Defining Ocean Migratory Corridors and Critical Habitats off North Carolina

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EAST CAROLINA UNIVERSITY

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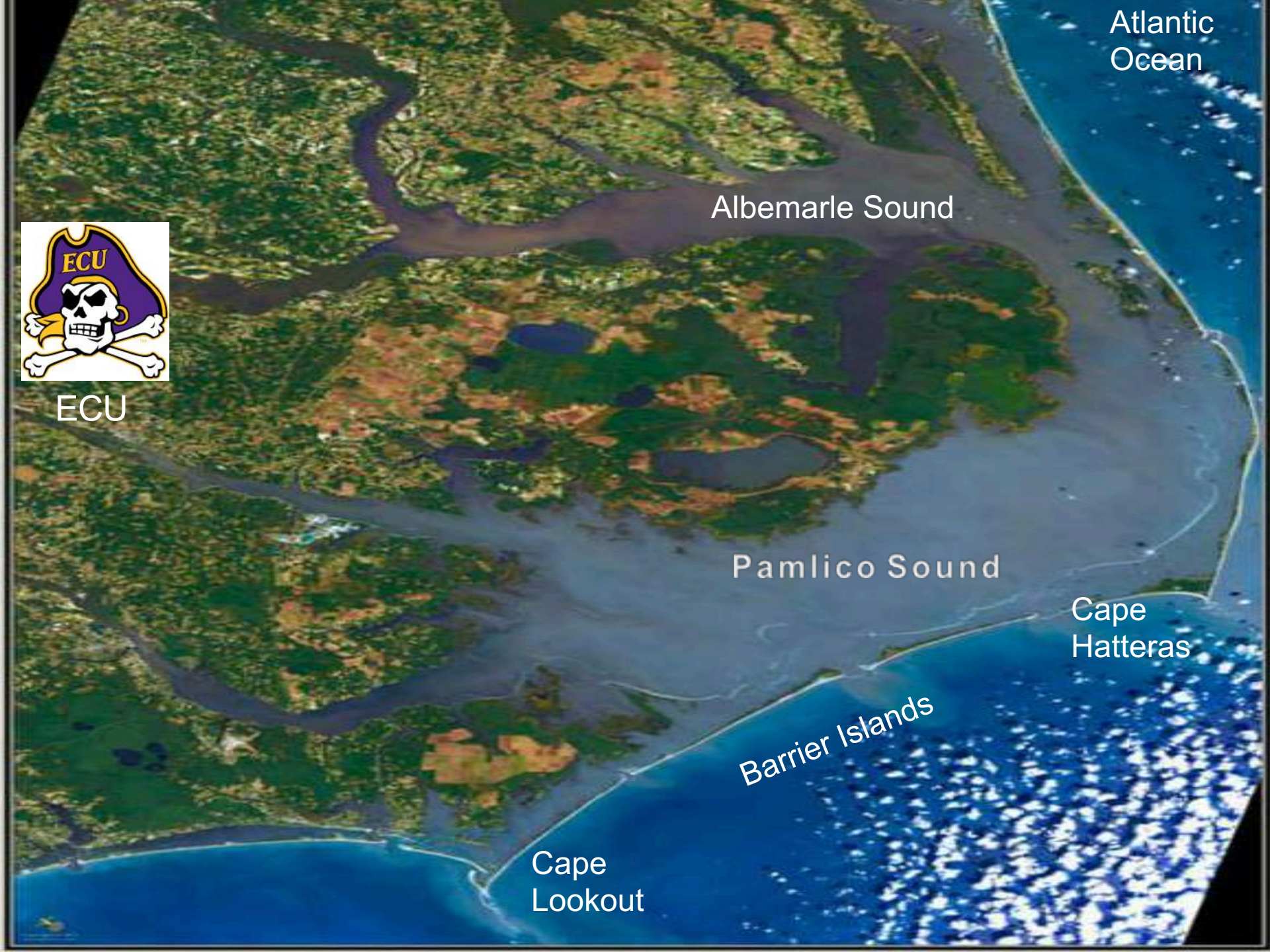

Atlantic
Ocean
Albemarle Sound
ECU
Pamlico Sound
Cape
Hatteras
Barrier Islands
Cape
Lookout

