	0
TRP1-VP3	*S. alterniflora*	25%	100%	149	Y	716	6388	0	84
TRP1-VP4	*S. alterniflora*	5%	20%	94	N	120	1072	0	61
	T. latifolia	20%	80%	173	N	459	4096	0	0
TRP1-VP5	*S. alterniflora*	5%	33%	89	N	50	449	0	32
	T. latifolia	5%	33%	188	N	131	1168	0	0
	S. robustus	5%	33%	117	N	61	543	0	0
TRP1-VP6	*S. alterniflora*	20%	80%	134	Y	490	4369	0	36
	S. robustus	5%	20%	166	Y	76	677	0	0
TRP1-VP7	*S. olneyi*	5%	6%	90	N	24	217	0	0
	S. patens	75%	94%	45	N	784	6995	0	0
TRP1-VP8	*S. olneyi*	5%	6%	90	N	11	102	0	0
	S. patens	75%	94%	67	N	428	3818	0	0
TRP1-VP9	*S. patens*	40%	73%	41	N	332	2960	0	0
	P. punctatum	15%	27%	36	Y	62	550	0	0
Mean for Plot		47%		142		618	5510	0	34
Mean for Site		47%		142		618	5510	0	34

Table E-6
CEDAR SWAMP WETLAND RESTORATION SITE
PEAK SEASON 2009 60 X 60 M PLOT DATA
PSEG EEP DETRITAL PRODUCTION MONITORING PROGRAM

Quadrat No. (a)	Species Identification	% Cover		Height (cm)	Flowering (Y/N)	Biomass Live Standing		Dead Standing	Litter
		Aerial	Relative			gdw/m^2	lb/acre	gdw/m^2	gdw/m^2
Cedar Swamp - Plot 1 8/12/09									
CSP1-VP1	*S. alterniflora*	50%	100%	108	N	606	5408	0	46
CSP1-VP2	*S. cynosuroides*	30%	100%	183	N	1196	10670	0	0
CSP1-VP3	*S. alterniflora*	30%	100%	106	N	490	4374	0	35
CSP1-VP4	*S. alterniflora*	40%	100%	103	N	608	5420	0	40
CSP1-VP5	*S. cynosuroides*	35%	78%	137	N	737	6576	0	91
	Dead S. cynosuroides	10%	22%	87	N	0	0	512	0
CSP1-VP6	*S. alterniflora*	35%	100%	85	N	660	5889	0	210
CSP1-VP7	*S. alterniflora*	50%	100%	90	N	404	3602	0	63
CSP1-VP8	*S. alterniflora*	45%	100%	105	N	775	6917	0	140
CSP1-VP9	*S. alterniflora*	85%	100%	102	N	1247	11127	0	16
Mean for Plot		46%		113		747	6665	57	71
Mean for Site		46%		113		747	6665	57	71