



# Tracking climate change and invasive species in the U.S. South Atlantic Bight: a multistressor ecosystem investigation of warm-temperate hardbottom communities

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Michael Burton (NMFS)

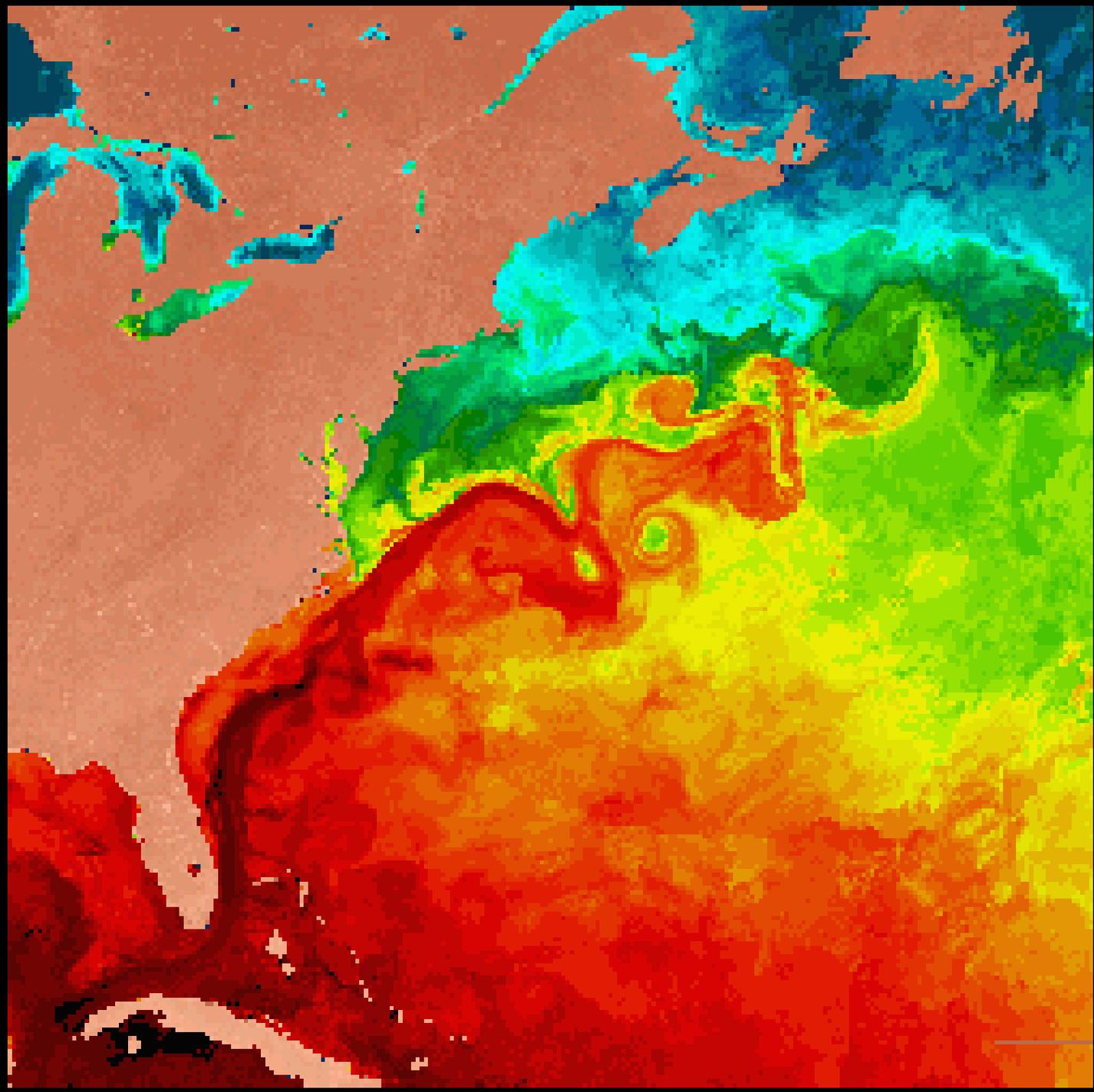
Andrew Shepard (NURC)

Wilson Freshwater, Lynn Leonard (UNCW)

