

THE SEA STAR WASTING SYNDROME IN THE PACIFIC NORTHWEST

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November 30, 2013

INTRODUCTION

Over the past few years Vancouver Aquarium researchers and others have observed extraordinarily high densities of the sunflower star *Pycnopodia helianthoides* on rocky slopes in Howe Sound, a coastal British Columbia fjord located just NW of Vancouver. At some sites these stars occupied a wide band in the shallow subtidal zone with densities of up to 12 per square metre. Scientists were unable to explain how or why such high densities had developed.



Toward the end of August, 2013, divers began seeing sunflower stars dying in unusual numbers. They reported hundreds that appeared to be disintegrating, their rays falling off and internal organs protruding through ruptures in the body wall. Dubbed “the wasting syndrome,” this phenomenon quickly spread through the entire sunflower star population, killing an estimated tens of thousands in Howe Sound alone. By the end of October, virtually all sunflower stars were dead.



While sunflower stars took the brunt of the wasting syndrome, other sea stars were also dying, including the morning sun star *Solaster dawsoni*, the giant pink star *Pisaster brevispinus*, the mottled star *Evasterias troschelii*, the purple/ochre star *Pisaster ochraceus*, the vermilion star *Mediaster aequalis*, the rainbow star *Orthasterias koehlerii*, the striped sun star *Solaster stimpsoni* and the leather star *Dermasterias imbricata*. These stars were more widely distributed and less numerous throughout Howe Sound, yet they were dying in a similar way as the sunflower stars.

Howe Sound appeared to be “ground zero” for the wasting syndrome, as there had been few reports of the problem from other areas of the PNW. But surveys in nearby Indian Arm, another coastal fjord where there had also been abnormally high densities of sunflower stars, revealed a similar sudden mass mortality in October.

On Oct. 9 the population of sunflower stars at Croker Island (near the head of the inlet) was still very large, although some dying animals were observed. But by Oct. 29 the population had suffered nearly 100% mortality. All of the sunflower stars had disappeared reduced to extensive mats of white bacteria. The morning sun stars were also decimated and many mottled stars were dying. The two photos at right show the dramatic change that occurred over the course of 20 days. The images show the same large rock on Oct. 9 and then on Oct. 29.

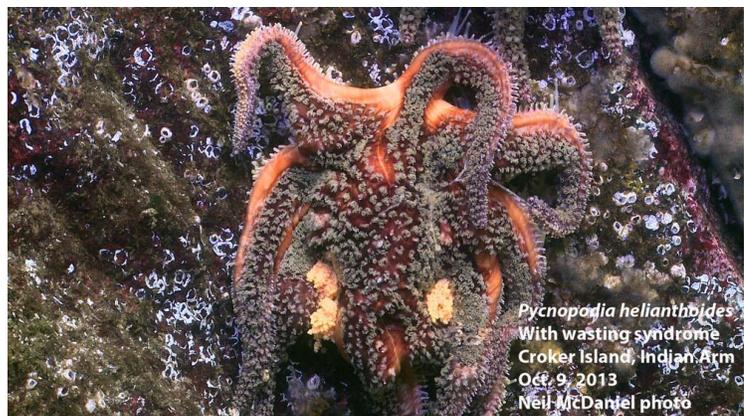


By late October the syndrome had been reported from the Gulf Islands, around Nanaimo and into Puget Sound and the San Juan Islands. It appears to be spreading throughout the entire Strait of Georgia and Puget Sound.

To date there have been no reports from Campbell River north through the Johnstone Strait or from the west coast of Vancouver Island of recent outbreaks, although there have been sunflower star die-offs documented in the past in Barkley Sound. In 2009 Bates *et. al.* reported on wasting disease present in the population of *Pisaster ochraceus* in Barkley Sound. They observed that the wasting disease in *Pisaster* was highly temperature sensitive and that populations in sheltered bays appeared to sustain chronic, low levels of infection.

PROGRESSION OF THE WASTING SYNDROME

Pycnopodia helianthoides
(sunflower star) Healthy animals are usually plump with rays that are puffy. In the first stages of the syndrome the animals become much flatter and the edges of the rays become much more distinct. They still move about but appear emaciated.

