

Past the near meadows: shellfish performance across eelgrass-driven pH gradients

Micah Horwith, WA DNR



Photo: Jonas Thormor

Nearshore habitat mosaics



Nearshore habitat mosaics



Nearshore habitat mosaics



Bare

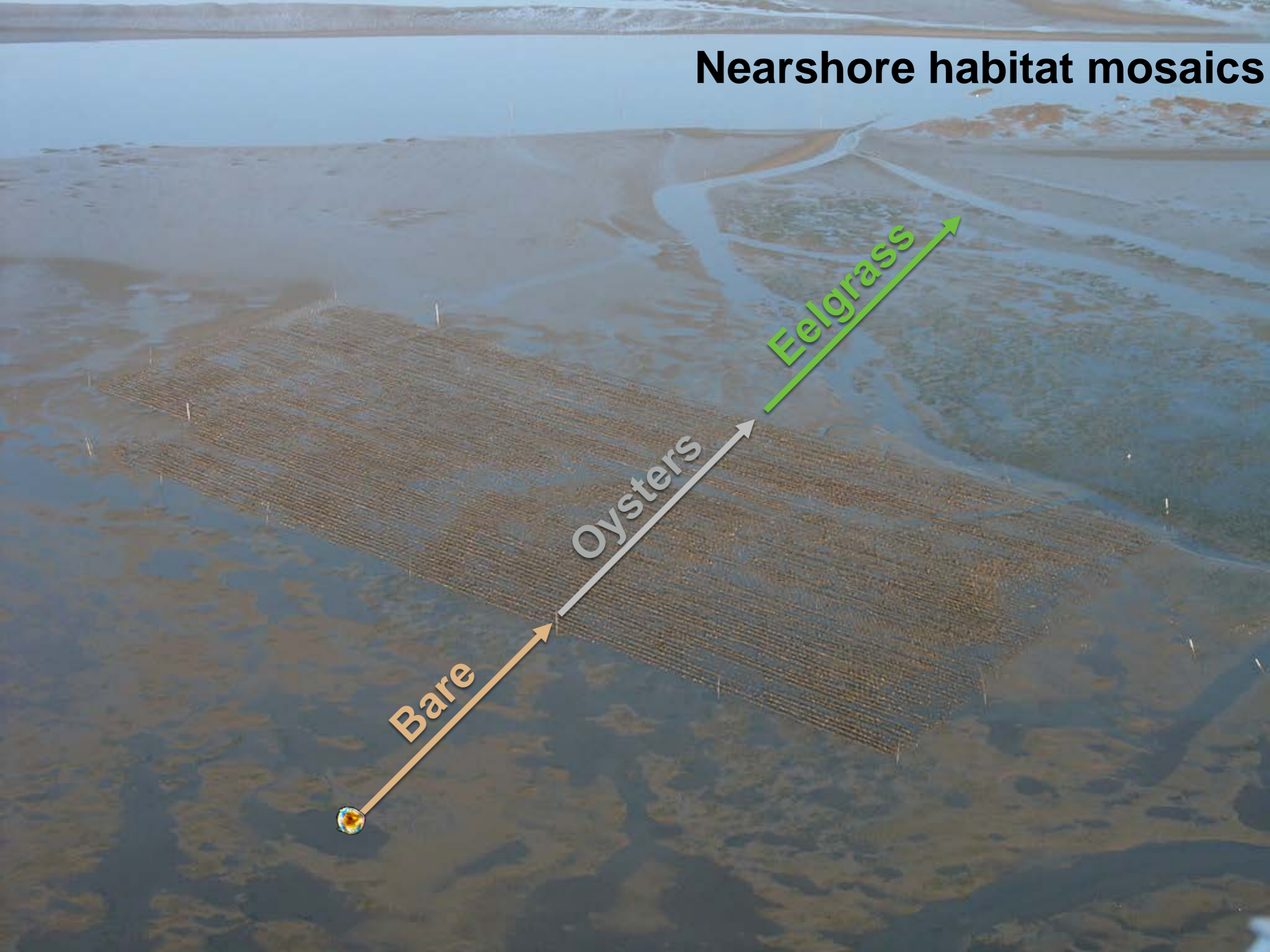
Nearshore habitat mosaics



Bare

Oysters

Nearshore habitat mosaics

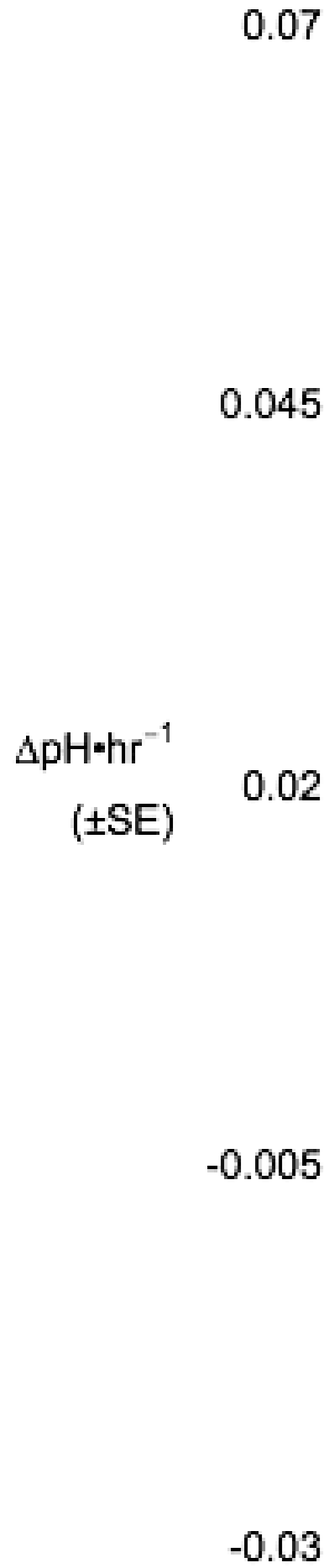


Bare

Oysters

Eelgrass

Nearshore habitat mosaics



Nearshore habitat mosaics

Habitats

● Bare

$\Delta\text{pH}\cdot\text{hr}^{-1}$
($\pm\text{SE}$)

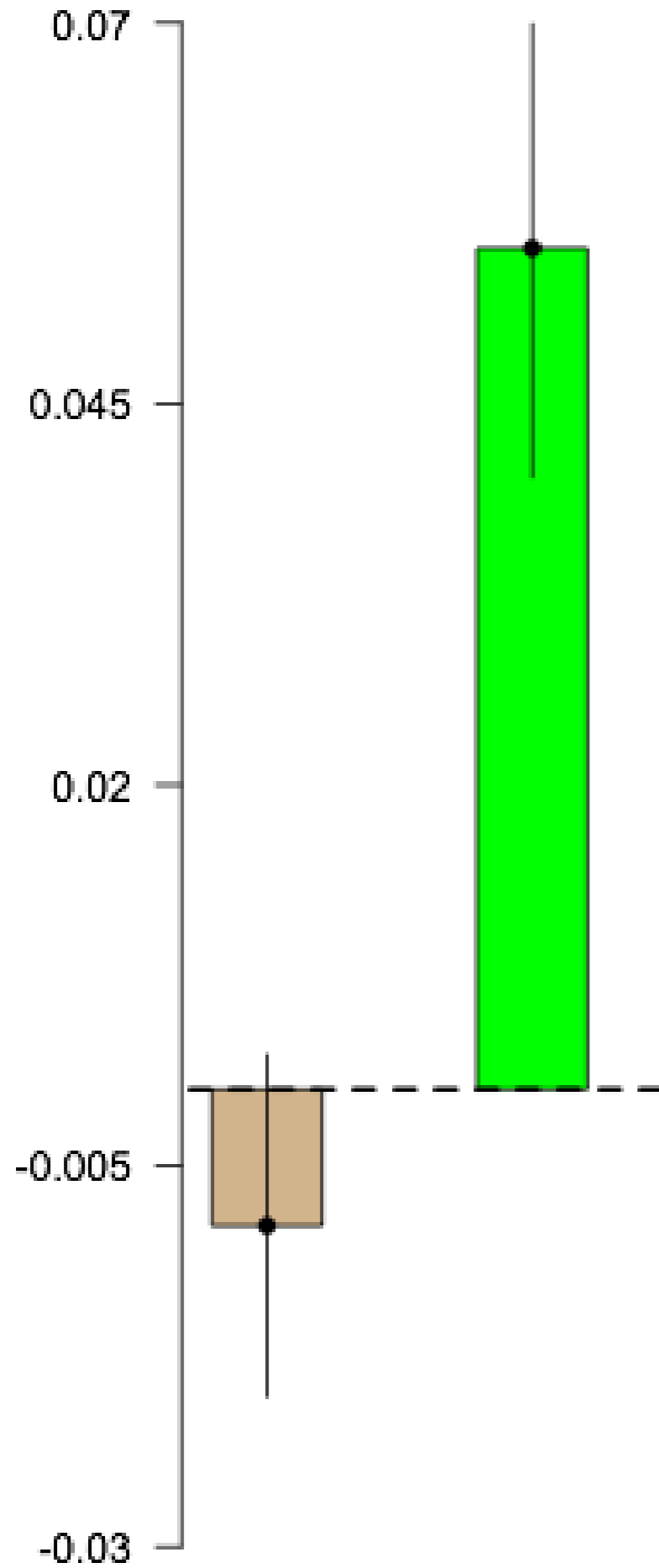


Nearshore habitat mosaics

Habitats

- Bare
- Eelgrass

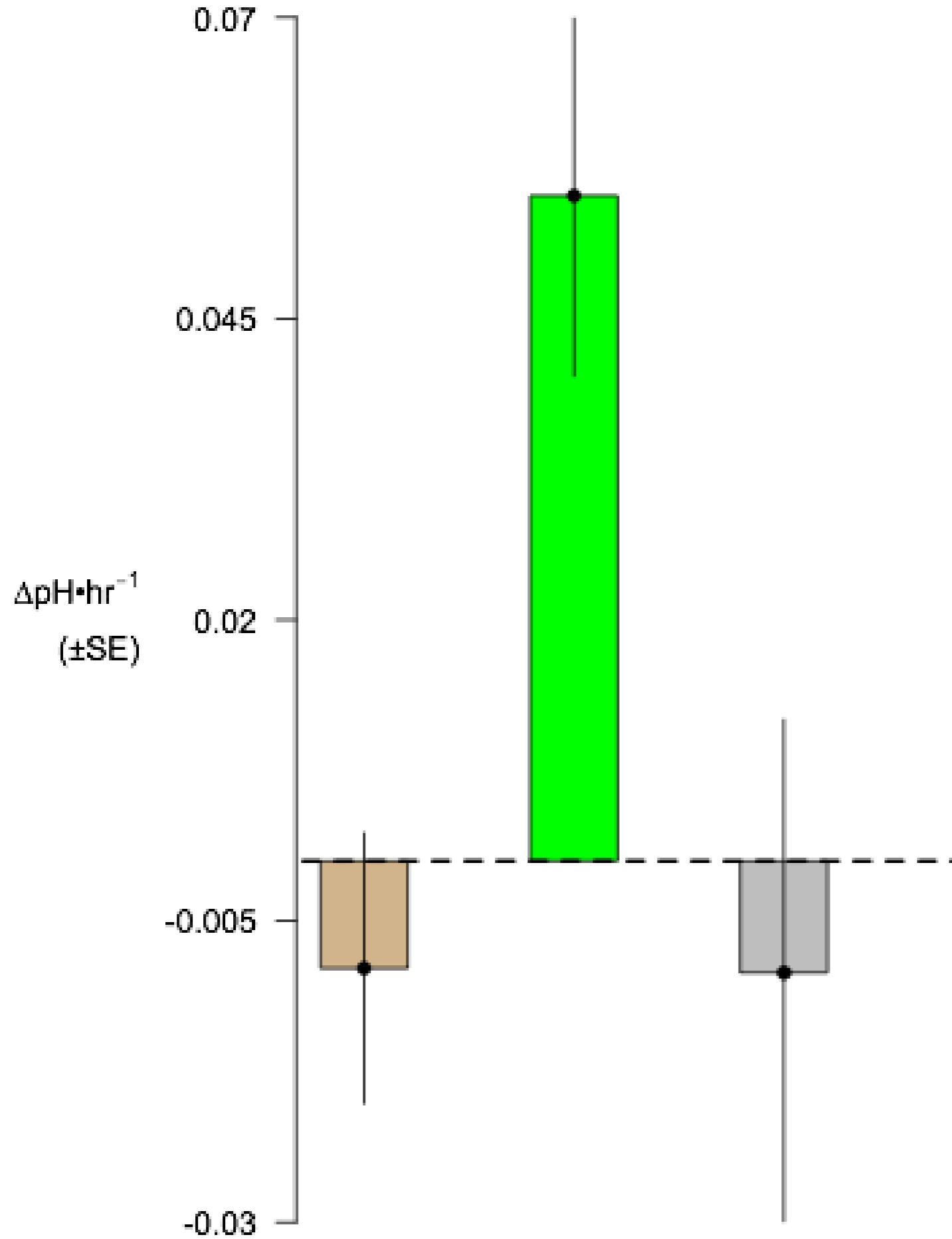
$\Delta\text{pH}\cdot\text{hr}^{-1}$
($\pm\text{SE}$)



