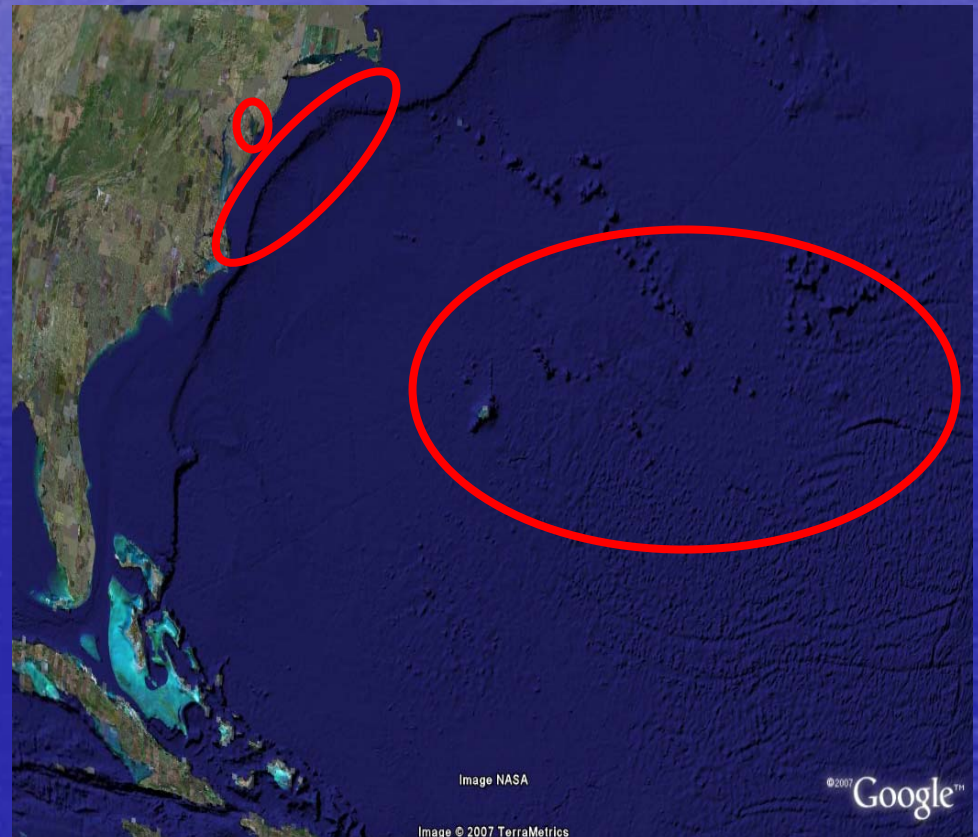


LARVAL FISH INGRESS THROUGH
TWO COASTAL DELAWARE INLETS:
An assessment of local heterogeneity

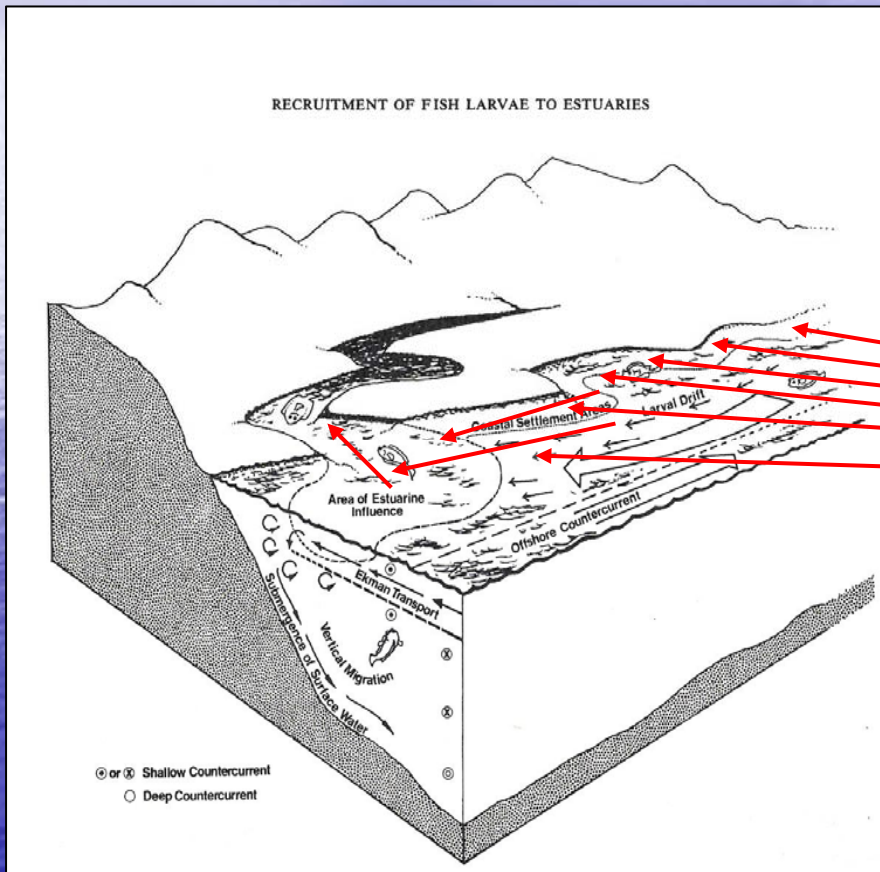
Michael P. Rhode
University of Delaware
June 6, 2008

Introduction

- Estuarine nurseries
- Larval assemblages
- Similarities in reproduction modes and/or preference to a particular condition
- Spawning locations of larvae entering Delaware's coastal inlets



Introduction



- Offshore spawned larval transport

- Offshore

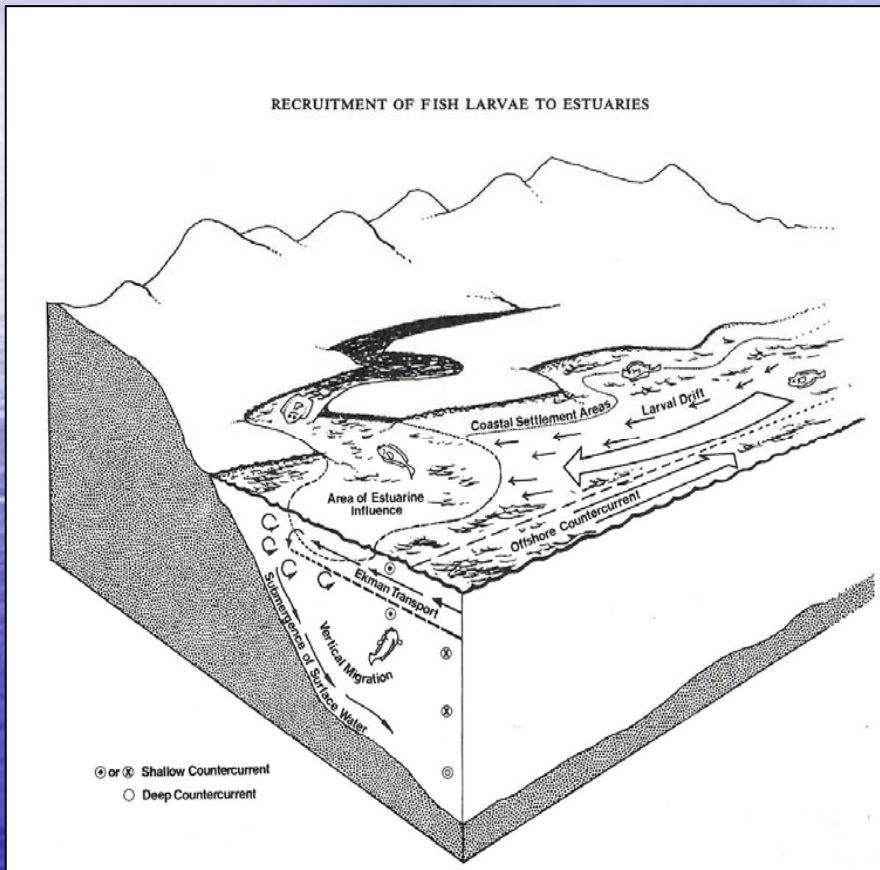
- spawning sites to near shore

- Near shore to estuary mouth

- From estuary mouths into estuaries

Boehlert and Mundy, 1988

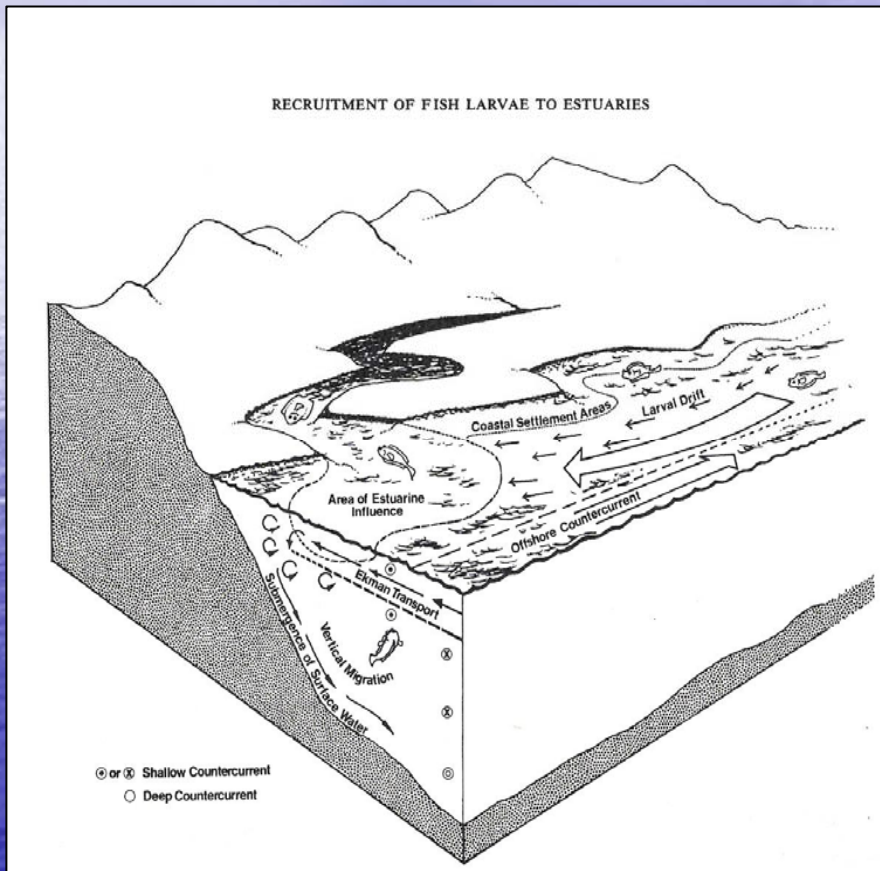
Introduction



Boehlert and Mundy, 1988

- Larval behavior
 - important aspect of assemblage formation
- Cues
 - Salinity
 - as affected by river discharge and tidal mixing
 - Temperature
 - Turbidity
 - Olfactory
 - Current speeds
 - Bottom composition
 - Lunar phase

