

2020 Review Sea Star Stewardship Program

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Acknowledgements

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Despite the difficult year we faced with additional health and safety protocols, we were truly blessed to have a group of dedicated volunteer citizen scientists join us in the field. Many thanks to our partner representatives Patrick Schroeder (Ucluelet Aquarium), Alys Hoyland (Paddle West Kayaking), Tanya Nestoruk (Wild Pacific Trail), Selina Quintal (Ocean Outfitters), and Satchel Robertson (Cedar Coast Field Station) for taking on a challenging field season and being incredible site leaders and intertidal educators. Special thanks to Ryan Rogers at Paddle West Kayaking for lending us essential kayaking equipment allowing us to monitor our more remote sites and for use in our volunteer appreciation day. We also want to acknowledge our incredible volunteers who joined us rain or shine! SIMRS is grateful to be able to conduct this research on the traditional territories of Ahousaht, Tla-o-qui-aht, and Yuułu?i?ath First Nations.



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Project Summary

The Sea Star Stewardship Program (SSSP) is a citizen scientist project monitoring the health of intertidal ecosystems and the spread of Sea Star Wasting Syndrome throughout the Clayoquot Sound Biosphere Region. As part of a North America-wide monitoring network, valuable data is collected to track the spread of marine disease and better understand the ecological effects on surrounding marine ecosystems. These surveys help fill a data gap for long term baseline intertidal data and act as an early warning system for future environmental threats in the Clayoquot Biosphere Region. The SSSP is more than just citizen science; the education and outreach aspects of this program develops ocean stewardship and strengthens community ties throughout the region and beyond.

Project Goals

1. Increase capacity of intertidal monitoring through citizen science.
2. Educate the public about the importance of intertidal ecosystems and the effects of sea star wasting syndrome.
3. Encourage local community members to become stewards of regional intertidal zones and demonstrate conservation and research initiatives.

Overview

Sea stars are an iconic species that play an important ecological role in inter and subtidal ecosystems. Since 2013, sea star populations along the Pacific coast of North America have been suffering mass mortality events due to Sea Star Wasting Syndrome (SSWS). Since 2015, SIMRS has been monitoring regional sea star health at multiple locations between Ucluelet and Tofino, British Columbia. The goal of this monitoring project is to observe and document the spread of SSWS and changes in species demographics, while educating and engaging community members and visitors.

In 2019, the Sea Star Stewardship Program (formerly titled Tidepool Guardian Program) was introduced as a way to expand upon our current sea star monitoring by involving local businesses and organizations to become leaders in conducting localized sea star surveys. The survey methods and protocols followed those outlined by the Multi Agency Rocky Intertidal Network (MARINe) and University of California Santa Cruz and surveys were conducted by a diverse group of volunteers at specific site locations. Between 2015-2018, sea star surveys were conducted at 2-4 different sites. In 2019 a total of 6 sites were surveyed, and in 2020 we expanded to 7 site locations.



Species identification, sea star size, and disease category data is collected and sent to MARINe researchers. Over the 2020 season, 5573 sea stars were surveyed with 5% of them having signs of SSWS and 95% being healthy. A total of 6 different sea star species were observed within our survey areas this season, with a first-time documentation of the species *Pisaster brevispinus* since our surveys began in 2015. Measurements of *Pisaster ochraceus* determined a large size distribution between 5-200mm radius, with the majority falling between 40-70mm.

The Sea Star Stewardship Program was successful in engaging people in intertidal stewardship despite the challenges posed by the pandemic. We continued to foster strong relationships with our current partner businesses and organizations while also forming new alliances, such as that with the Sea Smart organization. SIMRS was limited in volunteer capacity due to social distancing standards, and therefore we only had 22 volunteer participants this season. However, we found this did not hugely impact our surveys since many of the volunteers returned to participate in multiple surveys throughout the season. This high level of dedication towards our project from a small team of people actually helped make our data collection more efficient and more standardized.

