SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

SAFMC Fishery Ecosystem Plan II Development, Ecosystem Modeling and Ecosystem Science Needs

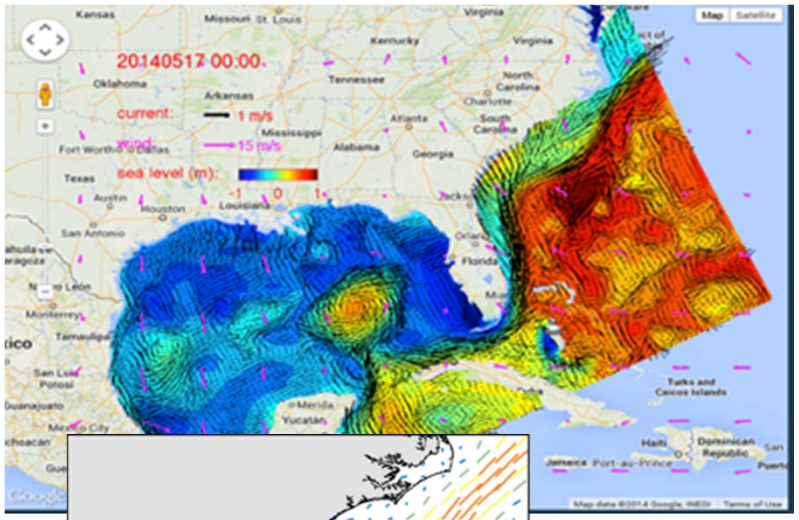
Roger Pugliese, SAFMC

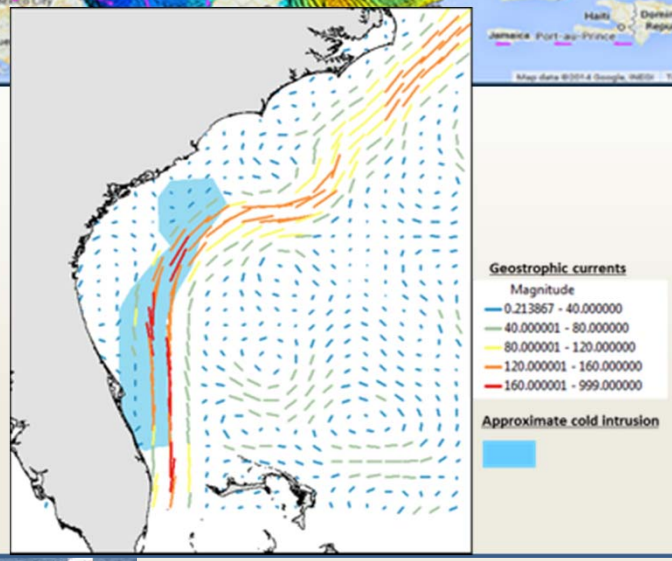
Ecosystem Science Coordination Meeting
with Dr. Jason Link, Kevin Craig and Todd Kellison
NMFS Beaufort Lab
February 2017

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Fishery Ecosystem Plan II Development

- More concise
- More operationally focused
- Linked to online tools and models



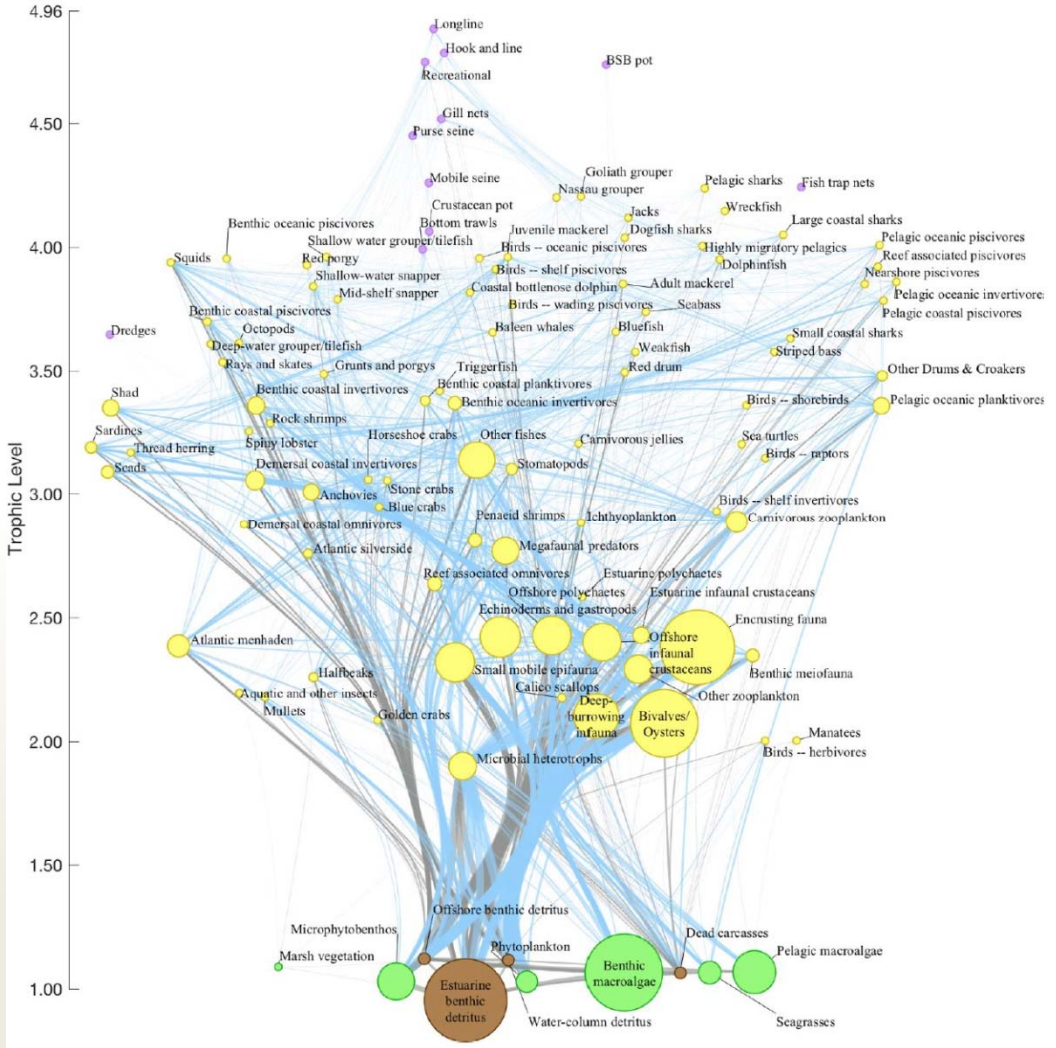


SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Updating the Fishery Ecosystem Plan

Including:

- Climate Change
- Sea Level Rise
- Food Webs
- Links to Models and online tools



....To Conserve and Manage

Updating the Fishery Ecosystem Plan
New Approach

- Multiple writing teams of experts – using online and face-to-face meetings
- Broad engagement of experts and organizations
- Online tools for drafting, editing, and sharing materials
- Creating integrated and linked digital documents

