# Responses of Nekton to Climate and Anthropogenic Related Changes in Long Island Sound Salt Marshes

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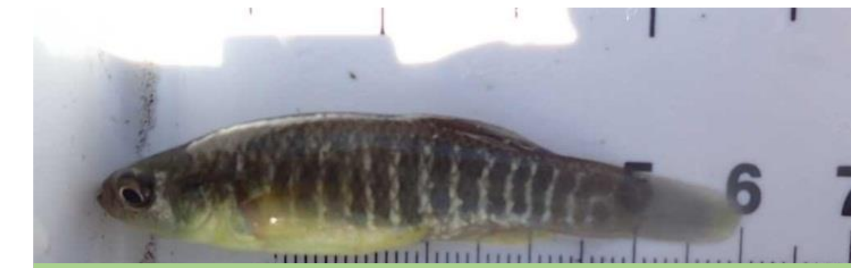


Figure 8. Picture of *Fundulus heteroclitus* taken while sampling.

## Introduction

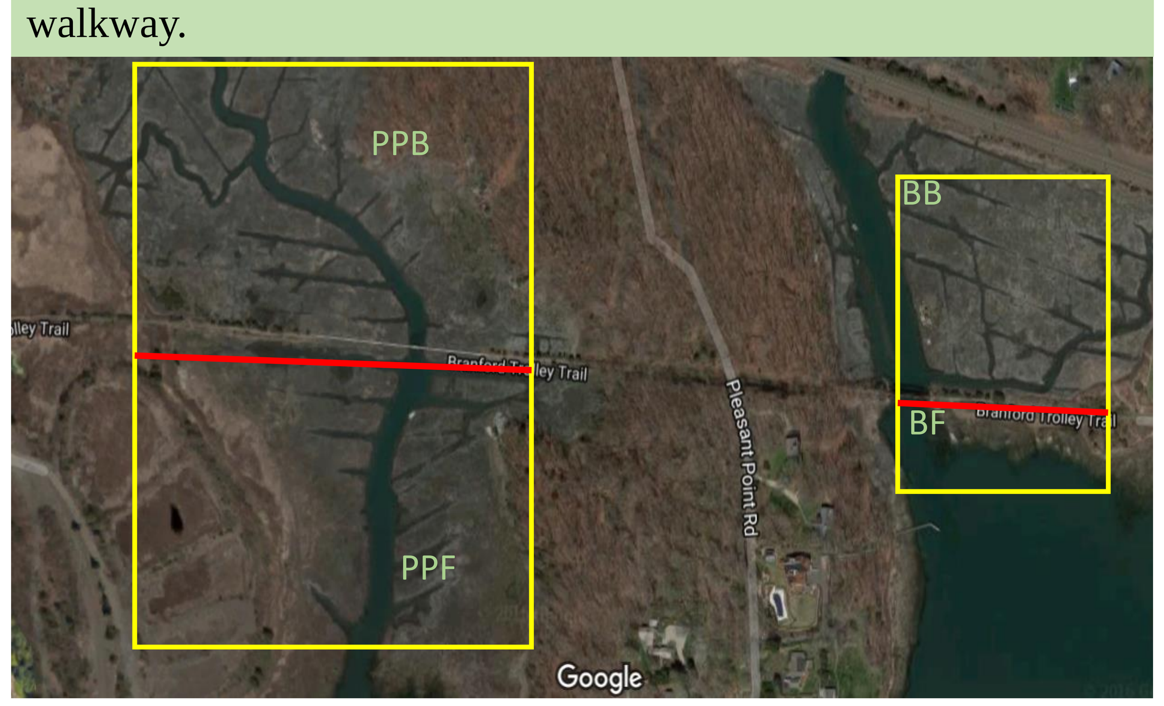
*Background*

Nekton (fish and mobile invertebrates) use salt marshes as breeding and feeding grounds. These critical habitats however are being impacted by sea level rise (Craft et al. 2009) and human development which may limit the ability for marshes to expand (Torio and Chmura 2013). Combined these impacts can lead to the drowning and loss of marsh habitats and alter the ways nekton use these critical habitats. This study focused on assessing how nekton utilize salt marsh habitats along the central Connecticut Coast of Long Island Sound (Figure 1). Knowing how nekton use salt marshes will provide a better understanding of how these ecosystems are being impacted by climate and anthropogenic changes, and help in future management efforts.

