PUGET SOUND KELP

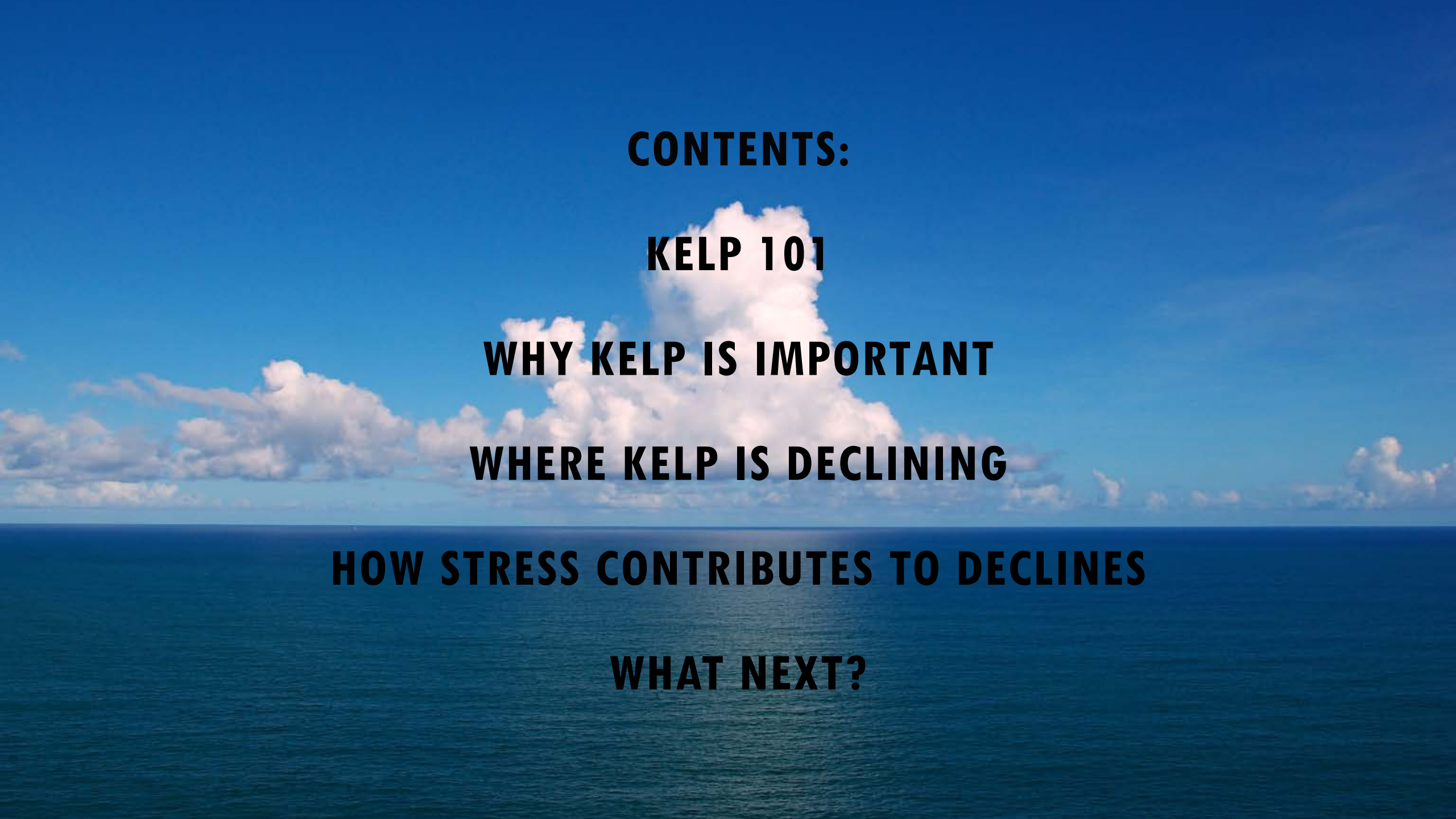
Trends, Roles and Stressors

Max Calloway

Puget Sound Kelp Conservation & Recovery Plan

Year 2, Workshop 4

6/13/18



CONTENTS:

PEW

TOPICS PROJECTS FEATURES ABOUT GET INVOLVED SEARCH

Four Types of Coastal Habitats and Why They Matter

Mangroves, seagrass, salt marshes, and coral reefs sustain ocean life and help mitigate climate change

ARTICLE May 31, 2019 By: Simon Reddy Topics: Environment Science & Oceans Conservation Projects: Protecting Coastal Wetlands and Coral Reefs
Tags: Habitat protection & Climate Read time: 2 min

- Kelp regularly left out of such assessments and reports

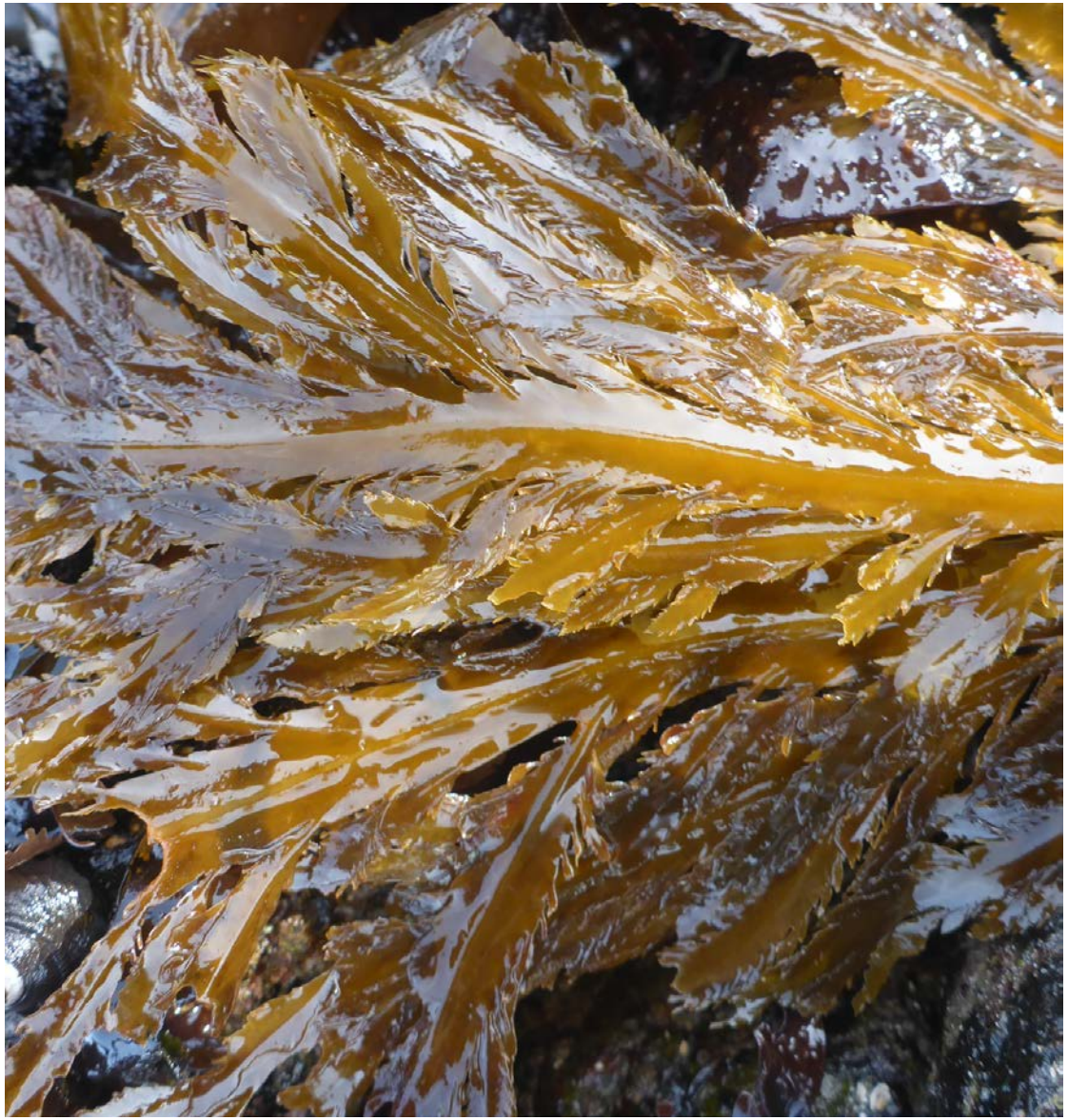
WHAT IS KELP?

"Brown" seaweed

Order: Laminariales

Other brown seaweeds are not kelp:

- Rockweed (*Fucus* spp.)
- Acid kelp (*Desmarestia* spp.)



