



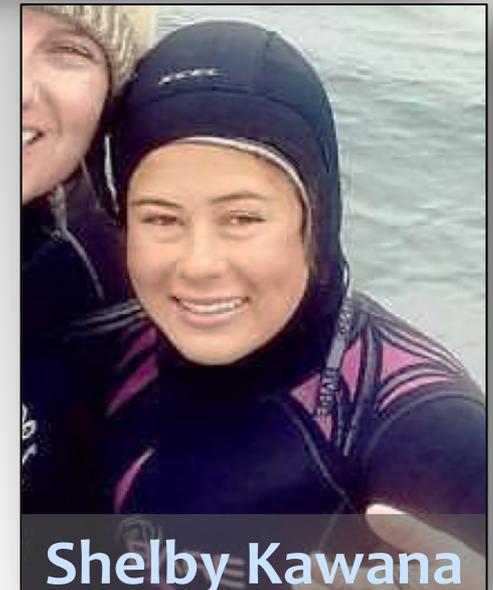
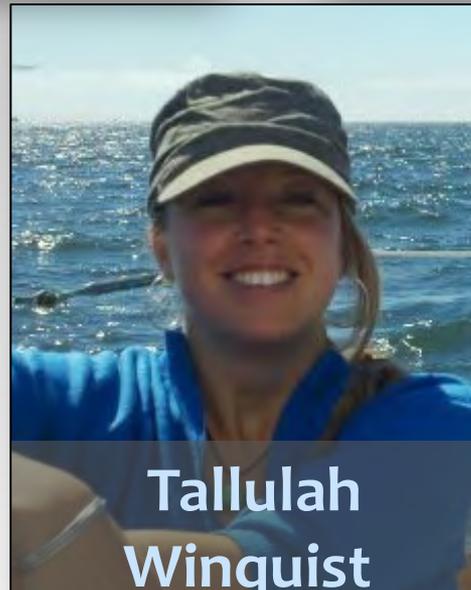
Recent Large-Scale Kelp Loss in Northern California



Dr. Cynthia Catton

Monterey Bay National Marine Sanctuary Meeting
April 20, 2018

BML - Kelp Forest Health Lab



Interns and Volunteers

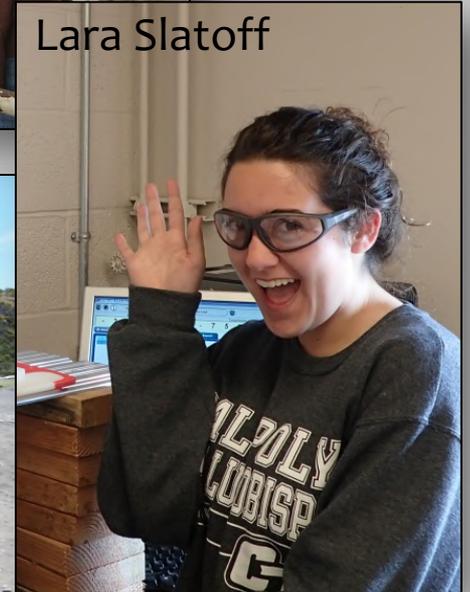
Shiho Koike



Jesse Bray



Lara Slatoff



Gabby Genhart-Steihler



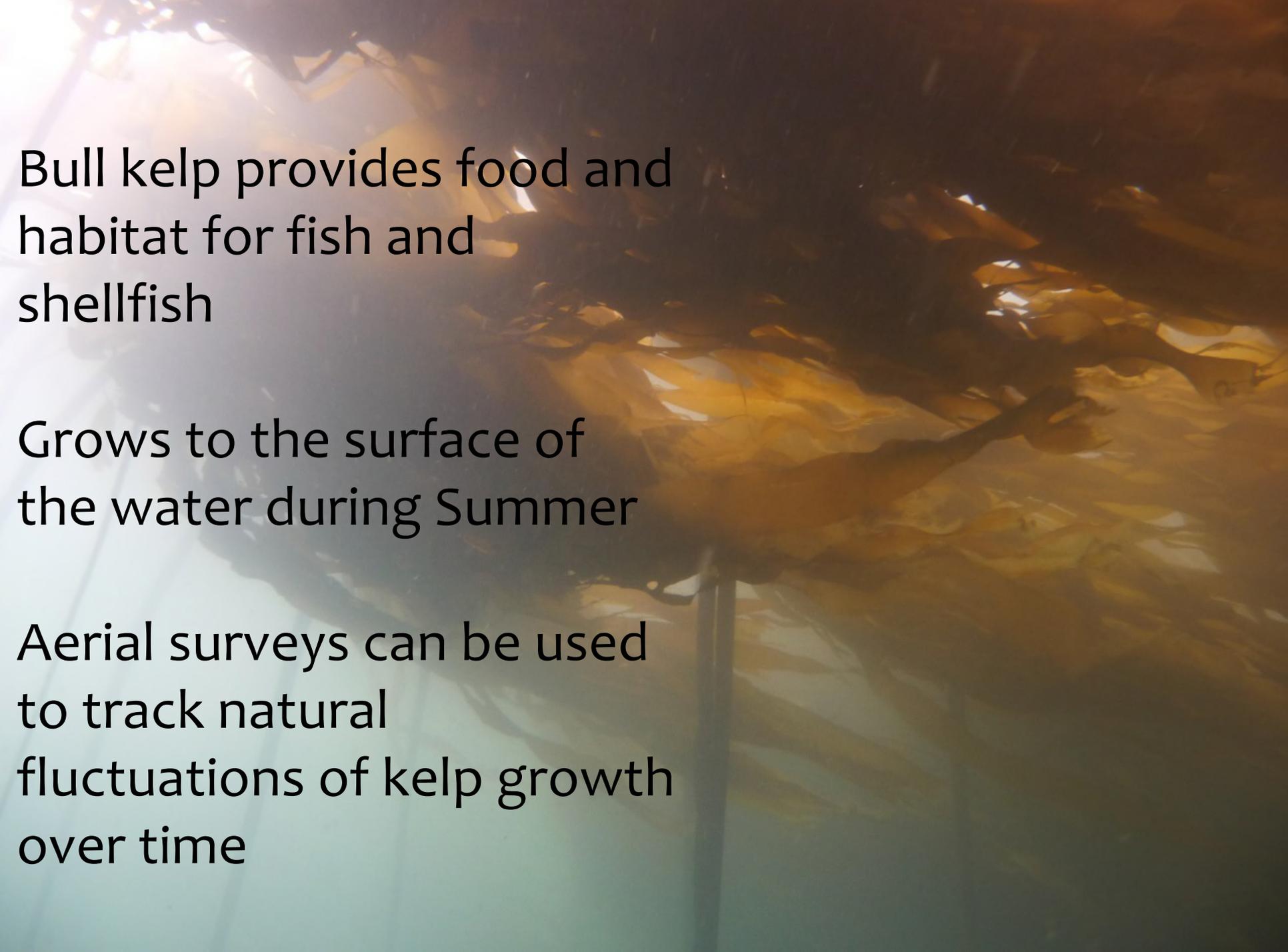
Alex Grinshpan

And so many more!!!

Bull Kelp (*Nereocystis luetkeana*)

A critical
foundation
species for
kelp forest
ecosystems on
the north
coast



An underwater photograph showing a dense canopy of bull kelp. The kelp blades are a vibrant yellowish-brown color and are illuminated from above by sunlight, creating a bright, hazy atmosphere. The background is a deep, dark blue-green, suggesting the depth of the water.