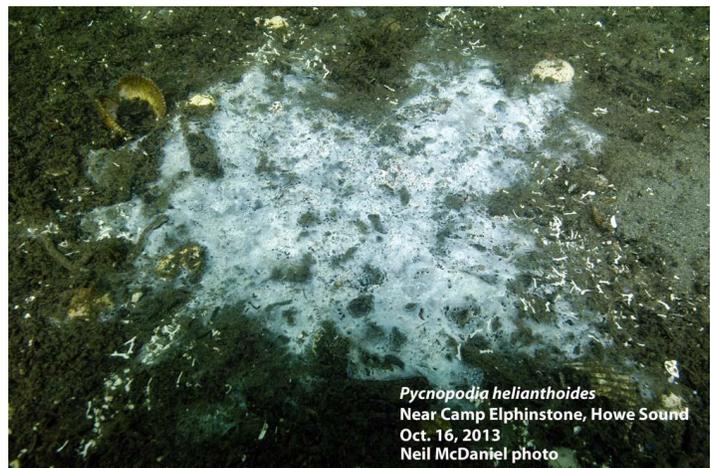


As the animals become more stressed, they often drop several rays (which wander off on their own for a while). At this point the body wall becomes compromised and the pyloric caeca and/or gonads may protrude through lesions. As things progress, the animals lose the ability to crawl and may even tumble down steep slopes and end up in pile at the bottom. Soon after they die and begin to rot.



Pycnopodia helianthoides
Defence Islands, Howe Sound
Sept. 19, 2013
Neil McDaniel photo

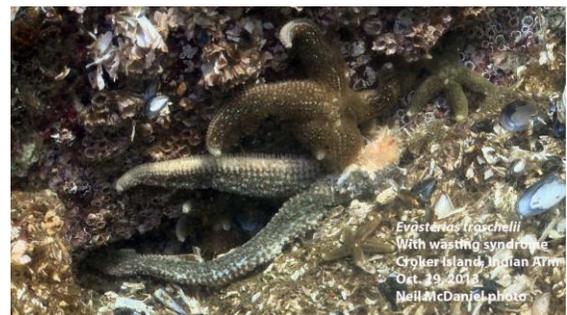
The bacteria *Beggiatoa* then takes over and consumes all of the organic matter, leaving a scattering of skeletal plates on the bottom. The syndrome develops quickly and in only one to two weeks animals can go from appearing healthy to a white mat of bacteria and skeletal plates.



Pycnopodia helianthoides
Near Camp Elphinstone, Howe Sound
Oct. 16, 2013
Neil McDaniel photo

***Evasterias troschelii* (mottled star), *Pisaster ochraceus* (purple/ochre star)**

In affected animals lesions appear in the body wall, through which the internal organs often protrude. Rays may detach from the disc. Lesions become larger as the disease progresses and death soon follows.



Evasterias troschelii
With wasting syndrome
Croker Island, Indian Arm
Oct. 19, 2013
Neil McDaniel photo

***Solaster dawsoni* (morning sun star)**

Initially the star thins and looks emaciated. Then multiple small lesions appear in the body wall which soon grow larger. Internal organs spill from within the body. Lesions become larger as the disease progresses and death follows within a week.



Solaster dawsoni
Croker Island, Indian Arm
Oct. 9, 2013
Neil McDaniel photo

***Pisaster brevispinus* (giant pink star)**
 Healthy pink stars have five heavy-set, very stout rays. Dying stars shrink and usually die without casting off any rays. Within a few weeks the body is reduced to a white star-shaped puddle of mat bacteria.



PNW SEASTAR CHECKLIST

The following checklist includes 28 species of sea stars encountered from the intertidal down to subtidal depths of 30 metres in the Pacific Northwest, from southern BC to Washington. Some species such as *Pisaster ochraceus* are common and ubiquitous throughout the region while others, such as *Ceramaster arcticus* are rarely found.

The list is annotated to identify the species which have so far been observed affected by the “wasting syndrome.” For many species there are “no data,” indicating that there have been no observations reported to date.

Of the 28 species, five have suffered high mortalities due to the syndrome, including *Pycnopodia helianthoides*, *Pisaster brevispinus*, *Pisaster ochraceus* and *Evasterias troschelii* and *Solaster dawsoni*. Five other species, *Dermasterias imbricata*, *Mediaster aequalis*, *Solaster stimpsoni*, *Orthasterias koehleri* and *Leptasterias* sp. have suffered more limited mortalities.

