



Kelp Communities in Transition

A spatial mosaic among populations of bull kelp, sea urchins, abalone, and sea stars within Oregon's rocky reef habitats

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ODFW Marine Resources
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Oregon Ocean Science Trust / Jan 2024



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Kelp Communities in Transition



HB5202: Science and monitoring on nearshore keystone species including sea otters, nearshore marine ecosystems, kelp and eelgrass habitat and sequestration of blue carbon
Project Title: Kelp communities in transition: A spatial mosaic among changing populations of bull kelp, sea urchins, and sea stars within rocky reef habitats along the southern Oregon coast

Research Team:

Steve Rumrill (PI), Shellfish Program Leader, Oregon Department of Fish and Wildlife Marine Resources Program
Scott Groth (PI), South Coast Shellfish Biologist, Oregon Department of Fish and Wildlife

Project Partners:

Oregon Commercial Sea Urchin Harvesters
Oregon Science Divers: University of Oregon, Oregon Coast Aquarium, US Forest Service, Oregon ReefCheck
Coastal Conservation: Oregon Kelp Alliance, Elakha Alliance

Project Objectives:

This project will address how the ecological characteristics of rocky reef habitats differ between areas that have experienced loss of kelp versus areas where kelp beds persist by filling critical data gaps regarding recent shifts in kelp beds and rocky reef habitats located at strategic conservation sites along the southern Oregon coast. The project will:

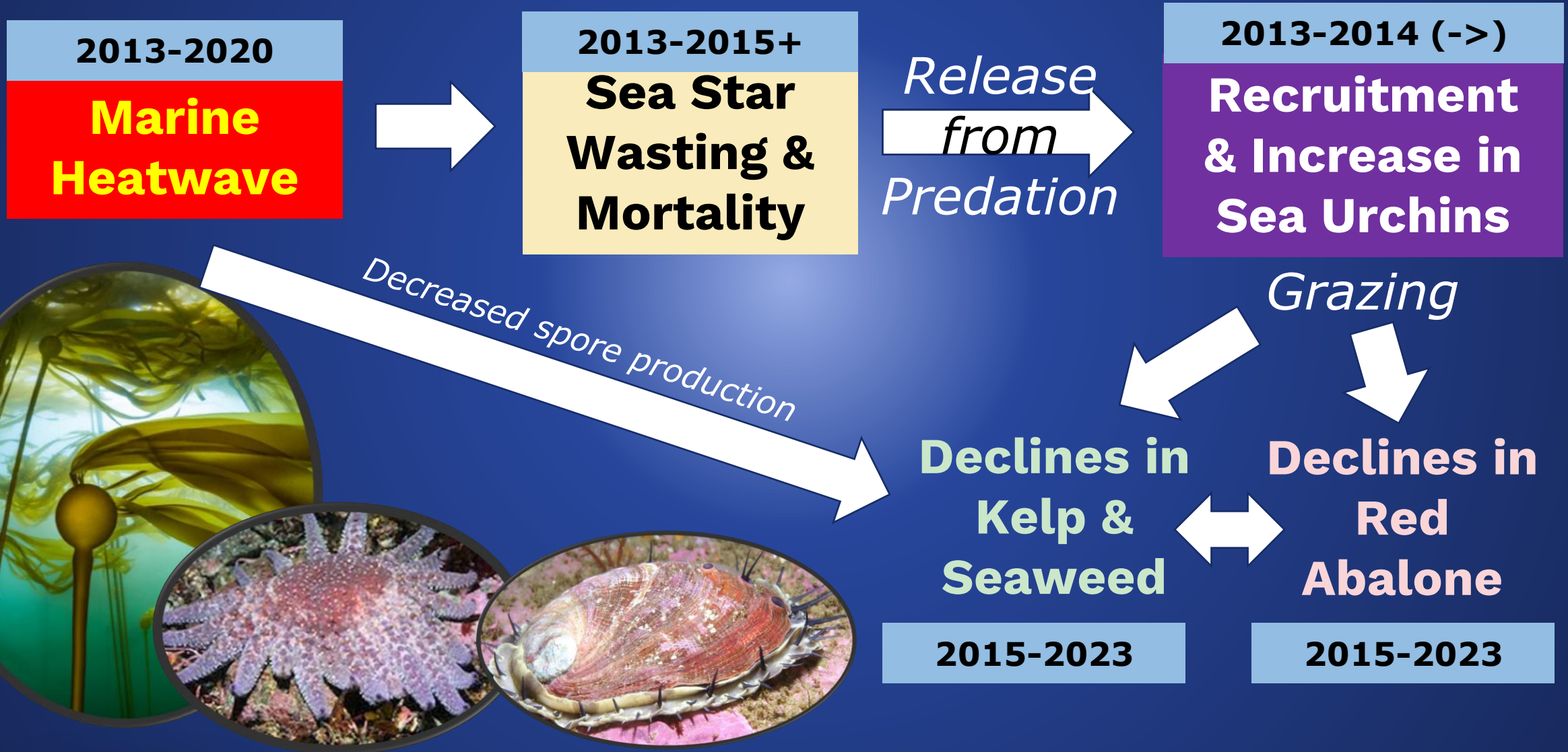
- Conduct new underwater surveys at sites where bull kelp beds have decreased in spatial extent and ecological communities recently transitioned into urchin barrens;
- Conduct new underwater surveys at sites where bull kelp beds persist and ecological communities are presumed to still function in a relatively typical manner; and
- Conduct outreach activities to share new datasets, disseminate information, and raise awareness among project participants, resource managers, and coastal stakeholders about the ecological impacts associated with recent shifts in kelp beds and rocky reef habitats along the southern Oregon coast.

Project Timeline: March 2023-September 2024

Project Award: \$193,341



Context: Recent Changes to Rocky Reef Communities and Kelp Habitat along the Southern Oregon Coast (2013-2023)





Kelp Beds Provide Ecologically Important Benefits & Habitat in Shallow Rocky Reef Areas

- **Primary production, nutrient cycling & carbon storage**
- **Complex 3-D heterogeneous structure**
- **Hot-spots for marine biodiversity**
- **Habitat for seaweeds, invertebrates, fishes, sea birds, marine mammals**
- **Buffer exposed coastlines from waves & storms**

