Quantifying Anthropogenic Effects on Invertebrates and Vertebrates Biomass and Biodiversity in the Indian River Lagoon

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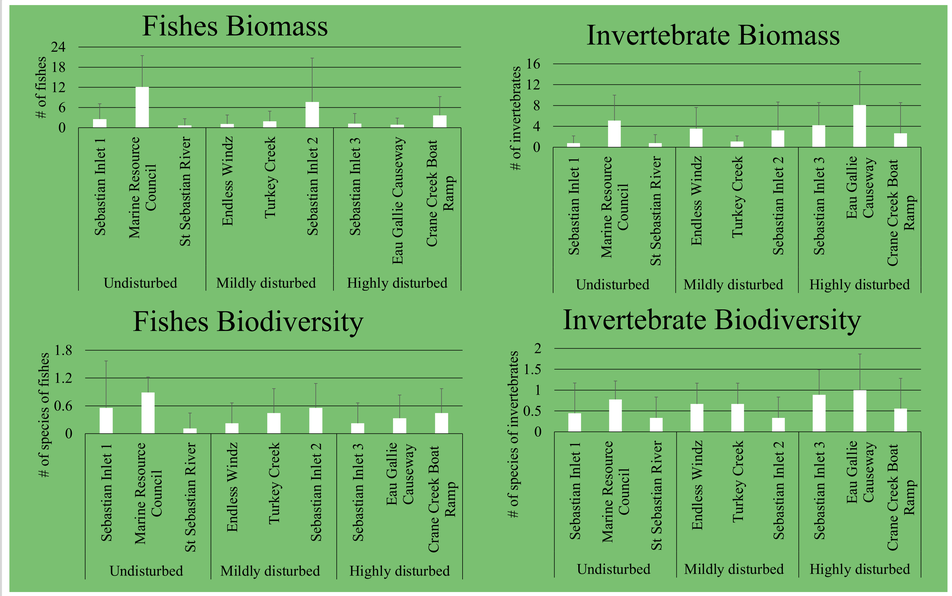
Introduction

The biomass and biodiversity of fishes in the Indian River Lagoon is threatened by anthropogenic disturbances, including non-point source pollution, habitat loss, fragmentation, hydrologic changes, overharvesting, and introduction of exotic species (Kennish 2002). Decreased water quality and increase in muck deposits in the central Indian River Lagoon was caused by such human disturbances (Sigua et al. 2000, Trefry et al. 2019).

The hypothesis of this study is highly and mildly disturbed areas in the Indian River Lagoon (identified by higher turbidity, greater muck depth, lower pH, higher nitrogen, and higher phosphates) will have lower biomass and biodiversity of invertebrates and vertebrates compared to undisturbed areas.

Methods and Materials

A seine net (5 m x 1.25 m, mesh size 0.6 cm x 0.6 cm) was used to sample 15-meter distances three times on each of three days at nine sites: three undisturbed sites (Sebastian Inlet 1, Marine Resource Council, and St Sebastian River), three mildly disturbed sites (Endless Windz, Turkey Creek, and Sebastian Inlet 2), and three highly disturbed sites (Sebastian Inlet 3, Eau Gallie Causeway, and Crane Creek Boat Ramp). Water turbidity was measured with a secchi disk to determine relative disturbance levels at each site. The phosphates, nitrate nitrogen and the pH were measured with LaMott water quality test kits.



Results

Water Quality

The water quality measured at the undisturbed sites was nitrate nitrogen (ppm) 0 ± 0, phosphate (ppm) 0.03 ± 0.058, pH 7 ± 0, muck depth (cm) 15 ± 6.245, and turbidity (cm) 90.83 ± 9.465. The water quality measured at the mildly disturbed sites was nitrate nitrogen (ppm) 0 ± 0, phosphate (ppm) 0.03 ± 0.058, pH 7.33 ± 0.578, muck depth (cm) 19.33 ± 10.693, and turbidity (cm) 104.17.83 ± 41.932. The water quality measured at the highly disturbed sites was nitrate nitrogen (ppm) 0 ± 0, phosphate (ppm) 0.03 ± 0.058, pH 7 ± 0, muck depth (cm) 15 ± 7.937, and turbidity (cm) 73.33 ± 22.684.

