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FINAL REPORT
COOPERATIVE AGREEMENT (NA07NMF4410116)
OCTOBER 1, 2007 – MARCH 31, 2009

During the period October 1, 2007 to March 31, 2009 the South Atlantic Fishery Management Council (SAFMC) worked to ensure the mandates of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) are met relative to the conservation and management of the South Atlantic coral and coral reef resources.

Project Status

Project: NOAA CRG 2008 Support and Maintenance for Serving Maps of Coral and Live/Hard Bottom EFH and EFH-HAPCs via the Internet.

Through this project the Florida Fish and Wildlife Research Institute (FWRI) has continued to enhance and maintain the Internet Mapping Server (IMS) application for the SAFMC, including spatial information on coral resources in the South Atlantic region. Throughout the duration of the project, the IMS site has continued to improve as new data sets and functionality are integrated. This constitutes the final report for this award and provides a summary of completed work and deliverables. The products developed for this project directly assist the Council to manage and conserve fishery resources, and the habitats they depend upon, in the South Atlantic region. This project focused on the following tasks:

- Advance the developing prototype EcoSpecies database
- Supplement the South Atlantic EcoResearch database
- Incorporate geospatial Service-Oriented Architecture (SOA) web services.

EcoSpecies Database

FWRI created a personal geodatabase for importing spatial and non-spatial data related to the Florida Estuarine Living Marine Resources (FLELMR) database. The new geospatially enabled version of FLELMR is now referred to as EcoSpecies.

During the first phase of this effort, FWRI defined several relationship classes that linked estuarine spatial data with the FLELMR tables of species' abundance, attributes, habitats, reproduction, and value status. Although, the EcoSpecies geodatabase design was valid, there were problems using "relates" (linking tabular data to spatial features) to convey information cartographically. FWRI created summary tables for the Indian River Lagoon to test the prototype. The summary tables provided a comprehensive overview of species' life modes, spatial strategies, and habitat preference.

The focus of the second phase of EcoSpecies was to effectively display the valuable information contained within the non-spatial FLELMR tables via a map format. FWRI

accomplished this task by restructuring the original FLELMR tables and creating new spatial feature classes to represent a variety of habitat zones.

The original structure of the FLELMR tables for "abundance" and "habitat" were simplified by reformatting the tables and reducing the number of fields. The new schema for the "abundance" table includes the EDASUBEDA (estuarine watershed) and EDA_SZNAME (unique estuarine salinity zone) for estuaries. The new "SAFMC_abundance" table describes the seasonal abundance of a species life stage by estuarine salinity zones. Seasonal abundance was calculated by summing the abundance values for each month of a season and dividing by 3. Values of 0, 1, and 9 were not used to calculate averages. The seasons are defined as follows:

Winter: December – February
Spring: March – May
Summer: June – August
Fall: September – November

Please note the "SAFMC_abundance" table is a subset of the original FLELMR table. Only SAFMC managed species and the 4 major estuaries (Saint Johns River, Indian River Lagoon, Biscayne Bay, and Florida Bay) of Florida's East coast are listed.

FWRI also restructured the original "habitat" table of FLELMR. A simplified version called Bathyl_zones lists each species life stage depth and salinity zone preference. See **Appendix A** for the new and original habitat and abundance table structures.

The FLELMR documentation was insufficient to explain values of "9" in the original "abundance" tables. FWRI assumes the codes were derived from the original NOAA Estuarine Marine Living Resources (ELMR) classification scheme. A geodatabase domain for species relative abundance was created using the following categories:

- 0 - Not Present
- 1 – No Data Available
- 2 - Rare
- 3 - Common
- 4 - Abundant
- 5 - Highly Abundant

FWRI also created geodatabase domains for species life stage and reliability codes.
Life Stage

- E - Egg
- L - Larvae
- J - Juvenile
- A - Adult
- S - Spawning Adults

Reliability

- 1 – Highly Certain
- 2 – Moderately Certain
- 3 – Reasonable Inference

Feature classes representing Estuarine Salinity and Coastal Estuarine Watersheds were added to the Ecospecies database. The Coastal Estuarine Watersheds contains the land portions of the Coastal Assessment Framework's 150 Estuarine (and sub-estuarine) Drainage Areas (EDAs) and 324 Coastal Drainage Areas (CDAs). The Estuarine Salinity zones represent the average annual salinity found in certain estuaries along the coastal United States of America. The salinity concentrations used to define the salinity zones were:

- Tidal Fresh (0 - 0.5 parts per thousand)
- Mixing Zone (0.5 - 25 parts per thousand)
- Seawater Zone (25 parts per thousand or greater)

The 14 species in FLELMR that are managed by SAFMC are listed in **Table 1**. Only a small proportion of these 14 species have been reviewed or updated. These species include Goliath Grouper, Lane Snapper, Mutton Snapper and Sheepshead.

Common Name	Species Name	ELMR	FLEMLR
Black sea bass	*Centropristis striata*	124	1515
Goliath grouper	*Epinephelus itajara*	165	1520
Red grouper	*Epinephelus morio*	166	1521
Gag grouper	*Mycteroperca microlepis*	167	1527
Mutton snapper	*Lutjanus analis*	169	1654
Gray snapper	*Lutjanus griseus*	76	1659
Lane snapper	*Lutjanus synagris*	170	1662
White grunt	*Haemulon plumieri*	175	1693
Sheepshead	*Archosargus probatocephalus*	77	1701
Atlantic spadefish	*Chaetodipterus faber*	177	1761
Spiny lobster	*Panulirus argus*	54	5585
Brown shrimp	*Farfantepenaues aztecus*	50	5588
Pink shrimp	*Farfantepenaeus duorarum*	51	5590

*No Atlantic spadefish or black sea bass abundance data available for the east coast.

As an *example*, FWRI created new feature datasets for Adult and Juvenile Relative Abundance for Sheepshead. The Relative Abundance feature class files show species abundance for East coast Florida Estuaries by salinity zone. **Appendix B** displays juvenile and adult Sheepshead seasonal abundance by salinity zone.

After SAFMC reviewed the example summary products, FWRI posted relevant EcoSpecies data, including coral-reef dependent species, to the South Atlantic Habitat and Ecosystem IMS.

EcoResearch Database

The EcoResearch database was designed to provide a catalogue of relevant coral and ecosystem research in the South Atlantic region. Approximately 174 research project footprints were compiled for the region. The accompanying database of metadata records

was finalized for this effort, and FWRI added the EcoResearch shapefile to the existing SAFMC Habitat and Ecosystem IMS (**Figure 1**).

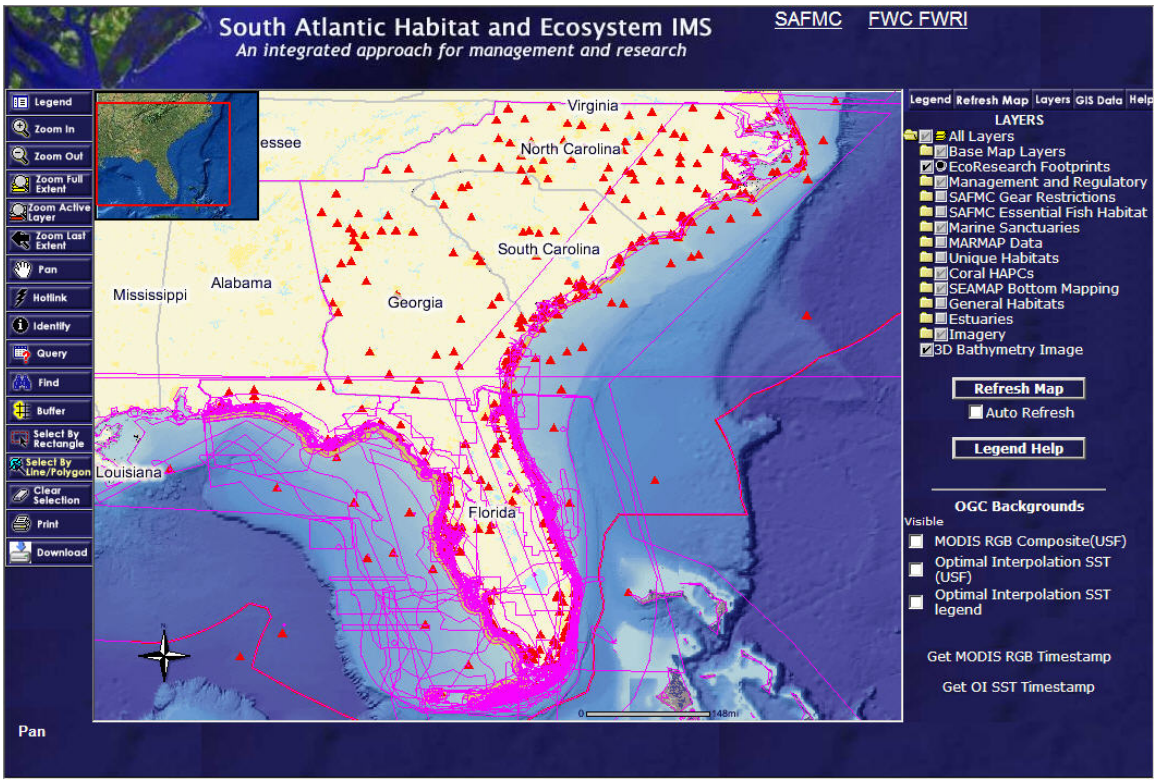


Figure 1. EcoResearch footprints for the IMS.