Acid kelp, *Desmarestia ligulata*

Rockweed, *Fucus distichus*

KELP LIFECYCLE

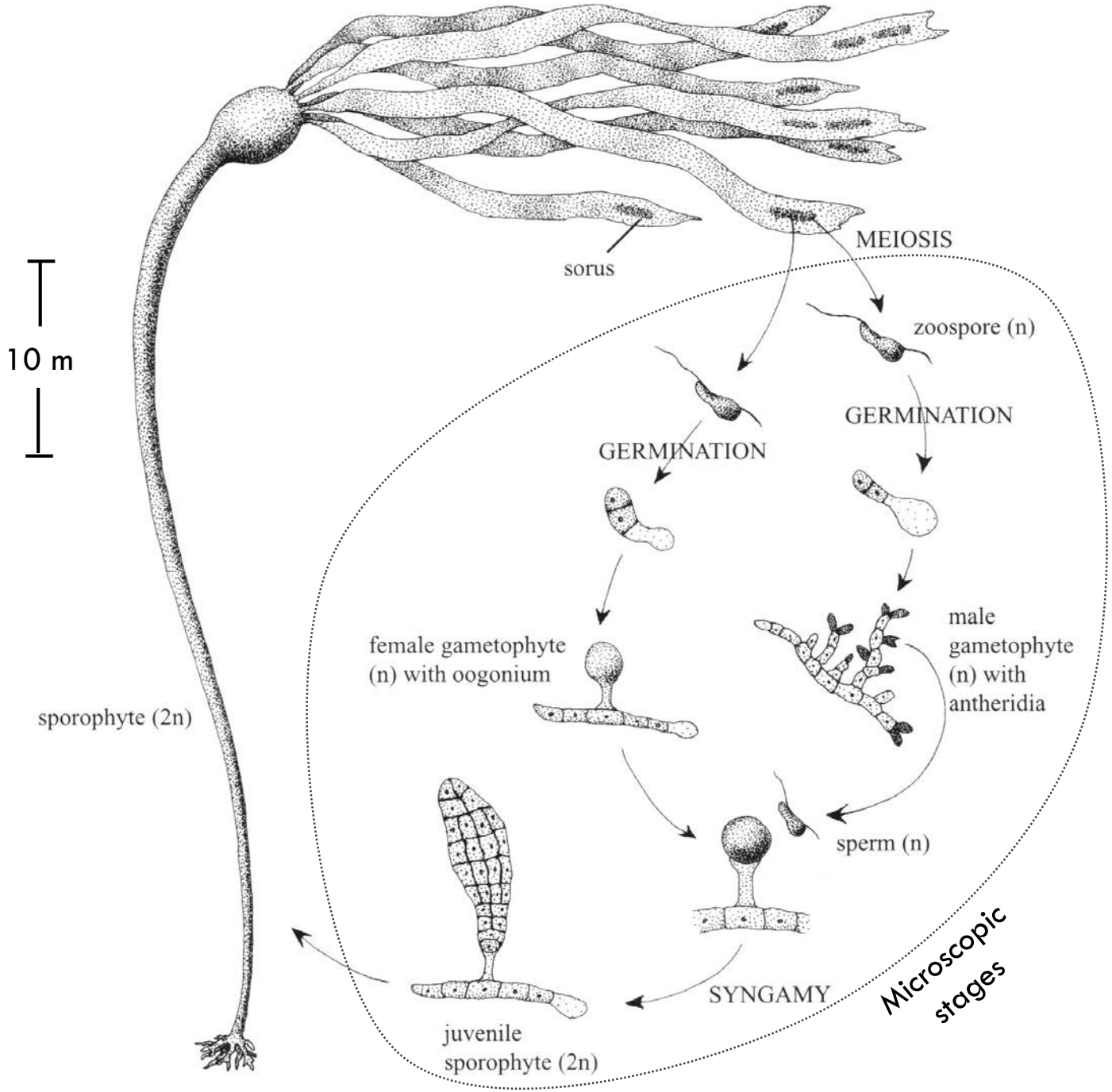


Photo Courtesy: Mondragon and Mondragon 2003

Photos: © John D Reynolds(left), © M. Goff (right), courtesy of inaturalist.org

PROSTRATE KELP

Seersucker kelp, *Costaria costata* (left)
Sugar kelp,
Saccharina latissima (right)

Photo: Helen Berry

Photos: © Patrick Webster (left), © Bill Bouton (right), courtesy of inaturalist.org

STALKED OR STIPITATE KELP

Pterygophora californica (left)
Laminaria setchellii (right)

Photos: © kathawk (left), © Stefaie (right), courtesy of inaturalist.org

FLOATING KELP

Bull kelp, *Nereocystis luetkeana* (left)

only floating species in Puget Sound

Giant kelp, *Macrocystis pyrifera* (right)

Photo: NOAA

KELP FOREST HABITATS

Ecosystem services

FOUNDATION SPECIES & ECOSYSTEM ENGINEER

Primary productivity rivals that of rainforests and agricultural fields

Alters physical environment

- Carbon uptake may ameliorate OA conditions
- Nutrient uptake may help combat nutrient pollution
- Slows water movement

Living habitat:

- More volume of habitat than eelgrass
- Food
- Refuge & Nursery
- Increases biodiversity

Photo Courtesy: /www.eikojonesphotography.com/kelp

Adult Chinook salmon foraging in a kelp bed. Artwork used with permission of the Pacific Salmon Foundation

CRITICAL FISH HABITAT

Nurseries for juvenile rockfish and salmon

Important refuge & spawning ground for forage fish

High quality feeding grounds for forage fish, adult salmon and rockfish

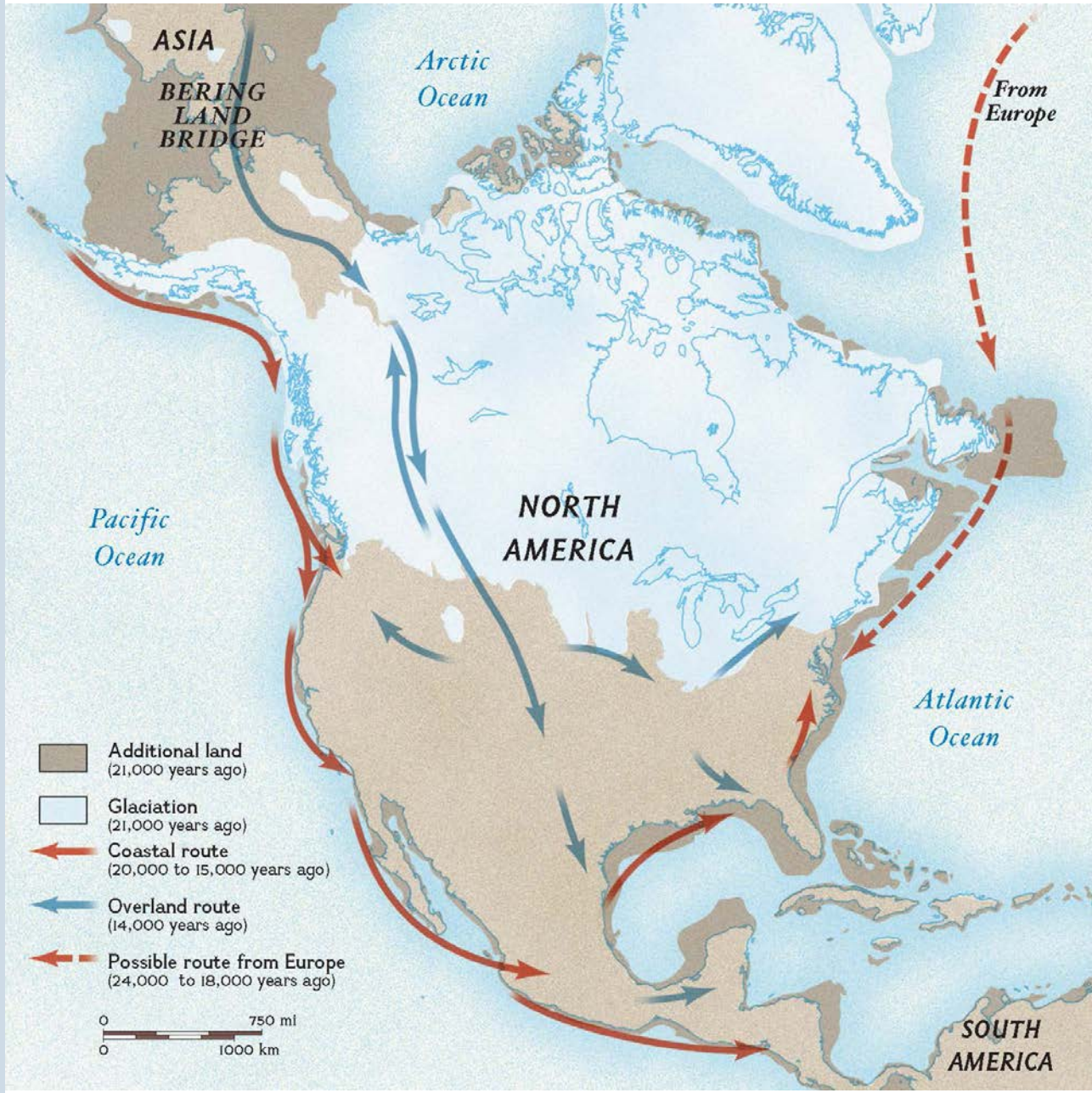
- Higher marine invertebrate abundances than eeelgrass and non-kelp habitats

Painting by Mark Hobson, Tofino, B.C., www.markhobson.com

KELP HIGHWAY

Allowed colonization of Western Hemisphere before ice free overland routes were available.

