

Chiixuu Tll iinasdli

Indigenous & Scientific Leadership in Kelp Restoration
Builds Connections & Knowledge for People & Place in
Gwaii Haanas

© Lynn Lee

International Temperate Reef Symposium . Hobart, Tasmania . Jan 2023

Lynn Lee, Gwiisihlgaa Dan McNeill, Pauline Ridings, Mike Featherstone, Daniel Okamoto, Nathan Spindel, Aaron Galloway, Gary Saunders, Emily Adamczyk, Luba Reshitnyk, Ondine Pontier, Miranda Post, Robyn Irvine, Gulxa taa'a gaagii ng.aang Nadine Wilson, Sgiids Kung Vanessa Bellis, and many many more team members



Canada



Fisheries and Oceans
Canada



Hakai
Science on the Coastal Margin



UNIVERSITY
OF OREGON



1. Build Knowledge & Trust Together



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Canada



HAIDA NATION



Fisheries and Oceans
Canada



Hakai
Science on the Coastal Margin



UNIVERSITY
OF OREGON



UNIVERSITY OF
NEW BRUNSWICK

200+ Good People Working Together

Gwaii Haanas Parks Canada

Dr. Lynn Lee Nadine Wilson
Niisii Guujaaw Chavonne Guthrie
Clint Johnson Charlotte Houston
Tana Hooper Marilyn Deschenes
Robyn Irvine Miranda Post
Ceitlynn Epnors Jody Bissett
Technical Services Thierry Boyer
Many talented field & office staff

Haawa Thanks

Gwaii Haanas Archipelago
Management Board
Council of the Haida Nation
Project Steering Committee
Project Technical Committee

Haida Fisheries Program

Vanessa Bellis Dan McNeill
Ben Penna Richard Smith
Jaasaljuus Yakgujanaas
Dion Lewis Shaun Edgars
Barney Edgars HFP field staff
Tristan Blaine Erika Paradis
Candice St Germain Ryan Miller
Doug Swanston Dorin Wingham

Pacific Urchin Harvesters

Mike Featherstone Stan McNeill
Urchin fishing vessels & crews
D & D Pacific Fisheries

Fisheries and Oceans Canada

Pauline Ridings Tammy Norgard
Merlin Best Other biologists

Florida State University

Dr. Dan Okamoto Nate Spindel
Leandre Vigneault (contractor)
Grad students & technicians

University of Oregon

Dr. Aaron Galloway
Grad students & technicians

University of New Brunswick

Dr. Gary Saunders Cody Brooks
Technicians

University of British Columbia

Emily Adamczyk

Hakai Institute

Ondine Pontier Luba Reshitnyk



HAIDA NATION

2. Address How Past Actions have Shaped Today

Loss of First Nations access to abalone

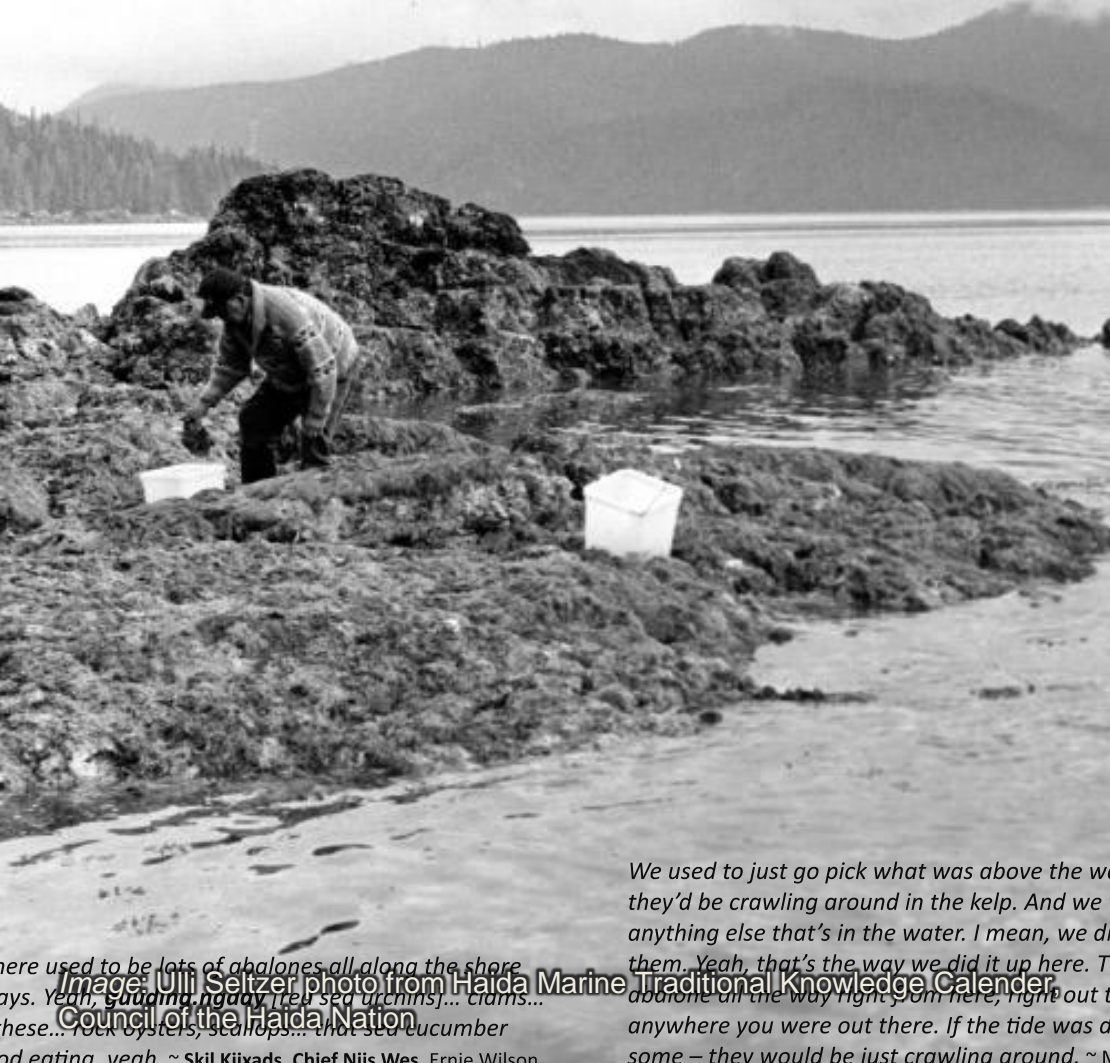


Image: Ulli Seltzer photo from Haida Marine Traditional Knowledge Calendar, Council of the Haida Nation

We used to just go pick what was above the water. They'd be crawling around in the kelp. And we'd pick anything else that's in the water. I mean, we'd pick them. Yeah, that's the way we did it up here. They'd be crawling all the way right from here, right out to anywhere you were out there. If the tide was down some – they would be just crawling around. ~ M

Sea otters: Special Concern



© Jared Towers

Northern Abalone: Endangered



© Ryan Miller/millermarine.ca

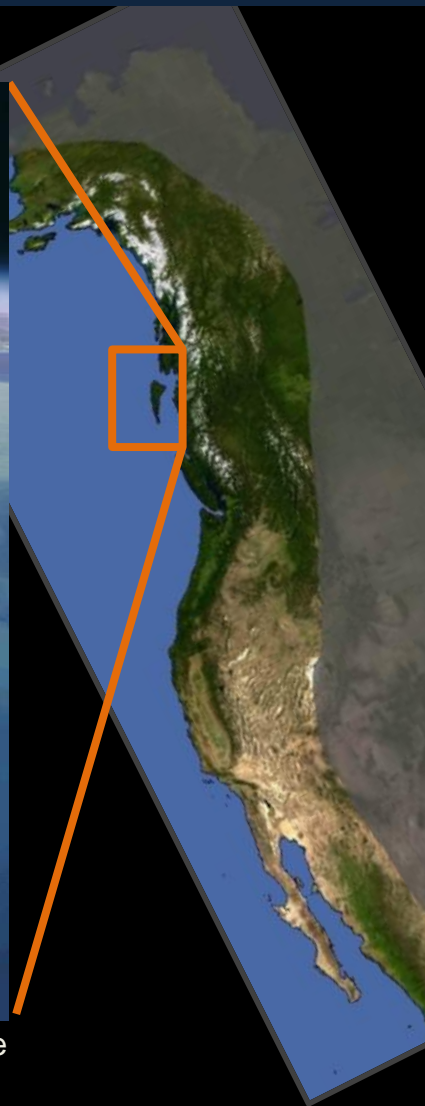
3. Restore Relationships Among People & Place

Transform urchin barrens to kelp forests over 3 km & ~20 ha



Herring © Mark Hiebert
Person © Parks Canada/Nadine Wilson
Others © Lynn Lee

Gwaii Haanas, Haida Gwaii, northern BC, Canada



map © Gowgaia Institute

Cooperative Management & Collaboration Gwaii Haanas Archipelago Management Board

3 Council of the Haida Nation + 3 Government of Canada



© Full Moon Photo/Jason Shafto

Haida Ethics & Values . Guiding Principles

Yahguudang—Respect



Giid tlljuus—Balance



Gina 'waadluxan gud ad kwaagid—
Interconnectedness

Isda ad dii gii isda—
Giving and Receiving



'Laa guu ga k_unhllns—
Responsibility

Gina k'aadang.nga gii uu tll
k'anguudang—Seeking Wise Counsel



Designs © Tyson Brown

Haida Ethics & Values . Guiding Principles

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Gina 'waadluxan gud ad kwaagid—
Interconnectedness

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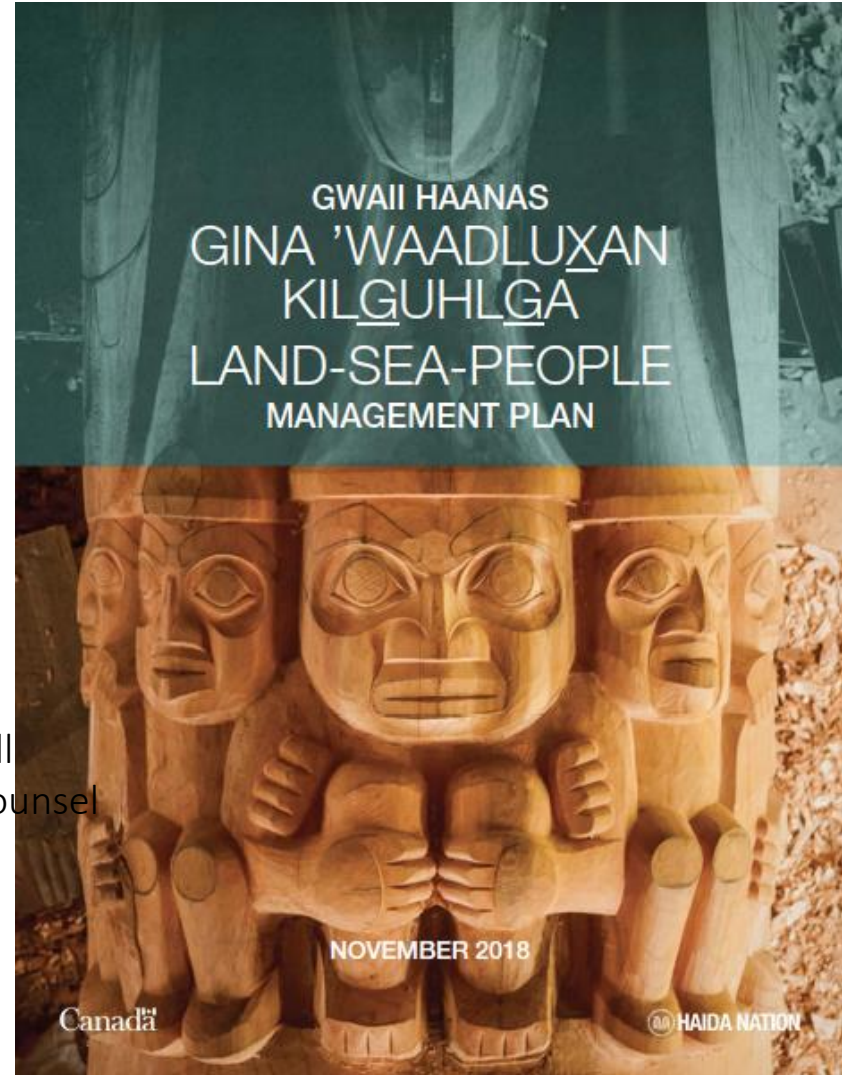


