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### *Variance in Parasite Occurrence Between Three Native and One Non-Native Palaemon Species of Grass Shrimp*

The presence of parasites in four species of *Palaemon* grass shrimp were investigated from four collection sites along the New Jersey coast. One of the four species, *Palaemon macrodactylus*, is an invasive species originating from Japan. The goal of this study was to compare parasite load and composition as well as damage to the exoskeleton between the native species and the nonnative species. Water samples were collected and analyzed for the presence of ammonia, nitrates, orthophosphate, coliform bacteria, temperature, pH, conductivity, dissolved oxygen, and total dissolved solids to determine if there is a link between parasite load and water quality. Data analysis showed the invasive species had significantly less parasites and damage to the exoskeleton compared to the native conspecifics. This could lead to a competitive advantage and an increase in the invasive population numbers.

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# Variance in parasite occurrence between three native and one non-native *Palaemon* species of grass shrimp.

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## Abstract

The presence of parasites in four species of *Palaemon* grass shrimp were investigated from four collection sites along the New Jersey coast. One of the four species, *Palaemon macrodactylus*, is an invasive species originating from Japan. The goal of this study was to compare parasite load as well as damage to the exoskeleton between the native species and the nonnative species. Water samples were collected and analyzed for the presence of ammonia, nitrates, orthophosphate, coliform bacteria, temperature, pH, conductivity, dissolved oxygen, and total dissolved solids to determine if there is a link between parasite load and water quality. Data analysis showed the invasive species had significantly less parasites and damage to the exoskeleton compared to the native conspecifics. This could lead to a competitive advantage and an increase in the invasive population numbers.

## Introduction

Invasive species, when introduced into non-native habitats have the capability to destruct ecosystems and offset the normal harmonious balance. An example of a well-documented invasive species that traveled to the United States and many regions of Europe by ballast water, is *Palaemon macrodactylus*, an aquatic shrimp species typically found in the estuaries of Southeast Asia (Warkentine and Rachlin, 2010). To attest to the advantages possessed by this invasive shrimp species, the following study was conducted in which *Palaemon macrodactylus* was compared to three other grass shrimp species native to the United States, *Palaemon intermedius*, *Palaemonetes vulgaris*, and *Palaemonetes pugio*. The study examined parasite occurrence and exoskeleton trauma found in a sampled quantity of shrimp at four New Jersey shore locations in Red Bank, Parlin, Tuckerton, and Sandy Hook. The damage inflicted on the exoskeleton as well as the location of the trauma was noted per individual shrimp sampled. The trauma count per species acted as a comparison point when viewing the factors that could potentially attribute to the invasive's success. To account for parasite occurrence differing by location, parameters were taken into consideration, in which each of the four sites sampled at were evaluated for quantitative levels of pH, temperature, conductivity, nitrate, ammonia, orthophosphate, total dissolved solids, dissolved oxygen, and the qualitative presence of coliform bacteria. The data collected is useful in not only understanding the conditions in which the various shrimp species are capable of functioning within but also provides insight into the factors that are ideal for the growth of *Microphallus turgidus* parasites.

## Methods

### Field Collection and Water Analysis

- Shrimp were collected monthly at four locations along the New Jersey coast. Collections were done at Sandy Hook via a seine net, and Red Bank, Parlin, and Tuckerton using a dip net at low tide. The first one hundred shrimp of a species were measured in length while the remaining specimens attributed to a total count overall. All shrimp collected were noted for the presence of parasites and exoskeleton trauma, all of which were brought back to the lab for further examination.
- In the field, a portable multiparameter meter and digital pH meter were utilized in collecting data on conductivity, dissolved oxygen, pH, and temperature. Coliform bacteria test vials were utilized in sampling the water in the field as well.

### Water Sample Collection and Laboratory Analysis

- Water samples were gathered and analyzed within a 48-hour hold period back at the lab.
- Using the DR 900, ammonia, nitrate, and orthophosphate values were measured in the lab. Total dissolved solids were determined as well through filtration and heating in an analog gravity convection oven.
- The shrimp specimens brought back to the lab containing parasites or exoskeleton trauma were examined under a dissecting microscope. Each shrimp was labeled with the location, species, and specimen number. The trauma marks and parasite location were logged.

## Methods

### Laboratory Setup

- In the lab, the shrimp were held in 24 in. x 12 in. x 10 in. aquaria. Each tank was filled with gravel, a filter, and an aerator pump, all of which were cleaned weekly.
- Salinity was kept at a range equivalent to the collection site in which the shrimp were sampled. Instant Ocean Sea Salt was utilized to make the appropriate concentration of sea water. The shrimp were fed fish flakes every 2-3 days.