Our Project Teams

We have 20 teams and 150 participants from 55 organizations

1. Anadromous & Catadromous Species
2. Artificial Reef Habitat
3. Coral and Coral Reef Habitat
4. Council Artificial Reef Policy Statement
5. Deepwater Coral Habitat
6. Estuarine Emergent Marsh
7. Food Web and Connectivity
8. Hard Bottom Habitat
9. Intertidal Flats Habitat
10. Managed Species
11. Mangrove (formerly Estuarine Shrub/Scrub Mangrove)
12. Marine and Estuarine Water Column
13. Oyster Reefs and Shell Banks Habitat
14. Protected Species
15. Seagrass/ SAV Habitat
16. Soft Bottom Subtidal Habitat
17. South Atlantic Climate Variability & Fisheries
18. South Atlantic Climate Regional Action Plan
19. Threats to Ecosystem Habitats
20. Ecosystem Modeling Team

Updated Content and Design

- Updates baseline habitat, species and fisheries information and provides a living document with regional ecosystem perspective
- Addresses directives to the Council such as a blueprint for Snapper/Grouper, Citizen Science, Ecosystems approach
- Involves the past and current SSC Chairs
- Highlights long-term research and monitoring needs, SEAMAP Plan, SA Mapping Strategy, Managed Area System Management Plans, all available online for those working in the Region
- Linkages to regional partners and the SALCC funded ecosystem model to support long-term habitat and species distribution models, linkages to SEDAR and other tools for the SSC

Updated Content and Design

- Expands the conservation directive for EFH to a broader perspective
- Links to SALCC Blueprint provides the value of watersheds and uplands into the model
- Highlights connectivity (N-S & E-W)
- Support for mapping enhances all managed areas, (Coral HAPCs, deepwater MPAs, Spawning Special Management Zones)

Create the best possible information for use by managers and decision-makers

- Work with managers and decision-makers to ensure the tools and models meet their needs
- Working with SSC Chair and past Chair
- Ecospecies Online System supports FEP II providing online access to detailed managed species, habitat and fisheries info
- FEP II Executive Summary will provide a concise policy-oriented document

Create the best possible information for use by managers and decision-makers

Goal: Link all online models and tools to the managed species model

- Provide spatial information on species
- Provide environmental info for stock assessment
- Habitat characteristics
- Connectivity of spawning, food, food webs, and links to marine protected areas

Snapshot of Ecospecies Listing and site.

Quickly find information related to:

- Species Life History
- EFH Designation
- SEDAR Inputs

Database:

- Print reports
- Edit or update the species information

South Atlantic Fishery Management Council

Conserving and managing America's fisheries from three to 200 miles off the coasts of North Carolina, South Carolina, Georgia and Florida.

SAFMC Home | About SAFMC | Habitat Management | Ecosystem Library | SAFMC Acronyms | Ecosystem Glossary

Home | Organisms | Reports | About | Glossary | Editors

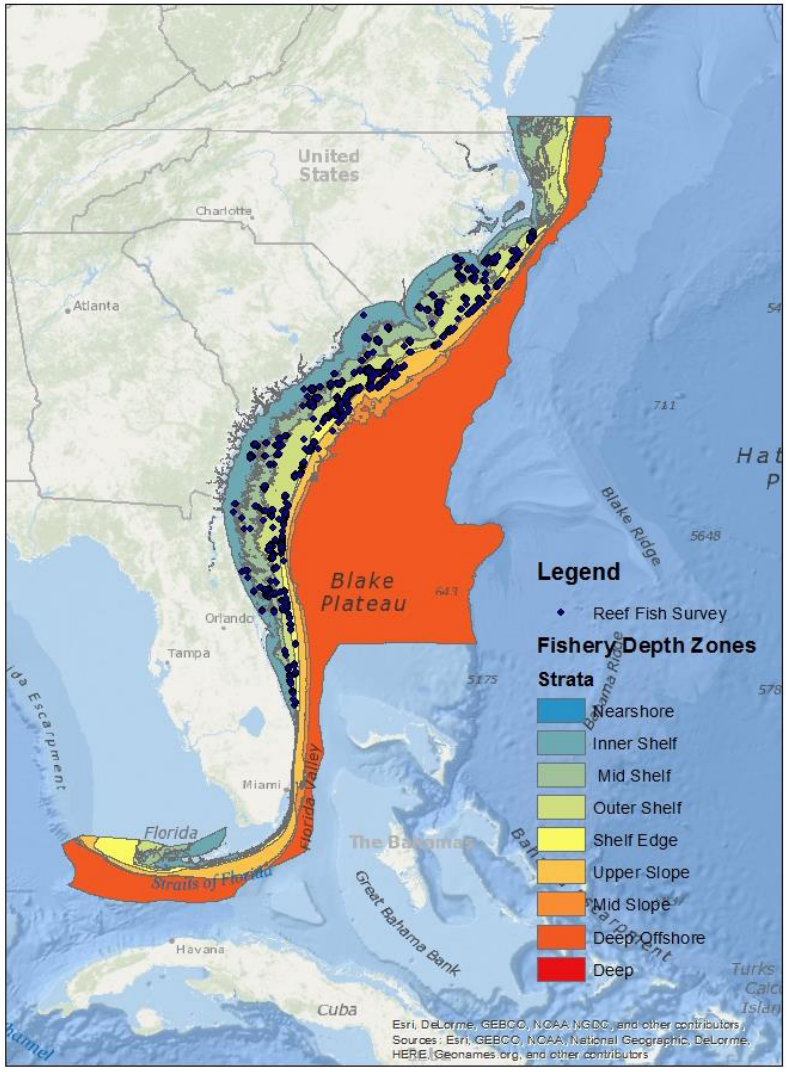
EcoSpecies: Species List

Select Filter | Search

Note: use the column headings to sort the rows; then search to have the search results in order

Common Name	Phylum	Class	Order	Family	Genus	Species	Id
Almaco Jack	Chordata	Actinopterygii	Perciformes	Carangidae	Seriola	rivoliana	168691
American Oyster	Mollusca	Bivalvia	Ostreoida	Ostreidae	Crassostrea	virginica	79872
Atlantic Croaker	Chordata	Osteichthyes	Perciformes	Sciaenidae	Micropogonias	undulatus	169283
Atlantic Cutlassfish	Chordata	Osteichthyes	Perciformes	Trichiuridae	Trichiurus	lepturus	172385
Atlantic Menhaden	Chordata	Osteichthyes	Clupeiformes	Clupeidae	Brevoortia	tyrannus	161732
Atlantic Spadefish	Chordata	Osteichthyes	Perciformes	Ephippidae	Chaetodipterus	faber	169539
Atlantic Thread Herring	Chordata	Osteichthyes	Clupeiformes	Clupeidae	Opisthonema	oglinum	161748
Banded Rudderfish	Chordata	Actinopterygii	Perciformes	Carangidae	Seriola	zonanta	11112
Bank Sea Bass	Chordata	Actinopterygii	Perciformes	Seranidae	Centropristis	ocyurus	167690
Bar Jack	Chordata	Actinopterygii	Perciformes	Carangidae	Curanx	ruber	168615
Bay Anchovy	Chordata	Steichthyes	Lupeiformes	Engraulidae	Anchoa	mitchilli	161839
Bay Scallop	Mollusca	Bivalvia	Ostreoida	Pectinidae	Argopecten	irradians	79737
Bay Squid	Mullusca	Cephalopoda	Teuthida	Loliginidae	Lolliguncula	brevis	82379
Bay Whiff	Chordata	Osteichthyes	Pleuronectiformes	Bothidae	Citharichthys	spilopterus	172725
Black Drum	Chordata	Osteichthyes	Perciformes	Sciaenidae	Pogonias	cromis	169288
Black Grouper	Chordata	Actinopterygii	Perciformes	Serranidae	Mycteroperca	bonaci	167760
Black Sea Bass	Vertebrata	Osteichthyes	Perciformes	Serranidae	Centropristis	striata	167687