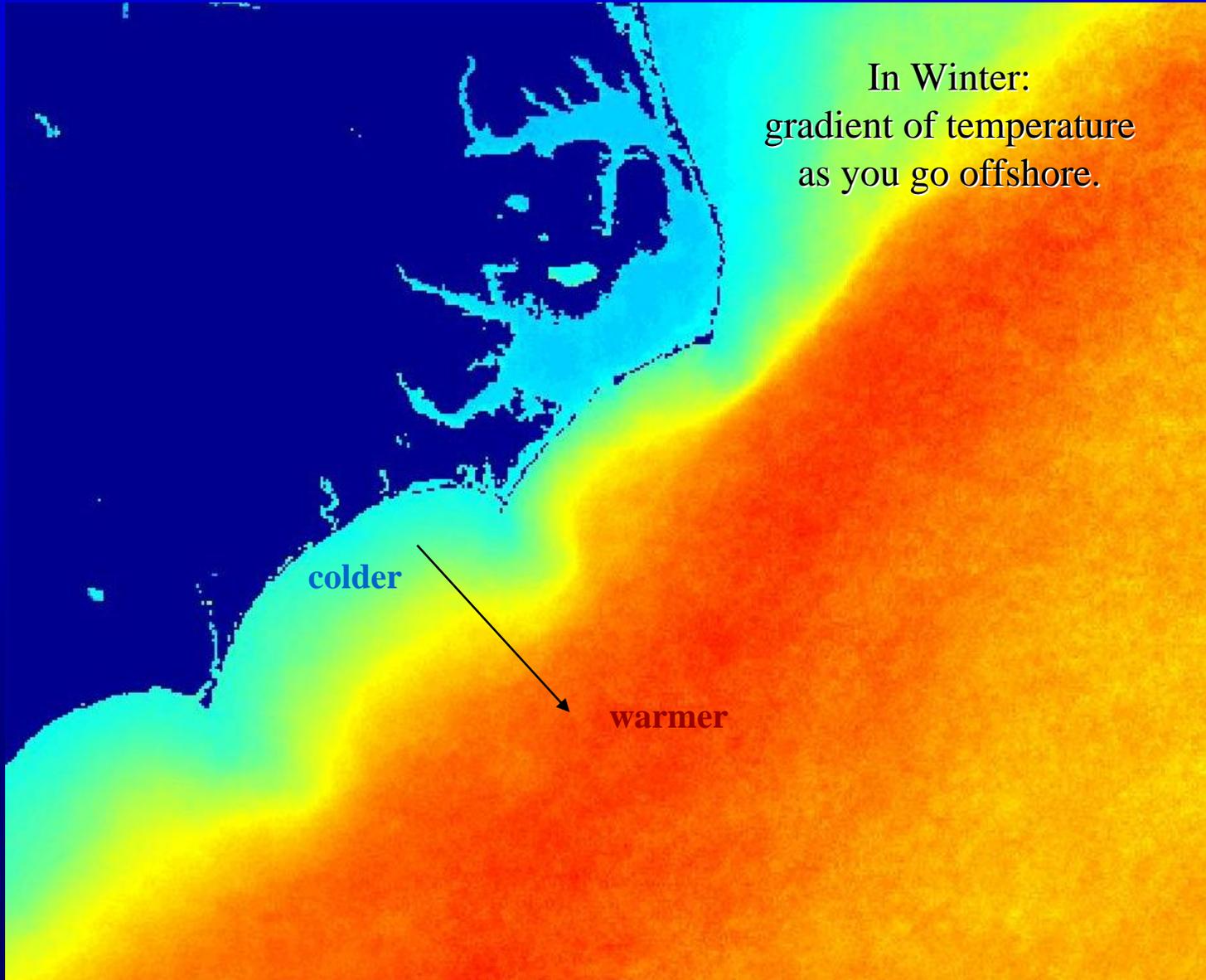
Madilyn Fletcher (USC)



Photos by D. Kesling except where noted



In Winter:  
gradient of temperature  
as you go offshore.



## Key Characteristics of the SE LME

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- Shelf divided into inner (0-20 m), middle (20-40m), and outer shelf (40m-shelf break) zones
- Differences in productivity, temperature, species composition



# Climate change research at the NOAA Beaufort Laboratory

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- 1975 - 1977 Underwater reef fish surveys conducted by Parker at “210 Rock”
- 1990 – 1992 Repeated Parker’s original surveys for comparison
- 1998. Parker RO, Dixon RL. Changes in a North Carolina reef fish community after 15 years of intense fishing – global warming implications. *Trans Amer Fish Soc* 127:908-920.

