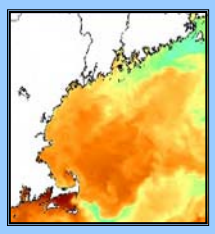

Will the Asian Shore Crab Increase its Range in Maine?

An Analysis of Sea Surface Temperatures to Assess Risk of Further Invasion.

Elizabeth Stephenson

School of Marine Sciences

Hemigrapsus sanguineus

- **Native to Japan, China, and Russia**
- **Likely arrived in ships' ballast water**
- **Carapace width up to ~ 35 mm**
- **Omnivorous diet**
- **Primarily an intertidal crab**
- **Has reached high densities (~100+ per m^2) in southern New England.**
- **Detected in Southern Maine in 2001, now found as far north as Penobscot Bay in low densities**

Photo: R.H. Seeley

Will the Asian shore crab, *Hemigrapsus sanguineus*, continue to spread up our coast and reach high densities in Maine?

- How are the abundance and distribution *Hemigrapsus sanguineus* in Maine correlated with temperature?
- Based on temperatures, will *H. sanguineus* continue its invasion in Maine?
- How can I answer these questions with GIS?

Factors that may affect distribution and abundance patterns of *H. sanguineus* in Maine:

- **Biological Factors**:
  - Competition for food/shelter
  - Presence of predators
- **Physical Factors**
  - Currents/Larval supply
  - Salinity
  - Presence of suitable substrate
  - Temperature

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  - Presence of suitable substrate
  - **Temperature**

Why Temperature?

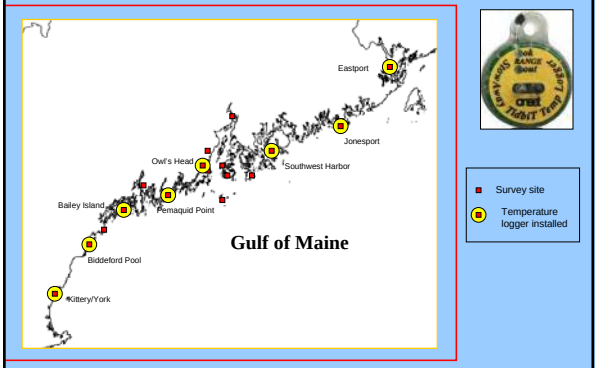
Temperature has a major impact on the global distribution of species.

- mortality – freezing, overheating
- can affect reproduction and development

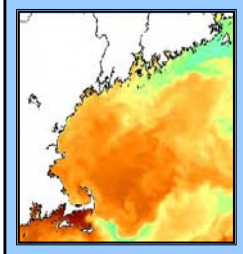
Methods

- Surveyed sites along Maine coast to determine abundance of *H. sanguineus*
- Installed temperature loggers at selected sites to obtain localized temperature data. Data collected from 2003-2004.
- Analyzed satellite sea-surface temperature data using GIS to determine large scale patterns. Data collected from 2003-2004.

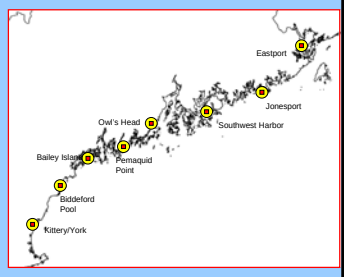
Locations of Survey Sites and Temperature Data Loggers



Satellite Map of Sea Surface Temperatures



Temperature Data Loggers



Methods

Temperature analysis:

- As per Adey and Steneck 2001
- Mean Summer Temperatures (Average of July, August, September)
- Mean Winter Temperatures (Average of January, February, March)

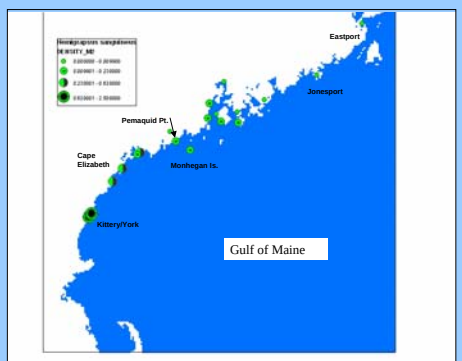
Methods

Used results from site surveys and GIS-aided temperature analysis to:

- determine the relationship between temperature and crab demographics
- predict risk of further invasion.

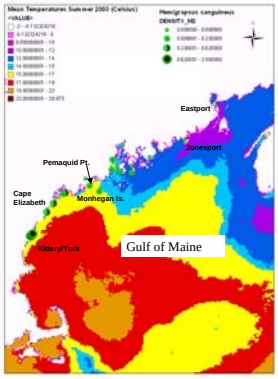
Results

Density of *H. sanguineus* at Survey Sites



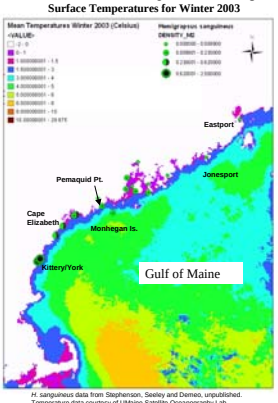
Stephenson, Seeley and Demeo, unpublished

Current Distribution of *H. sanguineus* and Average Sea Surface Temperatures for Summer 2003



H. sanguineus data from Stephenson, Seeley and Demeo, unpublished.
Temperature data courtesy of UMaine Satellite Oceanography Lab

Current Distribution of *H. sanguineus* and Average Sea Surface Temperatures for Winter 2003

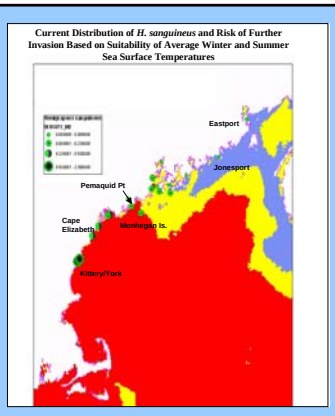


H. sanguineus data from Stephenson, Seeley and Demeo, unpublished.
Temperature data courtesy of UMaine Satellite Oceanography Lab

Current Distribution of *H. sanguineus* and Risk of Further Invasion Based on Suitability of Average Winter and Summer Sea Surface Temperatures

Risk of Further Invasion:

- High
- Moderate
- Low



H. sanguineus data from Stephenson, Seeley and Demeo, unpublished.
Temperature data courtesy of UMaine Satellite Oceanography Lab

Conclusions

- *H. sanguineus* is unlikely to increase its current range
- The population densities of *H. sanguineus* may increase in areas around Pemaquid Point, and Casco Bay, and, with less likelihood, Penobscot Bay

Future Research Using GIS:

- Analyze differences in temperature and *H. sanguineus* abundances between southern New England and Maine
- Analyze temperature patterns in the native range of *H. sanguineus* to aid in predicting the crab's ultimate range in Maine.

Acknowledgements

Thanks to Ryan Weatherbee and the UMaine Satellite Oceanography Lab for providing the satellite temperature data in GIS format.