Scallop Habitat Assessment Models

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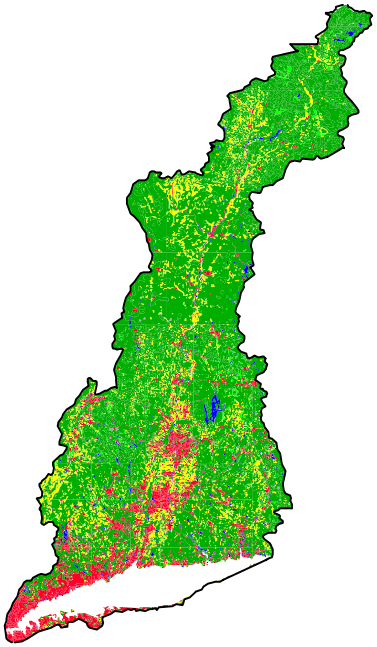
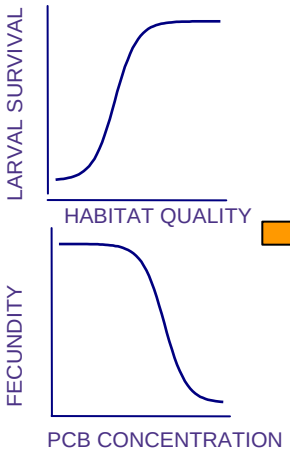
NHEERL Ecological Effects Research

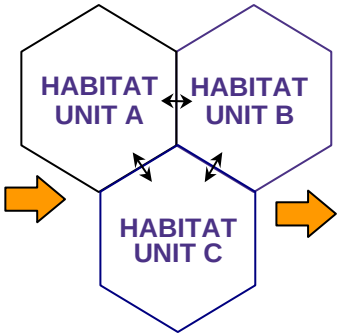
- The Aquatic Stressors Framework
  - describes research to understand the relations between key stressors of concern for EPA's Office of Water and responses of populations of fish, shellfish, and aquatic-dependent wildlife
- The Wildlife Research Strategy
  - approach for integrating NHEERL's ecological effects research focusing on risks to populations of wildlife and aquatic species

NHEERL Wildlife Research Strategy





$$n_t = Mn_{t-1}$$



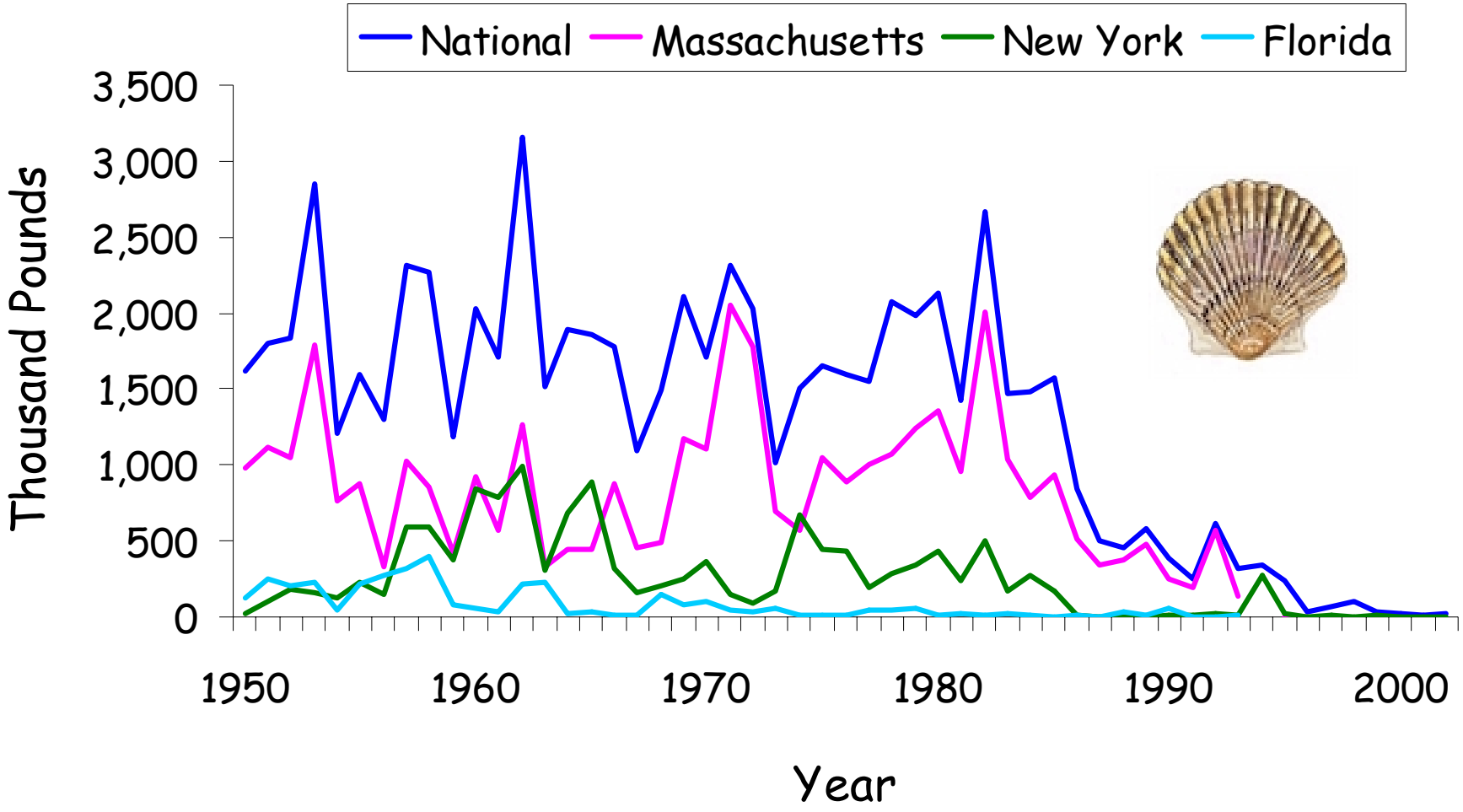
Population Level Assessment of risks


AqS Goal:
Develop Methods for Predicting Biological Effects of Habitat Alteration
How do populations of fish, shellfish, and aquatic dependent wildlife respond to habitat alteration?

