FISEA: Ecosystem and climate indicators for coastal- and estuary-dependent fisheries of the SE US Continental Shelf LME

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NOAA Fisheries

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InterAgency Partnerships

Principal funding for FISEA provided by
Fisheries And The Environment (NOAA)

Other funding sources and collaborators:

Data support provided by

NCDMF: *T. Moore, K. West, R. Monaghan*

NOAA and CMAST: *H. Walsh, J. Hare, K. Zettl*

Fisheris and the Environment

Mission: The mission of the FATE Program is to provide the information necessary to effectively adapt management to mitigate the ecological, social and economic impacts of major climate-driven shifts in the productivity of living marine resources

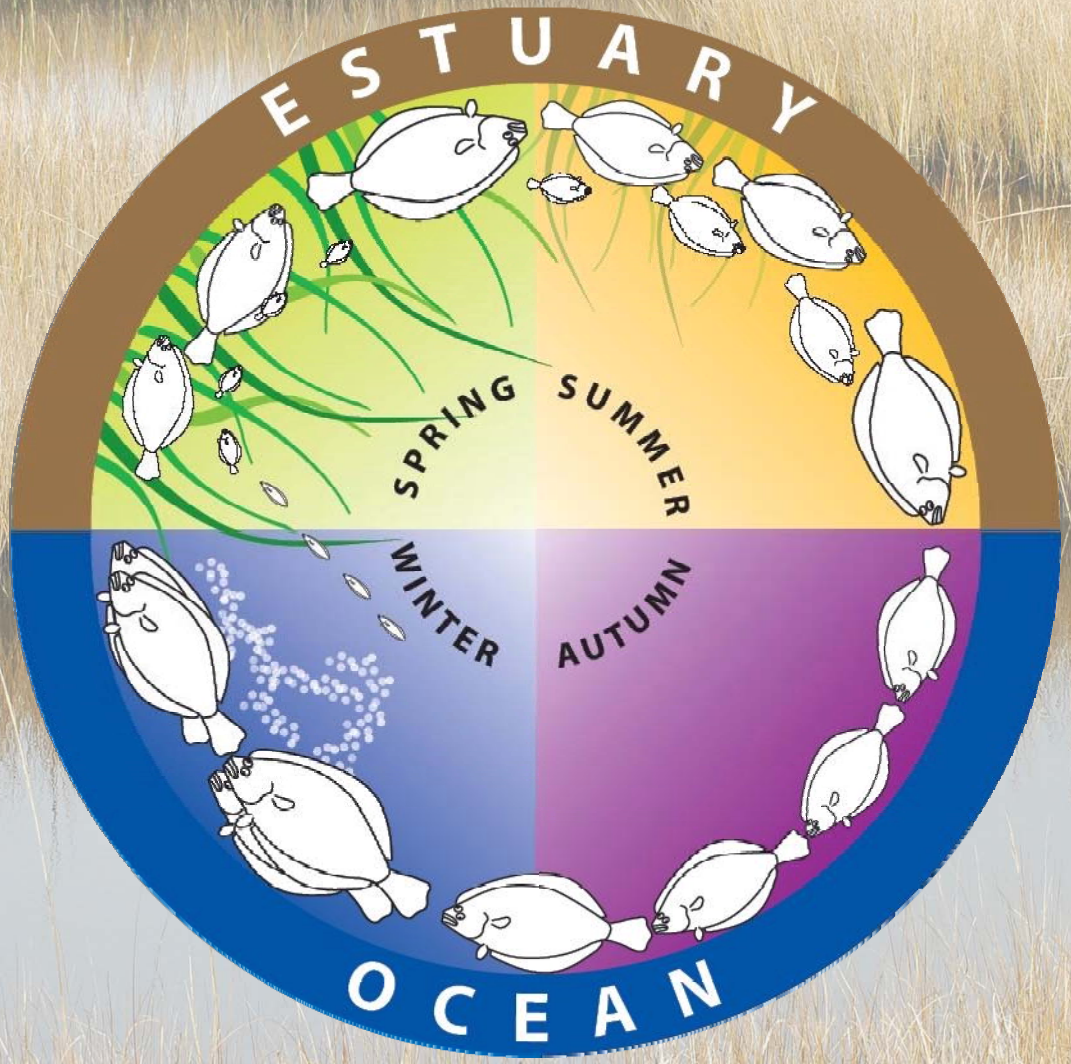
FISEA: *Fishery-Indicators of the US SouthEast Atlantic*

FATE Objectives

1. Develop indicators of population and ecosystem status for estuary/coastal species from early life-stages using ichthyoplankton observation platforms

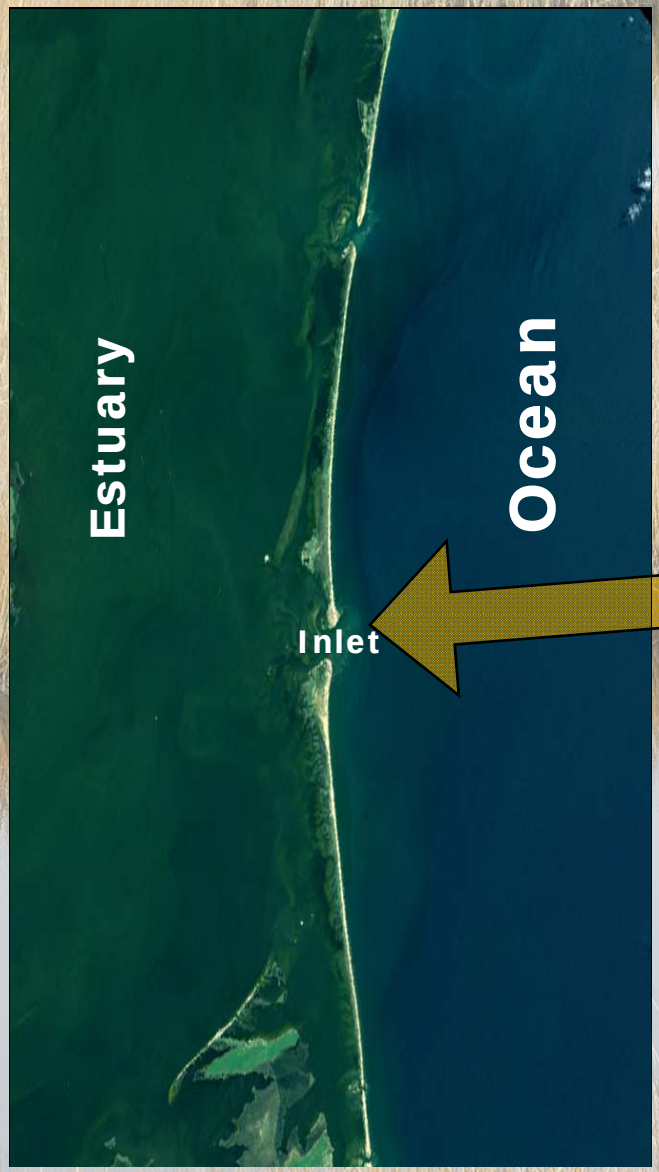
2. Derive links between larval fish community assemblages and:
   - dynamics at later life stages
   - drivers related to climate change and variation

