Distribution, Abundance, and Size Composition of Red Snapper in the Eastern Gulf of Mexico: Insights from Fishery-Independent Video Surveys

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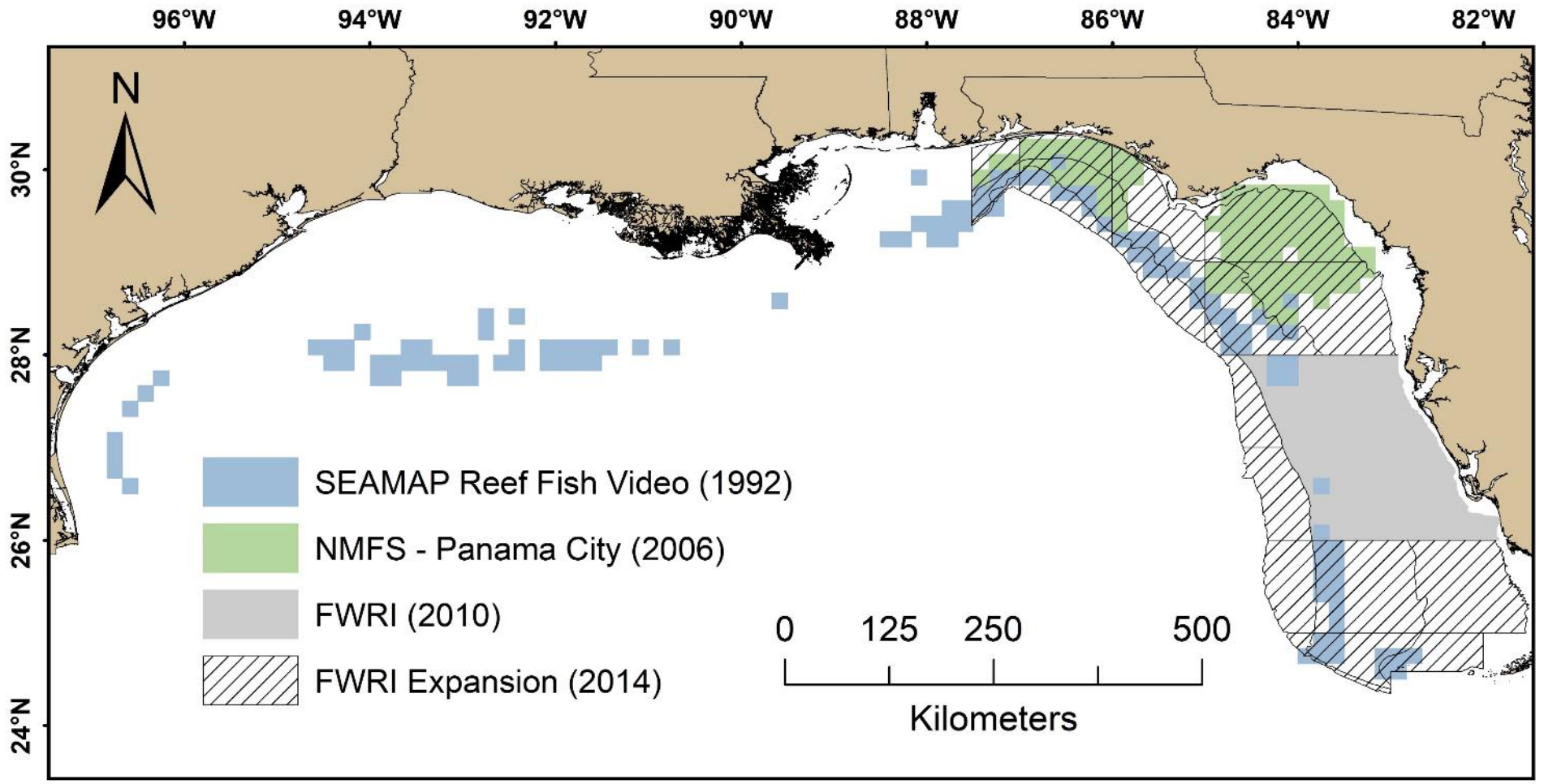
GMFMC SSC Meeting, January 12, 2022