Introduction



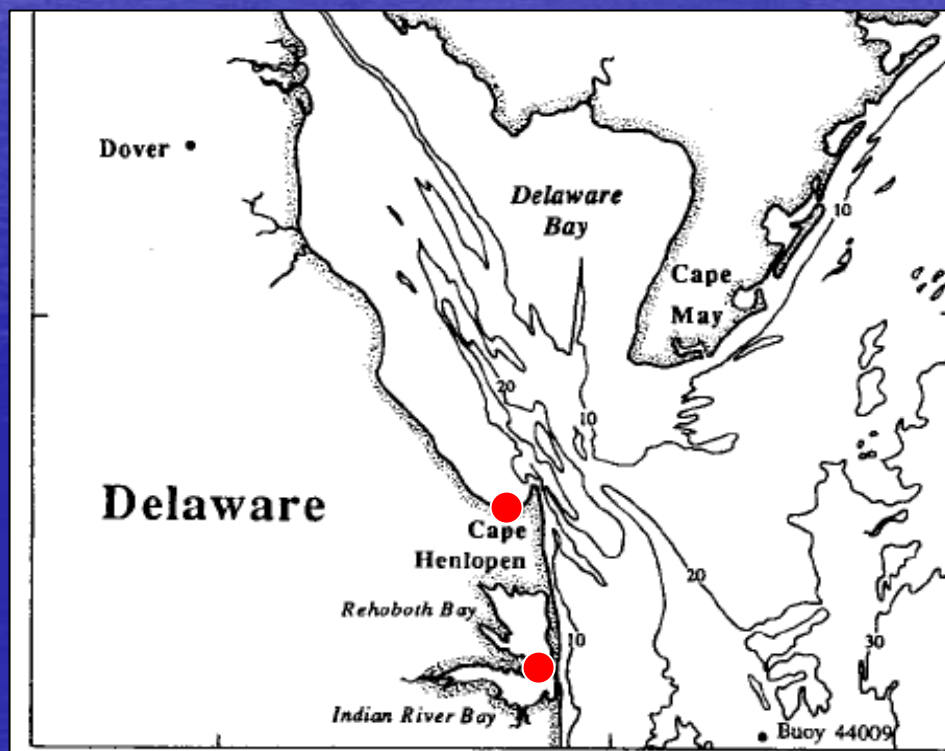
Boehlert and Mundy, 1988

- Knowledge gaps
 - Transition mechanisms offshore enabling fish larvae to move from near shore into estuarine systems
 - Species-specific behaviors
 - vertical migration
 - accumulation in convergences
 - Physical processes

Objective

Establish a weekly ichthyoplankton time series at two Delaware sites to monitor trends in assemblage structure and ichthyoplankton ingress dynamics.

- Establish weekly time series at two local sites
- Assemblage Structure
 - Biodiversity
 - Seasonality
- Timing of ingress
- Average Size



Study Sites



- Roosevelt Inlet
 - Sampling site ~5 km from Cape Henlopen

- Indian River Inlet
 - Massey's Landing ~4 km from inlet mouth

Methods



- Year round weekly sampling
 - Roosevelt Inlet
January 30, 2006-May 30, 2007
 - Indian River Inlet
May 15, 2006-May 30, 2007
- Protocol followed a 20 year larval fish time series at Little Egg Inlet, NJ
 - Witting *et al.*, 1999

Roosevelt Inlet vs Massey's Landing

May 15, 2006-May 30, 2007 (during simultaneously sampling)