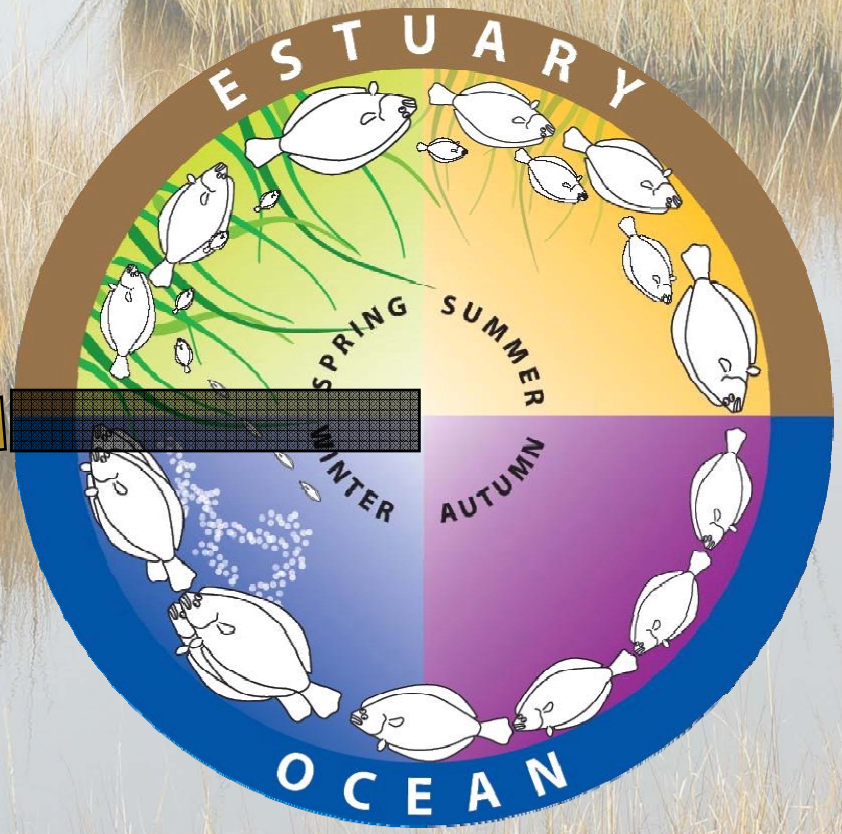
Estuary-dependent life histories



Graphic adapted from Kaiser and Able 1994

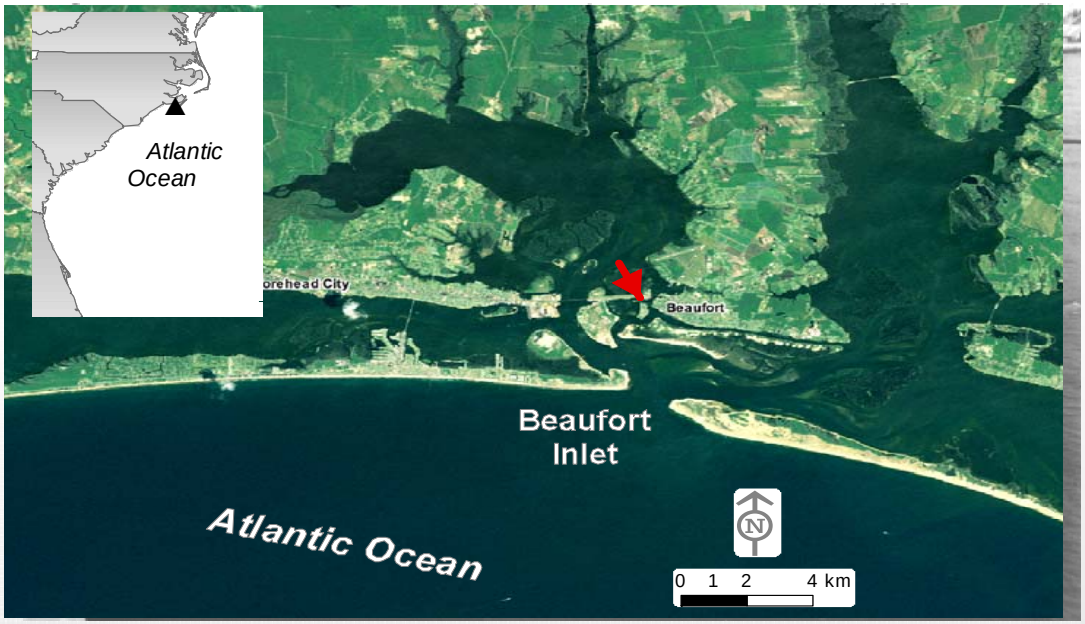
Estuary-dependent life histories





The Bridgenet Observation Platform
NOAA Beaufort Laboratory, NC

- 1987-present
- Weekly sampling
- Mid flood tide
- Surface net



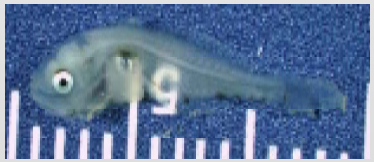
Historically November - April for Atlantic menhaden ingress and other winter shelf-spawners (WSS)

Some years include spring/summer (1993, 2001)

Recent addition of year-round (2005-present)

Beaufort Inlet ingressing larvae: *Winter Shelf-Spawners*

Common Name	Scientific Name	Total Number
Spot	***Leistomus xanthurus***	**215,054**
Pinfish	*Lagodon rhomboides*	154,973
Atlantic croaker	***Micropogonias undulatus***	**74,242**
Atlantic menhaden	***Brevoortia tyrannus***	**48,973**
Anchovy	Engraulidae	18,652
Gulf flounder	***Paralichthys albigutta***	**9,852**
Pigfish	*Orthopristis chrysoptera*	8,613
Goby	Gobiidae	6,260
Southern Flounder	***Paralichthys lethostigma***	**6,254**
Striped mullet	***Mugil cephalus***	**4,824**
Summer flounder	***Paralichthys dentatus***	**2,173**

