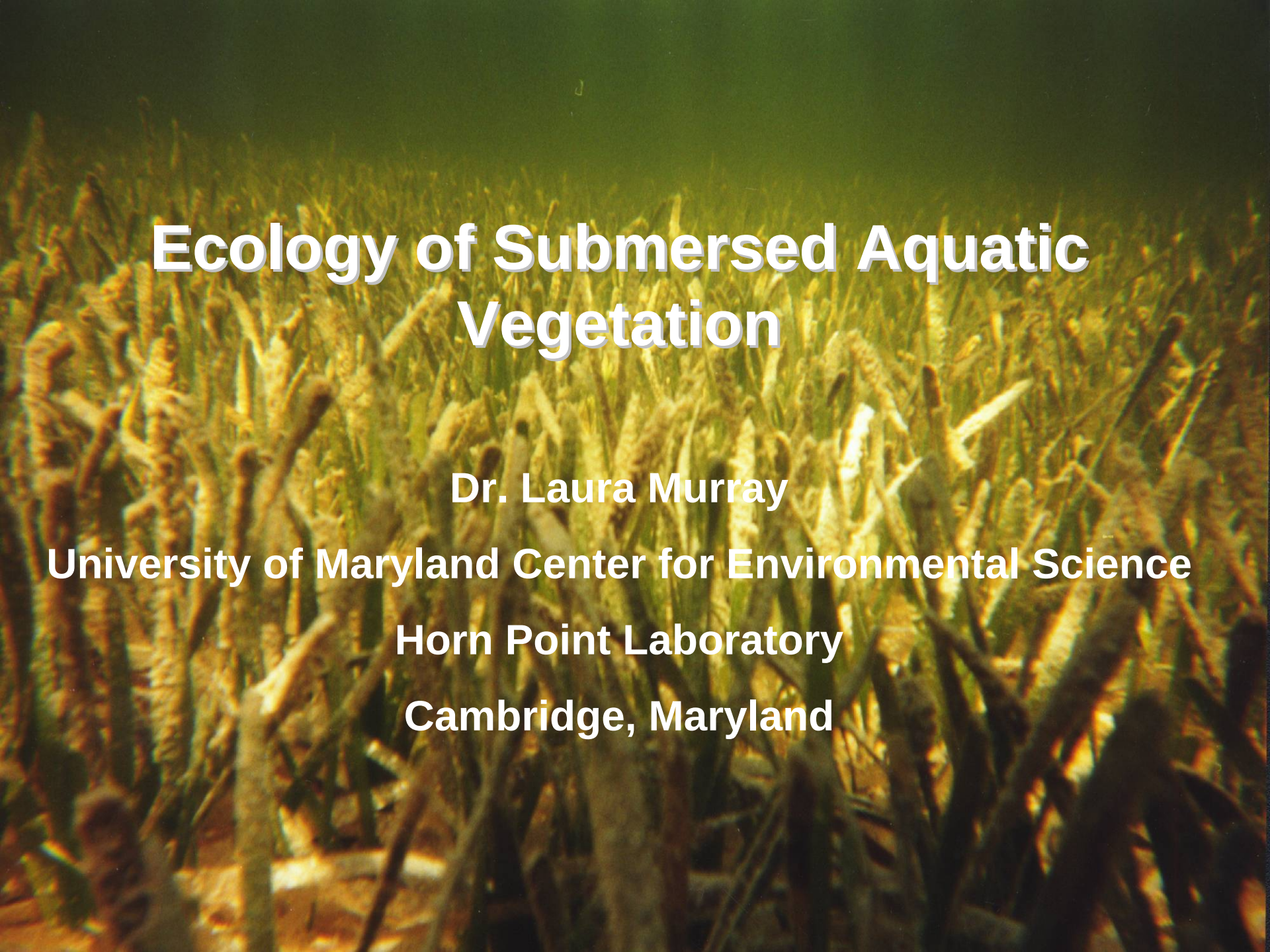

Ecology of Submersed Aquatic Vegetation

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Outline:

I. What are SAV

II. SAV adaptations and habitat

III. Importance of SAV

IV. History of SAV decline

V. Case Study: Chesapeake Bay

VI. Keys to Successful Restoration

I. What are SAV?

a. Roots, stems, leaves

b. Angiosperms (flowering plants)

c. Evolved from terrestrial plants

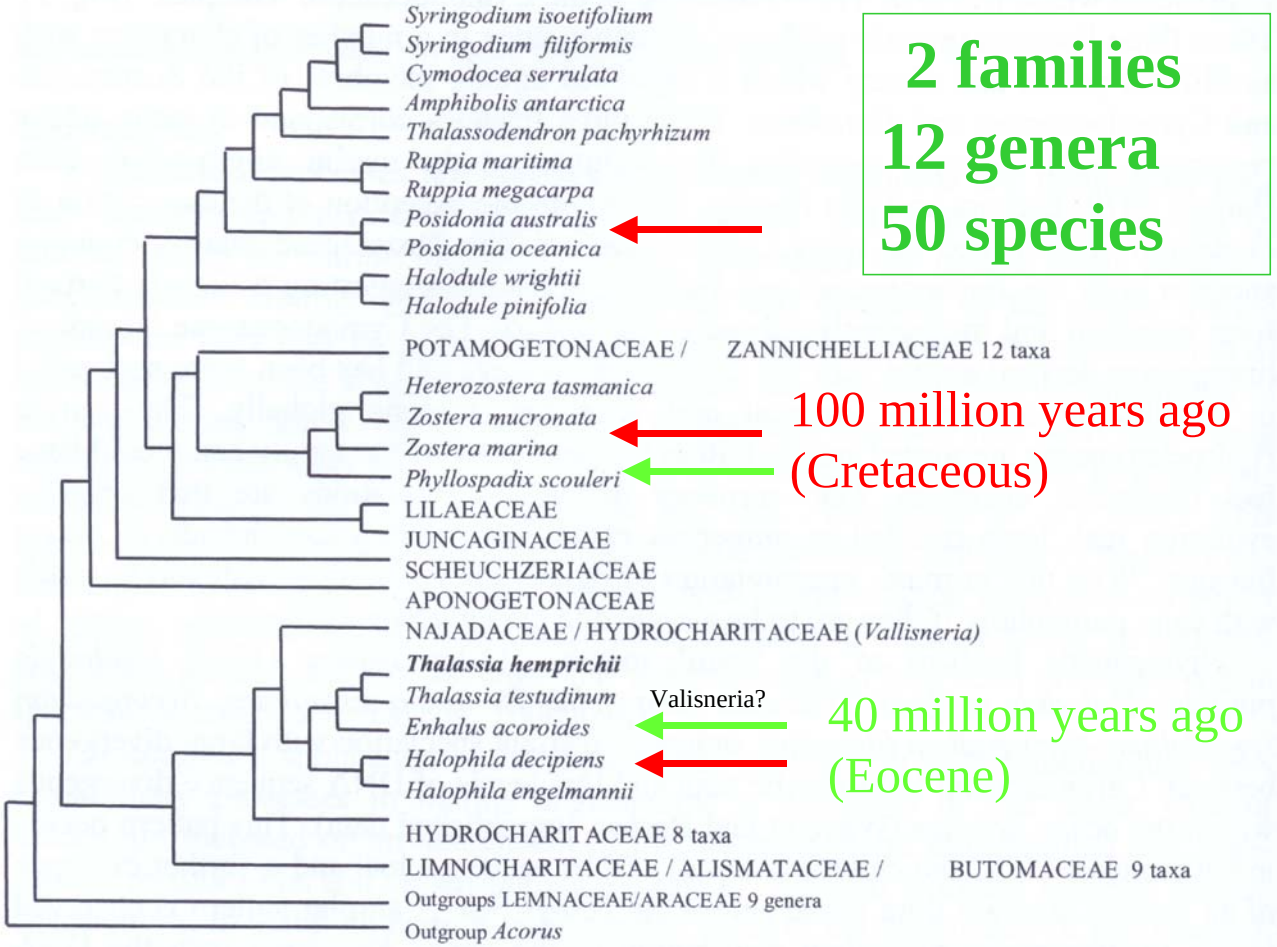
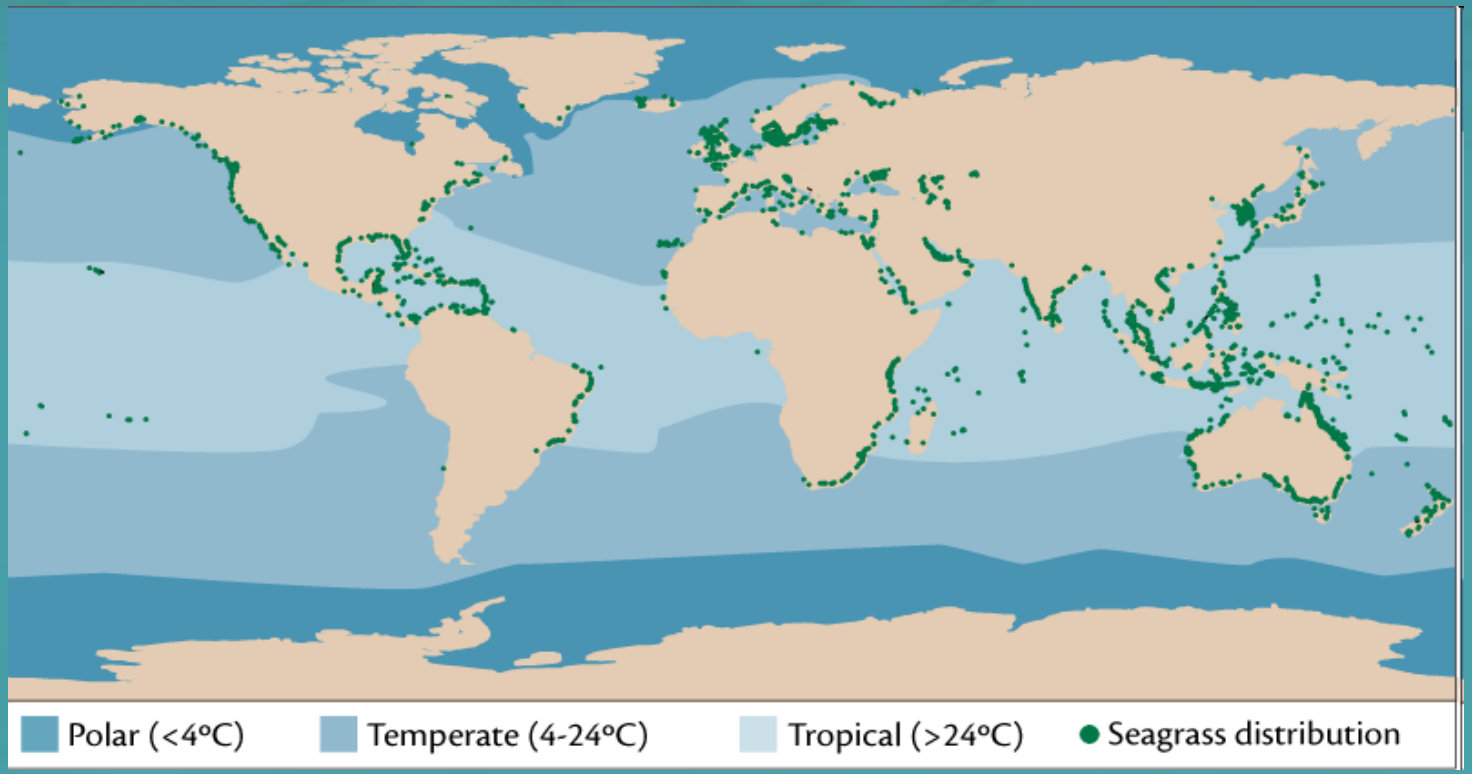


