

## Completion Report

Period: 2/1/2014 - 1/31/2015

**Project: R/HCE/PD-1 - *Proposal to assess the prevalence and virulence of sea star Wasting Syndrome along the Washington Coast***

### STUDENTS SUPPORTED

*No Students Reported This Period*

### CONFERENCES / PRESENTATIONS

Newton, A.L, I. Hewson, C.D. Harvell, C. Burge, M. Garner, E. LaDouceur, S. Knowles, S. Frasca Jr, R.

Smolowitz, T.M. Work, B. Miner, M. Miner, P. Raimondi, L. Lahner, M. Haulena, M. Murray, J.K.

Gaydos, and J. Wynne. 2014 The Pacific Coast Sea Star Mortality Event: Current Status of the

Ongoing Investigation. Wildlife Disease Association, Albuquerque, NM, public/profession presentation, 100 attendees, 2014-02-01

Moritsch, M., J. Maynard, D. Harvell, M. Miner, R. Gaddam, and P. Raimondi. 2014. Identifying

environmental and anthropogenic factors associated with sea star wasting disease through largescale

geospatial analysis. Poster at the Monterey Bay National Marine Sanctuary Currents Symposium. Seaside, CA, public/profession presentation, 200 attendees, 2014-02-01

Miner, C.M. 2014 Sea Star Wasting Syndrome: detecting, tracking and following the progression.

ReSources for Sustainable Communities, Bellingham, WA., public/profession presentation, 20 attendees, 2014-02-01

Anderson, L., C.M. Miner, R. Gaddam, and P. Raimondi. 2014. Sea star wasting syndrome: Detecting and

tracking the progression. Poster at Point Lobos State Natural Reserve Underwater Parks Day.

Carmel, CA, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2014 Sea Star Wasting Syndrome: detecting, tracking and following the progression. Port

Townsend Marine Science Center, Port Townsend, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2014 Sea Star Wasting Syndrome: detecting, tracking and following the progression. Padilla

Bay National Estuarine Research Reserve, Mount Vernon, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2014 Sea Star Wasting Syndrome: detecting, tracking and following the progression.

Hatfield Marine Science Center, Newport, OR, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2014 Sea Star Wasting Syndrome: detecting, tracking and following the progression.

Presentation to Haystack Rock Awareness Program, City Hall, Cannon Beach, OR, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2014. Sea star wasting syndrome. MARINe Annual Workshop, Newport Beach, CA, public/profession presentation, 20 attendees, 2014-02-01

Miner, B., M. Miner, I. Hewson, D. Harvell, and P. Raimondi. 2014 Wasting syndrome in sea stars along

the west coast of North America. Salish Sea Ecosystem Conference. Seattle, WA, public/profession presentation, 100 attendees, 2014-02-01

Miner, C.M. 2014 Sea Star Wasting Syndrome: Long-term Surveys, Disease Studies, and Citizen Science

Effort. Presentation to Oregon Coast Watch. Bandon, OR, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2014 Sea Star Wasting Syndrome: Long-term Surveys, Disease Studies, and Citizen Science

Effort. ReSources public presentation. Bellingham, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2014 Sea Star Wasting Syndrome: Long-term Surveys, Disease Studies, and Citizen Science

Effort. Northwest Aquatic and Marine Educators, 39th Annual Conference. Bandon, OR, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2014 Documenting the Impacts of Sea Star Wasting Syndrome through Long Term Surveys

and Citizen Science Monitoring. Island County Beach Watchers, Camano Island, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2014 Sea Star Wasting Syndrome: Long-term Surveys, Disease Studies, and Citizen Science

Effort. Feiro Marine Life Center, Port Angeles, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2014 Sea Star Wasting Syndrome: Long-term Surveys, Disease Studies, and Citizen Science

Effort. Sound Living 4th Annual "Communiversities", Everett Community College, WA,

public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M., MARINe 2014 Documenting the Impacts of Sea Star Wasting Syndrome through Long Term Surveys and Citizen Science Monitoring. Western Society of Naturalists, Tacoma, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M. 2015 Documenting the Impacts of Sea Star Wasting Syndrome through Long Term Surveys and Citizen Science Monitoring. Storming the Sound, La Conner, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, C.M., P.T. Raimondi, M.M. Moritsch, Multi-Agency Rocky Intertidal Network 2015 Documenting the Impacts of Sea Star Wasting Syndrome through Long-Term Surveys and Identifying Possible Factors Contributing to Disease Presence. Eastern Fish Health Workshop, Mount Pleasant, SC, public/profession presentation, 20 attendees, 2015-01-01

Miner, C.M. 2015 Wasted Stars: A brief overview of what we've learned from lab studies and long-term monitoring. MARINe Annual Workshop, Moss Landing, CA, public/profession presentation, 20 attendees, 2015-01-01

Miner, C.M. 2015 Documenting the Impacts of Sea Star Wasting Syndrome through Long Term Surveys and Citizen Science Monitoring. Olympic National Park Perspectives Series, Port Angeles, WA, public/profession presentation, 20 attendees, 2015-01-01

Miner, B.G., C.M. Miner, I. Hewson, C.D. Harvell, P. Raimondi. 2014. Wasting syndrome in sea stars along the west coast of North America. Salish Sea Ecosystem Conference, Seattle, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, B.G., W. Koehl, R. Beck, I. Hewson. 2014. Infectiousness of sea star wasting disease. Western Society of Naturalists, Seattle-Tacoma, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, B.G., C.M. Miner, I. Hewson, C.D. Harvell, P. Raimondi. 2014. Wasting syndrome in sea stars along the west coast of North America. Oregon Institute of Marine Biology, Coos Bay, OR (invited seminar), public/profession presentation, 20 attendees, 2014-02-01

Miner, B.G. 2014 Biology Club WWU, Bellingham, WA, public/profession

presentation, 20 attendees, 2014-02-01

Miner, B.G. 2014 Emerald Sea Dive Club, Edmonds, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, B.G. 2014 Fidalgo Shoreline Academy, Anacortes, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, B.G. 2014 Community Education Seminar, Bellingham WA (Part II), public/profession presentation, 20 attendees, 2014-02-02

Miner, B.G. 2014 Community Education Seminar, Bellingham WA (Part I), public/profession presentation, 20 attendees, 2014-02-02

Miner, B.G. 2014 Padilla Bay National Estuarine Research Reserve, Mt Vernon, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, B.G. 2014 South Sound Estuary Association, Tacoma, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, B.G. 2014 Fall Family Open House WWU, Bellingham, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, B.G. 2014 Youth Earth Submit, Mt. Vernon, WA, public/profession presentation, 20 attendees, 2014-02-01

Miner, B.G. 2015 One Ocean Education and Salish Sea Environmental Services, Anacortes, WA, public/profession presentation, 20 attendees, 2015-01-01

Miner, B.G. 2015 State of Bellingham Bay Research Symposium, Bellingham, WA, public/profession presentation, 80 attendees, 2015-01-22

Hewson, I., C. Burge, C. D. Harvell, M. Haulena, L. Lahner, B. Miner, M. Miner, M. Murray, A. Newton, P.

Raimondi, and J. Wynne. 2014 Microbial Ecology of Pacific Asteroidea Affected by Wasting Disease.

Joint Aquatic Sciences Meeting. Portland, OR, public/profession presentation, 100 attendees, 2014-05-18

Hewson, I., M. Eisenlord, L. James, C. Burge, M. Miner, B. Miner, P. Raimondi, M. Haulena, L. Lahner, A.