Why examine how changes in habitat affect populations of bay scallops?

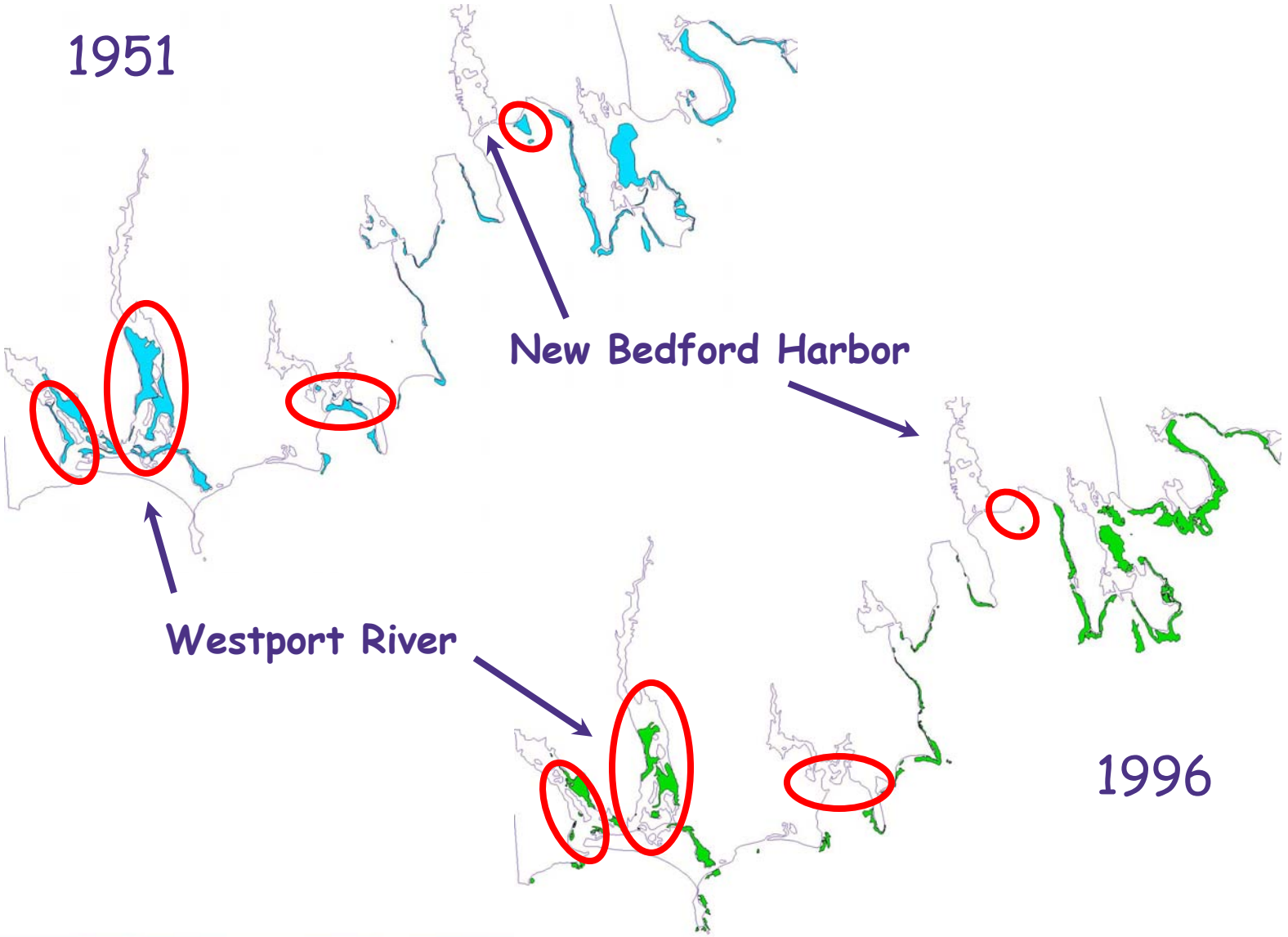
- Bay scallops are a high priority species
- Estuarine wetlands are priority ecosystems
- Scallop dependence on submerged aquatic vegetation (SAV) is well demonstrated
- Essential habitat (SAV) for scallops has been substantially altered/lost
- Numerous SAV and scallop restoration efforts are underway

Scallop Harvests



Data from NOAA Commercial Fisheries Annual Landings

Eelgrass Abundance in MA



Questions This Effort is Trying to Address

How can we use the knowledge of scallop-habitat relationships to guide criteria development and inform/evaluate restoration efforts?

For example, if a state's Designated Use is maintaining healthy populations of fish and wildlife, then what attributes of habitat must be maintained or restored?

Defining Designated Uses

Current Designated Uses in RI and MA:

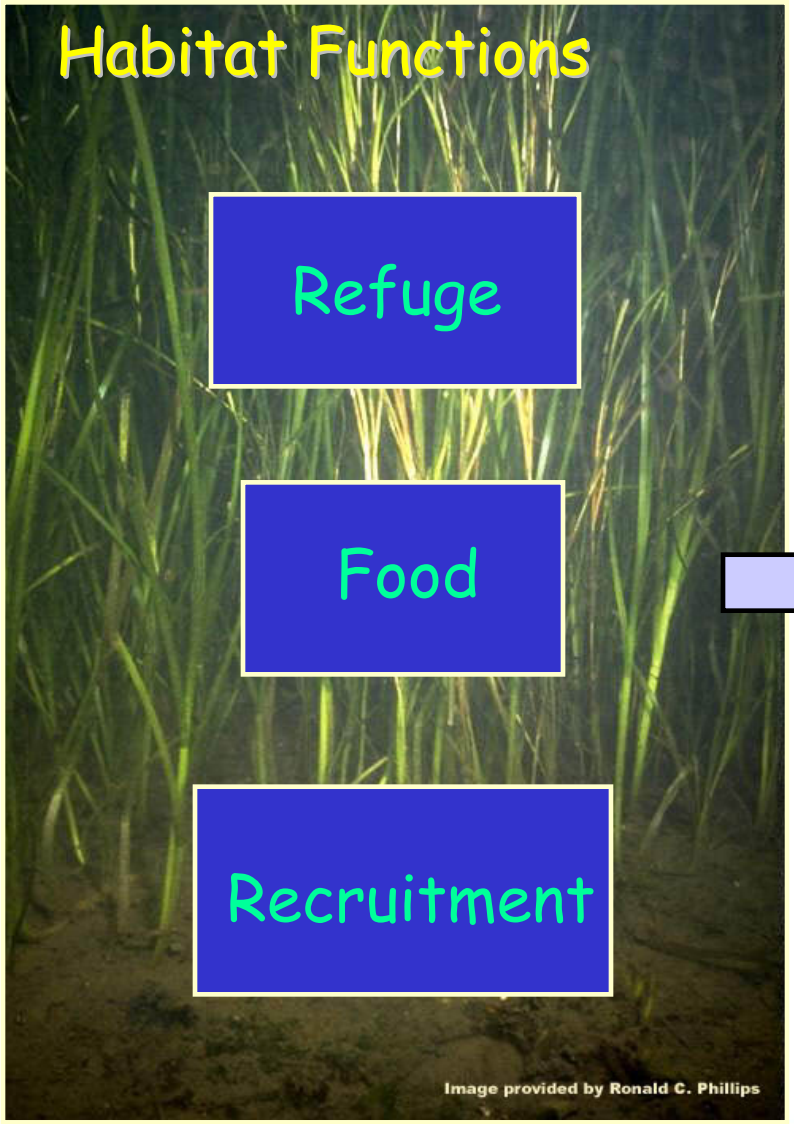
- Shellfish harvesting
  - ➢ Consumption
  - ➢ Depuration and relay
- Aquacultural uses
- Fish and wildlife habitat
- Primary and secondary contact recreational activities

Defining Designated Uses

Current Designated Uses in FL:

- Shellfish Propagation
- Shellfish Harvesting
- Maintenance of a healthy, well-balanced population of fish and wildlife

Functional Assessment for a Specialist or Habitat-Specific Species



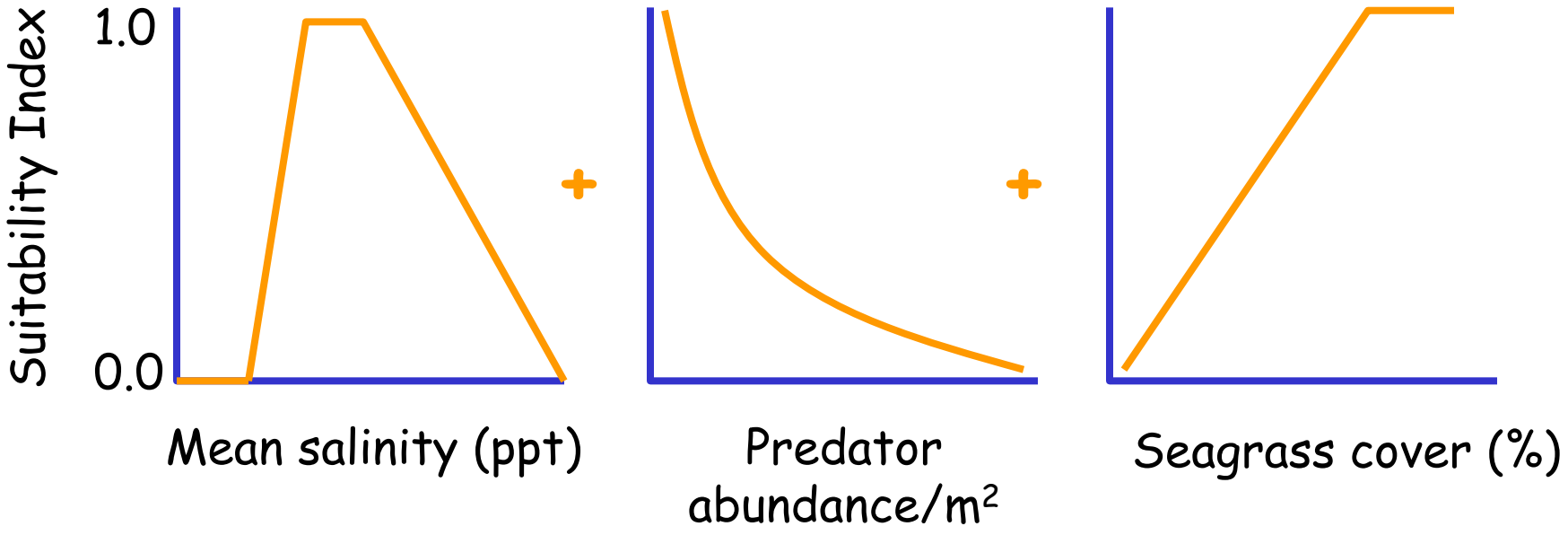
How will we assess habitat requirements for bay scallops at appropriate spatial scales?