Presentation Overview

- Objective: Update video portion of *SEDAR 74-SID-03* to provide insight into spatial and temporal dynamics of red snapper:
  - Incorporating 2020 data (count only – size composition unavailable)
  - Exploring depth-related patterns (especially 10-m depth contours from 10 – 60 m)
  - Extending annual regional trends through 2020

- To provide proper context for interpretation:
  - Provide background on historical and new (2020) survey design
  - Separate data from natural and artificial habitats
  - Application of basic generalized linear models for time series

Gulf Reef Fish Video Surveys



Comparison of Gulf Video Surveys

	SEAMAP	**Panama City**	**FWRI**
Depth	Shelf Break	Inner Shelf	Shelf and Shelf Break
Spatial Extent	Gulf Wide	Northeastern Gulf	Eastern Gulf
Habitat Mapping	Multibeam Sonar Targeted	Side Scan Sonar Targeted / Random	Side Scan Sonar Random
Habitat	Natural	Natural	Natural and Artificial (2014)
Spatial Strata	Four regions	Two regions, three depths	Nine regions, three depths
Habitat Strata	Small and large reef	Three reef quality strata	Artificial and natural reef
Allocation	Proportional to reef	Unequal probability	Proportional to area
Design	2-stage design	2-stage design	2-stage design
Sampling Gear	Cameras with resolution of 1920 H x 1200 V with 86.3° HFV and 60.7° VFV	Cameras with resolution of 1920 H x 1200 V with 86.3° HFV and 60.7° VFV	Cameras with resolution of 1920 H x 1200 V with 86.3° HFV and 60.7° VFV
Abundance Metric	MaxN	MaxN	Max N
Taxa	Managed Fishes	All Fishes	All Fishes