Newton, S. Fradkin, J. Gaydos, D. Harvell. 2014 Poster Presentation. Update on an Ongoing Pacific

Coast-Wide Sea Star Epizootic. Association for the Sciences of Limnology and Oceanography,

Honolulu, HI., public/profession presentation, 100 attendees, 2014-02-25

Anderson, L., C.M. Miner, M. Moritsch, R. Gaddam, and P. Raimondi. 2014. Intertidal monitoring: tracking the progression of sea star wasting syndrome. California State University Monterey Bay seminar. Monterey, CA., public/profession presentation, 20 attendees, 2014-02-01

Anderson, L.A, M.Frenock, R.N. Gaddam, C.M. Miner, P.T. Raimondi, M. Redfield, and R.Williams. 2014  
 Poster Presentation. Tracking Sea Star Wasting Syndrome: A Collaborative Effort by Researchers and Citizen Scientists. Monterey Bay National Marine Sanctuary Currents Symposium, Monterey, CA., public/profession presentation, 100 attendees, 2014-04-26

**ADDITIONAL METRICS**

<b>P-12 Students Reached:</b>	0	<b>P-12 Educators Trained:</b>	0
<b>Participants in Informal Education Programs:</b>	25	<b>Volunteer Hours:</b>	40
estimating 2 people participating from each group trained in WA - Alki Jetty Citizen Science volunteers; Bainbridge Beach Naturalists; Cama Beach Foundation; Cherry Point Aquatic Reserve Citizen Stewardship Committee; Edmonds Underwater Park Stewards; Feiro Marine Life Center; Kitsap Beach Naturalists; Port Townsend Marine Science Center; Salish Sea Stewards; Vashon Beach Naturalists + individuals: Mark Nayer; Michael Diehl & Judith Rogerson; Michael Kyte; Tim Manns		estimating 20 surveys; 2 people each; 1 hour each	
<b>Acres of coastal habitat protected, enhanced or restored:</b>	0	<b>Resource Managers who use Ecosystem-Based Approaches to Management:</b>	0
<b>Annual Clean Marina Program - certifications:</b>	0	<b>HACCP - Number of people with new certifications:</b>	0

**ECONOMIC IMPACTS**

*No Economic Impacts Reported This Period*

**SEA GRANT PRODUCTS**

*No Sea Grant Products Reported This Period*

## HAZARD RESILIENCE IN COASTAL COMMUNITIES

*No Communities Reported This Period*

### ADDITIONAL MEASURES

Number of stakeholders modifying practices:

Sustainable Coastal Development

# of coastal communities:

### PARTNERS

Partner Name: Bainbridge Beach Naturalists, type: NGO, scale: Local

Partner Name: Cama Beach Foundation

Partner Name: Cherry Point Citizen Stewardship Committee, type: NGO, scale: Local

Partner Name: Cornell University, type: Academic Institution, scale: State

Partner Name: Edmonds Underwater Park Stewards, type: NGO, scale: Local

Partner Name: Feiro Marine Life Center

Partner Name: Kitsap Beach Naturalists, type: NGO, scale: Local

Partner Name: Multi-Agency Rocky Intertidal Network, type: Other, scale: Regional

Partner Name: Partnership for Interdisciplinary Studies of Coastal Oceans, type: Academic Institution, scale: Regional

Partner Name: Port Townsend Marine Science Center

Partner Name: Salish Sea Stewards, type: NGO, scale: Local

Partner Name: Vashon Beach Naturalists

### IMPACTS AND ACCOMPLISHMENTS

Title: **Washington Sea Grant probes devastating sea star wasting syndrome through surveys, experiments, and volunteer monitoring**

Type: impact

Relevance, Response, Results:

Relevance: In 2013, fatal lesions and tissue breakdown appeared suddenly and mysteriously in great numbers of sea stars on Washington's Olympic Peninsula. Die-offs spread throughout nearshore waters from Mexico to Alaska. Researchers declared it "the largest known marine wildlife epizootic" ever seen, and because sea stars are keystone predators, their losses threatened broader ecological disruption.

Response: Washington Sea Grant worked with Oregon and California Sea Grant, responding quickly to document and investigate this mysterious animal disease. In Washington, research teams, including WSG experts, surveyed subtidal and intertidal areas from the San Juan Islands to South Puget Sound. They trained and equipped a statewide network of about 100 volunteers to survey 18 intertidal sites statewide, recording the number, size, and condition of any stars present. The team reached out to the public through seminars and media appearances and created a [seastarwasting.org](http://seastarwasting.org) website with a frequently updated tracking map. They conducted laboratory experiments to see whether wasting stars could infect healthy ones.

Results: The collected survey and observational data contributed to an important paper coauthored by WSG- and OSG-sponsored researchers and published in PNAS that identified a densovirus associated with sea star wasting syndrome. But laboratory experiments found that, while healthy stars housed with wasting stars did become sick, densovirus transmission between them was not the cause—suggesting a more complex etiology.

Recap:

Recap: Washington Sea Grant-supported researchers and staff document an unprecedented marine epizootic, deploying citizen scientists to gather valuable data on sea star wasting syndrome.

Comments:

Primary Focus Area: HCE

Secondary Focus Area: OLWD

Associated Goals: Ocean and coastal resources are managed using ecosystem-based approaches. (HCE)

The public is ocean literate. (OLWD)

Partners:

Bainbridge Beach Naturalists

Cama Beach Foundation

Cherry Point Citizen Stewardship Committee

Cornell University

Edmonds Underwater Park Stewards

Feiro Marine Life Center

Kitsap Beach Naturalists

Multi-Agency Rocky Intertidal Network

Partnership for Interdisciplinary Studies of Coastal Oceans

Port Townsend Marine Science Center

Salish Sea Stewards

Vashon Beach Naturalists

Related Partners: *none*

## **PUBLICATIONS**

*No Publications Reported This Period*

## **OTHER DOCUMENTS**

*No Documents Reported This Period*

**LEVERAGED FUNDS**

Type: influenced Period: 2014-02-01::2014-12-14 Amount: \$6765

Purpose:

Proposal to Assess the Prevalence and Virulence of Sea Star Wasting Syndrome along the Oregon Coast

Source: Oregon Sea Grant

**COMPLETION NARRATIVE**

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# Project Completion Report: Assessing the prevalence and virulence of sea star Wasting Syndrome along the Oregon and Washington Coast

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A joint report to:

## Oregon Sea Grant Program

- Project: R/ECO-29-PD
- Start date: 12/15/2013.
- End date: 01/31/2015
- Grant number: NA10OAR4170059
- Investigators: Kristen Milligan, Pete Raimondi, Melissa Miner

## Washington Sea Grant Program

- Start date: 12/01/2013.
- End date: 12/31/2014
- Investigators: Benjamin Miner, Melissa Miner

## Project Contact Information

Kristen Milligan (Oregon State University, [milligak@science.oregonstate.edu](mailto:milligak@science.oregonstate.edu))

Benjamin Miner (Western Washington University, [benjamin.miner@wwu.edu](mailto:benjamin.miner@wwu.edu))

Melissa Miner (UC Santa Cruz, [cmminer@ucsc.edu](mailto:cmminer@ucsc.edu))

Pete Raimondi (UC Santa Cruz, [raimondi@ucsc.edu](mailto:raimondi@ucsc.edu))

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## **Proposal Objectives**

The proposed project objectives were to document sea star wasting syndrome with respect to species affected, prevalence, virulence, spatial distribution and geographic extent. The collected information was used to assess impact to sea star populations in Oregon and Washington, and allow for the ability to document recovery.

## **Summary of Progress**

The current epidemic of sea star wasting syndrome (SSWS) is arguably the largest marine disease event ever recorded (Harvell pers. com.). The magnitude and severity of this event made it essential that we collect as much pre-impact data about sea star populations as possible, in a rapid but coordinated fashion. Because SSWS spans the west coast from Alaska to Mexico, combining the response effort in Washington and Oregon supported by WA Sea Grant and OR Sea Grant ensured data compatibility and efficiency. Through their existing west coast-wide long-term sea star monitoring program, the MARINe (Multi-Agency Rocky Intertidal Network) and PISCO (Partnership for Interdisciplinary Studies of Coastal Oceans) groups were able to identify where

additional survey data were needed, and fill in gaps through rapid surveys and involvement of citizen science groups.

Within two months of receiving funding, rapid surveys had been done by UCSC & WWU researchers at 10 intertidal and 16 subtidal sites in Washington and plans for training of citizen science groups to do surveys were in the works. Seventeen citizen science groups (with approximately 120 volunteers) were trained to do long-term surveys of sea star size distribution and health during 2014, which resulted in an additional 20 intertidal and 9 subtidal sites in Oregon and Washington. Furthermore, we coordinated with other research institutions to survey 24 intertidal sites and 1 subtidal site using the MARINE sampling approach to ensure compatible data, which can be used for impact assessment and to document recovery. In January 2014, we created [seastarwasting.org](http://seastarwasting.org), a public website for sharing updates about the spread and impact of SSWS that includes a SSWS “tracking” map that is regularly updated with observations of SSWS along the coast. Updates and recent findings were also shared through numerous public seminars and interviews with the media.

## Detailed Project Outcomes

### Rapid surveys in Washington

Rapid surveys of intertidal sea stars were done at 10 sites by Ben and Melissa Miner (WWU/UCSC) to help fill in spatial and temporal gaps in the existing MARINE long-term survey data in Washington (Fig. 1 and 2). During the period of this rapid Sea Grant funding, results from these surveys documented severe declines in intertidal sea star populations throughout much of the Salish Sea/Puget Sound region in late spring/early summer 2014, which had previously been largely spared (Figs. 3 & 4). As of the most recent sampling date, a few areas have started to show possible signs of recovery, with an influx of new recruits (Figs. 3 & 4). We will be watching closely to see if these juvenile stars survive over the long term.