'Laa guu ga k_unhllns—
Responsibility

Gina k'aadang.nga gii uu tll
k'anguudang—Seeking Wise Counsel



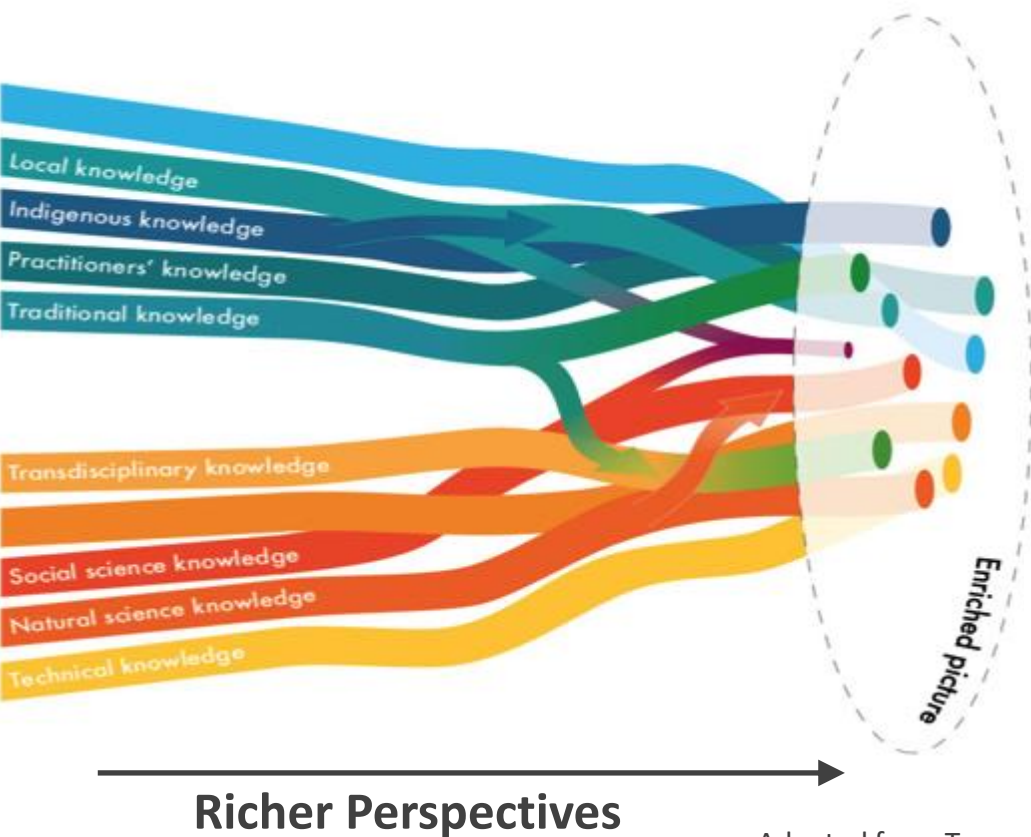
Designs © Tyson Brown



Respect & Weave Different Ways of Knowing

Haida + Experiential + Scientific Knowledge

Opportunities for Innovation Enriched picture

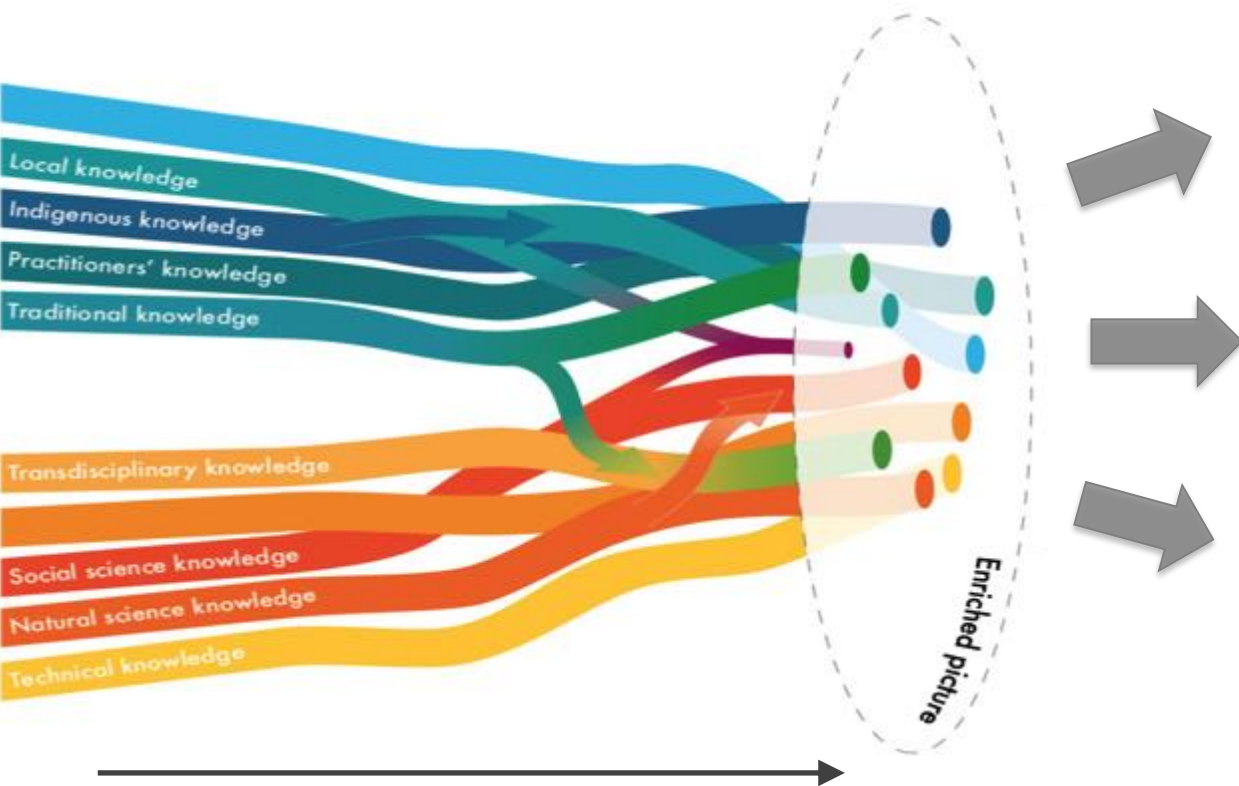


Adapted from Tengo et al 2014

Respect & Weave Different Ways of Knowing

Haida + Experiential + Scientific Knowledge
Opportunities for Innovation

**Enriched
picture**



Adapted from Tengo et al 2014



Effects of Past Actions on Present

photo: worldwideweb



Maritime fur trade
late 1700s – mid-1800s

Trophic cascade

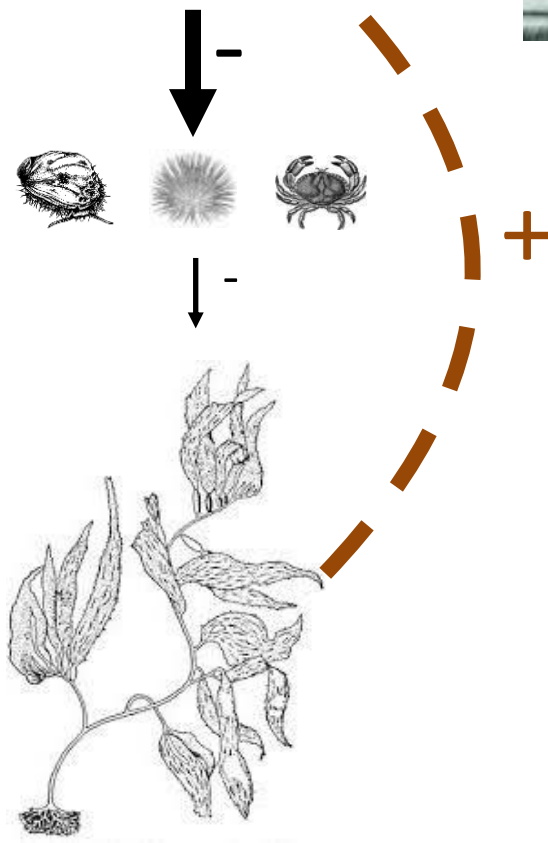
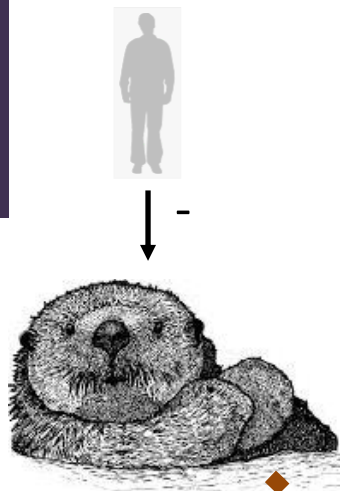


photo: Menzies 2015

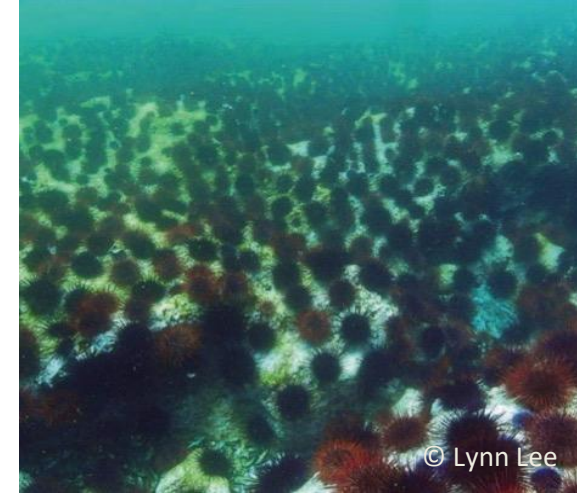
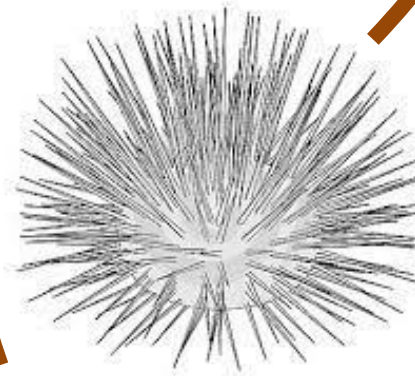
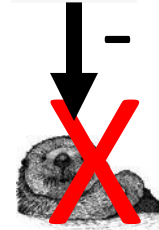
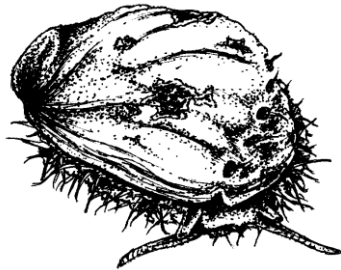
Millennia-long relationship
Haida, sea otters, shellfish, kelp
& coastal ecosystems



Effects of Past Actions on Present

Trophic cascade

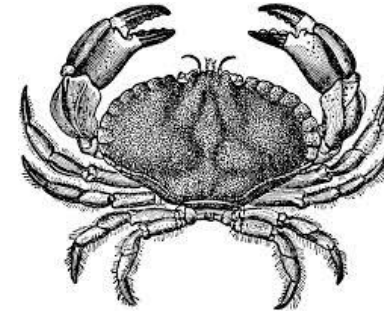
Shellfish released from predation when sea otters extirpated



© Lynn Lee

“Below high water mark in some places the large urchins are very thickly strewn over the bottom.”