- 67,367 fish larvae
- 48 species in 31 families

Roosevelt Inlet



- 50,659 fish larvae
- 43 species

VS

Massey's Landing

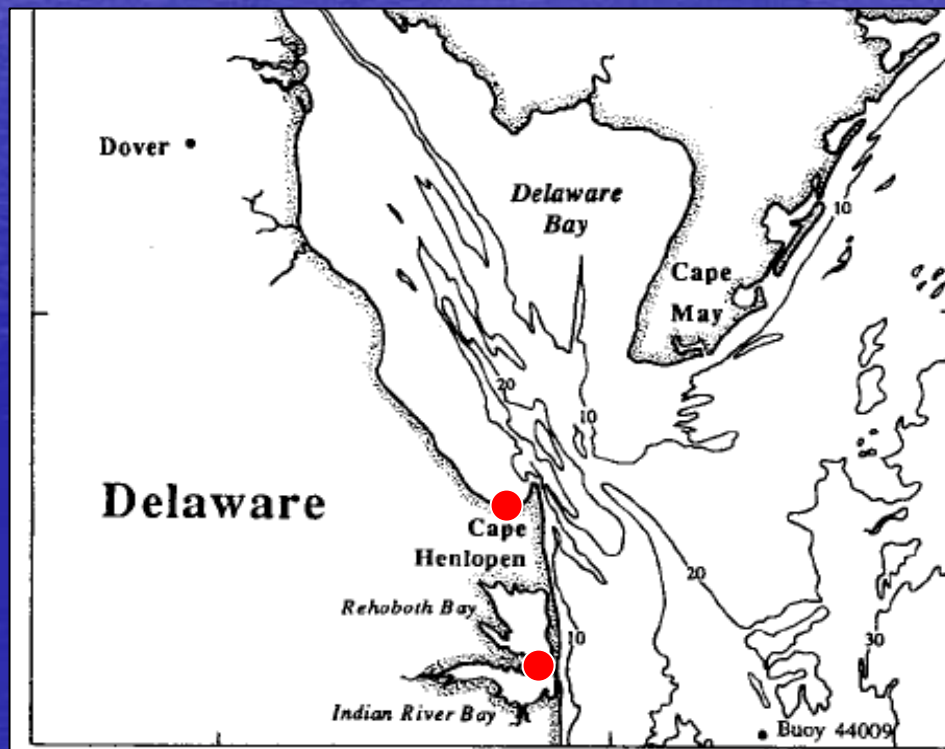


- 16,708 fish larvae
- 36 species

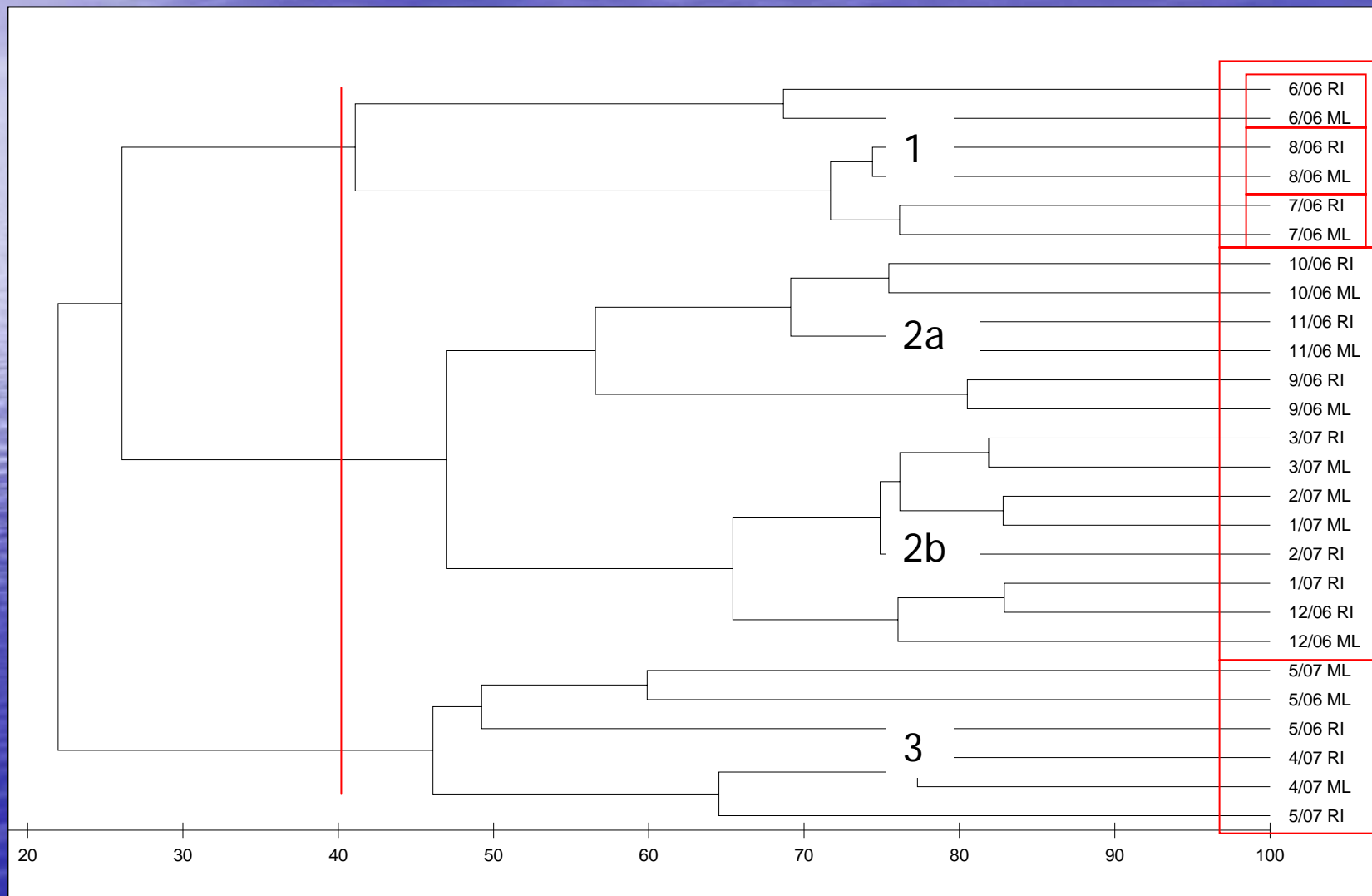
Objective

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 - Biodiversity
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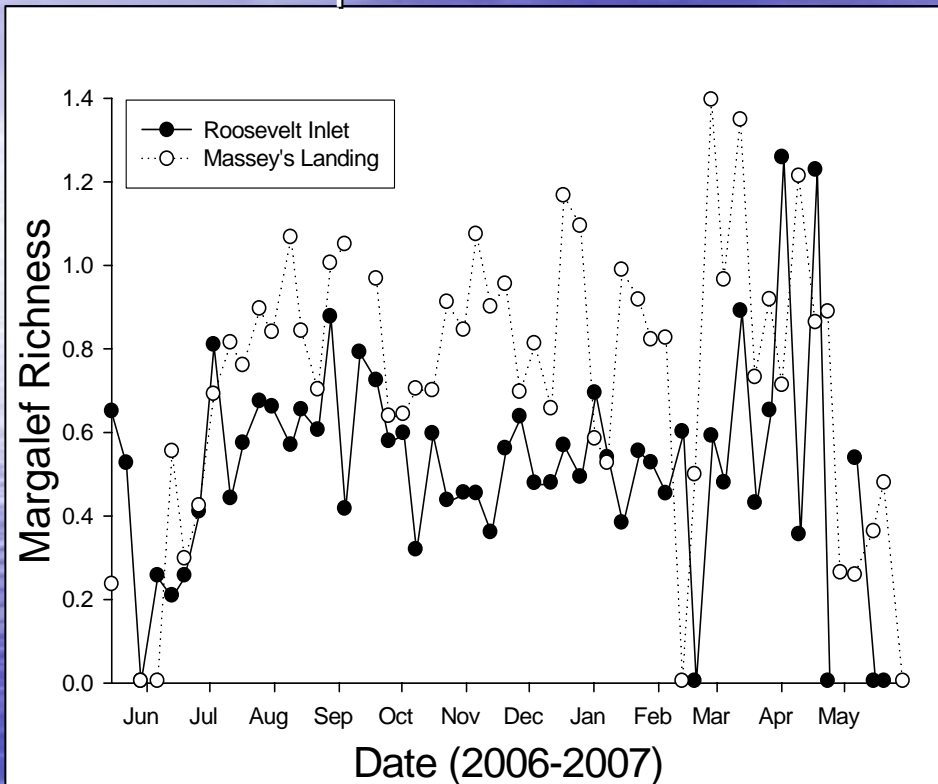


Biodiversity



Biodiversity

Species Richness

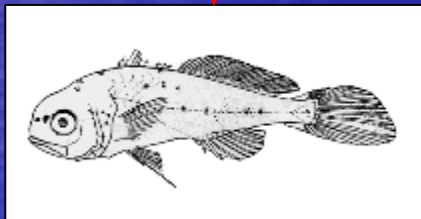
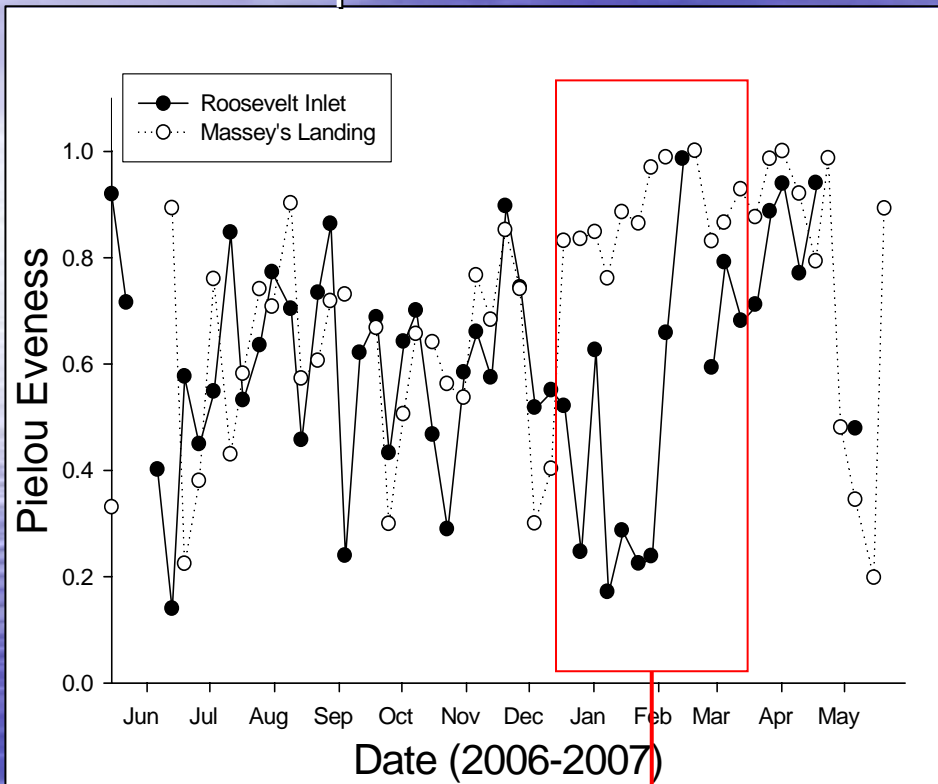


- RI: 43 species / 50,659 fish larvae
- ML: 36 species / 16,708 fish larvae

- Species richness
 - species count
- Margalef's index
 - sensitive to the occurrence of rare species
- Not Significant
- General species occurrence patterns in this geographical area are controlled by the same set of habitat and environmental factors

Biodiversity

Species Evenness



- Species evenness
 - quantifies how equal the abundance of each species is
 - declines occur during recruitment events
- Pielou's evenness
 - the less variation in a population between relative species, the closer to 1
- Significant
- Large scale recruitment events

