Regional adaptation in feeding preference for chemically-rich seaweeds by the marine herbivore, *Ampithoe longimana*

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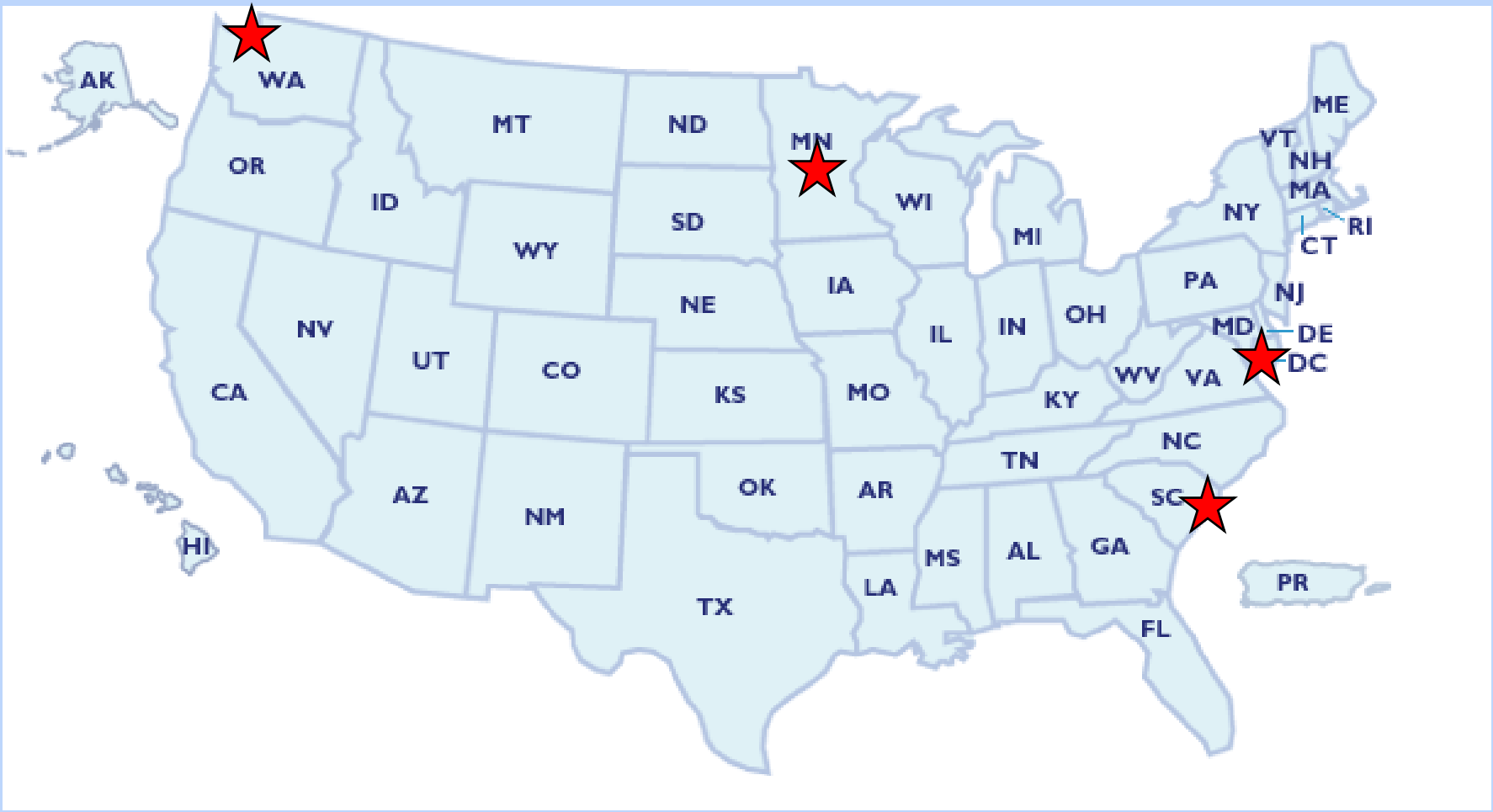
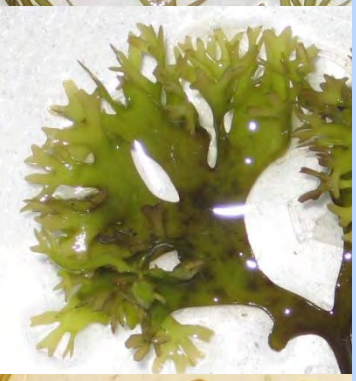
U.S. Senate Commerce Committee

