



Effects of Shading from Bridges on Estuarine Wetlands

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Rationale

A photograph of a concrete bridge over a marshy area. The bridge has two large concrete pillars supporting it. In the foreground, there is a grassy field with several people sitting on the ground. The background shows a body of water and some trees under a clear blue sky.

- **The effects of shading from bridges of different heights on marsh productivity is unknown**
- **If the effects can be quantified, ecosystem damage and costly mitigation can be minimized**

Objective

- **The overall objective of the research project was to determine the effects of shading from bridges, which span salt or brackish-water marshes, on ecosystem structure and function.**

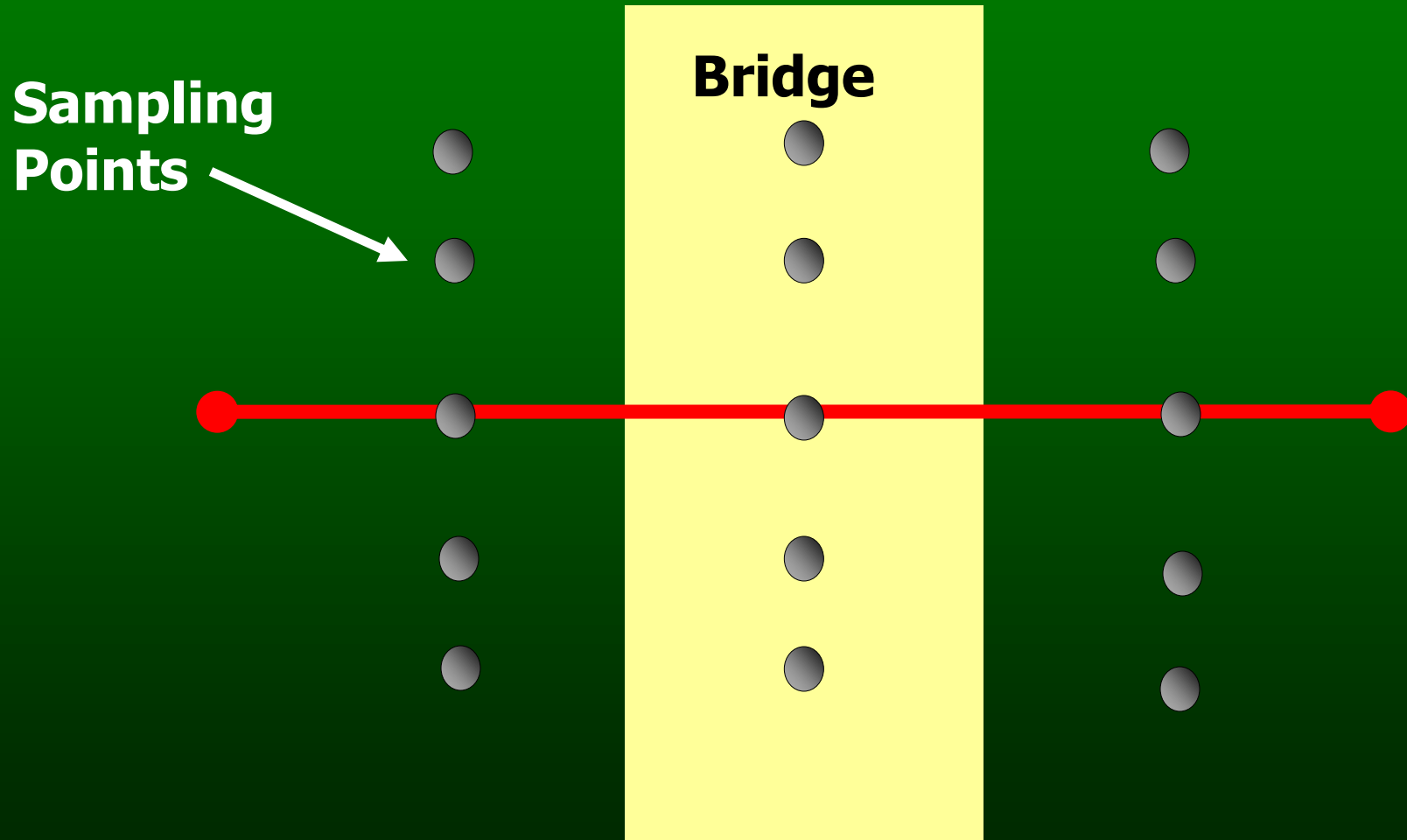
Specific Objectives were to:

1. Evaluate the effects of height and width of bridges on marsh structure and function including emergent vegetation, soils, and benthic invertebrates.
2. Directly assess light attenuation by bridges using sensors to measure photosynthetic photon flux density under and near the bridges.
3. Compare the relative effects of shading on growth of the dominant species of salt marshes, *Spartina alterniflora* (a C₄ plant), with the growth of the dominant species in brackish marshes *Juncus roemerianus* (a C₃ plant).

Variables Measured

- **Plant Biomass**- Measure of primary production
- **Soil C and N**- Measure of change in nutrient pools
- **Light**- Direct measure of bridge shading
- **Infauna**- Indicator of secondary production

Materials and Methods



Materials and Methods

A photograph of a person in a green shirt standing in a marshy area next to a red canoe. The canoe has "RCSU-040 5" written on it. In the background, there is a large concrete structure, possibly a bridge or pier, and a body of water under a cloudy sky.

- Biomass
- Soils
- Light
- Infauna

Locations of Bridge Study Sites

Bogue Inlet

A long, multi-span concrete bridge spans across a wide body of water. The bridge features several tall, cylindrical concrete piers supporting a continuous deck. The water is dark blue with gentle ripples. In the background, a clear blue sky is visible with a few wispy clouds and a single bird in flight on the right side. A utility tower is also visible on the right side of the bridge.