Partnership with FWRI and SAFMC Habitat and Ecosystem Atlas/ GIS Services, Digital Dashboard and EcoSpecies: Supports FEP II Presentation of GIS and Detailed information on Species, Habitat Fishery Independent Surveys and Developing South Atlantic Mapping Strategy



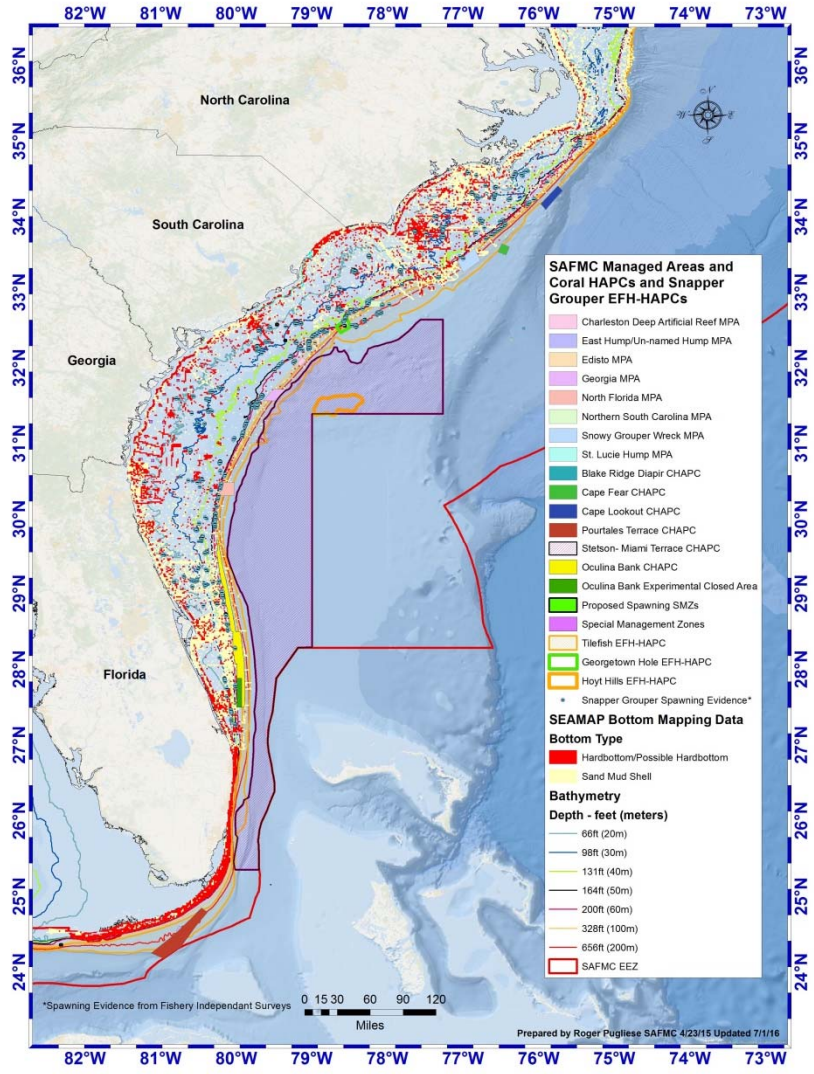
Regional Partners: Developing South Atlantic Habitat and Ecosystem Tool and Models - FWRI

- South Atlantic Habitat and Ecosystem Atlas and Digital Dashboard
- South Atlantic Ecospecies Online Species Information System / Life History and Habitat Tool – Enhancing and serving detailed managed species information integrating population and management status and vulnerability information and direct links to FEP II Sections

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Online Systems Supporting EBFM in the Region

SAFMC/FWRI Online Services Provide a Continually Refined Comprehensive View of Spatial Management Supporting Habitat Conservation and Ecosystem Based Management in the Region



....To Conserve and Manage

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

FEP II EFH Update Development / 5 Year Review Timeline

- **September 2016** Council Meeting: Review FEP II Development highlighting Food Webs and Connectivity and Climate Variability and Fisheries Sections. Guidance for developing Policy recommendations.
- **November 2016** Habitat and Ecosystem Advisory Panel: Review FEP II Section Development Policy Statement Drafts for Artificial Reefs, Food Webs and Connectivity and Fisheries and Climate Variability. November 2016 Managed Species Team Meeting Refinement of Ecospecies System Supporting FEP II.
- **December 2016** Council Meeting: Review and Approve Policy Statement Drafts Food Webs and Connectivity and Climate Variability and Fisheries. Overview of FEP II Online Functionality, Ecosystem Modeling advancements, links to SALCC Conservation Blueprint and input on draft mapping Strategy.
- **March 2017** Council Meeting: Review FEP II Sections.
- **June 2017** Council Meeting: Review FEP II Sections, Interactive Executive Summary, Review and Policy Statement Draft for Artificial Reefs and South Atlantic Mapping Strategy.

Development of Ecosystem Models and Ecosystem Modeling Suite for the South Atlantic Region

- The SAFMC, initiated the investigation of regional ecosystem modeling, collaborated with University of British Columbia through the Lenfest Sea Around Us Project in the creation of the first South Atlantic Bight Ecopath model. Building on the previous collaboration, SAFMC again collaborated with Tom Okey et al. in a prey focused Ecopath model.

- A new South Atlantic ecosystem modeling effort funded by the SALCC, is being conducted to engage a broader scope of regional partners. This effort is drawing on existing ecosystem and other supporting models to facilitate development of a suite of ecosystem models ultimately providing evaluation tools for the SCC and Council. A new Ecopath model is under development and supporting model inputs through regional partners to refine links between the SAFMC FEP II and other regional conservation planning efforts (e.g., SALCC Conservation Blueprint V 2.1).

Overall Project Objectives

To build a flexible and integrative ecosystem modelling suite for the South Atlantic Region

- Advance and integrate existing models and data
- Advance and refine the LCC conservation blueprint
- Support the South Atlantic Fishery Management Council's move to ecosystem based fishery management and its Fishery Ecosystem Plan

How Are We Getting There?

