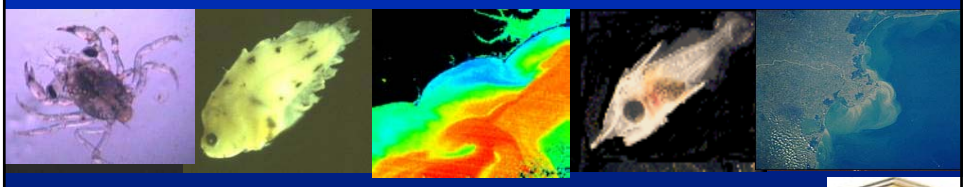
CORMP Fisheries Component

Recruitment and Coastal Ocean Processes:

Gulf Stream & River Plume Influences

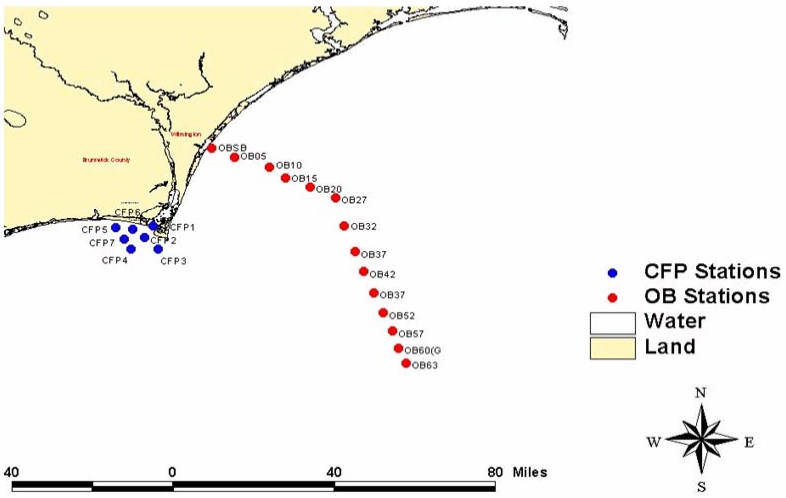


UNCW

NOAA

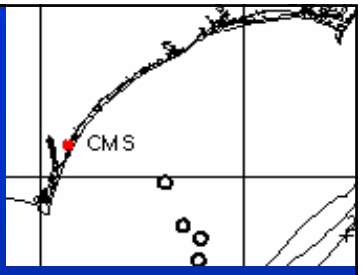
Sea Grant North Carolina

UNCW/NOAA Coastal Monitoring Program

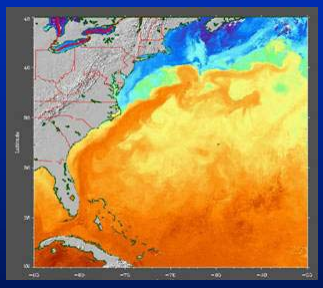


Fish Recruitment to Onslow Bay

- Approx. 200 reef-associated spp. in Carolinas (Schwartz, 1989)



- Recruits: local or advected into Onslow Bay from distant sources ?
  - Connectivity ?
  - Source vs. Sink ?



- Coupling spatial distribution of larvae with oceanographic data to identify sources and assist MPA design.

ACKNOWLEDGEMENTS

Coastal Ocean Research and Monitoring Project

Funding and Support

NOAA/OAR
Got-em on Live Bait Club

Co-Investigators

Dr. Frederick Bingham
Dr. Lawrence Cahoon
Dr. Jeff Govoni

Technical Assistance

Dr. Jon Hare
Dr. Dave Jones
Dr. Monica Lara
Dr. Claire Paris
Dr. Bill Richards

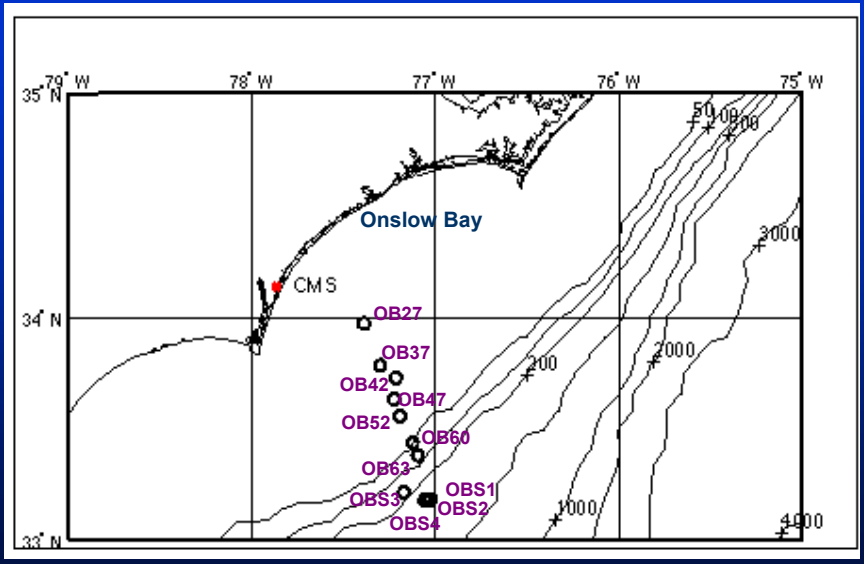
Objectives:

1) Identify water masses as shelf, GS/Shelf, GSF, and GS

2) Describe larval fish assemblages in these water masses

3) Compare length-frequency and concentration data for abundant and reef-associated taxa

Methods



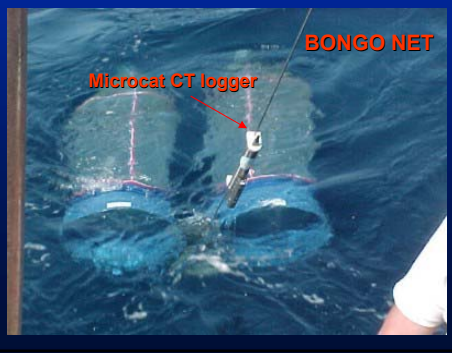
Samples collected monthly, April 2000-December 2001

Neuston Net

- 950 µm mesh net
- 1 m X 2 m mouth opening
  - 10 minutes
  - ~ 2 knots
  - half in/half out at surface

Bongo Net

- 333 µm mesh net
- 60 cm diameter mouth openings
  - 5-10 minutes
  - ~ 1.5 knots
  - stepped oblique pattern
- Deployed to ~10 m from bottom, or 100 m at GS

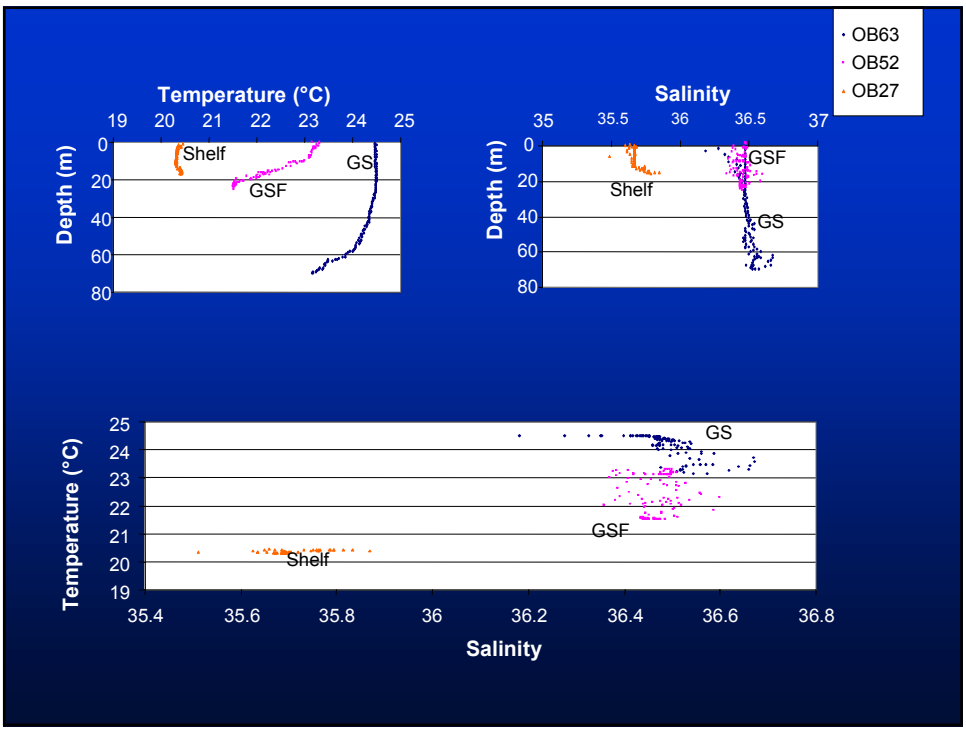


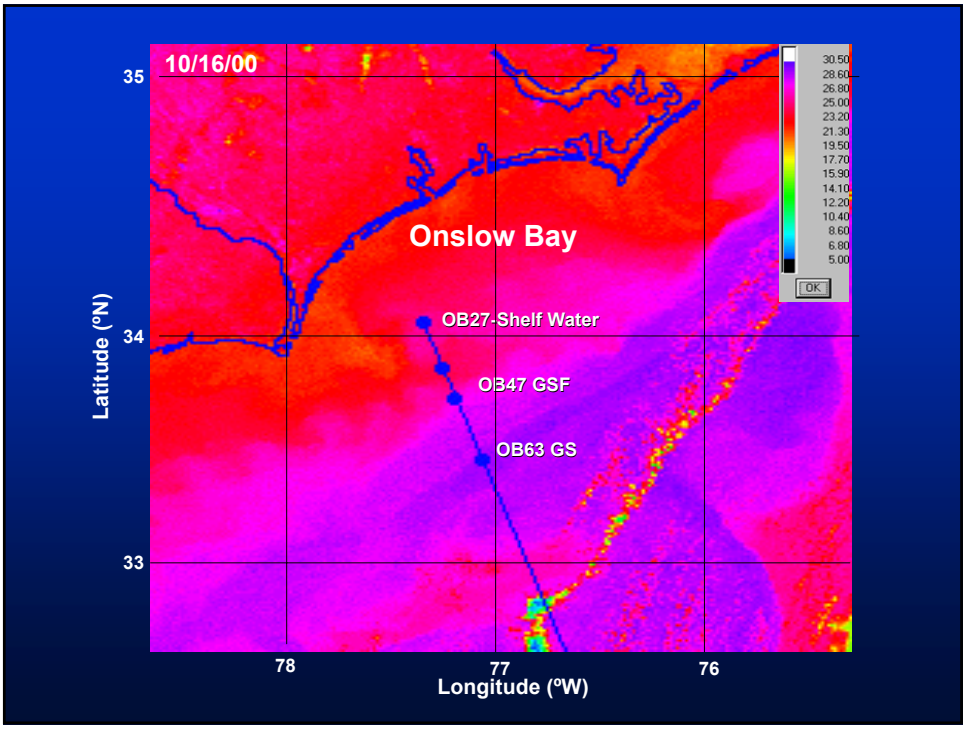

Hamilton
MONTVALE
3
4
5
6
7

Objectives

1) Identify water masses as shelf, GS/Shelf, GSF, and GS

- **CTD and Microcat loggers**
- **AVHRR images**
- **ADCP (*in situ*)**
- **Microcat loggers (*in situ*)**





Objectives

2) Describe larval fish assemblages, concentrations & familial diversities in different water masses

Total Numbers

	Shelf	GS/S	GSF	GS	Total
Bongo	5818 (n=29)	6160 (n=23)	2459 (n=20)	2182 (n=24)	16619
