

Vulnerability of Oregon Seagrass Beds to Eutrophication



Coastal Science
Serving Oregon

<http://seagrant.oregonstate.edu/research/current-research/>

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Vulnerability of Oregon Seagrass Beds to Eutrophication

1. WHAT ARE SEAGRASSES?

2. WHY DO SEAGRASSES MATTER? WHY DO WE CARE ABOUT SEAGRASSES?

3. THREATS TO SEAGRASS

4. WHAT YOU CAN DO / HOW YOU CAN HELP



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WHAT ARE SEAGRASSES?

Seagrasses and submersed vascular plants: ecological group of aquatic vascular plants

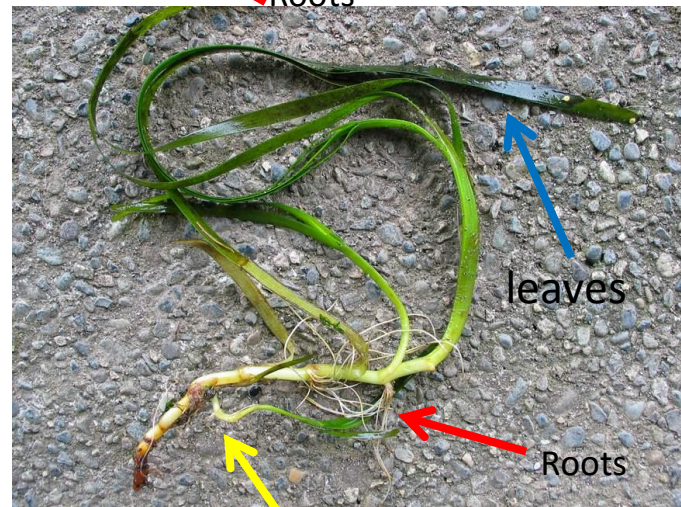
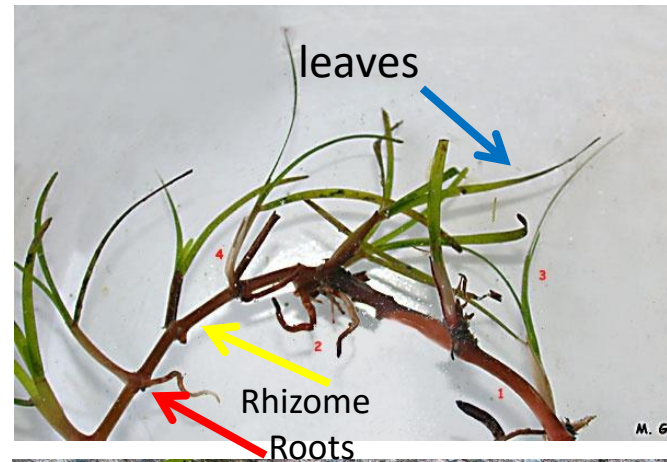
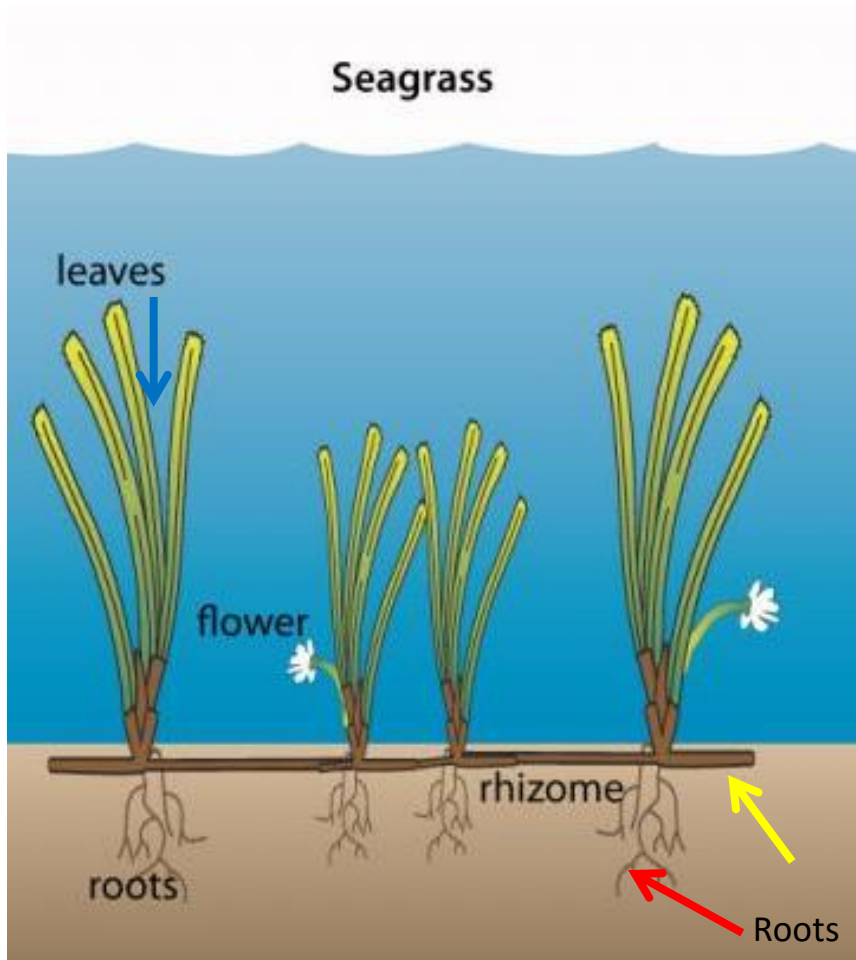
- Terrestrial and freshwater ancestors
- Angiosperms (flowering plants)
- Appeared ca. 100 Million Years ago
- Few species (ca. 60)... compared to terrestrial.....



1. WHAT ARE SEAGRASSES?

Seagrasses and submersed vascular plants: ecological group of aquatic vascular plants