*Hypotheses*

- There are no differences in nekton use among and within different marsh habitats and locations.
- There are no differences in nekton use of the marshes over the summer study period.

**Figure 1.** Pleasant Point (PP) and Banca (B) salt marsh study sites in Branford CT. Both were divided into front (F) and back (B) portions (e.g. BF is Banca Front). Red line indicates raised walkway.




## Methods

All data were collected during high tide.

A 1m throw net was used to collect data in high marsh areas (Figure 2a). Fish were sized and counted; individuals < 2 cm were not identified; Invertebrates were only counted.

Video cameras were used to collect data in low marsh areas, creeks (Figure 2b); videos were analyzed by counting fish in the field of view for 5 minute segments; direction of movement was also recorded.

Statistical analyses were used to test the hypotheses.

**Figure 2a** (left) **2b** (right)**.** Sampling gear used to collect data.

**Table 1.** Fish species by location and habitat over the study period.

| Location | *F. heteroclitus* | *C. variegatus* | *M. menidia* | < 2 cm | Total Count |
|---|---|---|---|---|---|
| Pleasant Point Back | 85.71% | 3.57% | 0.00% | 10.71% | 28 |
| Pleasant Point Front | 80.43% | 13.04% | 2.17% | 4.35% | 46 |
| Banca Back | 87.37% | 0.00% | 6.32% | 6.32% | 95 |
| Banca Front | 33.33% | 0.00% | 0.00% | 66.67% | 24 |
| Habitat Type | | | | | |
| high marsh | 93.75% | 6.25% | 0.00% | 0.00% | 16 |
| transition veg. | 79.25% | 11.32% | 0.00% | 9.43% | 53 |
| transition bare | 23.53% | 0.00% | 0.00% | 76.47% | 17 |
| creek veg. | 85.05% | 0.00% | 6.54% | 8.41% | 107 |
| creek bare | 0.00% | 0.00% | 0.00% | 0.00% | 0 |

**Table 2.** Invertebrate species by location and habitat over the study period.

| Location | *Palaemonetes sp.* | *Carcinus maenas* | *Callinectes sapidus* | Amphipod | Total Count |
|---|---|---|---|---|---|
| Pleasant Point Back | 100.00% | 0.00% | 0.00% | 0.00% | 2 |
| Pleasant Point Front | 90.16% | 9.84% | 0.00% | 0.00% | 61 |
| Banca Back | 88.57% | 5.71% | 2.86% | 2.86% | 35 |
| Banca Front | 94.44% | 5.56% | 0.00% | 0.00% | 18 |
| Habitat Type | | | | | |
| high marsh | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| transition veg. | 90.91% | 9.09% | 0.00% | 0.00% | 55 |
| transition bare | 0.00% | 0.00% | 0.00% | 0.00% | 0 |
| creek veg. | 90.16% | 6.56% | 1.64% | 1.64% | 61 |
| creek bare | 0.00% | 0.00% | 0.00% | 0.00% | 0 |

