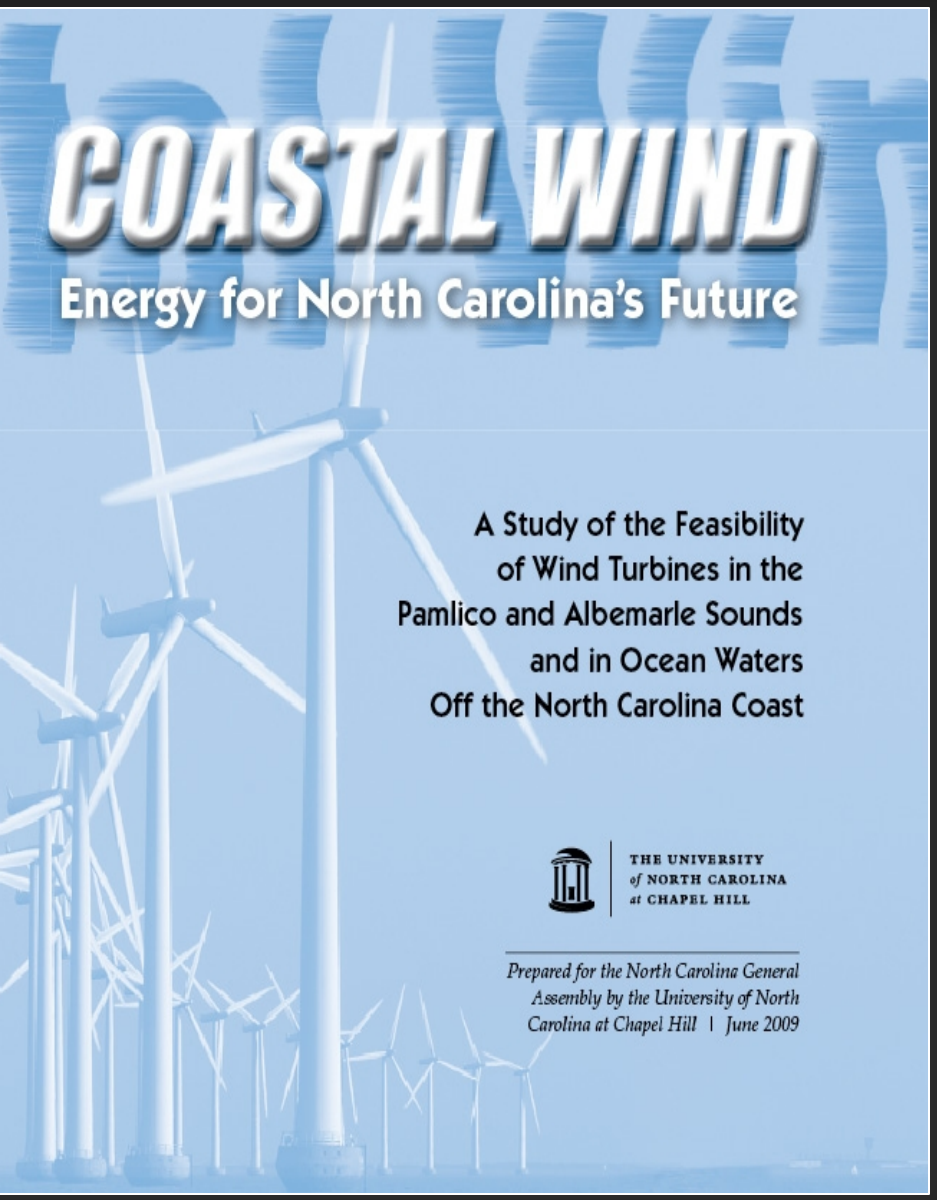
UNC Offshore Wind Power Development Follow-Up Study: Suggested revisions to AOI #3 and suggested cautions in AOI #4

Christine M. Voss, Charles H. Peterson, Stephen R. Fegley, Joseph Morton

Aug 2012-BOEM NC Task Force Meeting

Institute of Marine Sciences
University of North Carolina at Chapel Hill
Morehead City, NC



- Requested by the North Carolina General Assembly
- UNC-CH designated to conduct the study beginning in Fall 2008
- Study completed in June 2009: www.climate.unc.edu/coastal-wind
- Study area
  - Pamlico and Albemarle Sounds
  - Coastal ocean in waters < 30 m in depth (wind assessment to 50 meters in depth)

Ecological impacts, synergies, use conflicts in 2009 study

Pete Peterson, Steve Fegley, Joan Meiners

- Mortality risks to birds and bats from direct contact with rotors
- Risks to marine mammals, sea turtles, fish, and bottom-dwelling invertebrates and key habitats
- Conflicts with commercial fishing, diving, and water-based recreation including fishing
- Conflicts with military, sand mining, shipping, and cultural (including NPS viewscapes and shipwrecks) uses
- Synergies with other ecosystem services

2009 Procedure for estimating risks to wildlife

Interview experts, managers, bird watchers, fishermen, and duck hunters:
- 54 in-person interviews
- 5 phone interviews

Review relevant literature:
- 21 environmental assessments
- 21 government reports
- 40 peer-reviewed articles
- 14 unpublished manuscripts

Accumulate and organize pertinent information:
- distributions and temporal patterns of organisms
- possible presence of endangered, threatened, or species of concern
- specific behavioral responses to structures, noises, and visual cues
- distribution of fishery habitat and fishing activities

Estimation of risk:
- examine accumulated information for patterns and specific concerns
- use general ecological data and paradigms to reduce uncertainty
- consult with experts again on preliminary assessments

Acknowledgements:

INTERVIEWS -

Tom Bachman, charter boat owner (habitat, fisheries)
Jeremy Braddy, waterman (birds)
Mike Bryant, USFWS(birds, habitats)
Rich Carpenter, NCDMF (fish, fisheries)
James Casey, US Navy (military conflicts)
Mary Clark, NC State Natural History Museum (bats)
David Cobb, NCWRC (birds, fish)
B.J. Copeland, NCMFC (fish, fisheries)
Barry Costa-Pierce, Rhode I. Sea Grant, URI (synergies)
Jack Cox, commercial fisherman (fisheries, habitats)
Louis Daniel, NCDMF (fish, fisheries)
Ann Deaton, NCDMF (fish, fisheries)
Wendy Dow, DUML (marine mammals, sea turtles)
NC Ferry crew (anonymous, habitats, fish, transportation, birds)
Bert Frost, US Natl. Park Serv. (conflict maps)
John Fussell III, author (birds)
David Gaskill, waterman (birds, fishing)
Walker Golder, NC Audubon Vice-director (birds)
Tilman Gray, commercial fisherman (fish, fisheries)
Nathan Hall, waterman (birds)
J. Christopher Haney, Defenders of Wildlife (birds)
Craig Hardy, NCDMF (fish, fisheries)
Jess Hawkins, NCMFC (fish, fisheries)
Herb Hendrickson, Professor Emeritus UNCG (birds)
Eileen Hoffman, Old Dominion Univ. (synergies)
Richard W. Lawrence, NC Dept of Cultural Resources (wrecks)
David S. Lee, retired from NC State Natural History Museum (birds)
Mike Marshall, NCDMF (fish, fisheries)
Catherine McClellan, DUML (marine mammals, sea turtles)
Carol McCoy, US Natl. Park Serv. (conflict maps)
Red Munden, NCDMF (birds, fish, fisheries)
Francis O'Beirn, Marine Inst, Galway, Ireland (synergies)
Jeff Oden, commercial fisherman (fish, fisheries)
James Parnell, UNCW (birds)
Brian Patteson, offshore bird and fishing cruise leader (birds, fish)
Willie Phillips, formerly NC Marine Fish. Commission (fish)
David Plummer, USMC (military air space)
Andrew Read, DUML (marine mammals, sea turtles)

INTERVIEWS (continued) –

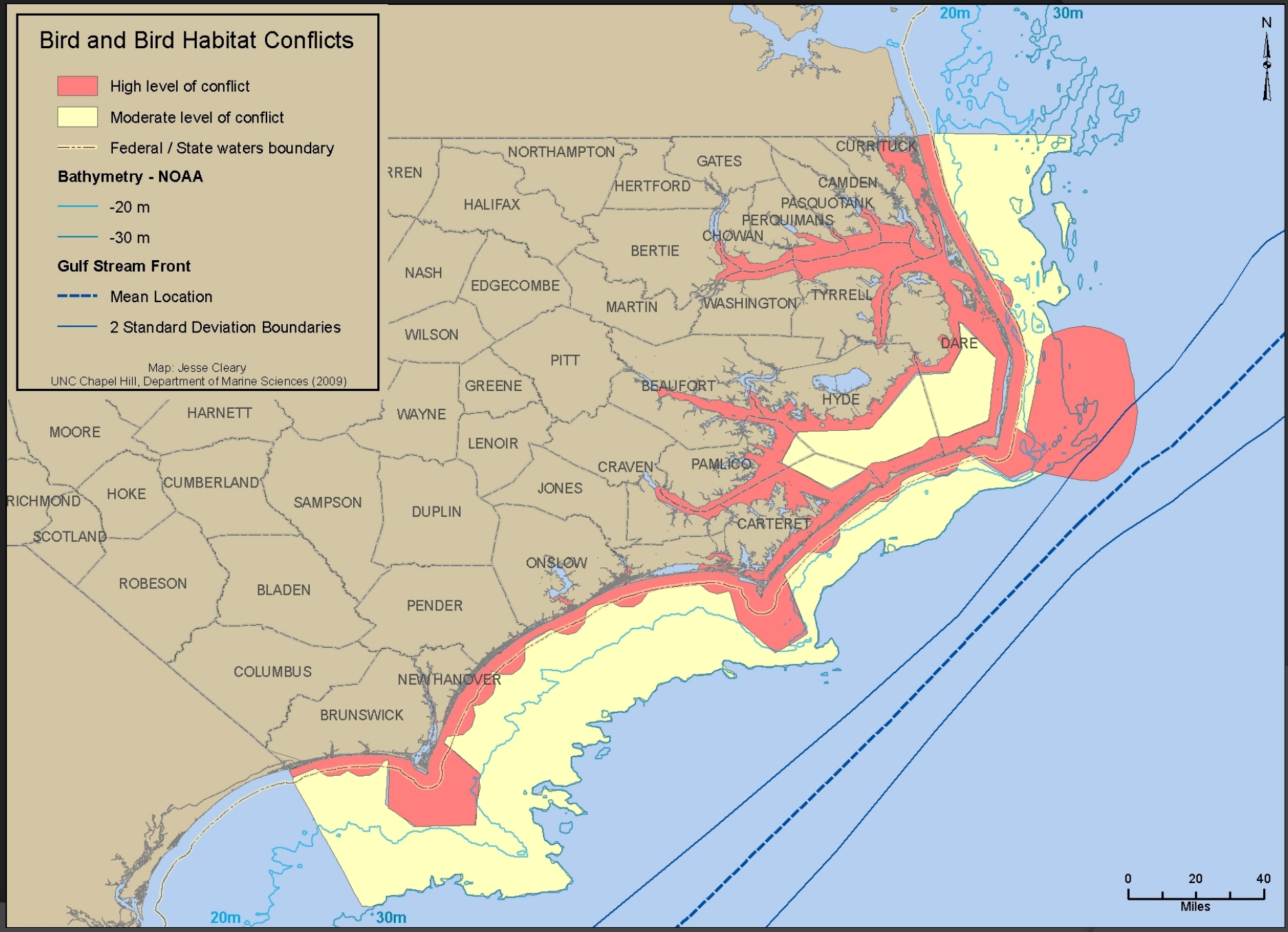
Steve Ross, UNCW (fish)
Paul Spitzer, Cooperative Oxford Laboratory (birds)
David Taylor, NCDMF (fish, fisheries)
Paul Thompson, Univ. of Aberdeen (marine mammals)
Billy Carl Tillet, commercial fisherman (fish, fisheries)
David Vela, Regional director, SE Region, US Natl. Park Serv. (conflict maps)
Danielle Waples, DUML (marine mammals, sea turtles)
Katy West, NCDMF (fish, fisheries)
Mark Wilde-Ramsing, NC Dept of Cultural Resources (wrecks)
Lynne Williams, DUML (marine mammals, sea turtles)
Sara Winslow, NCDMF (fish, fisheries)
Jerry Wright, former Chair of the NC Wildlife Resources Commission (birds)