A little about me…



Ecology and Evolution of Seaweed Herbivore Interactions





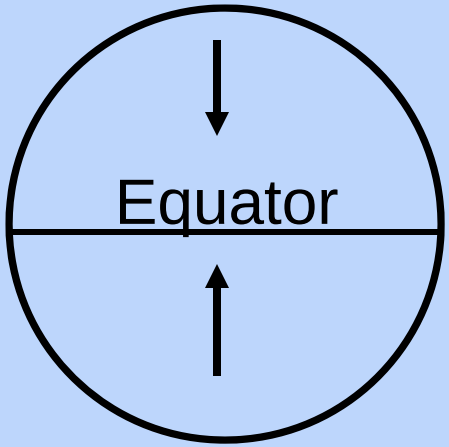

Seaweed Defense

Herbivores can consume 60-100% of a plant's total daily production (Hay and Steinberg 1992)

Seaweeds use physical, chemical, spatial and temporal defenses to protect themselves against their herbivore predators (Duffy and Hay 1990)

Seaweeds produce an assortment of secondary metabolites to protect themselves from herbivores (Hay and Fenical 1988, Paul 1992)

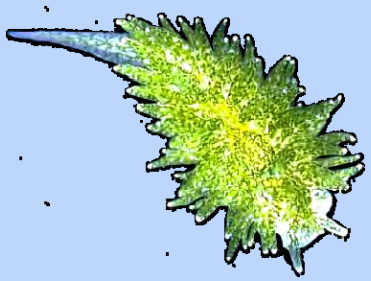
Biogeography of Seaweed Herbivore Interactions



- With decreasing latitude:
  - Herbivory pressure increases (Gaines and Lubchenco 1982)
  - Palatability of seaweeds decreases (Hay and Fenical 1988, Cronin and Hay 1996)
  - Concentration and diversity of chemical defense compounds increases (Paul *et al.* 2001)

More intense herbivory in the tropics and subtropics has caused seaweeds in these areas to evolve chemical defenses

Herbivores?

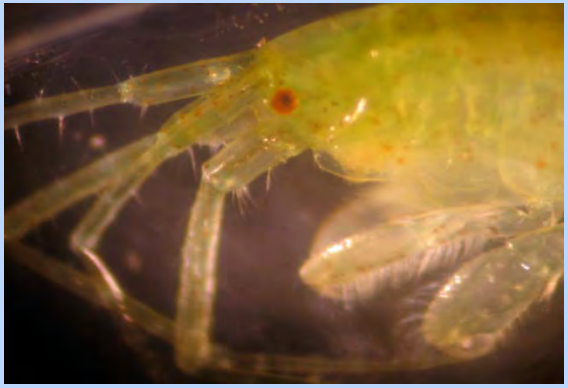


- They still have to eat…

Have increased chemical defenses of seaweeds in the tropics and subtropics caused herbivores in these areas to evolve increased tolerance???

