



Recommendations of the SAFMC Marine Protected Area Expert Workgroup

Nick Farmer

SERO

George Sedberry

Chair, MPA-EWG

SAFMC Meeting
Wilmington, North Carolina
December 2-6, 2013



SAFMC MPA Expert Workgroup

Participants:

Scientists	Fishermen
Joey Ballenger	Mark Brown
Churchill Grimes	Jack Cox
Stacey Harter	Don DeMaria
Will Heyman	Bobby Freeman
Chris Koenig	Ben Hartig
Ken Lindeman	Rusty Hudson
George Sedberry	Mark Marhefka
Gabe Ziskin	Ralph Delph

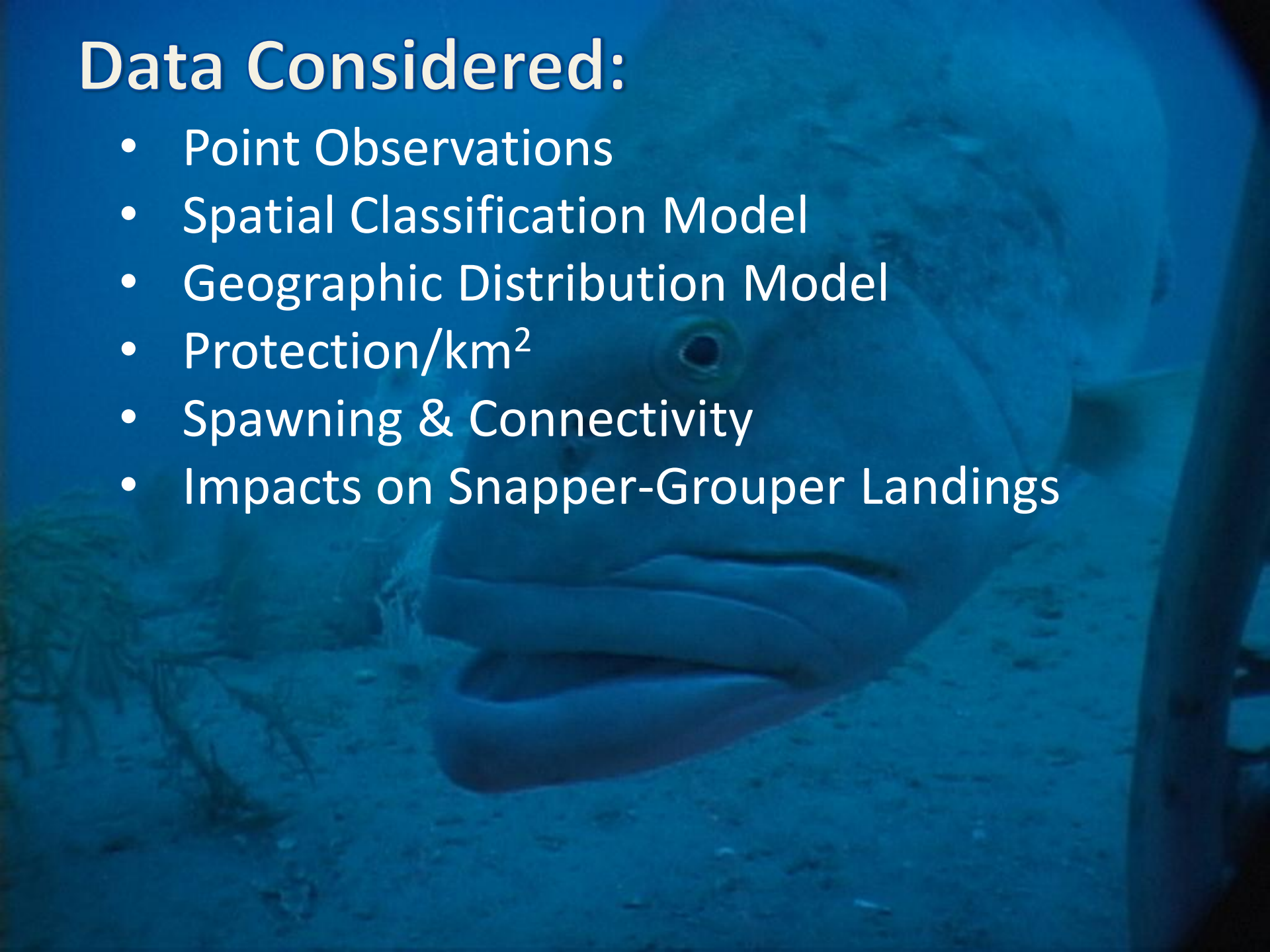
Goal: To support the fishery with minimum impacts to fishermen, while using ecosystem-based management to end overfishing of speckled hind and warsaw grouper.

Meetings: Pooler, GA (May 2012), and Charleston, SC (Feb 2013)



Data Considered:

- Point Observations
- Spatial Classification Model
- Geographic Distribution Model
- Protection/km²
- Spawning & Connectivity
- Impacts on Snapper-Grouper Landings

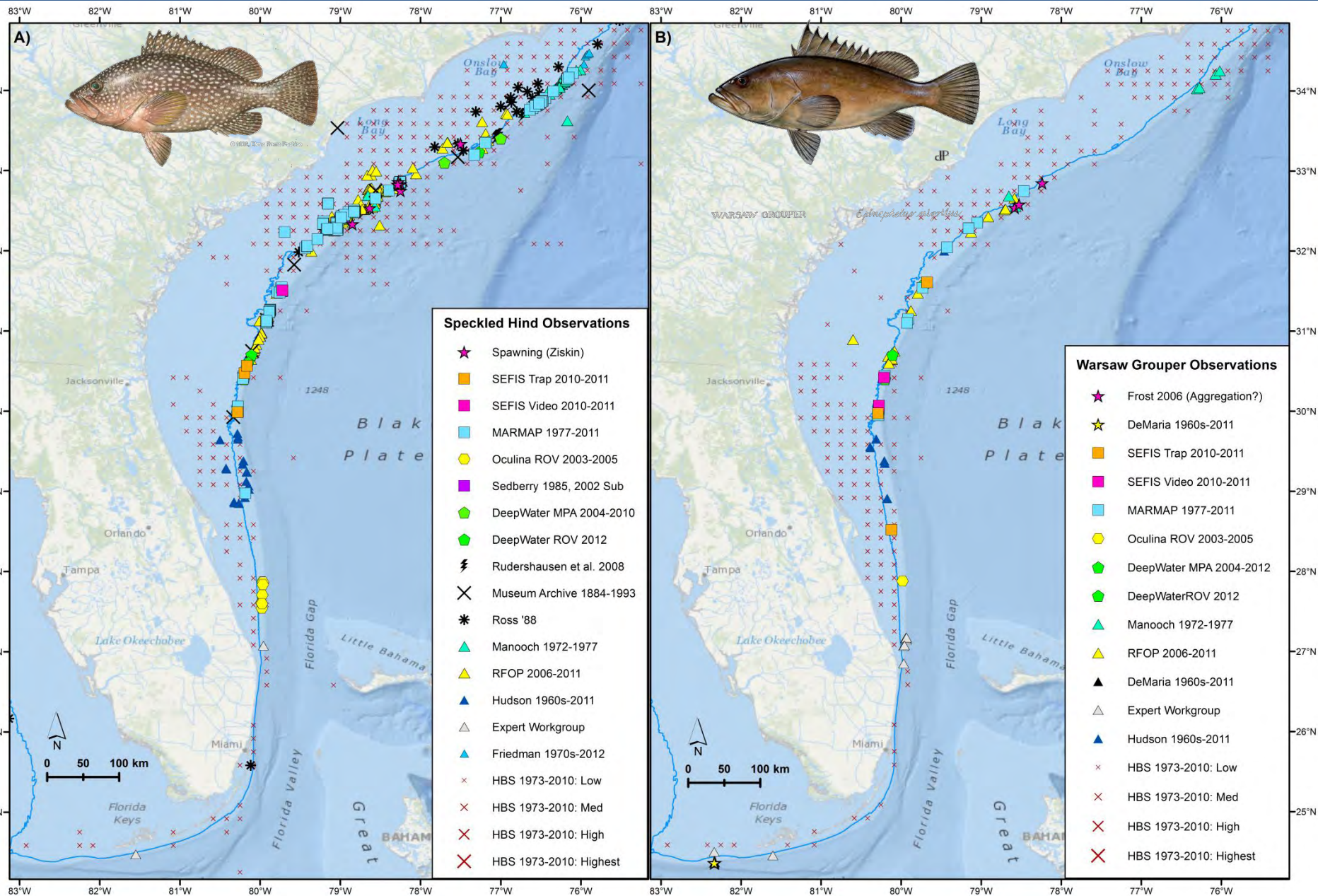


DATA SOURCES

Table 1. Point data sources evaluated in meta-analysis.

Data Source	Years	Resolution	Discards?	Depth?
Headboat Logbook (HBS)	1973-2011	0.17° X 0.17°	2004-present	No
Reef Fish Observer (RFOP)	2006-2011	Lat/Long	Yes	Yes
Marine Resources Monitoring Assessment and Prediction (MARMAP)	1977-2011	Lat/Long	Yes	Yes
Deep-Water Remote Operated Vehicle (DW-ROV) Survey	2004-2011	Lat/Long	Yes	No
Fisher Reports	1960s-2011	Loran & Lat/Long	Yes	Some
Southeast Fishery-Independent Survey (SEFIS)	2010-2011	Lat/Long	Yes	Yes
REEF	1980s-2011	Lat/Long	Yes	No
Oculina ROV	2003-2005	Lat/Long	Yes	Yes
Fisheries Research Group (FRG)	1972-1977	Lat/Long	Yes	Yes
Sedberry Sub	1985, 2002	Lat/Long	Yes	Yes
Rudershausen et al.	2007	Lat/Long	Yes	Yes
Museum Collections	1884-1991	Lat/Long	Yes	Yes

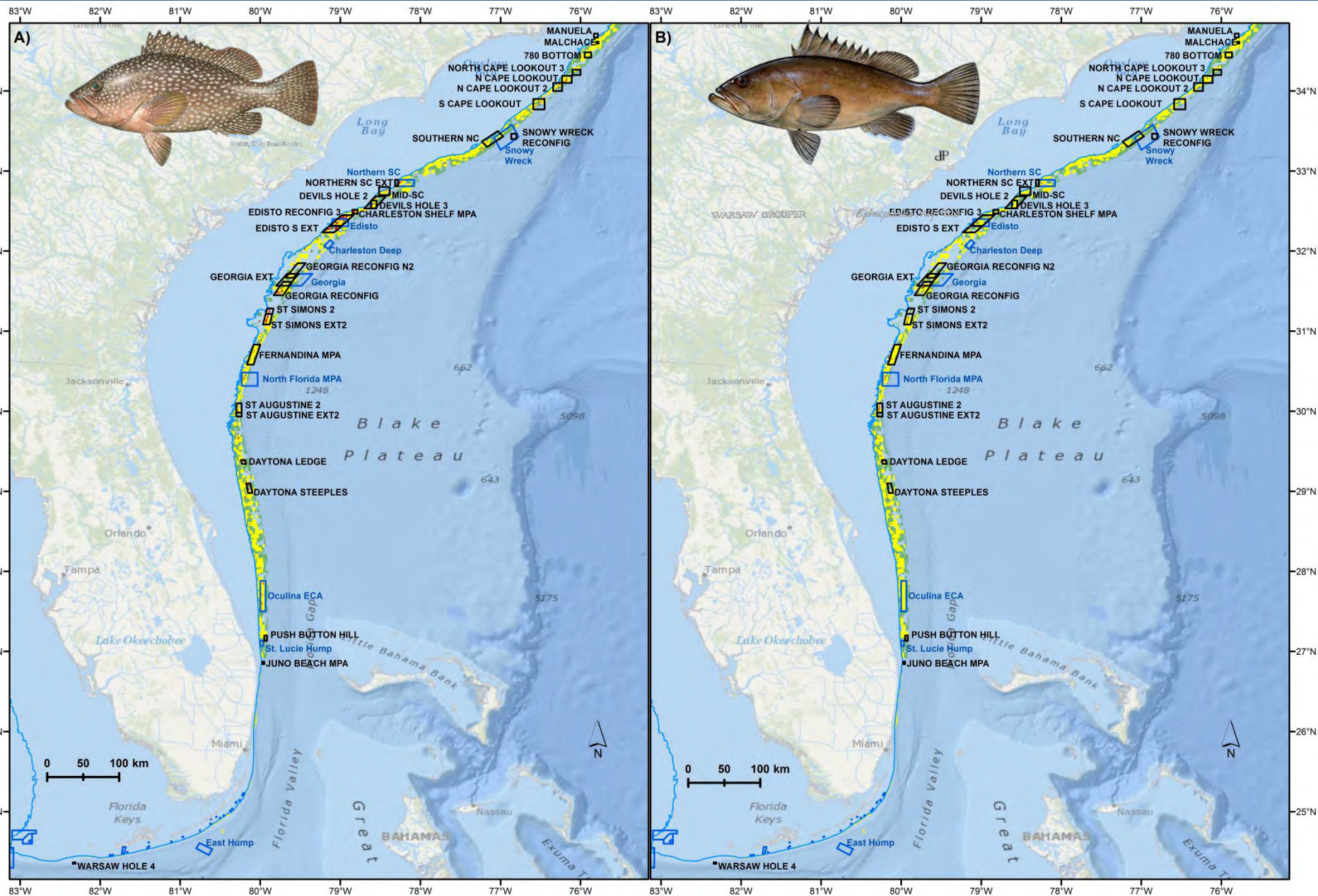
POINT OBSERVATIONS



Farmer & Karnauskas (2013); Figure 2

SPATIAL CLASSIFICATION MODEL

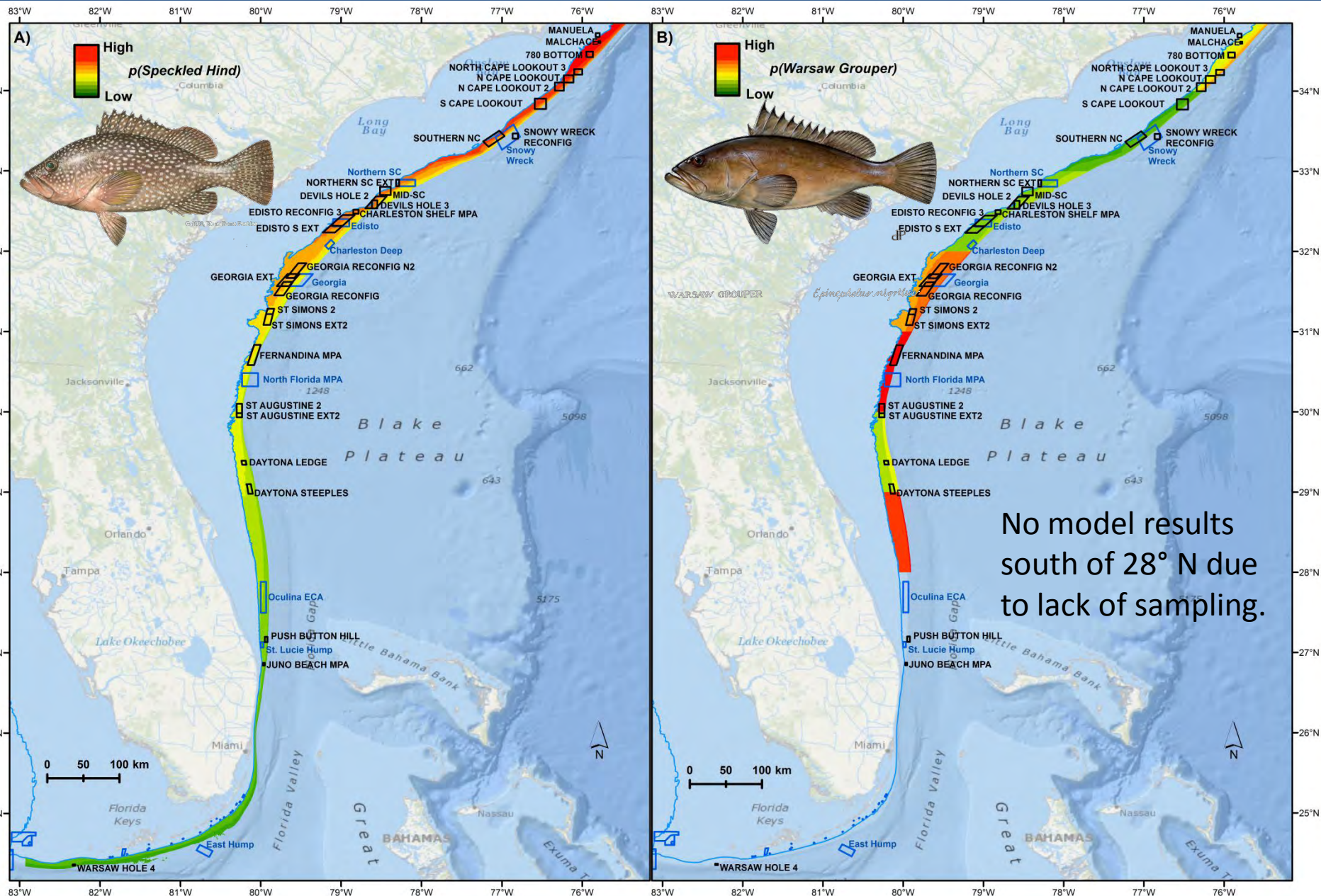
Integrates habitat
+ point obs. data



Farmer & Karnauskas (2013); Figure 4

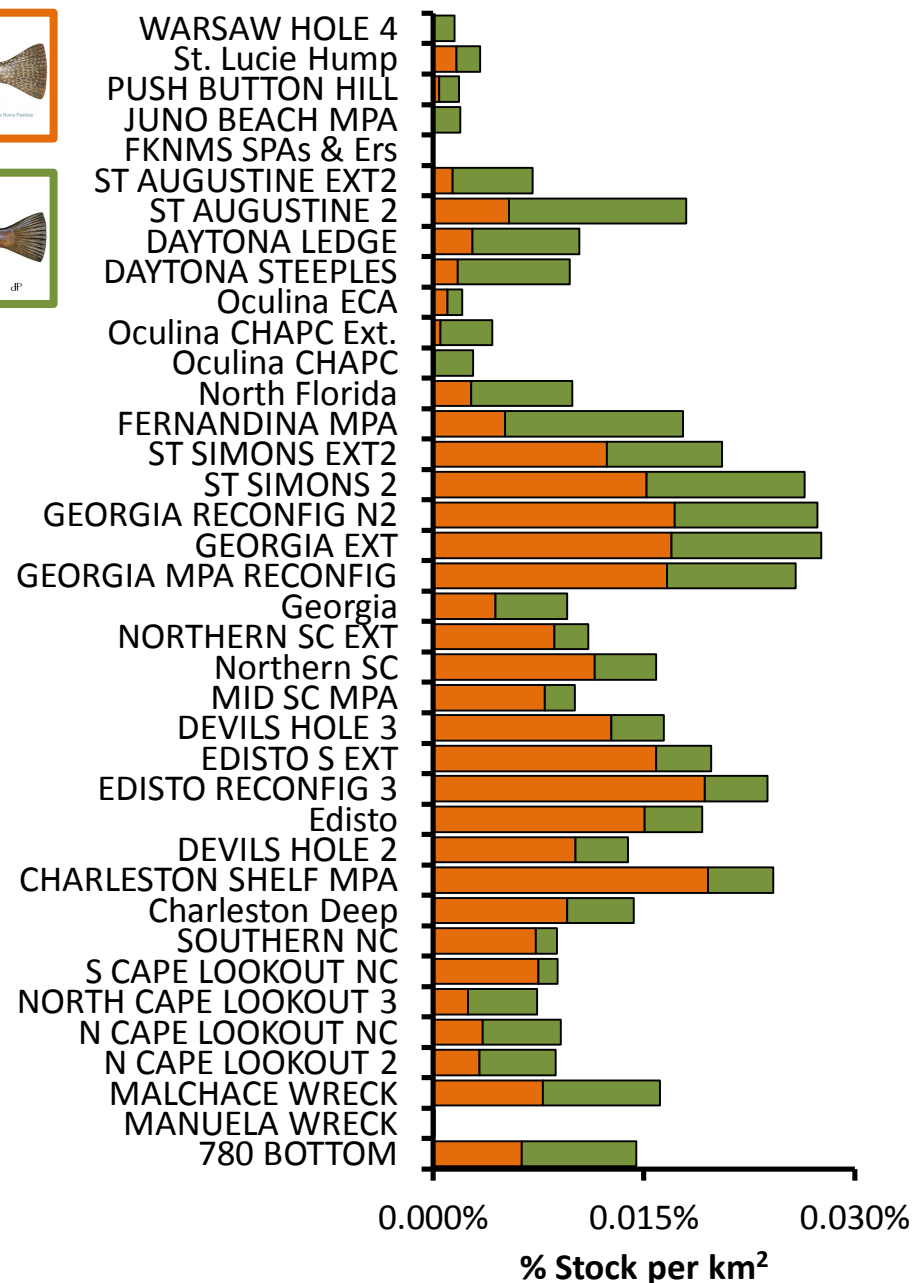
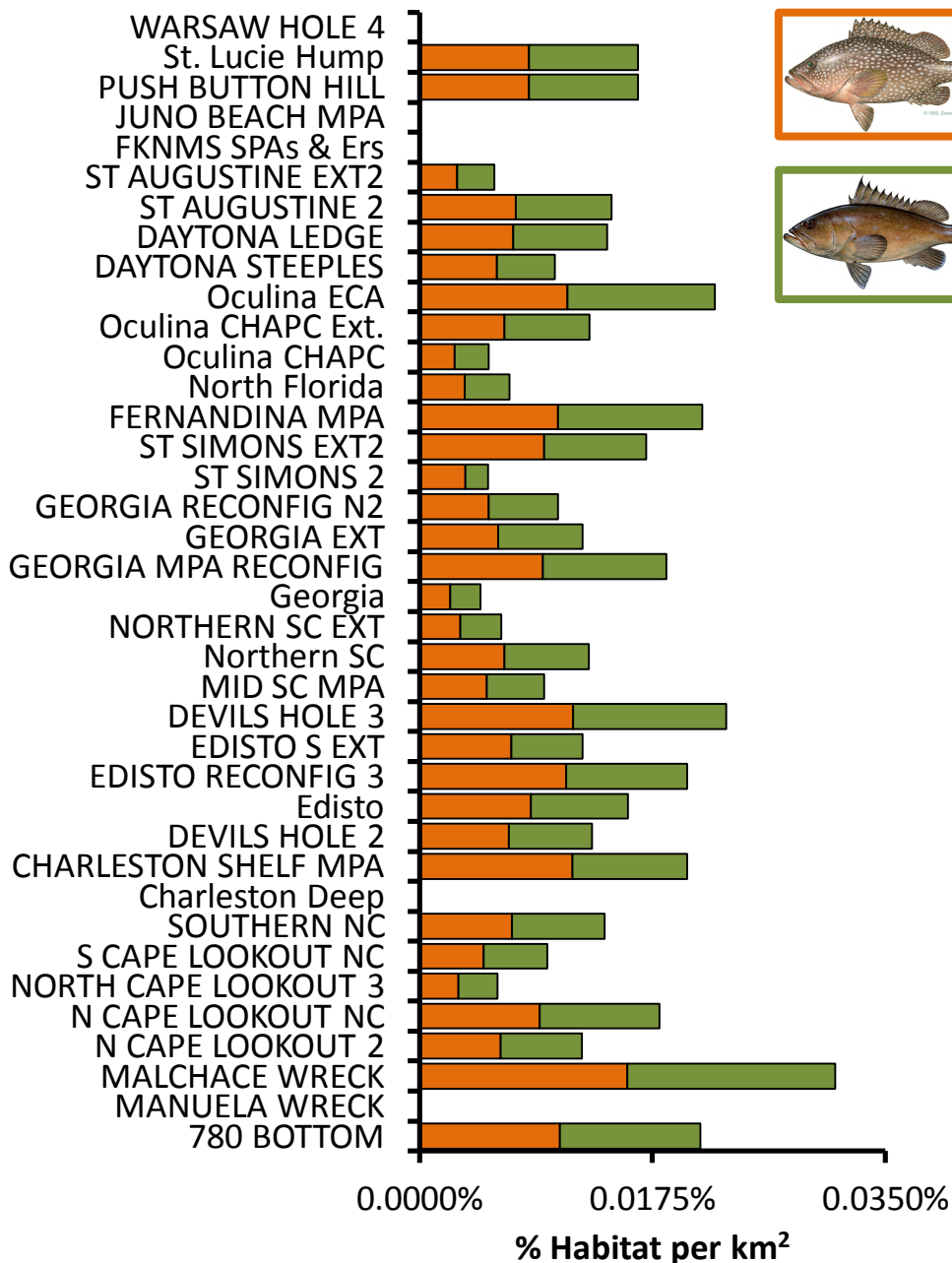
GEOGRAPHIC DISTRIBUTION