The Cold Fusion custom code was implemented to allow spatial queries of the EcoResearch shapefile. The spatial query uses ColdFusion to access a database consisting of abbreviated project metadata records. Users can draw a line, polygon or rectangle to select an area of interest. **Figures 2, 3 & 4** provide examples of a line selection, tabular results, and abbreviated metadata record.

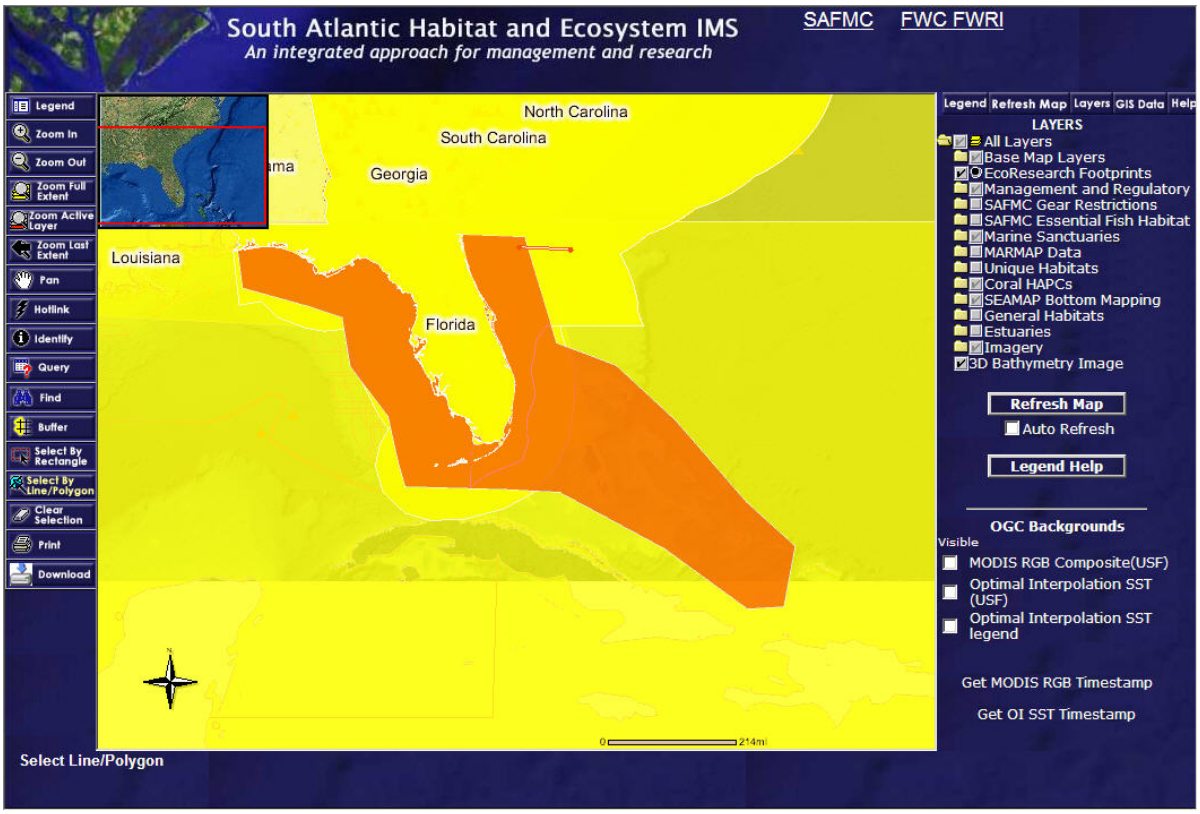


Figure 2. Line selection results with record 9 highlighted.

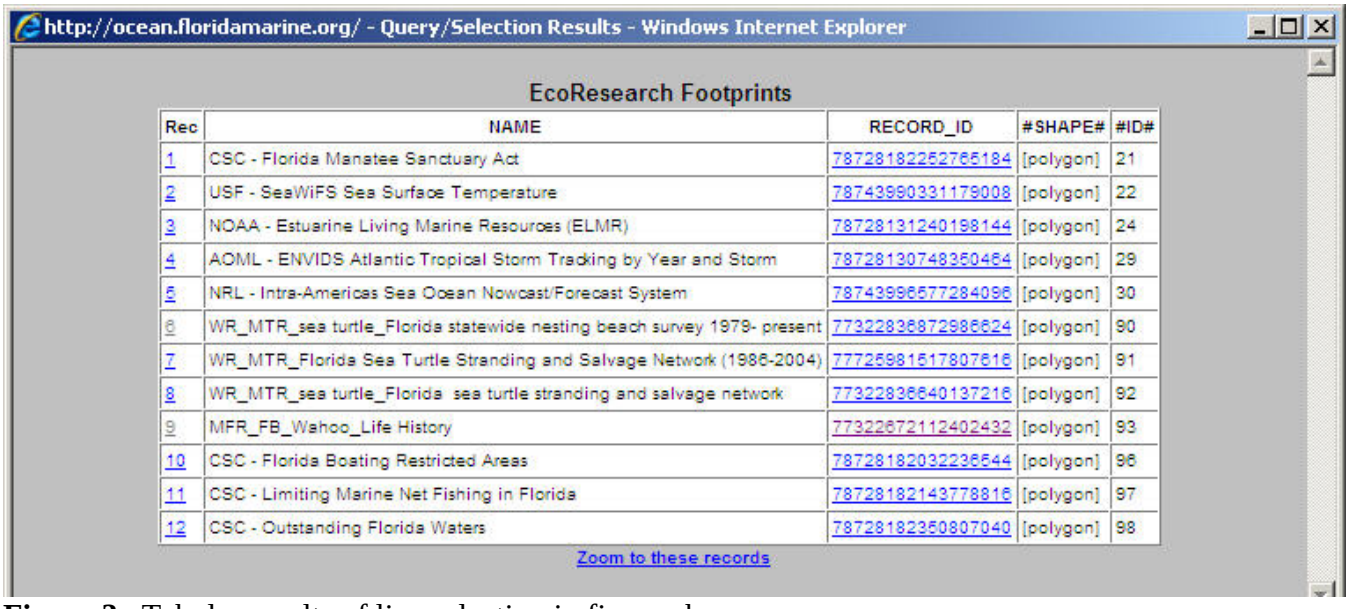


Figure 3. Tabular results of line selection in figure above.

Record Title: MFR_FB_Bio_Wahoo_Life History	Full Metadata
Originator: FWC-FWRI (Florida Fish and Wildlife Conservation Commission-Fish and Wildlife Research Institute)	Online linkage not available
Abstract: Wahoo, Acanthocybium solandri, were collected from various sources, such as tournaments, carcass retrieval, and Fisheries Dependent Monitoring (FDM) collections. Samples were taken from waters surrounding Florida, as well as Bahamian waters year round for a minimum of three years. Otoliths, vertebrae, dorsal scales, pectoral scales, spines, dorsal rays, pectoral rays, pelvic rays, were taken and prepared using various techniques to determine the best method for ageing wahoo. Gonads were taken to determine sexual maturity, batch fecundity, gonadal-somatic indeces, and for histology. Morphometrics were taken to determine age-length-weight relationships. Recreational and commercial demographics taken from TIPS and MRFSS and catch per unit effort (CPUE) calculated for the Atlantic and gulf coasts. In addition a special web-based survey was created to further investigate the wahoo angler. Data from the survey was collected for 2 years and gave insight into demographics such as age, gender, county of residence, fishing location, wahoo fishing experience. CPUE was also calculated for four areas in Florida, east coast, keys, west coast, and the panhandle.	

Figure 4. Example image for an abbreviated metadata record.

Geospatial Service-Oriented Architecture (SOA) web services
FWRI created a prototype map service using an ArcMap.mxd produced for the SAFMC Deepwater Habitat Mapping project. For demonstration purposes, a Web mapping application was then created using ArcGIS Server Manager. **Figure 5** below shows the view of the test SAFMC ArcGIS Server Web Mapping application. The Proposed Deepwater Coral HAPCs, ESDIM Bottom Type Locations, Harbor Branch Oceanographic Institute Research Dives and the Oculina Coral HAPC are visible. The map service and Web application were created using the ArcGIS Server system defaults.

