Science, Service, Stewardship

South Atlantic MPA Monitoring Program

Stacey Harter, Andrew David, John Reed

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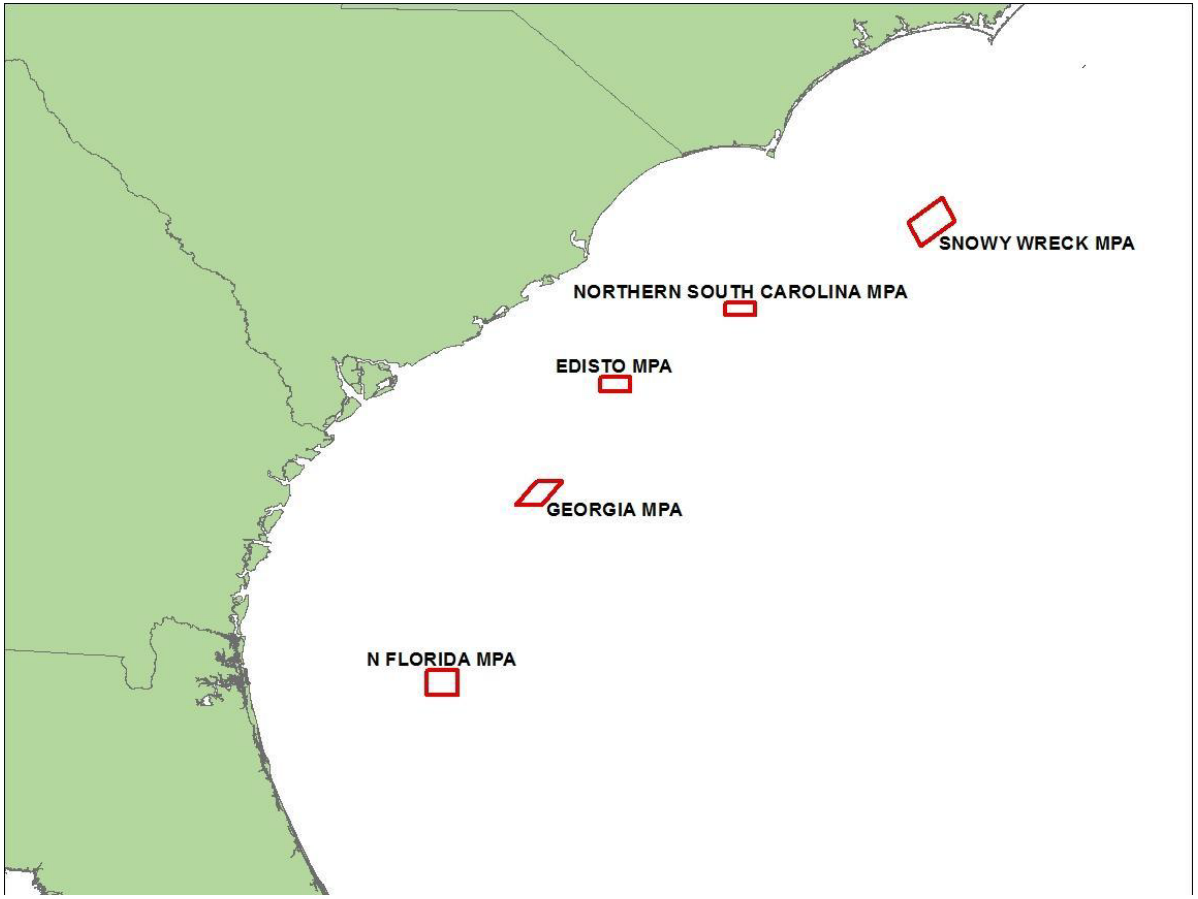
General Overview

- Efforts have been concentrated on 5 of the 8 MPAs.
- Sampling timeframe: 2004-2013, with the exceptions of 2005 & 2011
- ROV and mapping surveys



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Objectives

1. Determine the abundance and distribution of economically important reef fish species and macro-benthos in and around the MPAs in the U.S. South Atlantic;
2. Evaluate the habitat of the areas with respect to species composition and abundance as well as geomorphology; and
3. Correlate fishery and habitat data to detect trends in fish and invertebrate populations as the protected areas mature.

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Site Selection – the importance of mapping!

- In earlier years of the survey, ROV dive sites were selected based either on knowledge from fellow researchers or basic bathymetric charts. We expanded our sampling universe each year.
- We acquired several multibeam maps from George Sedberry in 2011 and collected our own multibeam data in 2012 & 2013, aboard NOAA Ship *Pisces* with the ME-70 multibeam and EK-60 split beam systems. Maps have also been shared with SEFIS (NOAA Beaufort Lab).
- Hard bottom reef habitat targeted
- Sampled sites inside and outside the MPAs each year

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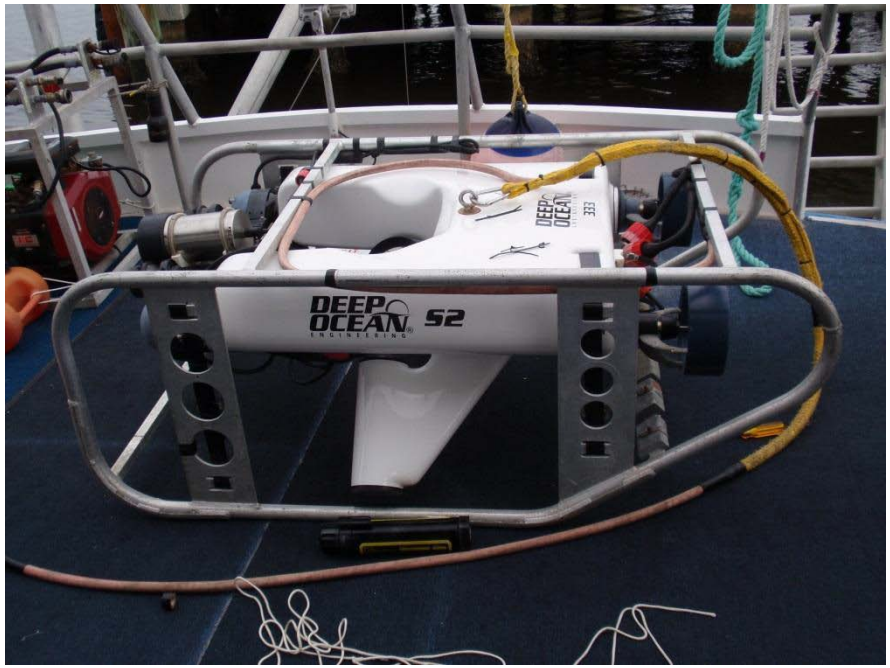
Methodology



Remotely Operated Vehicle (ROV)

- Transects were conducted with an ROV
- All fish were identified and counted from the videotapes.
- Habitat notes: habitat type, rugosity, slope, amount of relief.
- John Reed joined the project in 2010 and has expanded the survey to include an analysis of macro-benthos.
- Fish densities calculated as #/km for each dive.

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Overview of Results

- Surveys were conducted in four years prior to MPA implementation (2004, 2006-2008) and four years after implementation of the fishing restrictions (2009, 2010, 2012, 2013).
- Conducted 168 dives over these eight years, 71 pre-closure and 97 post-closure.
- This project has mapped 145 km^2 in 2012 and 218 km^2 in 2013.
- Multibeam data from other sources exists for additional portions of the MPAs, but a large portion remains unmapped.

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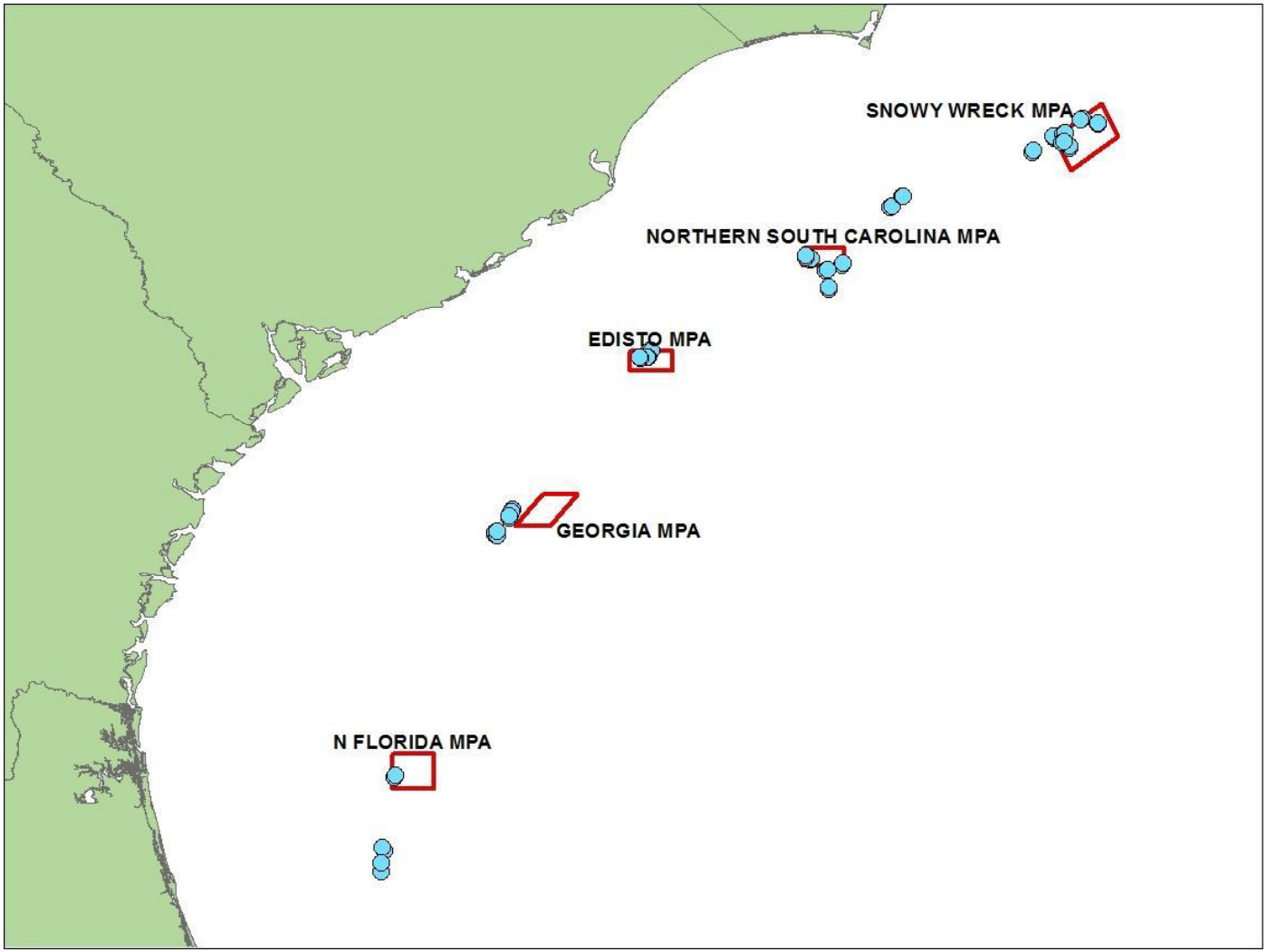
2004
31 Dives