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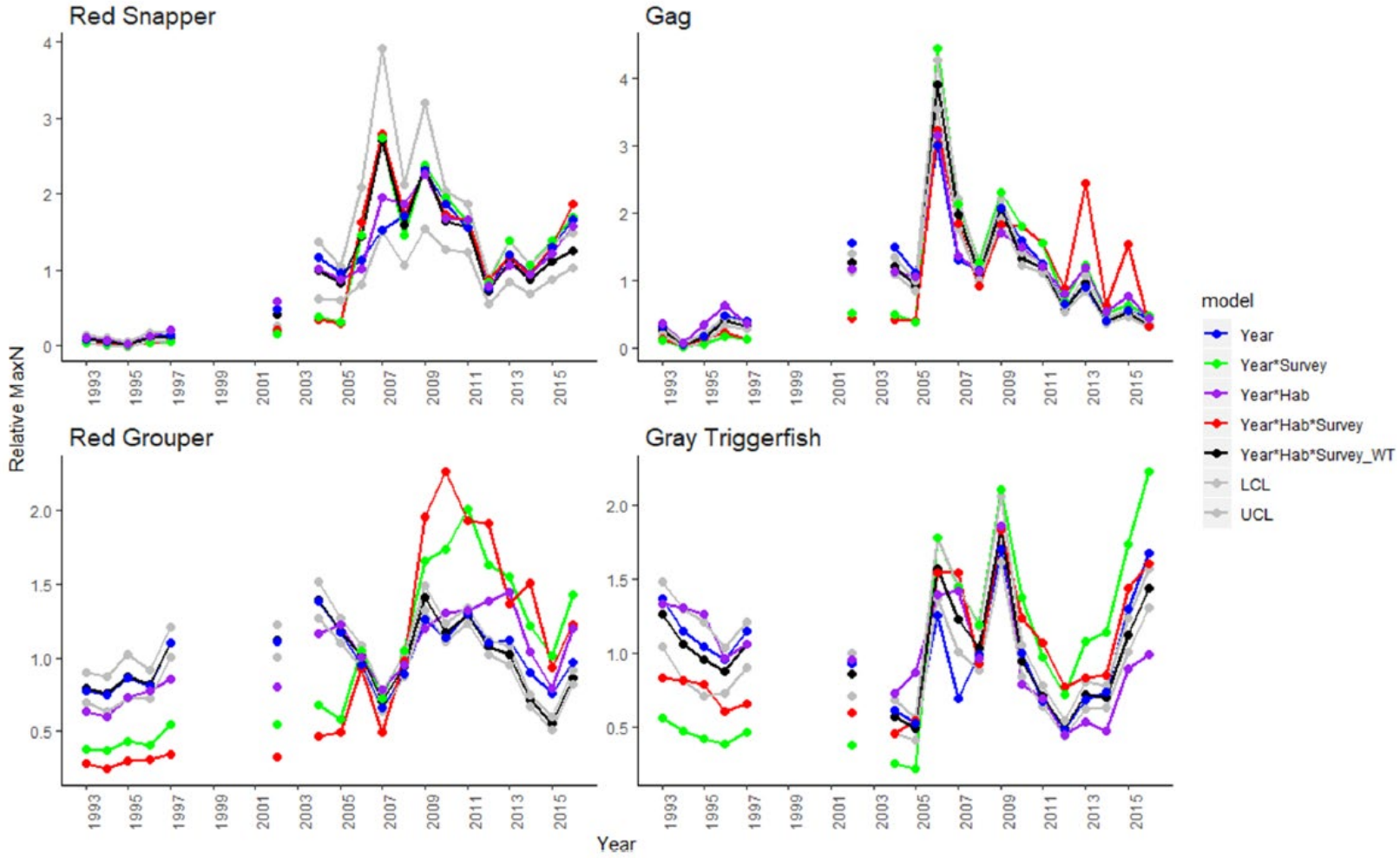