- Established an inter-disciplinary regional science team to ensure the approaches taken include leading-edge thinking and produce the best possible information for resource decision-making
- Work with managers and decision-makers to ensure models meet their needs for conservation, management, and science planning
- Ecosystem models reveal the important connectivities and dynamics between coastal/ocean and estuarine-riverine ecosystems
- Develop ecosystem models to understand ongoing changes in the system and tools to develop effective management strategies

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

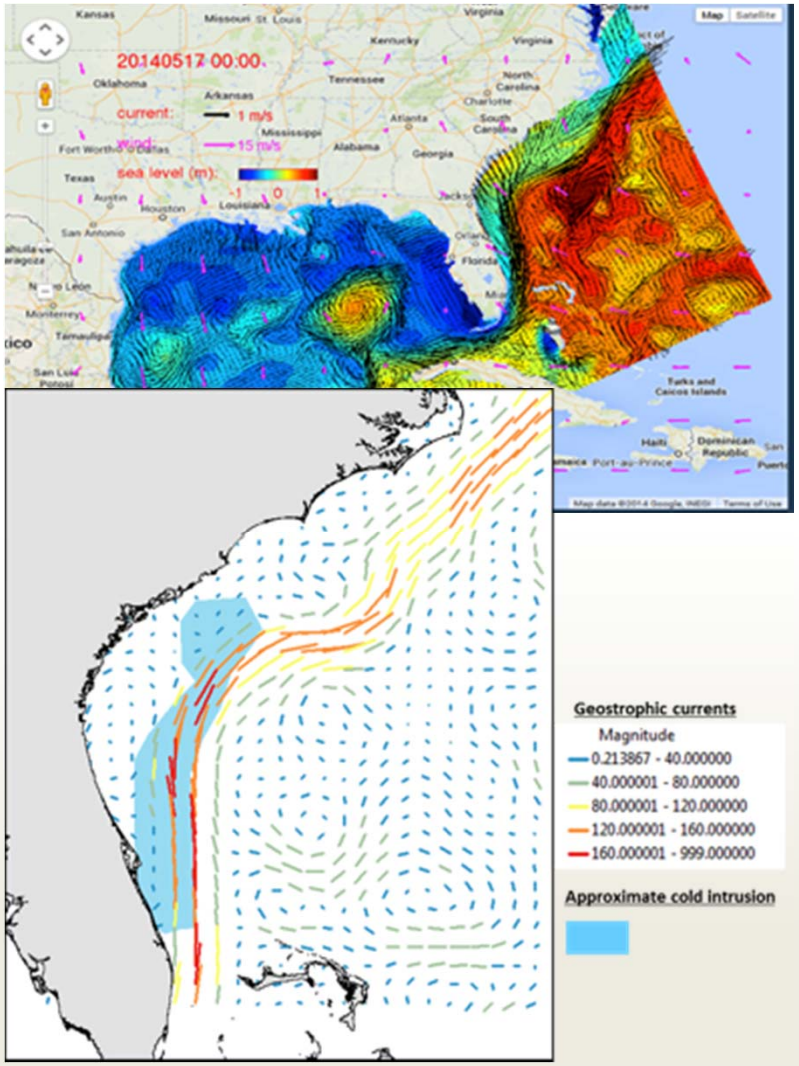
Development of Ecosystem Models and Ecosystem Modeling Suite for the South Atlantic Region

– Our Project Team/Principal investigators –

- **Dr. Marcel J. Reichert –** Marine Resources Research Institute, South Carolina Department of Natural Resources
- **Dr. Luiz Barbieri –** Florida Fish and Wildlife Conservation Commission, FWRI
- **Dr. Thomas Okey –** Ocean Integrity Research, Victoria, BC, Canada
- **Dr. Jerald S. Ault –** Professor and Director, Fisheries Ecosystem Modeling and Assessment Research, Rosenstiel School of Marine and Atmospheric Science, University of Miami
- **Dr. Ruoying He –** Department of Marine, Earth and Atmospheric Sciences, North Carolina State University
- **Dr. Peter Sheng –** Professor and Director, Coastal and Oceanographic Engineering Program, University of Florida
- **Vembu Subramanian –** RCOOS Program Manager and Data Management Coordinator, SECOORA
- **Dr. Patrick N. Halpin –** Director, Geospatial Analysis Program Duke University
- **Simeon Yurek –** SALCC
- **Roger Pugliese –** Senior Fishery Biologist, South Atlantic Fishery Management Council

The Models Will:

- Link to hydrodynamic oceanographic models and satellite data
- Provide more realistic predictions about spatial policy options
- Predict impacts of episodic events that are limited in space (oil spills, red tides, upwelling)
- Meet the immediate needs of the SSC and the South Atlantic Council

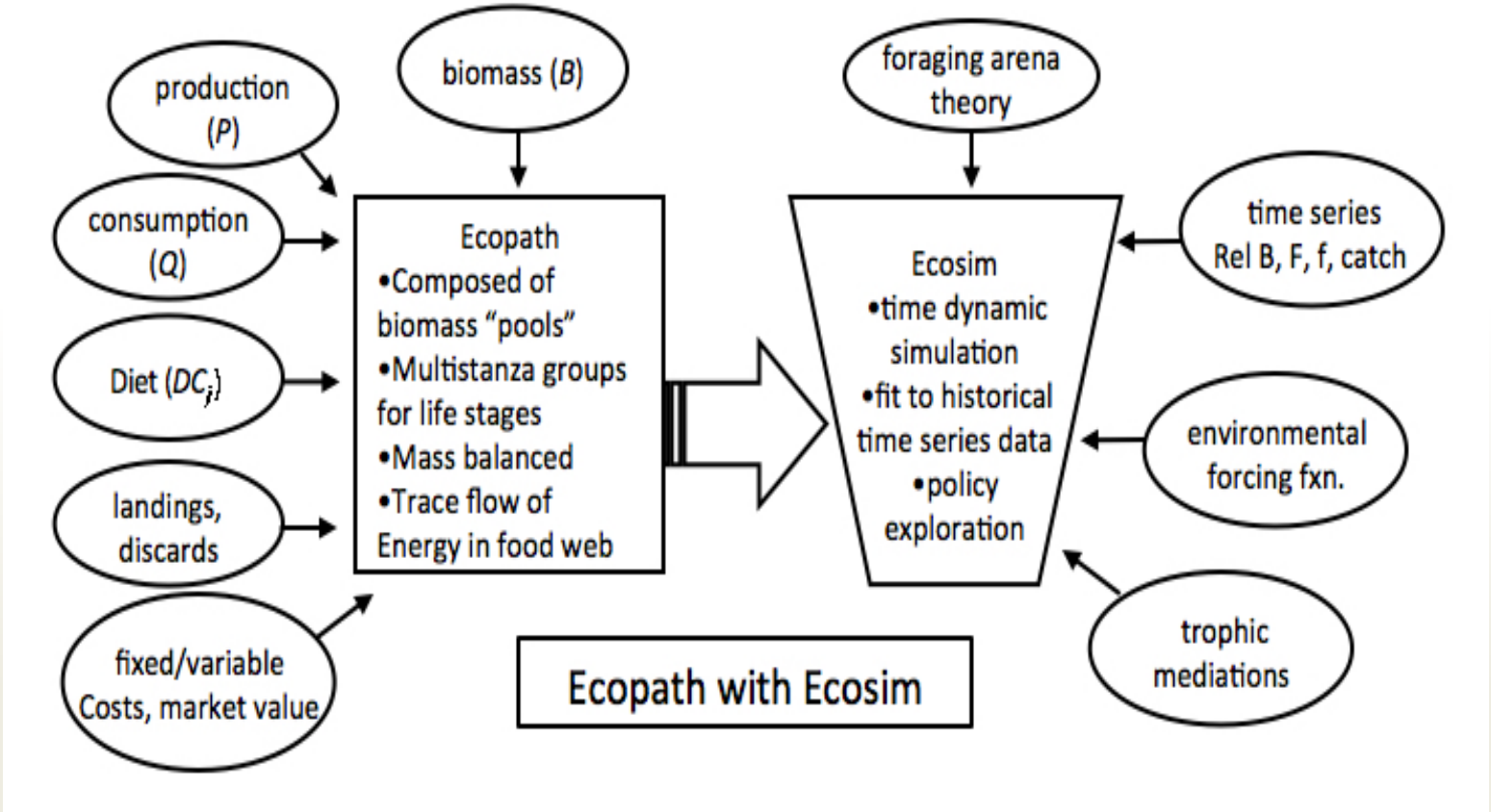


Phase 1- Update South Atlantic E/E/E model

- Grant 1
  Develop South Atlantic Ecopath with Ecosim Model Tom Okey
- Grant 2
  Data Conditioning
  Principal Researcher: Marcel Reichert