The Hatteras Bight: A Dynamic Place

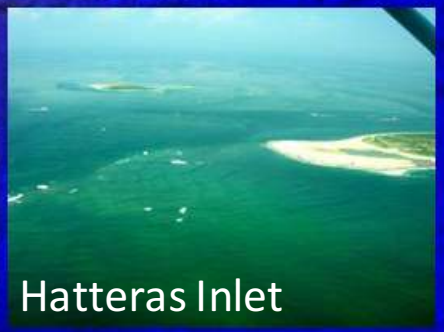
State Jurisdictional Boundary

Virginia

North Carolina

Hatteras Bight

Continental Shelf



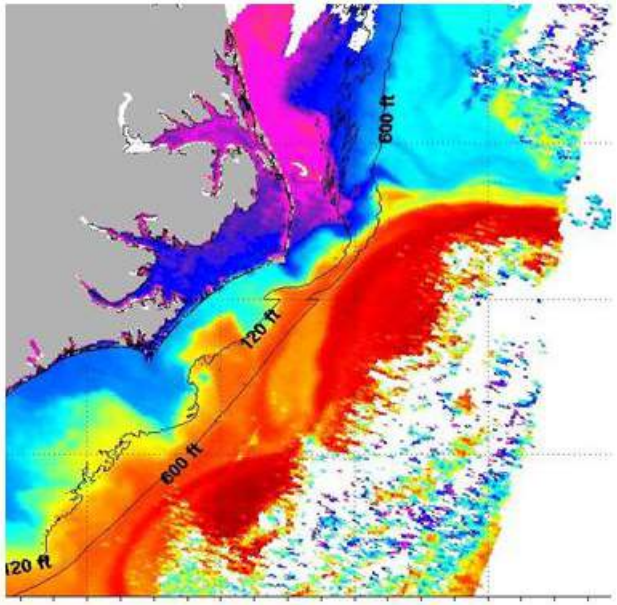
Hatteras Inlet

N

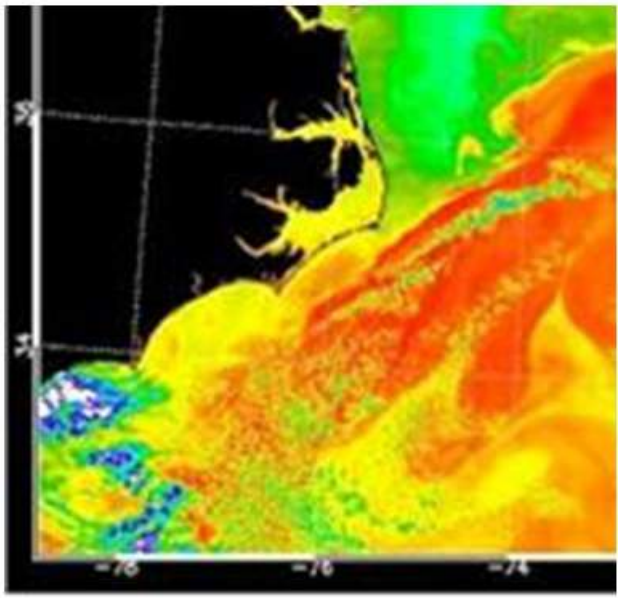
50

Kilometers

February



May

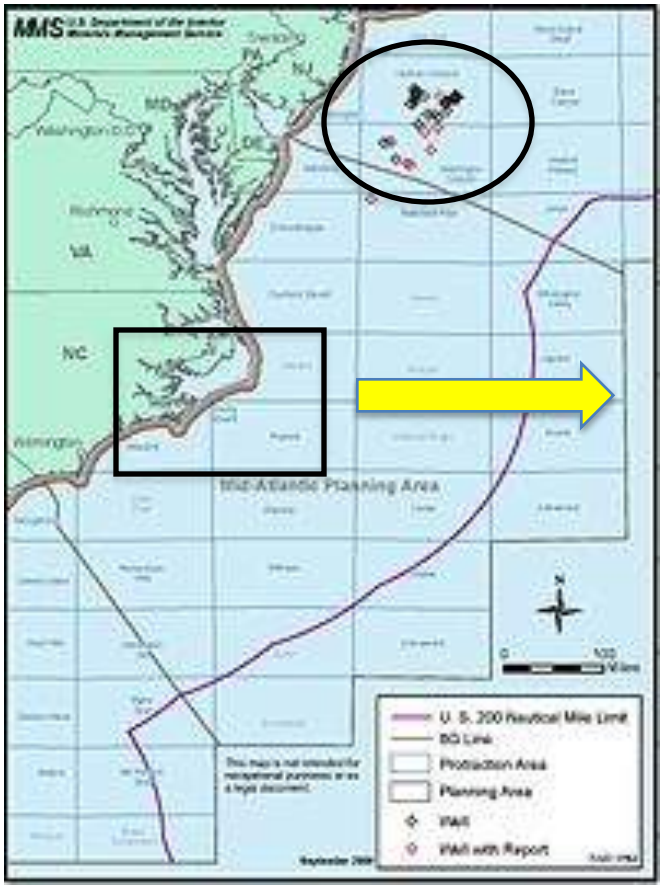


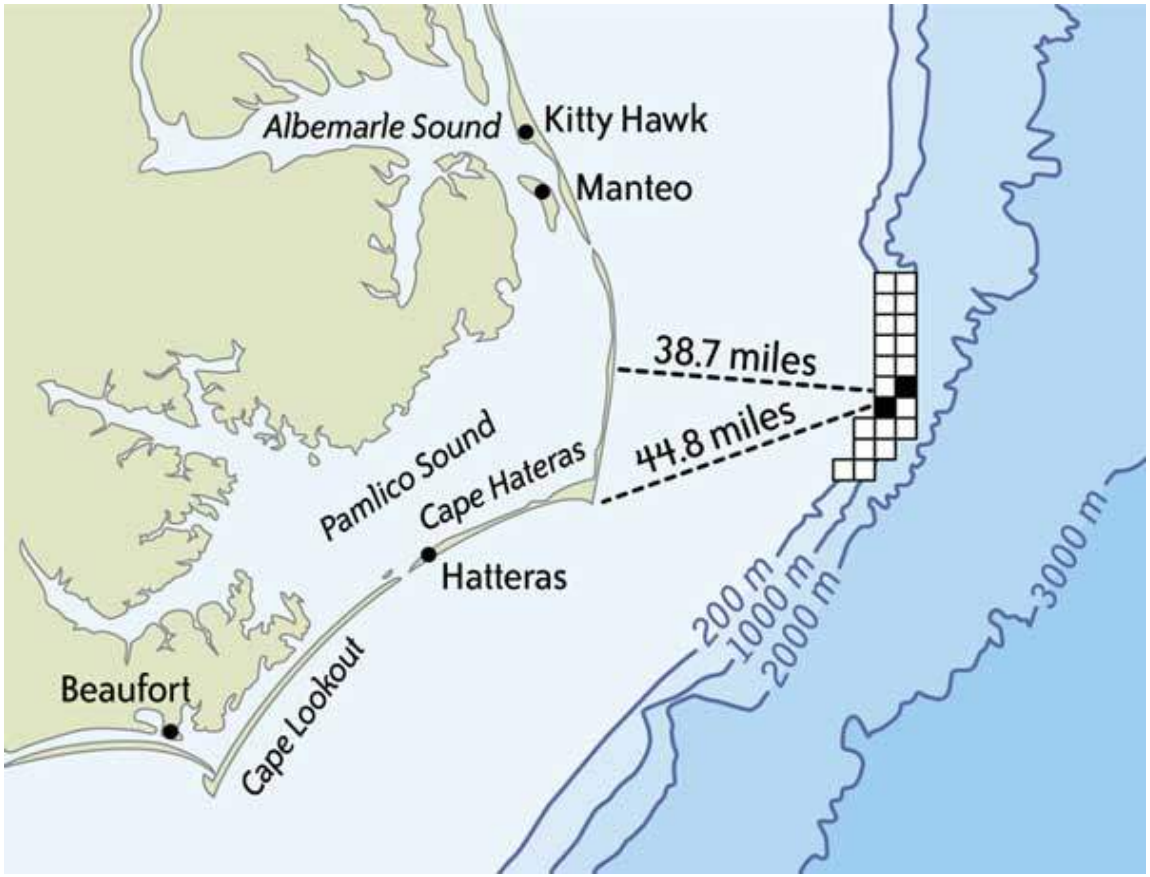
North Carolina Concerns

- Wind farms
- Offshore exploration for natural gas
- Barrier Island development/ inlet stabilization
- Wave and tidal energy
- Military uses – acoustics, bombing ranges, etc.
- Sustainability of commercial & sport fisheries
- Ocean transportation

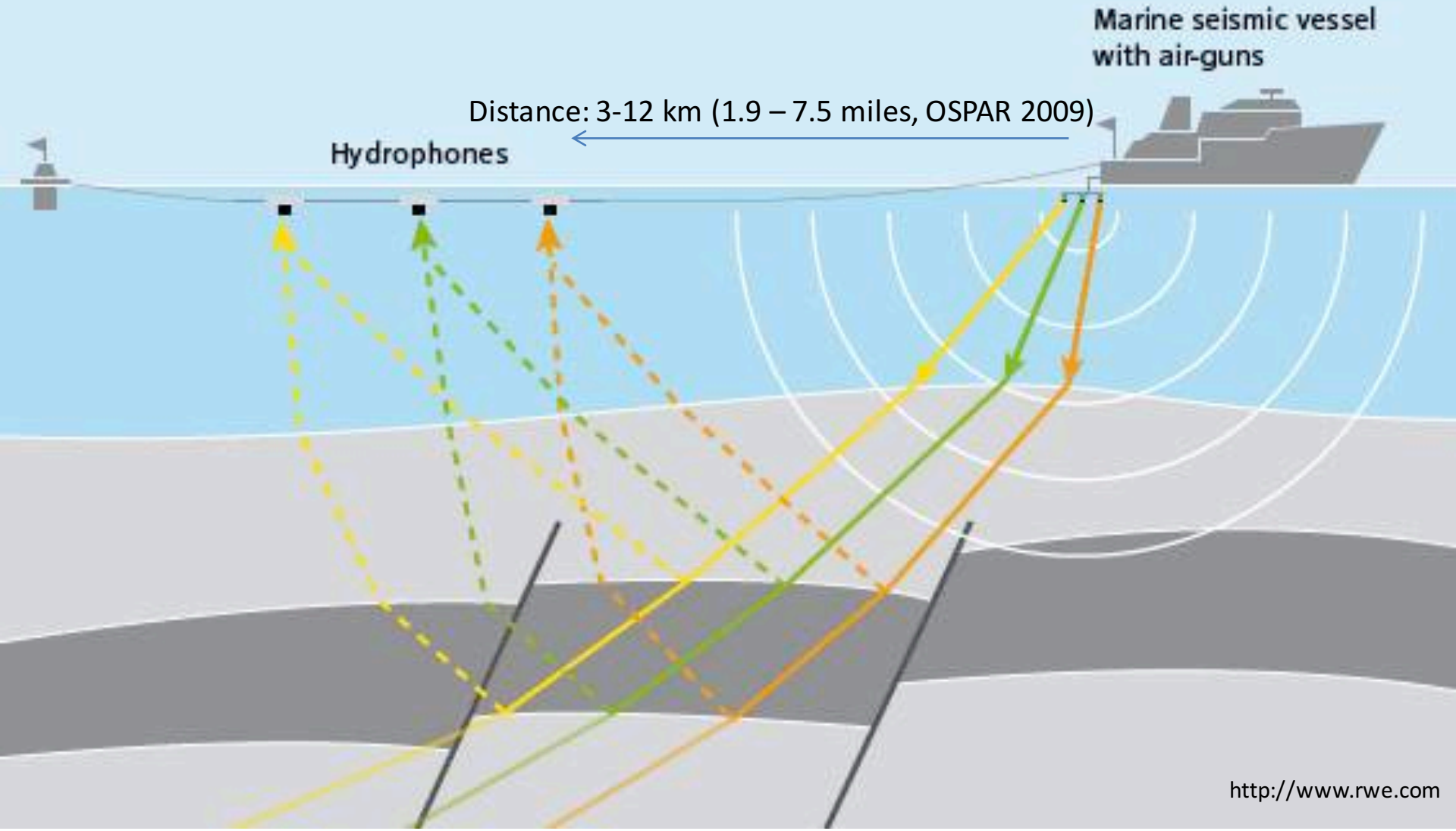
A migratory fish

Locations of Proposed Wind Farms and Seismic Surveys





Seismic Surveys

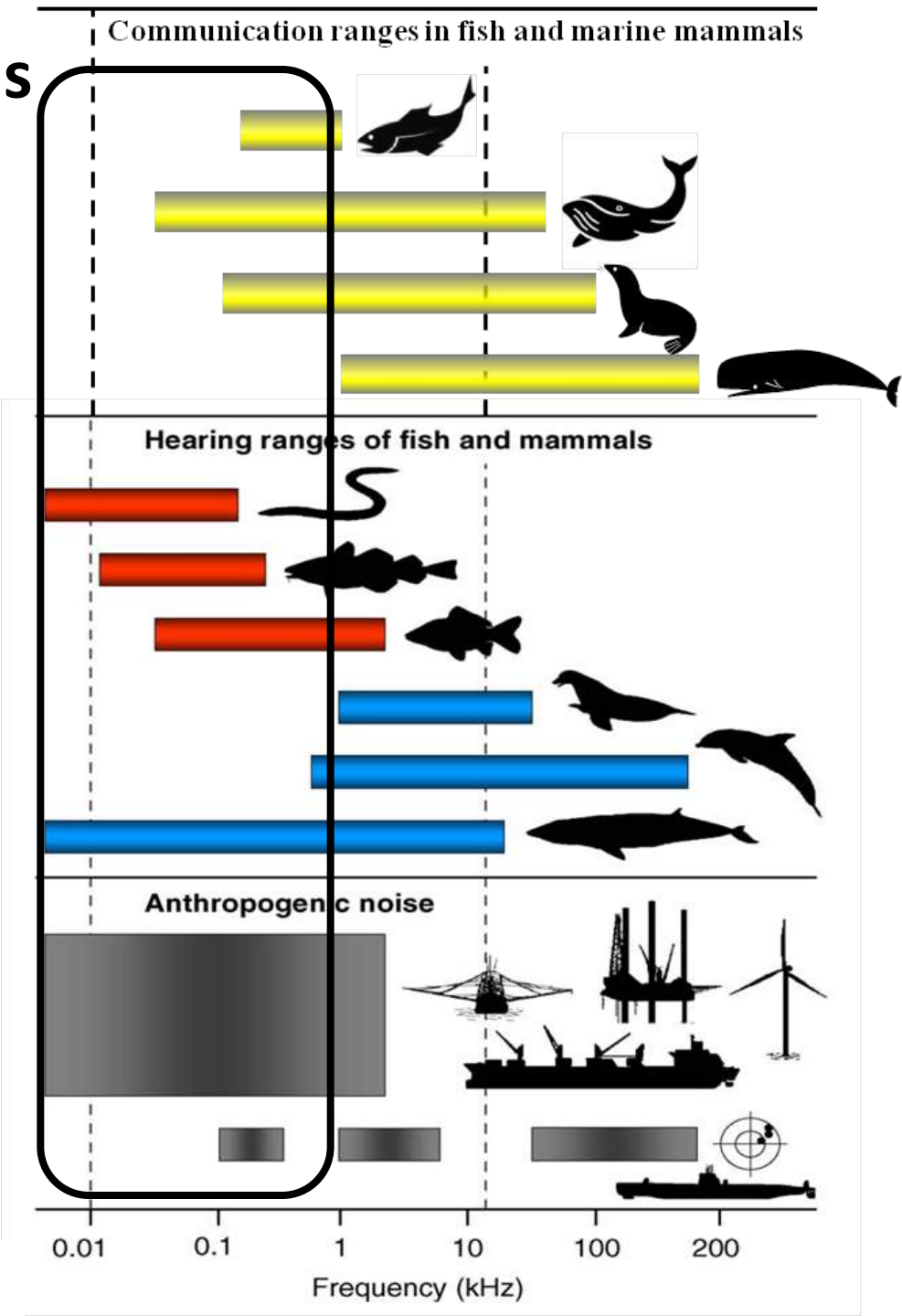


Seismic Surveys and Animals

The X axis is frequency of sound:

- Top – frequencies of animal communication.
- Middle – hearing frequencies.
- Bottom – human-made noise frequencies.

