pacificrockyintertidal.org

The progression of Sea Star Wasting Syndrome: an update

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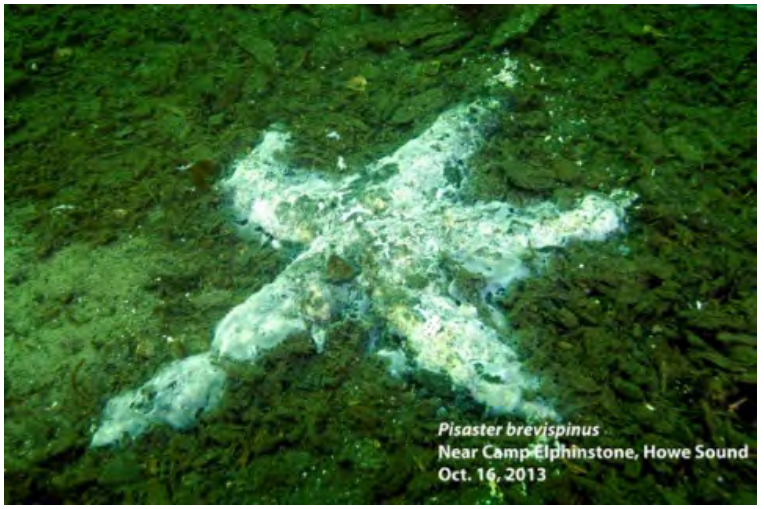
OUTLINE:

- 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)

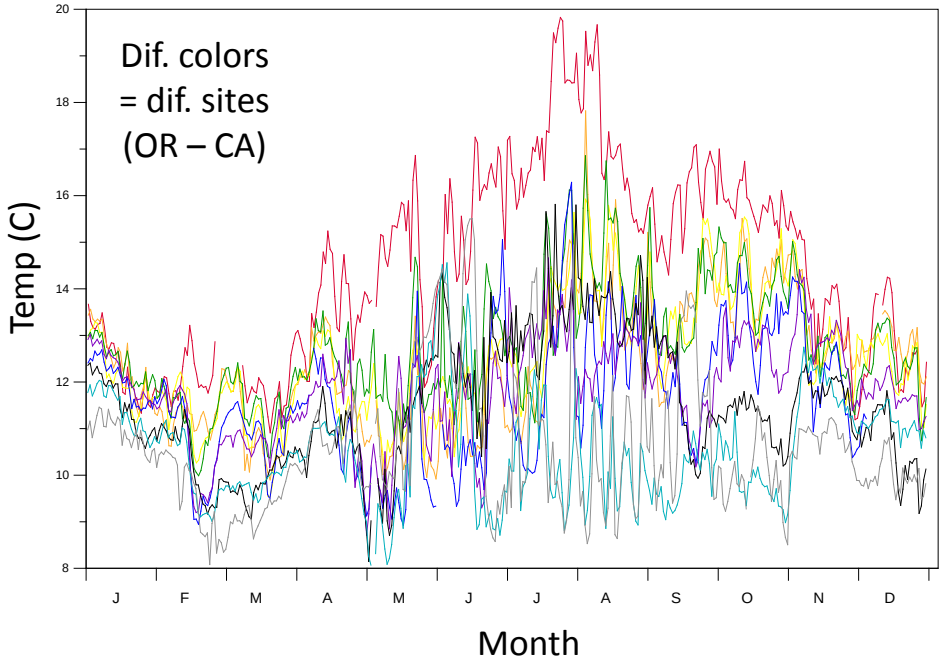
- Wasting first confirmed by researchers in June, 2013 in Olympic Natl. Park, **WA** (*Pisaster ochraceus*)

- 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

Photo: Steve Fradkin

Patiria miniata

Photo: Freya Sommer

Leptasterias spp.

Photo: Steve Fradkin

Henricia spp.

Photo: Laura Anderson

Dermasterias imbricata

Photo: Nate Fletcher

Species Affected

Pycnopodia helianthoides

Photo: Neil McDaniel

Pisaster giganteus

Photo: Leanne Foster

15+ spp

Orthasterias koehleri

Photo: Feiro Marin Life Center

Pisaster brevispinus

Photo: Neil McDaniel

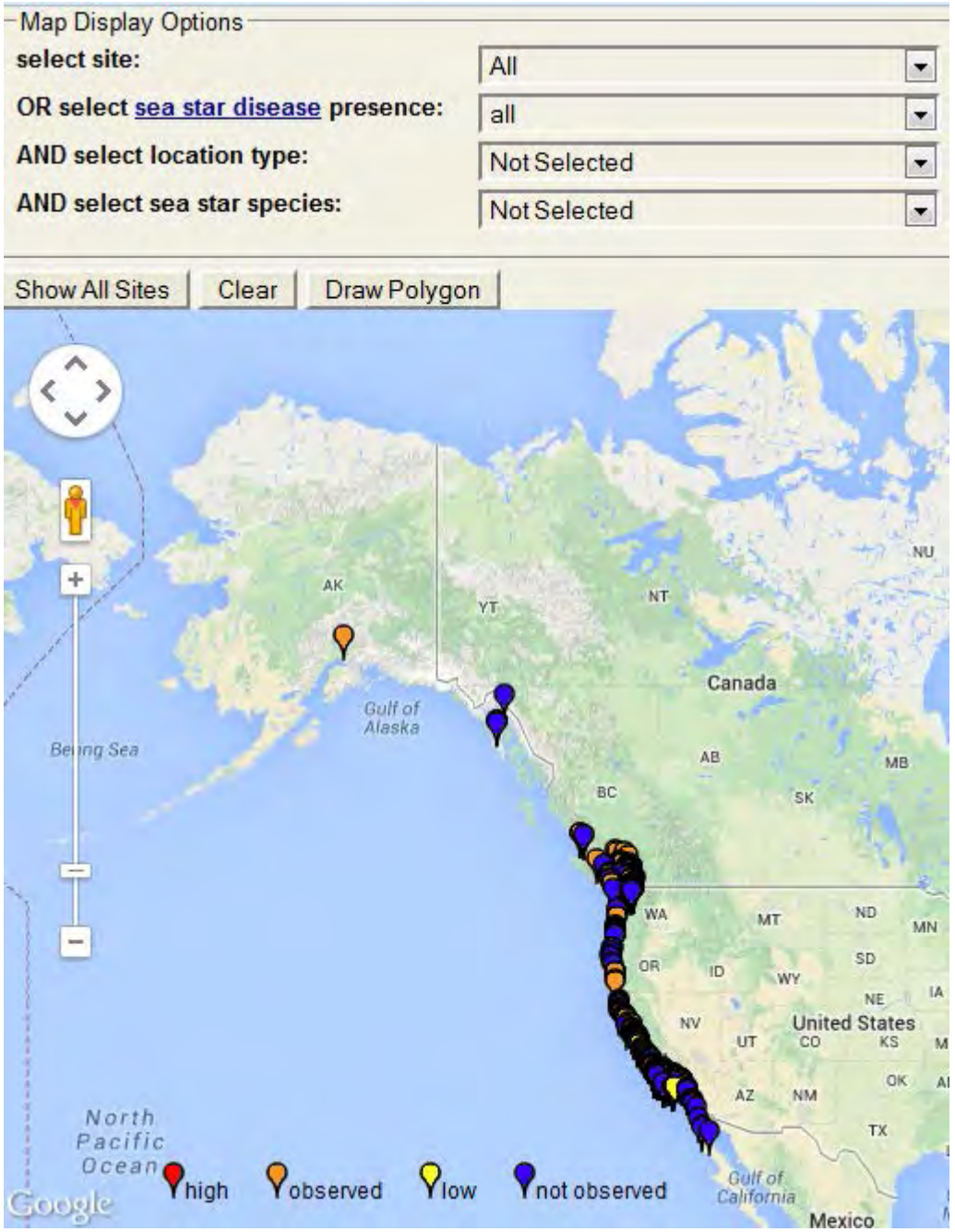
Distribution of SSWS

Tracking Map:

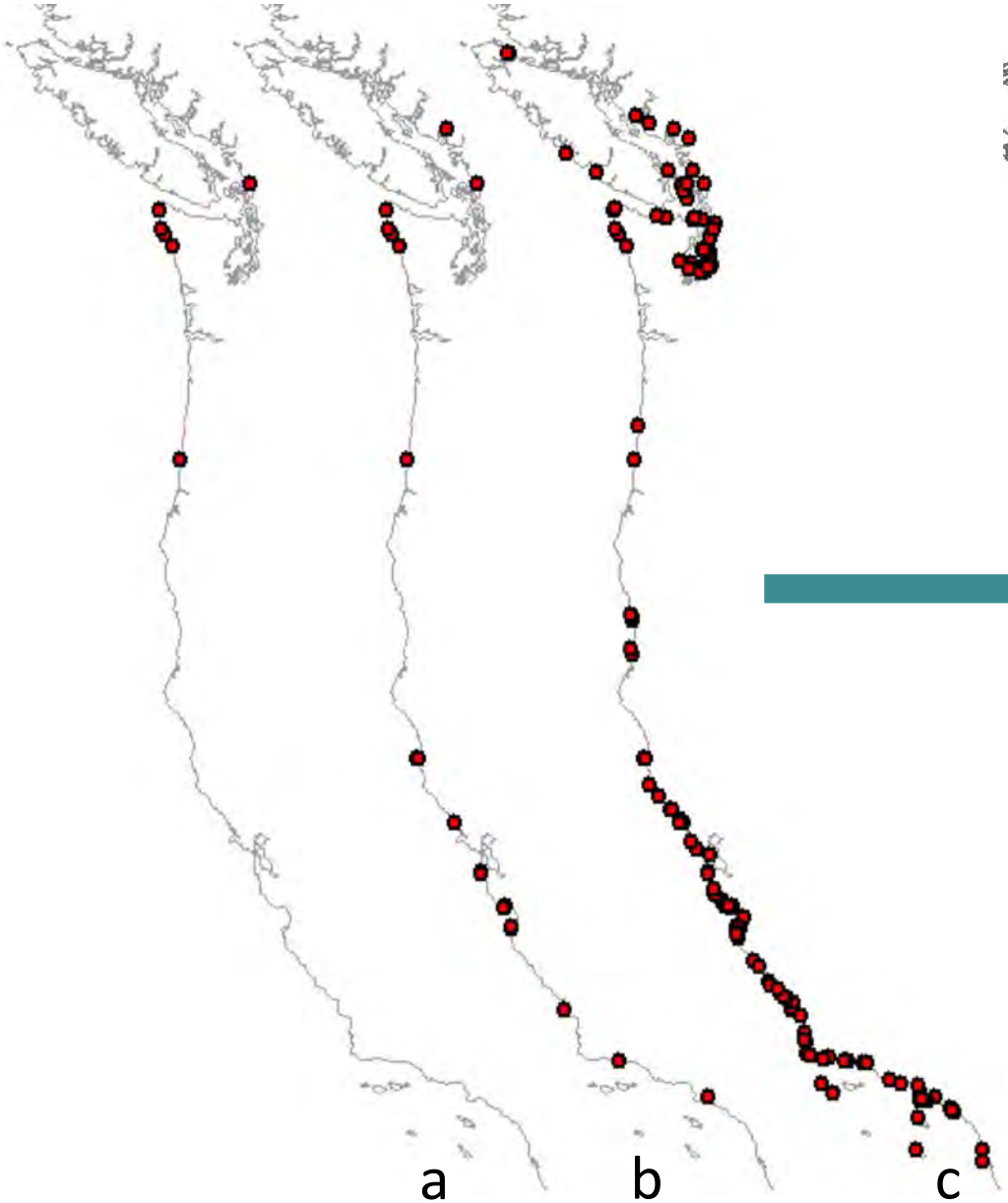
www.seastarwasting.org

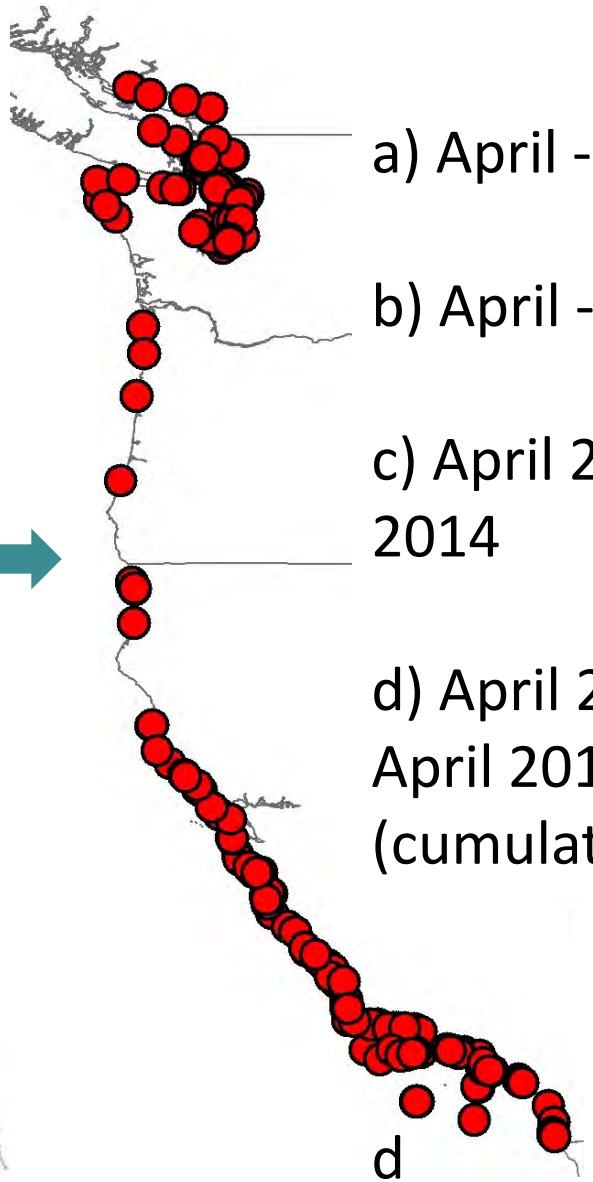
updated frequently

Help from citizen scientists



Progression of SSWS





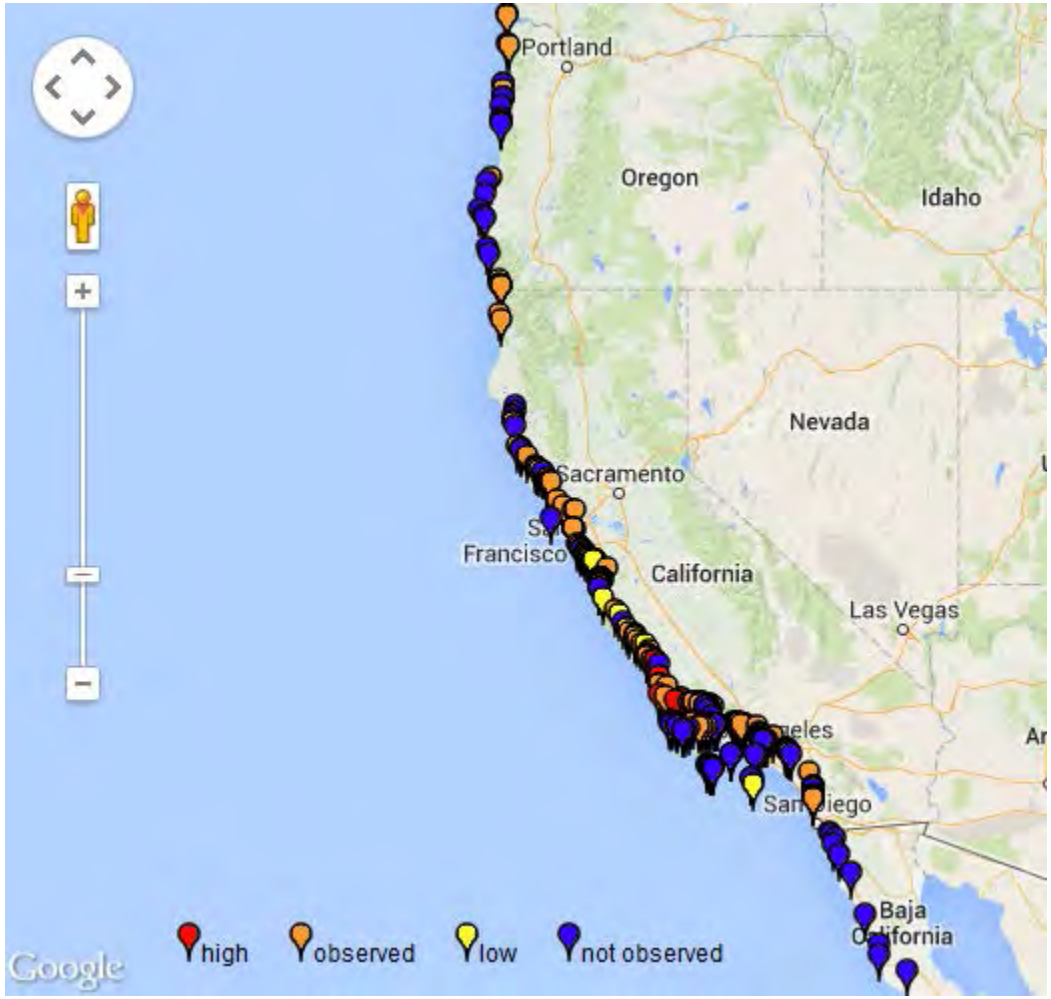
a) April - June 2013

b) April - Oct 2013

c) April 2013 - Feb 2014