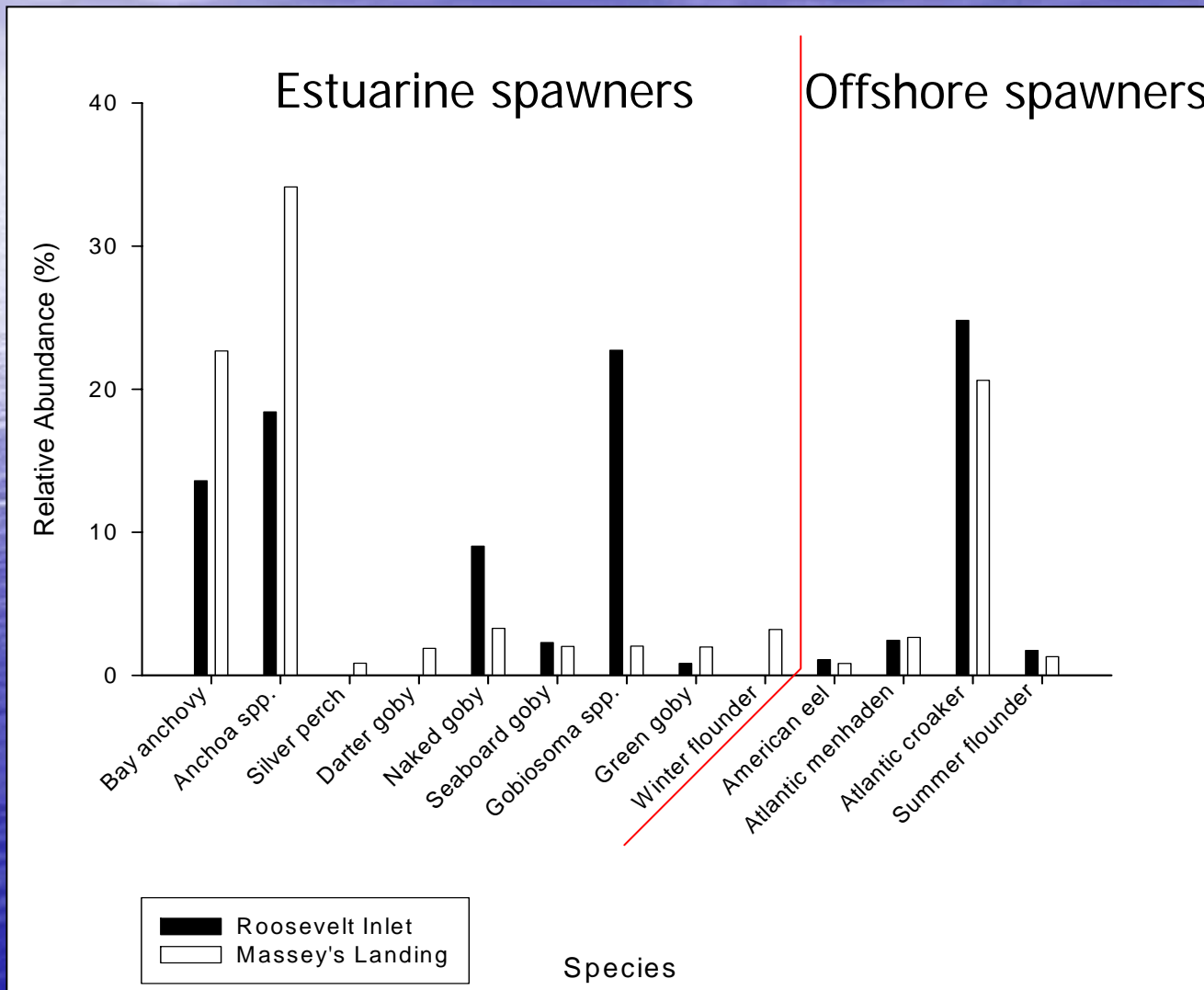
Roosevelt Inlet

	Species	Common name	Total#	%	Spawning Site
1		Atlantic croaker	12567	24.8	MAB (southern)
2			11504	22.7	Estuary
3			9325	18.4	Estuary /MAB
4		Bay anchovy	6887	13.6	Estuary /MAB
5		Naked goby	4568	9.0	Estuary
6		Atlantic menhaden	1237	2.4	MAB /SAB
7		Seaboard goby	1163	2.3	Estuary
8		Summer flounder	879	1.7	MAB
9		America eel	546	1.1	Sargasso Sea
10		Green goby	419	0.8	Estuary

Massey's Landing

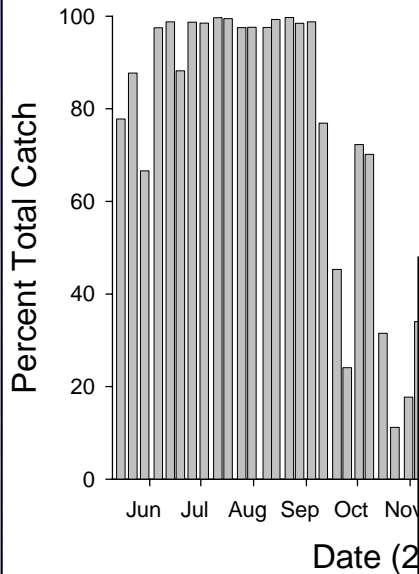
	Species	Common name	Total#	%	Spawning Site
1			5703	34.1	Estuary /MAB
2		Bay anchovy	3787	22.7	Estuary /MAB
3		Atlantic croaker	3443	20.6	MAB (southern)
4		Naked goby	547	3.3	Estuary
5	<i>Pseudopleuronectes americanus</i>	Winter flounder	534	3.2	Estuary /MAB
6		Atlantic menhaden	441	2.6	MAB /SAB
7			338	2.0	Estuary
8		Seaboard goby	335	2.0	Estuary
9		Green goby	330	2.0	Estuary
10	<i>Ctenogobius boleosoma</i>	Darter goby	314	1.9	Estuary
11		Summer flounder	215	1.3	MAB
12	<i>Bairdiella chrysoura</i>	Silver perch	141	0.8	Nearshore
13		American eel	137	0.8	Sargasso Sea

Roosevelt Inlet vs Massey's Landing

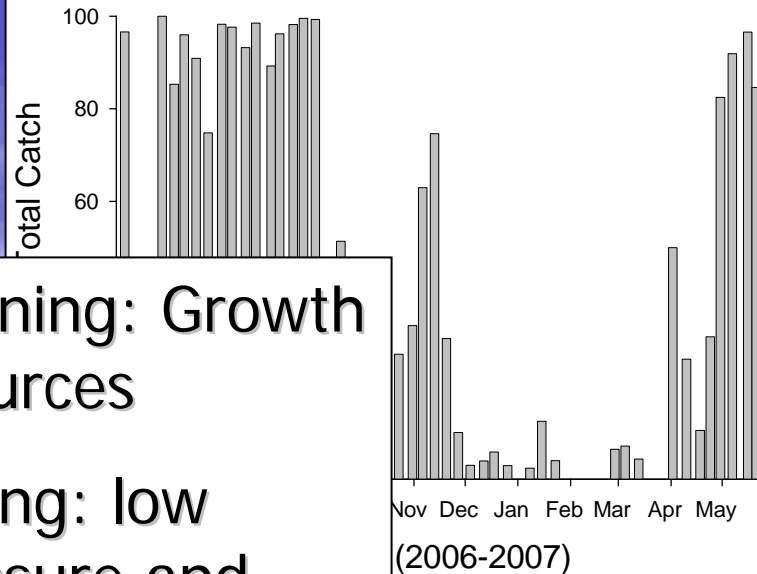


- Separate communities into guilds of species based on spawning location
- Many fishes spawn at times and in places that promote larval feeding or transport/retention

Estuarine Spawner Ingress
Roosevelt Inlet



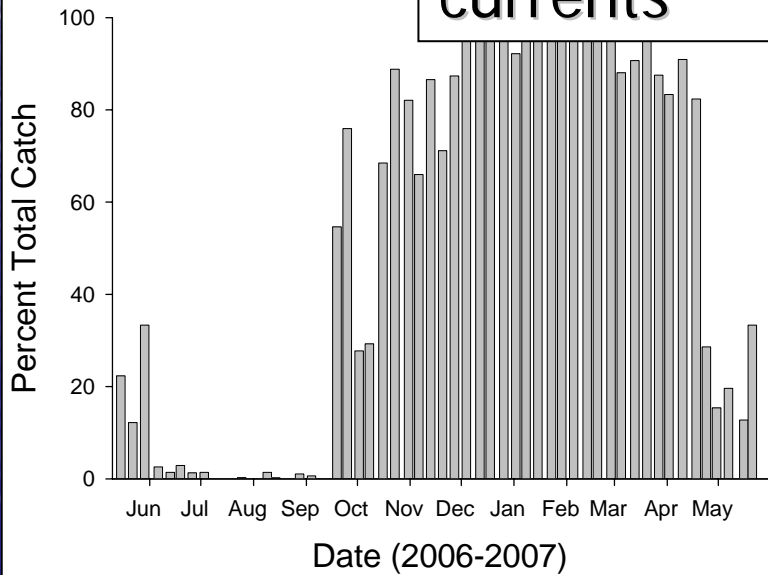
Estuarine Spawner Ingress
Massey's Landing



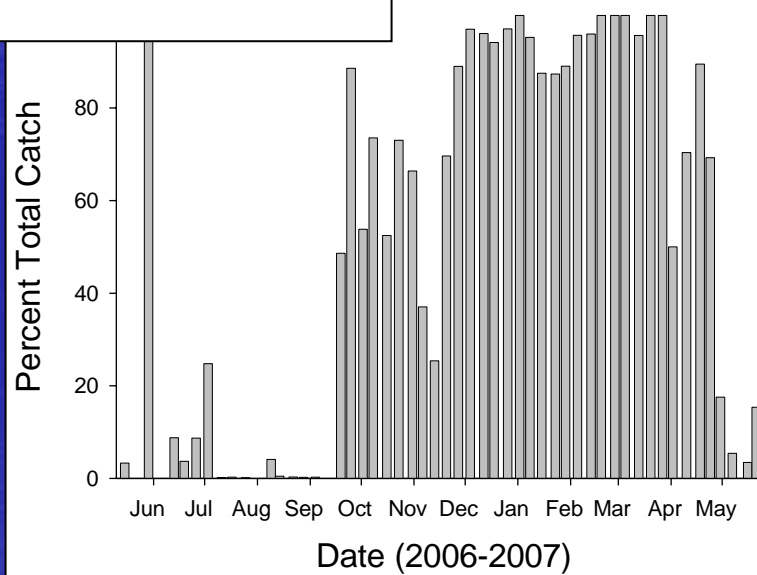
Summer spawning: Growth and prey resources