Spatial predictive model
with gear standardization



Farmer & Karnauskas (2013); Figure 5

PROTECTION / KM²



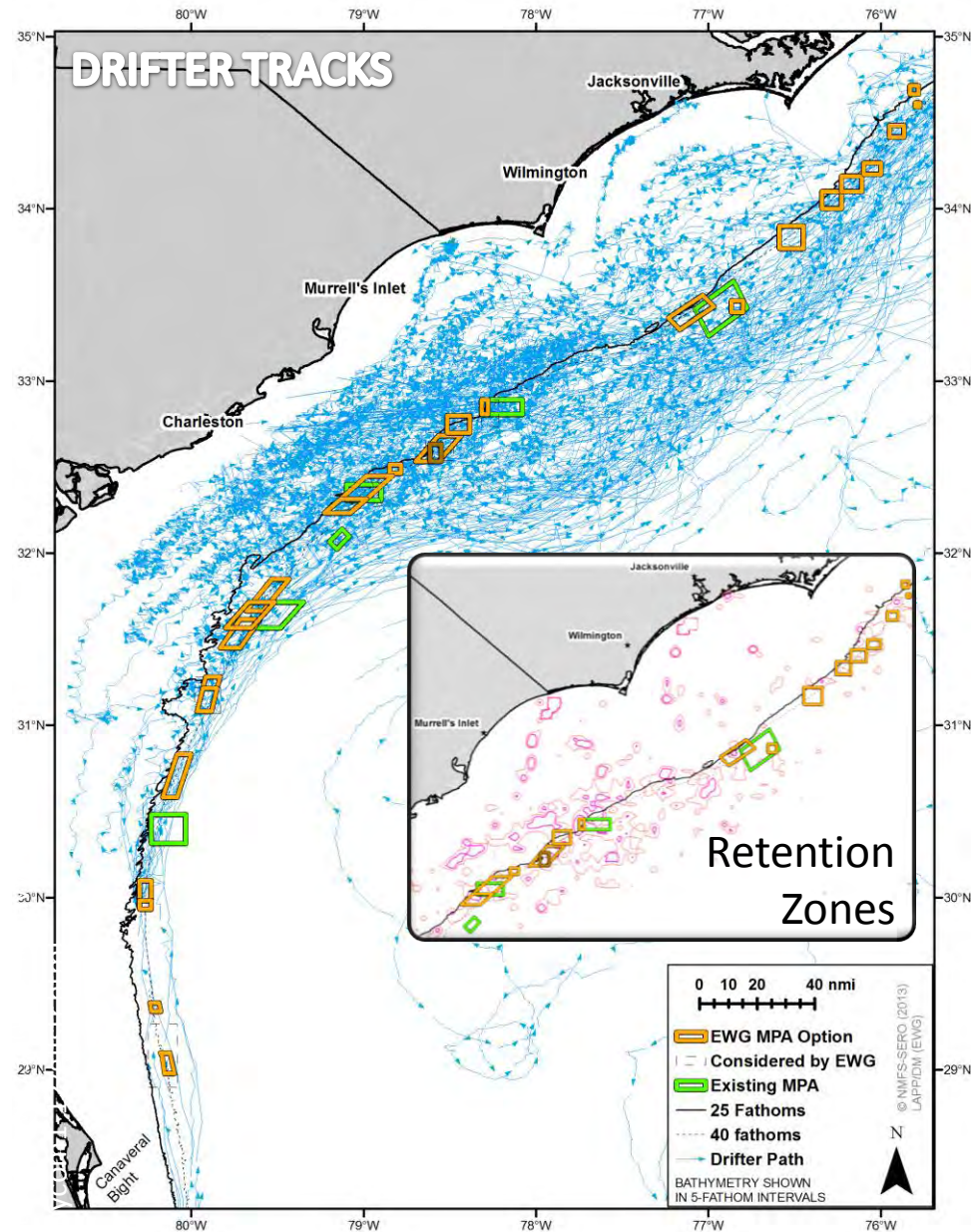
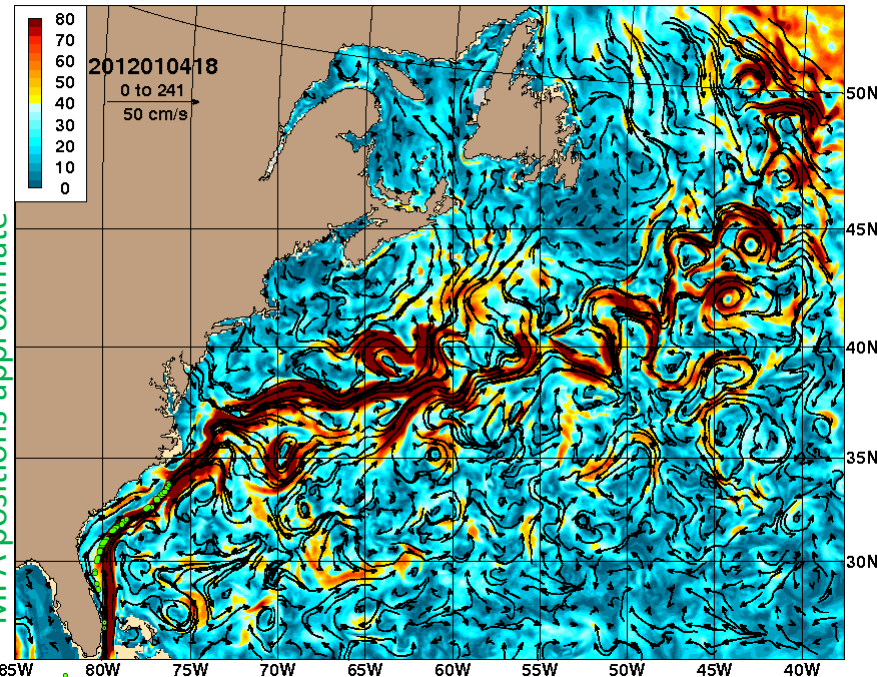
SPAWNING & CONNECTIVITY

Few documented SH or WG spawning locations: SC shelf, Warsaw Hole, TSER

Biogeomorphology and spawning aggregations for related stocks hint at other important sites.

Gulf Stream S→N flow + retention zones in eddies and gyres leads to high connectivity between sites.

Speed/currents layer 1 Jan 01, 2012 00Z 90.9



See 'SERO-LAPP-2012-08' for details

IMPACTS ON ASSOCIATED STOCKS

Determined species associated with speckled hind and warsaw grouper using percent co-occurrence, hierarchical cluster analysis, and dimension reduction analysis

Overlaid proposed MPAs on commercial (1° tall × 5 fa) and headboat (1/6° × 1/6°) mean landings (2009-2011)

Potential reduction in landings for MPA i computed as:

$$\%Impact_i = \overline{\%Landings_i^{2009-2011}} * \frac{area_i^{protected}}{area_i^{total}}$$

Assumptions:

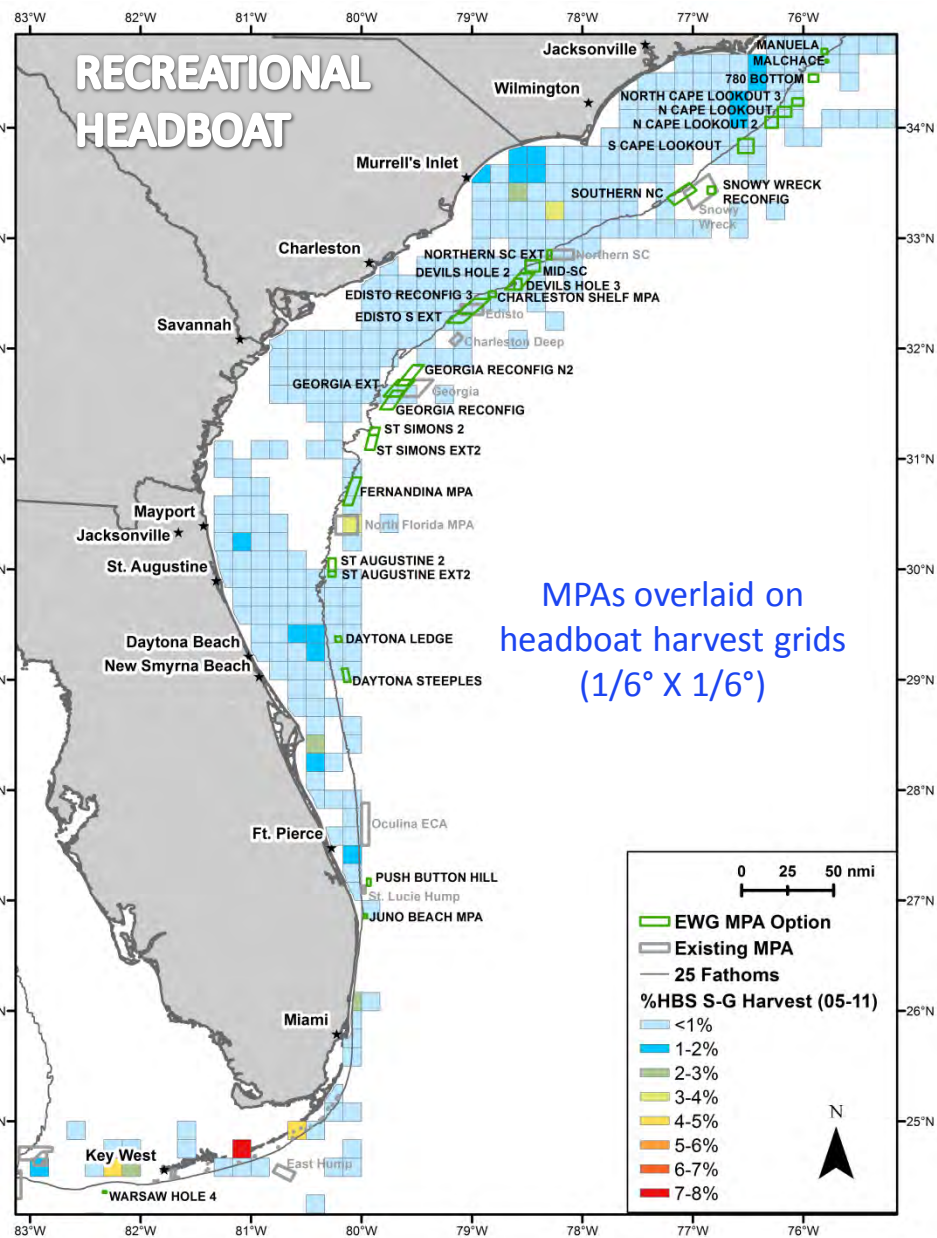
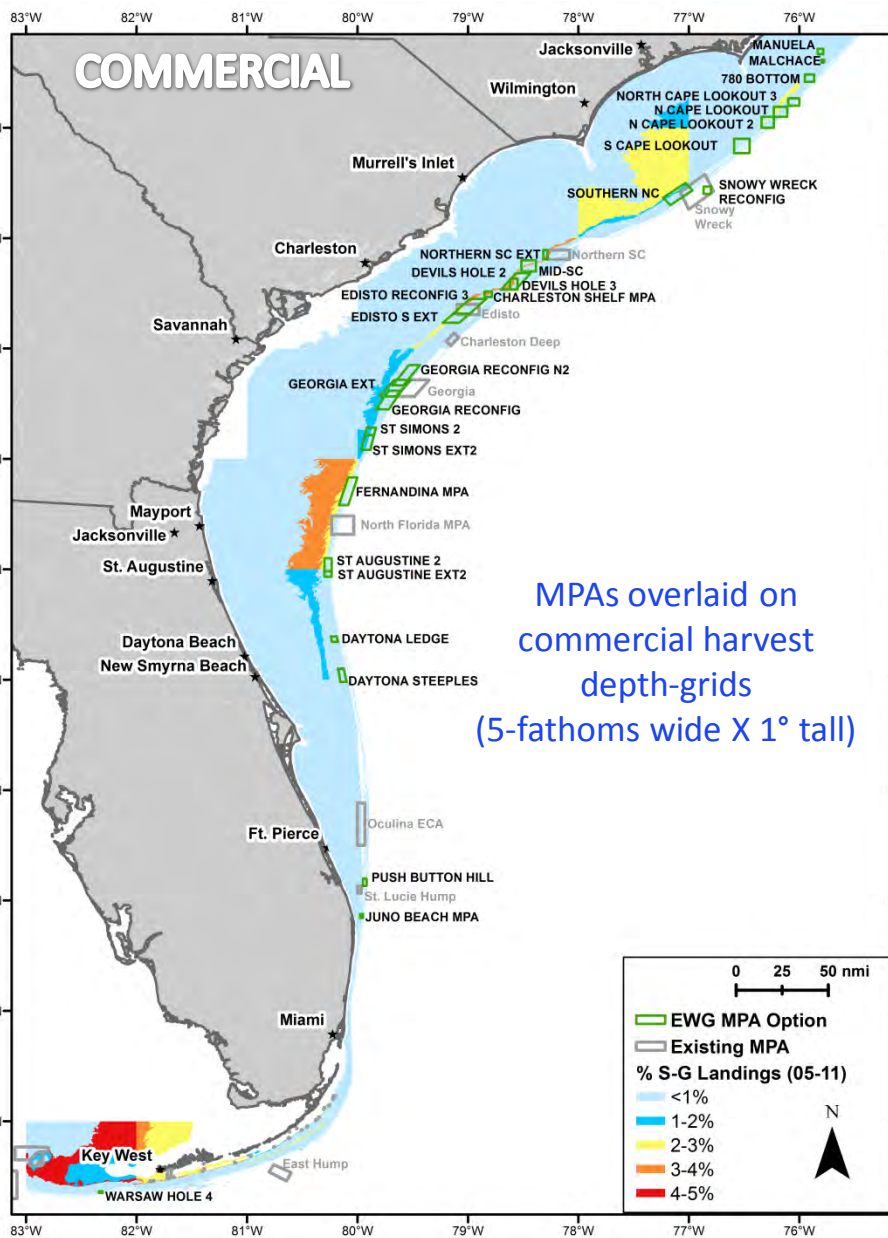
Landings uniformly distributed in logbook-areas

Historical locations are predictive

No effort shifting

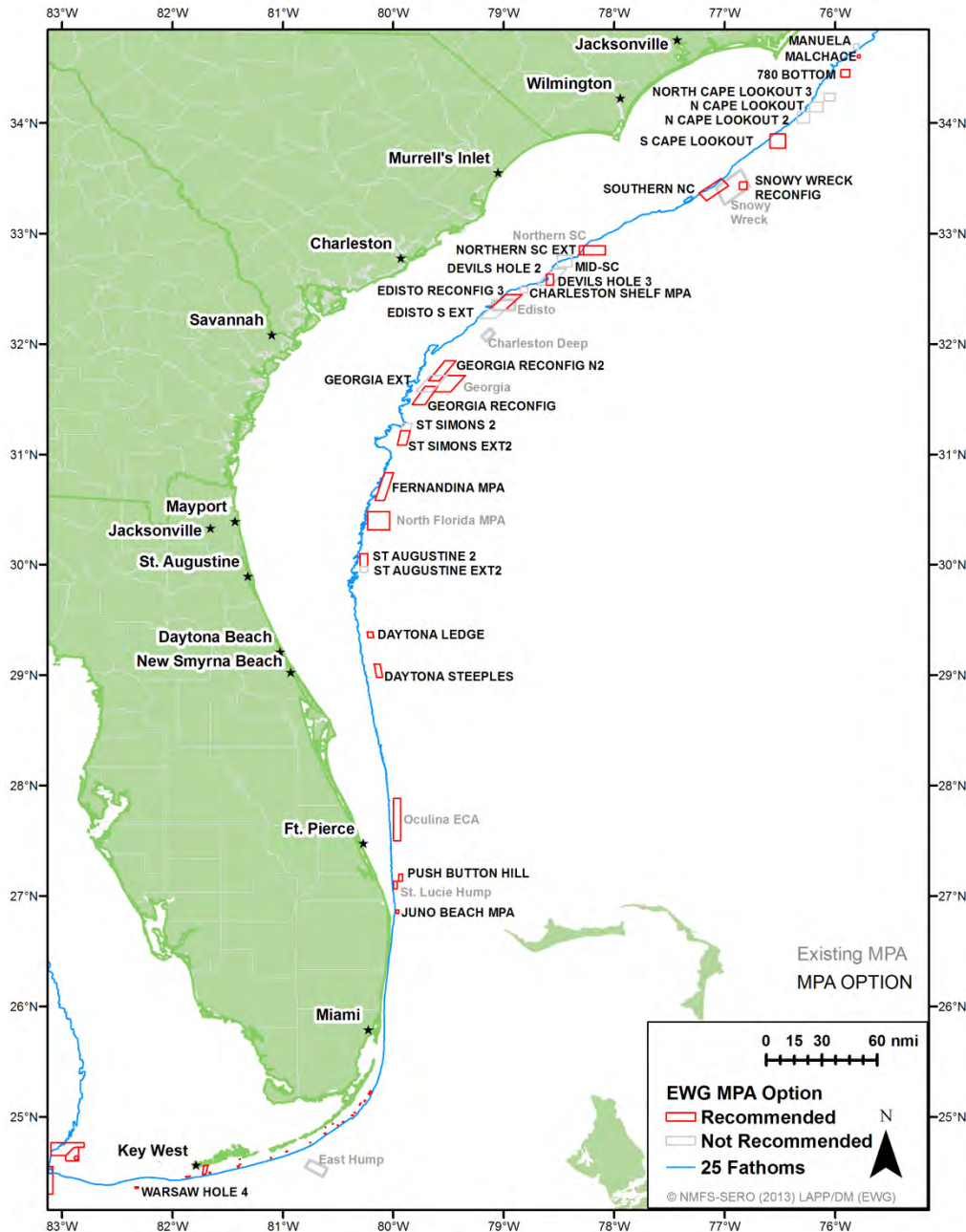


IMPACTS ON S-G LANDINGS



See 'Reg17 Socioeconomic Impacts' for details

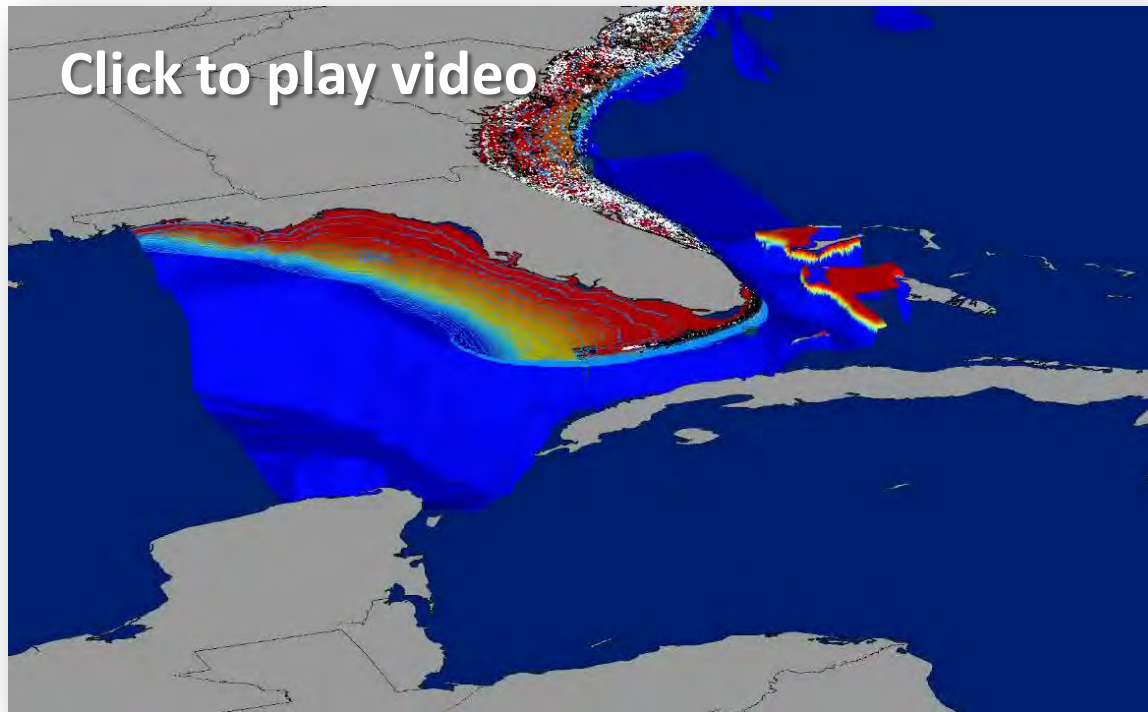
MPAs CONSIDERED



The EWG considered a broad suite of options, then based recommendations upon the following criteria:

1. Does the location contain relatively high numbers of one or both of the groupers of concern, based on point data and distribution modeling?
2. Is it an area with high bycatch, where protection would achieve the stated goal of reducing bycatch?
3. Can the site be designed to reduce socioeconomic impact?
4. Does the site contain potential spawning locations?
5. Is there connectivity between sites?
6. Are sites spaced to provide fishing opportunities between sites?