Ampithoe longimana

- Relatively sedentary
- Lives in tubes on seaweed
- No larval dispersal stage

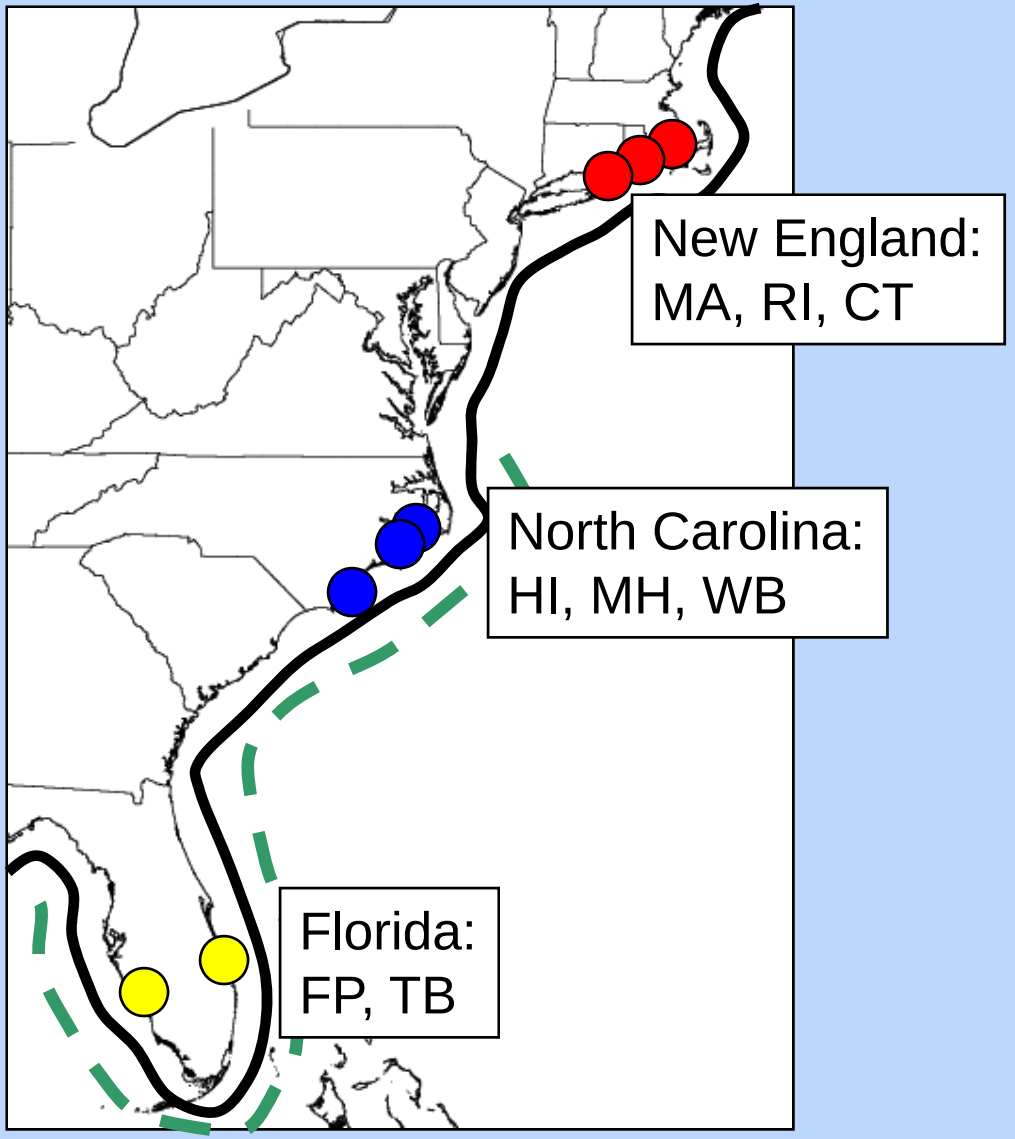


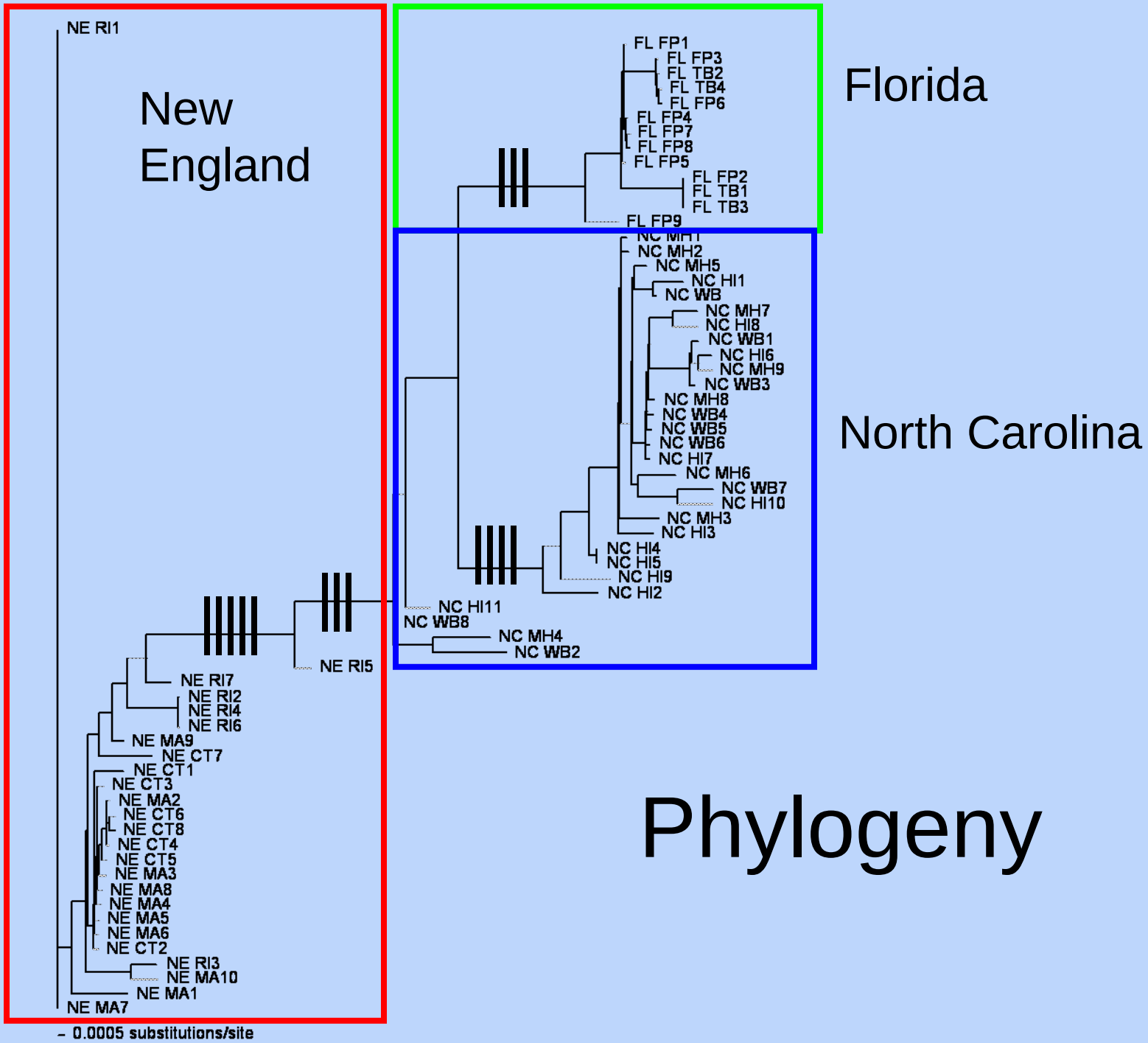
Dictyota

- *Dictyota* produces diterpene alcohols and polyphenolics
- Omnivorous fish avoid *Dictyota* (Cronin and Hay 1996)

Distribution/ Collection

- *A. longimana*
  - Gulf of Mexico to Maine
- *Dictyota spp.*
  - Tropical and Subtropical Algae