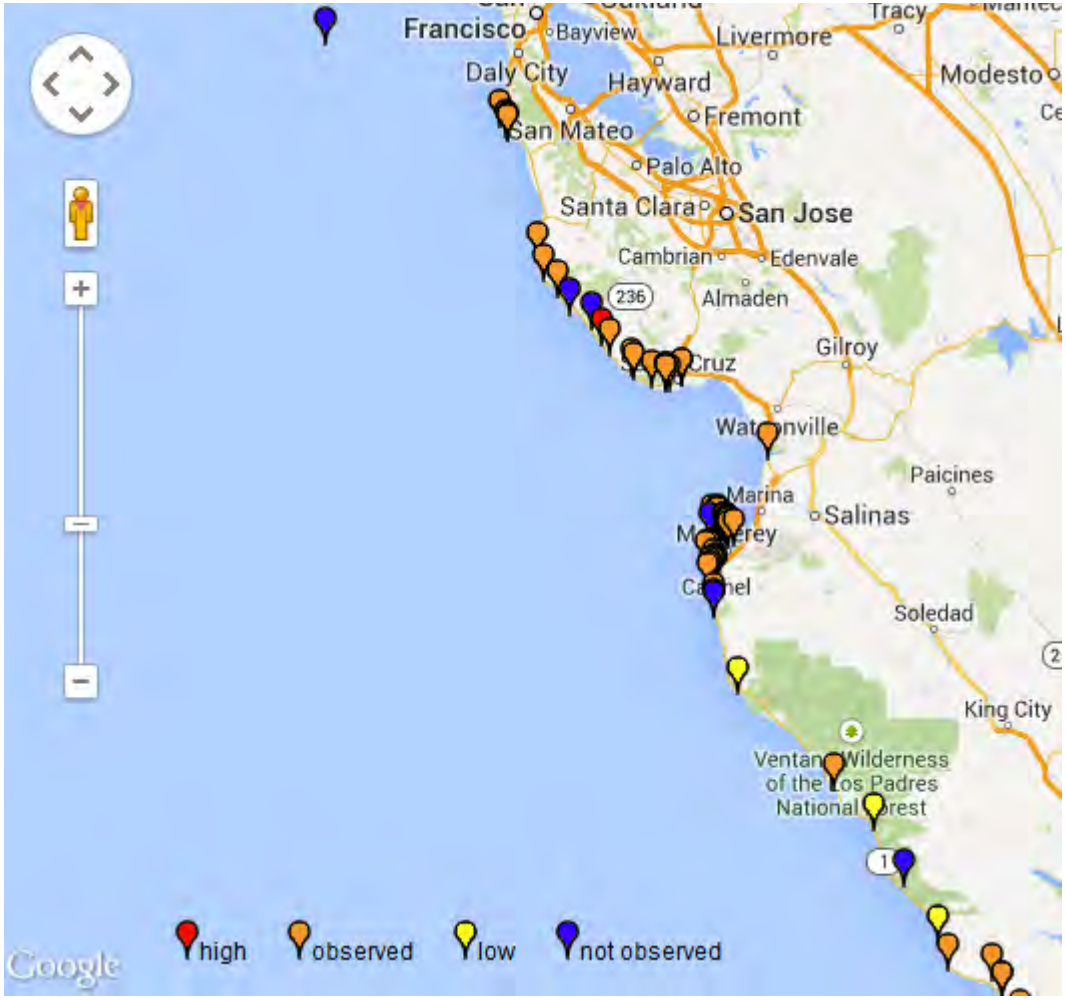
d) April 2013 - April 2014 (cumulative)

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

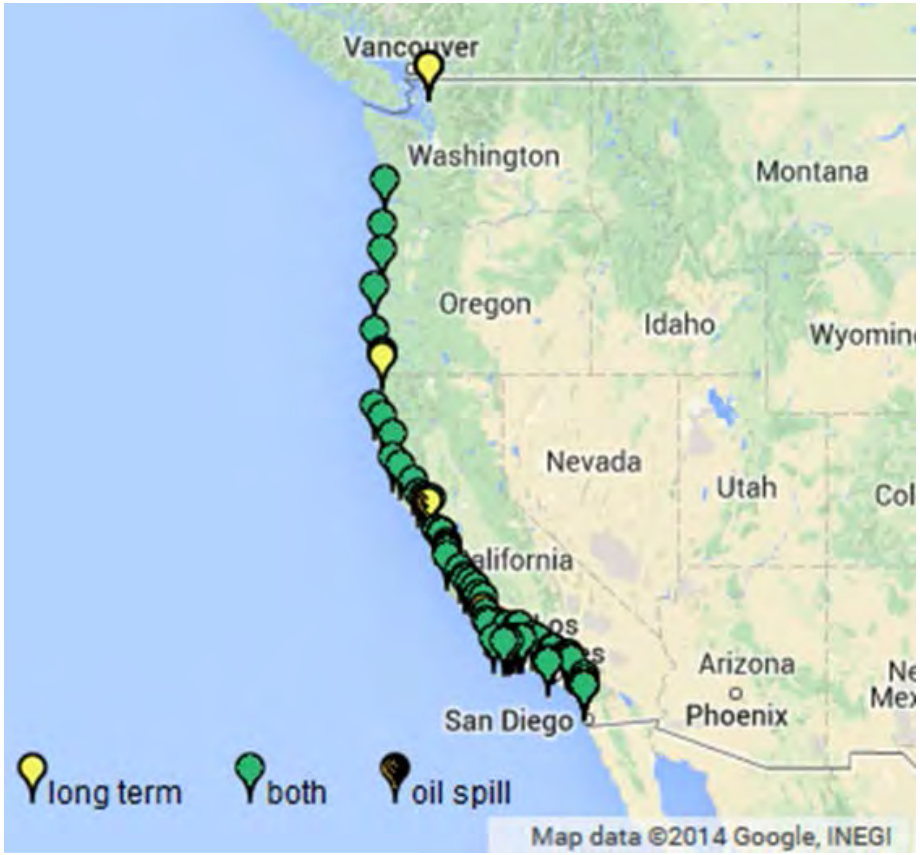
- Species other than *Pisaster ochraceus* counted, not measured (disease category noted)