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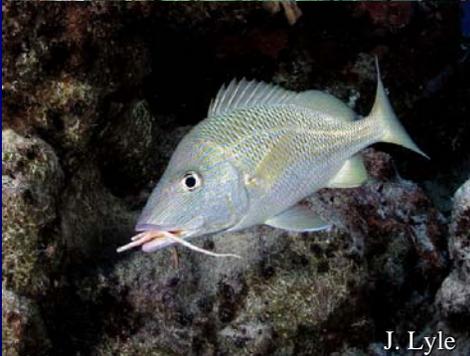
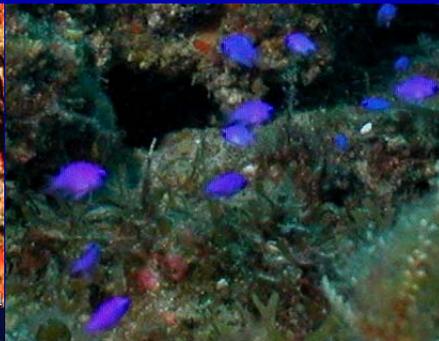
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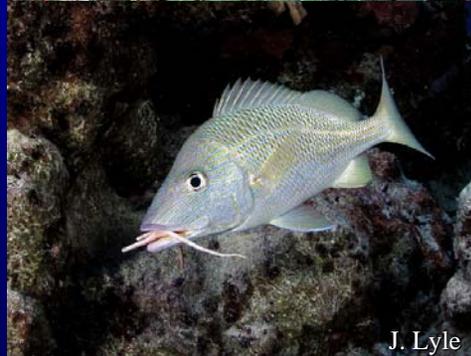
# Dominant fishes on 210 Rock

1970's



# Species composition of fishes had become “more tropical”

1990's



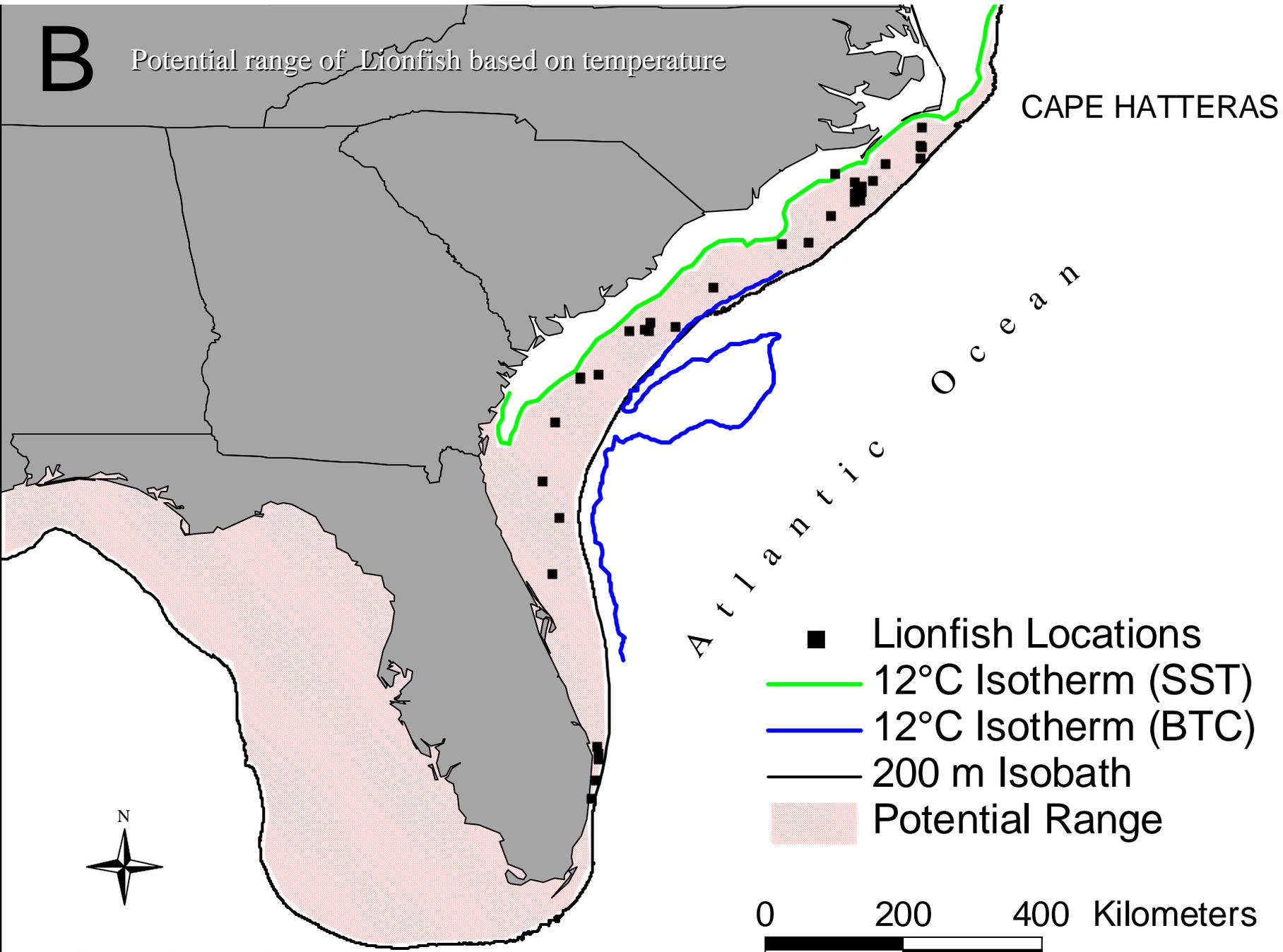
- 2 Lionfish reported on 2 wrecks 60 miles apart in 140ft of water off NC in 2000
- NOAA began tracking in 2001...continues...
- Field studies 2004 –and ongoing
- Thermal tolerance work published in 2004



