Sea Stars: wasting disease taking its toll

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What's happening with sea stars?

Starting in the late summer of 2013, Howe Sound began experiencing a mass mortality of sea stars. The die off is part of a larger outbreak of sea star wasting syndrome happening up and down the west coast of North America from Alaska to southern California, and possibly into Mexico.[1] The event, which is affecting at least 20 different species of sea stars along the coast, might be the largest wildlife mortality event in recent history.[2] Although a virus has been associated with sea star wasting,[3] the causes and consequences of the outbreak remain largely unknown. In Howe Sound, the sunflower star, *Pycnopodia helianthoides*, (Figure 1) was the hardest hit species, with dense aggregations disappearing from many sites in a matter of weeks. More recently, there have been sporadic influxes in tiny young sea stars at some sites. However, the fate of these juveniles is not clear, as they seem to vanish as quickly as they appear. In 2015 and 2016 there has been a low but consistent number of small (quarter- to saucer-sized), mostly healthy-looking sunflower stars. Wasting is also still present at low levels in purple stars (*Pisaster ochraceus*) and mottled stars (*Evasterias troschelii*), but other species such as leather stars (*Dermasterias imbricata*), vermillion stars (*Mediaster aequalis*) and blood stars (*Henricia* spp.) appear to be abundant and healthy in Howe Sound.

Figure 1. A healthy sunflower star moves across sea colander kelp (left). A diseased sea star begins to lose its grip near Pam Rocks, Sept 2013 (right). (Photos: Donna Gibbs)

Why are sea stars important?

Sea stars are important predators in the marine environment. Many sea stars are keystone predators, meaning that they have a disproportionately large influence on their surrounding marine communities.[4] In subtidal habitats, sunflower stars are voracious predators of bottom-dwelling invertebrates and are the main predator of green sea urchins (*Strongylocentrotus droebachiensis*) in Howe Sound. The sudden decline in sunflower stars may be responsible for the widespread explosion in the green sea urchin population currently underway (Figure 2), which in turn may be leading to a decline in kelp cover (primarily the sea colander kelp, *Agarum fimbriatum*).[5] Because kelp provides critical habitat for a variety of fish and invertebrates, a decline in sea stars could have large-scale ecological impacts at multiple levels of the food web. Other species of sea stars function as more specialized predators, scavengers and/or detritivores (animals that feed on dead organic material), and also play an important role in the ecosystem.[6] In addition, sea stars have an intrinsic, cultural value to the public. In the absence of sea star wasting, sea stars have been a familiar sight on the beaches, shorelines and underwater habitats of Howe Sound. There is considerable public concern regarding the wellbeing of sea stars.