- Disease also being recorded during biodiversity surveys

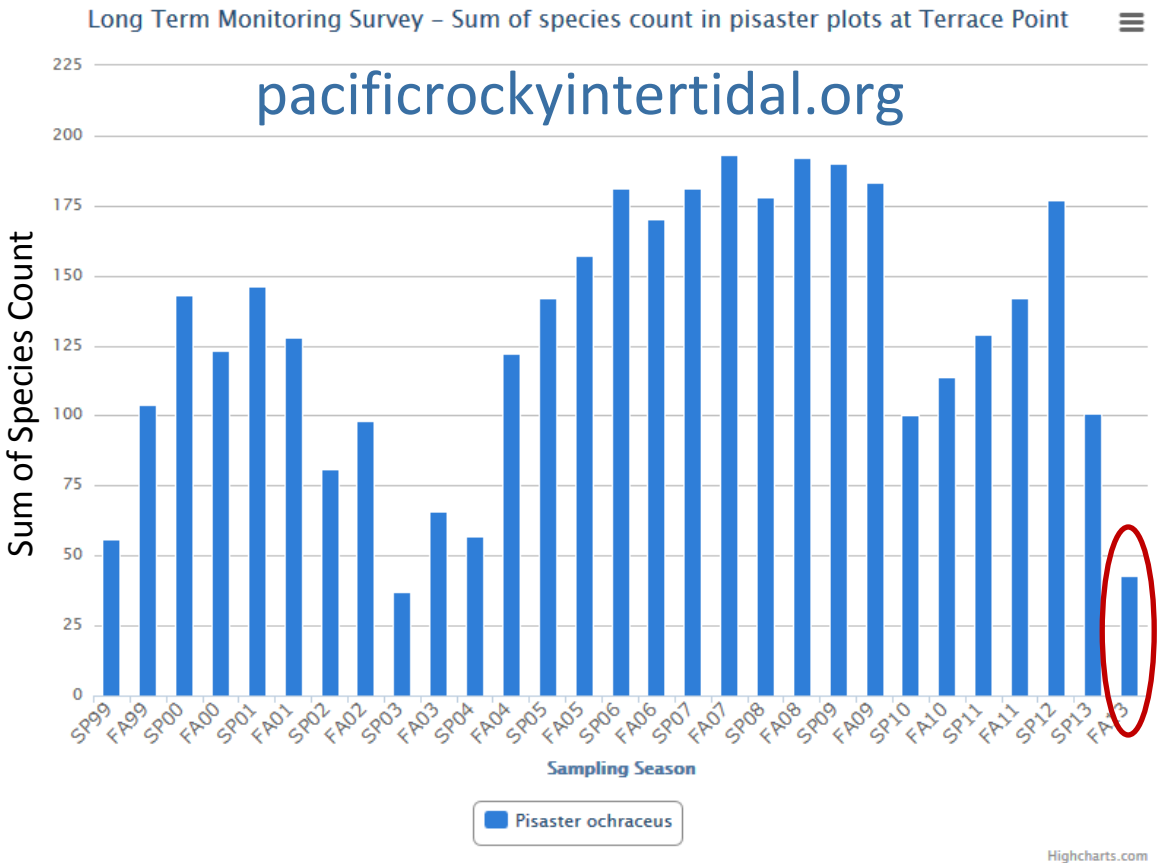
Surveys: Preliminary Results

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

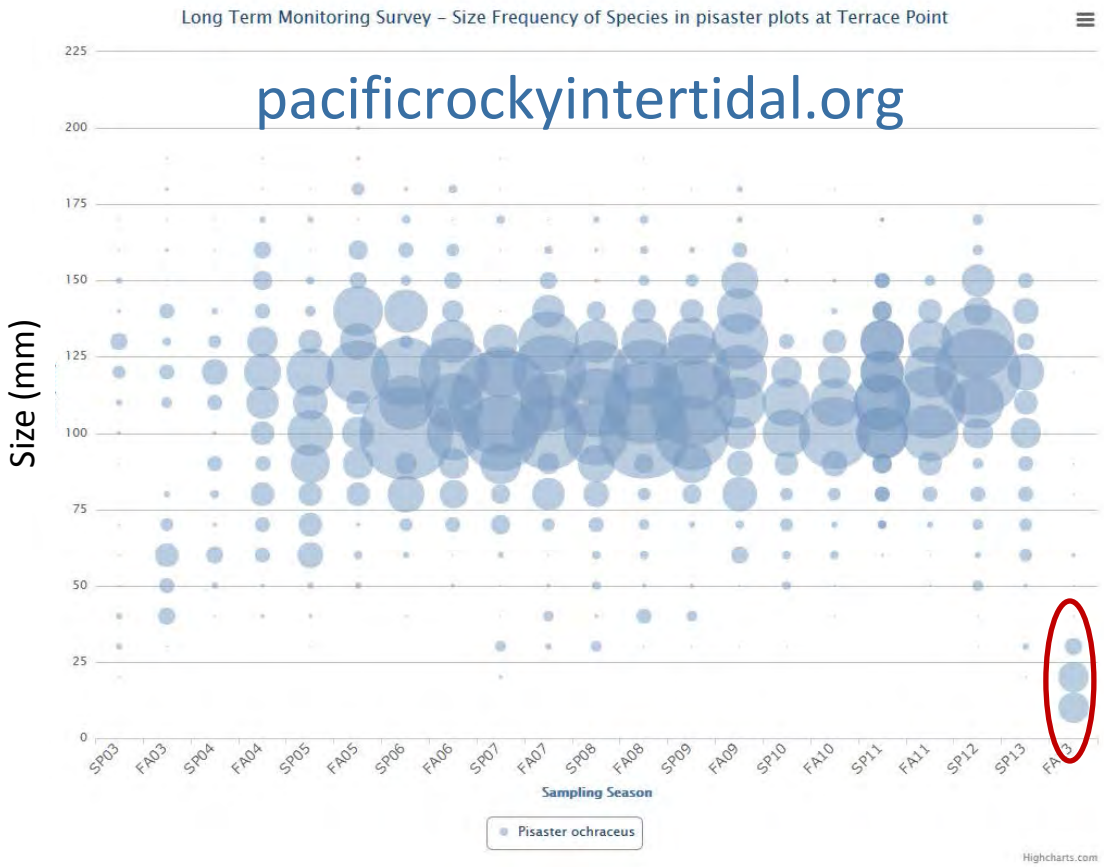
- Extent of impact varies by region and can be patchy



Long-Term Monitoring: Sea Star Counts

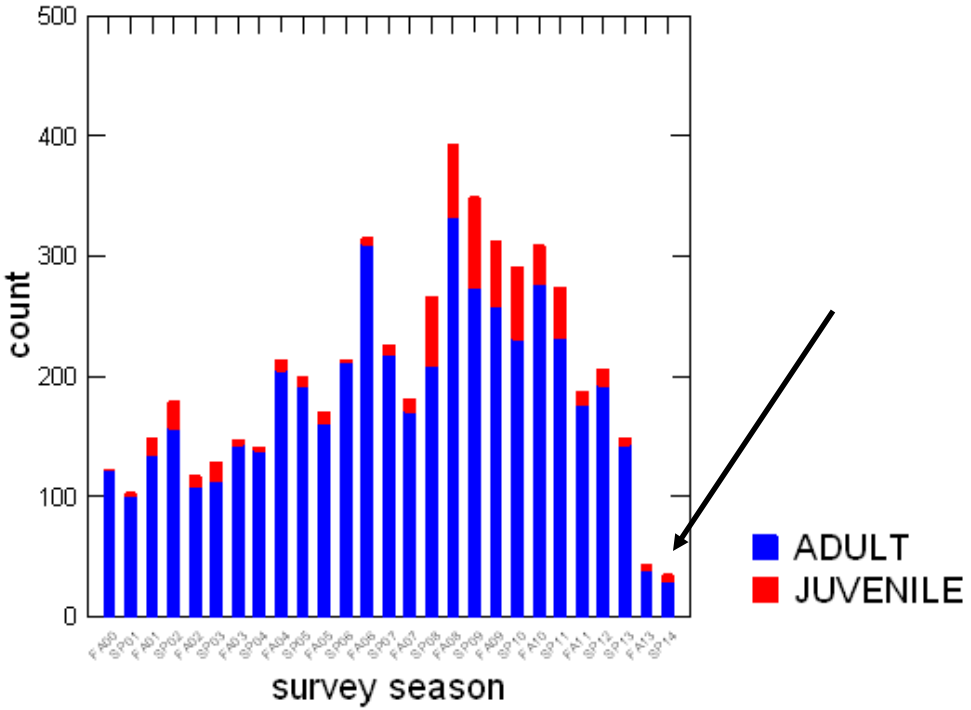


Long-Term Monitoring: Sea Star Sizes



Long-Term Monitoring: Sea Star Counts

scott creek



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

Ocean Science Trust

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
Rock outcrop #1
Croker Island, Indian Arm
Oct. 29, 2013
Neil McDaniel photo

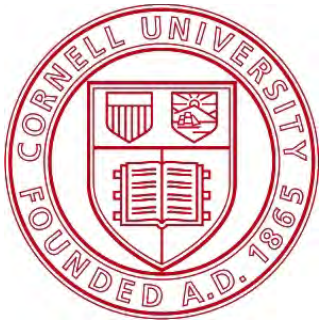
What's next?

- 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



Pathogen Studies

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.

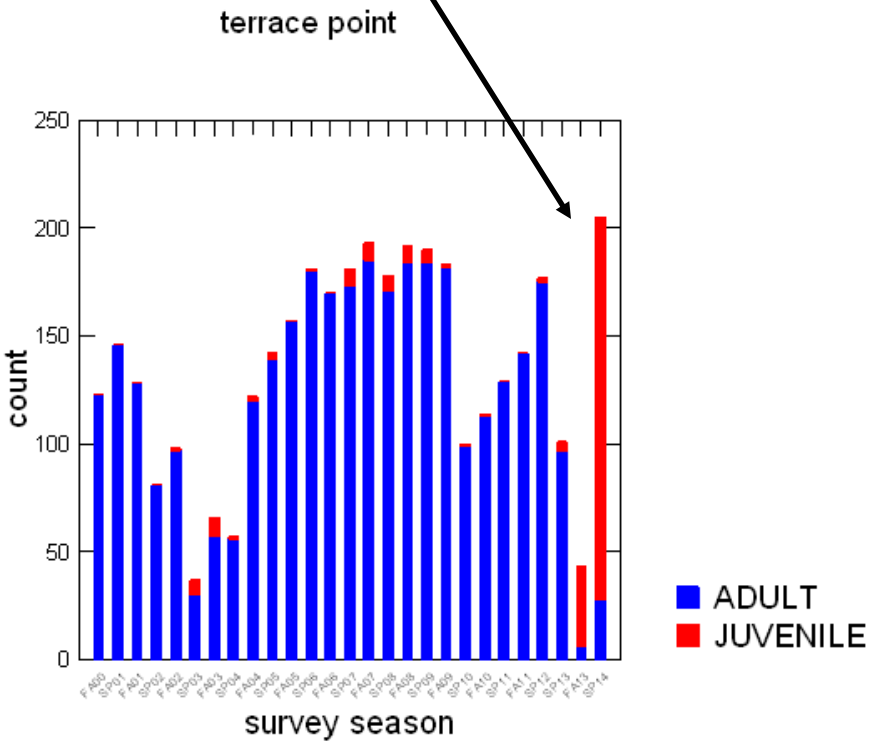
Infectiousness Experiments

- 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

WESTERN
WASHINGTON UNIVERSITY

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
- http://echinoblog.blogspot.com/2013/09/starfish-wasting-disease.html