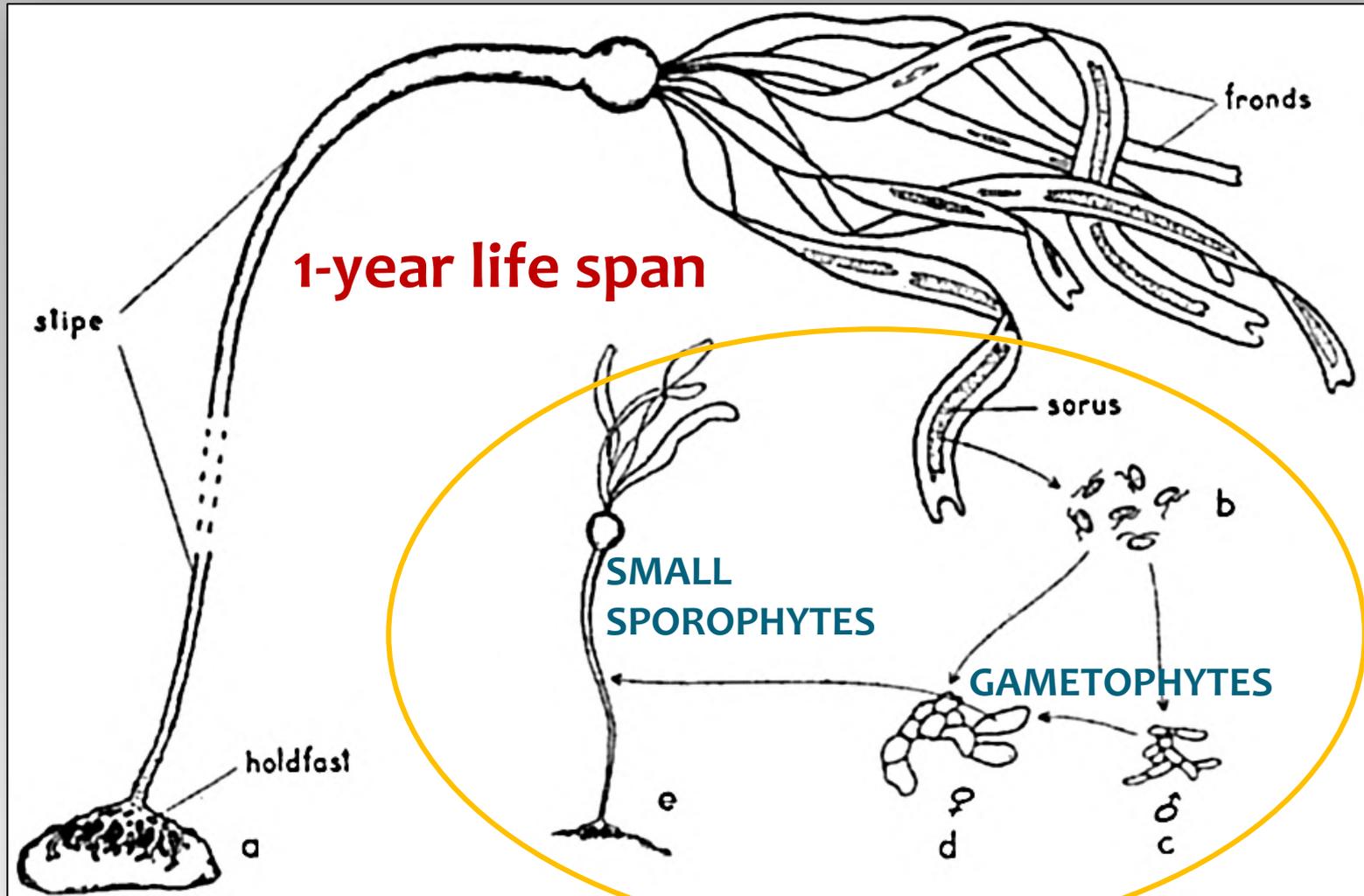
Bull kelp provides food and habitat for fish and shellfish

Grows to the surface of the water during Summer

Aerial surveys can be used to track natural fluctuations of kelp growth over time



Annual Life-History of Bull Kelp



Other shorter kelp species are also important and may have thick woody stalks



Pink crustose algae are very hard and not good to eat, but **very important** habitat for young shellfish



Red Abalone





Flat Abalone



Pinto Abalone

The image shows three abalone shells resting on a dark, textured rock surface. The rock is covered with various marine organisms, including green algae, white lichen, and a yellow sponge. The shells are arranged in a triangular pattern. The top-left shell is labeled 'Flat Abalone', the bottom-center shell is labeled 'Red Abalone', and the right shell is labeled 'Pinto Abalone'. Each shell has a distinct color and texture, and all three have visible siphons extending from their apertures.

Flat Abalone

Pinto Abalone

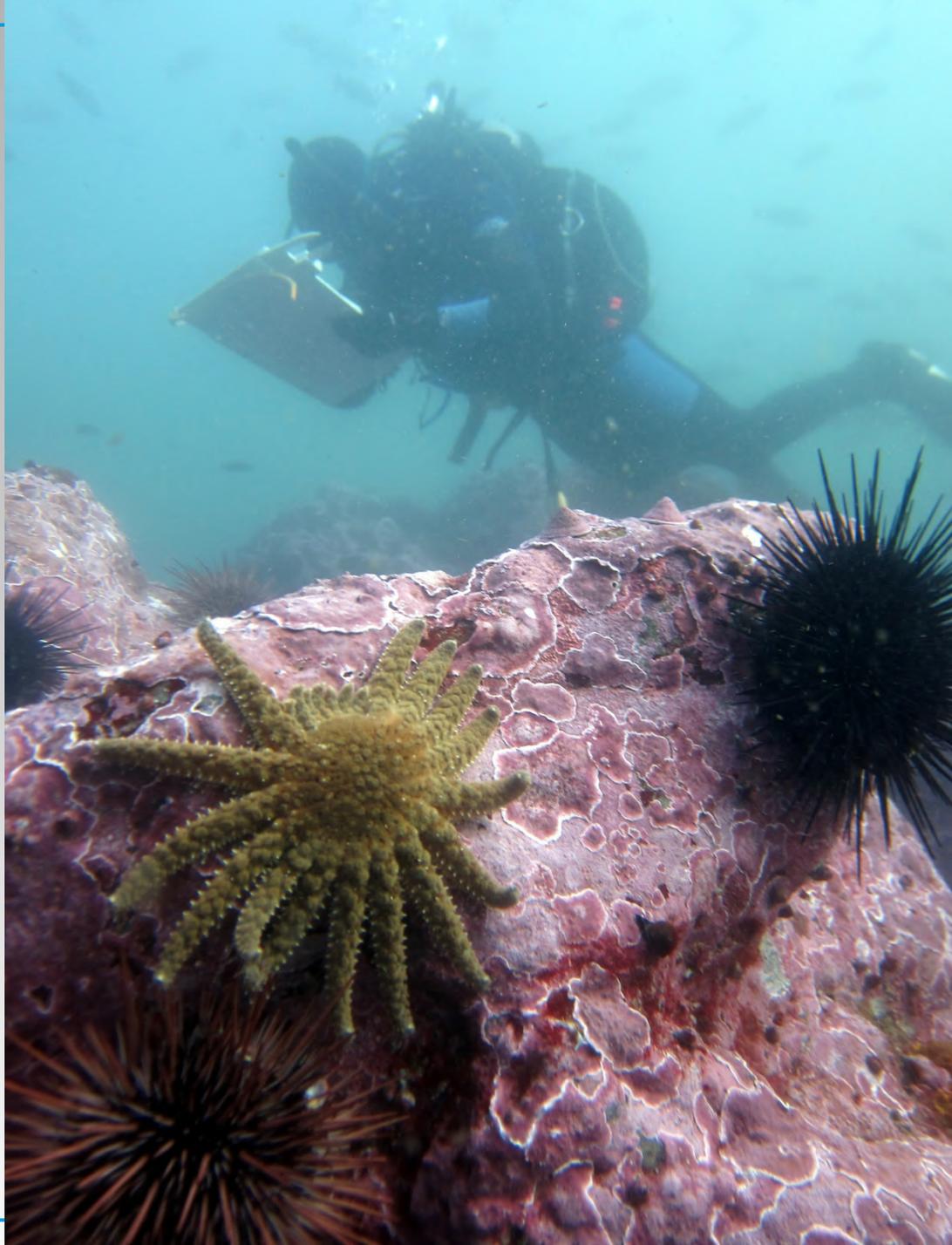
Red Abalone



Red Urchins

Purple Urchins

**Sunflower Star –
Important urchin
predator**



Giant-Spined Star



An underwater photograph showing several ochre seastars on a rocky reef. The seastars are bright yellow-orange with a white, dotted pattern on their arms. They are surrounded by other marine life, including a large white, feathery organism in the upper right, a dark purple starfish to the left, and a dark sea urchin at the bottom. The background is a mix of purple, green, and brown rocks.