~ George Dawson, 1877, Houston-Stewart Channel, Haida Gwaii



Sea otters present



Sea otters absent

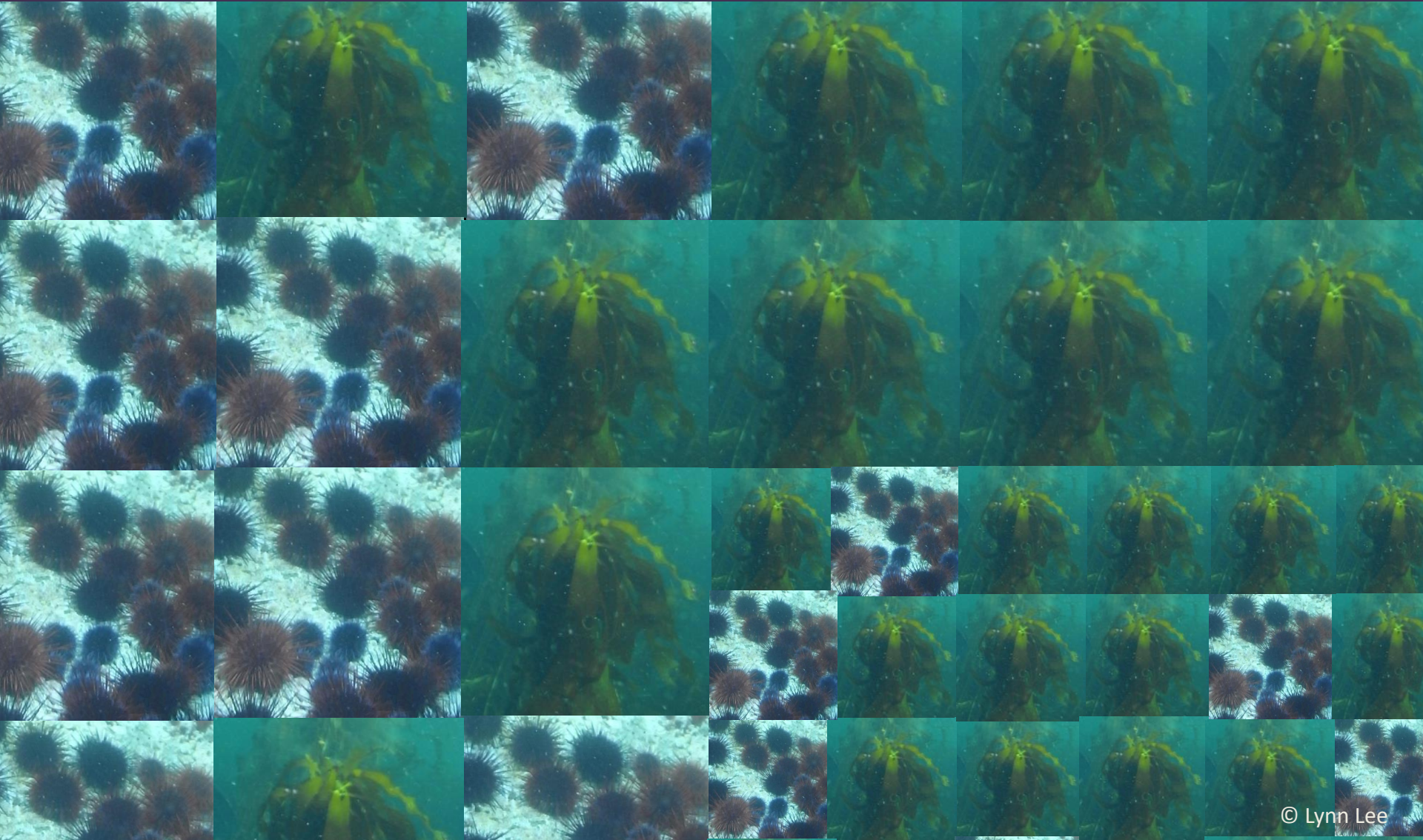


Sea otters recovering

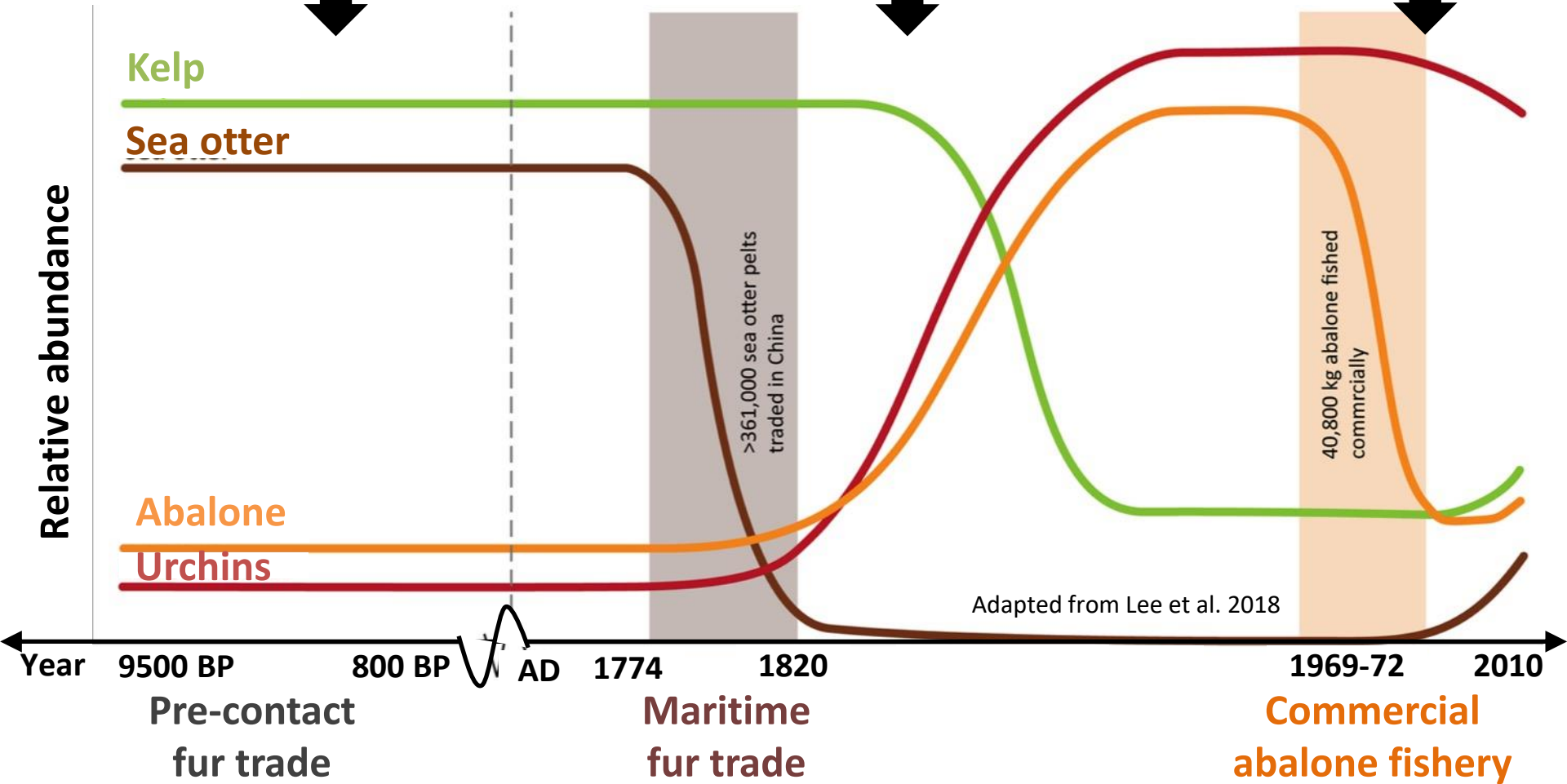


© Lynn Lee

Dynamic Mosaic of Ecological Conditions



© Lynn Lee



Mimick Sea Otter Predation on Urchins to Restore Kelp

Promote Cultural, Social & Ecological Gains & Foster Resilience to Climate Change

- Increased local biodiversity
- + habitat for species important to people
- + physical shoreline protection
- + carbon cycling & sequestration

Mitigate low dissolved oxygen & acidification

Nutrient subsidies to coasts & deepwater

Potential source for carbon storage

© Lynn Lee

Ecological & Cultural Importance iinang *Herring* Spawn



© Lynn Lee

Ecological & Cultural Importance

K'aaw Herring roe-on-kelp



Background © Lynn Lee

inset: photo from Gwaa^{canad} in Haida Marine Traditional Knowledge Calendar, Council of the Haida Nation

Share Knowledge & Build Capacity

- Summer 2017-18 Pre- & 2019-21 Post-restoration surveys
- Continued help forest community monitoring as possible



Other photos © Ryan Miller/millermarine.ca



© Dan Okamoto

Kelp Restoration via Urchin Cracking & Fishing

Haida Traditional Fishing



© Parks Canada/C.Houston



© Parks Canada/L.Lee



© Parks Canada/C.Houston

In situ Urchin Cracking



© Ryan Miller/millermarine.ca

Commercial Fishing



© Pacific Urchin Harvesters Association

Kelp Restoration via Urchin Cracking & Fishing



Fall 2018 & Spring 2019

- 3 km coastline 0-15 m depth
- ~150 diver days
- 6 commercial vessels
- 1 Haida Fisheries vessel
- ~500,000 urchins removed/cracked
- >90% reduction in urchin density

© Ryan Miller/millermarine.ca

© Pacific Urchin Harvesters Association

Annual Site Maintenance via Commercial Fishing & Urchin Cracking Monitored by Haida Guardians

Summer 2019 – Spring 2022

- 6 commercial vessels
- 1 Haida Fisheries vessel
- ~50 diver days
- ~200,000 urchins removed/cracked

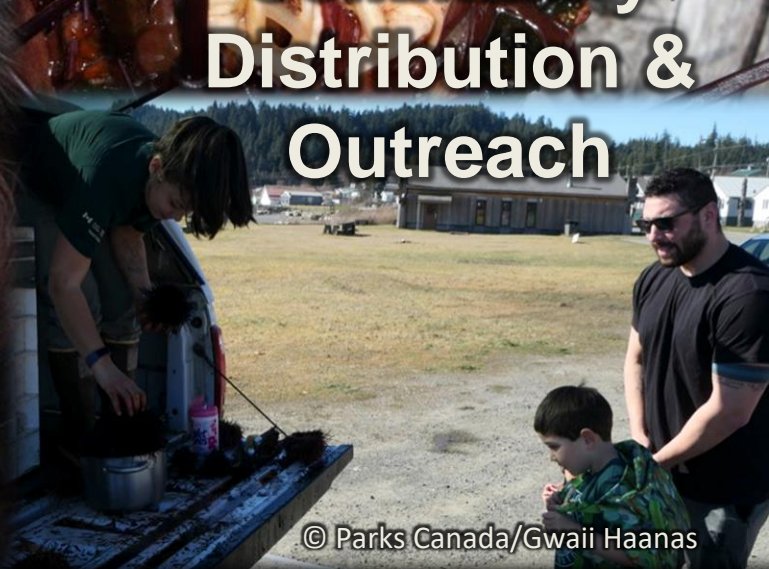


© Parks Canada/L. Lee

Guuding.ngaay *Red Urchin* Traditional Food to Communities

Classroom Lessons

Farm to School Program



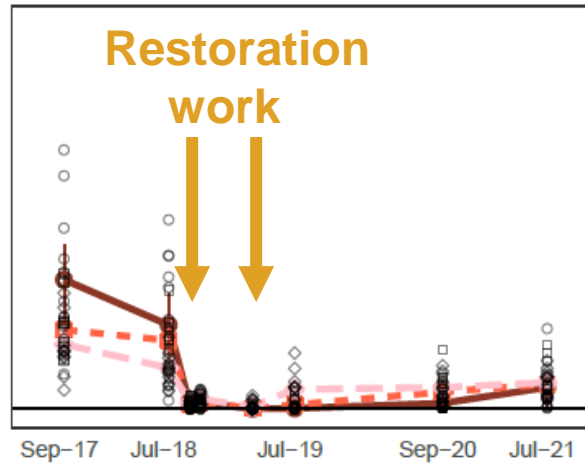
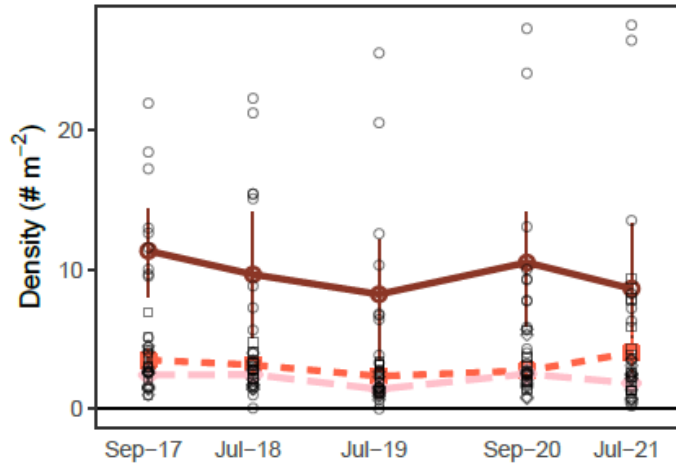
© Parks Canada/Nadine Wilson
**Community
Distribution &
Outreach**

Pre- & Post- Work... Urchin & Abalone

CONTROL

TREATMENT

Red urchin



red urchin

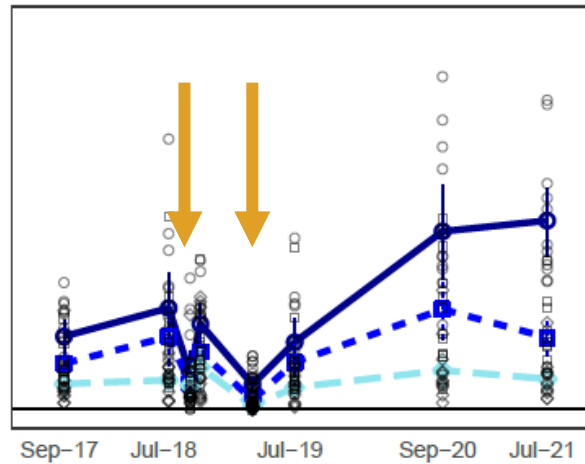
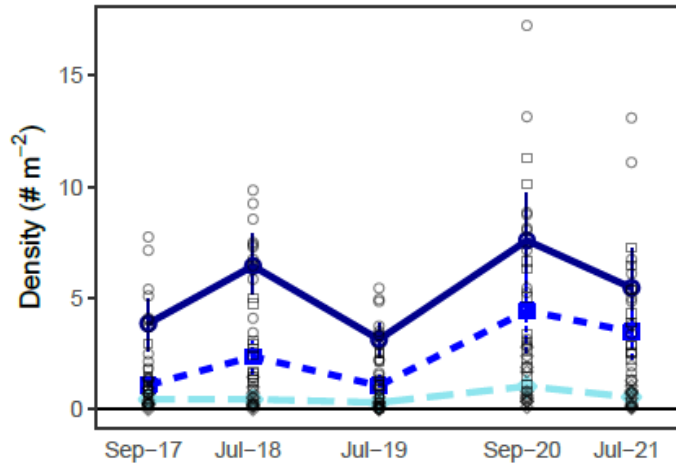
- shallow
- -■- - mid
- -◇- - deep