Phylum Echinodermata

Class Asteroidea

Order Paxillosida

Family Luidiidae

Luidia foliolata (sand star): not affected

Order Valvatida

Family Asterinidae

Asterina miniata (bat star): no data

Family Poranidae

Poraniopsis inflatus inflatus (thorny star): no data

Family Goniasteridae

Ceramaster arcticus (Arctic cookie star): no data

Ceramaster patagonicus (cookie star): no data

Gephyreaster swifti (gunpowder star): no data

Hippasteria spinosa (spiny star): no data

Mediaster aequalis (vermilion star): some mortality

Family Asteropseidae

Dermasterias imbricata (leather star): some mortality

Order Velatida

Family Solasteridae

- Solaster dawsoni* (morning sun star): high mortality
- Solaster endeca* (northern sun star): not affected
- Solaster stimpsoni* (striped sun star): some mortality
- Solaster "paxillatus"* (orange sun star): not affected
- Crossaster papposus* (rose star): not affected
- Lophaster furcilliger vexator* (crested star): not affected

Family Pterasteridae

- Pteraster militaris* (wrinkled star): no data
- Pteraster tessellatus* (slime star): not affected

Order Spinulosida

Family Echinasteridae

- Henricia aspera aspera* (ridged blood star): not affected
- Henricia leviuscula* (blood star): not affected
- Henricia sanguinolenta* (fat blood star): no data

Order Forcipulatida

Family Asteriidae

- Pycnopodia helianthoides* (sunflower star): very high mortality
- Evasterias troschelii* (mottled star): high mortality
- Orthasterias koehlerii* (rainbow star): some mortality
- Pisaster brevispinus* (giant pink star): high mortality
- Pisaster ochraceus* (ochre/purple star): high mortality
- Stylasterias forreri* (velcro star): no data
- Leptasterias hexactis* (drab six-armed star): no data
- Leptasterias aequalis* (colourful six-armed star): some mortality?
(species not determined)

REPORTS OF WASTING SYNDROME IN THE PACIFIC NORTHWEST

This summary is based on emails and personal correspondence received over the past few months. It is by no means comprehensive.

Howe Sound

Sept. 2/13: Kelvin Grove: dying and dead *Pycnopodia* (see video by Jonathan Martin)
<http://www.youtube.com/watch?v=ebArXhSKkMg>

Sept. 3/13: Whytecliff: dying and dead *Pycnopodia* (see video by Jonathan Martin)
<http://www.youtube.com/watch?v=ElSbLpQQows>

Sept. 19/13: Defence Islands: dying and dead *Pycnopodia* (still images by Neil McDaniel, samples collected by Doug Swanston)

Sept. 19/13: Bowen Island, south shore: Vancouver Aquarium (Donna Gibbs, Jeff Marliave) reported 100% mortality of *Pycnopodia*. Western shore Hutt Island, 100% mortality of *Pycnopodia*.

Oct. 16/13: Defence Islands: 100% mortality of *Pycnopodia*. Vancouver Aquarium (Donna Gibbs, Jeff Marliave).

Oct. 16/13: McNab Creek: high mortality of *Pycnopodia*. Vancouver Aquarium (Donna Gibbs, Jeff Marliave).

Oct. 16/13: Camp Elphinstone: 100% mortality of *Pycnopodia* and *Pisaster brevispinus*. (still images by Neil McDaniel and Doug Swanston).

Oct. 20/13: Kelvin Grove: one dying *Dermasterias imbricata* (still images by Diane Reid).

Oct. 23/13: Porteau: high mortality *Pycnopodia*, dying *Evasterias*, some dead *Pisaster brevispinus*. Doug Swanston.

Nov. 12/13: Eagle Harbour: no *Pycnopodia*, 8 *Pisaster ochraceus* appeared OK, several dying *Evasterias*, 2 *Dermasterias* appeared OK. (Andy Lamb)

Nov. 14/13: near Langdale: One dying *Pisaster ochraceus*. (still images by Tom Sheldon)

Indian Arm

Sept. 15/13: Bedwell Bay: approx. 100 dying or dead *Pycnopodia* observed in shallow water by kayaker (photos by Ruth Foster)

Oct. 9/13: Croker Island at south end: thousands of *Pycnopodia*, some appeared OK, but approx. 20% dying or dead. Several *Solaster dawsoni* dying. (photos by Neil McDaniel, 10 specimens collected by Doug Swanston).