Overview of EWG MPA Recommendations



HABITAT

-  Not Hardbottom
-  Possible Hardbottom
-  Hardbottom

EWG RECOMMENDED MPAS

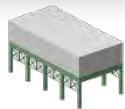
-  Existing MPA
-  New MPA

POINT OBSERVATIONS

-  Warsaw Grouper
-  Speckled Hind



Major City



Artificial Reef/Wreck

WATER DEPTH



0

fathoms

100

78°W

77°W

76°W

NORTH CAROLINA

Jacksonville

Wilmington

Malchace Wreck

780 Bottom

S Cape Lookout

Southern NC

Snowy Wreck Reconfig

Snowy Wreck MPA

Northern SC MPA



0 4 8 16 nmi

Recommended by EWG

Existing MPA

25 Fathoms

34°N

34°N

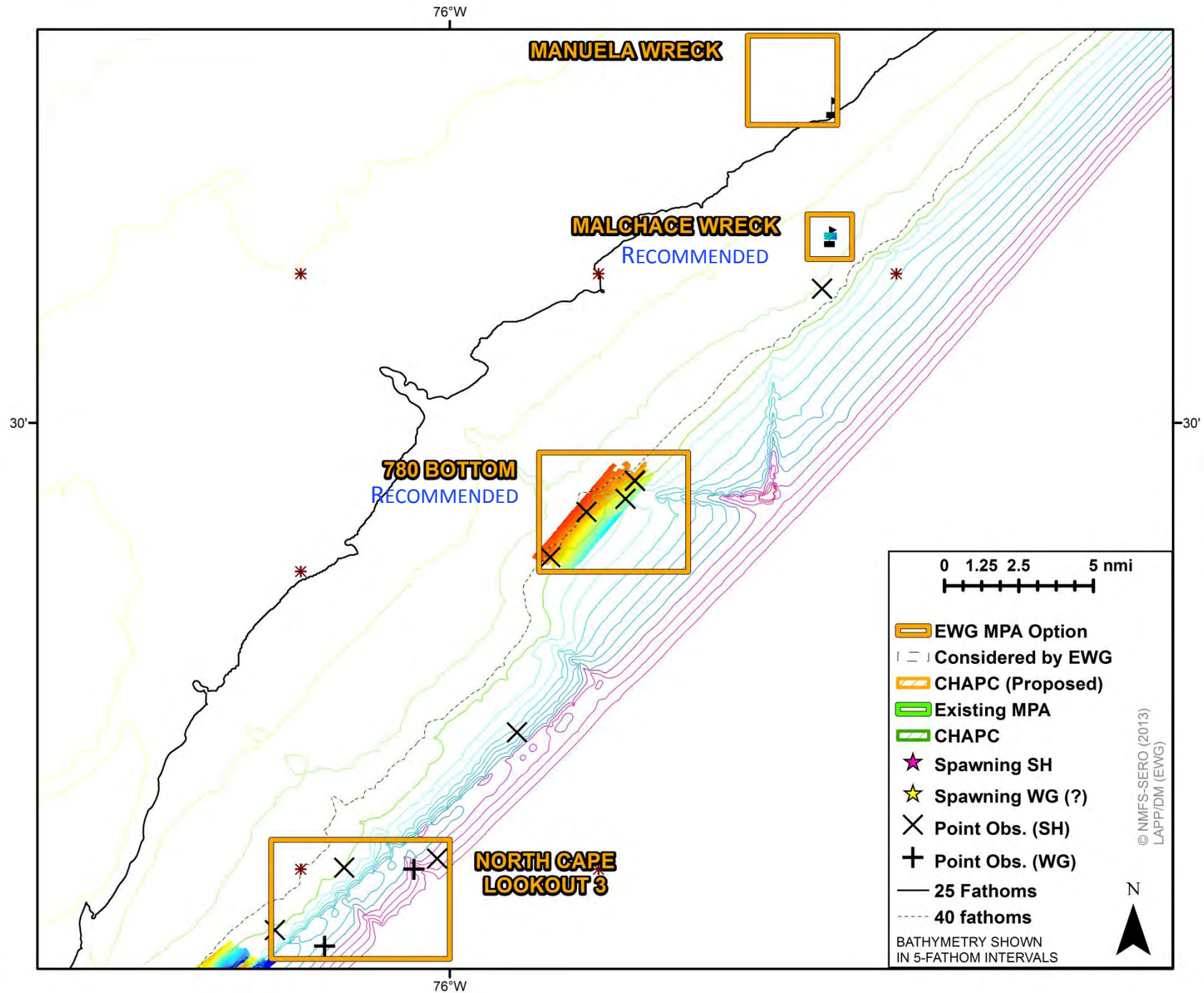
33°N

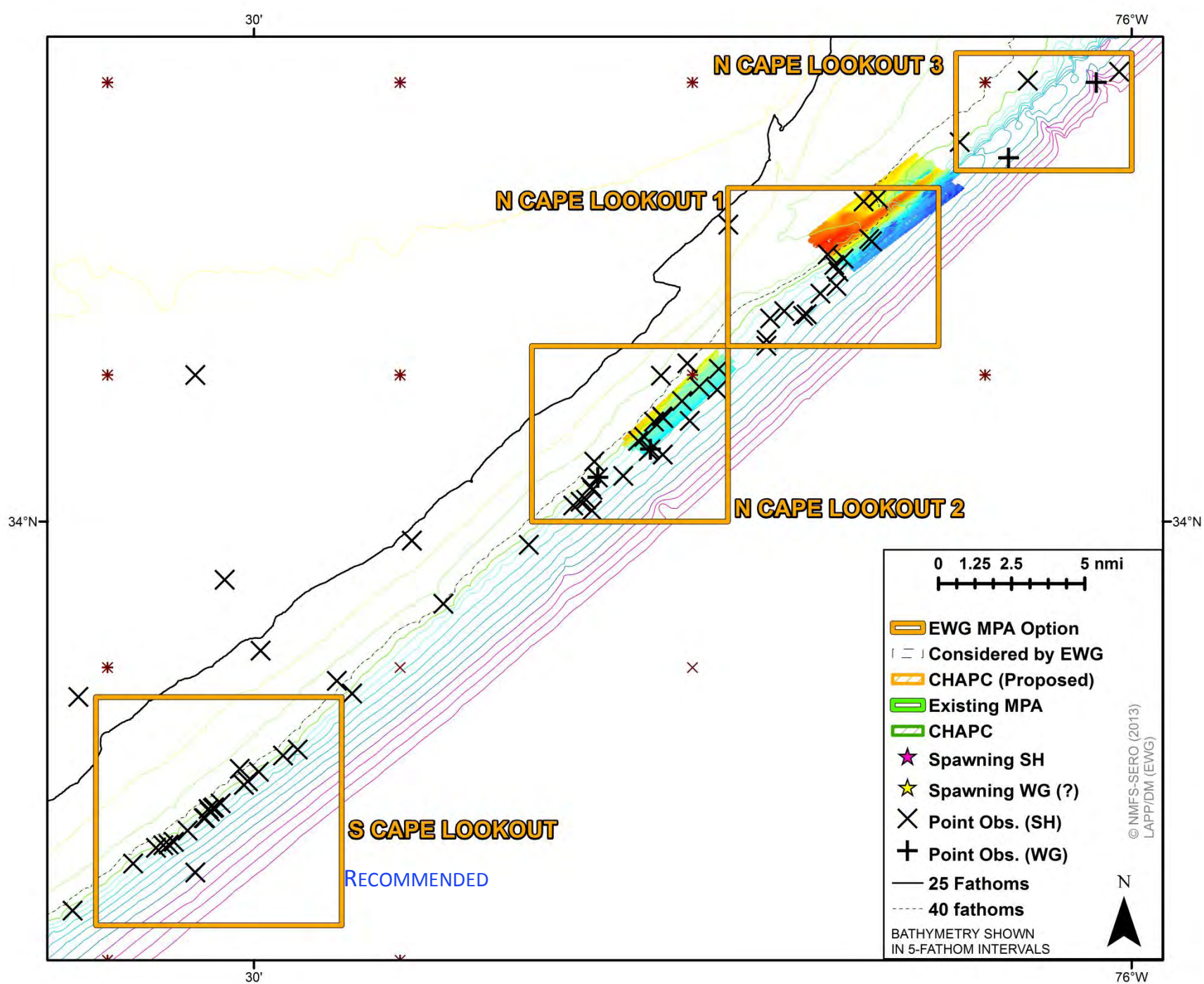
33°N

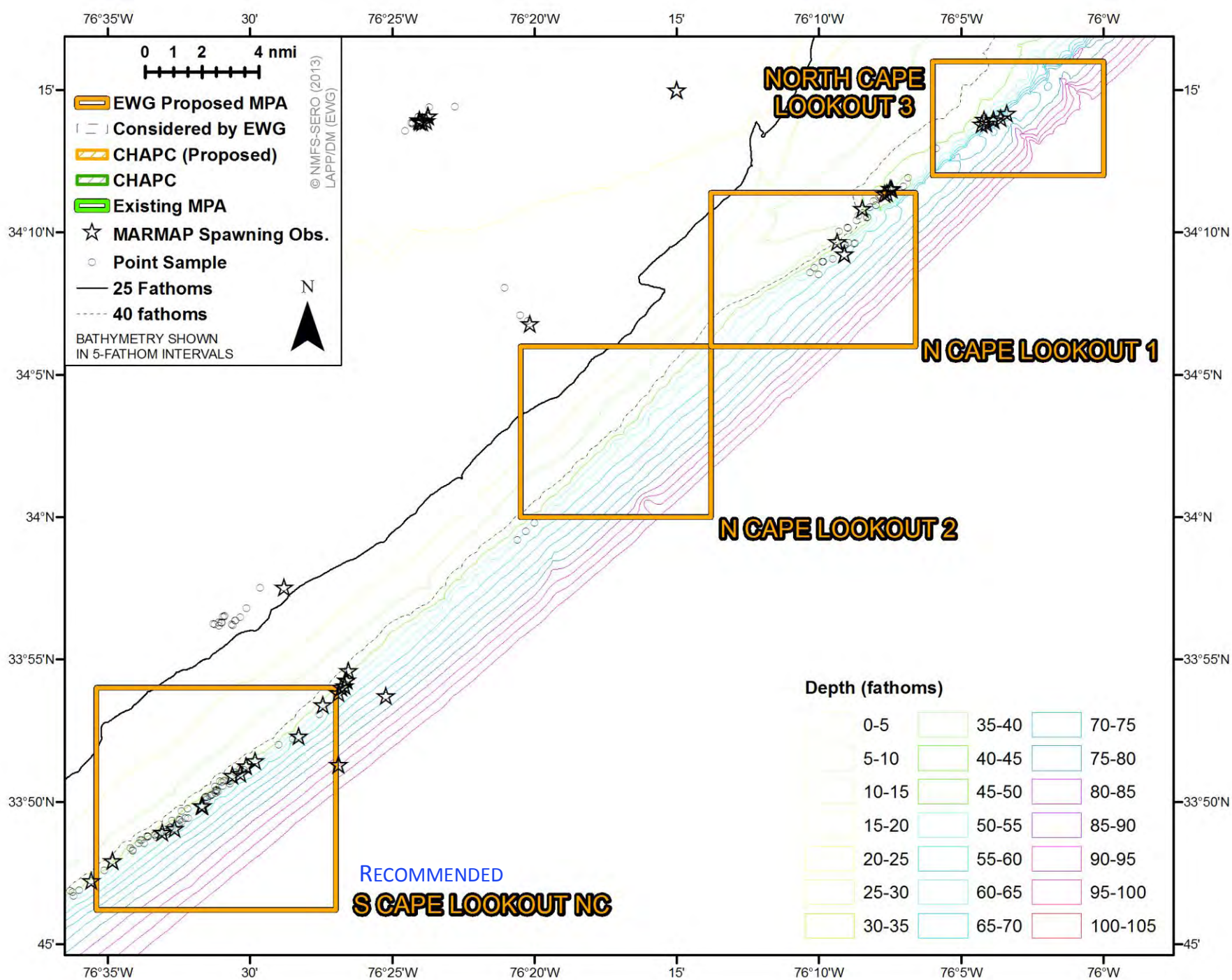
78°W

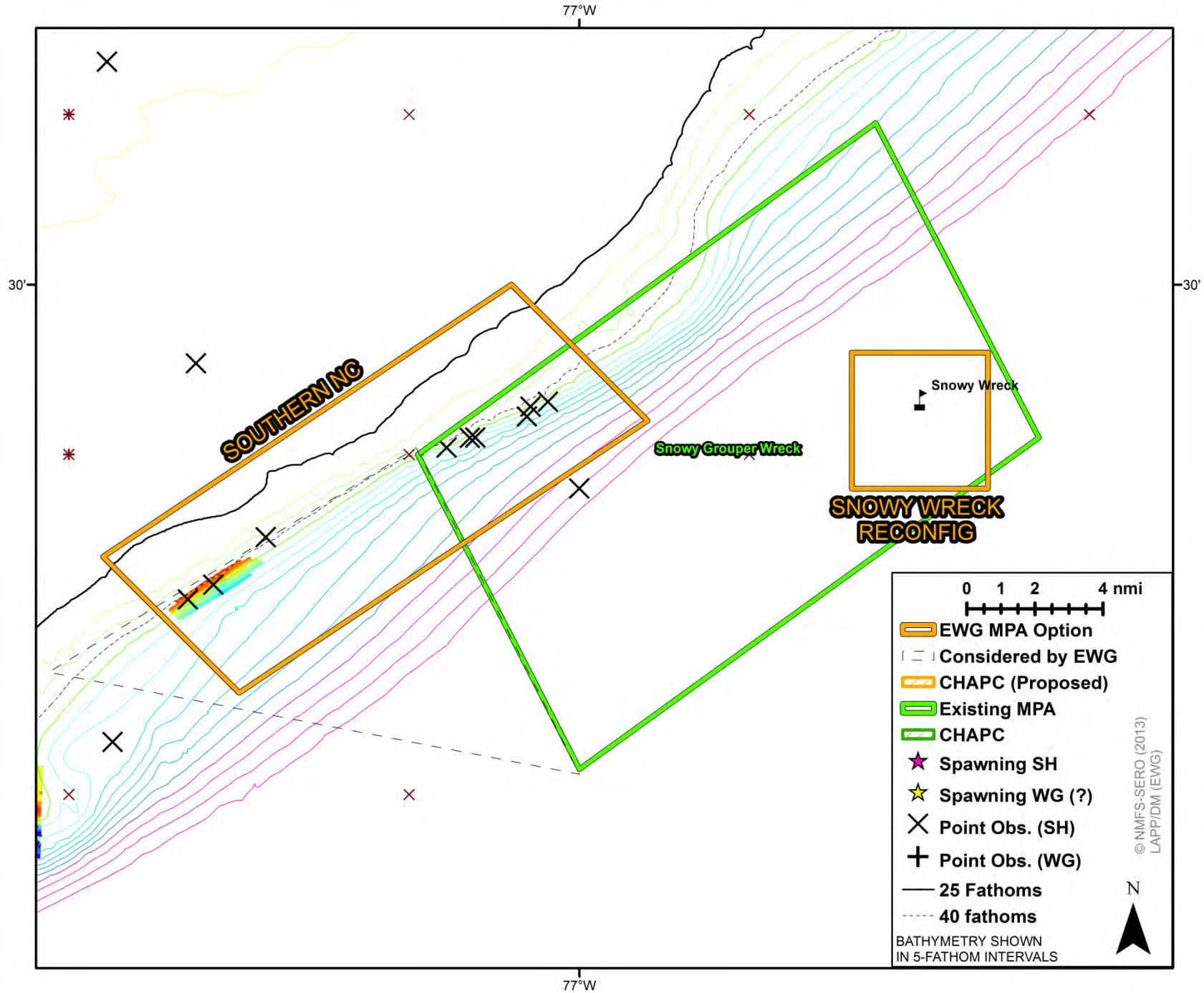
77°W

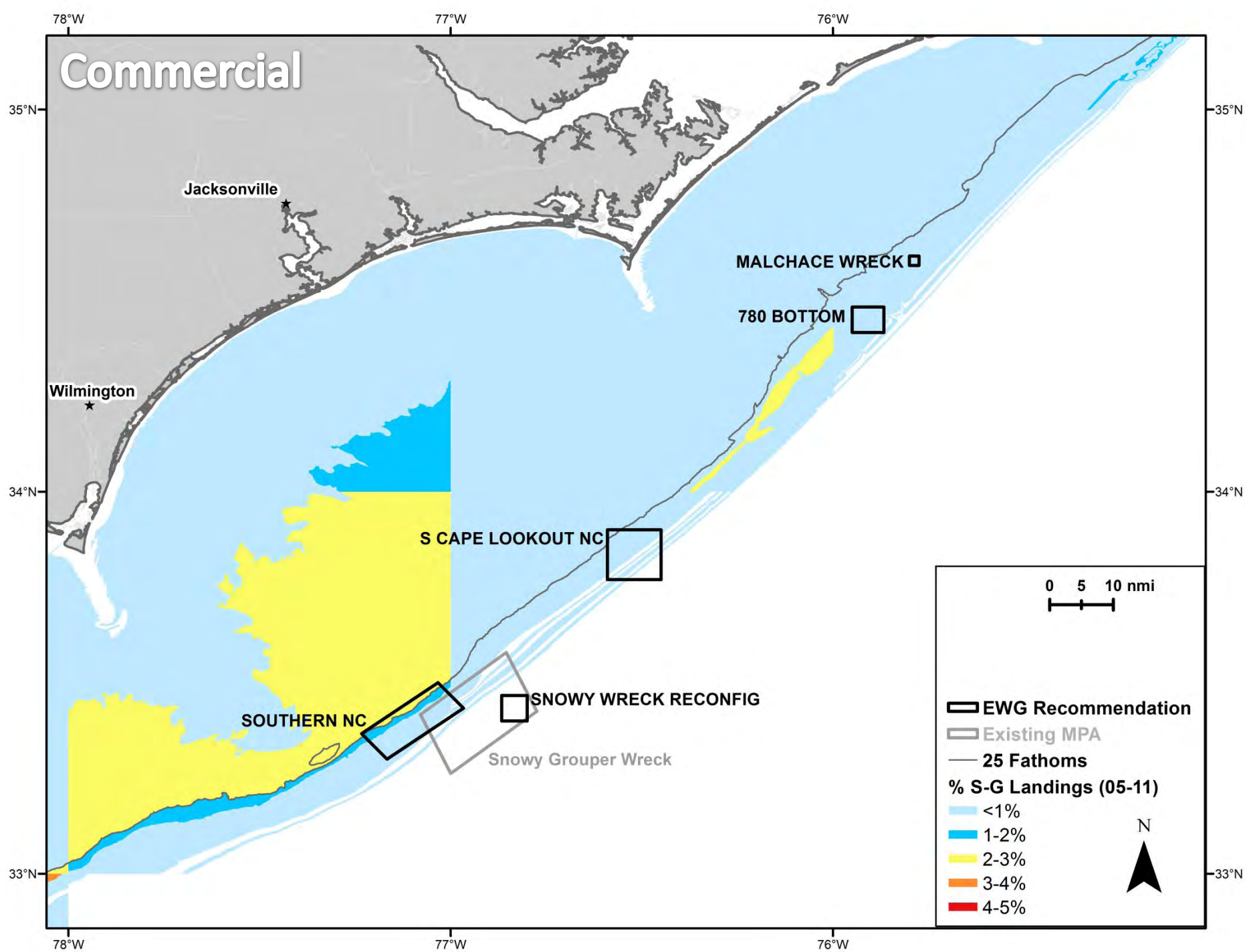
76°W

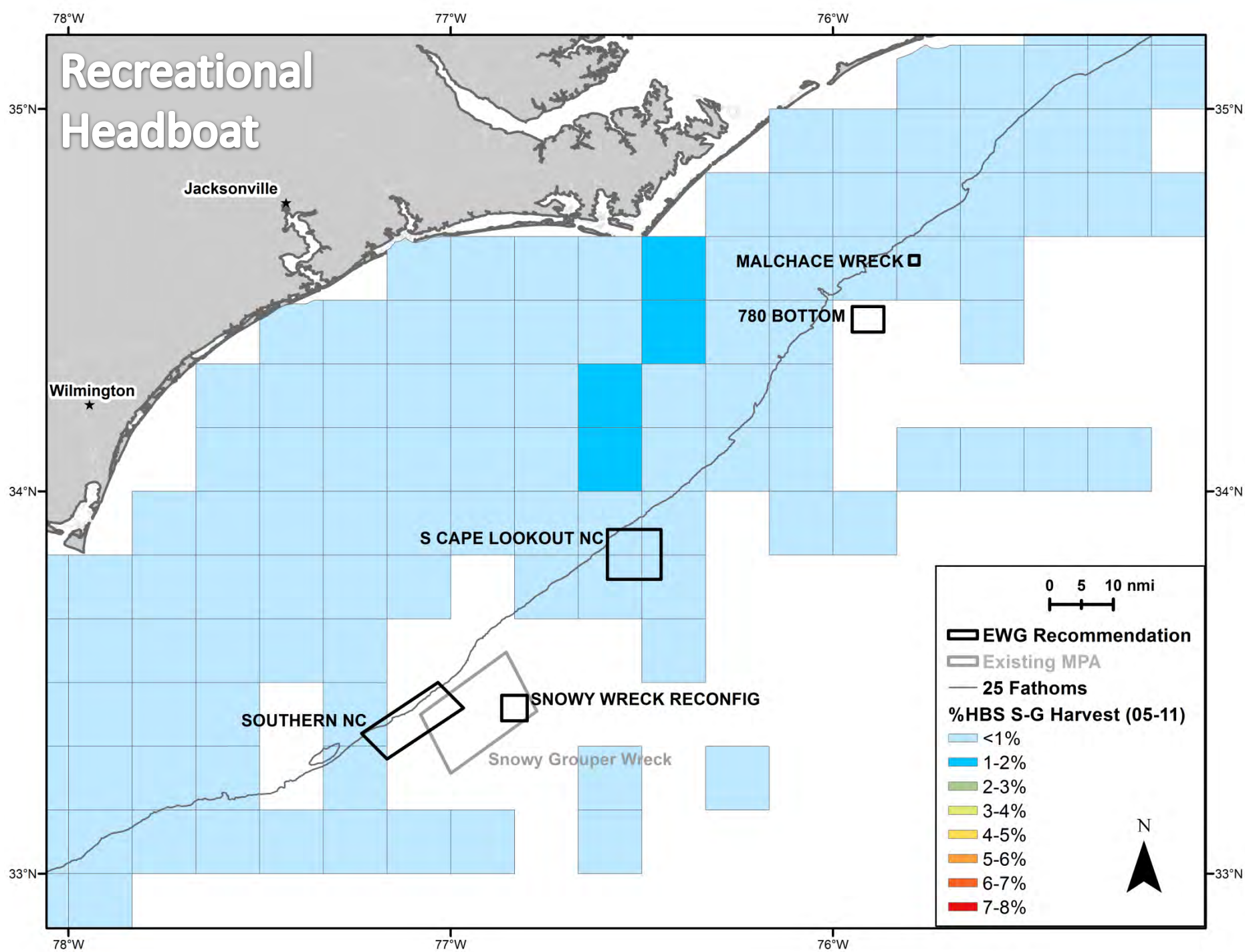










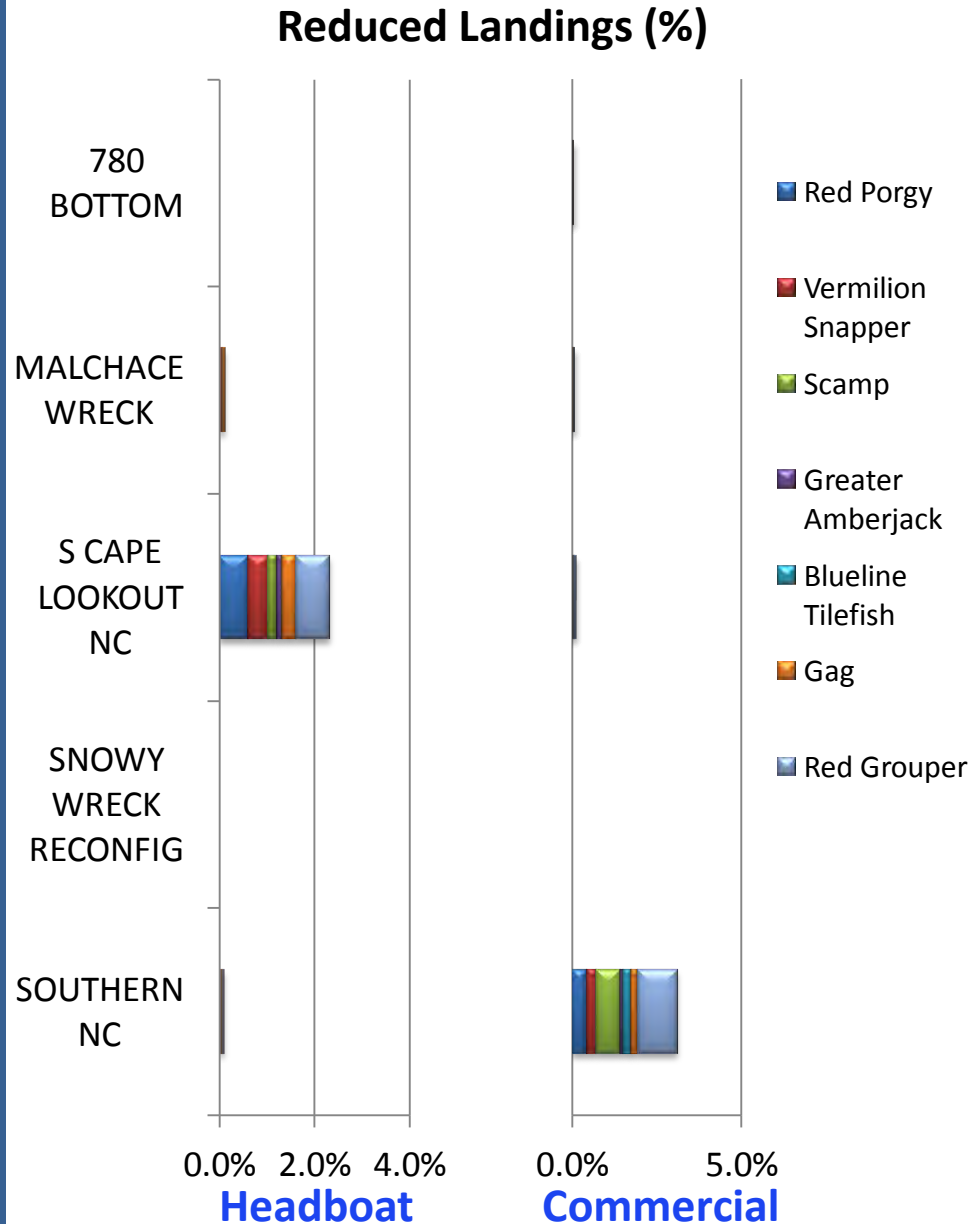


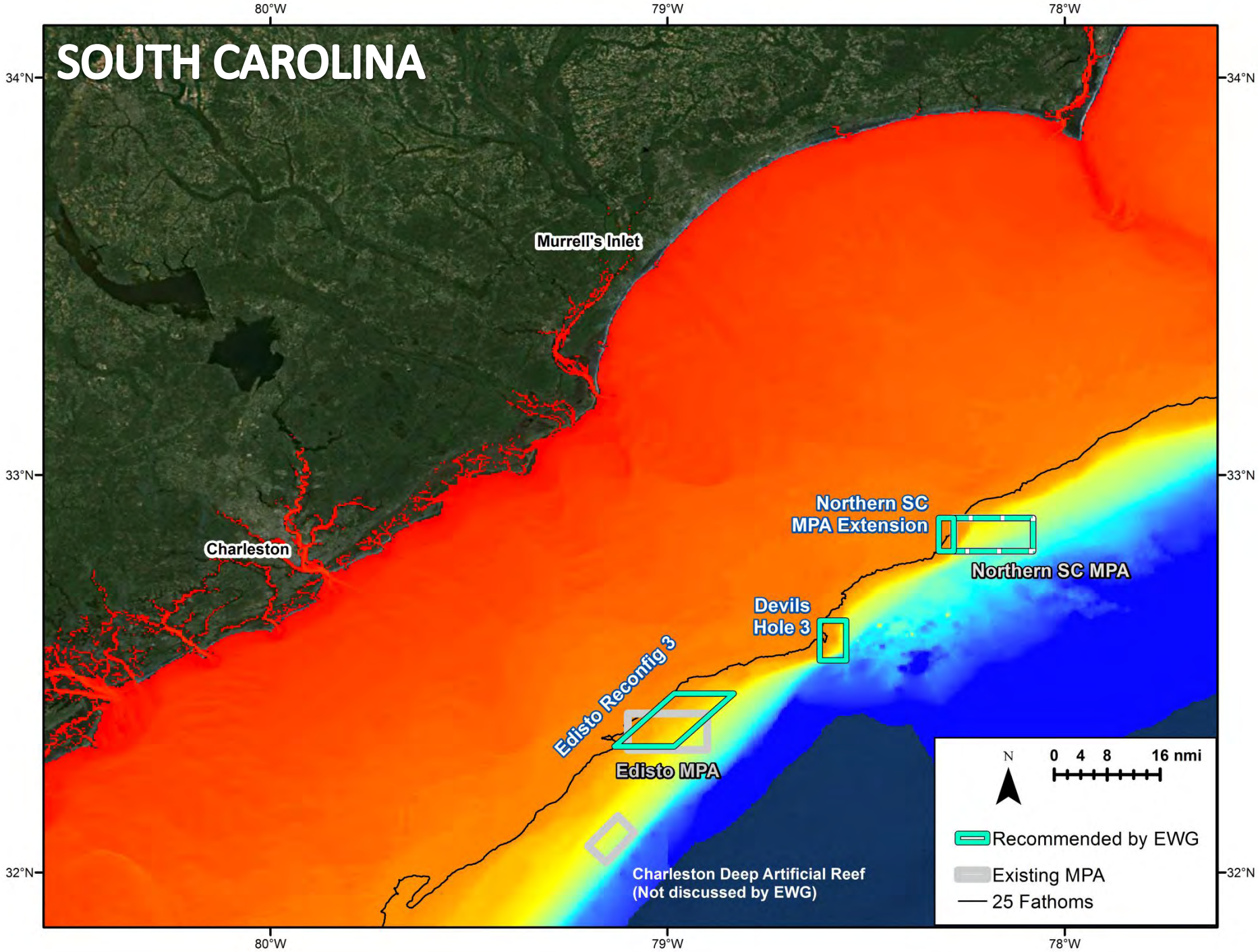
North Carolina MPAs

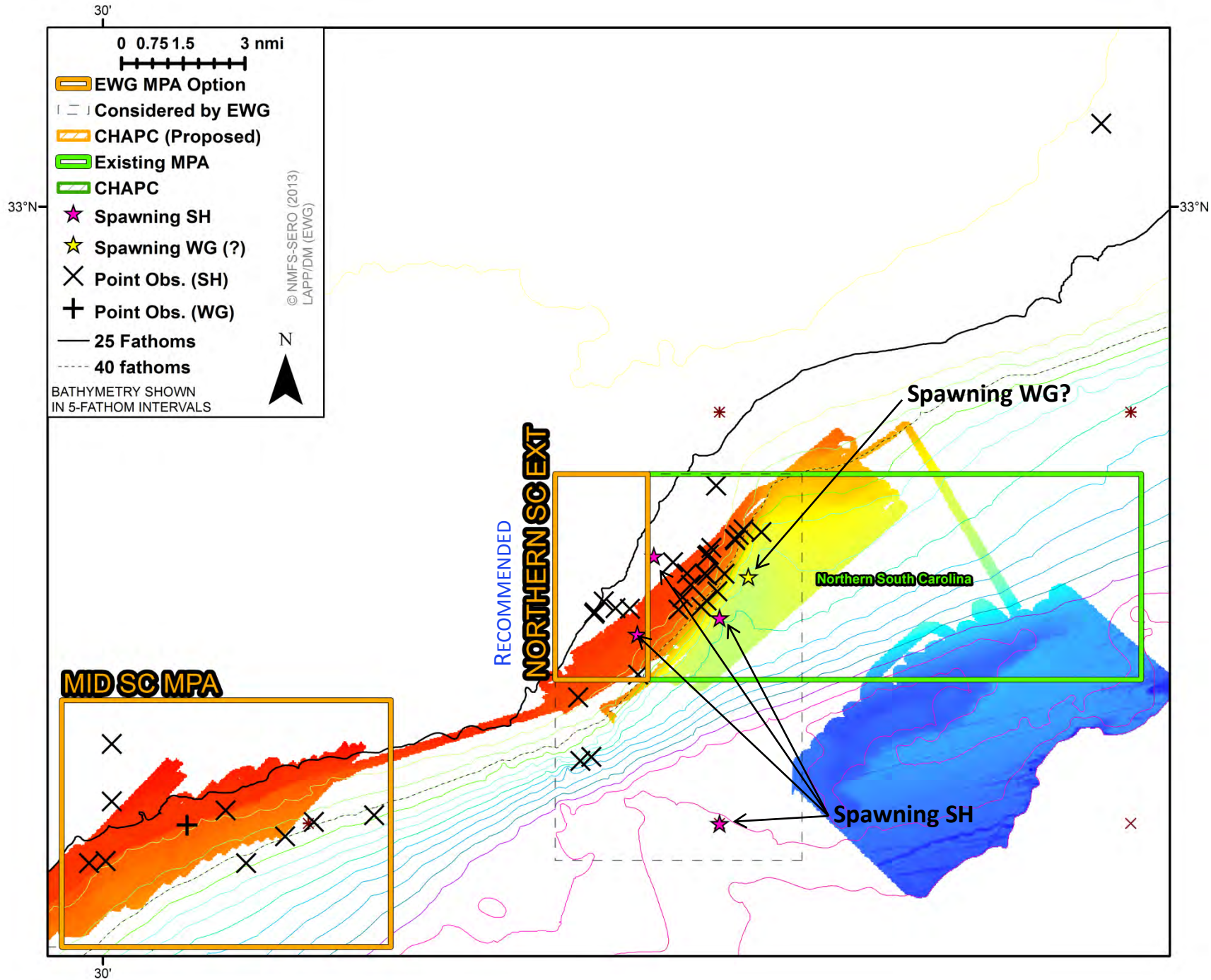
Name	Area (mi²)	Spawning	Conservation Benefits (%)					Landings Reductions (%)													
			Speckled Hind			Warsaw Grouper		Recreational Headboat						Commercial							
			%Habitat	%Stock [X-val]	%Stock [AIC]	%Habitat	%Stock [X-val&AIC]	Red Porgy	Vermilion	Scamp	Amberjack	Blueline	Gag	Red Gpr	Red Porgy	Vermilion	Scamp	Amberjack	Blueline	Gag	Red Gpr
780 Bottom	22	Likely Many S-G	0.7	1.0	0.4	0.8	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Malchace Wreck	2.5	Maybe WG?	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S Cape Lookout	72.4	Many S-G	1.1	1.4	1.4	1.0	0.3	0.6	0.4	0.2	0.1	0.0	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Snowy Wreck Reconfig	17.8	Snowy Grouper	Intended to protect Snowy Grouper Wreck					-	-	-	-	-	-	-	-	-	-	-	-	-	-
Southern NC	88.7	Many S-G	1.7	1.5	1.7	1.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.7	0.1	0.2	0.2	1.2