1. Linear extent around whole pacific rim
2. Abundant food resources
3. Similar ecosystems along entire range
4. Natural breakwaters and anchors for hunter-gatherers



Map by J. You and N. Cary, courtesy *Science*

Received: 8 March 2018 | Revised: 13 April 2018 | Accepted: 27 April 2018

DOI: 10.1111/conl.12566

POLICY PERSPECTIVE

WILEY Conservation Letters
A journal of the Society for Conservation Biology Open Access

Seagrass meadows support global fisheries production

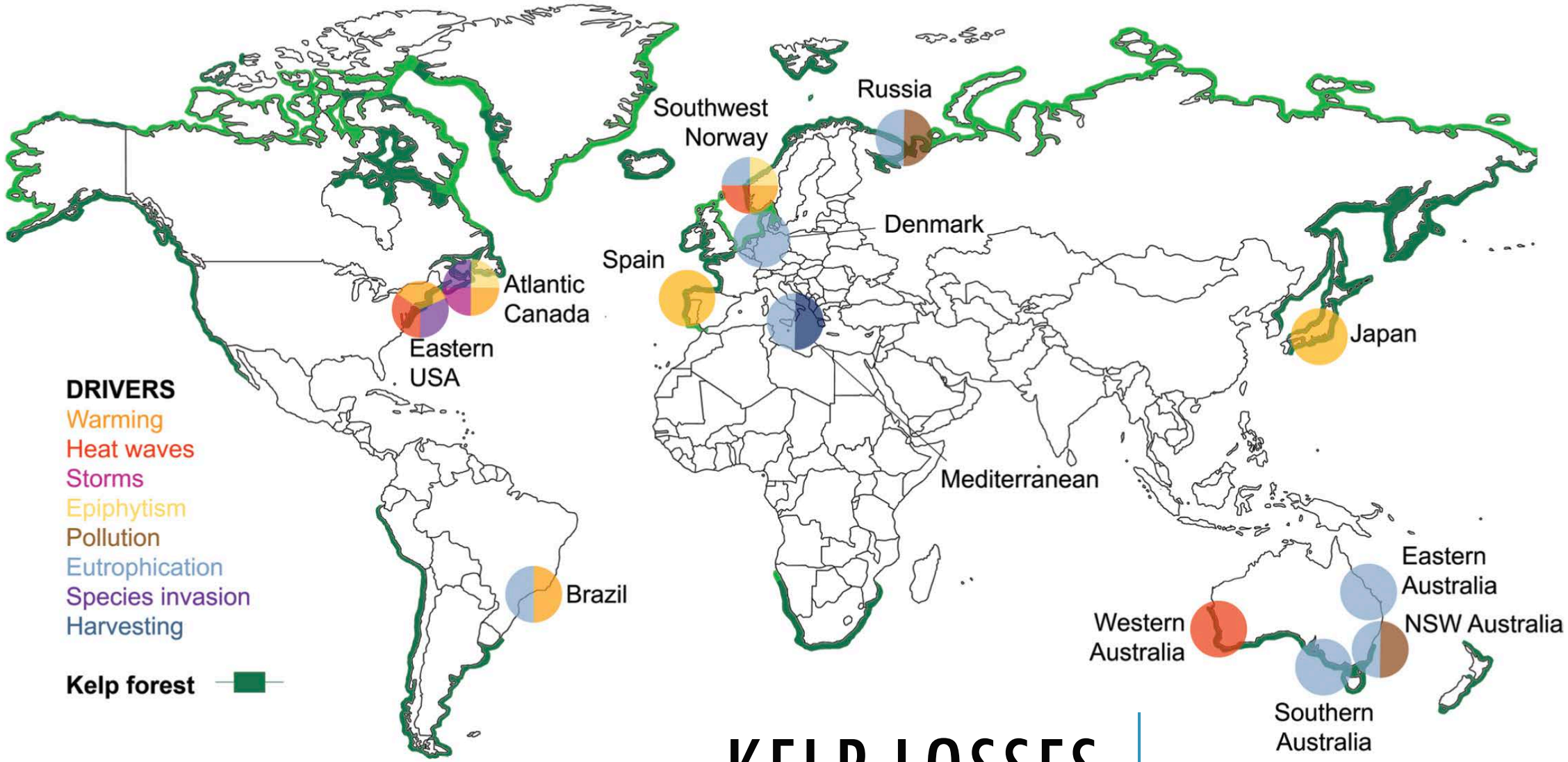
Richard K.F. Unsworth[1,4] | Lina Mtwana Nordlund[3] | Leanne C. Cullen-Unsworth[2,4]

- Nursery habitat
- "Stock" open water fisheries
- Enhance food webs
- Increase biodiversity

BIODIVERSITY CRISIS

UN Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services Policy Summary:

- 1 million species threatened with extinction
- Biodiversity, ecosystem functions and services in decline worldwide
  - Many functions and services irreplaceable.