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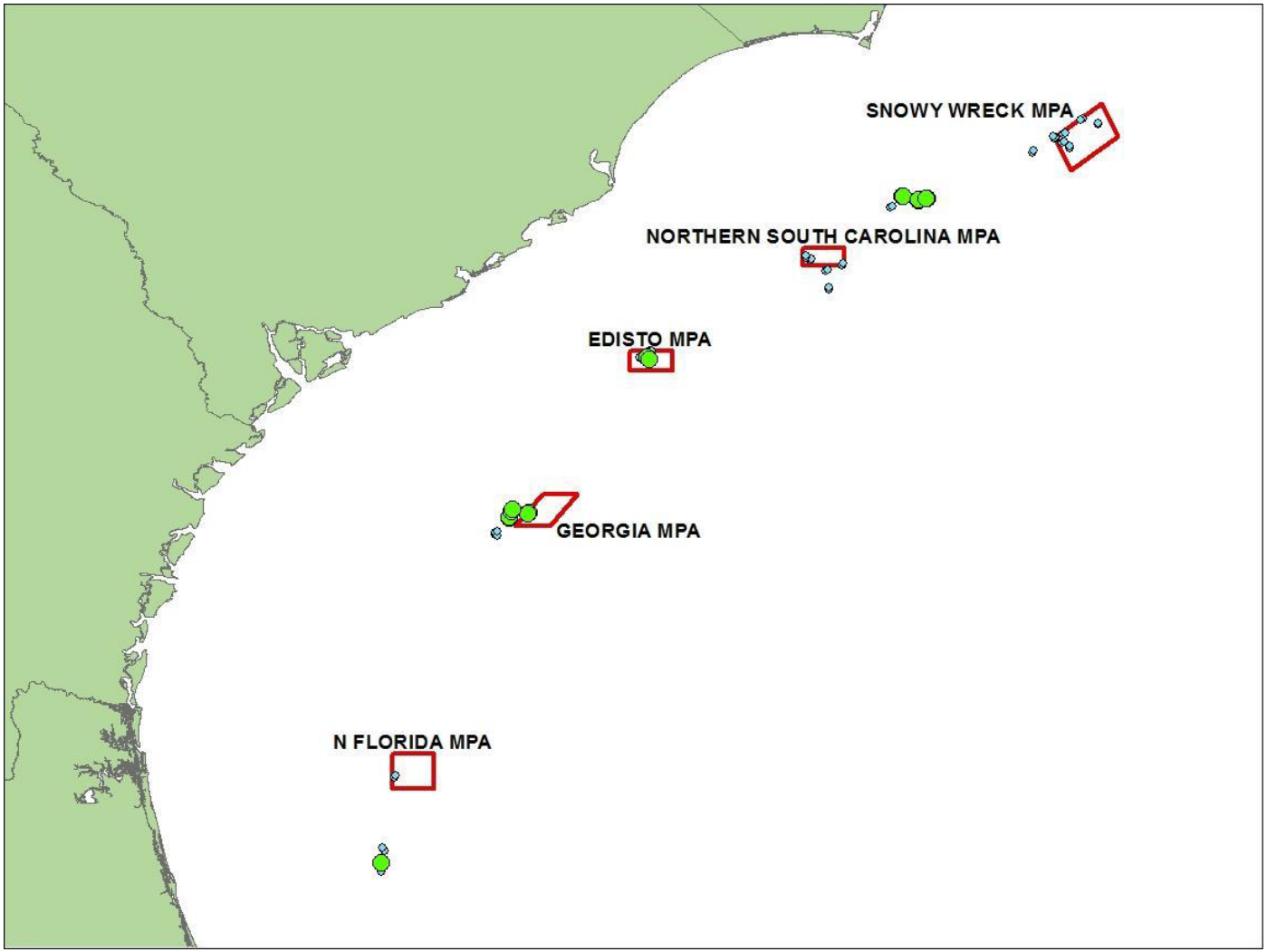
2006
9 Dives



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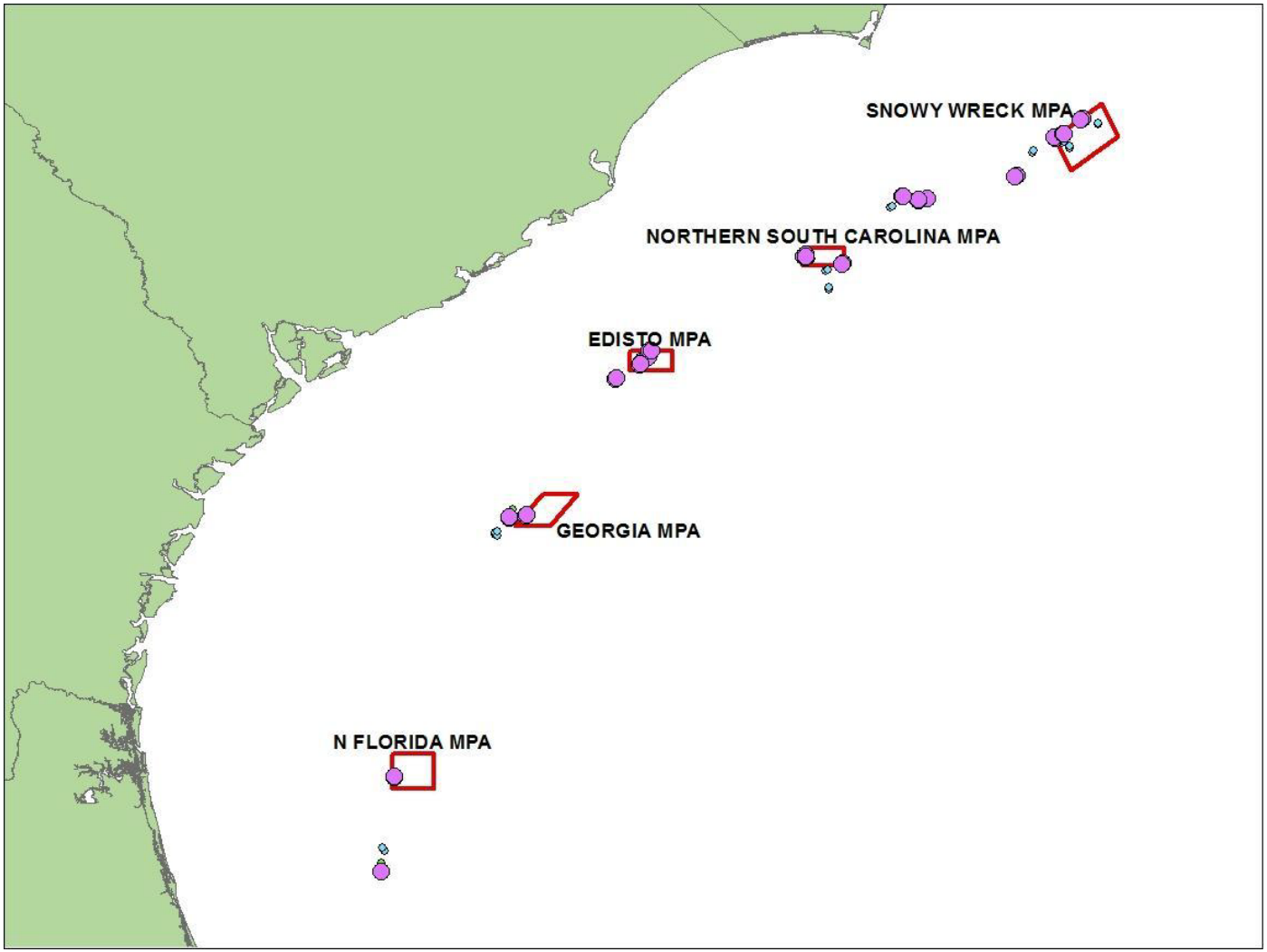
2007
20 Dives



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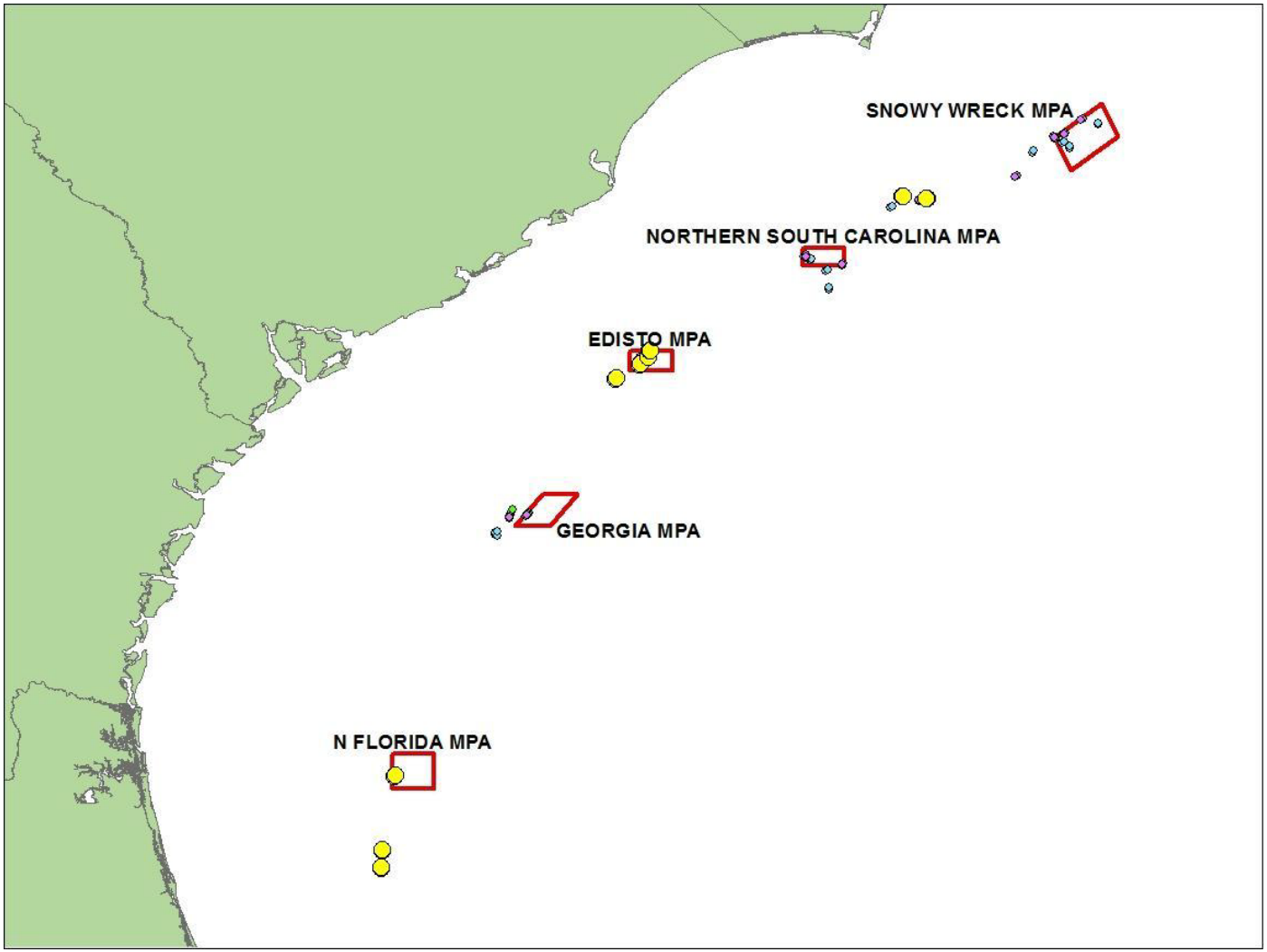
2008
11 Dives