Ochre Seastars

Leather Star



**Six-Armed
Star**



Sea Otter in Bodega Bay (May 10, 2017)



© Jackie Sones 2017



Climate Change Expectations

- Increased:

- Global surface temperature
- Sea level rise
- Ocean acidification

Variable Effects by Latitude & Altitude

Large-Scale Impacts

Likely Multiple Compounding Stressors

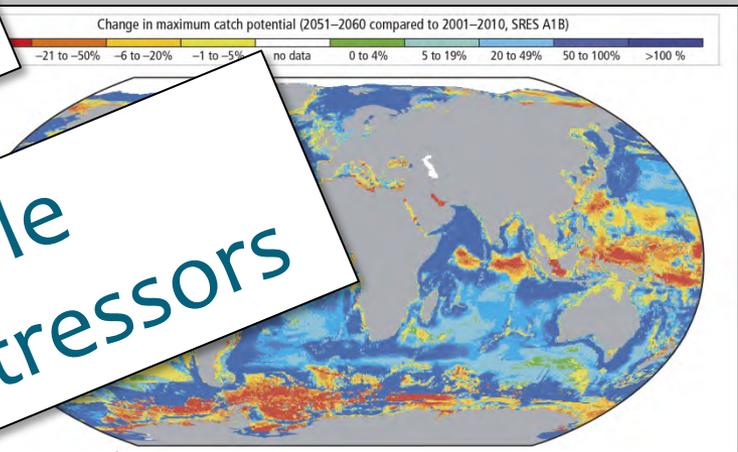
- Decreased: and Intensity of:

- Precipitation
- Harmful algal blooms

- Diseases

- Reduced:

- Extreme weather events
- Sea ice and snow cover
- Ocean fisheries



“Perfect Storm” Decimates Northern California Kelp Forests

Northern California
Beyond Tipping Point

**Dramatic Changes in Kelp
Forest Ecosystems**

Total bull kelp habitat area ~15 km²

Key range ~250 km coast



Recent Severe Kelp Loss in Northern California



L. Rogers-Bennett (CDFW)



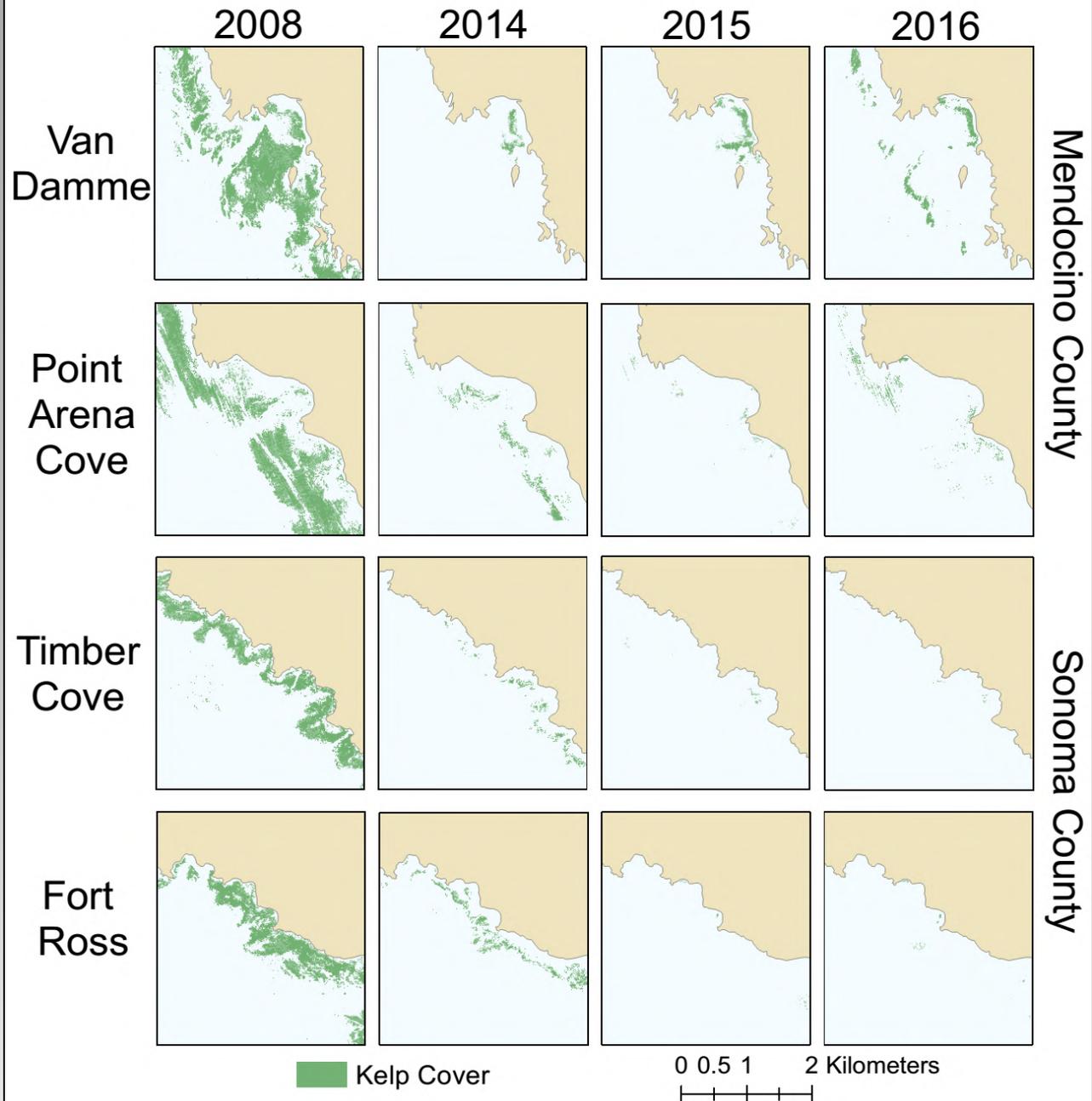
A. Weltz (CDFW)

Aerial Kelp Surveys (CDFW)