Fig. 1. Cladogram based on *rbc*L DNA sequence data from phylogenetic relationships among seagrass species and other families in the subclass Alismatidae. Adapted from Les *et al*. (1997).

d. Entire life cycle occurs underwater

e. Inhabit waters ranging from fresh to ocean and tropical to boreal



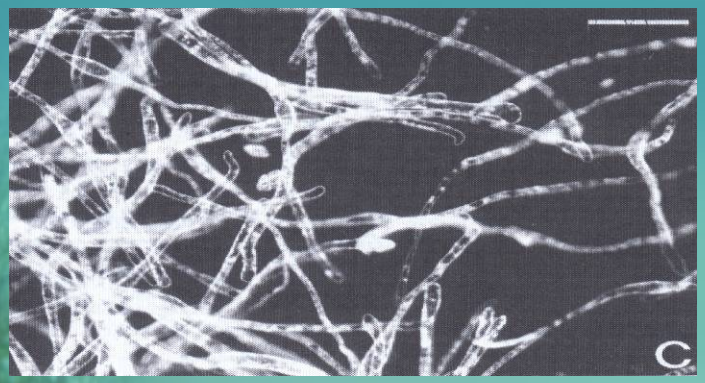
Seagrasses cover

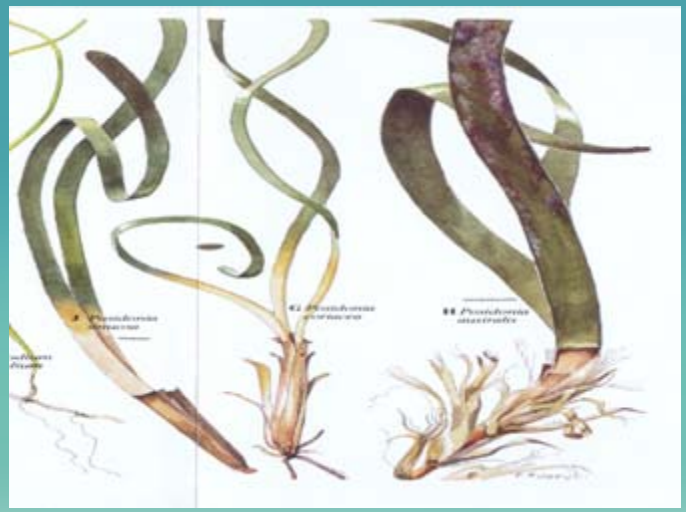
- **10% of the coastal oceans**
- **0.15% global ocean**
- **1% total biomass of marine plants**

II. SAV adaptations and habitat

a. Adaptation to an aquatic environment

1. Hydrophyllic pollen
2. Flexible tissues (little to no lignin)
3. Hydrodynamic design (physical stress)
4. No cuticle (gas and nutrient exchange)
5. Lacunar system





b. Adaptations to anaerobic sediment

1. Transport of oxygen to roots via lacunar system to maintain aerobic respiration .
2. Utilization of alternative metabolic pathways
3. Oxidize toxic byproducts of anaerobic sediments.

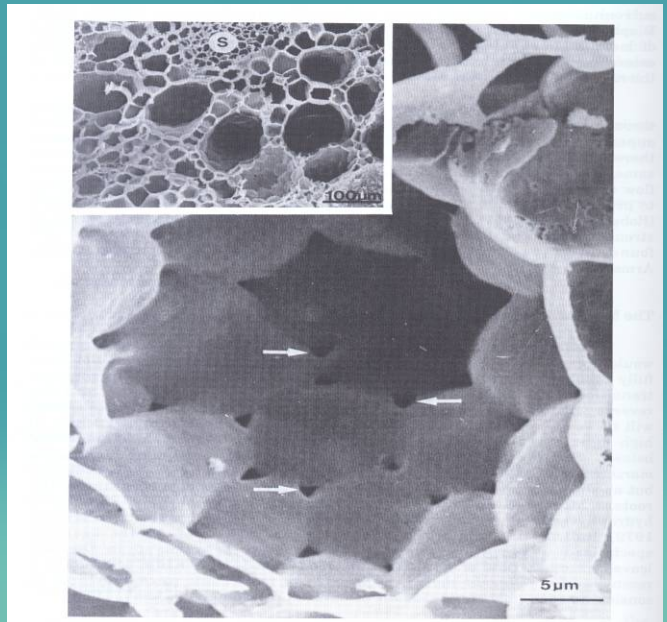
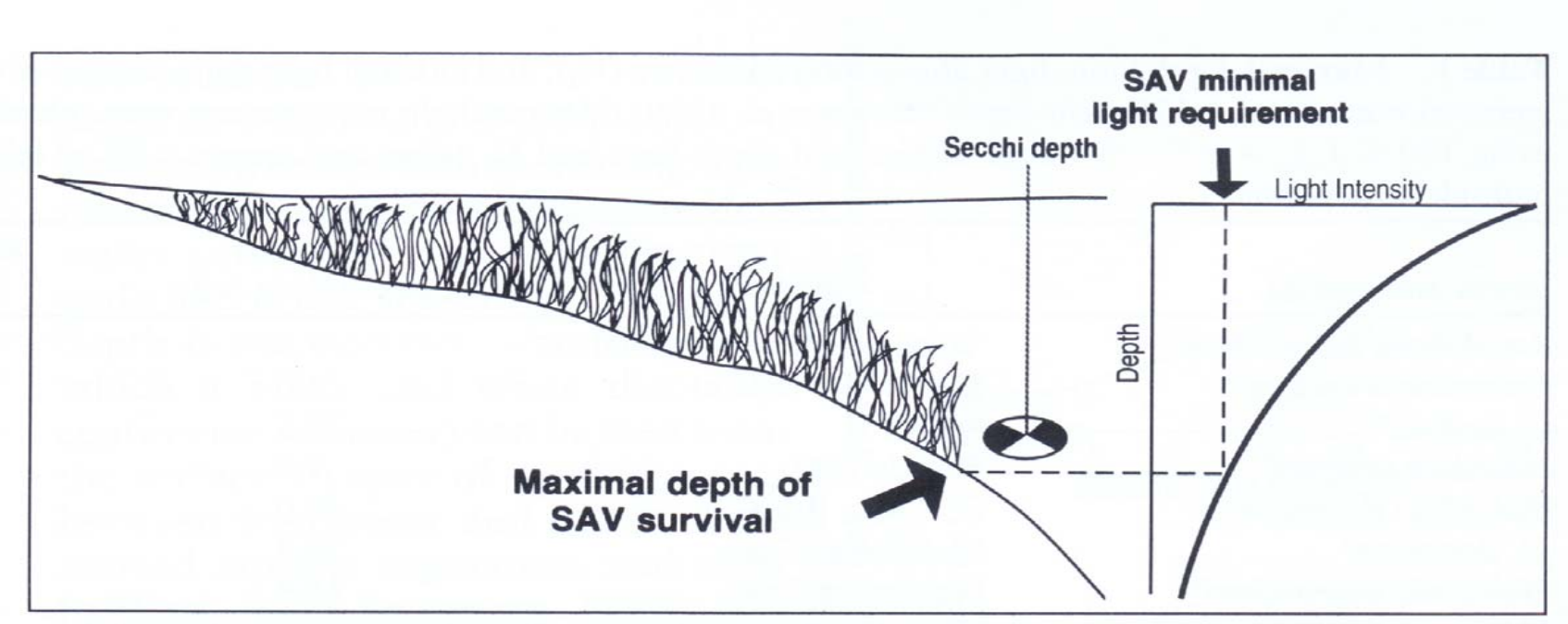