pacificrockyintertidal.org

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

pacificrockyintertidal.org

Primary Funders

BOEM
Bureau of Ocean Energy Management

The Bureau of Ocean Energy Management

National Park Service

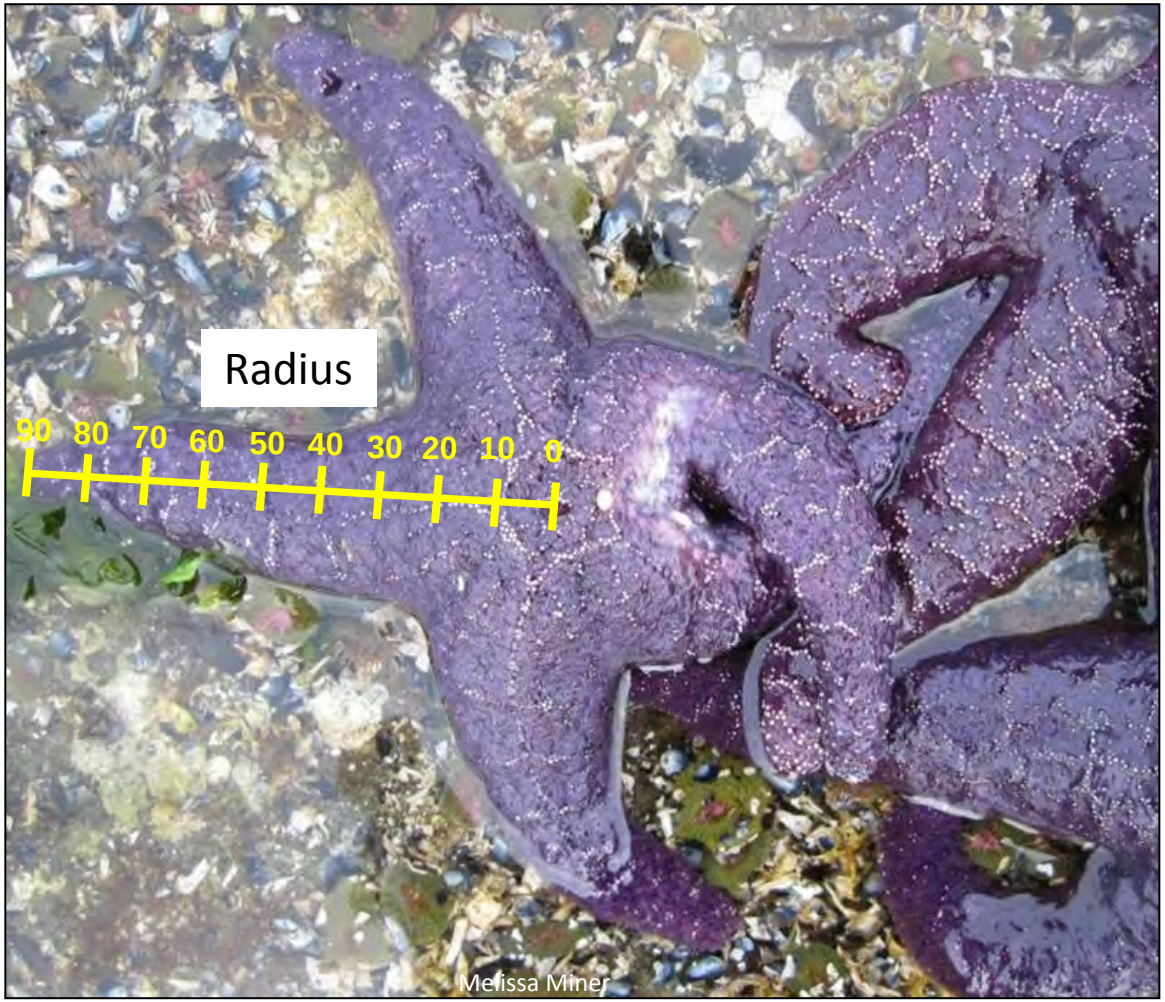
The National Park Service

Partnership for Interdisciplinary Studies of Coastal Oceans

Sea Grant California
Coastal Science Serving California

Sea Grant

Sea Star Sizes



Protocol and datasheet available at seastarwasting.org

Disease Severity Categories:

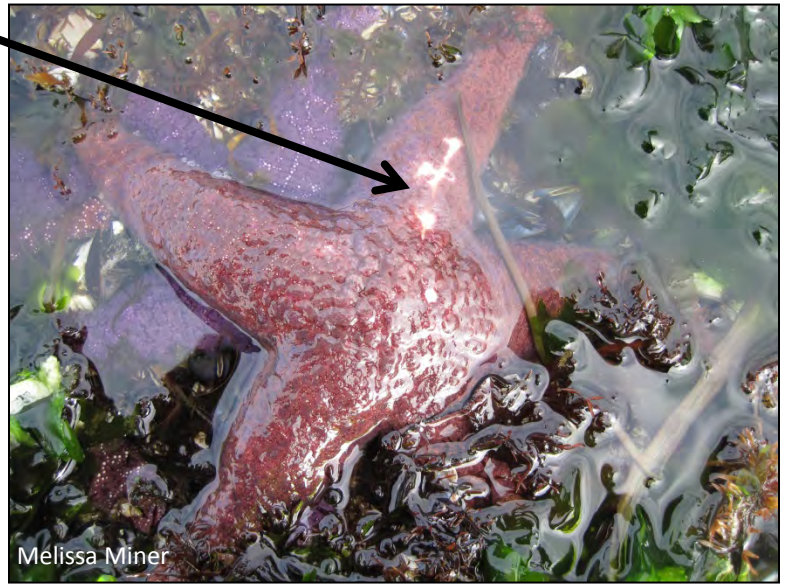
0-4 based on Bates et al. 2009

Category 0

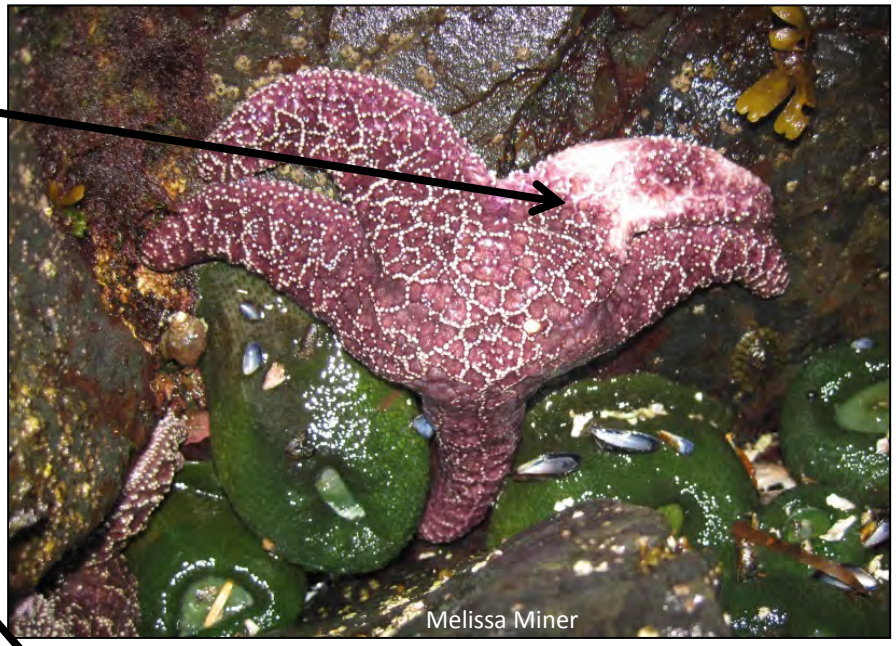
Healthy!