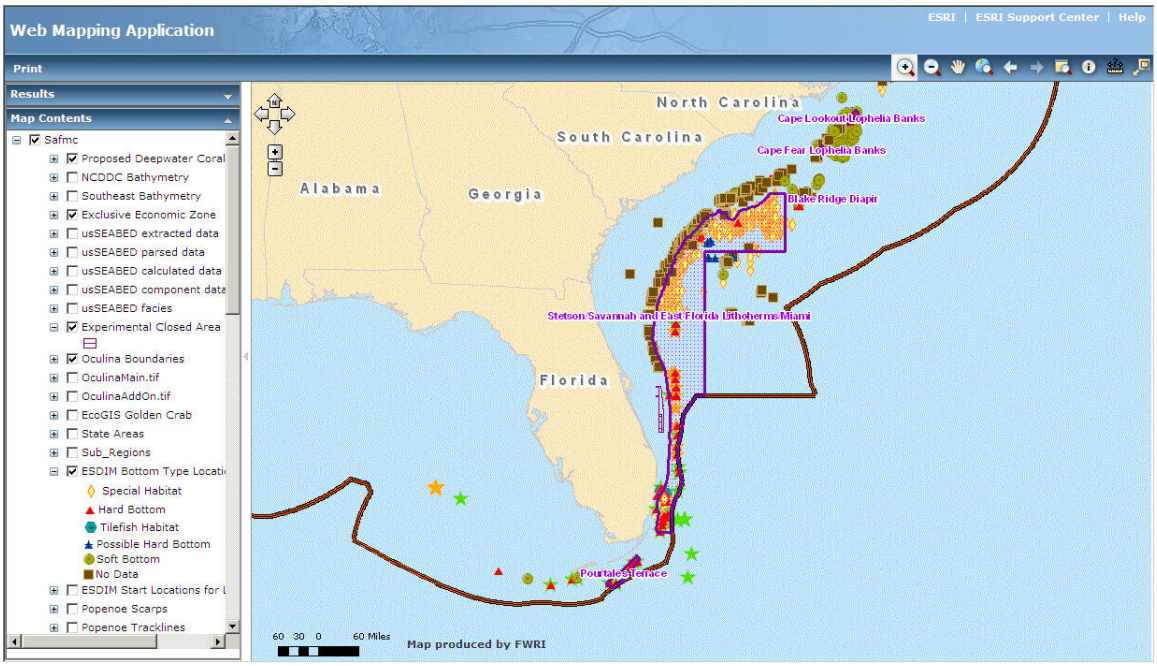


Figure 5. Prototype ArcGIS Server application for SAFMC.

It should be noted that single machine deployment of ArcGIS Server is mostly useful for developing and testing purposes only. This configuration is not suitable for a production environment. When it is time to deploy an ArcGIS Server application, it will need to be transferred to a distributed installation of ArcGIS Server. This is necessary to achieve an acceptable level of performance for the number of users accessing the system.

A distributed installation of ArcGIS Server exists when components of the ArcGIS Server system reside on multiple machines in the same local network. A distributed installation is more complex to administer and keep secure than a single machine deployment. FWRI is proactively seeking IT support and approval for implementing ArcGIS Server in a secure environment.

The ideal approach for deploying ArcGIS Server in a production environment is to use a reverse proxy web server. The reverse proxy web server receives incoming HTTP requests through a firewall that restricts traffic to a known port. It then sends the request through another firewall--using a port unknown to the end user--to the ADF Web server. This ADF Web server hosts ArcGIS Server Web applications and services and resides in a secure internal network. The ADF Web server is then free to establish unrestricted Distributed Component Object Model (DCOM) communications with the other ArcGIS Server components. In this way, the entire GIS server operates within a secure internal network and does not require firewalls among its components. **Figure 6** shows FWRI's proposed architecture supported by a reverse proxy web server. This activity is continuing under CRCP award NA08NMF4410465.

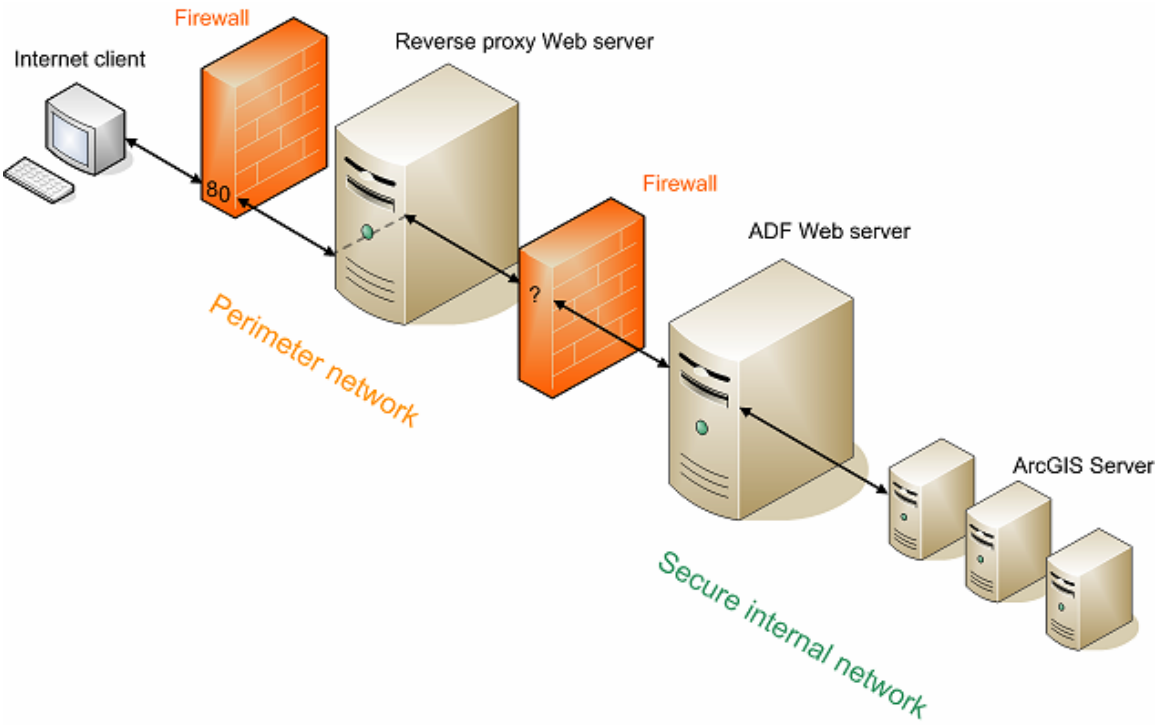


Figure 6. Proposed architecture for ArcGIS Server (Source: ESRI).

Maintenance

- Added EcoResearch Footprint shapefile to the IMS application. Updated AXL, ArcIMS param.js, dbgtData.js, and TOC files.

- Backed up the data directory for the IMS application. Thoroughly reviewed all files and removed extraneous data sets.
- Created master list of current shapefiles for the IMS application.
- Downloaded 2001 landcover data for North Carolina, South Carolina, Georgia, and Florida from http://www.csc.noaa.gov/crs/lca/southeast.html.
- Reprojected landcover data from Albers to Geographic.
- Imported .txt metadata in ArcCatalog for all landcover images.
- Formatted a Southeast Coastal Ocean Observing Regional Association (SECOORA) Asset Inventory shapefile for inclusion in the IMS.

Travel
FWRI hosted the SAFMC Ecosystem and Habitat IMS Workshop on November 5 -7, 2008. The workshop focused on identifying GIS needs supporting management, research, and regional collaboration to enhance the IMS as a support tool for Ecosystem-Based Management. Participants gave recommendations for enhancing and/or refining the functional capabilities of the IMS to better support local, state, other regional habitat, coral, and ecosystem GIS needs.

FWRI staff attended the Joint Habitat and Coral Advisory Panel meeting in Charleston, SC November 17 – 20, 2008. Staff provided the APs with a presentation highlighting the present and future structure of the South Atlantic Habitat and Ecosystem IMS (Researcher Section, EcoSpecies Module, etc.).

Project: NOAA CRG 2008 Support Fisheries Scientist to provide Additional Technical Support for Council Coral Conservation and Management Activities.
Under this award, the Coral Fishery Scientist provided direct support to the Council for the following activities:

- Edited the evolving Fishery Ecosystem Plan (FEP) for the South Atlantic region and continued to coordinate directly with regional scientists and resource managers participating in the development of the FEP document.

- Compiled new information and updated existing information on the fisheries for golden crab and royal red shrimp. These fisheries are prosecuted in areas of the South Atlantic where deepwater coral ecosystems exist.

- Coordinated with golden crab and royal red shrimp fishermen to determine the footprint of their fisheries and thus establish the extent of overlap with the proposed deepwater coral HAPCs.

- Attended the Trans-Atlantic Coral Ecosystem Study (TRACES) meeting in Wilmington in February 2008. This initiative aims to bring together researchers from Canada, the U.S. and the European Union to collaborate on studies of deepwater coral ecosystems in the North Atlantic. The Council's Deepwater Coral Research and Monitoring Plan will be incorporated, as appropriate, in the TRACES science plan to ensure that Council needs are addressed through this international initiative.

- Briefed the Ecosystem Committee at the March 2008 SAFMC meeting on the proposed 4d rule and critical habitat for *Acropora*. The Fishery Scientist coordinated with the Coral Advisory Panel to develop and submit comments to NOAA Fisheries Service.

- Continued to assist in the maintenance and enhancement of the Council's Habitat and Ecosystem website. In March 2008, the Fishery Scientist developed webpages to accompany the Habitat Restoration Research Cruise to the Oculina Bank. Cruise logs and photographs were posted daily on the site as well as interviews with crew and researchers. To browse the pages go to: http://www.safmc.net/HabitatManagement/DeepwaterCorals/OculinaBank/ExpeditionsandExplorers/2008OculinaCruise/tabid/550/Default.aspx

- Prepared and distributed a Request for Proposals for the 2009-2010 CRCP funding cycle. The Fishery Scientist subsequently coordinated review of submitted proposals with the SAFMC's Ecosystem and Habitat Committees Chairs. The Fishery Scientist prepared the proposal package for submission to the CRCP.