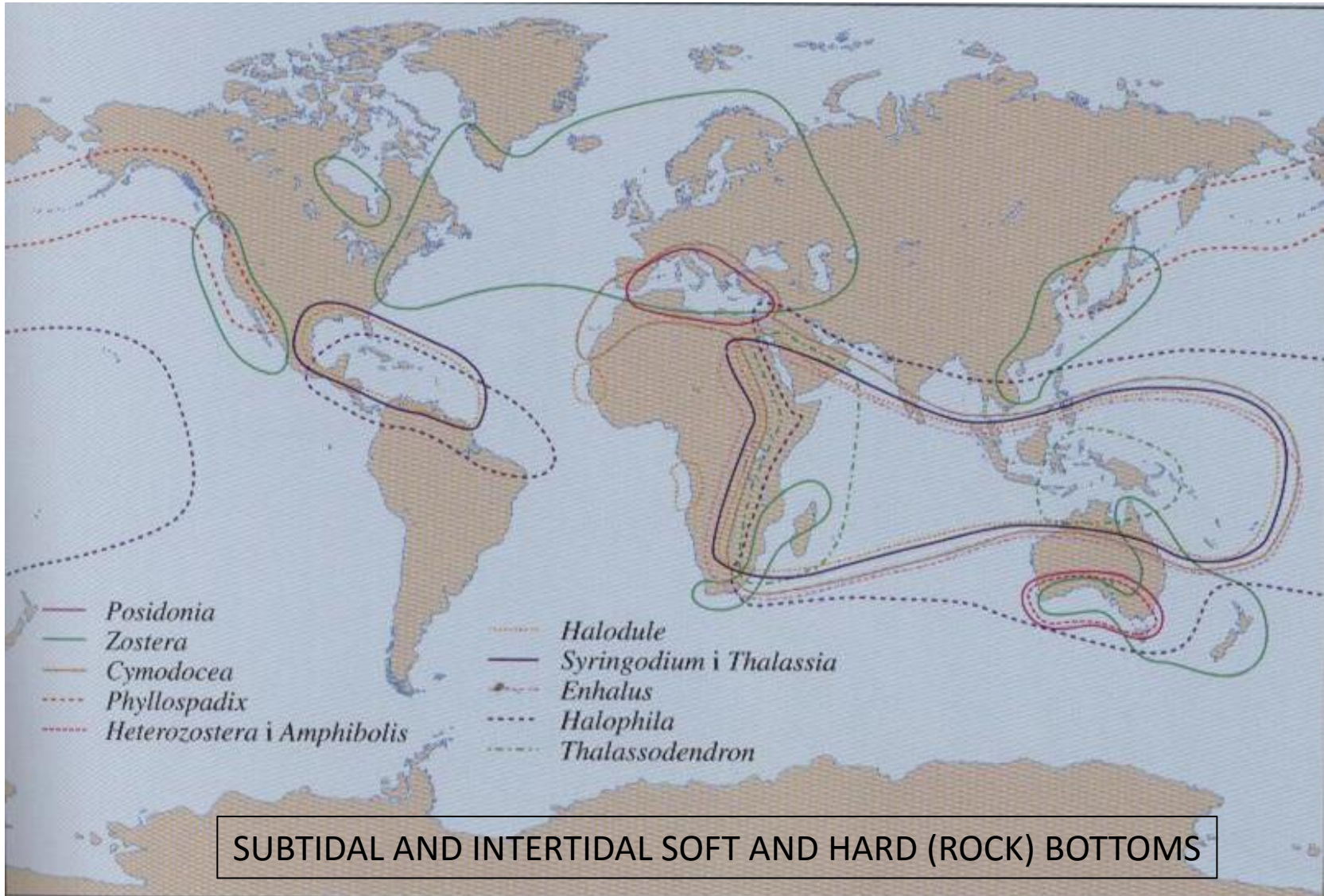
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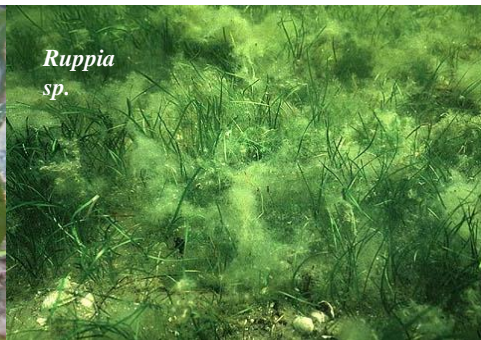
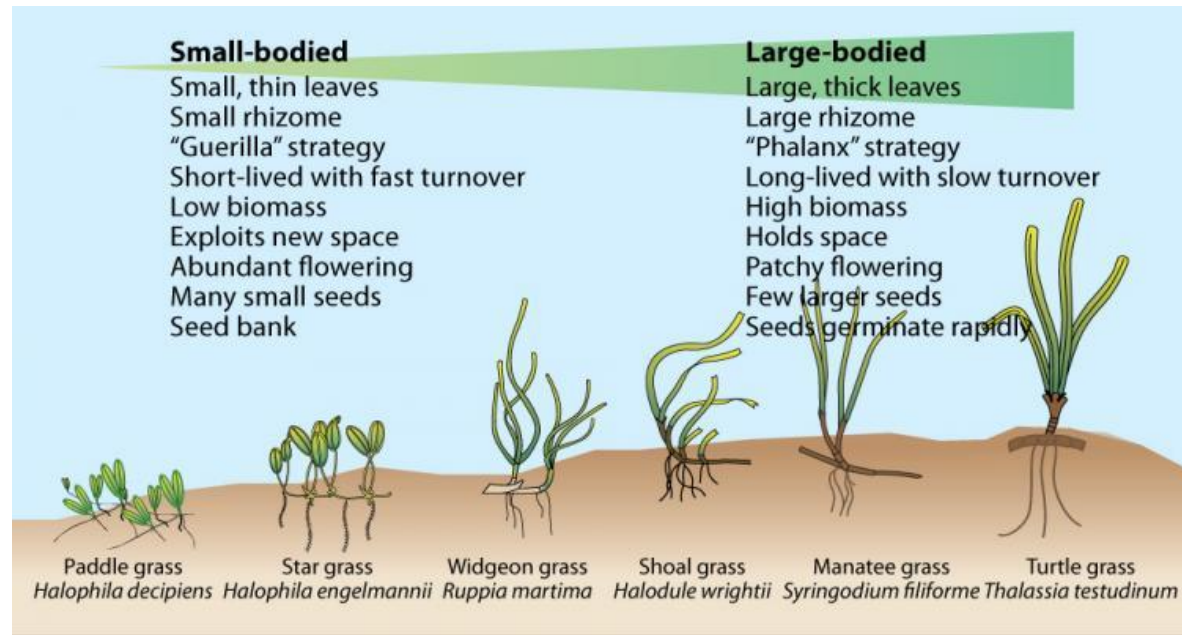
Rhizome (underground stem)

WHERE SEAGRASSES ARE

Seagrasses : worldwide distribution, higher diversity in the tropics

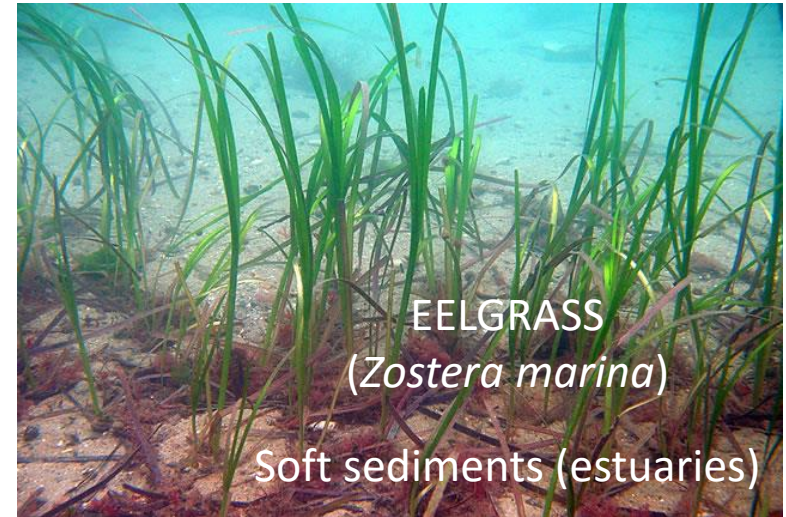
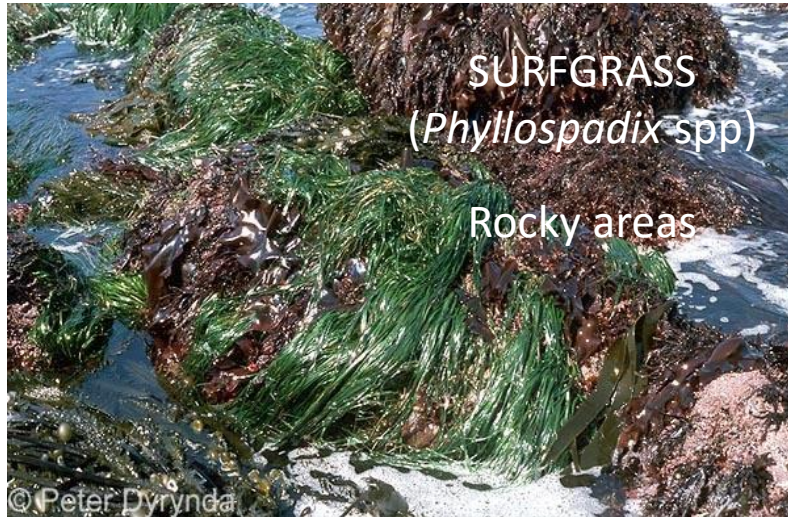


1. WHAT ARE SEAGRASSES?



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SEAGRASSES OF THE PACIFIC NORTH WEST



DWARF / JAPANESE EELGRASS (*Zostera japonica*)

Soft sediments (estuaries). NON-NATIVE; INTRODUCED FROM JAPAN

2. WHY DO SEAGRASSES MATTER? WHY DO WE CARE ABOUT SEAGRASSES?

**CONTRIBUTION TO GLOBAL PRIMARY PRODUCTION:
SOME OF THE MOST PRODUCTIVE SYSTEMS IN THE WORLD!
(food for other species)**

Table 1. Comparison between average seagrass and other marine and terrestrial ecosystems. NPP (net primary production). Simplified and modified from Margalef, 1986 and Duarte and Cebrián, 1996.