Neuston	1735 (n=29)	1392 (n=22)	657 (n=20)	834 (n=25)	4618
Total	7553	7552	3116	3016	21237

Bongo Catches

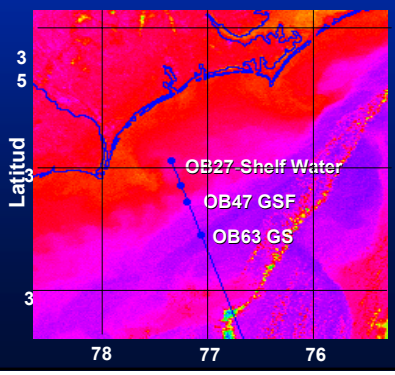
	Shelf		GS/S		GSF		GS	
Total Larvae	Bothidae	11%	Clupeidae	20%	Bothidae	18%	Bothidae	20%
	Callionymidae	11%	Bothidae	13%	Labridae	15%	Myctophidae	8%
	Gobiidae	11%	Gobiidae	11%	Carangidae	5%	Scombridae	6%
	Labridae	10%	Carangidae	8%	Myctophidae	4%	Sciaenidae	5%
	Sparidae	9%	Labridae	6%	Triglidae	3%	Ophidiidae	4%
Total		52%		58%		45%		43%
Reef Fish Larvae	Gobiidae	11%	Gobiidae	11%	Labridae	15%	Labridae	3%
	Labridae	10%	Labridae	6%	Serranidae	3%	Serranidae	3%
	Sparidae	5%	Sparidae	3%	Gobiidae	2%	Scaridae	2%
	Haemulidae	4%	Haemulidae	3%	Apogonidae	1%	Gobiidae	2%
	Lutjanidae	1%	Lutjanidae	2%	Priacanthidae	1%	Scorpaenidae	1%
Total		31%		25%		22%		11%

Objectives

3) Describe length frequencies and length-concentration relationships of abundant and reef larval fishes

- Compare among water masses for indications of larval source

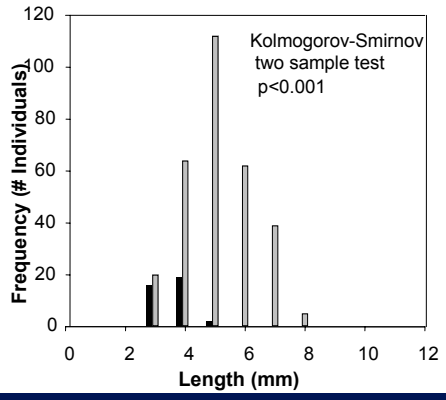
Prediction: larvae smaller, more abundant at source