**B**

Potential range of Lionfish based on temperature

CAPE HATTERAS



Kimball et al. 2004

# Spatial and temporal pattern of colonization.....



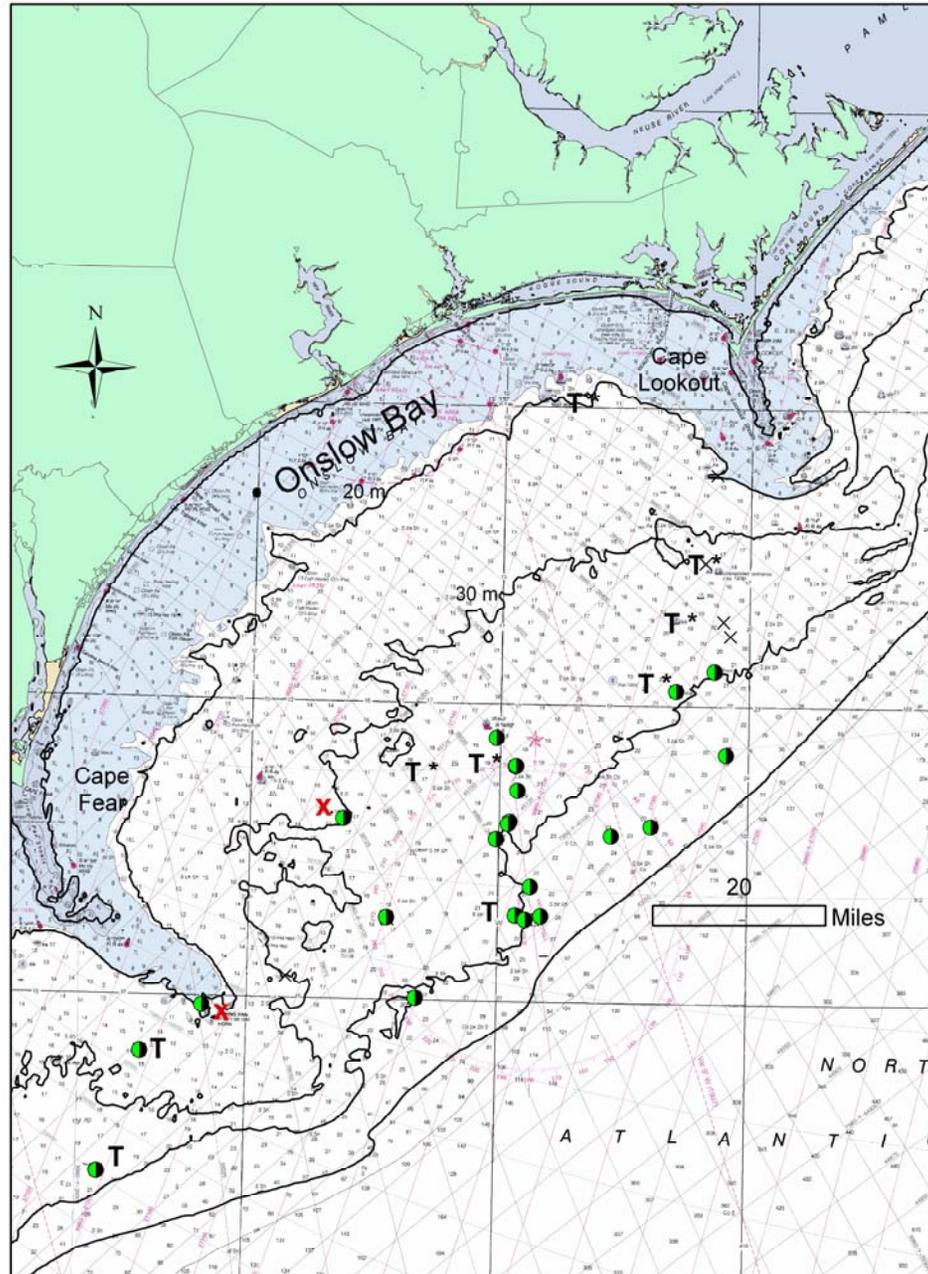
- Pattern suggests Gulf Stream dispersal
- Mid 1990's lionfish reported off West Palm Beach Florida
- Spawning initially off Florida?.....
- Only juveniles north of Cape Hatteras (perish in winter?)
- Reports in Bahamas began 2004 increasing in 2005-2007
- Now in Cuba (verified-2007)