Height 19.8 m

Width 11.1 m

H/W Ratio 1.78

Spartina alterniflora

Ocean Isle



Height 15.2 m

Width 9.9 m

H/W Ratio 1.55

Spartina alterniflora

High transect

Height 14.7m

Width 10.7

H/W Ratio High 1.36

New River

Low transect

Height 7.3 m

Width 10.7

H/W Ratio 0.68

Spartina alterniflora

Salter Creek

A photograph of a concrete bridge over a body of water. The bridge has several large, cylindrical concrete piers supporting a wide, flat deck. The bridge curves into the distance. In the foreground, there is a field of tall, dry grass. In the background, there is a line of trees under a clear blue sky.

Height 11.6 m

Width 10.7 m

H/W Ratio 1.08

Juncus roemerianus

New Bern

Height 8.5 m, Width 16.7 m

H/W Ratio 0.51

Spartina cynosuroides

Wrightsville Beach



Height 5.85 m

Width 20.82 m

H/W Ratio 0.28

Spartina alterniflora



Cedar Island

Height Range 2.9-15.5 m

Width 9.9 m

H/W Ratio 0.29-1.57

Spartina alterniflora,

S. cynosuroides, *S. patens*,

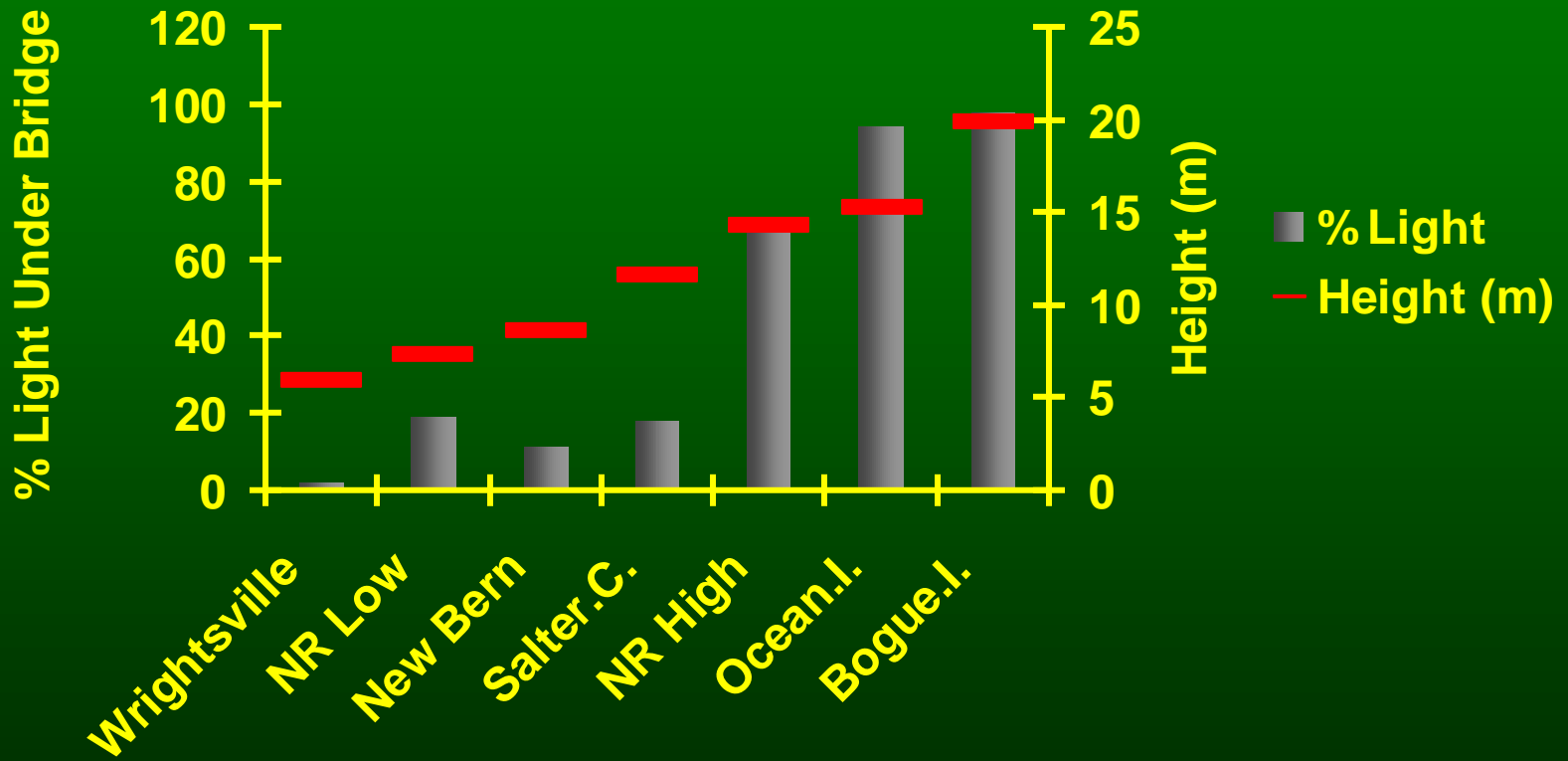
Juncus roemerianus

Light Measurements

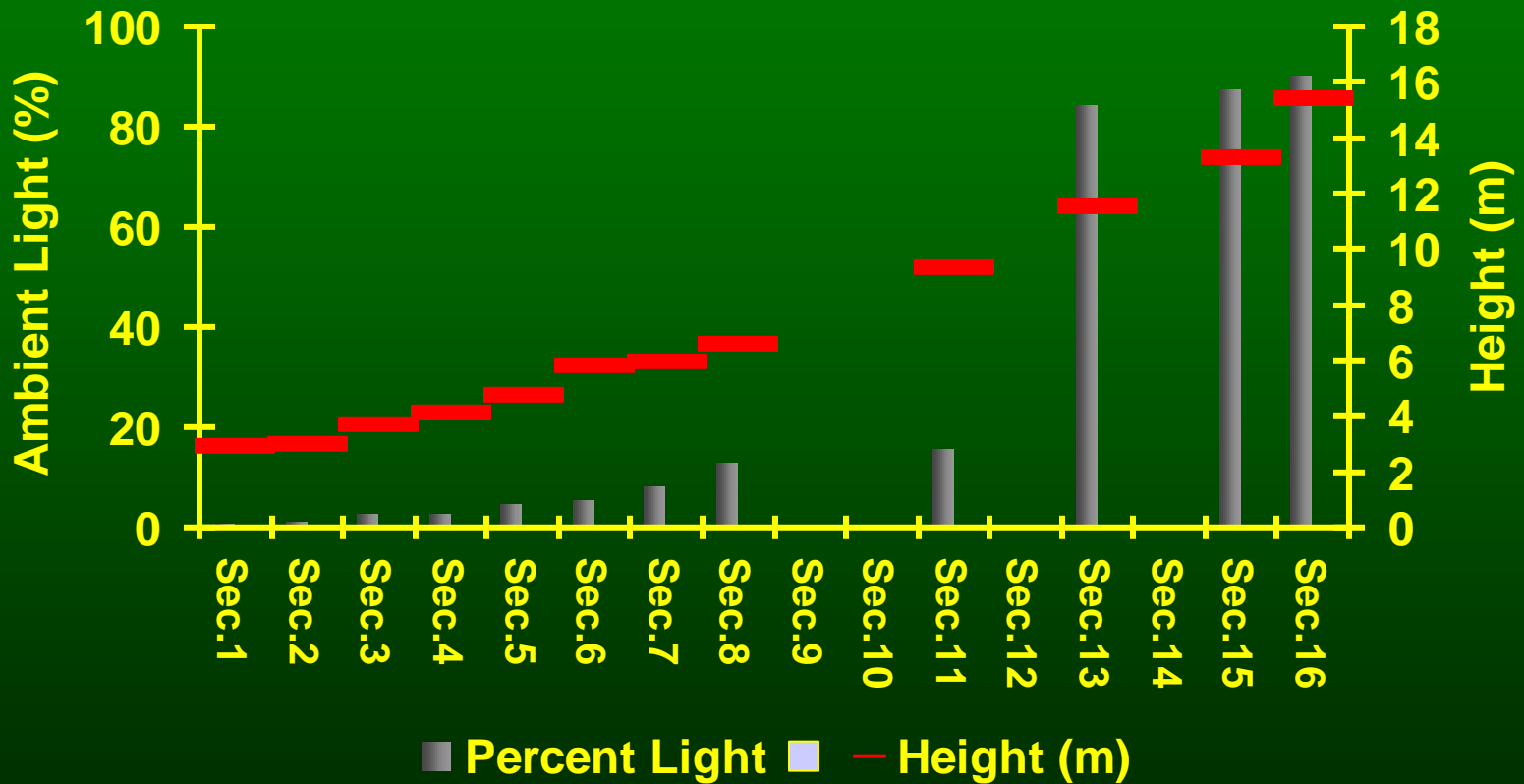


9 ppt

Per cent Ambient Light Under Bridges

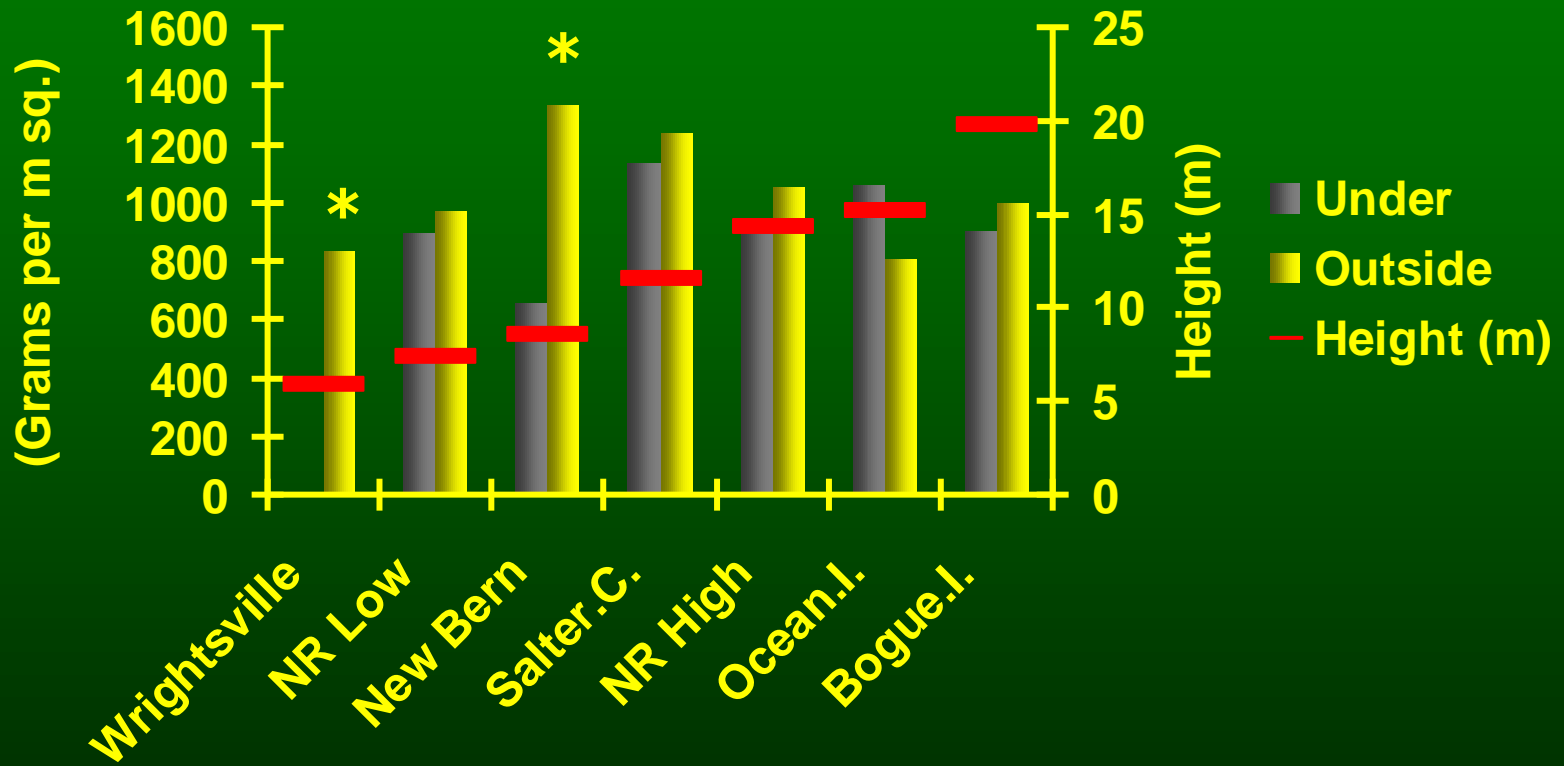


Per cent Ambient Light Beneath Cedar Island Bridge

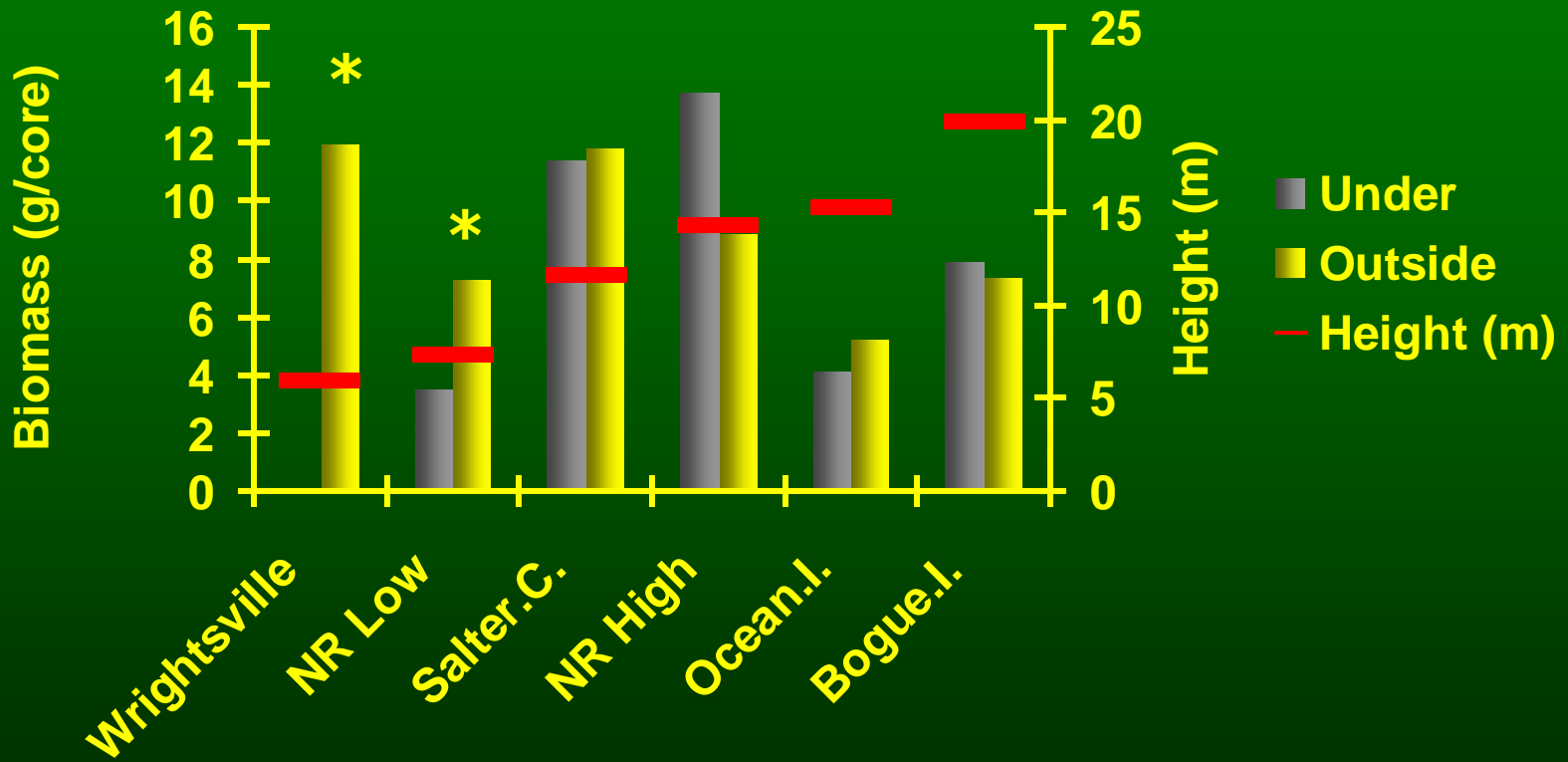


Effects of Shading on Above and Below-Ground Biomass

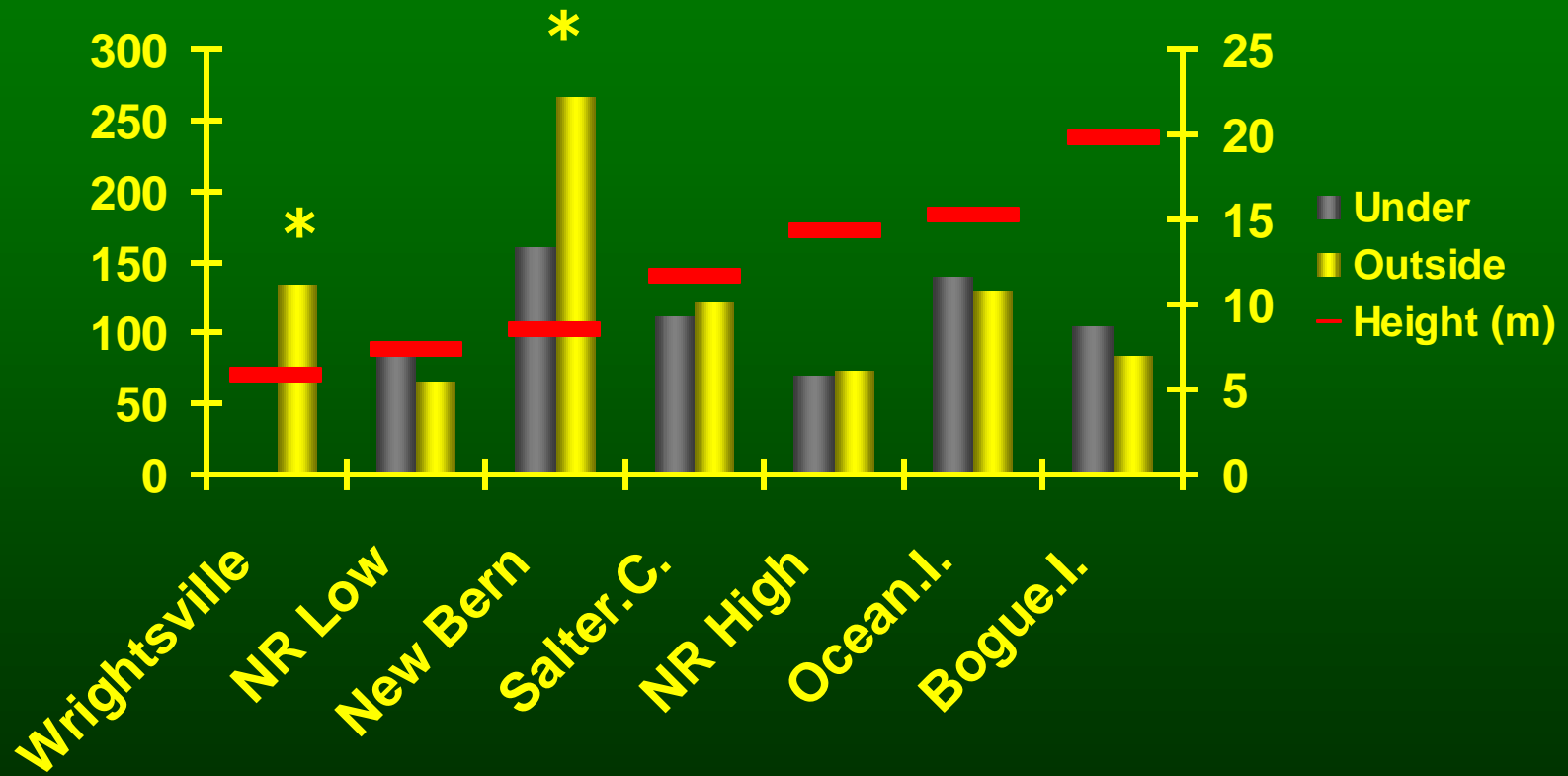
Aboveground Biomass (g/m²)