- **Grant 3**
  Review of Estuarine Data and Models
  Principal Researcher: Peter Sheng
- **Grant 4**
  A Coupled Marine Environmental Assessment and Prediction System for the Southeastern U.S. Coastal Ocean in Support of Effective Marine Ecosystem-Based Management
  Principal Investigator: Ruoying He
- **Grant 5**
  South Atlantic Fisheries Ecosystem Modeling & Prediction
  Principal Investigator: Jerald S. Ault

Creation of a base South Atlantic (EwE) model is an essential first step for linking to the existing SALCC Blueprint.



Advancing Ecosystem Modeling in the South Atlantic region

SOUTH ATLANTIC
LANDSCAPE CONSERVATION COOPERATIVE

An integrative Ecopath / Ecosim / Ecospace model & the companion physical modeling requirements

- Ecopath: A trophodynamic fishery-ecosystem model that accounts for all flows and components
- Ecosim: Allows temporal simulation of the ecological and socio-economic effects of changes in fisheries or other stressors
- Ecospace: Allows exploration of spatially-explicit questions such as the effects of habitat protection on the ecological and socio-economic values

History of the SAB model

- 2001 - Strawman 48-box model constructed
- 2004 - Preliminary 98-box model developed
- 2013 - Model refined to address forage fish questions

Construction & refinement

- Sponsored by SAFMC
- 42-box model
- 98-box model

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Fisheries Centre Research Reports

2001 Volume 9 Number 4

Southeastern United States, Atlantic Shelf, Page 167

A PRELIMINARY ECOPATH MODEL OF THE ATLANTIC CONTINENTAL SHELF ADJACENT TO THE SOUTHEASTERN UNITED STATES

Thomas A. Okey[1] and Roger Pugliese[2]

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email: t.okey@fisheries.ubc.ca

[2]South Atlantic Fishery Management Council, One Southpark Circle, Suite 306, Charleston SC 29407 USA

ABSTRACT

The biological communities of the Atlantic continental shelf adjacent to the southeastern United States are well known, but this knowledge is not integrated into a cohesive description of that region. We constructed a preliminary food web model of this area using Ecopath with Ecosim, as a way to initiate a long-term process of integrating this knowledge, learning more about the structure and resiliency of the system, and helping to guide research priorities in the future. The current model is considered to be a first iteration that can be used as a vehicle to stimulate a more rigorous refinement effort in the near future. The ecologically defined area covered by this model extends from Cape Hatteras, North Carolina to the easternmost extent of the Florida Keys, and from the intertidal zone (or the entrance of estuarine systems) to the 500 m isobath. The time period characterized by this preliminary model is the four years from 1995 to 1998.

the Gulf Stream advect the underlying nutrient rich slope waters onto the shelf (Mallin *et al.* 2000).. This region as a whole supports a diverse assemblage of marine organisms, as it is somewhat of an ecological interface, or gradient, between warm-water and cold-water species assemblages. We refer the reader to Mallin *et al.* (2000) for a general description of the ecological setting, processes, and related research. A brief overview of special habitats is presented below.

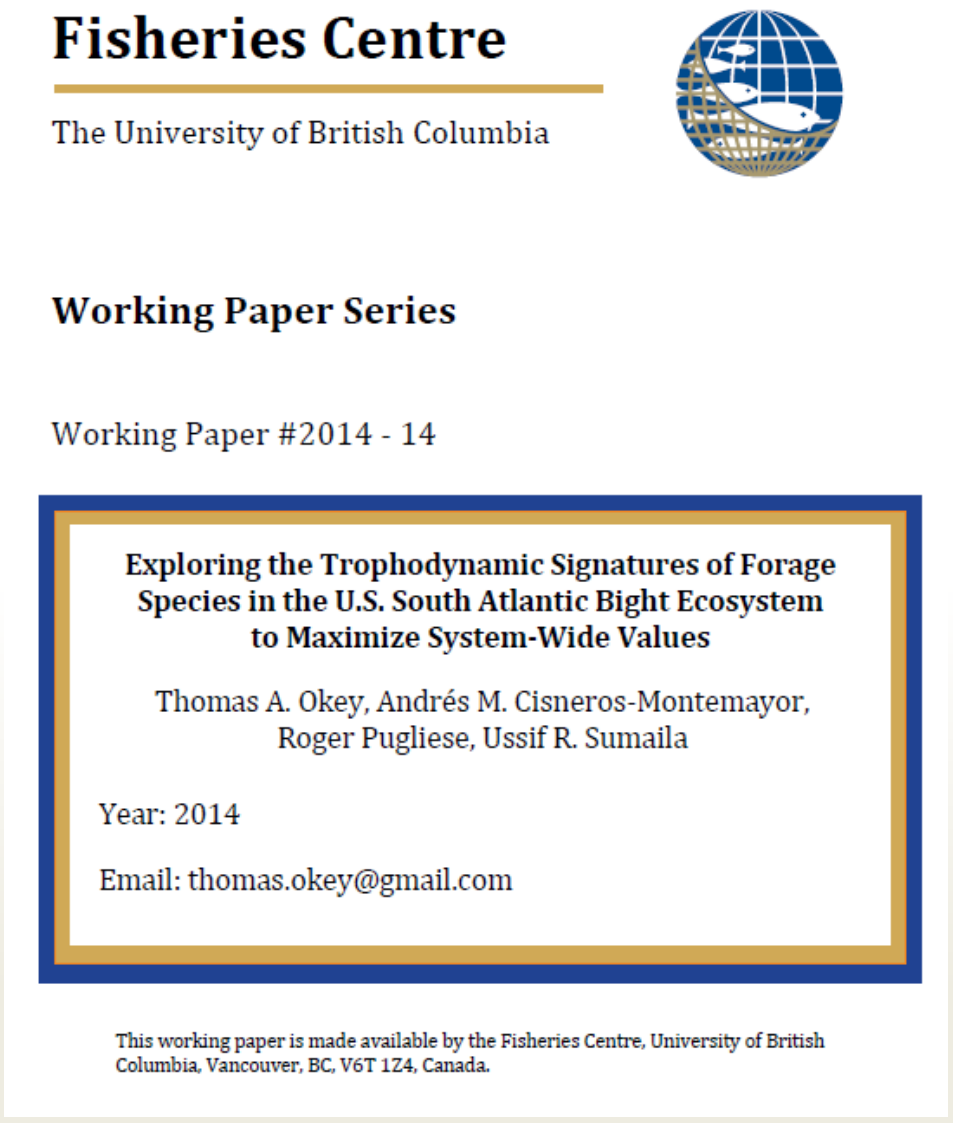
Human activities along the east coast of the southeastern United States have influenced the adjacent continental shelf ecosystem for thousands of years, as native Americans conducted some limited artisanal fisheries and modified fire regimes and the vegetation in upland watersheds (e.g., Cronon, 1983). Modifications to the ecology of the continental shelf ecosystem accelerated soon after the arrival of Europeans, who began fishing coastal waters (e.g., Mowat, 1984; Reeves *et al.*, 1999) in addition to introducing domesticated livestock, weed plants, disease, and new kinds of agriculture (e.g., Crosby, 1986).