93% kelp loss in 2014

Additional 33% loss in 2015

Limited kelp growth in 2016 and 2017



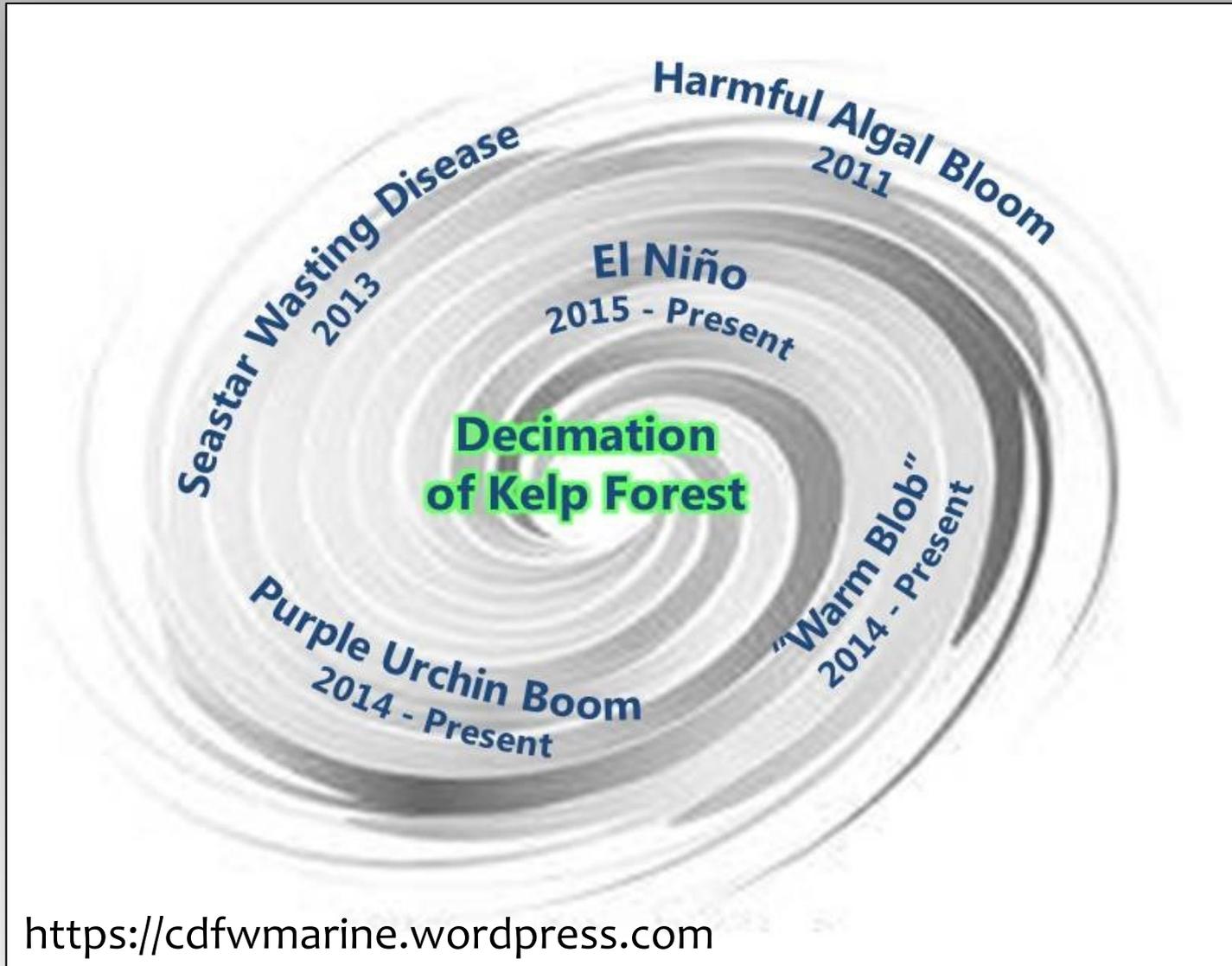
Van Damme – August 2017



Van Damme – August 2017

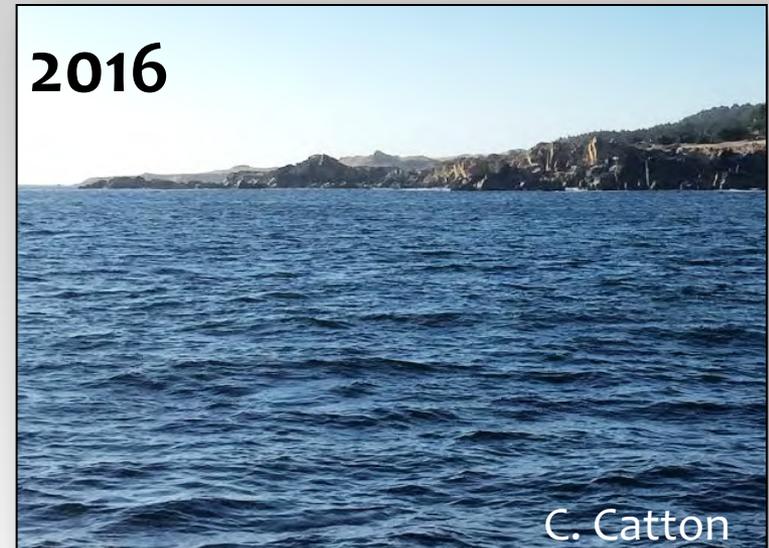


“The Perfect Storm”