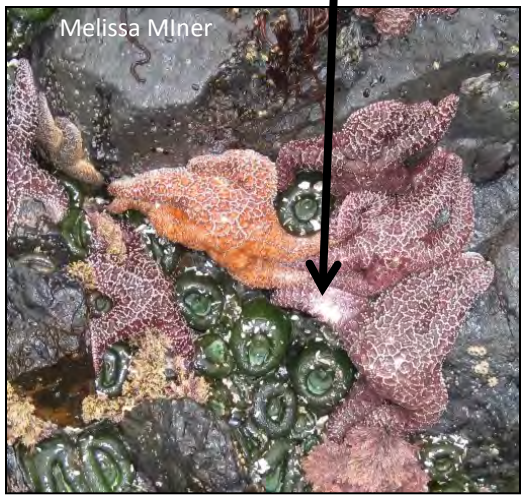
Category 1:

Lesion(s) on 1 arm or body

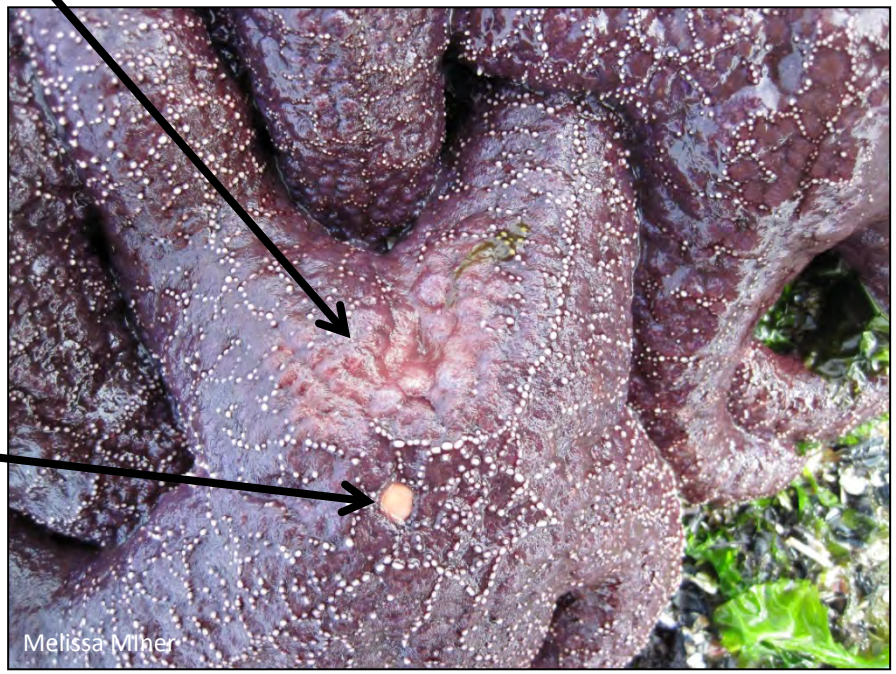


Category 1

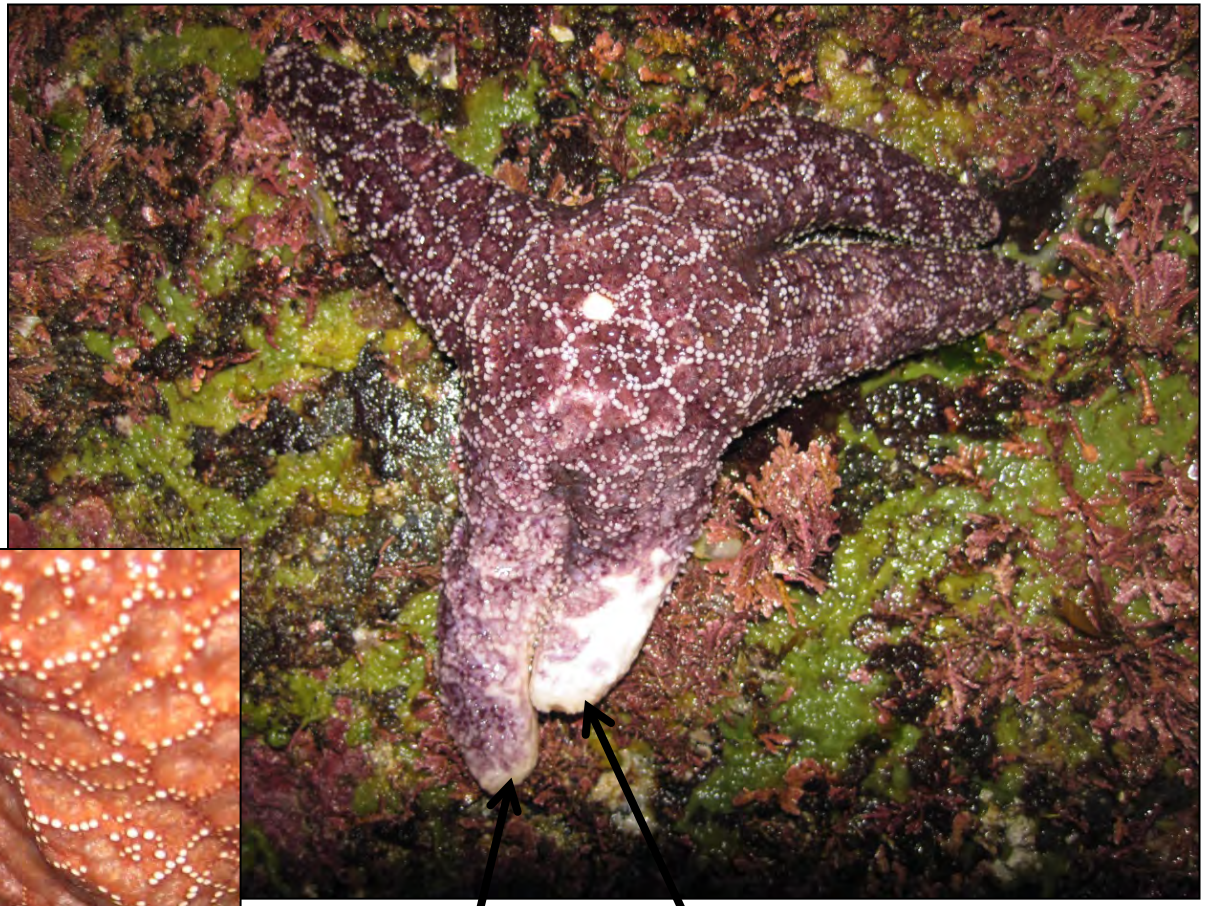




NOT a lesion
(madreporite)