Background

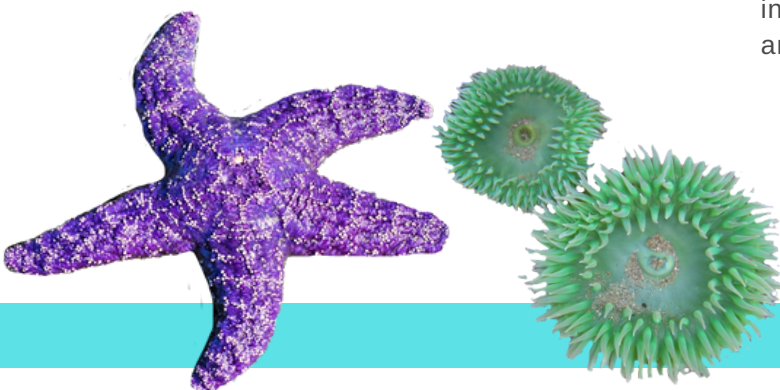
Rocky intertidal zones on the west coast of Vancouver Island, British Columbia provide a rich habitat that supports a high diversity and abundance of marine species. Sea stars are present in many of these intertidal habitats and play an important role within the ecosystem. They are considered a keystone species, controlling the abundance and composition of organisms within their community at a disproportional rate. Unfortunately, up to 20 species of sea stars have undergone mass mortality throughout the Pacific Coast of North America, due to the effects of Sea Star Wasting Syndrome [1].

First observed in Washington in 2014, SSWS is identified by lesions, limb autotomy, loss of turgor, and tissue degradation or melting which rapidly progresses to death [1]. Outbreaks of the disease have coincided with warmer water temperatures, however the cause of SSWS and the long-term effects on intertidal communities is unknown [2]. Although the most serious die-offs occurred in 2013/2014, the disease still persists at lower levels in many locations between Alaska and Mexico [2].

Sea star wasting syndrome is considered the largest epizootic outbreak of noncommercial marine life in history.

In response to this disease outbreak, SIMRS began monitoring for SSWS in 2015. Every year since, sea star surveys have been conducted during the summer months at a number of different site locations between Tofino and Ucluelet. The goal of these surveys is to determine the progression of the disease and to monitor for changes in sea star population dynamics, all the while educating the public and promoting stewardship through the involvement of volunteer citizen scientists. Additionally, SIMRS has joined other organizations across North America as part of a Marine Disease Outbreak Taskforce. As part of this team we are equipped with the tools and know-how to monitor for future outbreaks in our area and can provide advice and assistance outside our region.

In 2019, the Sea Star Stewardship Program was developed as a way to expand upon the current monitoring program and develop local stewardship of intertidal zones. This program encouraged local businesses and organizations to partner with SIMRS and play a leadership role in conducting regional sea star surveys. These partner leaders were trained in the protocols and methods of leading surveys at their designated site and were provided with background information and equipment necessary for conducting surveys. Throughout the season, our partners became sea star ambassadors by recruiting volunteers and educating the public about the importance of this monitoring project. By adding multiple partnerships, we were able to increase the number of survey sites and involve greater participation by both locals and visitors.



Survey Methods

The methods and protocols of this project are based off of those set out by the Multi Agency Rocky Intertidal Network and the Pacific Rocky Intertidal research group at the University of California Santa Cruz (UCSC) [3]. Designated intertidal sites are surveyed at low tide (<0.7m) once a month between May and August every year.

Survey areas of the site were determined by identifiable geographical markers, and volunteers carried out the surveys by either foot or by kayak depending on the site location. Each sea star within the survey area was identified to species and assigned to a specific disease category (Figure 1). From 2015-2018 disease was categorized from 0 to 4 with 0 being completely healthy sea stars and 4 being severely diseased. In 2019, MARINE changed these categories and sea stars were then put into “Healthy”, “Mild”, and “Severe” disease categories (Figure 1). Due to this change, sea stars disease categories are not compared between 2019/2020 and previous years, instead comparisons are made using the presence or absence of the disease.

Sea stars were also measured from the center of the disk on the aboral side (top side) to the nearest 10 mm. During the surveys volunteers



and staff took care not to touch the sea stars, as the spread of the disease is still unclear. If by accident there was contact, the equipment would be soaked in bleach for 15 minutes to avoid any potential spread of the disease.