- Three-tiered modeling approach:
  - Habitat Suitability Index
  - Demographic Population Model
  - Systems Model

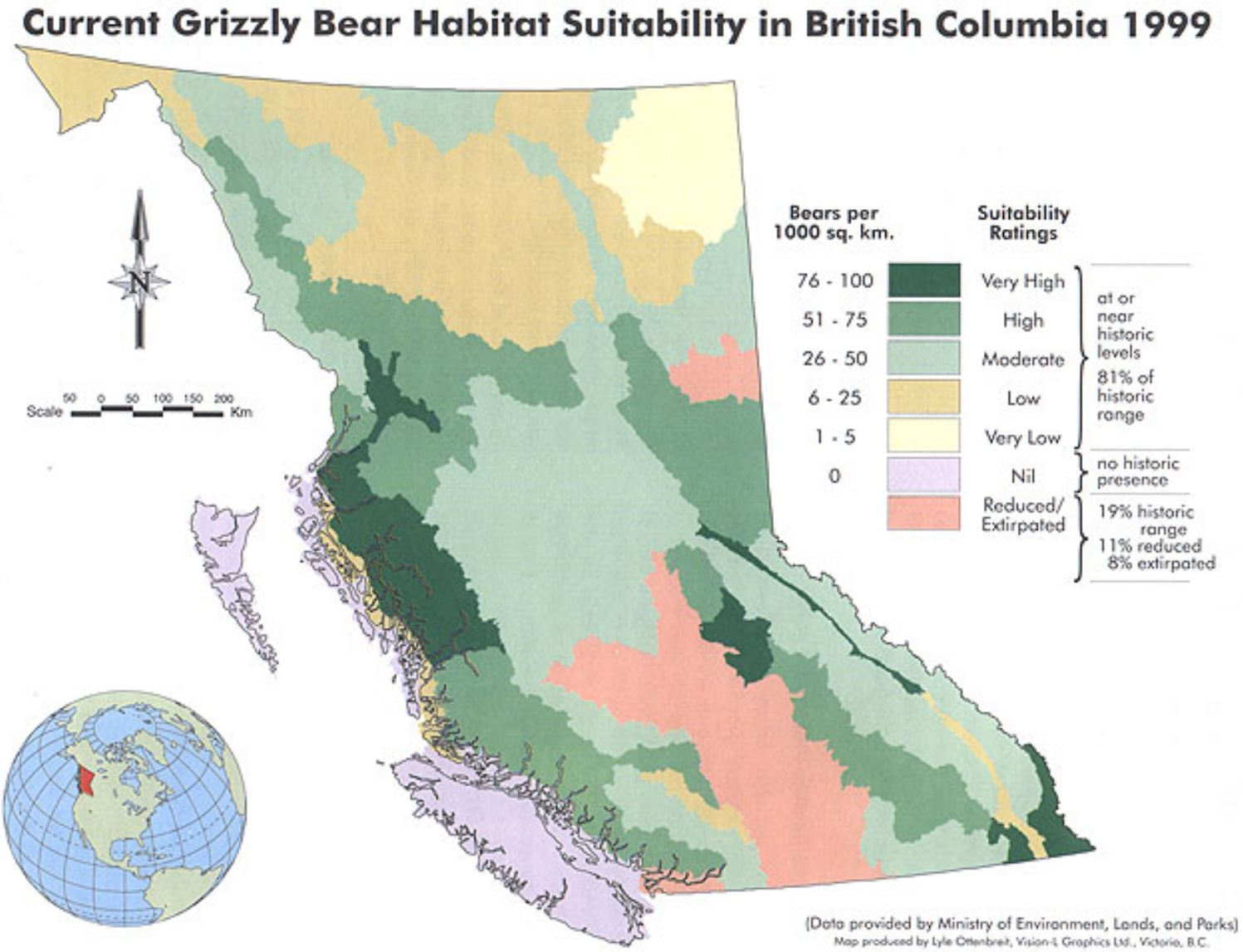
- Adapt models for other biogeographic provinces along the Atlantic and Gulf coasts via collaborations with other scallop researchers in MA, RI, CT, NY, MD, VA, NC, FL

Habitat Suitability Index (HSI)

- Represents the combined interactions of all species-habitat relationships
- Output is a numerical index that scores the capacity of a habitat to support the selected species (ranges from 0-1)