Nearshore habitat mosaics

Habitats

- Bare
- Eelgrass
- Oysters

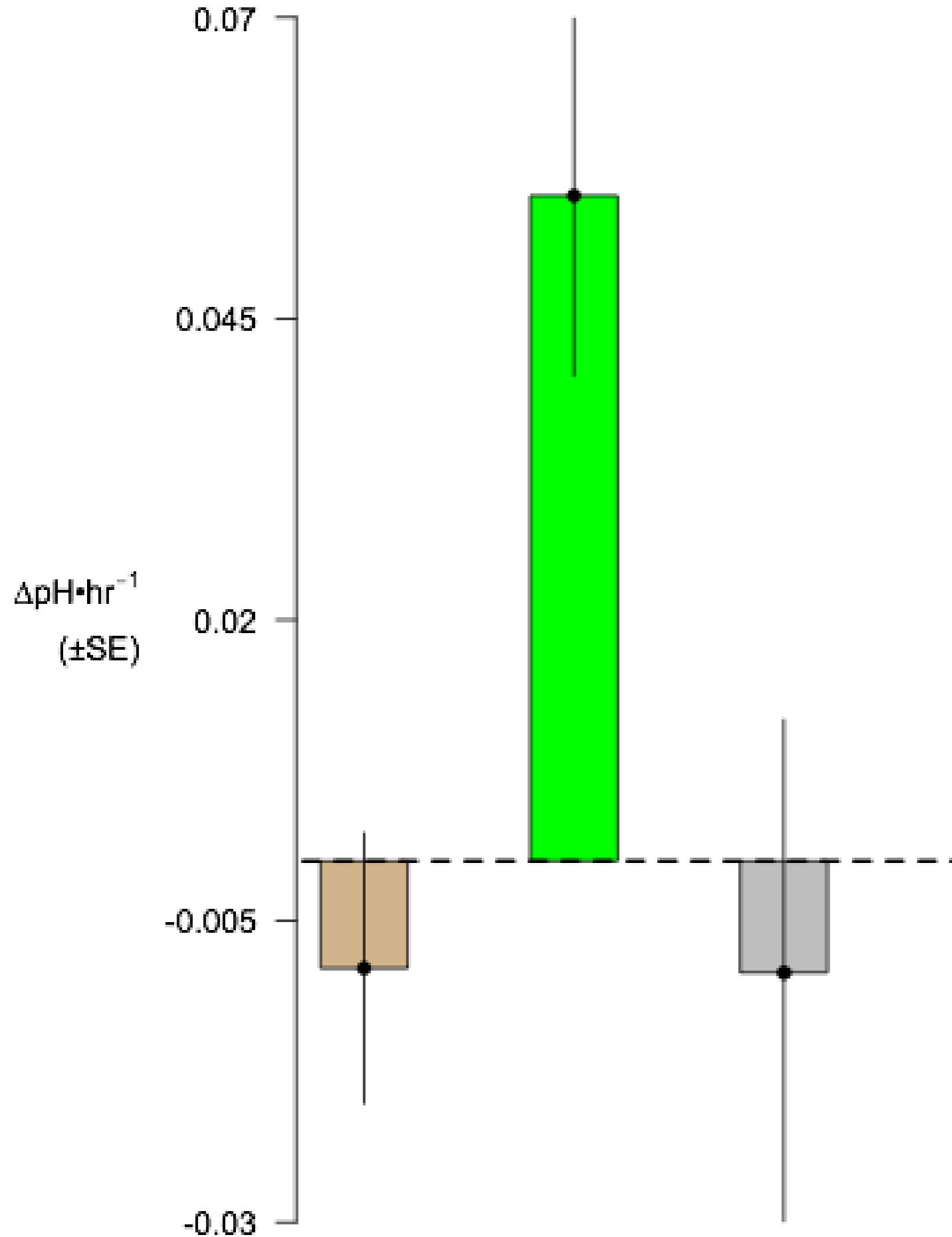


Nearshore habitat mosaics

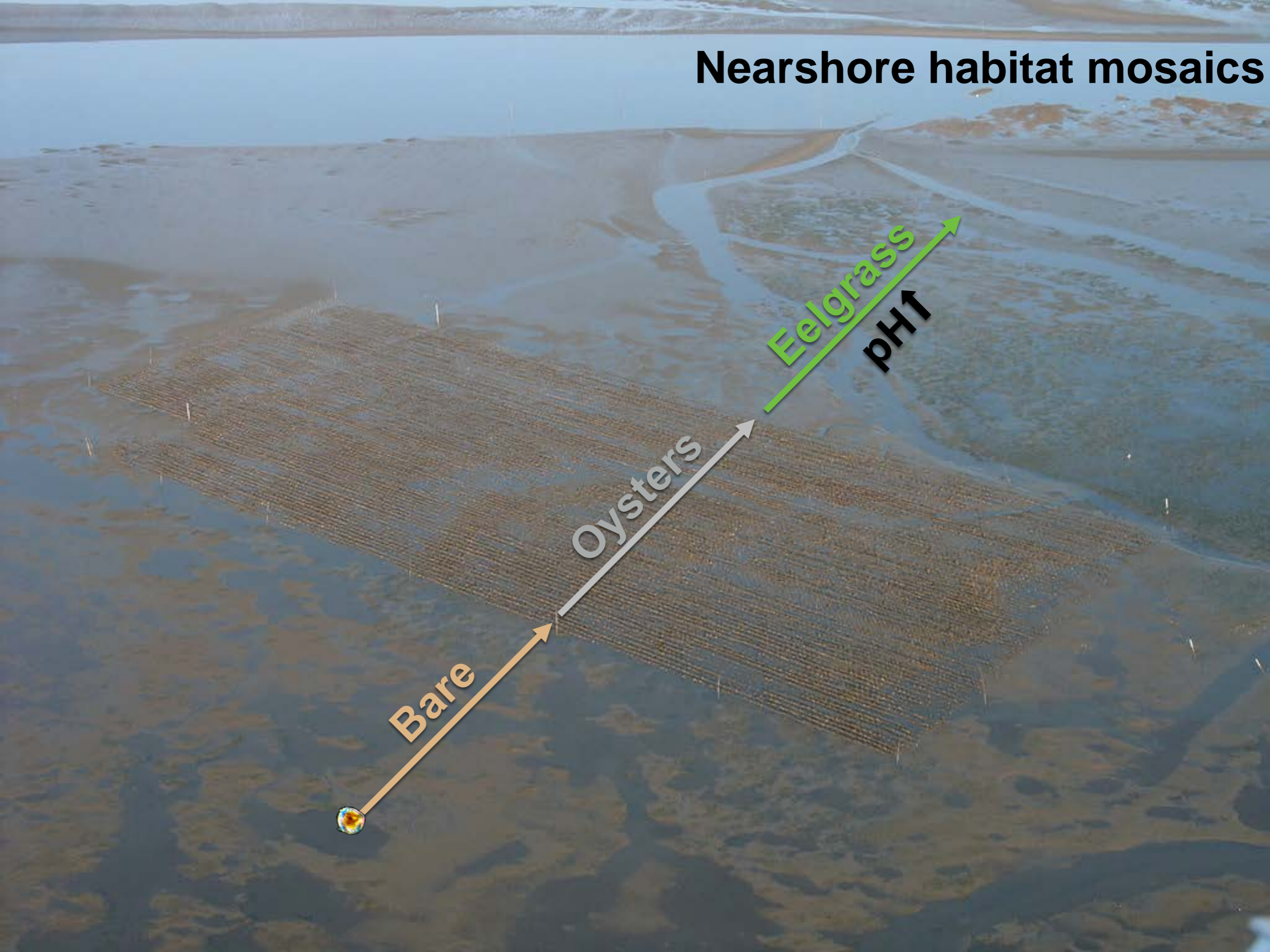
Habitats

- Bare
- Eelgrass
- Oysters

- Eelgrass consumes CO₂, increases pH



Nearshore habitat mosaics



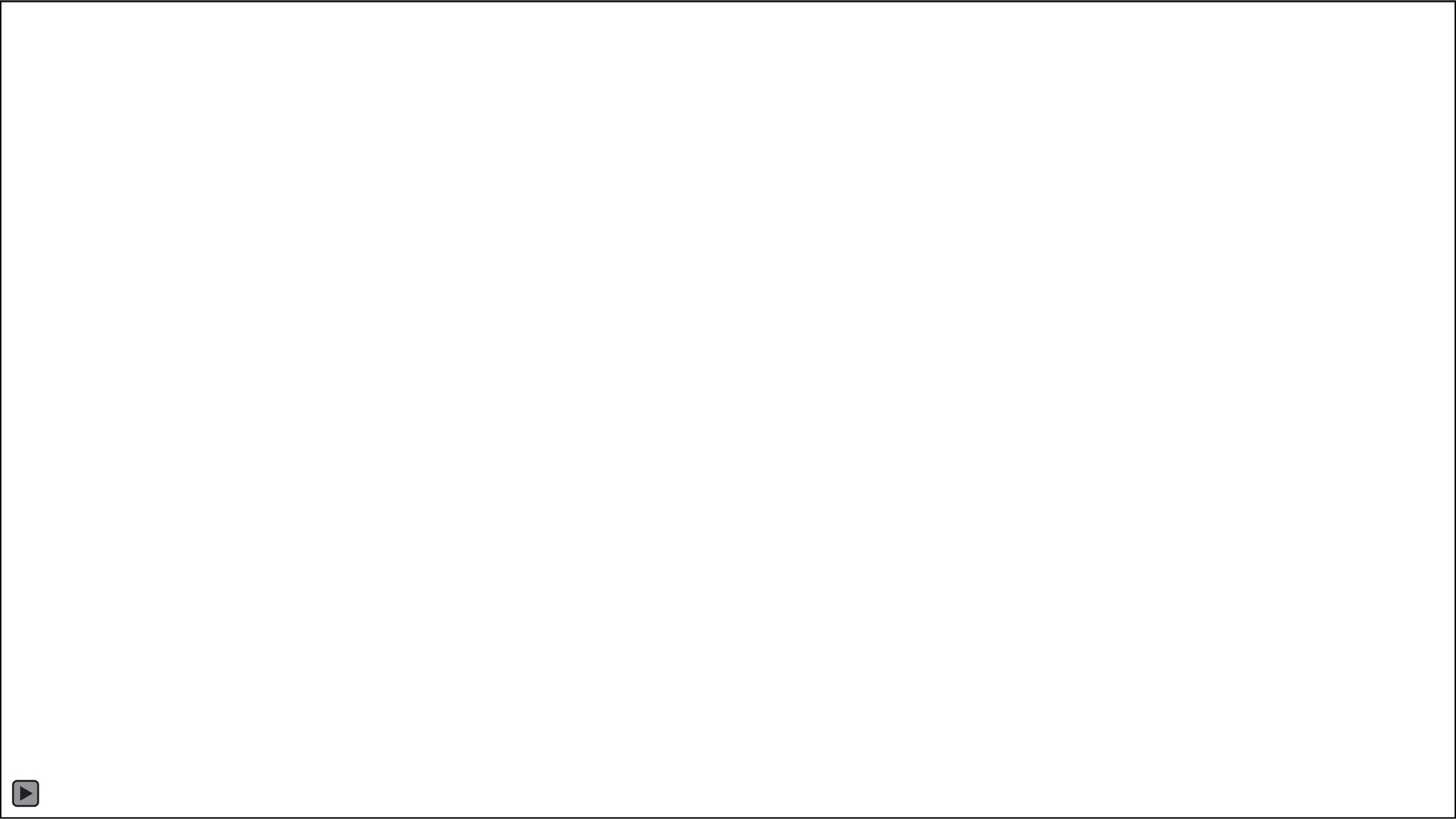
Bare

Oysters

Eelgrass

pH ↑

Shellfish larvae and eelgrass-driven



Shellfish larvae and eelgrass-driven pH gradients



Photo: Jonas Thormor

Shellfish larvae and eelgrass-driven pH gradients



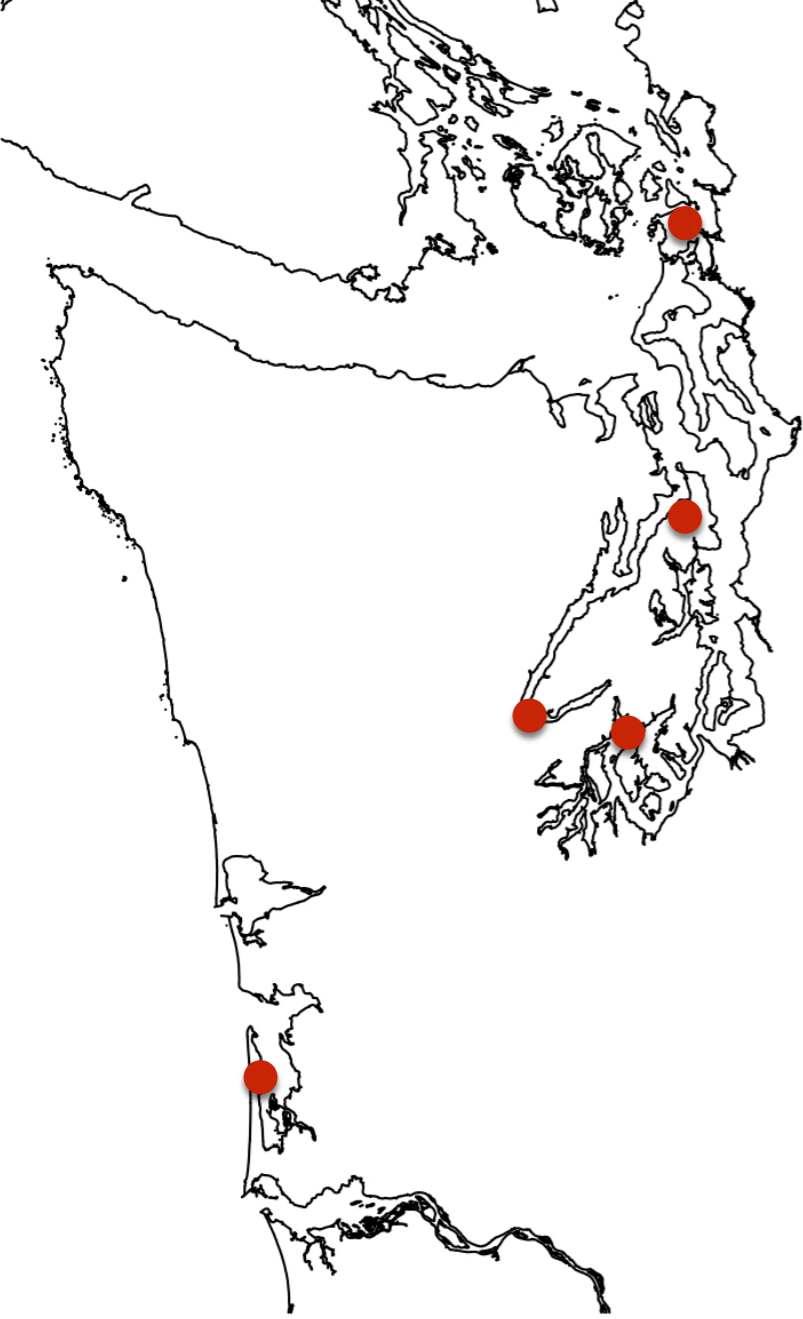
Photo: Jonas Thormor

Shellfish larvae and eelgrass-driven pH gradients

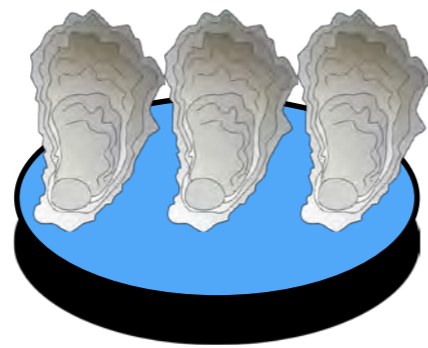
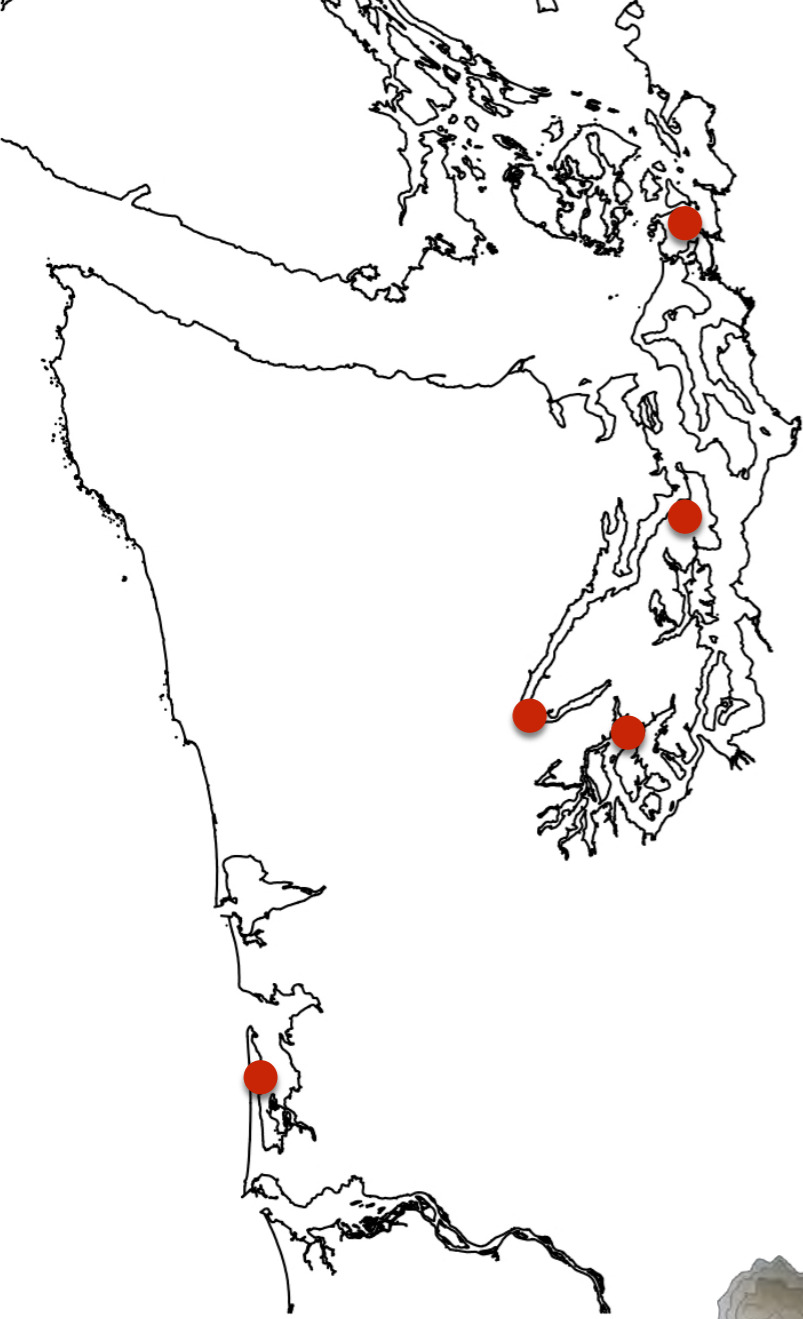