Rapid surveys of subtidal sea stars were done at 16 sites by Ben Miner in collaboration with divers from UC Santa Cruz (Figure 2). Many of these sites will be re-surveyed in 2015, which will allow for assessment of impact and possible recovery.

### Coordination of surveys with other researchers in Washington and Oregon:

Additional rapid surveys using MARINE methods were done by other research groups in Oregon and Washington, in close coordination with our survey effort to ensure good spatial representation and data consistency. Intertidal surveys were done at 4 sites in Oregon by ODF&W, 11 sites on the San Juan Islands, WA by Morgan Eisenlord & Drew Harvell (Friday Harbor Labs/Cornell), 1 site in Port Angeles, WA in coordination with Olympic Coast National Marine Sanctuary, and 9 sites in south Puget Sound, WA by Michael Behrens (Pacific Lutheran University) (Table 1).

### **Training of Citizen Science groups in Washington and Oregon:**

To more effectively survey the vast amount of un-sampled coastline along the OR and WA coasts, we enlisted the help of several established citizen science programs, and members of the general public. Training was provided to each group in order to ensure consistency in sampling methods and sea star identification. In WA, Jeff Adams (WA Sea Grant) assisted with training citizen science groups in South Puget Sound, which allowed for many more groups to be trained during the critical, and brief period before the disease hit many areas. In Oregon, MARINE/UCSC staff and PISCO/OSU staff collaborated to identify and train groups in Oregon (See Tables 1 and 2II). In all, 20 intertidal sites were established by citizen science groups (18 WA, 2 OR) and 9 subtidal sites (6 WA, 3 OR).

Sampling gear was purchased and distributed to citizen science groups that did not have sufficient or appropriate gear on hand. These supplies included small measuring tapes printed with the [seastarwasting.org](http://seastarwasting.org) logo for measuring sea stars, 30 meter fiberglass transect tapes for marking permanent plots/transects, high-powered flashlights and headlamps, and waterproof paper for datasheets.

### **Compilation of Observational Data**

In addition to quantitative surveys at long-term, permanent monitoring sites, qualitative data, in the form of observations of healthy and sick stars, were compiled by the MARINE group. A web entry form allowed participants to enter information about species of sea stars observed, their condition (healthy vs. sick), and key site attributes (e.g. location, habitat type). These observations provided much finer scale spatial and temporal data, which have been used to construct a “tracking” map of the distribution of SSWS, an animated map of the emergence of SSWS throughout the west coast of North America (both can be viewed at [seastarwasting.org](http://seastarwasting.org)), and for building a series of models to explore possible correlations between environmental factors and disease emergence coast-wide (Monica Moritsch, UCSC).

### **Infectiousness Experiments**

Ben Miner completed laboratory experiments at Western Washington University to test whether sea stars showing symptoms of wasting syndrome can infect healthy sea stars. Two undergraduate students helped extensively with the experiment and will be co-authors on the publication. The main findings of the experiments were that healthy sea stars that are housed with symptomatic sea stars became sick, and the cause was not the transfer of sea star associated densovirus from sick to healthy sea stars.

### **Partners and Collaborators**

The PI's involved in this project are active members of PISCO (Partnership for the Interdisciplinary Studies of Coastal Oceans) and MARINE (Multi-Agency Rocky Intertidal Network), who's partners include over 30 universities, government agencies, and other organizations in AK, WA, OR & CA (see [pacificrockyintertidal.org](http://pacificrockyintertidal.org) and [pisco.org](http://pisco.org) for complete list). Major MARINE/PISCO partners include: The Bureau of Ocean Energy Management, the National Park Service, CSUP, CSUF, UCLA, UCSB, UCSC, and OSU.

This project fostered additional collaboration, particularly between the MARINE/PISCO groups and citizen science groups, as well as with research groups previously not connected to MARINE/PISCO. See tables 1 & 2 below for complete list.

Collaboration with Ian Hewson and Drew Harvell at Cornell via tissue sample collection and sharing of information about disease spread and impact helped lead to the discovery of a “sea star associated densovirus”, which is thought to play a role in the development of the disease in sea stars.

## Publications

Hewson, I., J.B. Button, B.M. Gudenkauf, B.G. Miner, A.L. Newton, J.K. Gaydos, J. Wynne, C.L. Groves, G. Hendler, M. Murray, S. Fradkin, M. Breitbart, E. Fahsbender, K.D. Lafferty, A.M. Kilpatrick, C.M. Miner, P. Raimondi, L. Lahner, C.S. Friedman, S. Daniels, M. Haulena, J. Marliave, C.A. Burge, M.E. Eisenlord, and C.D. Harvell (2014). Densovirus associated with sea-star wasting disease and mass mortality. *Proceedings of the National Academy of Sciences*

## Outreach

SeaGrant funding has helped to support continued updates and improvements to seastarwasting.org, a website developed jointly by UC Santa Cruz and OSU to share the most up-to-date information about the extent and impact of the disease, and also recent developments in the understanding of cause of SSWS. An important feature of this website is the “tracking map”, where observational data submitted by researchers, aquariums, divers, and tidepoolers is displayed on a Google map, and users can track spread of the disease coast-wide and locally. Information on this map can be filtered by site, region, echinoderm species (urchins are included as well as sea stars), habitat type, and disease level, and sampling history information can be viewed for each site. The website also provides information about how people can participate in the sea star monitoring effort, either through long-term surveys or by submitting observations online. Detailed identification guides for adult and juvenile stages of many sea star species are provided, and methods used to conduct both subtidal and intertidal surveys are available for downloading. Seastarwasting.org also served as a centralized source for links to newspaper articles and radio and television stories related to the sea star wasting epidemic. OSU printed 2400 bookmarks printed with a brief summary of the SSWS epidemic and website URL for distribution at public seminars. This bookmark was created in collaboration with the OSU College of Science, who provided graphics support.

### **Work supported by OR & WA Sea Grant funding was presented at numerous public seminars and talks given at scientific meetings:**

Anderson, L.A, M.Frenock, R.N. Gaddam, C.M. Miner, P.T. Raimondi, M. Redfield, and R.Williams. 2014 Poster Presentation. Tracking Sea Star Wasting Syndrome: A Collaborative Effort by Researchers and Citizen Scientists. Monterey Bay National Marine Sanctuary Currents Symposium, Monterey, CA.

Anderson, L., C.M. Miner, M. Moritsch, R. Gaddam, and P. Raimondi. 2014. Intertidal monitoring: tracking the progression of sea star wasting syndrome. California State University Monterey Bay seminar. Monterey, CA.

Hewson, I., M. Eisenlord, L. James, C. Burge, M. Miner, B. Miner, P. Raimondi, M. Haulena, L. Lahner, A. Newton, S. Fradkin, J. Gaydos, D. Harvell. 2014 Poster Presentation. Update on an Ongoing Pacific

Coast-Wide Sea Star Epizootic. Association for the Sciences of Limnology and Oceanography, Honolulu, HI.