The black rectangle shows those frequencies produced by seismic testing, and the overlap with fish and mammals



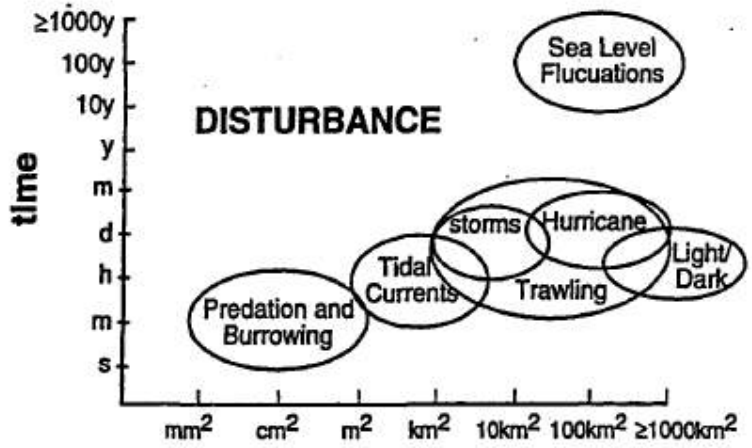
Modified from: OSPAR 2009 (top) and Slabbekoorn et al. 2010 (middle, bottom)

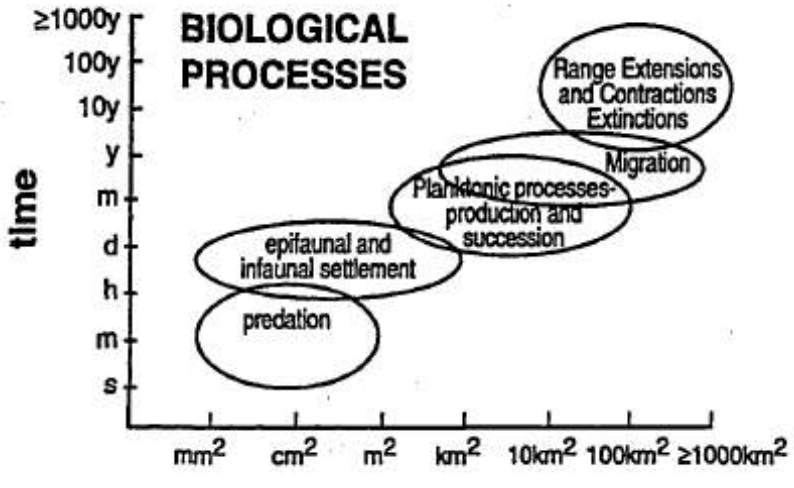
Migratory Pathways

- Marine mammals
- Sea turtles
- Atlantic and shortnose sturgeons
- Coastal pelagic sharks, skates and rays
- Anadromous fishes (striped bass, shads, river herrings)

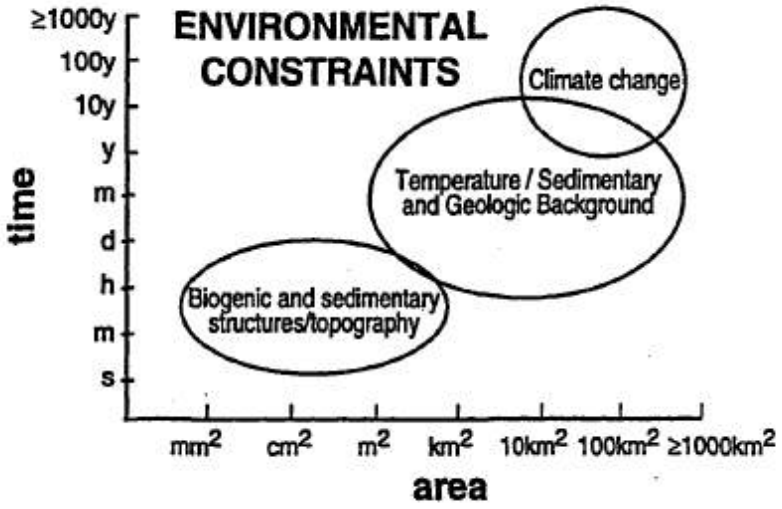
- **What influences seasonal migrations along the coast?**
- **What role does Cape Hatteras play in influencing timing and continuance of coastal migratory pathways?**

The Importance of Habitat





Factors Influencing Groundfish Assemblages (Langton et al. 1995)



But first you have to know where the animals are, where they go, and something about the environment…

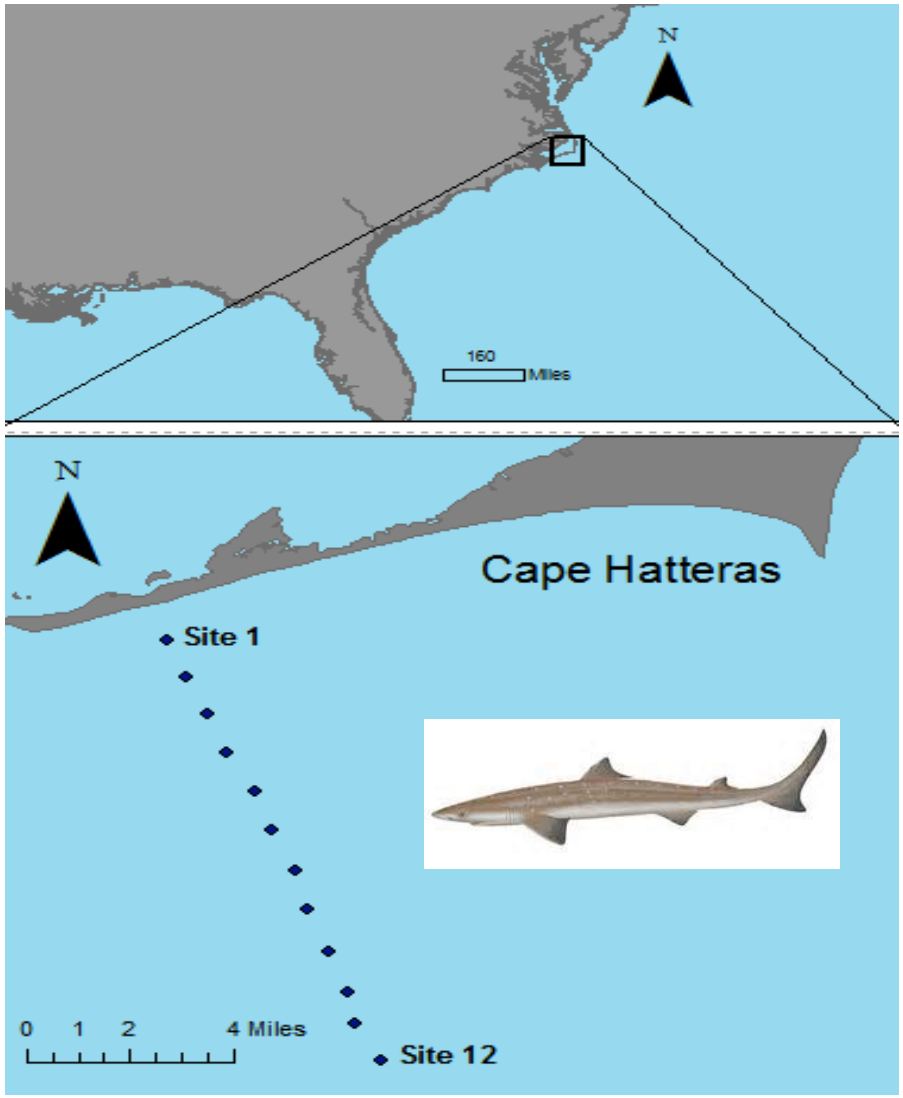
Rulifson Lab Shark Research: Behavior, Distribution, Abundance