Figure 20.7 Electron micrographs showing the structure of lacunae and diaphragm in *Halophila ovalis*. Arrows indicate pores in the diaphragm. S, stele.

c. SAV and light

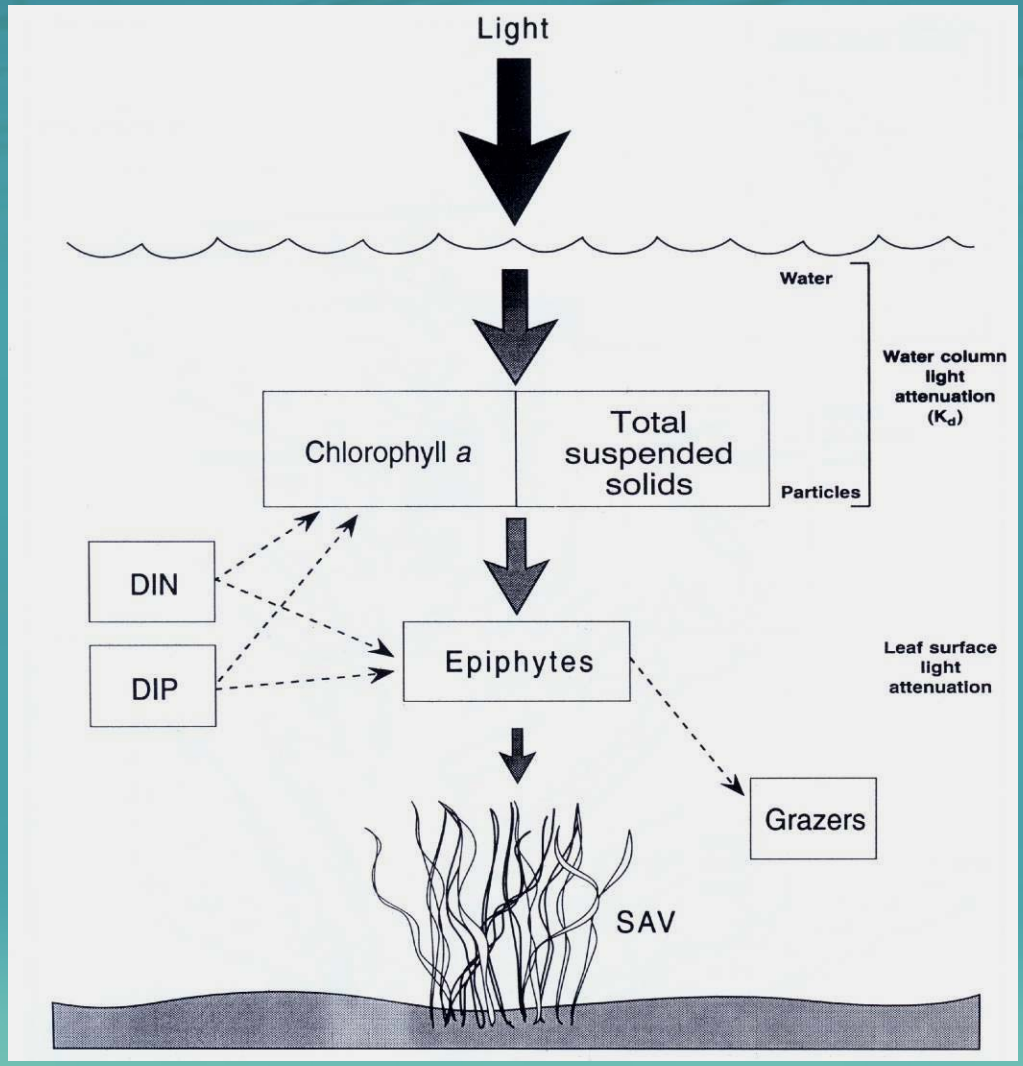
1. Minimum light requirement

Average of 10-15 % of surface light, or secchi disk depth



Dennison et al. 1992

2. Nutrient effect on light availability



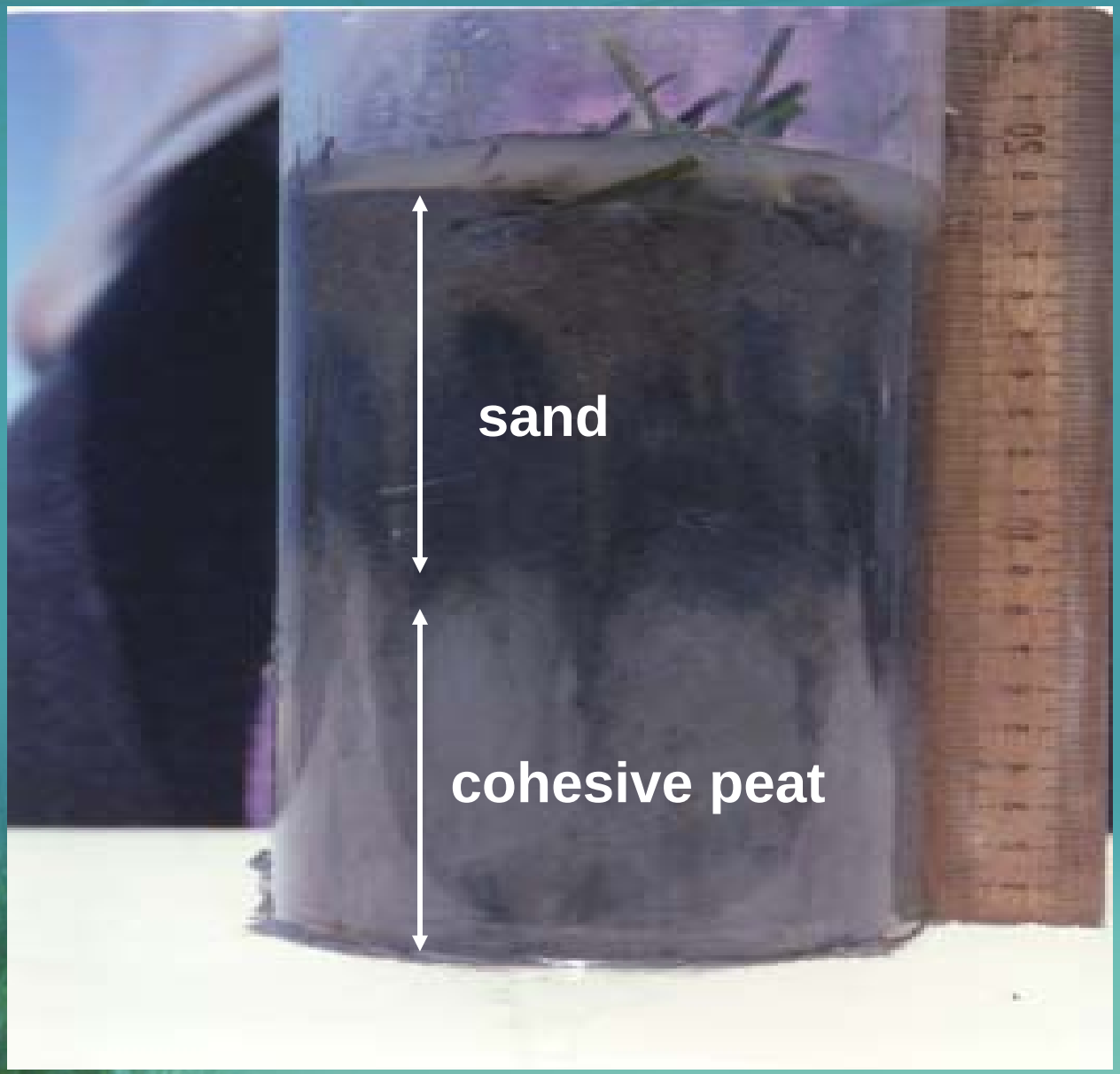
low nutrients→ low algae→ increased light