Photo: Jonas Thormor

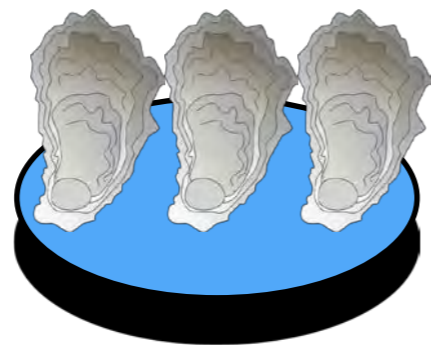
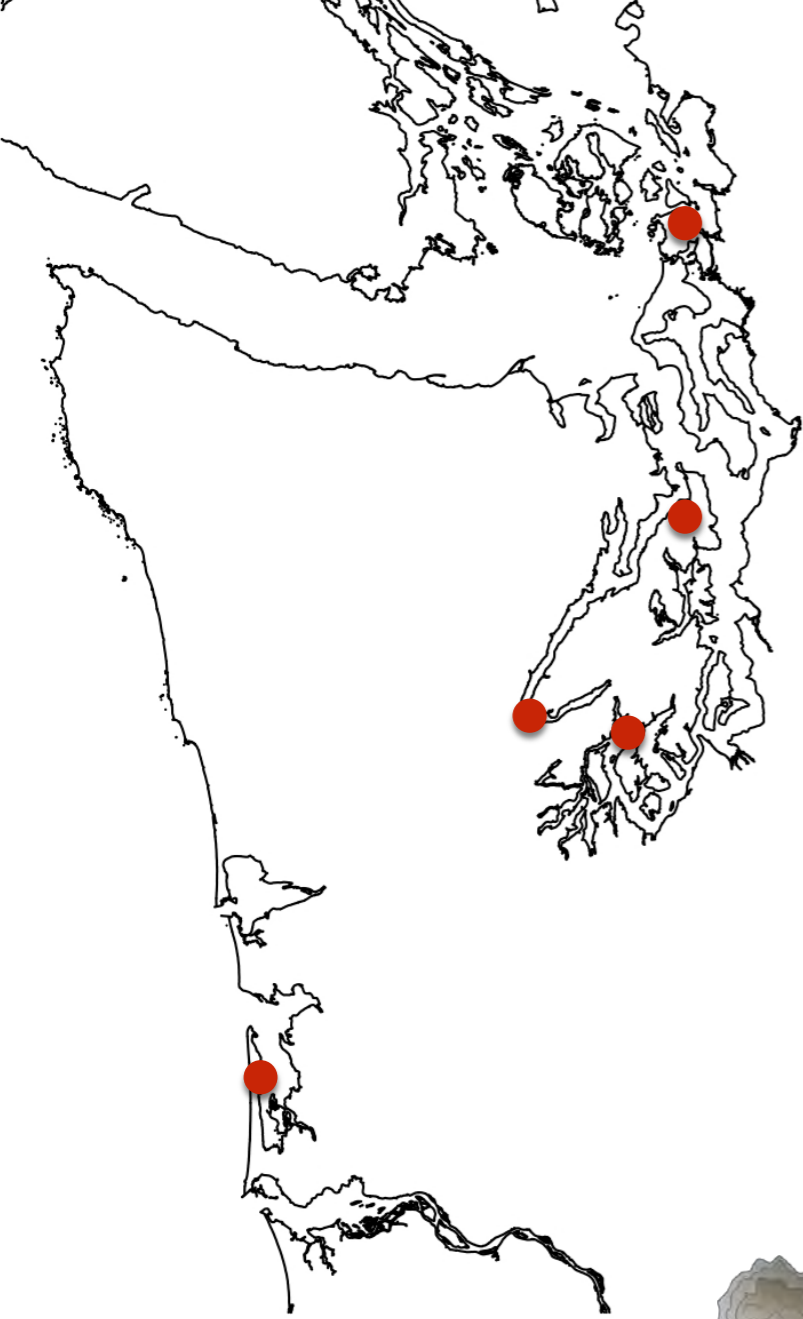
OA refuge for juvenile shellfish



OA refuge for juvenile shellfish

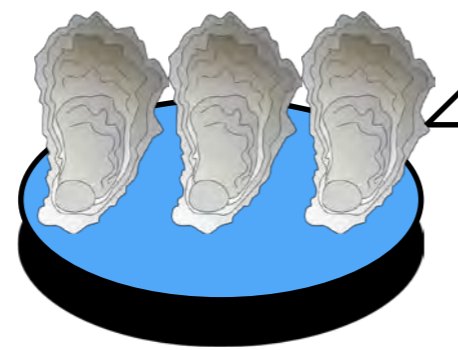
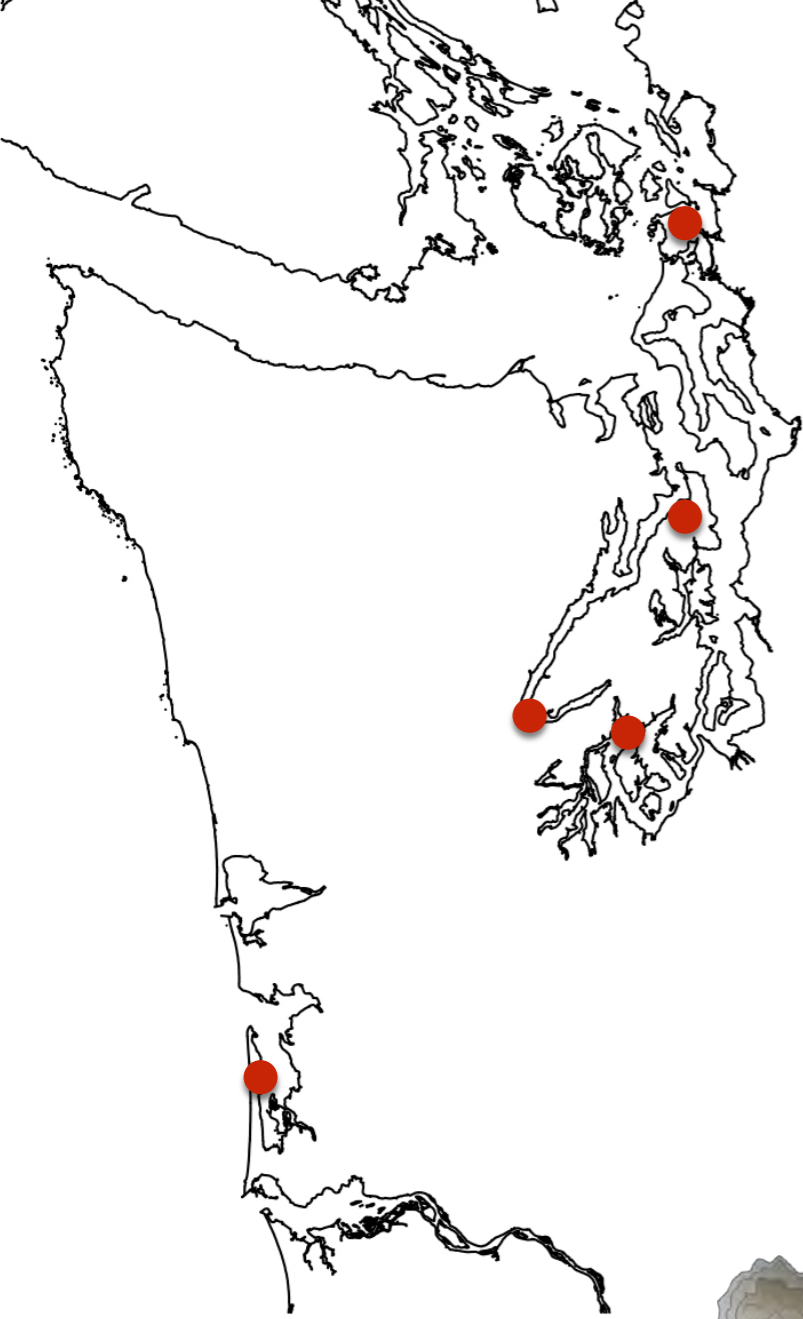


OA refuge for juvenile shellfish

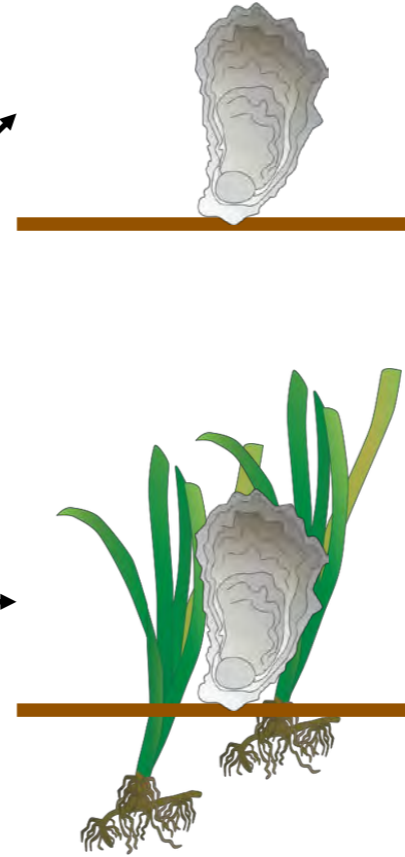


Shell length

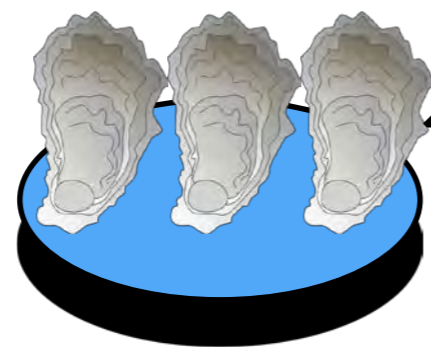
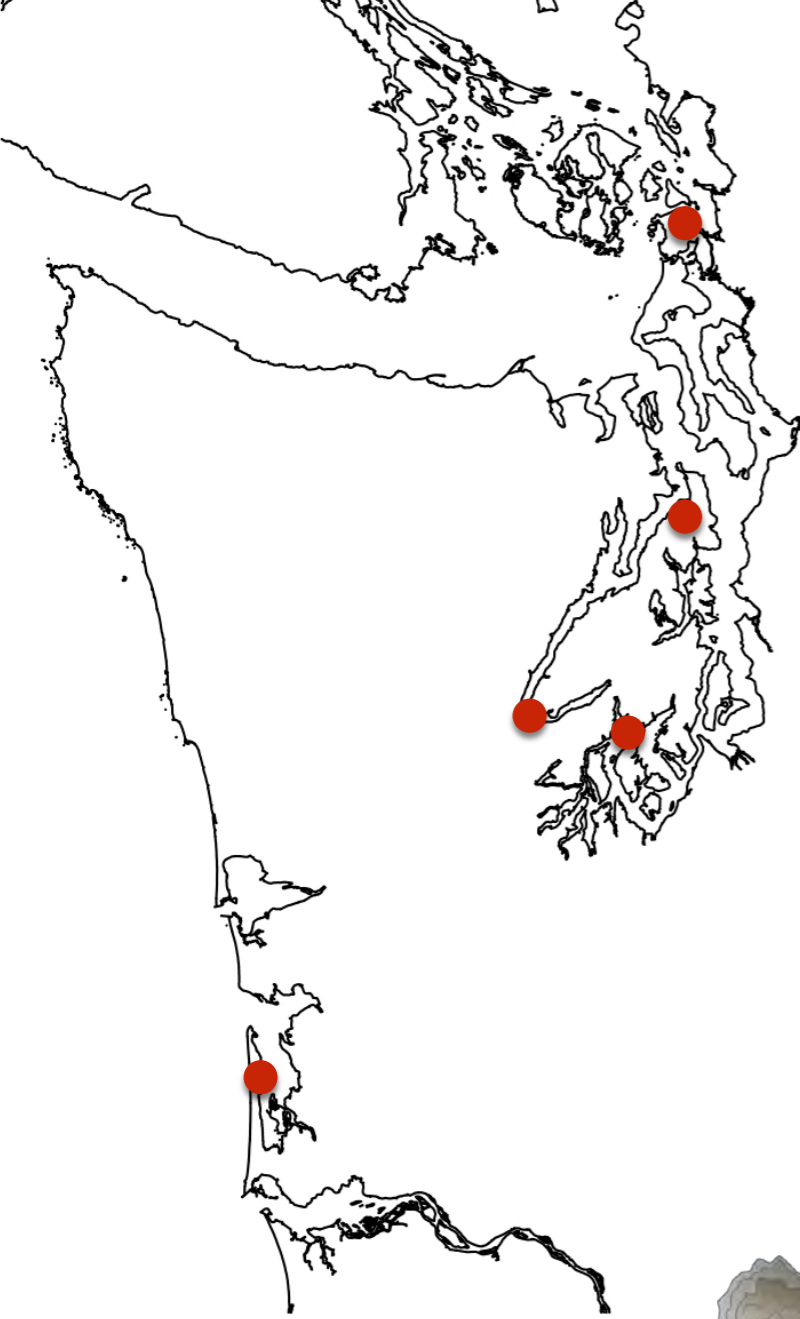
OA refuge for juvenile shellfish



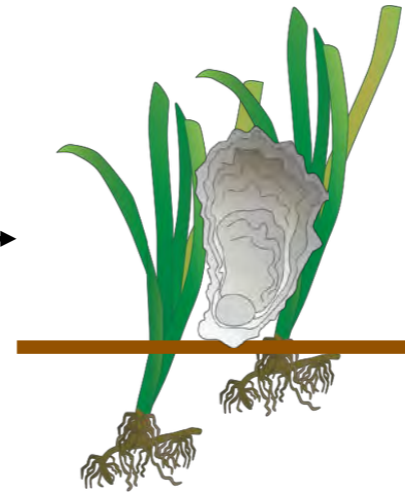
Shell length



OA refuge for juvenile shellfish



Shell length



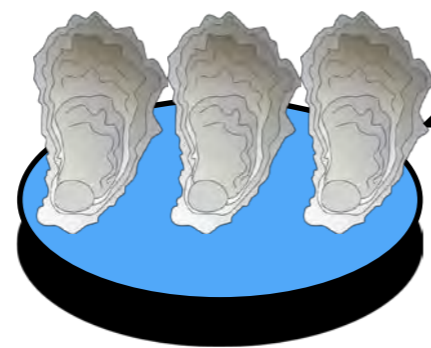
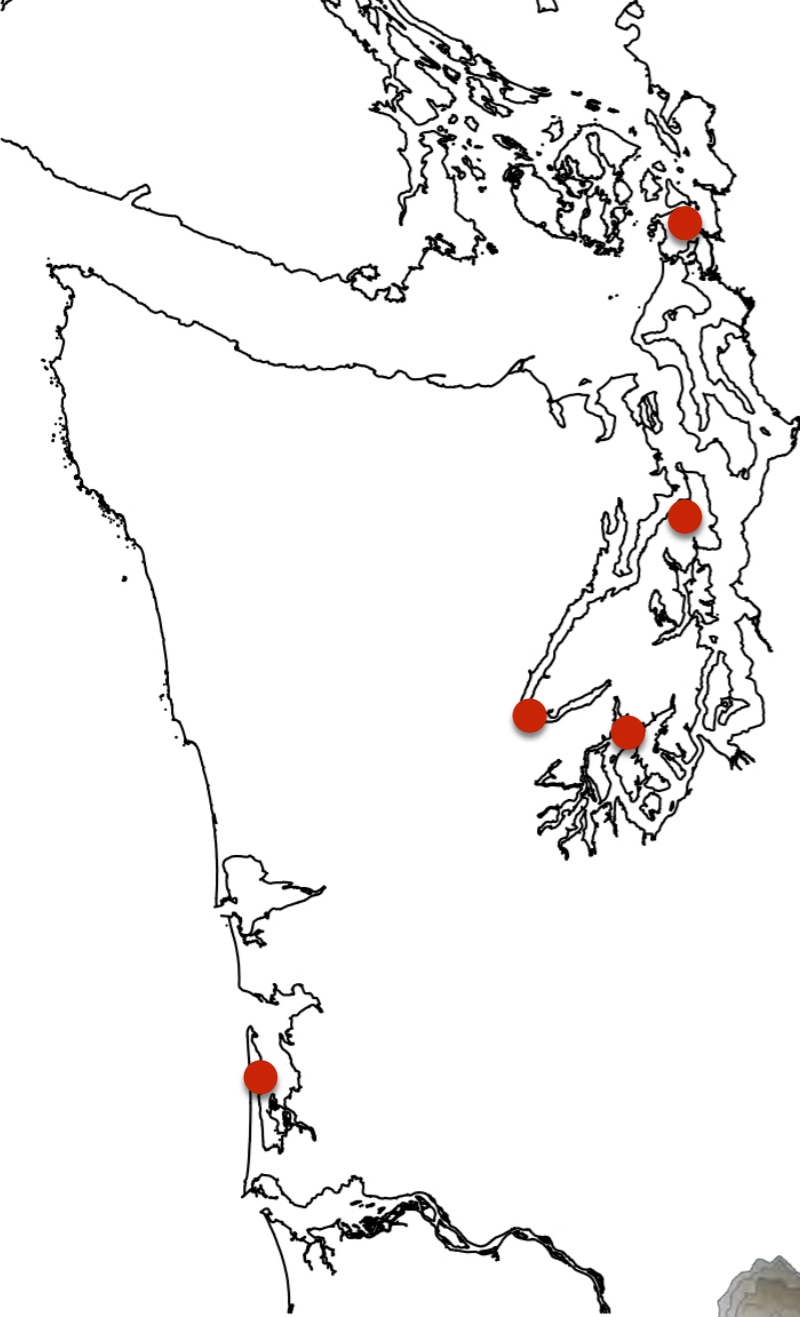
Shell length, mass, and strength