GATHERING LITERATURE-

Richard Barber, Duke Univ. Marine Laboratory
Denene Blackwood, IMS
Laura Bradley, IE student, UNC
Dean Carpenter, NC Albemarle Pamlico Natl. Estuary Prog.
David Carr, Southeastern Law Conference
David Cobb, NCWRC
Robert Dunn, IE student, UNC
Carolyn Elfland, UNC
Jill Fegley, NOAA Natl. Estuarine Research Reserve System
Scott Gies, NC Dept. Env. Natural Resources
George Hagerman, Director, Virginia Tech Advanced Res. Inst.
Andrea Hale, IE student, UNC
Joseph Kalo, UNC
Wilson Laney, US Fish & Wildlife Serv.
David S. Lee, retired from NC State Natural History Museum
David McCarthy, UNC
Stephanie Miscovich
Rachel Noble, IMS
Emily Nurminen, IE student, UNC
David Plummer, USMC (military air space)
Walt Rogers, IE student, UNC
Harvey Seim, UNC
Robert Vogt, IE student, UNC
Steve Wall, NC Dept. of Env. Natural Resources
Brianna Young, IE student, UNC

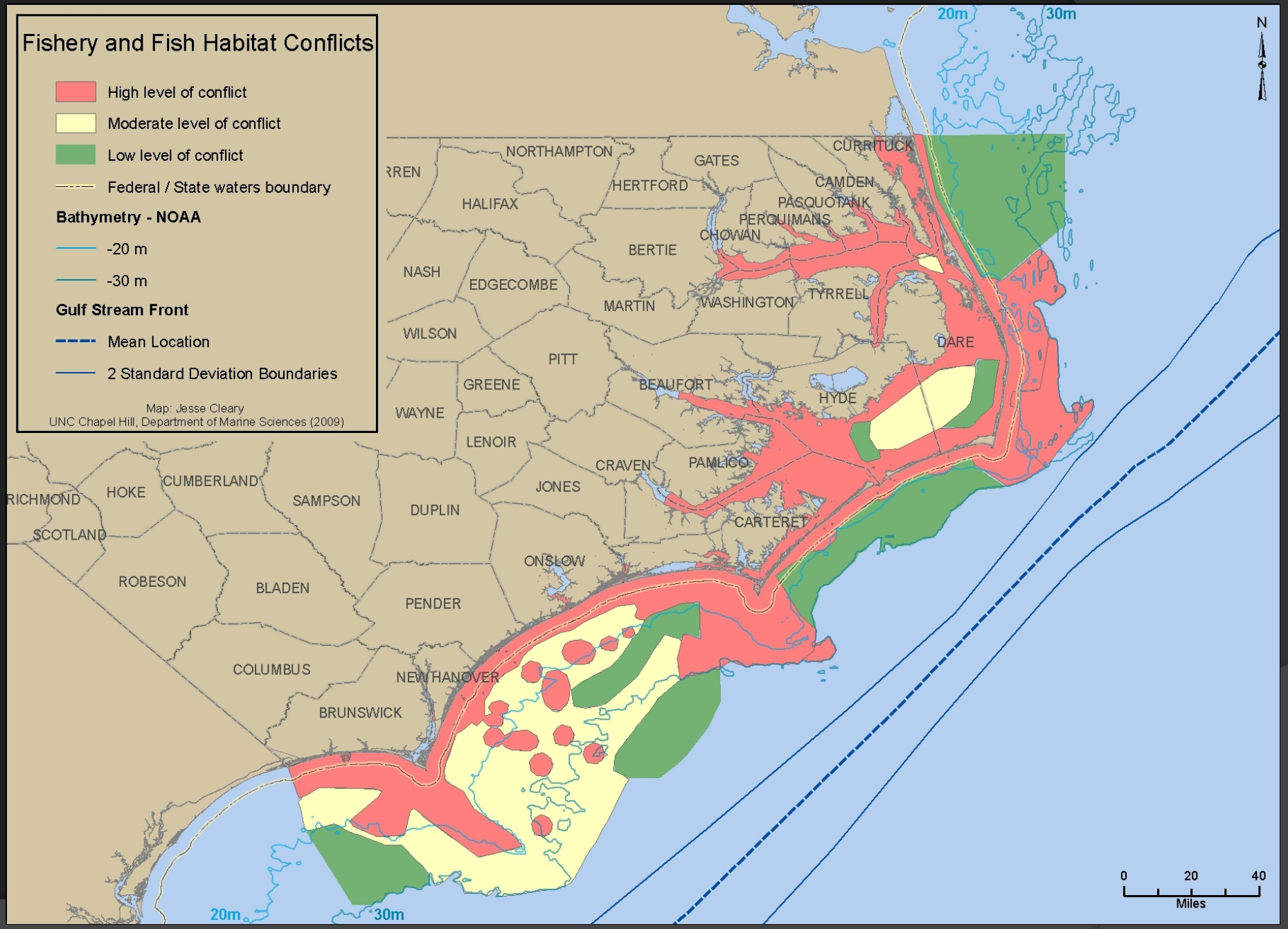
Bird and bat risk conclusions

- Birds at risk
  - Passerines (songbirds) during their nocturnal, seasonal migrations
  - Threatened and Endangered, plus declining, species (piping plover, red knot, other migrating shorebird species, and roseate tern) during fall/spring migrations and summer/winter residence
  - Large-bodied, low-flying, slow fliers (pelicans, gulls)
  - True pelagic seabirds (albatross) – Gulf Stream risks
- Bats at risk – migrating insectivorous species


Bird and Bird Habitat Conflicts
High level of conflict
Moderate level of conflict
Federal / State waters boundary
Bathymetry - NOAA
-20 m
-30 m
Gulf Stream Front
Mean Location
2 Standard Deviation Boundaries
Map: Jesse Cleary
UNC Chapel Hill, Department of Marine Sciences (2009)
20m
30m
N
NORTHAMPTON
GATES
CURRITUCK
HERTFORD
CAMDEN
HALIFAX
PASQUOTANK
PERQUIMANS
CHOWAN
BERTIE
NASH
EDGECOMBE
MARTIN
WASHINGTON
TYRRELL
WILSON
DARE
PITT
GREENE
BEAUFORT
HYDE
HARNETT
WAYNE
MOORE
LENOIR
CRAVEN
PAMLICO
CUMBERLAND
JONES
HOKE
SAMPSON
DUPLIN
CARTERET
SCOTLAND
ONSLOW
ROBESON
BLADEN
PENDER
COLUMBUS
NEW HANOVER
BRUNSWICK
0
20
40
Miles

Critical fish habitat, fishing/diving uses

- Primary, secondary nurseries, migration paths, strategic habitats, submerged aquatic vegetation, shell bottom, oyster reefs (sounds), and live reefs, wrecks, artificial reefs (ocean)
- Larval fish and blue crab migration corridors (may require seasonal constraint on construction window)
- Intense fishing uses
  - Trawling potentially limited by wind farm presence and made more navigationally challenging (shrimp, crabs, flounder)
  - Dredging incompatible within wind farms (scallops, oysters)
  - Long hauling incompatible within wind farms (various fishes)
- High productivity regions
  - Gulf Stream, three Capes, all inlets, the “Point”
  - All inlets with 5 mile radius from center point


Fishery and Fish Habitat Conflicts
High level of conflict
Moderate level of conflict
Low level of conflict
Federal / State waters boundary
Bathymetry - NOAA
-20 m
-30 m
Gulf Stream Front
Mean Location
2 Standard Deviation Boundaries
Map: Jesse Cleary
UNC Chapel Hill, Department of Marine Sciences (2009)
20m
30m
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NORTHAMPTON
GATES
CURRITUCK
HERTFORD
CAMDEN
HALIFAX
PASQUOTANK
PERQUIMANS
CHOWAN
BERTIE
NASH
EDGECOMBE
MARTIN
WASHINGTON
TYRRELL
WILSON
DARE
PITT
GREENE
BEAUFORT
HYDE
WAYNE
LENOIR
CRAVEN
PAMLICO
JONES
CUMBERLAND
HOKE
SAMPSON
DUPLIN
CARTERET
SCOTLAND
ONSLOW
ROBESON
BLADEN
PENDER
COLUMBUS
NEW HANOVER
BRUNSWICK
0
20
40
Miles

Sea turtles and marine mammals

- Protected under Endangered Species Act and/or Marine Mammal Protection Act
- Risk during installation – noise and injury from bottom disturbance
  - Right and humpback whales – fall, winter/spring in ocean
  - Loggerhead, Kemp's Ridley, green – summer/fall in ocean and sound
  - Bottle-nosed dolphin – all year in ocean and sound
  - Manatee – summer/fall in sound
- Risk during operation – noise and electromagnetic fields – unknown and area of current research interest