System	Area covered (10 ⁶ km ²)	NPP (gC m ⁻² year ⁻¹)	Total NPP (PgC year ⁻¹)
Marine phytoplankton			
Oceanic waters	332	130	43
Coastal waters	27	167	4.5
Coastal macrophytes			
Mangroves	1.1	1000	1.1
Seagrasses	0.6	817	0.49
Macroalgae	6.8	375	2.55
Microphytobenthos	6.8	50	0.34
Terrestrial ecosystems			
Forests	41	400	16.4
Crops	15	350	5.25
Deserts	40	50	2
Terrestrial ecosystems	148	200	29.6
Continental waters	1.9	100	0.19
Oceans	359	132	47.5

2. WHY DO SEAGRASSES MATTER? WHY DO WE CARE ABOUT SEAGRASSES?

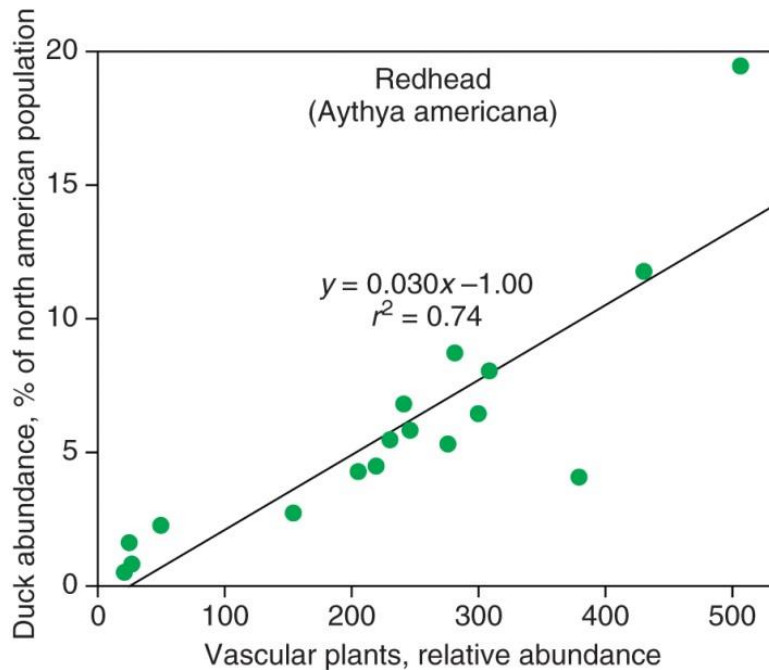
**IMPORTANT CONTRIBUTORS TO BIODIVERSITY:
PROVIDE FOOD, HABITAT, REFUGE, NURSERY.... FOR NUMEROUS SPECIES**



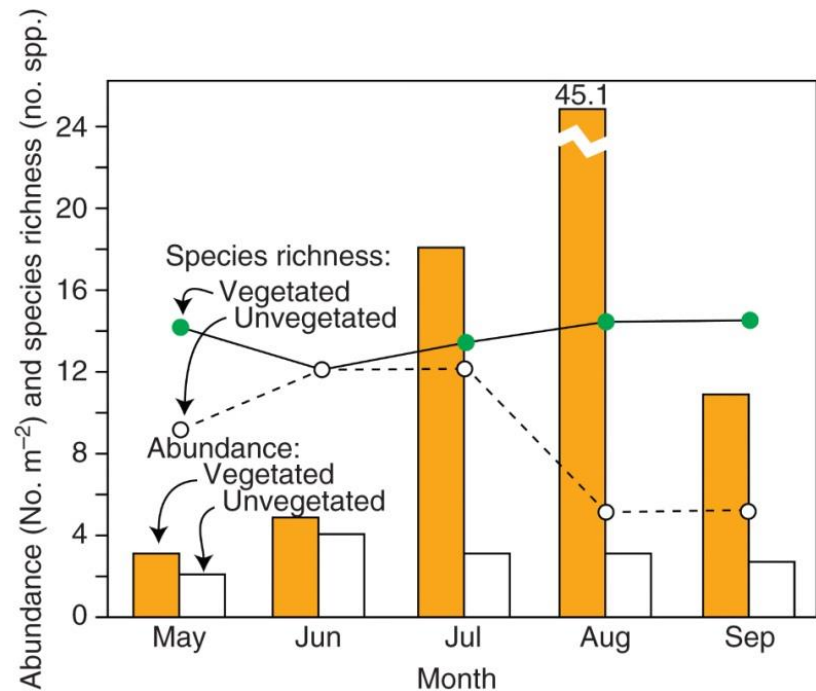
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BIRDS