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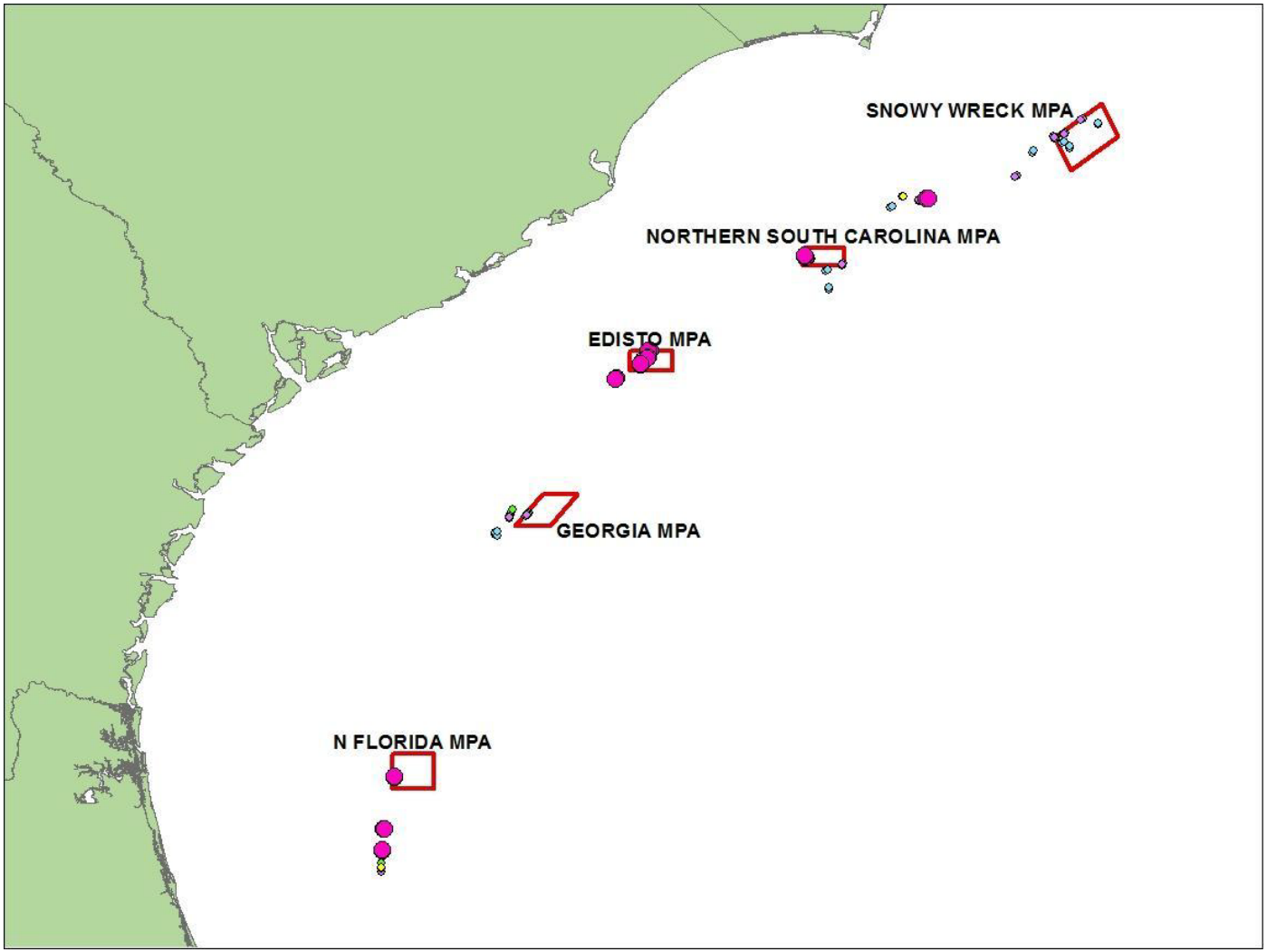
2009
10 Dives



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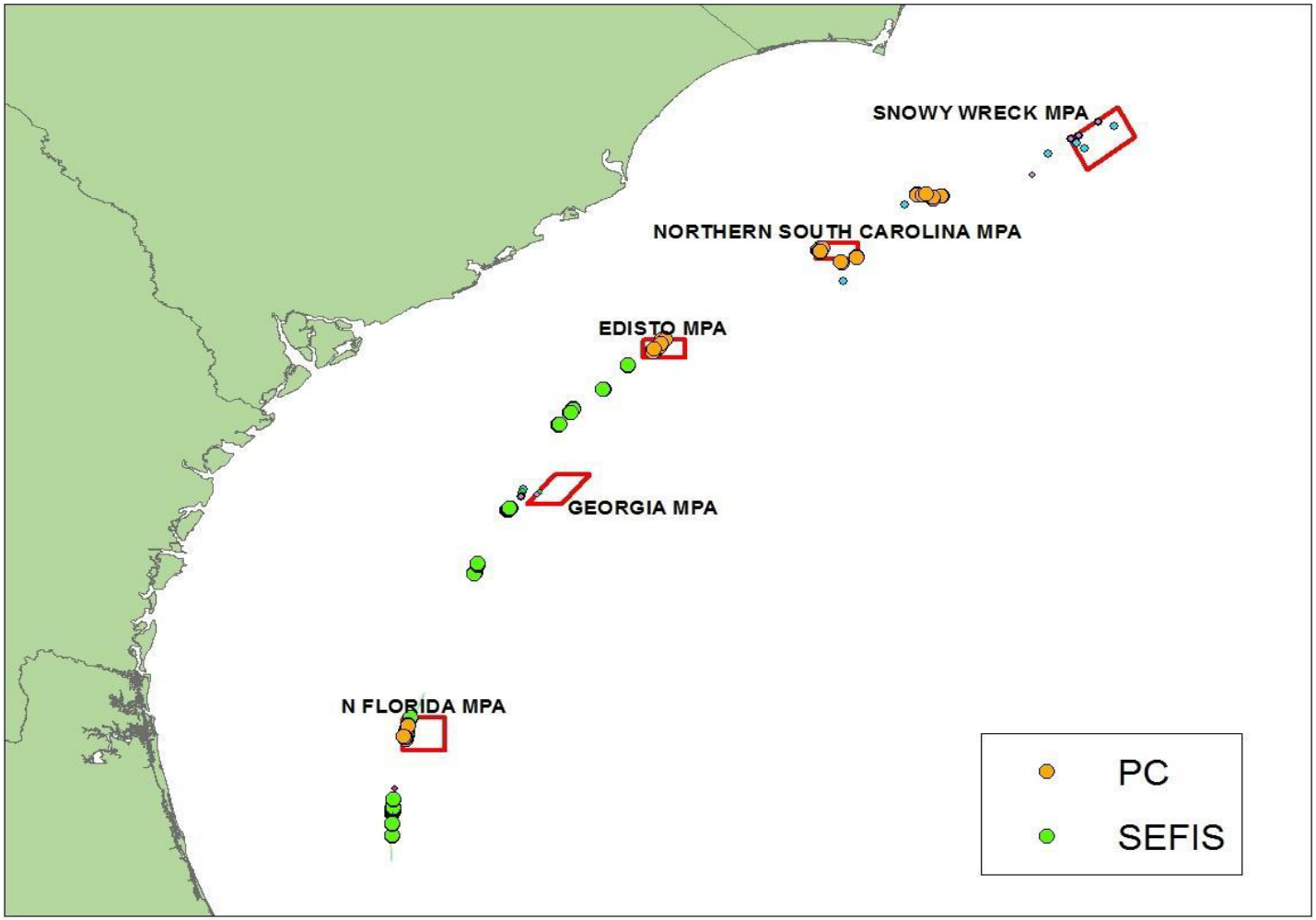
2010
PC - 17 Dives, SEFIS – 25 Dives



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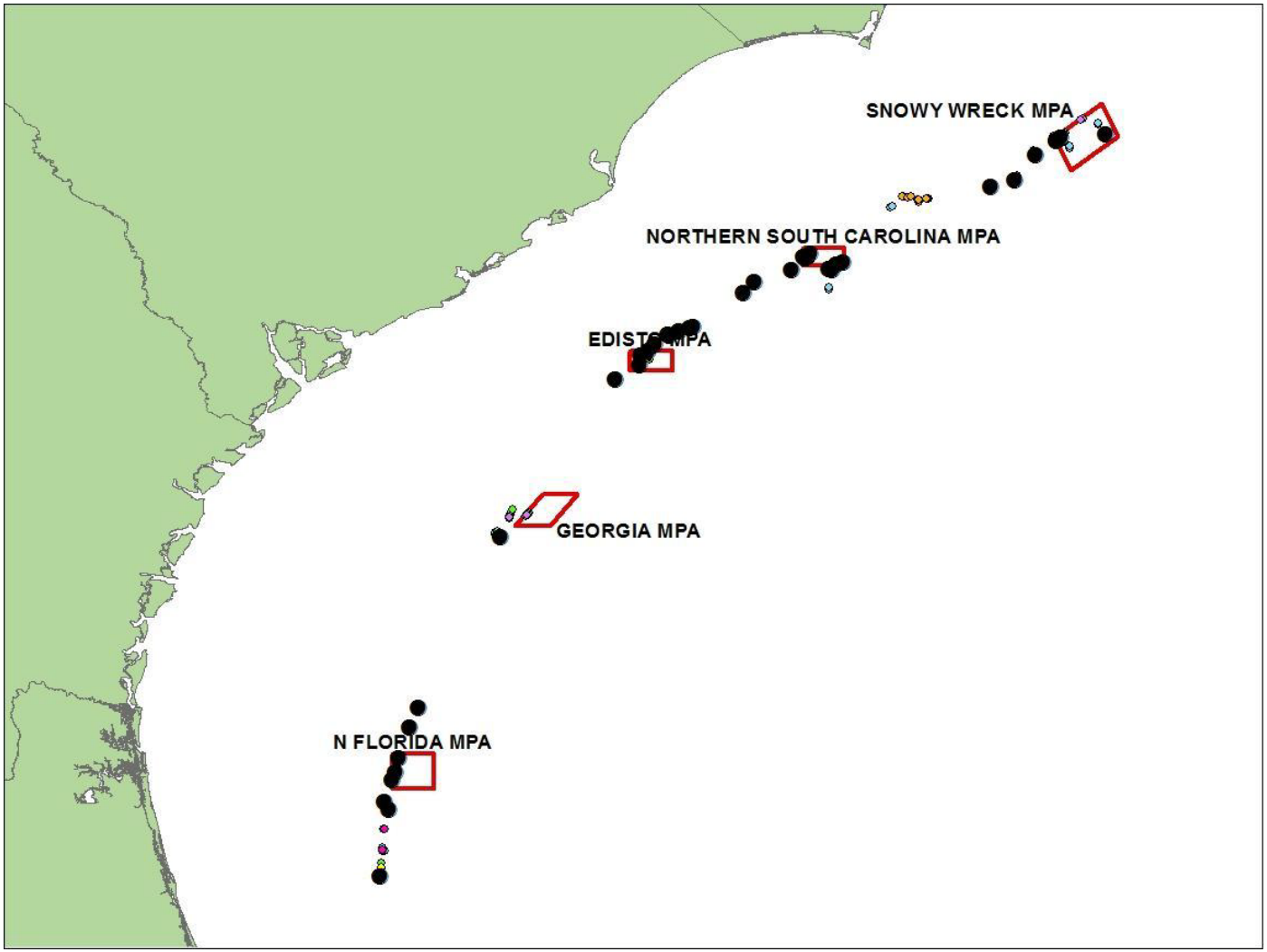
2012
37 Dives



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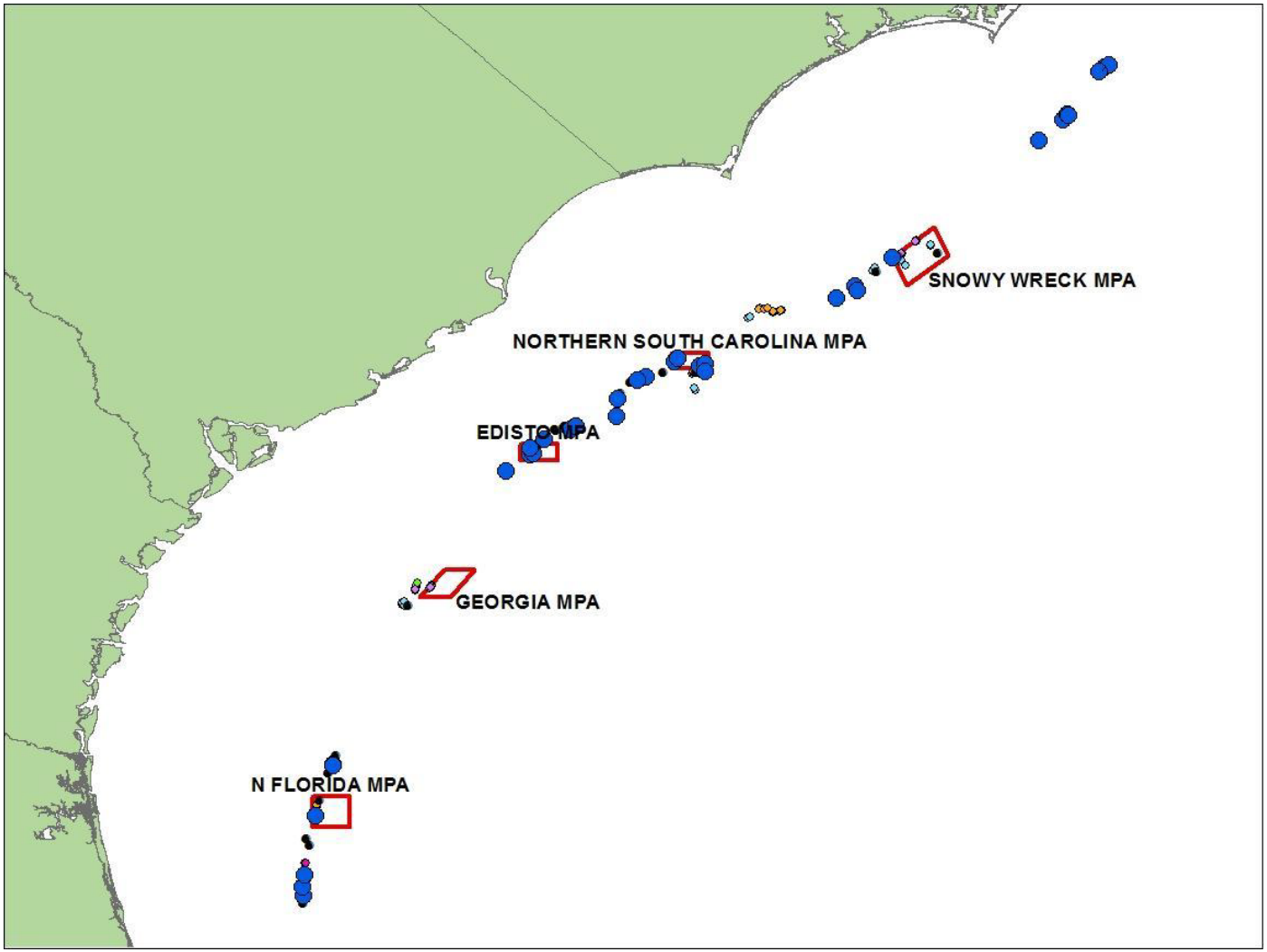
2013
33 Dives