Foundation Suitability Based on Geology and Geologic Dynamics

Federal / State waters boundary

Bathymetry - NOAA

-20 m

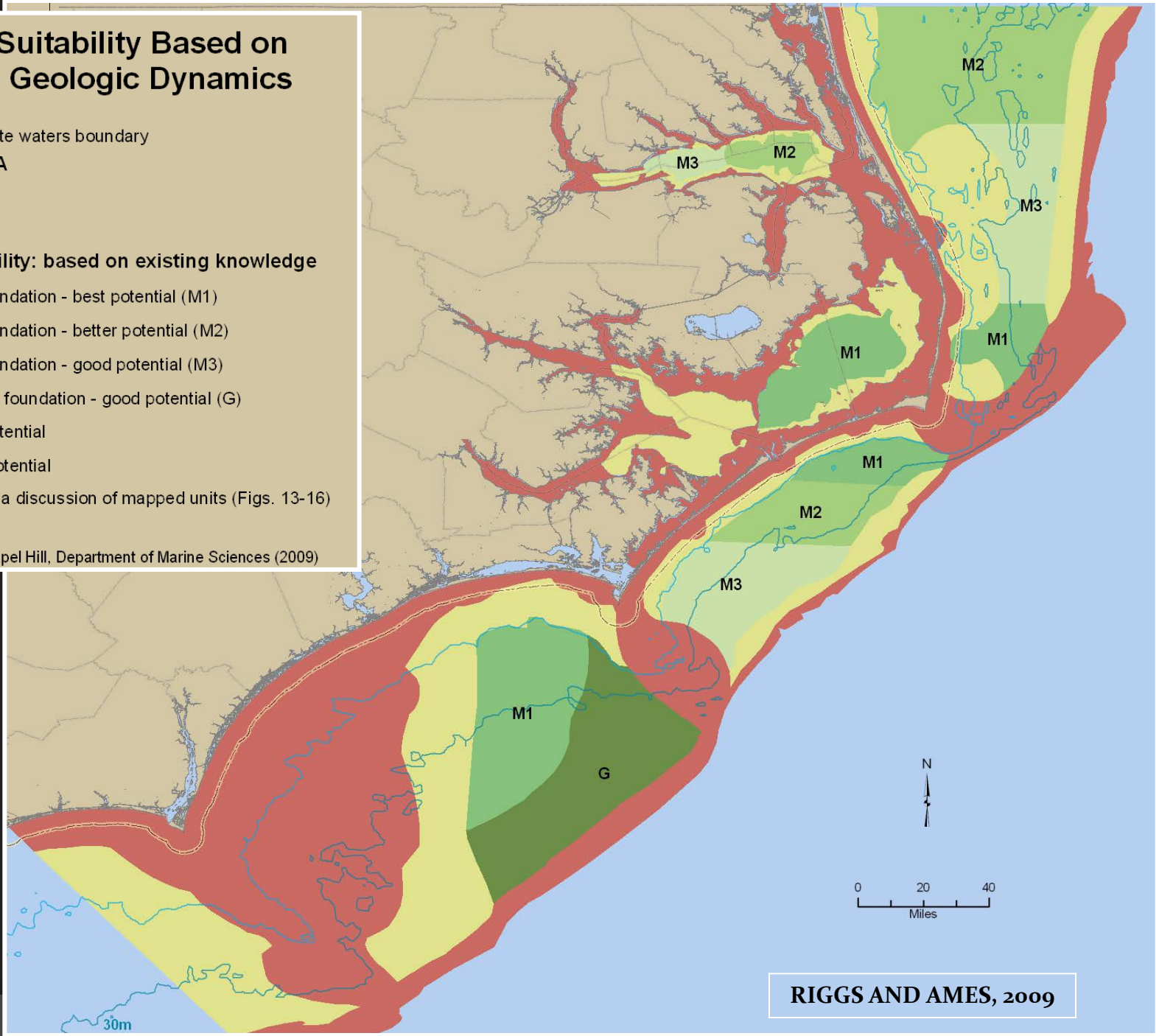
-30 m

Foundation Suitability: based on existing knowledge

- M1 — Monopile foundation - best potential (M1)
- M2 — Monopile foundation - better potential (M2)
- M3 — Monopile foundation - good potential (M3)
- G — Gravity Base foundation - good potential (G)
- Moderate Potential
- No to Low Potential

See Chapter 4 text for a discussion of mapped units (Figs. 13-16)

Map: Jesse Cleary, UNC Chapel Hill, Department of Marine Sciences (2009)

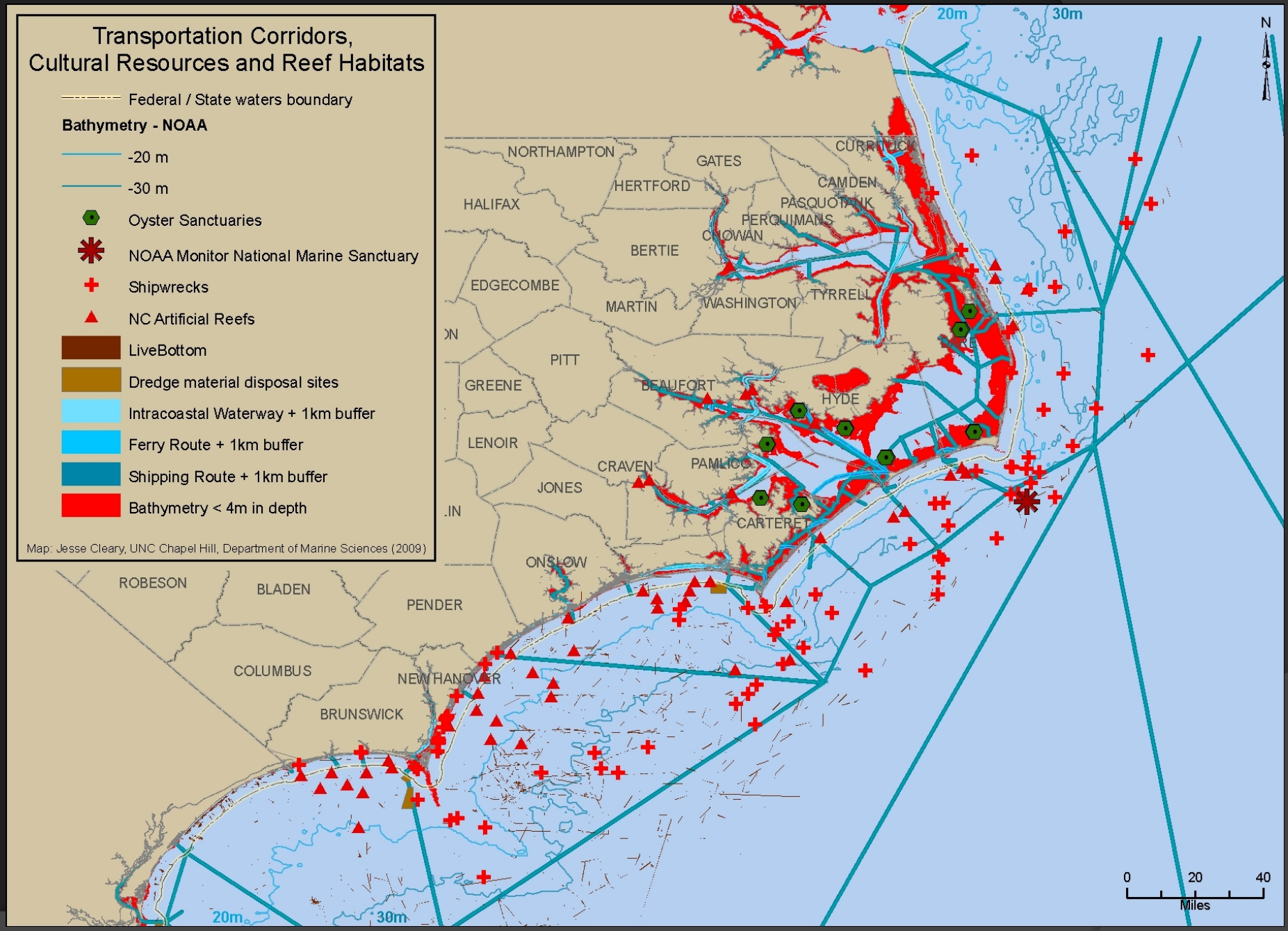


RIGGS AND AMES, 2009

Department of Geological Sciences

Navigation corridors, cultural resources, reef habitats

- All marked navigation channels (ferries, shipping, Intracoastal Waterway) -1 km buffer on each side
- Shipwrecks, including Monitor National Marine Sanctuary
- Artificial reefs, live bottom, and oyster sanctuaries
- Viewscapes of National Seashores (NPS) around National Heritage sites (eg, OBX villages, lighthouses)
- Dumping grounds