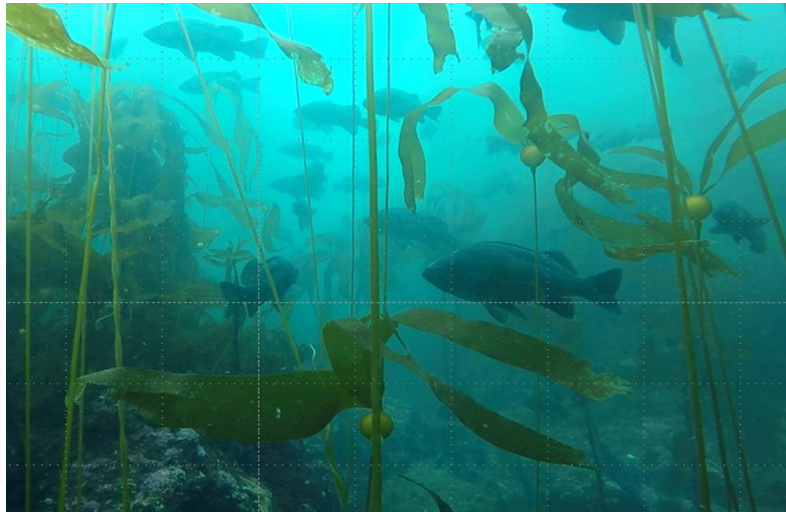
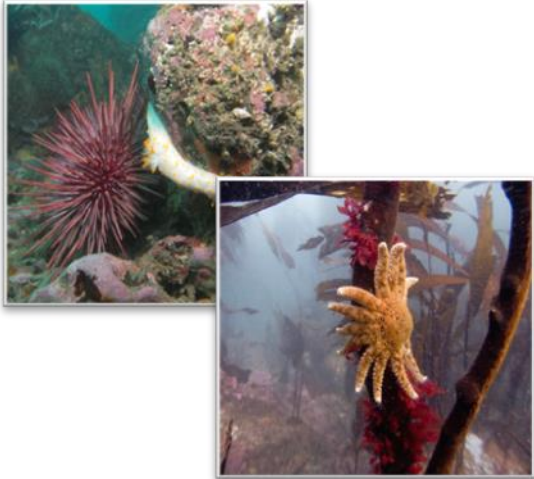


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Variability in Bull Kelp along the Oregon Coast

Bull kelp beds are naturally highly variable in space and time along the OR coast:

- Substantial Reduction at some sites after marine heatwave 2014-15
- *i.e.*, Orford Reef, Blanco, Humbug, Brookings



Orford Reef 2014, abundant bull kelp



Orford Reef 2016, little bull kelp

The value of ecosystem services in global marine kelp forests

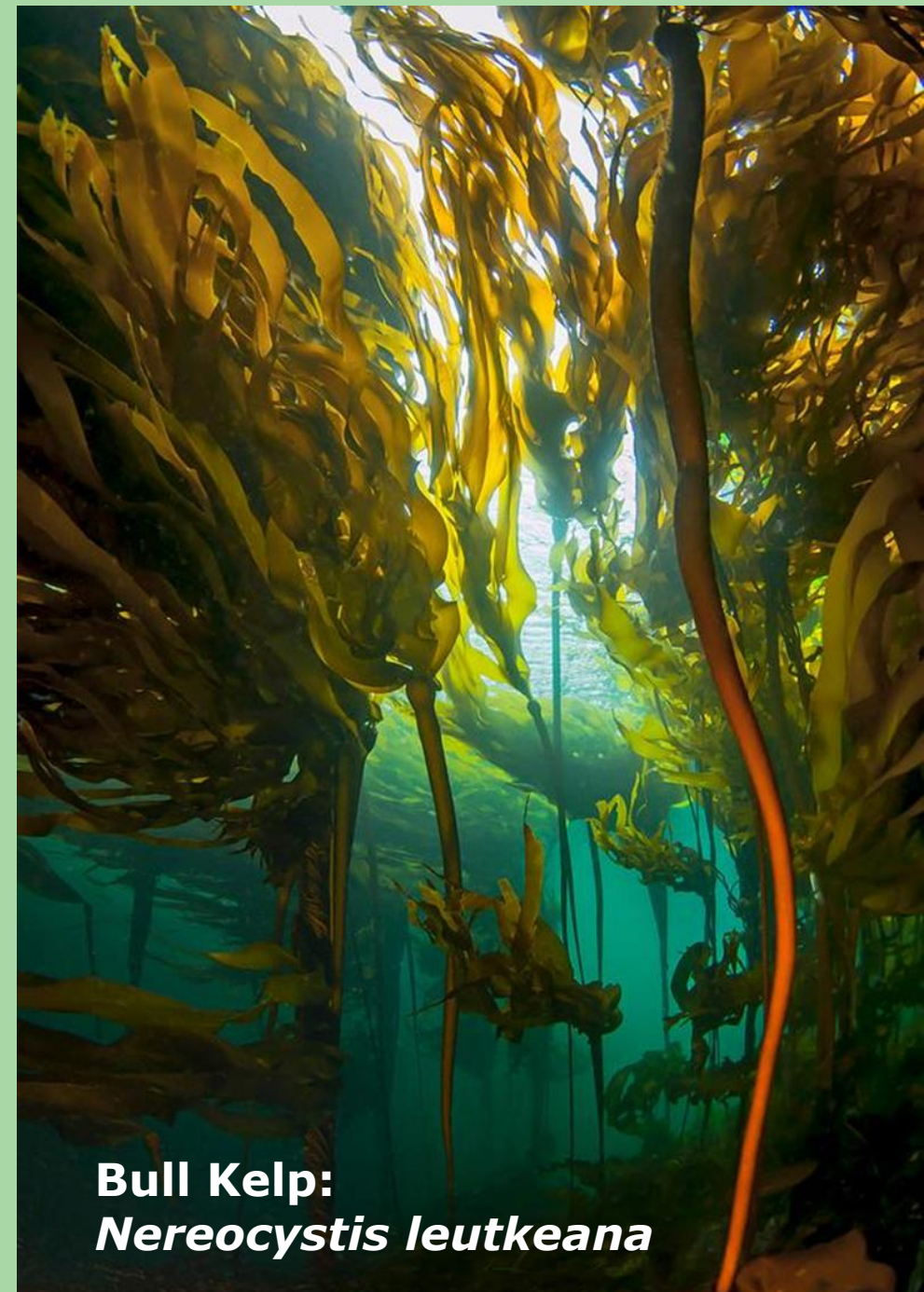
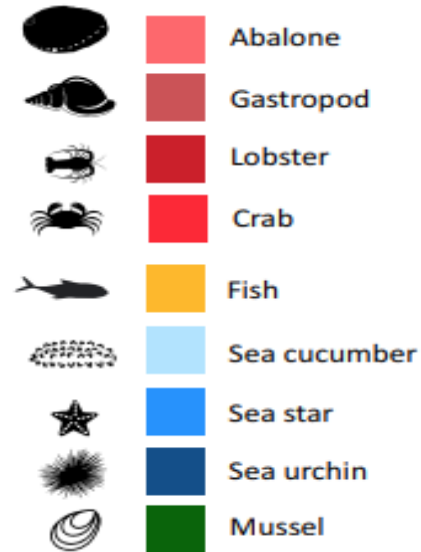
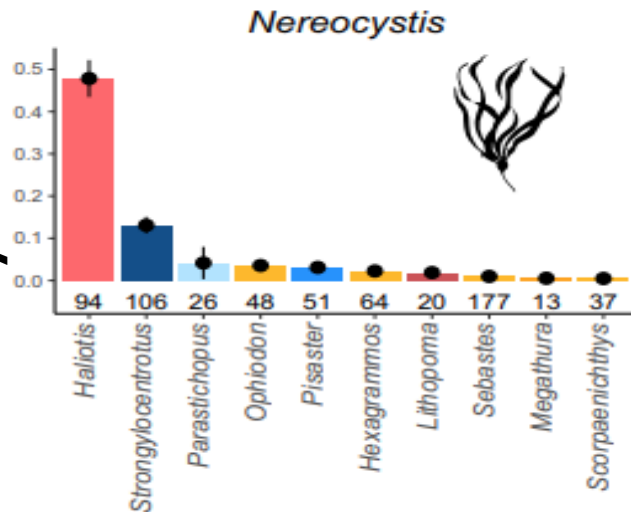
Eger *et al*, 14 March 2023