Below-Ground Biomass

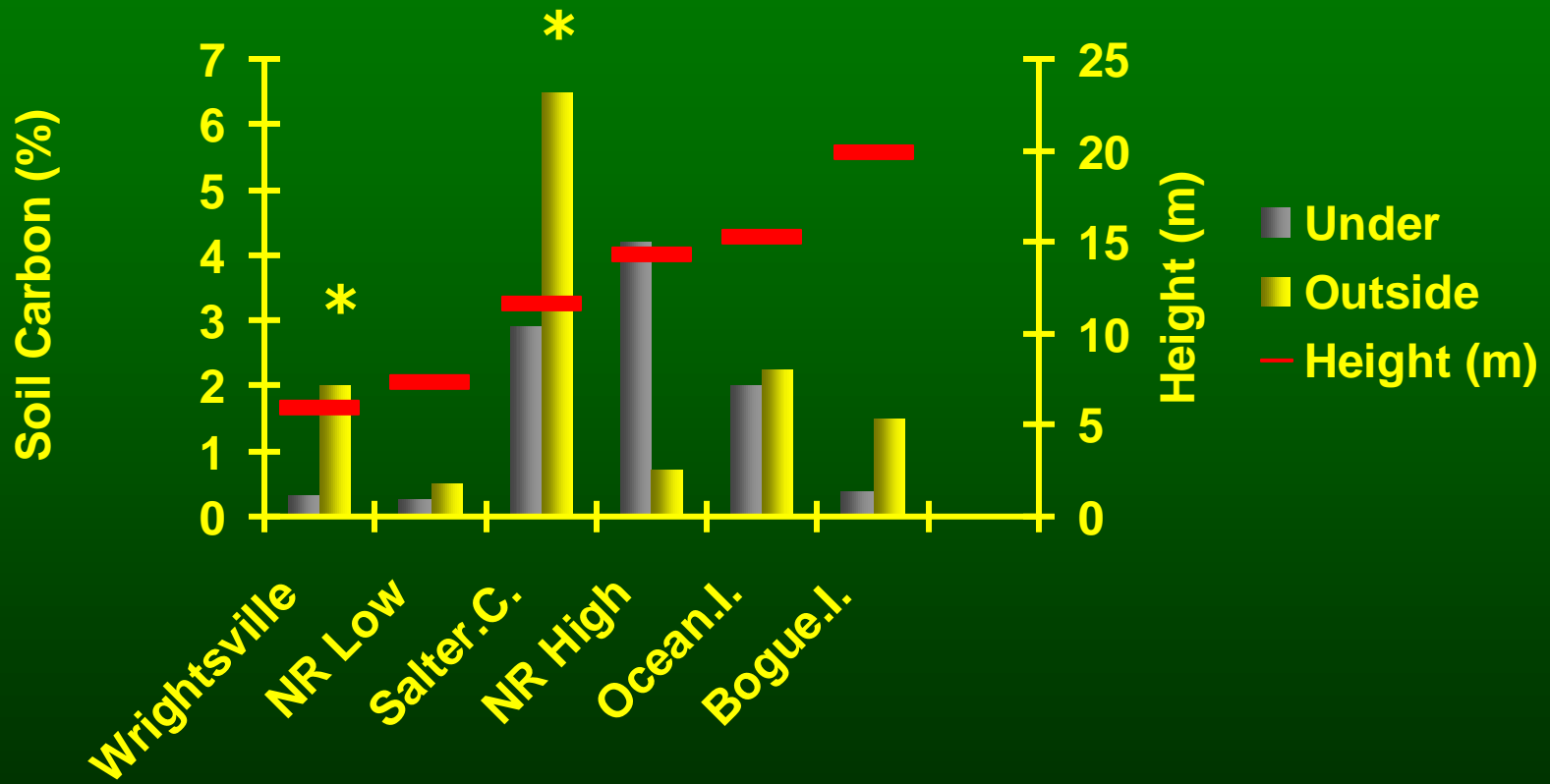


Stem Heights

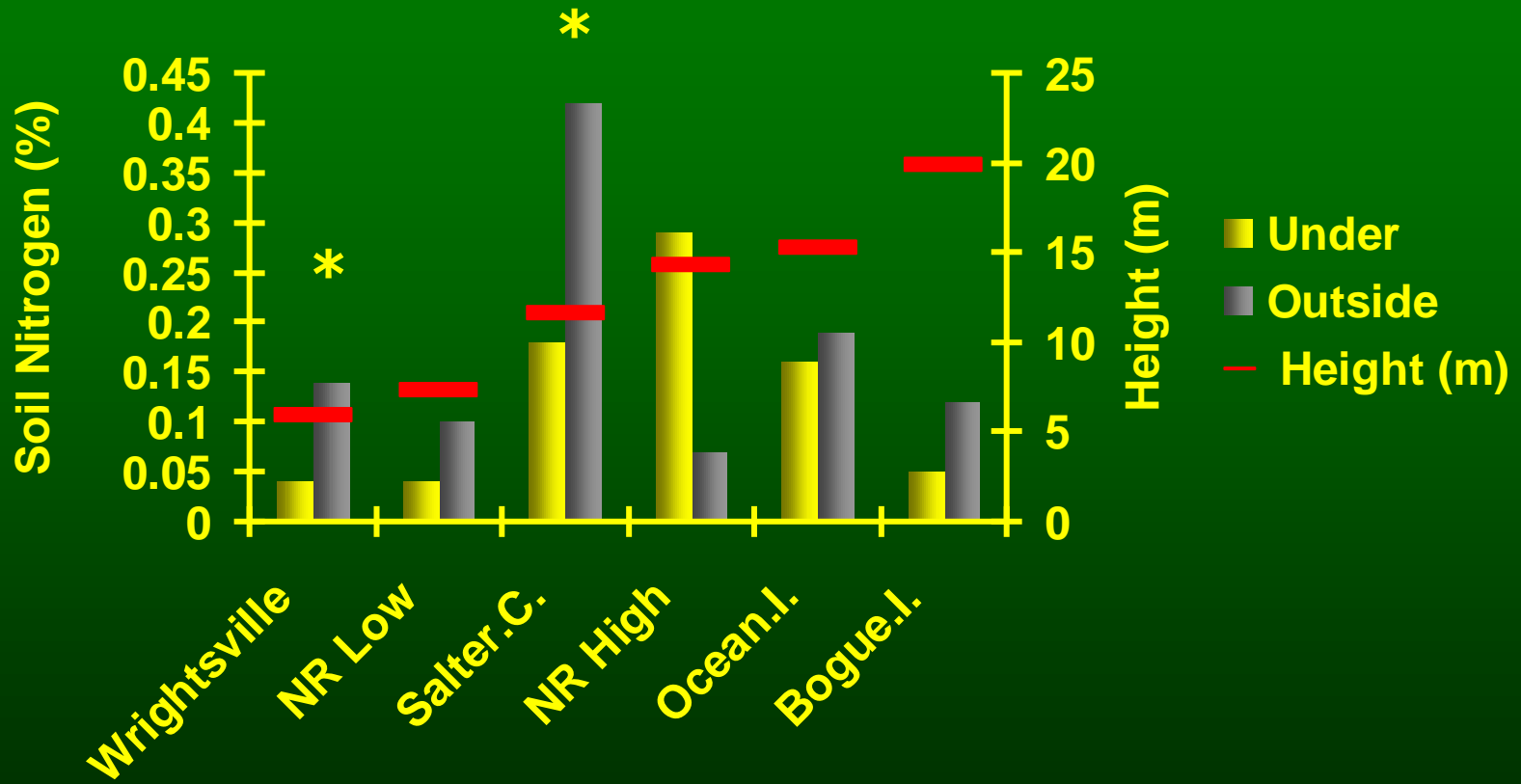


Effects of Shading on Carbon and Nitrogen Pools

Soil Carbon

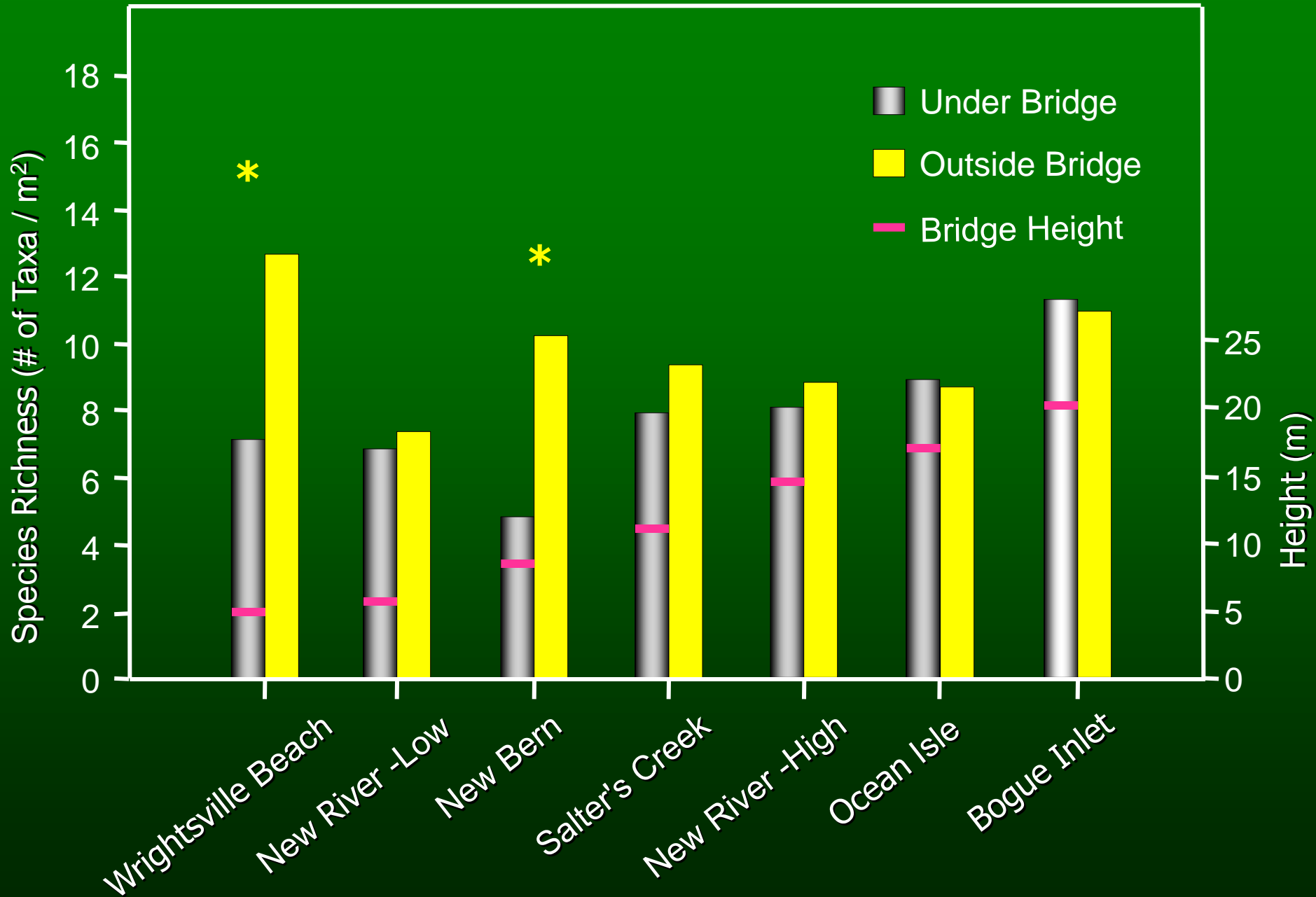


Soil Nitrogen

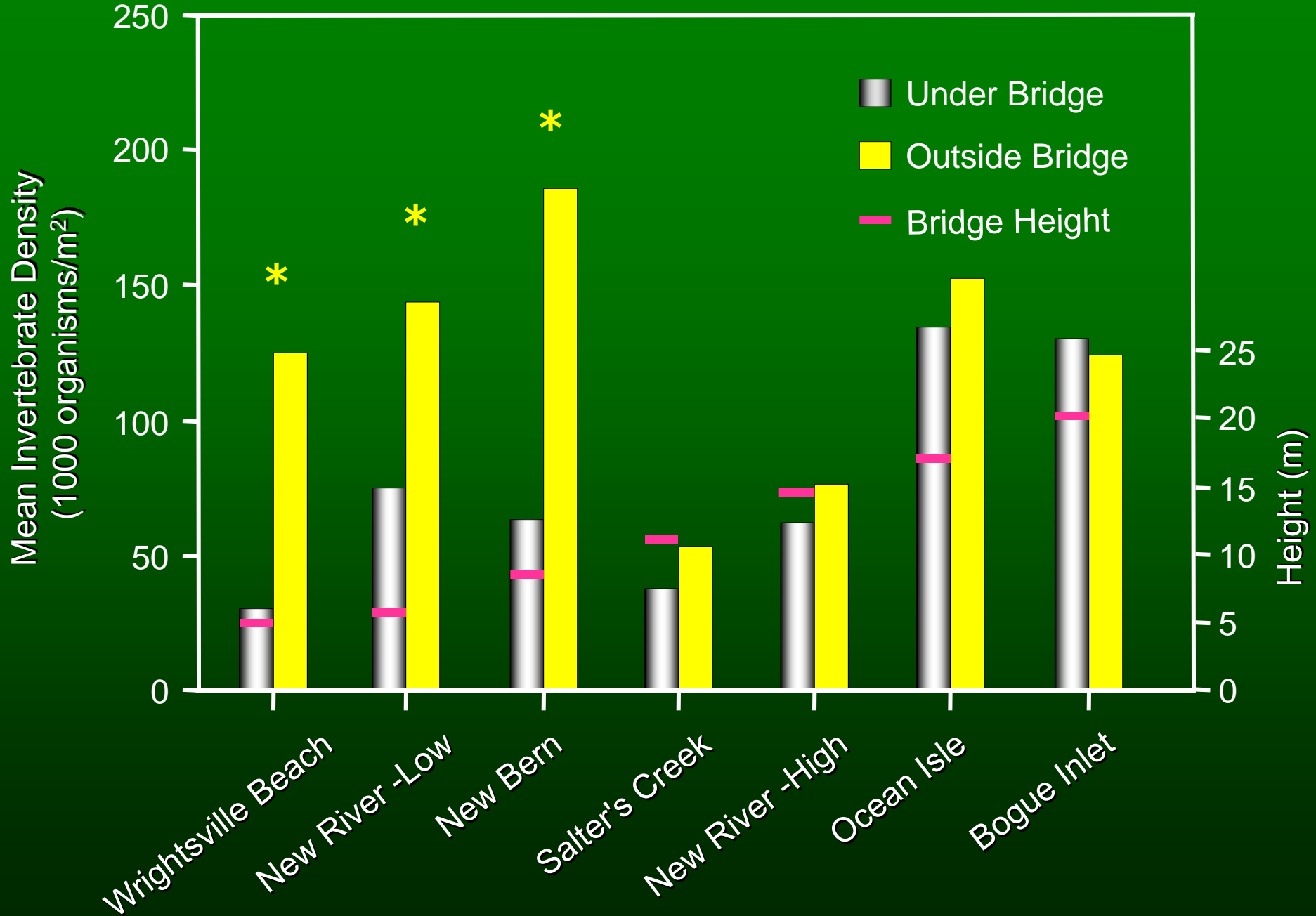


Effects of Shading on Infauna

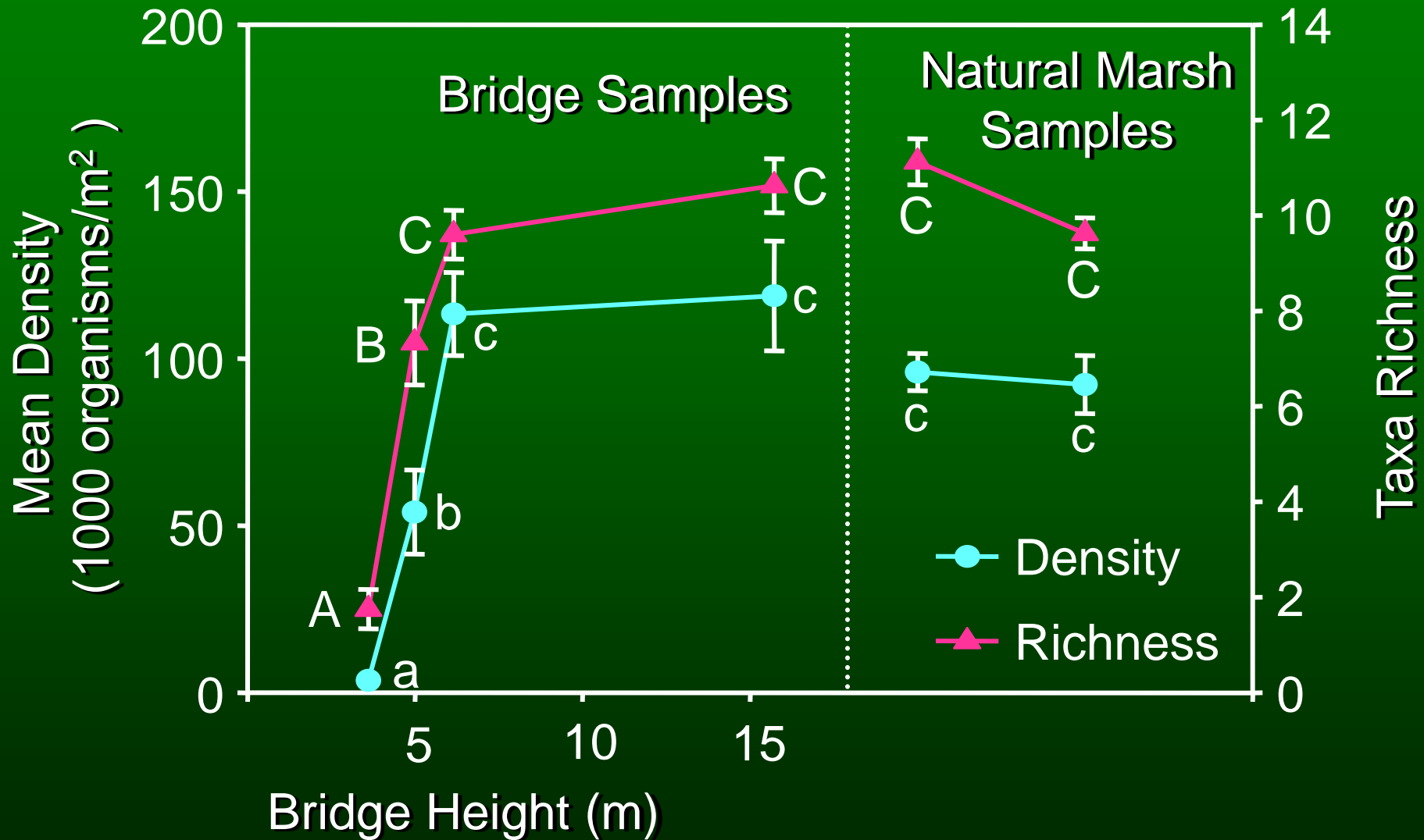
Invertebrate Species Richness



Invertebrate Density (2000 Data)