If a sea star was not 100% visible it was not given a disease category as this cannot be determined with certainty. However, it was still counted, and species identification and radial measurements would be noted if possible. The start time and end time of the survey was recorded along with tide height, water temperature, pH, and salinity. Afterwards, the data collected from the survey was entered into SIMRS database and at the end of the survey season the data is synthesized and sent to the research group at UCSC to be added to a larger North American wide database.



Figure 1: From left to right: Mildly diseased sea star (previously category 1), Severely diseased (previously category 4), Healthy (all spawning, previously category 0) [2]. Photos by Melissa Miner.

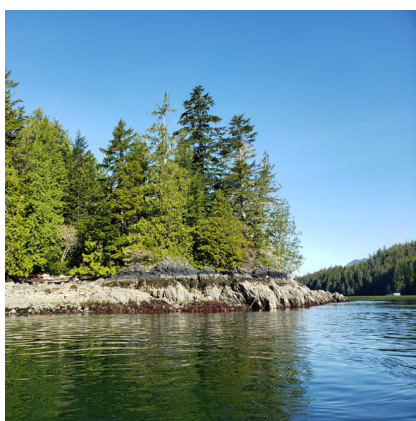


Figure 2: Google Earth map of 2020 Sea Star Stewardship sea star survey site locations (Top, Left – Stockham Island; Vargas Beach; Vargas Islets; Tonquin Beach; Frank Island. Bottom, Right – He-Tin-Kis; Ucluelet Aquarium [5].

Survey Sites

New site locations have been added over the years, while others have been eliminated for various reasons. Two new survey site locations were established in 2019 at Stockham Island and Big Beach, and two others were established at Stockham Island and He-tin-kis in 2020 (Figure 2). The Big Beach site and Strawberry Isle sites were eliminated in 2020 due to accessibility limitations.

Two sites however, have remained consistent between 2015-2019: Tonquin Beach and Ucluelet Aquarium. A site at Wickaninnish Beach was previously surveyed between 2015-2017 with approval of a research permit by the Pacific Rim National Park Reserve. Due to the variability and complexity of each specific site location, only within site comparisons are considered.



Pictured from left to right: Stockham Island, Ucluelet Aquarium, and Tonquin Beach survey sites.

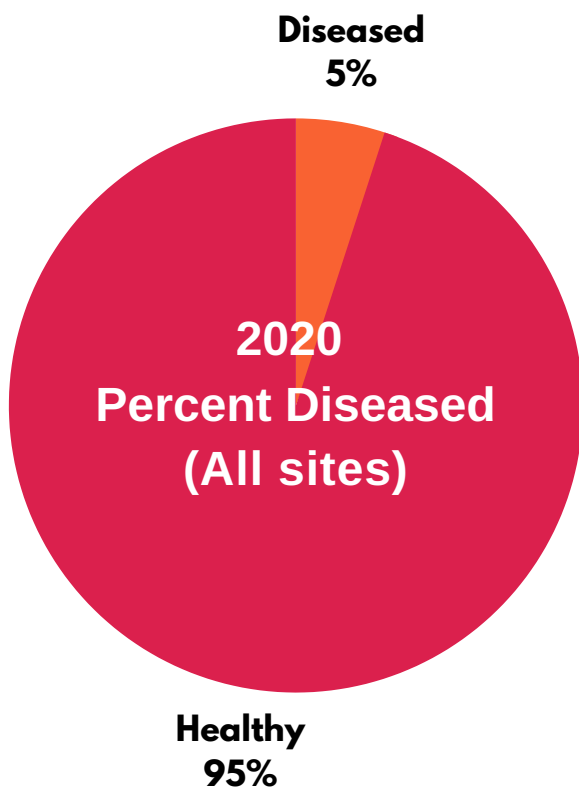


5,573 Sea stars counted

3,174 Healthy sea stars

132 Mildly diseased stars

43 Severely diseased stars



Results

All site locations were surveyed once a month between May and August 2020, with the exception of the Vargas Island sites which were not surveyed in May. A total of **5,573** sea stars were counted during the 2020 survey season, with **3,174** categorized as healthy, **132** as mildly diseased, and **43** as severely diseased. Of the 5,573 sea stars counted, **2,221** were observed with less than 100% of their body visible and since these sea stars can't be categorized with accuracy they have been removed from our disease analysis. Results from the surveys are only compared within each site and not between sites due to lack of a control site, and because of the many biotic and abiotic variables that differ site to site. (See data in Appendix A).

