Decadal scale losses of foundation species and ecological consequences

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Background

In the last three decades, the abundances of two of the most important foundation species in the Gulf of Maine – horse mussels (Modiolus modiolus) and kelp in the genus Saccahrina – have experienced large changes. This is likely due to complex events involving the overfishing of green sea urchins Stronglyocentrotus droebachiensis, storm disturbance, rising ocean temperatures and bottom up effects of massive recruitment.

The horse mussels create medium sized reefs which increase overall invertebrate biodiversity in the benthic community by creating a refuge from predation, and by increasing habitat structural complexity. The famous marine biologist Gunnar Thorson, called horse mussel beds "the most luxuriant society cold temperate seas can offer." Likewise, kelp forests are known to increase biodiversity and productivity of the benthic community. These foundation species and sea urchins are linked in a feedback loop that is regulated by positive (for horse mussels) and negative (for kelp) interactions with sea urchins. Urchin populations were overfished by 1995.

Research objectives and questions

- How have the abundances of horse mussels, kelp and sea urchins changed in the Southern Gulf of Maine over the past 3 decades?
- Can these changes be predicted by the frequency and intensity of storm disturbance?
- Is there a legacy effect of urchin overfishing on the two foundation species?

How we're doing it

We are starting to repeat benthic surveys at 17 sites for the abundance of horse mussels, urchins and kelp, previously conducted by J. Witman in the late 1970's – 1997, from off Portland Maine in the north to Massachusetts Bay. Changes in sea surface temperature and data on storm frequency and intensity (wave height) is available from NOAA weather buoys. We have started working on aspects of this project, but funding is needed to proceed. Part of this effort is synchronized with the Kelp Ecosystem Ecology Network (KEEN) http://www.kelpecosystems.org, led by Jon's former senior thesis student, Dr. Jarrett Byrnes.