Transportation Corridors,
Cultural Resources and Reef Habitats
Federal / State waters boundary
Bathymetry - NOAA
-20 m
-30 m
Oyster Sanctuaries
NOAA Monitor National Marine Sanctuary
Shipwrecks
NC Artificial Reefs
LiveBottom
Dredge material disposal sites
Intracoastal Waterway + 1km buffer
Ferry Route + 1km buffer
Shipping Route + 1km buffer
Bathymetry < 4m in depth
Map: Jesse Cleary, UNC Chapel Hill, Department of Marine Sciences (2009)
20m
30m
N
NORTHAMPTON
GATES
CURRITUCK
HERTFORD
CAMDEN
HALIFAX
PASQUOTANK
PERQUIMANS
CHOWAN
BERTIE
EDGECOMBE
MARTIN
WASHINGTON
TYRRELL
PITT
GREENE
BEAUFORT
HYDE
LENOIR
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PAMLICO
JONES
CARTERET
ONSLOW
ROBESON
BLADEN
PENDER
COLUMBUS
NEW HANOVER
BRUNSWICK
0
20
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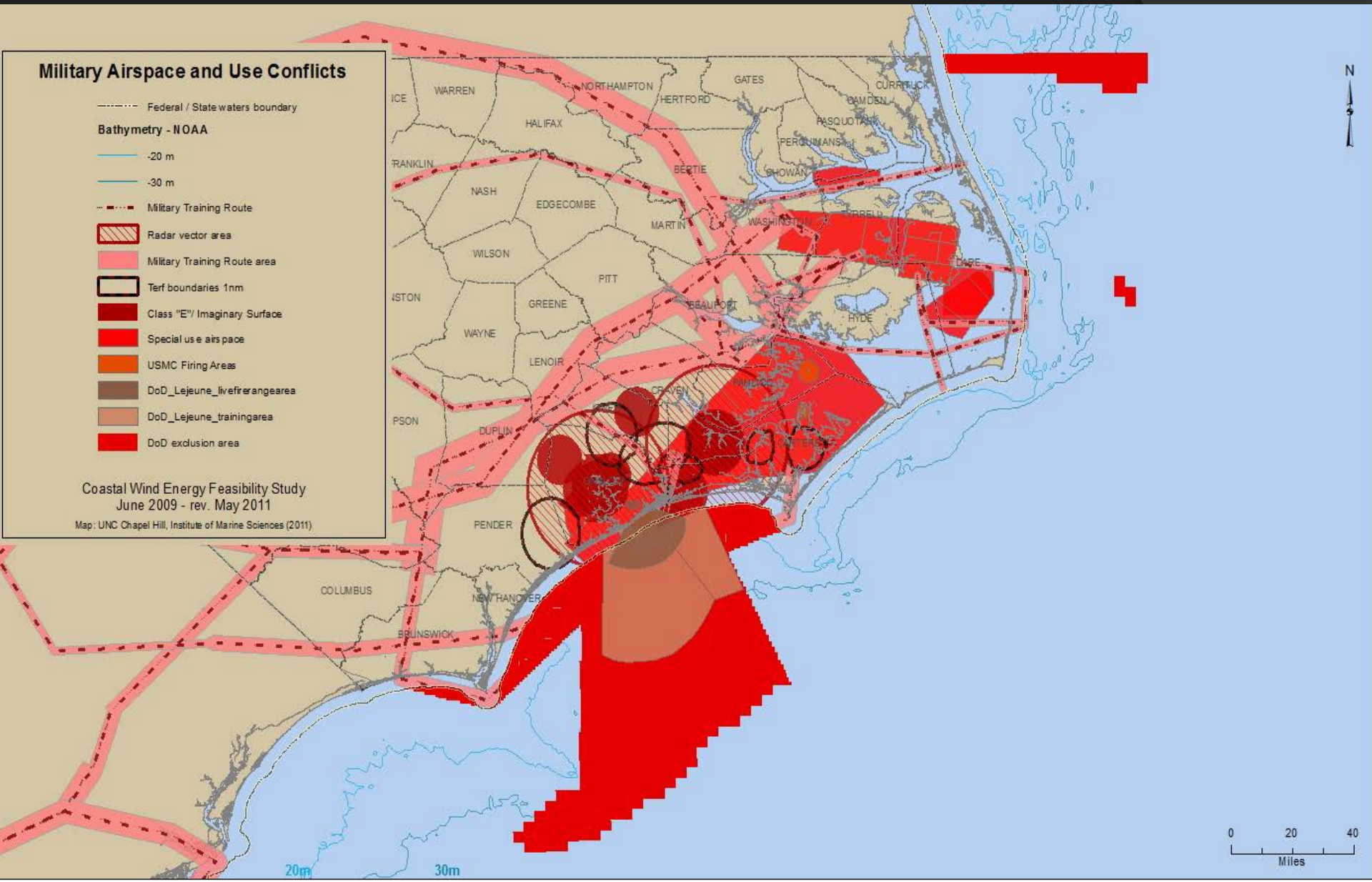
Miles


Military Airspace and Use Conflicts
Federal / State waters boundary
Bathymetry - NOAA
-20 m
-30 m
Military Training Route
Radar vector area
Military Training Route area
Terf boundaries 1nm
Class "E"/ Imaginary Surface
Special use airspace
USMC Firing Areas
DoD_Lejeune_livefirerangearea
DoD_Lejeune_trainingarea
DoD exclusion area
Coastal Wind Energy Feasibility Study
June 2009 - rev. May 2011
Map: UNC Chapel Hill, Institute of Marine Sciences (2011)
WARREN
NORTHAMPTON
HERTFORD
GATES
CURRITUCK
CAMDEN
PASQUOTANK
PERQUIMANS
CHOWAN
HALIFAX
BERTIE
NASH
EDGECOMBE
MARTIN
WASHINGTON
TYRRELL
DARE
WILSON
PITT
GREENE
BEAUFORT
HYDE
WAYNE
LENOIR
CRAVEN
PAMLICO
DUPLIN
PENDER
COLUMBUS
NEW HANOVER
BRUNSWICK
20m
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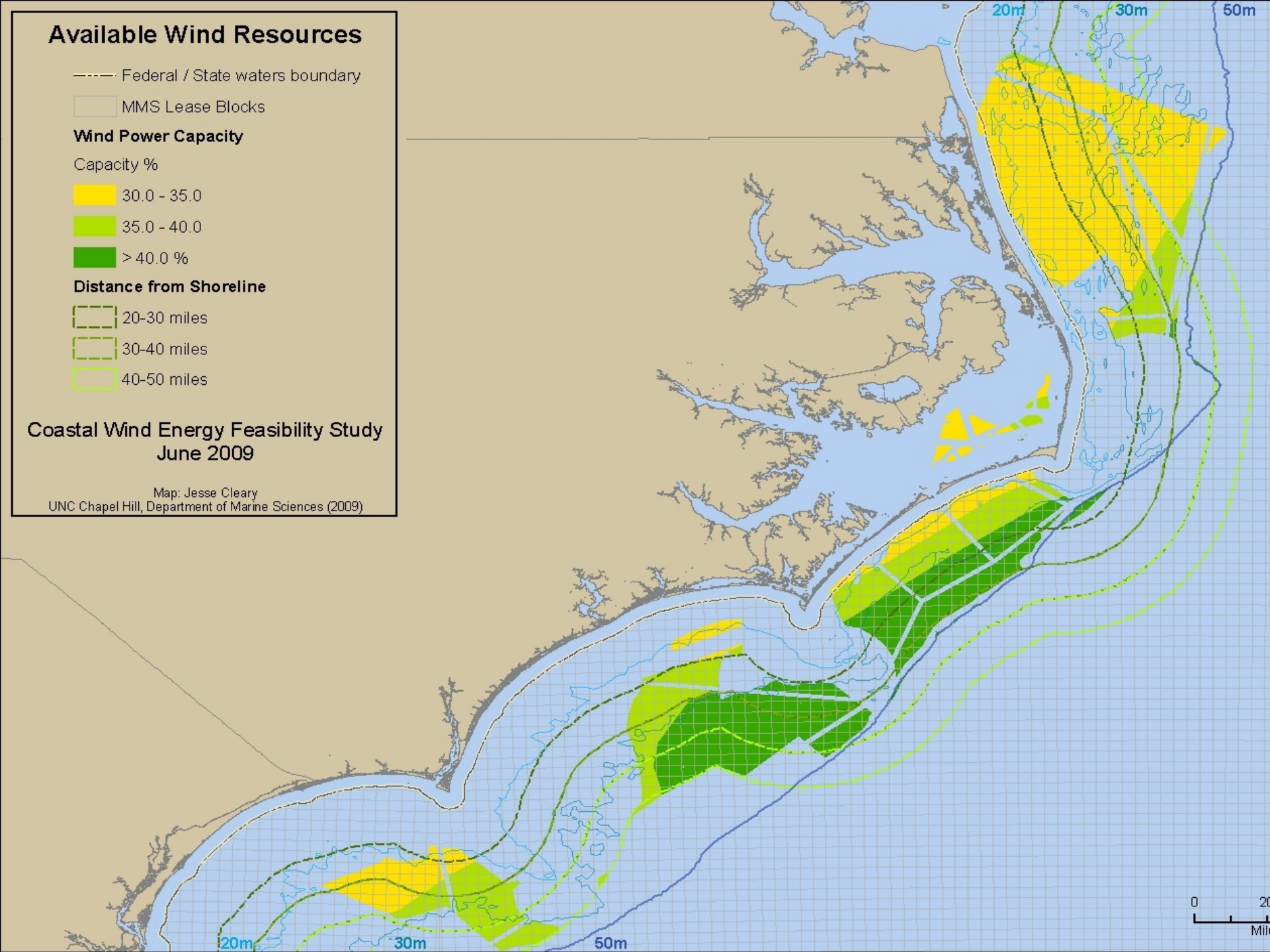
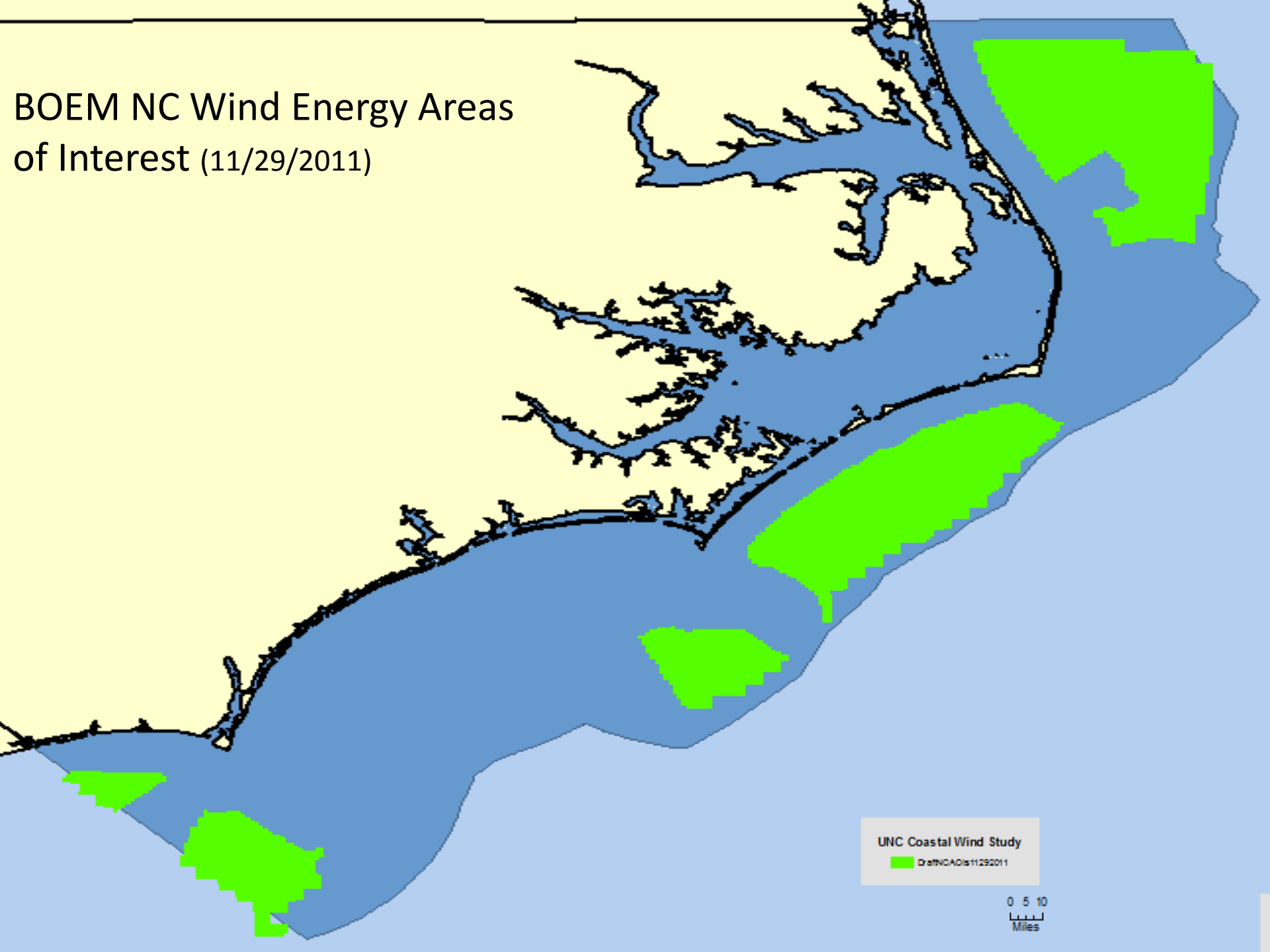