high nutrients→ high algae→ decreased light

3. Sediment effect on light availability

low wave energy &/or reduced erosion→increased light

d. Sediments with low organic content

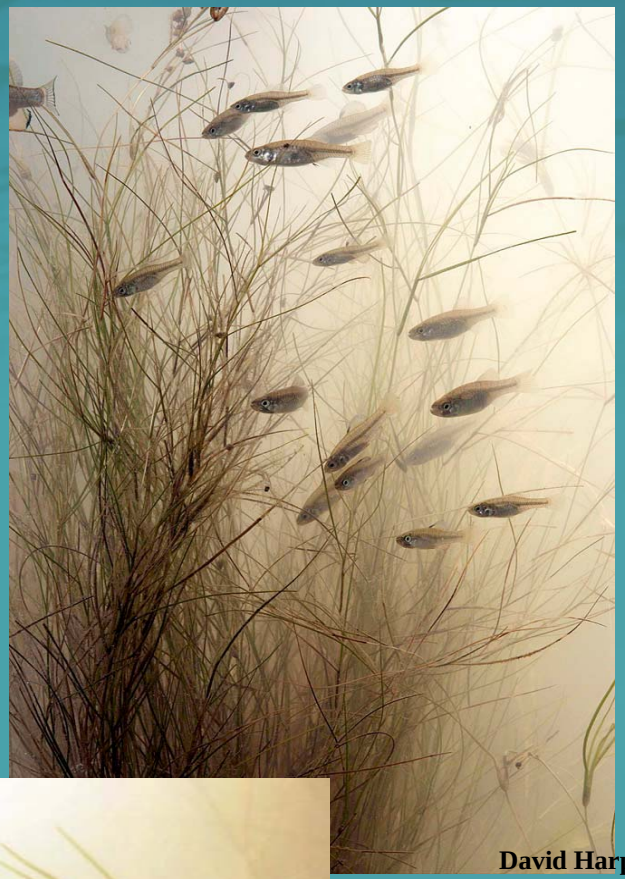


5-20% organics in sediment

III. Importance of SAV

a. Habitat

1. Nursery ground
2. Refuge area
3. Food for fauna



b. Filter

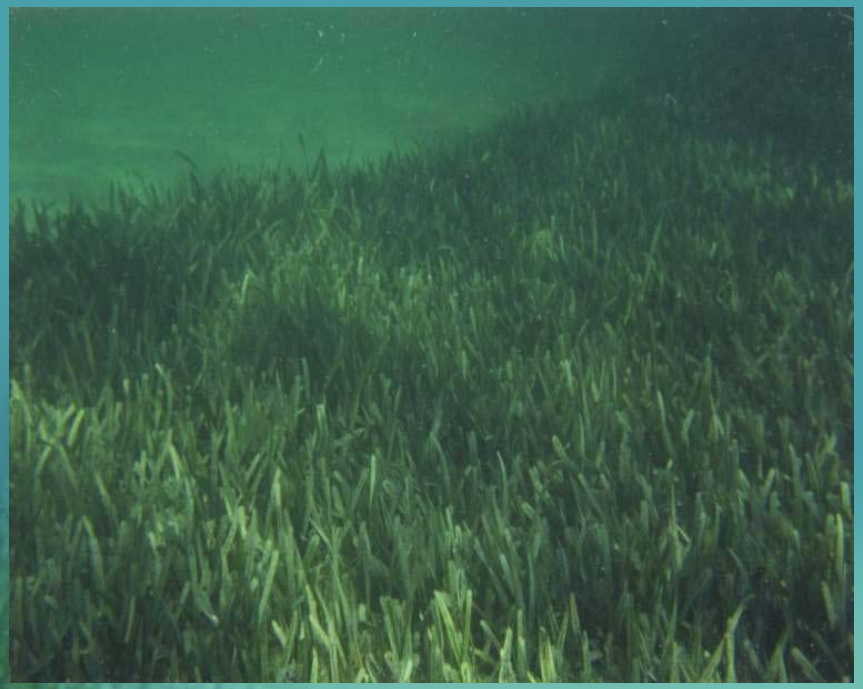
Vegetated

These aerial photographs were taken within minutes of each other and the two sites are less than 1 mile apart.

Un-vegetated

c. Production

Annual production rates similar to that of subsidized agriculture 10-25 g C/m2/yr.