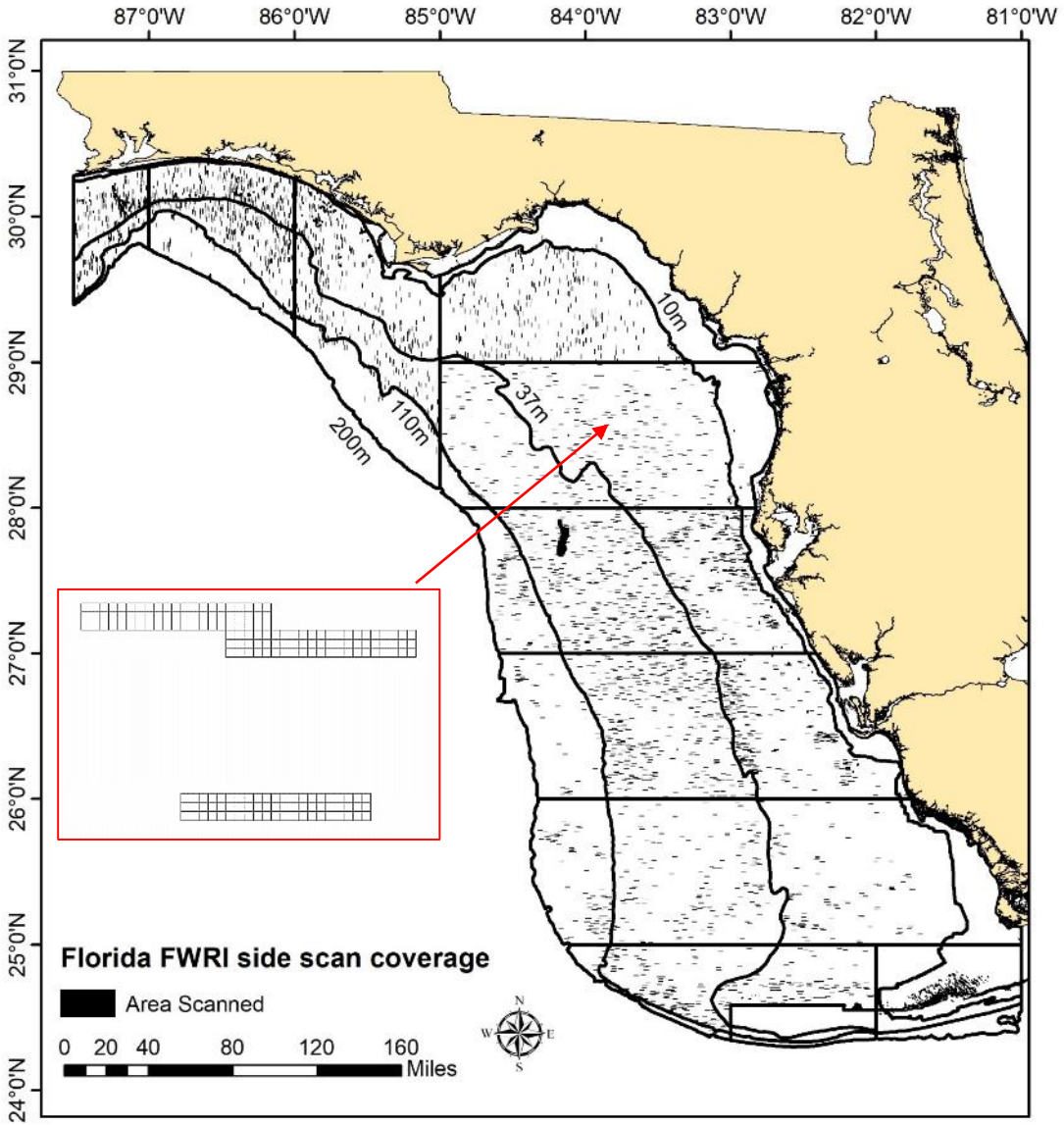
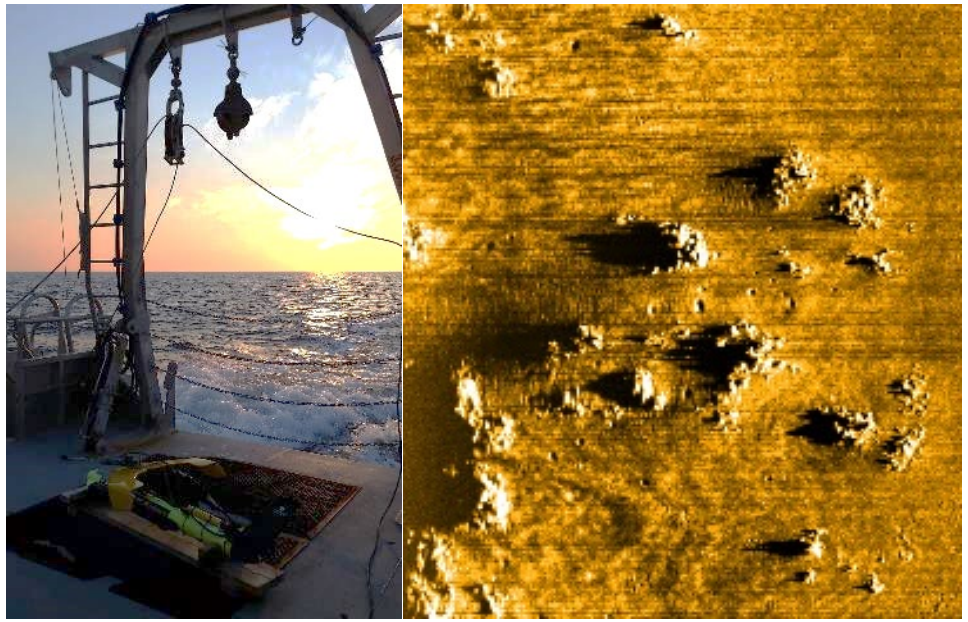
Generation of Combined Video Indices