Hewson, I., C. Burge, C. D. Harvell, M. Haulena, L. Lahner, B. Miner, M. Miner, M. Murray, A. Newton, P. Raimondi, and J. Wynne. 2014 Microbial Ecology of Pacific Asteroidea Affected by Wasting Disease. Joint Aquatic Sciences Meeting. Portland, OR

Milligan, K. and J. Watson 2014 Cape Perpetua Land/Sea Symposium

Miner, B.G. 2015 State of Bellingham Bay Research Symposium, Bellingham, WA

Miner, B.G. 2015 One Ocean Education and Salish Sea Environmental Services, Anacortes, WA

Miner, B.G. 2014 Youth Earth Submit, Mt. Vernon, WA

Miner, B.G. 2014 Fall Family Open House WWU, Bellingham, WA

Miner, B.G. 2014 South Sound Estuary Association, Tacoma, WA

Miner, B.G. 2014 Padilla Bay National Estuarine Research Reserve, Mt Vernon, WA

Miner, B.G. 2014 Community Education Seminar, Bellingham WA (Part I)

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Miner, B.G., C.M. Miner, I. Hewson, C.D. Harvell, P. Raimondi. 2014. Wasting syndrome in sea stars along the west coast of North America. Salish Sea Ecosystem Conference, Seattle, WA

Miner, C.M. 2015 Documenting the Impacts of Sea Star Wasting Syndrome through Long Term Surveys and Citizen Science Monitoring. Olympic National Park Perspectives Series, Port Angeles, WA

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Miner, C.M., P.T. Raimondi, M.M. Moritsch, Multi-Agency Rocky Intertidal Network 2015 Documenting the Impacts of Sea Star Wasting Syndrome through Long-Term Surveys and Identifying Possible Factors Contributing to Disease Presence. Eastern Fish Health Workshop, Mount Pleasant, SC

Miner, C.M. 2015 Documenting the Impacts of Sea Star Wasting Syndrome through Long Term Surveys and Citizen Science Monitoring. Storming the Sound, La Conner, WA

Miner, C.M., MARINE 2014 Documenting the Impacts of Sea Star Wasting Syndrome through Long Term Surveys and Citizen Science Monitoring. Western Society of Naturalists, Tacoma, WA

Miner, C.M. 2014 Sea Star Wasting Syndrome: Long-term Surveys, Disease Studies, and Citizen Science Effort. Sound Living 4<sup>th</sup> Annual "Communiversities", Everett Community College, WA

Miner, C.M. 2014 Sea Star Wasting Syndrome: Long-term Surveys, Disease Studies, and Citizen Science Effort. Feiro Marine Life Center, Port Angeles, WA

Miner, C.M. 2014 Documenting the Impacts of Sea Star Wasting Syndrome through Long Term Surveys and Citizen Science Monitoring. Island County Beach Watchers, Camano Island, WA.

Miner, C.M. 2014 Sea Star Wasting Syndrome: Long-term Surveys, Disease Studies, and Citizen Science Effort. Northwest Aquatic and Marine Educators, 39<sup>th</sup> Annual Conference. Bandon, OR

Miner, C.M. 2014 Sea Star Wasting Syndrome: Citizen Science Effort. Sea Star Wasting Syndrome: Status of the Science and Identification of response Actions. A 2-Day Workshop on Sea Star Wasting Syndrome along the West Coast. Hatfield Marine Science Center, Newport, OR

Miner, C.M. 2014 Sea Star Wasting Syndrome: Long-term Surveys, Disease Studies, and Citizen Science Effort. ReSources public presentation. Bellingham, WA

Miner, C.M. 2014 Sea Star Wasting Syndrome: Long-term Surveys, Disease Studies, and Citizen Science Effort. Presentation to Oregon Coast Watch. Bandon, OR.

Miner, B., M. Miner, I. Hewson, D. Harvell, and P. Raimondi. 2014 Wasting syndrome in sea stars along the west coast of North America. Salish Sea Ecosystem Conference. Seattle, WA.

Miner, C.M. 2014. Sea star wasting syndrome. MARINe Annual Workshop, Newport Beach, CA.

Miner, C.M. 2014 Sea Star Wasting Syndrome: detecting, tracking and following the progression. Presentation to Haystack Rock Awareness Program, City Hall, Cannon Beach, OR.

Miner, C.M. 2014 Sea Star Wasting Syndrome: detecting, tracking and following the progression. Hatfield Marine Science Center, Newport, OR.

Miner, C.M. 2014 Sea Star Wasting Syndrome: detecting, tracking and following the progression. Padilla Bay National Estuarine Research Reserve, Mount Vernon, WA.

Miner, C.M. 2014 Sea Star Wasting Syndrome: detecting, tracking and following the progression. Port Townsend Marine Science Center, Port Townsend, WA.

Anderson, L., C.M. Miner, R. Gaddam, and P. Raimondi. 2014. Sea star wasting syndrome: Detecting and tracking the progression. Poster at Point Lobos State Natural Reserve Underwater Parks Day. Carmel, CA.

Miner, C.M. 2014 Sea Star Wasting Syndrome: detecting, tracking and following the progression. ReSources for Sustainable Communities, Bellingham, WA.

Moritsch, M., J. Maynard, D. Harvell, M. Miner, R. Gaddam, and P. Raimondi. 2014. Identifying environmental and anthropogenic factors associated with sea star wasting disease through large-scale geospatial analysis. Poster at the Monterey Bay National Marine Sanctuary Currents Symposium. Seaside, CA.

Newton, A.L, I. Hewson, C.D. Harvell, C. Burge, M. Garner, E. LaDouceur, S. Knowles, S. Frasca Jr, R. Smolowitz, T.M. Work, B. Miner, M. Miner, P. Raimondi, L. Lahner, M. Haulena, M. Murray, J.K. Gaydos, and J. Wynne. 2014 The Pacific Coast Sea Star Mortality Event: Current Status of the Ongoing Investigation. Wildlife Disease Association, Albuquerque, NM.

Sullivan, J. 2014 Departmental Seminar, Oregon State Integrative Biology

Sullivan, J 2014 Citizen Science Research Opportunities, Invited Presentation and interactive session, Oregon Sea Grant State of the Coast Conference

Sullivan, J 2014 Zooming in on Sea Star Wasting Syndrome: Observations at small size classes and potential for recovery. Poster at Oregon Sea Grant State of the Coast Conference, Florence, OR.

Sullivan, J 2014 CoastWatch/Oregon Shores Citizen Science training

Sullivan, J 2014 Siuslaw Watershed Council presentation

Sullivan, J 2014 Oregon Shell club presentation

Sullivan, J 2014 CoastWatch/Oregon Shores annual meeting presentation

Sullivan, J 2014 Sharing our Coast Conference at Hatfield, SSWS update and workshop

PISCO-OSU Graduate students Jenna Sullivan and Elizabeth Cerny-Chipman organized a display about sea star wasting at the OSU State of the University event at the Portland Convention Center. This display was the feature of the College of Science's table at the event. 500 attendees.

Many newspaper & journal articles, and radio & TV interviews resulted from work funded in part by OR & WA Sea Grant. Links to a sampling of these are listed below, and can also be found on [seastarwasting.org](http://seastarwasting.org):

[Will the King of the Rock Fall?](#) (Feb 4, 2015)

[Signs of hope, and a prime suspect, in sea star wasting disease](#) (Jan 23, 2015)

[Sea stars may be on path to recovery; summer could provide answers](#) (Jan 20, 2015)

[Scientists Search for Cause of Sea Star Wasting Syndrome](#) (Jan 16, 2015)

[Zombie Starfish - Nature's Weirdest Events](#) (Jan 12, 2015)

[Sea Star Wasting Disease](#) (Dec, 2014)

[Sea Star die-off Baffles Scientists](#) (Dec 23, 2014)

[Cause of Whidbey starfish deaths discovered](#) (Dec 12, 2014)

[Ocean Currents Broadcast on KWMR](#) (Dec 1, 2014)

[In search of the starfish killer: the quest to save the original keystone species](#) (Nov 18, 2014)

[Virus devastating sea stars on Pacific Coast identified](#) (Nov 17, 2014)

[Meet the Tiny Killer Causing Millions of Sea Stars to Waste Away](#) (Nov 17, 2014)

[Densovirus associated with sea-star wasting disease and mass mortality](#) (Nov 17, 2014)

[AK: Sea Star Mystery](#) (Oct 24, 2014)

[Is Alaska Safe For Sea Stars?](#) (Oct 8, 2014)

[Sea star Wasting Syndrome plagues shores of Camano Island](#) (Sept 30, 2014)

[Recovery Caucus proposes bill on sea star wasting syndrome](#) (Sept 23, 2014)

[Proposed Emergency Legislation Aims To Address Starfish Wasting Syndrome](#) (Sept 18, 2014)

[Program on sea star wasting disease kicks off series](#) (Sept 13, 2014)

[Scientists at Odds Over Sea Star Die-Off](#) (Sept 12, 2014)

[Sea stars wasting in local waters](#) (Sept 7, 2014)

[Sea stars making a comeback: Researchers study reason for die-off](#) (Sept 1, 2014)

[Signs of sea-star recovery in California but not in NW](#) (Aug 26, 2014)

[Sea Star Deaths along the West Coast Elicit Close Study](#) (Aug 14, 2014)

[Scientists Investigate Outbreak Of Sea Star Wasting Syndrome](#) (Aug 11, 2014)

[Disease killing sea stars reaches local public aquariums](#) (Aug 7, 2014)

[Peninsula marine life centers losing sea stars to mysterious disease](#) (July 28, 2014)

[Warming Water Temperatures Could Be Driving Massive Sea Star Die Off](#) (July 26, 2014)