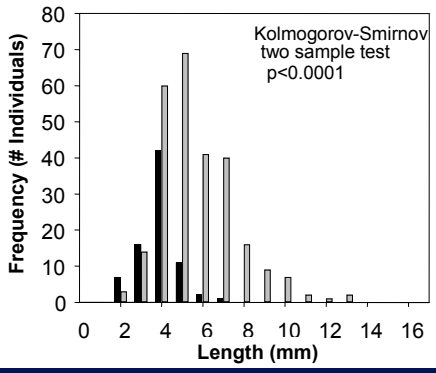
Pictures: www.larvalbase.org

Length-frequency Distributions as Indicators of Larval Source

***Leiostomus xanthurus*, Dec01**



***Urophycis*, Dec01**

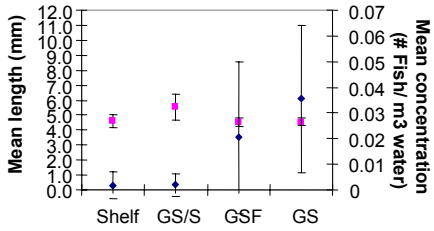


GS
Shelf

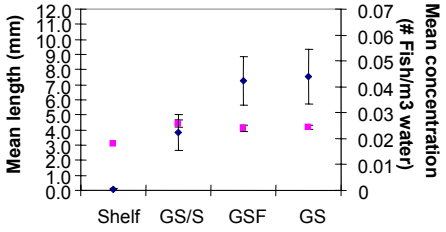
Myctophidae

length
concentration

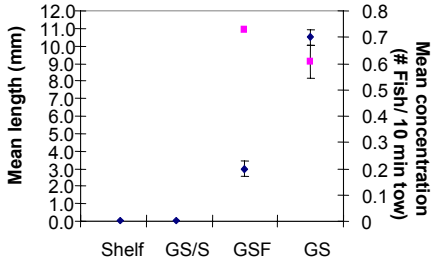
Bongo April 2000-January 2001



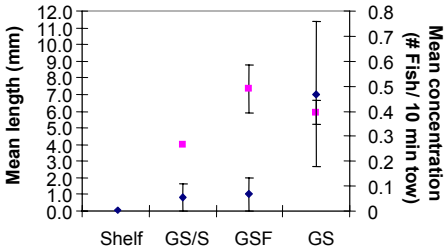
Bongo April 2001-December 2001



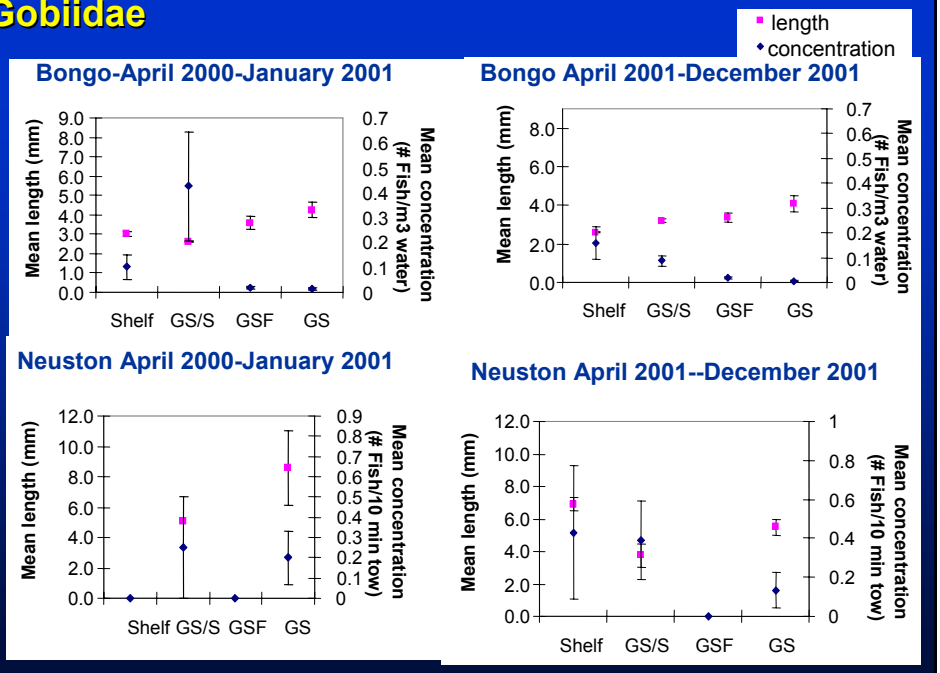
Neuston April 2000-January 2001



Neuston April 2001--December 2001



Gobiidae



Future Directions

- Deploy drifters while sampling continuously in GS filaments to track larval fate.
- Develop molecular markers for taxonomic identification of early staged larvae (A. Wilbur).
- Develop markers (otolith chemistry, genetics) for sourcing juveniles.

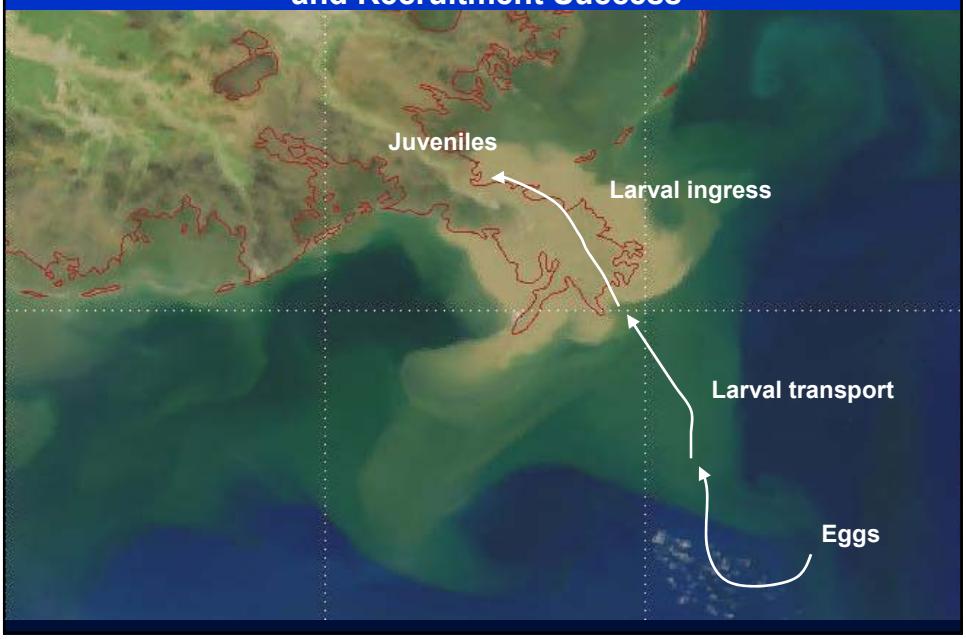
CFR Discharge Plume and Fisheries Recruitment: Aggregation and Trophic Enhancement