Abalone

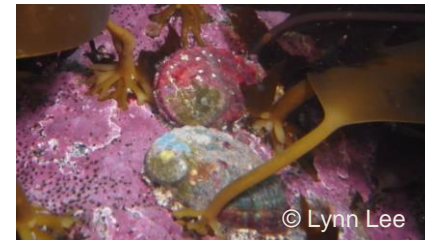
Control

Restoration



abalone

- shallow
- -■- - mid
- -◇- - deep



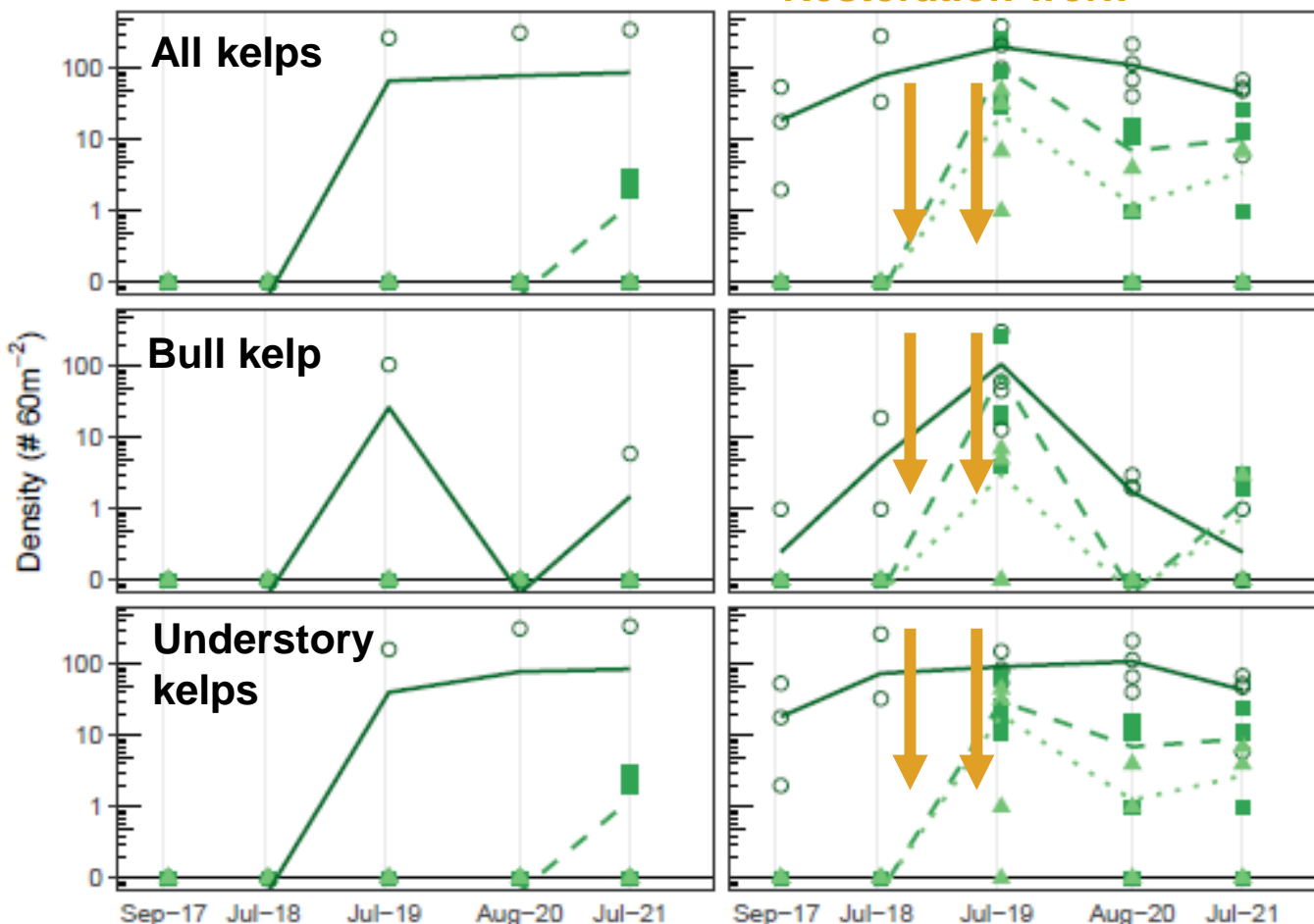
Data: Lee, Bellis, Okamoto & Spindel

Pre- & Post- Work... Kelp Recovery

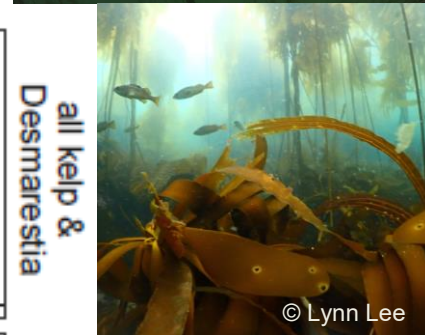
CONTROL

TREATMENT
Restoration work

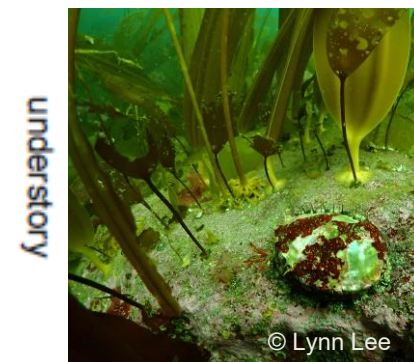
Kelps (log scale)



Data: Lee, Bellis, Okamoto & Spindel



- shallow
 - mid
 - - -△- - - deep
- canopy



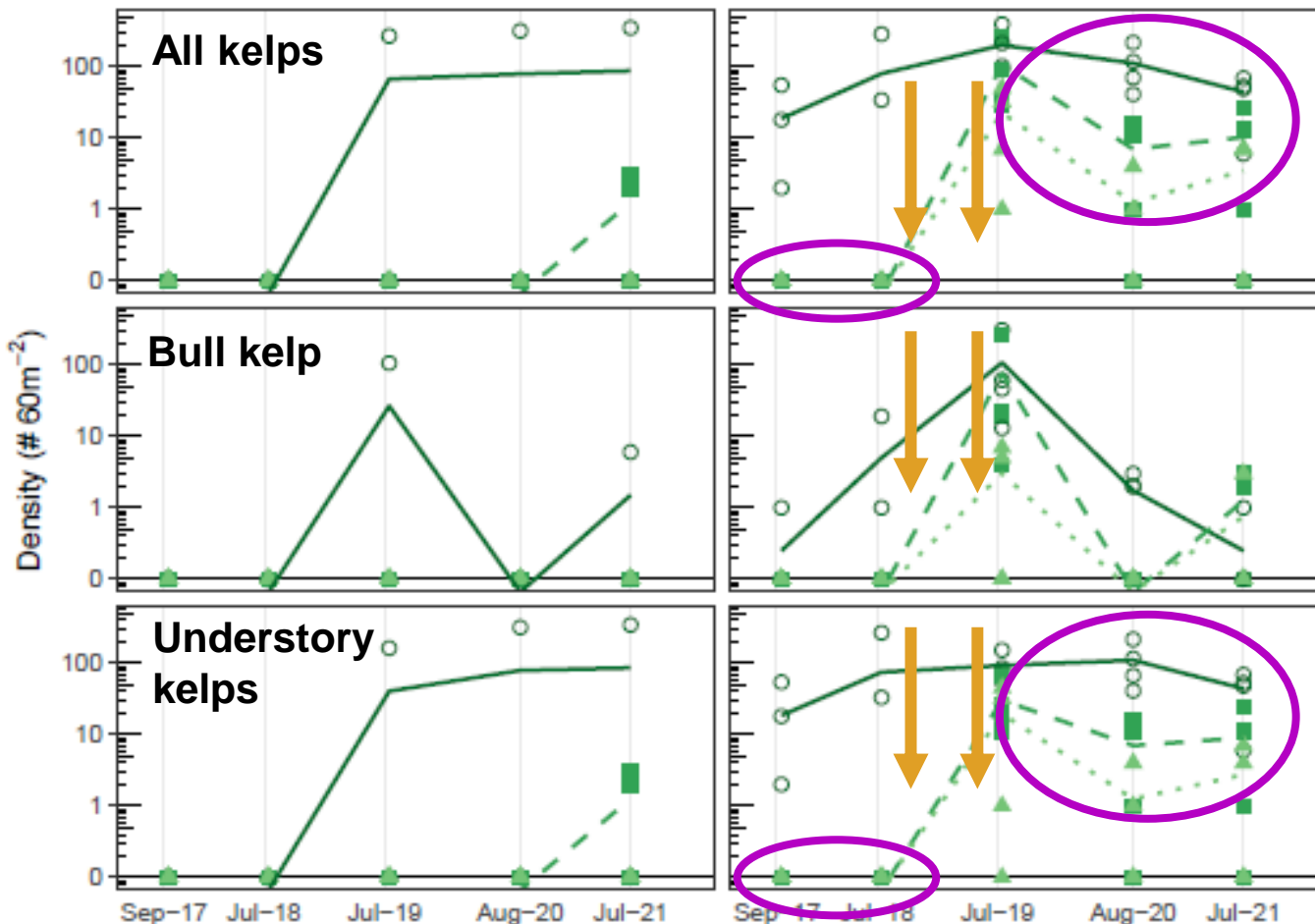
Pre- & Post- Work... Kelp Recovery

CONTROL

TREATMENT

Restoration work

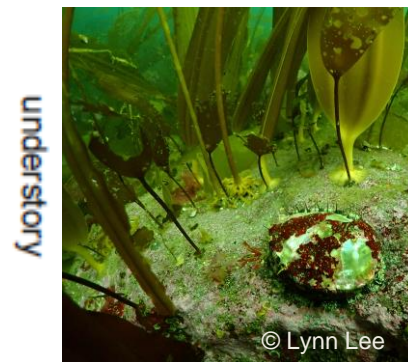
Kelps (log scale)



Data: Lee, McNeill, Okamoto & Spindel



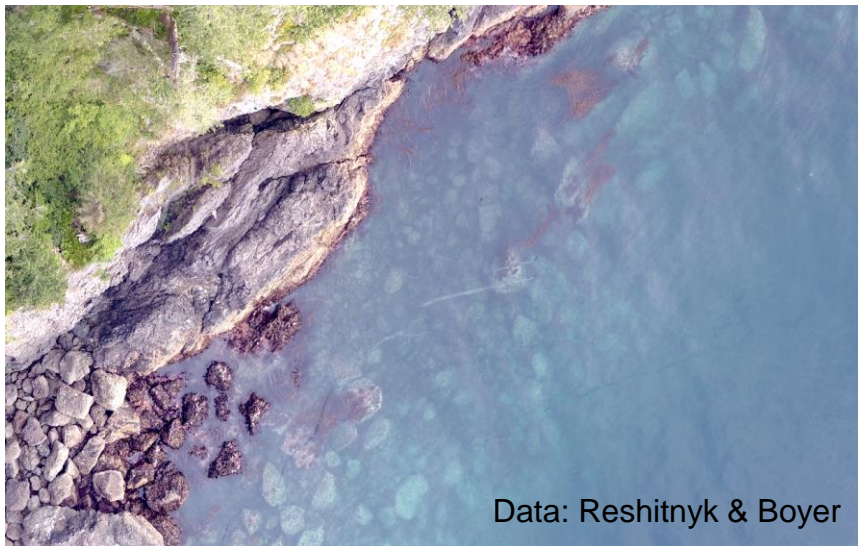
- shallow
- mid
- deep



July 2018

8 months after work...