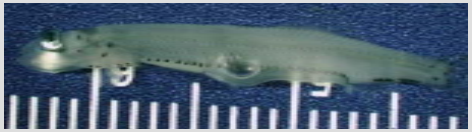


Atlantic croaker

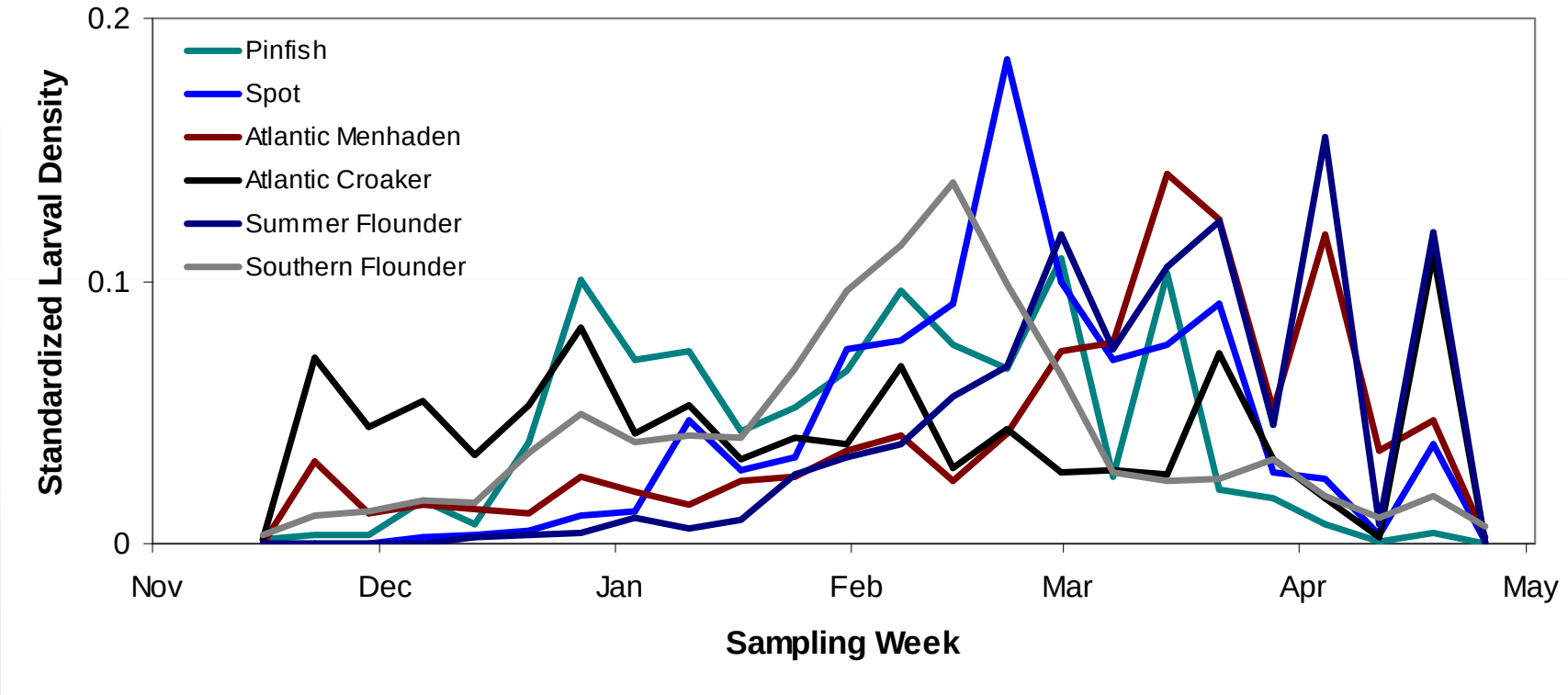
Spot

Southern flounder

Atlantic menhaden



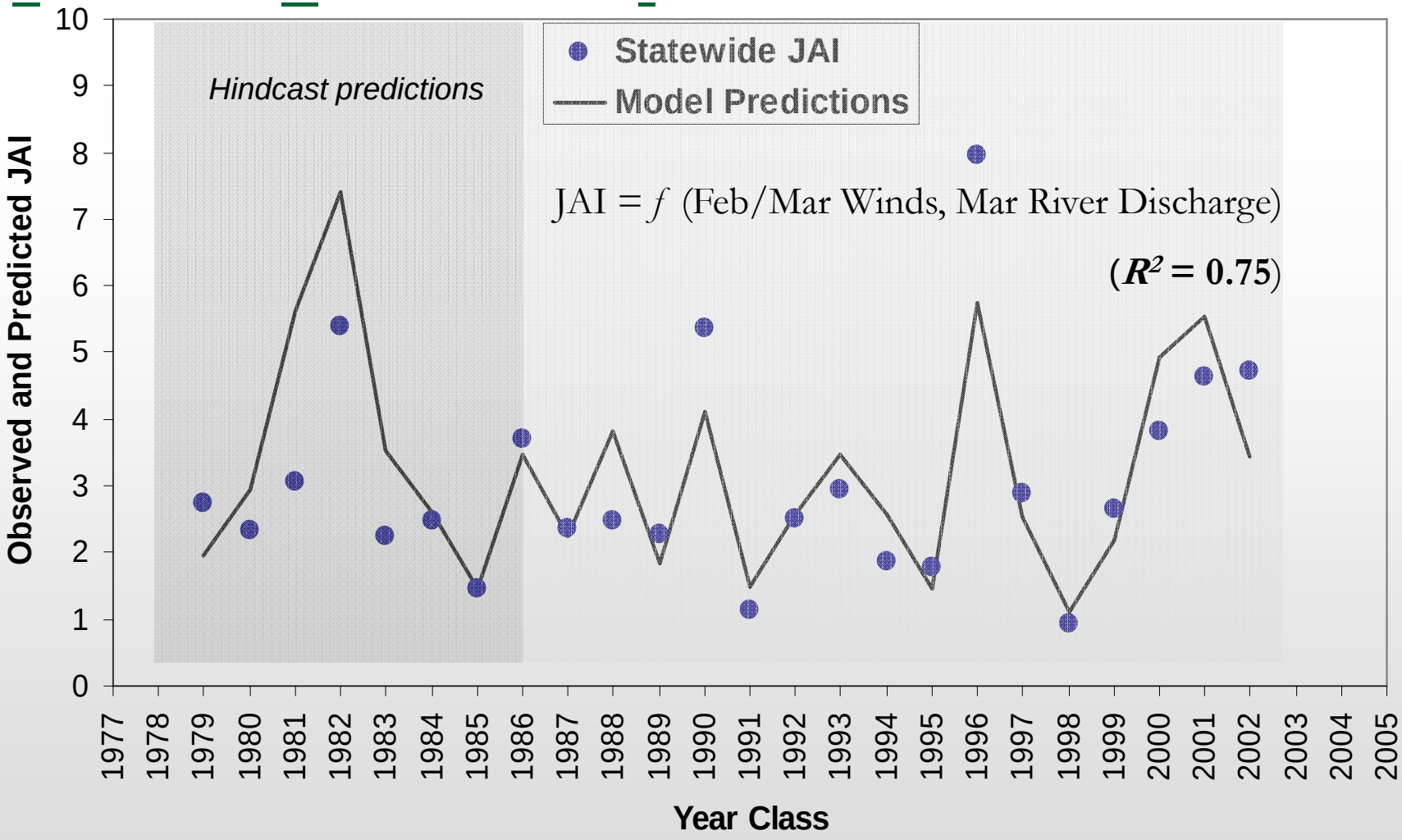
Time series of abundance



But. . .*What do these abundances represent?*

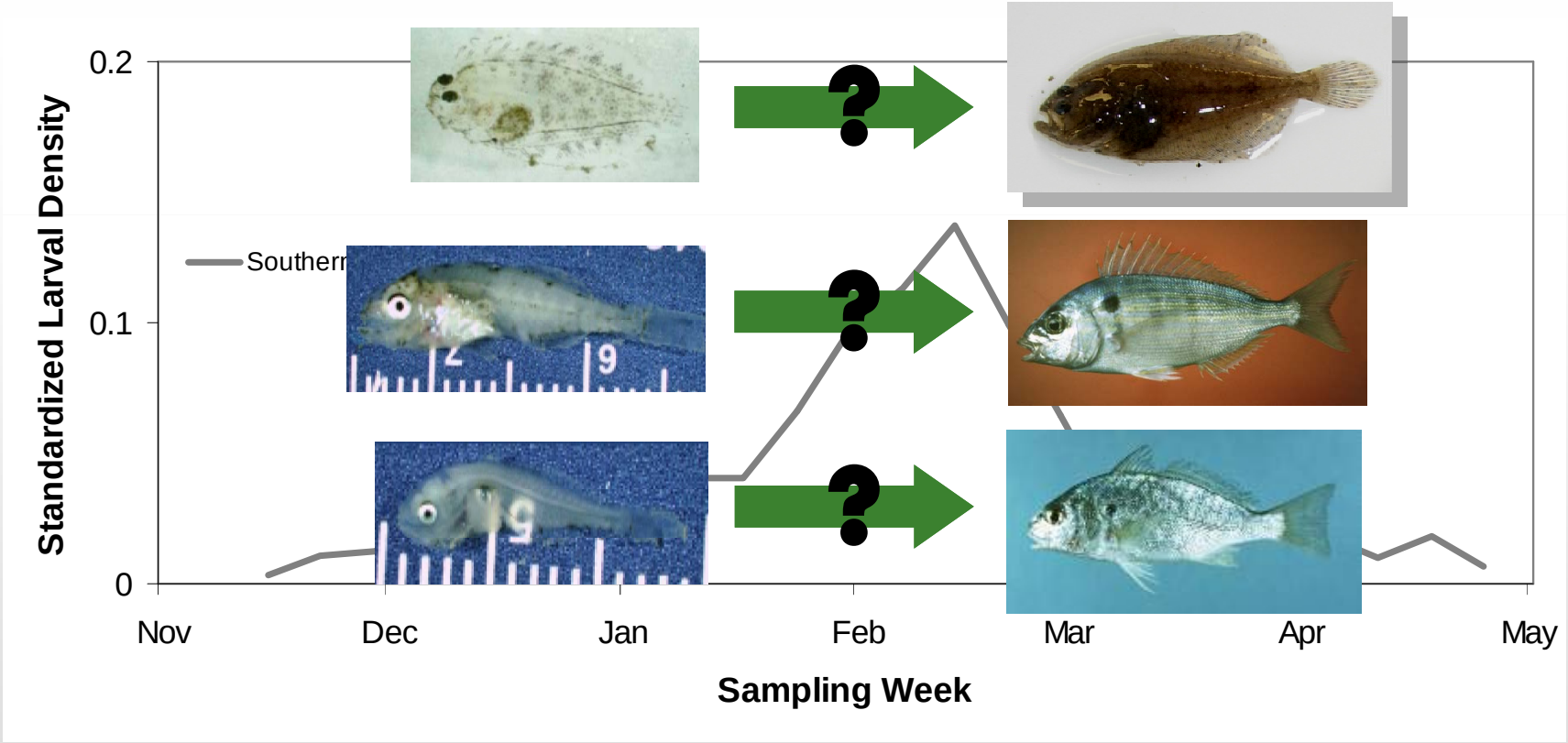
Meteorological drivers of recruitment:

Juvenile abundance indices- southern flounder

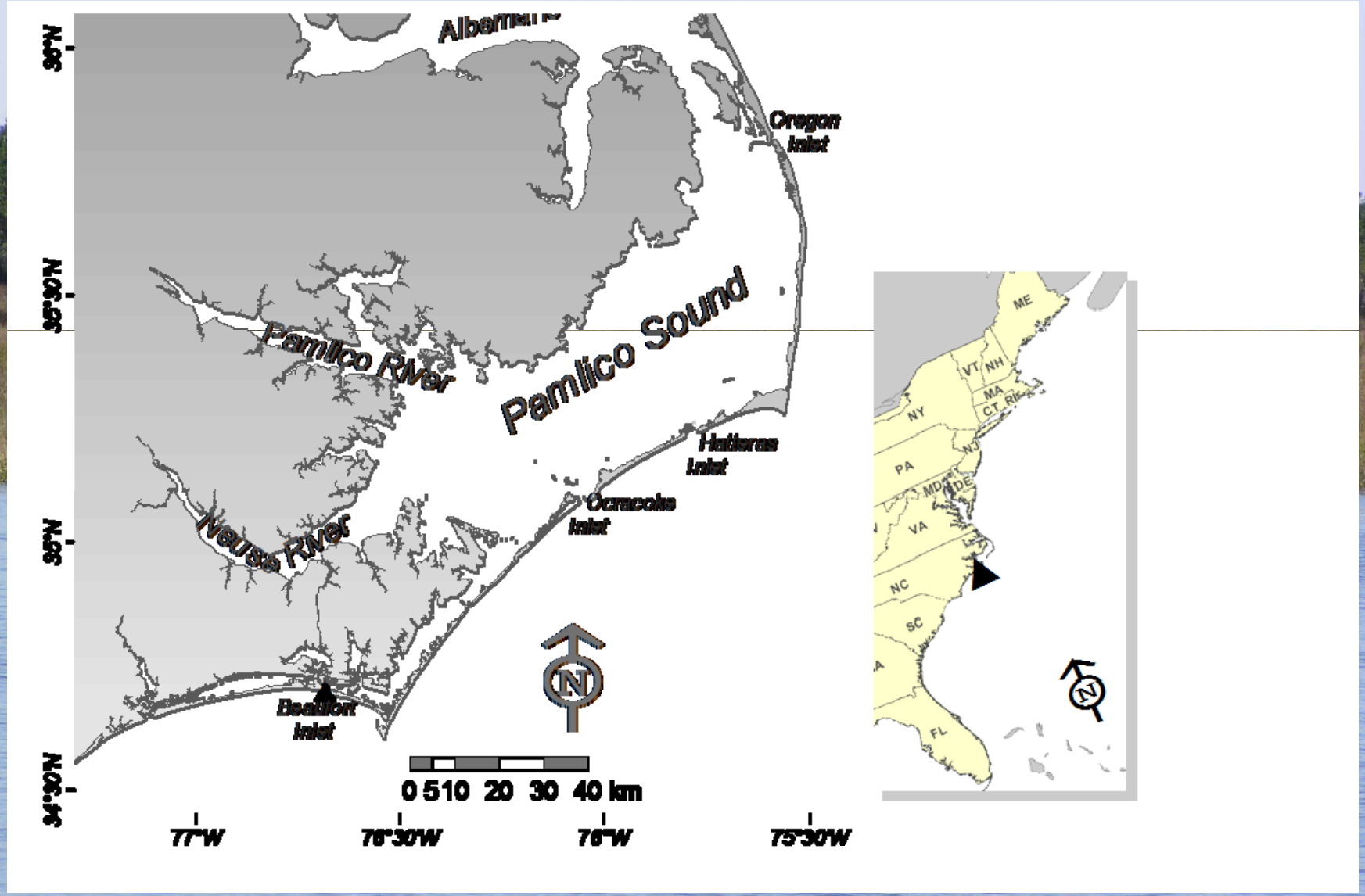


Taylor, Miller, Pietrafesa, Dickey and Ross, *in prep*

Time series of abundance – peak ingress for southern flounder



Complimentary programs – *Juvenile data*



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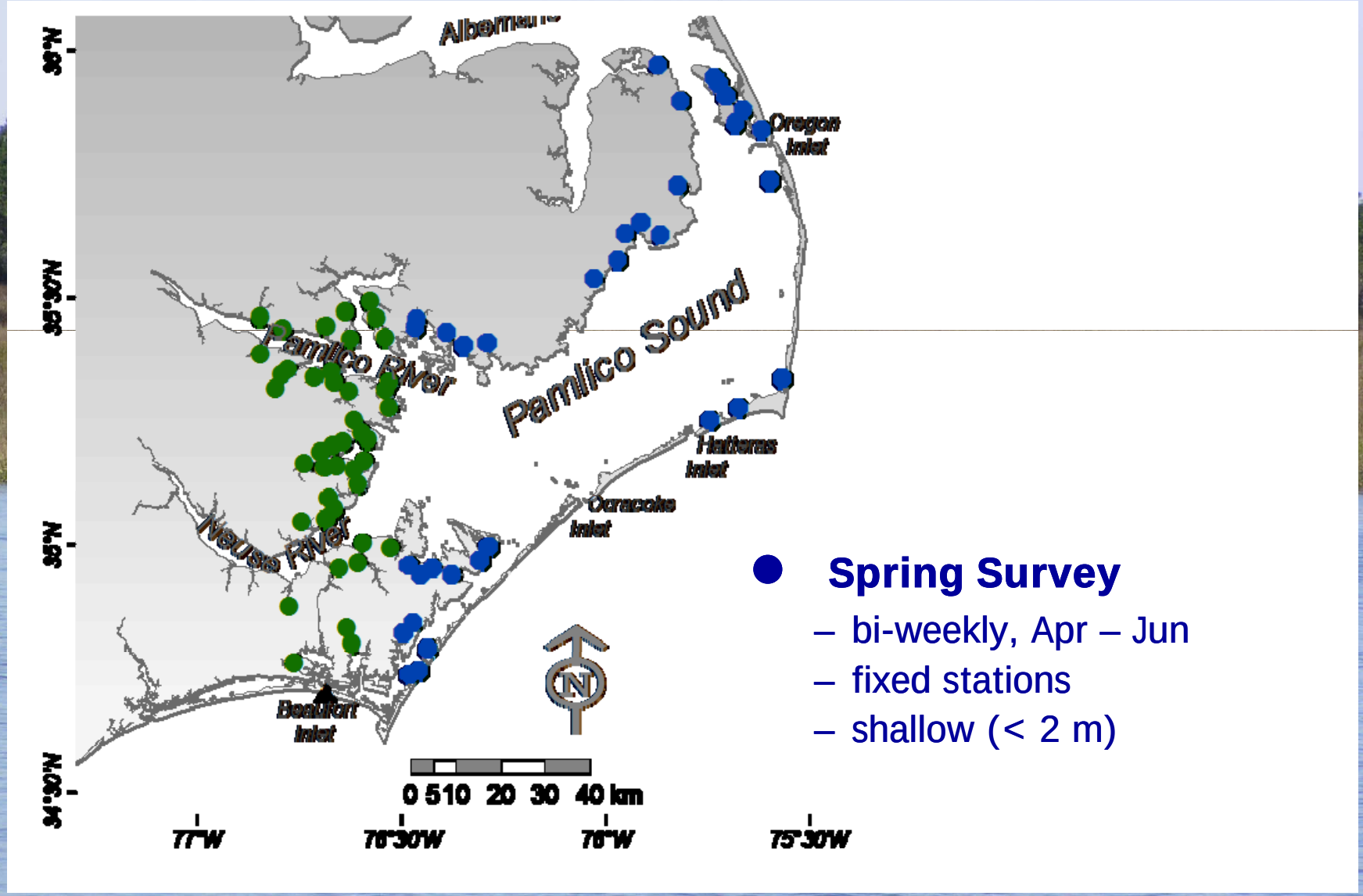
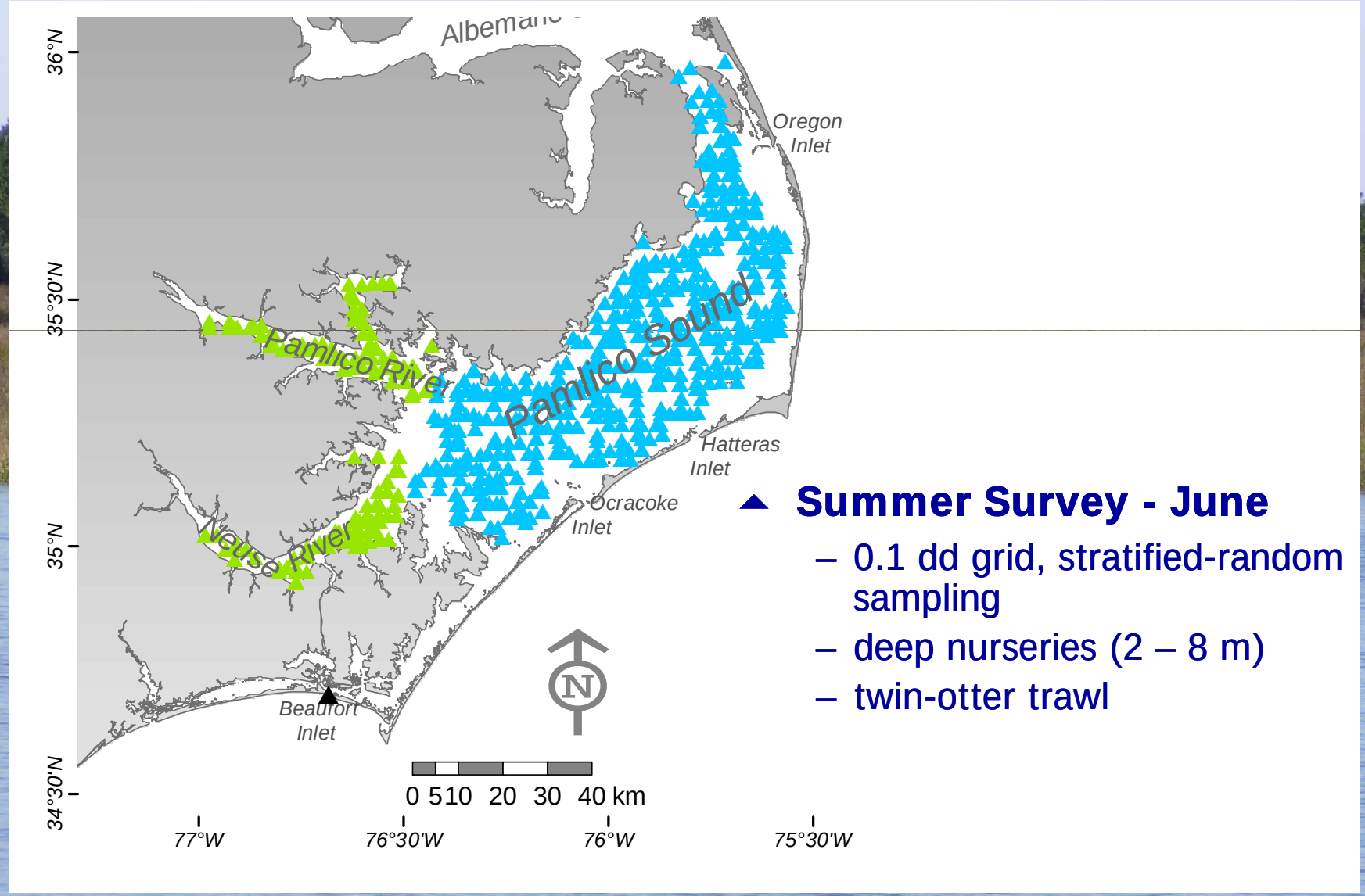


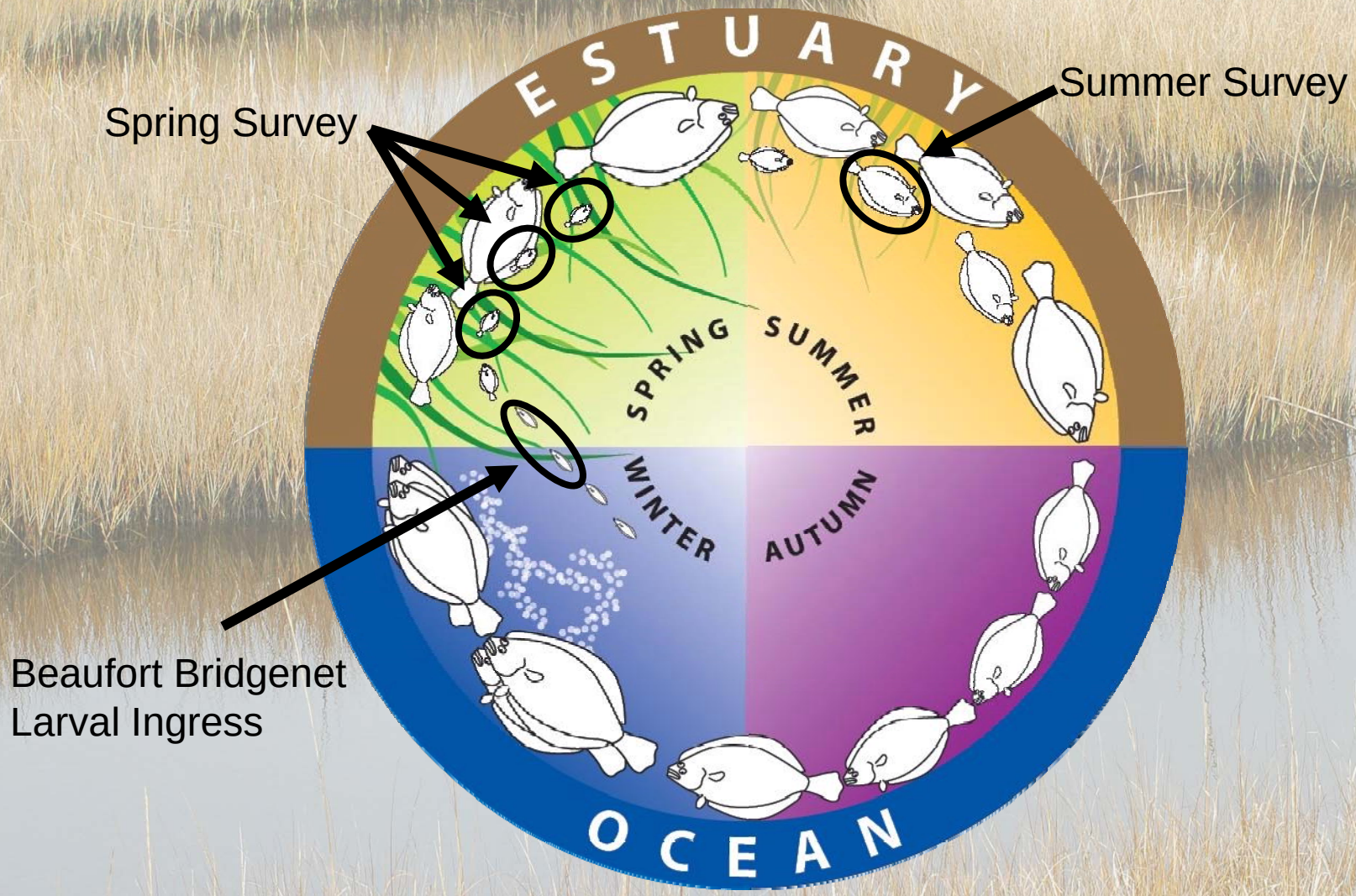
- **Spring Survey**
  - bi-weekly, Apr – Jun
  - fixed stations
  - shallow (< 2 m)