This year, all 7 of the survey sites had wasting syndrome present, with both mild and severe symptoms observed across all sites. The highest proportions of the disease were observed at the Vargas Island Beach site with **9.58%** of the visible stars having symptoms. The next highest proportions were at Ucluelet Aquarium and He-Tin-Kis Beach, both with about **8%** of the visible population having wasting syndrome. It's worthy to note however, that the sample size at He-Tin-Kis was significantly smaller than that of Ucluelet Aquarium, with only **72** fully visible sea stars as compared to **276**. The highest number of diseased sea stars was recorded at Tonquin Beach with a total of **60** stars with symptoms, but this only made up about **5%** of the visible population. (See data in Appendix A).

Overall, a total of **175** individuals were documented in 2020 with signs of wasting in a population of **2,221**, meaning about **95%** of the visible stars were healthy and **5%** were wasting. In contrast, a total of **65** diseased individuals were found in a population of **3,352** in 2019, resulting in **98%** healthy and **2%** diseased population for 2019 [6]. Having more individual sea stars with wasting syndrome documented in a smaller sample size in 2020, it's possible that a higher amount of wasting disease was present than the previous season. (See Appendix A).

Results Cont'd

Species Composition

Species identification was noted for every sea star that was surveyed at all site locations. A total of 7 different species have been identified in survey sites since 2015: *Pisaster ochraceus*, *Patiria miniata*, *Dermasterias imbricata*, *Evasterias troschelii*, *Henricia leviuscula*, *Pycnopodia helianthoides*, *Pisaster brevispinus*. The most abundant species seen across all survey sites is *P. ochraceus*, commonly known as Ochre Stars. This species is one of the most affected by Sea Star Wasting Syndrome, along with *P. helianthoides* which have suffered substantial die-offs across their home range [1;2;4]. In 2020 about **6%** of the surveyed Ochre stars had signs of wasting – the highest rate of all species documented this year. We identified a total of 6 different species at our survey sites this season, one of which has never before been recorded in our survey sites – *Pisaster brevispinus* – located at the Ucluelet Aquarium site. Leather stars (*D. imbricata*) were found at all but 2 survey sites in 2020, and Bat stars (*P. miniata*) were found at 3 of the 7 sites. Other more rarely recorded species documented this year include the Mottled star (*E. troschelii*) found at both the Stockham Island and Tonquin Beach sites, as well as the Pacific Blood Star (*H. leviuscula*) found only at Stockham Island. (See data in Appendix B)

Size Distribution

Radius measurements (from tip of arm to central disc) of all species was collected during the surveys at all site locations. It takes approximately 5 years for *P. ochraceus* to mature to an average size of 90 mm radius [2;4]. Determining size range and distribution helps us understand species recruitment and growth over time. In 2020, just under half (**~45%**) of the population of *P. ochraceus* falls within the **40-70mm** range (Appendix C), which is approximately the same percent of the population that fell within that size range in 2019. This indicates there was **no obvious**



Ochre Star
(*Pisaster ochraceus*)

Leather Star
(*Dermasterias imbricata*)



Bat Star
(*Patiria miniata*)



Mottled Star
(*Evasterias troschelii*)



Blood Star
(*Henricia leviuscula*)



Sunflower Star
(*Pycnopodia helianthoides*)



Pink Sea Star
(*Pisaster brevispinus*)



Photos of blood star and pink star by Jerry Kirkhart. Photo of sunflower star by Janna Nichols. Photos of ochre, leather, and bat star by SIMRS. Images modified to remove background.

change in the average size of this species from last year. However, the size distribution of *P. ochraceus* was wider this year reaching to 200mm in 2020 compared to a maximum of 180mm in 2019 (Appendix C). There was **relatively no change in recruitment** (animals smaller than 30mm) from 2019 to 2020 for the species *P. ochraceus*. Approximately **18%** of the sea stars measured in both years were under 30mm in radius, for a total of 646 recruits in 2020 and 505 recruits counted in 2019 [6] (Appendix D).

