The progression of Sea Star Wasting Syndrome: an update

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OUTLINE:

• What is Sea Star Wasting Syndrome (SSWS)?
• Where is SSWS?
• Who is monitoring SSWS and how?
• What has been found
• What is next
Sea Star Wasting Syndrome

- General description of symptoms in 15+ spp of sea stars

- **Lesions** appear followed by tissue decay then eventual fragmentation and death
Sea Star Wasting Syndrome

- Ultimate cause not clear - microbiologists are attempting to isolate potential pathogen(s)

- Wasting first confirmed by researchers in June, 2013 in Olympic Natl. Park, WA (*Pisaster ochraceus*)

- Now reported from AK to Northern Baja

- Previous wasting events associated with El Niño (e.g. warmer water temps in S. CA 1983-84; 1997-98), fewer spp affected
How does this event differ from previous events?

- Geographic extent MUCH broader (including the East Coast – although the cause may not be the same)

- Not associated with El Niño although some affected regions appear to have experienced temperature spikes during summer 2013

- Continuing well beyond Nov. (when observations for all previous events stopped)
Species Affected

*Pisaster ochraceus*

*Leptasterias spp.*

*Patiria miniata*

*Henricia spp.*

*Dermasterias imbricata*
Species Affected

*Pycnopodia helianthoides*

*Pisaster giganteus*

*15+ spp*

*Orthasterias koehleri*

*Pisaster brevispinus*

Photo: Leanne Foster

Photo: Neil McDaniel

Photo: Feiro Marin Life Center

Photo: Neil McDaniel
Distribution of SSWS

Tracking Map:
www.seastarwasting.org

*updated frequently*

Help from citizen scientists
Progression of SSWS

a) April - June 2013
b) April - Oct 2013
c) April 2013 - Feb 2014
d) April 2013 - April 2014 (cumulative)
If the outbreak started from a **single** location its cause is likely different from a situation where there were **multiple** initiation points (**introduced...?**)
Introduced vs. Native

- If **Introduced**, where did it come from? (map can help reveal this)
- If **Native**, what factors brought about the spread of SSWS?
Who does intertidal research at UCSC

- UCSC intertidal research is conducted under the auspices of the Multi-Agency Rocky Intertidal Network (MARINE), a consortium of 32 groups that collect compatible data and enter these into a centralized database.
  - UCs/Cal State Universities
  - National/State Parks
  - CDFW
  - Navy
  - Private Consulting Agencies

- Long-term monitoring and coastal biodiversity surveys
Long-Term Sea Star Monitoring

• Typically 3 permanent plots (per site) established in areas of high *Pisaster ochraceus* density

• For each individual:
  – Record size
  – Record disease category: 0-4 (based on Bates et al. 2009)
  – Protocol on [seastarwasting.org](http://seastarwasting.org)

• Species other than *Pisaster ochraceus* counted, not measured (disease category noted)

• Disease also being recorded during biodiversity surveys
Surveys: Preliminary Results

- As of March, SSWS has been observed at 68 of 106 (64%) long-term MARINe monitoring sites surveyed since summer 2013

- Extent of impact varies by region and can be patchy
Long-Term Monitoring: Sea Star Counts

Long Term Monitoring Survey – Sum of species count in pisaster plots at Terrace Point

pacificrockyintertidal.org
Long-Term Monitoring: Sea Star Sizes

Long Term Monitoring Survey – Size Frequency of Species in pisaster plots at Terrace Point

pacificrockyintertidal.org
Long-Term Monitoring: Sea Star Counts

[Bar chart showing sea star counts by season for Scott Creek, including categories for adult and juvenile sea stars.]
Hopkins Case Study

• Sampled Oct. 18, 2013: no sign of SSWS, abundances in plots within “normal” fluctuations documented since establishment in 1999

• Resampled Nov. 5: about 50% of ochre stars (*Pisaster ochraceus*) **diseased**

• Overall, abundance **lower** than 14 years of preceding data

• Also received reports that sunflower stars (*Pycnopodia helianthoides*) had been abundant subtidally before, but during more recent dives, **none** were observed
Rapid Assessment Surveys

- **Reconnaissance** of areas not regularly sampled and/or areas of special interest
  
  - Funded by Ocean Science Trust (OST)
  - North Coast and North Central Coast (Pigeon Point to OR border)
  - Southern CA
Subtidal Surveys

• 24 sites between Santa Cruz and Point Conception have been/are being surveyed (along with 13 sites in WA) to detect and track sea star wasting

• Protocols similar to intertidal protocols (i.e. differentiate by size class and disease stage)

• Observations suggest large, soft-bodied, subtidal spp may be harder hit than intertidal individuals (faster)
20 days later
What’s next?