Key Ecosystem Services:

- fisheries production
- nutrient cycling
- carbon removal

Value of Bull Kelp:
\$64,400 - 147,100
per hectare per
year

Genera
 contribution to site
 fishery value



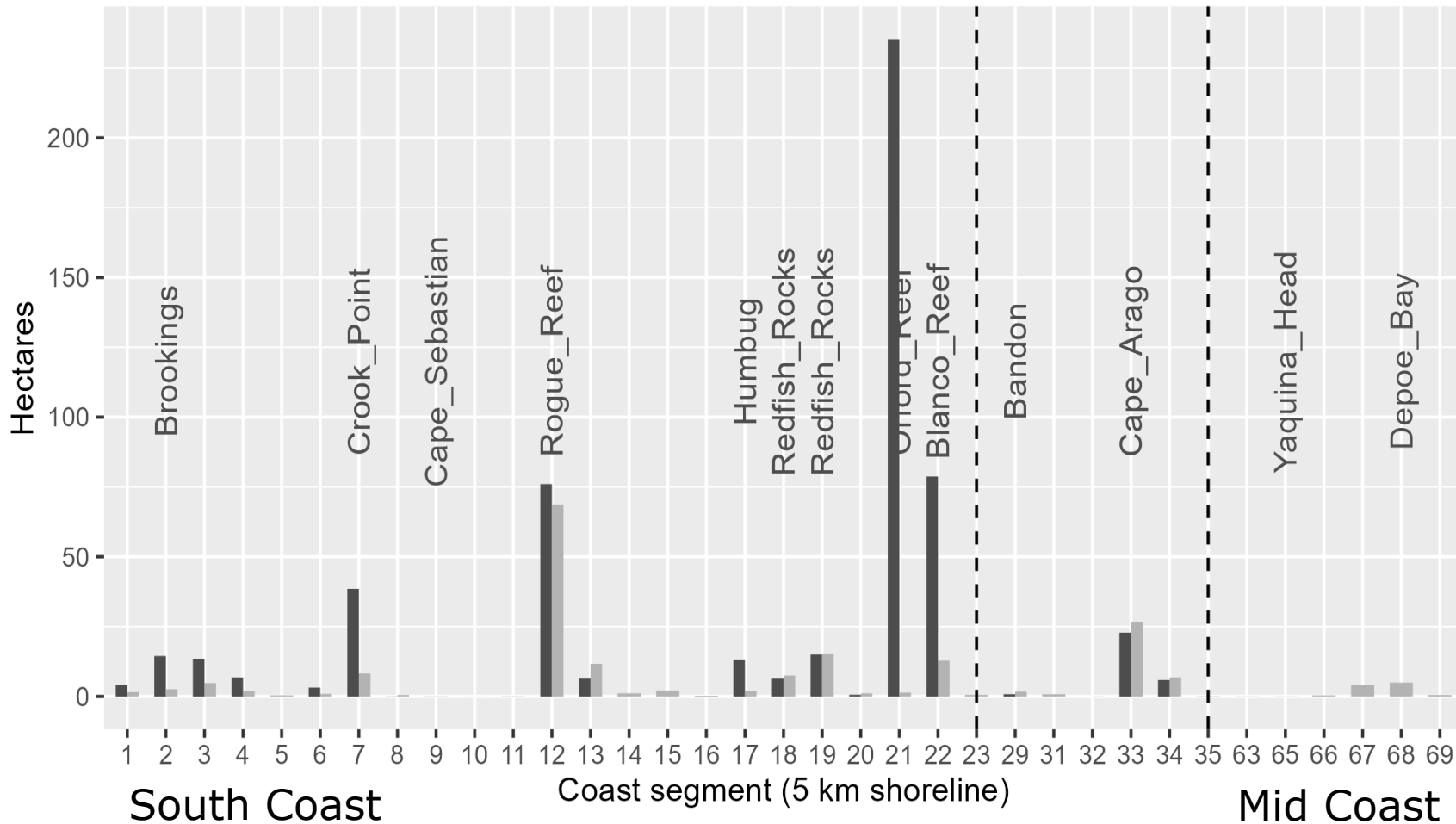
Bull Kelp:
Nereocystis leutkeana



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Spatial Variability and Decline in Bull Kelp along the Oregon Coast (2010-2022)

Classified kelp coverage (surface + subsurface) in ODFW aerial surveys

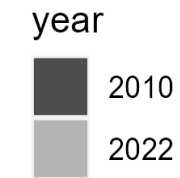


Total canopy area (CA to Cape Arago)

2010: 536 hectares

2022: 182 hectares

Overall ~ 66% reduction from 2010





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Recent Decline of Bull Kelp in Oregon (2010-2022)

Total canopy area (CA to Cape Arago)

2010: 536 hectares

2022: 182 hectares

Overall ~ 66% reduction from 2010

X

**Median Economic Value:
\$105,750 / hectare**

=

**Economic Loss in OR:
\$55.7M in 2010
\$19.2M in 2022**





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Spatial Variability and Decline in Bull Kelp along the Oregon Coast (2010-2022)

ODFW Aerial: 2022

ODFW Aerial: 2010

Brookings region (Oct 2022: 82% reduction in kelp area from 2010)

2010: 36 acres of kelp (14.5 hectares, or 145,000 m²)

2022: 6.4 acres of kelp (2.6 hectares, or 26,000 m²)

Bull Kelp Beds Persist at Some Sites: (ODFW Aerial Surveys 2022)



Cape Arago
2010: 23 ha
2022: 26 ha



Rogue Reef
2010: 76 ha
2022: 64 ha



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Kelp Communities in Transition: a spatial mosaic among changing populations of bull kelp, sea urchins, abalone, and sea stars within rocky reef habitats

Central Science Question:

"How do the ecological characteristics of rocky reef habitats differ between areas that experienced kelp loss versus areas where kelp persists?"