## Hardbottom habitats off NC...

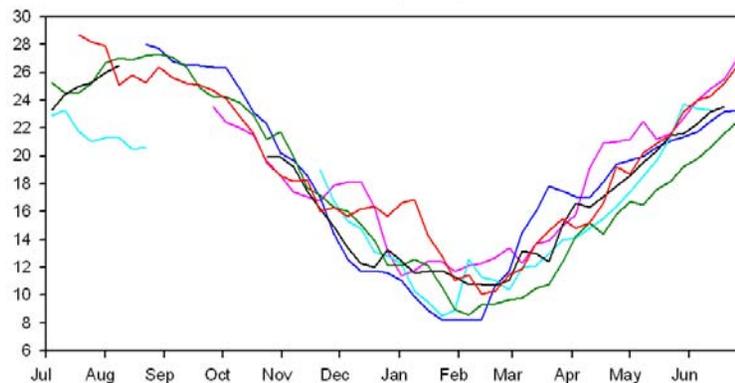
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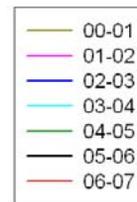
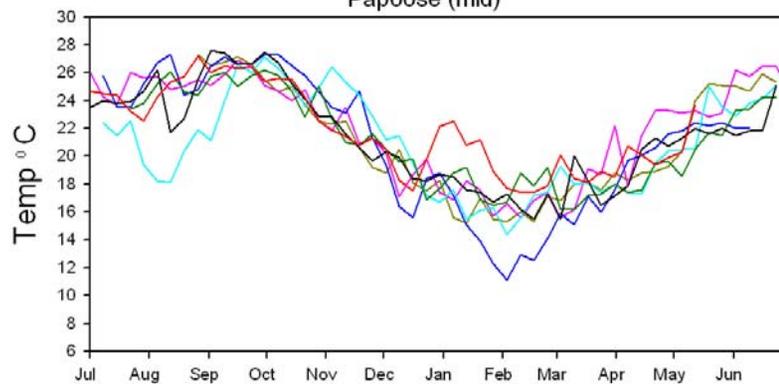
- May be experiencing warmer winter water temperatures...
- Giving rise to a greater proportion of tropical species in the fish community
- Have experienced the arrival and increasing densities of the invasive lionfish...
- Whose distributional limits appear to be regulated by winter water temperatures