New England
Florida
North Carolina
NE RI1
NE RI7
NE RI2
NE RI4
NE RI6
NE MA9
NE CT7
NE CT1
NE CT3
NE MA2
NE CT6
NE CT8
NE CT4
NE CT5
NE MA3
NE MA8
NE MA4
NE MA5
NE MA6
NE CT2
NE RI3
NE MA10
NE MA1
NE MA7
NE RI5
FL FP1
FL FP3
FL TB2
FL TB4
FL FP6
FL FP4
FL FP7
FL FP8
FL FP5
FL FP2
FL TB1
FL TB3
FL FP9
NC MH1
NC MH2
NC MH5
NC HI1
NC WB
NC MH7
NC HI8
NC WB1
NC HI6
NC MH9
NC WB3
NC MH8
NC WB4
NC WB5
NC WB6
NC HI7
NC MH6
NC WB7
NC HI10
NC MH3
NC HI3
NC HI4
NC HI5
NC HI9
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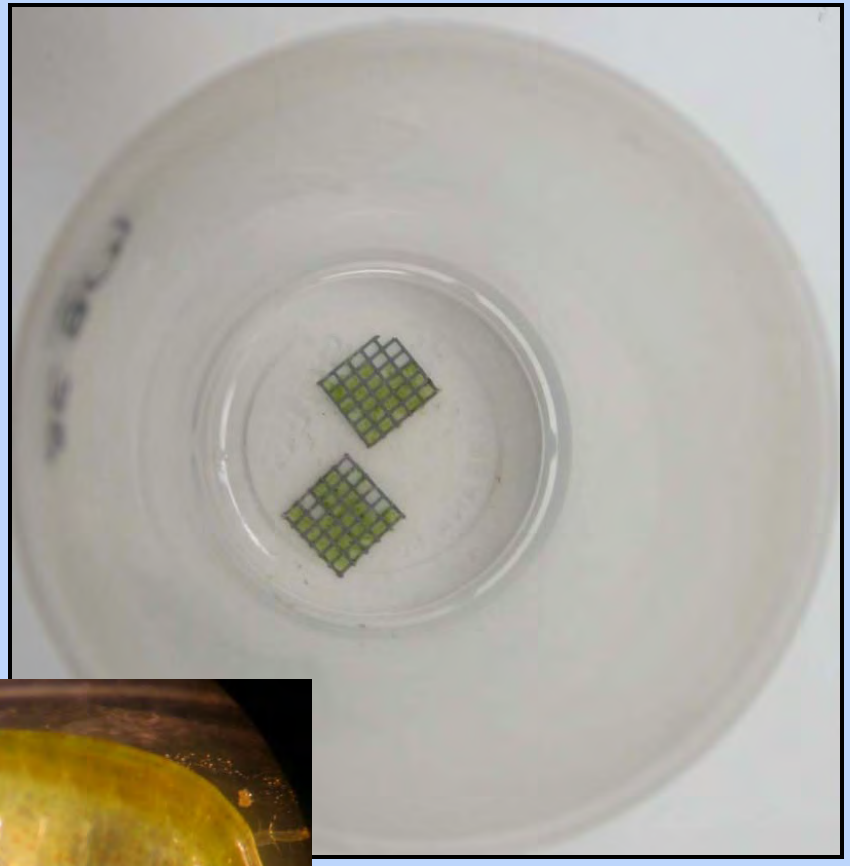
NC HI11
NC WB8
NC MH4
NC WB2
0.0005 substitutions/site