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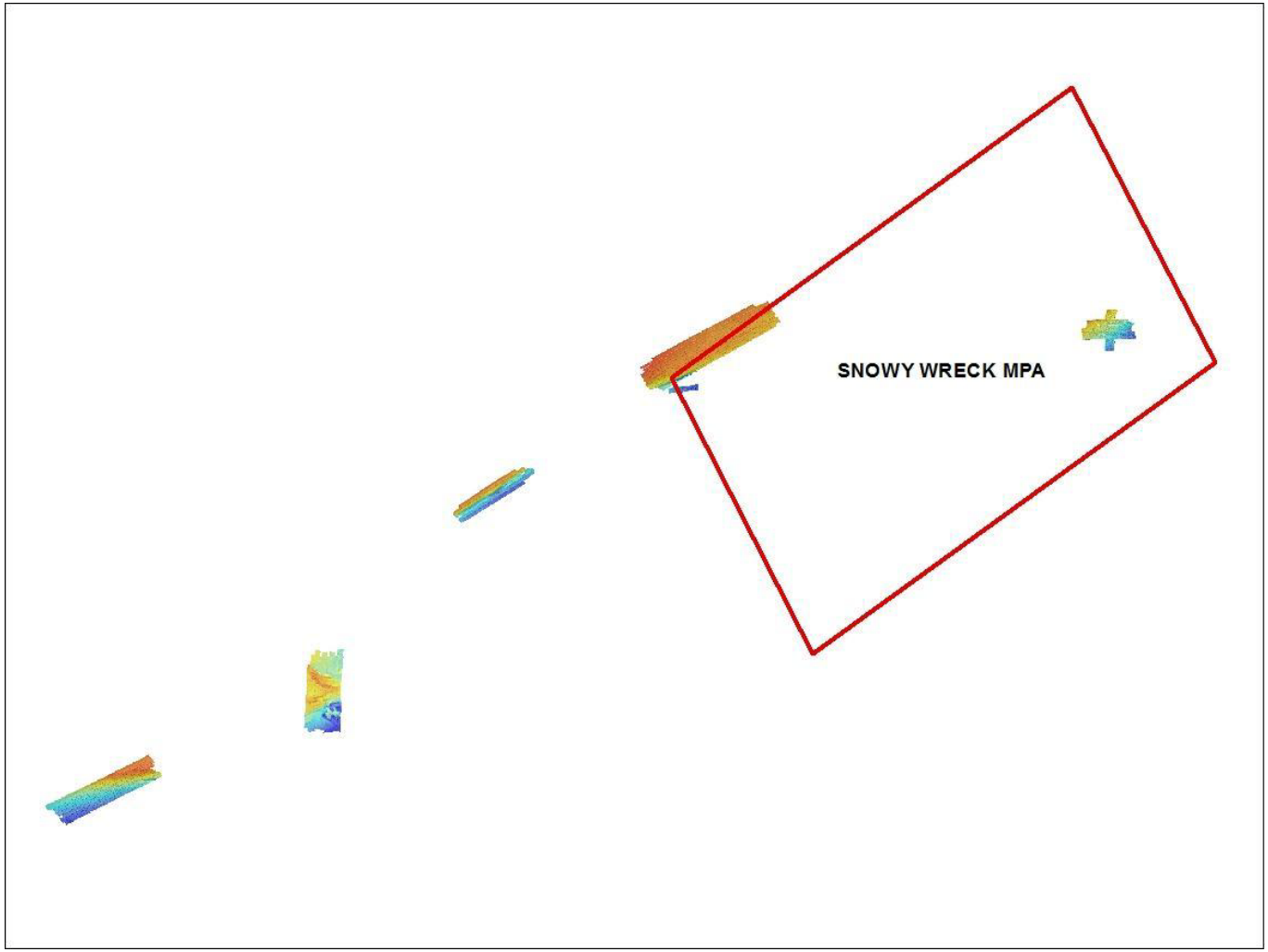
Mapping – Snowy Wreck MPA



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Snowy Wreck MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Amberjack (Greater & Almaco)	16.3	12.2	0.0	47.4	
Blueline Tilefish	0.0	0.0	0.0	0.2	
Gag Grouper	0.4	0.0	0.6	0.1	X
Gray Triggerfish	0.0	0.0	0.0	3.8	
Graysby	0.5	0.0	0.6	0.2	X
Hogfish	0.2	2.6	0.9	1.6	X
Lionfish	1.7	1.3	21.4	16.8	X
Porgy - Calamus sp.	0.2	1.3	2.3	1.9	X
Red Grouper	0.0	0.0	1.5	0.4	X
Red Porgy	0.0	0.0	25.7	3.5	X
Rock Hind	0.0	0.0	0.0	0.2	
Scamp	7.6	6.5	4.6	3.4	
Snowy Grouper	2.8	1.4	0.0	0.7	
Speckled Hind	0.4	2.1	0.0	0.1	
Striped Grunt	0.0	0.0	0.0	85.3	
Tomtate	0.0	0.0	120.8	64.7	X
Vermilion Snapper	0.0	0.0	0.0	101.6	
Yellowmouth Grouper	0.0	0.0	0.0	0.1	

- 8 grouper species
- 1 snapper species

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Snowy Wreck MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
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Blueline Tilefish	**0.0**	**0.0**	**0.0**	**0.2**	
Gag Grouper	0.4	0.0	0.6	0.1	X
Gray Triggerfish	0.0	0.0	0.0	3.8	
Graysby	0.5	0.0	0.6	0.2	X
Hogfish	0.2	2.6	0.9	1.6	X
Lionfish	1.7	1.3	21.4	16.8	X
Porgy - Calamus sp.	0.2	1.3	2.3	1.9	X
Red Grouper	0.0	0.0	1.5	0.4	X
Red Porgy	0.0	0.0	25.7	3.5	X
Rock Hind	0.0	0.0	0.0	0.2	
Scamp	7.6	6.5	4.6	3.4	
Snowy Grouper	**2.8**	**1.4**	**0.0**	**0.7**	
Speckled Hind	**0.4**	**2.1**	**0.0**	**0.1**	
Striped Grunt	0.0	0.0	0.0	85.3	
Tomtate	0.0	0.0	120.8	64.7	X
Vermilion Snapper	0.0	0.0	0.0	101.6	
Yellowmouth Grouper	0.0	0.0	0.0	0.1	

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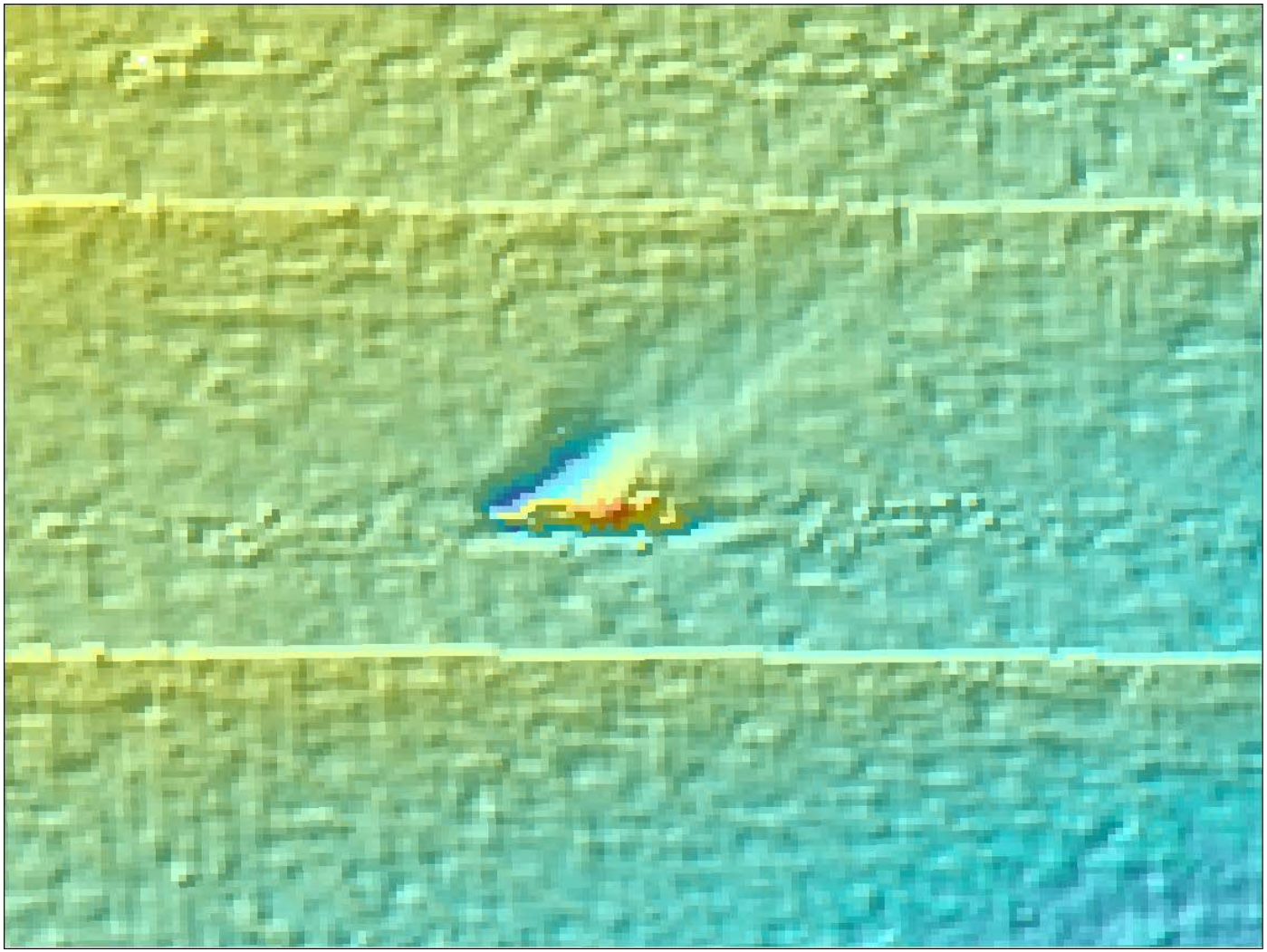
Snowy Wreck