ECU Hatteras Acoustic Array

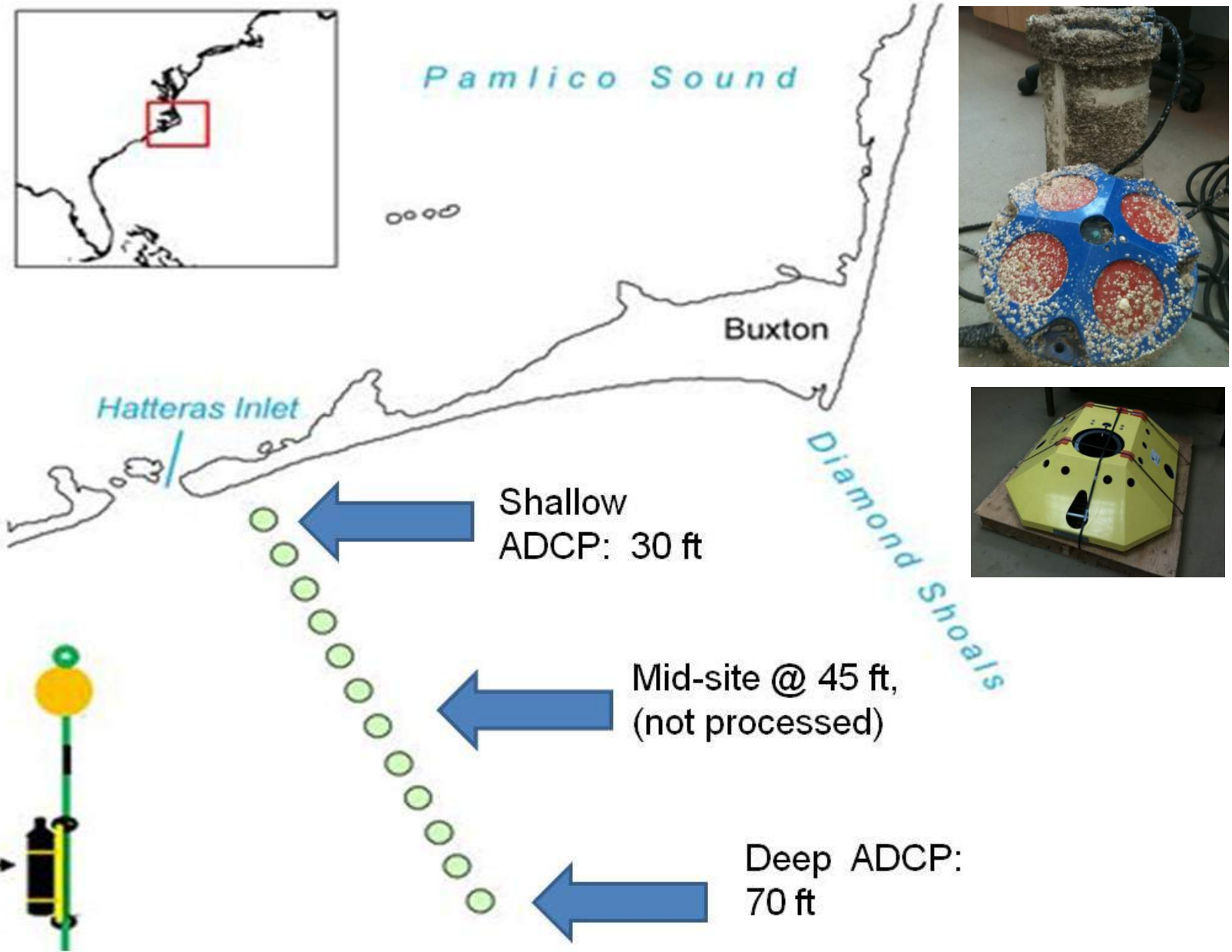
developed for a Spiny Dogfish shark study

- 12 VEMCO VR2W receivers, placed 2 m off bottom.
- Spacing about 1 mile apart (based on extensive range testing for these waters).
- “Listening Fence” extends out 12 miles perpendicular from shoreline off Hatteras Village, NC.
- Array includes acoustic doppler current profilers (ADCPs).

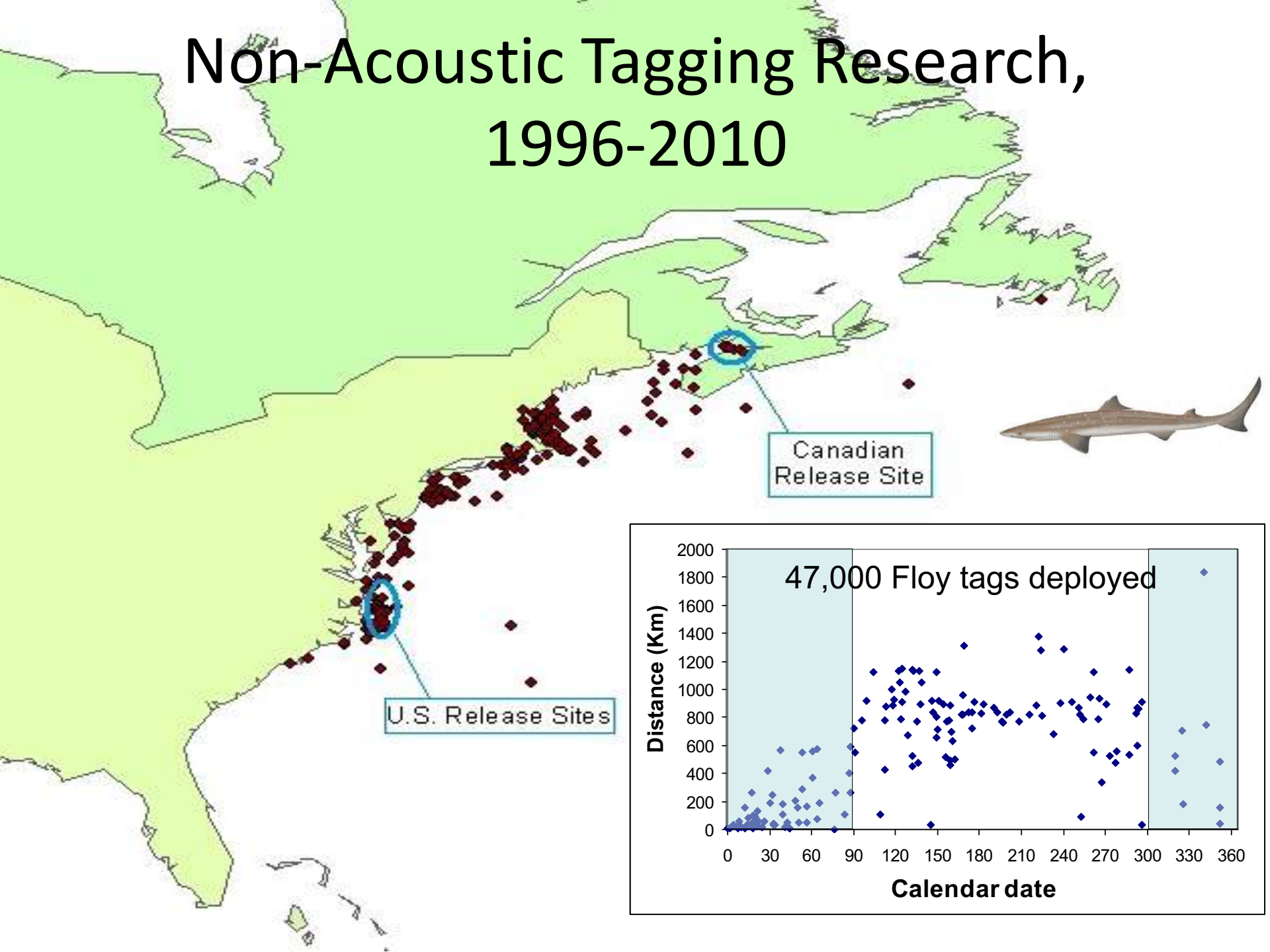
This ADCP fiberglass trawl shield was painted with red bottom paint when initially deployed – high energy, sand transport blasted paint off.



Hatteras Bight Acoustic Array

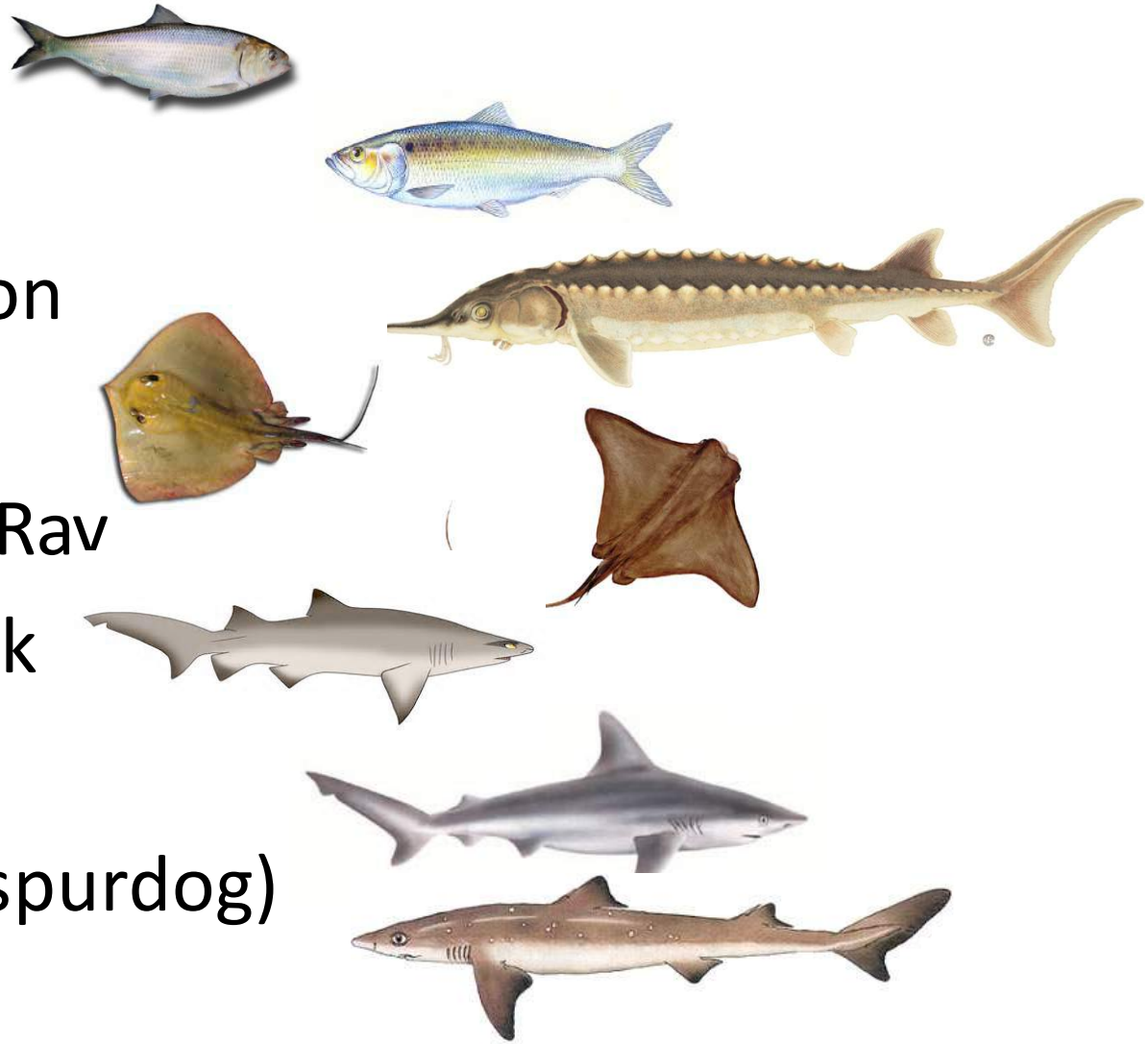


Non-Acoustic Tagging Research, 1996-2010



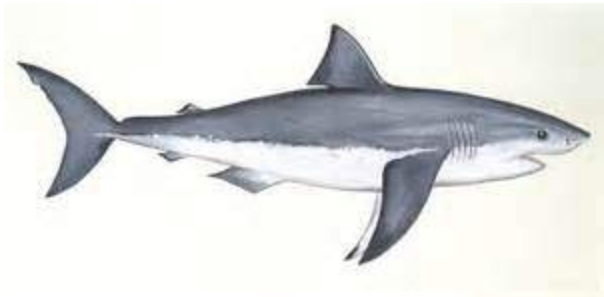
Acoustically Tagged Species Recorded by the Hatteras Acoustic Array