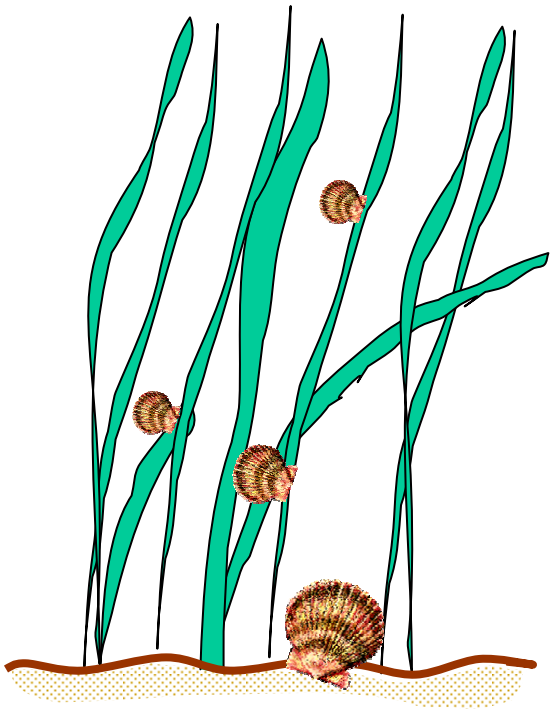


Example HSI Map



Population Model

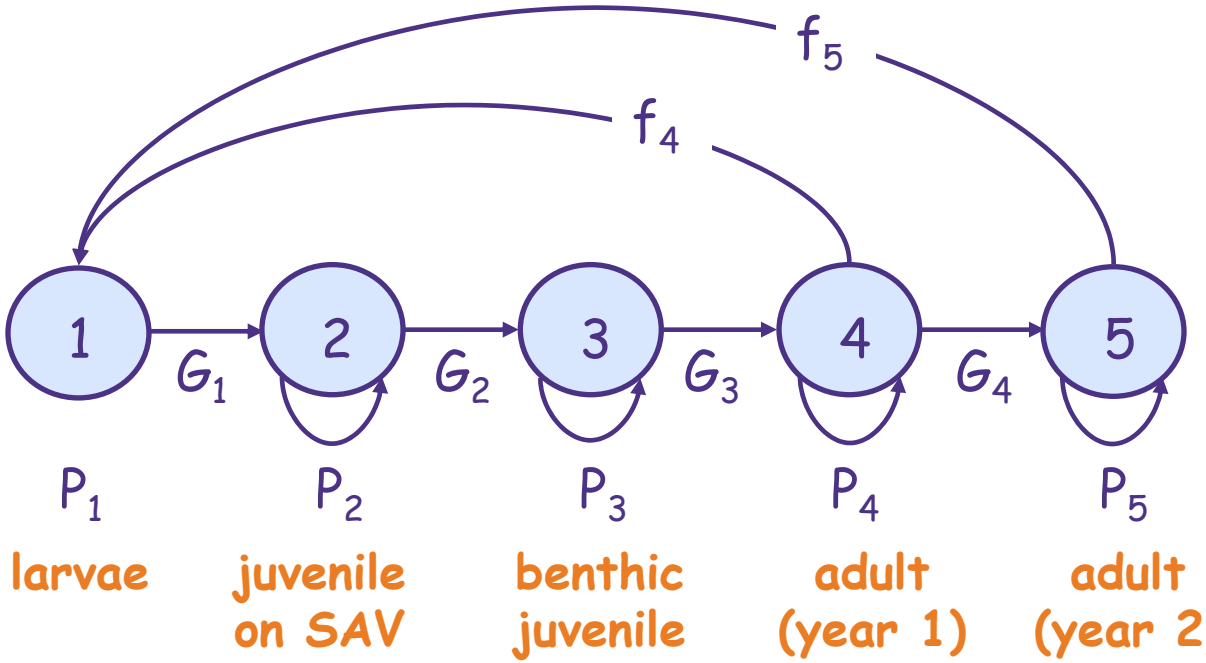
- Links habitat alteration effects with demographic attributes of the scallop population



Stage	Survivorship	Fecundity
larvae	0.001%	0
juveniles on SAV	20%	0
benthic juveniles	20-50%	0
adults (year 1)	10-20%	12.6×10^6 – 18.6×10^6
adults (year 2)	0%	6.9×10^6 - 10.2×10^6

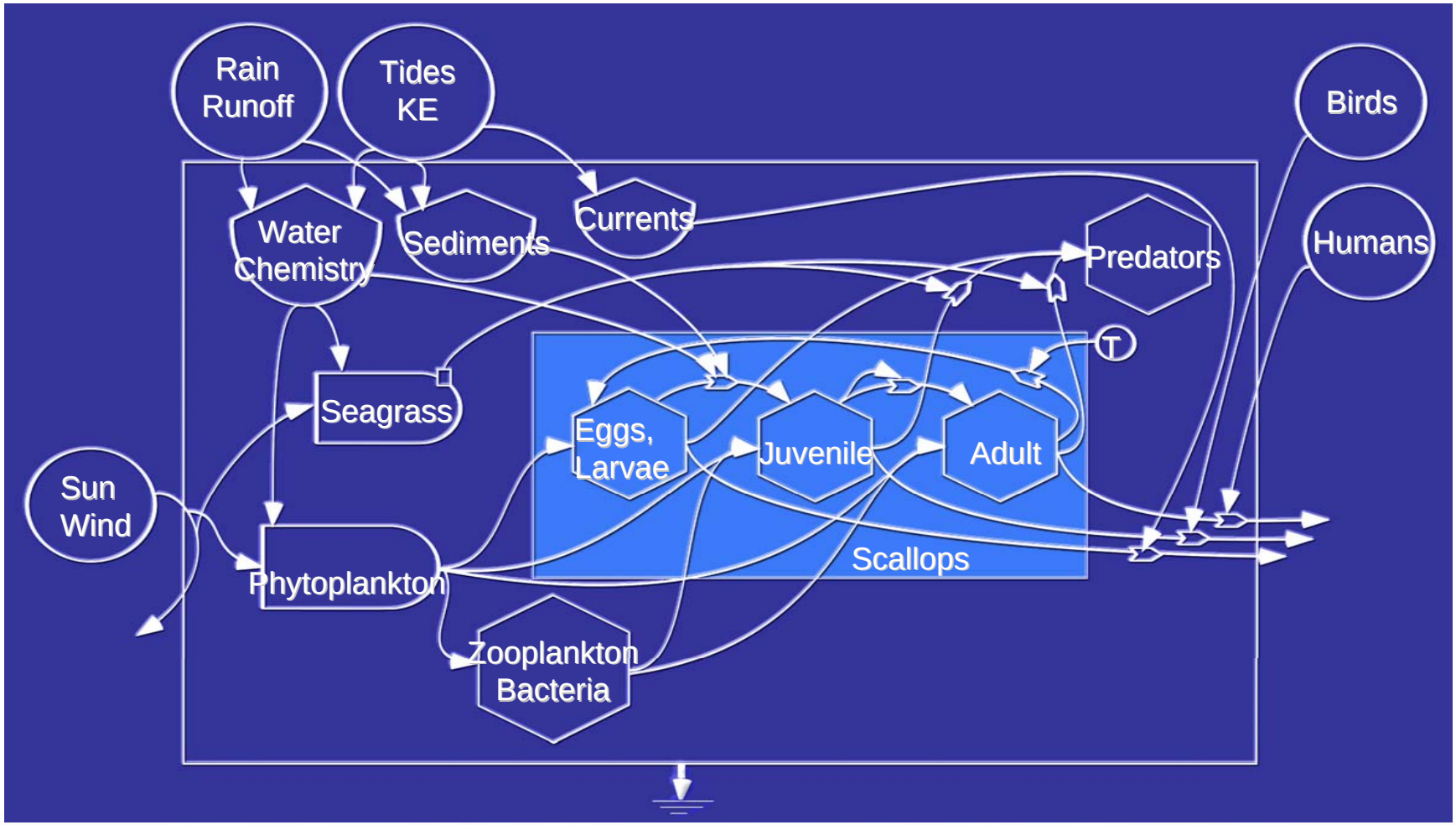
Population Model

- Calculates the population growth rate for different habitat alteration scenarios, which can be used as a measure of population-level effects resulting from habitat loss.