Thompson, K.A., T.S. Switzer, M.C. Christman, S.F. Keenan, C.L. Gardner, K.E. Overly, and M.D. Campbell. 2022. A novel habitat-based approach for combining indices of abundance from multiple fishery-independent video surveys. Fisheries Research. https://doi.org/10.1016/j.fishres.2021.106178.

Pre-Survey Habitat Mapping

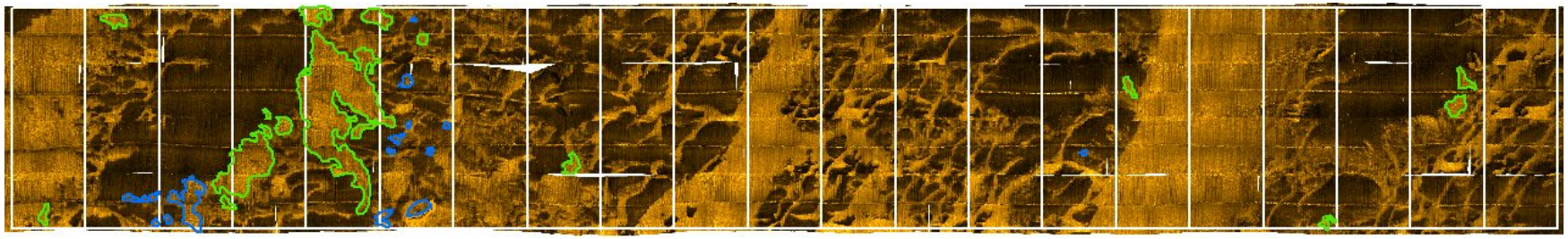




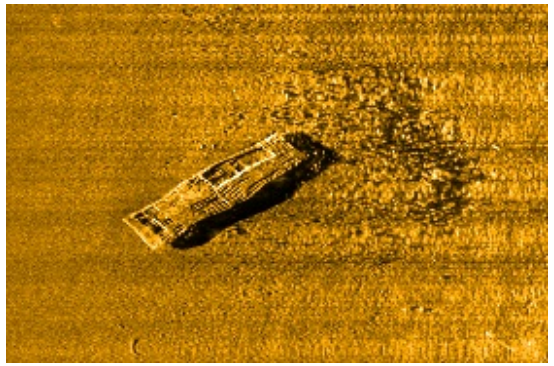
Klein 3900 SSS @ 445 kHz

- Primarily SSS (some multibeam)
- Standardized, random surveys (some focused efforts)

Pre-Survey Habitat Mapping



- Manual digitization:
  - Delineate and classify all reef habitats
  - Quantify reef area / composition



ORIGIN	HABITAT CLASS
Geologic	Boulder/Boulder Field
	Escarpment
	Fragmented Hard Bottom
	Fracture
	Flat Hard Bottom
	Ledge
	Mixed Hard Bottom
	Potholes
	Pinnacle
	Pavement
	Rubble Field
	Spring/Sink Hole
Unknown	Unknown Natural

ORIGIN	HABITAT CLASS
Biogenic	Aggregate Coral Reef
	Aggregation of Patch Reefs
	Individual Patch Reef
	Reef Rubble
	Spur and Groove

ORIGIN	HABITAT CLASS
Anthropogenic	Aircraft
	Cable
	Construction Materials
	Dredged Channel
	Chicken Coop
	Dredge Deposit
	Military Tanks
	Marine Wreckage
	Oil Platform Materials
	Pipeline Area
	Reef Modules
	Rock Piles
	Tires
	Unknown Reef material
	Other Vehicles
	Large vessel/barge
	Small Vessel