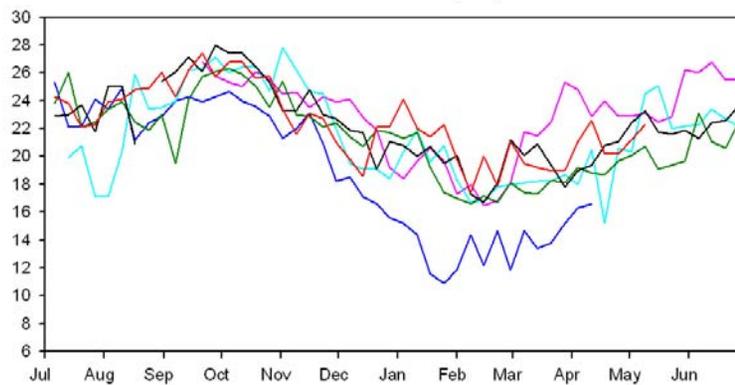
Suloid (inner)

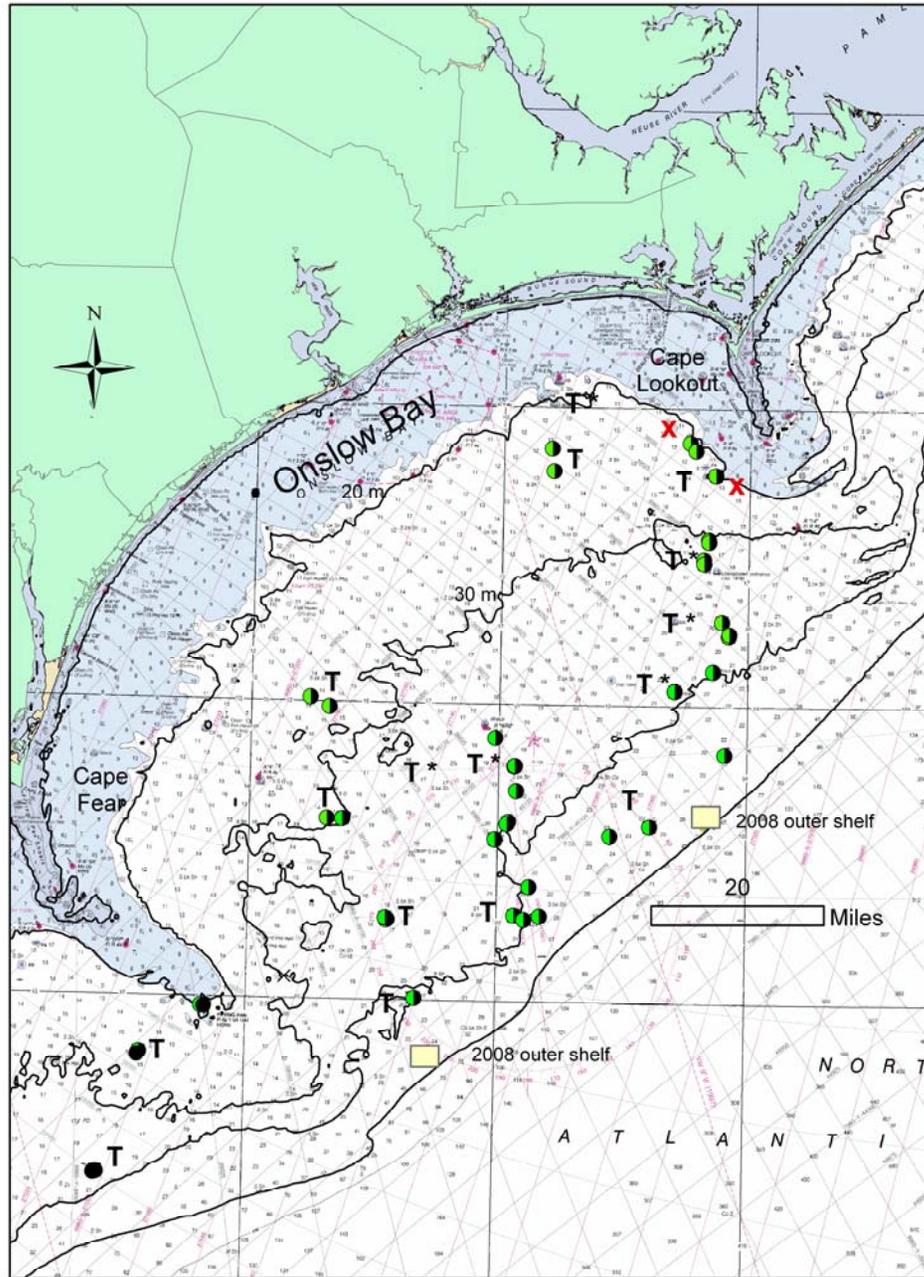


Papoose (mid)



lobster wreck (mid)