[Dying starfish stump experts](#) (July 26, 2014)

[Scientists Look for Causes of Baffling Die-Off of Sea Stars](#) (July 17, 2014)

[What's killing all the sea stars?](#) (July 2, 2014)

[Sunflower stars found in sound](#) (July 2, 2014)

[Starfish are 'just melting': Disease killing 80 percent of them](#) (June 28, 2014)

[Peninsula volunteers pitching in on sea star wasting disease research](#) (June 23, 2014)

[Scientists Close in on the Cause of Sea Star Wasting Syndrome](#) (June 17, 2014)

[Sea Star Video - "Falling Stars"](#) (June 13, 2014)

[Mystery Sea Stars 'Goo' Disease Spreads to Oregon](#) (June 10, 2014)

[Sea star wasting syndrome epidemic along the coast](#) (June 7, 2014)

[Sea Star Disease Hits Hard On Oregon Coast](#) (June 6, 2014)

[A plot to spot wasted stars](#) (June 4, 2014)

[Sea star disease epidemic surges in Oregon, local extinctions expected](#) (June 4, 2014)

[Die-Off Spawns New Sea Stars](#) (May 24, 2014)

[Scientists scurrying to determine what's killing starfish](#) (May 23, 2014)

[Biologists investigate mysterious sun star beach stranding](#) (May 14, 2014)



[Mystery starfish plague extends to Canada and Mexico, but the answer is within our grasp](#) (May 8, 2014)

[Scientists look for pathogen that's killing sea stars](#) (May 7, 2014)

[Sea Star Wasting Syndrome Arrives In Oregon](#) (May 5, 2014)

[Scientists narrow in on Sea Star Wasting Syndrome devastating the West Coast](#) (May 4, 2014)

[Death of the Stars](#) (May 2, 2014)

[Slideshow: Sea Stars Dying in Mysterious Plague](#) (May 1, 2014)

[Starfish mysteriously disappearing along the Pacific Coast](#) (May 1, 2014)

[Sea star population plummets at Shell Beach from mysterious wasting disease](#) (Apr 5, 2014)

[Sea stars in Southern California are dying in droves from mysterious disease](#) (Apr 3, 2014)

[Professor Studies Disappearing Sea Stars](#) (Mar 26, 2014)

[Mass Sea Star Death Leaves Researchers Perplexed](#) (Mar 11, 2014)

[What's Killing the Starfish - KQED broadcast](#) (Mar 5, 2014)

[Ocean Currents Broadcast on KWMR](#) (Mar 3, 2014)

[Sea Star Wasting Syndrome \(Thank You Ocean Report\)](#) (Mar 3, 2014)

[Sea star wasting devastates Pacific Coast species](#) (Feb 17, 2014)

[Mysterious epidemic devastates starfish population off the Pacific Coast](#) (Jan 30, 2014)

### **New Extramural Funding**

PISCO-OSU Graduate students Elizabeth Cerny-Chipman and Jenna Sullivan are supported in 2015 with a 1-year National Science Foundation award for rapid response to SSWS (Principal Investigator Dr. Bruce Menge).

Ben Miner has submitted a pre-proposal to WA Sea Grant to research the recovery of the sea star populations.

Table 1: Research institutions that collaborated with MARINE/PISCO to survey sea stars in intertidal and subtidal habitats in Oregon and Washington

<b>Group/Individuals</b>	<b>State</b>	<b># Intertidal Sites</b>	<b># Subtidal Sites</b>
Steve Rumrill, ODF&W	OR	4	
Drew Harvell & Morgan Eisenlord, FHL	WA	11	
Liam Antrim, OCNMS	WA	1	
Michael Behrens, PLU	WA	8	1
<b>Total</b>		<b>24</b>	<b>1</b>

Table 2: Citizen Science groups trained to do long-term monitoring of sea stars in intertidal and subtidal habitats in Oregon and Washington

<b>Group/Individuals</b>	<b>State</b>	<b># Intertidal Sites</b>	<b># Subtidal Sites</b>
Haystack Rock Awareness Program	OR	1	
OR State Parks	OR	1	
Oregon Coast Aquarium	OR		3
Oregon Coast Watch	OR	*	
Alki Jetty Citizen Science volunteers	WA	1	
Bainbridge Beach Naturalists	WA	2	
Cama Beach Foundation	WA	1	1
Cherry Point Aquatic Reserve Citizen Stewardship Committee	WA	3	
Edmonds Underwater Park Stewards	WA		2
Feiro Marine Life Center	WA	1	
Kitsap Beach Naturalists	WA	2	
Mark Nayer	WA		2
Michael Diehl & Judith Rogerson	WA	1	
Michael Kyte	WA	3	
Port Townsend Marine Science Center	WA	1	1
Salish Sea Stewards	WA	1	
Tim Manns	WA	1	
Vashon Beach Naturalists	WA	1	
<b>Total</b>		<b>20</b>	<b>9</b>

\* Long-term surveys are not done by OR Coast Watch, but numerous volunteers have submitted observational data via [seastarwasting.org](http://seastarwasting.org)

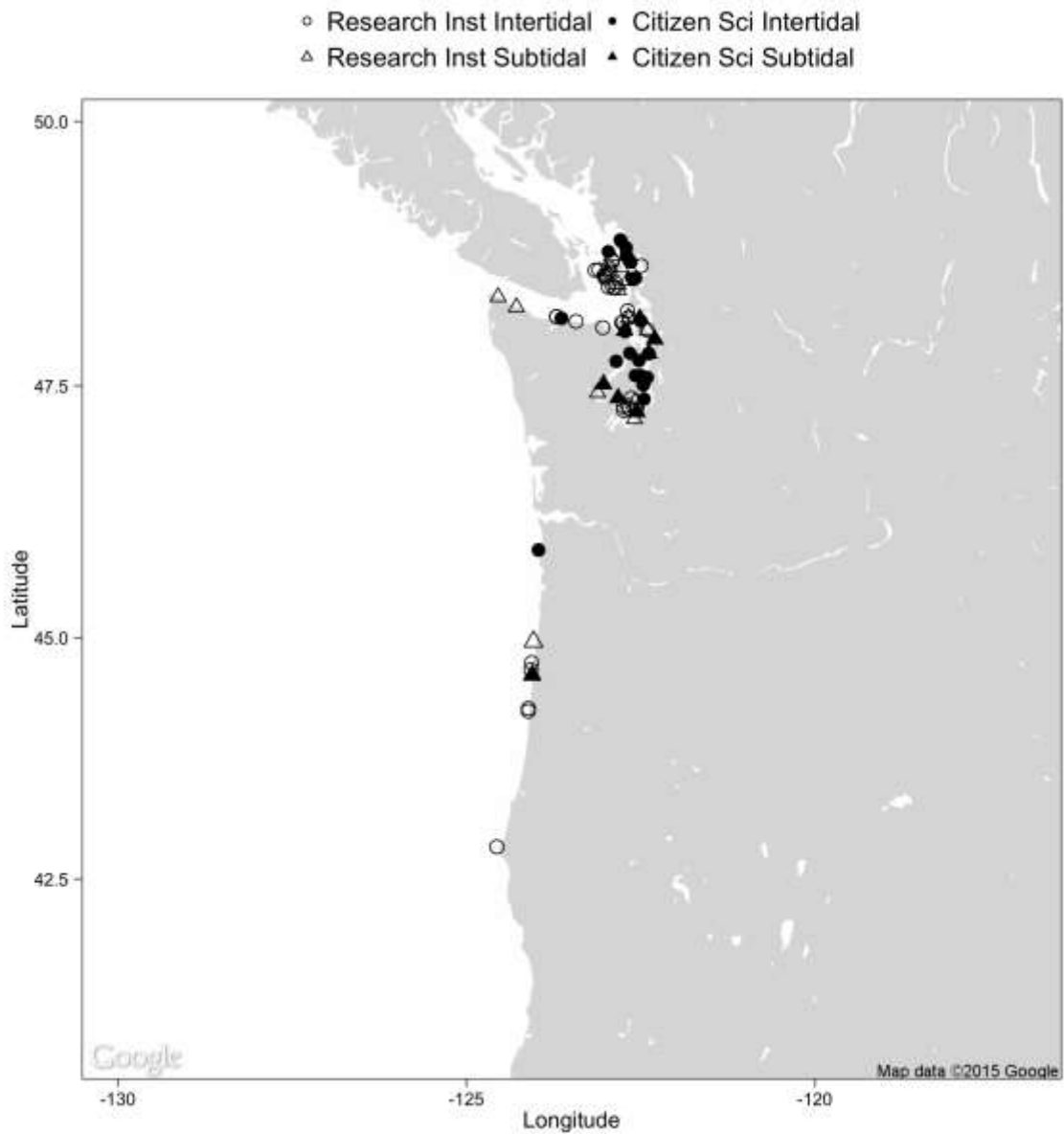


Figure 1. Citizen science and rapid survey sites in Washington and Oregon where sea stars were measured and assessed for signs of sea star wasting syndrome.