Available Wind Resources
Federal / State waters boundary
MMS Lease Blocks
Wind Power Capacity
Capacity %
30.0 - 35.0
35.0 - 40.0
> 40.0 %
Distance from Shoreline
20-30 miles
30-40 miles
40-50 miles
Coastal Wind Energy Feasibility Study
June 2009
Map: Jesse Cleary
UNC Chapel Hill, Department of Marine Sciences (2009)
20m
30m
50m
20m
30m
50m
0

BOEM NC Wind Energy Areas of Interest (11/29/2011)



Goals of 2011-2012 UNC follow-up study for BOEM & NC Dept. of Commerce

- Extend 2009 UNC Wind Study assessment from 30 m to 50 m isobath
- Conduct a more detailed, fine-scale assessment of AOI #3 & its adjacent inshore area (previously excluded because of hardbottom habitat density)- because of the great potential commercial interest here
- Conduct a local stakeholders meeting to solicit advice based on proprietary & public information on locations of wrecks, artificial reefs, & natural hardbottom to identify those areas within expanded AOI #3 that could be suitable for development of wind power without high risk of conflict with hardbottom EFH (Essential Fish Habitat)
- Using previously collected information and newly provided data from the stakeholders, we also reviewed potential EFH conflicts in all other AOIs, resulting in recommended cautions in AOI #4

2012 estimating risks to birds, marine mammals & sea turtles

Data from Ocean Biogeographic Information System Spatial Ecological Analysis of Megavertebrate Populations (OBIS-SEAMAP):

- Programme Intégré de Recherches sur les Oiseaux Pélagiques (PIROP) geo-referenced, vessel-based survey data on pelagic seabirds (1966-1992)
- NOAA Southeast Fishery Science Center (SEFSC) marine mammal surveys (1992, 1998, and 1999)
- Commercial Pelagic Observer Program (POP)
- The Duke/UNC Oceanographic Consortium pelagic cruises conducted August 2004

Key informant interviews:

- Red Munden (local birder), John Stanton (USFWS), Brian Patteson (ornithologist/ecotourism business), John Fussell III (ornithologist/author), David Lee (ornithologist/NC Mus. of Nat. Hist.), Kevin McCabe & Kim Moser (ecotourism business), Charlie Griffin (fisherman), Jack Holland (NC DENR), Andrew Read (DUML), Spurgeon Stowe (fisherman), UNC studies for Duke Energy

Accumulate and organize pertinent information:

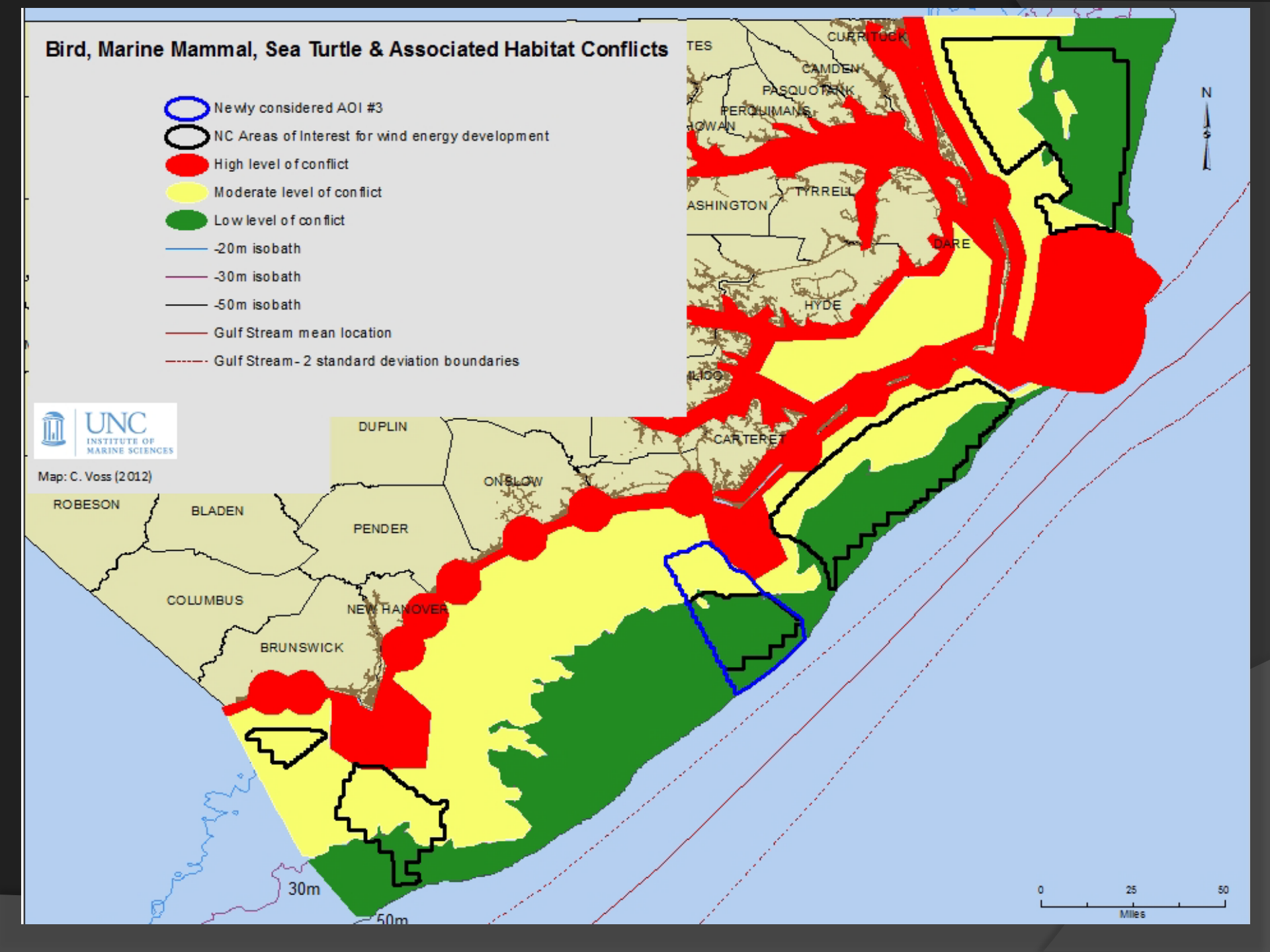
- distributions & temporal patterns of organisms
- presence of endangered, threatened, or species of concern
- specific behavioral responses to structures, noises, & visual cues

Estimation of risk:

- examine accumulated information for patterns & specific concerns
- use general ecological data and paradigms to reduce uncertainty
- consult with experts again on preliminary assessments

Acknowledgements:

- Nate Bachelor, NOAA fisheries biologist (hard-bottom habitats)
- Rick Baldwin, charter boat captain (fish, fisheries, transit corridors, fish habitat)
- Debby Boyce, diving company owner (transit corridors, diving)
- Dale Britt, charter boat captain (fish, fisheries, fish habitat)
- Chip Collier, NC Division of Marine Fisheries (fish, fisheries)
- Steve Coulter, charter boat captain (fish, fisheries)
- Jack Cox, commercial fisherman (fisheries, habitats)
- Lee Dantzler, recreation fisherman, (fisheries, fish habitat)
- Maurice Davis Sr., charter boat captain (fisheries, fish habitat)
- Maurice Davis Jr., charter boat captain (fish, fisheries, fish habitat)
- John Ellis, U.S. Fish and Wildlife Service (fish, fisheries, fish habitat)
- John Fussell III, naturalist, author (birds)
- Brian Patteson, bird and fishing cruise leader (birds, fisheries, marine mammals, sea turtles)
- Terrell Gould Jr., charter boat captain (fish, fisheries, fish habitat)
- Tillman Gray, commercial fisherman (fish, fisheries)
- Charlie Griffin, commercial fisherman (fisheries, sea turtles, birds, marine mammals)
- Jess Hawkins, NC Marine Fisheries Commission (fish, fisheries, fish habitat, transportation)
- Lauren Heesemann, Monitor National Marine Sanctuary (hard-bottom habitats)
- Jack Holland, NC Division of Marine Fisheries (fish, fishing, birds, fish habitat)
- Wilson Laney, U.S. Fish and Wildlife Service (fish, fisheries, fish habitat)
- David Lee, former curator of birds NC Natural History museum, naturalist (birds, sea turtles)
- Terry Leonard, dive boat captain, diver (diving, wrecks)
- Jim Lyons, former teacher, fisherman (fish, fisheries)
- Kevin McCabe, bird expert, fisherman (birds, fish, fisheries)
- Kim Moser, bird expert (birds)
- Fentress “Red” Munden, NC Division of Marine Fisheries (birds, fish, fisheries)
- Ron McPherson, charter boat captain (fisheries, fish habitat)
- Alex Ng, commercial fisherman (fisheries)
- Robert Purifoy, dive boat captain, diver (transit corridors, diving, wrecks, fish habitat)
- Andrew Read, Duke University Marine Lab (marine mammals, sea turtles)
- Stan Riggs, East Carolina University (geologic foundations)
- Fritz Rohde, NOAA Habitat Conservation Division (fish, fisheries)
- Steve Ross, University of North Carolina at Wilmington (fish, fish habitat)
- Bryan Schoonard, Florida Fish and Wildlife Service GIS (fish habitat)
- Chris Southerly, NC Department of Cultural Resources (wrecks)
- Capt. Joe Shute, charter boat captain (fish, fisheries)
- John Stanton, U.S. Fish and Wildlife Service (birds, bird habitats)
- Joe Smith, NOAA leader of menhaden sampling (menhaden)
- Spurgeon Stowe, charter boat captain (fisheries, birds, marine mammals, sea turtles)
- Dennis Trowell, NC Division of Marine Fisheries (fish, fishing, fish habitat)
- Paula Whitfield, NOAA fisheries biologist, (hard-bottom habitats)
- Mark Wilde-Ramsing, NC Department of Cultural Resources (wrecks)