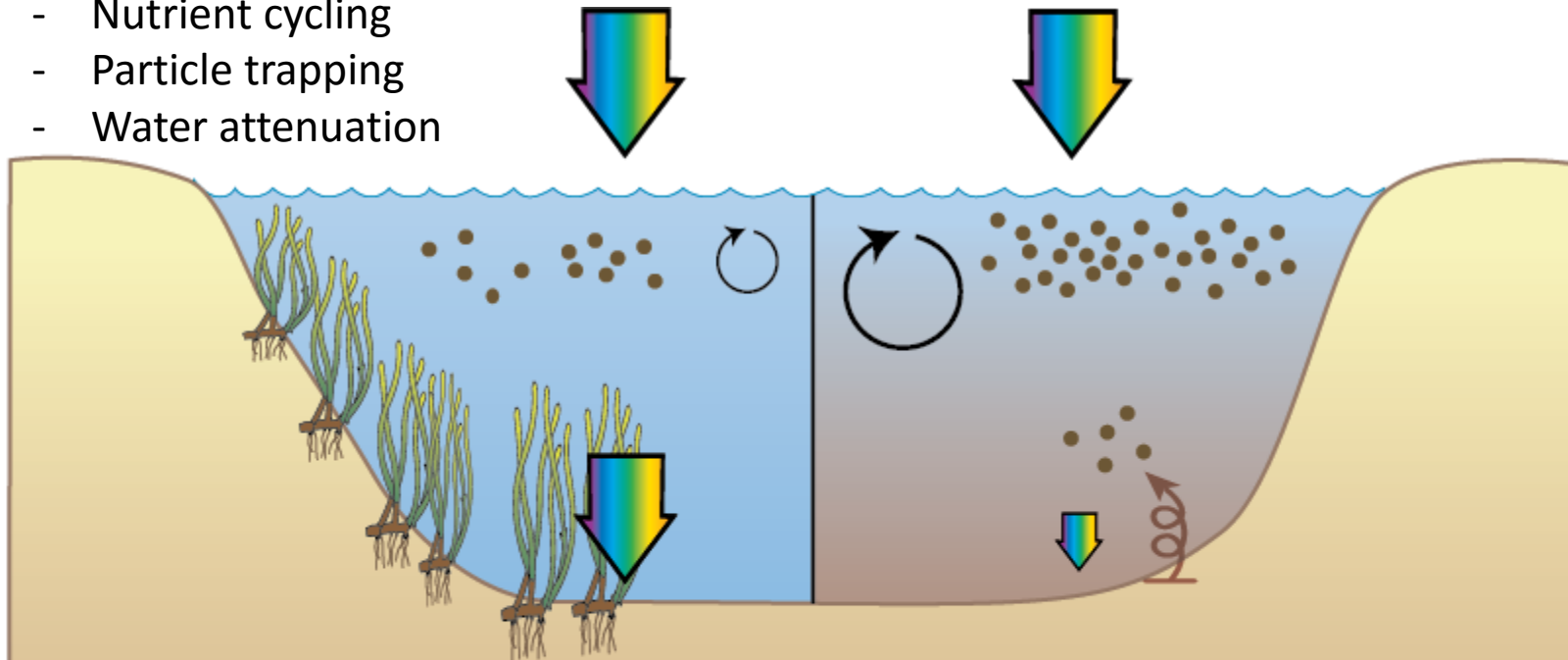
FISH



2. WHY DO SEAGRASSES MATTER? WHY DO WE CARE ABOUT SEAGRASSES?

WATER QUALITY, SHORELINE PROTECTION, CARBON SINK

- Oxygen production
- Nutrient cycling
- Particle trapping
- Water attenuation



Seagrasses keep the water clear! Water slows when it hits seagrass leaves. This reduces wave energy

⌚ and allows sediment ●● to fall out ⌇ of the water column to the bottom. When sediment

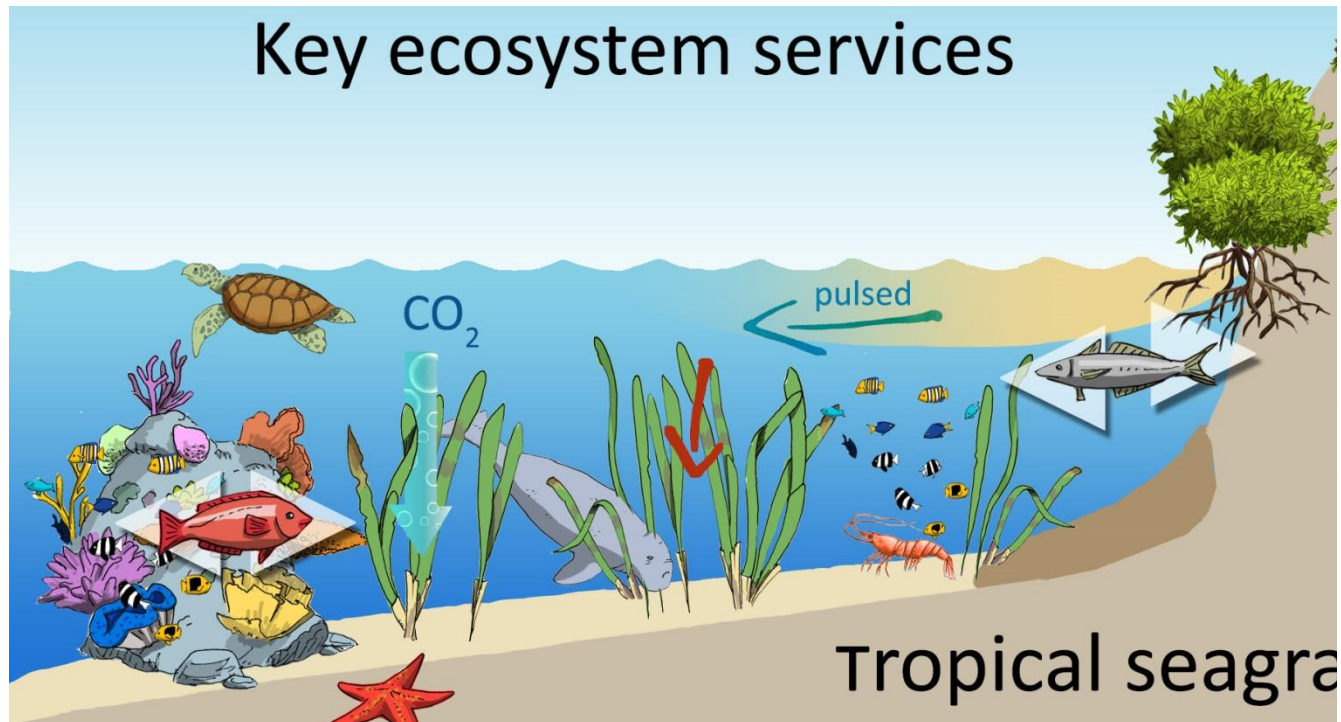
is on the bottom and not suspended, less light ⌇ is blocked. Therefore, there is increased light at

the seagrass canopy, something important for maintaining photosynthesis.

2. WHY DO SEAGRASSES MATTER? WHY DO WE CARE ABOUT SEAGRASSES?

BENEFITS TO SOCIETY (ECOSYSTEM SERVICES):

- Fisheries
- Water quality
- Coastal protection
- Carbon sink
- Aesthetic



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BENEFITS TO SOCIETY (ECOSYSTEM SERVICES):

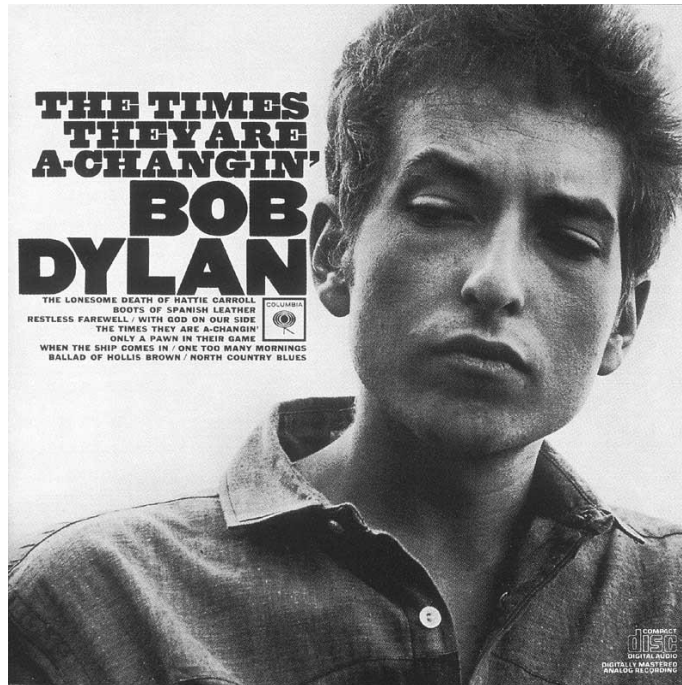
- Fisheries
- Water quality
- Coastal protection
- Carbon sink
- Aesthetic

Estimates of economic value (some numbers....)