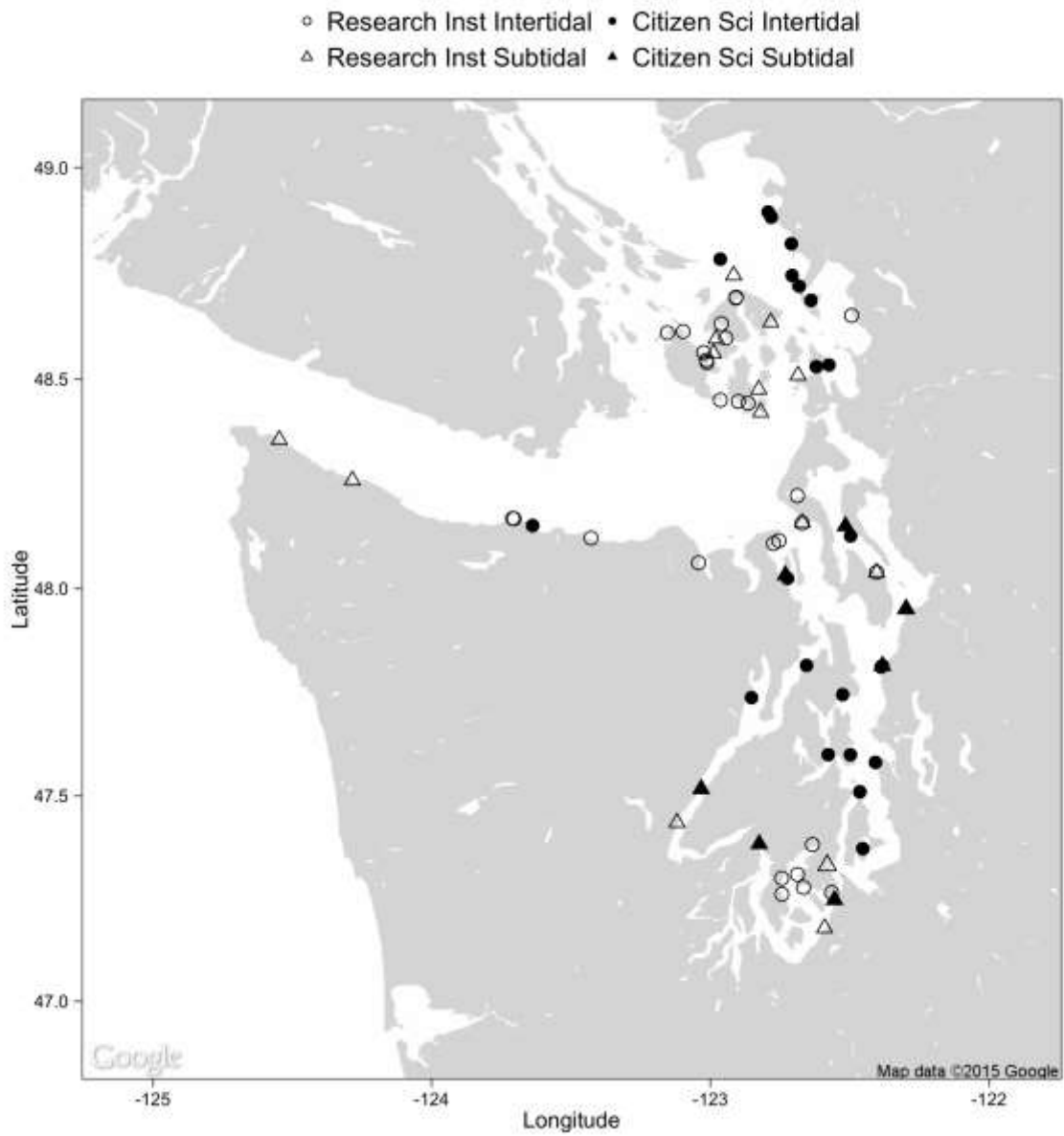


Figure 2. Citizen science and rapid survey sites in Washington where sea stars were measured and assessed for signs of sea star wasting syndrome.

*Pisaster ochraceus*

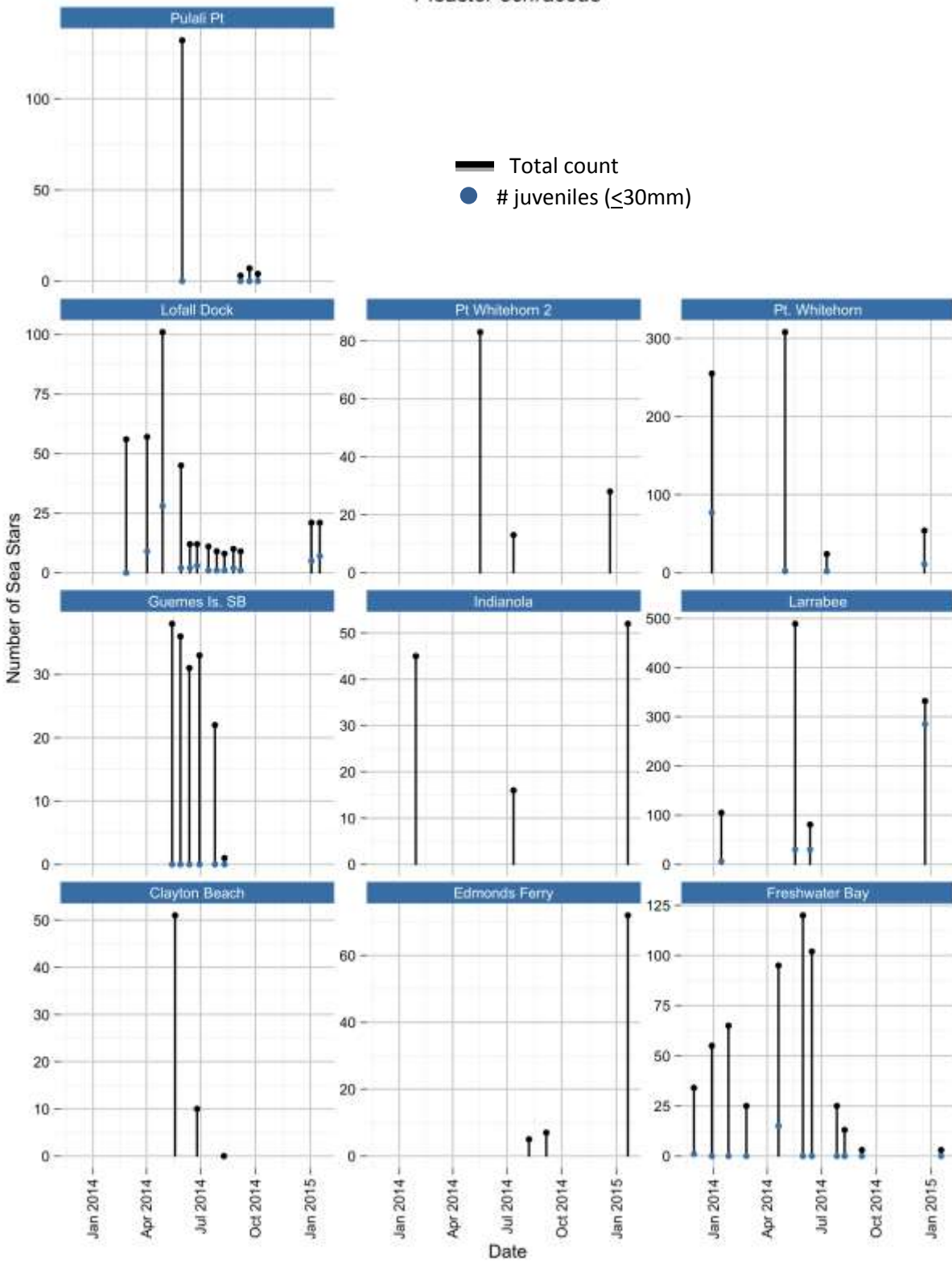


Figure 3. *Pisaster ochraceus* abundance at citizen science and rapid survey intertidal sites sampled at least 3 times.