Bird, Marine Mammal, Sea Turtle & Associated Habitat Conflicts
Newly considered AOI #3
NC Areas of Interest for wind energy development
High level of conflict
Moderate level of conflict
Low level of conflict
-20m isobath
-30m isobath
-50m isobath
Gulf Stream mean location
Gulf Stream - 2 standard deviation boundaries
UNC INSTITUTE OF MARINE SCIENCES
Map: C. Voss (2012)
CURRITUCK
CAMDEN
PASQUOTANK
PERQUIMANS
TYRRELL
DARE
HYDE
CARTERET
DUPLIN
ONSLOW
PENDER
ROBESON
BLADEN
COLUMBUS
NEW HANOVER
BRUNSWICK
30m
50m
N
0
25
50
Miles

2012 estimating risks to fish, fishing & diving & fish habitat

Data from :

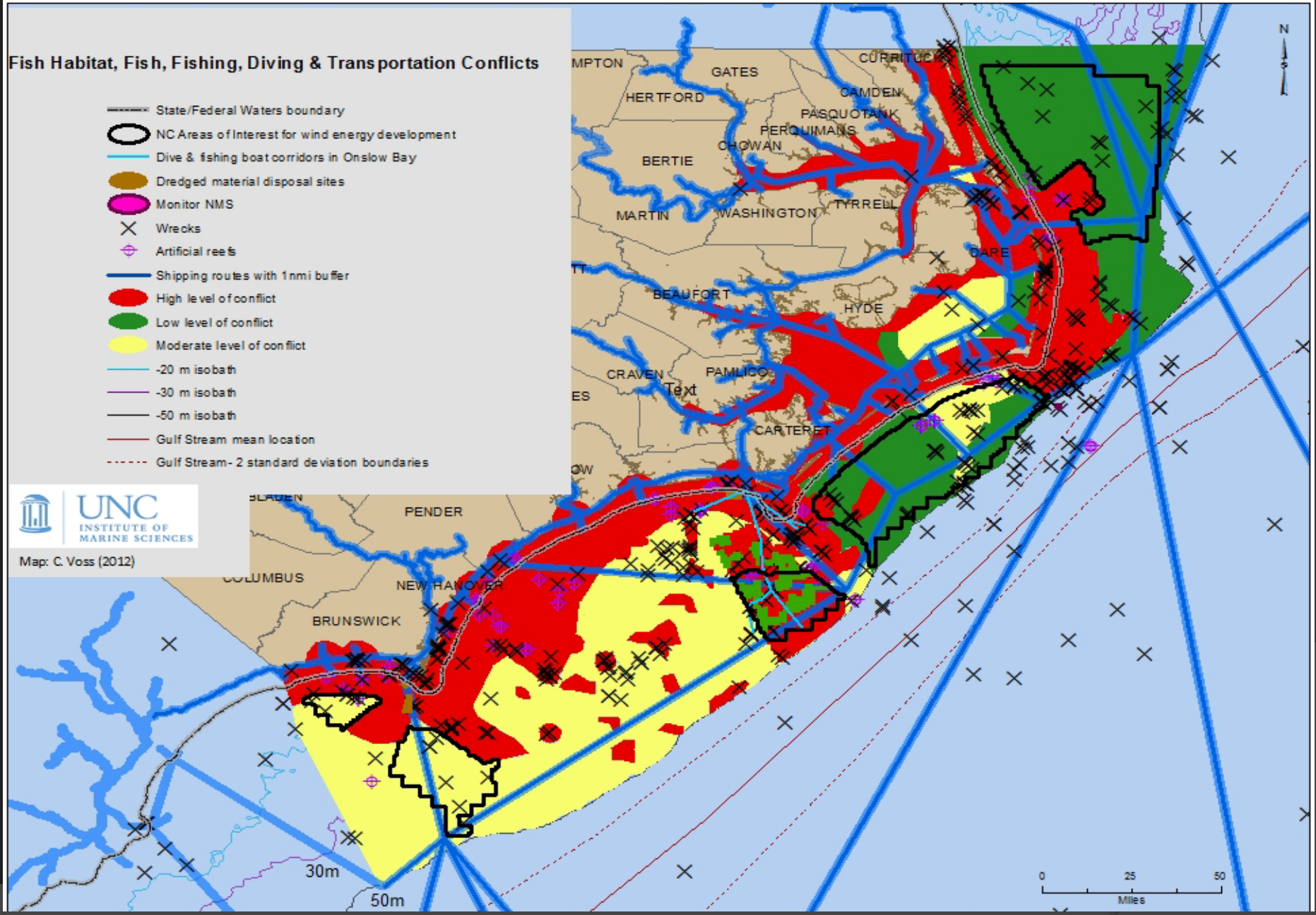
- Southeast Area Monitoring & Assessment Program (SEAMAP) –National Marine Fisheries Service
- Southeast Coastal Ocean Observing Regional Association (SECOORA) – South Atlantic Fisheries Management Council
- NC Division of Marine Fisheries (hardbottom, artificial reefs, wrecks)
- NC Dept. of Cultural Resources (Mark Wilde-Ramsing, Chris Southerly)
- NOAA Beaufort Lab (Paula Whitfield, Chris Taylor)

Information from stakeholders:

- Rick Baldwin, Dale Britt, Chris Kimrey, Ron McPherson, Joe Shute (charter boat/recreational fishing)
- Jack Cox, Sonny Davis Sr., Maurice Davis Jr., Terrell Gould Jr., Alex Ng (commercial fishing/headboats)
- Lee Dantzler (recreational fishing)
-Debby Boyce, Bud Daniels, Terry Leonard, Bobby Purifoy (dive industry)
-Jess Hawkins (ecotourism/former NC DMF/NC MFC) – stakeholder meeting facilitator

Additional considerations:

- 0.5-km buffer for hardbottom (Larry Cahoon, UNCW)
- 30-m buffer for wrecks (NC DCR)
- 1.0-nmi buffer for shipping routes (USCG NJ criteria)
-Dive & fishing boat corridor (MHC-area stakeholders)