- Briefed the SAFMC's Snapper Grouper Committee at the June 2008 meeting in Orlando, FL on research conducted in the Oculina Bank HAPC. She summarized the results of two studies conducted in spring 2008 to assess the effectiveness of habitat restoration modules placed in the HAPC in 1999 and 2001. The studies concluded that: (1) the use of technical divers was not the most appropriate method of surveying the recruitment modules since divers were limited by bottom time and at the mercy of the often very strong currents in this habitat; (2) the "reefballs" that were located at Sebastian Pinnacles did not support enhanced coral or fish populations, but definitive conclusions could not be drawn because of the small sample size and suboptimal location of those that were observed; and (3) Chapman's Reef, while still considered a 'live' habitat, appears to have been impacted (possibly by trawling); coral and reef fish populations were not as prolific as reported in 2001 and recruitment blocks were completely destroyed; there was also a considerable amount of heavy fishing line observed in this area.

- The Fishery Scientist attended the 11th International Coral Reef Symposium in Ft. Lauderdale, FL in July 2008.

- The Fishery Scientist coordinated the joint meeting of the Golden Crab and Deepwater Shrimp Advisory Panels in September 2008 in Charleston, SC. The panels discussed alternatives for establishment of deepwater Coral HAPCs. In addition, she presented information on the proposed actions for Shrimp Amendment 7.

- Drafted the SAFMC's Comprehensive Ecosystem-based Amendment 1 (CE-BA 1). This amendment would establish 5 deepwater Coral Habitat Areas of Particular Concern (CHAPCs), encompassing 23,000 square miles of ocean

bottom, to protect deepwater corals and associated habitat in the South Atlantic region; establish fishing access areas for the shrimp and golden crab industries so they may continue fishing their traditional grounds; and amend all SAFMC FMPs, including the Coral FMP, to provide spatial data on Essential Fish Habitat (EFH) and HAPCs as mandated by the EFH Final Rule. The Fishery Scientist was lead plan coordinator for the SAFMC for this amendment. As such, she coordinated development of the various sections of the document with staff from the NMFS Southeast Regional Office, participated in planning meetings and conference calls, conducted public hearings for the proposed actions, presented information to the SAFMC and prepared the various versions of the document. The CE-BA 1 is currently scheduled to be approved for submission to the Secretary of Commerce in September 2009. The Fishery Scientist will continue work on this activity under grant NA08NMF4410465 as needed.

- Prepared coral progress reports for projects funded through CRCP.

- The Fishery Scientist participated in other Council activities as needed.

Final Report 2007

Prepared by:	Submitted by:	
Myra Brouwer	*Robert K. Mahood*	June 30, 2009
Fishery Scientist	Executive Director	Date

Appendix A. Original FLELMR "Habitat" Table.

Name	Type	Size
OBJECTID	Long Integer	4
FLELMR_EST_CODE	Double	8
FLELMR_CODE	Double	8
LIFE_STAGE	Text	11
LAKE	Long Integer	4
SPRING_RUN	Long Integer	4
COASTAL_PLAIN	Long Integer	4
PIEDMONT	Long Integer	4
UPLAND	Long Integer	4
BEACH_SURF_ZONE	Long Integer	4
NERITIC	Long Integer	4
OCEANIC	Long Integer	4
DOMAIN_UNKNOWN	Long Integer	4
INLET_MOUTH	Long Integer	4
LAGOONAL	Long Integer	4
CHANNEL	Long Integer	4
INTERTIDAL_FLAT	Long Integer	4
TIDAL_FRESH	Long Integer	4
MIXING_ZONE	Long Integer	4
SEAWATER_ZONE	Long Integer	4
LIMNETIC	Long Integer	4
OLIGOHALINE	Long Integer	4
MESOHALINE	Long Integer	4
POLYHALINE	Long Integer	4
EUHALINE	Long Integer	4
C_0_5	Long Integer	4
C_5_10	Long Integer	4
C_10_15	Long Integer	4
C_15_20	Long Integer	4
C_20_25	Long Integer	4
C_25_30	Long Integer	4
C_GT_30	Long Integer	4
TEMP_RANGE_UNKNOWN	Long Integer	4
INTERTIDAL	Long Integer	4
SUBTIDAL	Long Integer	4
INNER_SHELF	Long Integer	4
MIDDLE_SHELF	Long Integer	4
OUTER_SHELF	Long Integer	4
MESOBENTHAL	Long Integer	4
BATHYOBENTHAL	Long Integer	4
UNKNOWN_DEPTH_PREFERENCE	Long Integer	4
MUD_SILT_CLAY	Long Integer	4
QUARTZITIC_SAND	Long Integer	4
CALCAREOUS_SAND	Long Integer	4
LIVE_BOTTOM	Long Integer	4

PEBBLE_COBBLE_GRAVEL	Long Integer	4
BOULDER_ROCKY_OUTCROP	Long Integer	4
SHELL	Long Integer	4
CORAL	Long Integer	4
VASCULAR_SAV	Long Integer	4
MACROALGAL_SAV	Long Integer	4
MARSH	Long Integer	4
MANGROVE	Long Integer	4
OTHER_FORESTS	Long Integer	4
FLOATING_VEGETATION	Long Integer	4
WRACK	Long Integer	4
ARTIFICIAL_REEF	Long Integer	4
NONE	Long Integer	4
UNKNOWN_STRUCT_HABITAT	Long Integer	4
CITATION_LIST	Text	255
COMMENTS	Text	255

New Bathyl Zone Habitat Table

Name	Type	Size
OBJECTID	Long Integer	4
FLELMR_EST_CODE	Double	8
FLELMR_CODE	Double	8
LIFE_STAGE	Text	11
TIDAL_FRESH	Long Integer	4
MIXING_ZONE	Long Integer	4
SEAWATER_ZONE	Long Integer	4
INTERTIDAL	Long Integer	4
SUBTIDAL	Long Integer	4
INNER_SHELF	Long Integer	4
MIDDLE_SHELF	Long Integer	4
OUTER_SHELF	Long Integer	4
MESOBENTHAL	Long Integer	4
BATHYOBENTHAL	Long Integer	4
UNKNOWN_DEPTH_PREFERENCE	Long Integer	4
CITATION_LIST	Text	255
COMMENTS	Text	255

Original FLELMR “Abundance” table

Name	Type	Size
OBJECTID	Long Integer	4
FLELMR_EST_CODE	Double	8
FLELMR_CODE	Double	8
LIFE_STAGE	Text	1
TF_JAN	Long Integer	4
TF_FEB	Long Integer	4
TF_MAR	Long Integer	4
TF_APR	Long Integer	4

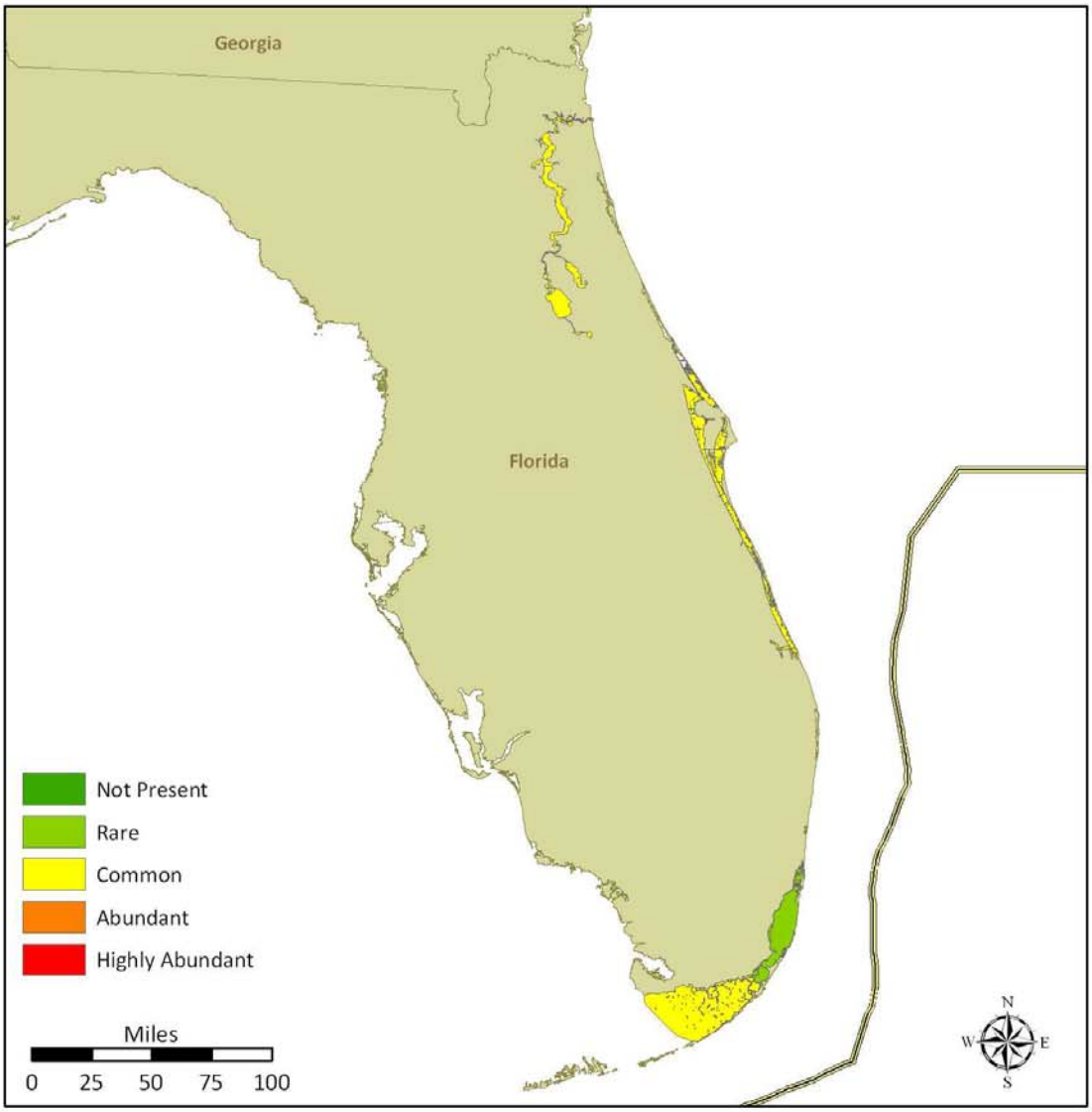
TF_MAY	Long Integer	4
TF_JUN	Long Integer	4
TF_JUL	Long Integer	4
TF_AUG	Long Integer	4
TF_SEP	Long Integer	4
TF_OCT	Long Integer	4
TF_NOV	Long Integer	4
TF_DEC	Long Integer	4
TF_RELIABILITY	Long Integer	4
MZ_JAN	Long Integer	4
MZ_FEB	Long Integer	4
MZ_MAR	Long Integer	4
MZ_APR	Long Integer	4
MZ_MAY	Long Integer	4
MZ_JUN	Long Integer	4
MZ_JUL	Long Integer	4
MZ_AUG	Long Integer	4
MZ_SEP	Long Integer	4
MZ_OCT	Long Integer	4
MZ_NOV	Long Integer	4
MZ_DEC	Long Integer	4
MZ_RELIABILITY	Long Integer	4
SZ_JAN	Long Integer	4
SZ_FEB	Long Integer	4
SZ_MAR	Long Integer	4
SZ_APR	Long Integer	4
SZ_MAY	Long Integer	4
SZ_JUN	Long Integer	4
SZ_JUL	Long Integer	4
SZ_AUG	Long Integer	4
SZ_SEP	Long Integer	4
SZ_OCT	Long Integer	4
SZ_NOV	Long Integer	4
SZ_DEC	Long Integer	4
SZ_RELIABILITY	Long Integer	4