North Carolina MPAs

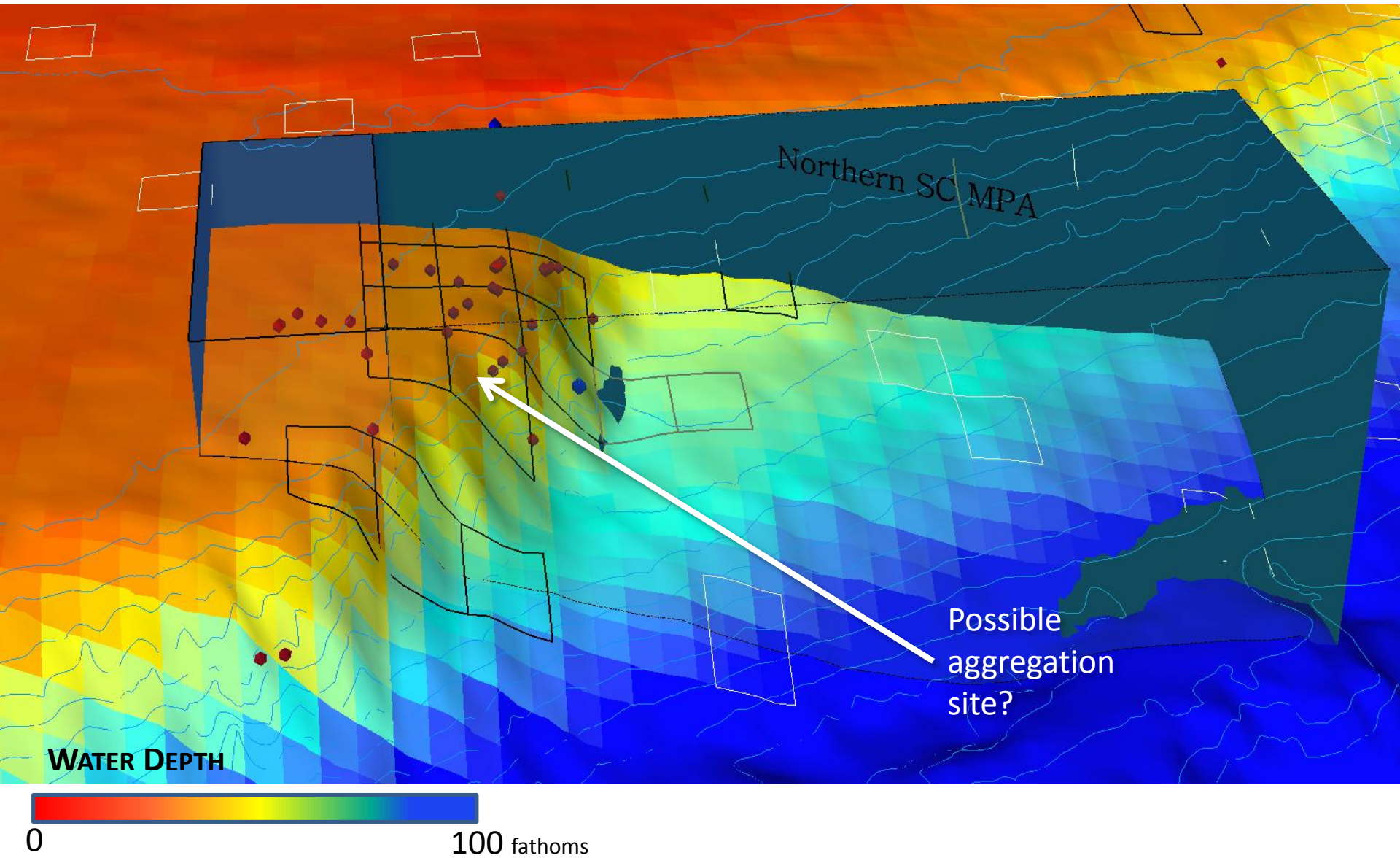
Name	Area (mi²)	Spawning	Conservation Benefits (%)				
			Speckled Hind			Warsaw Grouper	
			%Habitat	%Stock [X-val]	%Stock [AIC]	%Habitat	%Stock [X-val&AIC]
780 Bottom	22	Likely Many S-G	0.7	1.0	0.4	0.8	0.5
Malchace Wreck	2.5	Maybe WG?	0.1	0.1	0.1	0.1	0.1
S Cape Lookout	72.4	Many S-G	1.1	1.4	1.4	1.0	0.3
Snowy Wreck Reconfig	17.8	Snowy Grouper	Intended to protect Snowy Grouper Wreck				
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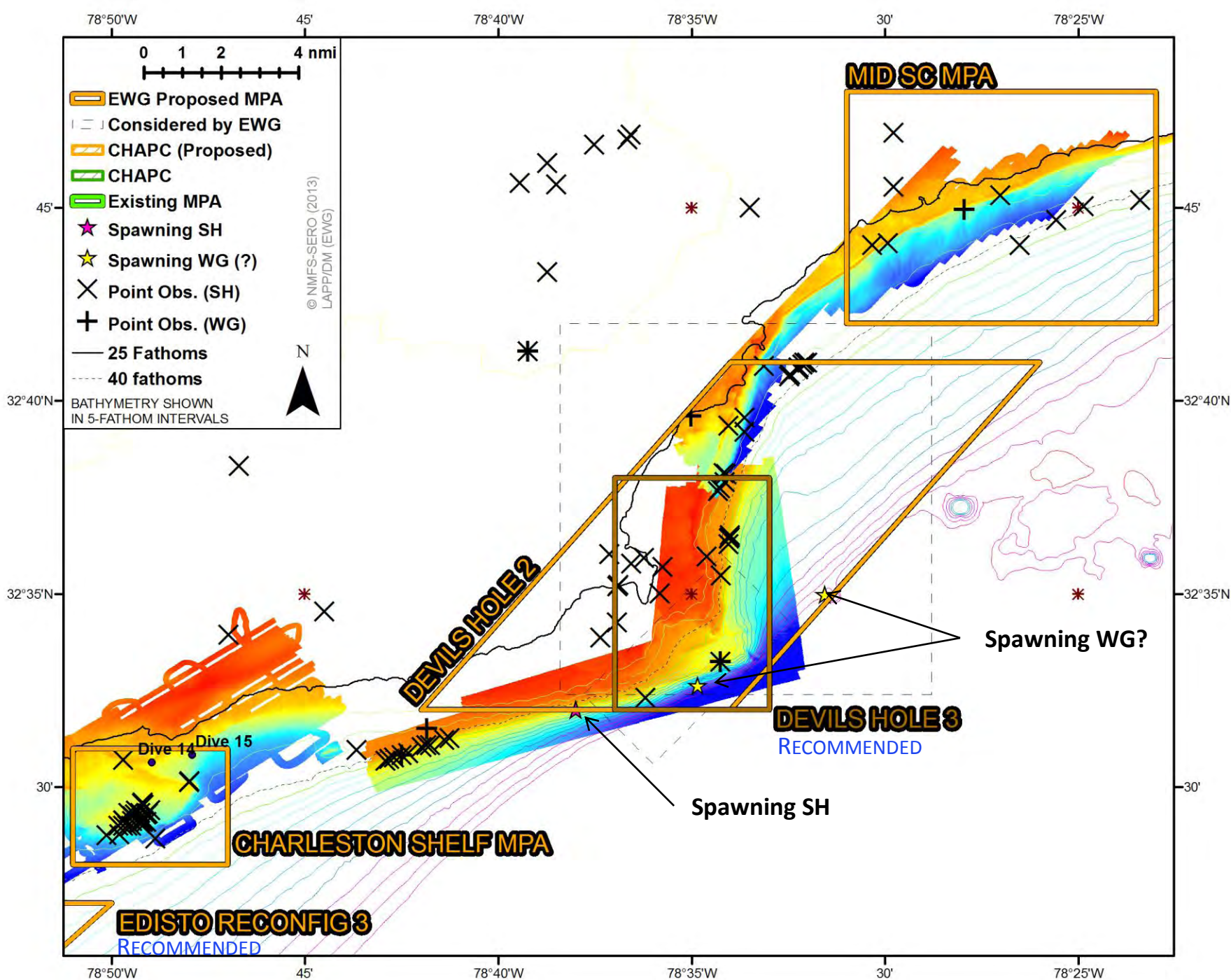




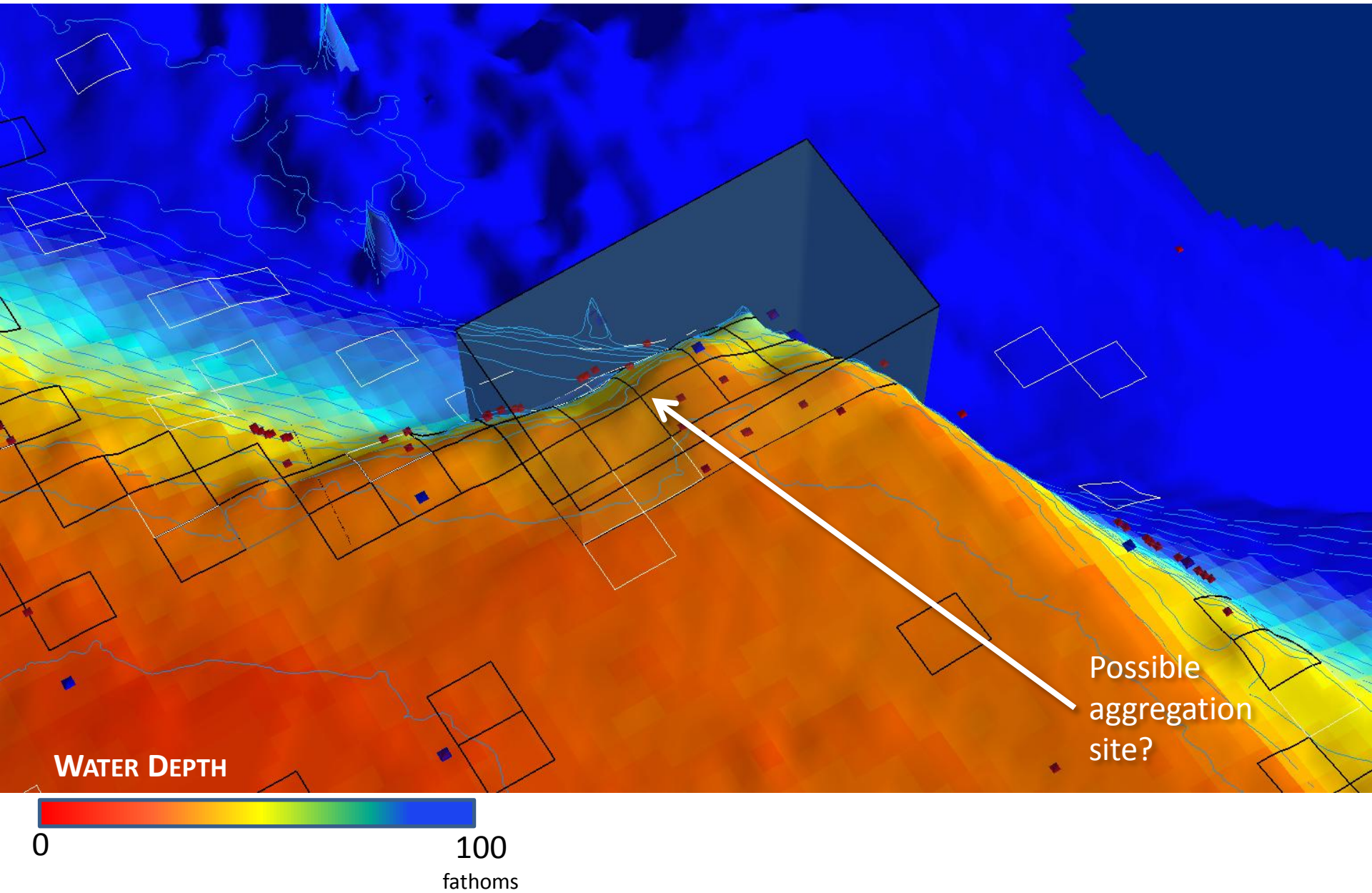


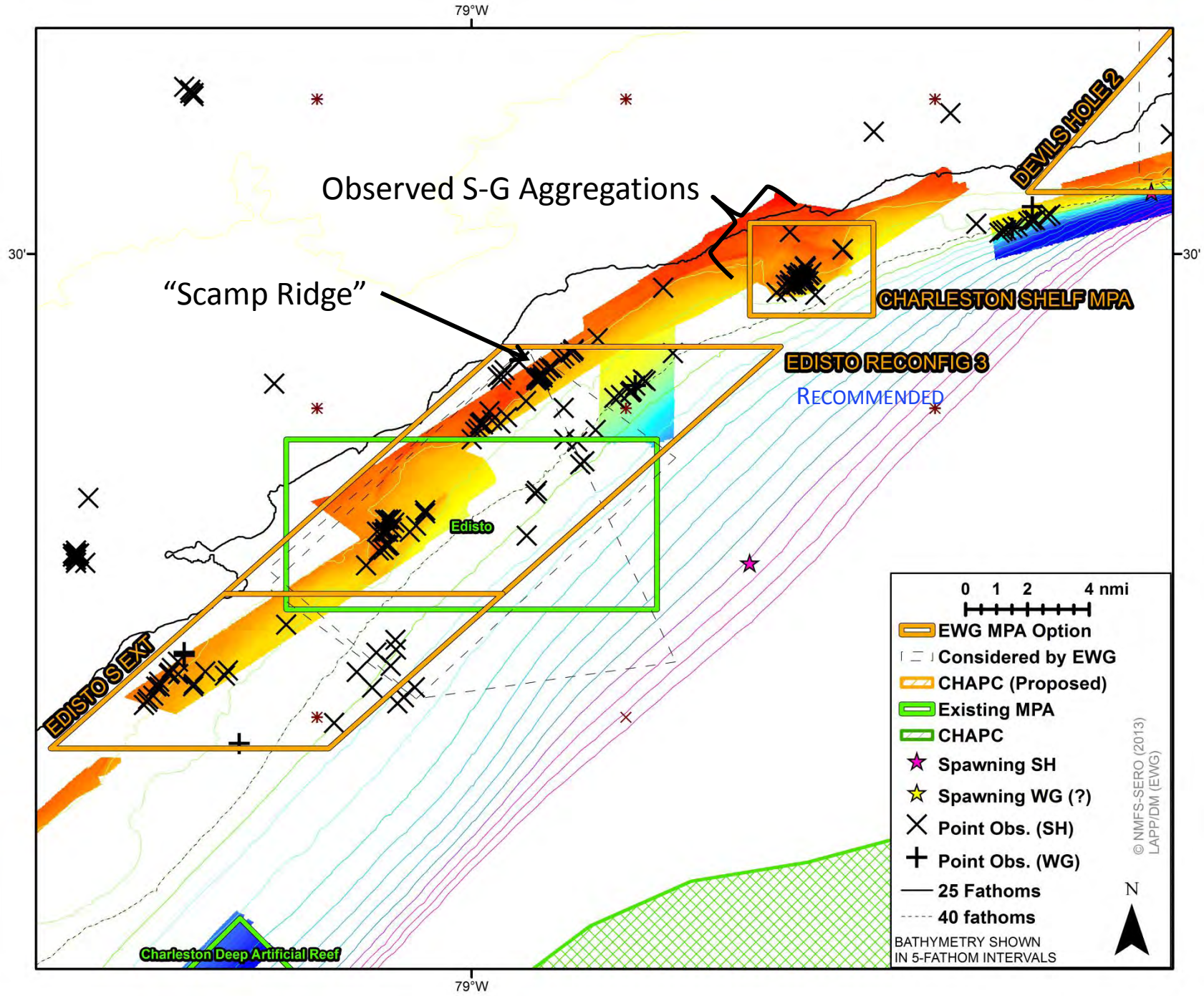
NORTHERN SC (Extend to West)