July 2019

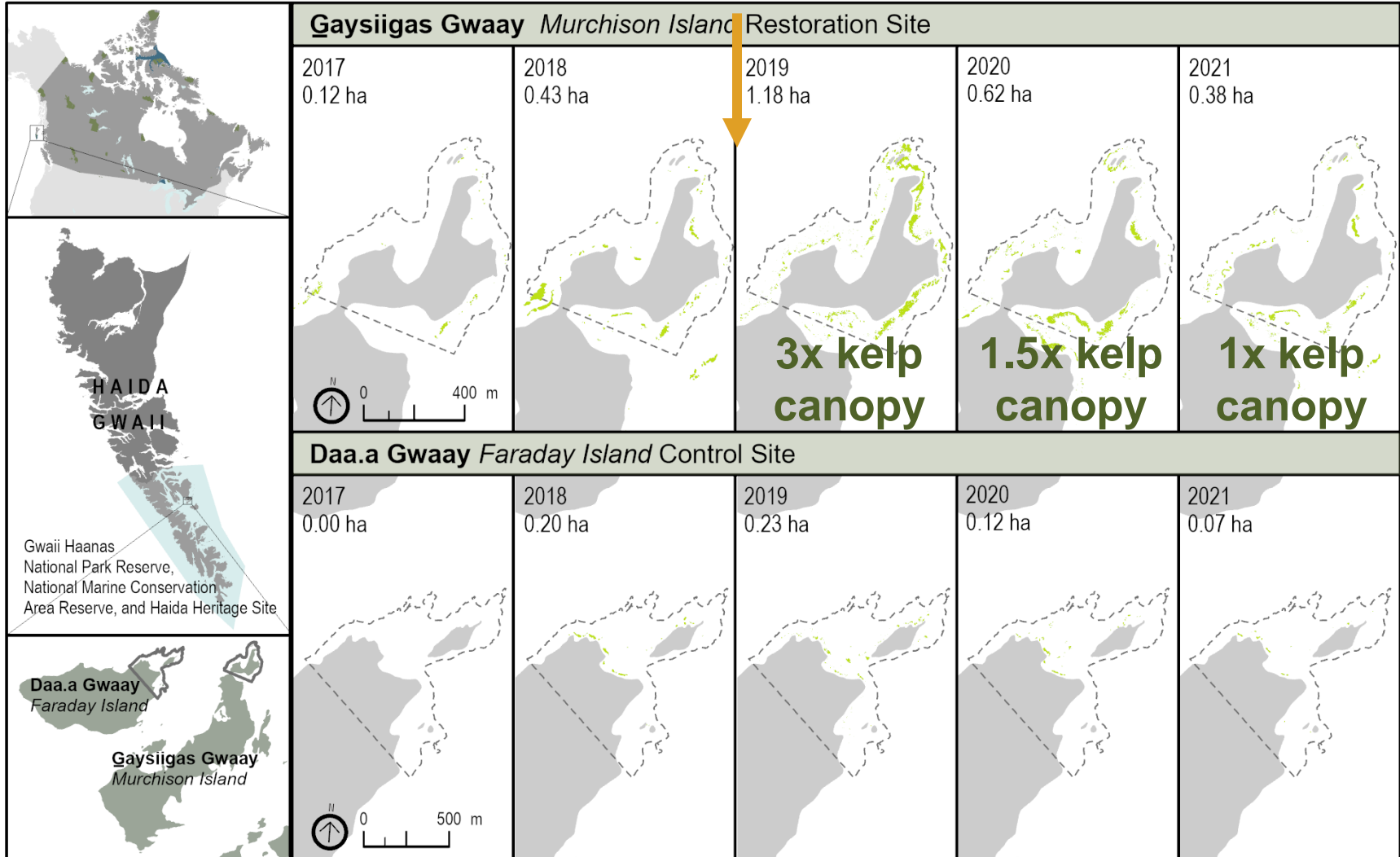


2017 & 18
Pre-restoration

Kelp Canopy Change

Restoration work

2019-2021
Post-restoration

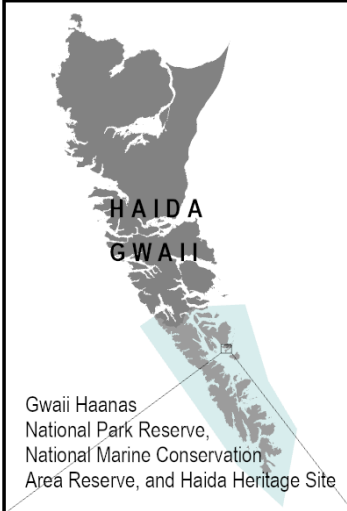


Lee et al. 2021. *Ecological Restoration*

2017 & 18
Pre-restoration

Kelp Canopy Change

2019-2021
Post-restoration

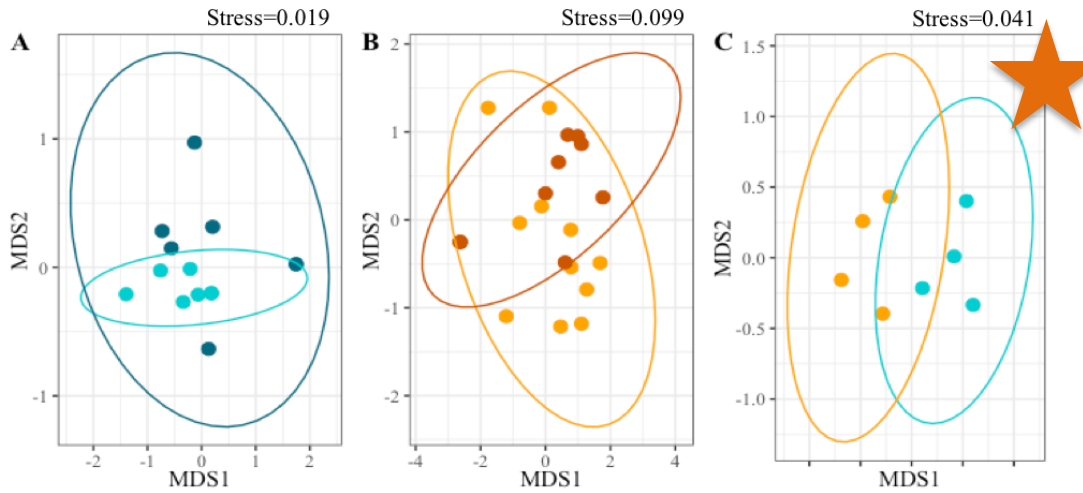
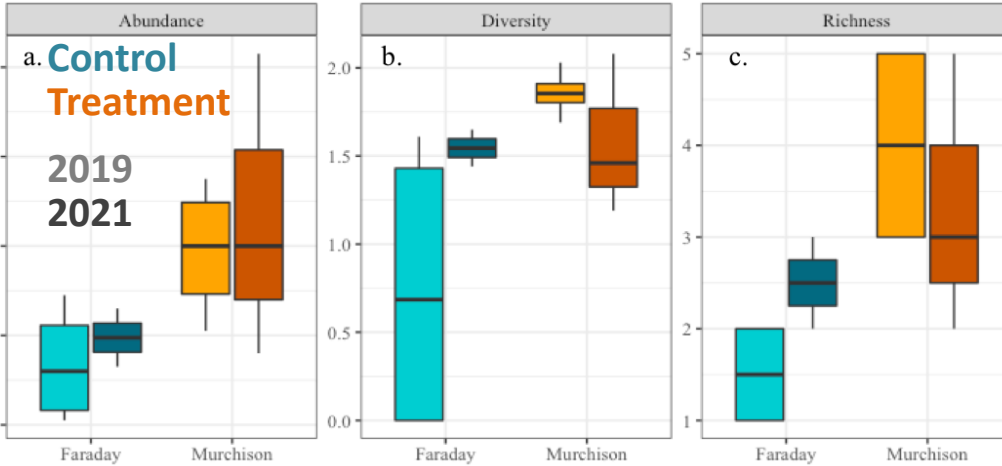


Algal Diversity Change

Abundance

Diversity

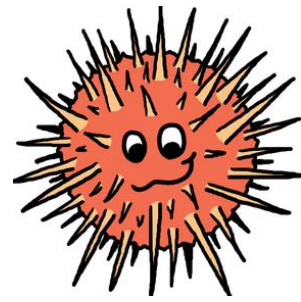
Richness



Data: Saunders & Brooks

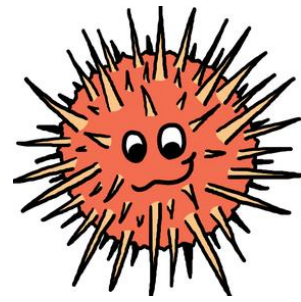


BUT... urchins are not all the same



© Lynn Lee

BUT... urchins are not all the same



© Ryan Miller



© Lynn Lee

Edge of Kelp



Edge of Kelp



Deeper in Urchin Barren



Edge of Kelp

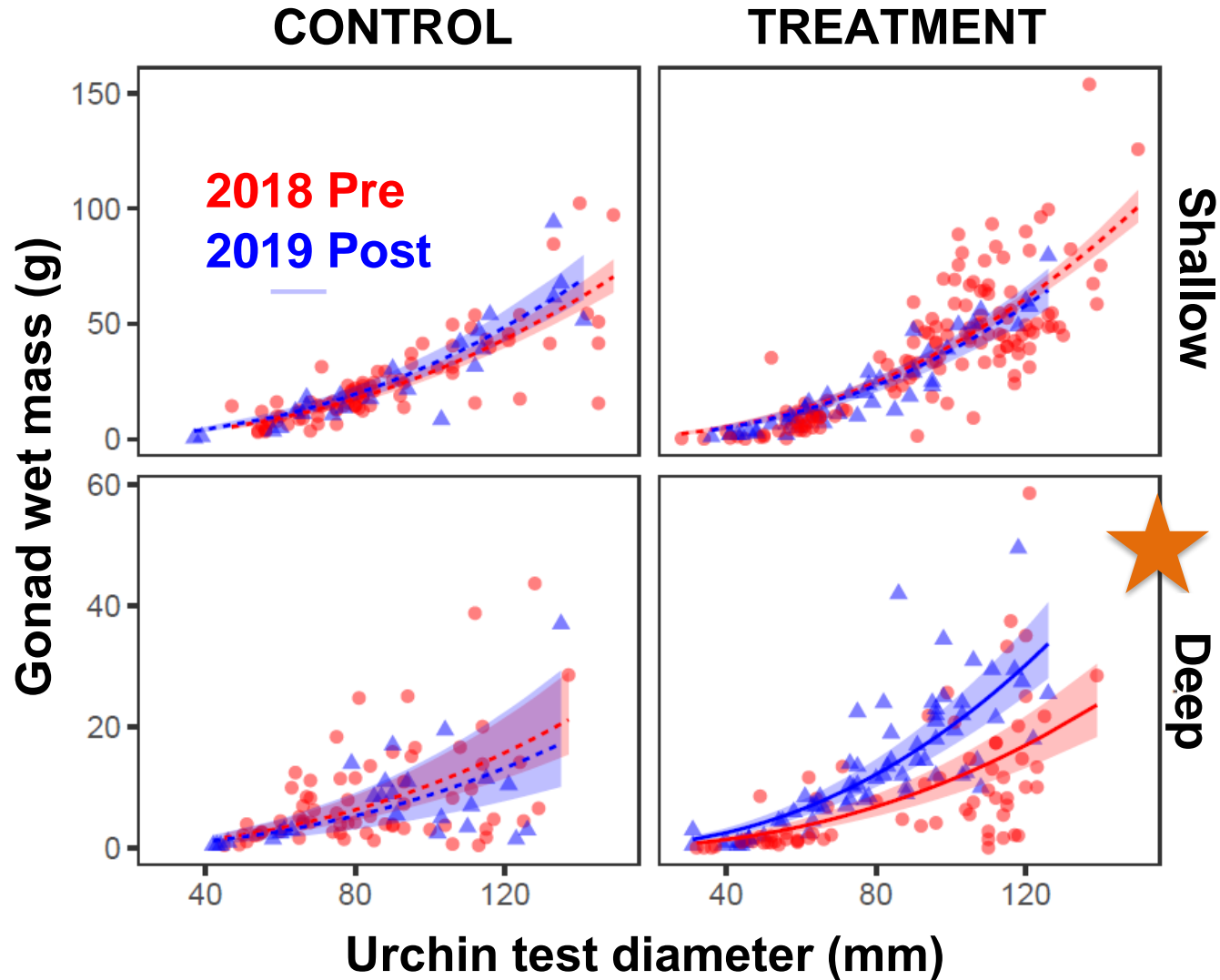
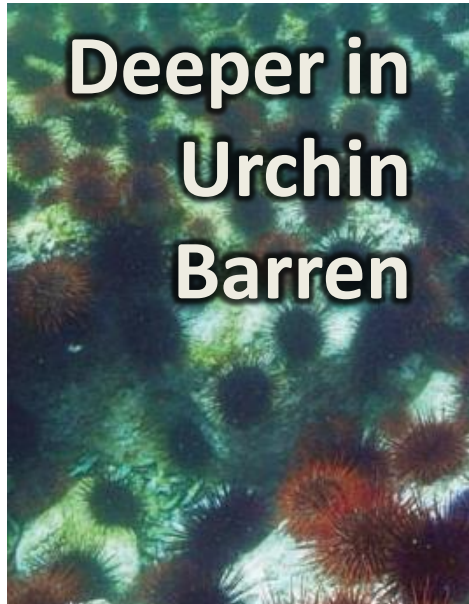
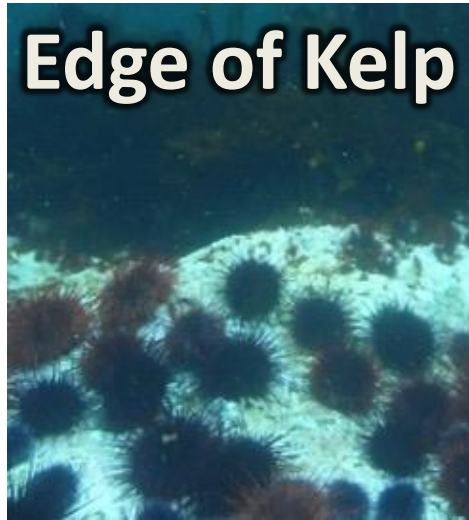


MORE GONADS

Deeper in Kelp = Barren



Does kelp restoration increase urchin gonad mass?