Fish Habitat, Fish, Fishing, Diving & Transportation Conflicts
State/Federal Waters boundary
NC Areas of Interest for wind energy development
Dive & fishing boat corridors in Onslow Bay
Dredged material disposal sites
Monitor NMS
Wrecks
Artificial reefs
Shipping routes with 1nmi buffer
High level of conflict
Low level of conflict
Moderate level of conflict
-20 m isobath
-30 m isobath
-50 m isobath
Gulf Stream mean location
Gulf Stream - 2 standard deviation boundaries
UNC
INSTITUTE OF
MARINE SCIENCES
Map: C. Voss (2012)
GATES
HERTFORD
CAMDEN
PASQUOTANK
PERQUIMANS
CHOWAN
BERTIE
MARTIN
WASHINGTON
TYRRELL
DARE
HYDE
BEAUFORT
CRAVEN
PAMLICO
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PENDER
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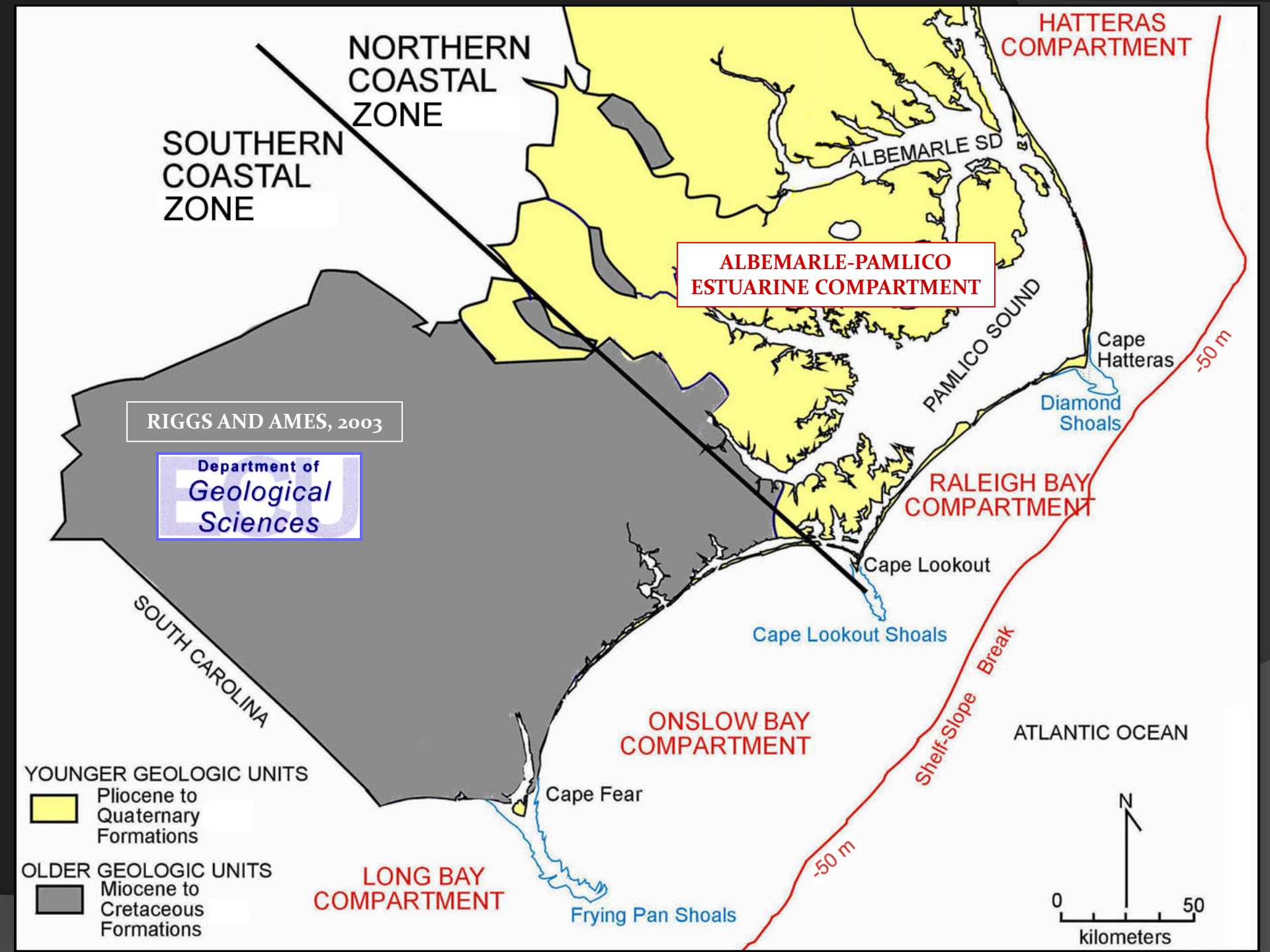
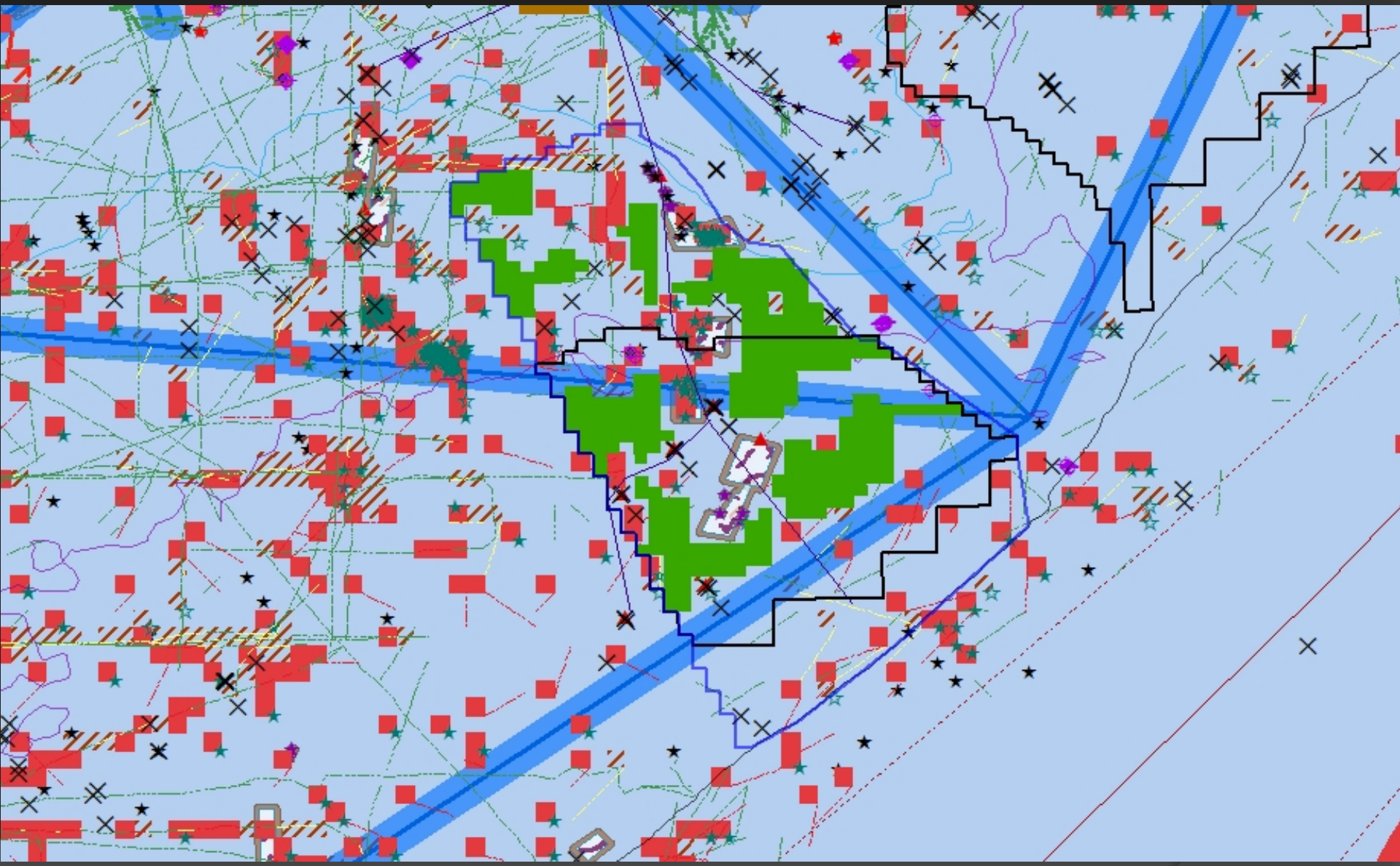
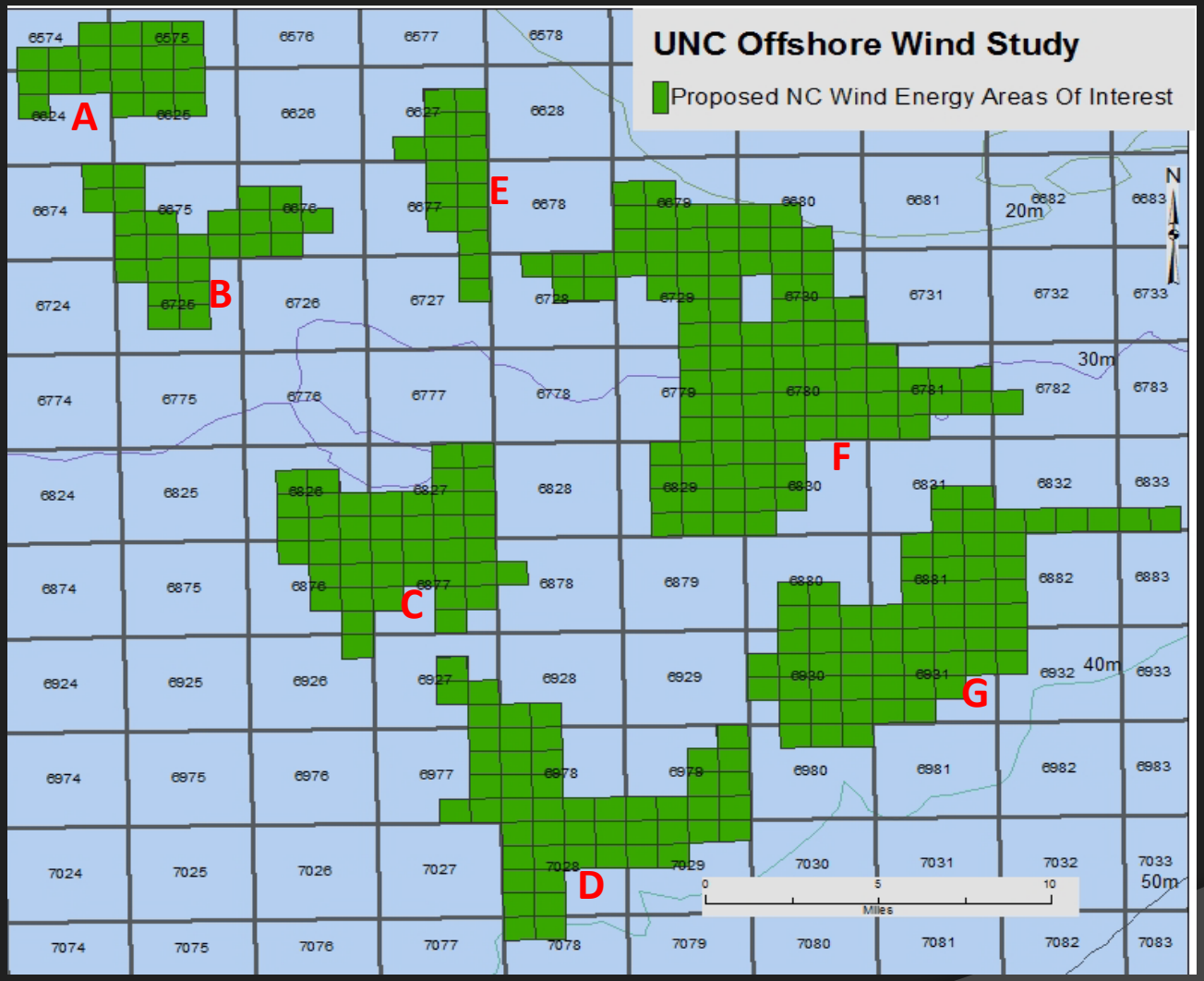

NORTHERN COASTAL ZONE
SOUTHERN COASTAL ZONE
HATTERAS COMPARTMENT
ALBEMARLE SD
ALBEMARLE-PAMLICO ESTUARINE COMPARTMENT
PAMLICO SOUND
Cape Hatteras
-50 m
Diamond Shoals
RIGGS AND AMES, 2003
Department of Geological Sciences
RALEIGH BAY COMPARTMENT
Cape Lookout
SOUTH CAROLINA
Cape Lookout Shoals
Shelf-Slope Break
ONSLOW BAY COMPARTMENT
ATLANTIC OCEAN
YOUNGER GEOLOGIC UNITS
Pliocene to Quaternary Formations
OLDER GEOLOGIC UNITS
Miocene to Cretaceous Formations
Cape Fear
LONG BAY COMPARTMENT
Frying Pan Shoals
-50 m
N
0
50
kilometers

Cape Lookout region



Recommendation for NC AOI # 3

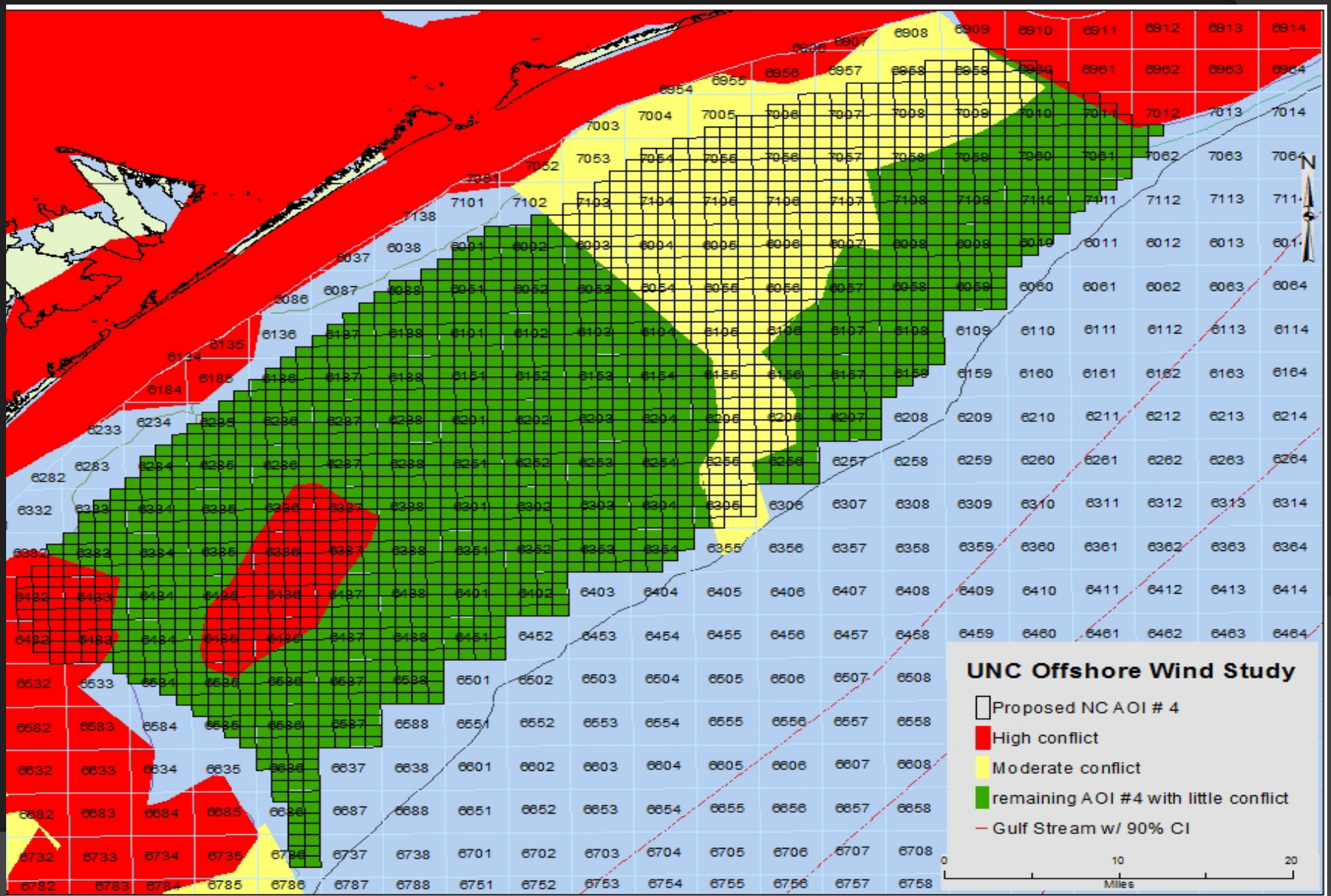


Number of aliquots in each component :