Complimentary programs – *Juvenile data*



- **Summer Survey - June**
  - 0.1 dd grid, stratified-random sampling
  - deep nurseries (2 – 8 m)
  - twin-otter trawl

Life-stage Observations



Analytical methods

Correlate 1987-2004 data series for 6 species:

- *Larval abundance*
  - November - April
  - larvae per 100 m^3
  - log-mean annual larvae
- *Juvenile abundance*
  - log-catch per tow
  - by season (spring/summer)
  - by location (river/sounds)

Correlation analysis

Pearson coefficients

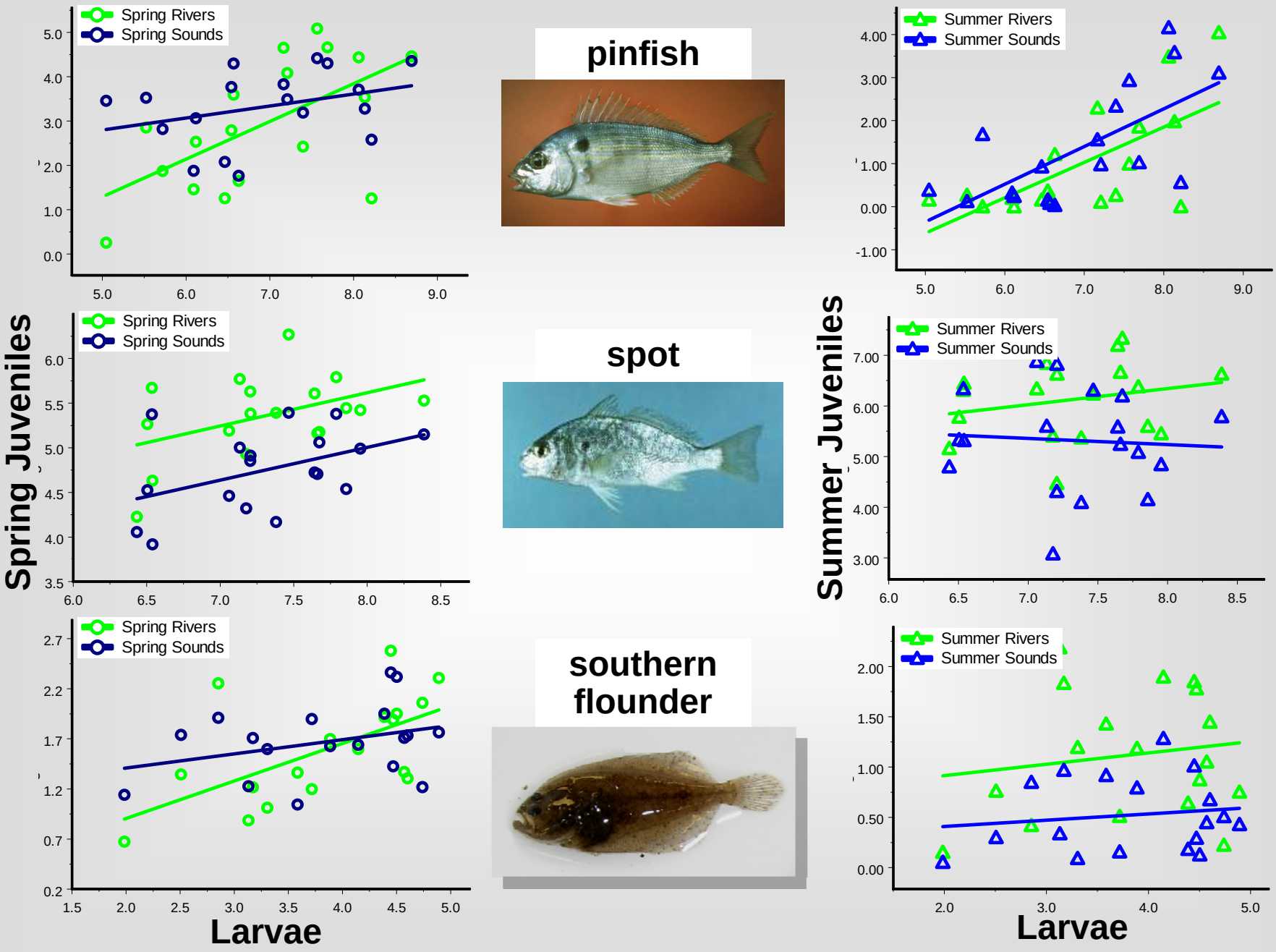
Bootstrap estimates of probabilities

** ~ $p < 0.01$

* ~ $p < 0.05$

Correlations between larval and juvenile abundance – ***Southern Species***

	SPRING		SUMMER	
Species	Rivers	Sounds	Rivers	Sounds
pinfish	+ **	+ *	+ **	+ **
spot	+ *	+ *	+ *	n.s.
southern flounder	+ **	+	+ *	n.s.
Atlantic menhaden	n.s.	n.s.	n.s.	n.s.
Atlantic croaker	n.s.	n.s.	n.s.	n.s.
summer flounder	n.s.	n.s.	n.s.	+ *


pinfish
spot
southern flounder
Spring Rivers
Spring Sounds
Summer Rivers
Summer Sounds
Spring Juveniles
Summer Juveniles
Larvae
Larvae

Correlations between larval and juvenile abundance – ***Northern Species***

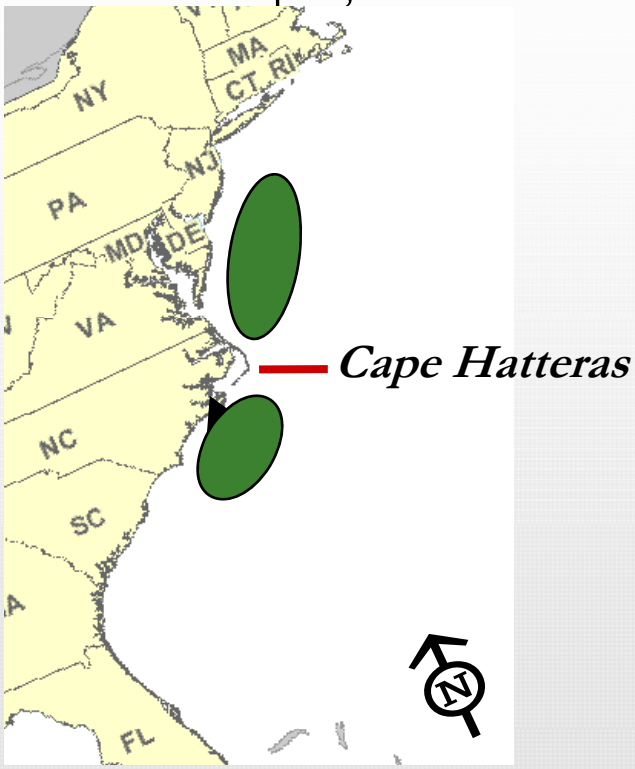
	SPRING		SUMMER	
Species	Rivers	Sounds	Rivers	Sounds
pinfish	+ **	+ *	+ **	+ **
spot	+ *	+ *	+ *	n.s.
southern flounder	+ **	+	+ *	n.s.
Atlantic menhaden	n.s.	n.s.	n.s.	n.s.
Atlantic croaker	n.s.	n.s.	n.s.	n.s.
summer flounder	n.s.	n.s.	n.s.	+~ *

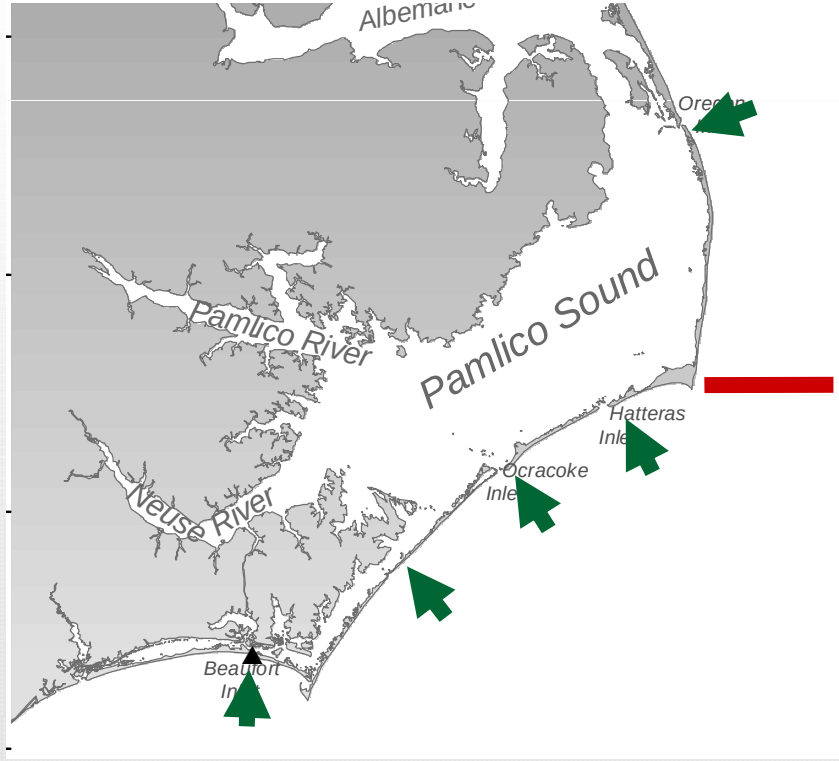
Factors affecting larval-juvenile relationship

- Larval supply
- Habitat selection
- Cohort restructuring between life-stages

Larval supply

- Spawning location determines transport pathway and inlet
  - ***North AND South***: Croaker, Summer Flounder, Menhaden
  - ***South***: Spot, Pinfish and Southern Flounder