New SAFMC_abundance table

Name	Type	Size
OBJECTID_1	Long Integer	4
OBJECTID	Long Integer	4
FLELMR_EST	Double	8
FLELMR_COD	Double	8
LIFE_STAGE	Text	1
SZ_NAME	Text	254
JAN	Long Integer	4
FEB	Long Integer	4
MAR	Long Integer	4
APR	Long Integer	4

MAY	Long Integer	4
JUN	Long Integer	4
JUL	Long Integer	4
AUG	Long Integer	4
SEP	Long Integer	4
OCT	Long Integer	4
NOV	Long Integer	4
DEC	Long Integer	4
RELIABILITY	Long Integer	4
EDA_SZNAME	Text	40
SPR_ABUN	Integer	2
SUM_ABUN	Integer	2
FAL_ABUN	Integer	2
WIN_ABUN	Integer	2

Appendix B. Example output from Ecospecies Database for Sheepshead.



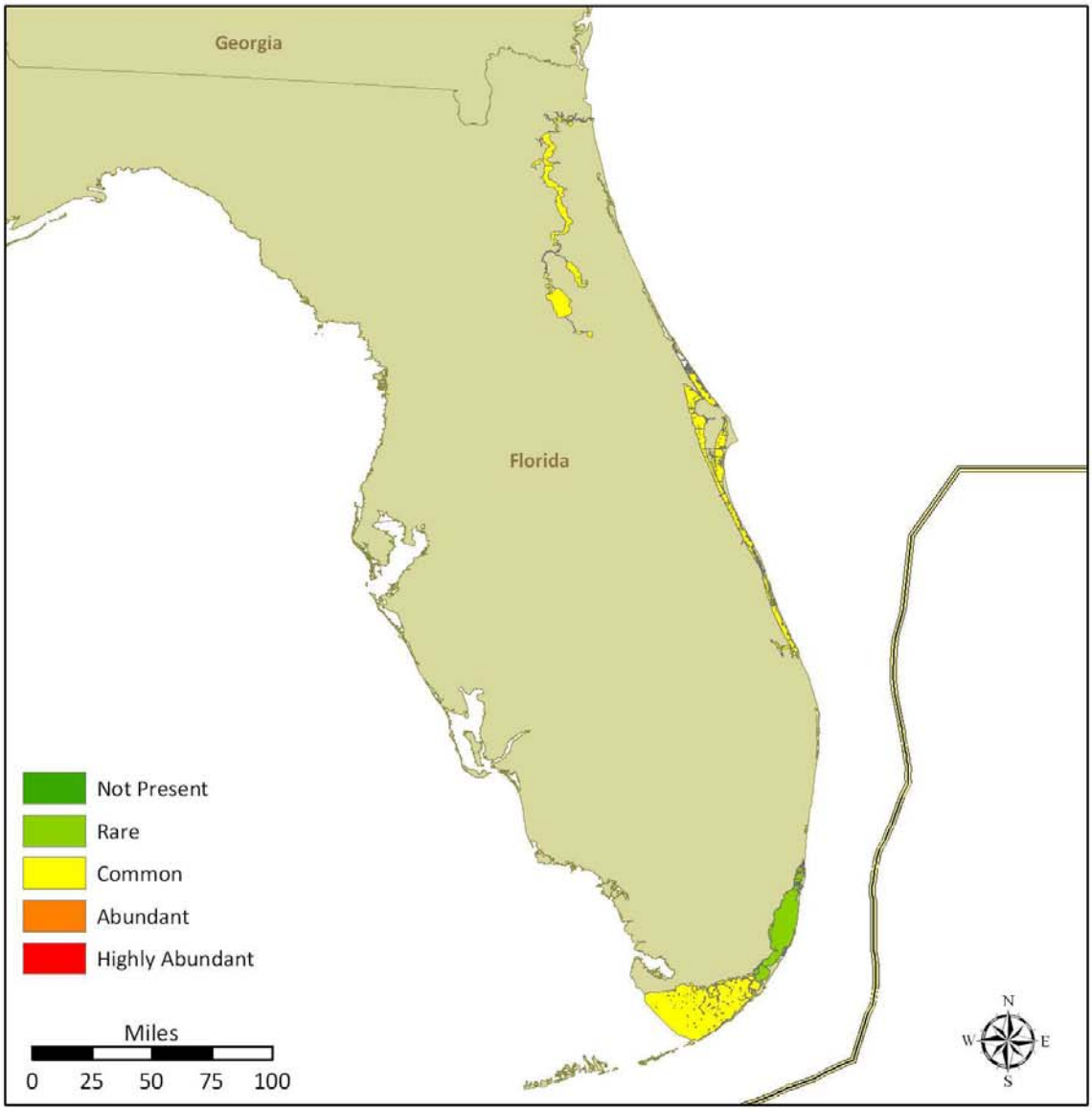
Salinity Zone	Abundance	Reliability
Florida Bay		
G010x Mixing Zone	Common	Moderately Certain
G010x Seawater Zone	Common	Highly Certain
Saint Johns River		
S180x Mixing Zone	Common	Moderately Certain
S180x Seawater Zone	Abundant	Moderately Certain
S180x Tidal Fresh Zone	Common	Reasonable Inference
Indian River Lagoon		
S190x Seawater Zone	Common	Highly Certain
Biscayne Bay		
S200x Mixing Zone	Rare	Moderately Certain
S200x Seawater Zone	Rare	Moderately Certain

This map is based on ELMR and FLELMR data and has not been thoroughly reviewed for correctness. Estuarine salinity zones source data provided by NOAA. The salinity concentrations used to define the salinity zones were:

- Tidal Fresh (0 - 0.5 parts per thousand)
- Mixing Zone (0.5 - 25 parts per thousand)
- Seawater Zone (25 parts per thousand or greater)

Please note: this effort is focusing on estuaries located on the East coast of Florida.