KELP LOSSES

Map: Filbee-Dexter & Wernberg, 2018, *BioScience*

NORTHERN CALIFORNIA

Perfect Storm

- Algal blooms
- Loss of seastars
- Urchin booms
- Warm water events

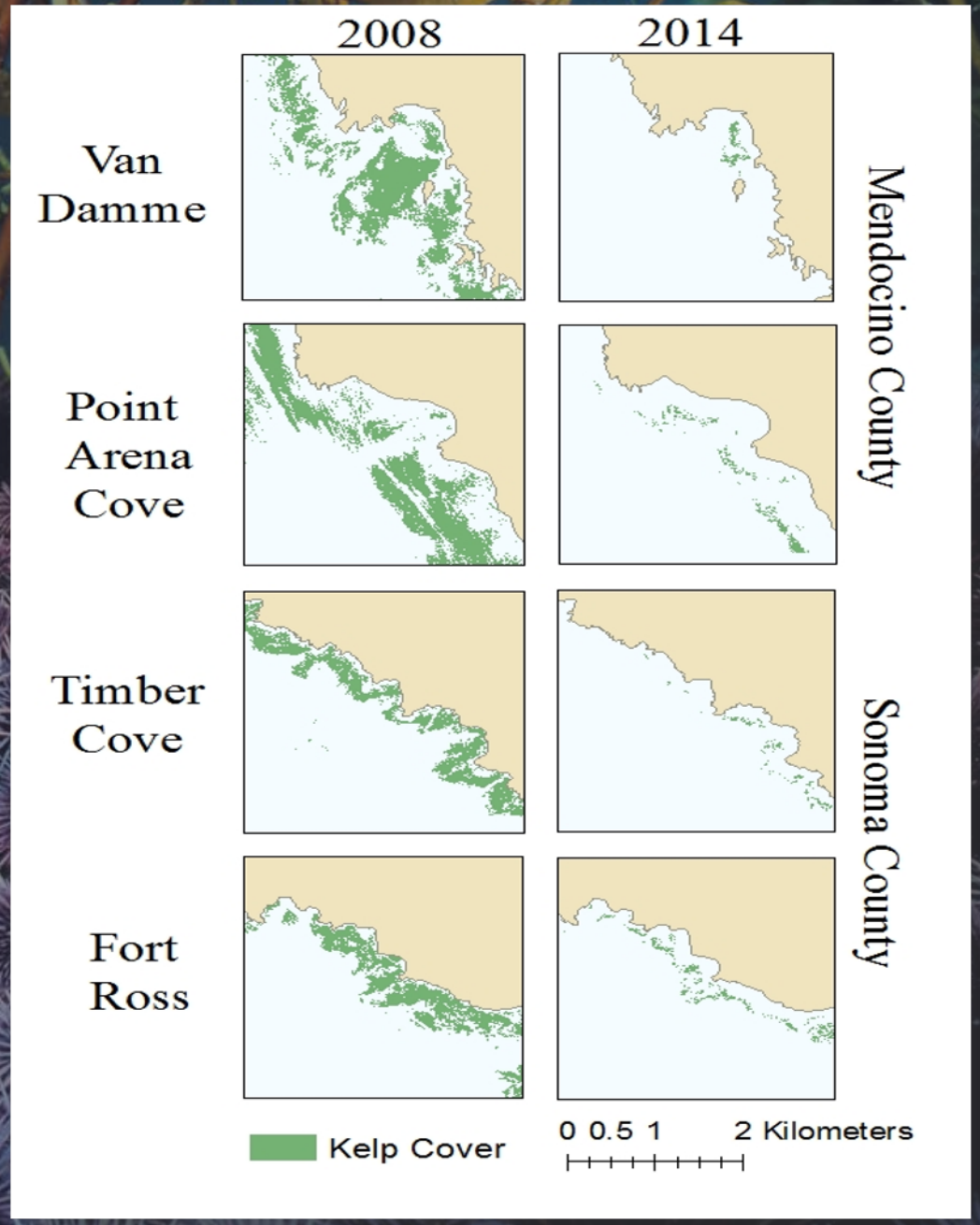


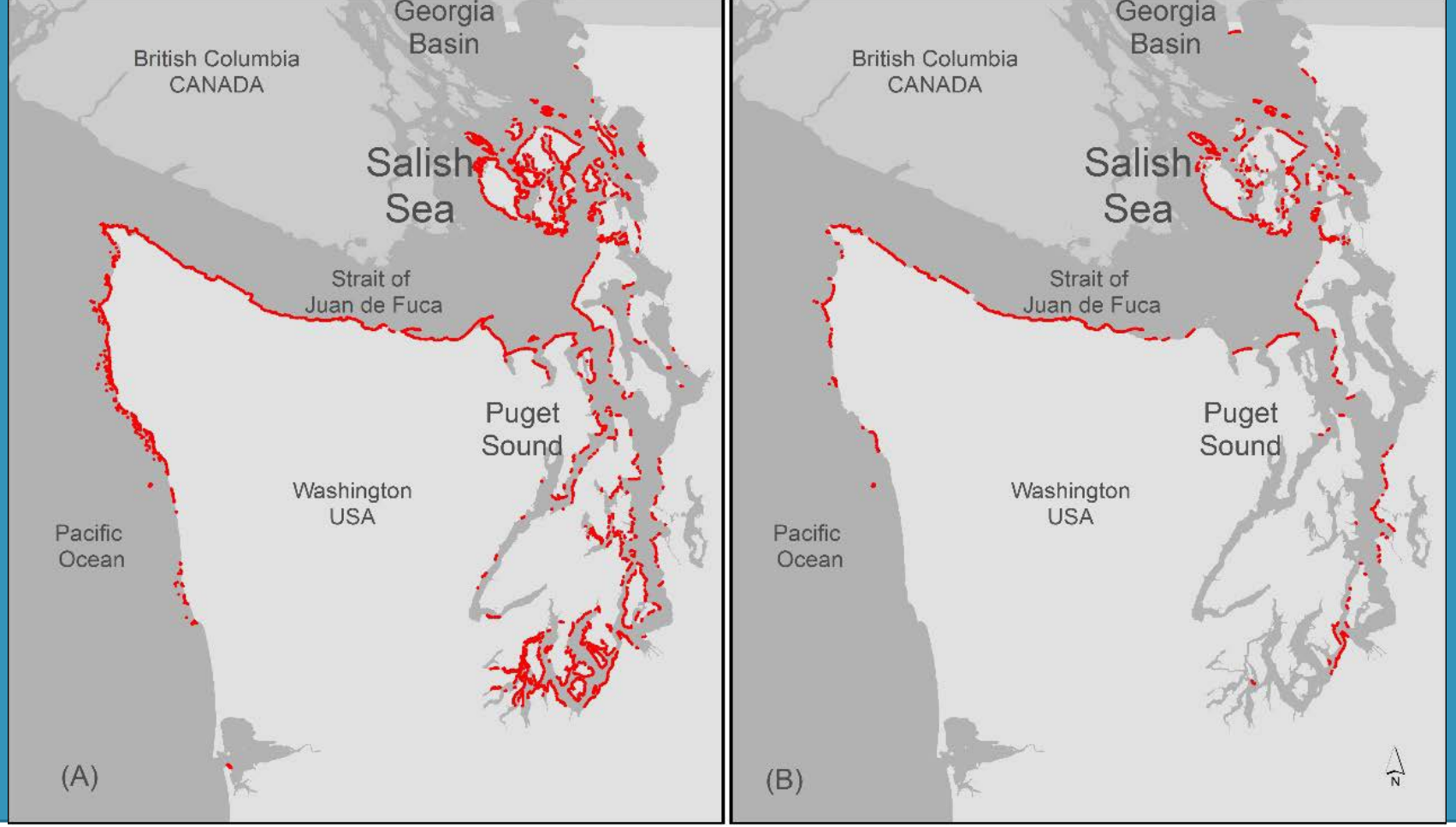
Photo: Stanford University; Graphic: California Department of Fish and Wildlife

WHAT ABOUT OUR REGION?

Some information on bull kelp distributions and trends

Very little data on understory

Region left out of 2016 global assessment



PUGET SOUND KELP DISTRIBUTION

(A) understory and (B) floating kelp distribution in Washington State (Washington Department of Natural Resources 2001).

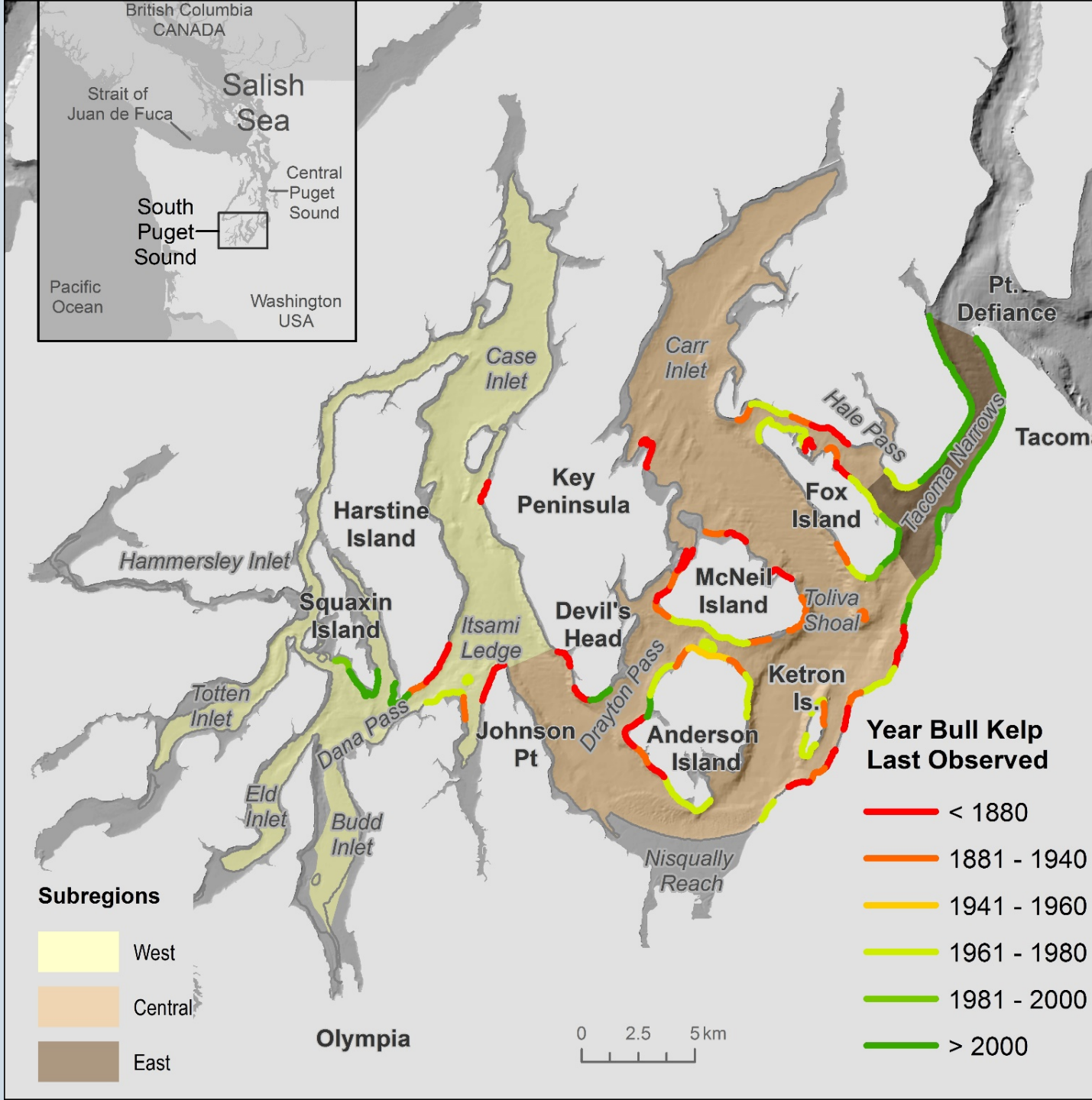
SOUTH SOUND BULL KELP

67% loss in linear extent

- Between 1873 & 2017

Two canopies lost between 2013 and 2018.

South Puget Sound water warmer than in other basins



CENTRAL SOUND BULL KELP

Bainbridge Island: Total bull kelp loss by 2015

Red and blue indicate historic floating canopies.

