Sea Star Wasting

by Bretwood Higman, Erin McKittrick, Rebecca_Siegel

LAST MODIFIED: 12TH AUGUST 2019
CREATED: JAN. 19, 2018



Copyright: Creative Commons Attribution

Table of Contents

1. Overview**
2. Outbreak
3. Cause
4. Climate Change
5. Impact on the Ecosystem
6. Citizen Science

Overview**

Since 2013, sea stars have been dying in record numbers on the west coast, from Baja California to Alaska. The reason for the die-off is a mysterious illness known as Sea Star Wasting Disease (SSWD). SSWD is currently affecting more thantwenty species (http://www.pnas.org/content/111/48/17278) of sea stars in nine families. Episodes of SSWD have been observed periodically on the west coast since 1978, but with so many species affected and a range stretching from Baja California to Alaska, this is the biggest episode ever recorded.

Sea star wasting resembles a mash-up of images from a horror movie. Zombie-like, the stars deflate and their flesh deteriorates while they are still alive. They contort, seemingly writhing in pain in slow motion, and then detach their own limbs. In the end, they melt like the Wicked Witch of the West, leaving behind only ooze and a star-shaped pile of white bonelike

Copyright: Creative Commons Attribution

plates. The cause of SSWD is not yet completely understood, although researchers have found a virus that is associated with symptomatic stars.

The current outbreak coincides with instances of abnormally warm water (http://news.nationalgeographic.com/2017/02/space-map-pacific-blob/)across the entire pacific coast. Sea star populations in areas where ocean temperatures are warmer than normal are harder hit than those in cooler waters. Sea stars are important predators and two of the hardest-hit species (Pisaster ochraceus and Pycnopodia helianthoides) are keystone species, and so this extensive die-off has the potential to greatly alter the ecosystem. Despite the scope of SSWD, much is unknown about it. Researchers are only beginning to understand its causes and effects, and research is hampered by the lack of baseline data with which to compare current observations.Citizen science (http://www.eeb.ucsc.edu/pacificrockyintertidal/data-products/sea-star-wasting/) is playing an important role.

Outbreak

Researchers from Olympic National Park in Washington were thefirst to observe (http://www.eeb.ucsc.edu/pacificrockyintertidal/data-products/sea-star-wasting/updates.html) the outbreak in June 2013. That August, divers near Vancouver observed melting sunflower stars (Pycnopodia helianthoides). More reports came from Puget Sound,

Copyright: Creative Commons Attribution

Southeast Alaska, and California (Bodega Bay down to Orange County). By 2015, SSWD had been found from the Kodiak Archipelago to Baja California.

SSWD was first detected in 1978 in the Gulf of California. Since then, sea star wasting events have been observed (http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0128150) in 1982-83, 1997, and 2008. Today's outbreak surpasses any other in terms of the number of species affected. Since 2013, wasting has been observed in 20 species of sea stars (http://www.pnas.org/content/111/48/17278), and in other echinoderm species as well, includingsea urchins (http://www.eeb.ucsc.edu/pacificrockyintertidal/data-products/sea-star-wasting/updates.html). In contrast, half that number– 10 sea star and three sea urchin species– were affected by the 1997 outbreak (http://www.mednscience.org/download_product/1611/0). The current wasting event has alsocontinued longer (http://www.eeb.ucsc.edu/pacificrockyintertidal/data-products/sea-star-wasting/updates.html) and spread farther than any other.

Sea Star Wasting in Kachemak Bay : In the summer of 2016, sea star wasting (https://www.adn.com/alaska-life/we-alaskans/2016/11/13/kachemak-bay-has-witnessed-massive-die-offs-of-sea-stars-and-other-species-whats-going-on/) devastated many species of sea stars in Kachemak Bay – one of the most recent and farthest north outbreaks.As of 2017, once common species are now rare (https://www.adn.com/alaska-news/environment/

Copyright: Creative Commons Attribution

2017/05/05/sea-star-populations-in-kachemak-bay-annihilated-by-wasting-disease/), and citizen scientist efforts are monitoring populations.

Cause

The Virus : There is strong evidence for a link between SSWD and a virus (Sea star associated densovirus (http://www.pnas.org/content/111/48/17278.full), or SSaDV). SSWD spreads from place to place, and can betransmitted to aquarium sea stars through unfiltered water (http://www.pnas.org/content/111/48/17278.full). Asymptomatic stars inoculated with virus-sized material from tissues of symptomatic stars develop SSWD symptoms, but not when heat is used to kill viruses first. The virus has been found in sea urchins (the species Strongylocentrotus purpuratus and Dendraster excentricus), as well as brittle stars, suggesting that these species could act as a reservoir for SSaDV between outbreaks.

Questions Remaining : If SSaDV was present in the past, then why were there no big outbreaks at those times? Additionally, the virus was found to be present in both symptomatic and asymptomatic stars of the same species. The researchers suggest that this could be because it takes two weeks for symptoms to develop, or because the virus is present on the surface but not yet in the tissues.

Copyright: Creative Commons Attribution

Climate Change

Several researchers have found a relationship between warmer water and SSWD. In a 1999 study (http://www.mednscience.org/download_product/1611/0), researchers in Southern CaliforniaÕs Channel Islands noted that observations of wasting coincided with warm-water years. In 2009,researchers in British Columbia (http://limpets.org/wp-content/uploads/2015/01/Pisaster-Wasting.pdf) experimented with holding asymptomatic ochre stars (Pisaster ochraceus) at different temperatures both in the lab and in the field. The stars held at warmer temperatures became symptomatic in greater numbers than those held at cooler temperature. The researchers concluded that at their site water temperature influences SSWD progression and timing, with warmer water seeming to exacerbate the disease. In their 2009 study of SSWD in ochre stars in British Columbia, Bates et al (http://limpets.org/wp-content/uploads/2015/01/Pisaster-Wasting.pdf)suggest that climate change could increase outbreaks for three reasons. Pathogen growth rates could increase as water temperature increases. Warmer waters could also allow pathogens range to expand. Finally, heat-stressed stars are more susceptible to SSWD.