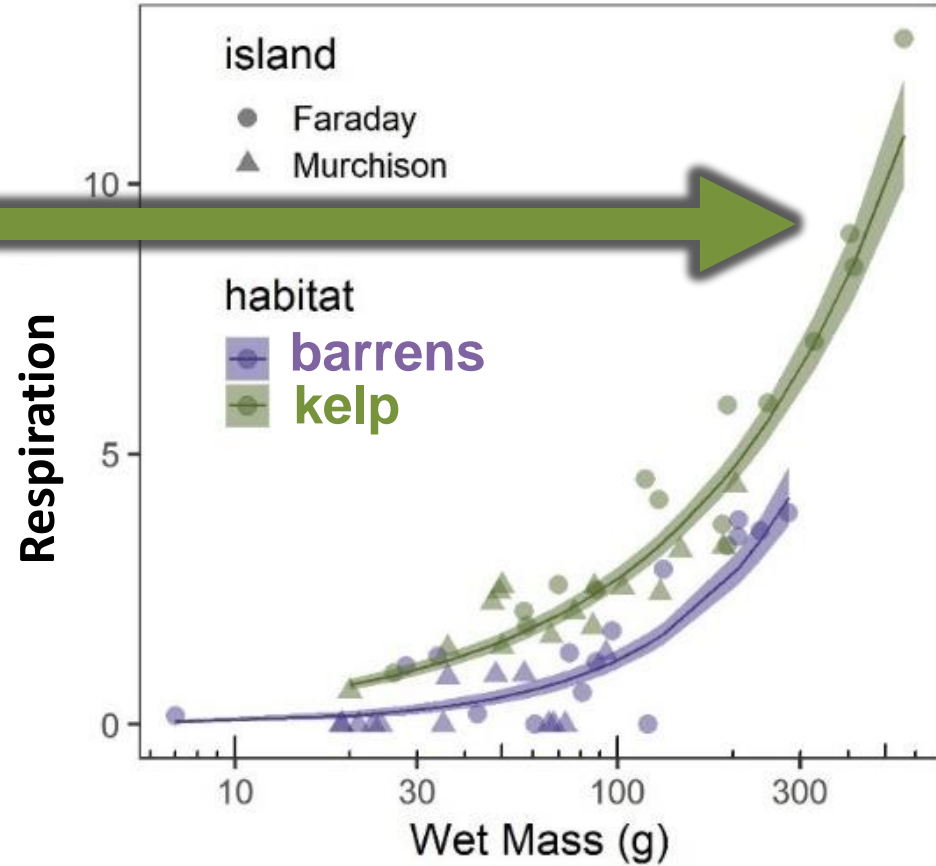


Data: Spindel & Okamoto

Edge of Kelp



Red Sea Urchin

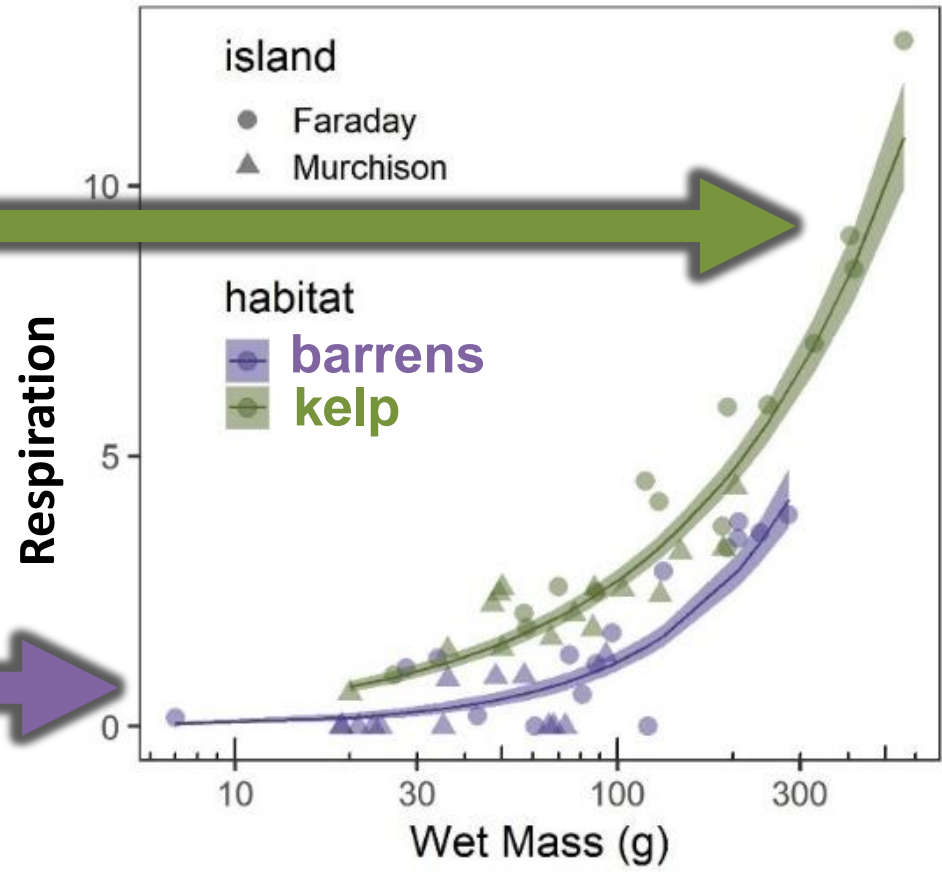


Spindel, Lee & Okamoto. 2021. *Ecology*

Edge of Kelp



Red Sea Urchin

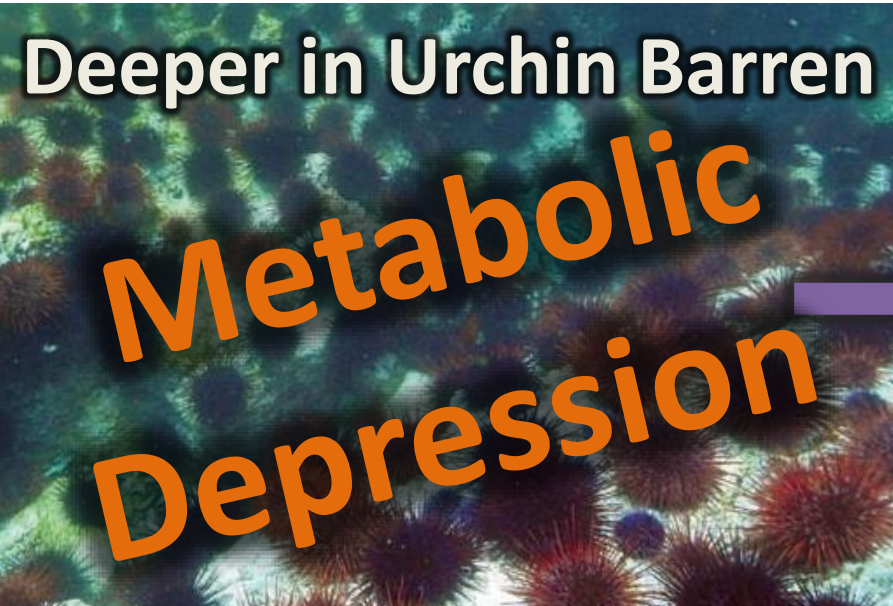
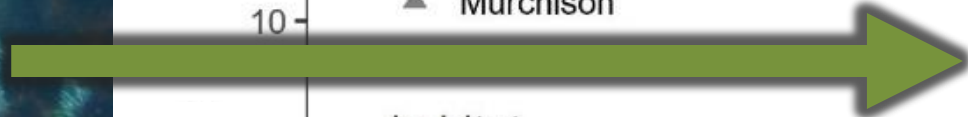
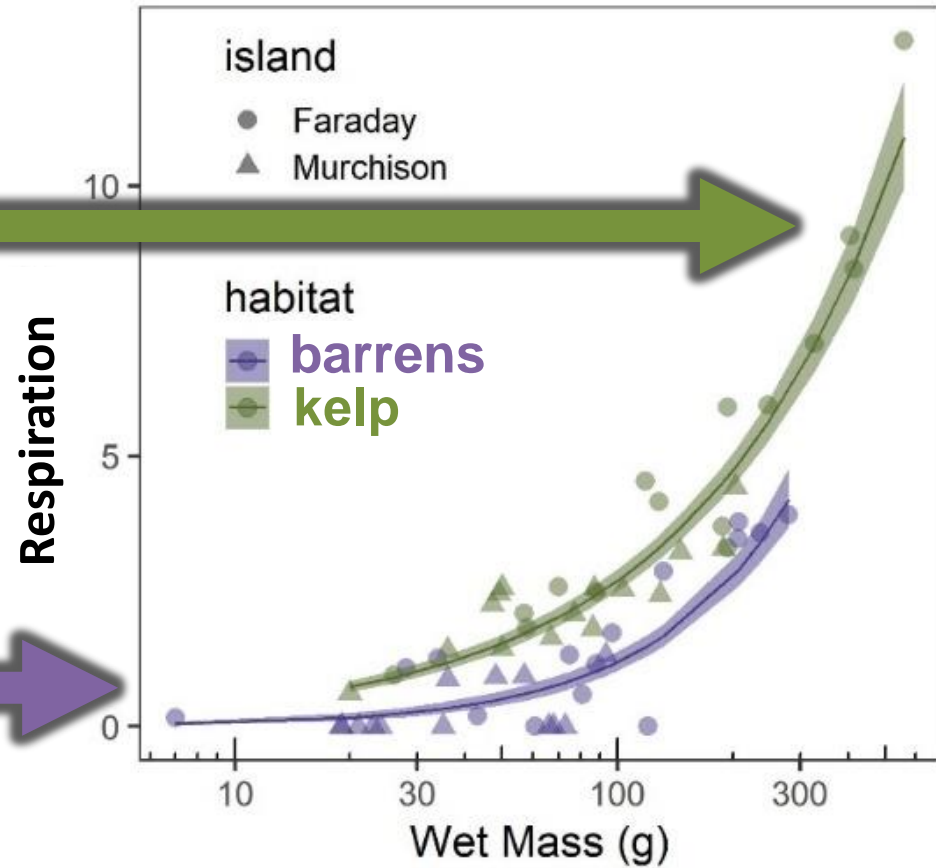