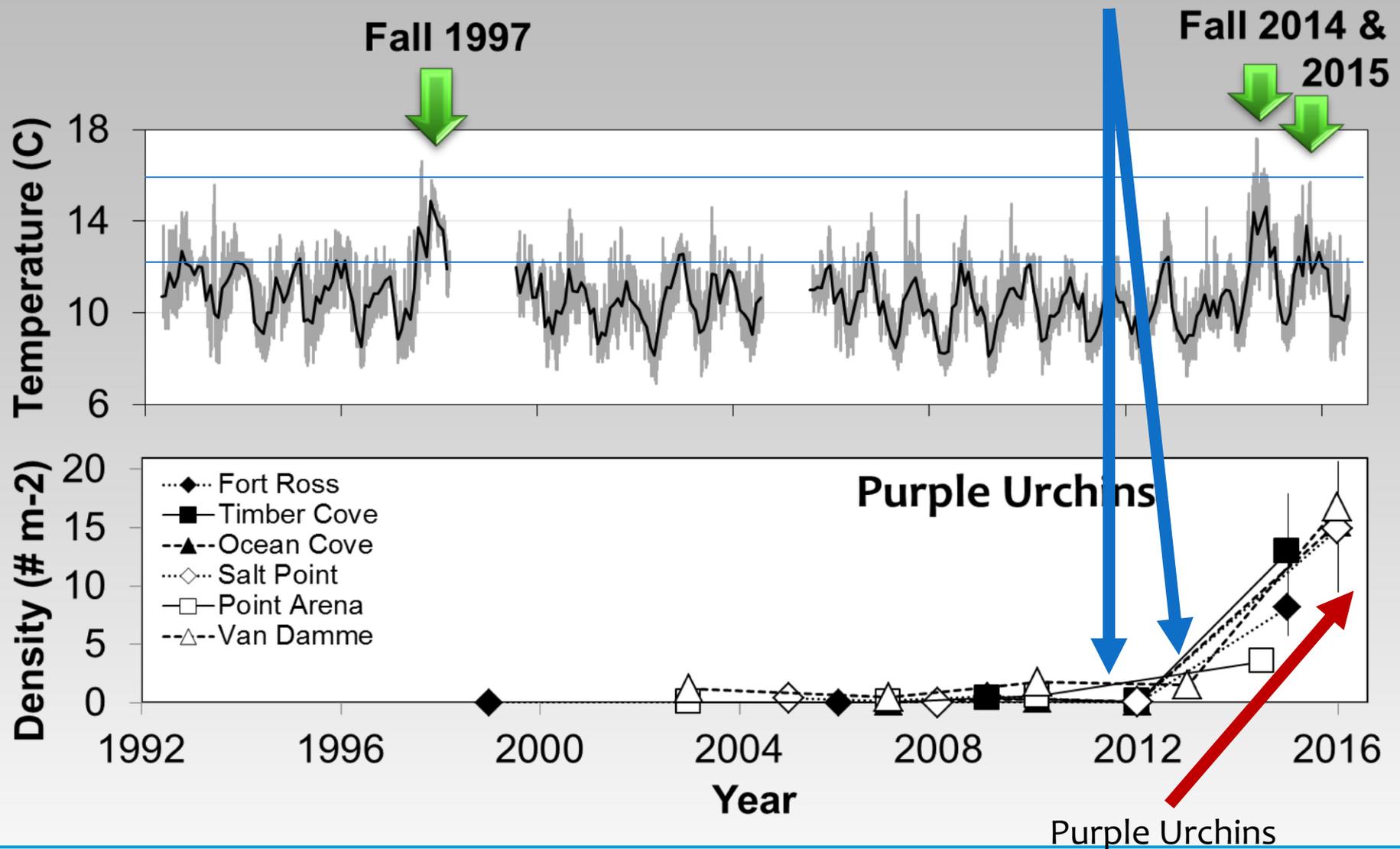


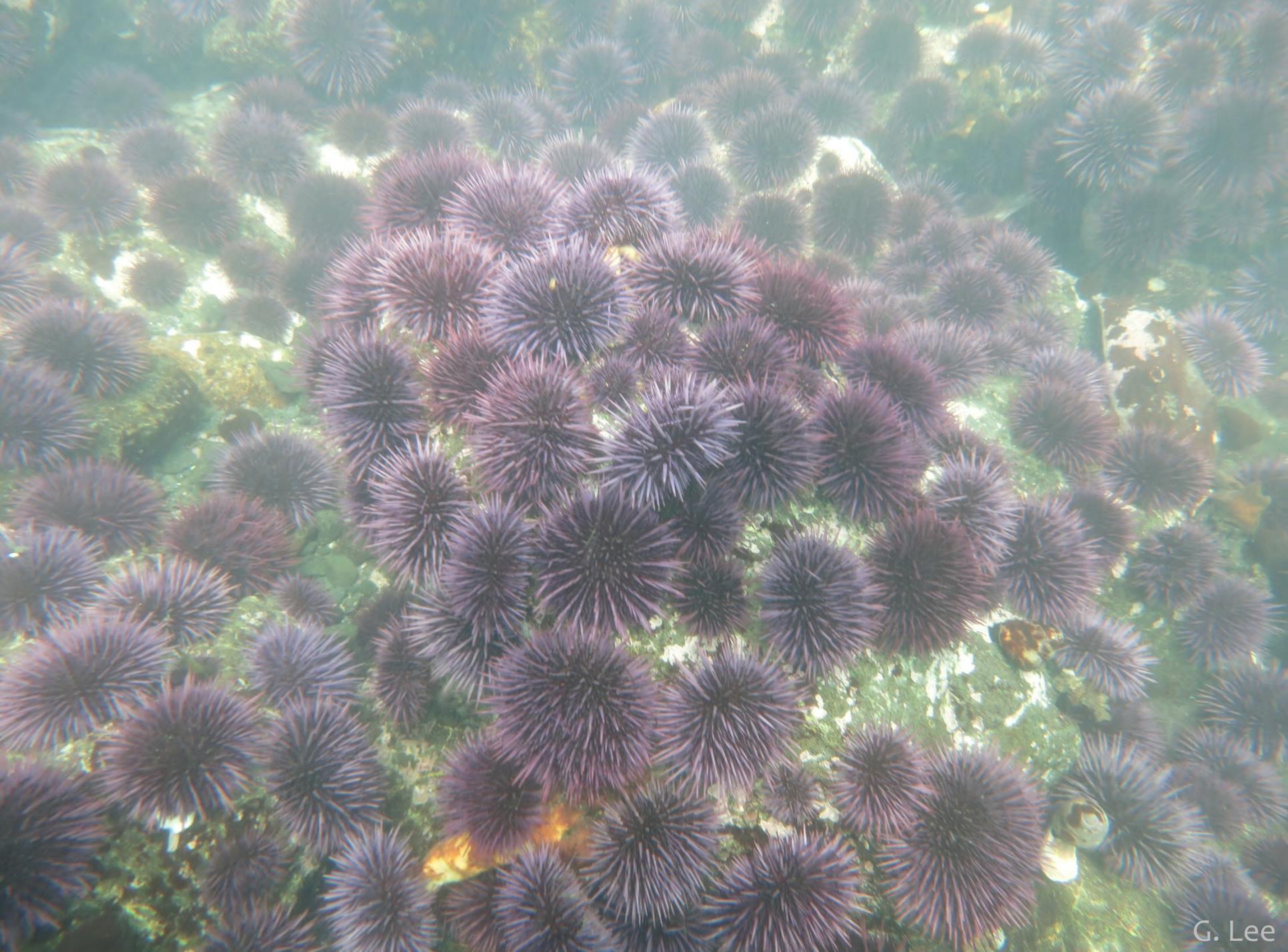
Multiple, Large-Scale Impacts

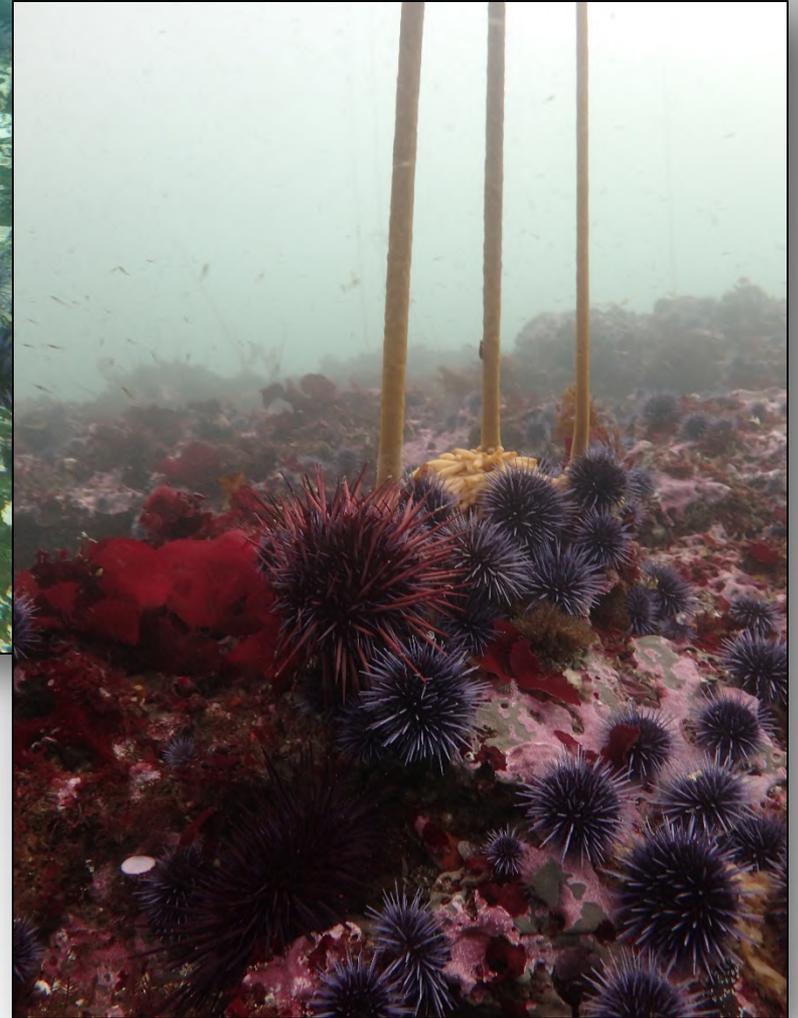
- >60 km • Harmful Algal Bloom (2011)
- >4,000 km • Sea Star Wasting Disease (2013)
- >600 km • Purple Urchin Explosion (2014 -)
- >4,000 km • Persistent Warm Water (2014 -)