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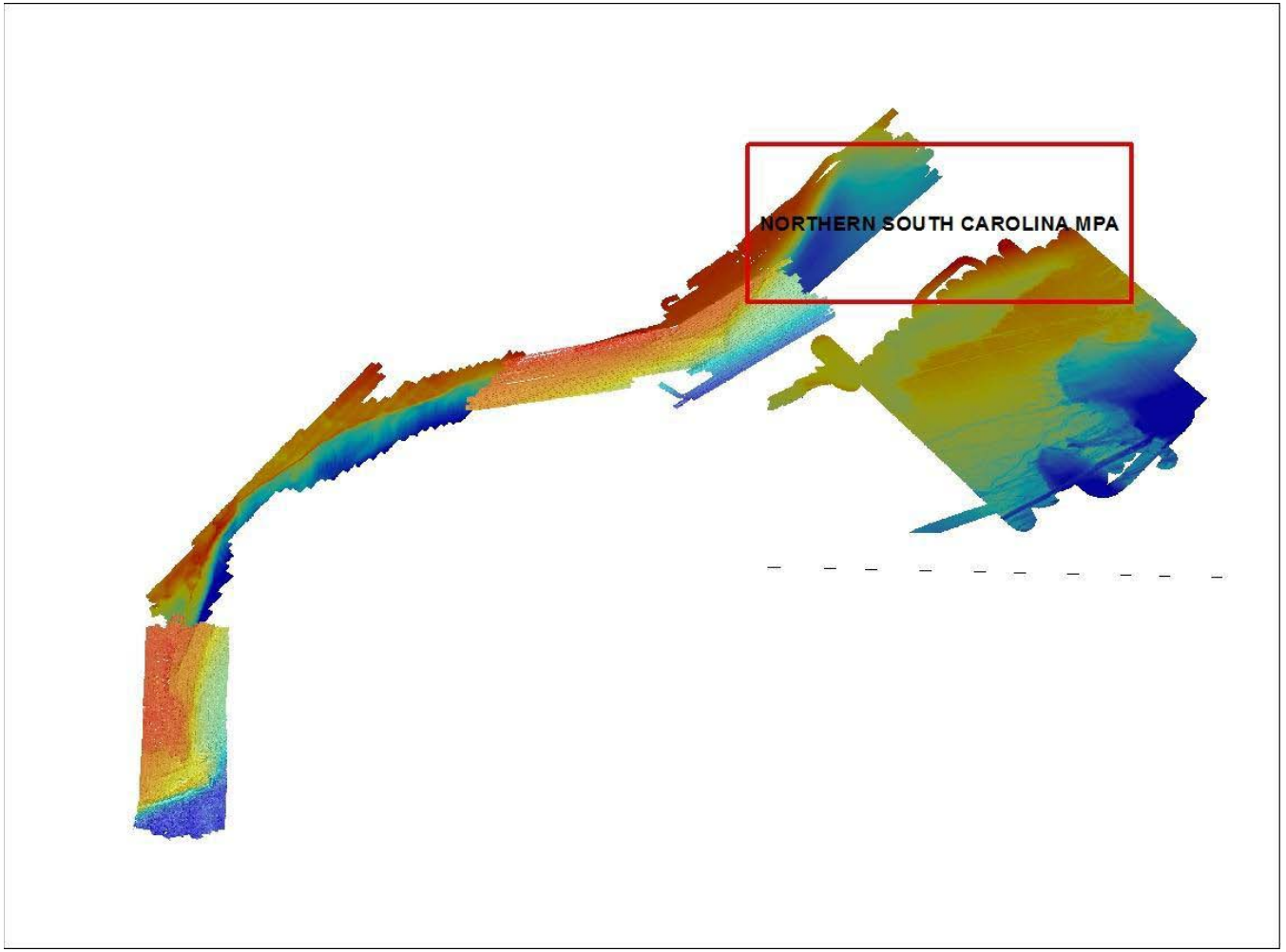
Mapping – Northern South Carolina MPA



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Northern South Carolina MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Amberjack (Greater & Almaco)	2.5	17.3	2.4	3.8	
Blueline Tilefish	4.4	0.4	0.6	1.0	
Coney Grouper	0.7	0.5	0.0	0.0	
Gag Grouper	0.4	0.4	1.1	1.0	X
Gray Snapper	0.0	0.0	0.0	0.9	
Gray Triggerfish	0.4	12.2	1.2	1.5	X
Graysby	1.6	1.9	2.0	2.1	X
Hogfish	4.0	21.1	3.4	5.2	
Lionfish	11.0	30.4	50.9	39.7	X
Porgy - Calamus sp.	6.2	21.4	12.5	9.2	X
Queen Triggerfish	0.0	0.0	0.0	0.0	X
Red Grouper	0.0	0.5	0.8	0.5	X
Red Hind	0.3	0.0	0.0	0.0	
Red Porgy	1.0	1.7	3.2	2.3	X
Rock Hind	0.9	3.5	0.3	0.2	
Scamp	12.0	7.7	11.1	9.2	

- 11 grouper species
- 2 snapper species

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Northern South Carolina MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Snowy Grouper	2.4	0.0	3.9	9.2	X
Speckled Hind	0.0	0.9	0.2	0.1	X
Striped Grunt	0.0	15.7	0.0	63.6	
Tomtate	420.7	0.0	1371.0	1496.1	X
Vermilion Snapper	32.4	0.0	232.5	45.4	X
White Grunt	1.3	9.3	1.4	0.4	X
Yellowedge Grouper	0.0	0.0	0.1	0.1	X
Yellowmouth Grouper	0.0	0.0	0.0	0.1	

- 11 grouper species
- 2 snapper species

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Blueline Tilefish	**4.4**	**0.4**	**0.6**	**1.0**	
Coney Grouper	0.6	0.5	0.0	0.0	
Gag Grouper	0.4	0.4	1.1	1.0	X
Gray Snapper	0.0	0.0	0.0	0.9	
Gray Triggerfish	0.4	12.2	1.2	1.5	X
Graysby	1.6	1.9	2.0	2.1	X
Hogfish	4.0	21.1	3.4	5.2	
Lionfish	11.0	30.4	50.9	39.7	X
Porgy - Calamus sp.	6.2	21.4	12.5	9.2	X
Queen Triggerfish	0.0	0.0	0.0	0.0	X
Red Grouper	0.0	0.5	0.8	0.5	X
Red Hind	0.3	0.0	0.0	0.0	

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Northern South Carolina MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Red Porgy	1.0	1.7	3.2	2.3	X
Rock Hind	0.9	3.5	0.3	0.2	
Scamp	12.0	7.7	11.1	9.2	
Snowy Grouper	**2.4**	**0.0**	**3.9**	**9.2**	**X**
Speckled Hind	**0.0**	**0.9**	**0.2**	**0.1**	**X**
Striped Grunt	0.0	15.7	0.0	63.6	
Tomtate	420.7	0.0	1371.0	1496.1	X
Vermilion Snapper	32.4	0.0	232.5	45.4	X
White Grunt	1.3	9.3	1.4	0.4	X
Yellowedge Grouper	**0.0**	**0.0**	**0.1**	**0.1**	**X**
Yellowmouth Grouper	0.0	0.0	0.0	0.1	

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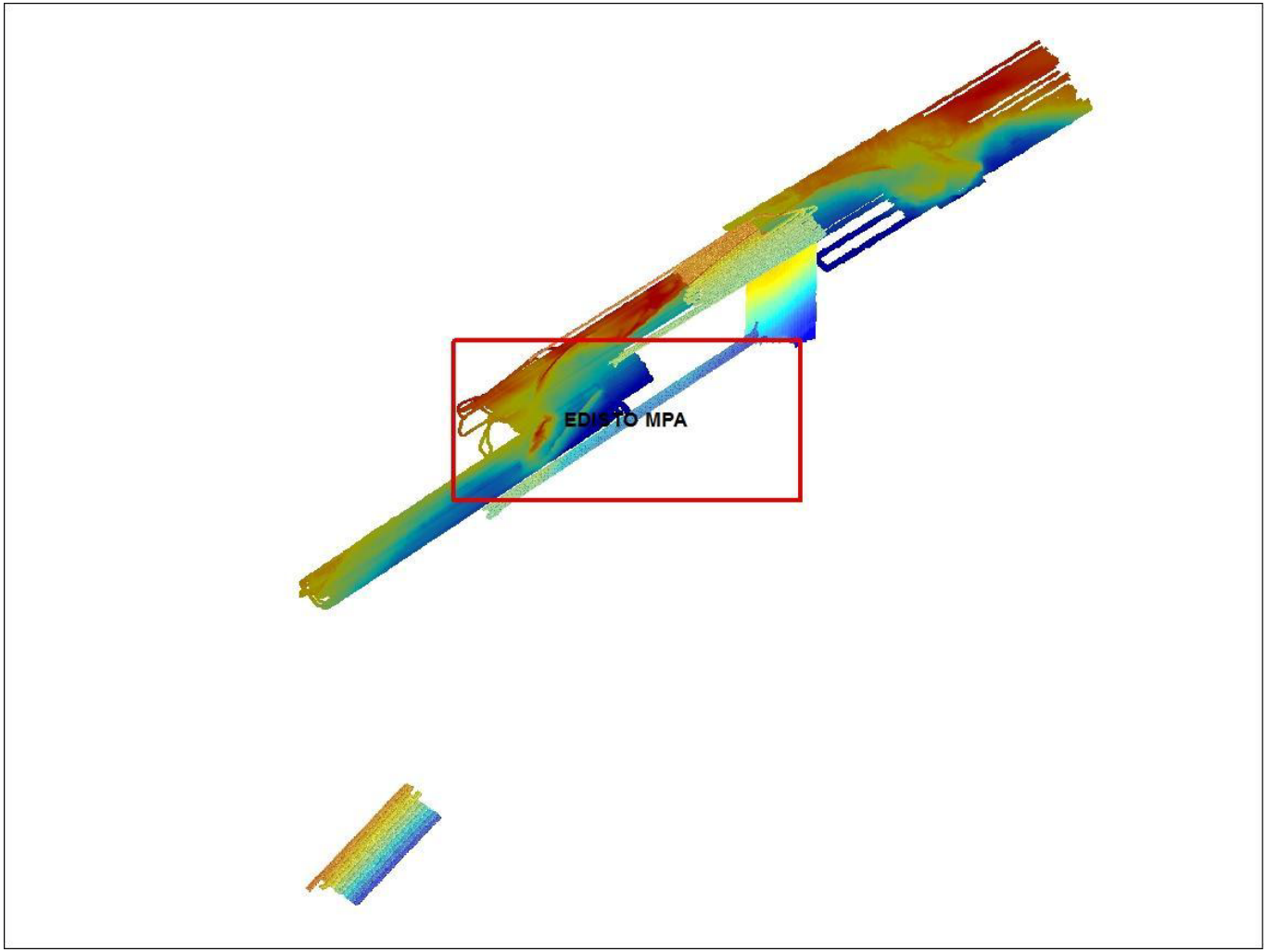
Mapping – Edisto MPA



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Edisto MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Amberjack (Greater & Almaco)	28.7	40.9	7.0	17.3	
Black Grouper	0.0	0.0	0.2	0.0	X
Black Margate	0.0	0.5	0.0	0.0	
Coney Grouper	0.2	0.0	0.0	0.1	
Gag Grouper	0.4	0.5	1.1	1.2	X
Gray Snapper	0.0	0.0	0.2	2.9	X
Gray Triggerfish	2.2	18.1	2.7	4.2	X
Graysby	0.9	4.5	1.9	6.7	X
Hogfish	2.7	2.7	2.5	1.8	
Lionfish	7.5	33.0	28.2	50.8	X
Porgy - Calamus sp.	3.8	12.4	8.8	18.4	X
Queen Triggerfish	0.7	0.0	0.8	0.4	X
Red Grouper	0.0	0.4	0.1	0.0	X
Red Porgy	12.2	3.6	40.7	13.0	X
Red Snapper	0.0	0.5	0.0	0.3	
Rock Hind	0.0	0.4	0.1	0.3	X

- 10 grouper species
- 4 snapper species

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Edisto MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Scamp	15.4	32.3	12.0	27.7	
Snowy Grouper	0.7	0.0	0.0	0.0	
Speckled Hind	2.1	0.0	0.0	0.1	
Striped Grunt	0.0	31.6	2.4	11.4	X
Tomtate	11.6	1577.0	301.6	2116.8	X
Vermilion Snapper	4.9	424.6	92.9	481.0	X
White Grunt	0.0	0.8	0.2	0.4	X
Yellowmouth Grouper	0.0	0.0	0.0	0.0	X
Yellowtail Snapper	0.0	0.0	0.0	0.1	