Stable isotope ratios

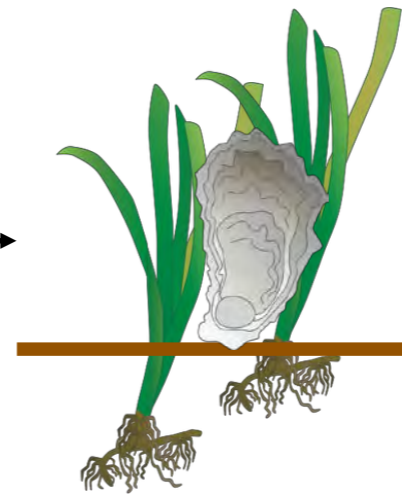
Fatty acid composition

Protein expression

OA refuge for juvenile shellfish



Shell length



Shell length, mass, and strength

Stable isotope ratios

Fatty acid composition

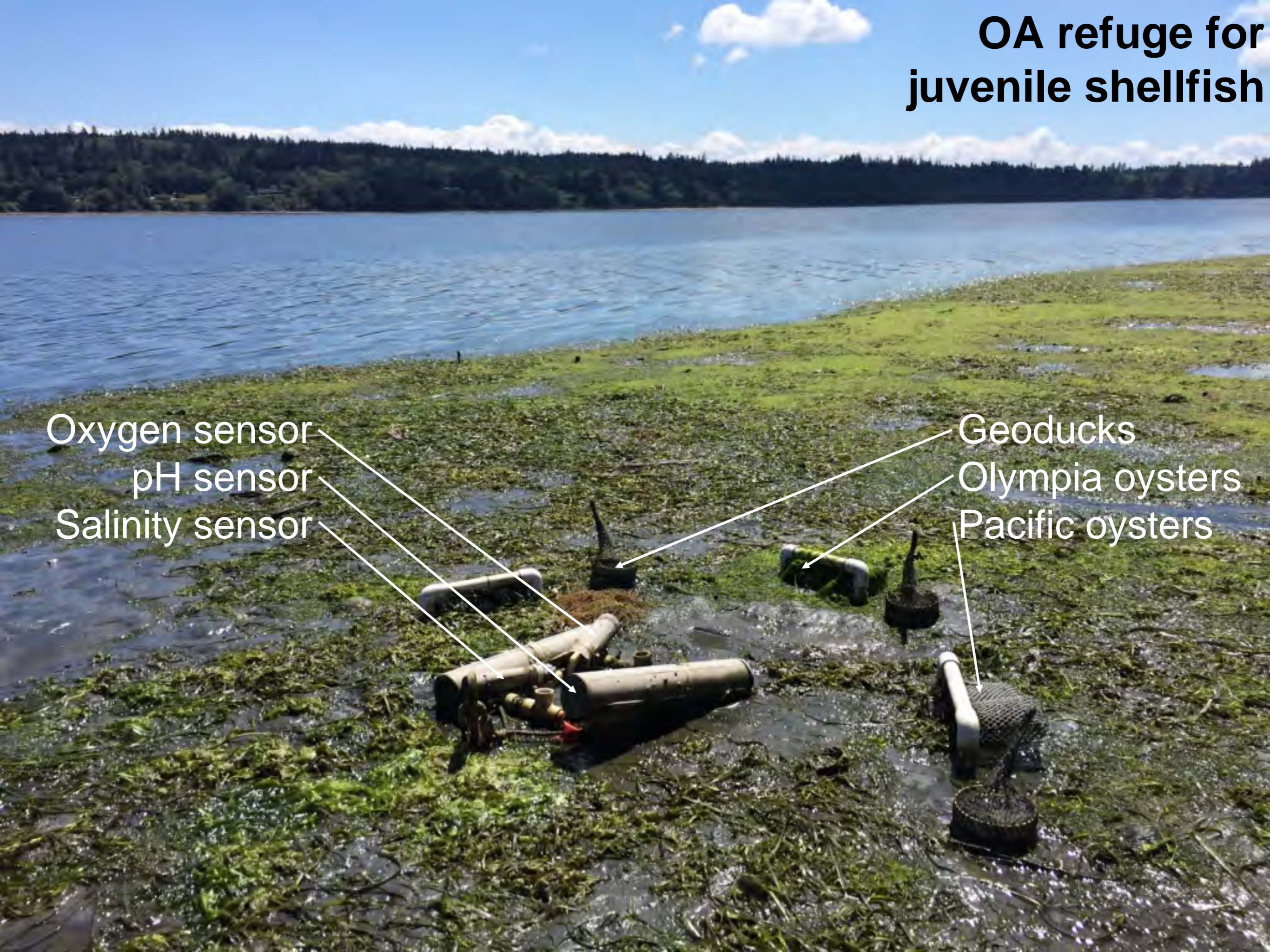
Protein expression

- Hatchery geoducks, Olympia and Pacific oysters exposed for 30 days, in & out of eelgrass

OA refuge for juvenile shellfish

Oxygen sensor
pH sensor
Salinity sensor

Geoducks
Olympia oysters
Pacific oysters



OA refuge for juvenile shellfish

Growth
(mm
 \pm SE)

10
9
8
7
6



OA refuge for juvenile shellfish

Habitats

● Bare

Growth
(mm
 \pm SE)



OA refuge for juvenile shellfish

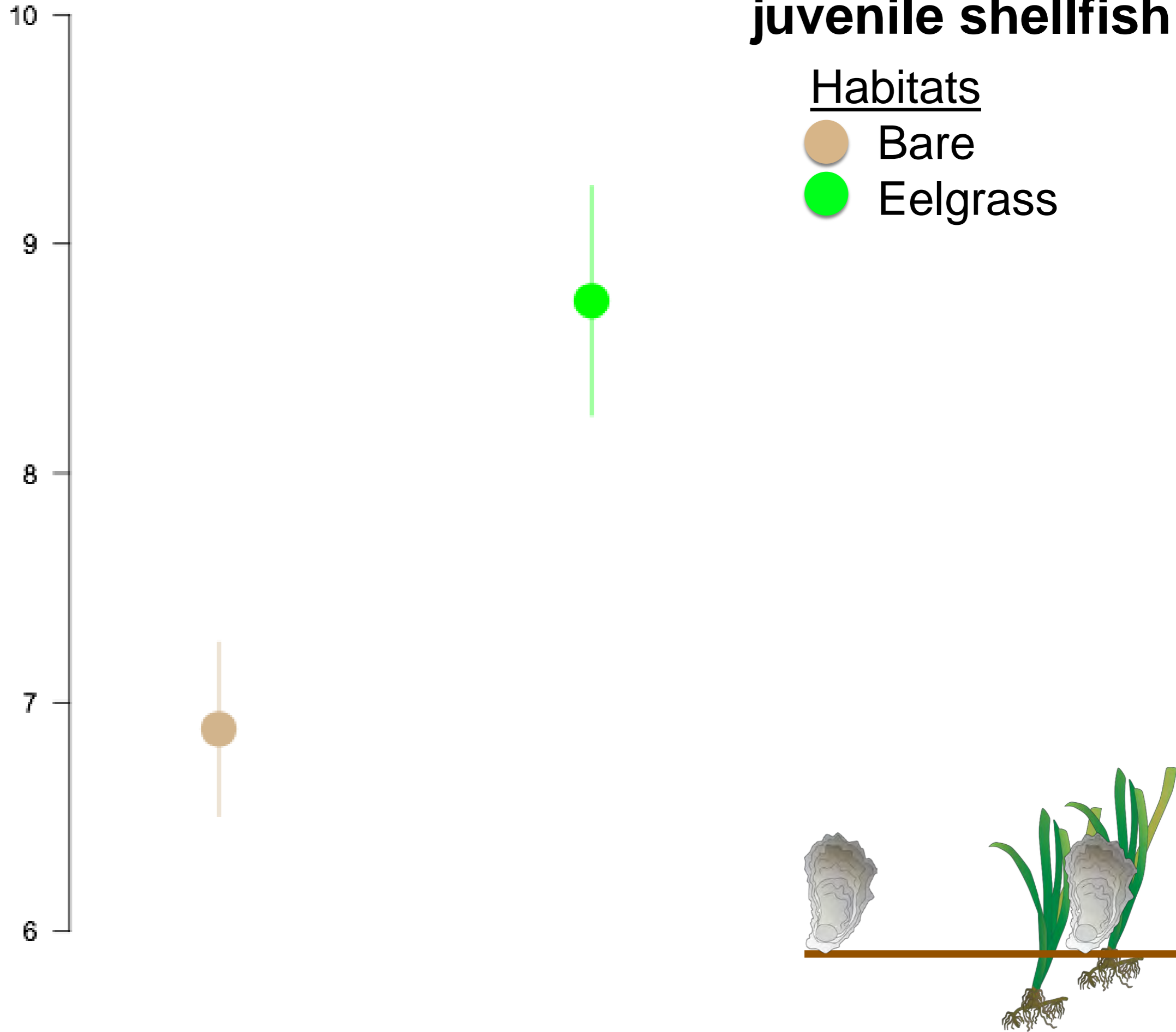
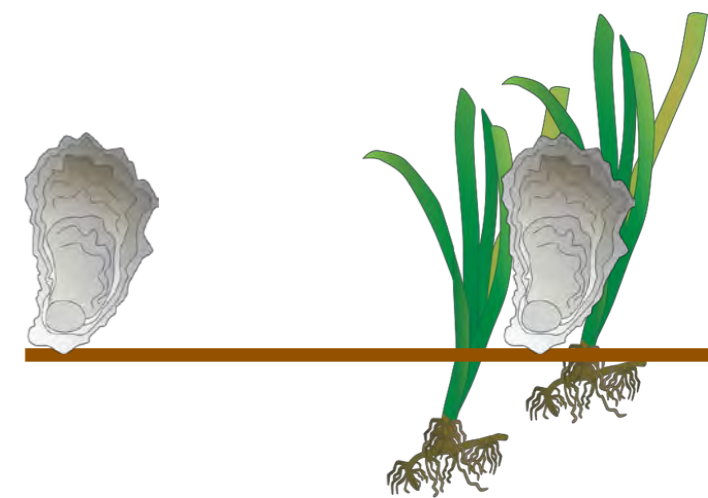
Habitats

Bare

Eelgrass

Growth
(mm
 \pm SE)

10
9
8
7
6



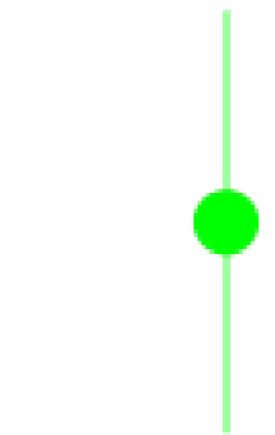
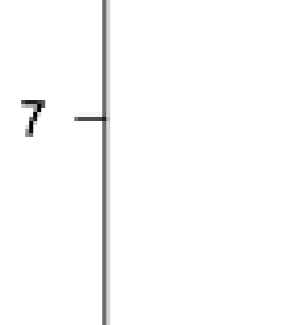
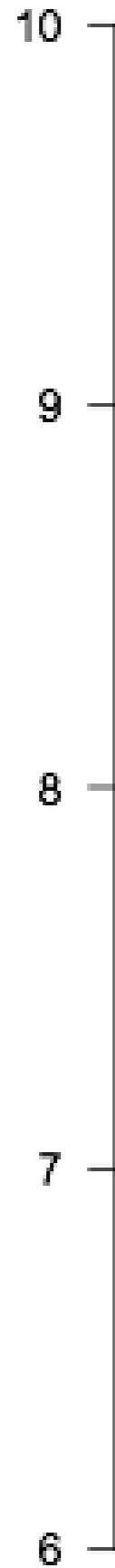
OA refuge for juvenile shellfish

Habitats

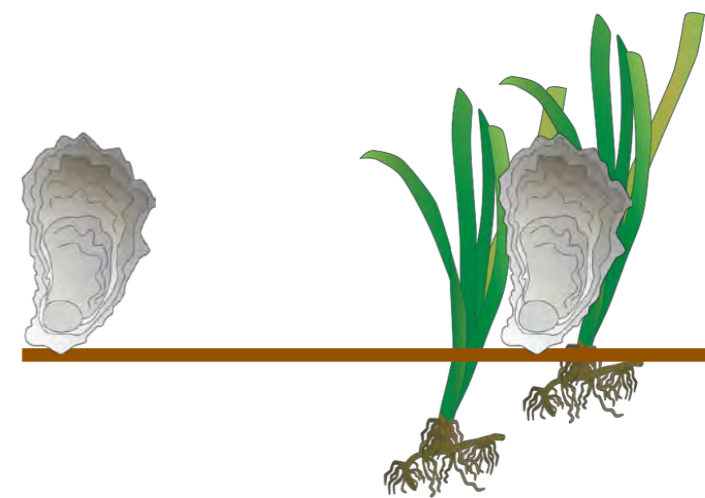
● Bare

● Eelgrass

Growth
(mm
 \pm SE)