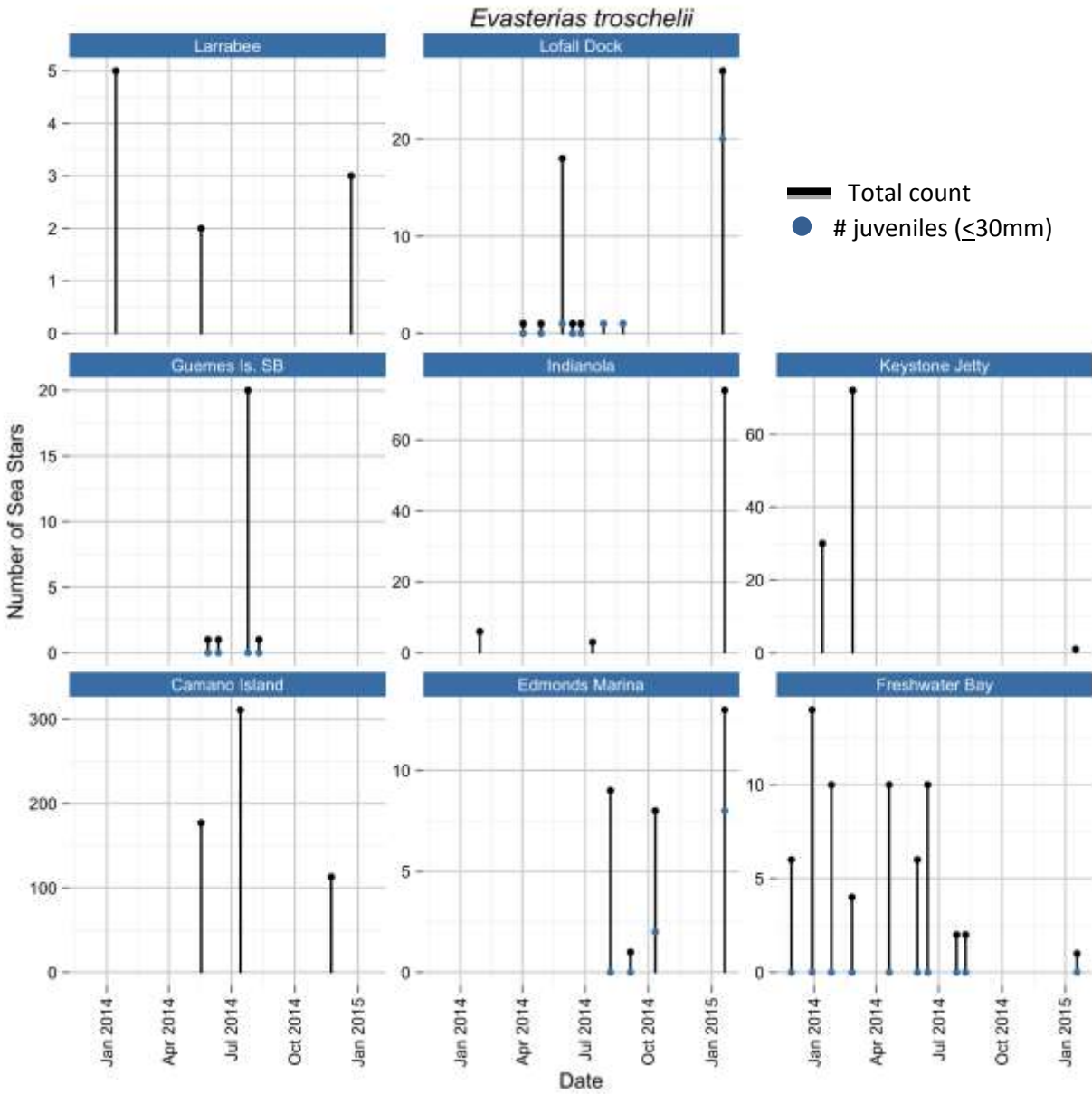


Figure 4. *Evasterias troschelii* (mottled star) abundance at citizen science and rapid survey intertidal sites sampled at least 3 times.

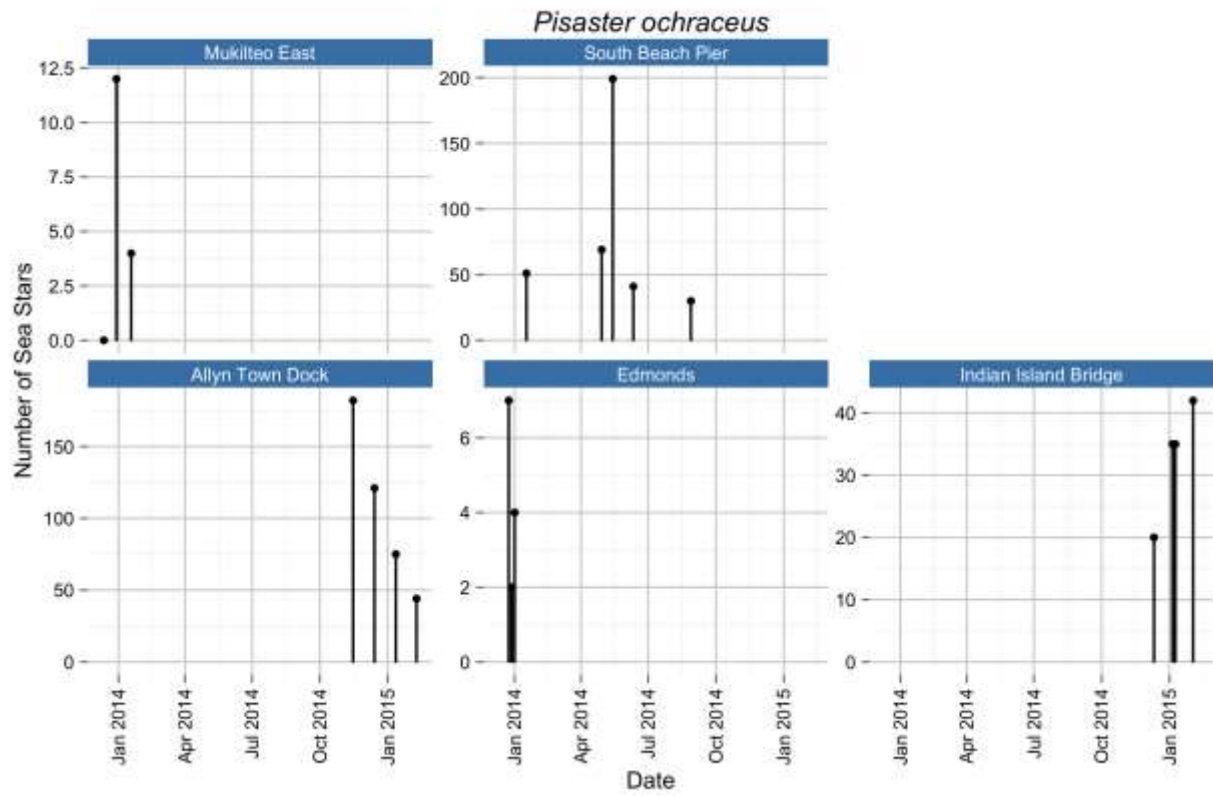


Figure 5. *Pisaster ochraceus* abundance at citizen science subtidal sites sampled at least 3 times.