Adult Sheepshead Relative Abundance
Summer (Jun - Aug)



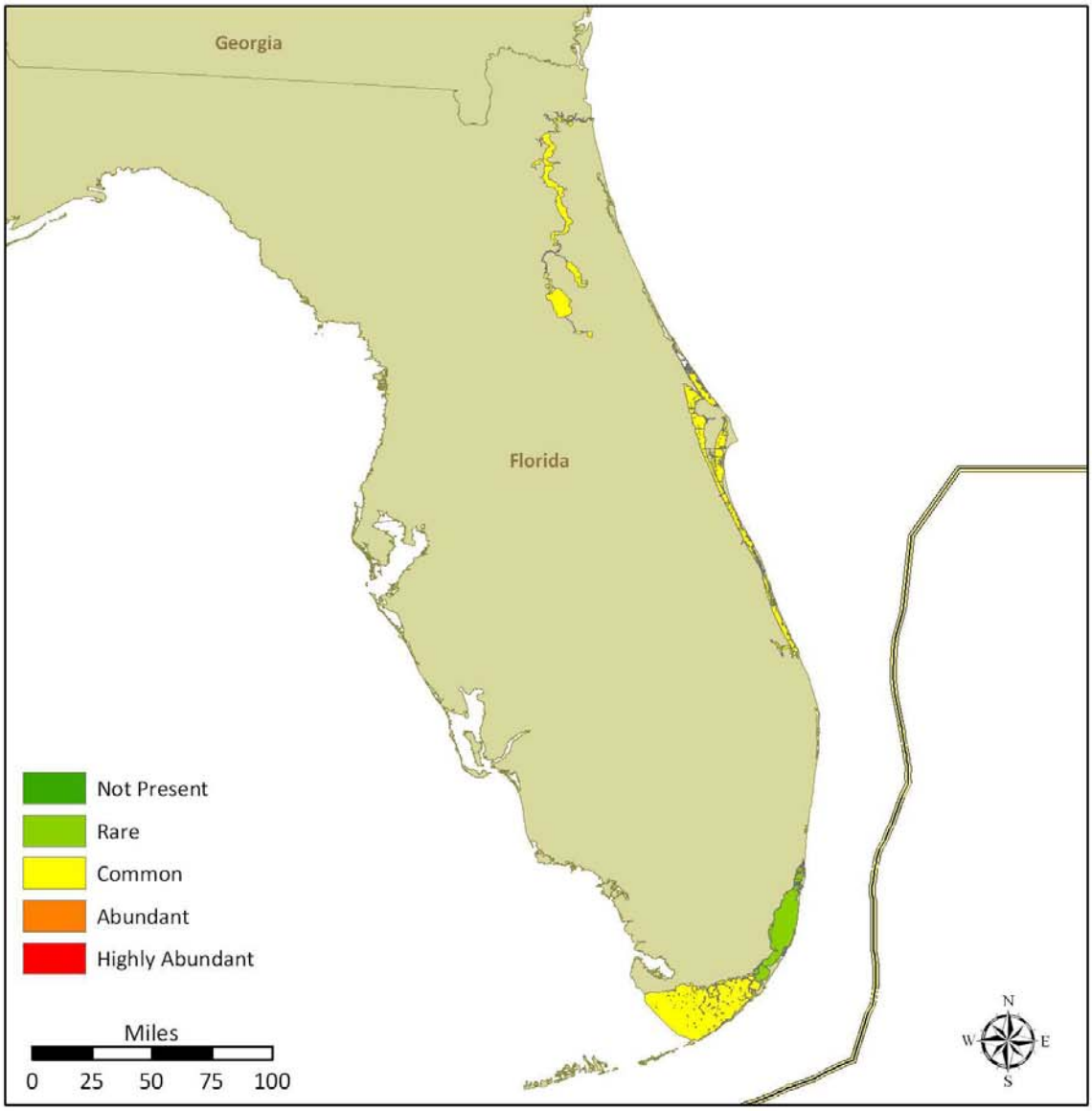
Salinity Zone	Abundance	Reliability
Florida Bay		
G010x Mixing Zone	Common	Moderately Certain
G010x Seawater Zone	Common	Highly Certain
Saint Johns River		
S180x Mixing Zone	Common	Moderately Certain
S180x Seawater Zone	Abundant	Moderately Certain
S180x Tidal Fresh Zone	Common	Reasonable Inference
Indian River Lagoon		
S190x Seawater Zone	Common	Highly Certain
Biscayne Bay		
S200x Mixing Zone	Rare	Moderately Certain
S200x Seawater Zone	Rare	Moderately Certain

This map is based on ELMR and FLELMR data and has not been thoroughly reviewed for correctness. Estuarine salinity zones source data provided by NOAA. The salinity concentrations used to define the salinity zones were:

- Tidal Fresh (0 - 0.5 parts per thousand)
- Mixing Zone (0.5 - 25 parts per thousand)
- Seawater Zone (25 parts per thousand or greater)

Please note: this effort is focusing on estuaries located on the East coast of Florida.

Adult Sheepshead Relative Abundance
Fall (Sep - Nov)



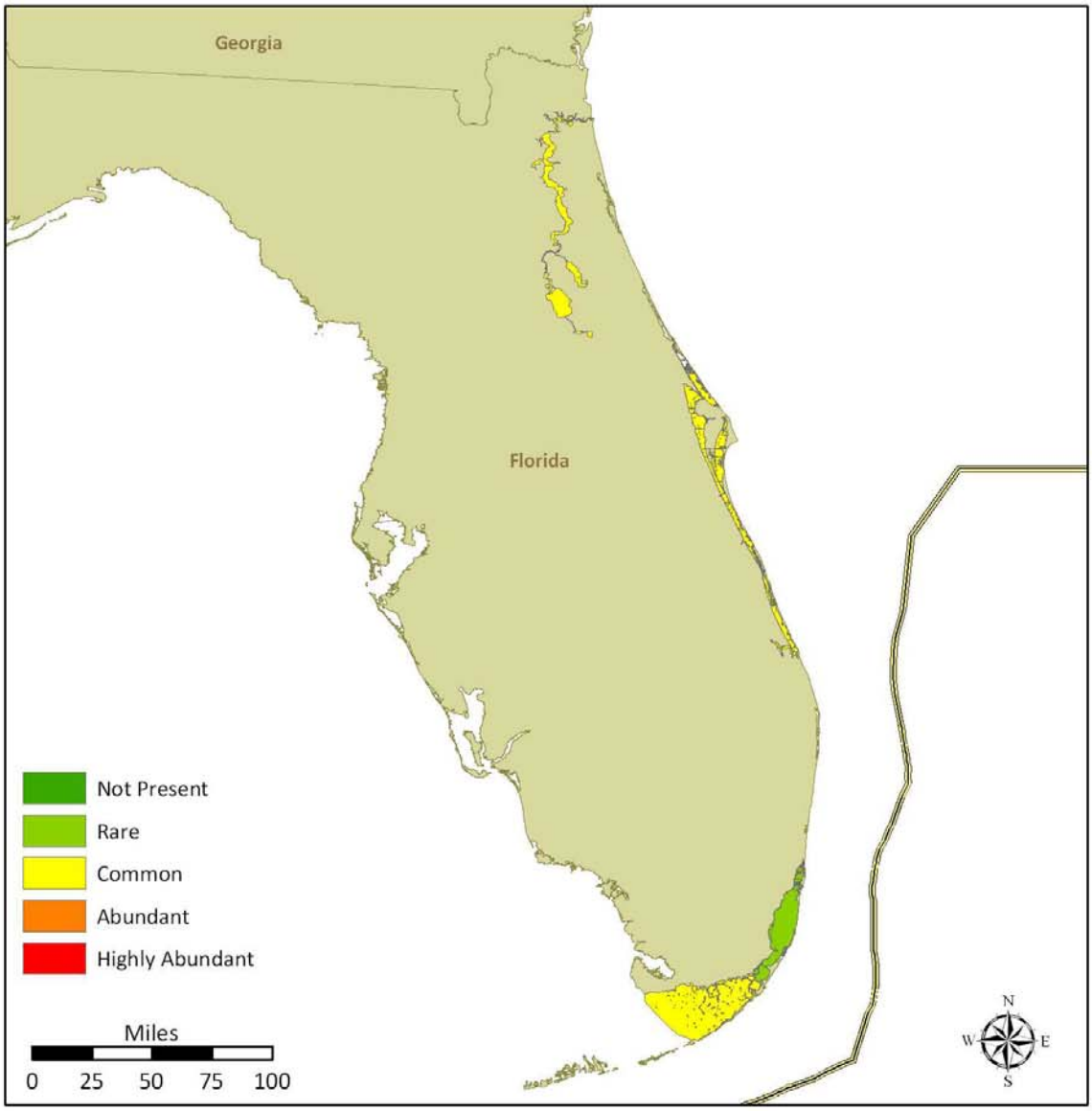
Salinity Zone	Abundance	Reliability
Florida Bay		
G010x Mixing Zone	Common	Moderately Certain
G010x Seawater Zone	Common	Highly Certain
Saint Johns River		
S180x Mixing Zone	Common	Moderately Certain
S180x Seawater Zone	Abundant	Moderately Certain
S180x Tidal Fresh Zone	Common	Reasonable Inference
Indian River Lagoon		
S190x Seawater Zone	Common	Highly Certain
Biscayne Bay		
S200x Mixing Zone	Rare	Moderately Certain
S200x Seawater Zone	Rare	Moderately Certain

This map is based on ELMR and FLELMR data and has not been thoroughly reviewed for correctness. Estuarine salinity zones source data provided by NOAA. The salinity concentrations used to define the salinity zones were:

- Tidal Fresh (0 - 0.5 parts per thousand)
- Mixing Zone (0.5 - 25 parts per thousand)
- Seawater Zone (25 parts per thousand or greater)

Please note: this effort is focusing on estuaries located on the East coast of Florida.