- Pacific oysters grew 25% faster in eelgrass

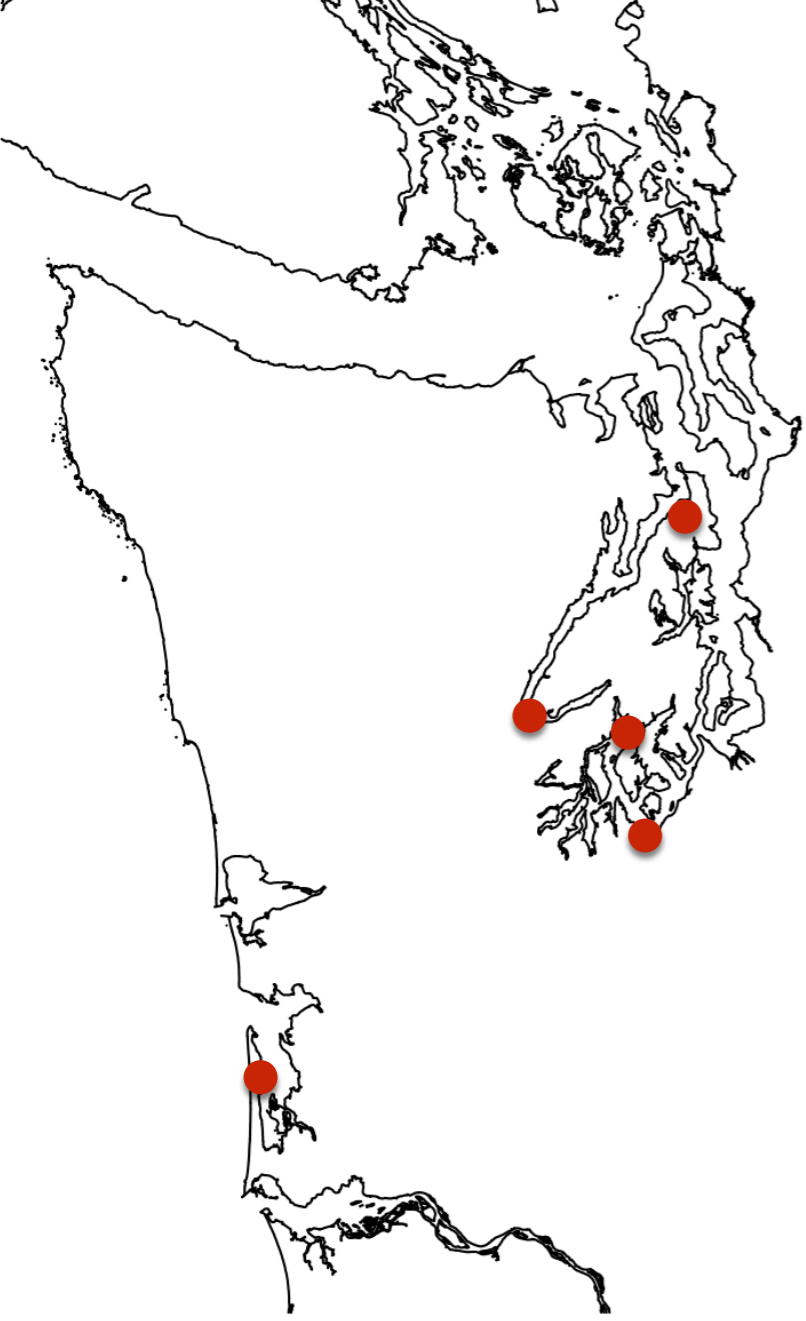


The halo of eelgrass

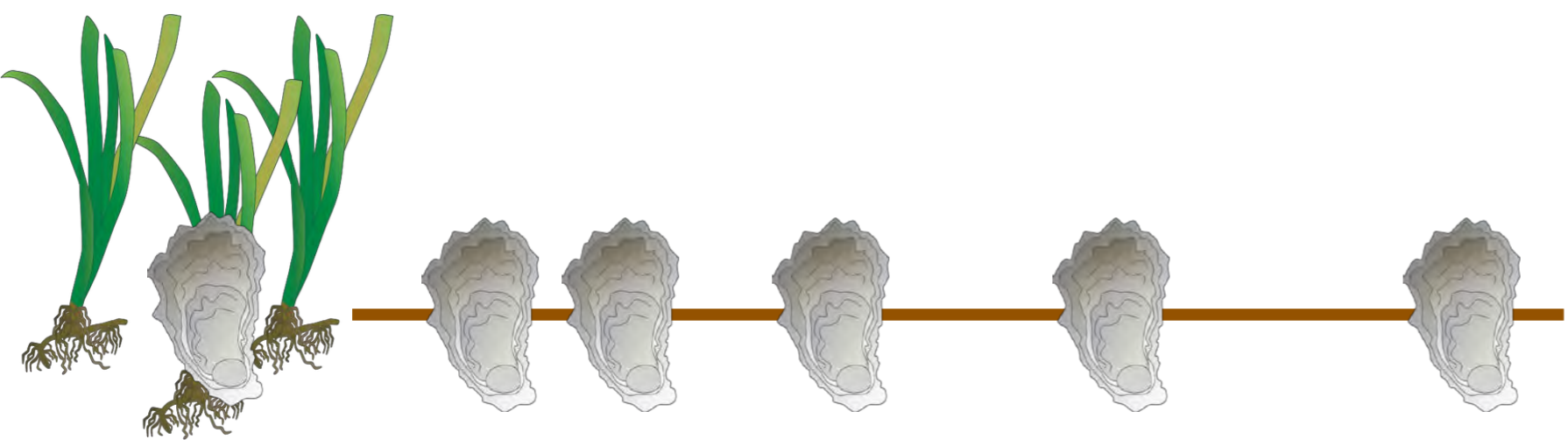
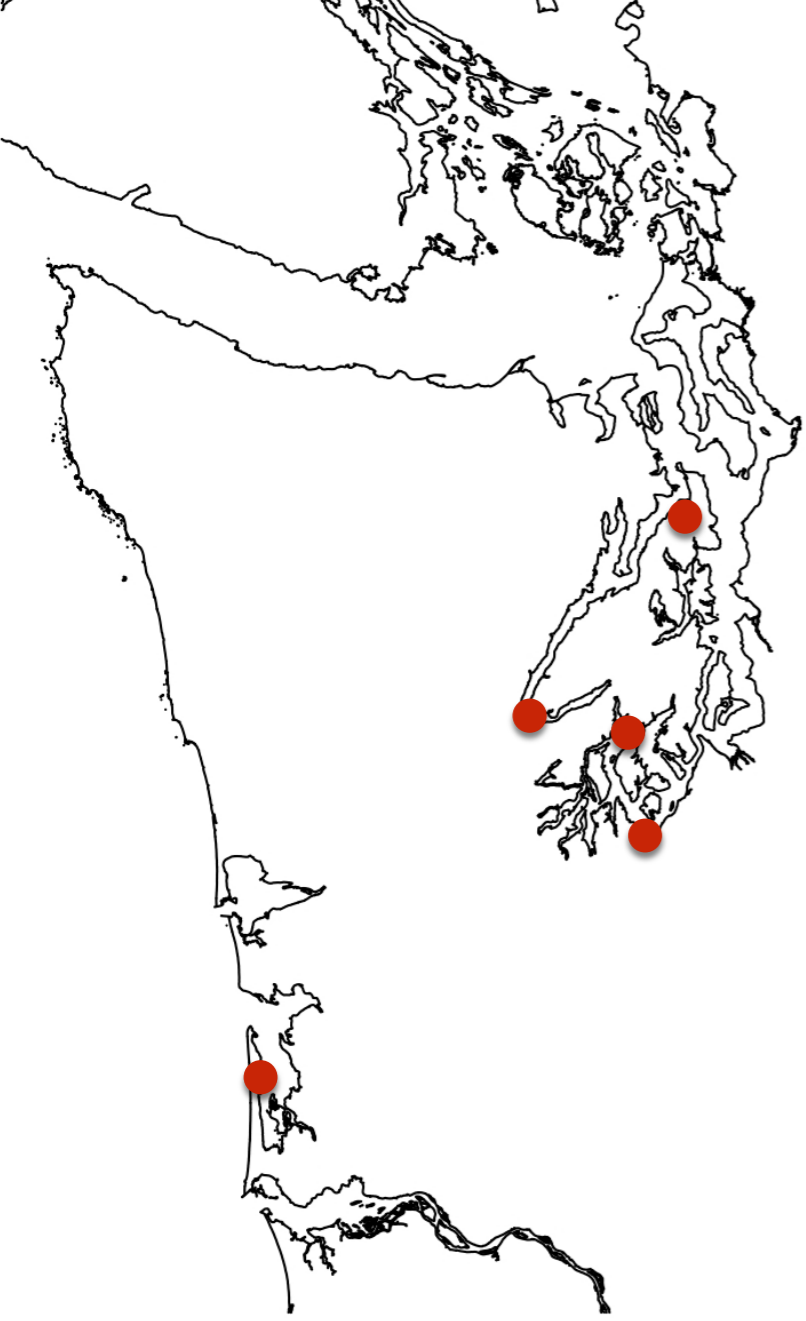


Photo: Jonas Thormor

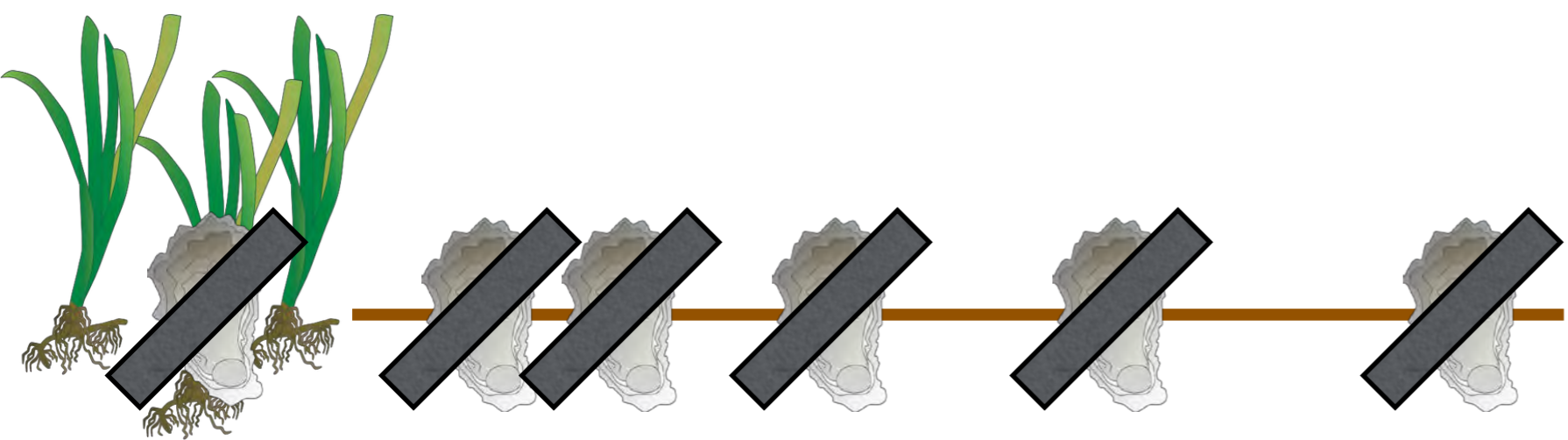
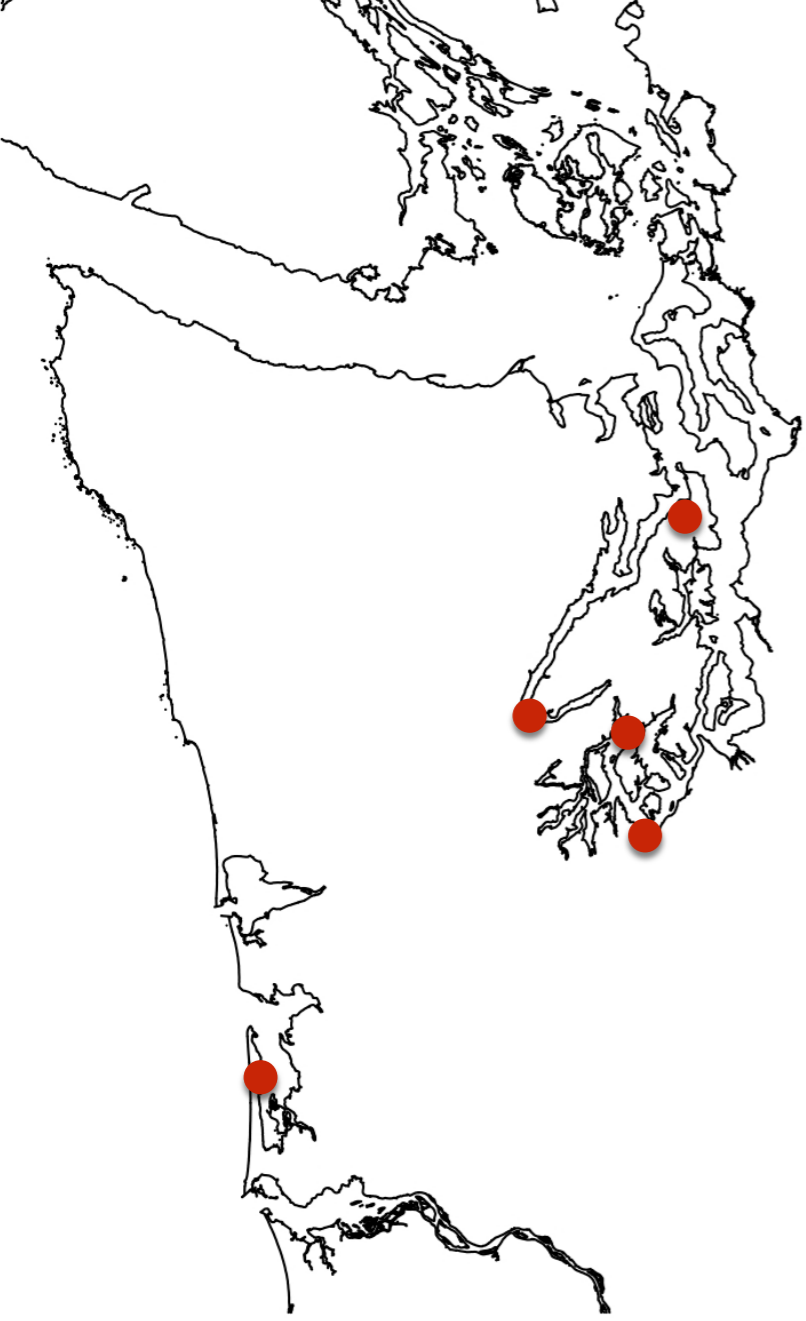
The halo of eelgrass