Spindel, Lee & Okamoto. 2021. *Ecology*

Edge of Kelp

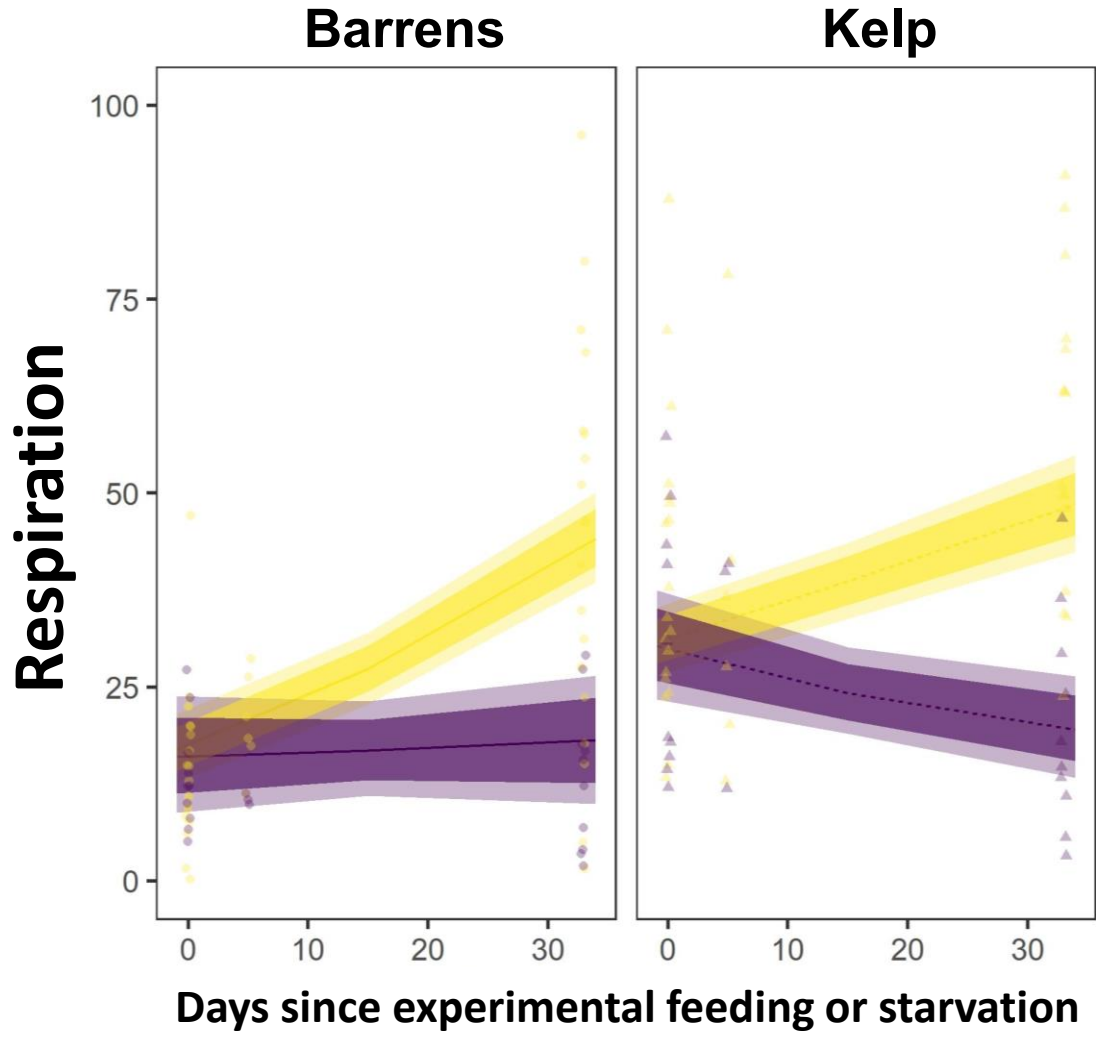


Red Sea Urchin



Spindel, Lee & Okamoto. 2021. *Ecology*

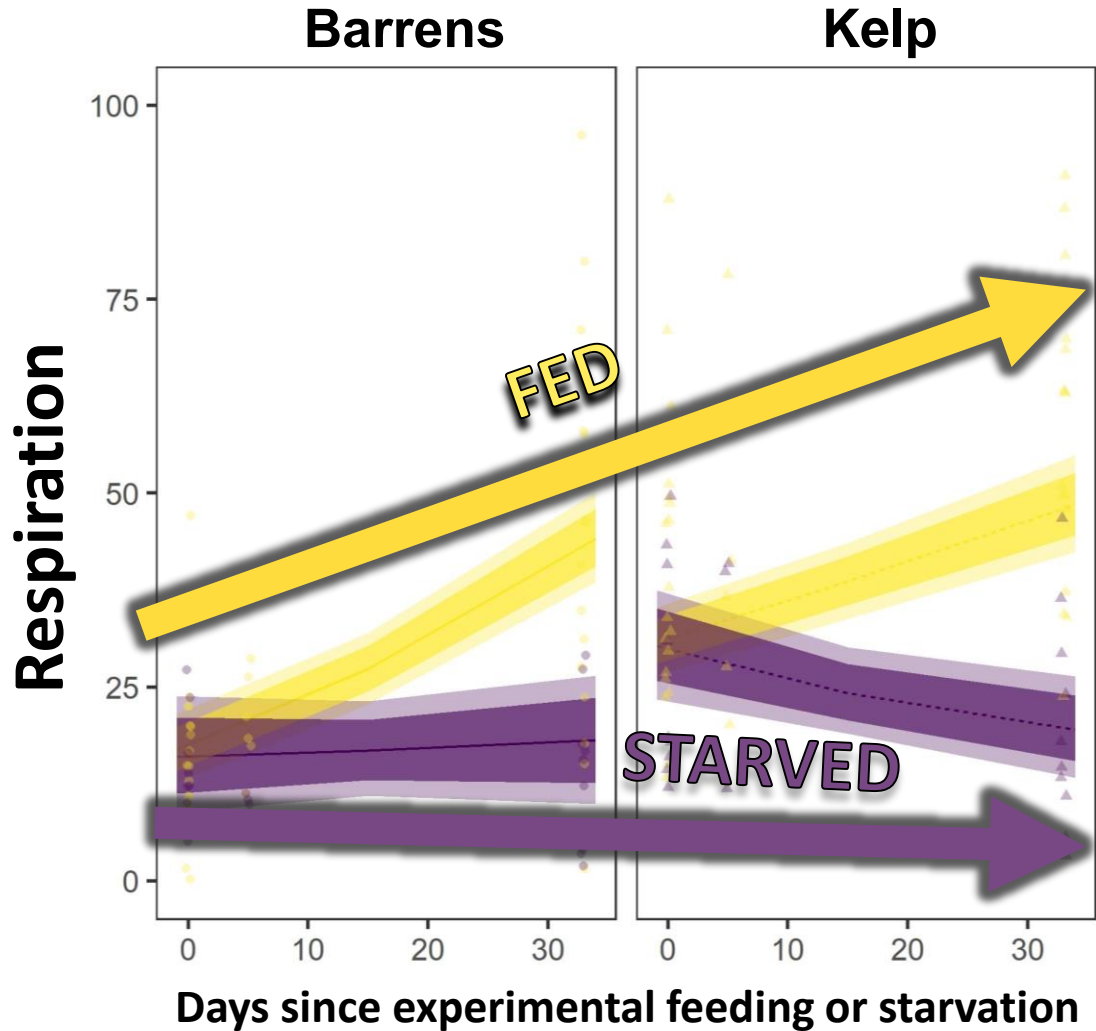
How do you get urchins out of a funk?



Spindel et al. *In prep.*

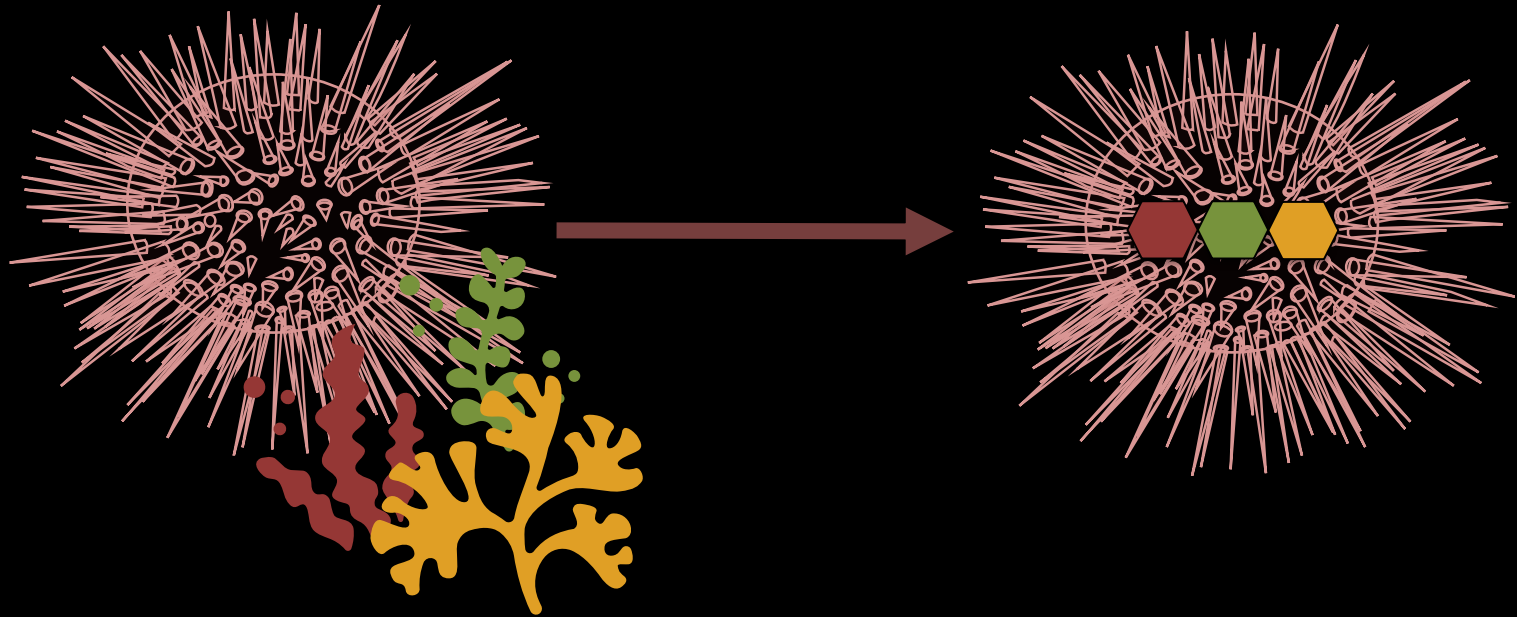
How do you get urchins out of a funk?

Give them kelp!



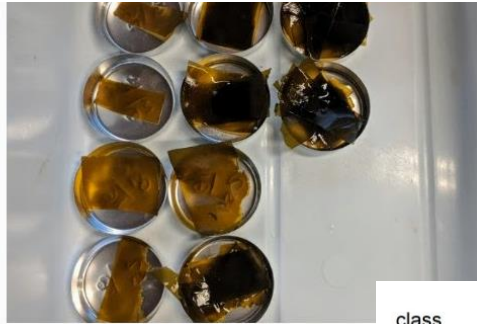
Spindel et al. *In prep.*

You are what you eat!