Oct. 29/13: Croker Island at south end: nearly 100% mortality of *Pycnopodia* and *Solaster dawsoni*, many *Evasterias* dying. *Dermasterias* and *Henricia* appeared OK.

Jervis Inlet

Oct. 9/13: Egmont Marina: all stars appeared OK. (Gus Angus).

Oct. 27/13: Egmont area: many *Pycnopodia* dying or dead. (Tom Heinecke).

Sechelt Inlet

Oct. 2/13: 9 Mile Point: 1 *Pycnopodia* dead. All other stars appeared OK. (still photos by Neil McDaniel).

Oct. 3/13: Sakinaw Rock: all stars appeared OK. (still photos by Neil McDaniel).

Oct. 23/13: Sakinaw Rock: 75+ *Pycnopodia* OK; 100+ *Crossaster* OK; circa 25 *Solaster dawsoni* OK; circa 6 *Luidia* OK; 50+ *Pisaster brevispinus* OK; 6 *Pteraster tessellatus* OK; circa 20 *Orthasterias* OK; circa 20 *Mediaster* OK; circa 5 *Solaster endeca* OK, circa 10 *Evasterias* OK; 1 *Solaster "paxillatus"* OK. (Neil McDaniel)

Oct. 24/13: 9 Mile Point: 1 dead *Solaster dawsoni*. All other stars appeared OK. (still photos by Neil McDaniel).

Nov. 15/13: Sakinaw Rock: 1 dying *Solaster dawsoni*. All other stars appeared OK. (still photos by Neil McDaniel)

Sunshine Coast

Nov. 7/13: Sharpes Bay, Thulin Passage (north of Lund): 10-20% *Pycnopodia* dying or dead. *Evasterias*, *Dermasterias* and *Pisaster ochraceus* appeared OK. (still photos by Doug Swanston)

Nanaimo

Nov. 25/13: Neck Point: 21/42 dying or dead *Pycnopodia*; 2/115 dying or dead *Pisaster ochraceus*, 12 *Pisaster brevispinus* appeared OK, 10 *Evasterias troschelii* appeared OK; 4 *Orthasterias koehleri* appeared OK; 13 *Dermasterias* appeared OK; 2/97 *Mediaster* dying or

dead; 2 *Pteraster tesselatus* appeared OK; 2/14 dying or dead *Solaster stimpsoni*; 4/11 dying or dead *Solaster dawsoni*. (Andy Lamb)

Gulf Islands

Oct. 24/13: Retreat Island, west side: all stars appeared OK. (Andy Lamb)

Oct. 24/13: reef near Walker Rock: 2 dead *Pycnopodia*, 2 dying *Solaster dawsoni*. (Andy Lamb)

Nov. 10/13: Hudson Island (near Thetis Island): all stars appeared OK. (Peter Luckham)

Nov. 17/13: Burial Islet (Sansum Narrows): all stars appeared OK. (Andy Lamb)

Nov. 17/13: near Maple Bay: 30% of *Pycnopodia* dying or dead, 2 *Pisaster brevispinus* and one *Solaster dawsoni* dying. *Evasterias* appeared OK. (Andy Lamb)

Nov. 21/13: Boeing 737 plane at Chemainus: 17/22 *Pycnopodia* dying or dead; 2/78 *Evasterias* dying; 5/19 *Pisaster brevispinus* dying; 1 *Orthasterias* dying, 1 *Mediaster* OK; 1 *Dermasterias* OK. (Andy Lamb)

Saanich Inlet

Nov. 20/13: Saanich Inlet: first signs of disease showing up in *Pycnopodia*. (Alisa Preston)

Northern Strait of Georgia

Oct. 28/13: Savary Island: *Evasterias* and *Pisaster ochraceus* appeared OK intertidally.