Top N.C. Commercial Fisheries

($72,000,000)

		2001 Landings (million dollars)	Plume-impacted ?
1.	Blue crab	32.0	****
2.	Shrimps	11.9	****
3.	Southern flounder	5.6	****
4.	Atlantic menhaden	4.6	****
5.	Summer flounder	4.4	****
6.	Atlantic croaker	3.1	****
7.	King mackerel	1.3	
8.	Swordfish	1.3	
9.	Spot	1.3	****
10.	Mullets	1.2	****
11.	Vermillion snapper	1.2	
12.	Bluefish	1.1	****
13.	Oysters	1.1	
14.	Seabasses	1.1	
15.	Weakfish	1.0	****

Role of Discharge Plumes in Life-Histories and Recruitment Success



River Discharge Plumes: Essential Fish Habitat ?

Essential fish habitat - waters and substrate necessary for spawning, breeding, feeding, or growth to maturity. Magnuson-Stevens Act, 16 U.S.C. 1801 et seq).

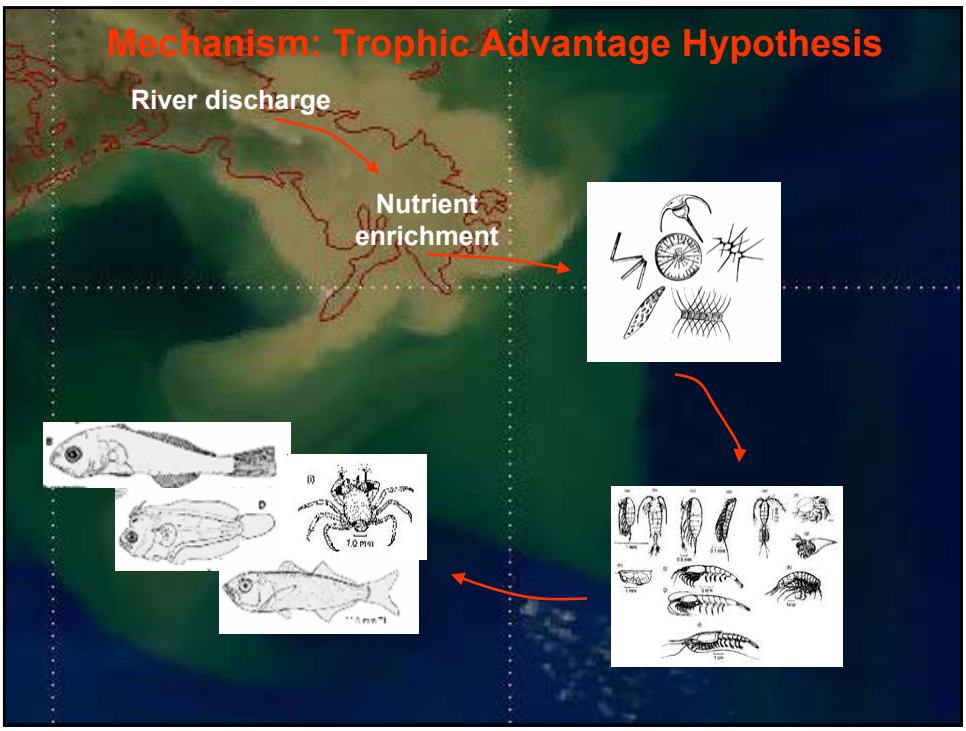
1996

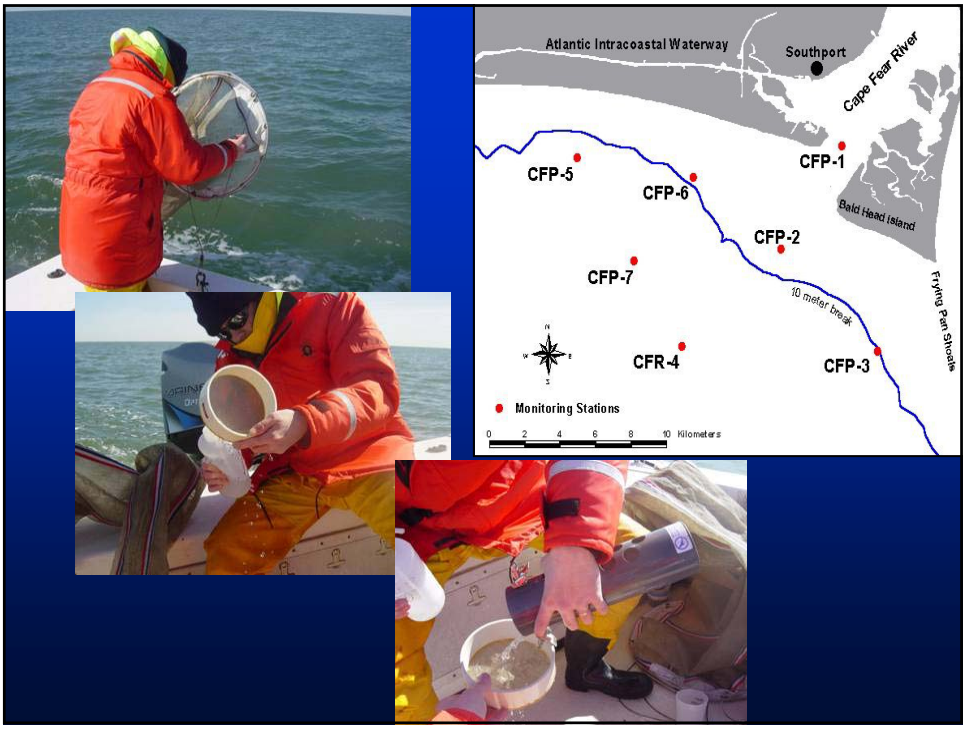
"… Magnuson-Stevens Act calls for direct action to stop or reverse the continued loss of fish habitats. Toward this end, Congress mandated the identification of habitats essential to managed species and measures to conserve and enhance this habitat."