Winter spawning: low predation pressure and shoreward transport currents

Offshore Spawner Ingress
Roosevelt Inlet

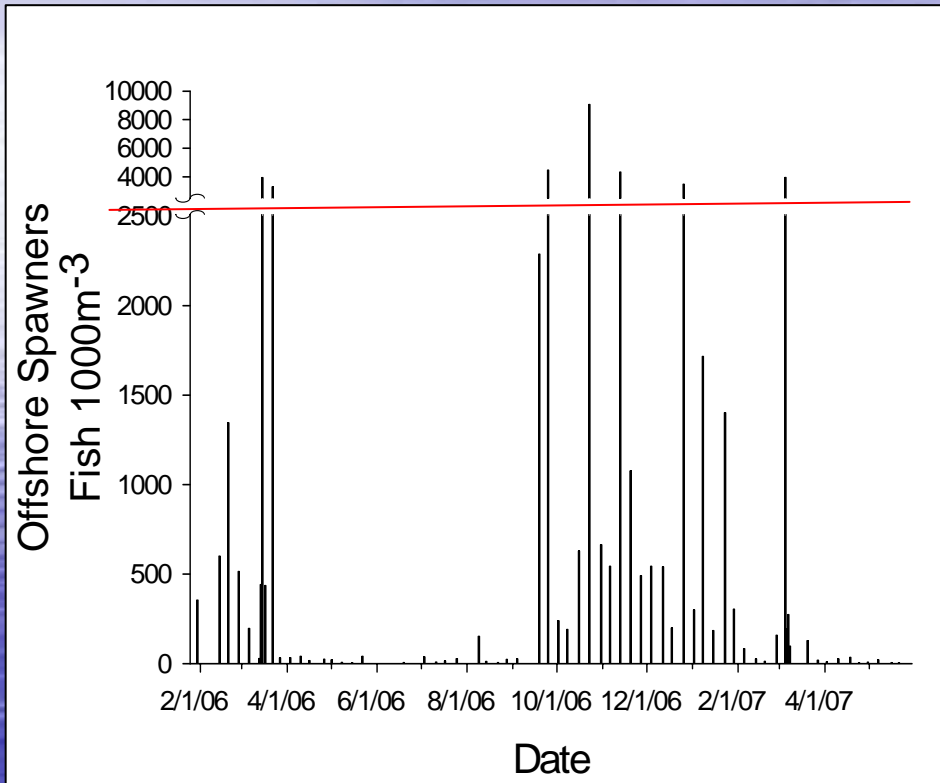


Spawner Ingress
Massey's Landing

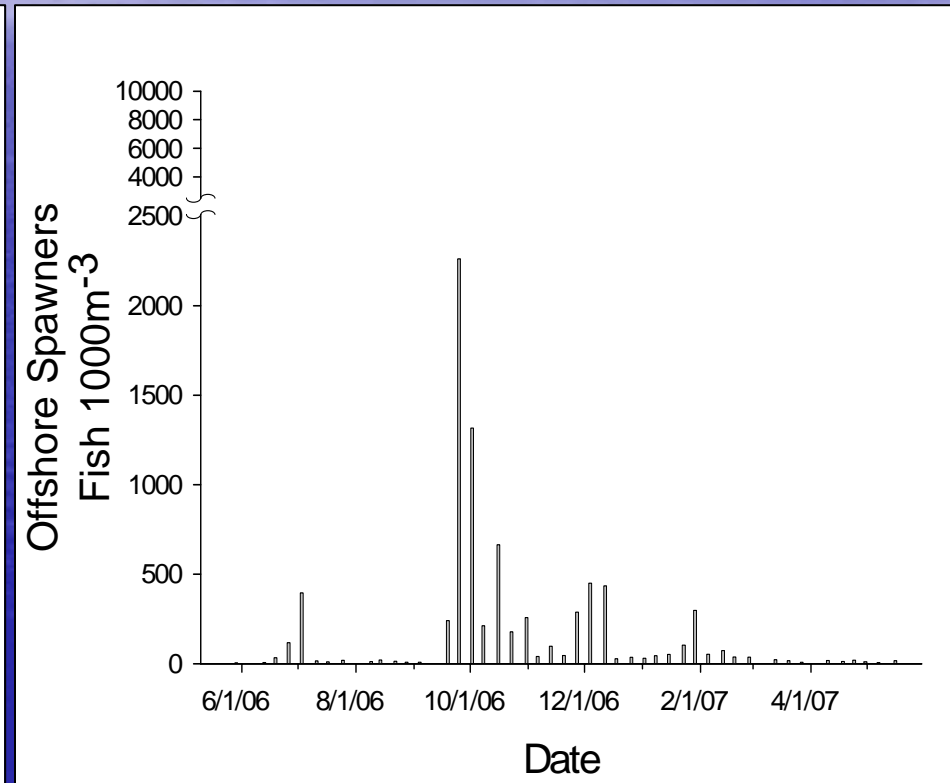


Recruitment Events

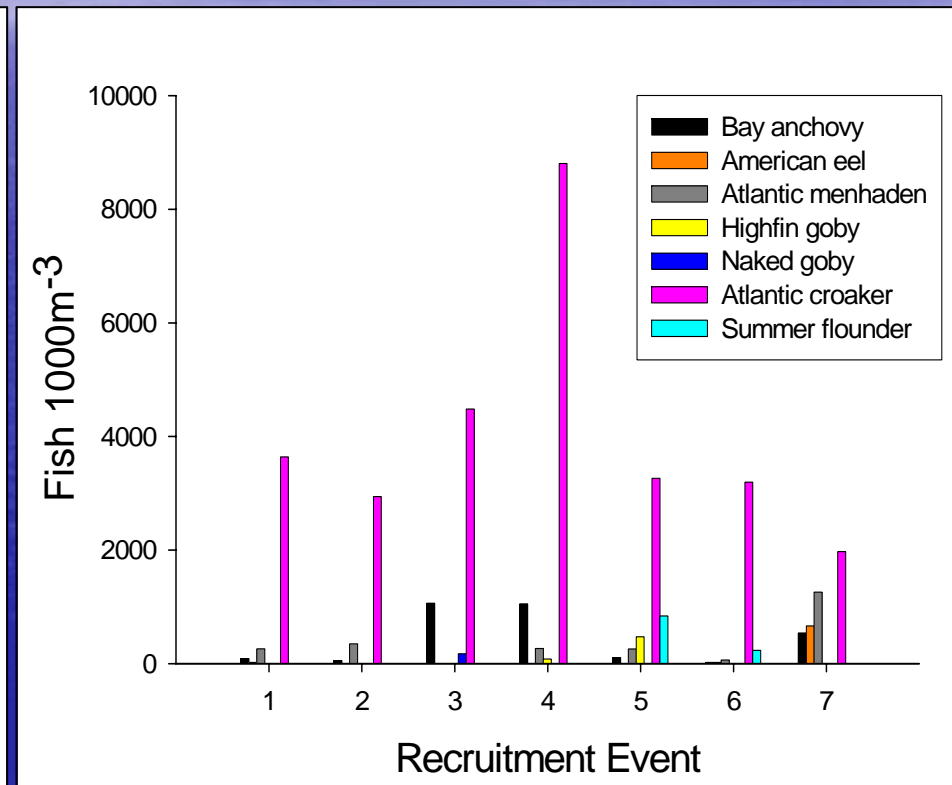
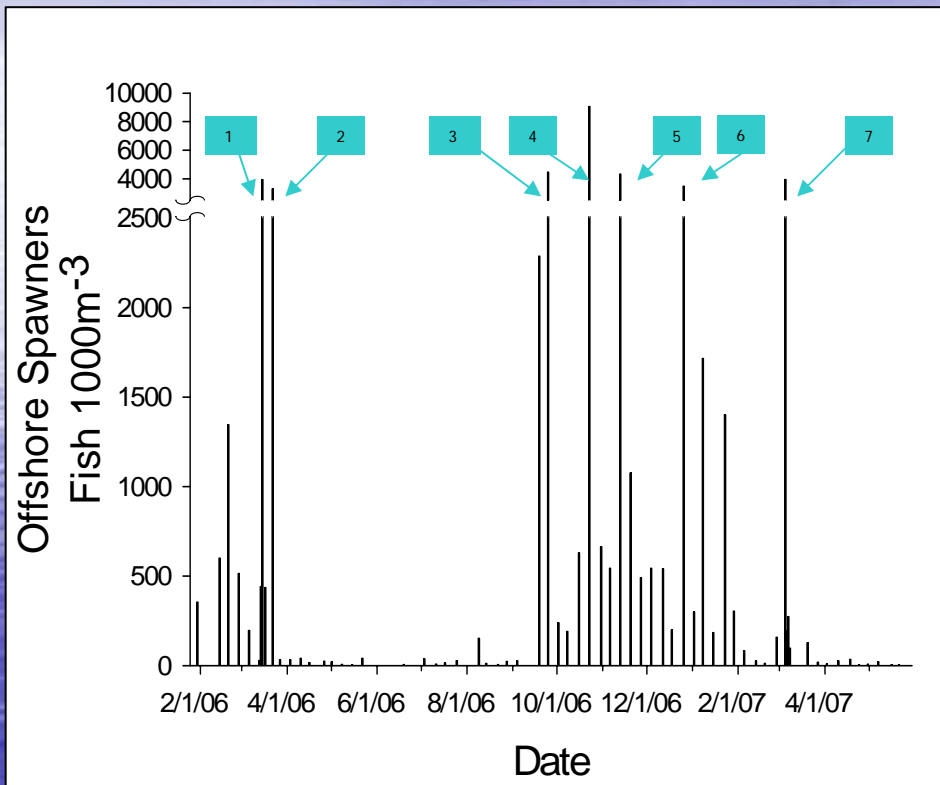
Roosevelt Inlet