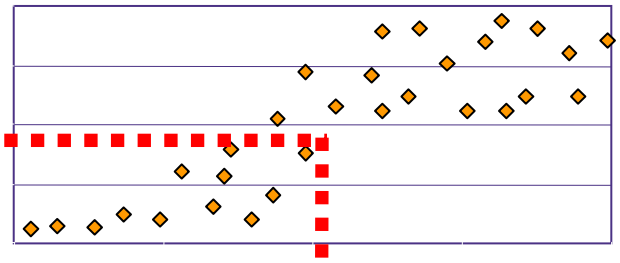
Systems Perspective of Scallop Habitat

- Links habitat alteration effects on the scallop population with ecosystem-scale environmental attributes

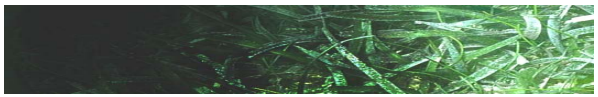


Products from this Approach

Populations



Habitat quality/quantity



HSI

Habitat

Stressors

Life History Information and Demographics

Population Models

Systems Model

Quantitative Risk Assessment of Populations

Project Applications

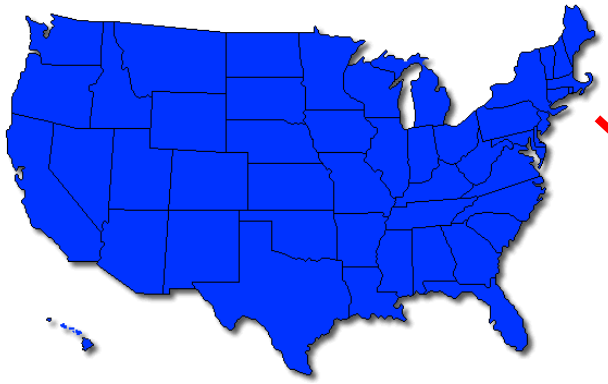
- Results can guide habitat criteria development and assessment of restoration efforts
- Because of links to SAV, project will dovetail with AED's AqS Nutrients Program
- Compliments SAV-species research at GED, MED and WED under AqS Altered Habitat
- Application of habitat and population models is consistent with Wildlife Research Strategy

Where are we now in the process?

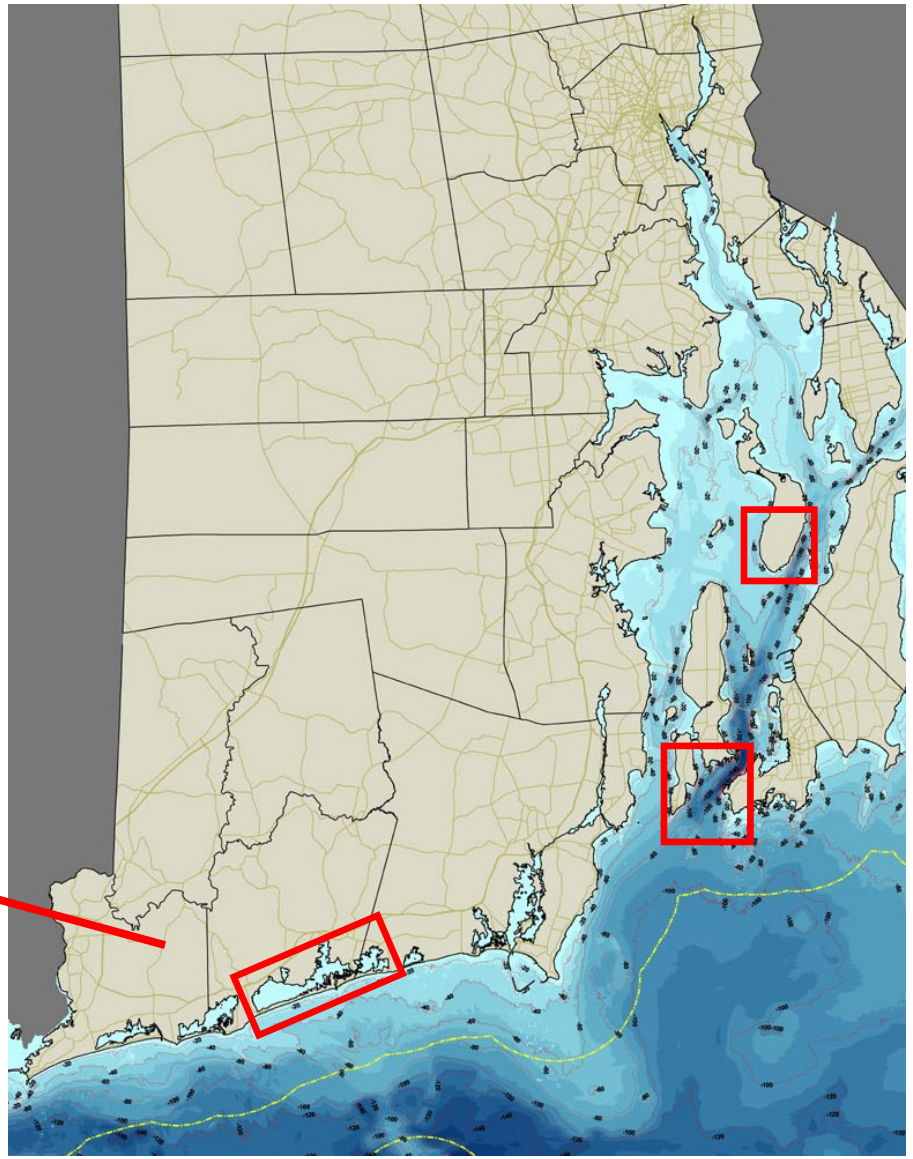
- Project is relatively new
- Preliminary HSI, population model, and systems model have been developed
- Continuing to mine the literature and searching for all available data
- We are identifying and meeting with local, state, and academic groups to build partnerships
- Experiments and field surveys are planned for this summer to obtain missing data necessary for refinement of the models