Linking River Discharge Plumes to Coastal Fisheries Production

"….*terrestrially enriched river discharge favorably influences the biological processes (i.e., growth, mortality, and recruitment) that underlie fishery production*." C.B. Grimes 2001

Mechanism: Trophic Advantage Hypothesis

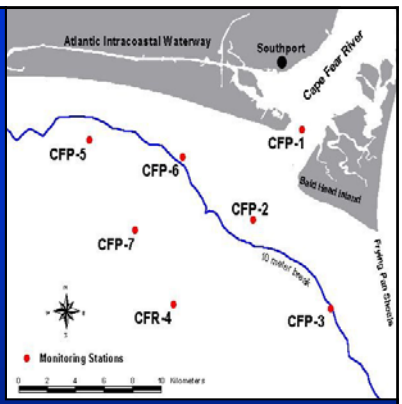




OBJECTIVES:

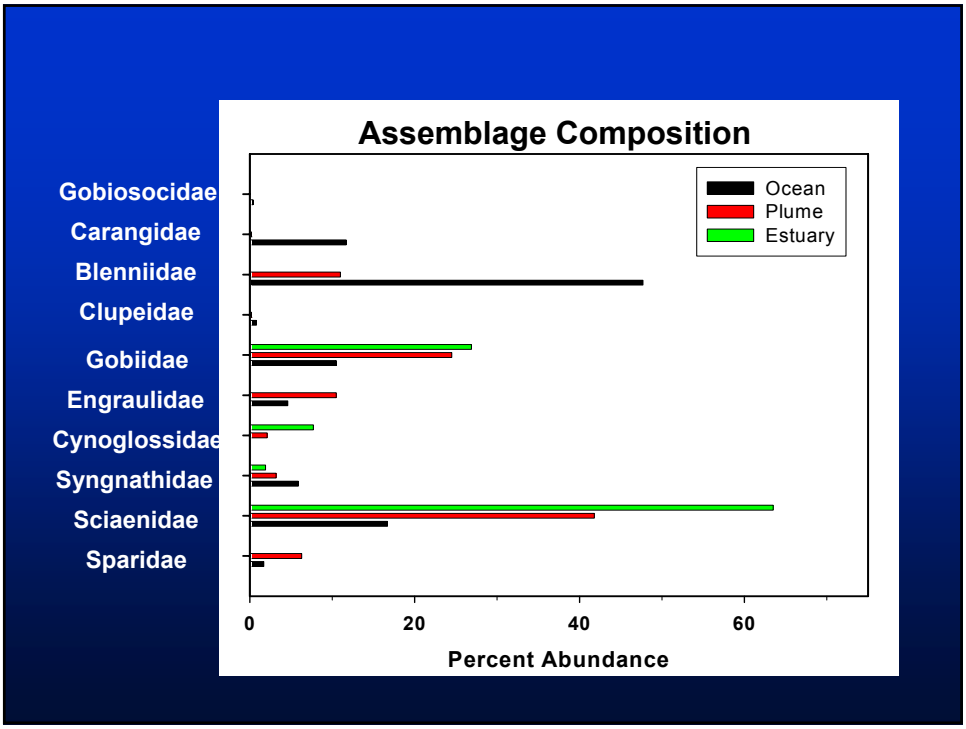
1. Aggregation hypothesis

- Larval distribution & abundance
  - monthly
  - estuary vs. plume vs. shelf
  - surface, 1m, bottom
- Juvenile distribution & abundance