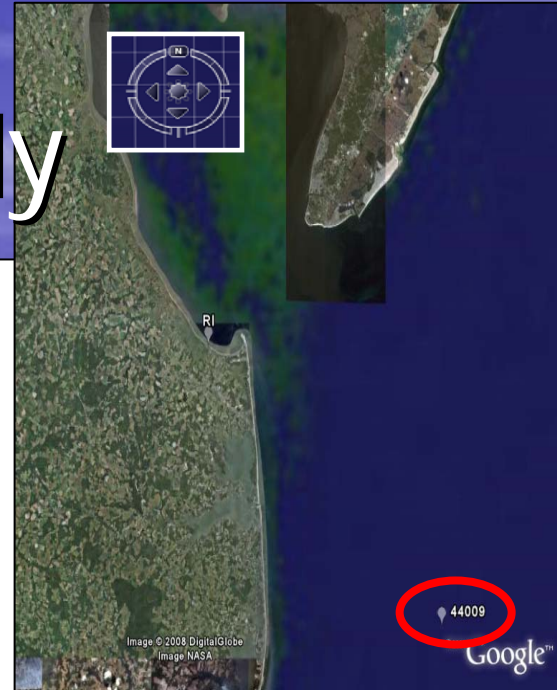
Massey's Landing



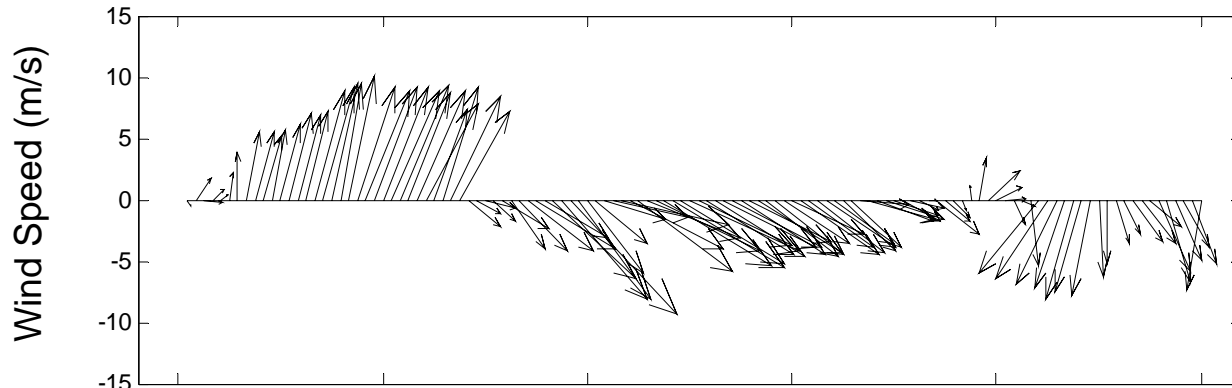
Roosevelt Inlet Recruitment Events



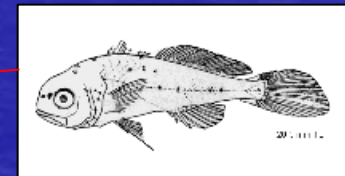
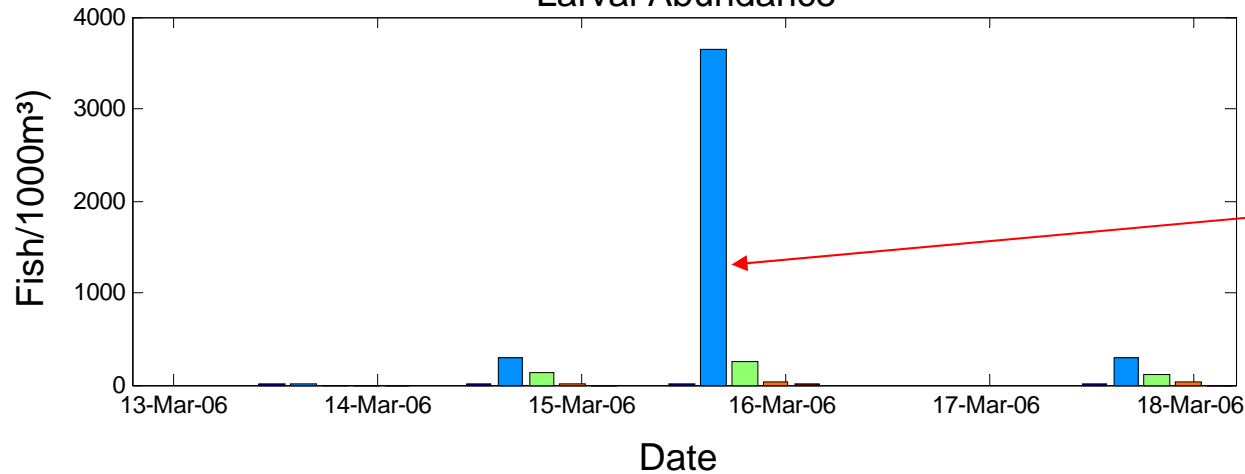
Four Day Intensive Study



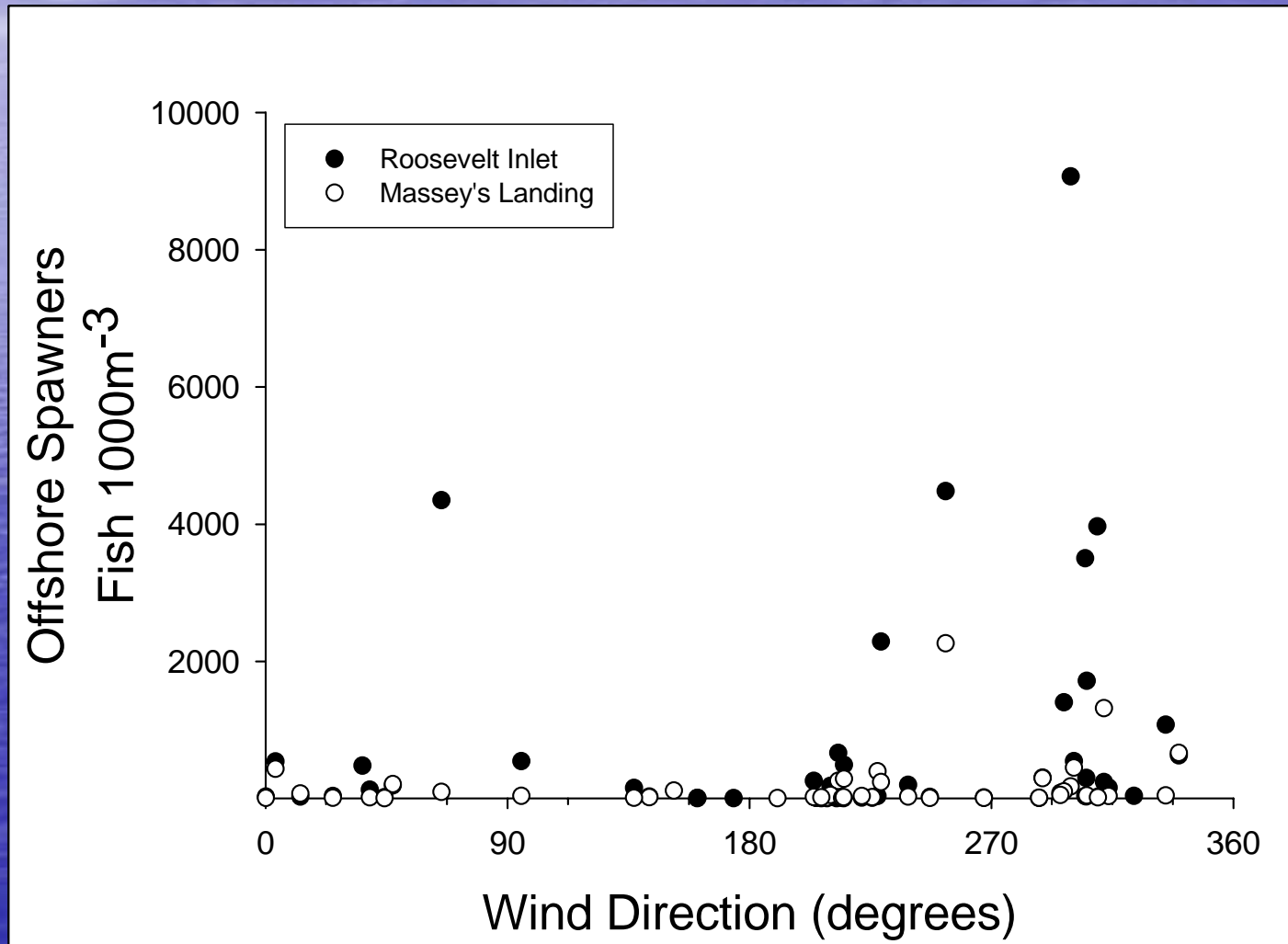
Station 44009-Delaware Bay 26 NM Southeast of Cape May, NJ