“  ” = fatty acid biomarkers

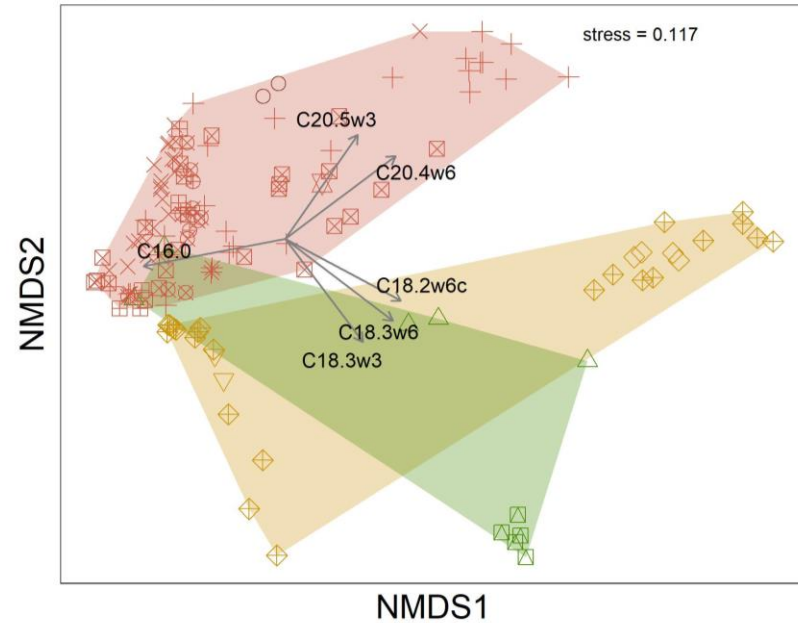
Build & Lab Test a Biomarker Library



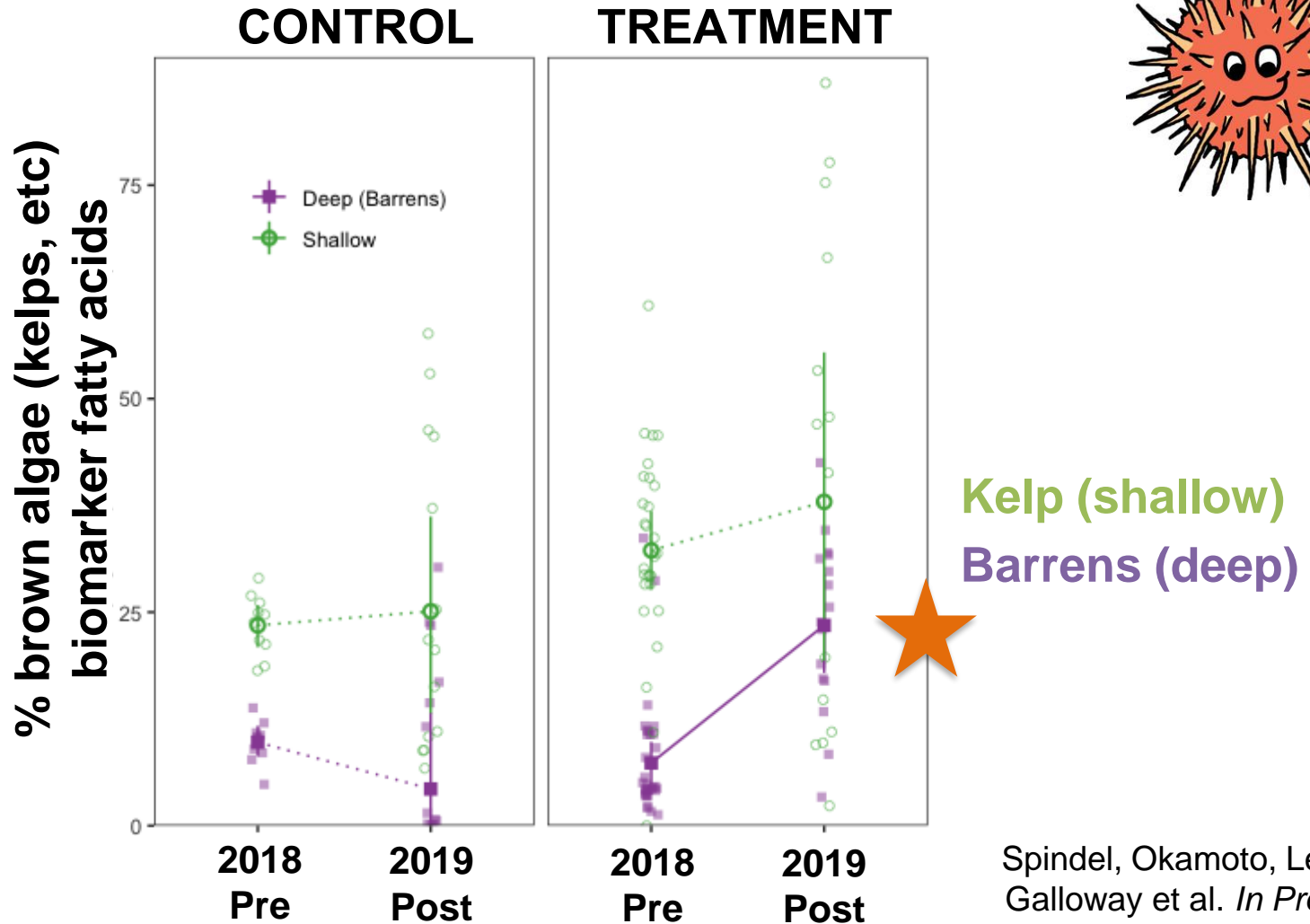
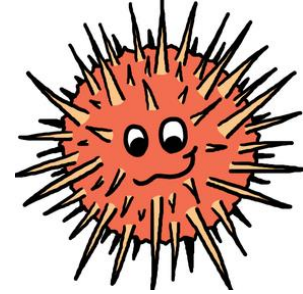
- class
- Bangiophyceae
 - Florideophyceae
 - Phaeophyceae
 - Ulvophyceae

- order
- Bangiales
 - △ Bryopsidales
 - + Ceramiales
 - × Corallinales
 - ◇ Desmarestiales
 - ▽ Dictyotales
 - ⊠ Gigartinales
 - * Hildenbrandiales
 - ⊕ Laminariales
 - ⊕ Nemaliales
 - ⊠ Nemastomatales
 - ⊠ Peyssonneliales
 - ⊠ Rhodymeniales
 - ⊠ Ulvales

Algal Fatty Acid Profiles Data: Spindel & Galloway

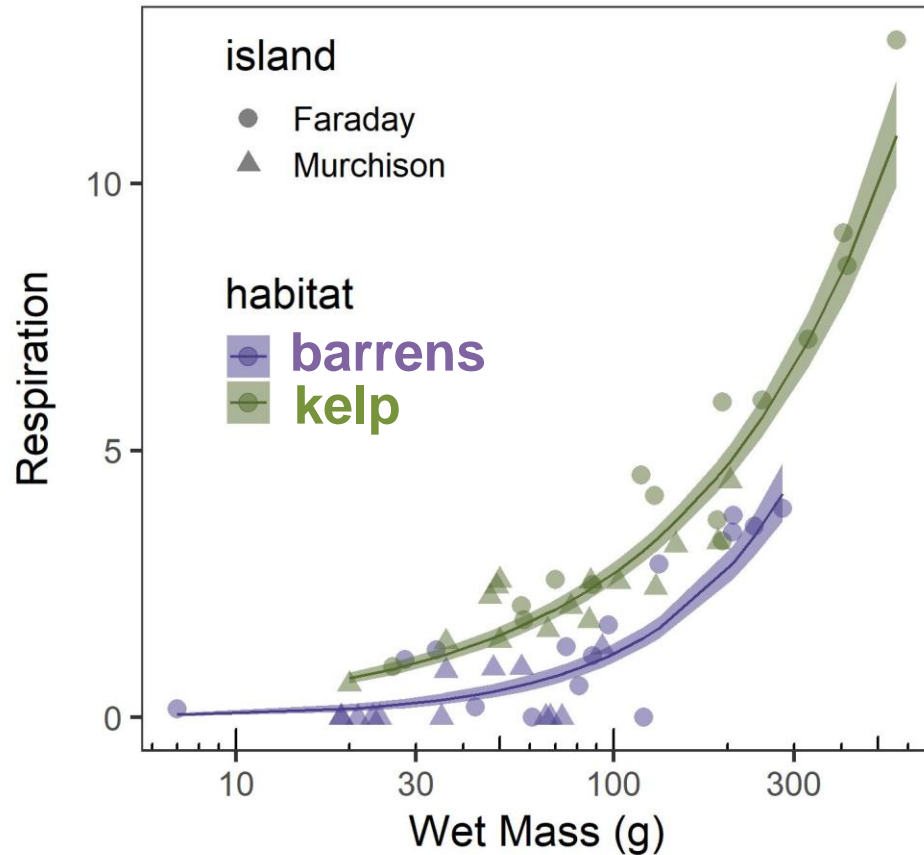


Trace Food Web Changes with Biomarkers

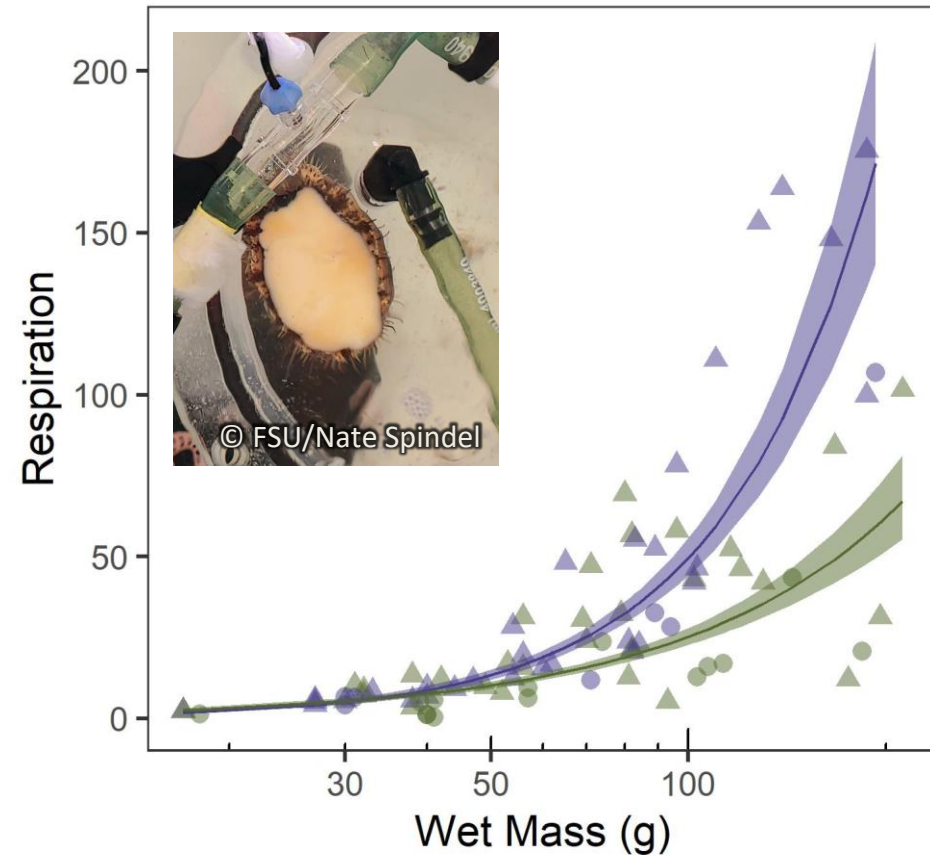


Metabolic Response Differs by Life History Strategy

Red Sea Urchin



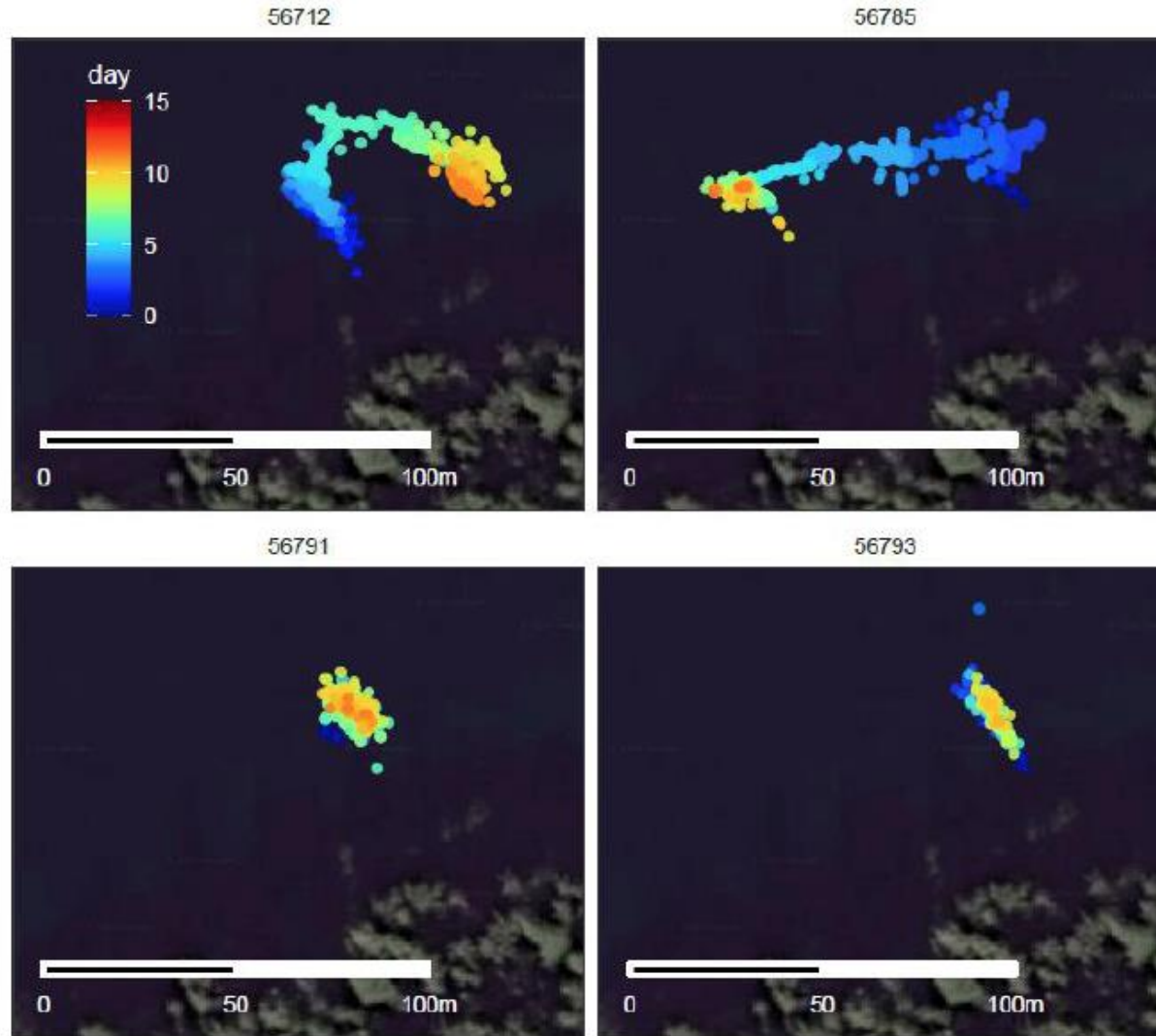
Northern Abalone



Data: Spindel & Okamoto

Tracking Fine-scale Northern Abalone Movement

Preliminary data over 15 days in summer/fall 2021



Data:
Okamoto & Lee

Foster Collaborations into the Future

- Inform stewardship plans with new knowledge
- Pilot alternative urchin fishing & other strategies to help kelp
- Continue site maintenance, monitoring & research
- Continue community outreach & education
- Expand kelp restoration area & share experiences with others
- Stay joyful & open to surprises & possibilities!



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© Markus Thompson/thalassia.ca

Haawa, Haw'aa, Thanks
for listening! QUESTIONS?



© Lynn Lee

From Urchin Barrens to Kelp Forest