Primary Goal:

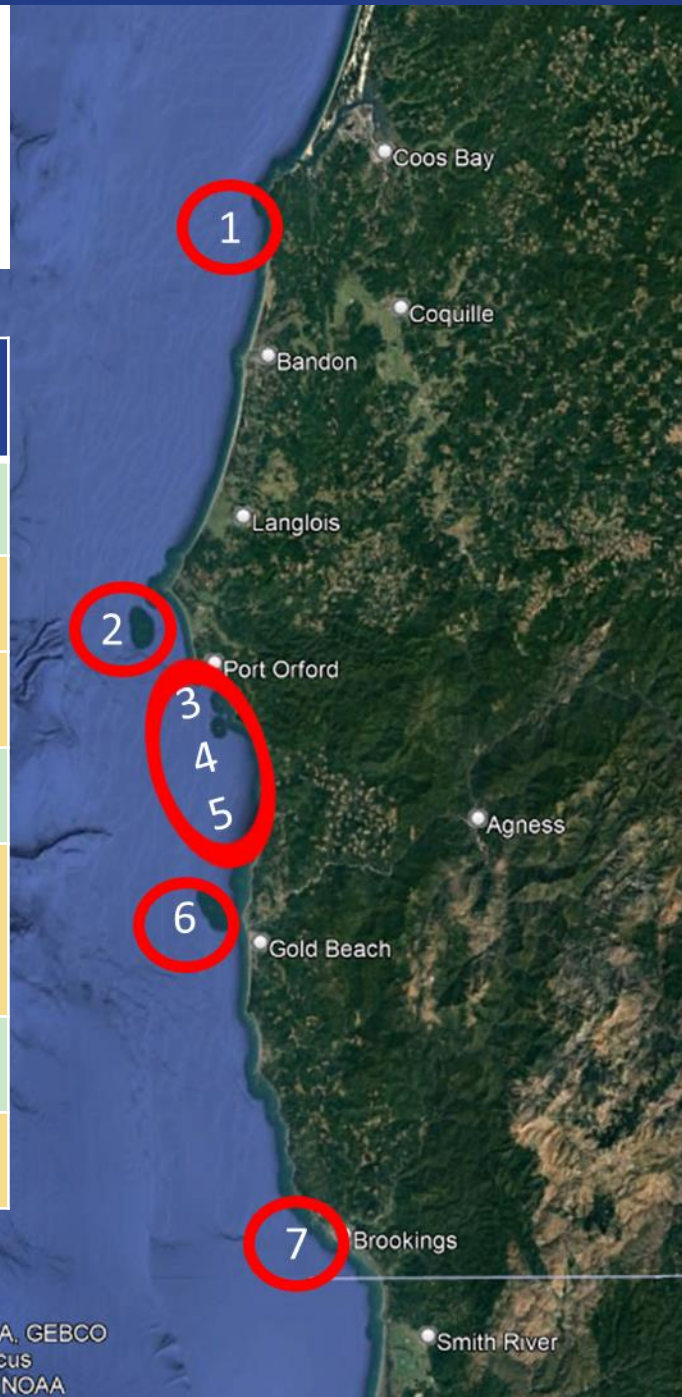
Fill critical data gaps regarding recent shifts in kelp beds and rocky reef habitats at strategic conservation sites along the southern Oregon coast

Objectives:

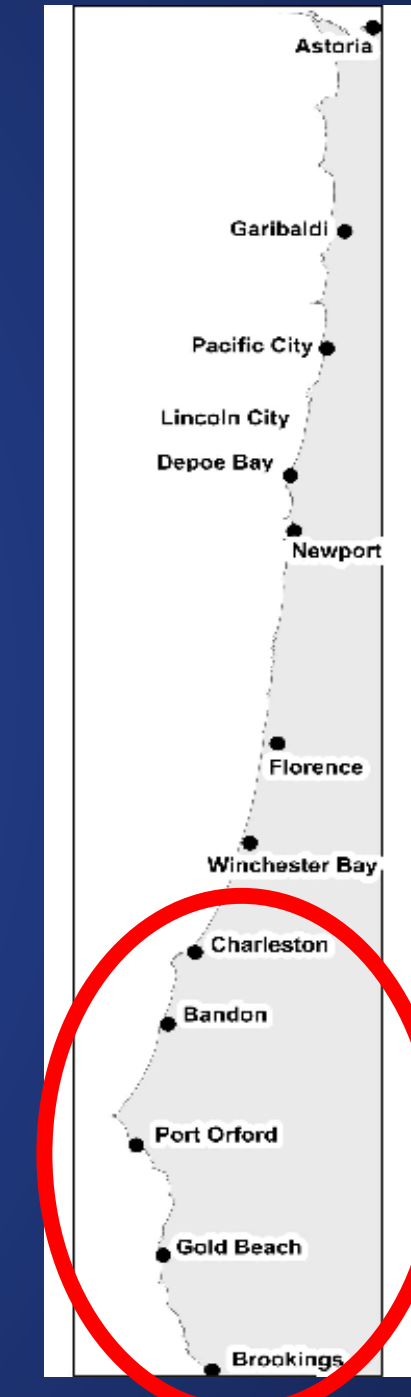
- 1. Habitats in Transition: surveys at sites where bull kelp has decreased and habitats have transitioned into urchin barrens**
- 2. Persistent Kelp Beds: surveys at sites where bull kelp persists and ecological communities still function in a typical manner**
- 3. Increased Awareness: share new data, disseminate information, and raise awareness about recent shift in kelp habitats and communities**