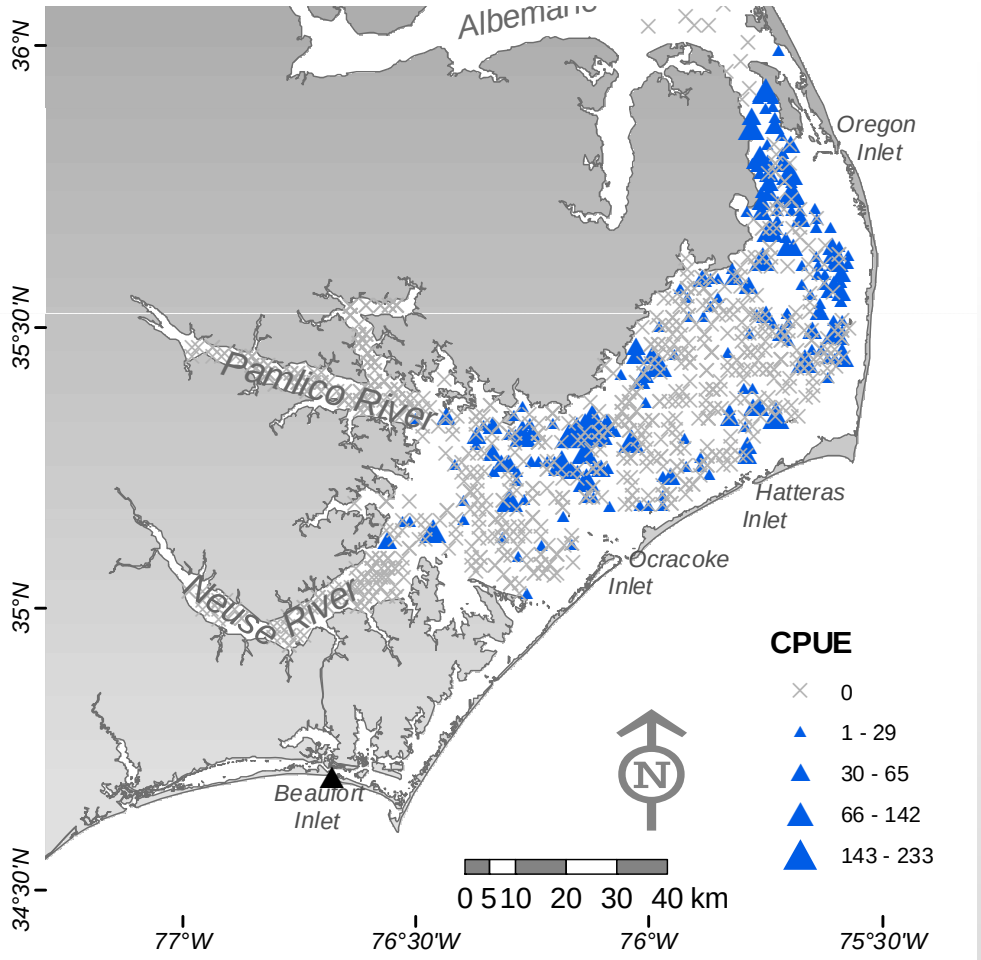
Factors affecting larval-juvenile relationship

- Larval supply
  - spawning location, inlets and transport pathways
- Habitat use
  - (dis)advantages of fixed and probability-based surveys
- Cohort restructuring between life-stages

Habitat use

- Summer Survey
  - Stratified by "region" not by habitat
    - SAV
    - Sediment type
    - Salinity regimes

Summer flounder- summer survey 1987-2004



Factors affecting larval-juvenile relationship

- Larval supply
  - spawning location, inlets and transport pathways
- Habitat use
  - (dis)advantages of fixed and random surveys
- Cohort restructuring between life-stages
  - predation/mortality at settlement

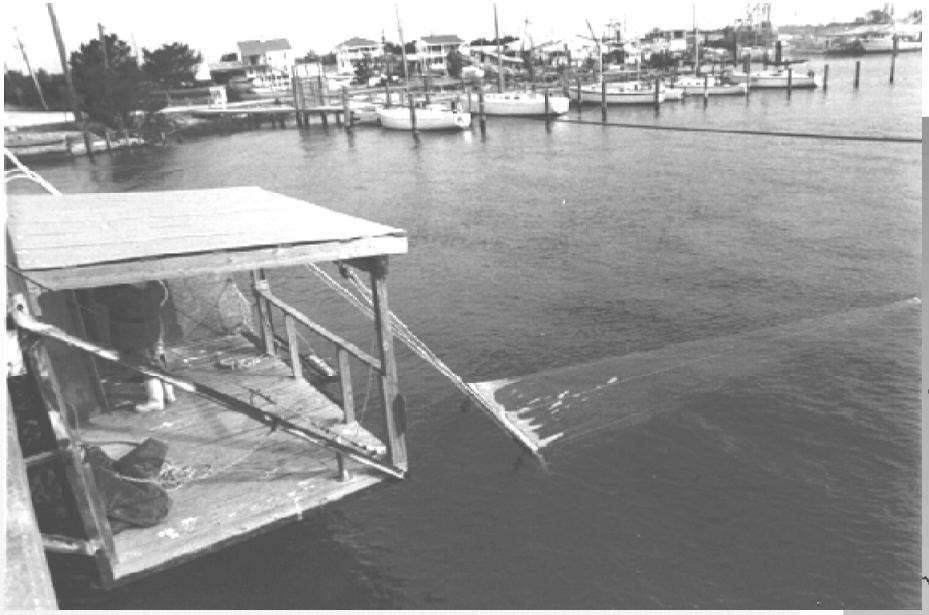
    e.g., Atlantic menhaden

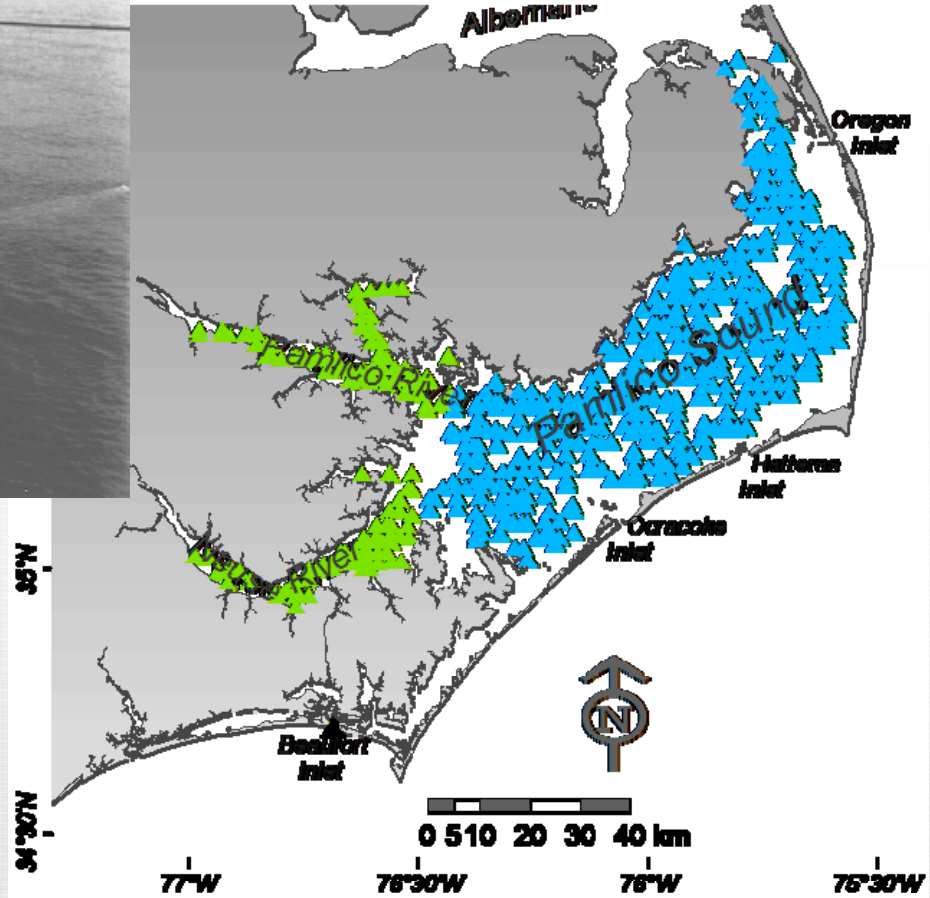
Conclusions

- Larval ingress indices correlate strongly with juvenile abundances indices for "southern" species and could serve as indices of abundance for species with similar geographic ranges

- Non-significant correlation <u>does not</u> mean no relationship between ingressing larvae and juvenile
  - Larval supply through unsampled inlets

Inlet/Ingress Observation Platforms





Little Egg Inlet, NJ (RUMFS)

Eastern Shore, MD (UM-ES)

Indian River Inlet, DE (UDel)

North Inlet, SC (USC)

Conclusions

- Larval ingress indices correlate strongly with juvenile abundances indices for "southern" species and could serve as indices of abundance for species with similar geographic ranges