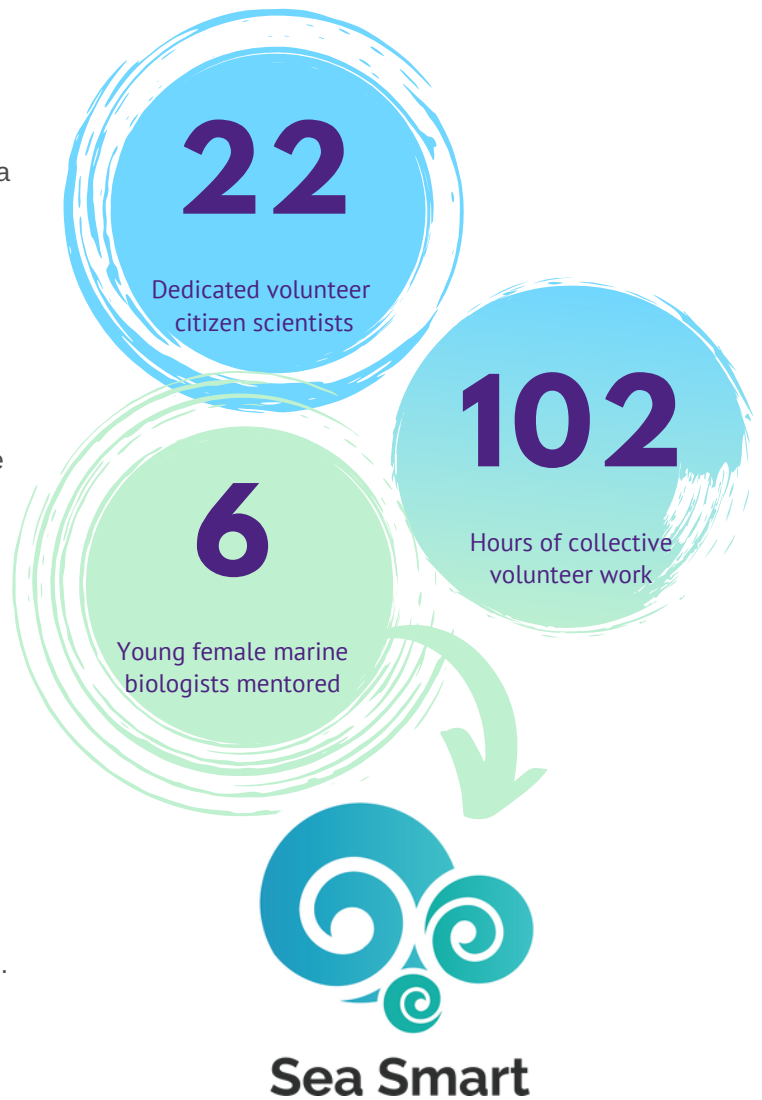
Education & Outreach

The Sea Star Stewardship Program engaged a wide range of people in stewardship of vital inter- and subtidal ecosystems. We believe that hands-on education enhances conservation by encouraging local people to become ambassadors for the marine environment within their own backyard. We succeeded in our goal to develop community stewardship, promote education, and increase volunteer participation. Participating in surveys gave volunteers a hands-on learning experience, increasing their knowledge of species identification, the effects of sea star wasting syndrome, and scientific data collection and field skills. Volunteers were not required to have any previous knowledge or experience in field work. SIMRS staff and partners taught volunteers in the field to ensure maximum engagement. In addition to volunteer involvement, the surveys also drew attention from visitors passing by and allowed participants to become teachers and ambassadors of the local intertidal ecosystem.



Partners & Protocols

We continue to partner with the Ucluelet Aquarium, Paddle West Kayaking, Cedar Coast Field Station, Ocean Outfitters and the Wild Pacific Trail. Our volunteers in 2020 included partner staff, locals, and visitors from diverse backgrounds all with a common interest in citizen science and a feeling of stewardship towards their environment. Due to Covid-19 protocols, we only took a limited number of volunteers to each field site to maintain the safety of volunteers and staff. Each call for volunteers received more applications than we could accommodate - indicating a high interest from local community members in engaging in citizen science.