Future Directions and Needs

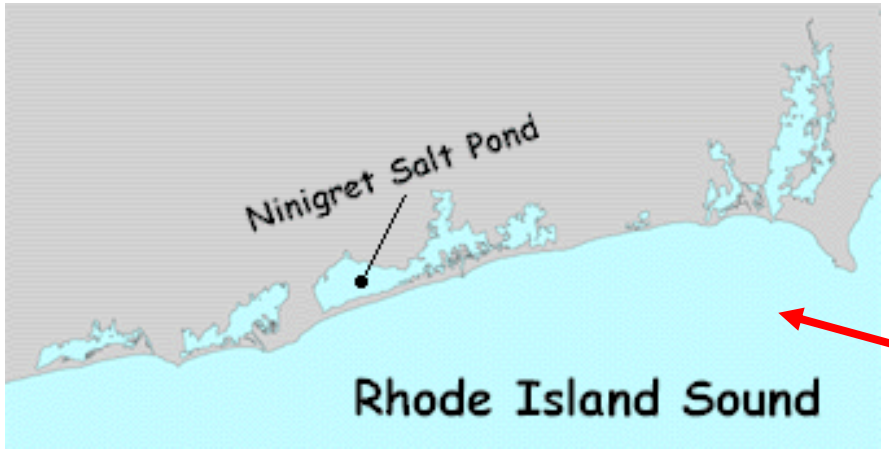
- Experiments and field surveys to obtain data necessary for refinement of the model parameters- NE and FL
- Field test the models
- Adapt the models for other regions
- Evaluate the attributes of the few remaining "thriving" populations in comparison to areas which historically supported self-sustaining populations
- Development of criteria to protect essential bay scallop habitats