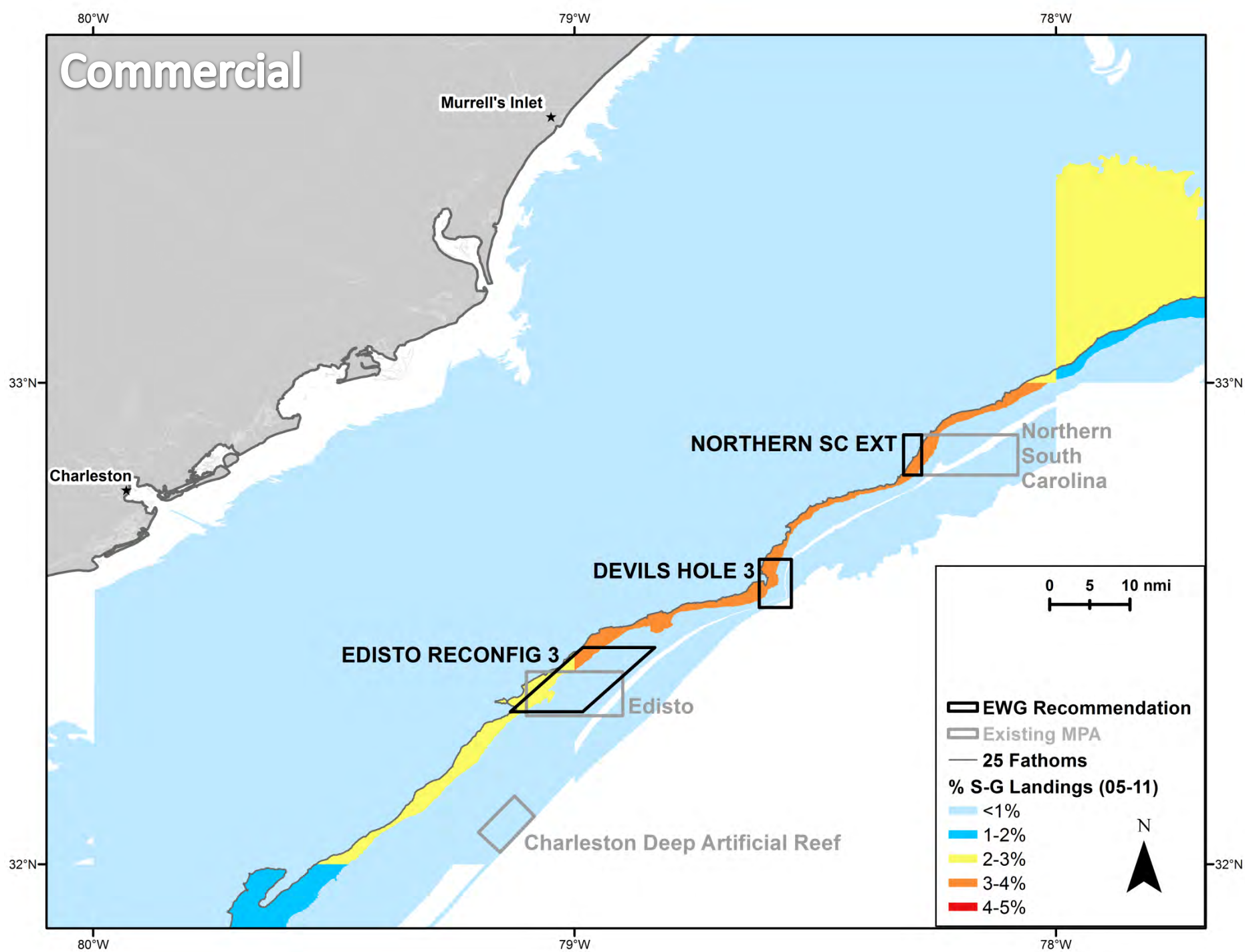


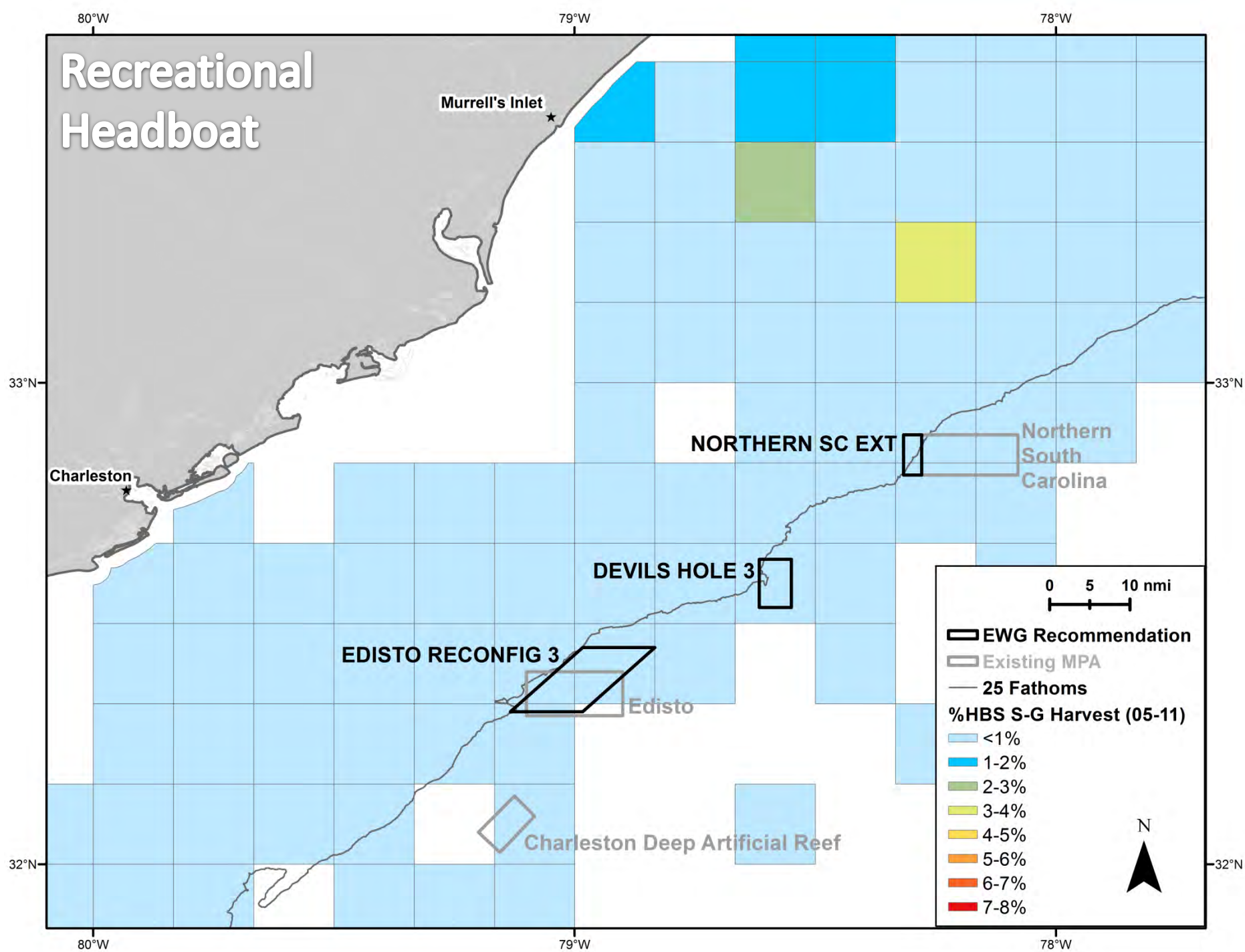


DEVIL'S HOLE







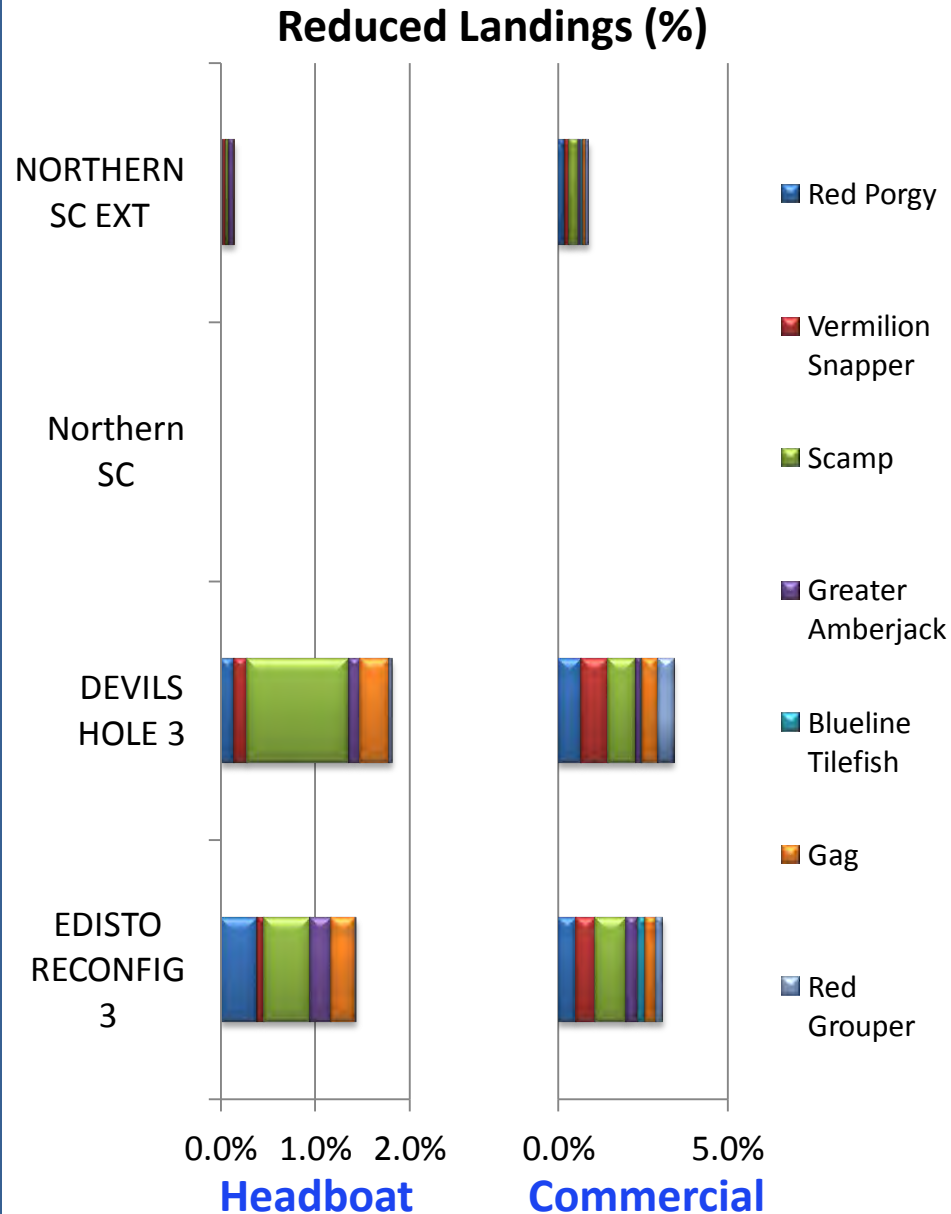


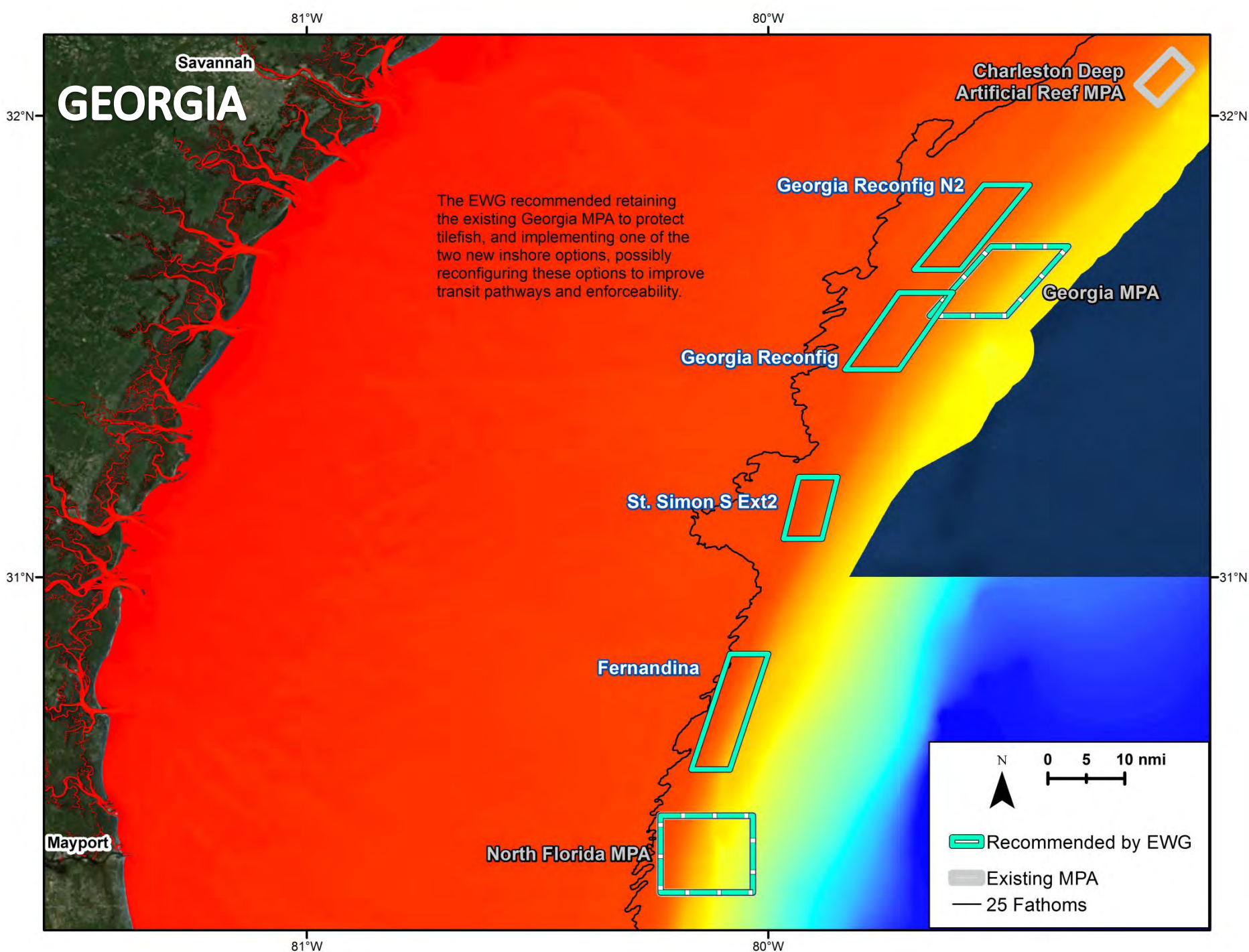
South Carolina MPAs

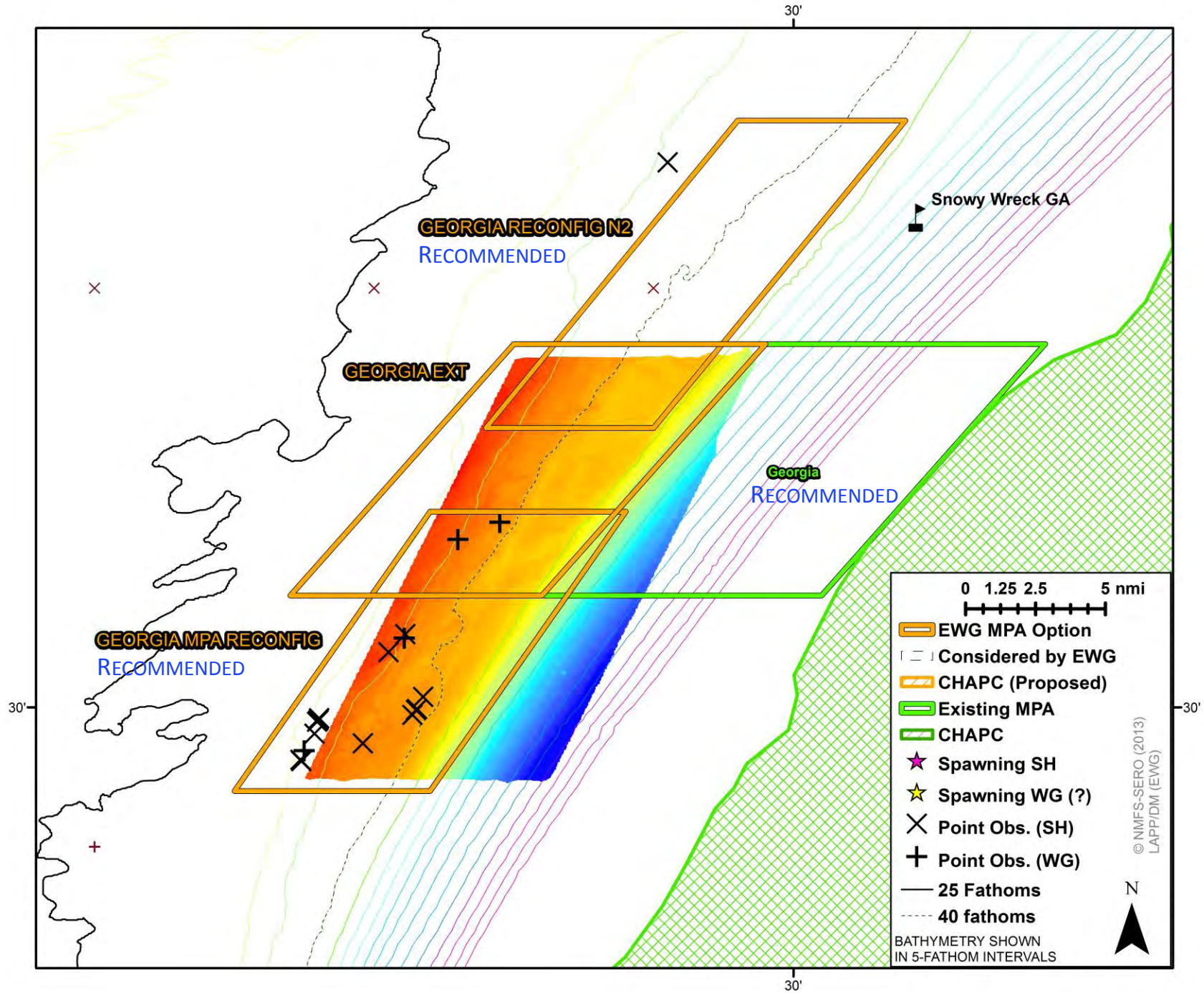
Name	Area (mi ²)	Spawning	Conservation Benefits (%)					Landings Reductions (%)													
			Speckled Hind			Warsaw Grouper		Recreational							Commercial						
			%Habitat	%Stock [X-val]	%Stock [AIC]	%Habitat	%Stock [X-val&AIC]	Red Porgy	Vermilion	Scamp	Amberjack	Blueline	Gag	Red Gpr	Red Porgy	Vermilion	Scamp	Amberjack	Blueline	Gag	Red Gpr
Edisto Reconfig 3	80.6	SH, Many S-G	3.0	1.5	4.0	2.4	0.9	0.4	0.1	0.5	0.2	0.0	0.3	0.0	0.5	0.6	0.9	0.3	0.2	0.3	0.2
Devils Hole 3	26.8	WG?, Many S-G	1.0	0.4	0.9	1.0	0.3	0.1	0.1	1.1	0.1	0.0	0.3	0.0	0.7	0.8	0.8	0.2	0.0	0.5	0.5
Northern SC	66.9	SH, Many S-G	1.5	1.0	2.0	1.4	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Northern SC Ext	12.5	SH, Many S-G	0.2	0.2	0.3	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.1	0.3	0.1	0.1	0.1	0.1

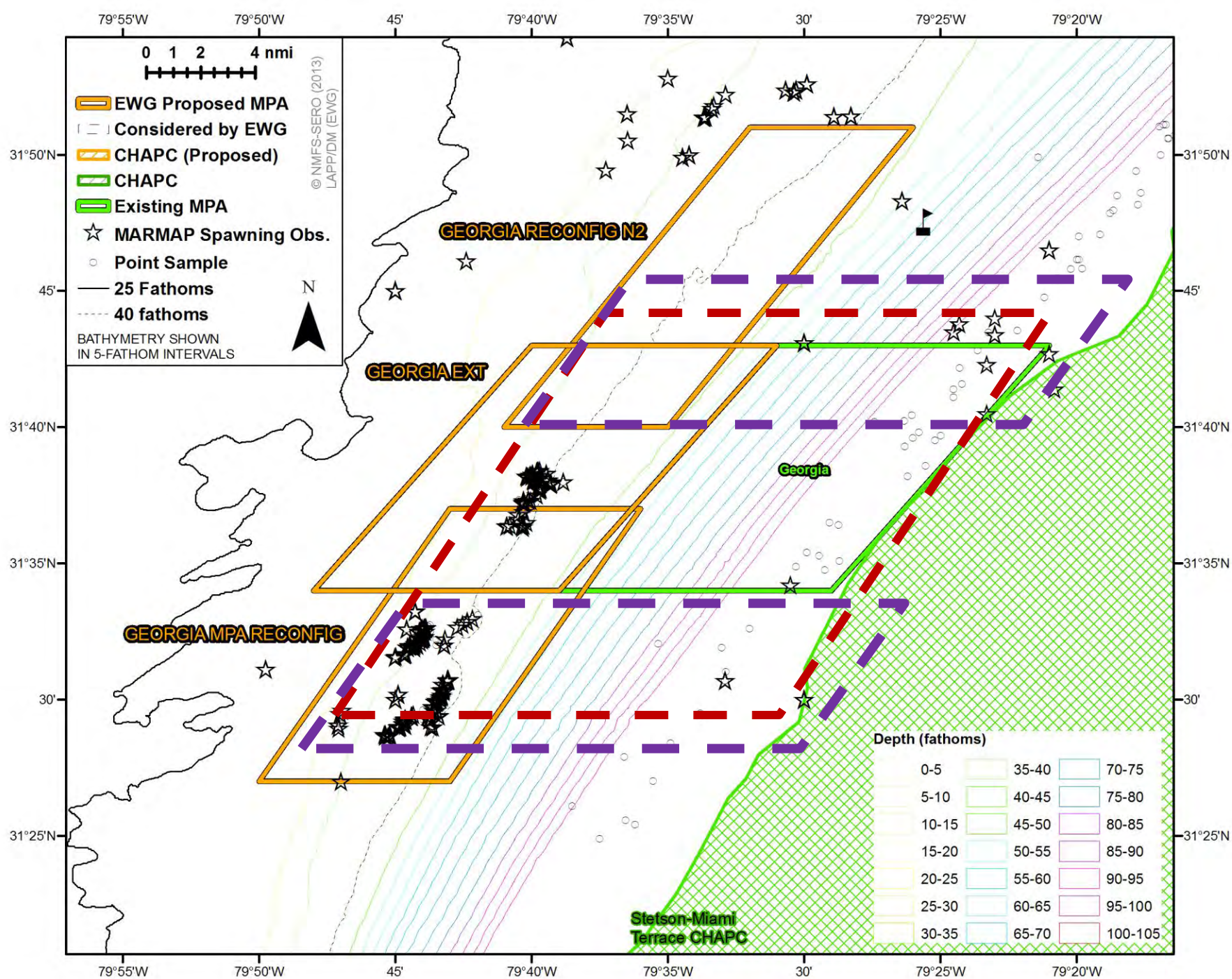
South Carolina MPAs

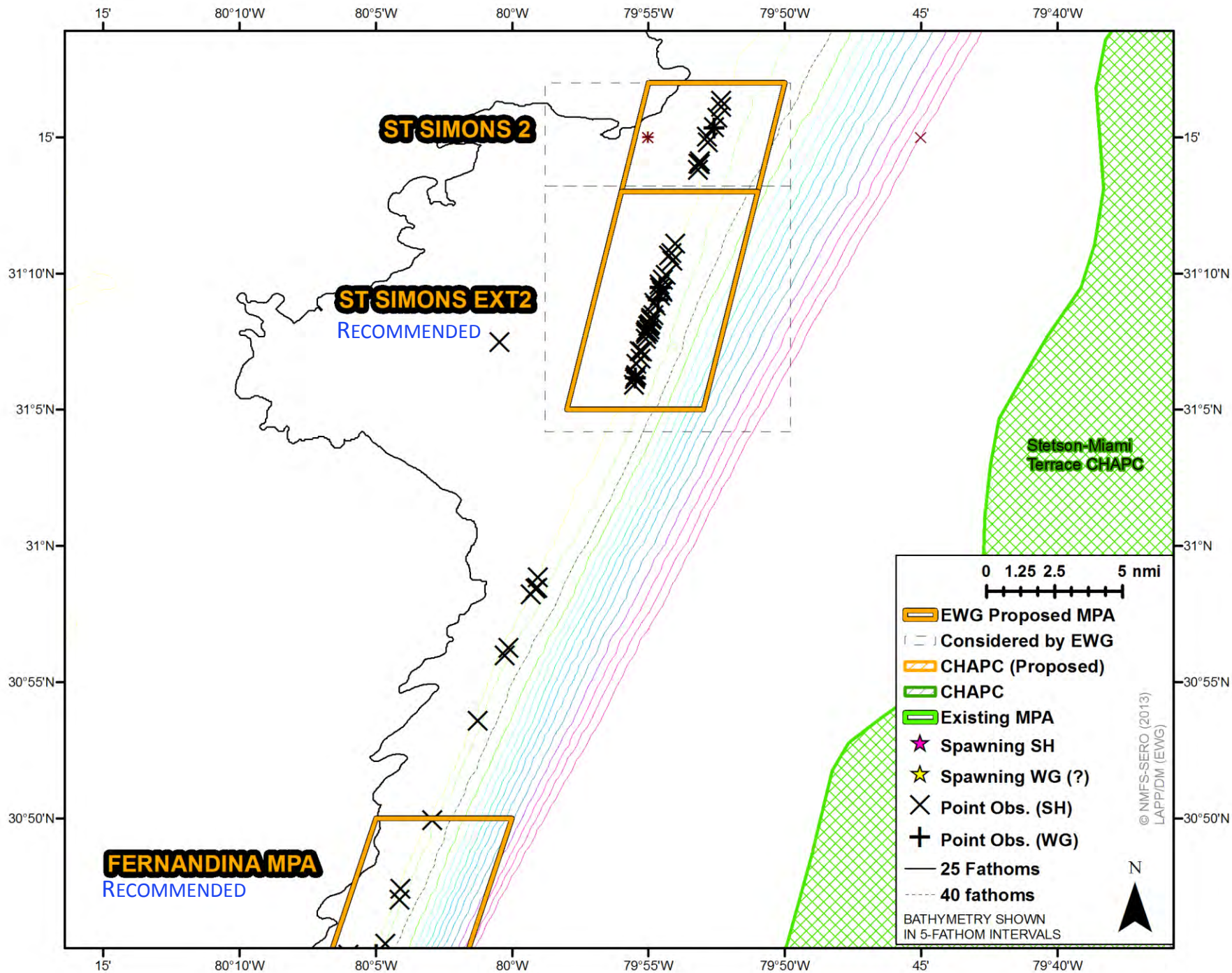
Name	Area (mi ²)	Spawning	Conservation Benefits (%)				
			Speckled Hind			Warsaw Grouper	
			%Habitat	%Stock [X-val]	%Stock [AIC]	%Habitat	%Stock [X-val&AIC]
Edisto Reconfig 3	80.6	SH, Many S-G	3.0	1.5	4.0	2.4	0.9
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Northern SC	66.9	SH, Many S-G	1.5	1.0	2.0	1.4	0.8
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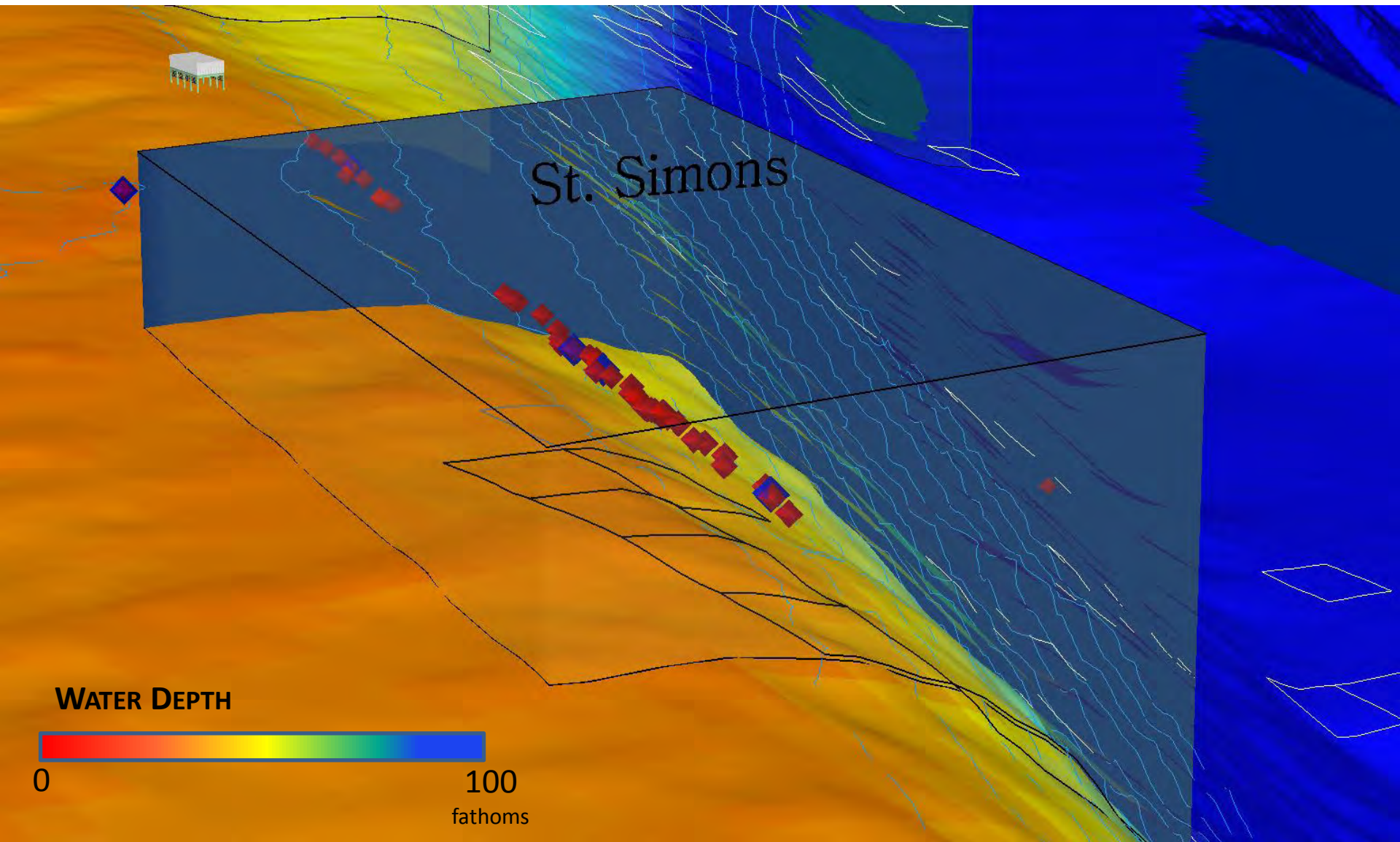