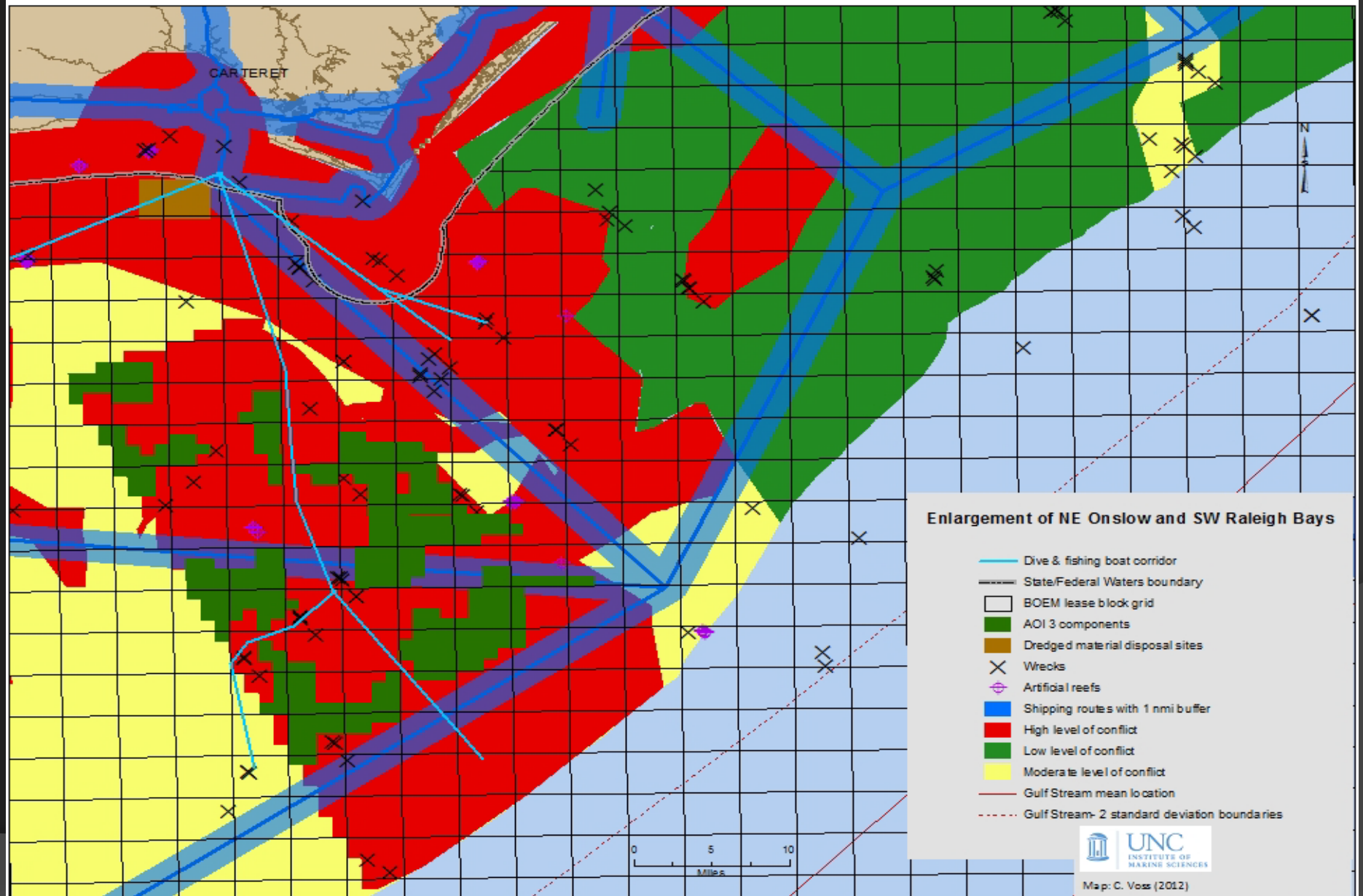
A =20, *B* =25, *C* =42, *D* =50, *E* =16, *F* =98, and *G* =64.

AOI # 4

Spatially explicit avoidance of known fish habitat conflicts in AOI # 4

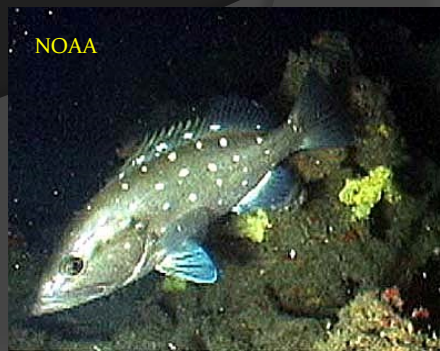


Spatially explicit avoidance of known fish habitat conflicts…

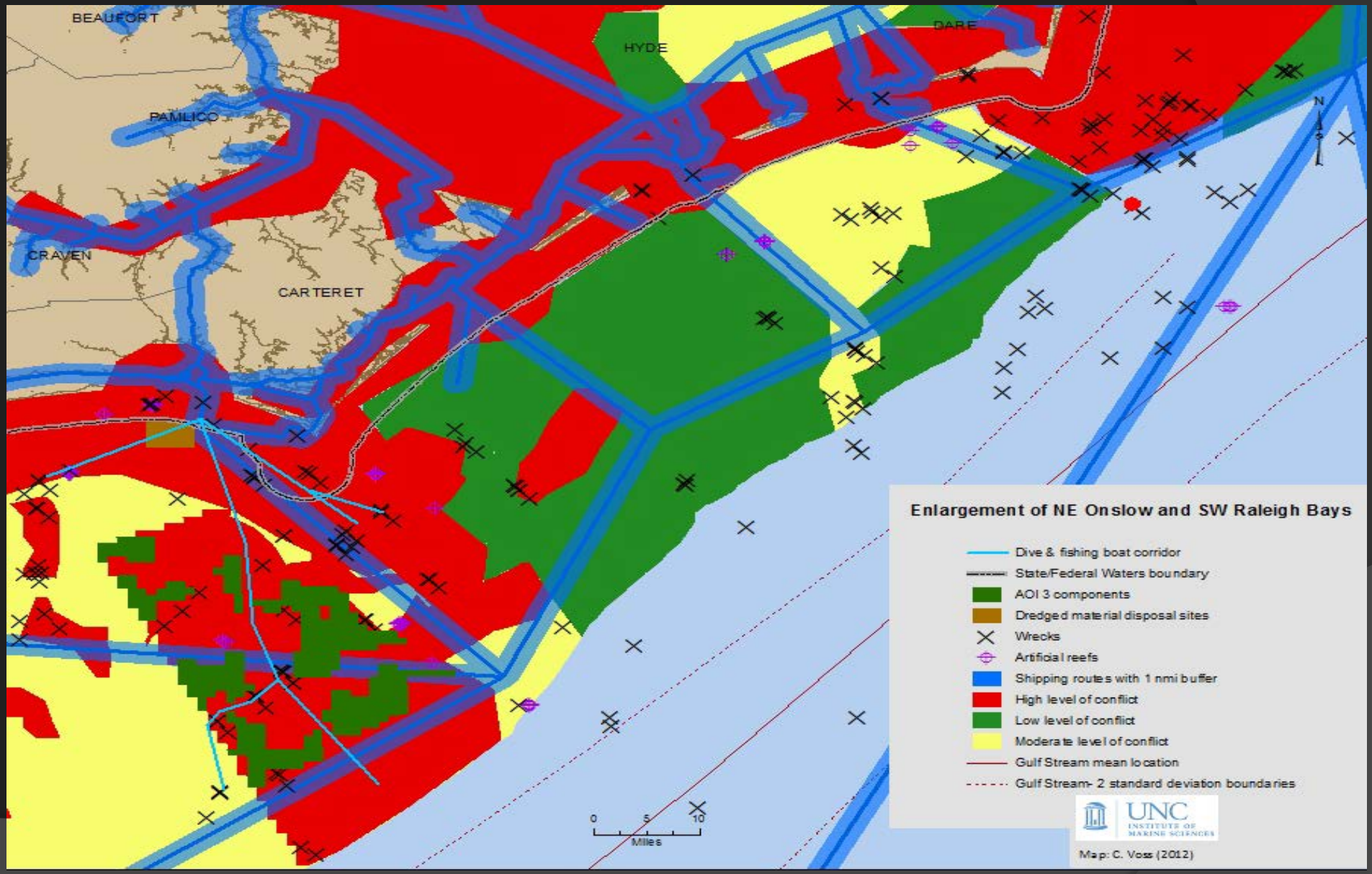


Synergies – Positive Interactions

- A stone, scour apron surrounds the monopile base (12-m radius with stones rising 2-3 m above bottom)
  - Excellent foundation for live-bottom reef in coastal ocean
    - Restores reef fish, including aiding recovery of overfished snapper/grouper species complex
    - Requires excluding fishermen to avoid overexploitation
    - The apron and monopile may also serve as substrate for blue mussels north of Cape Hatteras. These would provide food for scoters and could be harvested.
- Wind farms may induce upwelling downstream
  - In the sounds this could mitigate seasonal hypoxia and anoxia events
  - In the coastal ocean this could enhance local primary production
- Wind farms may protect mariculture operations from boat collisions



Recommendations for AOIs # 3 & 4



Questions ?