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- repeated multidisciplinary (biological, physical) investigation necessary to evaluate potential responses to climate change

# A selection of hypotheses for climate effects on hardbottom communities

- Water temperatures increase over time – all zones
- Community assemblages shift from seasonally mixed (temperate, subtropical) to subtropical – **Inner Shelf, Outer Shelf**
- Lionfish establish populations that persist through the winter – **Inner Shelf**

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- Lionfish establish populations that persist through the winter – Inner Shelf
- Seasonal stability continues but assemblage becomes more tropical – Middle Shelf
- Increased frequency of upwelling events – Middle Shelf
- Increased productivity from upwelling – Middle Shelf

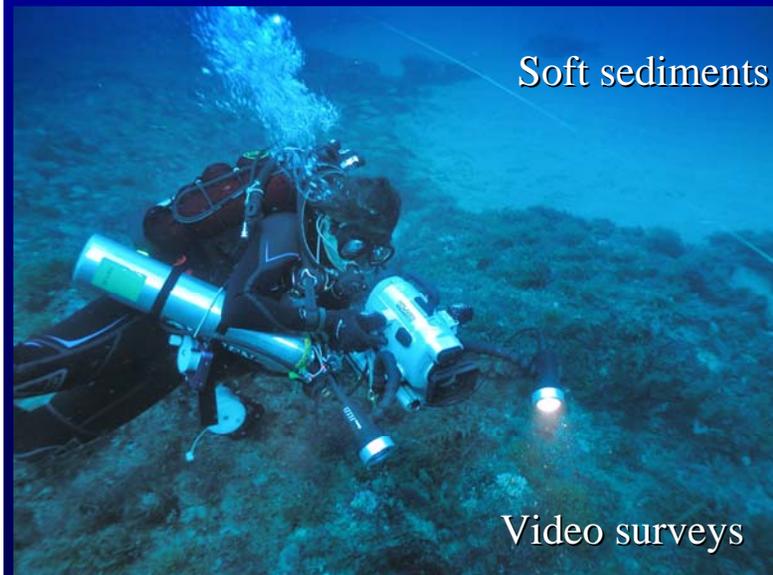
# Sampling Hardbottom Communities



quantitative fish collections



Visual surveys



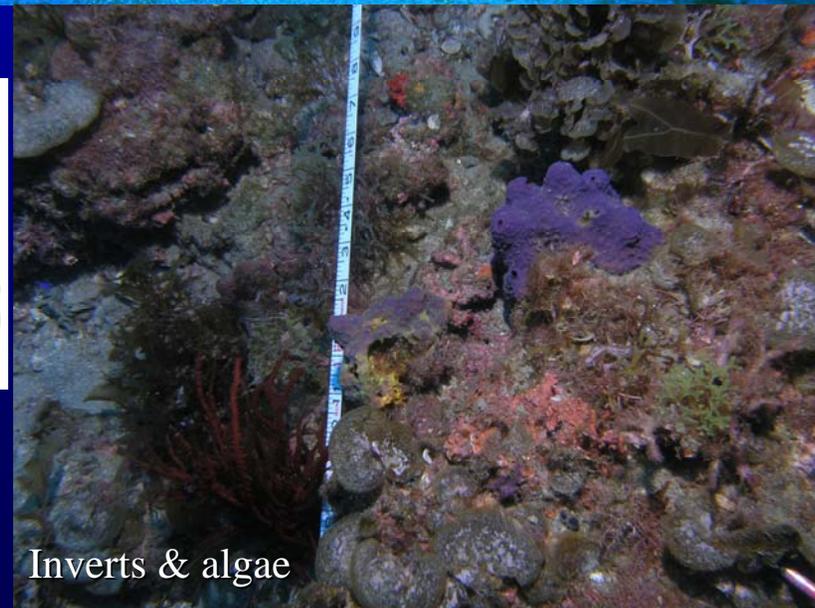
Soft sediments

Video surveys

upwelling



CORMP  
Caro-COOPS  
NDBC,  
SECOORA



Inverts & algae

# NOAA Relevancy

- Magnuson-Stevens Reauthorization (MSRA): conserve target and non-target species and habitats, consider ecological factors affecting fishery populations
- Ecosystem Goal: monitor at the ecosystem scale for more effective management
- Climate Goal: understand climate variability and change
- Weather and Water Goal: serve society's needs for weather and water information