- American Shad
- Hickory Shad
- Atlantic Sturgeon
- Cownose Ray
- Spiny Butterfly Rav
- Sand Tiger Shark
- Sandbar Shark
- Spiny Dogfish (spurdog)



Acoustically Tagged Species Recorded by the Hatteras Acoustic Array

- Bull Shark
- White Shark
- Lemon Shark
- Green Sea Turtle

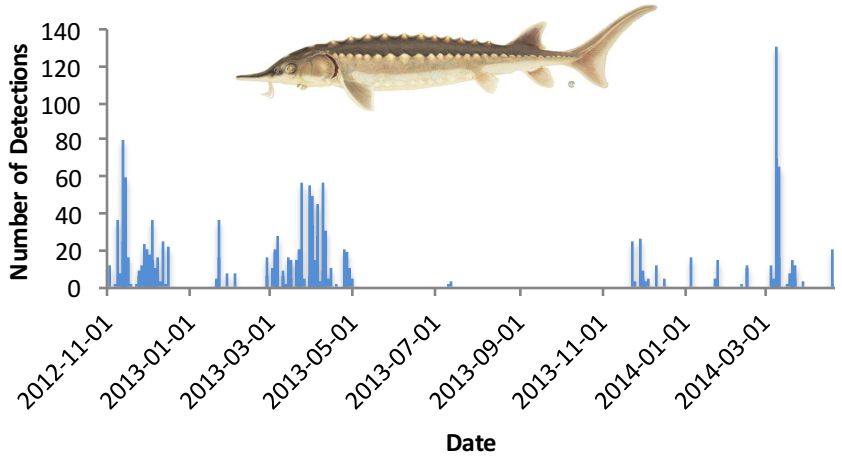


12 species to date.

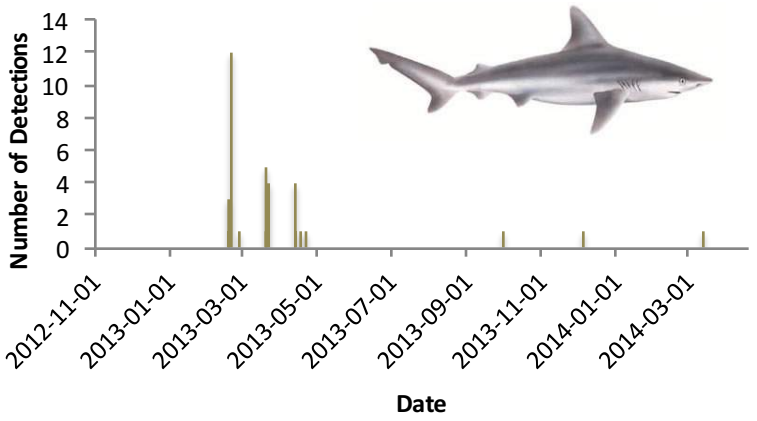
The Hatteras Array has been pulled due to lack of funding.