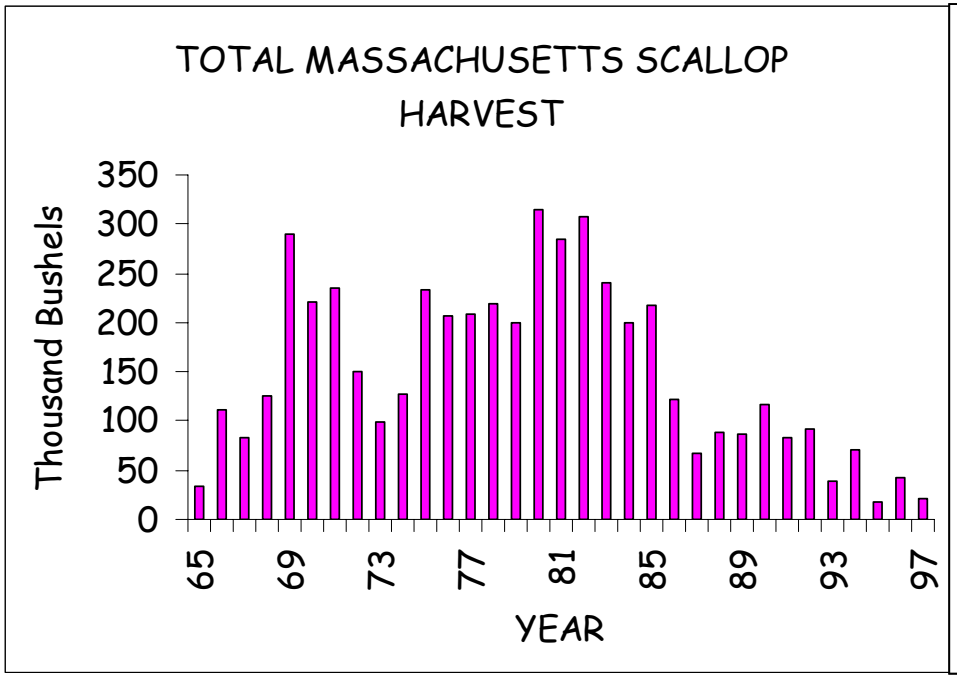
Narragansett Bay, RI

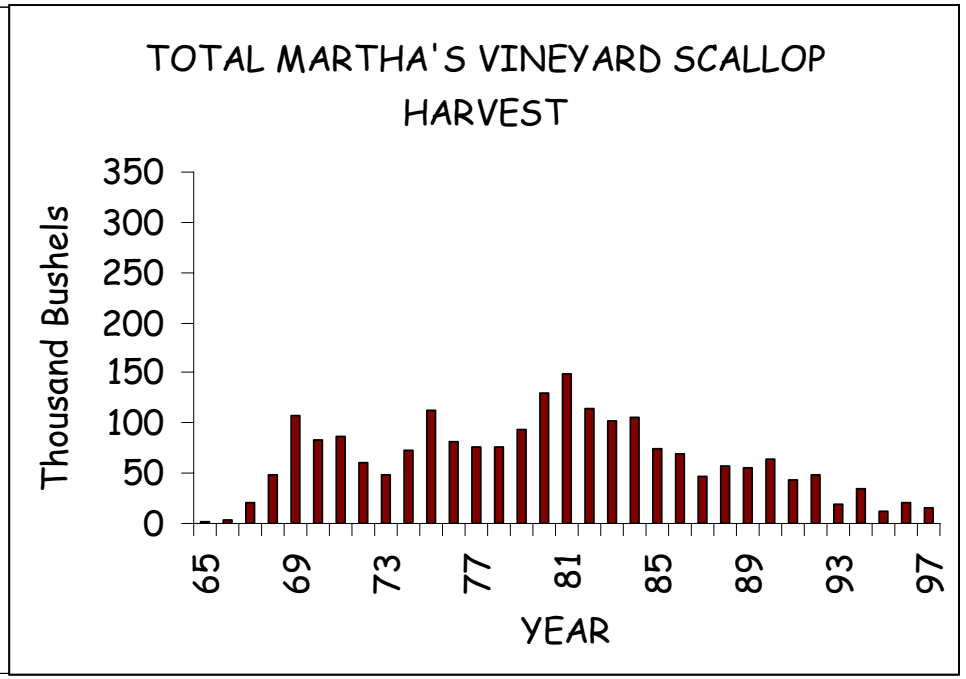


RI coastal salt ponds

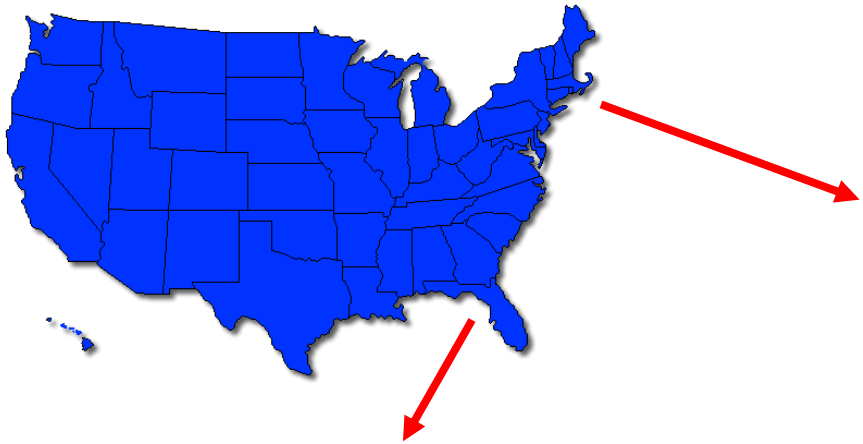


Massachusetts Bay Scallop Harvests

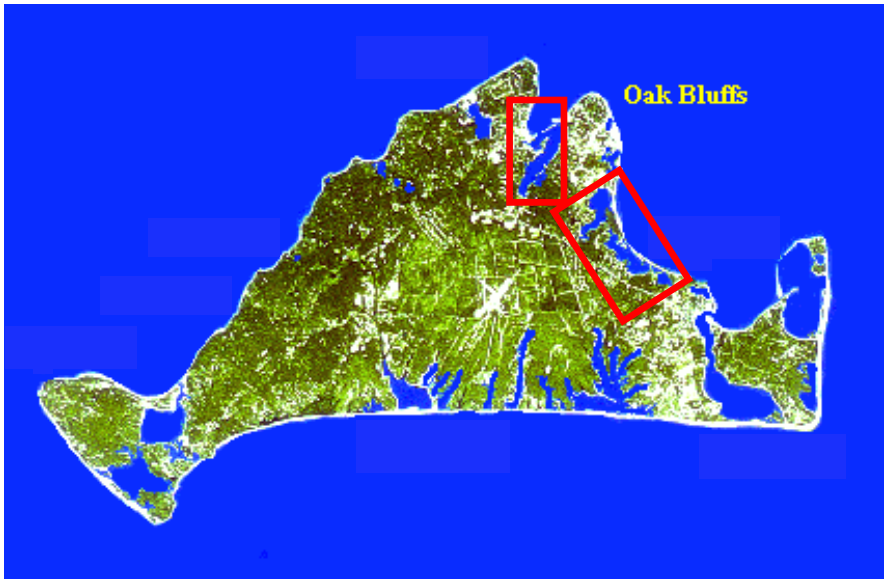


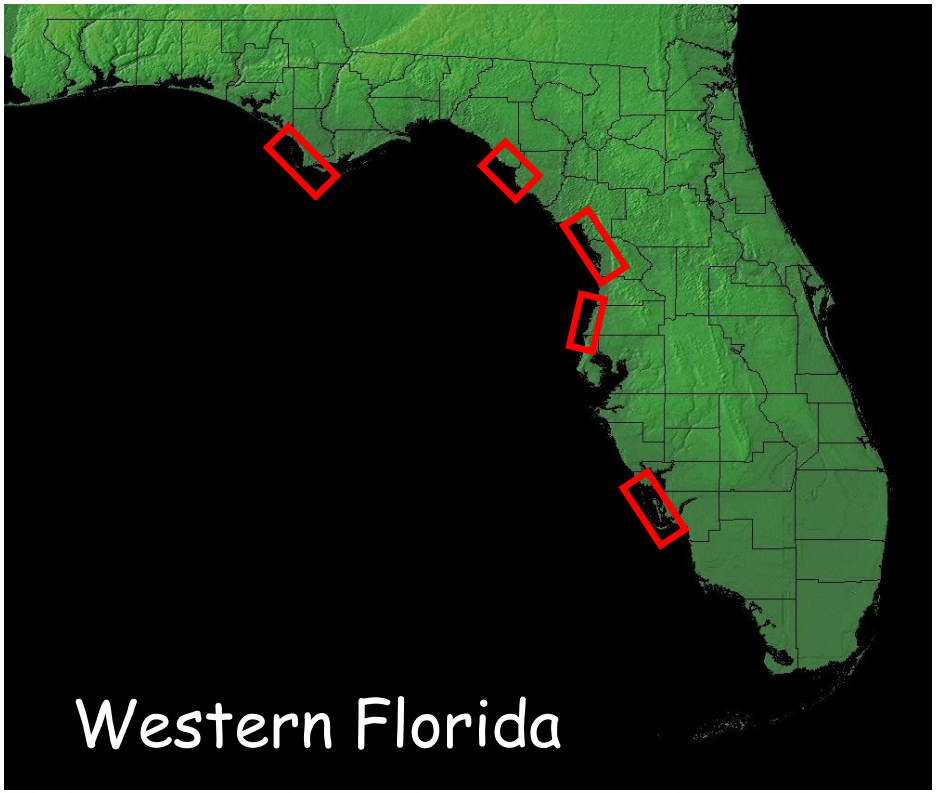


Data from Sandy MacFarlane, Coastal Resource Specialists, Orleans, MA



Martha's Vineyard, MA





Example Video Images of Habitats

Acknowledgments

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