- 10 grouper species
- 4 snapper species

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Edisto MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Amberjack (Greater & Almaco)	28.7	40.9	7.0	17.3	
Black Grouper	0.0	0.0	0.2	0.0	X
Black Margate	0.0	0.5	0.0	0.0	
Coney Grouper	0.2	0.0	0.0	0.1	
Gag Grouper	0.4	0.5	1.1	1.2	X
Gray Snapper	0.0	0.0	0.2	2.9	X
Gray Triggerfish	2.2	18.1	2.7	4.2	X
Graysby	0.9	4.5	1.9	6.7	X
Hogfish	2.7	2.7	2.5	1.8	
Lionfish	7.5	33.0	28.3	50.8	X
Porgy - Calamus sp.	3.8	12.4	8.8	18.4	X
Queen Triggerfish	0.7	0.0	0.8	0.4	X
Red Grouper	0.0	0.4	0.1	0.0	X
Red Porgy	12.2	3.6	40.7	13.0	X
Red Snapper	0.0	0.5	0.0	0.3	
Rock Hind	0.0	0.4	0.1	0.3	X

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Edisto MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Scamp	15.4	32.3	12.0	27.7	
Snowy Grouper	**0.7**	**0.0**	**0.0**	**0.0**	
Speckled Hind	**2.1**	**0.0**	**0.0**	**0.1**	
Striped Grunt	0.0	31.6	2.4	11.4	X
Tomtate	11.6	1577.0	301.6	2116.8	X
Vermilion Snapper	4.9	424.7	92.9	481.0	X
White Grunt	0.0	0.8	0.2	0.4	X
Yellowmouth Grouper	0.0	0.0	0.0	0.0	X
Yellowtail Snapper	0.0	0.0	0.0	0.1	

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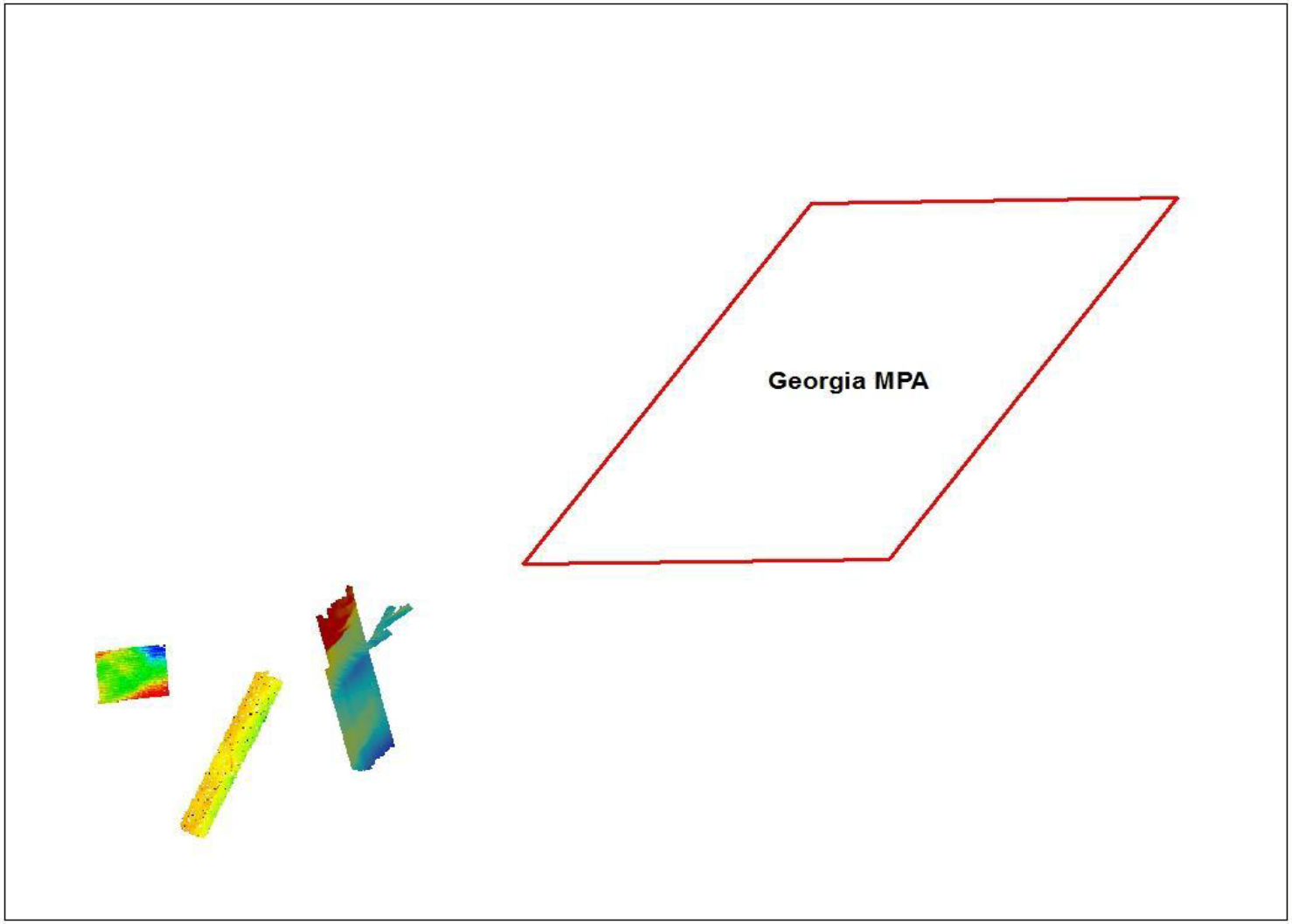
Georgia Mapping



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Georgia MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Outside MPA After Closure	Increase after closure?
Amberjack (Greater & Almacos)	0.0	10.4	0.0	
Blueline Tilefish	0.0	0.2	0.0	
Gag Grouper	0.0	0.5	0.0	
Gray Triggerfish	0.0	0.7	0.0	
Lionfish	0.0	0.8	14.0	X
Porgy - Calamus sp.	0.0	0.8	14.0	X
Red Grouper	0.0	0.2	0.0	
Red Porgy	0.0	30.3	2.8	
Red Snapper	0.0	8.5	0.0	
Scamp	29.0	16.2	0.0	
Snowy Grouper	21.1	0.0	0.0	
Tomtate	0.0	20.0	0.0	
Warsaw Grouper	0.0	1.9	0.0	*

- 5 grouper species
- 1 snapper species

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Georgia MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Outside MPA After Closure	Increase after closure?
Amberjack (Greater & Almacos)	0.0	10.4	0.0	
Blueline Tilefish	**0.0**	**0.2**	**0.0**	
Gag Grouper	0.0	0.5	0.0	
Gray Triggerfish	0.0	0.7	0.0	
Lionfish	0.0	0.8	14.0	X
Porgy - Calamus sp.	0.0	0.8	14.0	X
Red Grouper	0.0	0.2	0.0	
Red Porgy	0.0	30.3	2.8	
Red Snapper	0.0	8.5	0.0	
Scamp	29.0	16.2	0.0	
Snowy Grouper	**21.1**	**0.0**	**0.0**	
Tomtate	0.0	20.0	0.0	
Warsaw Grouper	**0.0**	**1.9**	**0.0**	

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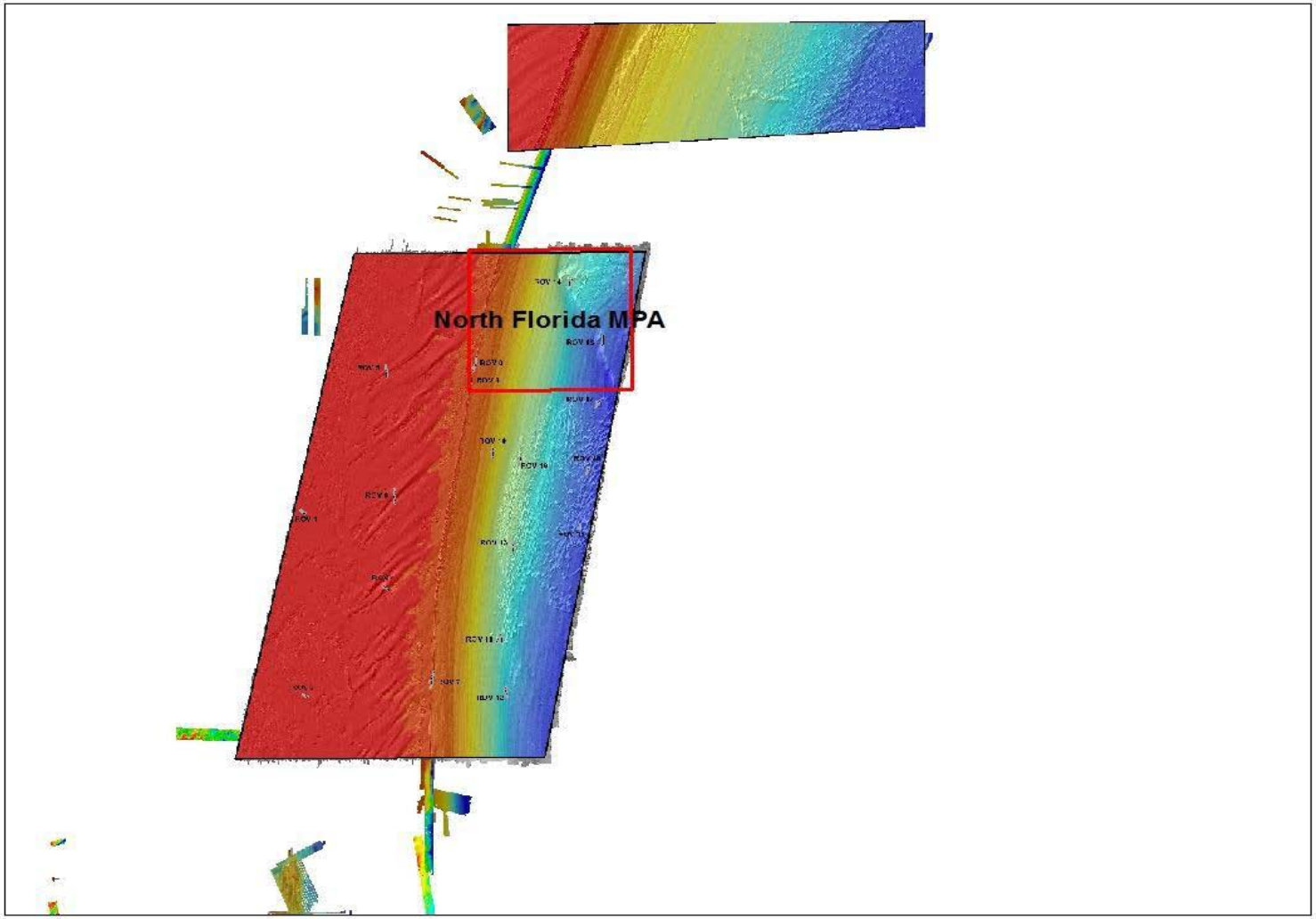
Mapping – North Florida MPA



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North Florida MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Amberjack (Greater & Almacos)	9.1	7.2	5.7	12.6	
Blackfin Snapper	0.0	0.0	0.0	0.1	
Gag Grouper	0.0	0.0	0.4	0.1	X
Goliath Grouper	0.0	0.0	0.2	0.0	X
Gray Snapper	0.0	0.0	0.1	12.7	X
Gray Triggerfish	15.0	0.4	1.7	6.9	
Graysby	0.0	0.1	0.0	0.0	
Hogfish	0.6	1.7	0.1	3.2	
Lane Snapper	0.0	0.6	0.0	0.0	
Lionfish	0.4	0.3	5.2	3.7	X
Margate	0.0	0.0	0.0	0.1	
Mutton Snapper	0.0	0.0	0.1	0.0	X
Porgy - Calamus sp.	0.3	0.1	0.5	1.9	X
Queen Snapper	0.3	0.0	0.0	0.0	