Rocky Reef Study Areas along the Southern Oregon Coast

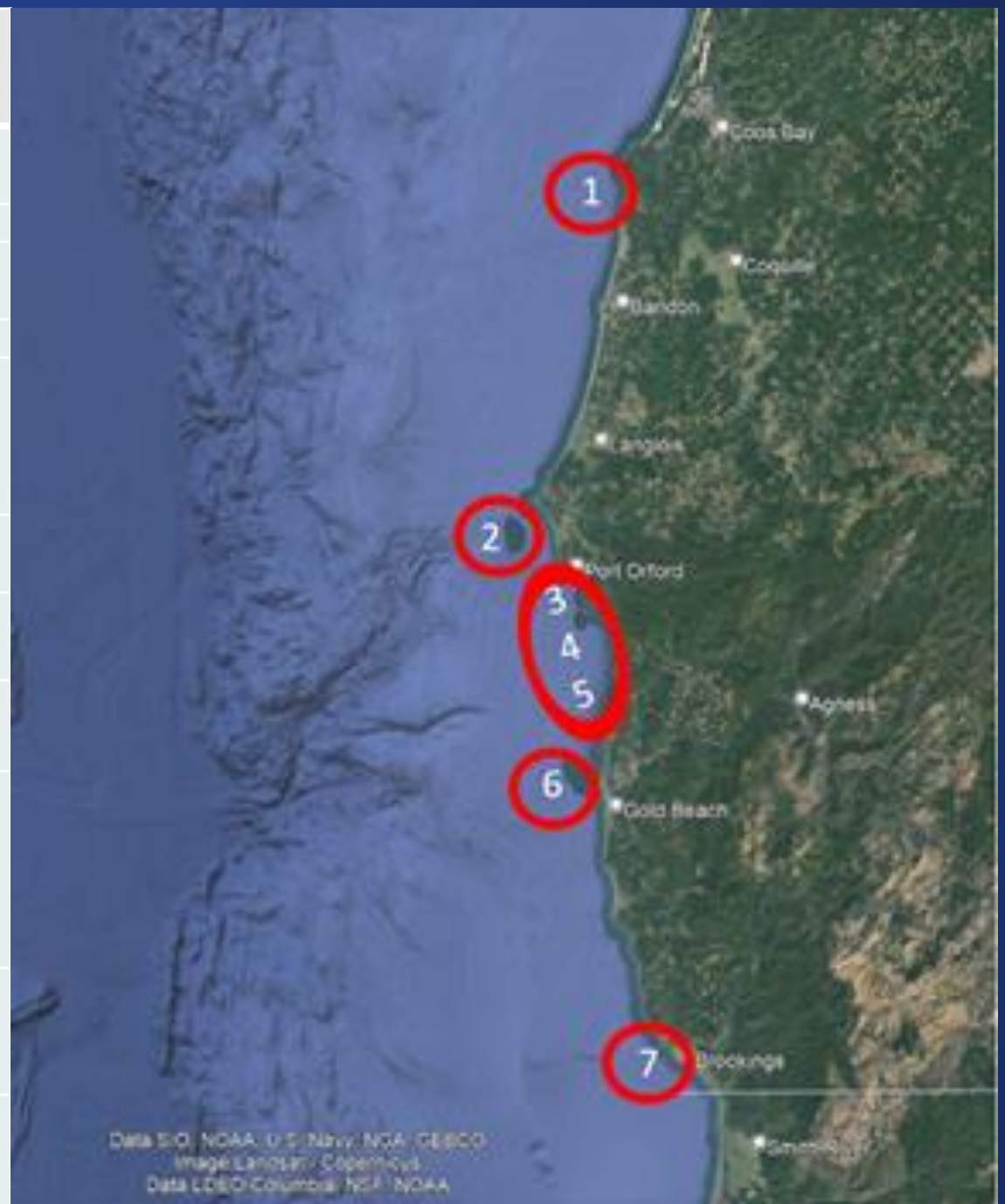
Site	Kelp Habitat
1. Cape Arago	persist
2. Orford Reef	decline
3. Nellies Cove	decline
4. Redfish Rocks	persist
5. Humbug Mountain	decline
6. Rogue Reef	persist
7. Chetco Point	decline



Data SIO, NOAA, U.S. Navy, NGA, GEBCO
 Image Landsat / Copernicus
 Data LDEO-Columbia, NSF, NOAA



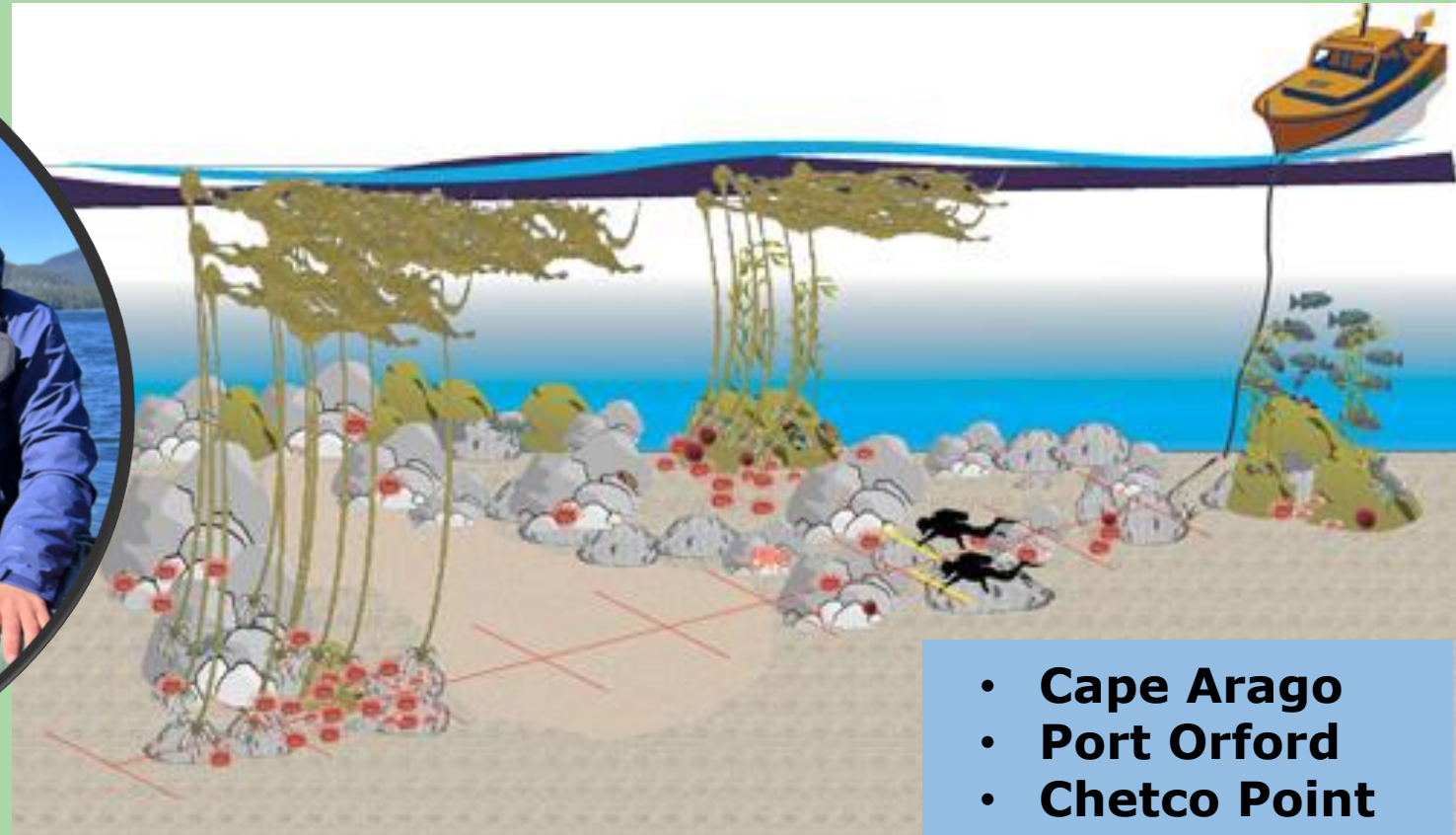
Study Area	GPS Coordinates	Survey Site	Diver Group	# SCUBA Surveys (2X30 m transects)
1. Cape Arago	43deg18'20"N 124deg24'06"W	South Cove	Science	2
		North Cove		2
		Lighthouse / Gregory Point		2
		Norton Gulch		2
2. Orford Reef	42deg46'59"N 124deg35'59"W	Site 1	Commercial	8
		Site 2		
		Site 3		
		Site 4		
3. Nellies Cove	42deg44'10"N 124deg30'24"W	Site 1	Science	4
		Site 2		
4. Redfish Rocks	42deg41'55"N 124deg28'25"W	Site 1		4
		Site 2		
5. Humbug Mountain	42deg40'32"N 124deg27'07"W	Site 1	Science	4
		Site 2		
6. Rogue Reef		Site 1	Commercial	6
		Site 2		
		Site 3		
		Site 4		
7. Chetco Point	42deg02'36"N 124deg17'26"W	Site 1	Science	8
		Site 2		
		Site 3		
TOTALS:		19 Study Sites		40 SCUBA Surveys