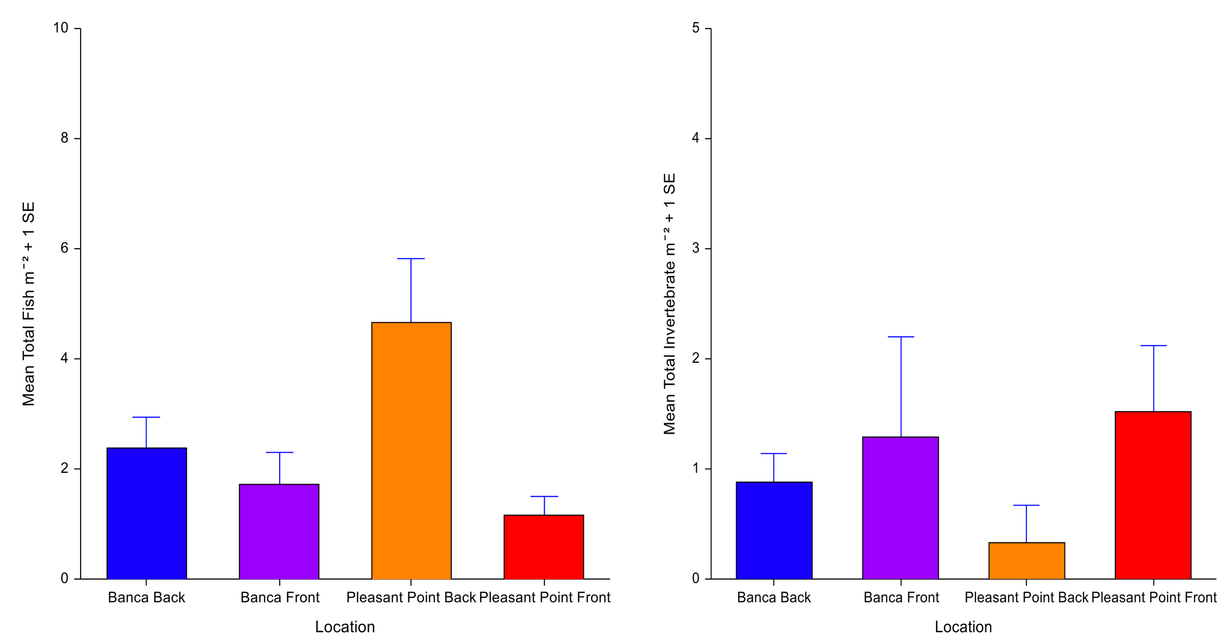


**Figure 3.** The mean total of fish (left) and invertebrates (right) sampled at each marsh section over the study.

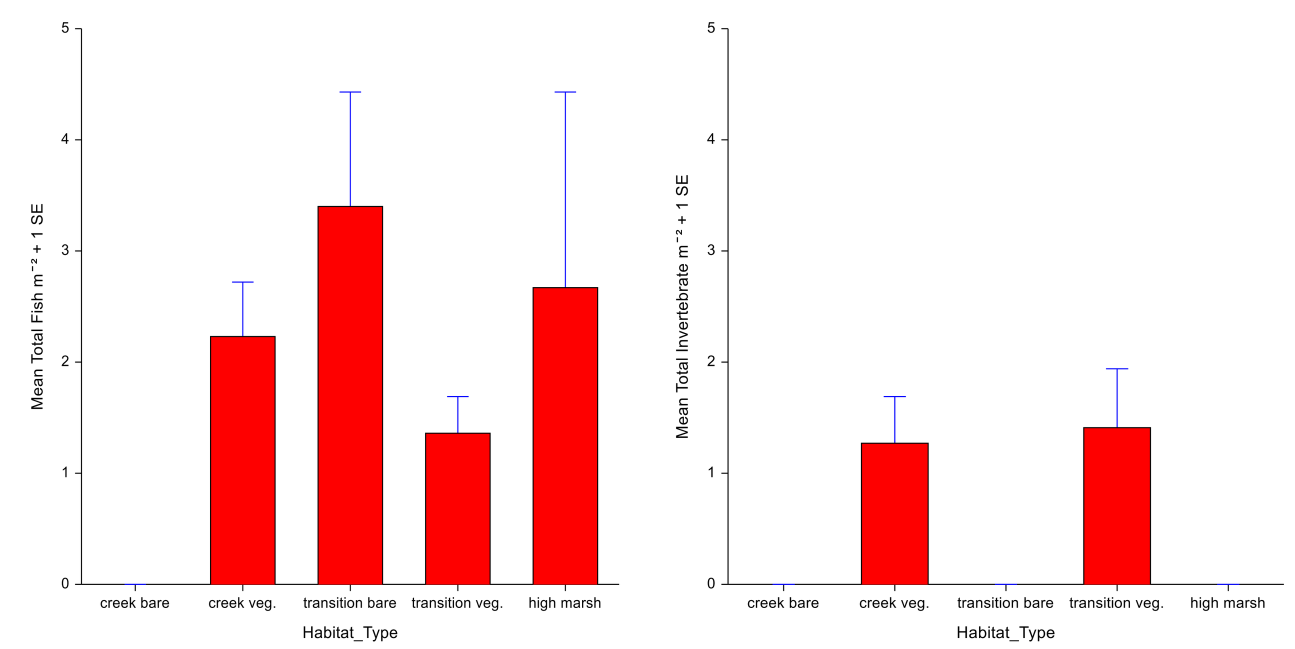


**Figure 4.** Mean total of fish (left) and invertebrates (right) found in each habitat time over the study.

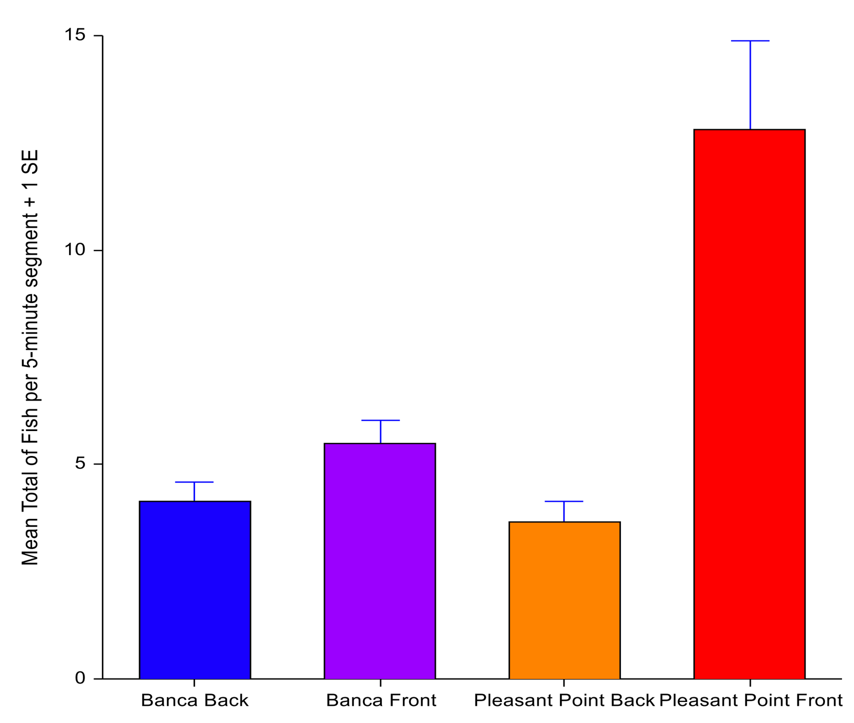


**Figure 5.** Mean total of fish seen in video over 5 minute segments at each marsh section.

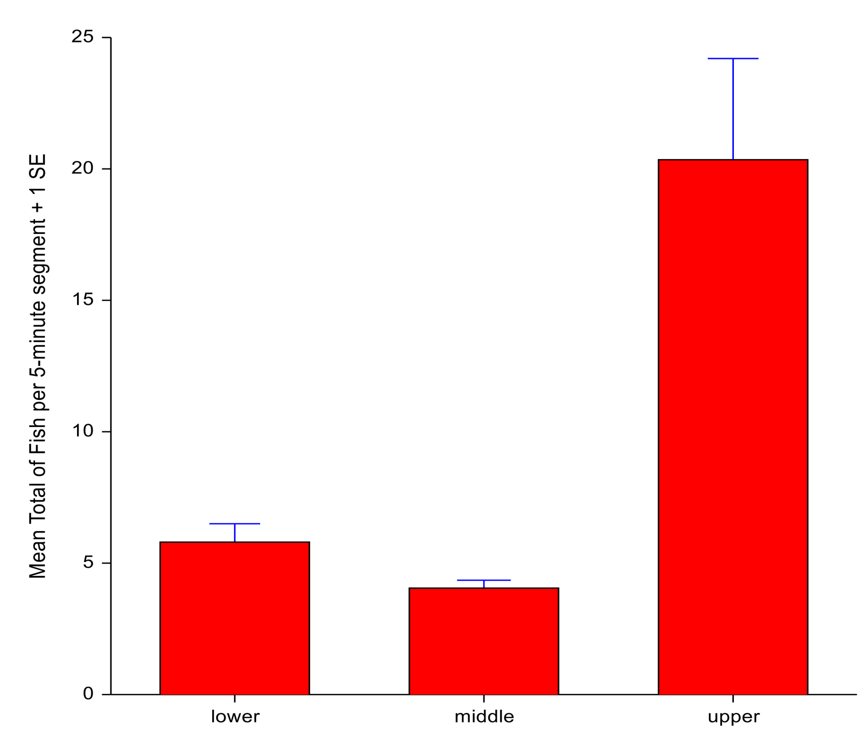


**Figure 6.** Mean total of fish seen in video over 5 minute segments at each creek location.

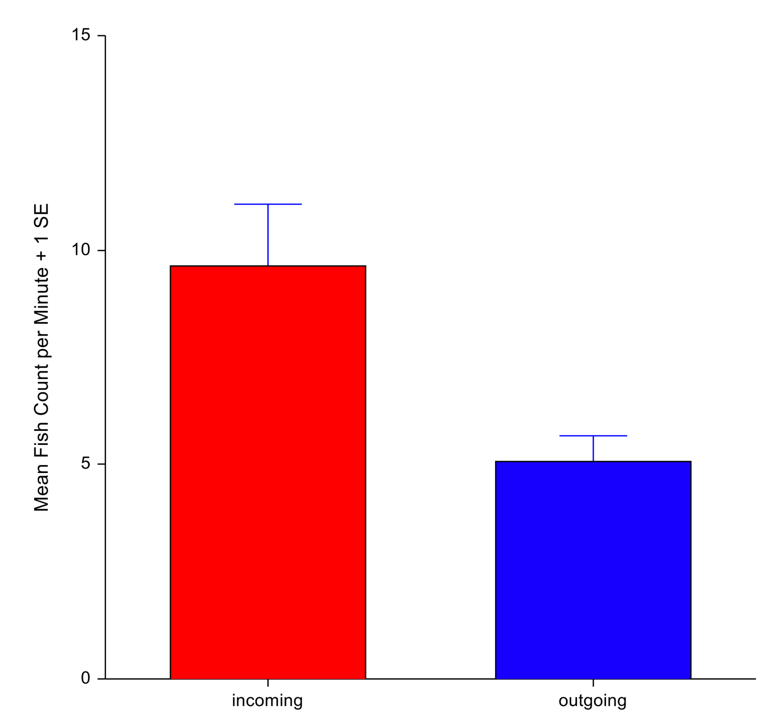


**Figure 7.** Mean total of fish seen in video per minute coming into the or going out of the marsh.

## Results and Conclusions

*Fundulus heteroclitus* (Figure 8) was the most abundant species found during the study, and could be the most resistance species to change due to its wide range of habitat (Table 1).