Increased Subtidal (10m) Temperature and Purple Urchin Populations



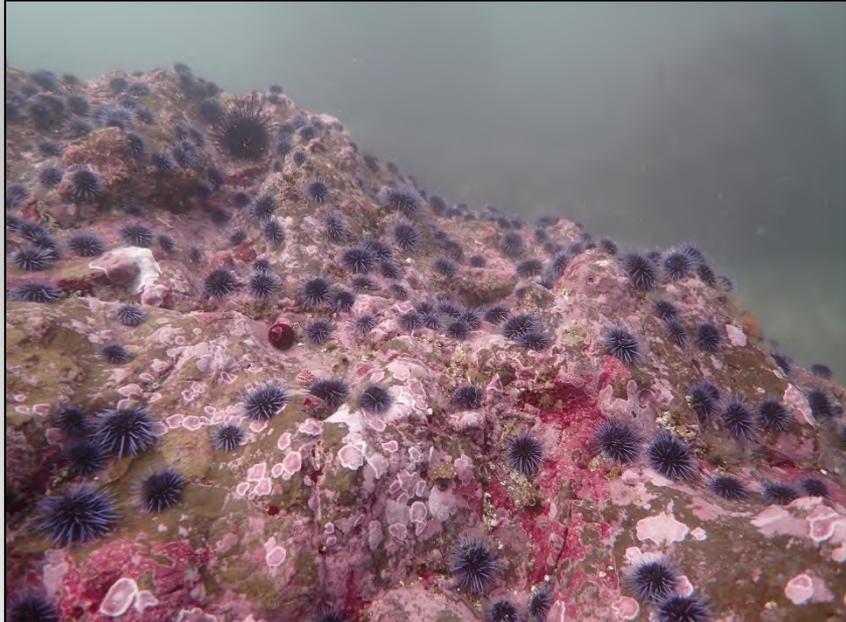




Urchins overgrazing
Bull Kelp at the holdfast

Mendocino County September 2017



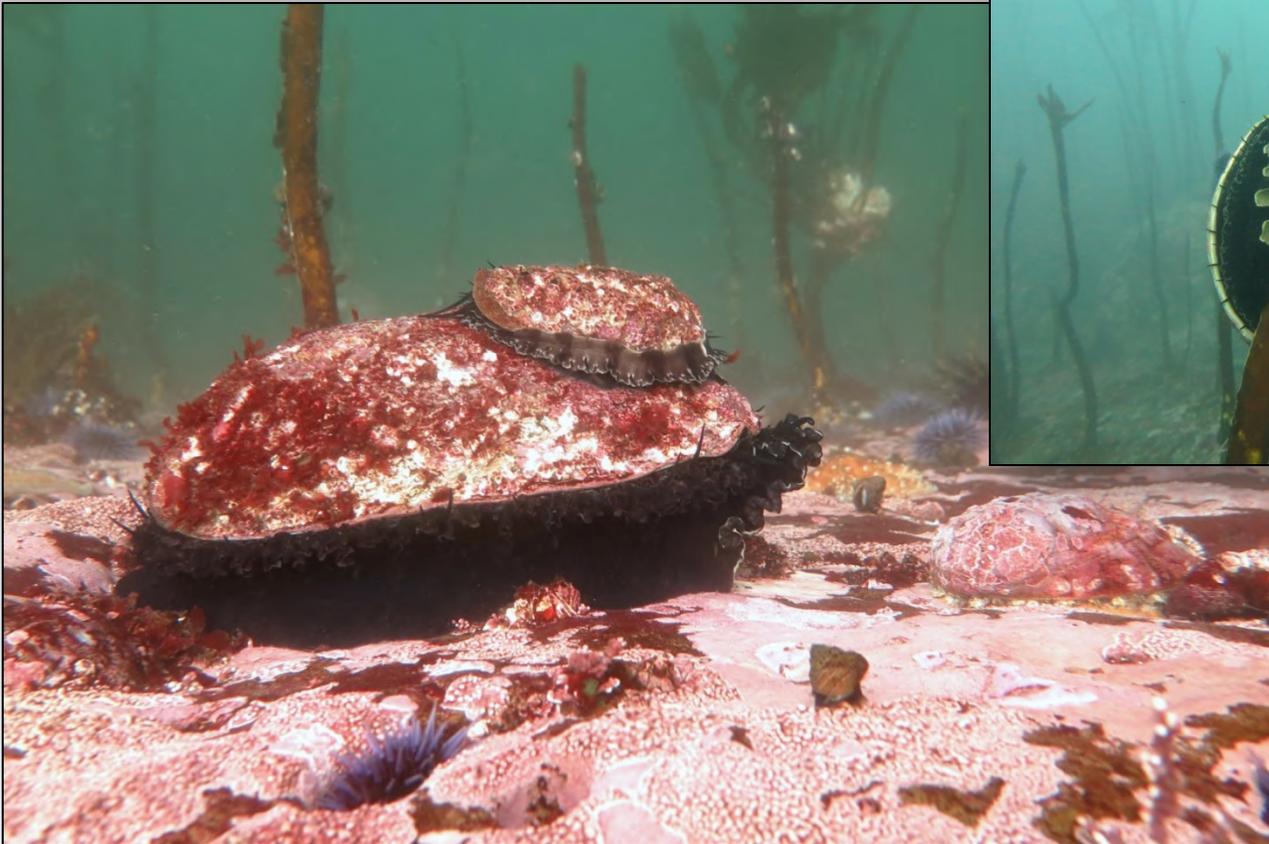


Leather stars and bat stars are dominating now

Very few observations of
seastar wasting disease



Starvation Conditions in Northern California (2014-2017)



A. Maguire (CDFW)



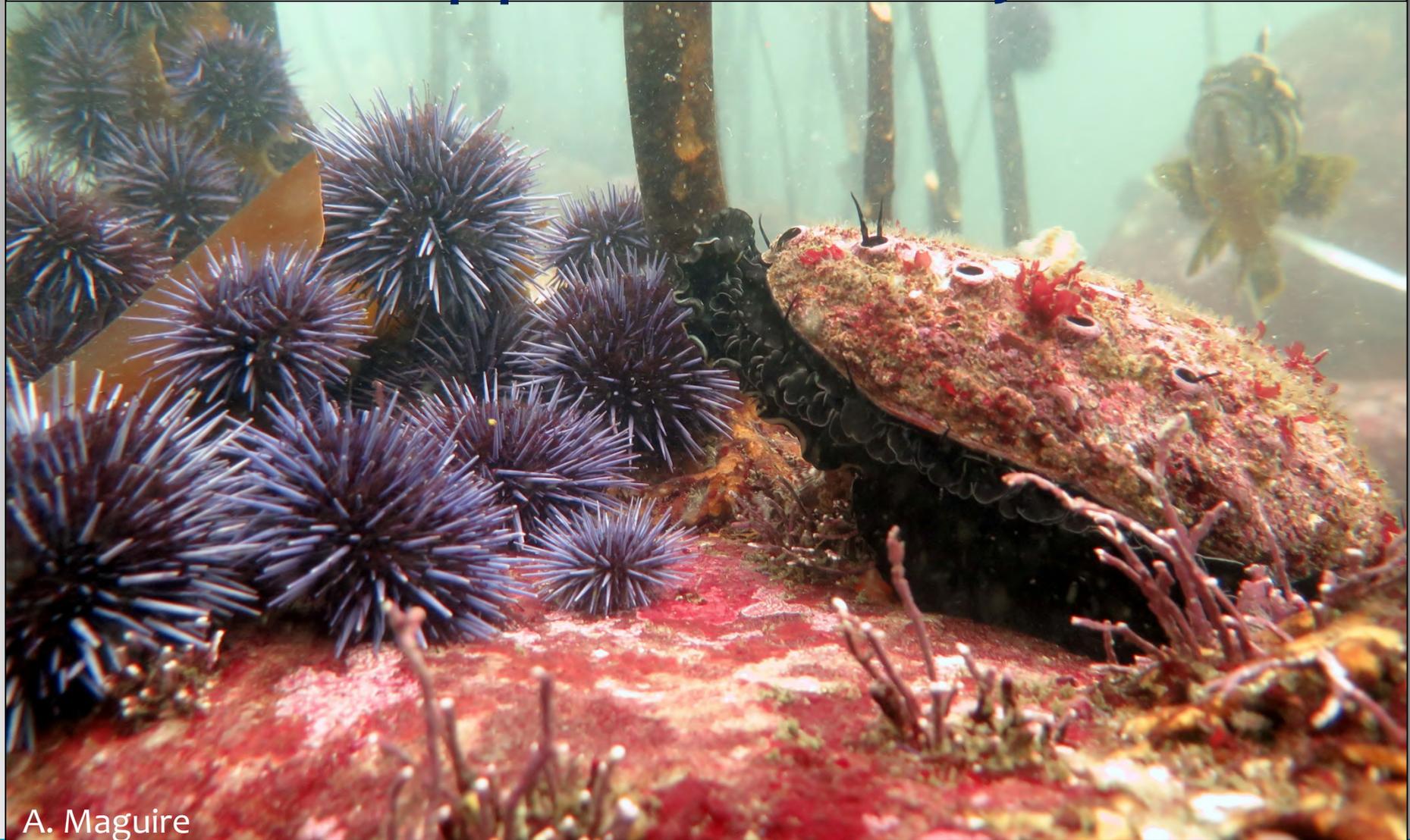
K. Joe (CDFW)

Impacts to Fisheries

- Red abalone fishery closure 2018
- Red urchin fishery
 - 80% decline in catch
 - Requested federal disaster relief