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

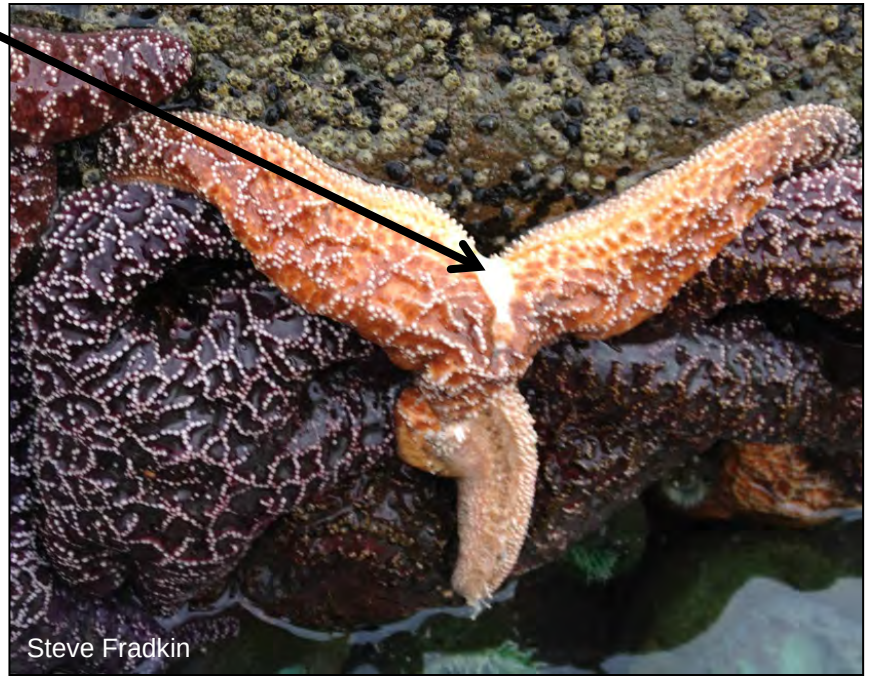
Tissue deterioration on 2nd arm

Missing 1 arm

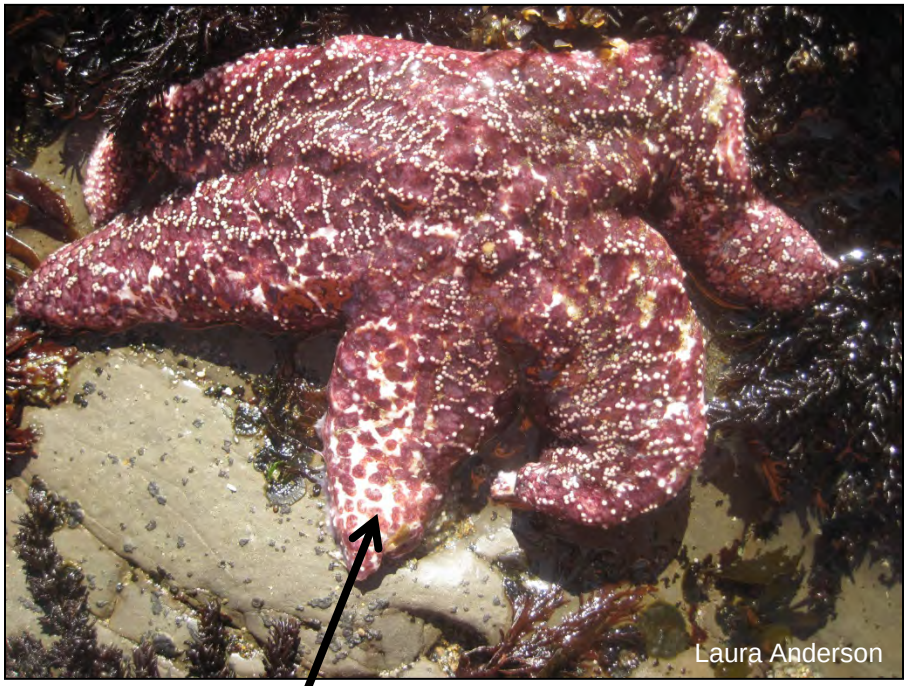
Category 4: severe tissue deterioration/death, ≥3 missing arms

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

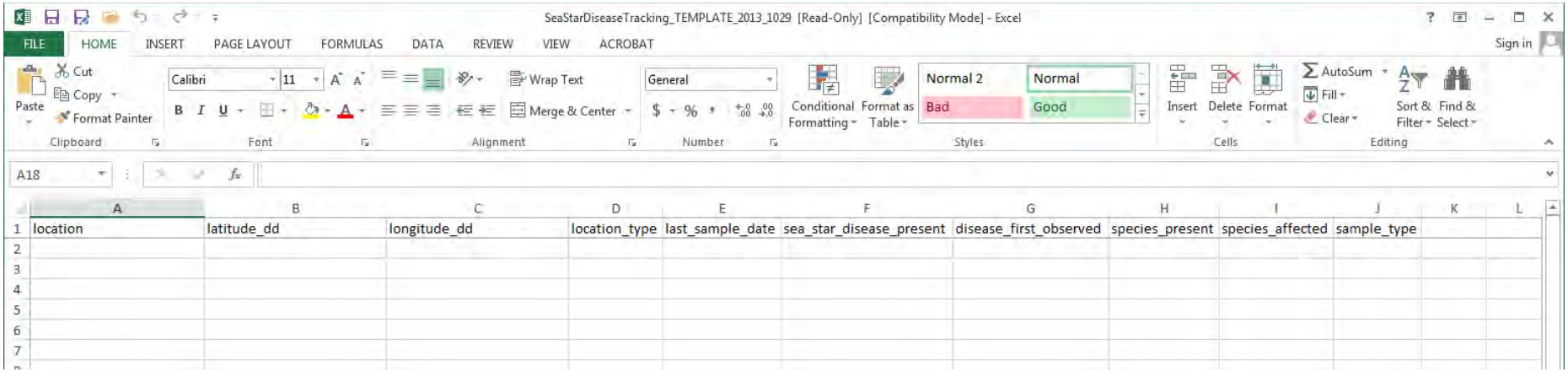
http://www.youtube.com/watch?v=mjrp3Eckr-E