Adult Sheepshead Relative Abundance
Winter (Dec - Feb)



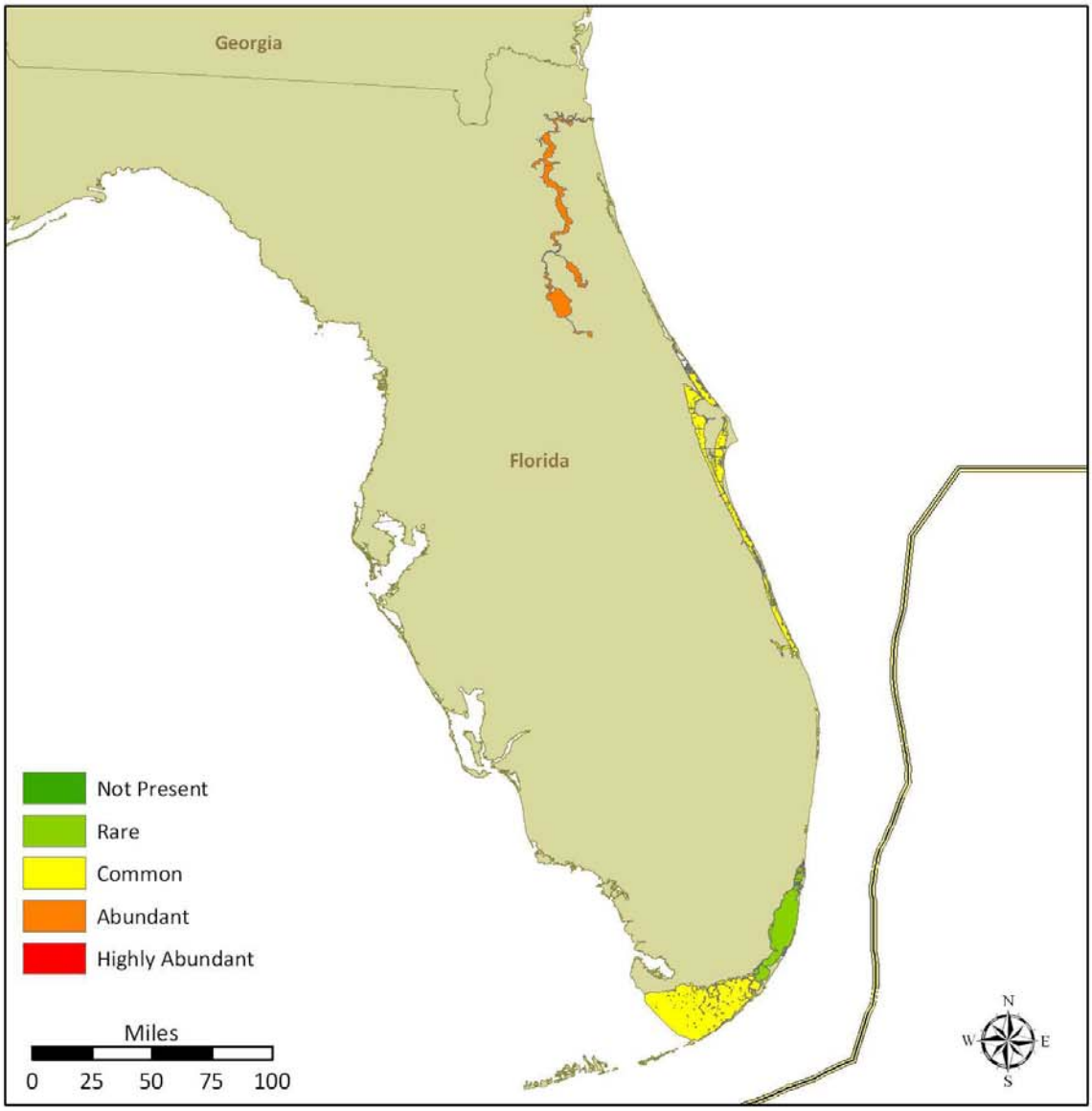
Salinity Zone	Abundance	Reliability
Florida Bay		
G010x Mixing Zone	Common	Moderately Certain
G010x Seawater Zone	Common	Highly Certain
Saint Johns River		
S180x Mixing Zone	Common	Moderately Certain
S180x Seawater Zone	Abundant	Moderately Certain
S180x Tidal Fresh Zone	Common	Reasonable Inference
Indian River Lagoon		
S190x Seawater Zone	Common	Highly Certain
Biscayne Bay		
S200x Mixing Zone	Rare	Moderately Certain
S200x Seawater Zone	Rare	Moderately Certain

This map is based on ELMR and FLELMR data and has not been thoroughly reviewed for correctness. Estuarine salinity zones source data provided by NOAA. The salinity concentrations used to define the salinity zones were:

- Tidal Fresh (0 - 0.5 parts per thousand)
- Mixing Zone (0.5 - 25 parts per thousand)
- Seawater Zone (25 parts per thousand or greater)

Please note: this effort is focusing on estuaries located on the East coast of Florida.

Juvenile Sheepshead Relative Abundance
Spring (Mar - May)



Salinity Zone	Abundance	Reliability
Florida Bay		
G010x Mixing Zone	Common	Moderately Certain
G010x Seawater Zone	Common	Highly Certain
Saint Johns River		
S180x Mixing Zone	Abundant	Moderately Certain
S180x Seawater Zone	Abundant	Moderately Certain
S180x Tidal Fresh Zone	Abundant	Moderately Certain
Indian River Lagoon		
S190x Seawater Zone	Common	Highly Certain
Biscayne Bay		
S200x Mixing Zone	Rare	Moderately Certain
S200x Seawater Zone	Rare	Moderately Certain

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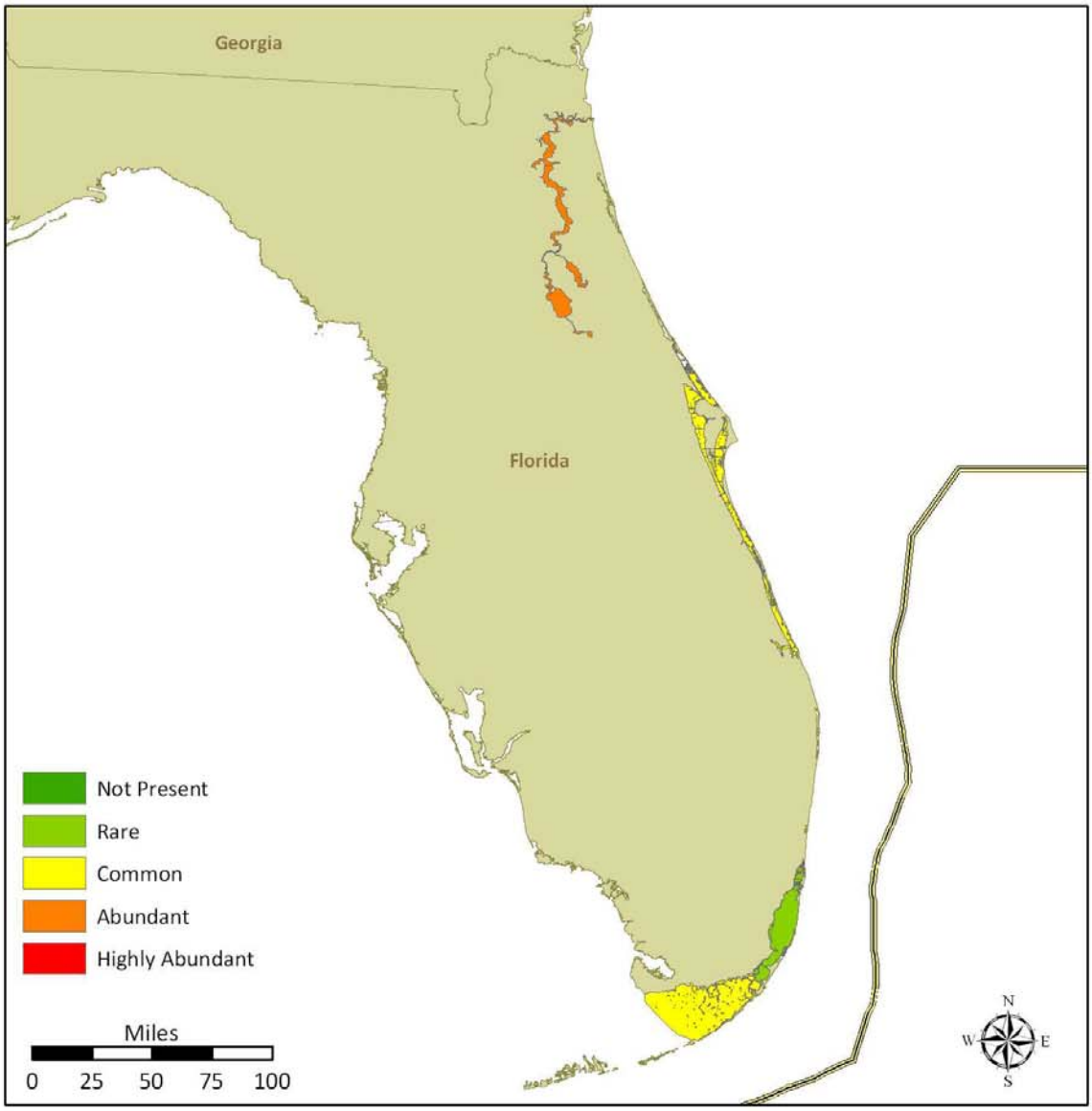
Juvenile Sheepshead Relative Abundance
Summer (Jun - Aug)



Salinity Zone	Abundance	Reliability
Florida Bay		
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Saint Johns River		
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S180x Seawater Zone	Abundant	Moderately Certain
S180x Tidal Fresh Zone	Abundant	Moderately Certain
Indian River Lagoon		
S190x Seawater Zone	Common	Highly Certain
Biscayne Bay		
S200x Mixing Zone	Rare	Moderately Certain
S200x Seawater Zone	Rare	Moderately Certain