d. Important component of the Coastal ecosystem

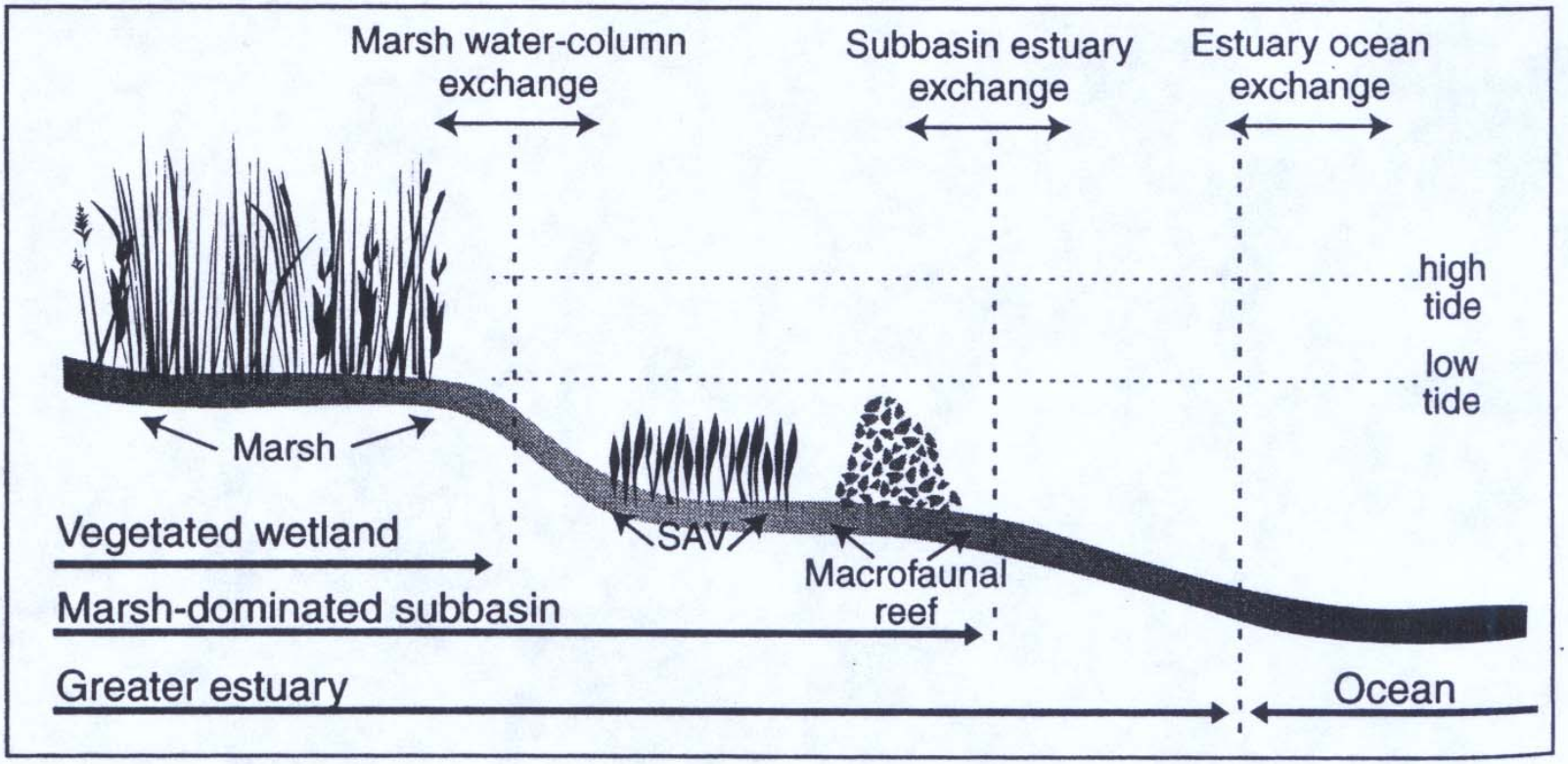
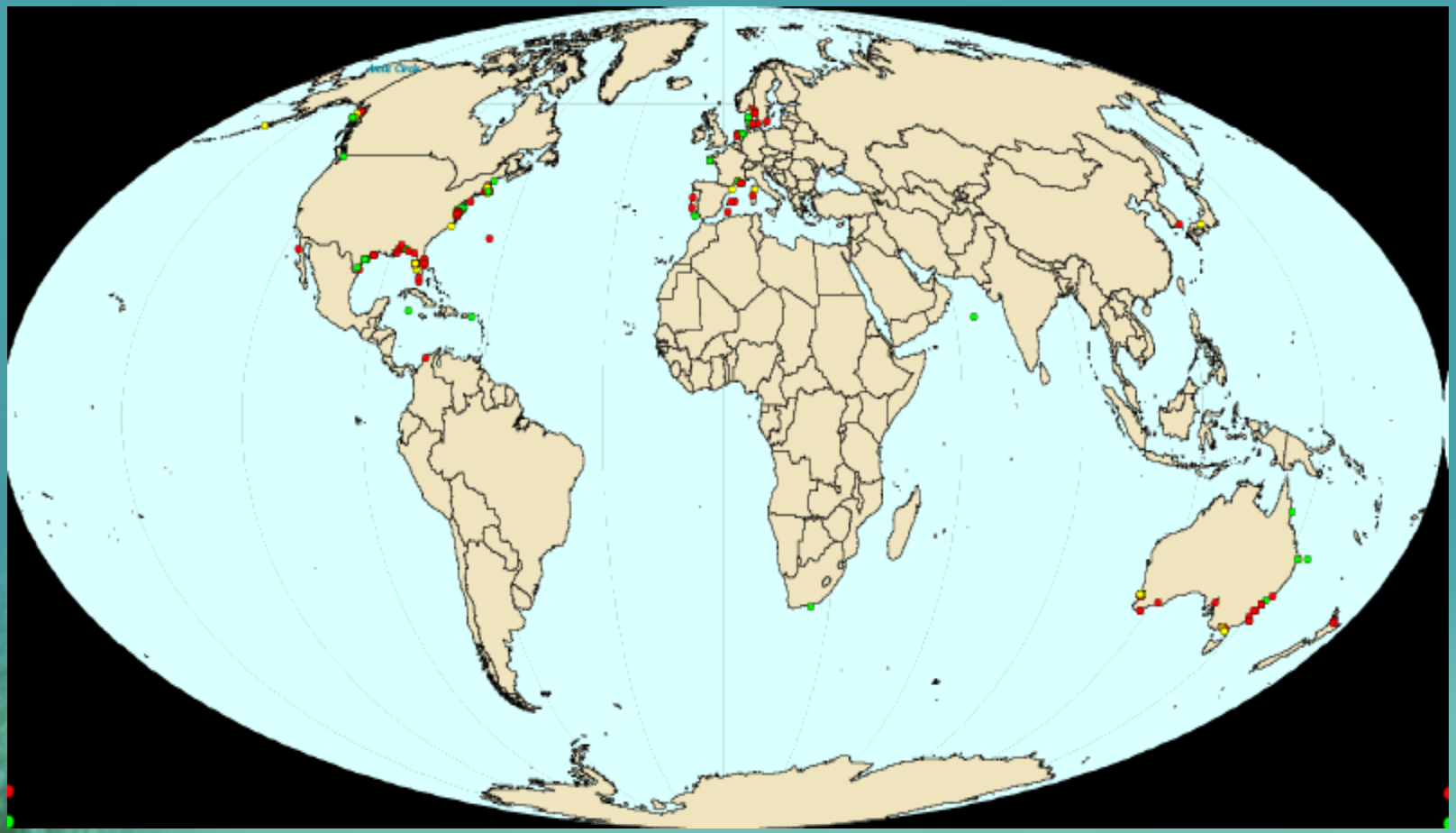


Figure 9-17 Hierarchy of estuarine–coastal landscape that includes estuarine subbasins nested within the greater estuary and vegetated wetlands nested within both. (*After Childers et al., 2000*)