Larval Abundance

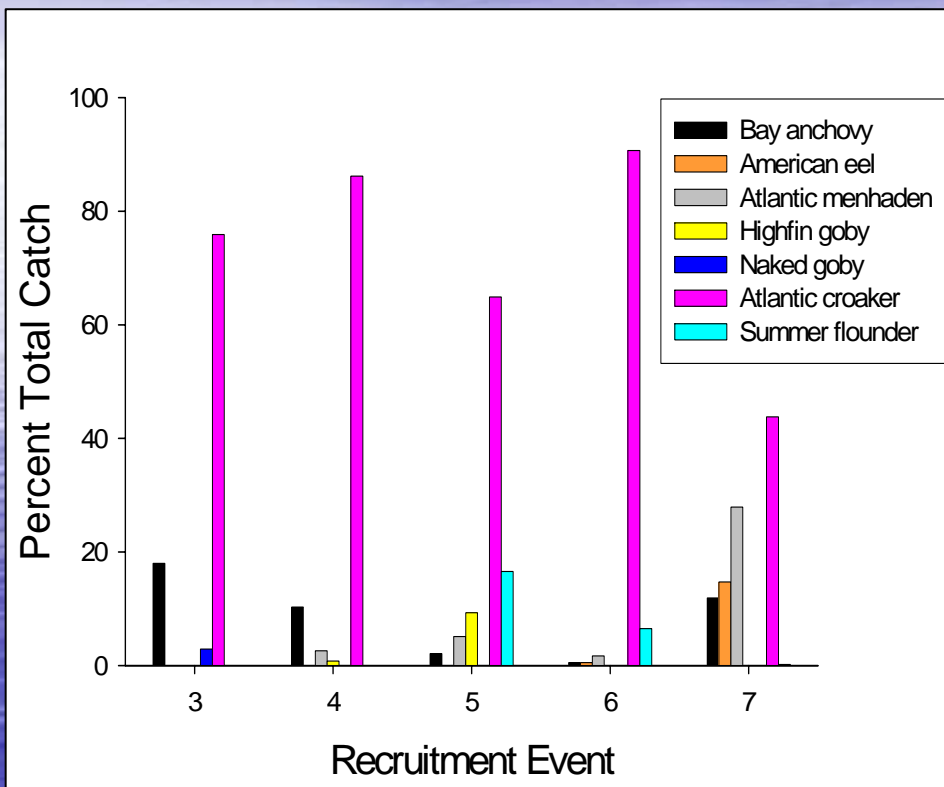


Offshore Spawner Environmental Influence

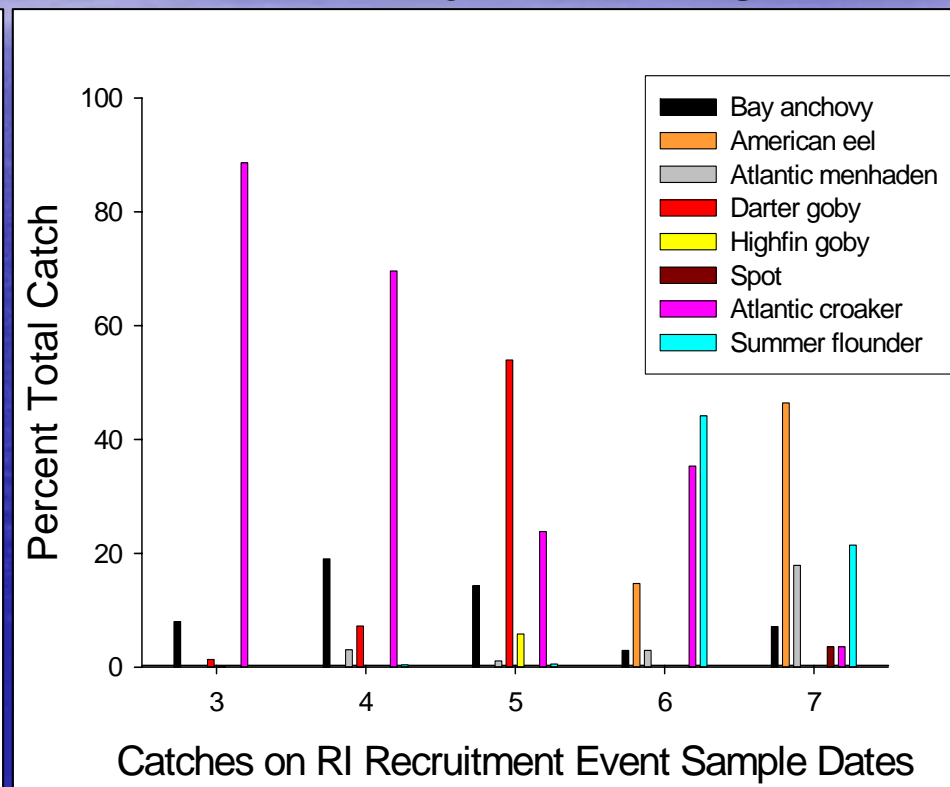


Relative Abundance

Roosevelt Inlet



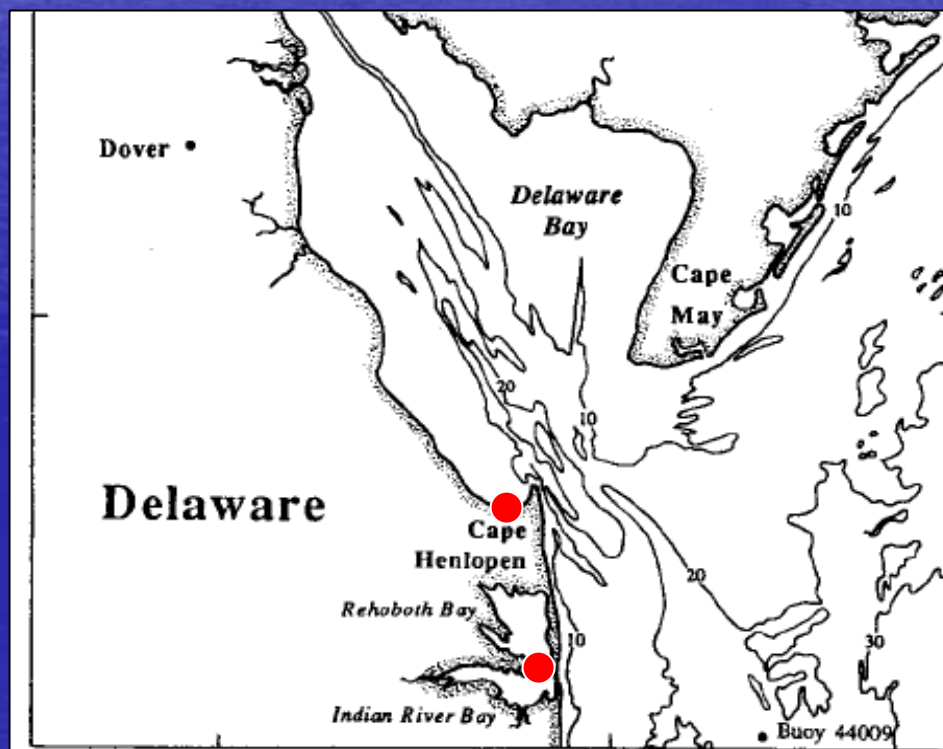
Massey's Landing



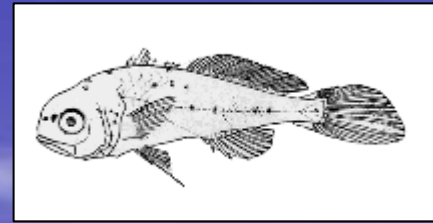
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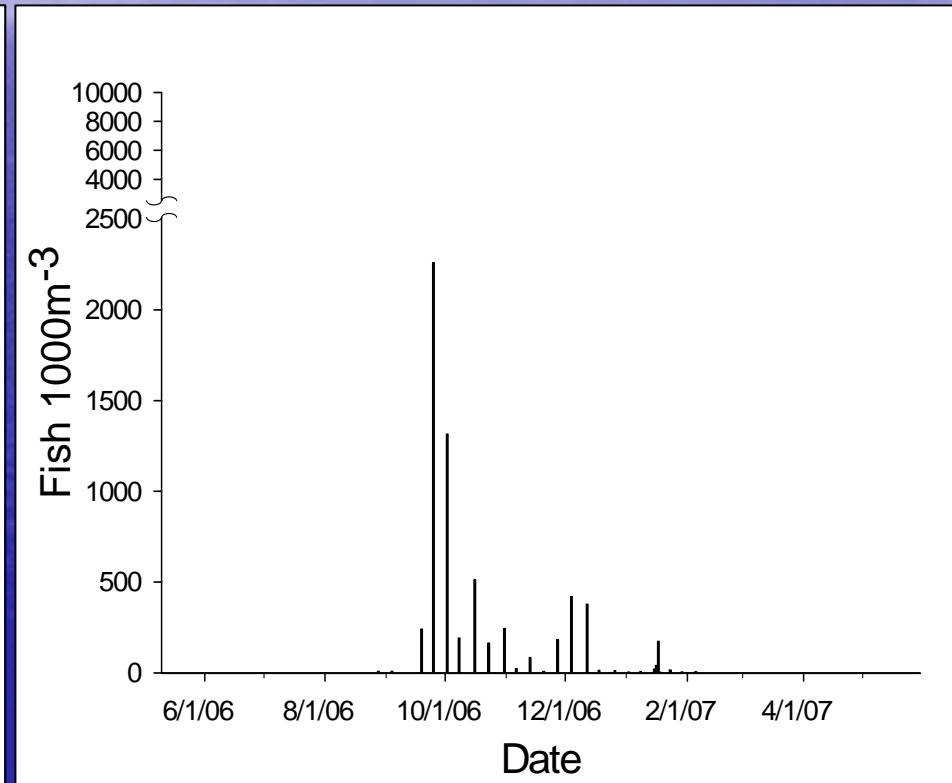
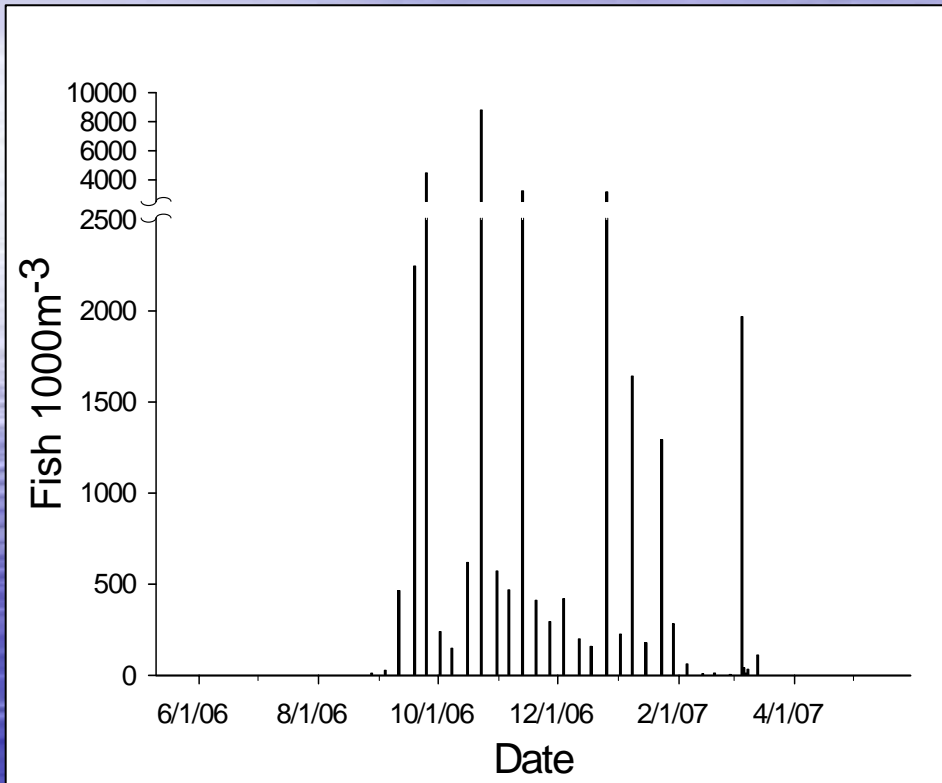