Examples of Habitats and Ground Truth Imagery

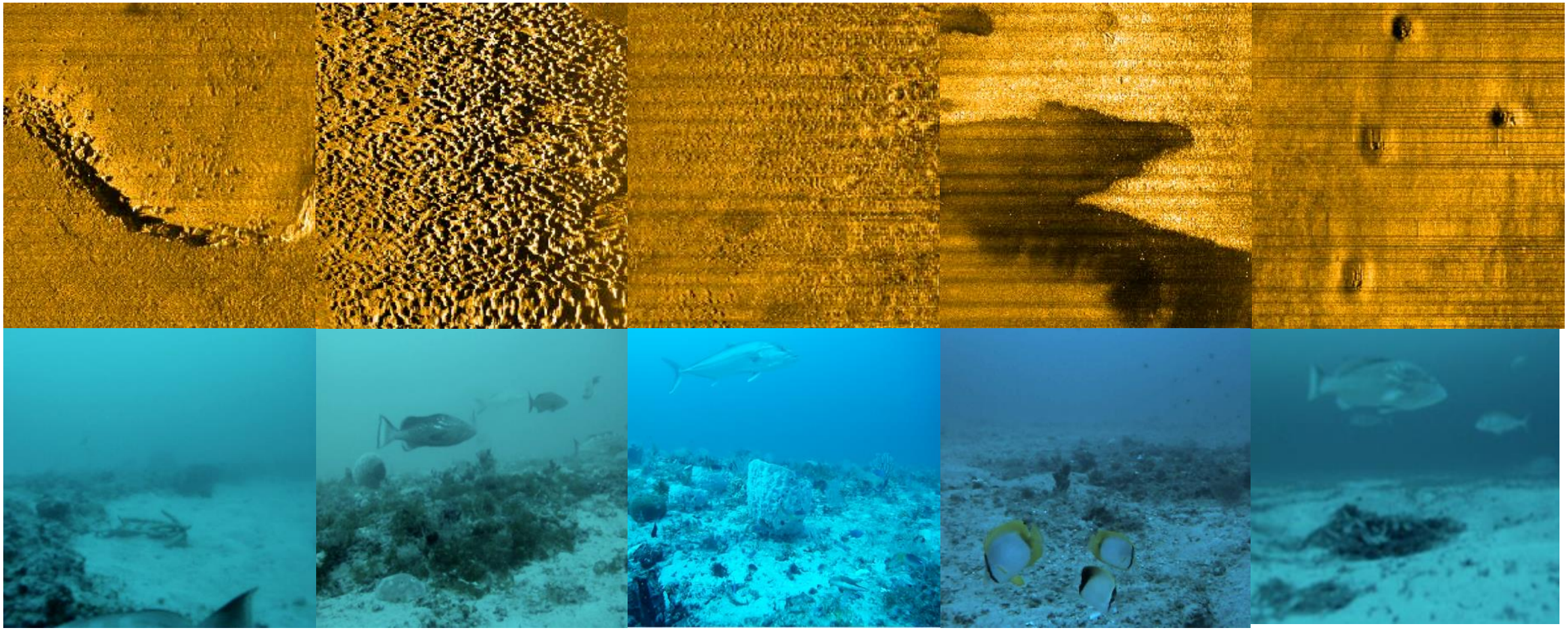
Ledge

Fragmented Hard Bottom

Mixed Hard Bottom

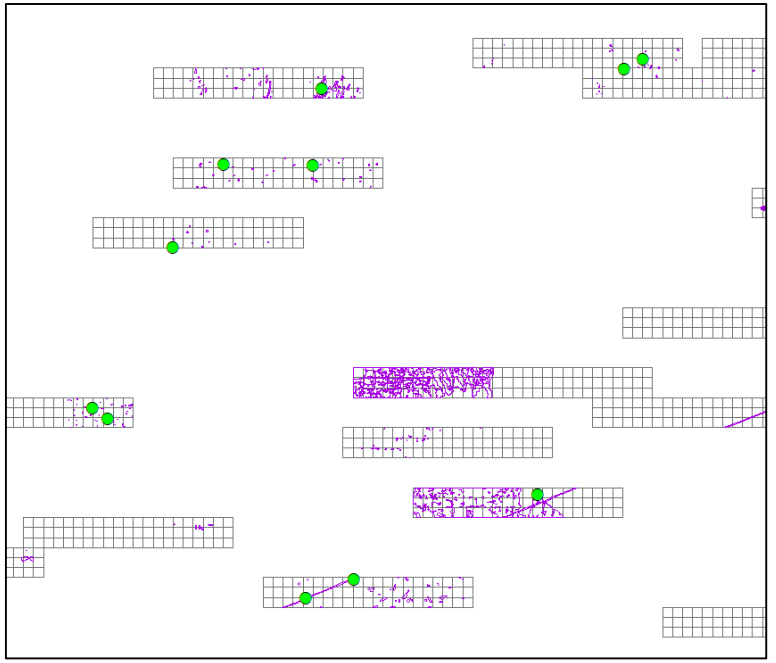
Flat (low-relief) Hard Bottom

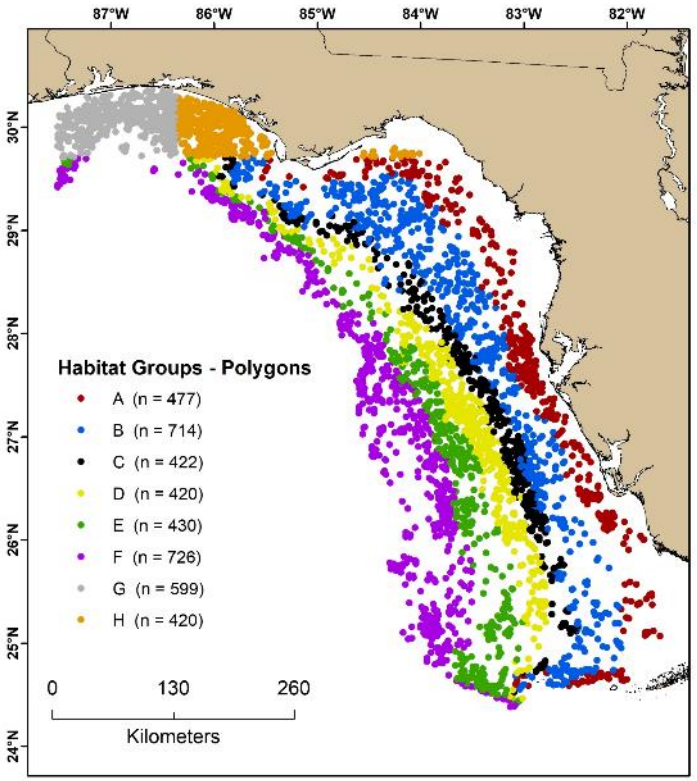
Pothole

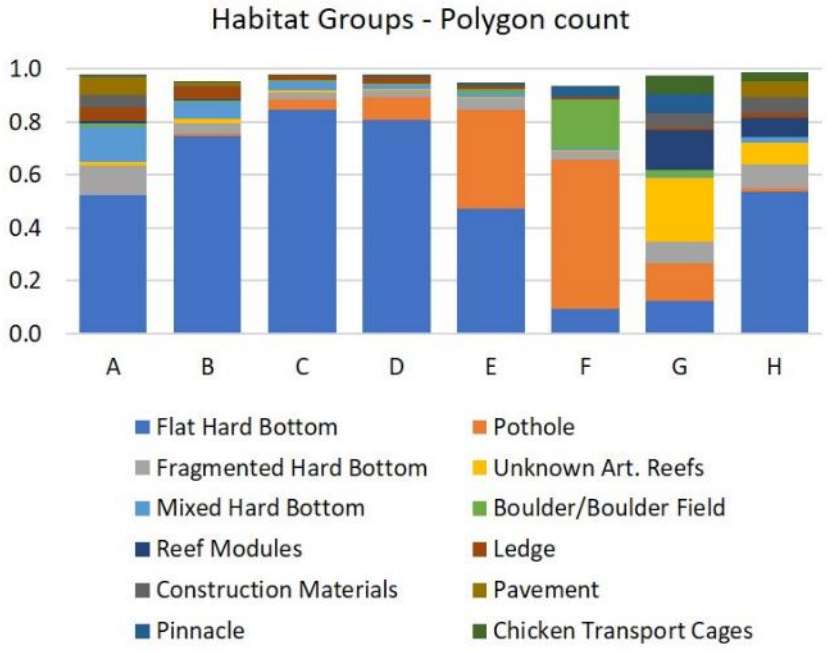


Utility of Habitat Mapping Data

- Randomized surveys yield insight into habitat composition and distribution:
  - Direct sampling efforts
  - Provide extrapolated estimates of habitat availability (~ 4,000 km^2 of hard bottom habitat in eGOM)
  - Inform effort allocation
  - Potential utility in abundance estimation?