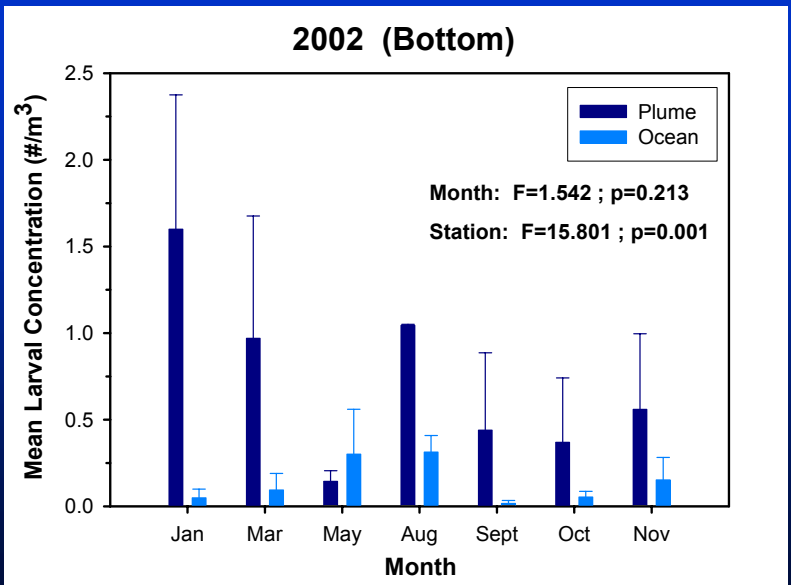


2. Trophic advantage hypothesis

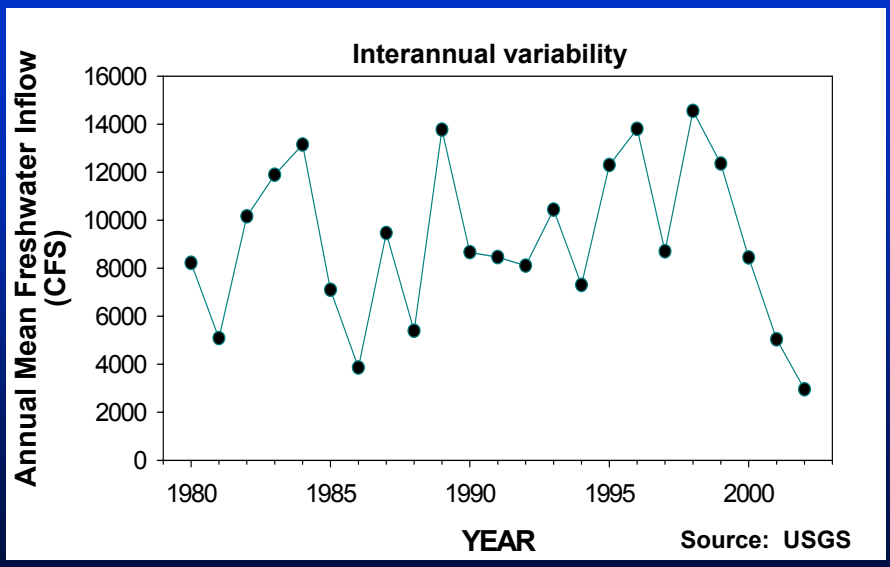
- Biochemical indicators of physiological condition
  - enzyme activity, RNA/DNA ratio, [non-polar lipid]



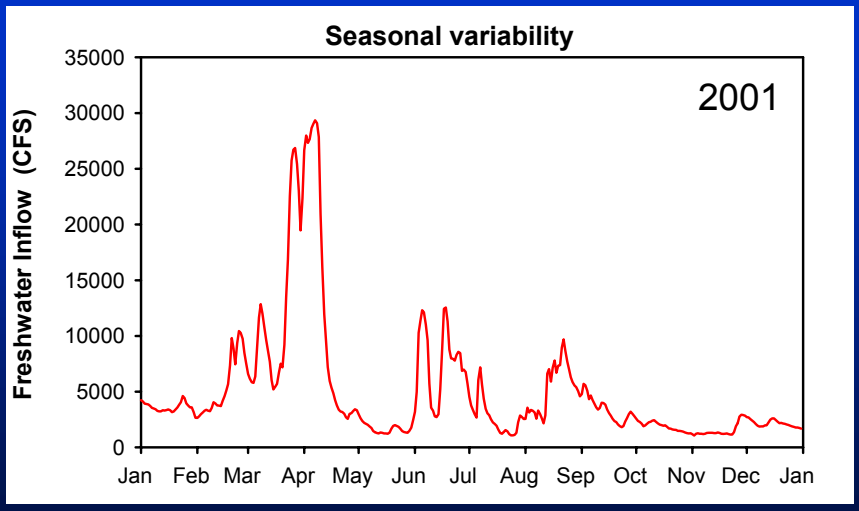
Preliminary Observations: Aggregation Hypothesis



Plume variability: Implications for fisheries production ?



Plume variability: Implications for fisheries production ?



Source: USGS

Genetic Identification of Planktonic Larvae

Ami E. Wilbur
Department of Biological Sciences
Center for Marine Science
University of North Carolina at Wilmington

Coastal Ocean Processes and Estuarine-dependent Fisheries

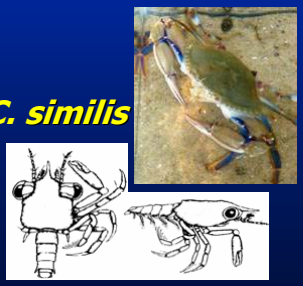
- Understanding patterns of larval abundance of specific species complicated by morphological similarities among closely related species
  - Larval identification laborious and requires extensive training
  - Inadequate knowledge of larval forms
  - Distinct species exhibit "identical" larval morphologies
- Genetic analysis can provide unambiguous identification