Loss of Jefferson Head forest (Port Madison, not pictured)

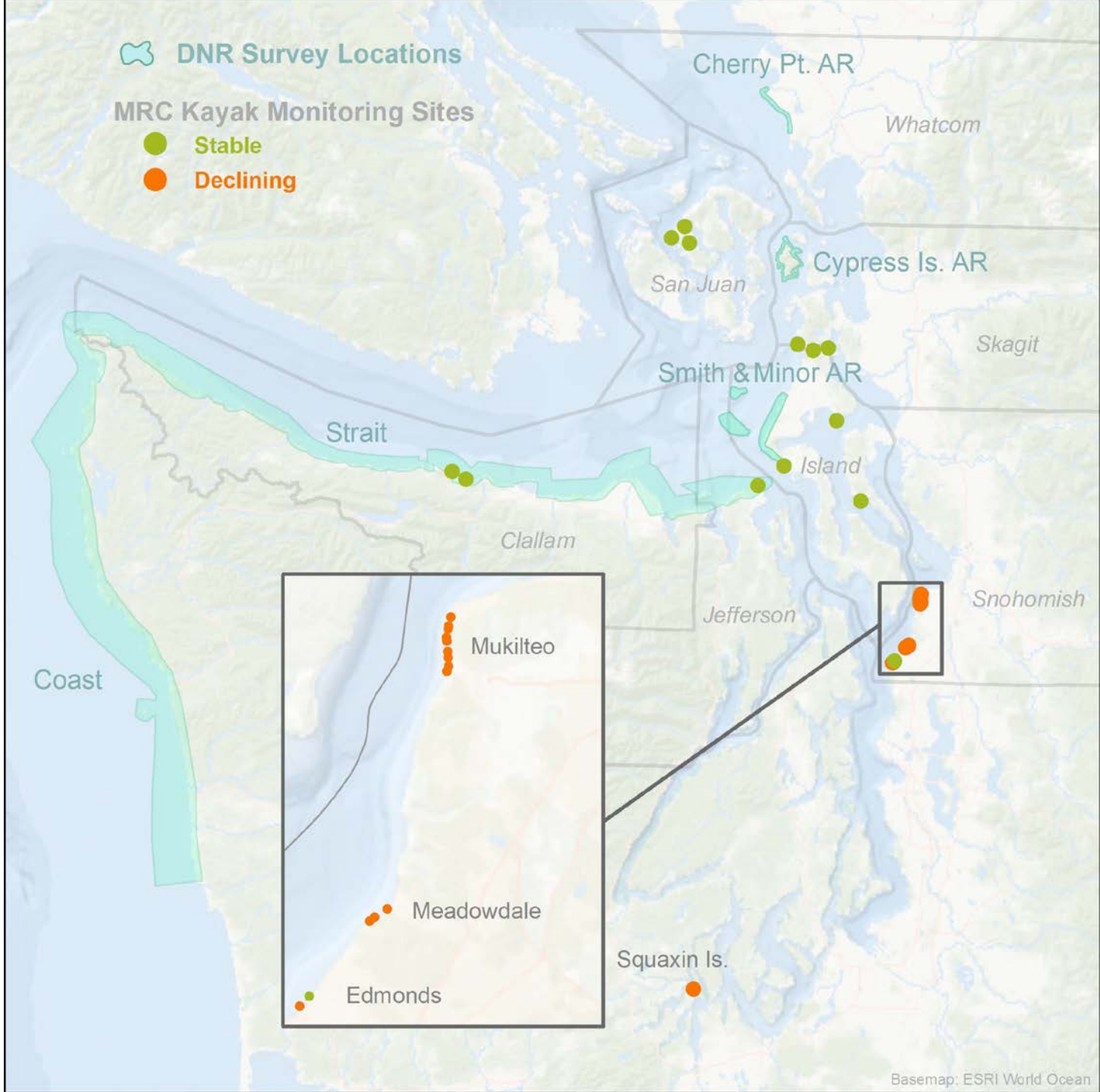
DNR: Currently working on historic analysis.

Photo Courtesy: PSRF

NORTHWEST STRAITS COMMISSION MARINE RESOURCE COMMITTEE KAYAK SURVEYS

Multiple bull kelp forests lost in Snohomish County.

Declines in bull kelp forest area at Edmonds (Snohomish Co.) and at Cherry Point (Whatcom Co.)



SAMISH NATION

Concern over potential losses

Pink: 2006

Turquoise: 2016

Data sets differ, difficult to compare.

Green: TEK interviews with tribal members

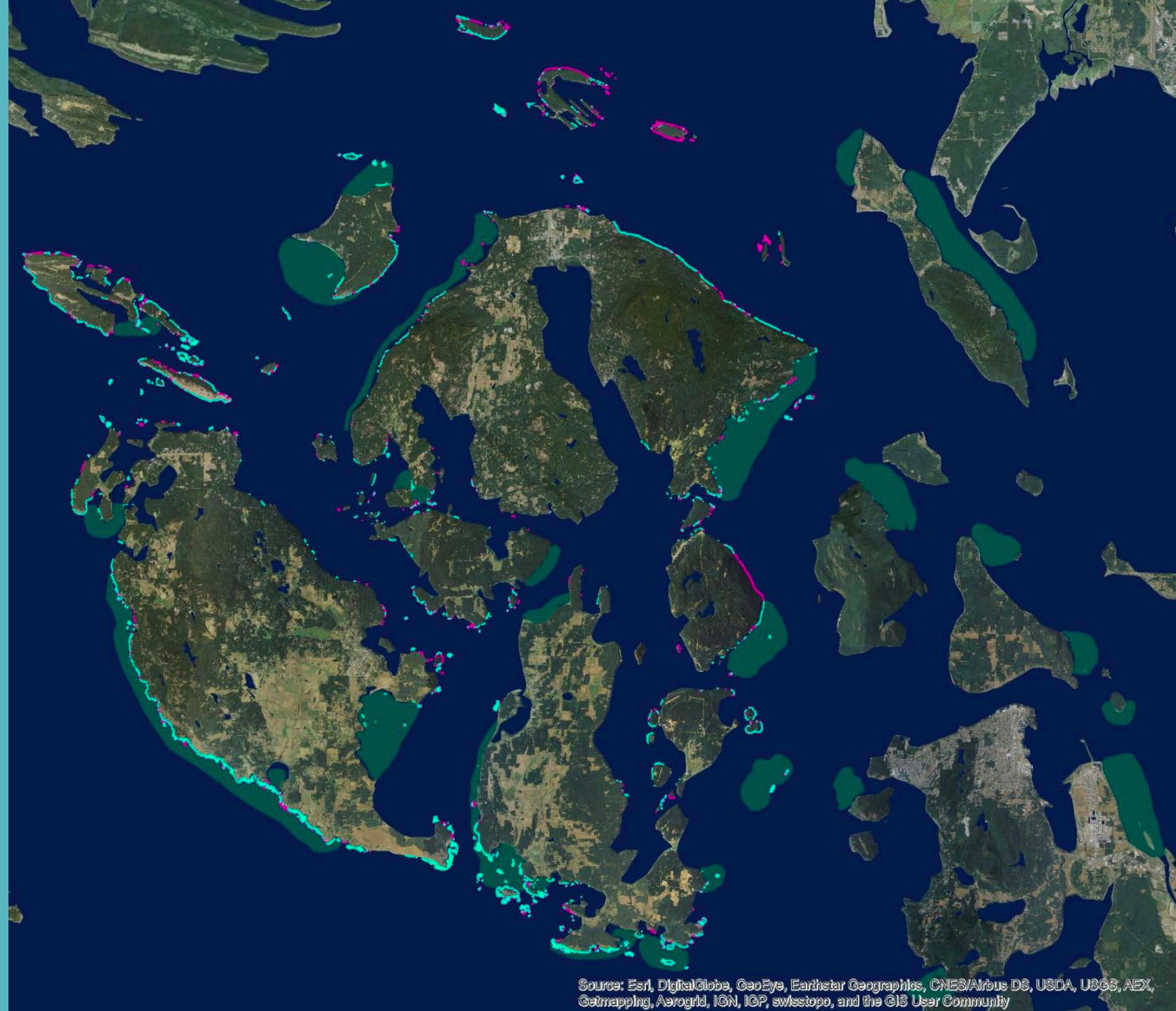
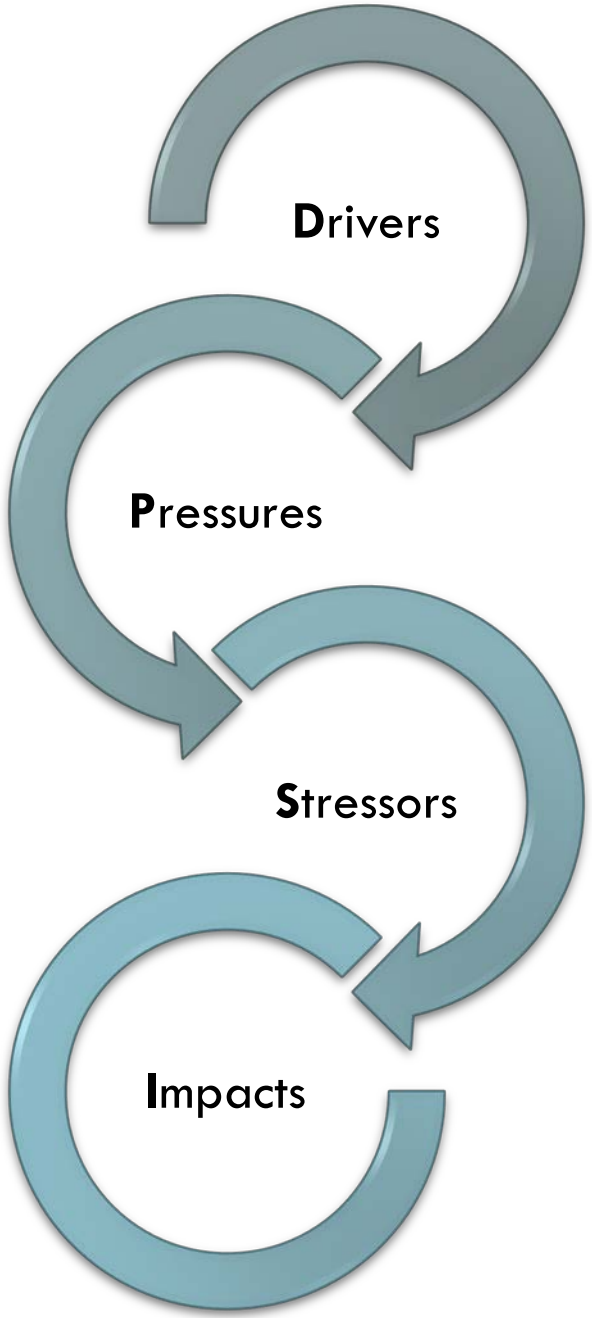