- Nutrient cycling: \$19,000 / hectare year = = \$3,800 Billion / year
 - Fisheries in Queensland, Australia: \$1.1 Million / year
 - Fisheries in South Australia: \$100 Million / year

3. THREATS TO SEAGRASS

HUMAN THREATS TO SEAGRASS ECOSYSTEMS



3. THREATS TO SEAGRASS

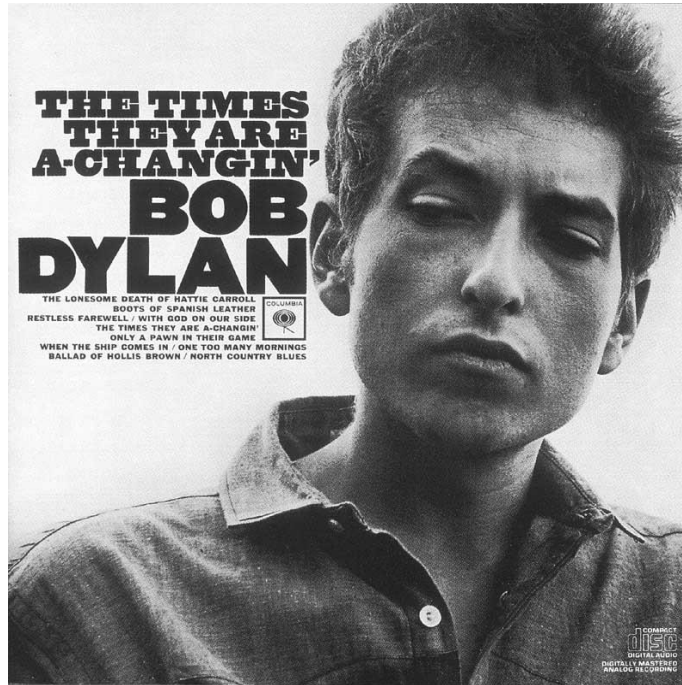
HUMAN THREATS TO SEAGRASS ECOSYSTEMS



Overfishing



Habitat destruction



Invasive species



Climate Change



Eutrophication (N inputs)



Pollution

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HUMAN THREATS TO SEAGRASS ECOSYSTEMS

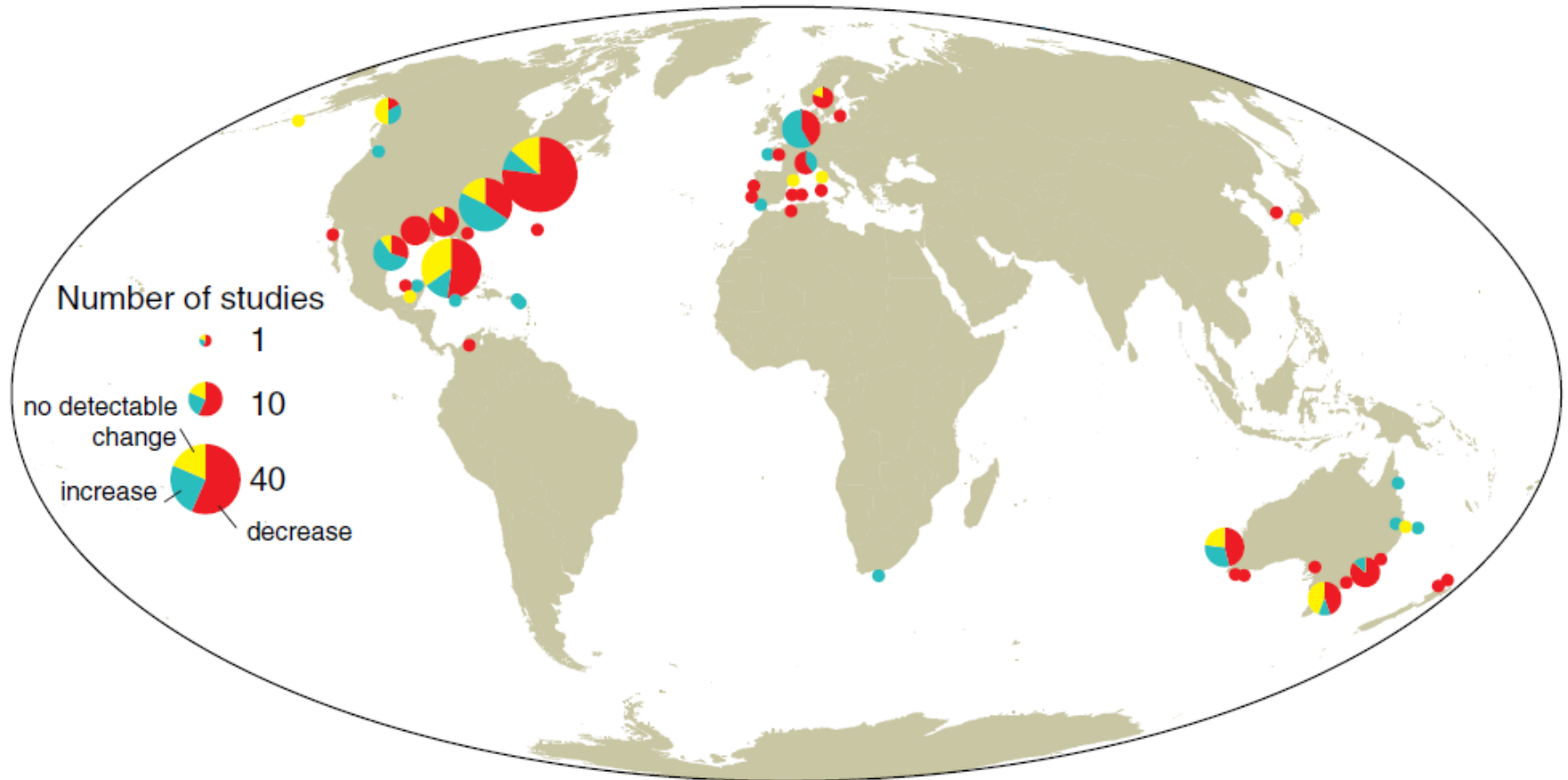
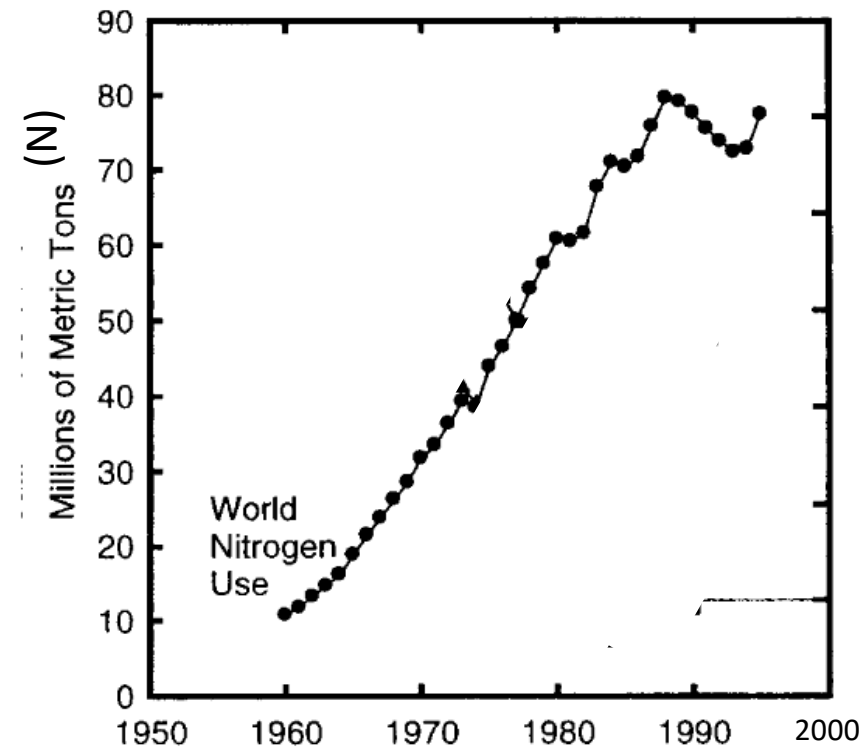
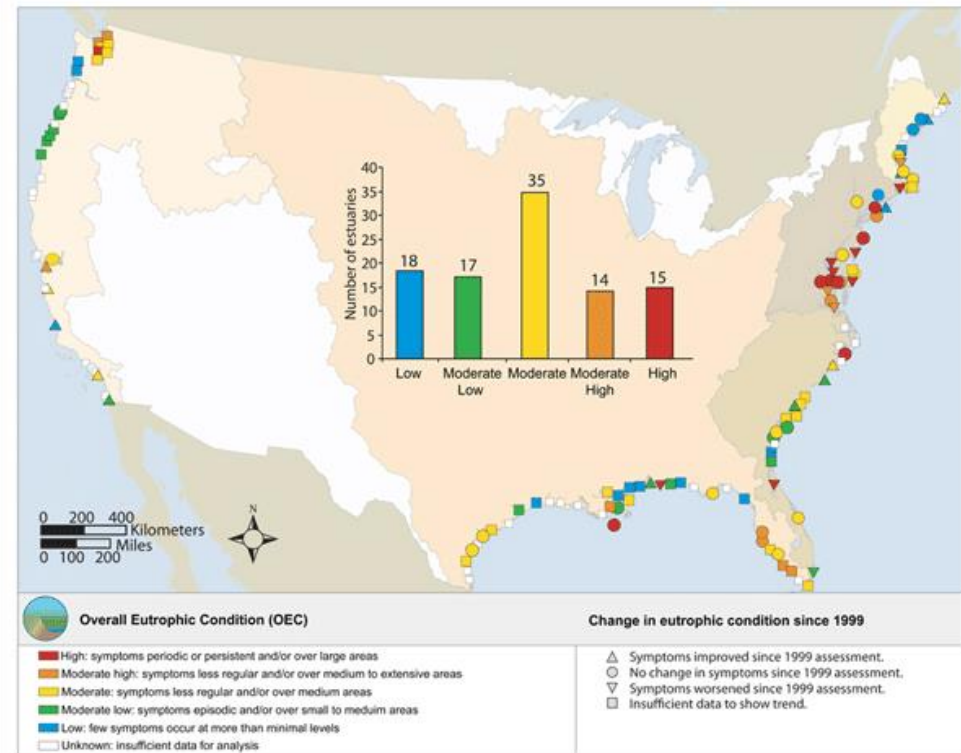