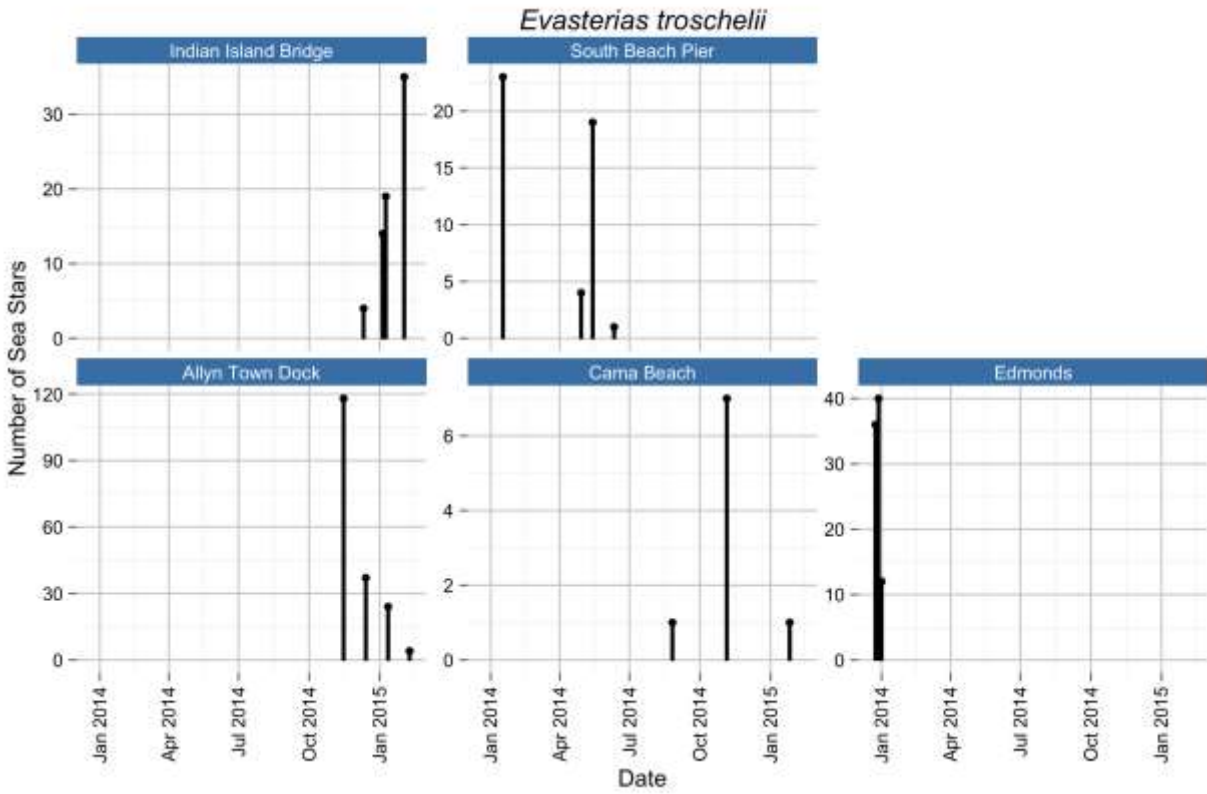


Figure 6. *Evasterias troschelii* (mottled star) abundance at citizen science subtidal sites sampled at least 3 times.



*Pisaster brevispinus*

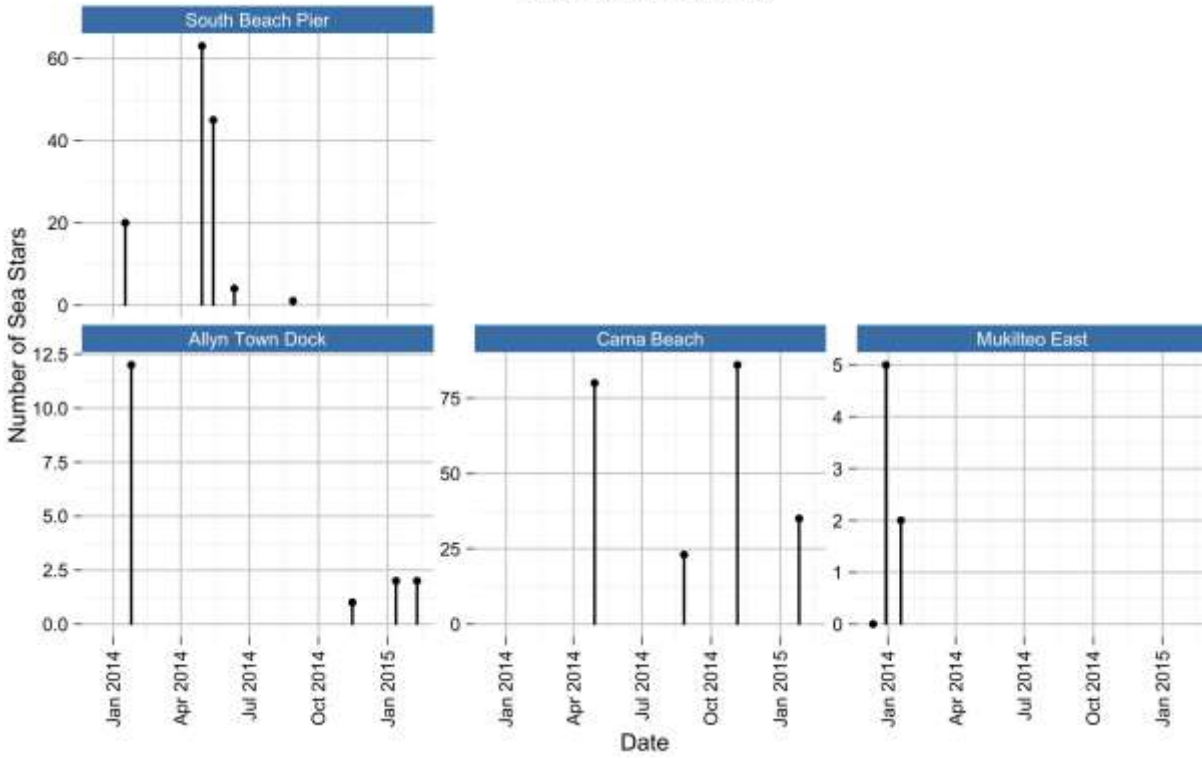


Figure 7. *Pisaster brevispinus* (giant pink star) abundance at citizen science subtidal sites sampled at least 3 times.

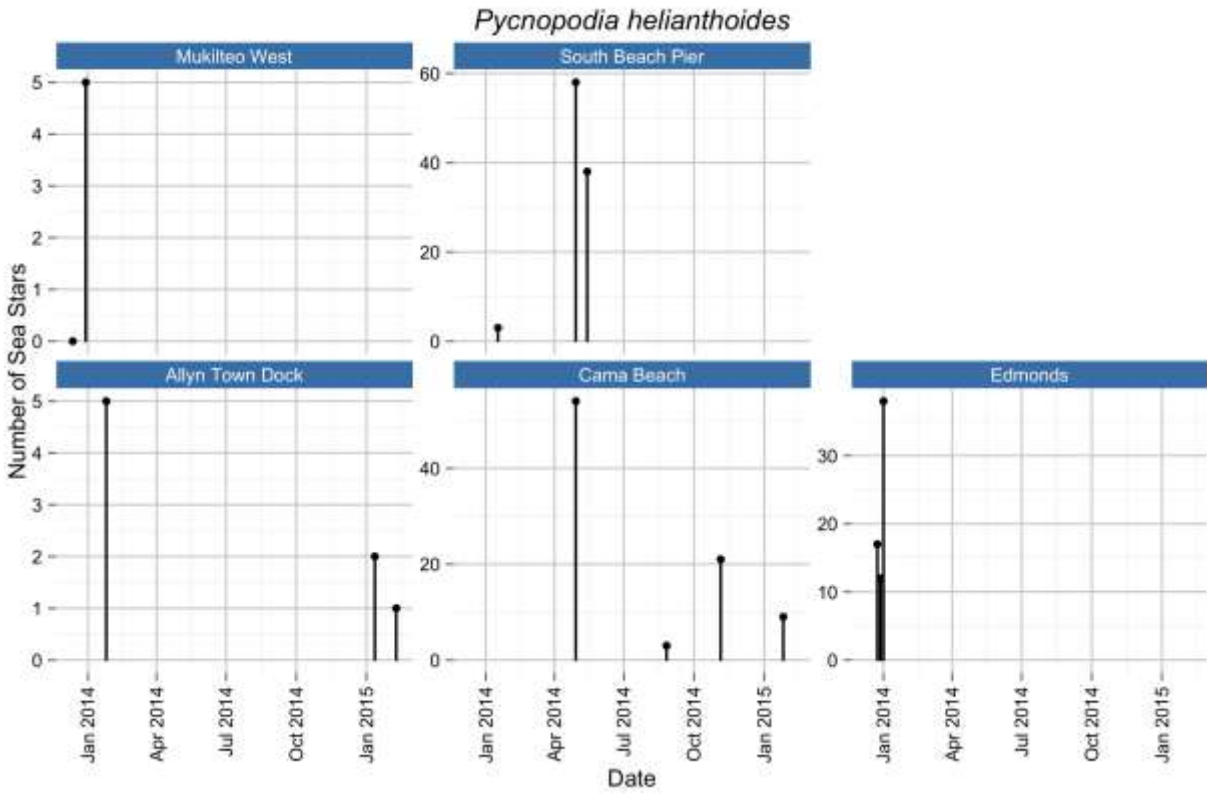


Figure 8. *Pycnopodia helianthoides* (sunflower star) abundance at citizen science subtidal sites sampled at least 3 times.