Other profound anthropogenic modifications to this continental shelf occurred during the 20th century with the widespread use of powered fishing and whaling vessels, and coastal urbanization and industrialization. One particularly destructive type of fishing is bottom trawling, which destroys biogenic seafloor habitat in addition to simply removing fishes (Watling and Norse, 1998; Turner *et al.*, 1999).

Trawling activity is intense in this area, and little doubt remains that these activities have considerably modified the continental shelf. The

Application to forage question

- Sponsored by Pew Charitable Trusts
- Forage groups articulated
- 99-box model



Fisheries Centre

The University of British Columbia

Working Paper Series

Working Paper #2014 - 14

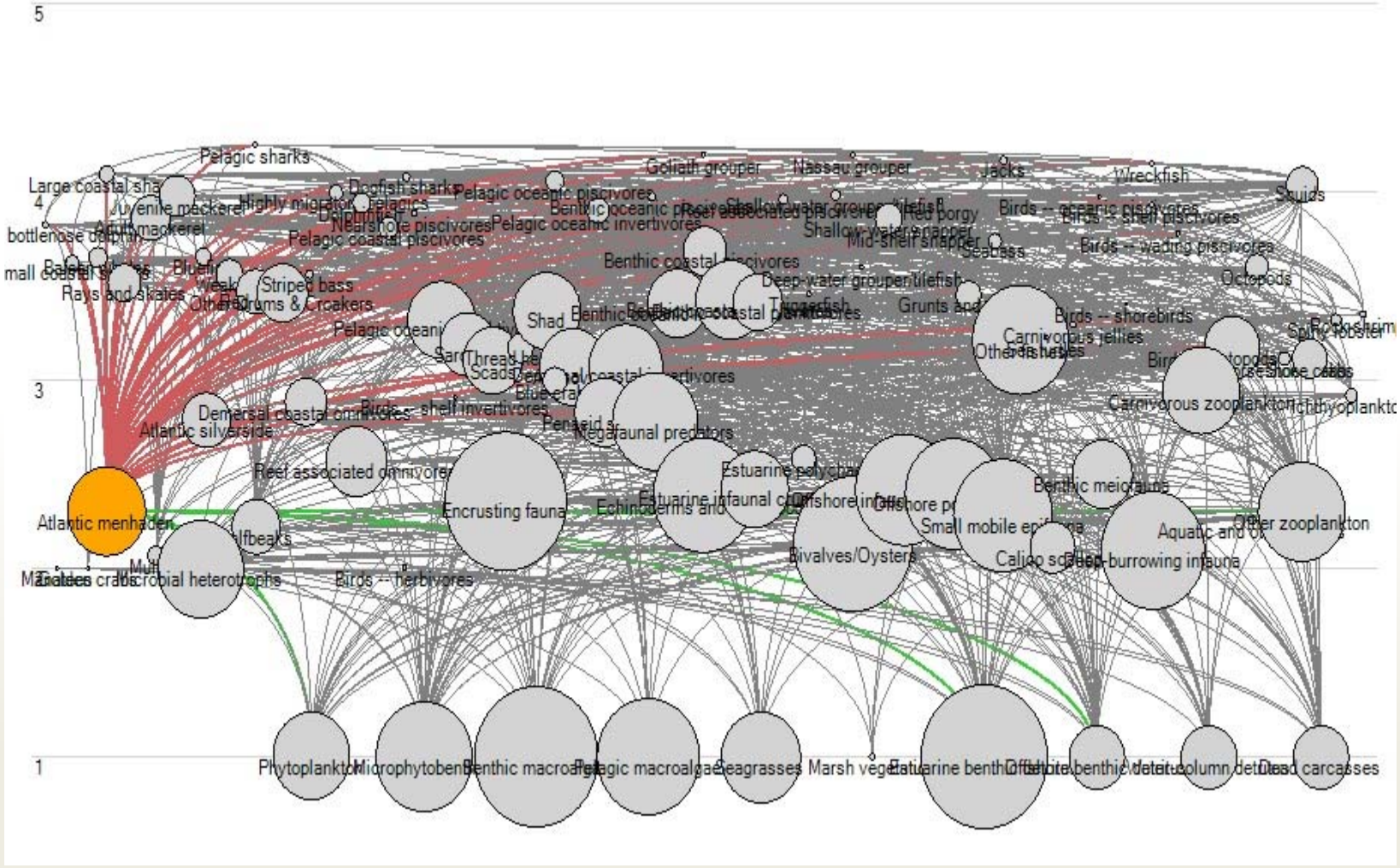
Exploring the Trophodynamic Signatures of Forage Species in the U.S. South Atlantic Bight Ecosystem to Maximize System-Wide Values

Thomas A. Okey, Andrés M. Cisneros-Montemayor, Roger Pugliese, Ussif R. Sumaila

Year: 2014

Email: thomas.okey@gmail.com

New 99 Box SAB model (forage)



Forage groups in the 99 box model

Group	Species included	B ($t \cdot km^{-2}$)	P/B ($year^{-1}$)	Q/B ($year^{-1}$)
Anchovies	Bay (*Anchoa mitchilli*), striped (*A. hepsetus*), silver (*Engraulis eurystole*)	3.75	1.45	17.50
Atlantic menhaden	*Brevoortia tyrannus* (not *B. patronus*)	7.05	1.70	7.84
Atlantic silverside	*Menidia menidia*	1.18	2.00	14.90
Halfbeaks	*Ballyhoo (Hemiramphus brasiliensis), balao (H. balao), common or Atlantic silverstripe* (*Hyporhamphus unifasciatus*)	1.22	2.60	11.70
Mullets	Striped (*Mugil cephalus*), other (*Mugil spp.*)	0.11	0.70	11.03
Sardines	Spanish (*Sardinella aurita*), scaled (*Harengula jaguana*)	1.93	1.11	11.82
Scads	Round (*Decapterus punctatus*), rough (*Trachurus lathami*), bigeye (*Selar crumenophthalmus*)	2.28	0.92	10.00
Shad	Alosa spp.	3.97	0.50	3.80
Thread herring	Atlantic thread herring (*Ophistonema oglinum*)	0.28	1.60	13.26
Pelagic oceanic planktivores	Chub mackerel (*Scomber japonicus*), lanternfish (*Diaphus spp.*), antenna codlet (*Bregmaceros atlanticus*), striated argentine (*Argentina striata*), flyingfish (Exocoetidae)	3.95	0.87	11.71
Squids	Shortfin (*Illex illecebrosus*), longfin (*Loligo pealei*)	0.45	2.67	36.50
Shrimps	Rock shrimps and penaeid shrimps	2.53	5.38	19.20