Single Species

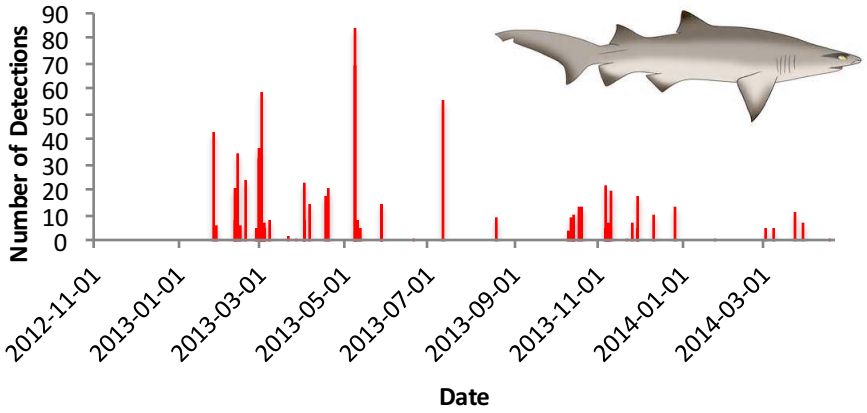
Atlantic sturgeon



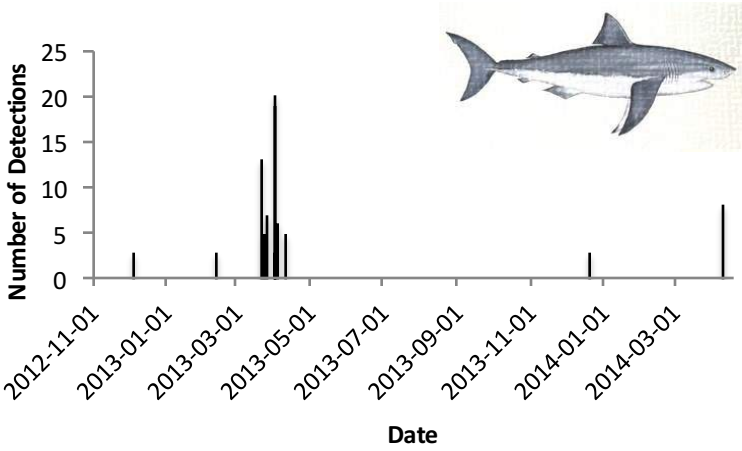
Sandbar shark



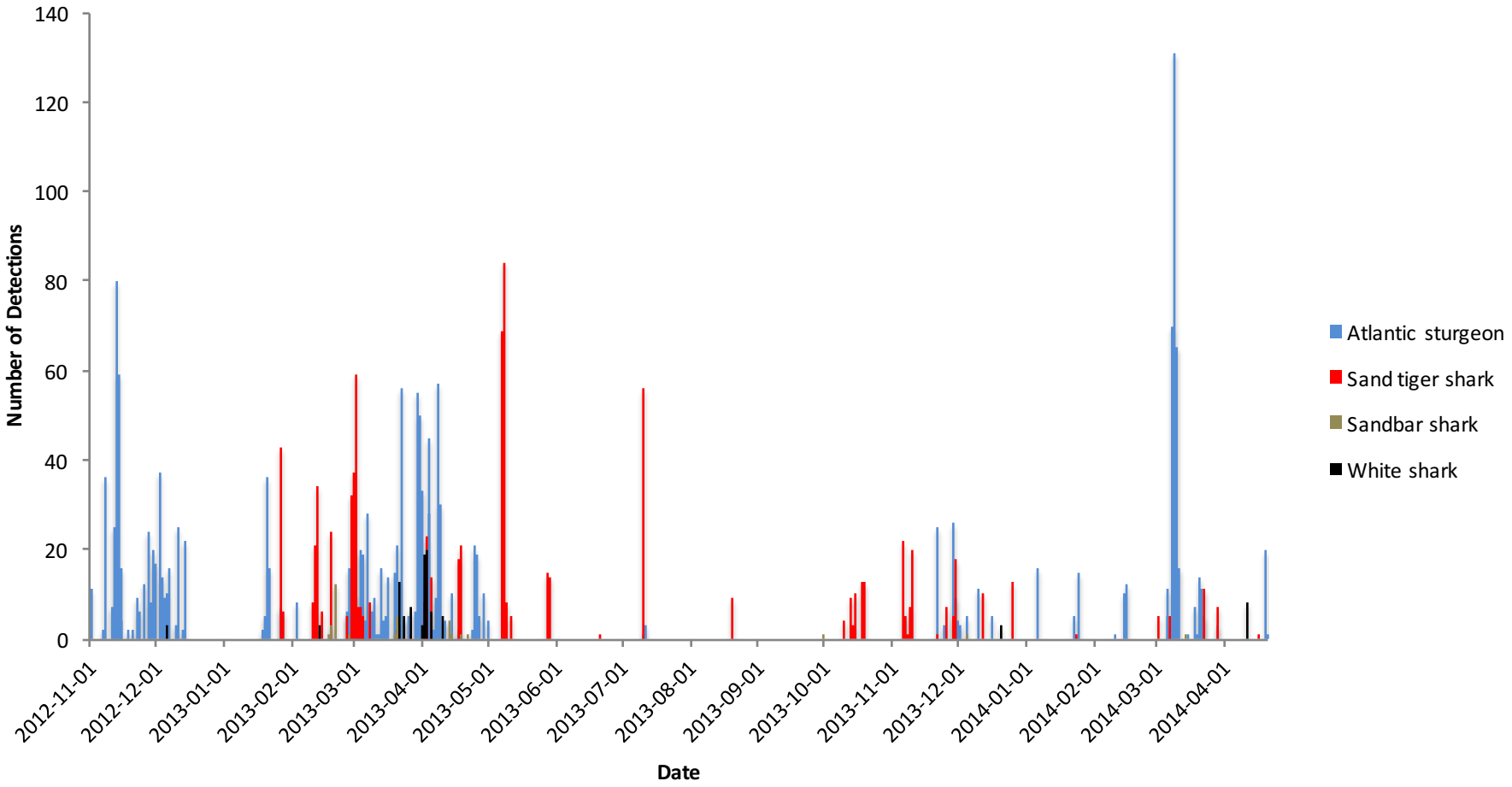
Sand tiger shark



White shark

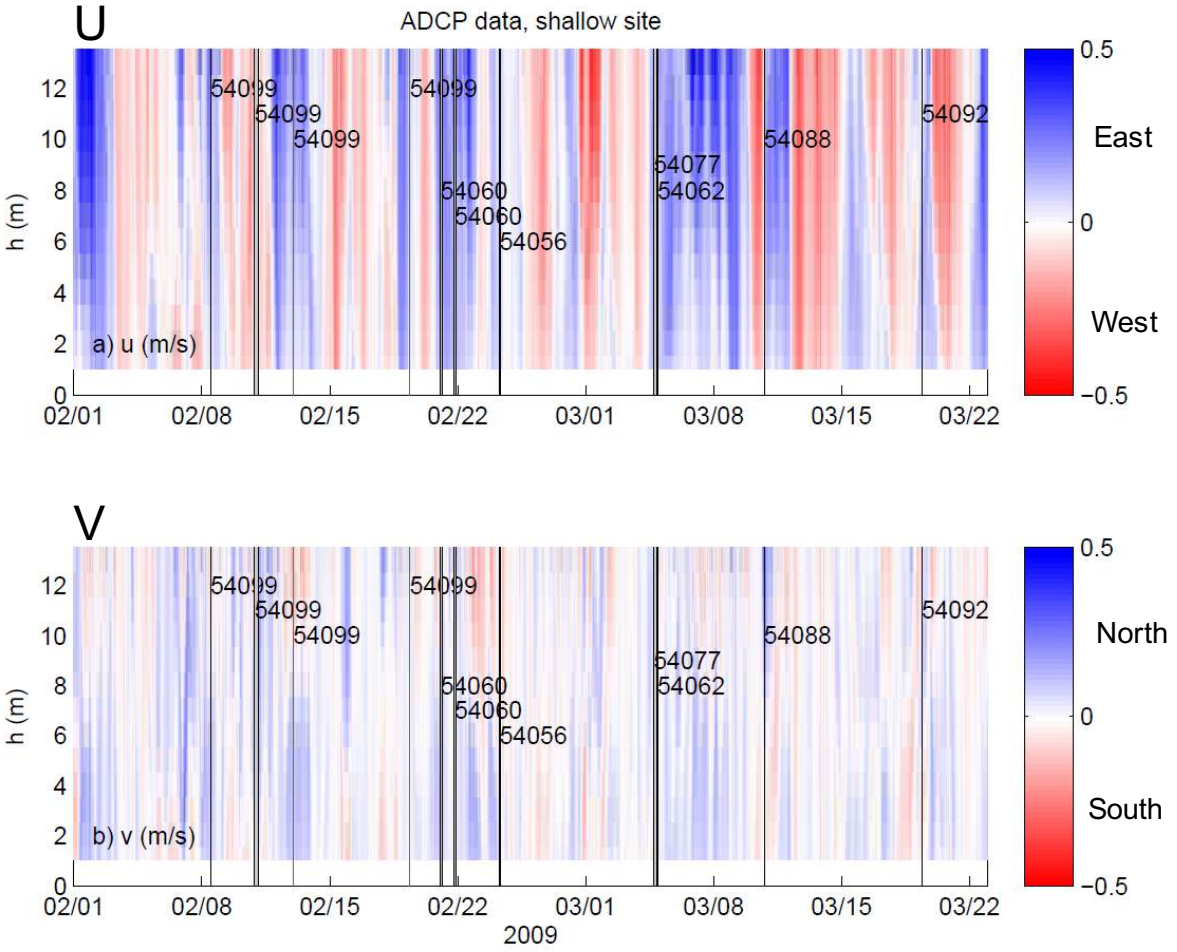


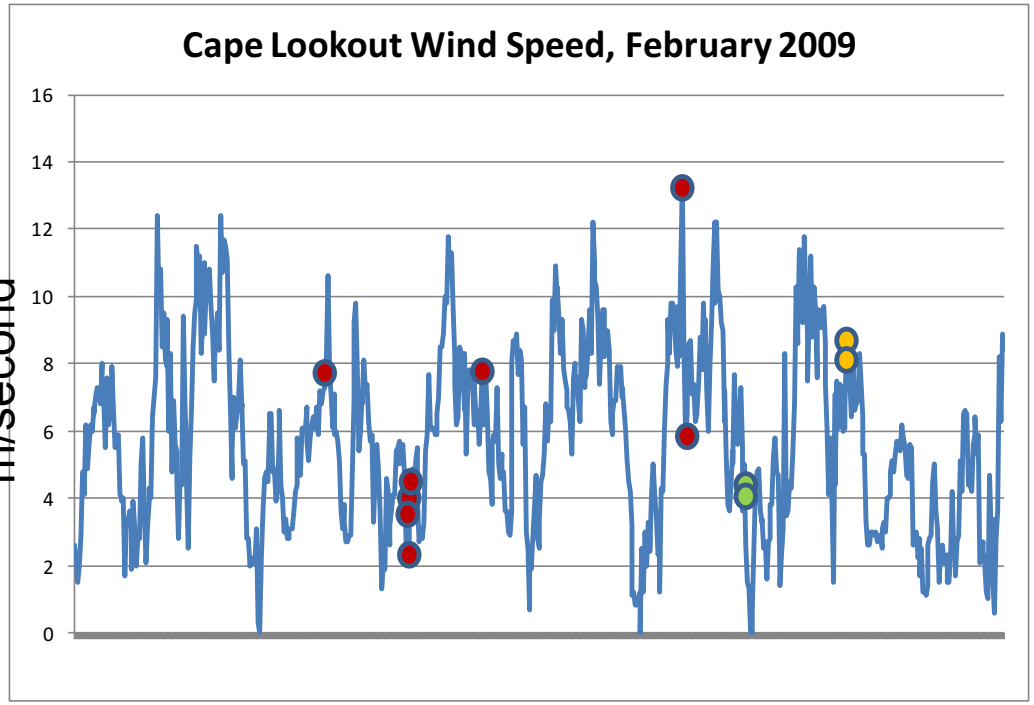
Sharks and Sturgeon Combined

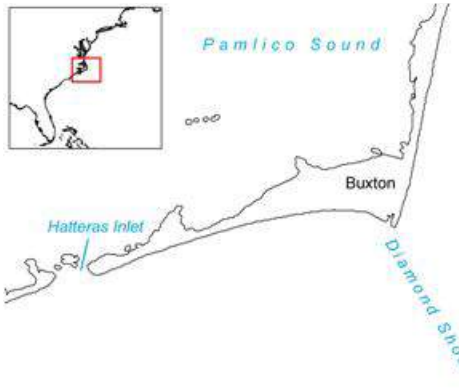


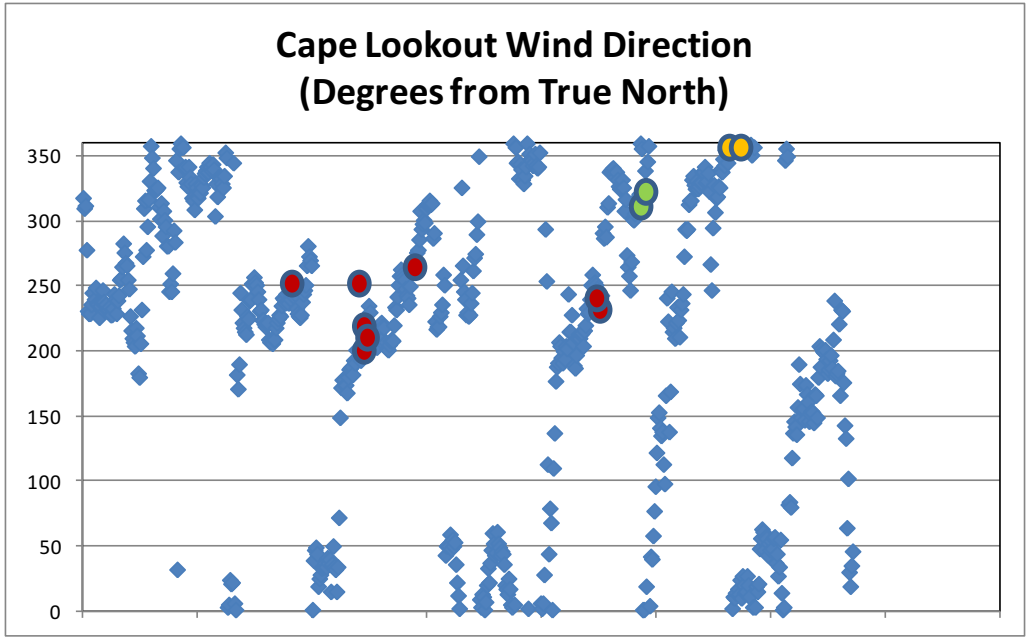
Shallow Water Dogfish Detections

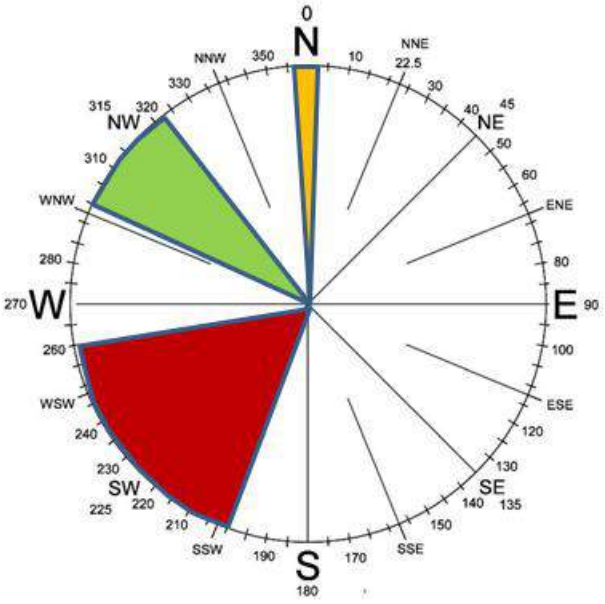
- Currents at the deep and shallow site are very similar, indicating a relatively uniform along-shelf flow.
- Fish detections are generally more common under moderate currents (0.2-0.4 m/s) flowing eastward (+u component).