## Results

The relationships between species, parasitic infection and collection site were explored using Exact Chi-square tests of association. All hypothesis tests were conducted at the 0.05 significance level. The bivariate associations between parasitic infection and species (Exact Chi-Square test,  $\chi^2(3) = 15.356$ ,  $p = 0.003$ ); between parasitic infection and collection site ( $\chi^2(9) = 26.011$ ,  $p < 0.001$ ,  $\alpha = 0.05$ ) and between collection site and species ( $\chi^2(9) = 1485.039$ ,  $p < 0.001$ ) were statistically significant. After stratifying by collection site, the conditional association between parasitic infection and species at each location was explored. At collection site 4, no inference was drawn because there were no specimens found with parasitic infection. However, the association between parasitic infection and species at site 1 ( $p = 0.125$ ), site 2 ( $p = 1.0$ ) and site 3 ( $p = 0.634$ ) were not statistically significant. This suggests that the bivariate association found between species and parasitic activity may be the result of the associations between collection site and species and, the association between collection site and parasitic infection.

Table 1. Species vs. Parasitic Infection

Species	No. shrimp with parasitic infection (%)
Species 1 (n = 95)	0 (0.0%)
Species 2 (n = 693)	19 (2.7%)
Species 3 (n = 2289)	23 (1%)
Species 4 (n = 782)	7 (0.9%)

Note: Six pairwise post-hoc comparisons between species were conducted using a Bonferroni adjusted  $\alpha$ -level = 0.0083. The difference in the proportion of specimens with parasitic infection between species 2 and 3 ( $p = 0.001$ ) was statistically significant.

Table 2. Water Quality Data

All water quality parameters measured at each of the four sites that the shrimp species were sampled at. Mean  $\pm$  standard deviation is provided for those able to be calculated

Parameters	Location			
	Red Bank	Parlin	Sandy Hook	Tuckerton
Temperature (°C)	28.6	26.3	28.4	23.8
Conductivity (mS / cm)	30.3	35.28	35.93	44.56
Total Dissolved Solids (mg / L)	17.87 $\pm$ 0.35	23.43 $\pm$ 0.25	24.46 $\pm$ 0.41	31.33 $\pm$ 0.45
pH	7.07	7.07	8	7.52
Dissolved Oxygen (mg / L)	2.42	5.46	8.6	5.7
Nitrate (mg / L)	0.191 $\pm$ 0.324	0.794 $\pm$ 0.087	0.037 $\pm$ 0.064	0.039 $\pm$ 0.035
Ammonia (mg / L)	0.29 $\pm$ 0.012	0.13 $\pm$ 0.021	0.045 $\pm$ 0.014	0.053 $\pm$ 0.046
Orthophosphate (mg / L)	0.84 $\pm$ 0.066	0.49 $\pm$ 0.025	0.36 $\pm$ 0.01	0.23 $\pm$ 0.02
Total Coliform Bacteria (+ / -)	+	+	+	+

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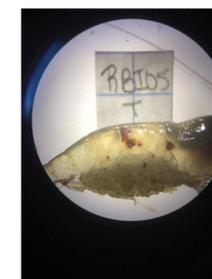
Table 2. – Spearman's Rank

Correlation coefficients are provided for the combined water quality data, the presence of parasites, and the *Palaemon macrodactylus* species.

	Macros	T	Cond	TDS	DO	pH	Nitrate	Ammonia	Phosphate
Parasites	0.97	-0.70	0.63	0.54	-0.36	-0.12	-0.68	-0.02	-0.25
Macros		-0.86	0.75	0.67	-0.27	-0.15	-0.53	-0.16	-0.39
T			-0.90	-0.86	-0.07	0.06	0.10	0.49	0.68
Cond				0.99	0.42	0.39	-0.46	-0.77	-0.90
TDS					0.52	0.46	-0.41	-0.84	-0.94
DO						0.87	-0.07	-0.90	-0.77
pH							-0.52	-0.76	-0.65
Nitrate								0.21	0.30
Ammonia									0.97

## Discussion

The results concluded from this preliminary study when taking into consideration the information gathered during the water analysis of the sites sampled at, parasitic infection did not seem to correlate to the water quality parameters investigated. The parameters that were taken into consideration were relatively consistent amongst the sites, with conductivity and total dissolved solids being the more prominent outlier. But even still, the data did not correlate to the water quality information collected. Review and sampling of other parameters like metals may be taken into consideration going forth. In terms of the invasive species, no significant difference was found amongst the proportion of parasites within *Palaemon macrodactylus* and the other species sampled, this may in part be due to the invasive species' small sample size that was collected over the course of the study. However, it was found that parasites were absent from the invasive specimens collected and were continued to be absent within this shrimp species located at one of the most highly parasitized areas sampled at. This ability to resist parasite infection may be a contributing factor to the invasive species success.



## Selected References

Warkentine, B. and J. Rachlin. 2010. The first record of *Palaemon macrodactylus* (Oriental Shrimp) from the Eastern Coast of North America. *Northeastern Naturalist*, 12(1), 91-102.