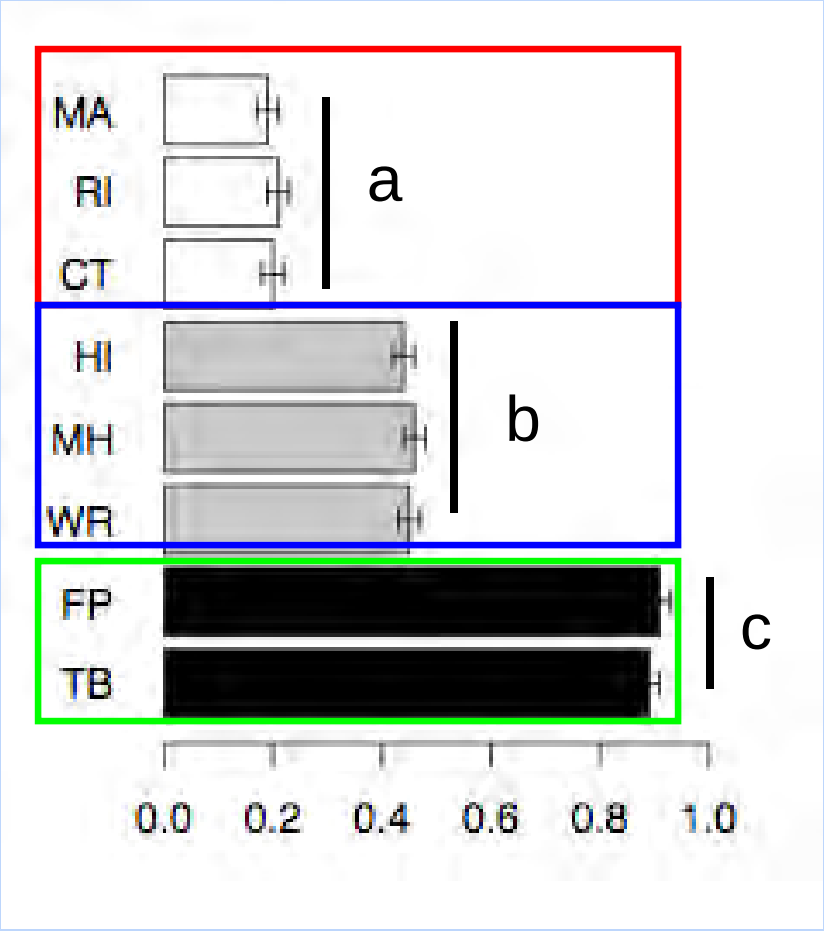
Phylogeny

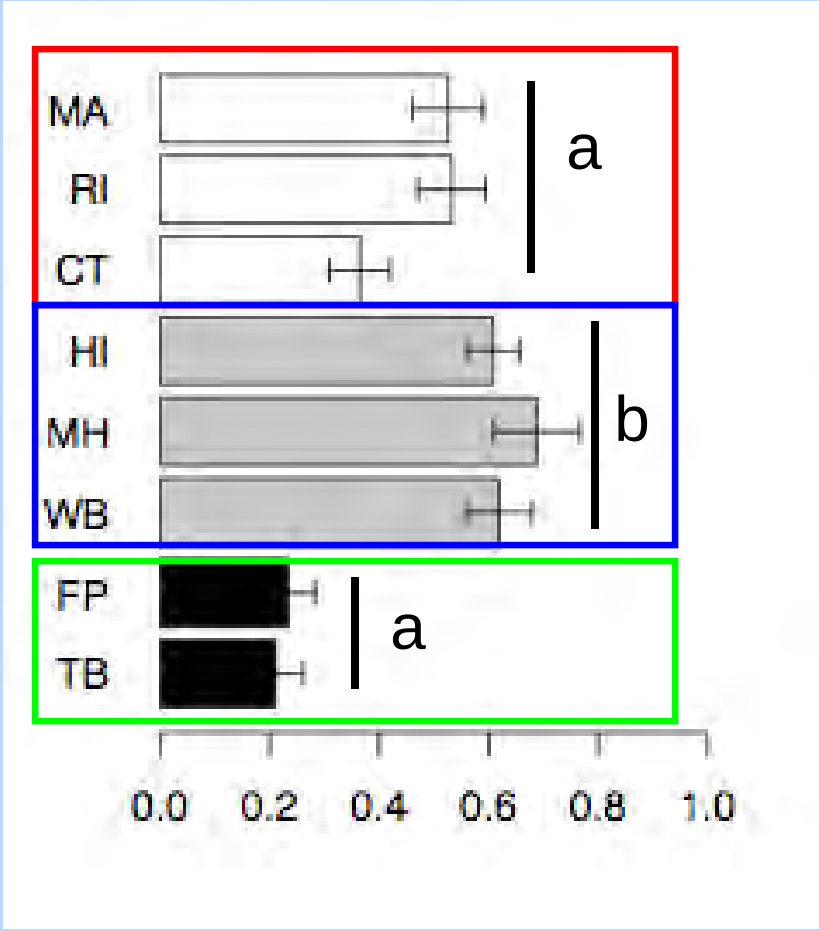
Feeding Assays



What we expected

What we observed

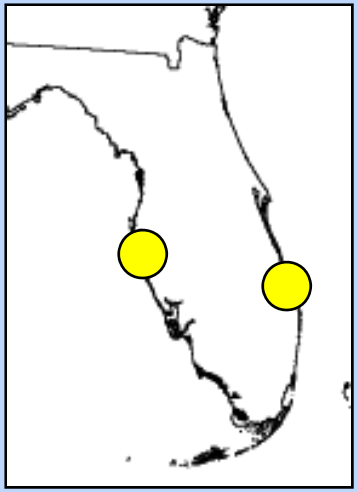




% Treatment Consumed

What does this mean?