Image Source: Samish DNR, *A Decade of Disappearance*

DETERMINING CAUSES OF DECLINE

Linking human activity to nearshore stress

HUMAN IMPACTS



- Population Growth
- Economic Needs

- Fishing
- Land use-changes
- Shoreline development
- Increased emissions
- Pollution

- Climate change
- Physical
- Biological

- Decreased resilience & recruitment
- Mortality
- Loss of biodiversity
- Community changes

CANDIDATE KELP STRESSORS

Physical

Temperature

Sediment

Nutrients

Biological

Grazing

Competition

Invasion

Interactions

Unpredictable

Synergistic

INCREASED OCEANIC TEMPERATURES

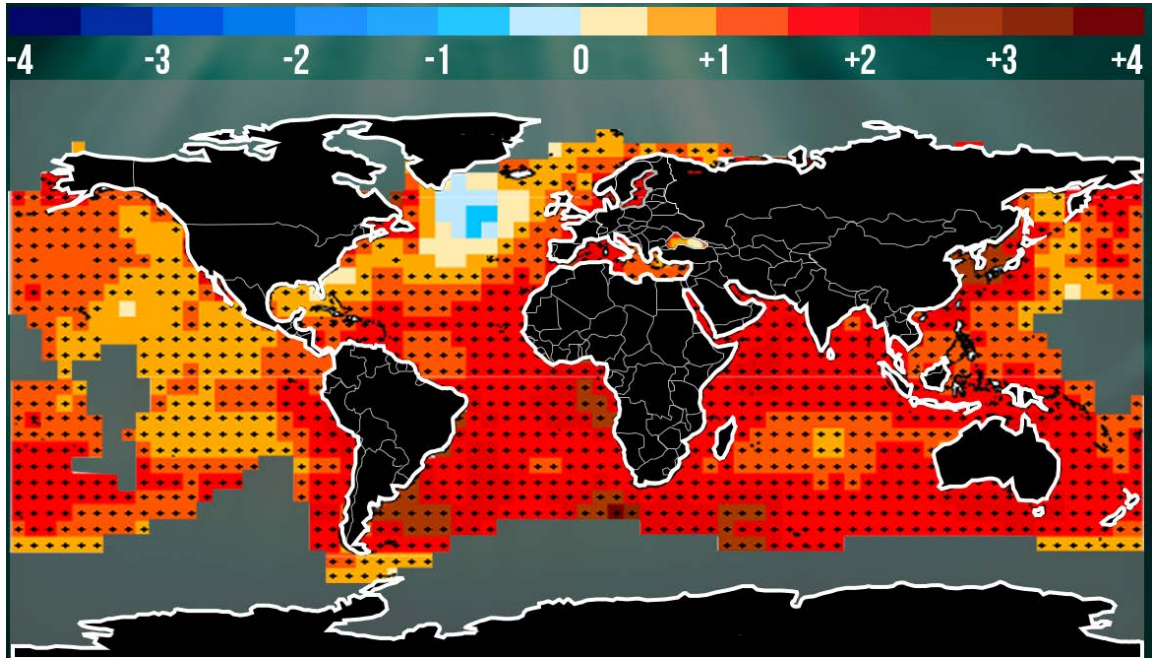
All Puget Sound kelp species have similar temperature requirements

Example species Bull kelp:

Reduces ability to recover from damage (> 15 °C)

Reduced spore germination rates (> 17 °C)

Mortality (18 °C – 20 °C)



SEDIMENT EFFECTS

Changes to land use and coastal development increase sediment delivery to nearshore

Reduces light

Kills microscopic lifestages
blocking attachment to substrates and smothering

Mobilizes pollutants

Photo: John Felis, USGS

NUTRIENT POLLUTION

WWTP effluent contributes 59% of land-based nitrogen inputs to Puget Sound
- (81% in summer)

Summer algal blooms deplete nitrogen and increase "dead-zones"

Nutrients alter seaweed competition

Turf algae displace kelp and trap sediment
- Correlated with urban development (evidence from Seattle, Europe and Australia)