Marine Biologists in Training

In 2020 we were able to expand our audience and participants to include people living outside of Clayoquot and Barkley Sound. We partnered with Sea Smart School for their online marine biology camp for girls. The camp is designed to teach girls aged 8-12 what it is like to be a marine biologist and how to pursue a career in STEM. Participants of the camp were presented with information about the importance of sea stars to inter and subtidal communities, wasting disease and its effects, as well as how to recognize and report the disease. Students were given the tools to start their own sea star surveys at home with the help of a parent or guardian. By engaging with youth, we hope to inspire the next generation of marine biologists to continue studying and conserving sea star populations along the coast of North America.



Check out our video on
[YouTube!](#)



Education & Outreach Cont'd

To further our outreach, SIMRS also teamed up with West Coast N.E.S.T. and Raincoast Education Society by taking part in a filmmaking course promoting Sustainable Development Goals. We created a video presentation to tell the story of our Sea Star Stewardship Program and share how it aligns with UNESCO's Sustainable Development Goal number 14: Life Below Water. This partnership project opened the doors for new ways of outreach by creating an avenue to educate an even broader audience about the Sea Star Stewardship Program through virtual engagement via multiple online platforms.

Volunteer Testimonials

"It was great to learn about different sea stars species, and to be able to have a closer look at them. Now that I've learned of what the sea stars wasting disease is, I am happy to spread the word to my friends and family. Thank you SIMRS and see you next season!"

- Virginie, Sea Star Stewardship volunteer



"I would highly recommend getting involved with the Sea Star Surveys for the 2021 season. The SIMRS team are happy to share lots of really cool facts about the species you can find amongst the tide pools - and there is plenty to discover. Exploring at low tide for sea stars introduced me to areas on our local beaches that I have never seen before. You are also contributing to citizen science research, which is vital for building a better understanding as to why Sea star wasting disease is prevalent among our local intertidal zone. Just a few hours of your spare time makes a big difference for this program."

- Sarah, Sea Star Stewardship volunteer



"I looked SO forward to the surveys every month. It was just a great and simple way get outside, contribute to science and meet like-minded individuals who are just as stoked about life along our coast. It really hit all the marks."

- Tami, Sea Star Stewardship volunteer

Looking Ahead

The cause, spread and long-term ecological effects of SSWS is poorly understood. Although the initial outbreak cannot yet be linked to a single event or factor, it is thought that environmental factors do play a role in the spread of the disease [1;2;4]. Changes in ocean temperature can act as an environmental stressor to sea stars and may contribute to the spread of the disease and/or cause changes in recruitment and population dynamics of sea stars [2;4]. Monitoring environmental factors such as temperature, salinity, and CO₂, in addition to sea star surveys is needed to understand this complex relationship. Additionally, conducting long-term biodiversity surveys would allow us to determine changes in intertidal communities due to sea star population changes caused by SSWS. There is a need for further research and monitoring of sea star populations and intertidal communities along the coast of British Columbia. SIMRS hopes to continue to provide important baseline data and increase the scope of our study in order to help fill these gaps in knowledge.

SSSP Objectives:

1

Provide useful and meaningful open source data by conducting long-term sea star monitoring on the west coast of Vancouver Island

2

Educate locals and visitors about intertidal ecosystems and the effects of sea star wasting syndrome

3

Encourage local communities to become stewards of regional intertidal zones and demonstrate conservation and research initiatives

The 2020 season has shown significant successes in all of these objectives and has proven that sea star wasting syndrome is still prevailing in many locations in our region. With the help and support of donors and partner organizations we hope to increase our capacity for sea star monitoring and education in 2021 and beyond.

Want to learn more about the SSSP and get involved?
Contact us at:

info@simrstofino.org
(250) 266-9090
www.simrstofino.org/seastar
@SIMRS_Tofino



References

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6. Strawberry Isle Marine Research Society (2019). *Tidepool Guardian Program 2019 Review*.