Fig. 2. Global map indicating changes in seagrass area plotted by coastline regions. Changes in seagrass areal extent at each site are defined as declining (red) or increasing (green) when areal extent changed by $>10\%$, or no detectable change (yellow) when final area was within $\pm 10\%$ of the initial area. There were 131 sites in North America, 34 sites in Europe, and 40 sites in Australia.

HUMAN THREATS TO SEAGRASS ECOSYSTEMS: **EUTROPHICATION**



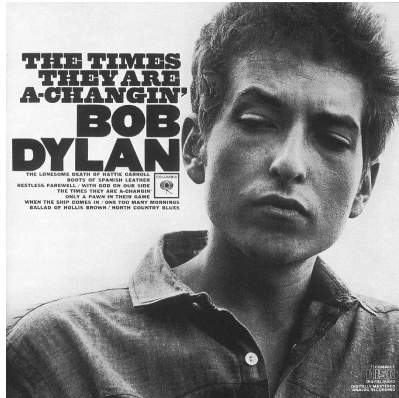
Frink et al. 1999



Bricker et al. 2007

3. THREATS TO SEAGRASS

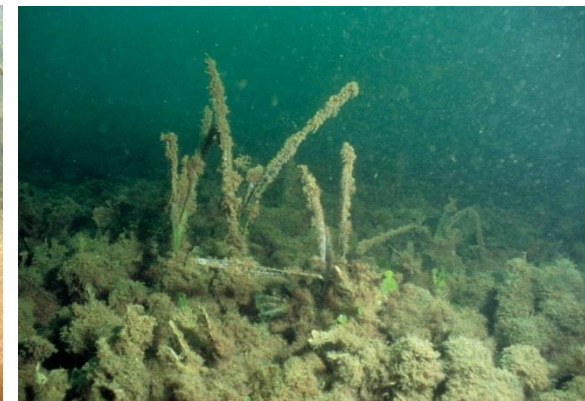
HUMAN THREATS TO SEAGRASS ECOSYSTEMS: **EUTROPHICATION**



Eutrophication (NUTRIENT POLLUTION)

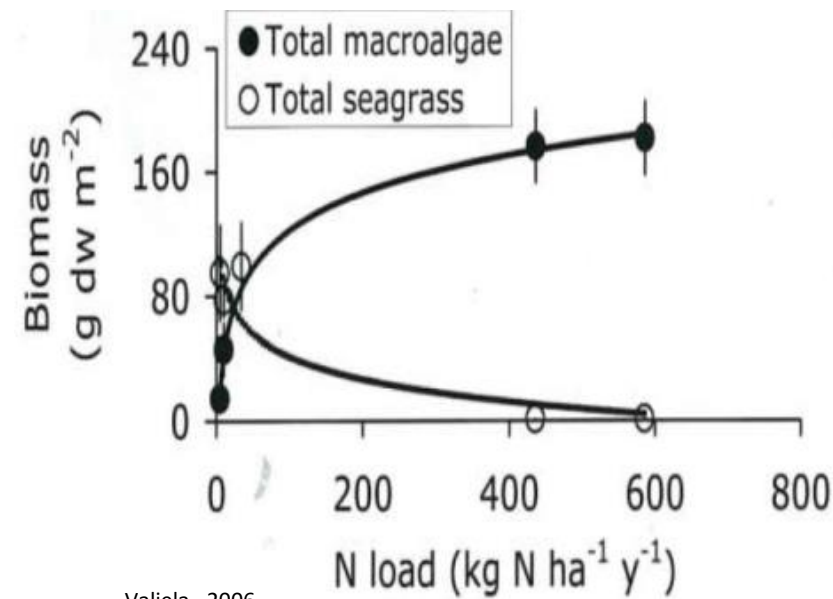
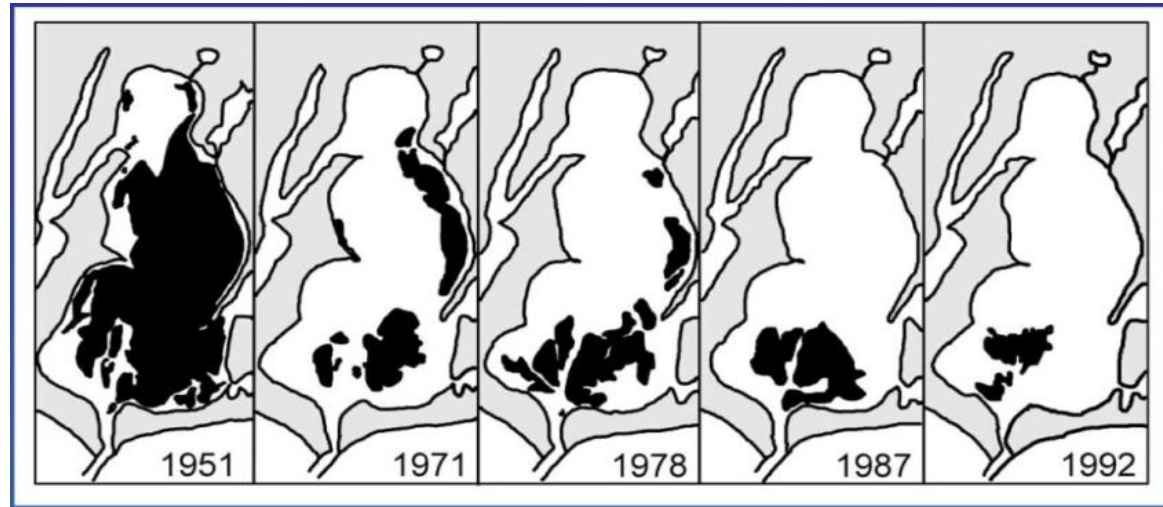
EUTROPHICATION IS A MAJOR CAUSE OF SEAGRASS DECLINE:

Nutrient pollution promotes the growth of algae that can outcompete seagrass for light

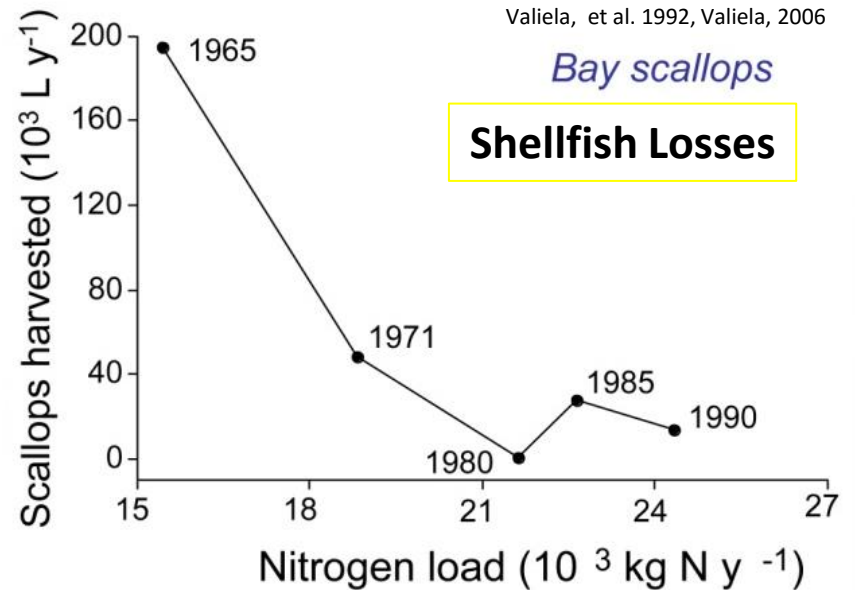


3. THREATS TO SEAGRASS

HUMAN THREATS TO SEAGRASS ECOSYSTEMS: EUTROPHICATION



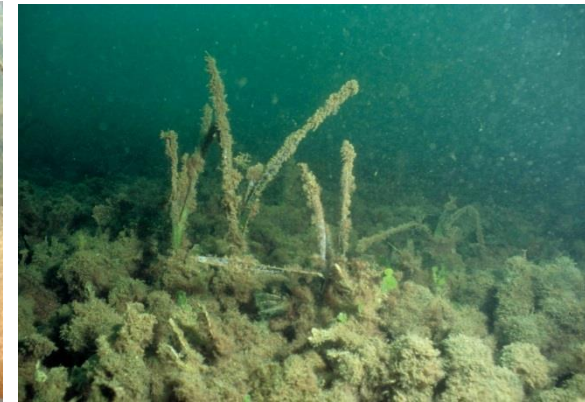
Valiela, 2006



Hughes et al. 2002

3. THREATS TO SEAGRASS

Nutrient Pollution: Nutrients can enhance algae growth that kills seagrass



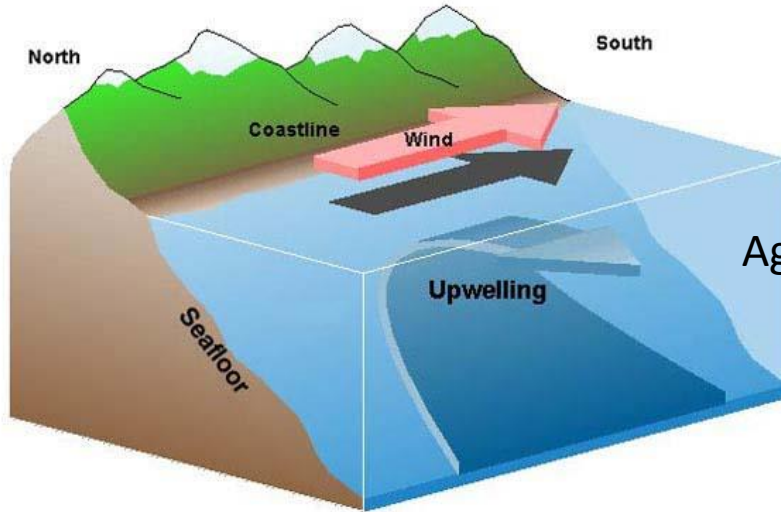
However..... Small grazers can buffer negative effects



Our project:

Vulnerability of Oregon Seagrass Beds to Eutrophication

Oregon estuaries are influenced by upwelling: natural nutrient inputs

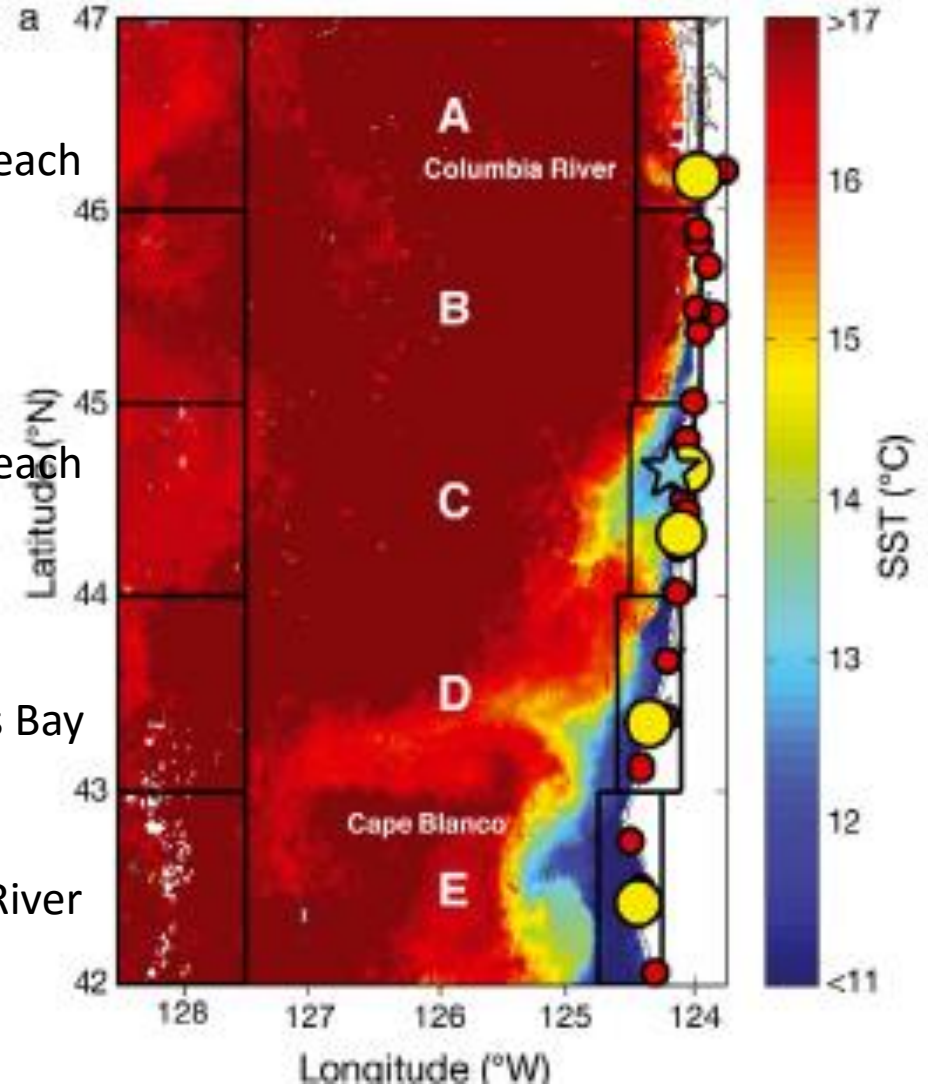


Clatsop Beach

Agate Beach

Coos Bay

Rogue River

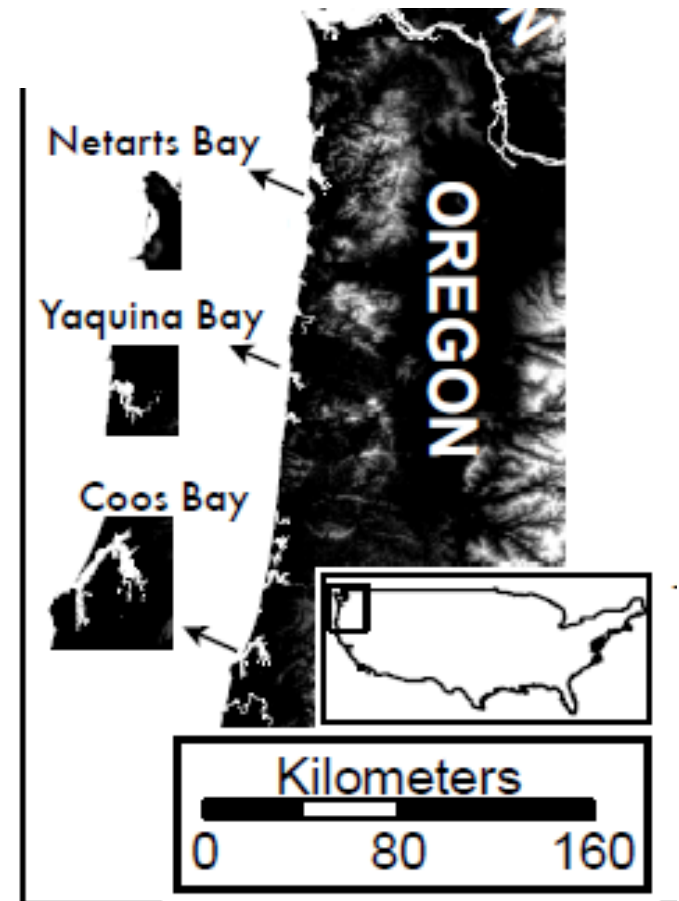


Our project:

Vulnerability of Oregon Seagrass Beds to Eutrophication



- How are eelgrass beds doing in OR estuaries?
- How does upwelling influence vulnerability?
- Are grazers contributing to seagrass health?



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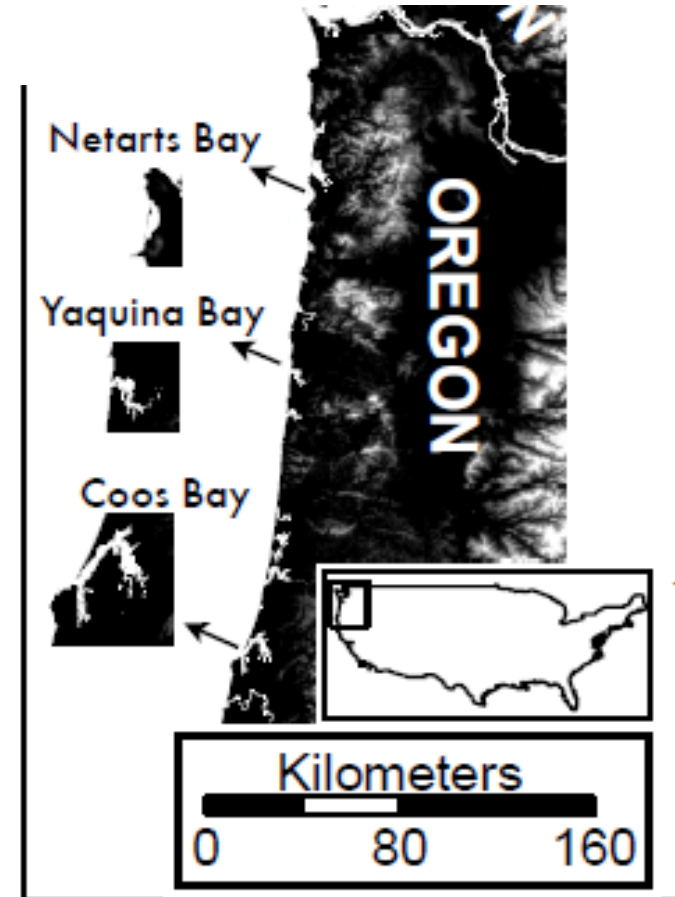
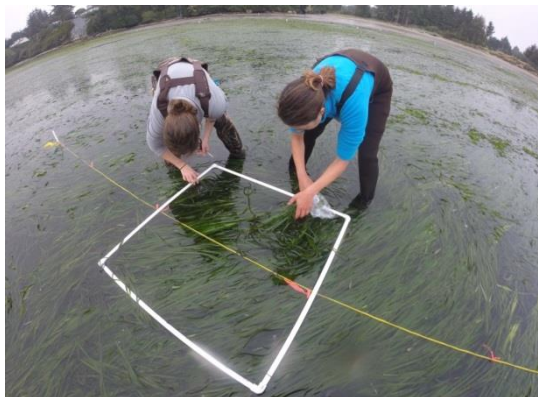
- How are eelgrass beds doing in OR estuaries? = how abundant are seagrass and algae?
- How does upwelling influence vulnerability? = compare different estuaries
- Are grazers contributing to seagrass health?
 - Who are the grazers in Oregon estuaries?
 - What do they feed on?



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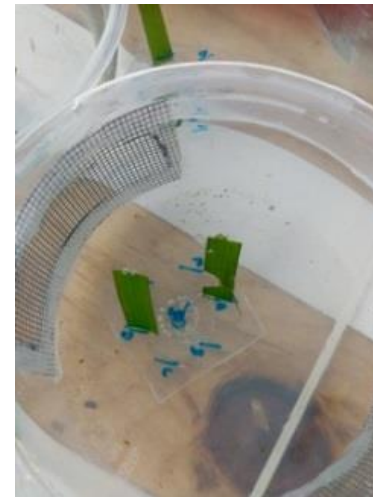
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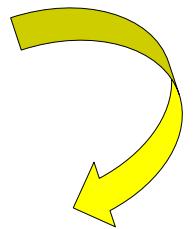
- Are grazers contributing to seagrass health?
 - Who are the grazers in Oregon estuaries? = field sampling
 - What do they feed on? = feeding trials



4. WHAT YOU CAN DO / HOW YOU CAN HELP



- Learn and TEACH about seagrasses
 - At your school (science, biology, ecology, conservation....)
 - Bring your students to HMSC
- Participate in monitoring a seagrass bed near you (STREAMWEBS) / HMSC
- Take home materials to teach in class



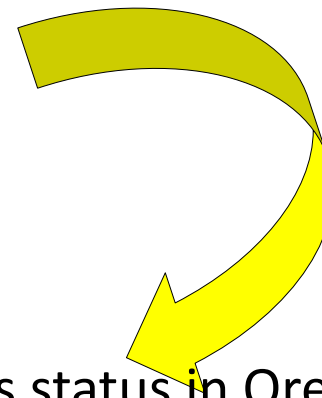
-SPREAD THE WORD!

4. WHAT YOU CAN DO / HOW YOU CAN HELP



- Today we shall learn

- How to identify and sample abundance of seagrass and algae
- How to analyze and interpret abundance data
- How to perform feeding trials



What these approaches can tell us about seagrass status in Oregon estuaries
and factors driving these patterns