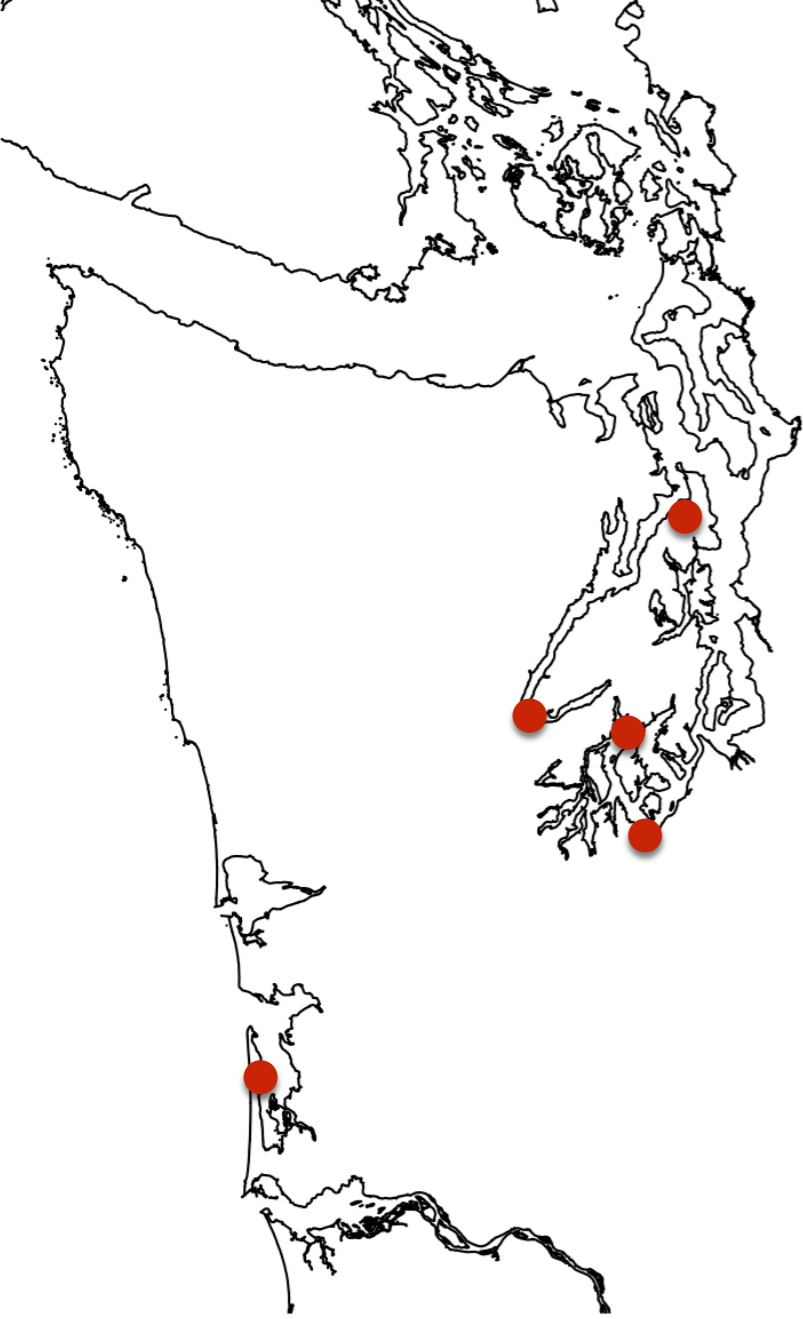
The halo of eelgrass



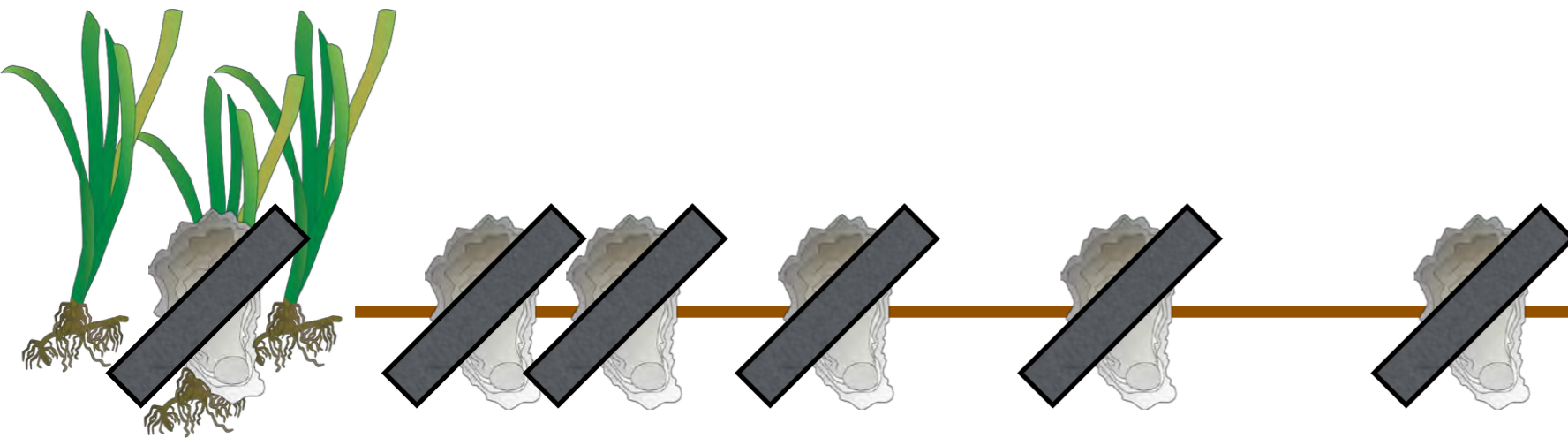
The halo of eelgrass



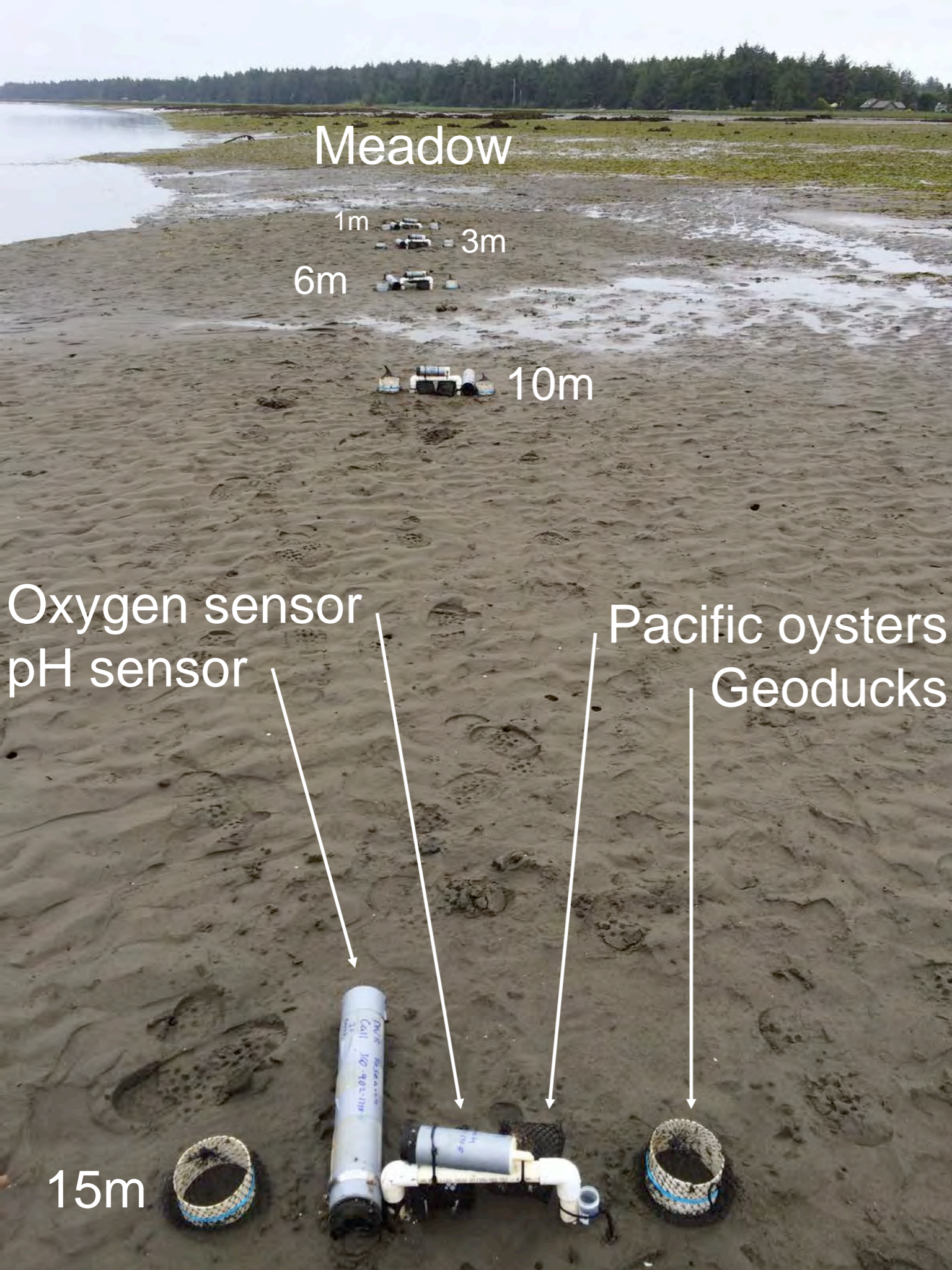
The halo of eelgrass



- Hatchery geoducks and Pacific oysters exposed for 80 days
- pH & shellfish performance assessed at each point along transect



The halo of eelgrass



- Hatchery geoducks and Pacific oysters exposed for 80 days
- pH & shellfish performance assessed at each point along transect

The halo of eelgrass

Growth
(mm
 \pm SE)

14
13
12
11
10
9

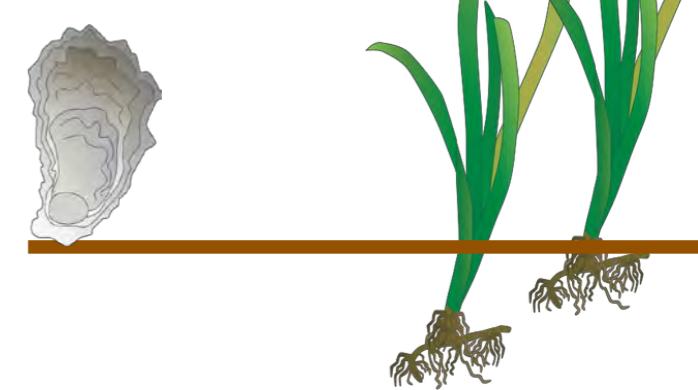


The halo of eelgrass

Habitats

● Bare

Growth
(mm
 \pm SE)

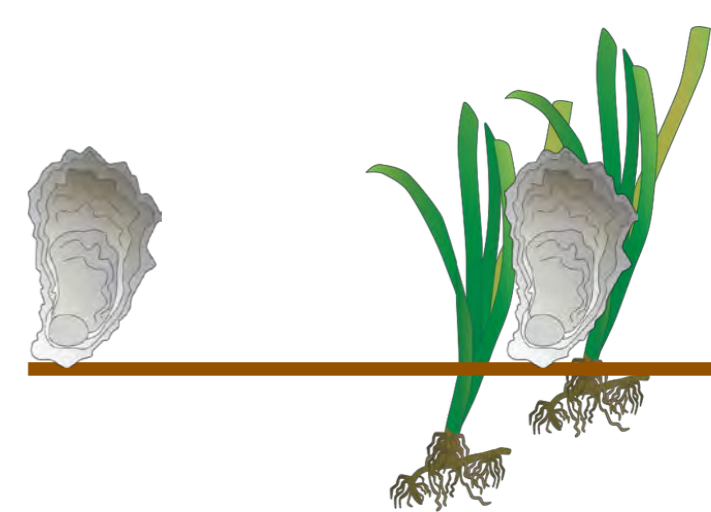


The halo of eelgrass

Habitats

-  Bare
-  Eelgrass

Growth
(mm
 \pm SE)



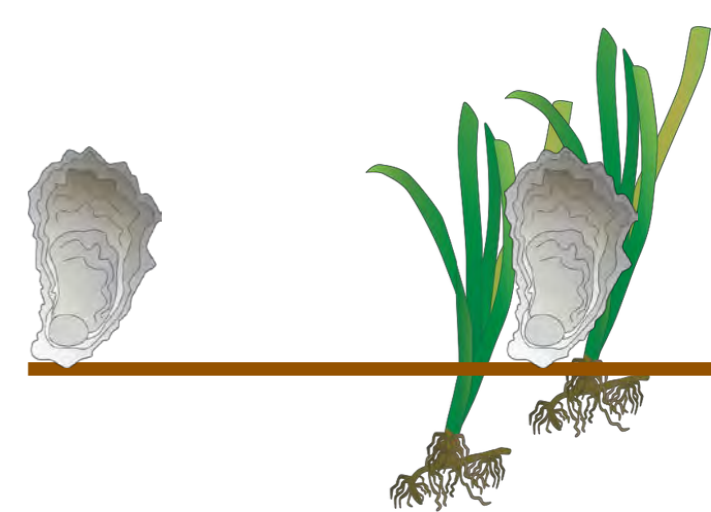
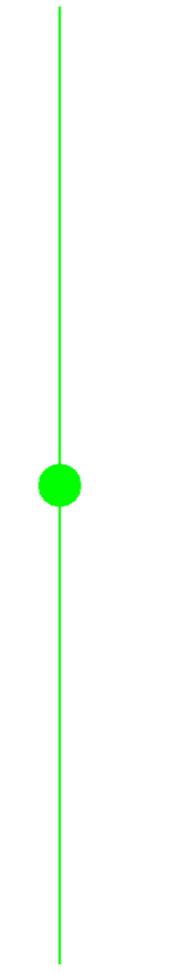
The halo of eelgrass

