In only 25 years, the Asian shore crab, *Hemigrapsus sanguineus*, has invaded and become established along the eastern US coast. It has displaced previously established species and greatly impacted local food web. Unfortunately, environmental factors that affect the distribution and density of this invasive species are not fully understood. In this study, we identify environmental and substrate factors that affect *H. sanguineus* density and use the results to infer the potential response of this species to future changes in climate. We analyzed water quality, weather, crab density, and substrate data collected from 2008 to 2012 at four sites around Prudence Island, RI. A generalized additive model (GAM) with Gaussian distribution errors was used to explore nonlinear relationships between *H. sanguineus* density and abiotic and substrate data. We determined the amount of percent deviance explained, as well as variables relative influence (percentage of the contribution to the deviance reduction). One-Way ANOVA was used to look for significant differences in substrate characteristics among sites. The GAM fit explained 76% of the deviance in the model. The three variables that contributed the most to the percentage explanation of the deviance were year (43%), site (15%) and cobb (13%); the least influential (1%) were gravel, shell, and PAR. Our results showed that sites with significantly higher amounts of cobbles and significantly lower salinities had significantly higher crab densities (ANOVA, P<0.001). Our analysis of these long-term datasets provided valuable insights into the ecology of *H. sanguineus*. According to predicted climate change scenarios of higher temperatures and more precipitation (hence lower salinities) in RI, we might expect that invasive species like *H. sanguineus* will be more prevalent as the climate changes, as long as the proper habitat is available.

**RESULTS**

**Hemigrapsus sanguineus Population Density**

- Across years, the highest density of *H. sanguineus* was observed during 2012 (One-Way ANOVA, P<0.001).
- Bear Point has significantly lower densities than Potter Cove (One-Way ANOVA, P<0.001).

**Substrate Characteristics**

- Across sites and years, cobbles was the dominant substrate.
- Potter Cove had significantly lower percent cobbles than the other sites (One-Way ANOVA, P<0.001).

**Salinity**

- Salinity was significantly lower at Bear Point and Nag Creek than at the other sites (One-Way ANOVA, P<0.001).

**DISCUSSION**

Our results show that sites with large amounts of cobbles and low salinities support significantly higher *H. sanguineus* densities around Prudence Island. Although previous studies have found that habitats with high components of cobbles and boulder are important habitat requirements for *H. sanguineus* (Lohrer et al. 2000b), environmental parameters such as salinity has been considered in more qualitative way (Lohrer et al. 2000b, Rohr 2012). According to predicted climate change scenarios (Frumhoff et al. 2007) of higher temperatures and increases in precipitation for Rhode Island (hence lower salinities in the Bay), we might expect that invasive species like *H. sanguineus* to become more prevalent as the climate changes, as long as the proper cobbles habitat is available.

**ACKNOWLEDGEMENTS**

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**LITERATURE CITED**


*Hemigrapsus sanguineus* Facts

- Invasive, opportunistic, omnivorous species.
- First discovered in a rocky intertidal zone in NJ in 1988; quickly established breeding populations and colonized an extensive part of the east coast of the US (see time series below).
- Females can produce up to 50,000 eggs 3 to 4 times from May to September.
- Larvae are part of the plankton for nearly a month, increasing the chances of reaching new areas.
- May significantly affect native fish, shellfish, crabs, and other commercially important species by competing for food and habitat.

**INTRODUCTION**

At the Narragansett Bay National Estuarine Research Reserve (NERR) on Prudence Island, high-resolution long-term water quality and weather data have been collected since 1995 as part of the National Estuarine Research Reserve’s System-Wide Monitoring Program (SWMP). Originally, the SWMP was designed to track short-term variability and long-term changes in benthic water quality through the collection of a broad suite of water and weather parameters. Later, the SWMP was augmented to include coastal and estuarine habitat mapping and biological monitoring (e.g., emergent wetlands, submersed aquatic vegetation, estuarine fauna, etc.). As part of SWMP biological monitoring, we have been monitoring the Asian shore crab, *Hemigrapsus sanguineus* (De Haan 1835), since 2006.

The Asian shore crab has been long recognized as an invasive species in Narragansett Bay. It now comprises over 98% of all crabs in unconsolidated cobble beaches in Narragansett Bay (Rohr and Raposa unpub. data). However, the ecological impacts of this invasion are not well understood; the NERR is involved in Asian shore crab monitoring program in part to help address this need.

Our goal is to demonstrate how combining long-term abiotic and biological datasets can help us better understand the ecology of the Asian shore crab. More specifically, we analyzed SWMP water quality and weather data together with data from the Reserve’s Asian shore crab monitoring program to identify factors that significantly affect Asian shore crab density.

**METHODS**

**Study Sites**

Prudence Island: Bear Point/Potter Cove, Nag Creek, T-Wharf
(Please see the map in the Introduction section).

**Time Frame**

- All data were collected from 2008 to 2012.
- Monthly sampling from June to October.

**Data**

- To determine crab density a 1-m² quadrat was used (N=3 per site).

**Statistical Analysis**

- All data were natural log transformed.
- We used a generalized additive model (GAM) with Gaussian distribution errors to explore nonlinear relationships between *H. sanguineus*-density and environmental and habitat (substrate) data.
- Percent deviance explained (pseudo-R²), as well as variables relative influence (percentage of the contribution to the deviance reduction) were calculated in the model.
- A series of One-Way ANOVA tests were used to test for significant differences in substrate, abiotic characteristics, and crab density among years and sites.

**RESULTS**

**General Additive Model**

- GAM fit explained 76% of the deviance in *H. sanguineus* density in the model.
- The three variables that contributed the most to the percentage explanation of the deviance were year (43%), site (15%) and cobb (13%); the least influential (1%) were gravel, shell, and PAR.
- GAM results showed two environmental and six habitat parameters were significantly influencing *H. sanguineus* density around Prudence Island (P<0.0001, Table 1).

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| Table 1. GAM results for environmental and substrate parameters included in the model. |