Atlantic Croaker



Roosevelt Inlet

Massey's Landing



- Non-synchronous timing of peak abundances and persistence

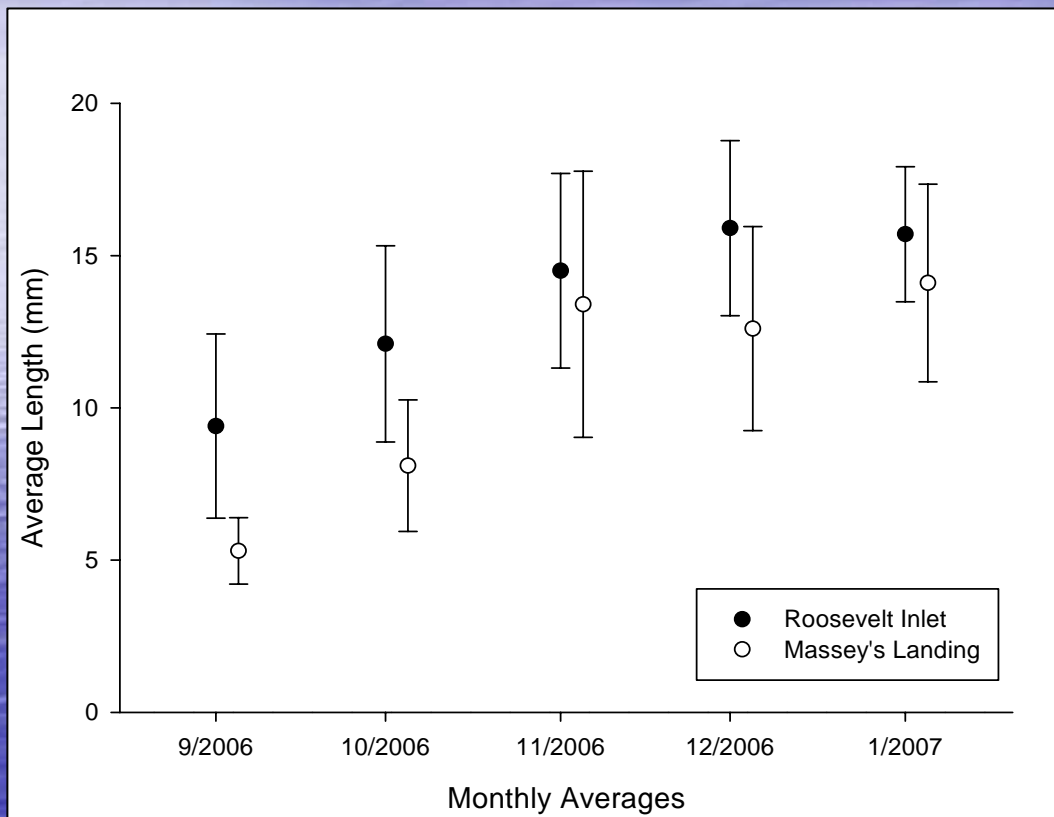
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Atlantic Croaker



- Significantly larger at Roosevelt Inlet
- Larval behavior becomes better developed in older larvae
- Cues which initiate species specific behaviors cause better developed fish to better affect horizontal position

Atlantic Croaker Recruitment

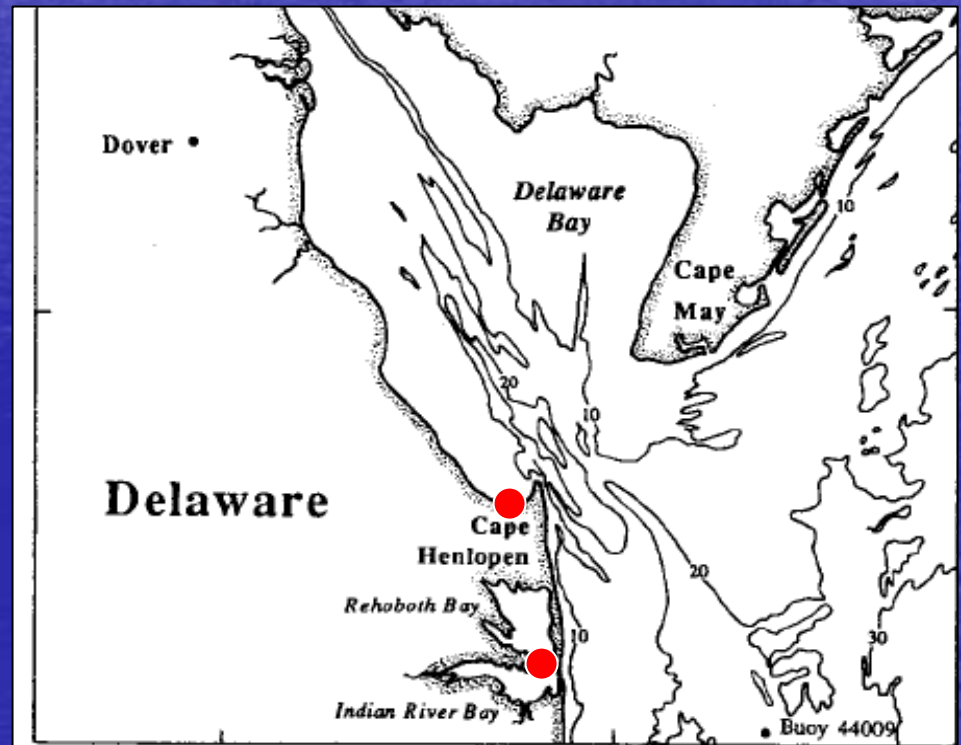


- Atlantic croaker are demersal
- Larvae concentrate in colder, saltier inward flowing waters near bottom
 - Prefer deep channels
- Cold surface waters increased survivability of demersal species

Conclusions

Establish a weekly ichthyoplankton time series at two Delaware sites to monitor trends in assemblage structure and ichthyoplankton ingress dynamics.

- Similarities in seasonality and diversity
 - General species occurrence patterns in this geographical area are controlled by the same set of habitat and environmental factors



Conclusions

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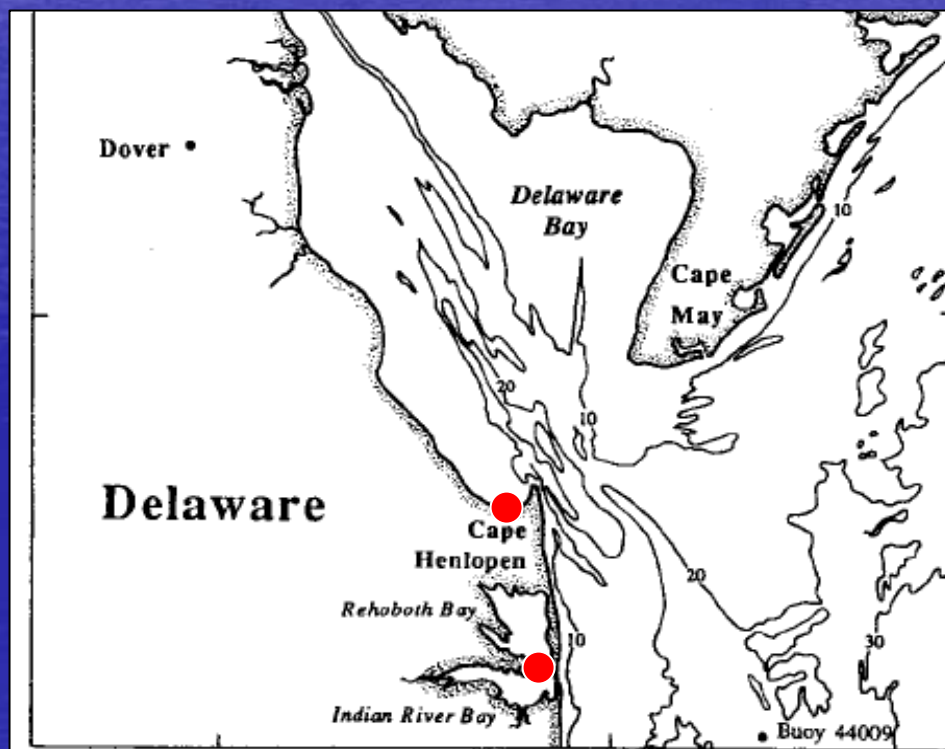
- Significant differences primarily in the relative abundance, persistence in collections and average larval size of Atlantic croaker

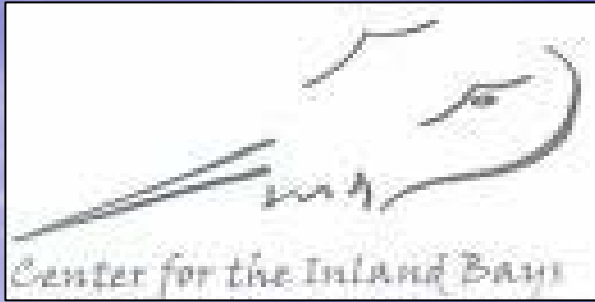


Conclusions

Establish a weekly ichthyoplankton time series at two Delaware sites to monitor trends in assemblage structure and ichthyoplankton ingress dynamics.

- Roosevelt Inlet allows for study of the transition mechanisms enabling fish larvae to move from near shore into estuarine systems





Center for the
Inland Bays



Tim Targett Lab



Roland Hagan
and Ken Able

RUMFS