Habitats

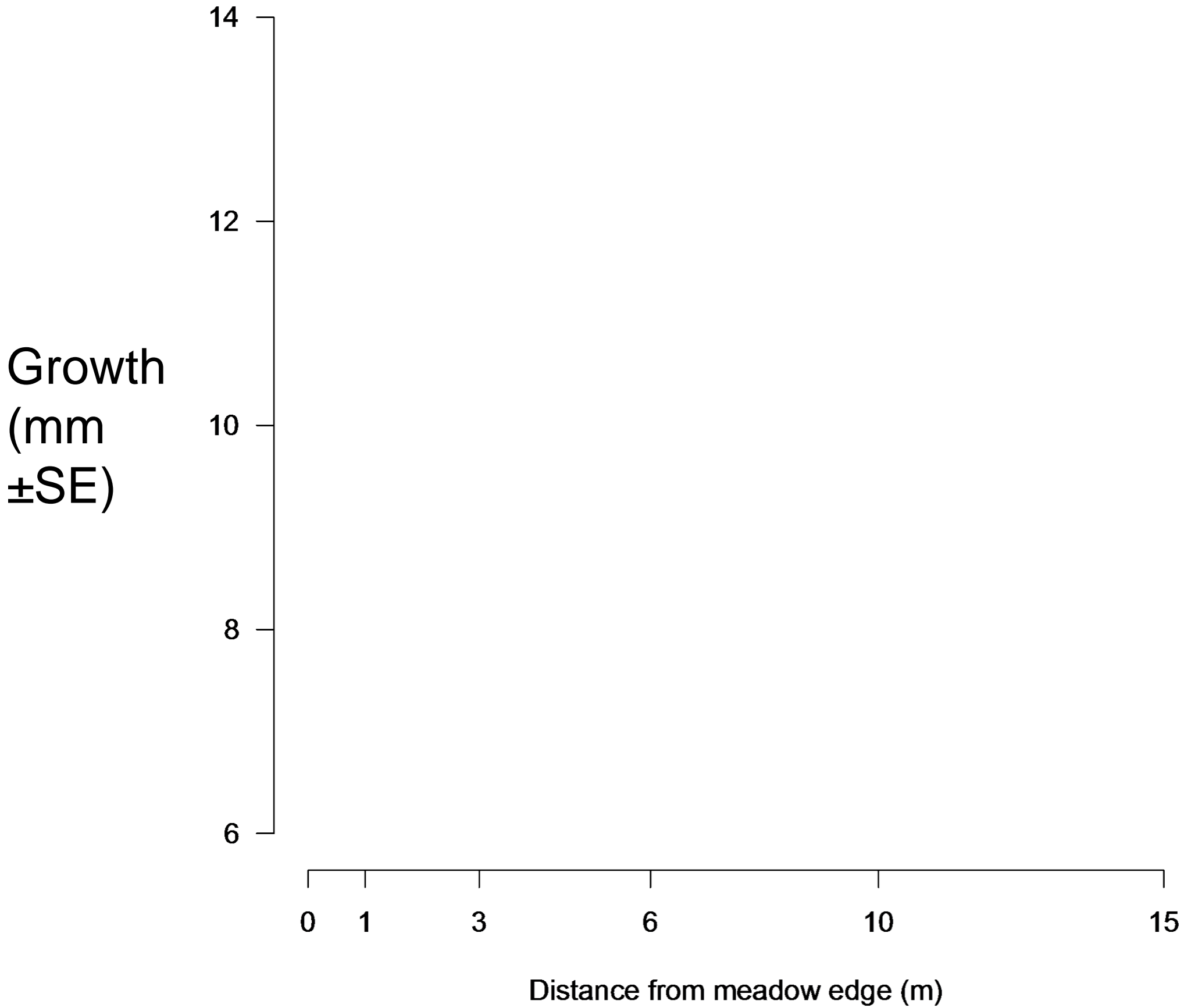
- Bare
- Eelgrass

- Pacific oysters again grew 25% faster in eelgrass

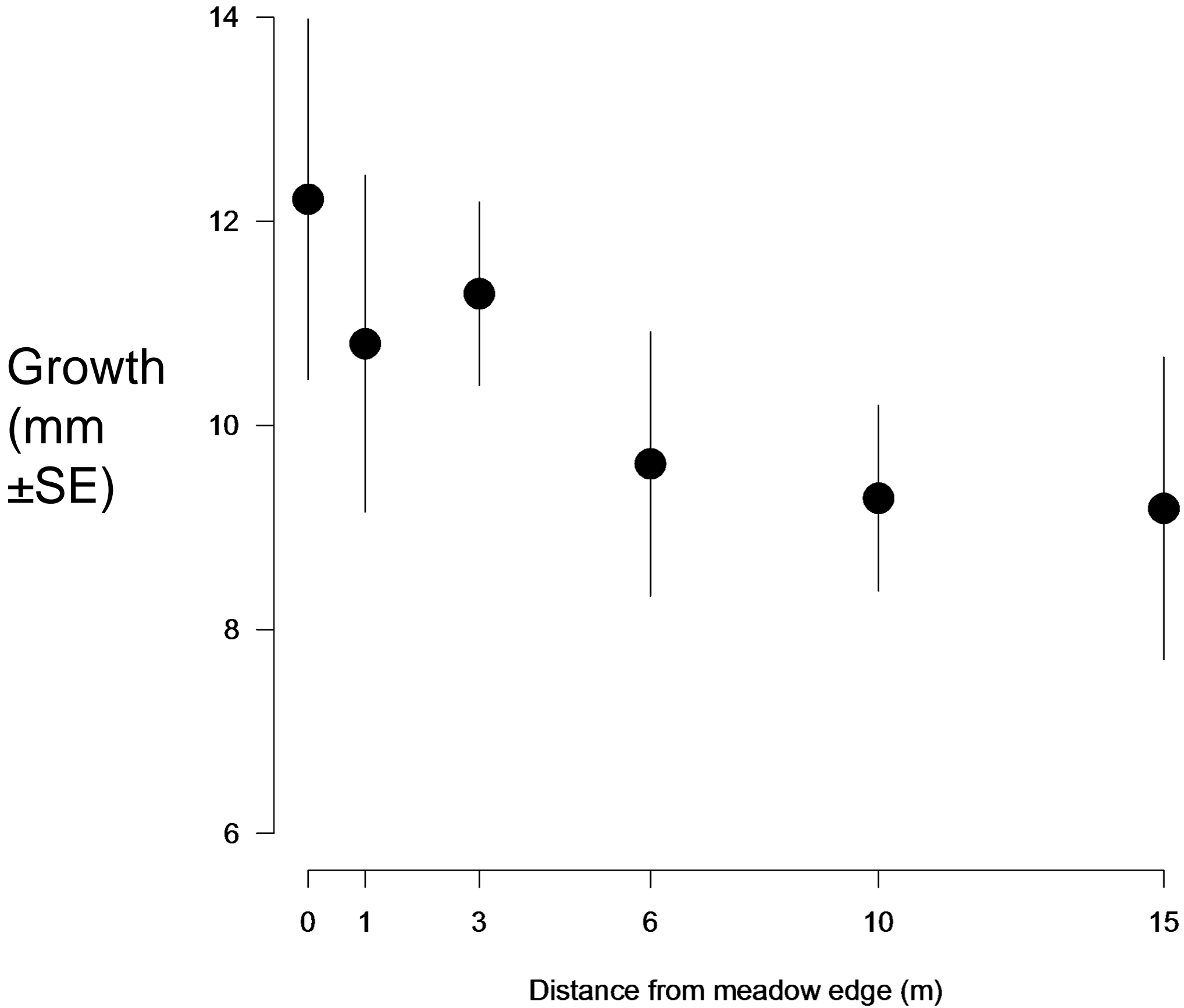
Growth
(mm
 \pm SE)