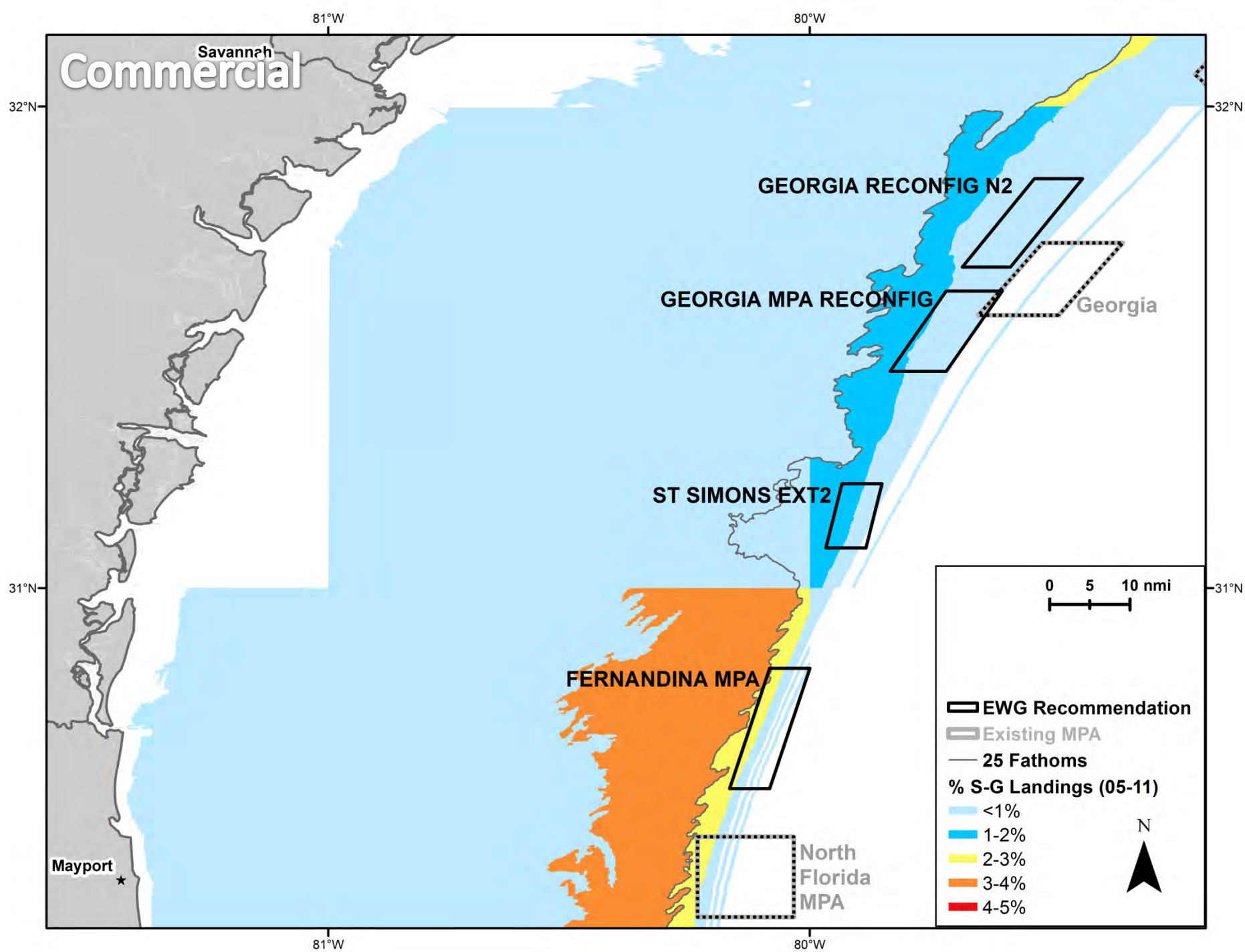


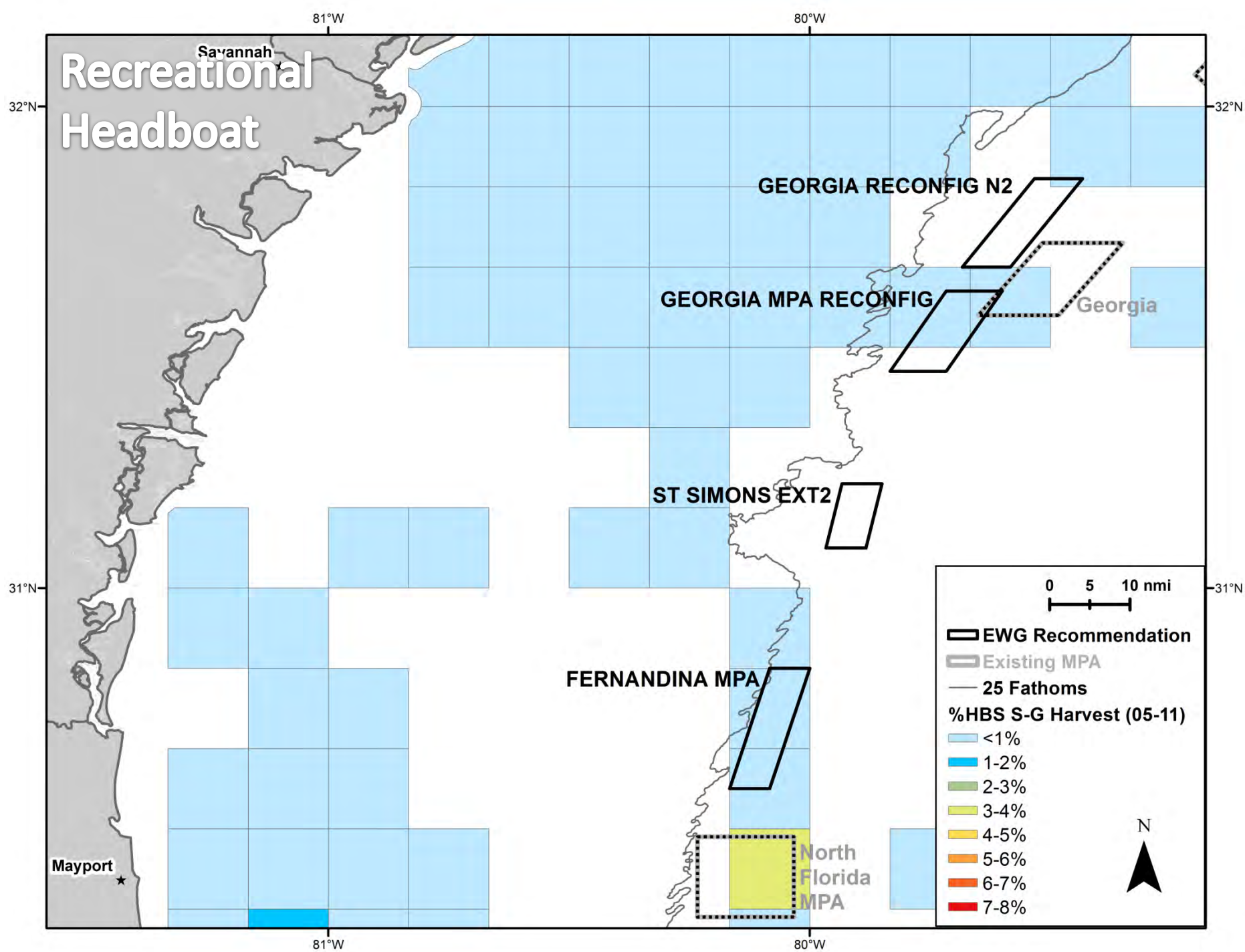




ST. SIMON'S + EXTENSION





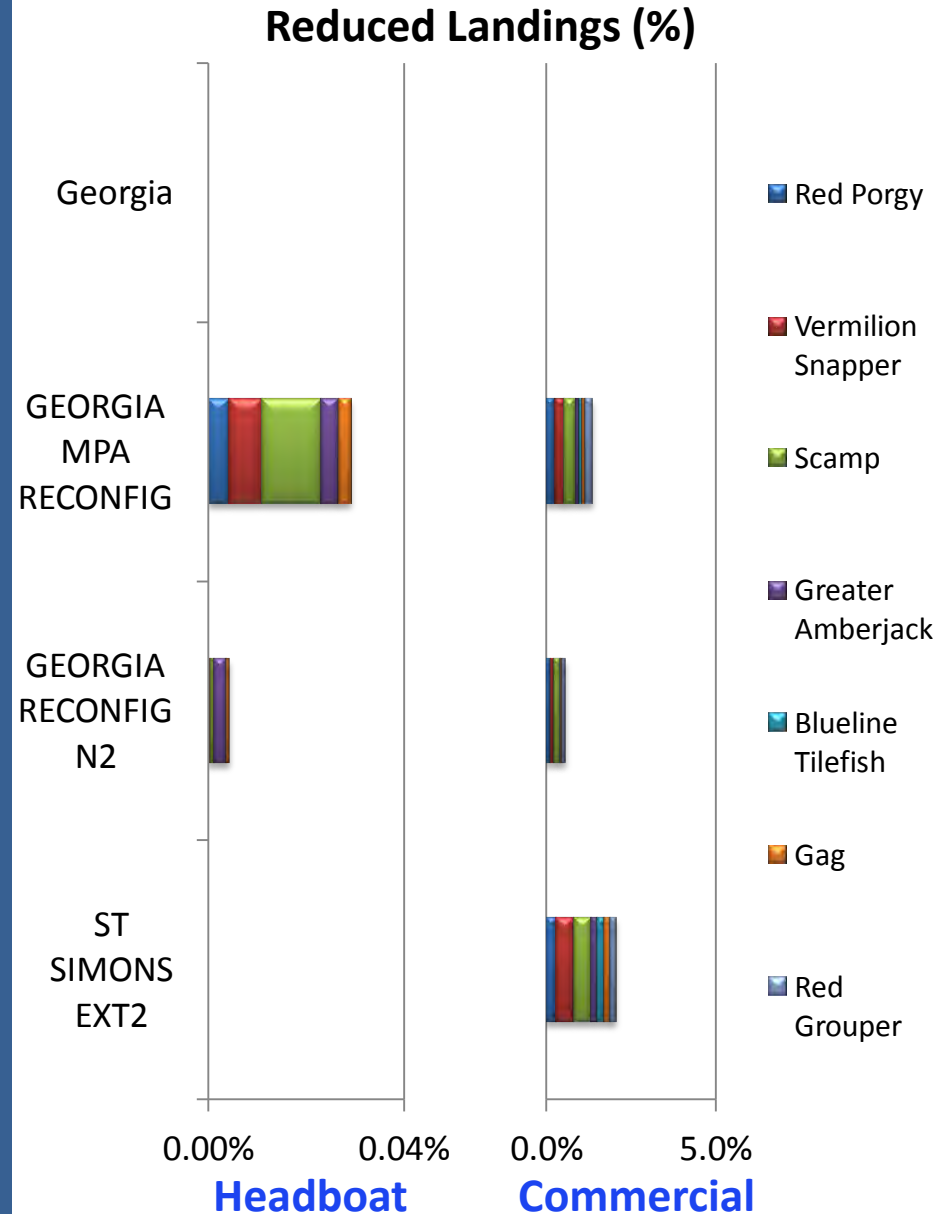


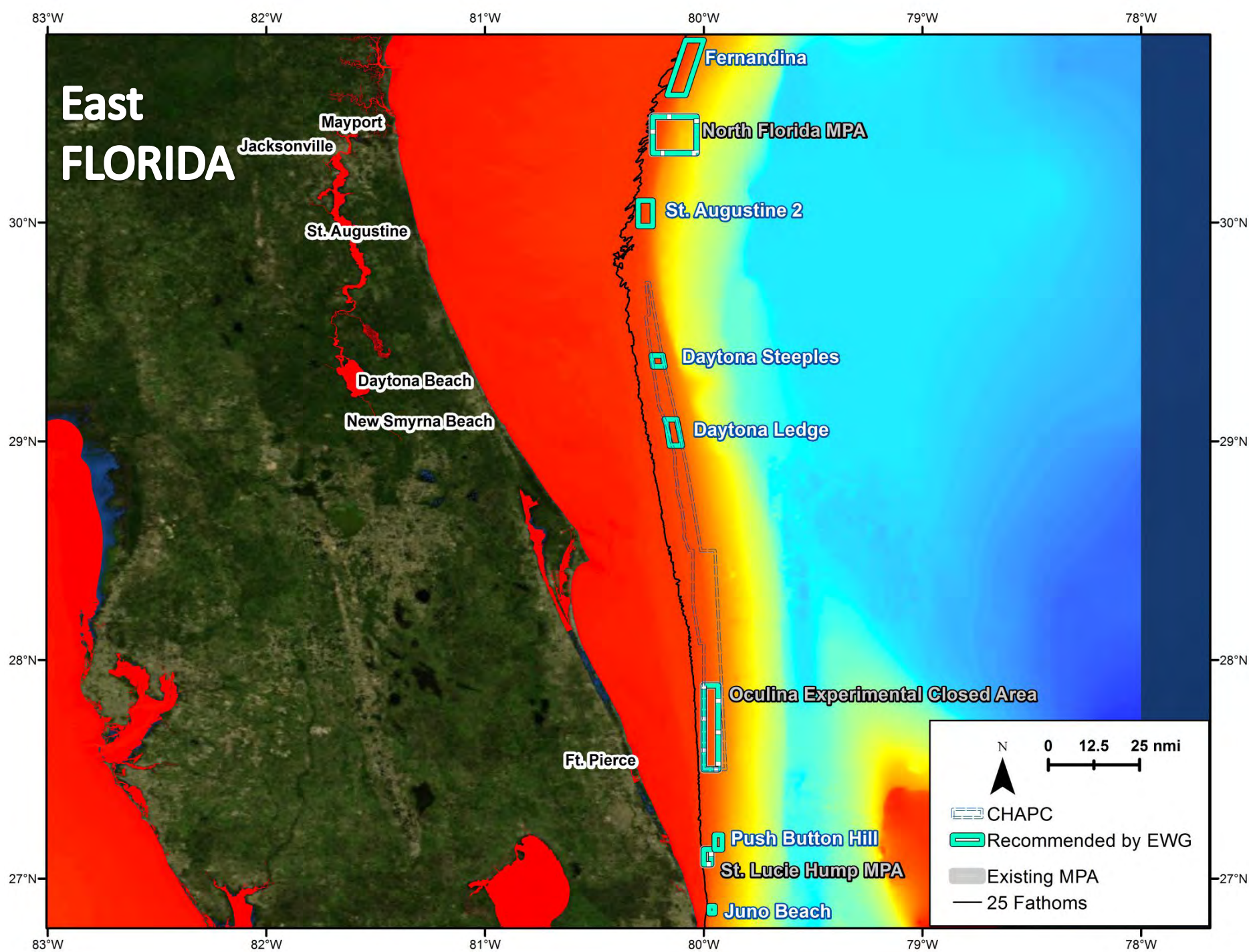
Georgia MPAs

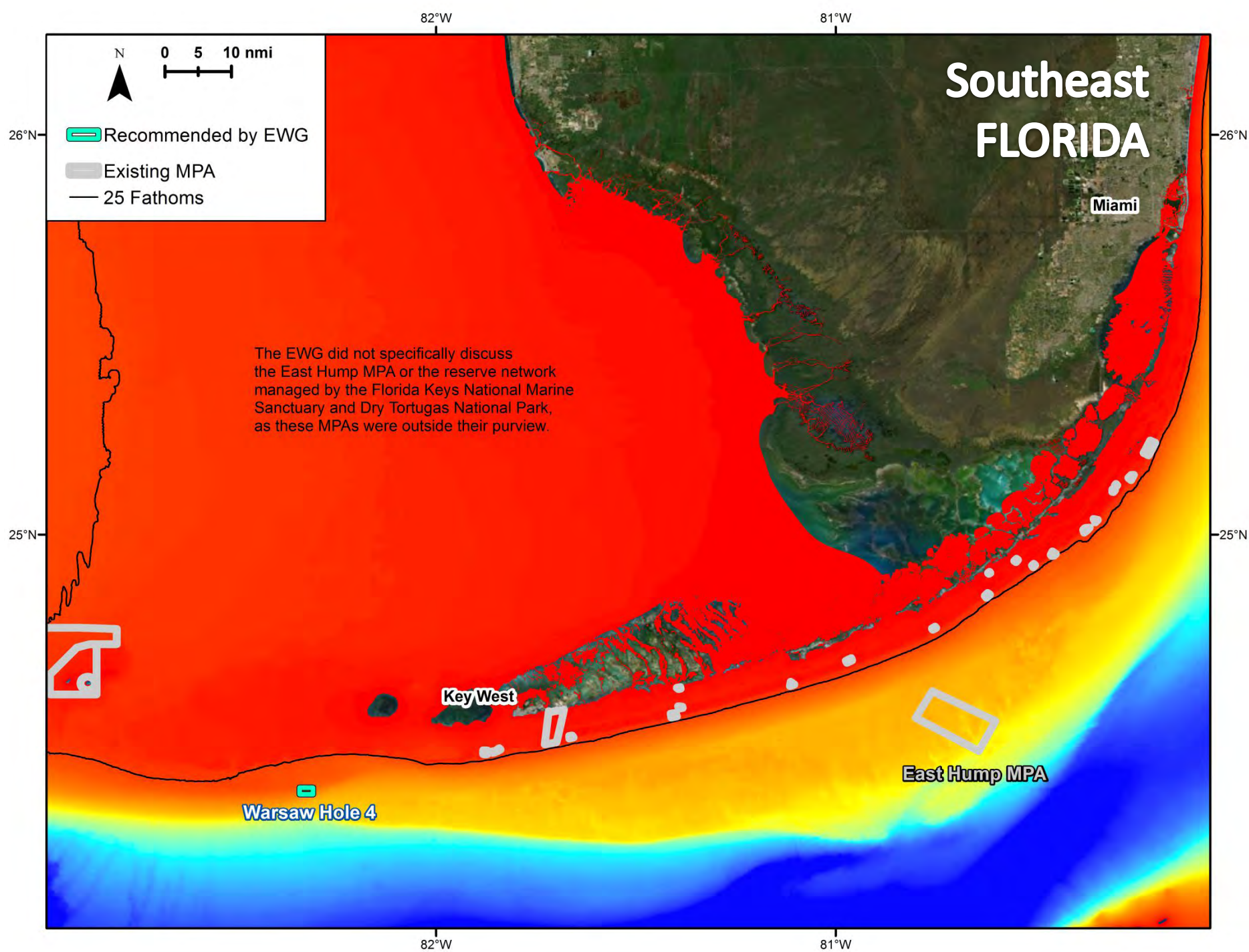
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			%Habitat	%Stock [X-val]	%Stock [AIC]	%Habitat	%Stock [X-val&AIC]	Red Porgy	Vermilion	Scamp	Amberjack	Blueline	Gag	Red Gpr	Red Porgy	Vermilion	Scamp	Amberjack	Blueline	Gag	Red Gpr
Georgia	101.5	Tilefish?	0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Georgia MPA Reconfig	79.0	Many Snapper-Grouper	2.4	1.0	3.4	2.3	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.3	0.1	0.1	0.1	0.2
Georgia Reconfig N2	74.3	Maybe S-G?	1.6	1.1	3.3	1.6	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.0	0.0	0.0	0.1
St Simons Ext2	45.3	Many Snapper-grouper	1.1	0.4	1.5	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.5	0.2	0.2	0.2	0.2

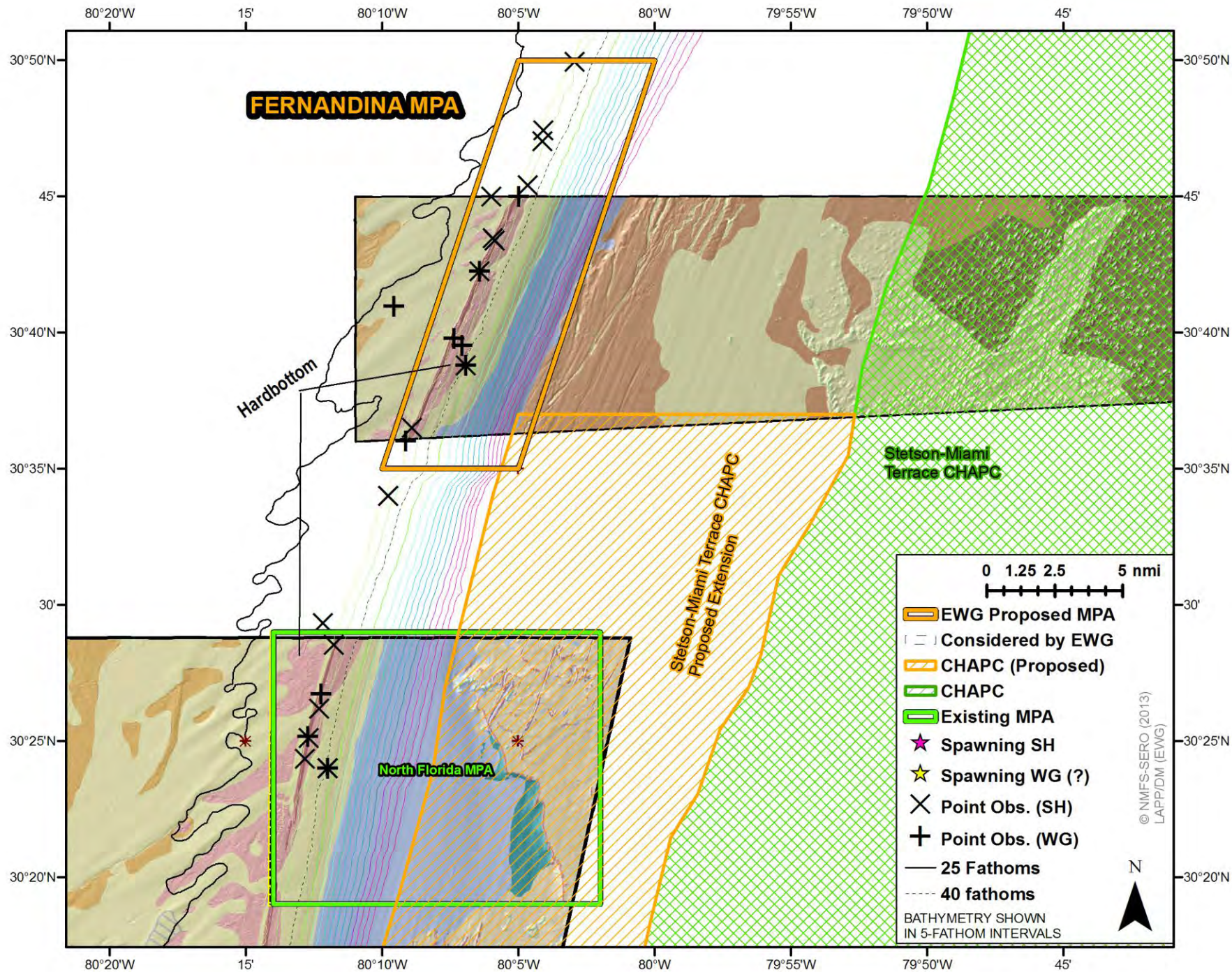
Georgia MPAs

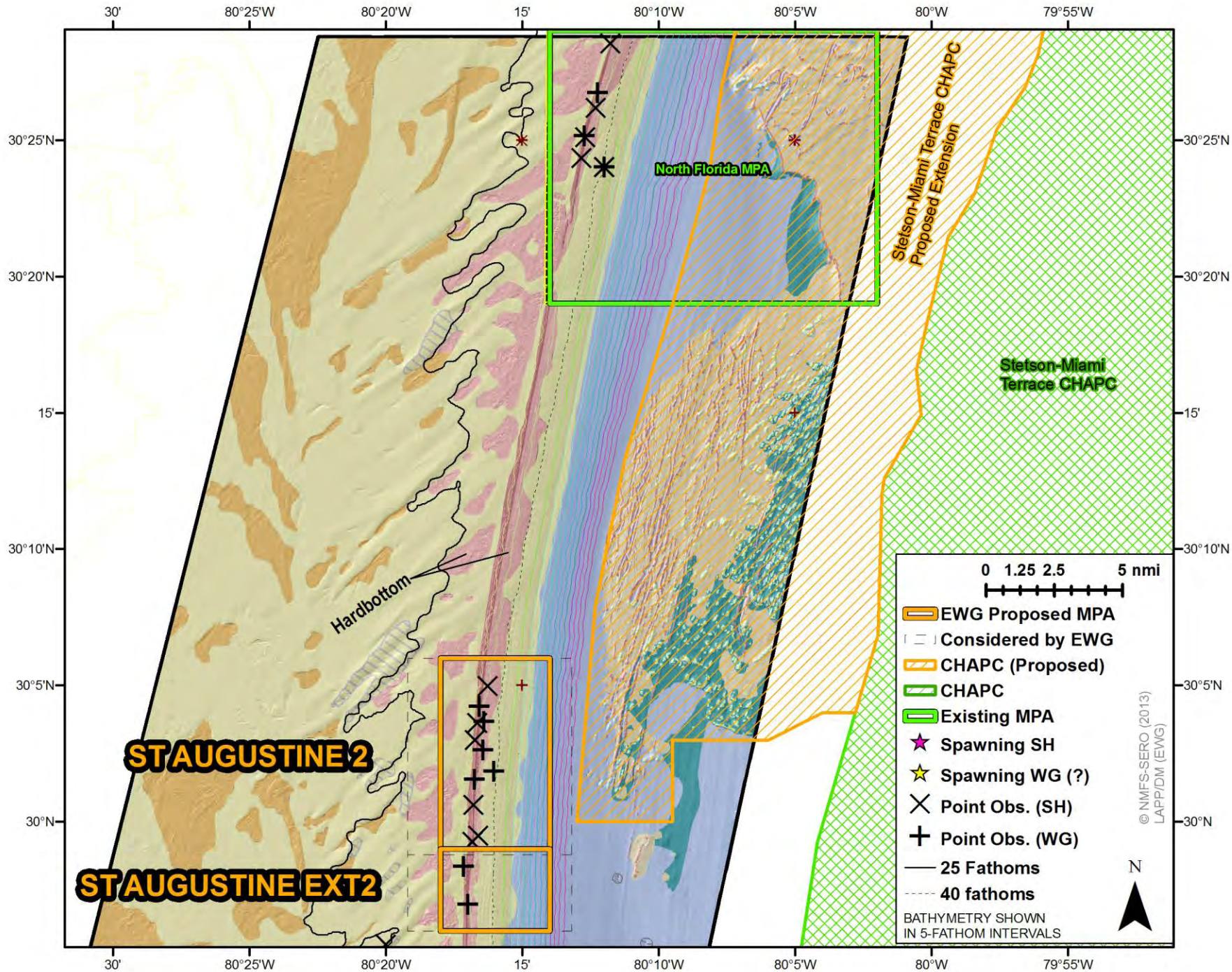
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			Speckled Hind			Warsaw Grouper	
			%Habitat	%Stock [X-val]	%Stock [AIC]	%Habitat	%Stock [X-val&AIC]
Georgia	101.5	Tilefish?	0.0	0.0	0.0	0.0	0.0
Georgia MPA Reconfig	79.0	Many Snapper-Grouper	2.4	1.0	3.4	2.3	1.9
Georgia Reconfig N2	74.3	Maybe S-G?	1.6	1.1	3.3	1.6	2.0
St Simons Ext2	45.3	Many Snapper-grouper	1.1	0.4	1.5	1.0	1.0