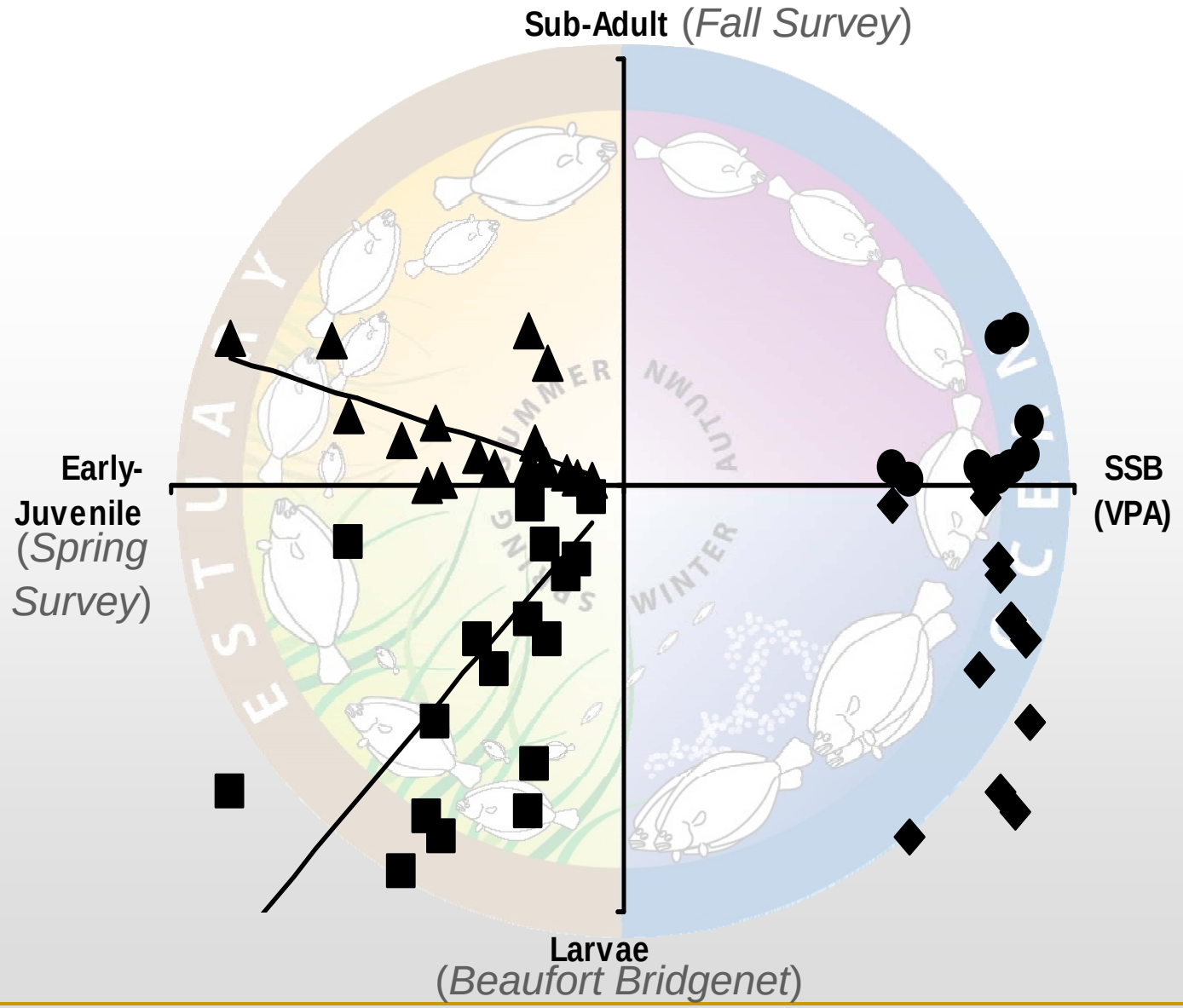
- Non-significant correlation <u>does not</u> mean no relationship between ingressing larvae and juvenile
  - Larval supply through unsampled inlets
  - Habitat-based approaches to juvenile abundance indices

Utility of larval indices

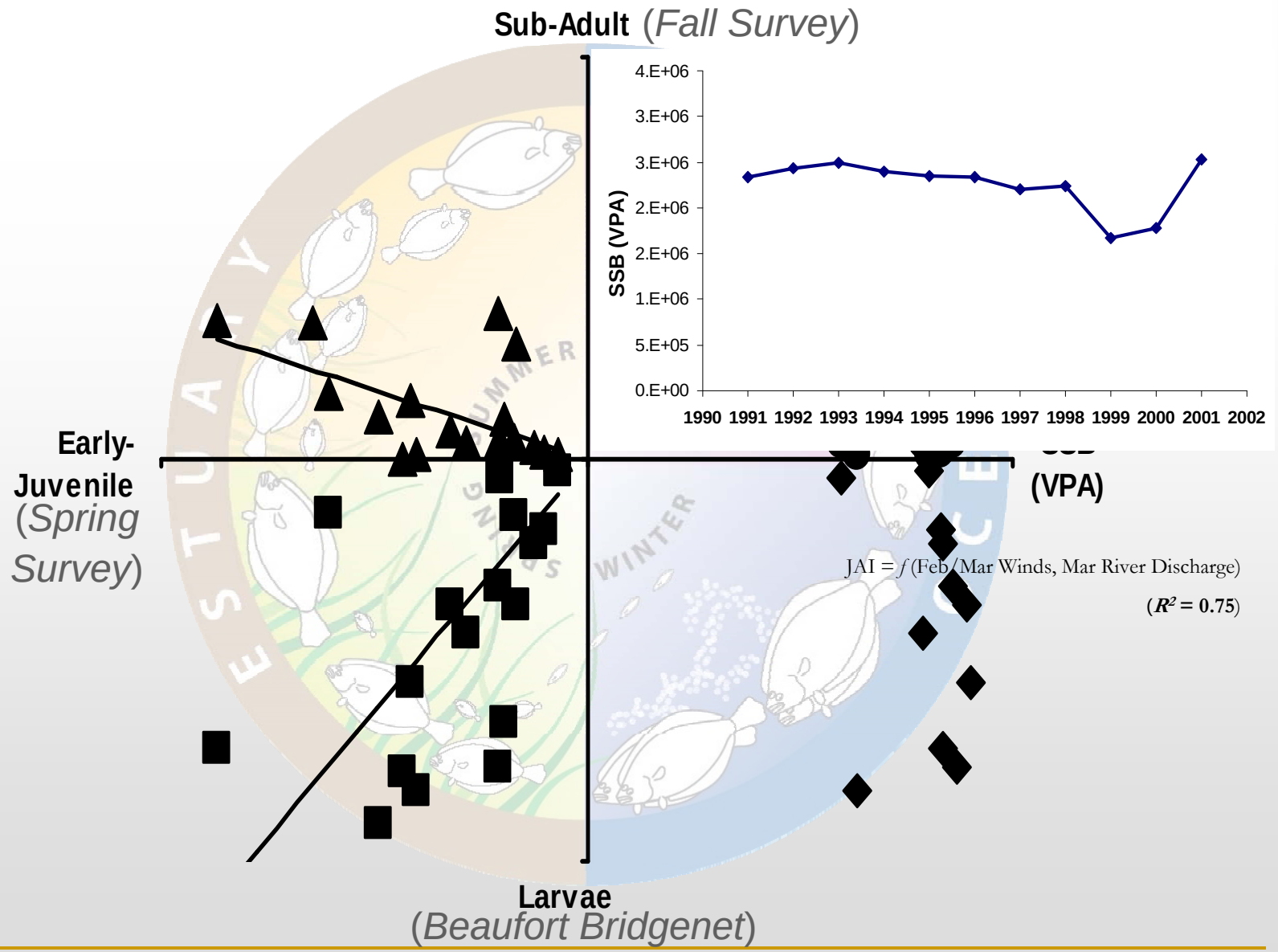
Cost-effective observation platform

1. Index of spawner performance
2. Fishery-independent tuning index for stock assessments
3. Index of year-class strength and triggers for fisheries management
4. Status and response to climate variation and change