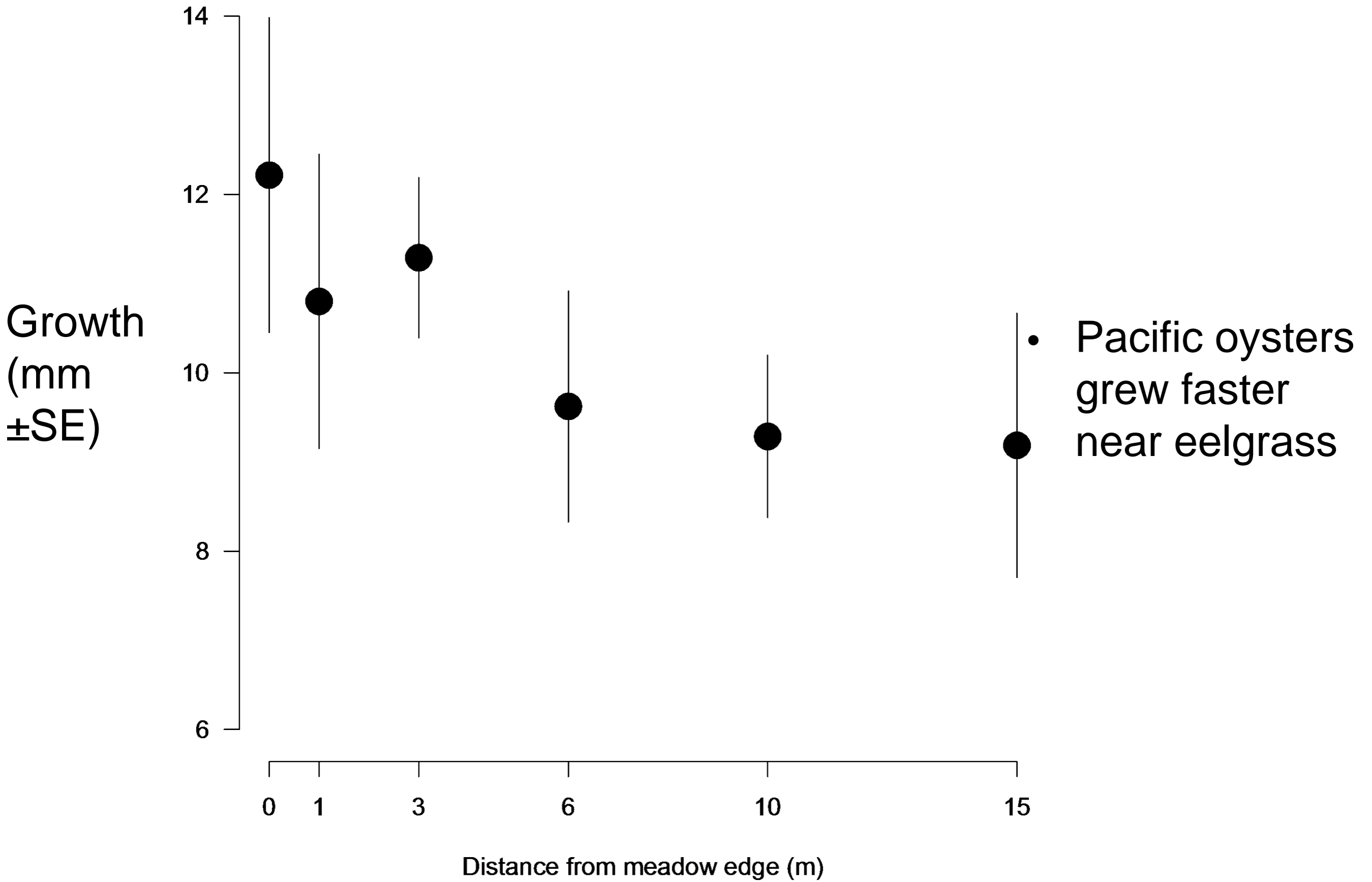
The halo of eelgrass



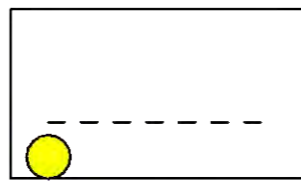
The halo of eelgrass



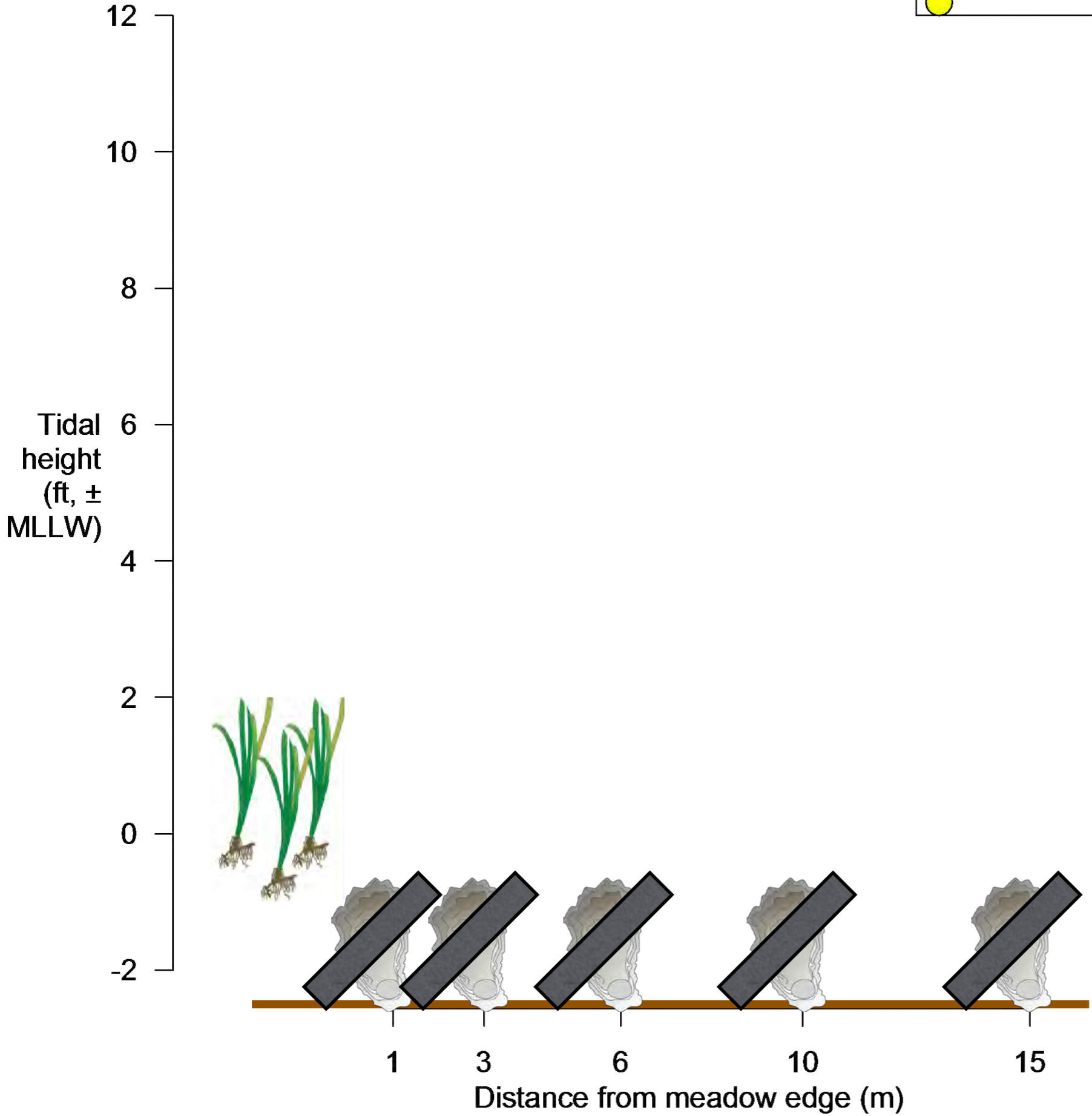
The halo of eelgrass



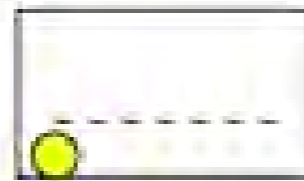
2017-07-12



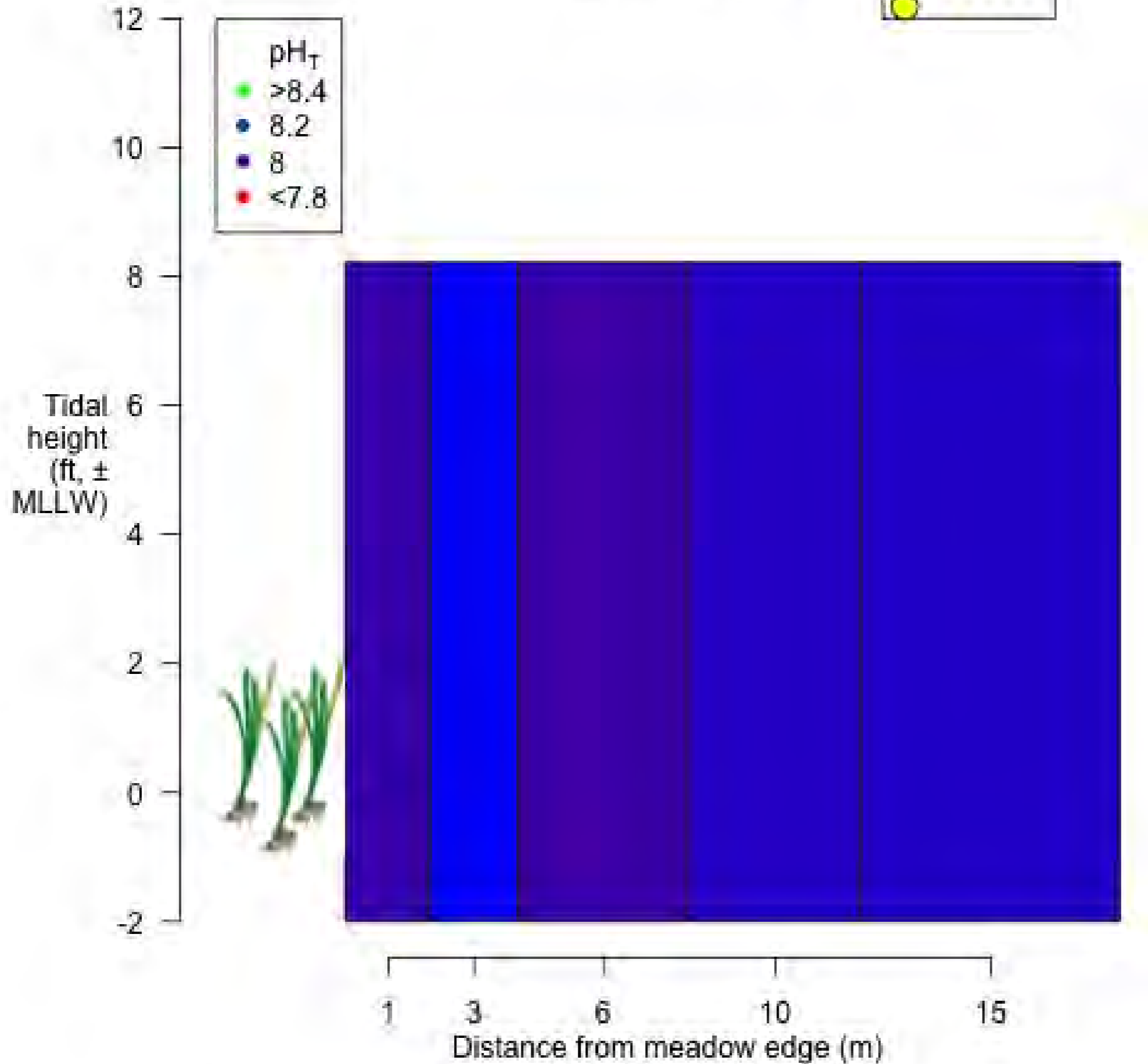
The halo of eelgrass



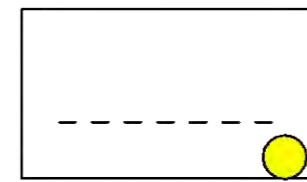
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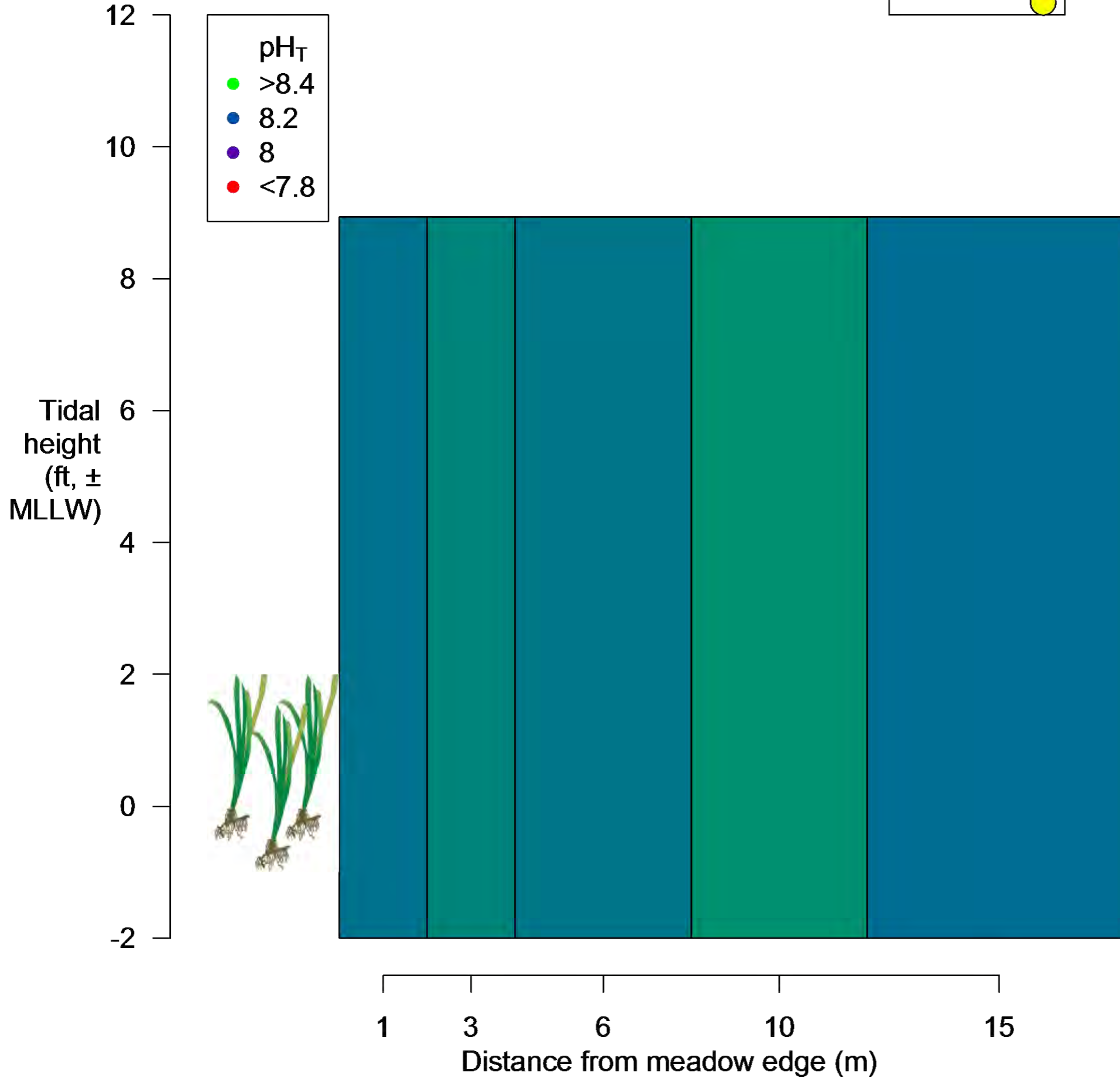
The halo of eelgrass



2017-07-12 23:59:00

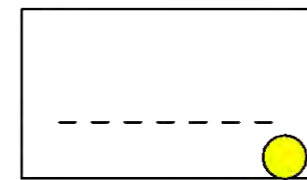


The halo of eelgrass

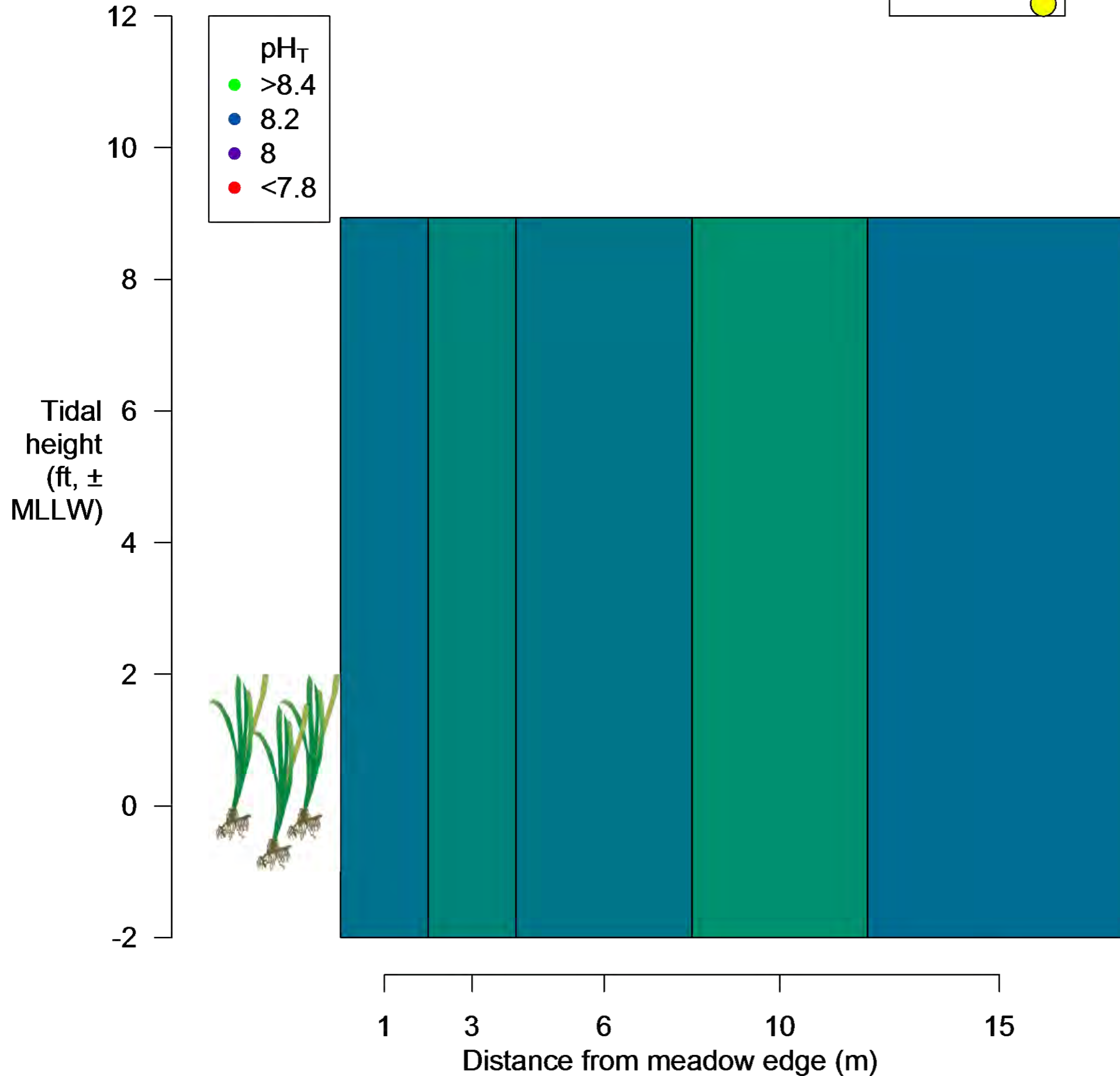


- Photosynthesis can have rapid effects on pH

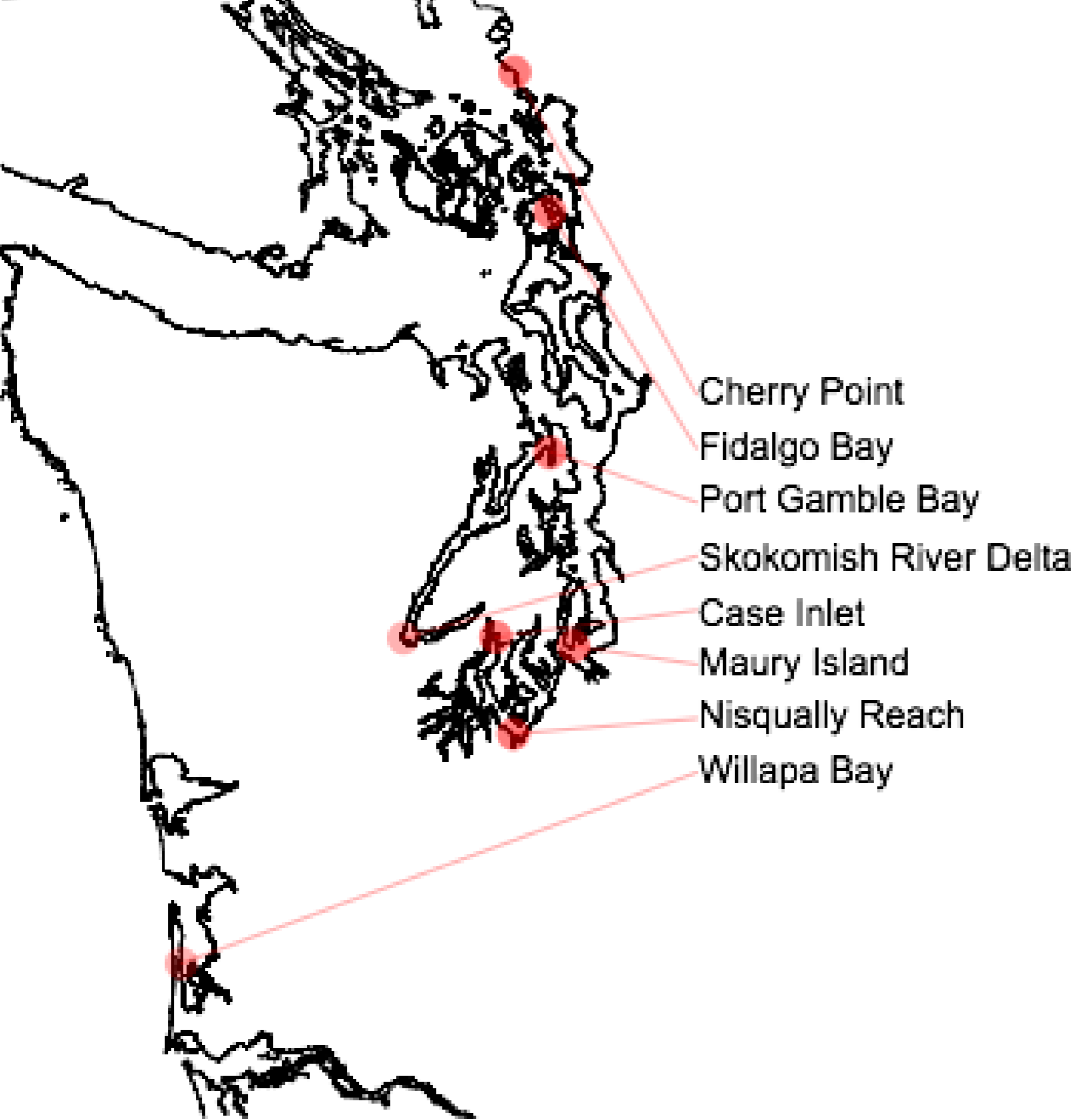
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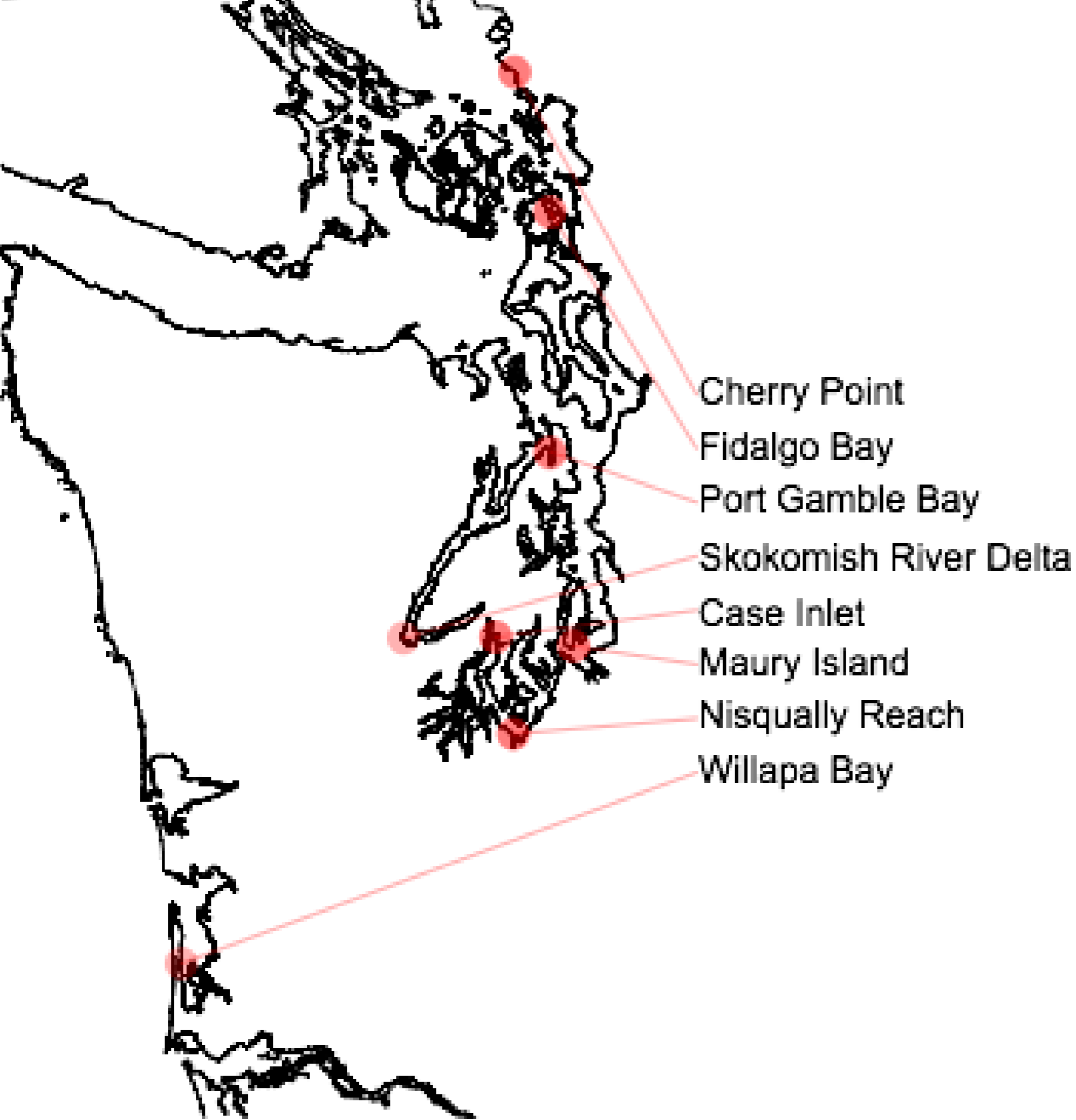


The halo of eelgrass



- Photosynthesis can have rapid effects on pH
- The eelgrass pH effect is pronounced at slack water

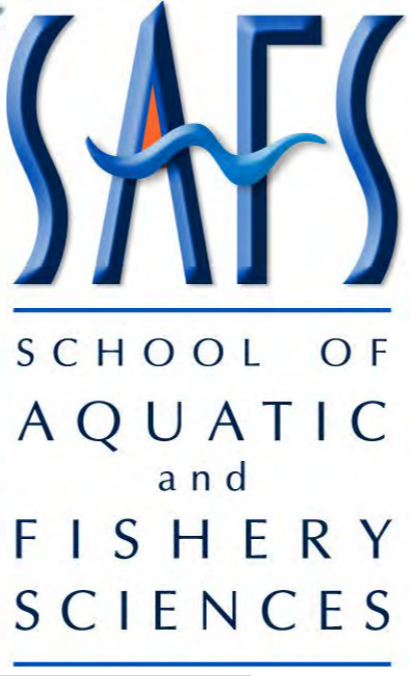




- Sensors measure:
 - pH
 - Temperature
 - [Oxygen]
 - Conductivity
 - [Chlorophyll]



Partners



Port Gamble
S'Klallam
Tribe

Samish
Indian
Nation

Skokomish
Indian
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