IV. History of SAV decline

a. Global



b. Local

Solomons Island 1950

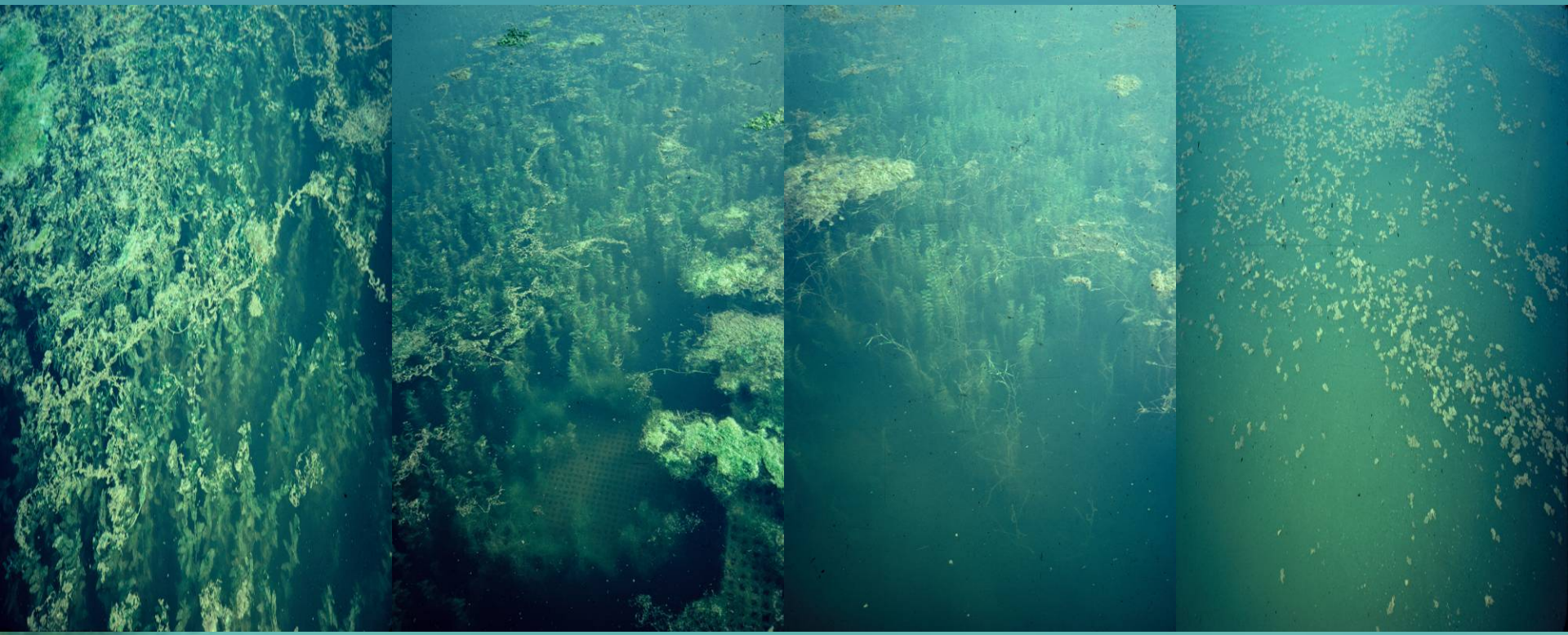
Solomons Island 1979

c. Reasons for disappearance

1. Increased nutrients
2. Increased sediments
3. Degradation of habitat

Increased Nutrients

Control | Low | Medium | High



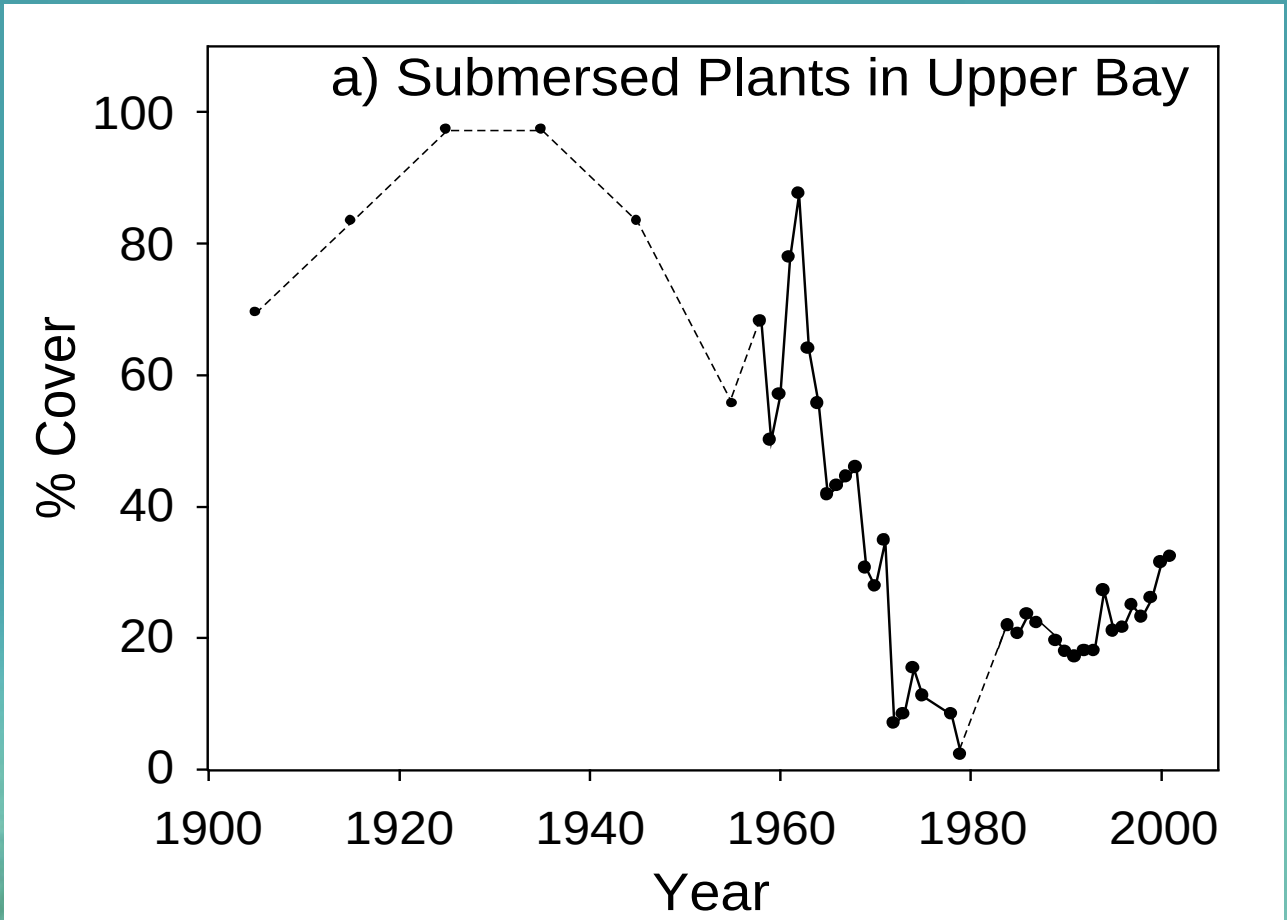
Horn Point Laboratory pond nutrient enrichment experiments

Sedimentation

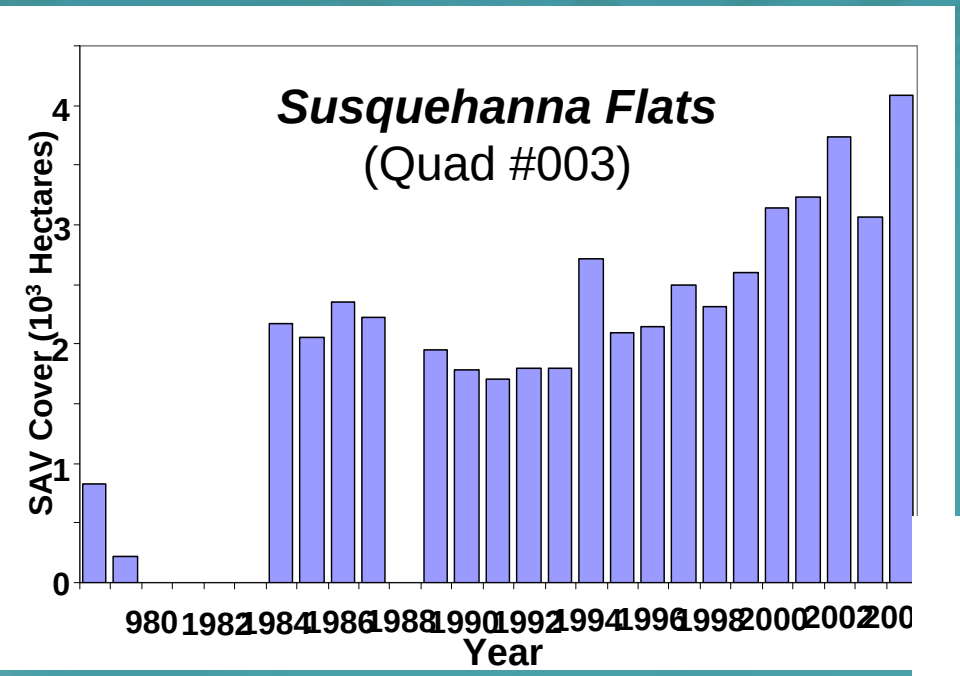
Habitat Loss

V. Case Study: Chesapeake Bay

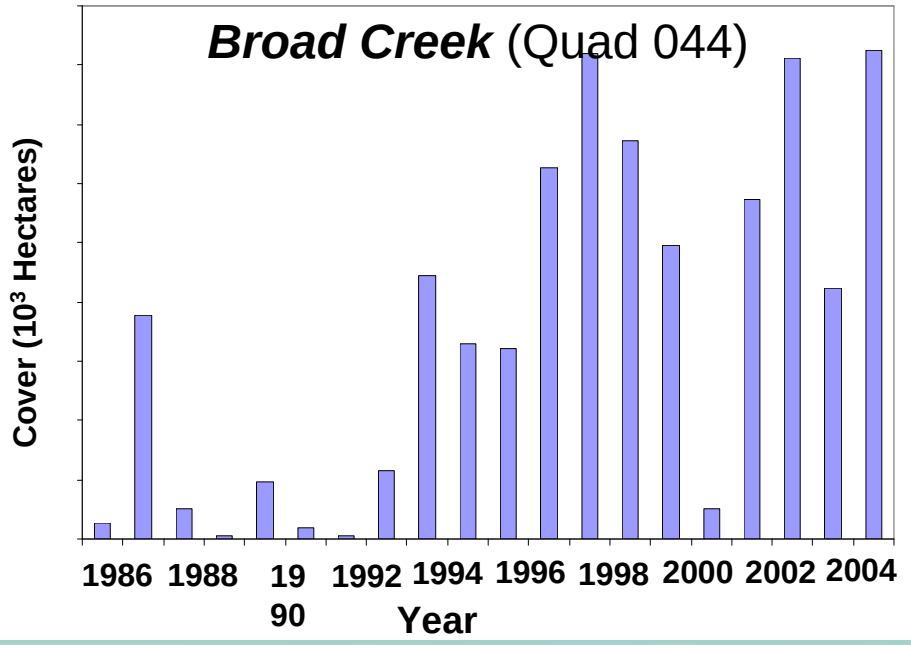
Historical decline and reappearance of SAV in Chesapeake Bay