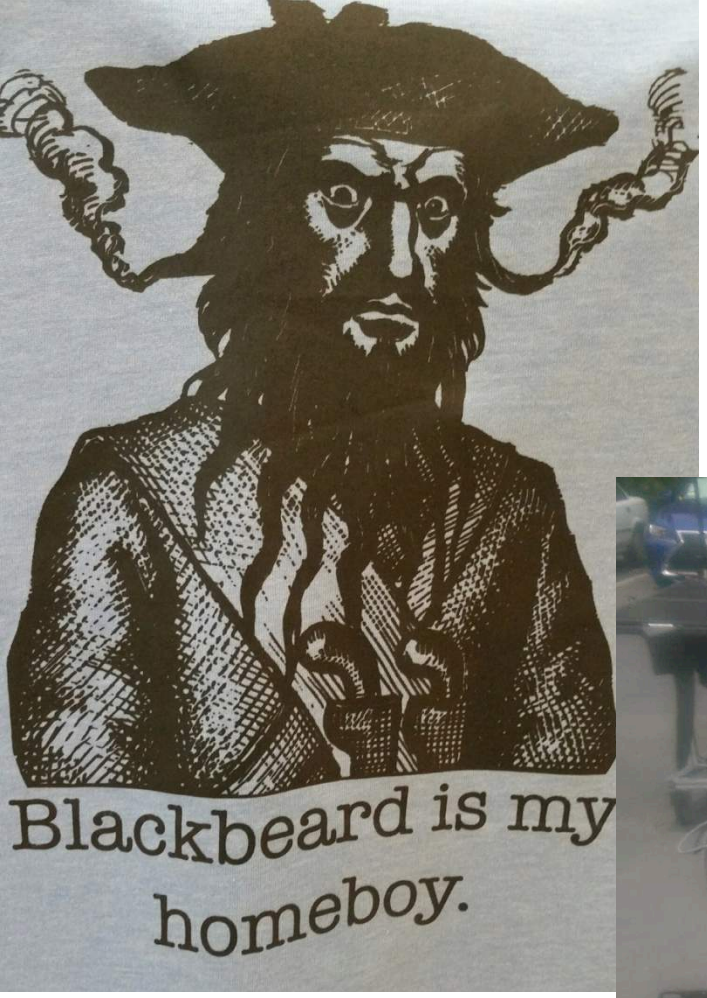



Cape Lookout Wind Speed, February 2009
m/second
16
14
12
10
8
6
4
2
0

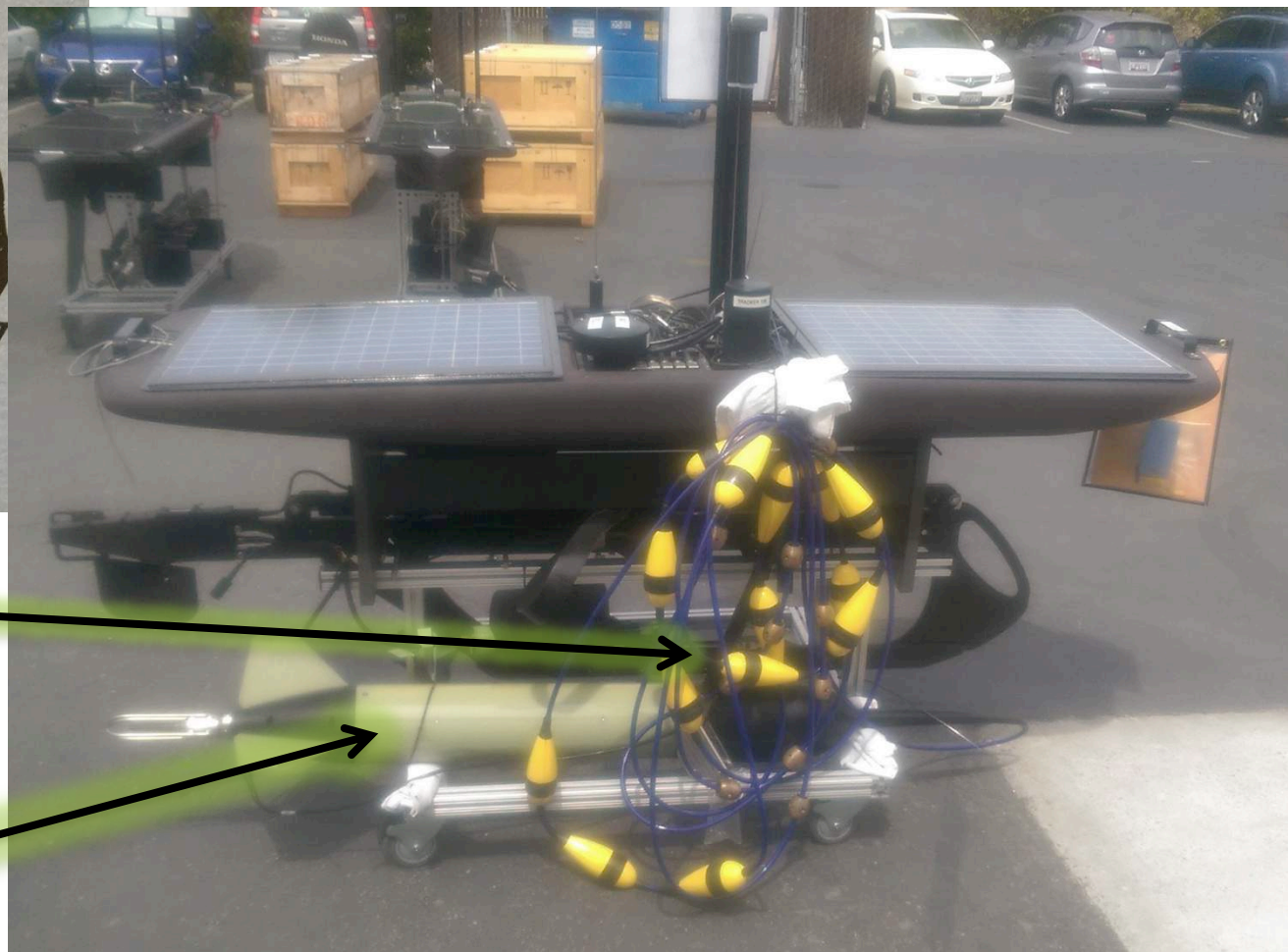

Pamlico Sound
Buxton
Hatteras Inlet
Diamond Shoals


Cape Lookout Wind Direction
(Degrees from True North)
350
300
250
200
150
100
50
0


0
N
10
NNE
22.5
30
NE
45
50
60
ENE
80
E
90
100
ESE
120
130
SE
135
140
150
SSE
170
S
180
190
SSW
210
220
SW
225
230
240
WSW
260
W
270
280
WNW
310
NW
315
320
330
NNW
350



The East Carolina University Acoustic Wave Glider (AWG) *"Blackbeard"*



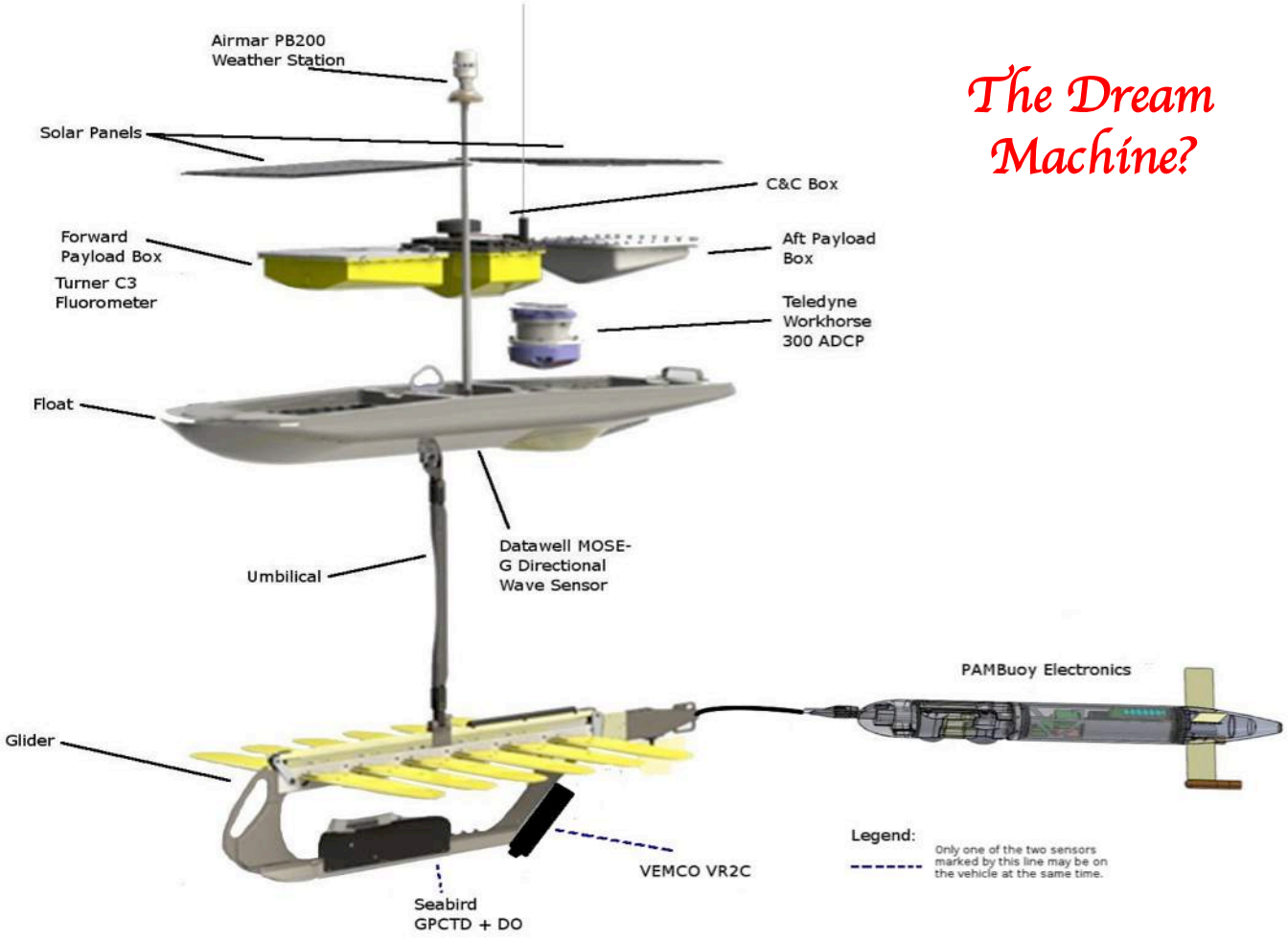
VEMCO VR2C

Decimus^{R} PAM Buoy

Acoustic Wave Glider "*Blackbeard*"

by Liquid Robotics

- Moves by wave power
- Instruments powered by sun
- Weather station
- Water currents & velocity
- Depth
- Water temperature, salinity, dissolved oxygen
- Listen for animal noises
- Listen for animals tagged with pinging tags