Create the best possible information for use by managers and decision-makers

- Work with managers and decision-makers to ensure models meet their needs
- Recruit top researchers to assist in an inclusive, long-term management effort
- Build an ecosystem modeling technical advisory group that ensures our approach includes both practical science and leading-edge thinking
- Multi-year modeling that seeks the best available science from all disciplines
- Establish linkages to coastal/ocean ecosystems, estuarine and riverine systems

Other objectives

- Engage SAFMC SSC in needs assessment
- Develop useful tools for the Council – initial focus to include species in the snapper grouper complex (e.g., red snapper and gray trigger fish)
- Define existing and desired data technology needs and coverage needs
- Create tools to conduct ecosystem-based evaluations of fisheries policies and tradeoffs
- Identify tradeoffs among conflicting management objectives , e.g. conservation vs. profits
- Integrate environmental data into the stock management process

Funding Sources

- The South Atlantic LCC has committed $150,000 to coastal integration funding as part of completing the connectivity of Blueprint 2.1 and enhancing linkages with developing SAFMC FEP

- The Southeast Coastal Ocean Observing Regional Association (SECOORA) is funding refined oceanographic models to support ecosystem modeling, enhance ecosystem condition forecasting and ecosystem-based fishery management.

*A robust plan and expert model development team leaves us **well-positioned to leverage available ecosystem partner funding** to create the next generation of South Atlantic Ecosystem Models which support and enhance regional Conservation and Management*

Phase 1 Outcomes
A 2-year project with funding! To improved & enhanced Ecosystem model for the South Atlantic Region

- Connect EwE with the SALCC Blueprint for Estuaries and Rivers (Food Web)
- ID and better utilize existing marine datasets
- Develop analytical tools & metrics for evaluation of fishery management alternatives
- Expand risk assessment capabilities through use more of the available data
- Provide better description of interactive influences: stock, productivity, uncertainty
- Suggest potential improvements in South Atlantic LCC Marine and Estuarine Indicators
- Collaborate with South Atlantic LCC post-doc working on coupling conservation actions and South Atlantic Indicators
- Inform Food Webs and Connectivity FEP II Section Writing Team - State of the SA Ocean and SA Food Web

Phase 2: Refining and linking Phase 1 Model to other models creating a suite of decision support tools.

Meet the immediate needs of the SSC and the South Atlantic Council for better understanding of the management decisions they face. This includes the ability to understand levels of uncertainty and to have the ability to evaluate the (biological and other) consequences for alternative management scenarios and, correlated views on the potential impact of any decision.

Grant 1
Develop South Atlantic Ecopath with Ecosim Model
Principal Researcher: Tom Okey

This latest iteration of the South Atlantic Basin model is the starting point for developing an updated EwE model that can be the core of an integrated end-to-end model of the SAB ecosystem that can achieve the broad objectives expressed herein. The updating and refinement can be achieved using resources such as the GOM gag model (Chagaris and Mahmoudi 2013), based on the original West Florida Shelf model (Okey and Mahmoudi 2002, Okey et al. 2004), as well as a variety of additional resources that include new data and information.

The spatial and temporal dynamic parts will continue to be refined through Year 2 and beyond as analyses proceed.

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Grant 2
Data Conditioning Principal Researcher: Marcel Reichert

SC-DNR's MARMAP and SEAMAP-SA fishery independent monitoring programs have collected long-term abundance and life history data from Cape Hatteras, NC to the St. Lucie, FL, dating back to the 70's and 80'. Since 2010, reef fish sampling efforts have been done in collaboration with SEFIS (SEFSC, Beaufort, NC). Sampling has been conducted annually with a variety of gears (incl. trawls, fish traps, and long lines). Available data include detailed sampling location coordinates, oceanographic variables (incl. water column temperature and salinity), species composition, relative abundance by species, and information on age, growth, reproduction, diet, and genetic variability of a variety of selected species.

Making data available for use in modeling efforts involves extracting relevant information, summarizing data, and possible base line analyses.

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SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Grant 3

Review of Estuarine Data and Models
Principal Researcher: Peter Sheng

Identify estuarine data and model along the Northeast and Central Florida coast to pilot usefulness and options for developing linked estuarine-marine models for predicting SALCC estuarine indicators. The model will be design to evaluate the success for South Atlantic Conservation Blueprint Indicators.

These indicators include:

(1) coastal condition: index of water quality, sediment quality, and benthic condition;

(2) wetland patch size: index based on the size of wetland patches; and

(3) water-vegetation edge: index of length of edge between open water and vegetation. During the first year, University of Florida (UF) will gather and review all available data (both fishery independent and fishery dependent) related to the above indices from several state and regional agencies

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LANDSCAPE CONSERVATION COOPERATIVE

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Grant 4

A Coupled Marine Environmental Assessment and Prediction System for the Southeastern U.S. Coastal Ocean in Support of Effective Marine Ecosystem-Based Management - Principal Investigator: Ruoying He

Contribute to the efforts of building regional marine ecosystem predictability, by implementing advanced regional marine environment assessment and prediction system. Such a system will predict coastal ocean conditions over the entire south Atlantic footprint with a high degree of scientific accuracy and provide detailed information to stakeholders in a timely and clear fashion.

Methodology: The proposed regional ocean modeling effort will be built upon NCSU's existing circulation nowcast/forecast modeling system to directly facilitate and enhance the effort of the South Atlantic Fishery Management Council (SAFMC) in support of the move to Ecosystem Based management to develop an ecosystem modeling suite with an emphasis on a fully parameterized Ecopath and Ecosim model for the South Atlantic Region.

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SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

Grant 5

South Atlantic Fisheries Ecosystem Modeling & Prediction

Principal Investigator: Jerald S. Ault

Refine an existing fisheries ecosystem model designed to evaluate multiple interacting threats to sustainability of fisheries resources, including direct impacts of fishing on target species, trophic impacts of fishing on prey species, and a variety of environmental impacts (e.g., degradation of water quality/habitats).

This project builds upon previous efforts that developed a combined fisheries ecosystem modeling-prediction tool that explicitly couples ocean physics and biological process models to produced forecasts that simultaneously evaluated fishing and non-fishing (water management) regulatory policies for sustainability of natural resources called ACES (Atlantic Coast Ecosystem Simulation). The project will assess multispecies fisheries risks from exploitation and environmental factors.

The project will refine and implement an integrated suite of mathematical predictive models in a robust ecosystem modeling framework for SALCC, building on existing efforts within and external to NOAA. Research will focus on developing the component layers of the ACES model by strategically utilizing existing biological and physical-environmental models and data.

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SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

SAFMC Policies and Research Needs Addressing South Atlantic Climate Variability and Fisheries

....*To Conserve and Manage*

SAFMC Policies Addressing South Atlantic Climate Variability and Fisheries

General Policies:

1. As species expand/shift their distributions due to changing ocean conditions and/or market demands, it is the Council's policy that the SAFMC will proactively work with:

a. State agencies, other Councils, Atlantic State Fishery Commission, NOAA Fisheries to manage species that span multiple jurisdictions.

b. South Atlantic LCC, NOAA RISAs, Southeast Climate Science Center, and other multi-organizational partnerships.

c. The fishing industries, fishing communities, and other interested civil stakeholders.