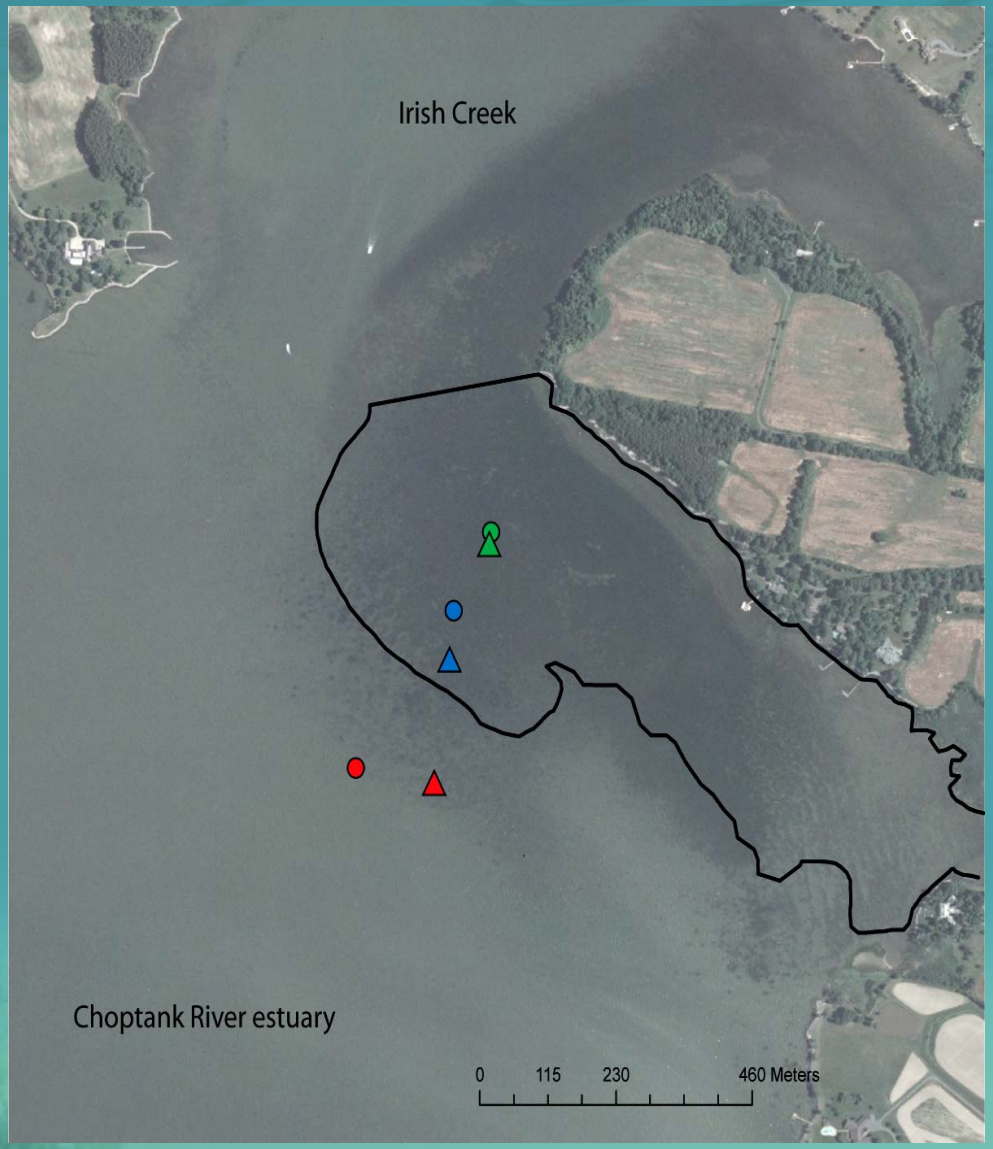
Sites in Chesapeake Bay with “stable” grass beds



WHY?