-8 grouper species

-8 snapper species

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North Florida MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Queen Triggerfish	0.0	0.4	0.2	0.4	X
Red Grouper	0.0	0.1	0.0	0.0	
Red Porgy	32.6	0.2	7.9	3.8	
Red Snapper	0.3	0.0	0.0	0.0	
Scamp	0.7	10.1	4.9	6.2	X
Snowy Grouper	0.0	0.0	0.0	0.0	X
Speckled Hind	0.0	0.0	0.4	0.4	X
Striped Grunt	0.0	46.4	2.9	0.1	X
Tomtate	294.4	921.0	350.4	674.6	X
Vermilion Snapper	111.9	670.1	446.0	1184.3	X
Warsaw Grouper	0.3	0.0	0.0	0.1	
Yellowtail Snapper	0.0	0.0	1.6	0.0	X

-8 grouper species

-8 snapper species

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North Florida MPA Fish Results

Species	Inside MPA Before Closure	Outside MPA Before Closure	Inside MPA After Closure	Outside MPA After Closure	Increase inside MPA?
Amberjack (Greater & Almacos)	9.1	7.2	5.7	12.6	
Blackfin Snapper	0.0	0.0	0.0	0.1	
Gag Grouper	0.0	0.0	0.4	0.1	X
Goliath Grouper	0.0	0.0	0.2	0.0	X
Gray Snapper	0.0	0.0	0.1	12.7	X
Gray Triggerfish	15.0	0.4	1.7	6.9	
Graysby	0.0	0.1	0.0	0.0	
Hogfish	0.6	1.7	0.1	3.1	
Lane Snapper	0.0	0.6	0.0	0.0	
Lionfish	0.4	0.3	5.2	3.7	X
Margate	0.0	0.0	0.0	0.1	
Mutton Snapper	0.0	0.0	0.1	0.0	X
Porgy - Calamus sp.	0.3	0.1	0.5	1.9	X
Queen Snapper	0.3	0.0	0.0	0.0	

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Red Grouper	0.0	0.1	0.0	0.0	
Red Porgy	32.6	0.2	7.9	3.8	
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Scamp	0.7	10.1	4.9	6.2	X
Snowy Grouper	**0.0**	**0.0**	**0.0**	**0.0**	**X**
Speckled Hind	**0.0**	**0.0**	**0.4**	**0.4**	**X**
Striped Grunt	0.0	46.4	2.9	0.1	X
Tomtate	294.4	921.0	350.4	674.6	X
Vermilion Snapper	111.9	670.1	446.0	1184.3	X
Warsaw Grouper	**0.3**	**0.0**	**0.0**	**0.1**	
Yellowtail Snapper	0.0	0.0	1.6	0.0	X

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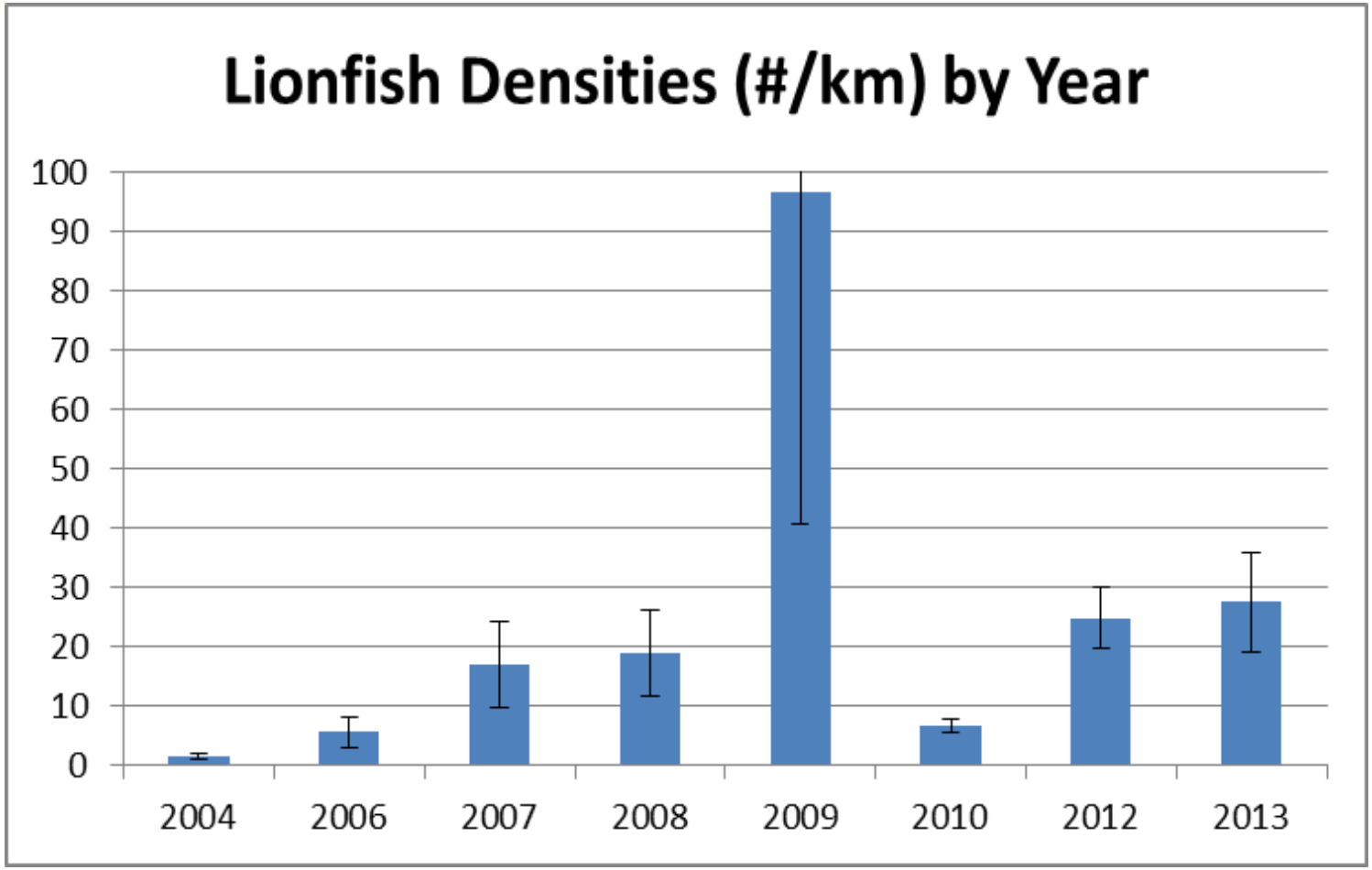
Lionfish



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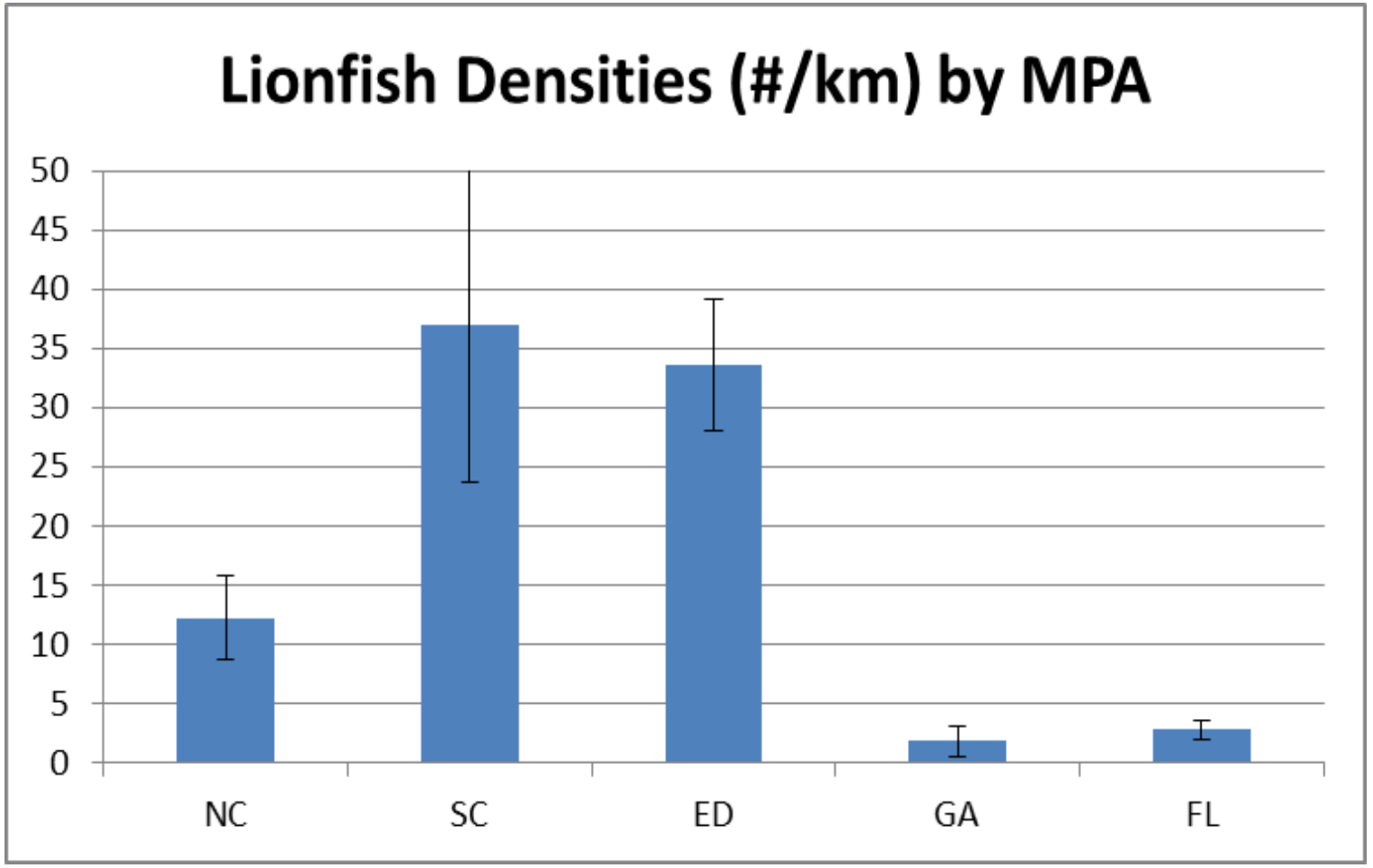
Lionfish



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Conclusions

- Snowy grouper and speckled hind may show an increase in density inside some of the MPAs
- Red porgies, vermilion snapper, and tomtate densities appear to have increased inside most of the MPAs
- Gag grouper densities appear to have increased in all the MPAs except Georgia.
- Highest snapper diversity was observed in the Florida MPA
- Highest grouper diversity was observed in the South Carolina MPAs.
- Post-closure data has only been collected for 4 years; with the target species being long-lived, it will take more time for full change in fishing mortality reductions to be realized.