SAFMC Policies Addressing South Atlantic Climate Variability and Fisheries

General Policies: (cont.)

2. A priority list of climate indicators should be developed by NOAA or regional partners or selected that likely track ecological, social, and economic trends and status. The Council requests annual summaries of these indicators, species likely to be influenced, and fisheries trends that appear to be due to changing ocean environmental conditions in the South Atlantic ecosystem.

3. Climate change requires the consideration of tradeoffs. Changing ocean conditions necessitate responses ranging from increasing buffers due to a higher level of uncertainty to adjusting quotas upward or downward to account for predicted and realized increases or decreases in productivity.

SAFMC Policies Addressing South Atlantic Climate Variability and Fisheries

General Policies: (cont.)

4. Given the uncertainty of climate impacts, the precautionary principle should be invoked as possible for future management decisions on issues that can be influenced by climate change.

5. Careful scientific and management evaluation should be undertaken as new fisheries develop, including consideration of how to avoid harmful impacts on essential fish habitat.

SAFMC Research Needs Addressing South Atlantic Climate Variability and Fisheries

1. Scientific research and collection of data to further understand the impacts of climate variability on the South Atlantic ecosystem and fish productivity must be prioritized. This includes research on species vulnerabilities in terms of distribution, habitat, reproduction, recruitment, growth, survival, and predator-prey interactions.

2. As appropriate, climate data and the effects of climate variability should be integrated into stock assessments. Climate impacts could also be a focus of the new proposed stock assessment research cycle.

SAFMC Research Needs Addressing South Atlantic Climate Variability and Fisheries

3. More three dimensional ocean observations of ocean conditions are needed to characterize the coastal- estuarine – ocean habitats.

4. Management Strategy Evaluations are desired to allow the Council to analyze potential regional climate scenarios and determine whether current harvest strategies are robust to future changes.

5. Greater understanding of the socio-economic impacts and fisheries responses to climate variability is needed.

6. Characterization of offshore ocean habitats used by estuarine dependent species which may be useful in developing ecosystem models.

SOUTH ATLANTIC FISHERY MANAGEMENT COUNCIL

SAFMC Policies and Associated Research Adressing South Atlantic Food Webs and Connectivity Needs

....*To Conserve and Manage*

SAFMC Policies Addressing South Atlantic Food Webs and Connectivity

General Policies:

1. Forage Fisheries – Managers should consider forage fish stock abundances and dynamics, and their impacts on predator productivity, when setting catch limits to promote ecosystem sustainability. To do so, more science and monitoring information are needed to improve our understanding of the role of forage fish in the ecosystem. This information should be included in stock assessments, ecosystem models, and other fishery management tools and processes in order to support the development of sustainable harvest strategies that incorporate ecosystem considerations and trade-offs.

Note: Initial preliminary definition and potential list of forage fish species presented in Appendix A.

SAFMC Policies Addressing South Atlantic Food Webs and Connectivity

General Policies:

2. Food Web Connectivity – Separate food webs exist in the South Atlantic, for example inshore-offshore, north-south, and benthic-pelagic, but they are connected by species that migrate between them such that loss of connectivity could have impacts on other components of the ecosystem that would otherwise appear unrelated and must be accounted for.

3. Trophic Pathways – Managers should aim to understand how fisheries production is driven either by bottom-up or top-down forcing and attempt to maintain diverse energy pathways to promote overall food web stability.

SAFMC Policies Addressing South Atlantic Food Webs and Connectivity

General Policies: (cont.)

4. Food Web Models – Food web models can provide useful information to inform stock assessments, screen policy options for unintended consequences, examine ecological and economic trade-offs, and evaluate performance of management actions under alternative ecosystem states.

5. Food Web Indicators – Food web indicators have been employed to summarize the state of knowledge of an ecosystem or food web and could serve as ecological benchmarks to inform future actions.

SAFMC Policies Addressing South Atlantic Food Webs and Connectivity

General Policies (cont.)

6. Invasive Species – Invasive species, most notably lionfish, are known to have negative effects on ecologically and economically important reef fish species through predation and competition and those effects should be accounted for in management actions.

7. Contaminants – Bioaccumulation of contaminants in food webs can have sublethal effects on marine fish, mammals, and birds and is also a concern for human seafood consumption.

SAFMC Research Needs Addressing South Atlantic Food Webs and Connectivity

1. Scientific research and collection of data to further understand the impacts of climate variability on the South Atlantic ecosystem and fish productivity must be prioritized. This includes research on species distribution, habitat, reproduction, recruitment, growth, survival, predator-prey interactions and vulnerability.

2. Characterization of offshore ocean habitats used by estuarine dependent species, which can be useful in developing ecosystem models.

3. Scientific research and monitoring to improve our understanding of the role of forage fish in the ecosystem, in particular abundance dynamics and habitat use.

SAFMC Research Needs Addressing South Atlantic Food Webs and Connectivity

4. Basic data are the foundation of ecosystem-based fisheries management thus, fixing existing data gaps in the South Atlantic must be addressed first in order to build a successful framework for this approach in the South Atlantic.

5. NOAA in cooperation with regional partners develop and evaluate an initial suite of products at an ecosystem level to help prioritize the management and scientific needs in the South Atlantic region taking a systemic approach to identify overarching, common risks across all habitats, taxa, ecosystem functions, fishery participants and dependent coastal communities.

SAFMC Research Needs Addressing South Atlantic Food Webs and Connectivity

6. NOAA in cooperation with regional partners develop risk assessments to evaluate the vulnerability of South Atlantic species with respect to their exposure and sensitivity to ecological and environmental factors affecting their populations.

7. NOAA coordinate with ongoing regional modeling and management tool development efforts to ensure that ecosystem management strategy evaluations

(MSEs) link to multispecies and single species MSEs, inclusive of economic, socio-cultural, and habitat conservation measures.

SAFMC Research Needs Addressing South Atlantic Food Webs and Connectivity

8. NOAA develop ecosystem-level reference points (ELRPs) and thresholds as an important step to informing statutorily required reference points and identifying key dynamics, emergent ecosystem properties, or major ecosystem-wide issues that impact multiple species, stocks, and fisheries. Addressing basic data collection gaps is critical to successful development of ELRPs.

9. Continued support of South Atlantic efforts to refine EFH and HAPCs is essential to protect important ecological functions for multiple species and species groups in the face of climate change.

Overarching and Other Needs Supporting EBFM for the South Atlantic Region

- **Completion of FEP II**
  - NOAA Fisheries Staff Support
- **Data**
  - Fully Support Baseline Surveys MARMAP, SEAMAP and SEFIS
- **Modeling**
  - Resources to expand Ecopath/Ecospace capabilities and fully fund modeling suite
- **Evaluation Tool Development**
  - Management Strategy Evaluations for South Atlantic Species
- **Climate Analyses**
  - Vulnerability Analyses for South Atlantic Species
- **Mapping**
  - Support South Atlantic Mapping Priorities

Questions?