SEA STAR WASTING DISEASE:
A REVIEW OF PAST AND CURRENT LITERATURE

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Abstract Sea stars are important organisms in their respective marine communities and often function as keystone predators. There has been an increase in observed outbreaks of sea star wasting disease, a bacterial infection of which not much information is known. Warm water periods associated with climate change and El Niño events are thought to facilitate the spread of this infection. Further microbiological data is needed in order to fully understand this phenomenon.

Key Words: *sea star, wasting disease, climate change, keystone predator*

Introduction

Wasting disease is a phenomenon affecting various taxa throughout the animal kingdom. It has been frequently observed in marine habitats, but there is a disproportional lack of literature addressing wasting disease in echinoderms. At the peak of its power, this ailment has been linked to major population declines of important organisms within marine communities.

One well-known case of severe population change as a result of wasting disease involves the near extinction of the black abalone, *Haliotis cracherodii*, of the California Channel Islands (Blanchette et al. 2005). This mollusk was infected with “withering foot” disease, or “withering syndrome of abalone” (Australian DAFF 2010), a condition that rapidly infected populations of *H. cracherodii*, during the El Niño event of 1982 (Blanchette et al. 2005). The International Union for Conservation of Nature (IUCN) currently lists the black abalone as critically endangered, and comments that the snail’s population trend is decreasing, on their List of Threatened Species (IUCN 2012).

In 1997 wasting disease was observed in echinoderms such as sea urchins, brittlestar, and sea cucumber (Eckert et al. 2000). It is still not clear whether there is a common etiologic agent infecting these varied groups of echinoderms. In fact, there is no scientific evidence currently confirming any causative agent behind this mysterious condition.

The disease has been observed in sea star populations as early as 1978 (Dungan et al. 1982). A pioneering study was done at this time on the sea star *Heliaster kubiniji* and its dramatic population decline after a wasting disease infestation spread rapidly throughout intertidal communities in the Gulf of California.

Studies

Not much has been unearthed about sea star wasting disease since Dungan's initial study of 1982. As he noted, the predatory star *H. kubiniji* occurred at very high densities in the gulf prior to July of 1978, after which date *H. kubiniji* populations in the area waned until the sea star was virtually eliminated (Dungan et al. 1982). Since then, wasting disease has been observed countless times in sea star populations on both coasts of the United States, but no research points to a definitive cause.

Eckert and peers conducted an interesting investigation in 2000. The study closely surveyed population trends of two sea star species in California, *Pisaster giganteus* and *Asterina miniata*. Transect lines and quadrant counts were used to measure population densities for the species. The average incidence of sick or dead sea stars was measured at 24.2% in 1997, and 2.0% in 1998 (Eckert et al. 2000), pinning 1997 as the year of the epidemic. Long-term data showed that populations of both species remained relatively constant from 1995 to 1997, with a sharp decline in 1998 (75% decline in *A. miniata*; 56% decline in *P. giganteus*). The population decline observed in 1998 as opposed to 1997 is reflective of the one year sampling interval, and shows that the large population declines occurred a year after the disease outbreak.

The dramatic effects of wasting disease on the physical bodies of sea stars have been documented thoroughly. An infected star is characterized by a disintegrating appearance, and usually dies within seven days of infection (Eckert et al. 2000). The onset of wasting disease contamination is marked by a deflated appearance accompanied by white lesions on the body's surface at the junctions of the arms with the central disk. These lesions rapidly become larger, until the entire body of the animal becomes fragmented, and then decays and dissolves while other parts of the body remain alive and functional. This process continues to eat away at the sea star's body until the entire thing has been consumed, or wasted (Dungan et al. 1982; Eckert et al. 2000).

In all cases where sea star wasting disease was closely explored, there was a high concentration of bacteria found inside the enlarged lesions (Dungan et al. 1982; Engle 1994; Eckert et al. 2000; Blanchette et al. 2005). Although the epidemiology of this disease is not fully understood, studies suggest that a warm water bacterium of the genus *Vibrio* is responsible for infection (Engle 1994; Eckert et al. 2000). One preliminary theory argues that warm water compromises the sea star's immune system enough for the bacterial infection to become fatal, as it has been observed that infected sea stars do have a chance of survival once moved into cold water (Eckert et al. 2000). Although little is known about the specific pathways this infection takes, most studies agree that elevated water temperatures make sea stars more susceptible to the disease.

Discussion

Different species of sea stars play various roles in their respective communities. Many sea star species function as "keystone" predators in communities from the rocky intertidal to kelp forest (Eckert et al. 2000; Blanchette et al. 2005). As predatory sea

stars keep prey species populations from booming, they influence the structure of the community they belong to.

A very pressing matter that stands out in the literature concerning sea star wasting disease is the emphasis placed on warm water periods. Studies agree that severe wasting disease outbreaks are associated with strong El Niño events (Eckert et al. 2000; Blanchette et al. 2005). It is strongly suggested that elevated temperatures facilitate the spread of infection (Blanchette et al. 2005), and that there is a suspected relationship between high seawater temperatures and incidence of wasting disease (Eckert et al. 2000).

There is disturbing evidence pointing towards an expected increase in water temperatures over the next century. Studies point to a dramatic warming tend attributed to green house gas emissions, which will affect the health of marine communities (IPCC 2001; Harley, 2004). There is already sea temperature data showing a long term warming trend in southern California (Eckert et al. 2000), where wasting disease outbreaks tend to be most severe. It is important to note that global climate change could have strong direct effects on species living in intertidal communities, as these species already survive under the pressures of physical environmental stressors (Harley, 2004).

Future investigations of this disease should focus on microbiological data, since there is virtually no literature pointing towards, or even suggesting, a specific bacterial pathogen. Climate change and climate mitigation efforts should also be taken into account, as intertidal communities tend to be more susceptible than others to the effects of warming periods.

Literature Cited

Australian DAFF. (2010). Disease Strategy Manual - Withering Syndrome of Abalone. *Department of Agriculture, Fisheries and Forestry (Australian Government).*

Blanchette, C. A., Richards, D. V., Engle, J. M., Broitman, B. R., & Gaines, S. D. (2005). Regime shifts, community change and population booms of keystone predators at the Channel Islands. In *Proceedings of the California Islands Symposium* (Vol. 6).

Dungan, M. L., Miller, T. E., & Thomson, D. A. (1982). Catastrophic decline of a top carnivore in the Gulf of California rocky intertidal zone. *Science (New York, NY)*, *216*(4549), 989.

Engle, J. M. (1994). Perspectives on the structure and dynamics of nearshore marine assemblages of the California Channel Islands. In W. L. Halvorson, & G. J. Maender (Eds.), *The Fourth California Islands Symposium: Update on the Status of Resources*. California: Santa Barbara Museum of Natural History.

Eckert, G. L., Engle, J. M., & Kushner, D. J. (2000). Sea star disease and population declines at the Channel Islands. In *Proceedings of the fifth California Islands symposium* (pp. 99-0038). US Minerals Management Service.

IUCN. (2012). IUCN Red List of Threatened Species. Version 2012.2. Web.

Watson, R. T. (Ed.). (2001). *Synthesis Report: Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.