Distinguishing larvae of *C. sapidus* and *C. similis*

- ***Callinectes sapidus*** **and** ***C. similis*** **co-occur over most of their range**
  - **Larvae differ subtly in morphology (Costlow and Bookout, 1977)**
- **Objectives***
  - **Identify suitable a genetic marker to distinguish** ***C. sapidus*** **and** ***C. similis***
  - **Develop rapid assay methodologies**
  - **Apply assay to evaluate abundance/distribution of** ***C. sapidus*** **larvae**

C. sapidus

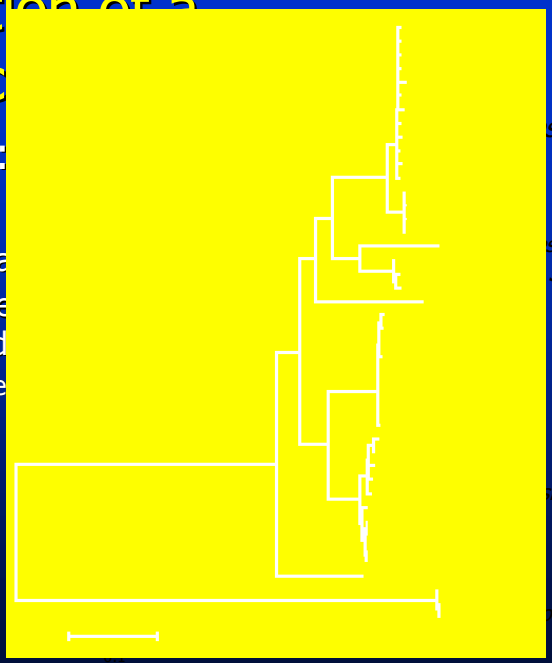
C. similis



**Marker development supported by NC Sea Grant's Blue Crab Research Program*

Identification of a Diagnostic

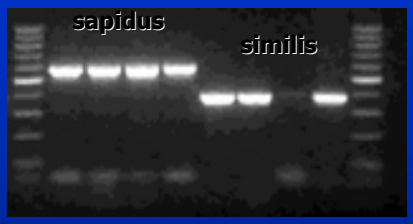
- mtDNA gene:
  - Cytochrome
    - 603 base pa
    - 189 variable *sapidus* and
      - (~12% se

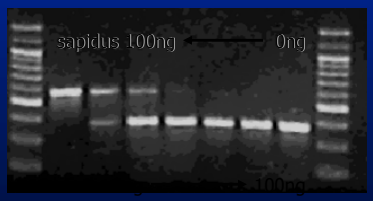


s ornatus
similis

Development of a rapid assay

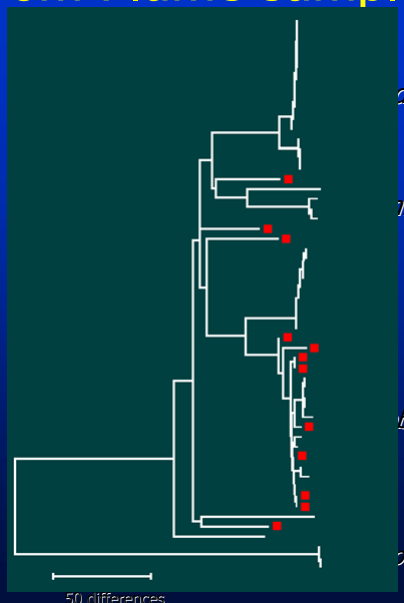
- Species distinction based on size differences in PCR product
  - 382 base pairs in *C. similis*
  - 579 base pairs in *C. sapidus*
- Multiplex PCR reaction
  - Incorporation of both sets of specific primers allows identification of single larva in one reaction





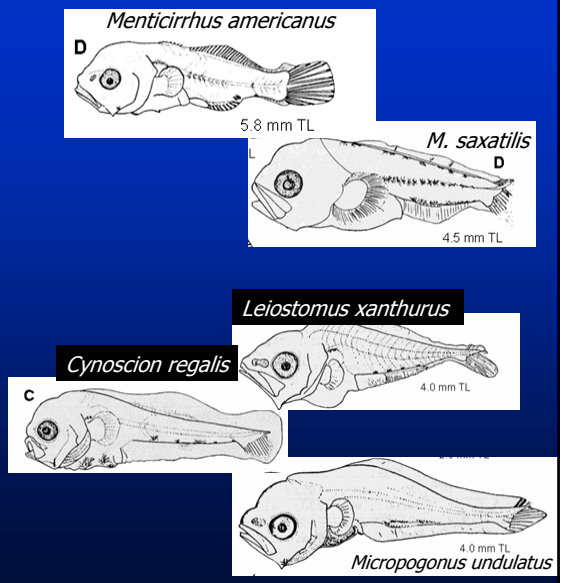
Preliminary Data from Plume samples

- Sap-sim assay negative for larvae collected in May/June
  - Portunid larvae not *Callinectes*
- Sequence analysis shows majority to be *Portunus*



Genetic identification of larval fishes

- Larval identification in the Sciaenidae
  - Includes many species of commercial interest
    - 3 species of Kingfish, 2 species of Weakfish, Croaker, Spot



Identification of Diagnostic Marker

- mtDNA gene
  - Sequence analysis of 603 base pairs of Cytochrome oxidase I
    - 9% sequence divergence between Northern and Southern Kingfish
    - 15.5% between Northern + Southern and Gulf Kingfish
    - 18.6% between Kingfish and Croaker