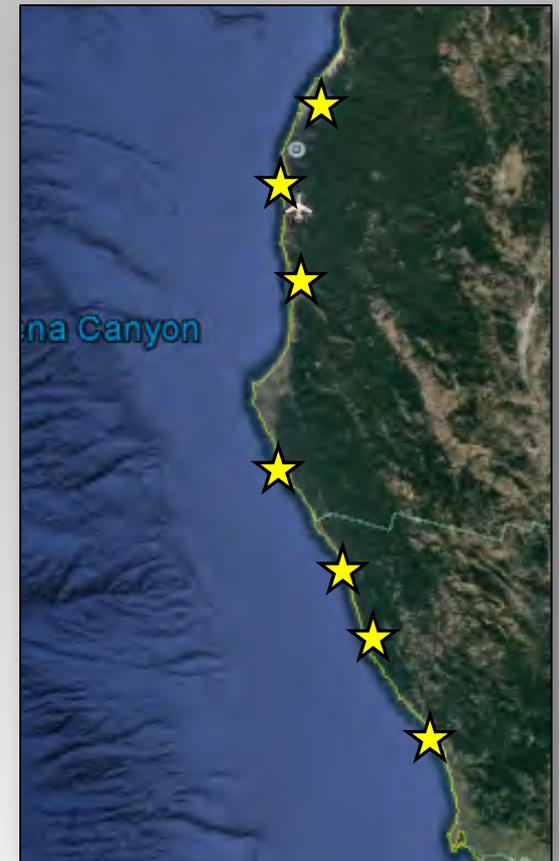


What Can We Do to Support Recovery?



Protect the Spore Bank through purple urchin control

- Maintain connectivity between sites through spore dispersal
- Benefit fisheries by enhancing localized food and habitat availability
- Protect culturally significant areas for local tribal nations

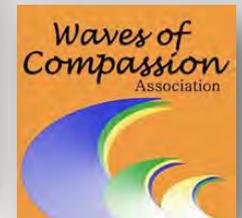
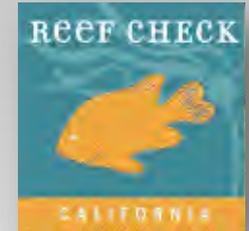


Kelp Ecosystem & Landscape Partnership for Research for Resiliency



- Broad partnership of stakeholders, scientists, and government agencies
- Focus on bull kelp forest ecosystem
 - Fill critical knowledge gaps
 - Assess recovery potential
 - Support rapid widespread kelp recovery by maintaining spore production along the coast

KELPRR Partnership



North Coast Urchin Industry

David Goldenberg



Rietta Hohman



National Marine Sanctuaries
National Oceanic and Atmospheric Administration





GFNMS-CDFW Joint Kelp Recovery Working Group

- Interdisciplinary team of stakeholders and scientists
- Evaluate potential effective recovery efforts
- Identify knowledge gaps
- Develop pathways to engage communities
- Produce report with management objectives and recommendations



www.noyocenter.org

Sheila Semans
Executive Director



Mission: To advance conservation of the ocean through education, exploration and experience

Non-Profits Supporting Urchin Removals

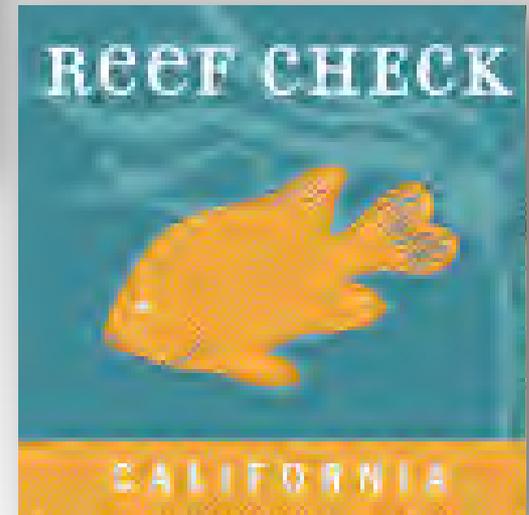
Watermen's Alliance – Josh Russo

Get Inspired – Nancy Caruso



Science & Monitoring

Reef Check – Jan Freiwald
(Anna Newman)



Activities To Date



Test methods for purple urchin control

- Collaboration with urchin industry
- Pilot studies completed
- Compared purple urchin culling methods
 - Efficiency
 - By-catch
 - Inundation rates
- Ready to scale up efforts