Kelp Communities in Transition: Underwater Surveys along the Southern Oregon Coast (2022-23)

Project Partner: Dr. Aaron Galloway (Univ. Oregon)

SCUBA divers record video and enumerate and measure kelp, seaweeds, urchins, abalone, sea stars along 30 m transects



- **Cape Arago**
- **Port Orford**
- **Chetco Point**

Kelp Communities in Transition: Underwater Surveys along the Southern Oregon Coast (2024)



Commercial Sea Urchin Divers

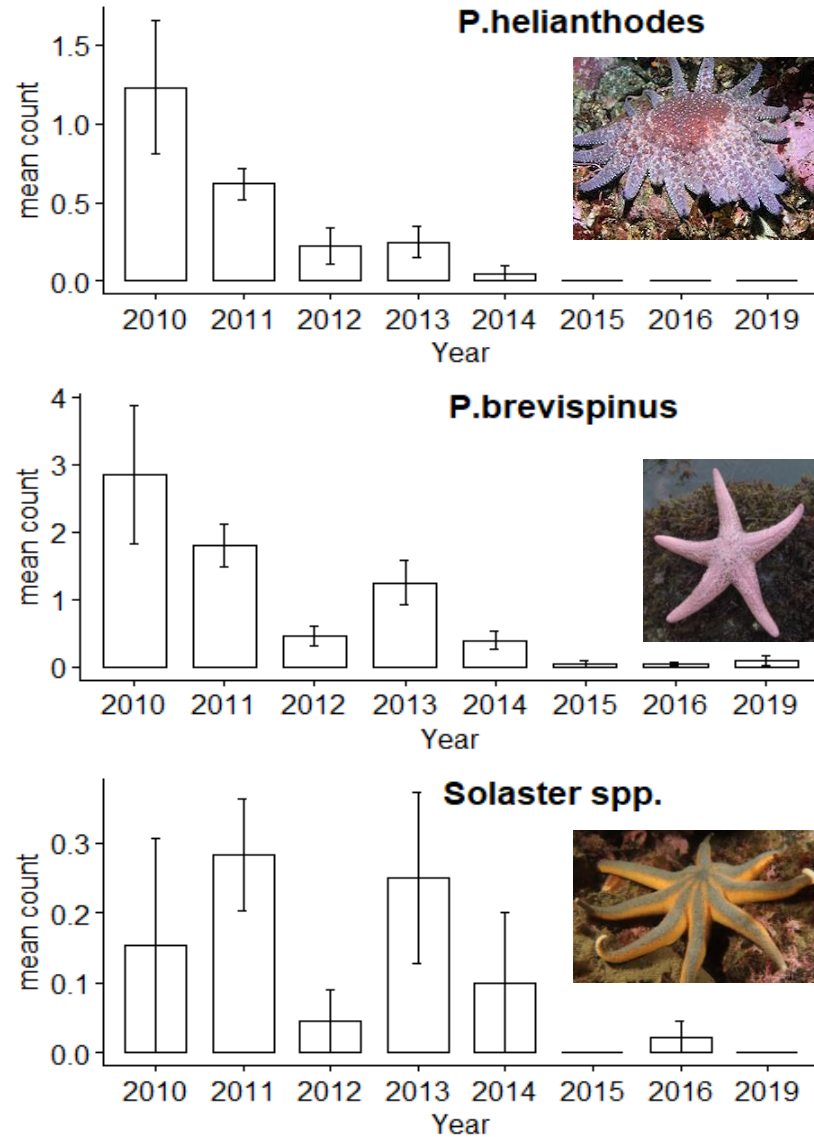


Changes to Rocky reef Communities and Kelp Habitat along the Southern Oregon Coast (2013-2023)