Grass beds can modify environmental conditions



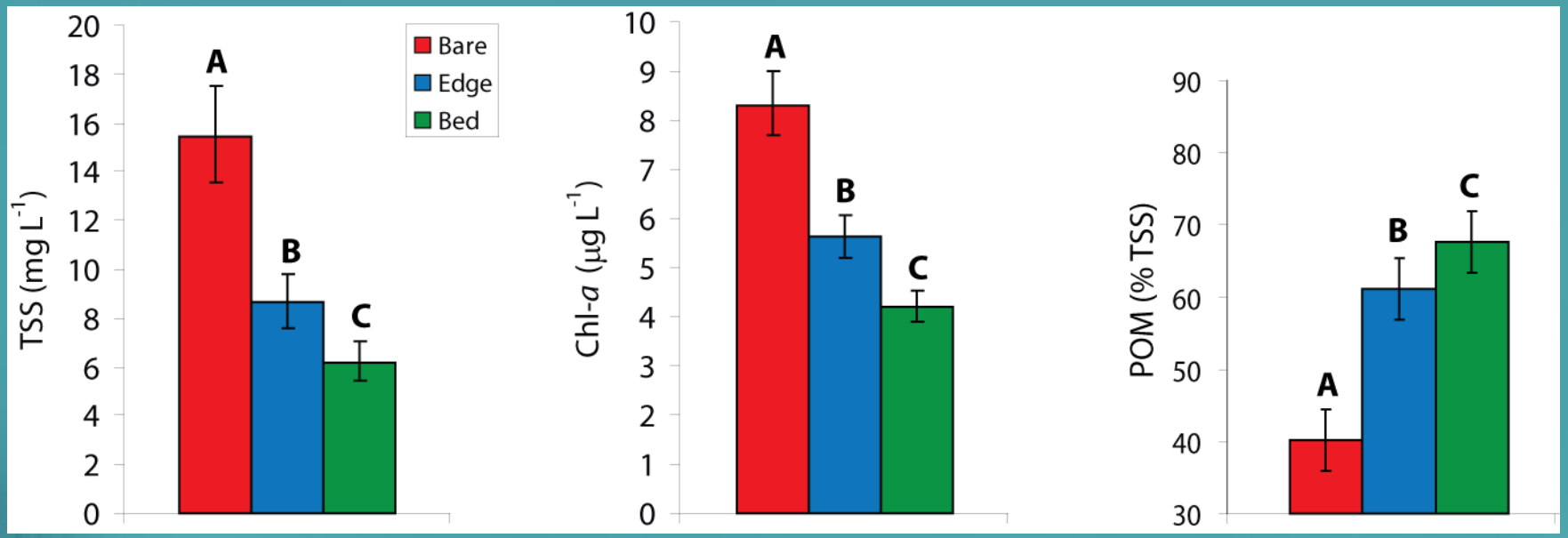
R. Gruber 2009

Water quality inside, at edge and outside grass bed

TSS

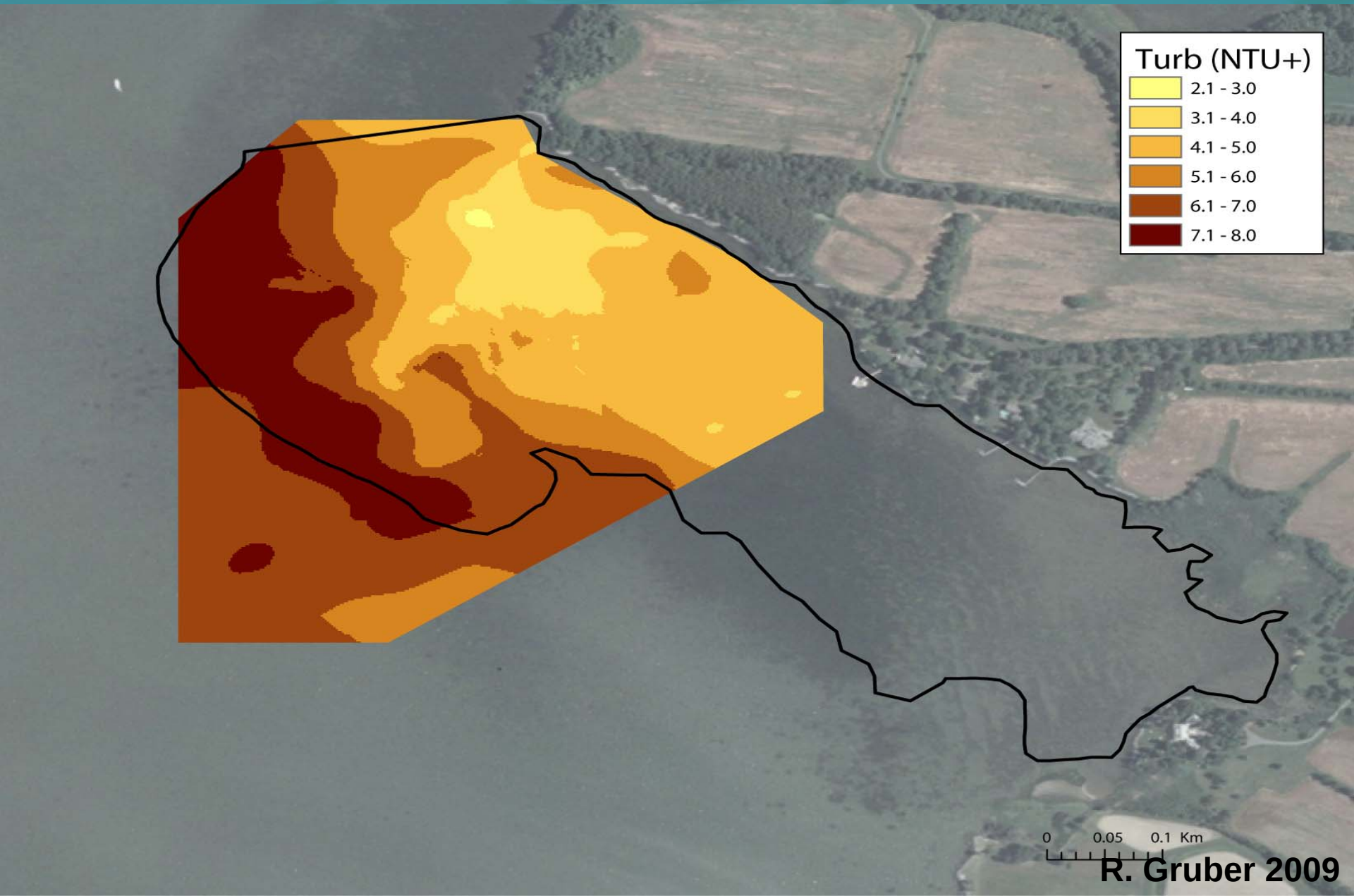
Chl-*a*

POM



R. Gruber 2009

Suspended materials reduced by grass bed



R. Gruber 2009

V. Restoration Efforts

a. Establish criteria for habitat

b. Expand criteria

c. Monitor sites

d. Propagate plants

e. Plant SAV

f. Monitor

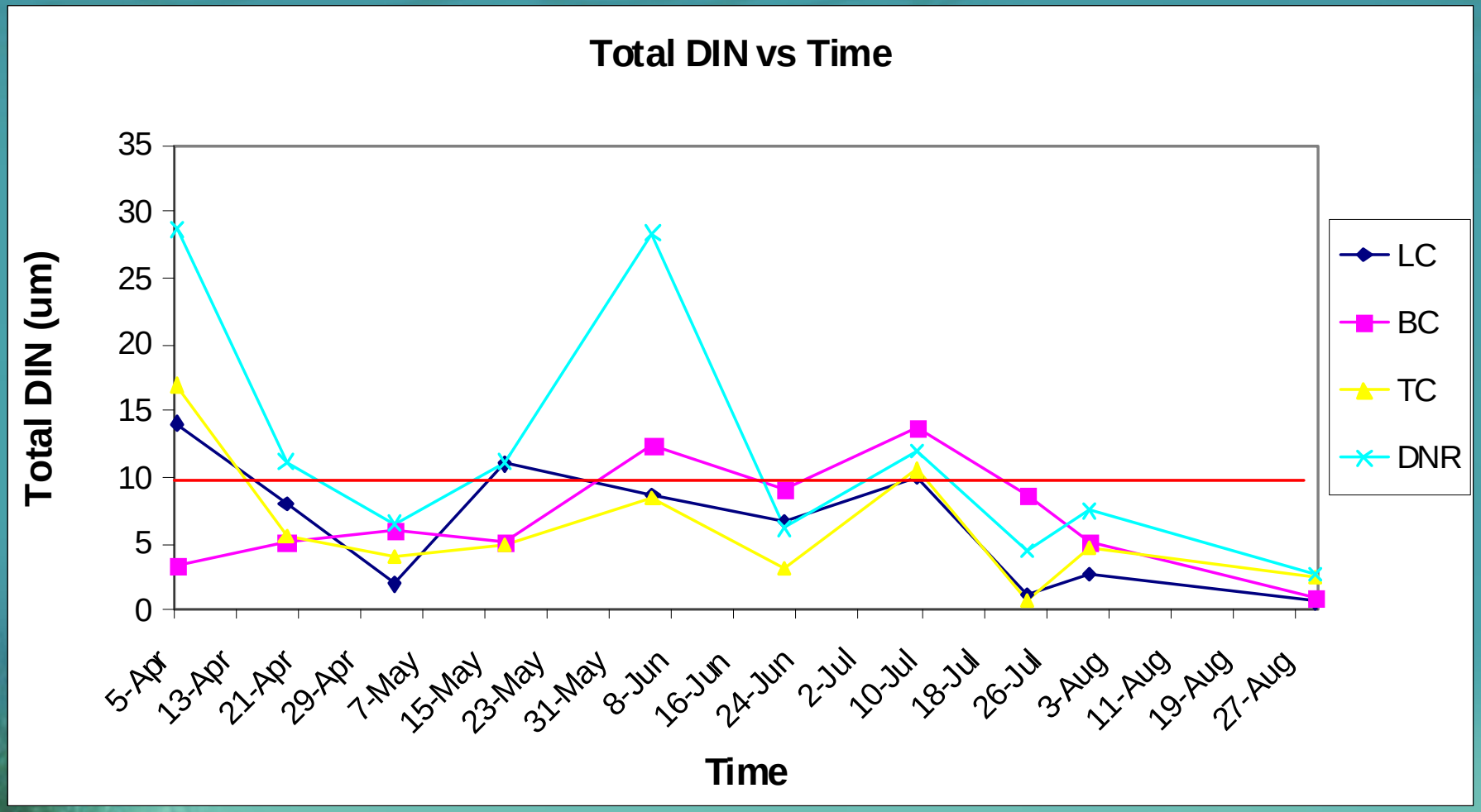
a. Chesapeake Bay Habitat Requirements SAV Restoration To One Meter Depth

- Secchi depth >1.0 m (light)
- Light attenuation coefficient <1.5 (Kd) m^{-1}
- Total Suspended Solids (TSS <15 mg/l)
- Phytoplankton (Chlorophyll *a* <15μg/l)
- Nitrogen (<10.71 μM)
- Phosphorus (<0.01 mg/l)
- Critical life period April-October
- Low to moderate current and waves

From "guidance for protecting submerged aquatic vegetation in Chesapeake bay from physical disruption" Chesapeake Bay Program

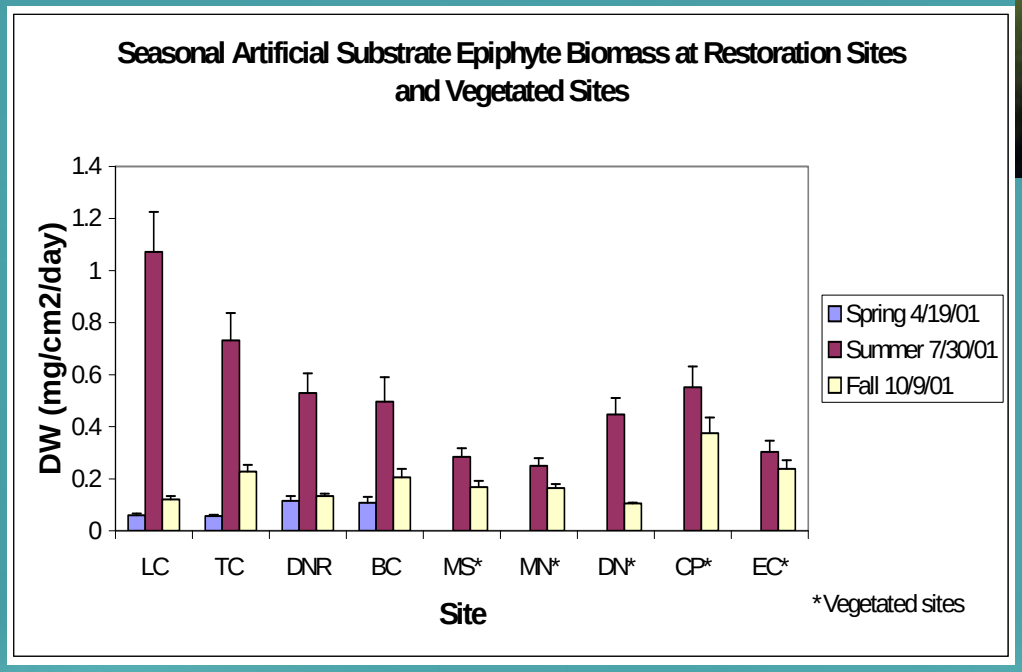
Don't just plant anywhere!

b. Monitor sites for one year for criteria parameters



Need to assess water quality at site.

c. Expand criteria for habitat suitability using artificial substrates



Epiphyte growth at 9 sites in Choptank River

Need easy way to assess planting site!

d. Propagate plants in greenhouses and classrooms

Don’t take from the wild!

e. Plant SAV in suitable sites

Helps assure survival.

f. Monitor for restoration success

Two years minimum.

Summary

SAVs are flowering plants

Special adaptations for living underwater

Important component of estuarine ecosystem

Declined, but have made some recovery, perhaps because can modify own environment

Restoration efforts, tricky, but can be successful

Lagnappe : Grasses doing better

"…Stump Pt., we were greeted with one of the most diverse beds I've ever seen. In an area maybe 4 times the size of my office we saw wild celery, water stargrass, elodea, Potamogeton nodosus, slender pondweed, sago pondweed, coontail, milfoil, Najas minor, southern naiad, and hydrilla." Mike Naylor, MDNR

Restoration success story: These grasses were planted in Broad Creek, a tributary to the Choptank River in 2001. Pictures taken in 2004. Patches continue to expand in 2005.