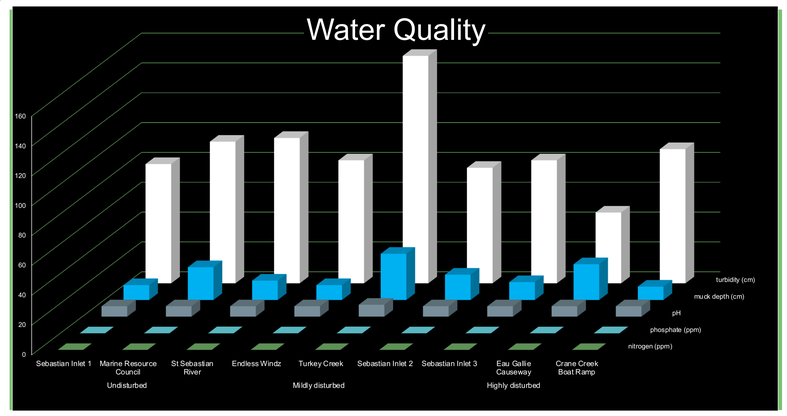
Biomass

Although the mean number of fishes were 5.1 for undisturbed sites, 3.6 for mildly disturbed sites, and 1.9 for highly disturbed sites, there were no significant difference between disturbance levels (1-way ANOVA, $F_{2,78}$=1.45, p=0.24). The mean number of invertebrates were 2.2 for undisturbed sites, 2.6 for mildly disturbed sites, and 5 for highly disturbed sites, but there were no significant difference between disturbance levels (1-way ANOVA, $F_{2,78}$=2.87, p=0.06).

Biodiversity

Although the mean number of fish species were 0.5 for undisturbed sites, 0.4 for mildly disturbed sites, and 0.3 for highly disturbed sites, there were no significant difference between disturbance levels (1-way ANOVA, $F_{2,78}$=0.72, p=0.49). The mean number of invertebrates were 0.5 for undisturbed sites, 0.6 for mildly disturbed sites, and 0.8 for highly disturbed sites, but there were no significant difference between disturbance levels (1-way ANOVA, $F_{2,78}$=1.86, p=0.16).

Fishes species collected were scaled sardine, *Harengula jaguana*, bay anchovy, *Anchoa mitchilli*, checkered puffer, *Sphoeroides testudineus*, spotfin mojarra, *Eucinostomus argenteus*, stripped mullet, *Mugil cephalus*, and juvenile snapper, *Lutjanus* sp. Invertebrate species collected were sea walnut comb jelly, *Mnemiopsis leidyi*, stocky cerith snail, *Cerith litteratum*, and ghost shrimp, *Palaemonetes paludosus*.



Discussion

The biomass and diversity of fishes was highest at undisturbed sites, medium at mildly disturbed sites, and lowest at highly disturbed sites. The opposite was observed for invertebrates in which the biomass and diversity was highest at highly disturbed sites, medium at mildly disturbed sites, and lowest at undisturbed sites. However, there were no significant differences in biomass or biodiversity between sites of different disturbance levels; this likely occurred because many of the seines had zero fishes and vertebrates. Invertebrate species may be more abundant in highly disturbed sites because predator fish biomass is reduced. Compared to historical data reported in Gilmore (1995), the diversity of species is lower a quarter century later. This study further supports the need to reduce human disturbances in the Indian River Lagoon to ensure the lagoon remains one of the most biodiverse estuaries in the Northern Hemisphere. The water quality at the highly and mildly disturbed sites was lower compared to the undisturbed sites.

Acknowledgements

Thank you, Savannah Luhn, for helping me seine :).

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