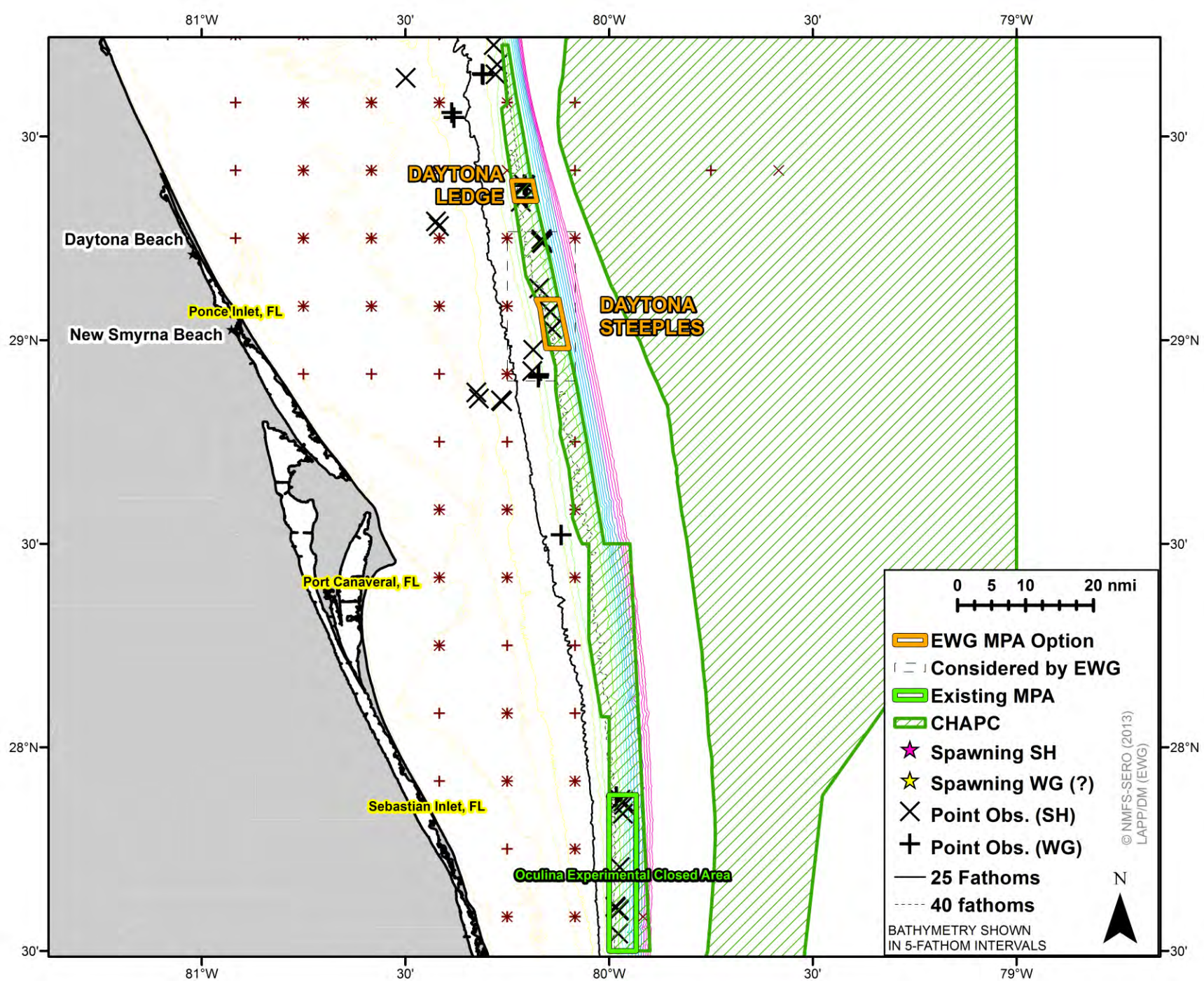


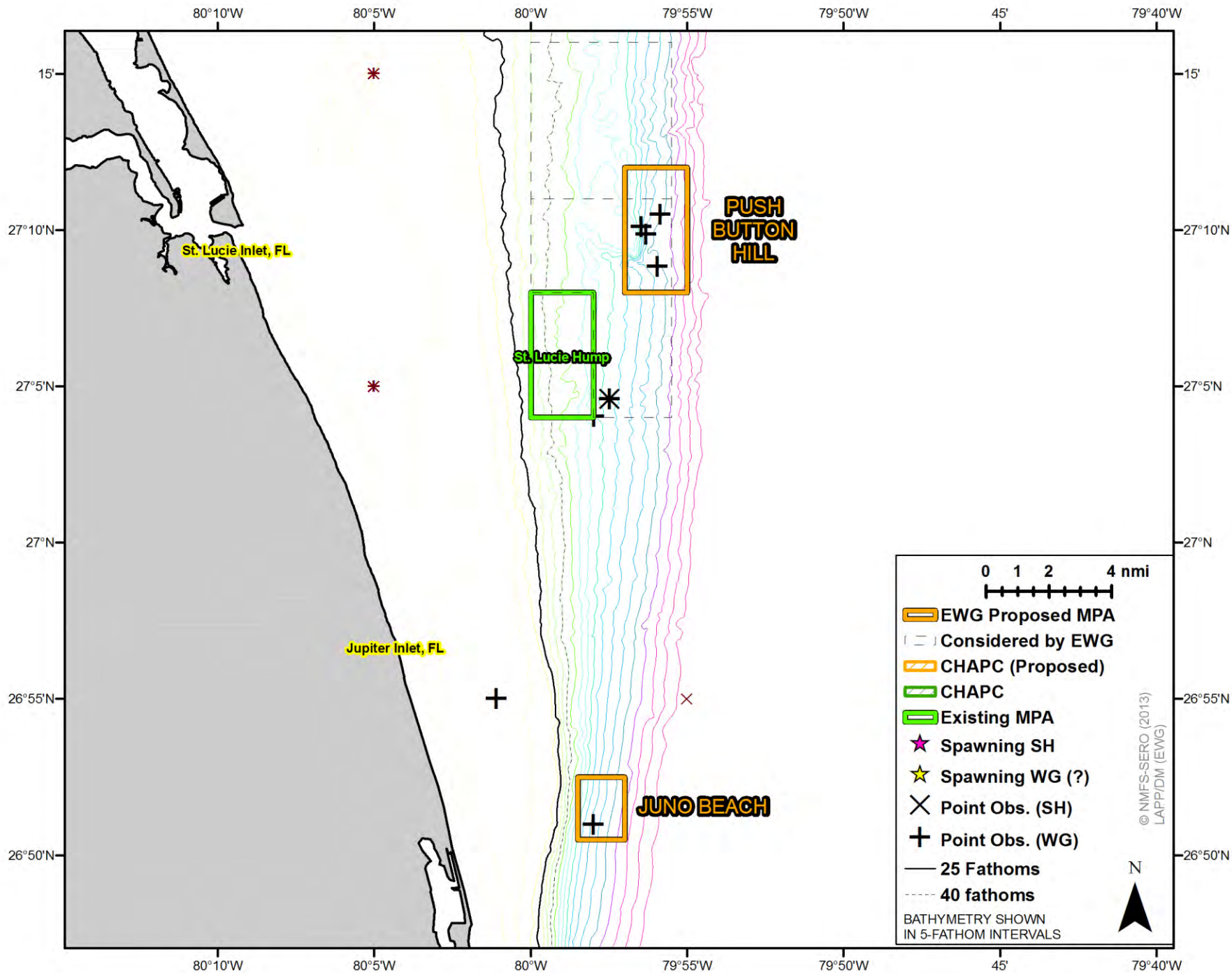




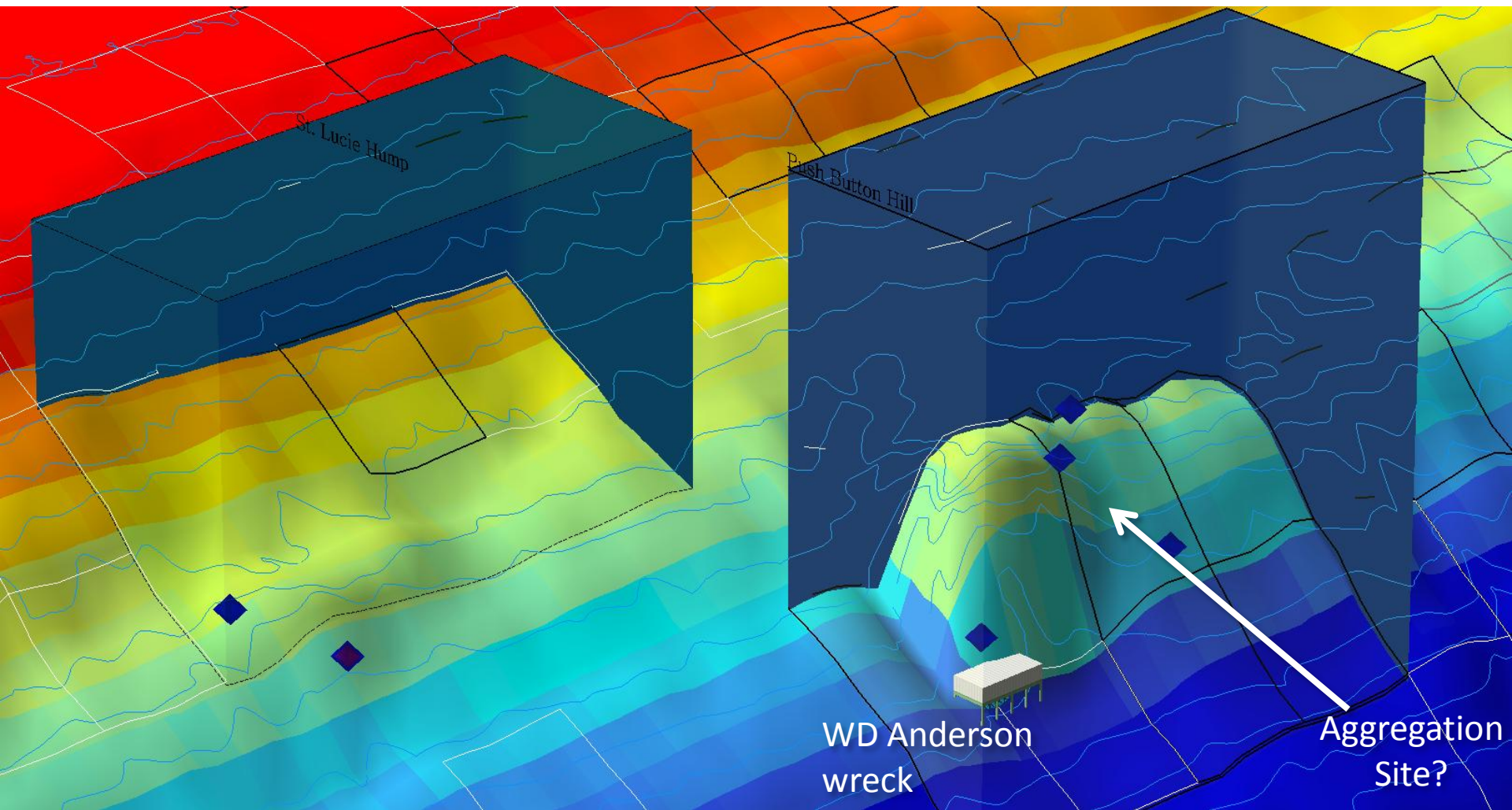








ST. LUCIE HUMPS + PUSH BUTTON HILL

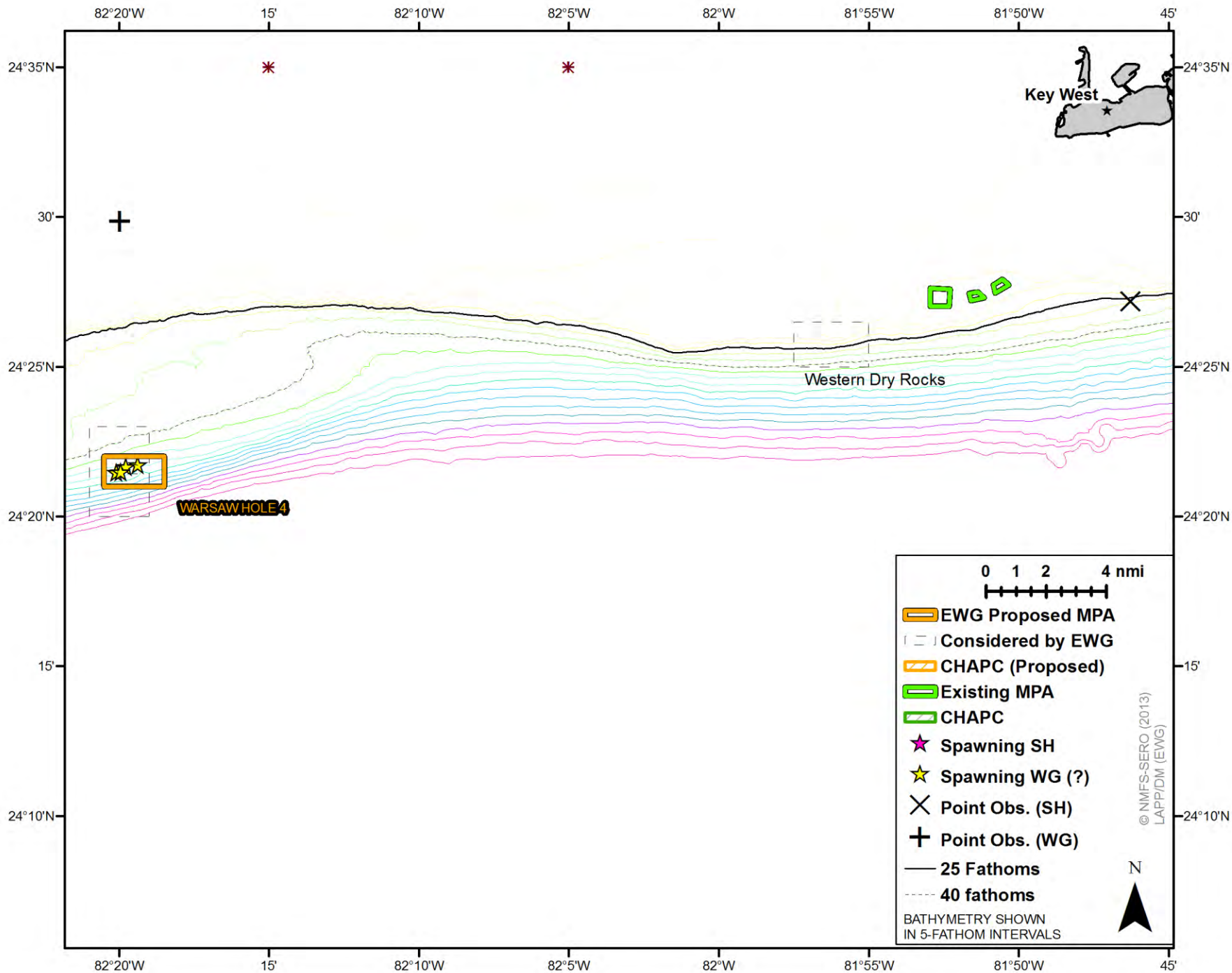


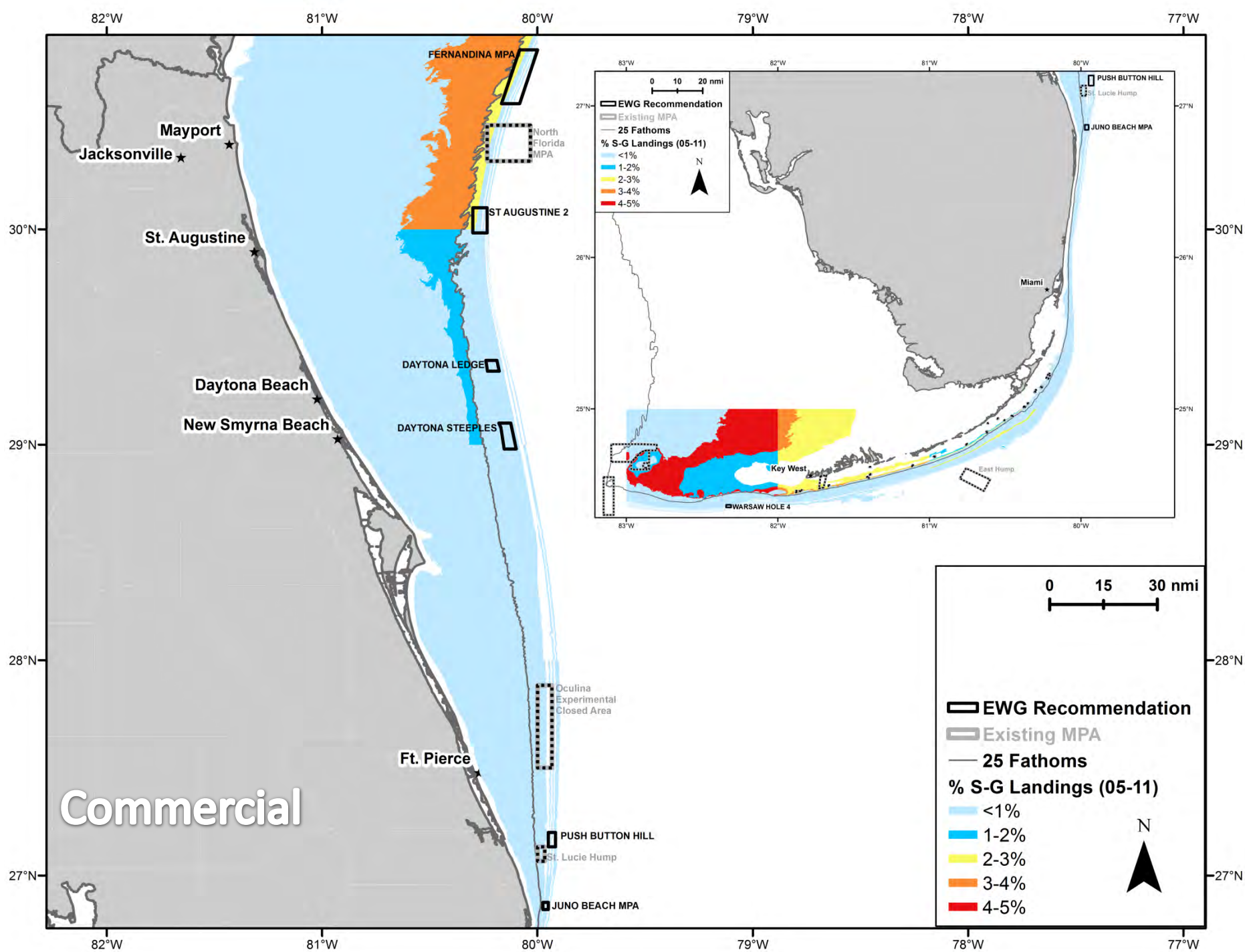
WATER DEPTH

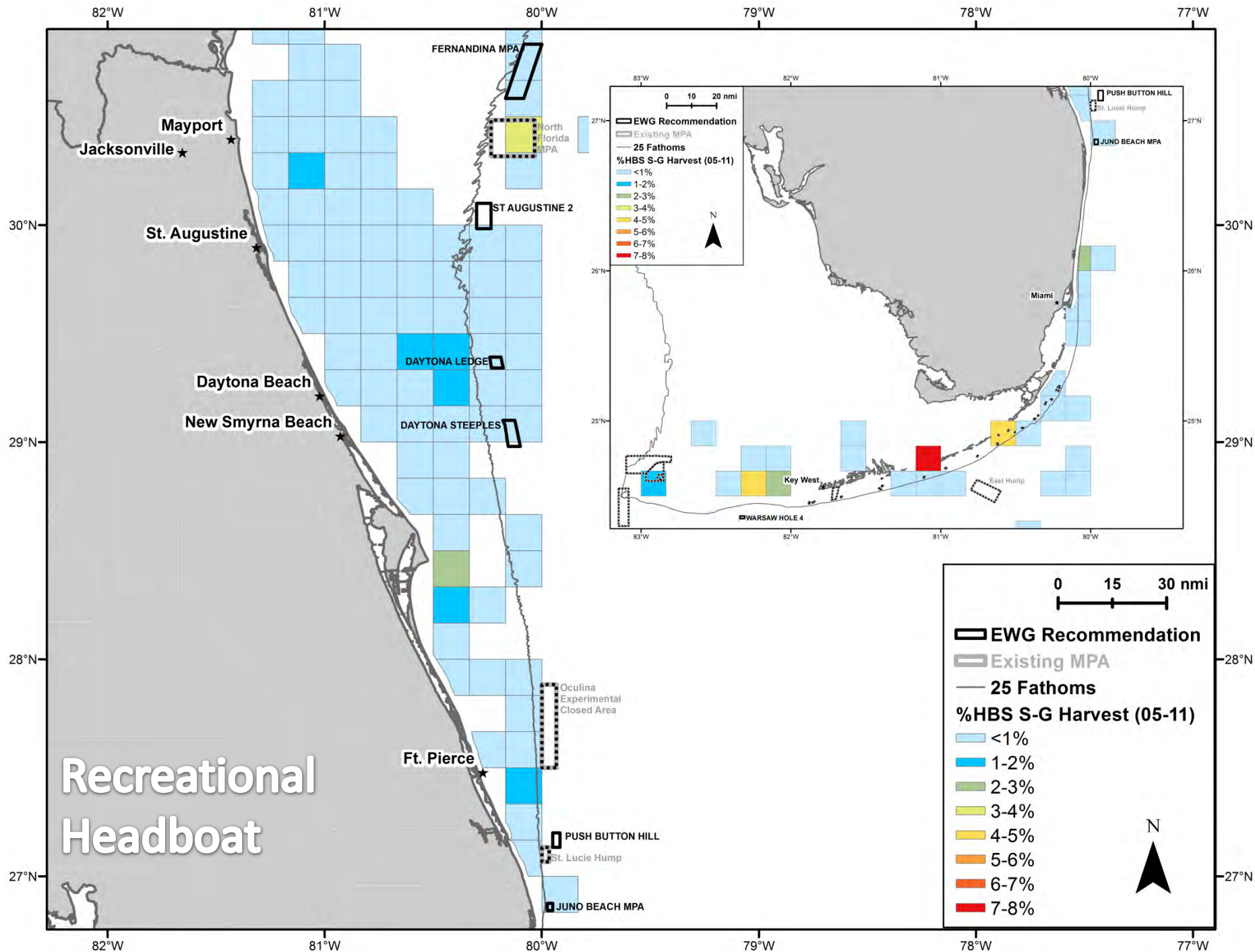


0

100 fathoms





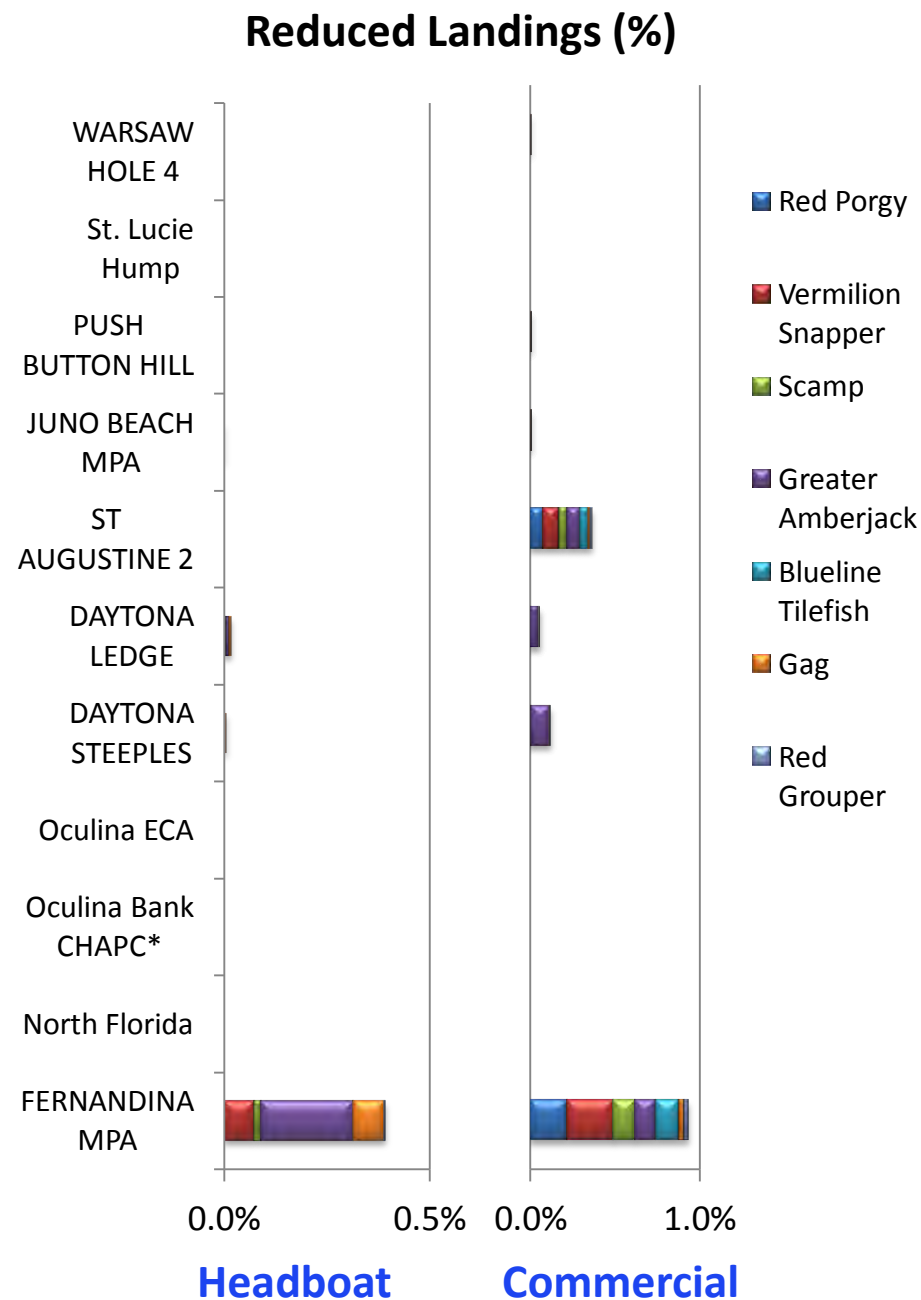


Florida MPAs

[illegible]

Florida MPAs

Name	Area (mi ²)	Spawning	Conservation Benefits (%)				
			Speckled Hind			Warsaw Grouper	
			%Habitat	%Stock [X-val]	%Stock [AIC]	%Habitat	%Stock [X-val&AIC]
Fernandina	85.4	Many SG	2.5	0.5	1.1	2.6	2.8
North Florida	137.0	Many SG	1.9	0.4	1.0	1.9	2.6
Oculina CHAPC*	503.0	Many SG	3.1	0.4	0.8	3.1	1.1
Oculina ECA	107.8	Many SG	3.2	0.1	0.3	3.3	
Daytona Steeples	26.6	Many SG	0.8	0.1	0.1	0.7	0.6
Daytona Ledge	11.0	Many SG	0.3	0.1	0.1	0.3	0.2
St. Aug. 2	32.1	Many SG	0.7	0.2	0.5	0.6	1.0
Juno Beach	3.5	Many SG	0.0	0.0	0.0	0.0	
Push Button Hill	9.4	Many SG	0.3	0.0	0.0	0.3	
St. Lucie Hump MPA	9.4	Many SG	0.2	0.0	0.0	0.2	
Warsaw Hole 4	2.4	WG (DeMaria)	0.0	0.0	0.0	0.0	



EWG Recommendations vs. Status Quo

MPA Scenario	Area (mi ²)	Conservation Benefits (%)					Potential Reduced Landings (%)														TOTAL NTZs
		SPECKLED HIND			WARSAW GROUPER		Red Porgy		Verm. Snapper		Scamp		Greater AJ		Blueline		Gag		Red Gpr		
		%Habitat	% Stock [X-val]	% Stock [AIC]	%Habitat	% Stock [X-val&AIC]	Com	Hbt	Com	Hbt	Com	Hbt	Com	Hbt	Com	Hbt	Com	Hbt	Com	Hbt	
STATUS QUO	1272	12%	3%	8%	12%	5%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
EWG RECS	1865	27%	11%	23%	26%	16%	3%	1%	3%	1%	4%	2%	1%	1%	1%	0%	1%	1%	2%	1%	14

STATUS QUO VS. EWG RECOMMENDED:	769	status quo closed area (mi ²)
	1362	EWG recommended closed area (mi ²)
	593	increase in closed area (mi ²)
	3.4	times the protection for speckled hind
	2.9	times the protection for warsaw grouper
	1.8	times the area closed

**estimates of closed area do not include CHAPC; estimated benefits assume CHAPC reduces bycatch at 50% efficiency*

Acknowledgements

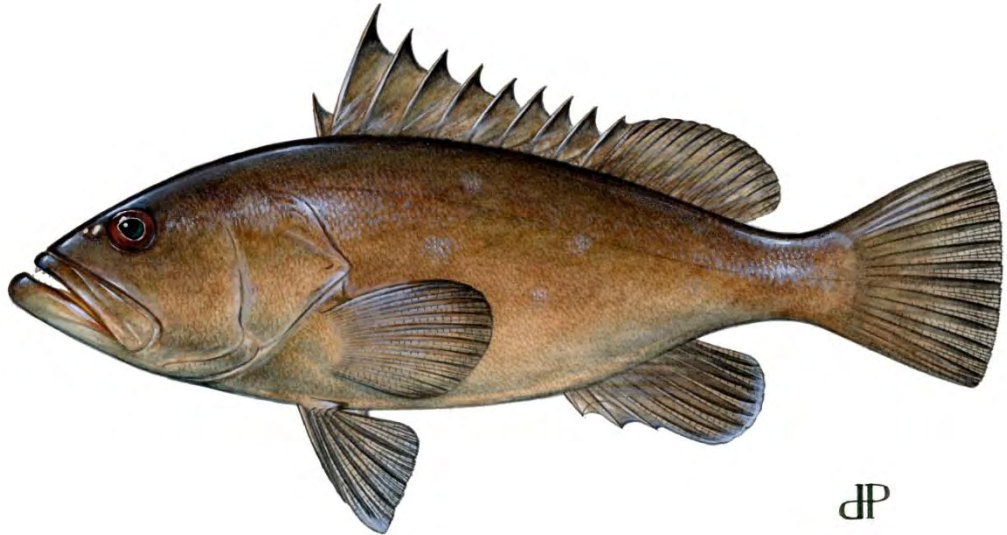
Nick Farmer	Mandy Karnauskas	Jack McGovern	Will Heyman	Andy Strelcheck
Michael Larkin	Roger Pugliese	Todd Kellison	Marcel Reichert	Andy David
Chris Harris	Christina Schobernd	Carlos Rivero	Erik Williams	Leslie Sautter
Stacey Harter	Ken Brennan	Don DeMaria	John Carmichael	Rusty Hudson
Mike Burton	Stacy Hargrove	Andy Herndon	Jason Rueter	Mandy Frick
Cindy Meyer	Karla Gore	Gregg Waugh	Scott Harris	Jessica Stephen
Tim Battista	Jeremiah Blondeau	Jim Bohnsack	Benjamin Ruttenberg	Rick DeVactor
Julie M. Defilippi	Alan Bianchi	David Gloeckner	Steve Turner	David Wyanski
Christy Semmens	Jeffery Buckell	Wilson Laney	David Newman	Ben Hartig
Leda Dunmire	Luiz Barbieri	Bonnie Ponwith	Jerry Ault	Michael Barnette
Chris Koenig	Churchill Grimes	Gabe Ziskin	Grant Gilmore	Frank Helies
Scott Raborn	Scott Baker	Liam Carr	Rick DeVactor	Joey Ballenger

Comments from the MPA EWG, SAFMC SSC, SERO staff, SEFSC, SAFMC, SAFMC staff, and many others have been most appreciated!