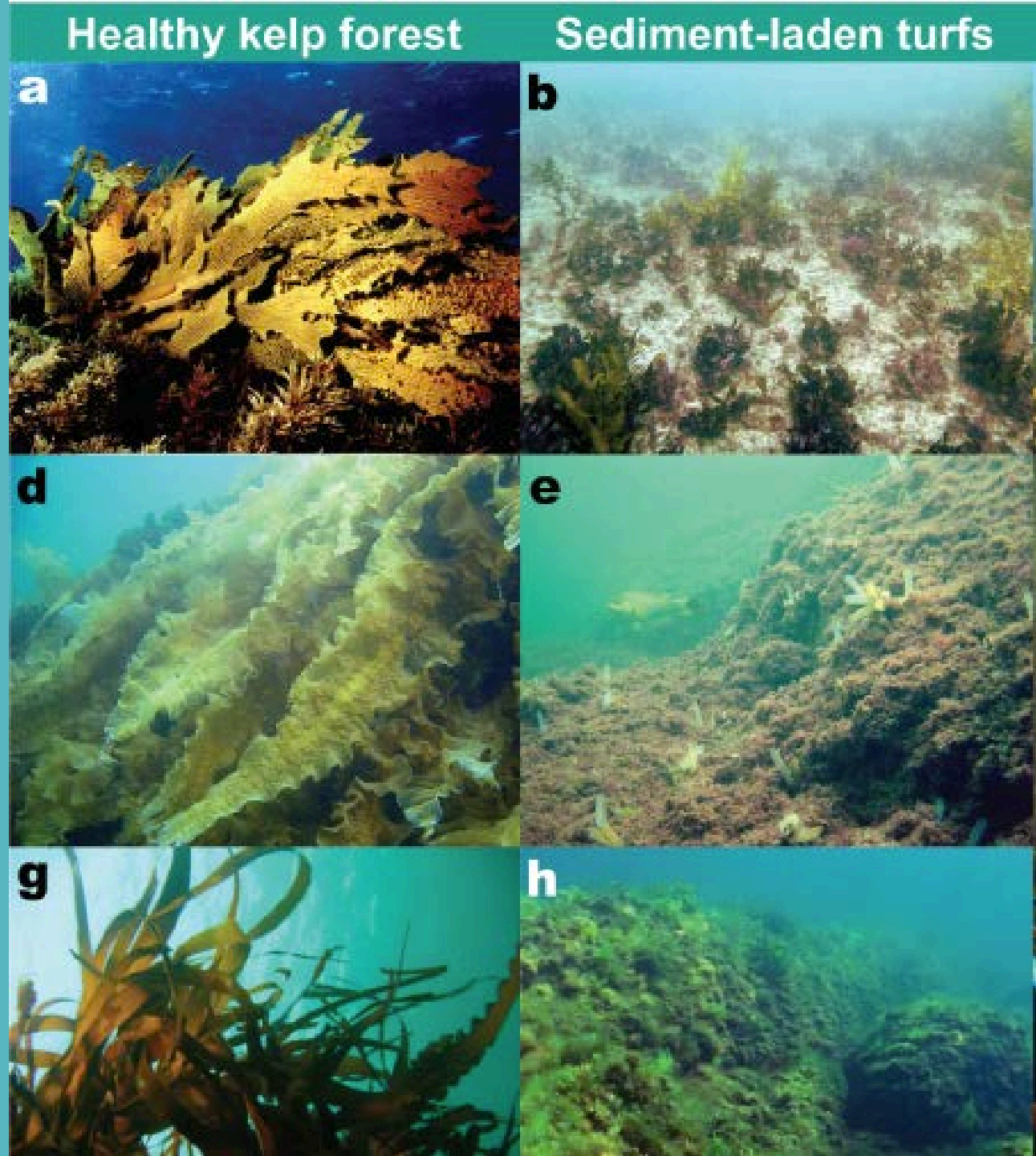


Image Source: Filbee-Dexter & Wernberg 2018, *BioScience*

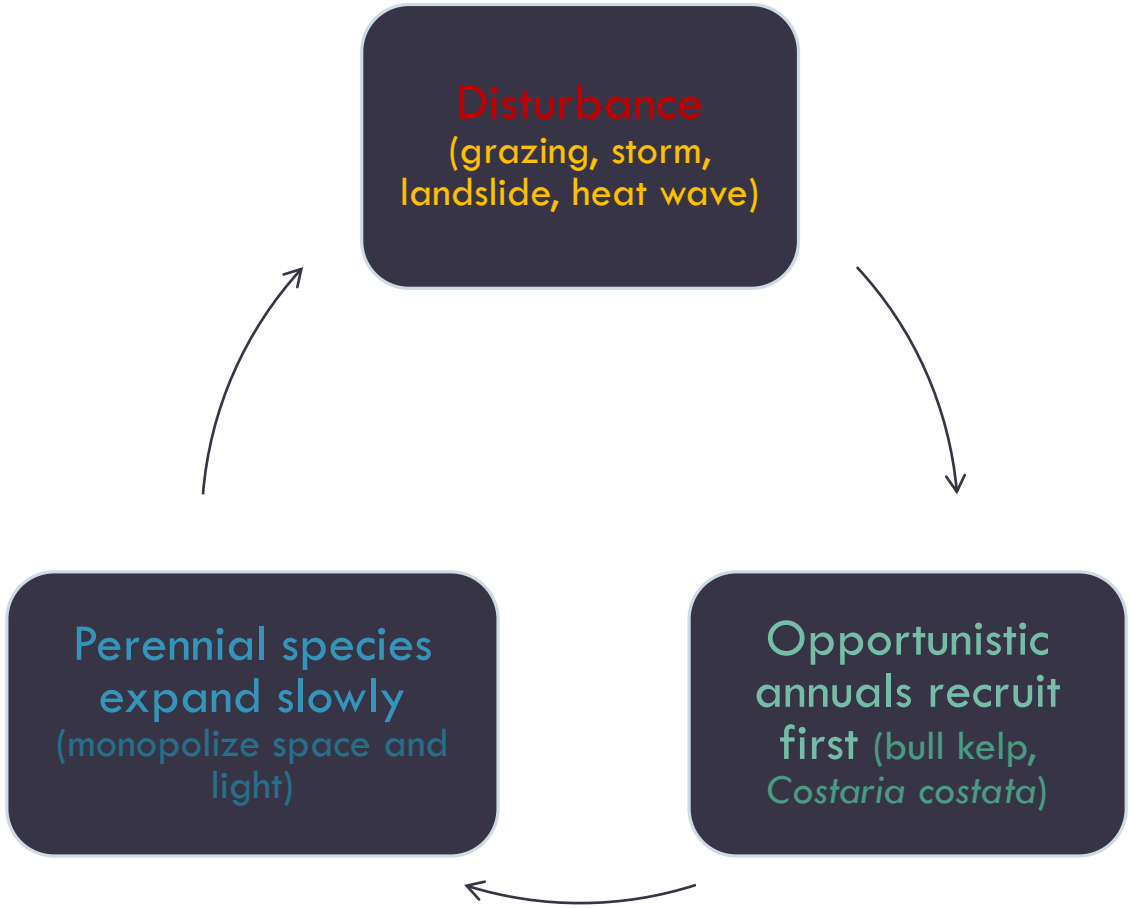
SEAWEED COMPETITION AND SUCCESSION

Disturbance is an important part of kelp forest dynamics

Kelp compete for light, nutrients and space

Perennial kelp can block recruitment of annual species

We do not know how competition and succession has changed in Puget Sound kelp forests

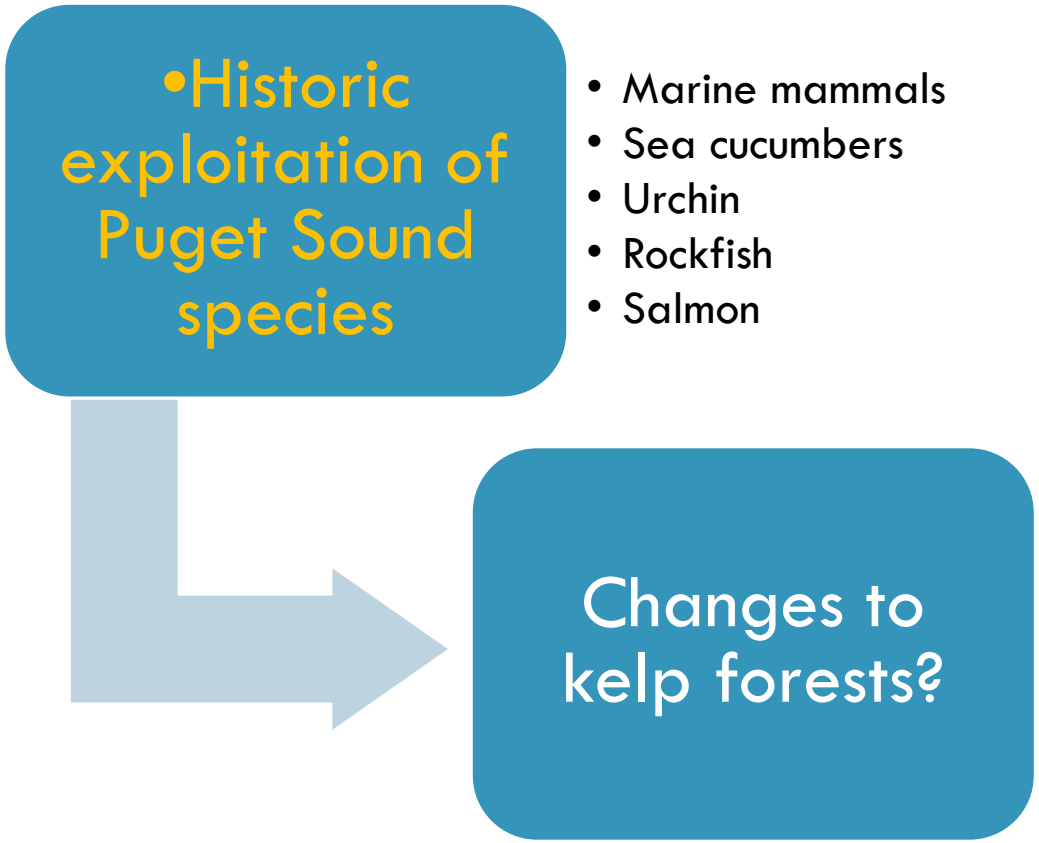


SARGASSUM MUTICUM

Photo: Jennifer Vanderhoof

- Perennial stipe
- "Leafs" out in early spring
- Displaces native species
- No data on trends or distributions in Puget Sound