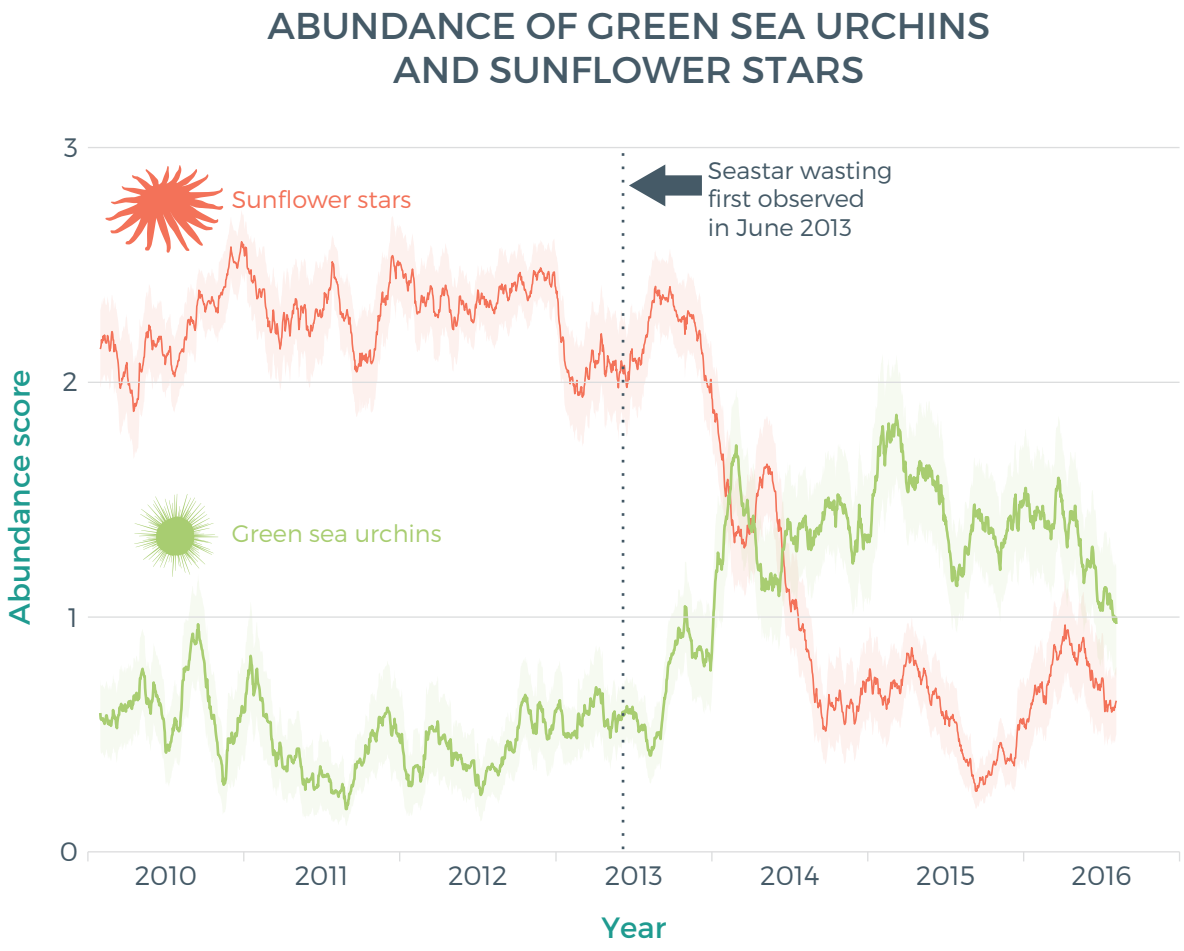
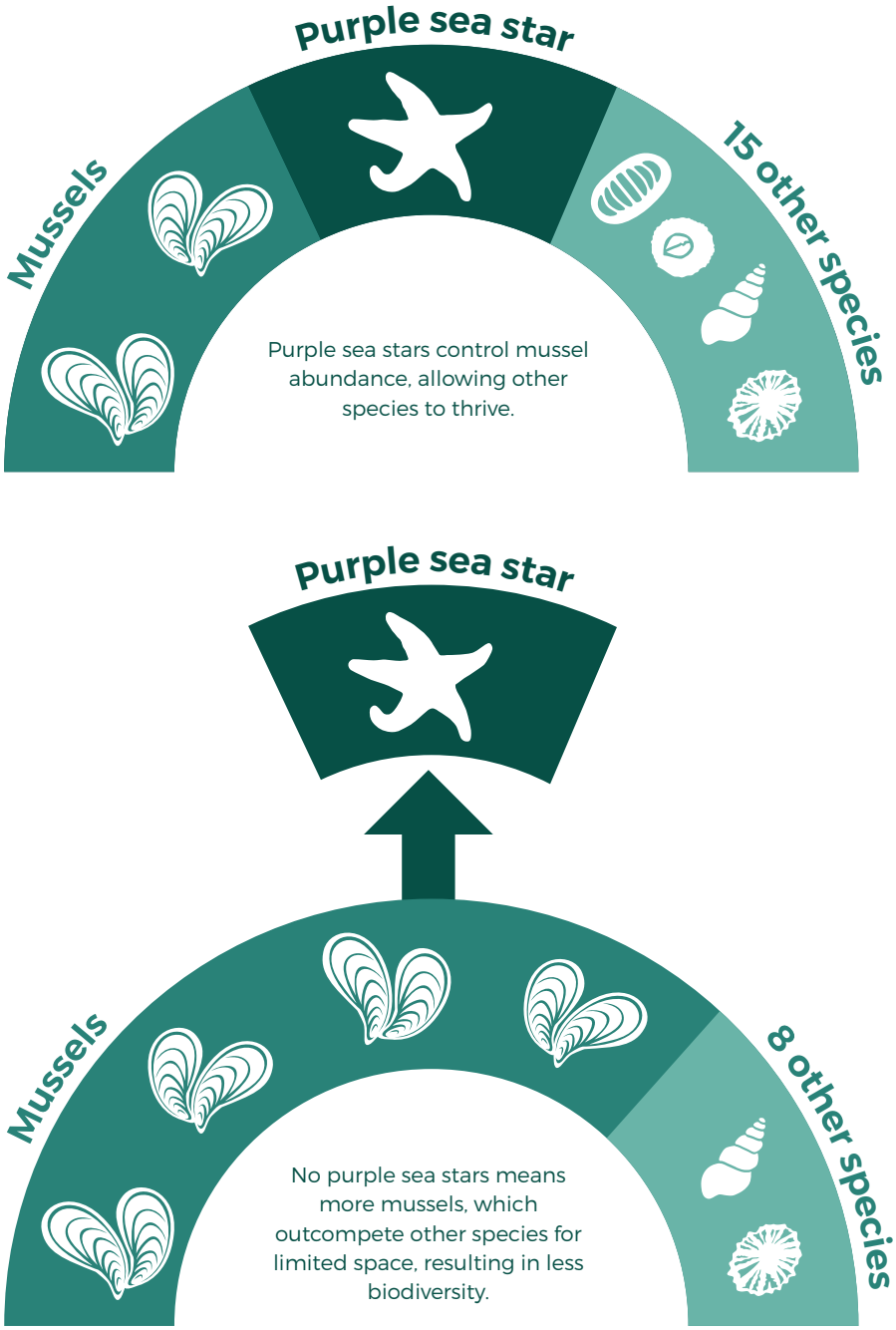