*F. majalis*, was found in both PPF and BF, but only in the videos. They weren't found at PPB and BB, but as lower marsh areas are lost they may move further into the marsh. *F. majalis* is known to compete with *F. heteroclitus* (Weisberg 1986), so if front marshes are lost this may increase competition.

*Cyprinodon variegatus* was found in pools in relatively high abundances at PPB, but during low tide. *C. variegatus* is an extremophile (Haney and Nordlie 1997), and may be the most resistant to change. Further testing is required on whether other marsh fish would be able to compete with *C. variegatus* in their niches

Few mobile invertebrates were sampled, other than *Palaemonetes sp.* (Table 2). This suggests low use of high marsh habitats by larger mobile invertebrates.

In general there were no statistically significant differences among any of the habitats across the marshes and over time (Figure 3, 4, 5), except for mean fish abundance which was highest at PPF. As such, the null hypotheses of no location or time differences are supported in most cases.

Fish were found to congregate in the upper portions of creeks and high marsh areas at high tide (Figure 6). Video data indicated that fish were moving both up (in) and down (out) the creeks during the high tides (Figure 7). This suggests a significant amount of movment during high tide, perhaps to find concentrations of food resources.

The nekton abundances found in this study are comparable to that found in other salt marshes along the United State's eastern seaboard.

**References**

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