- NC *A. longimana* have greater preference for *Dictyota* than NE and FL *A. longimana*
- This preference is mediated by algal chemical defense compounds



- What is going on in Florida?
  - Literature search for historical records describing the seaweed communities in Florida estuaries
  - Field survey of local host use

Regional Host Use

- *Dictyota* is not abundant in Florida estuaries
- NE and FL amphipods live on seaweeds not known to be chemically defended
- NC amphipods live primarily on brown seaweeds with lipophilic chemical defenses, especially in the genus *Dictyota*





LOCAL ADAPTATION!?!

- *A. longimana* appears to have locally adapted feeding preferences for *D. menstrualis* and *D. ciliolata*
- Herbivores in the tropics and subtropics do not necessarily have higher tolerance for seaweed chemistry than temperate herbivores
- Local seaweed communities drive feeding preference evolution

Washington D.C.

Life with the Senate Commerce Committee

- Areas of “Expertise”
  - Ballast Water
  - Marine Protected Areas
  - Harmful Algal Blooms
  - Coastal Zone Management
  - Climate Change
  - Sea Grant
  - Marine Mammals
  - Domestic Fisheries
  - International Fisheries
  - Coast Guard
- Hearings
  - Select topics and witnesses
  - Memos to Senators and Staff
  - Talking points, opening statements, and questions
- Markups
  - Vet language with Senate offices
  - Memos to Senators and Staff

Legislation

- Creating Legislation
  - Sea Grant Reauthorization
  - Ballast Water Treatment
  - Marine Mammal Research
  - Marine Mammal Stranding
  - Ocean Acidification
  - Climate Modeling
  - National Marine Sanctuaries
  - Maritime Pollution Prevention
  - Seafood Safety

- Moving Legislation
  - Reid Mega-package
  - Climate Change
  - Coast Guard Bill
  - Seafood Safety
- Negotiations
  - Conferencing with the House
- Creating Laws!!!
  - Marpol Annex VI


Thank You!

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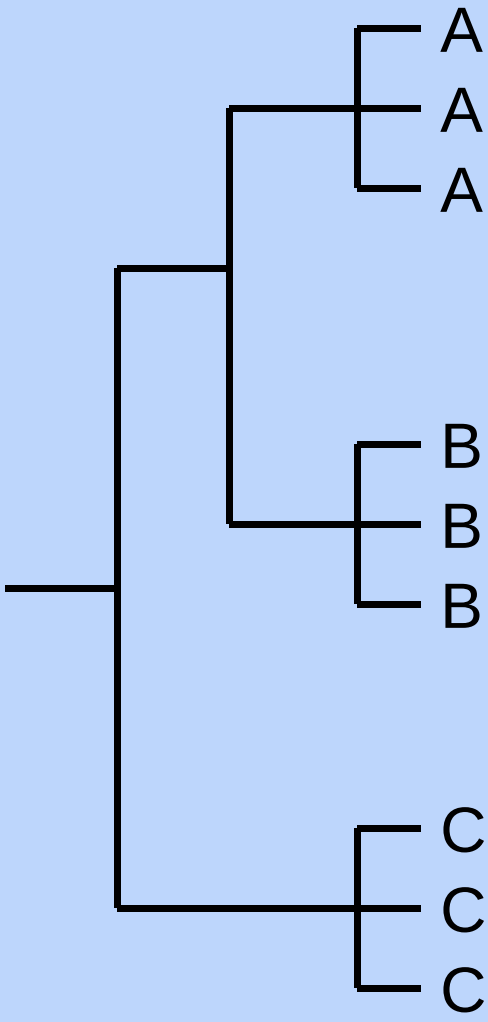
Low Gene Flow

Local Adapatation



High Gene Flow

Panmixia