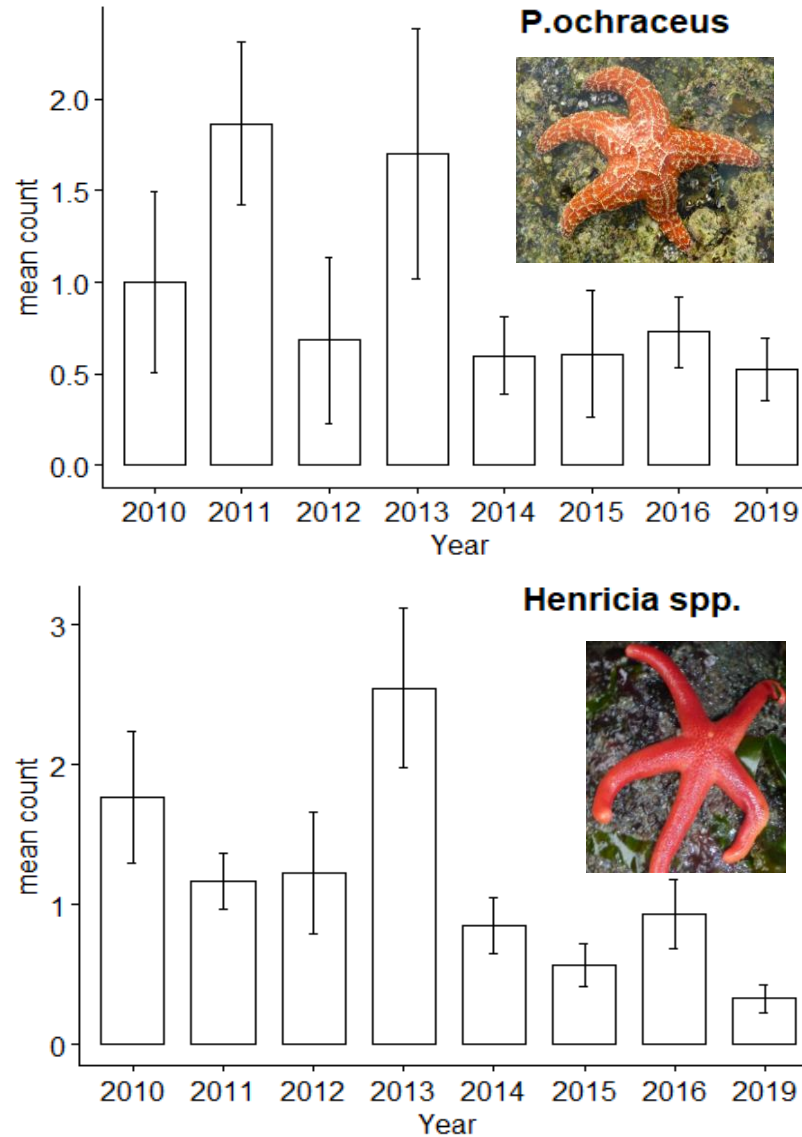


Changes in Abundance of Echinoderms in Rocky Reef Habitats

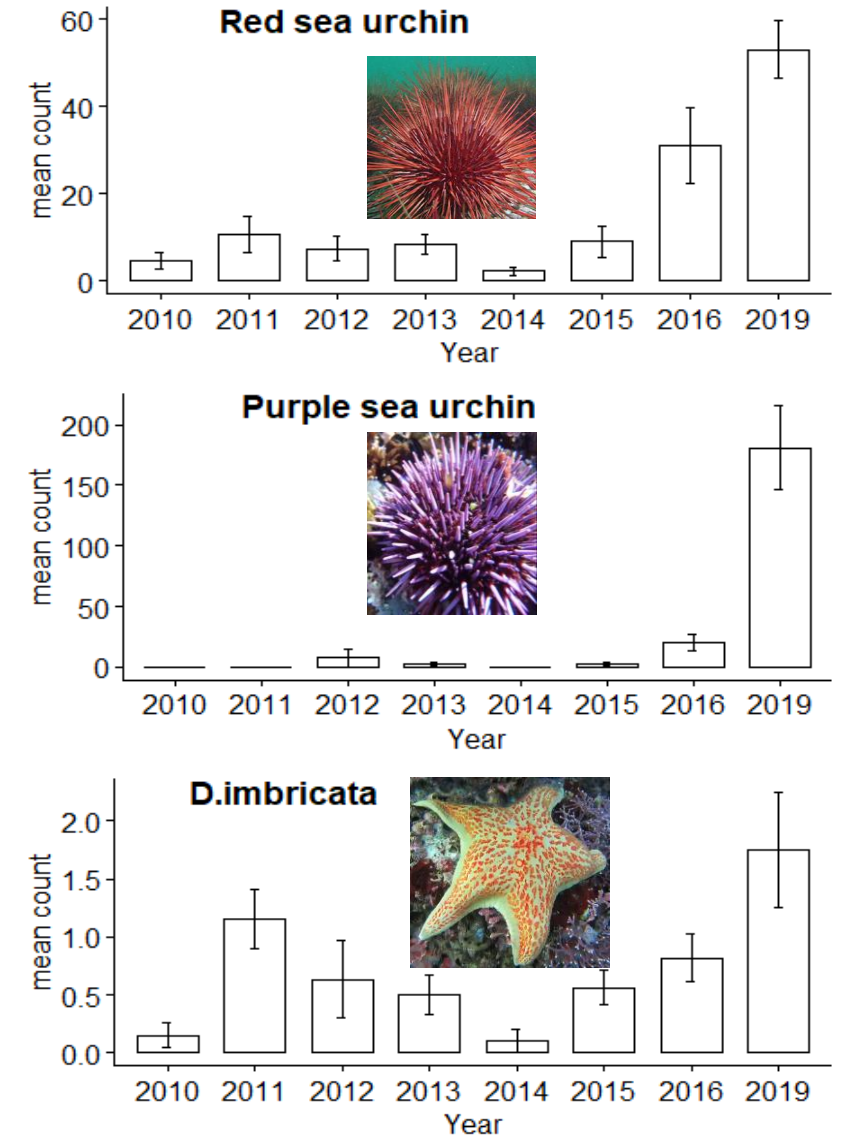
A. Decreased abundance



B. Little change



C. Increased abundance



Kelp Communities in Transition: Underwater Surveys along the Southern Oregon Coast

Orford Reef: Shift from Kelp Habitat to Urchin Barren



Next Steps (2024):

Commercial Urchin Divers

New underwater surveys at offshore areas:

- Orford Reef (4 sites)
- Rogue Reef (4 sites)

Science Divers

New underwater surveys close to shore:

- Cape Arago (3 sites)
- Nellies Cove (2 sites)
- Redfish Rocks (2 sites)
- Humbug Mountain (2 sites)
- Chetco Point (3 sites)

Kelp Communities in Transition: Underwater Surveys along the Southern Oregon Coast

Outreach and Dissemination (2023):

- **OR-AFS Conference / Eugene**
- **HMSC Research Summit**
- **OOST Strategic Planning Mtg.**
- **Public Mtgs (kelp / abalone):**
 - ✓ **Port Orford**
 - ✓ **Brookings**
- **OR Fish & Wildlife Commission**





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Help Communities in Transition

Oregon Fish and Wildlife Commission (Dec 15, 2023):

- **Suspend recreational abalone fishery indefinitely**
- **Adopt conservation and fishery management plan for red abalone**



Kelp Communities in Transition: Underwater Surveys along the Southern Oregon Coast

Outreach and Dissemination (planned 2024):

- **OR-AFS Conference / Bend**
- **OSU-HMSC Research Seminar**
- **UO-OIMB Research Seminar**
- **State of the Coast Conference**
- **Elakha Alliance - OR Sea Otter Science Symposium**
- **Cape Perpetua / Land-Sea Symposium**
- **ODFW Marine Reserves / Outreach**
- **ODFW Social Media**
- **OR Kelp Alliance**
- **OR Sea Grant / Outreach**
- **OR Coastal Resource Manager Workshop (Sep)**