Appendices

Appendix A:

Summary of sea star survey categories from May to August, 2020. Total Count refers to the total number of individual sea stars (all species combined); Total - <100% is the Total Count minus the individuals observed that were not fully visible; Total Mild and Total Severe refers to the number of individual sea stars with Mild or Severe symptoms of wasting disease; Total diseased is number of animals with any signs of wasting; Total Healthy is number of animals with no signs of wasting; % Disease is the Total Diseased divided by Total - <100% multiplied by 100; % Healthy is the Total Healthy divided by Total - <100% multiplied by 100.

| Site | Total Count | Total - <100% | Total Mild | Total Severe | Total Diseased | Total Healthy | % Diseased | % Healthy |
|-------------------|-------------|---------------|------------|--------------|----------------|---------------|------------|-----------|
| Frank Island | 1867 | 1034 | 27 | 7 | 34 | 1000 | 3.29% | 96.71% |
| Stockham Island | 569 | 421 | 19 | 10 | 29 | 392 | 6.89% | 93.11% |
| Tonquin Beach | 1981 | 1235 | 52 | 8 | 60 | 1175 | 4.86% | 95.14% |
| He-Tin-Kis | 94 | 72 | 3 | 3 | 6 | 66 | 8.33% | 91.67% |
| Ucluelet Aquarium | 681 | 276 | 12 | 11 | 23 | 250 | 8.33% | 90.58% |
| Vargas (Islets) | 166 | 147 | 6 | 1 | 7 | 140 | 4.76% | 95.24% |
| Vargas (Beach) | 215 | 167 | 13 | 3 | 16 | 151 | 9.58% | 90.42% |
| Total | 5573 | 3352 | 132 | 43 | 175 | 3174 | 5.22% | 94.69% |

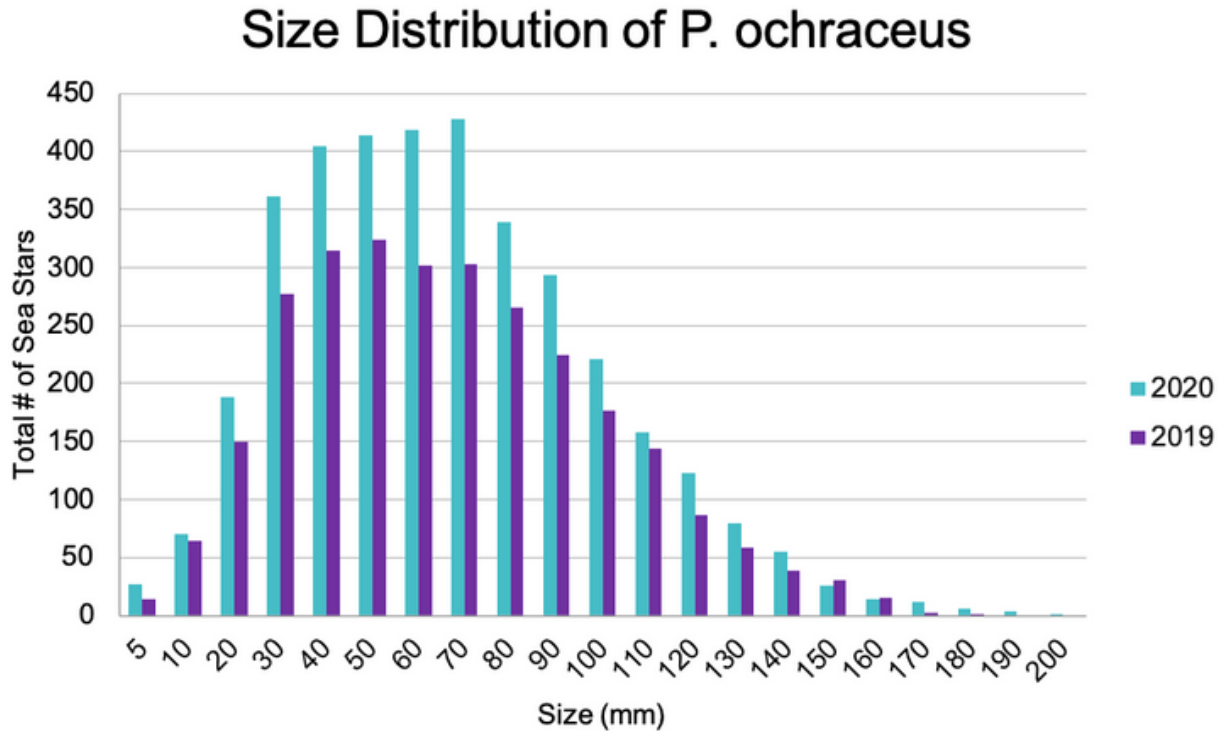
Appendix B:

Summary of species-specific counts and disease categories at each site location in 2020. Total Count refers to the total number of individual sea stars of that species; Total - <100% is the Total Count minus the individuals observed that were not fully visible; Total Mild and Total Severe refers to the number of individual sea stars with Mild or Severe symptoms of wasting disease; Total diseased is number of animals with any signs of wasting; Total Healthy is number of animals with no signs of wasting; % Disease is the Total Diseased divided by Total - <100% multiplied by 100; % Healthy is the Total Healthy divided by Total - <100% multiplied by 100.

| Site | Total Count | Total <100% | Total Healthy | Total Mild | Total Severe | % Diseased | % Healthy |
|-------------------------------------|-------------|-------------|---------------|------------|--------------|------------|-----------|
| <i>PISASTER OCHRACEUS</i> | | | | | | | |
| Frank | 1460 | 670 | 757 | 26 | 7 | 4.18% | 95.82% |
| Stockham | 235 | 134 | 76 | 16 | 9 | 24.75% | 75.25% |
| Tonquin | 1972 | 746 | 1166 | 52 | 8 | 4.89% | 95.11% |
| He-tin-kis | 93 | 27 | 60 | 3 | 3 | 9.09% | 90.91% |
| Ukee AQ | 439 | 272 | 147 | 11 | 9 | 11.98% | 88.02% |
| Vargas Islets | 148 | 17 | 124 | 6 | 1 | 0.00% | 94.66% |
| Vargas Beach | 197 | 48 | 134 | 12 | 3 | 10.07% | 89.93% |
| All sites total | 4544 | 1914 | 2464 | 126 | 40 | 6.31% | 93.69% |
| <i>DERMASTERIA IMBRICATA</i> | | | | | | | |
| Stockham | 317 | 12 | 302 | 3 | 0 | 0.98% | 99.02% |
| Tonquin | 5 | 0 | 5 | 0 | 0 | 0.00% | 100.00% |
| Ukee AQ | 187 | 118 | 67 | 1 | 1 | 2.90% | 97.10% |
| Vargas Islet | 18 | 2 | 16 | 0 | 0 | 0.00% | 100.00% |
| Vargas Beach | 18 | 0 | 17 | 1 | 0 | 5.56% | 94.44% |
| All sites total | 545 | 132 | 407 | 5 | 1 | 1.45% | 98.55% |
| <i>PATIRIA MINIATA</i> | | | | | | | |
| Stockham | 9 | 1 | 7 | 0 | 1 | 12.50% | 87.50% |
| He-tin-kis | 1 | 0 | 1 | 0 | 0 | 0.00% | 100.00% |
| Ukee AQ | 50 | 15 | 34 | 0 | 1 | 2.86% | 97.14% |
| All sites total | 60 | 16 | 42 | 0 | 2 | 4.55% | 95.45% |
| <i>HENRICIA LEVIUSCULA</i> | | | | | | | |
| Stockham | 5 | 0 | 5 | 0 | 0 | 0 | 100% |
| <i>EVASTERIAS TROSCHELII</i> | | | | | | | |
| Stockham | 3 | 1 | 2 | 0 | 0 | 0 | 100% |
| Tonquin | 4 | 0 | 4 | 0 | 0 | 0 | 100% |
| All sites total | 7 | 1 | 6 | 0 | 0 | 0 | 100% |
| <i>PISASTER BREVISPINUS</i> | | | | | | | |
| Ukee AQ | 1 | 0 | 1 | 0 | 0 | 0 | 100% |

Appendix C:

Number of sea stars per size category of *Pisaster ochraceus* in 2019 and 2020 across all sites combined.



Appendix D:

Number of sea star juvenile recruits counted (animals under 30mm) in each survey month in 2020 across all sites combined.