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



Map Display Options

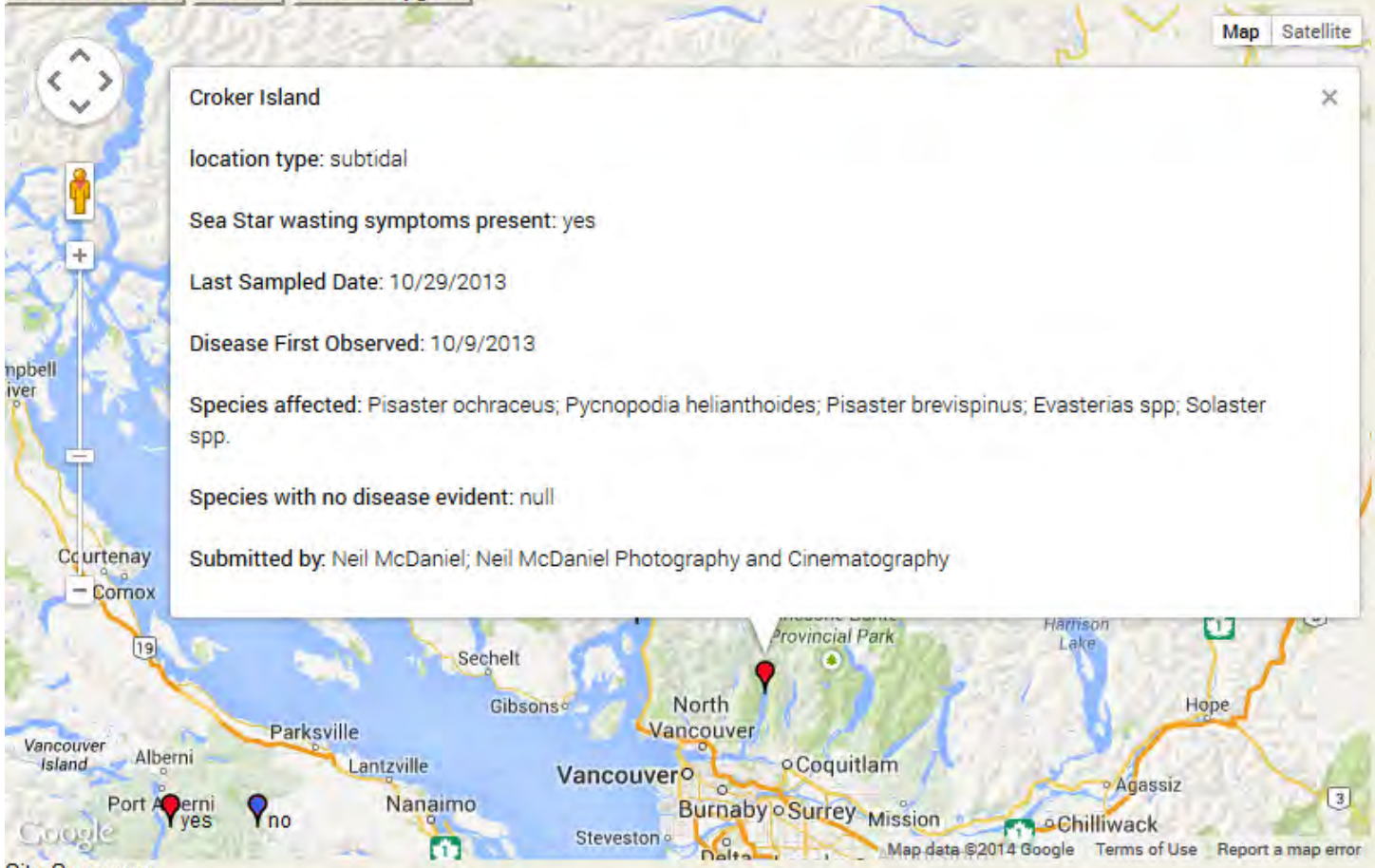
select site: All

OR select sea star disease presence: all

AND select location type: Not Selected

AND select sea star species: Not Selected

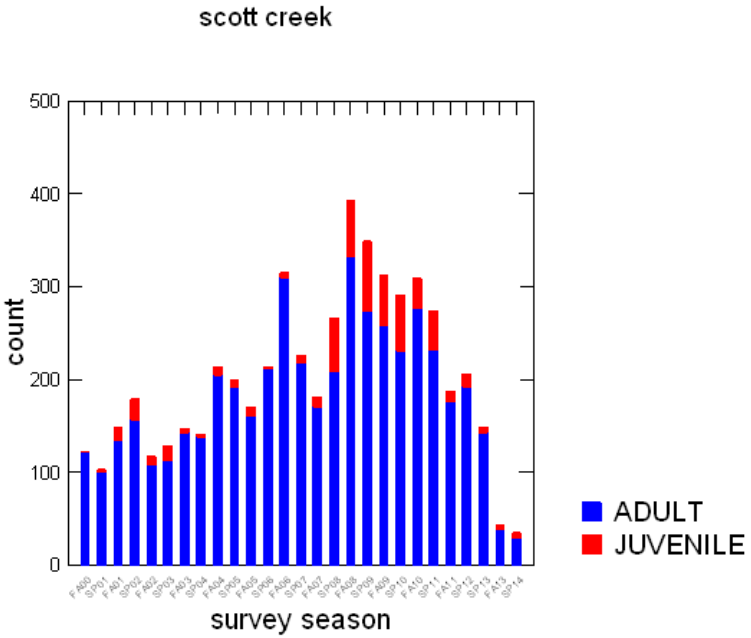
Show All Sites | Clear | Draw Polygon

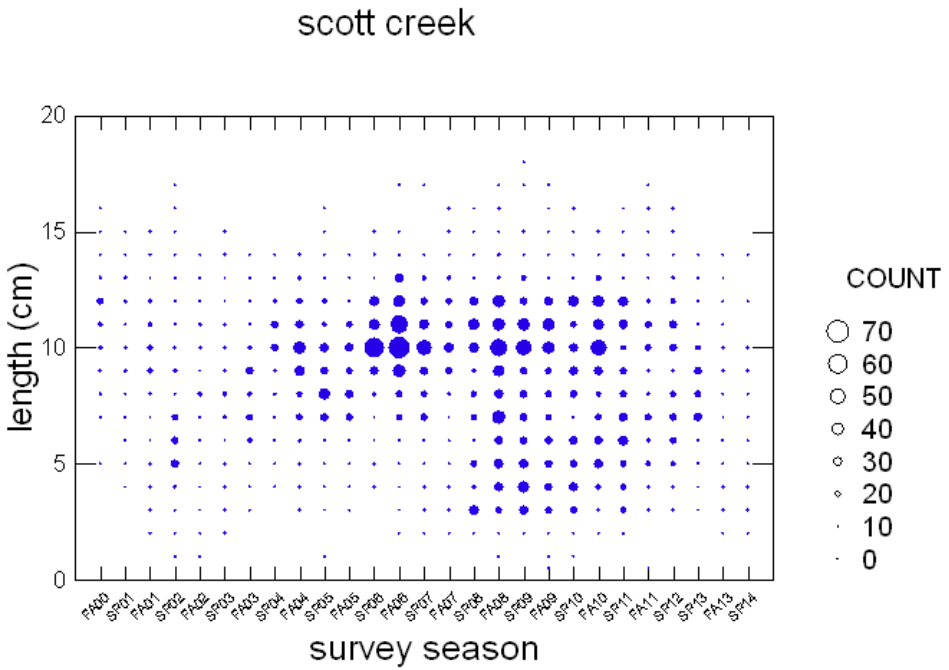


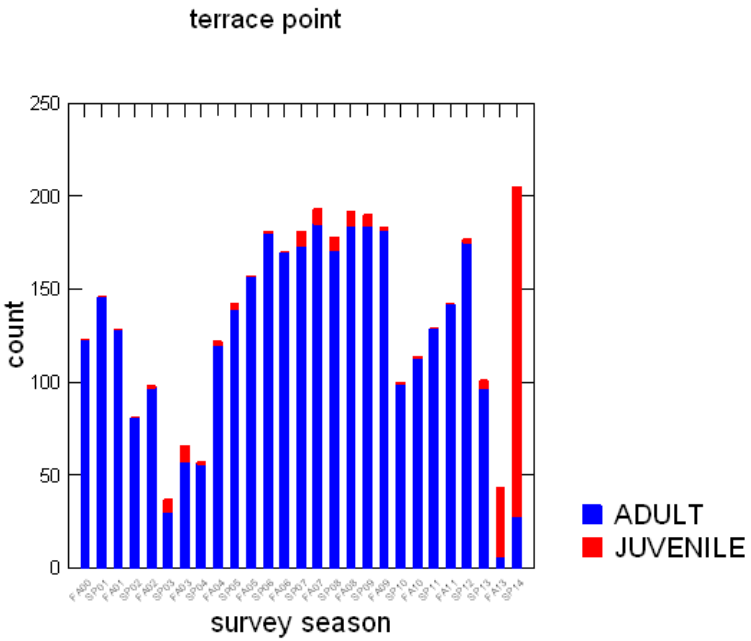
Site Summary:

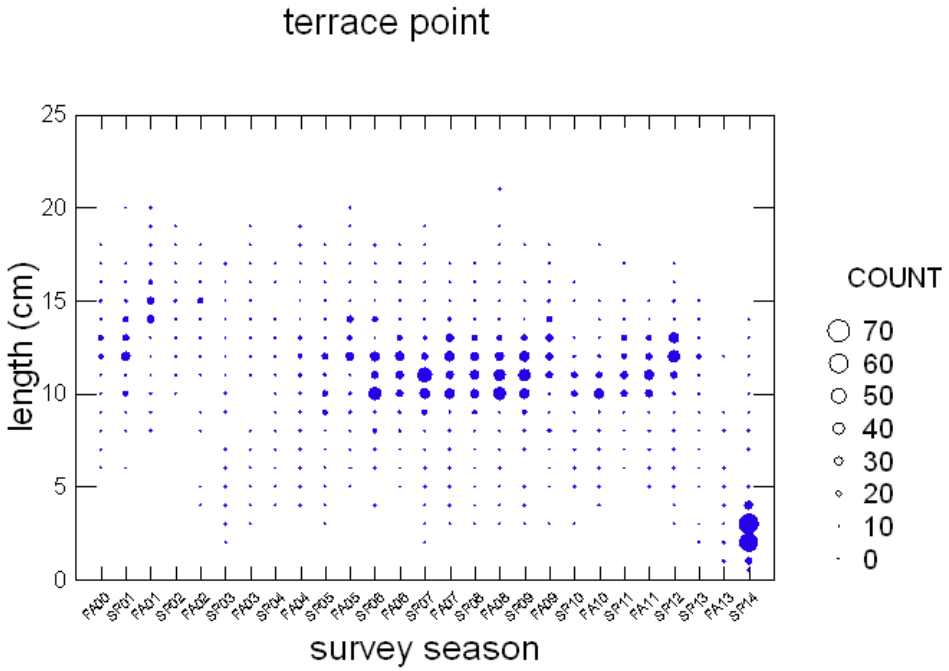
site name	Croker Island
Sea Star wasting symptoms present	yes
Disease First Observed	10/9/2013
Last Sampled Date	10/29/2013
Species affected	Pisaster ochraceus; Pycnopodia helianthoides; Pisaster brevispinus; Evasterias spp; Solaster spp.

Aaron Dufault, Abby Nickels, Allison Gong, Amy Dean, Angela Johnson, Ann Scarborough Bull, Ann Wasser, Ari Freedman, Avrey Parsons-Field, Betsy Steele, Bill Gomez, Brian Youngstrom, Callie Mack, Catherine Drake, Claudette Dorsey, Cristoph Pierre, Dan Schwartz, Daniel Clemens, Denise Boniface, Dida Kutz, Drew Harvell, Ellika Crichton, Emily Carrington, Fonseca Franco, Freya Sommer, Gabriela Montano, Gavin Wuttken, Gayle van Leer, Glenn VanBlaricom, Helle Anderson, Jackie Hildering, Jackie Patay, Jackie Sones, James Watanabe, Jason Adelaars, Jan Kocian, Janna Nichols, Jared Figurski, Jay Smith, Jeff Adams, Jeff Goddard, Jeff Harris, Jeffrey Zankel, Jennifer Burnaford, Jenny Schefski, Jeremy Long, Jessie Altstatt, Jim Lyle, Jim van Gogh, Joe Tzyburczy, Joe Weiss, Joel Elliott, John Gross, John Pearse, John Sayers, Joseph Gaydos, Joshua Sera, Judy Jordan-Biesele, Justine Maybee, Kate Melanson, Kelly Andrews, Katrine Heuer, Ken Bondy, Ken Collins, Ken Loomis, Kenneth Viknair, Kevin Lafferty, Kevin Lee, Kim Coonen, Kirby Johnson, Laura Jurgens, Laura Rogers-Bennett, Leanne Foster, Liam Antrim, Liam Zarri, Lisa Hall, Lorna Claerbout, Luke Miller, Maradel Gale, Mark Neyer, Marm Kilpatrick, Matt Robart, Mathew Phillips, Matthew Hoehn, Megan Wood, Michael Behrens, Michael Guardino, Michelle Beaudry, Mike Schaadt, Morgan Eisenwood, Neil McDaniel, Nicole Abeln, Patrick Webster, Peter Macht, Richard Cranor, Ron Kacmarcik, Rouvaishyana, Russel Barsh, Ryan Stephenson, Santiago Polo, Shannon Jarrell, Steve Clabuesch, Steve Lee, Steve Rubin, Steve Simmons, Steve Tuckerman, Steven Morgan, Stephen Whitaker, Tara Troyer, Tim Herrlinger, Tristin McHugh, Wendell Wood, Wyatt Patry, Yvette Ralph, and many others


scott creek
count
survey season
ADULT
JUVENILE


scott creek
length (cm)
survey season
COUNT
70
60
50
40
30
20
10
0


terrace point
count
survey season
ADULT
JUVENILE


terrace point
length (cm)
survey season
COUNT
70
60
50
40
30
20
10
0

- 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