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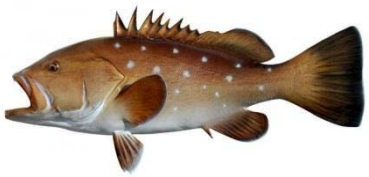
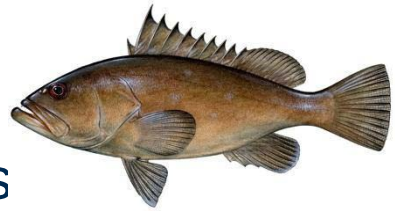
Acknowledgements

- Funding has been provided by SEFSC in 2004 and NOAA Coral Reef Conservation Program (CRCP) from 2006 to 2013 (2011-2013 CRCP funds in partnership with the SAFMC).
- ROV support from UNCW/Underwater Vehicles Program and NURC at the University of Connecticut.
- Vessel support from NOAA (*Delaware II* & *Pisces*), NASA (M/V *Liberty* & *Freedom)*, and M/V *Spree.*





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Connectivity of the MPAs

- Information from George Sedberry & Michelle Meadows
- SCDNR project funded by NMFS Special Programs Office
- Deployment of surface drifters and subsurface drogued drifters
- MARMAP spawning data was used to locate gag spawning grounds were detected
- Deployed on new and full moons during peak spawning periods (March and April)

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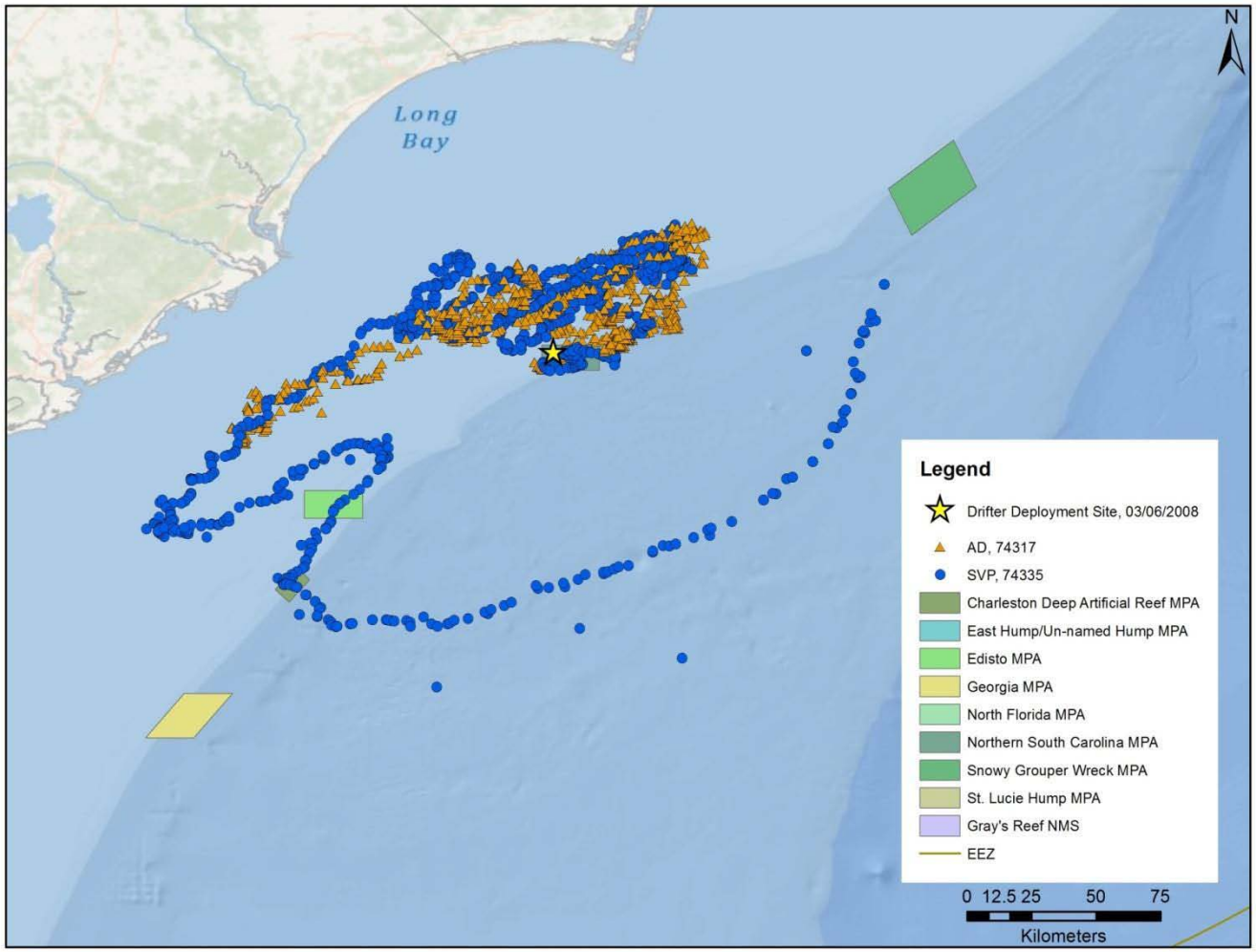
AD = surface drifter

SVP = subsurface drogued drifter

Subsurface drifter deployed in Northern SC MPA connects to Edisto and SC Deep MPAs.



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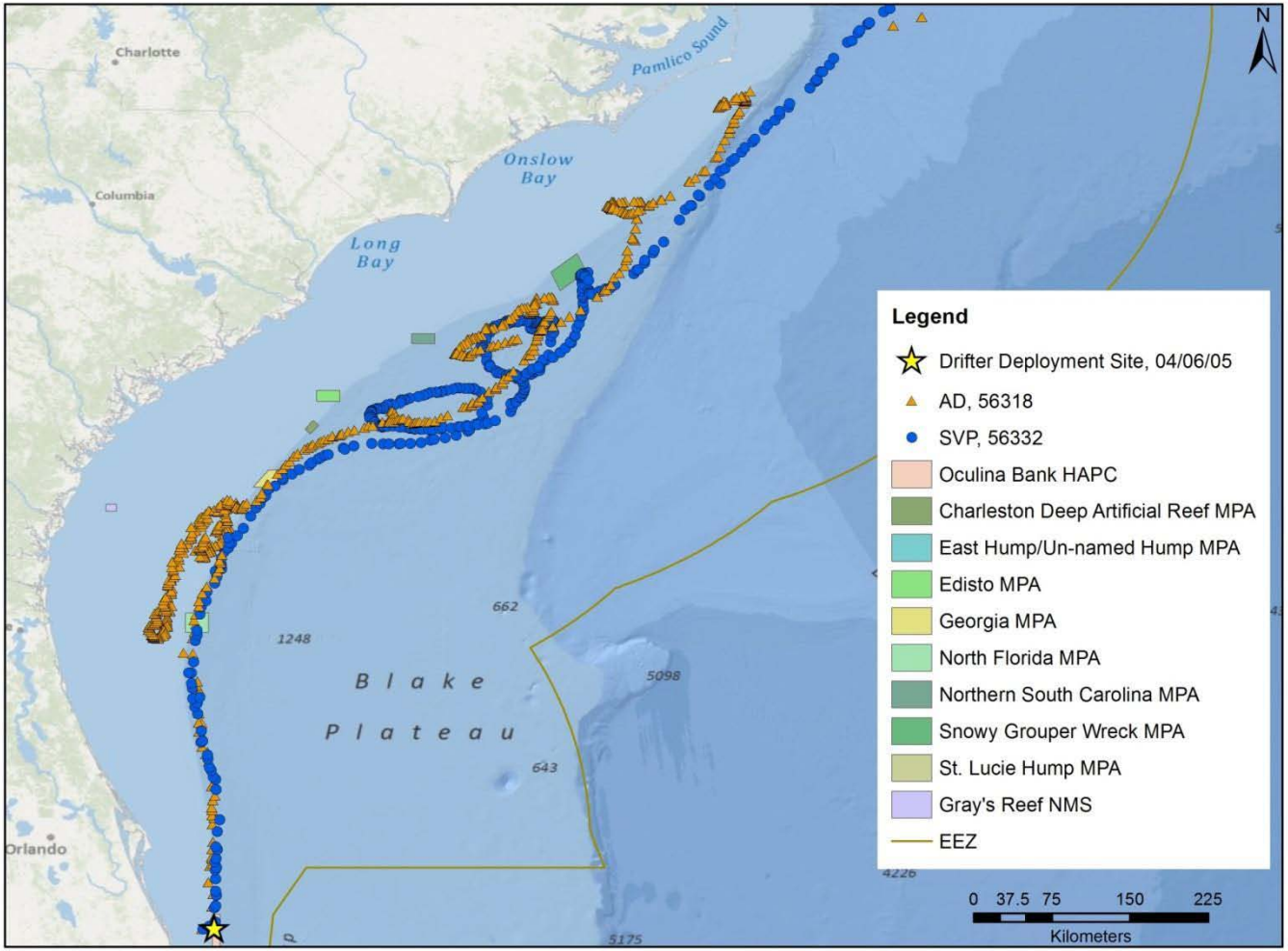
AD = surface drifter

SVP = subsurface drogued drifter

Drifters deployed in Oculina closed area connect to North FL, Georgia and Snow Wreck MPAs.



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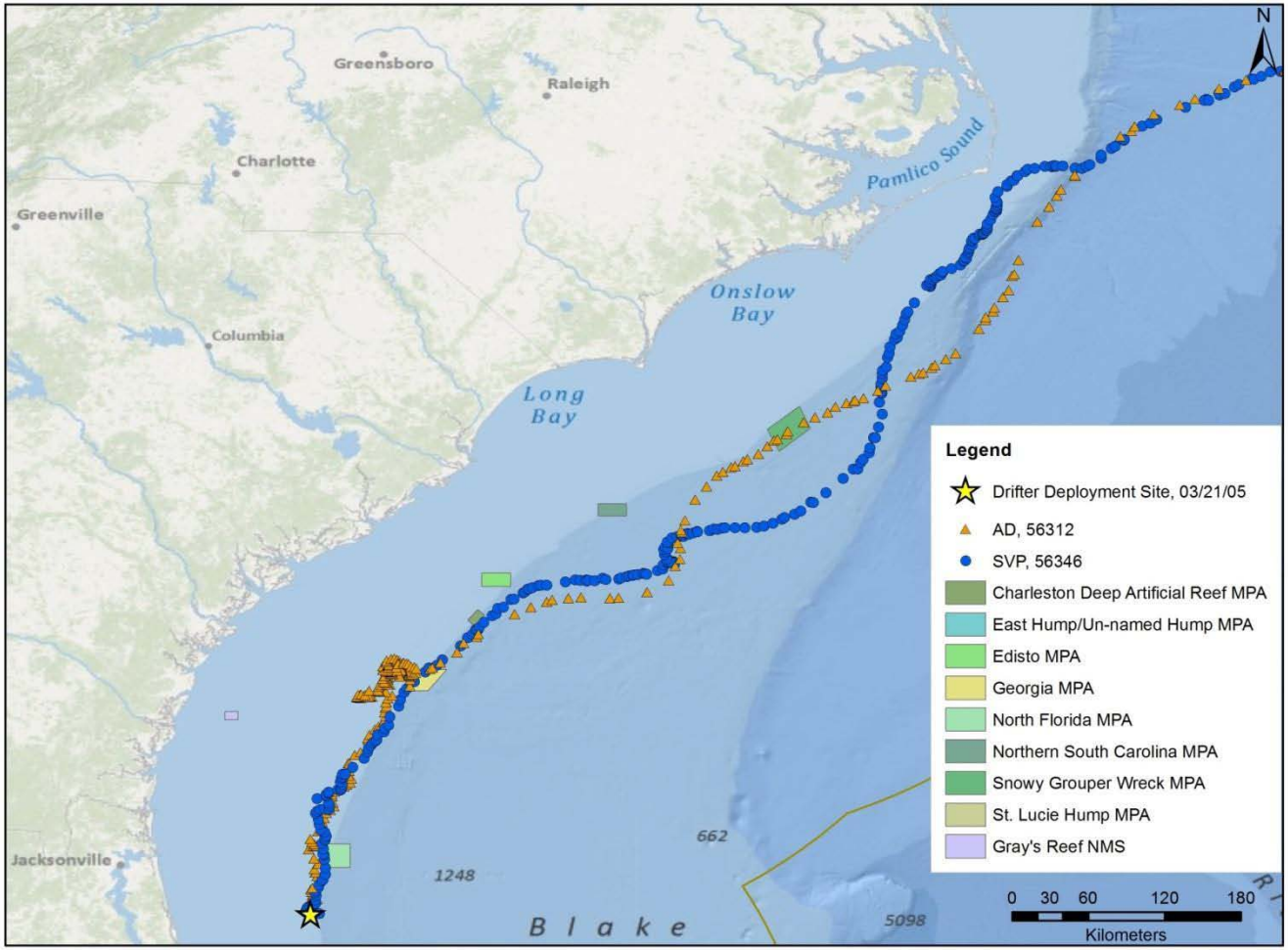
AD = surface drifter

SVP = subsurface drogued drifter

Drifters deployed in proposed St. Augustine MPA connect to North FL, Georgia, SC Deep and Snowy Wreck MPAs.



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AD = surface drifter

SVP = subsurface drogued drifter

Surface drifters deployed in Edisto MPA connect to Northern SC and Snowy Wreck MPAs.