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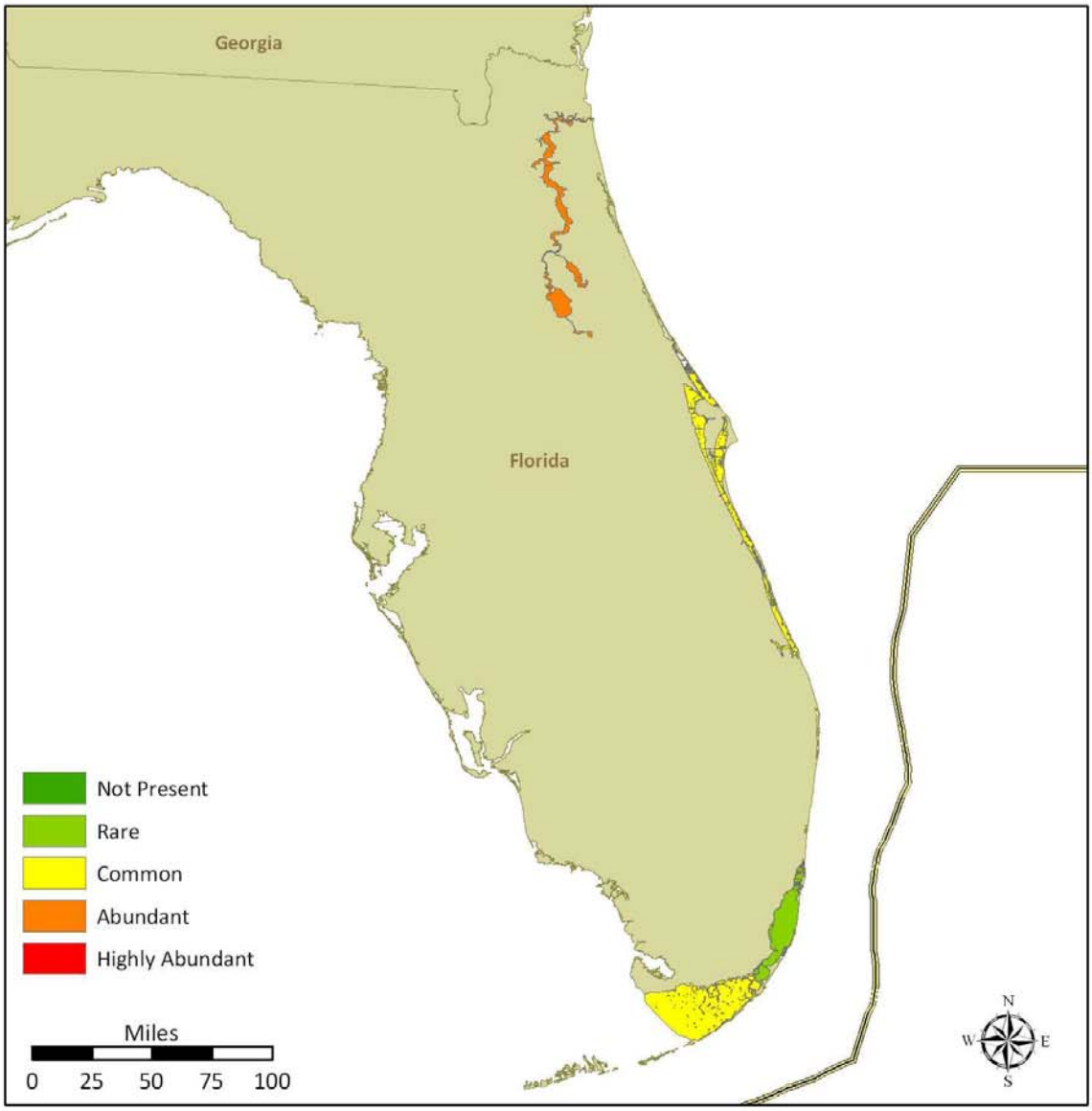
Juvenile Sheepshead Relative Abundance
Fall (Sep - Nov)



Salinity Zone	Abundance	Reliability
Florida Bay		
G010x Mixing Zone	Common	Moderately Certain
G010x Seawater Zone	Common	Highly Certain
Saint Johns River		
S180x Mixing Zone	Abundant	Moderately Certain
S180x Seawater Zone	Abundant	Moderately Certain
S180x Tidal Fresh Zone	Abundant	Moderately Certain
Indian River Lagoon		
S190x Seawater Zone	Common	Highly Certain
Biscayne Bay		
S200x Mixing Zone	Rare	Moderately Certain
S200x Seawater Zone	Rare	Moderately Certain

This map is based on ELMR and FLELMR data and has not been thoroughly reviewed for correctness. Estuarine salinity zones source data provided by NOAA. The salinity concentrations used to define the salinity zones were:

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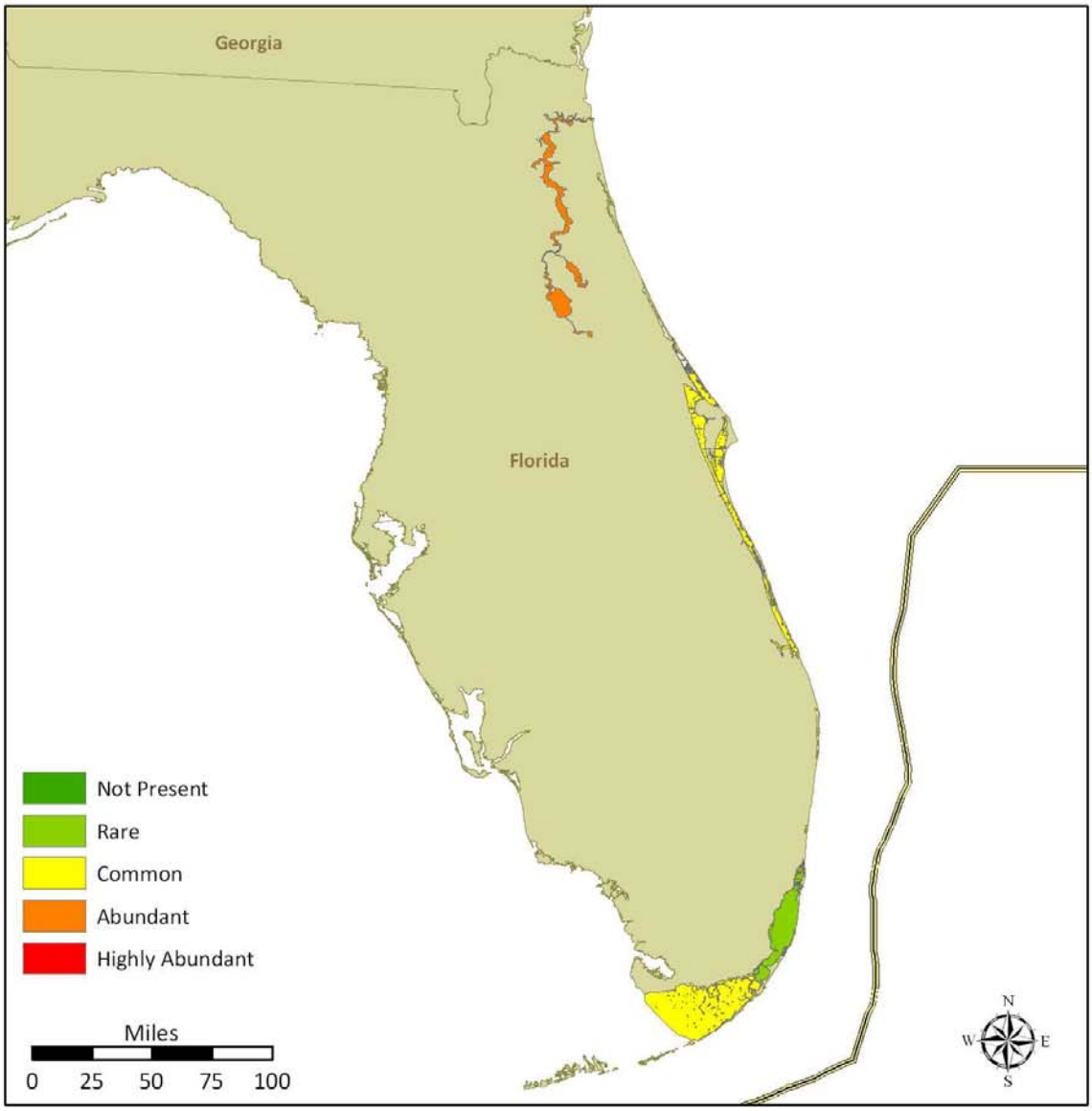
Juvenile Sheepshead Relative Abundance
Winter (Dec - Feb)



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Saint Johns River		
S180x Mixing Zone	Abundant	Moderately Certain
S180x Seawater Zone	Abundant	Moderately Certain
S180x Tidal Fresh Zone	Abundant	Moderately Certain
Indian River Lagoon		
S190x Seawater Zone	Common	Highly Certain
Biscayne Bay		
S200x Mixing Zone	Rare	Moderately Certain
S200x Seawater Zone	Rare	Moderately Certain

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