PUGET SOUND FISHING IMPACTS



GRAZERS LOVE KELP

Urchin barrens likely not an issue for Puget Sound

- Maybe in isolated areas

Kelp crabs prefer bull kelp to other native species

Small grazers (<2.5 cm) can have big impacts but are understudied

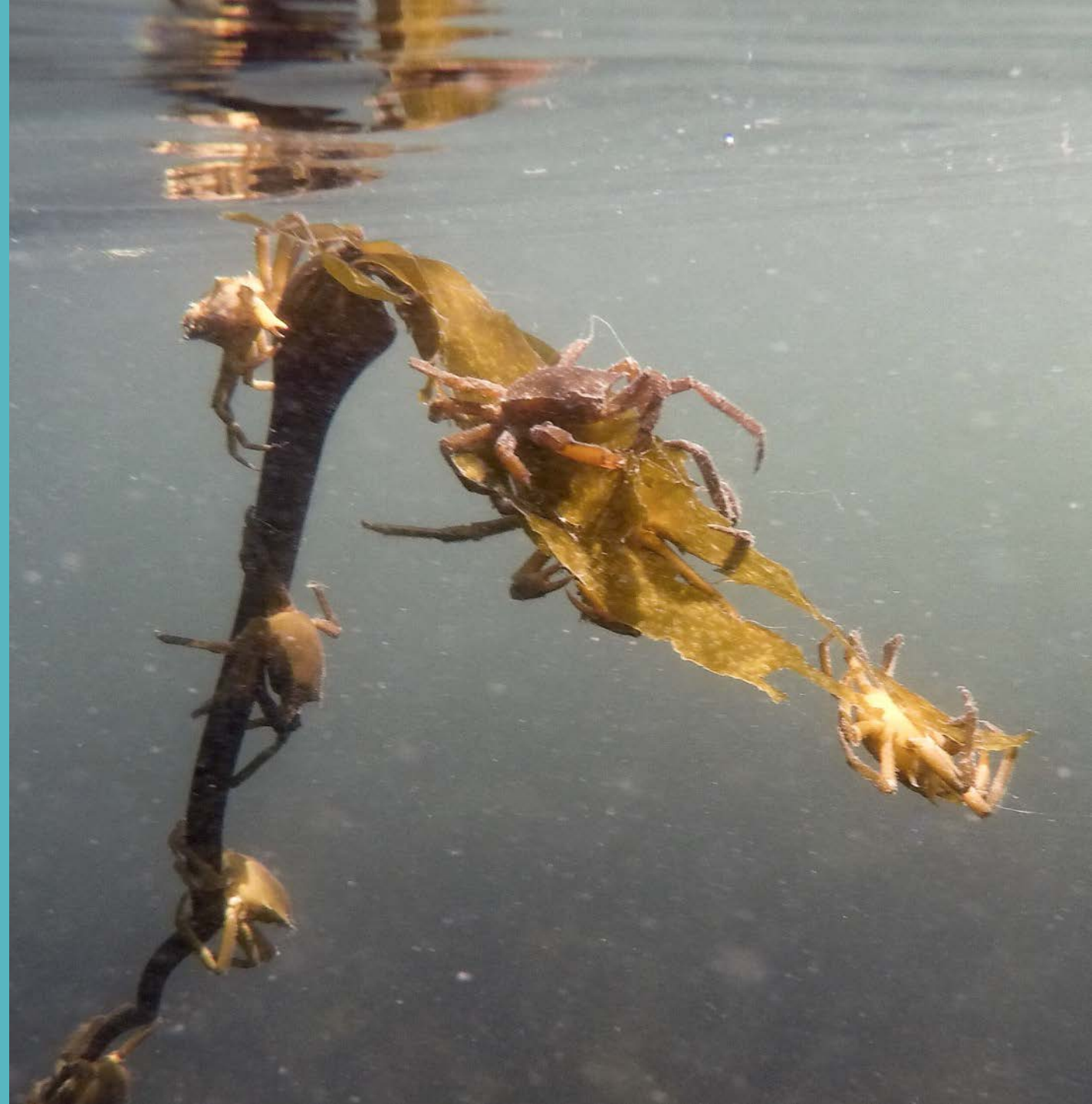


Photo: Julia Ledbetter, WA-DNR

PINPOINTING CAUSES

Third workshop developed priority actions

Develop and implement expanded kelp forest monitoring

Research into priority stressors and their effects

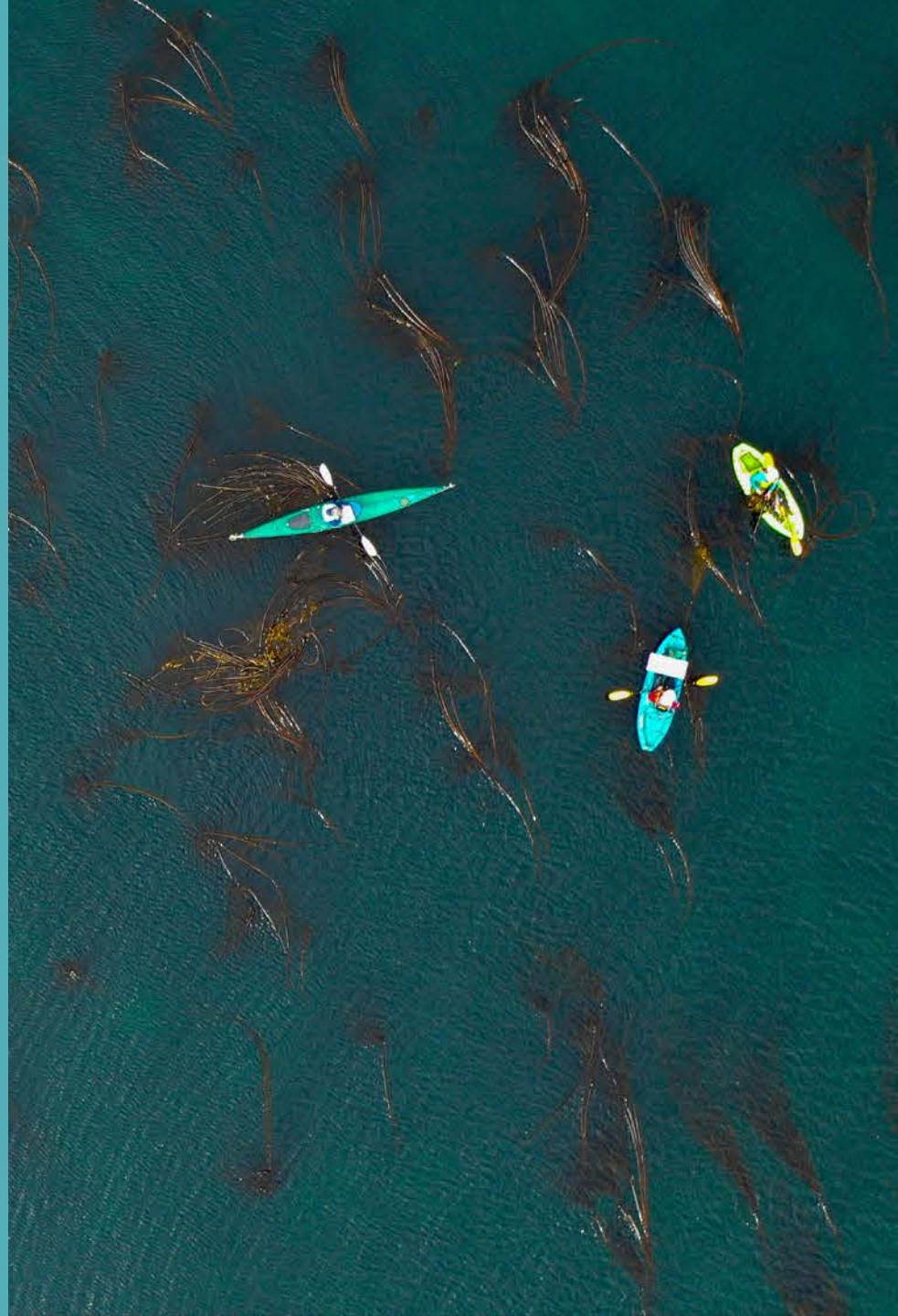


Photo: Russ McMillan, WA-DNR

TAKEAWAYS

Bull kelp is in decline in Puget Sound

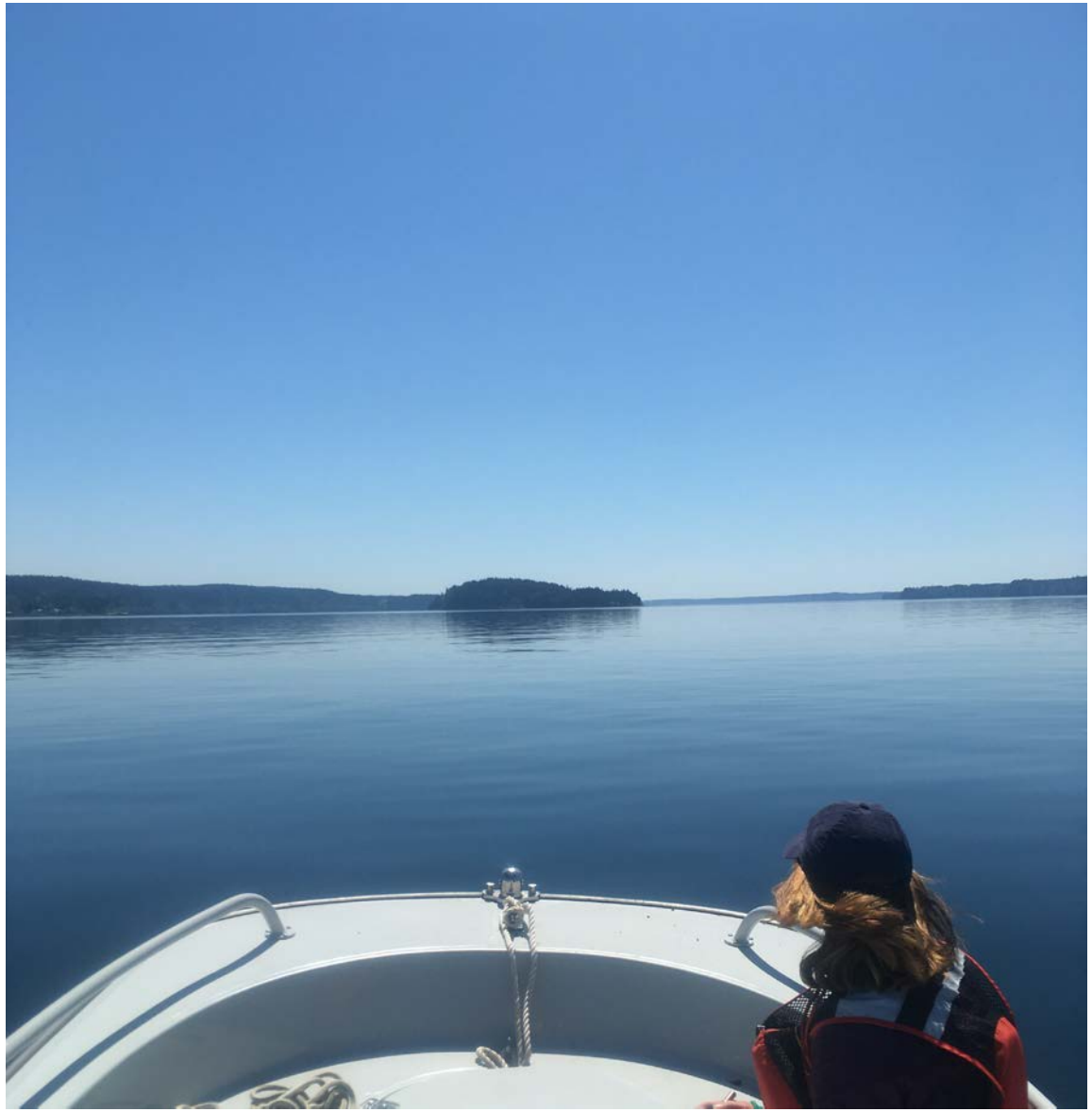
Little data on understory species

- Understory species have similar stress responses to bull kelp

Reasons for declines may be basin or embayment specific

Warming climate predicted to increase kelp stressors

Predicted regional population growth could increase human stressors without wise management



THANK YOU

Any questions?