Warm water can increase disease severity. Eisenlord et al (http://rstb.royalsocietypublishing.org/content/371/1689/20150212) (2016) conducted a study examining the relationship between water temperature and SSWD prevalence. They monitored water temperature and disease prevalence among ochre stars on the Washington coast and also tested the

Copyright: Creative Commons Attribution

effect of different water temperatures on the development of SSWD symptoms and mortality rates on captive, disease-exposed stars. Stars in warmer water experienced higher mortality and a faster progression from disease onset to death. This could be because warmer water put the stars in metabolic stress, hampered their thermoregulation, or suppressed the starsÕ immune systems.

The current outbreak coincides with instances of abnormally warm water (http://news.nationalgeographic.com/2017/02/space-map-pacific-blob/)across the entire pacific coast. The sea stars are not alone in being affected by the warm temperatures. Known as the ÒBlob,Ó as this trend is also connected to blooms of toxic algae and die-offs of species including California sea lions and common murres. As climate change warms the oceans, it will be important to better understand the role of water temperature in sea star wasting outbreaks.

Impact on the Ecosystem

A heavy reduction in sea star populations has the potential to greatly alter marine ecosystems. Sea stars are predators and were generally abundant prior to this die-off. Ochre stars and sunflower stars, two of the most heavily affected species, are what ecologists call keystone species (http://nationalgeographic.org/encyclopedia/keystone-species/). Keystone species have disproportionately large impacts on their environment relative to their abundance. When a keystone species disappears or declines, its ecosystem experiences drastic changes. For example, ochre stars (https://

Copyright: Creative Commons Attribution

www.britannica.com/science/keystone-species) prey on mussels (Mytilus trossulus and M. californianus). When the ochre star population declines or vanishes, the mussel population rises, becoming superabundant and crowding out other species, such as barnacles, sponges, and anemones. The ochre starsÕ predation allows great biodiversity in the intertidal zone, while a lack of ochre stars causes biodiversity to drop.

The exact ecosystem changes that will be caused by SSWD are unknown. Looking to past mass mortality events of similar species suggests the potential for large shifts. The case of the long-spined sea urchin (http://www.ncbi.nlm.nih.gov/pmc/articles/PMC33118/) provides an example of how the removal of one species can precipitate great changes in an ecosystem. Long-spined sea urchins (Diadema antillarum) live in Carribbean coral reefs, where they graze on algae. In 1983 a fast moving, unknown, and highly lethal agent swept through Carribean coral reefs, killing long-spined sea urchins. During the die-off, urchin populations fell by more than 90%. Without the urchins, the algae grew unimpeded, inhibiting coral growth and essentially smothering the reefs.

In some parts of the coastline, observers have noted the appearance of large numbers of juvenile sea stars. If high levels of recruitmen (http://www.eeb.ucsc.edu/pacificrockyintertidal/data-products/sea-star-wasting/recruitment.html)t occur across the affected region and the young stars are unaffected by wasting, it could be that the sea star population will regenerate

Copyright: Creative Commons Attribution

fairly quickly. However, in other areas, juveniles are rare. Ongoing research and monitoring will be needed to see what happens.

Citizen Science

Sea star wasting occurs in hard-to- reach places spanningthousands of miles of coastline (http://data.piscoweb.org/marine1/seastardisease.html). It is impossible for scientists alone to collect all the data necessary to understand an outbreak occurring on so massive a scale. Ocean mass mortality events like SSWD are projected torise in intensity and frequency (http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0126280) with global changes. It is therefore important to understand their causes and consequences.Citizen science (http://www.eeb.ucsc.edu/pacificrockyintertidal/data-products/sea-star-wasting/index.html), in which amateur scientists volunteer to help monitor SSWD and submit their data online, is an important way to overcome the challenges presented by sea star wastingÕs expansive range.

Citizen scientists can help establish baseline data, which enables scientists to identify trends in outbreak severity and frequency. Citizen scientists can also monitor the progress of an outbreak and subsequent changes in the ecosystem.

Monitoring data can only truly be understood when compared with past years. For example, many monitoring sites in the Puget Sound showed low incidence of SSWD in 2015 (http://

Copyright: Creative Commons Attribution

www.eeb.ucsc.edu/pacificrockyintertidal/data-products/sea-star-wasting/updates.html). If this information was taken alone, it would appear that these locations were only moderately affected by SSWD. However, comparison with past yearsÕ data reveals that the sites have experienced large population declines since the start of this SSWD event. A single yearÕs data provides only a snapshot, while multiyear datasets provide an understanding of changes over time. Citizen scientists play an important role in obtaining multiyear data across the length of the Pacific coast.

As of 2015, researchers have directed citizen science efforts to gather data about sea star population recovery as well as disease progression. Anyone interested in gathering SSWD data should visit USC Sea Star Wasting Citizen Science web page (https://www.eeb.ucsc.edu/pacificrockyintertidal/data-products/sea-star-wasting/index.html). *[USC Sea Star Wasting Citizen Science web page]: University of Southern California

Copyright: Creative Commons Attribution