Cedar Island 2001 Invertebrate Density and Richness

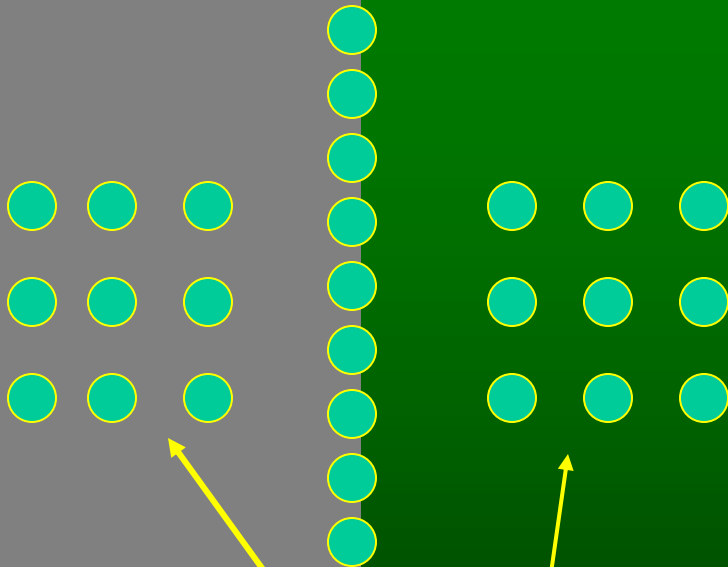


Evaluation of Marsh Plant Seedling Growth in Pots Transplanted Under the Cedar Island Bridge at Various Bridge Heights



Cedar Island Planting Layout

Bridge



- 3 Species in each randomized block (*Spartina alterniflora*, *S. patens*, *Juncus roemerianus*)

- 3 Blocks per bridge section

- Replicated at varying heights

Plantings

















Planting

Conclusions

- **Taller bridges greatly reduce the negative effects associated with shading.**
- **Lower and wider bridges reduce light to point that marsh productivity is affected.**
- **In general, one lane bridges greater than 9 m (29.5 ft) in height were found to have no effect on marsh productivity**
- **The Height/Width ratio takes into account the two main bridge characteristics that determine the degree of shading.**
- **Bridges with Height/Width ratios greater than 0.7 had little effect on marsh productivity.**

- **Stated simply, bridges with heights greater than 70% of their widths have little effect on marsh productivity.**
- **A conservative generalization might be that when heights of bridges are equal to or greater than widths, there will be no shading effects on marsh ecosystems**