• The impact of SSWS on the biological community needs to be assessed.

• *Pisaster ochraceus* is the basis of the **Keystone Species Concept** because of its potential to dramatically alter the rocky intertidal community in which it occurs.
Pathogen Studies

• Investigating candidate viruses, bacteria, and protozoa (and/or interactions between these) – no confirmed culprits

  – We have sent tissue samples to researchers at Cornell University (Harvell & Hewson)

  – Other groups are doing pathogen analyses: Univ. of Rhode Island (Gomez), Brown (Wessel), Roger Williams, Seattle Aquarium
There has been substantial speculation that the disease could be from increased radiation due to the nuclear power plant disaster in Fukushima, Japan. There is NO evidence to suggest that radiation is a cause of wasting syndrome.
Infectiousness Experiments

• Animals with visible symptoms of wasting are being combined with apparently healthy individuals to test for infectiousness (Ben Miner)

• Early results suggest animal to animal transmission and perhaps also through water
Arm Regrowth/Healing and Recruitment Pulse?
Other Sea Star Wasting Resources:

- Vancouver Aquarium
  - vanaqua.org/act/research/sea-stars

- iNaturalist
  - inaturalist.org/projects/pisaster-disaster-tracking-starfish-wasting-disease

- http://www.sickstarfish.com

THANK YOU

Cabrillo Marine Aquarium
Cabrillo National Monument
California Department of Fish and Wildlife
California Ocean Protection Council
California State Parks
Channel Islands National Park
Citrix Online
Comunidad y Biodiversidad
Golden Gate National Parks
Gulf of the Farallones NMS
Monterey Bay National Marine Sanctuary
Nature Conservancy
National Estuarine Research Reserve System
National Oceanic and Atmospheric Administration
North Pacific Research Board
Olympic Coast National Marine Sanctuary
Olympic National Park
Oregon State Parks
Point Reyes National Seashore
Quinault Indian Nation
Redwood National and State Park
Southern California Coastal Water Research Project
Tatman Foundation
United States Navy
University of California Institute for Mexico and the US
University of California Natural Reserve System
Washington State Department of Ecology
Wrigley Institute for Environmental Studies, USC
Primary Funders

The Bureau of Ocean Energy Management

The National Park Service

Partnership for Interdisciplinary Studies of Coastal Oceans

Sea Grant
Sea Star Sizes

Protocol and datasheet available at seastarwasting.org
Disease Severity Categories:
0-4 based on Bates et al. 2009

Category 0
Healthy!
Category 1:

Lesion(s) on 1 arm or body
Category 1

NOT a lesion (madreporite)
Category 2: lesions on 2 arms or 1 arm and body and/or deteriorating arm(s)

- Arm starting to separate
- Tissue deteriorating on 2 arms
Category 3: lesions on most of body, 1-2 missing arms

- Missing tips of 2 arms, lesion on 3rd
- Missing 1 arm
- Tissue deterioration on 2nd arm
- Missing 1 arm
Category 4: severe tissue deterioration/death, >3 missing arms

- Missing tips of all arms
- Missing most arms
Category 4

Lesions throughout arms & body

Missing 2 arms and tip of 3rd; multiple lesions on arms & body
http://www.youtube.com/watch?v=mjrp3Eckr-E
Citizen Science

• Concerned/interested individuals to organized groups

• Citizen Scientists greatly expand our spatial and temporal coverage (important where there are fewer long-term monitoring sites)

• Important even if no signs of disease are present
  – Tracking logs (individuals)
  – Train already-established CS groups to ID sea stars and incorporate MARINe protocols (count, measure, assign disease category)
  – Intertidal and Subtidal datasheets
Tracking Log: How to Report Wasting Syndrome

• For sites without permanent plots (send photos, wash hands after sampling, etc)

• Download from seastarwasting.org

• Record observations of both affected and healthy species—will be uploaded to Wasting Syndrome Map
Site Summary:

- **Site Name**: Croker Island
- **Sea Star wasting symptoms present**: yes
- **Disease First Observed**: 10/9/2013
- **Last Sample Date**: 10/29/2013
- **Species affected**: Pisaster ochraceus, Pycnopodia helianthoides, Pisaster brevispinus, Evasterias spp, Solaster spp
- **Location type**: subtidal
- **Submitted by**: Neil McDaniel, Neil McDaniel Photography and Cinematography
• Metagenomics used to identify possible viruses and bacteria that could be causative agents. Much better at detecting a more complete catalog of the microbial community than traditional sequencing techniques.
• Suspected pathogens then screened for in “healthy” and sick samples using less expensive PCR