Figure 2. Sixty-day running average abundance scores for green sea urchins (*Strongylocentrotus droebachiensis*; green solid line) and sunflower stars (*Pycnopodia helianthoides*; orange solid line) recorded in surveys from Jan 2010 to Sept. 4, 2016 in British Columbia. Data are from the Reef Environmental Education Foundation (www.reef.org) database, which collects qualitative observations from recreational SCUBA divers trained in basic marine life identification. Shadows around trend lines indicate 95 percent confidence intervals of the running average. (updated from Schultz et al. 2016).

Purple sea star is a keystone predator



What is the current state?

Based on data collected from 20 sites in Howe Sound, the abundance of sunflower stars declined by 89 percent on average following sea star wasting, from an average of roughly one sea star every two square meters in 2009–2010 to one sea star every 17 square meters in 2014 (Figure 2).[4] At least 15 other species in Howe Sound have been observed with signs of wasting; six species were considered to have high or very high mortality rates, and nine species were considered to have some mortality based on qualitative observations by citizen scientist Neil McDaniel[7] (Figure 3). For this article, the sighting frequency (the percent of dives during which a particular species was observed based on presence/absence data[8]) was qualitatively compared for groups of sea stars with high mortality versus lower mortality (Figure 3). It is no surprise that sighting frequency varies greatly, but rather unexpected that it increased for some species following sea star wasting syndrome. It is clear that neither relative abundance nor level of mortality can be inferred from these sighting frequency data. On a positive note, all species that were observed before the wasting event were still observed after the event, with the exception of the northern sea star (*Solaster endeca*). Although some species were seen less frequently following the die-off event compared to before, for many species the opposite was true: sighting frequency actually increased after the sea star wasting disease outbreak. One reason for this may be a heightened sense of awareness about sea stars (leading to more recording of sea star sightings) following the onset of wasting syndrome. It is also important to note that sighting frequency does not account for sea star health and many of the observed individuals may have been exhibiting signs of wasting.