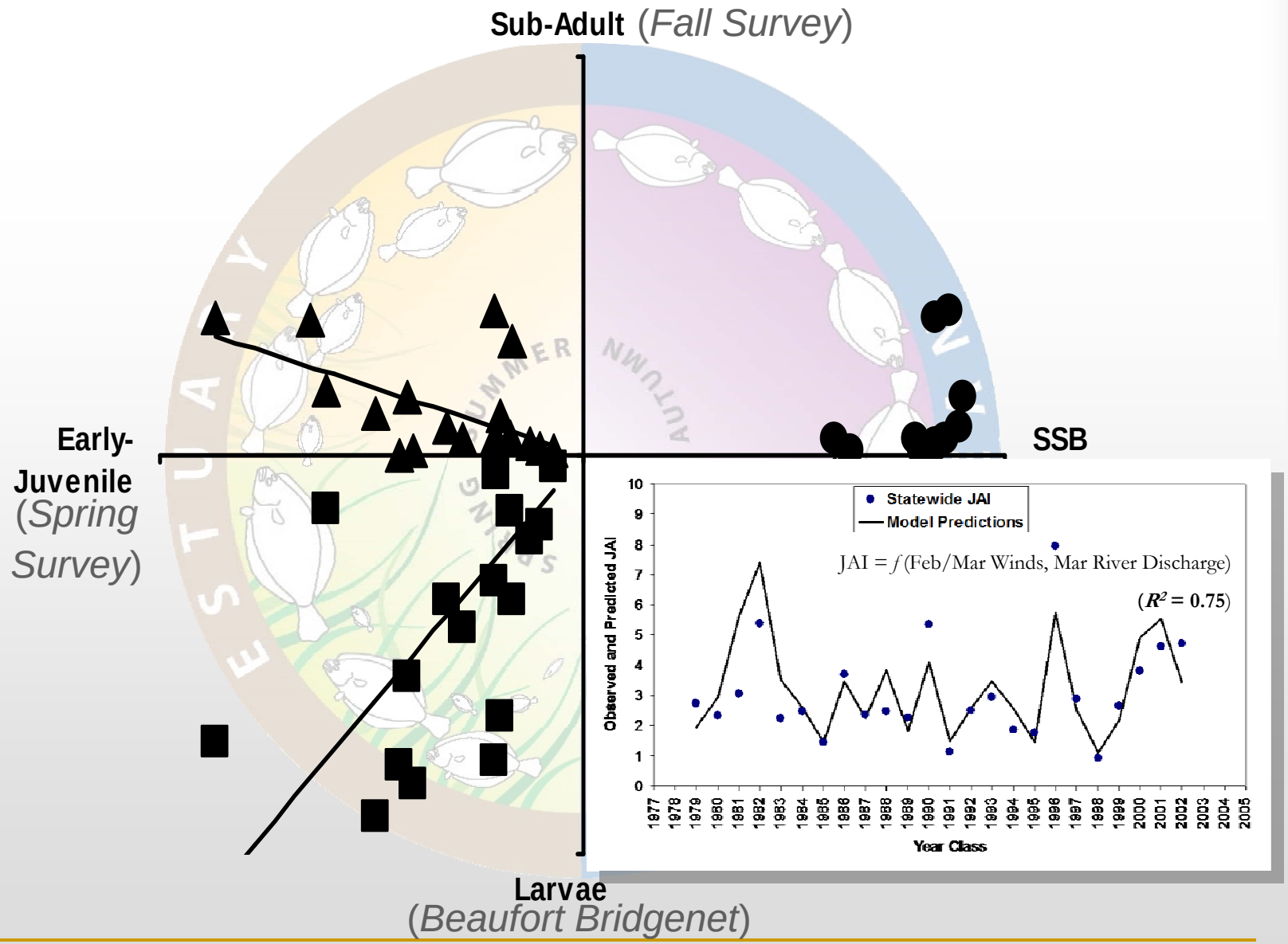
Southern flounder



Southern flounder

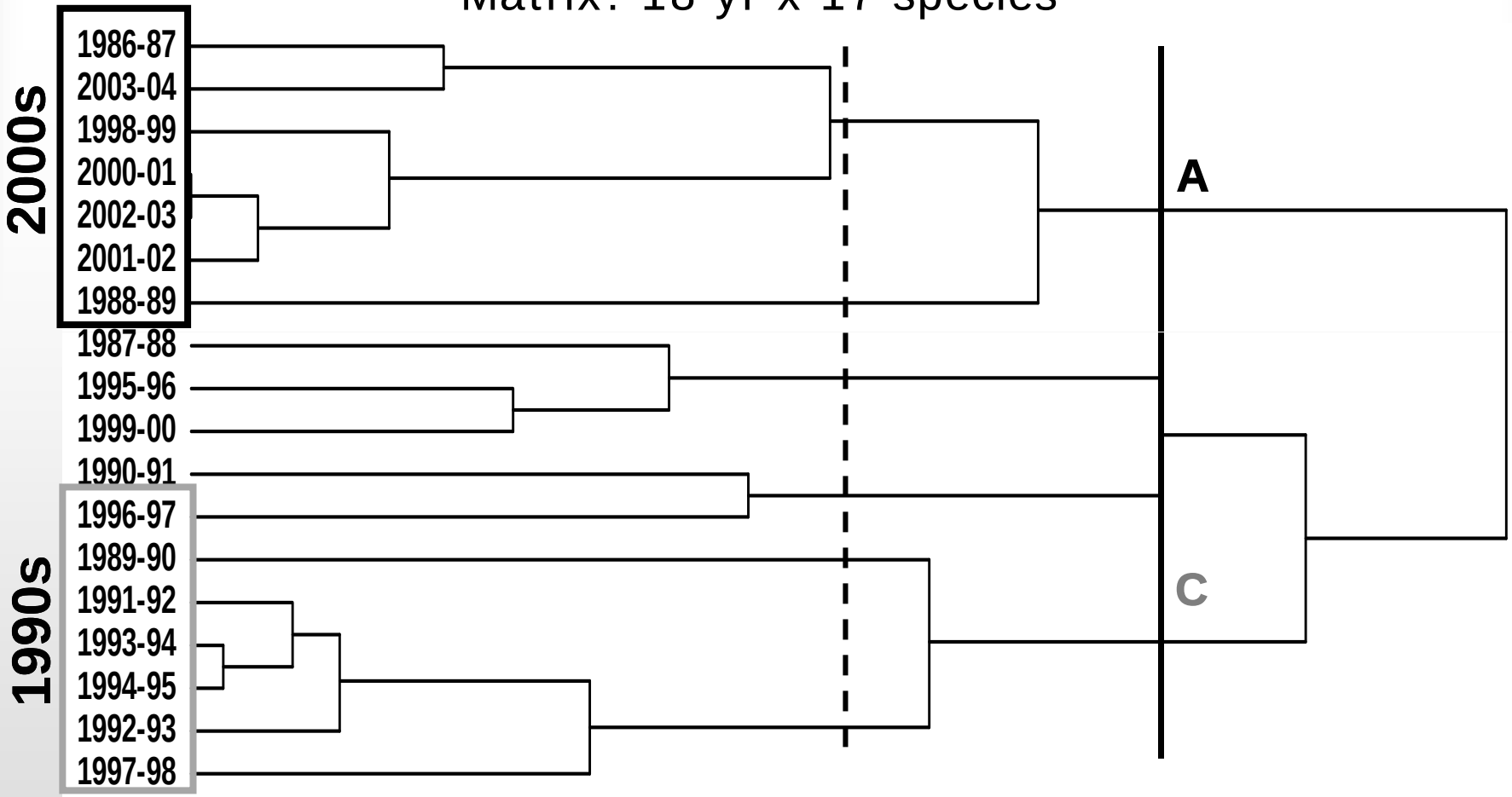


Southern flounder



Shifts in Community Assemblages

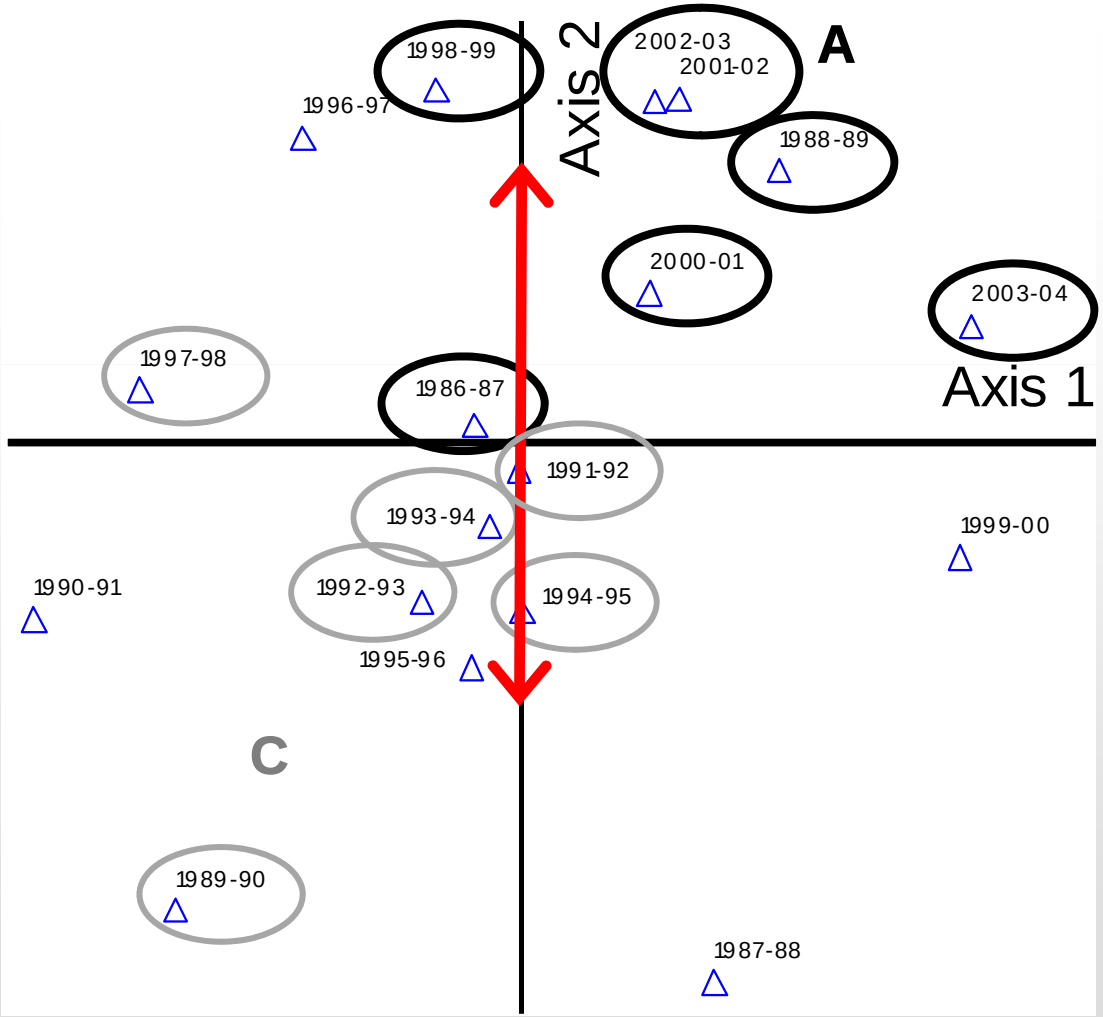
Matrix: 18 yr x 17 species



- Three large clusters of years

Mitchell, Buckel, Taylor, Martin, Shertzer, *in prep*

Shifts in Community Assemblages



- pinfish
- bay whiff
- gulf flounder
- lady fish
- pigfish

- spotted hake

Mitchell, Buckel, Taylor, Martin, Shertzer, *in prep*

FISEA: *Fishery-Indicators of the US SouthEast Atlantic*

Objectives

1. Develop indicators of population status for estuary/coastal species from early life-stages using long-term ichthyoplankton observation platforms
   - ✓ Southern Winter Shelf-Spawners
   - ❑ Northern WSS - *needs further refinement*
2. Derive links between larval recruitment for commercial and recreational species and:
   - ✓ abundance at later life stages
   - ❑ climate change drivers & community assemblages

FISEA: *Fishery-Indicators of the US SouthEast Atlantic*

Future direction

1. Look for similar patterns in independent datasets
   - Juvenile nursery habitats
   - Offshore monitoring programs (SEAMAP, MARMAP)

2. Attribute recent community shifts to:
   - Near-shore climate-ocean variability
   - Anthropogenic drivers
   - Long-term climate-change scenarios

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