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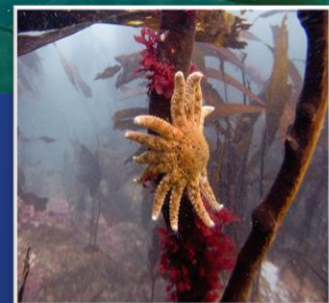
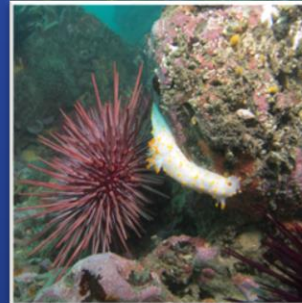
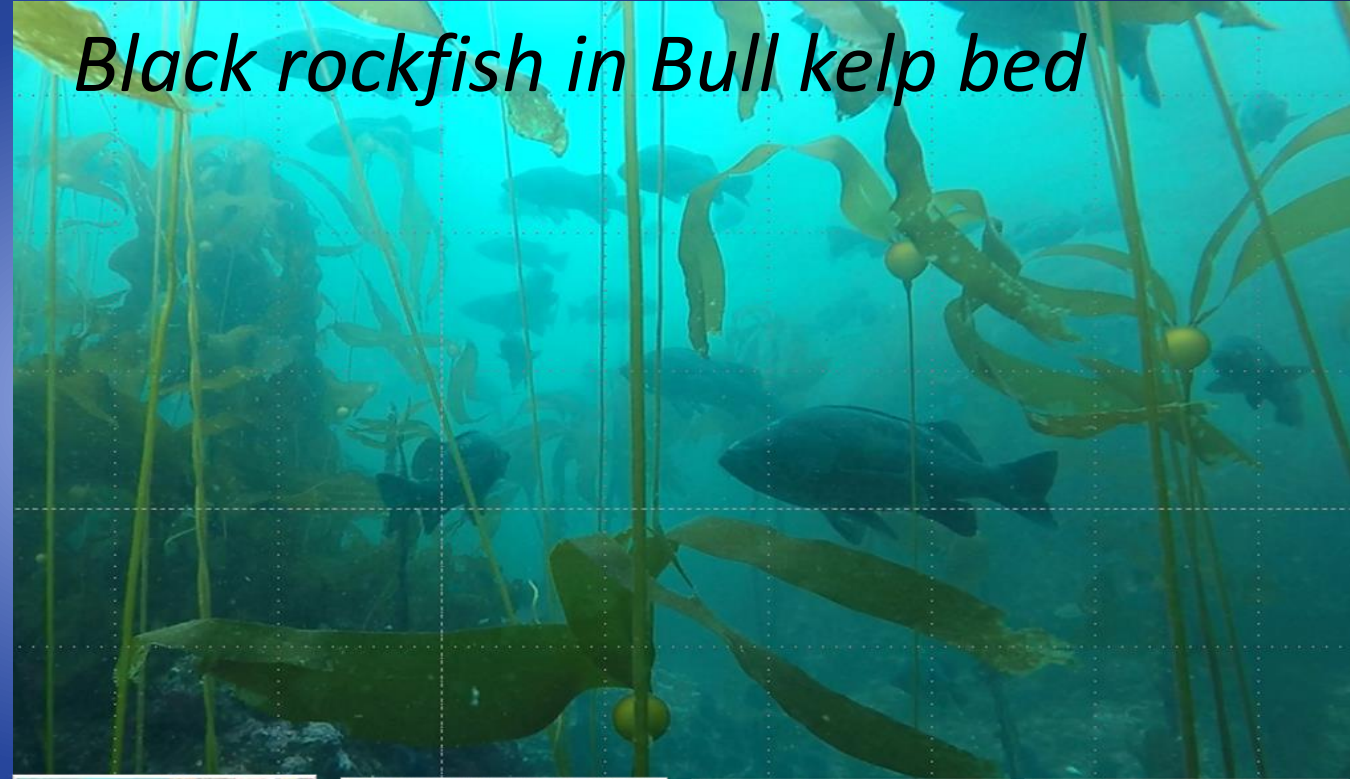
Help Communities in Transition

QUESTIONS?



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Recent Changes to Nearshore Rocky Reefs along the Southern Oregon Coast



Context: Recent Changes to Nearshore Rocky Reefs along the Southern Oregon Coast (2013-2023)



Starved Urchins

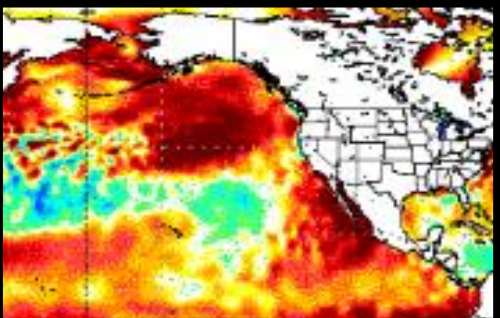


Sea Star Mortality



Decline in Red Abalone

Increased Abundance of Purple Urchins & Formation of Urchin Barrens



Patchy Demise of Bull Kelp

**Marine Heatwave
2013-2017 (2023)**



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Changes to Rocky Reef Communities and Kelp Habitats along the Southern Oregon Coast



Conclusions:

- Rocky reef habitats and communities have experienced substantial shifts over the past decade along the Oregon coast.
- Changing ocean conditions (ocean warming) are likely a primary driver for the transition.
- Changes include decline in kelp, mass mortality of sunflower sea stars, dramatic increase in sea urchins, and decline in abalone.
- Trophic cascades in the kelp habitat are complex and warrant further study.
- ODFW / Marine Resources Program is engaged in surveys, research, and monitoring to establish new baselines.





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Variability in Bull Kelp along the Oregon Coast

Bull kelp beds are naturally highly variable in space and time along the OR coast:

- reduced at some sites after marine heatwave 2014-15 / Orford Reef & Humbug
- increased at other sites / Rogue Reef, Redfish Rocks, Cape Arago
- appear static at one site / Depoe Bay

“What is responsible for the variability in changes to bull kelp beds?”

From: Hamilton *et al.* 2019



Orford Reef 2014, lots of bull kelp



Orford Reef 2016, little bull kelp



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Climate Mischief: Persistent Marine Heatwave & Ocean Warming along the Pacific West Coast

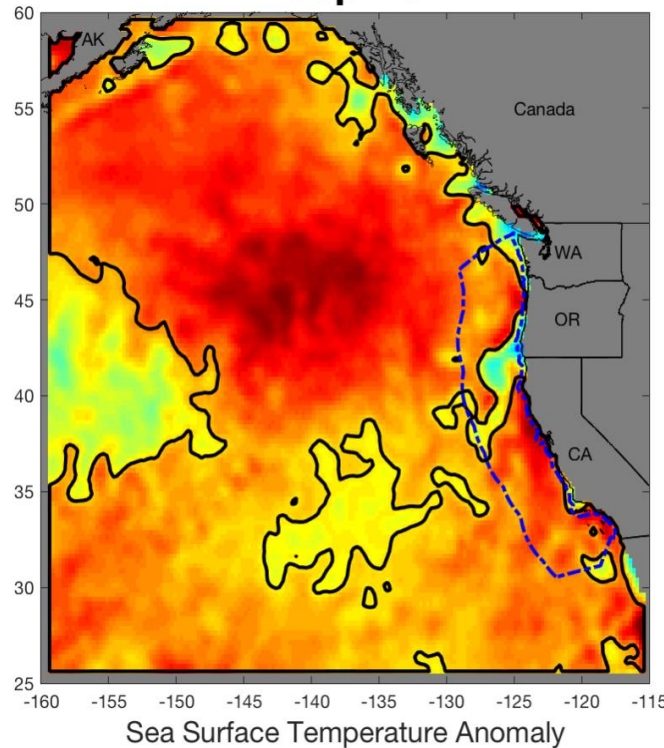
Marine Heatwaves Disrupt Nearshore Marine Ecosystems

Reported impacts:

- ✓ altered primary productivity
- ✓ proliferation of harmful algal blooms
- ✓ displacement of ocean habitats
- ✓ changes to populations of marine species
- ✓ disruption of commercial and recreational fisheries

Formation

22-Sep-2014



Persistence

Aug-30-2022