Disease continues to be a major threat to sea stars in Howe Sound, especially for the sunflower star. Wasting disease is ongoing. Some researchers have suggested the possibility of listing sea stars as imperiled under the Species at Risk Act.[9] However, many observers have reported high densities of newly settled "baby" sea stars in many areas.[10,11] The long term resilience of affected species is unknown and will depend largely on juvenile survival and the existence of healthy, adult sea star populations able to repopulate heavily impacted areas.

Figure 3. The sighting frequency of common sea stars in Howe Sound before sea star wasting syndrome (SSWS) (2009–2010; green bars) and after sea star wasting (2014–2015; orange bars). Top Panel includes species categorized as having experienced high or very high mortality, and Bottom Panel includes species categorized as having experienced some mortality.[7] Almost all species were observed both before and after the onset of SSWS. Sighting frequency data are from the Pacific Marine Life Surveys database.[8]

What is being done?

Researchers from institutions across the continent continue to work to understand sea star wasting syndrome. In Howe Sound, a number of groups monitor echinoderm populations and/or health status, including:

- Howe Sound Research, Coastal Ocean Research Institute: researching cascade effects and monitoring populations
- Neil McDaniel, Naturalist and Videographer: monitoring and documenting sea stars (www.seastarsofthepacificnorthwest.info)
- MARINe Network, University of California, Santa Cruz: collecting and mapping sea star observations from anywhere on the west coast of North America (www.seastarwasting.org)
- Reef Environmental Education Foundation (REEF; www.reef.org), which trains scuba divers to identify and record common species during recreational dives, tracks the qualitative abundance score of fish and invertebrates, including sunflower stars (*Pycnopodia helianthoides*), pink stars (*Pisaster brevispinus*), leather stars (*Dermasterias imbricata*) in the Northeast Pacific.
- Pacific Marine Life Surveys: taxonomists and citizen science divers Donna Gibbs, Charlie Gibbs and Andy Lamb have been recording biodiversity observations, including the presence of sea stars, in Howe Sound and elsewhere for several decades.

What can you do?

Individual and Organization Actions:

- If you see a sick or dying sea star, please submit your observations to the UC Santa Cruz monitoring site, www.seastarwasting.org. Your observations can help researchers track disease spread and understand the potential causes and consequences of sea star wasting. If applicable to your organization, encourage company-wide participation in this citizen science project.
- Ecosystems that are already stressed due to overfishing, pollution, habitat damage or other stressors are more prone to disease outbreaks and are less resilient to disturbance. Anything we can do to mitigate pressures on marine ecosystems may help prevent future disease outbreaks and promote ecosystem recovery.

Government Actions and Policy:

- Increase public education about sea star wasting disease to encourage participation in citizen science projects, and personal actions to help decrease overfishing, pollution, habitat damage and stressors.
- Financially support ongoing research projects, and assess the need for additional research. Support further studies specifically on the cause(s) of sea star wasting disease.
- If studies reflect the need, classify sea stars as an Imperiled Species by the Species At Risk Act.

Resources

Summary of sea star wasting and current map of observations
seastarwasting.org

Vancouver Aquarium sea star wasting webpage
vanaqua.org/act/research/sea-stars

Sea star health category guide
env.gov.bc.ca/bcparks/partnerships/Item/docs/protocols/intertidal/SeastarDiseaseCategoryGuide_2.0.pdf?v=1468460904481

Footnotes

[1] Stockstad, E. 2014. Death of the stars. Science (New York) 344:464-467; DOI: 10.1126/science.344.6183.464.

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[5] Schultz, J.A., R.N. Cloutier, and I.M. Côté. 2016. Evidence for a trophic cascade on rocky reefs following sea star mass mortality in British Columbia. PeerJ 4:e1980; DOI 10.7717/peerj.1980

[6] Lambert, P. 2000. Sea stars of British Columbia, Southeast Alaska, and Puget Sound. Vancouver: Royal British Columbia Museum, UBC Press.

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[11] Menge, B.A., E.B. Cerny-Chipman, A. Johnson, J. Sullivan, S. Gravem, and F. Chan. 2016. Sea star wasting disease in the keystone predator *Pisaster ochraceus* in Oregon: Insights into differential population impacts, recovery, predation rate, and temperature effects from long-term research. PLoS ONE, 11(5): e0153994.