QUESTIONS?



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JP

Discussion: Keys for Success

Public support

Involvement in MPA selection

Performance Metrics

*Baseline measures of habitat
and stock condition in/out*

Space use and movements

*Follow-up monitoring,
simulation modeling*

Adequate enforcement

Simple regulations

Mandatory VMS

Passive listening devices

Adaptive management

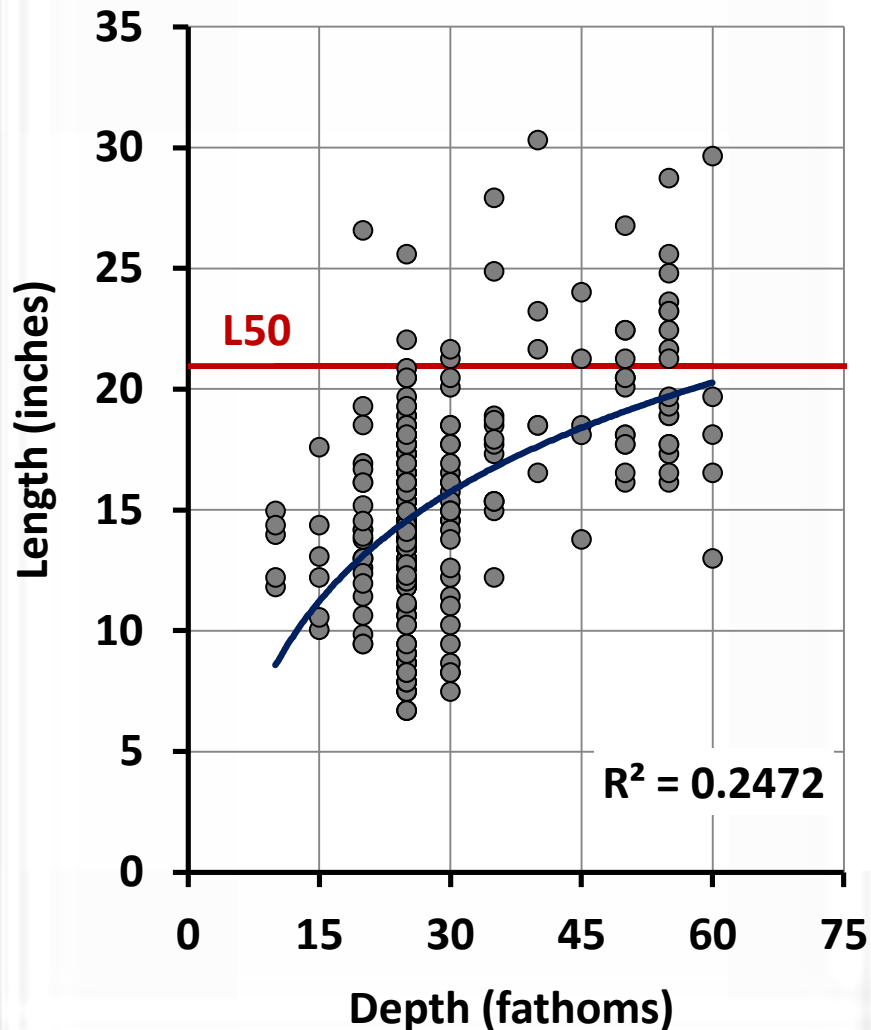
*Boundaries and number of
MPAs can be modified*

*Collect data for new
assessment*

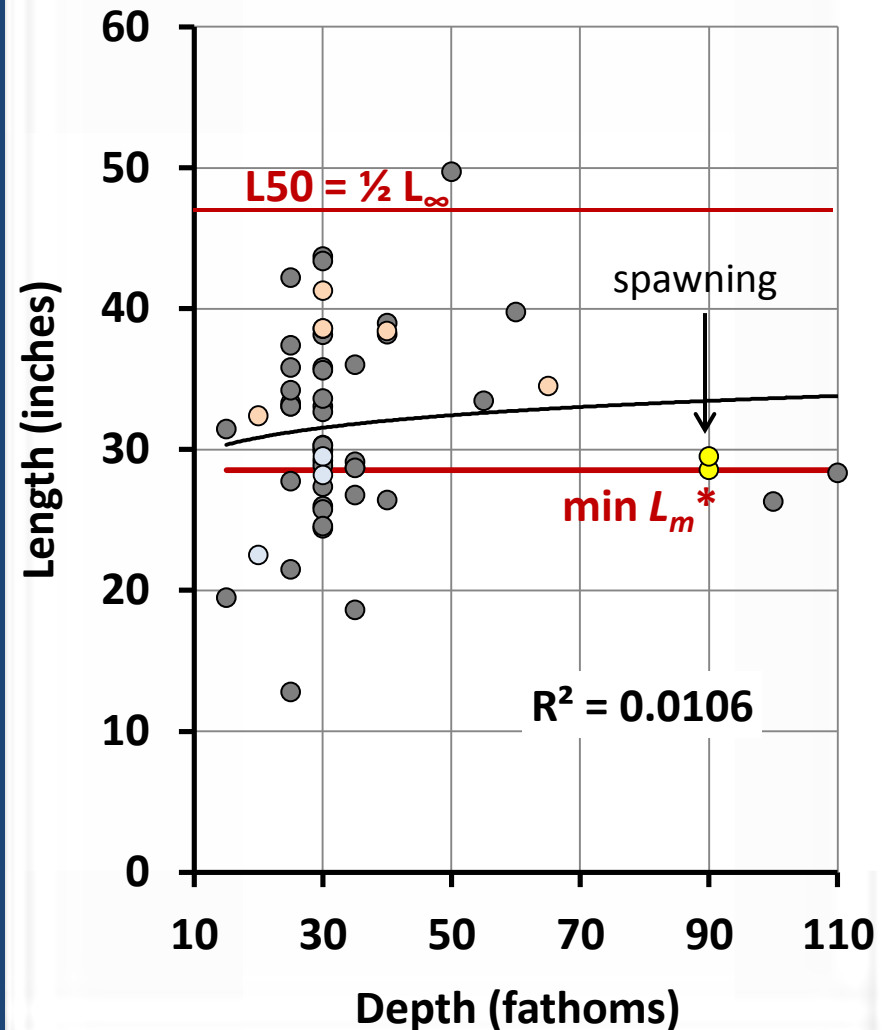


MATURITY VS. DEPTH

Speckled Hind

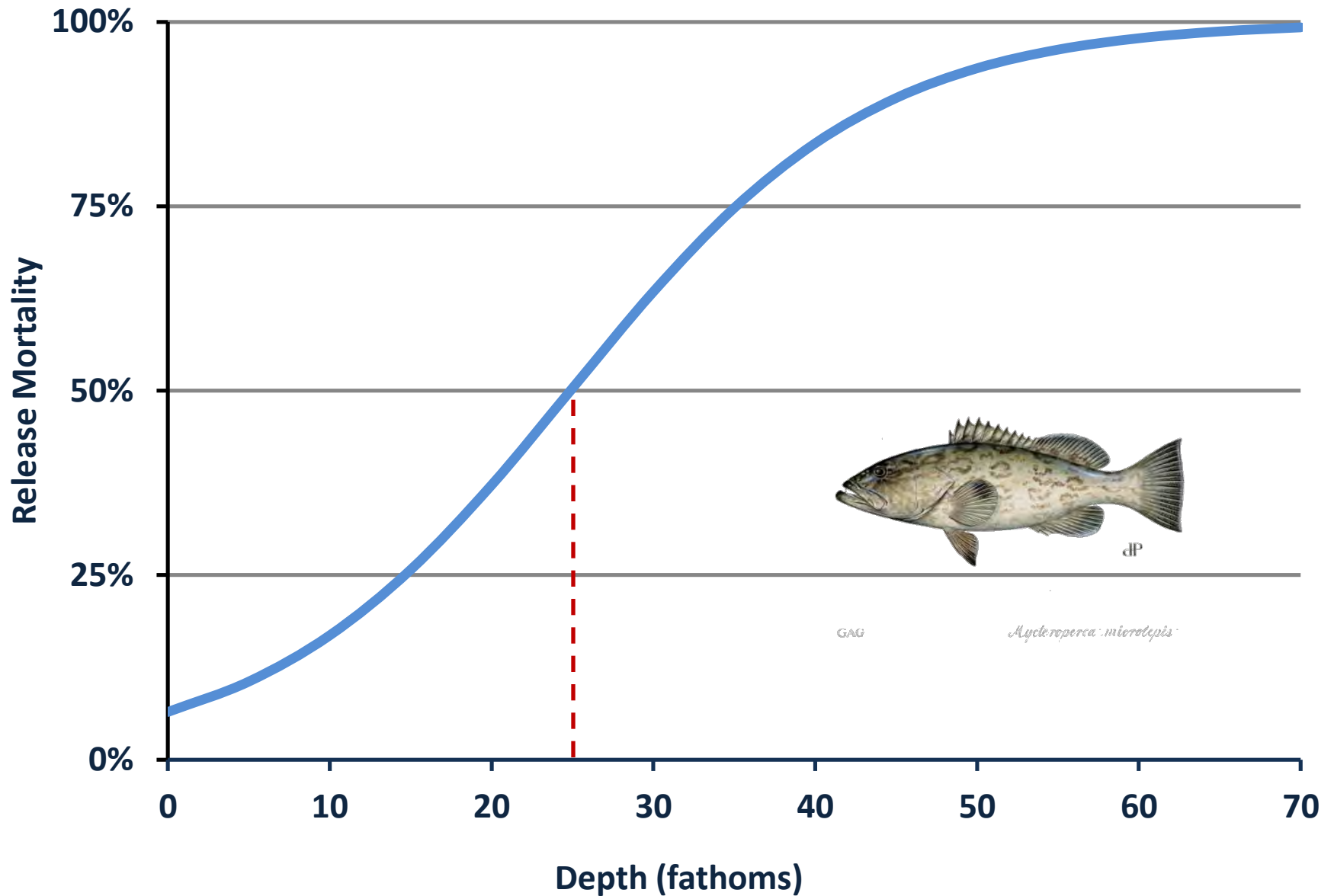


Warsaw Grouper



*min from n=9 mature fish (D. Wyanski, SC-DNR)

RELEASE MORTALITY



RELEASE MORTALITY

Burns (2009) Evaluation of the efficacy of the minimum size rule in the red grouper and red snapper fisheries with respect to J and circle hook mortality, barotrauma and consequences for survival and movement. USF Dissertation.



Table 3-1. Red snapper and red grouper mortalities during hyperbaric chamber tests. Data include number of mortalities for each depth, % of all fish tested by species, % of all fish tested at depth by species, and % of all mortalities by depth.

		Depth (m)				% of species
		12 fa 21.3	15 fa 27.4	23 fa 42.7	33 fa 61.0	
Red grouper	# of mortalities	0	2	6	-	40.0
	% by depth	0	50.0	75.0	-	-
	% of all RG mortalities	0	25.0	75.0	-	-

CLOSED AREAS FOR SH & WG

Depth: 25-100 fathoms

Higher probability of encounter

Likely >50% release mortality

> percentage mature fish

Alignment and size: Large, Shelf-Edge

Cover likely foraging and spawning habitats

Efficiency and enforceability

Location selection: Source Habitats

Documented occurrences (i.e., point observations)

Documented hardbottom habitat

Extend/modify existing MPAs or expand network

[illegible]

HABITAT SUITABILITY ANALYSIS

25-100 fathoms broken into **Habitat-Depth Grids**

Intersected SEAMAP 1-min habitat grids w/ 5-ftm bins

*Recent high-resolution bathymetry 'max slope' used
to reassign some SEAMAP 'Unknown' habitats*

Qualitative Habitat Suitability Analysis (by Stock)

Known – Point observation in grid

Probable – Headboat observation in grid or
Hardbottom/Possible Hardbottom habitat

No – No point observations in >5 samples

Unknown – Unknown habitat & <5 samples

GEOGRAPHIC DISTRIBUTION MODEL

Logistic regression model of $p(\text{detection})$:

Proc LOGISTIC (*Logit link*)

Stepwise Process (*AIC*) and 10-fold Cross-validation used to guide model selection:

VARIABLE	DESCRIPTION
latY	WGS Latitude, rounded to nearest tenth.
latYSq	Quadratic function of WGS Latitude
depthBeg	Beginning depth of 5-fathom depth bin
depthBegSq	Quadratic function of depth
Agg_Hab	Habitat classification: 'HB'- hardbottom, 'PH'- possible hardbottom, 'NH'- not hardbottom, 'UN'- unknown
Gear	MARMAP, HBS, FRG, SEFIS Trap, SEFIS Video, Oculina ROV, DW-ROV

Goal: Solve function by depth-grid controlling for gear effects to predict $p(\text{occurrence})$

GEOGRAPHIC DISTRIBUTION MODEL

Significant predictors of grouper distribution:

SPECKLED HIND				
Parameter		Estimate	Pr > ChiSq	Marginal Variability Explained
Intercept		-97.7162	<.0001	-
latYSq		-0.0877	<.0001	29.88%
gear	DWROV	0.421	0.1183	10.63%
gear	FRG	2.4874	<.0001	-
gear	HBS	0.9792	<.0001	-
gear	MMAp	-1.5909	<.0001	-
gear	OCULINA	2.1723	<.0001	-
gear	REEF	1.3389	0.0139	-
gear	RFOP	-0.3154	0.047	-
gear	SEFIS	-2.6889	<.0001	-
latY		5.795	<.0001	3.21%
Agg_Hab	HB	0.8587	<.0001	1.47%
Agg_Hab	NH	0.0105	0.9489	-
Agg_Hab	PH	1.1512	<.0001	-
DepthBegSq		-0.00013	<.0001	0.27%
			TOTAL	45.46%

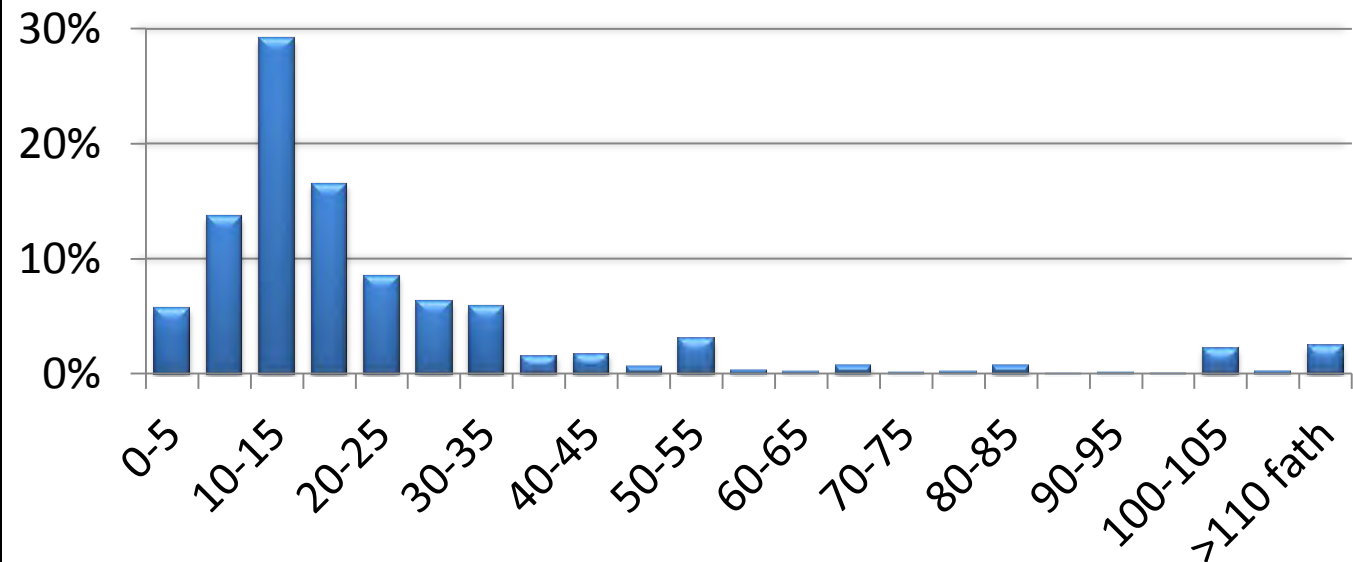
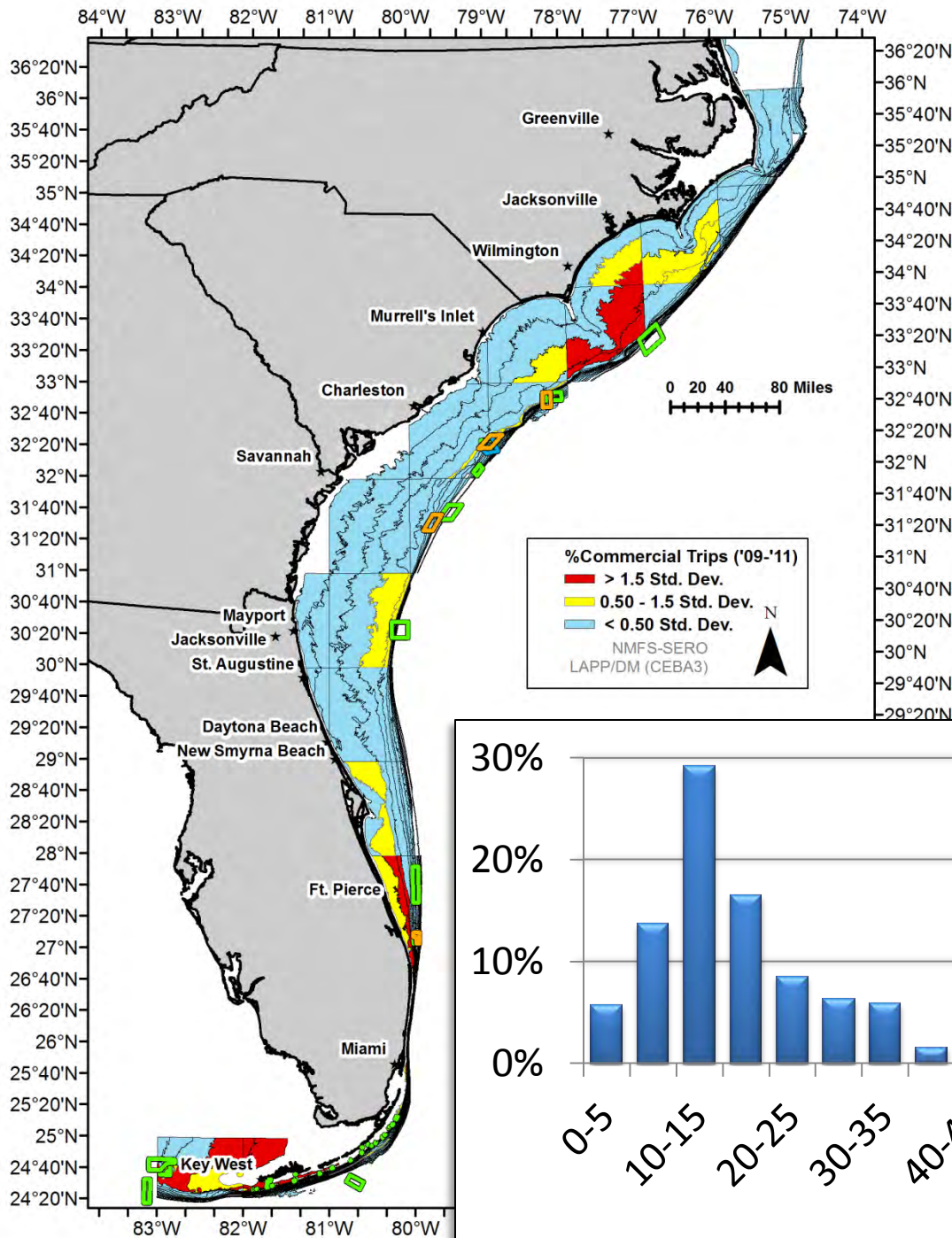
WARSAW GROUPEr				
Parameter		Estimate	Pr > ChiSq	Marginal Variability Explained
Intercept		-153.5	0.0017	-
latY		9.7189	<.0001	8.51%
gear	DWROV	1.6809	0.9706	5.14%
gear	FRG	4.2396	0.9259	-
gear	HBS	2.0493	0.9642	-
gear	MMAp	-0.7913	0.9862	-
gear	OCULINA	1.5921	0.9722	-
gear	REEF	-9.753	0.9787	-
gear	RFOP	0.7422	0.987	-
gear	SEFIS	-0.1458	0.9974	-
latYSq		-0.159	<.0001	6.03%
Agg_Hab	HB	0.4304	0.1299	0.79%
Agg_Hab	NH	0.8188	0.0073	-
Agg_Hab	PH	0.1356	0.643	-
			TOTAL	20.47%

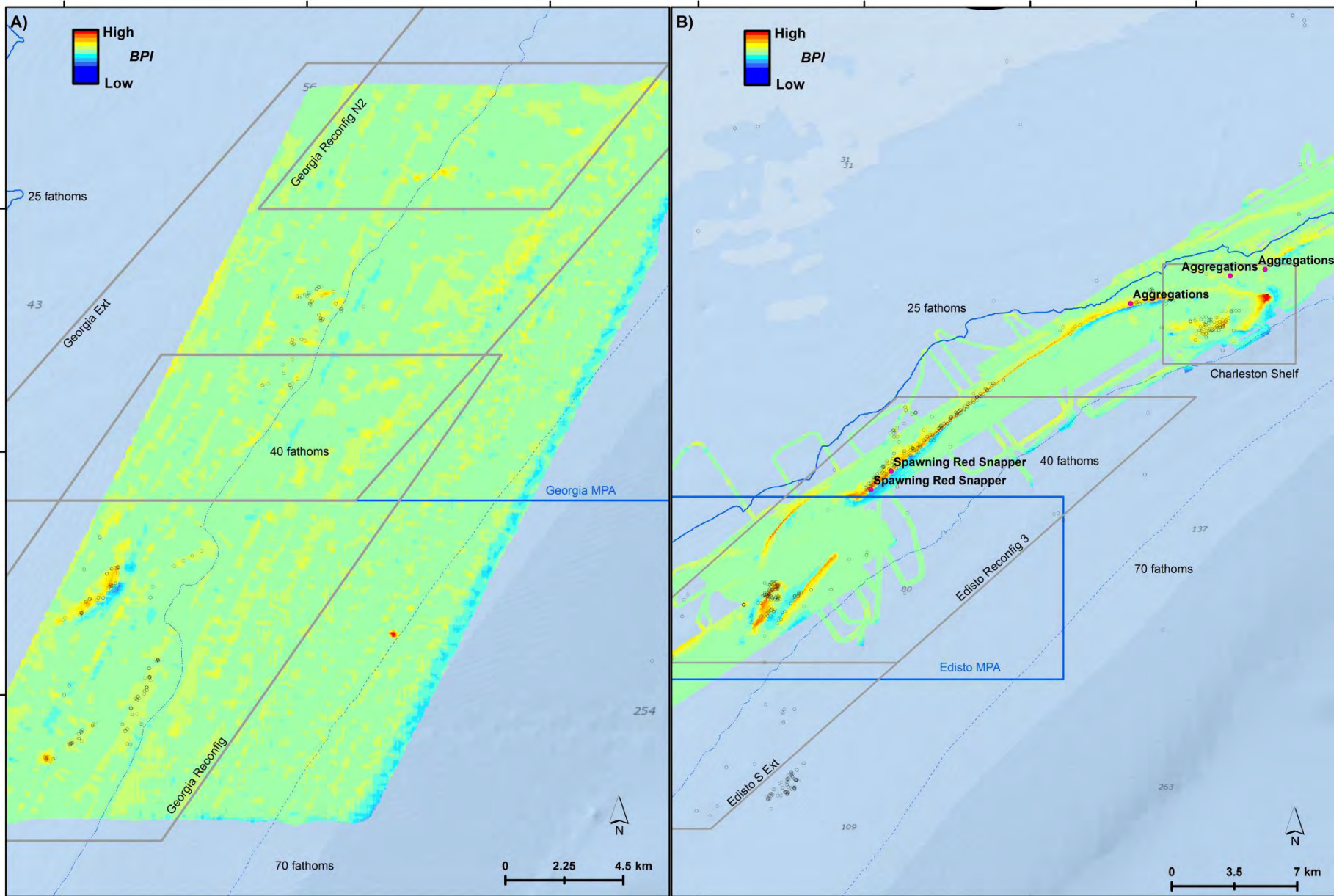
Latitude, Habitat Type, Sampling Gear

BYCATCH MORTALITY

Fish stocks and fishing effort are heterogeneously distributed

$$\text{Reduction in bycatch } F \approx \text{\%Stock in MPA} \times \text{\%Effort in MPA}$$





Example from current collaborative research between SERO, SEFSC, MARMAP, and MPA-EWG to predict and verify spawning aggregation locations using biogeomorphology. Small circles denote MARMAP observed SG spawning; labels denote NOAA DW-ROV cruise observations.