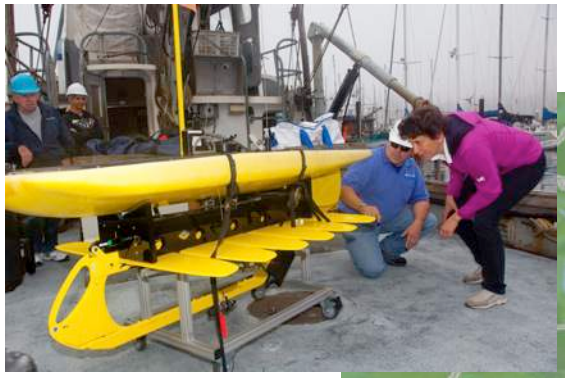
The Dream Machine?

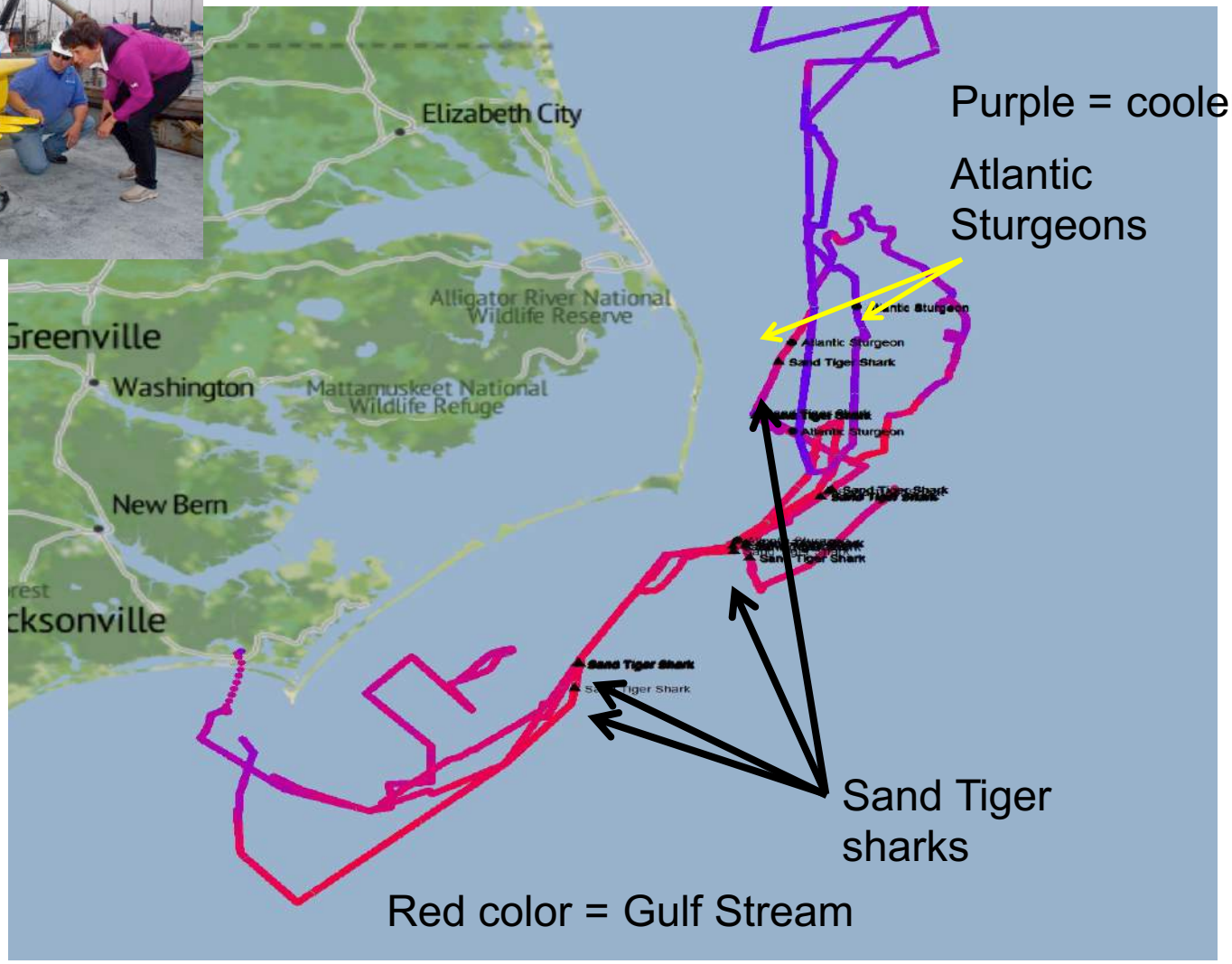
Data stream = Oceanography + meteorology + predators + prey

Blackbeard has Arrived!!

ARRGH!

Wave Glider “Carey” used by Barbara Block



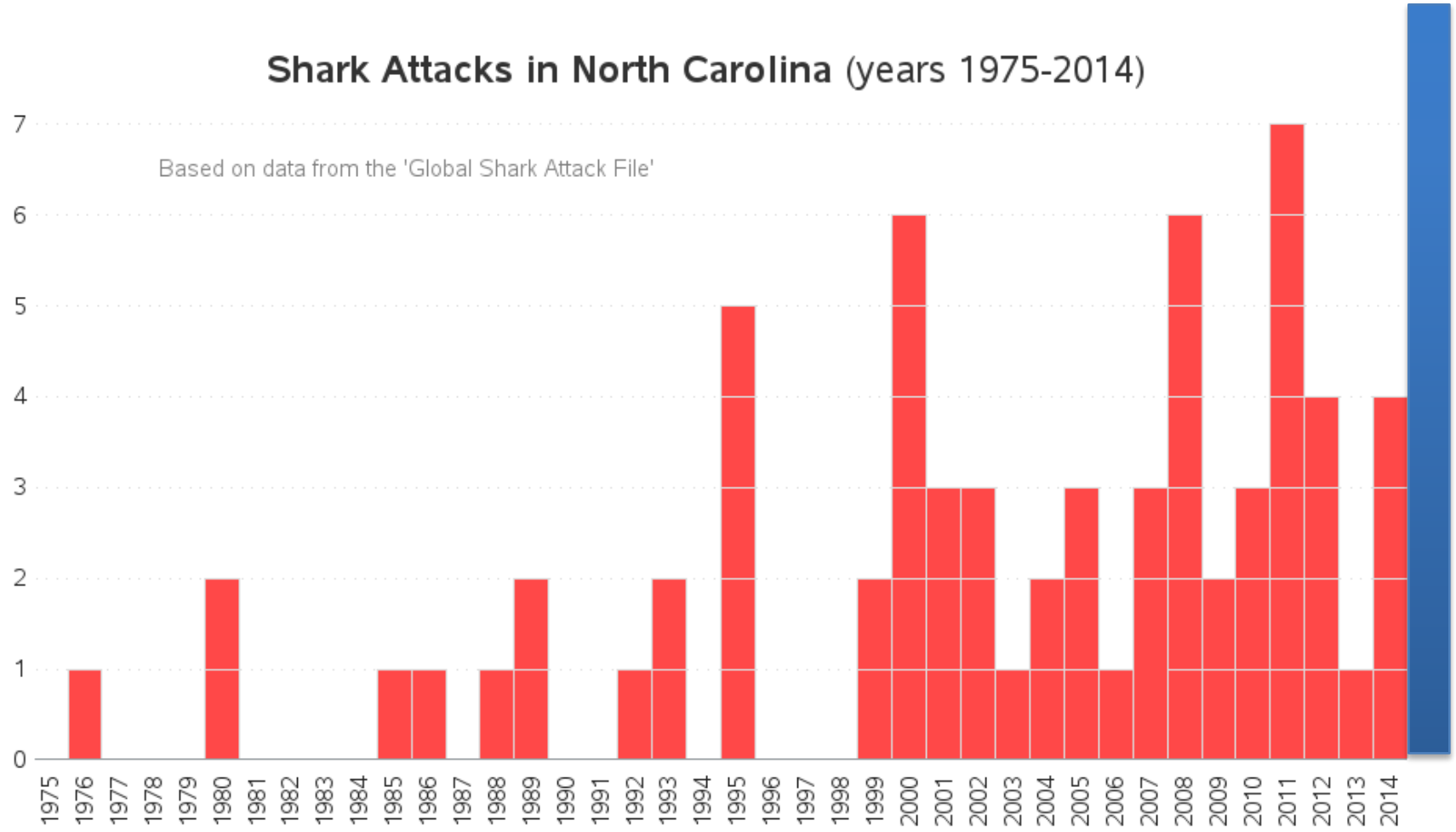


Shark Attacks in North Carolina (years 1853-2014)

East Carolina University

Tomorrow starts here.

2015 so far


Shark Attacks in North Carolina (years 1975-2014)
Based on data from the 'Global Shark Attack File'
0
1
2
3
4
5
6
7
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
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2006
2007
2008
2009
2010
2011
2012
2013
2014