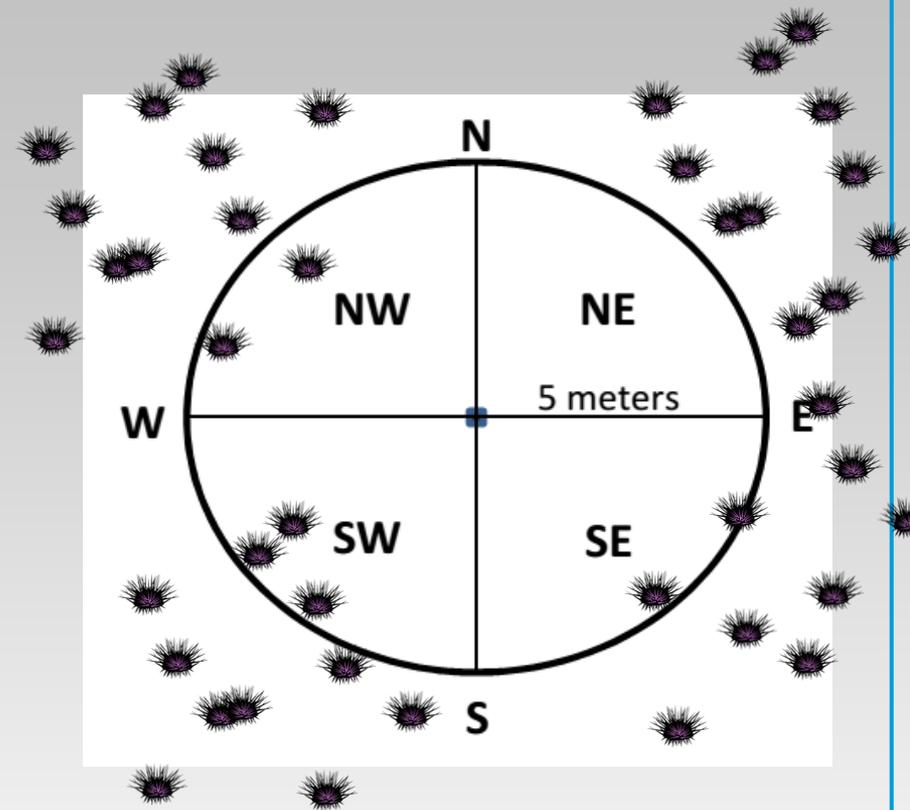


E. Wirschafter (KQED)

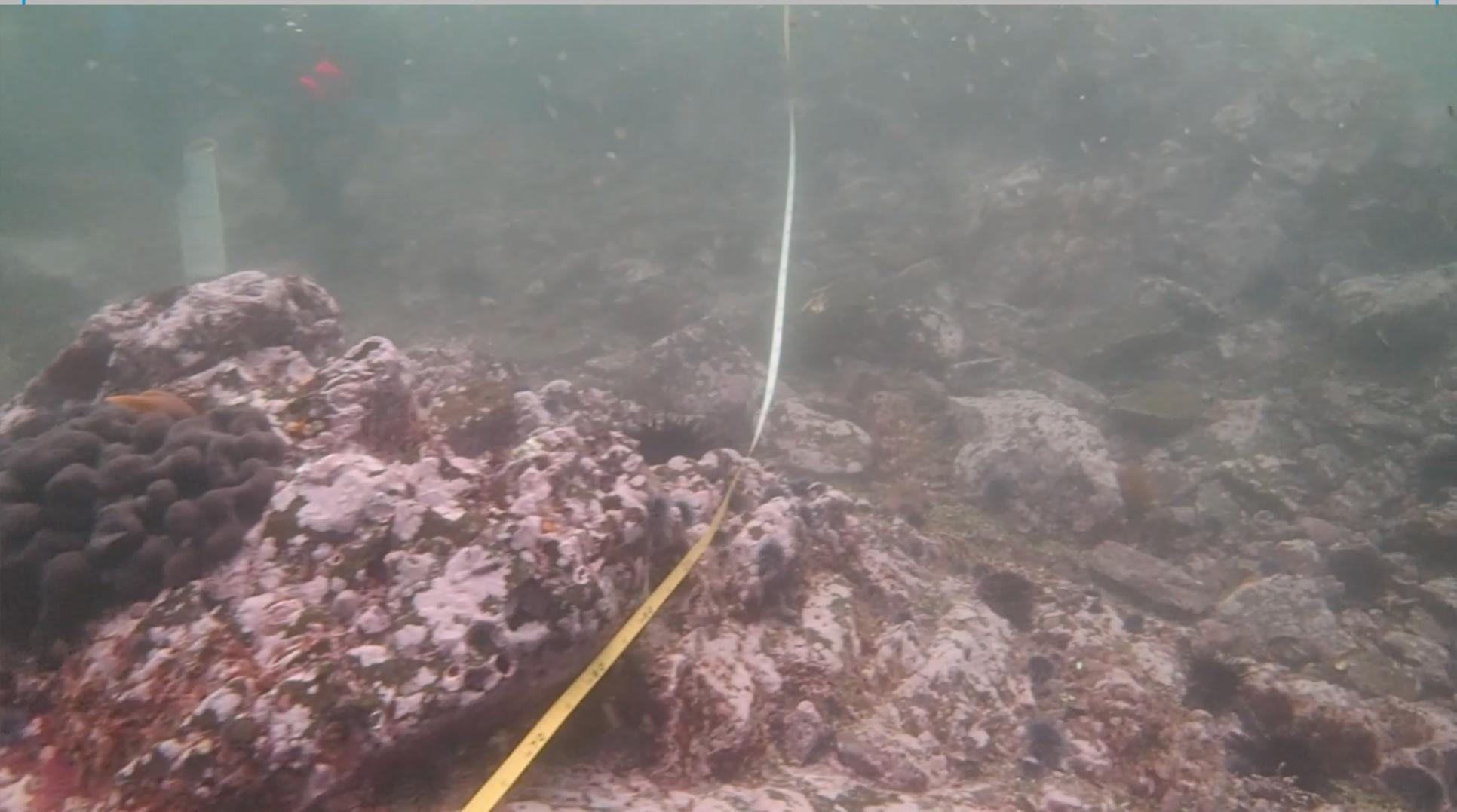
Removals vs “Smashing”

- Test efficacy of hand-picking vs smashing urchins in place
- How quickly do the urchins return?
- Cleared two sets of plots in August 2017
- Re-surveyed areas within 1 week and 1 month

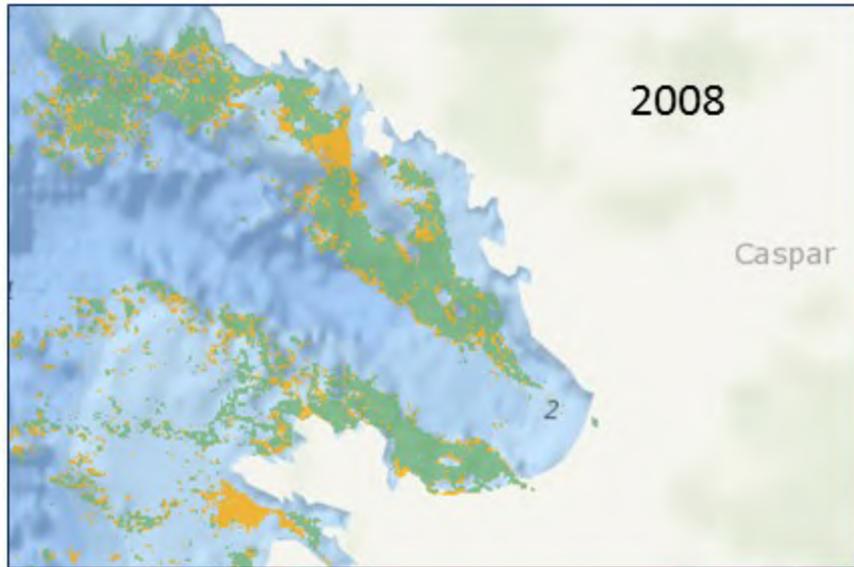
Experimental Clearing Plots



One Month After Urchin Clearing (September 2017)



Proposed Urchin Clearing Sites 2018



Involving Recreational Divers

- Developing application for scientific collection permit
- Protocol will include education on species ID and responsible harvest methods
- Focused work in the shallows to complement commercial diver efforts

Science and Monitoring

- Diver Effort Tracking
- Dockside Sampling
- Seasonal Subtidal Surveys
- Aerial Kelp Surveys
- Kelp Spore Experiments

Diver Effort Tracking

	A	B	C	D	E	F	G	H	I	
	Date	Diver's names	# hours underwater	Depth range (ft)	lbs urchins collected	# of urchins collected	size range of urchins	avg size	ft2 cleared	
2	12/31/2017	Jon, Harry	3	12'-35'	150	~~5,000	1/2"-2.5"	1.5"	~~700	
3	1/1/2018	Jon, Harry	4	20'-30'	350	~~12,000	1"-2"	1.5"	~1,200	Rec
4	2/2/2018	Jon, Harry	3.25	15-20'	284	~~10,000	1/2-2.5"	1.5"	~1,000	
5	2/3/2018	Jon, Harry	4.5	15-30'	538	~~16,000	1/2-2.5"	1.5"	~1,500	
6	2/7/2018	Jon, Harry	4.5	10-30'	354	~~11,000	1/2-3"	1.5"	~1,100	
7	2/8/2018	Jon, Harry	5	15-35'	592	~~18,000	1/2-2.5"	1.5"	~2,000	
8	2/9/2018	Jon, Harry	4.5	9-23'	481	~~15,000	1/2-2.5"	1.5"	~1,500	

Technology can help to track diver profiles and GPS

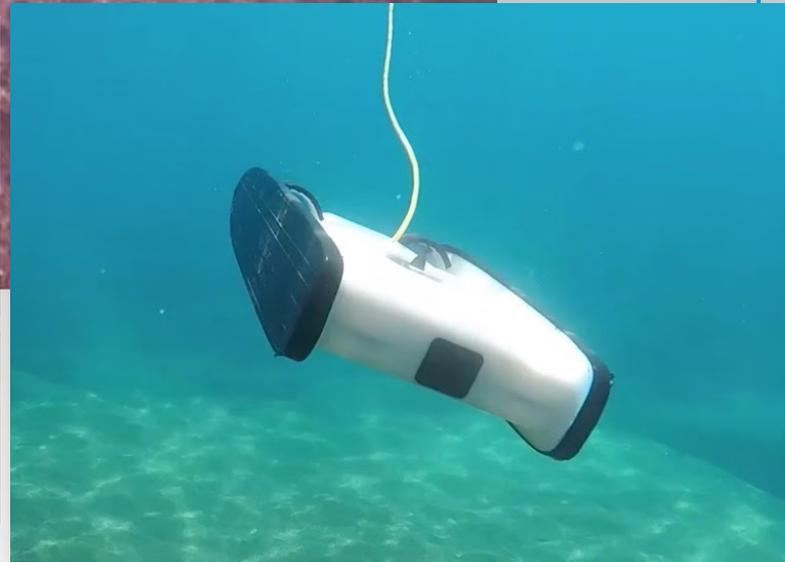


Dockside Sampling

- Noyo Science Center Volunteers
- Estimating # of Urchins
- Assessing gonad



Seasonal Subtidal Monitoring



Developing New Purple Urchin Markets (Long-Term Solution)

- Expanding non-traditional sushi markets
- Aquaculture-based conditioning
- Exploring preparation of tests for crafts
- Compost / Fertilizer



Bull Kelp Recovery Requires:

- Innovative thinking
- Improved scientific understanding
- Attention to scales (landscape and local)
- Strong collaborative partnerships





Thank you!

Cynthia.Catton@wildlife.ca.gov

K. Joe