Subtidally, 4 *Pisaster brevispinus* appeared OK. 3 dead *Pycnopodia*. *Dermasterias* appeared OK. (photos by Doug Swanston)

Puget Sound

Oct. 22/13: Pier 59: 40-60% of *Pycnopodia* dying or dead. (Jeff Christiansen)

Oct. 26/13: Pier 59: 80% of *Pycnopodia* dying or dead. (Jeff Christiansen)

Nov. 10/13: Fox Island: 30% of *Pycnopodia* dying or dead. (Karin Fletcher)

Nov. 10/13: Day Island: 30% of *Pycnopodia* dying or dead. (Karin Fletcher)

Nov. 13/13: Pier 59: 100% of *Pycnopodia* dying or dead. (Jeff Christiansen)

Nov. 15/13: Bainbridge Island: 20% of *Pycnopodia* and *Evasterias* dying or dead. (Jeff Christiansen)

Victoria

Nov. 3/13: Ten Mile Point: one dead *Pycnopodia*. (photos Jim Hestor)

Nov. 19/13: Shaw Discovery Centre. One display *Pycnopodia* dying. (Paula Romagosa, Curator)

San Juan Islands

Nov. 13/13: Anacortes Island. All stars appeared OK. (Ben Miner).

Nov. 19/13: Anacortes Island. 4% mortality. (Ben Miner)

Barkley Sound

Nov. 26/13: Rainy Bay: current populations of *Pycnopodia* appear normal. However video from Nov. 2011 and 2012 indicates wasting syndrome or something similar was present in the past.

(video by Peter Mieras, Rendezvous Dive Charters)

<https://www.dropbox.com/s/go9qab15vnktvu2/star%202011.mpg>

PATHOLOGY REPORTS

Oct. 4/13: Shellfish Health Report #8359 by the Pacific Biological Station Aquatic Animal Health Section (Gary Meyer) based on 1 *Solaster dawsoni* and 1 *Pycnopodia helianthoides* collected near Lions Bay, Howe Sound on Sept. 9, 2013 by Jonathan Martin. Microscopic and histological examination found no infectious diseases.

Oct. 4/13: Shellfish Health Report #8360 by the Pacific Biological Station Aquatic Animal Health Section (Gary Meyer) based on 4 *Solaster dawsoni*, 4 *Pycnopodia* and 2 *Evasterias troschelii* collected at the Defence Islands, Howe Sound on Sept. 19, 2013 by Doug Swanston. Microscopic and histological examination found no infectious diseases.

Nov 12/13: Cornell University Department of Microbiology (Ian Hewson). They have purified viruses from 50 sea star samples and bacteria on lesions of 16 stars. They have also extracted 162 DNA samples for bacterial fingerprinting/protozoan PCR (Polymerase Chain Reaction). This study includes samples of sea stars from Vancouver and Strait of Georgia, BC; the San Juan Islands, Seattle and Olympic Peninsula, WA and from Santa Cruz, CA. Results TBA.

Nov. 13/13: Shellfish Health Report #8361 by the Pacific Biological Station Aquatic Animal Health Section (Gary Meyer) based on 9 *Pycnopodia* and 1 *Solaster dawsoni* collected at Croker Island, Indian Arm on Oct. 9, 2013 by Doug Swanston. Histological and electron microscope ultrastructural examinations were carried out. Conclusions: “No infectious diseases were detected by histological examinations that would help to explain the cause of the mortalities. No viruses were detected in these samples using electron microscopy, however they should not be ruled out at this time as they are notoriously difficult to detect.”

REFERENCES

Bates AE, Hilton BJ, Harley, CDG 2009. Effects of temperature, season and locality on wasting disease in the keystone predatory sea star *Pisaster ochraceus*. *Diseases of Aquatic Organisms* Vol. 86:245-251.

ADDITIONAL INFORMATION

Vancouver Aquarium

www.aquablog.ca/2013/11/family-relations-in-starfish-wasting-syndrome/
www.aquablog.ca/2013/09/starfish-epidemic-in-howe-sound/

University of California at Santa Cruz

www.seastarwasting.org/

The Marine Detective by Jackie Hildering
www.themarinedetective.com

Echinoblog by Dr. Chris Mah
www.echinoblog.blogspot.com

NBC News Item
www.nbcnews.com/science/whats-eating-starfish-mystery-rot-threatens-populations-both-coasts-8C11481794

King 5 News Item
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