NORTHWEST ACADEMY

Investigating a Temporal Pattern of Sea Star Wasting Syndrome in the Ochre Sea Star (*Pisaster ochraceus*) on the Oregon Coast

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Introduction

- As global climate change affects more of the planet, some ecosystems are more affected than others.
- Starting in the summer of 2014, an increased frequency of marine heatwave events might be exacerbating a high fatality disease among sea stars called Sea Star Wasting Syndrome (SSWS).
- Symptoms include white blemishes on an affected star, lethargy and arm curling, and body disintegration, followed by death.
- In this study, we sought to understand the temporal patterns in SSWS cases, and see how stars later in the season may or may not be more at risk due to the disease.
- We also used archival data to examine changes in SSWS over the years since the original epidemic in 2014.

Fig 1: Healthy *Pisaster ochraceus*. Note that the white radial markings here are not signs of disease.

Fig 2: Diseased *P. ochraceus*. Note that the white blemishes are separate from the spines, and cover the usually purple epidermis. This star will die soon.

Procedure

Our study was generously funded by the Diack Ecology Education Program.
In the summer of 2022, we went to Mile 311 of Silver Point on the Oregon Coast, on 4 specific dates in order to observe the prevalence of SSWS.

- A clipboard and pencil were used by all involved, as was a flexible ruler to measure size with measurement of center of radial disk to longest ray, a proxy for age class.
- By drawing lines in the sand, we made sure that no sea star was counted more than once in one survey date. The surveyors then counted all the reachable sea stars within the box in the rocky intertidal zones at low tides.
- All sea stars were of the species *Pisaster ochraceus*, colloquially known as the Ochre sea stars, a prevalent species adapted to cold Pacific Northwest waters.

Field Survey Dates:

Silver Point, Cannon Beach, Oregon (Clatsop County).

June 18, 2022

July 17, 2022

July 31, 2022

August 14, 2022

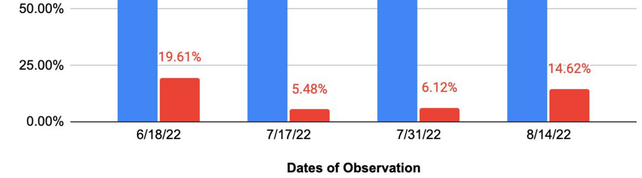
Field Survey Results

A total of 3807 individuals of *P. ochraceus* were counted over the 4 days at Mile 311, including size class measurements and scoring for the presence or absence of SSWS (healthy, mild disease, or severe disease). Disease designations were made using the protocol outlined in MARINe UCSC identification guides.

Date	Healthy	Mild	Severe	Total
6/18/22	373	71	20	464
7/17/22	1001	40	18	1059
7/31/22	1303	75	10	1388
8/14/22	765	112	19	896

Fig 3: Data table displaying raw quantitative data of diseased sea stars observed on Mile 311 of Silver point, on the Oregon Coast, over 4 select days in the summer of 2022.

Fig 4 (below): Bar charts displaying proportions of diseased (mild and severe) and healthy sea stars observed on four survey dates at Mile 311 of Silver point. The proportion of diseased individuals in the population ranged from 5.48% on July 17th, 2022 to 19.61% on June 18th, 2022.

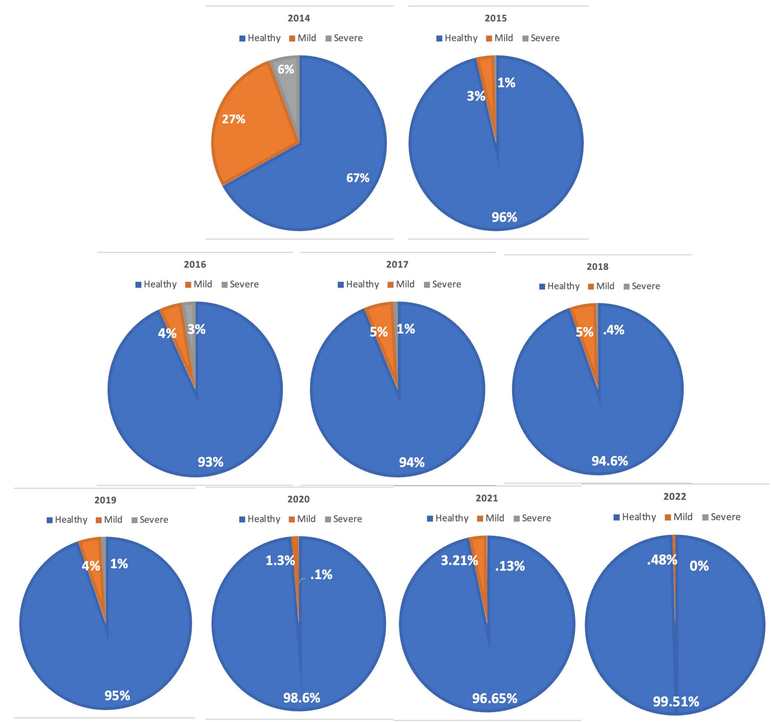


Analysis of Archival Oregon Coast Data

- We also analyzed archival SSWS data in the state of Oregon, collected over the span of a decade by various organizations and groups along the West Coast, obtained from MARINe (Multi-Agency Rocky Intertidal Network).
- We utilized Python to compile the large dataset, and also manually double-checked our work to ensure no errors were present in the algorithms.
- Long-term survey data may track possible changes in the proportion of sea stars with SSWS for a coarse-scale analysis of population health.

Year	Healthy	Mild	Severe	Total
2014	558	229	47	834
2015	1874	65	7	1946
2016	1888	86	52	2026
2017	5052	292	45	5389
2018	7728	411	30	8169
2019	7736	349	75	8160
2020	3008	39	3	3050
2021	3643	121	5	3769
2022	1636	8	0	1644

Fig 5: Data table of quantitative archival data, across multiple survey sites in Oregon, separated by survey year



Key Findings

By using a combination of archival data and our own field study, we were able to analyze the presence of SSWS among Oregon Coast populations of Ochre sea stars.

- The proportion of diseased individuals fluctuated summer 2022, 19.61% in mid-June to 5.48% in mid-July.
- The archival data show a clear decline in SSWS cases over time, since the height of the documented epidemic in 2014. In 2014, of the surveyed populations in Oregon, 27% displayed mild disease symptoms and 6% severe SSWS.
- From 2019 to 2022, mild SSWS symptoms were identified in less than 5% of the surveyed populations in the state of Oregon, suggesting significant recovery and rebound after the disease epidemic.
- Continued field monitoring and careful documentation of Ochre sea star population trends, including size classes to determine relative ages, should be conducted along with measurements of sea surface water temperature and other threats to survival.

Limitations and Future Research Directions

- The MARINe data was only collected during a single annual survey date; as a result, SSWS outbreaks could have been missed.
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