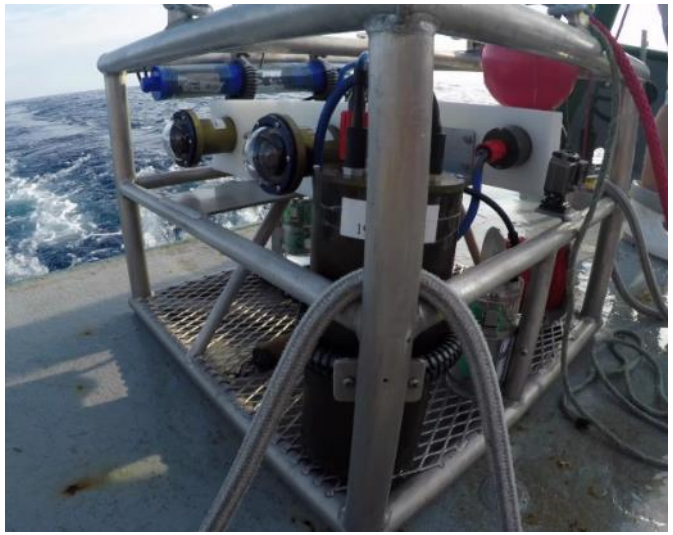


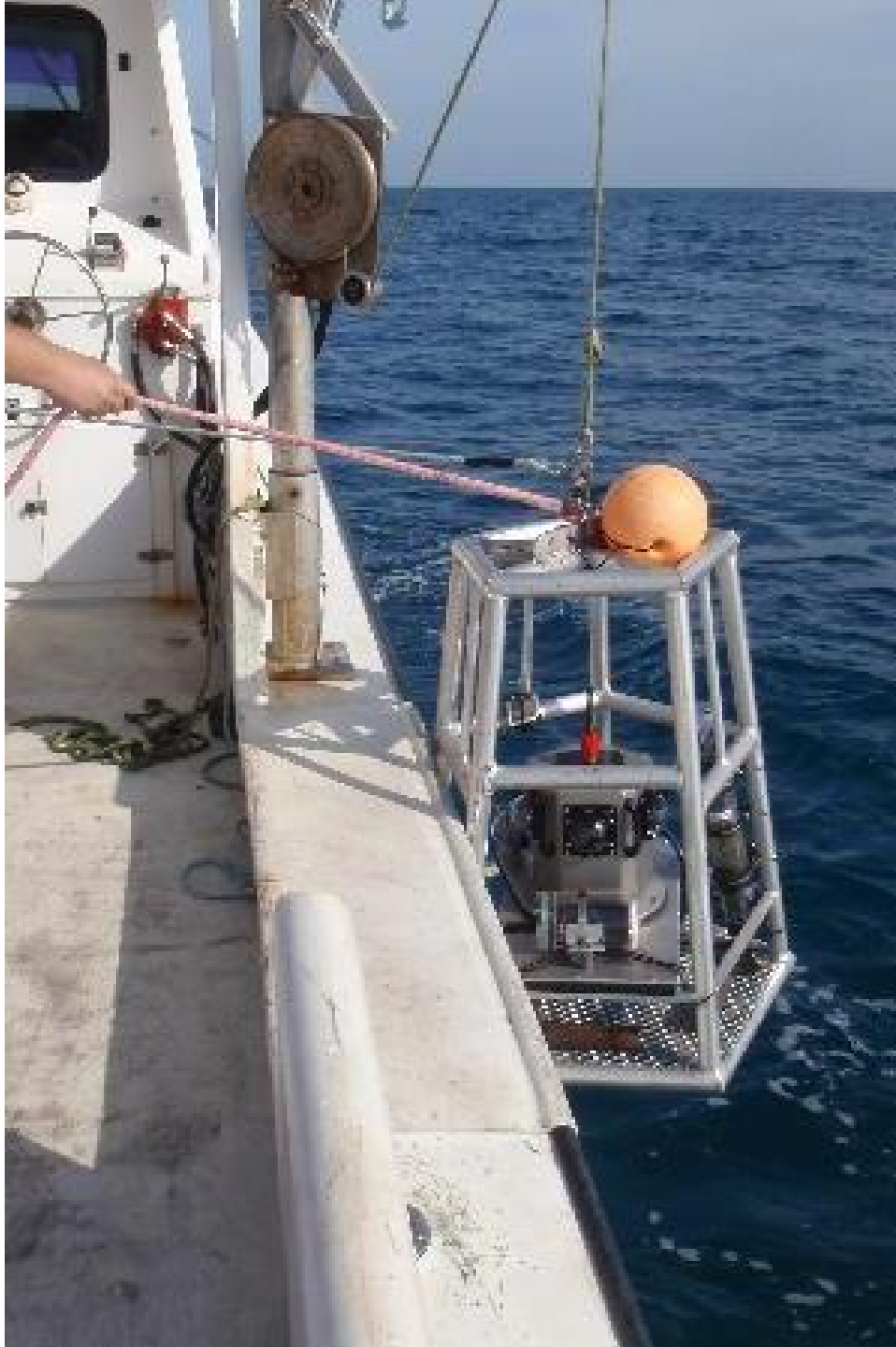




Video Collection Methods

- Stereo-baited remote underwater video (S-BRUV) arrays:
  - Deployed for 30+ minutes
  - Baited with Atlantic mackerel / squid
  - Historically, orthogonal cameras (below)
  - More recently, spherical cameras (right)



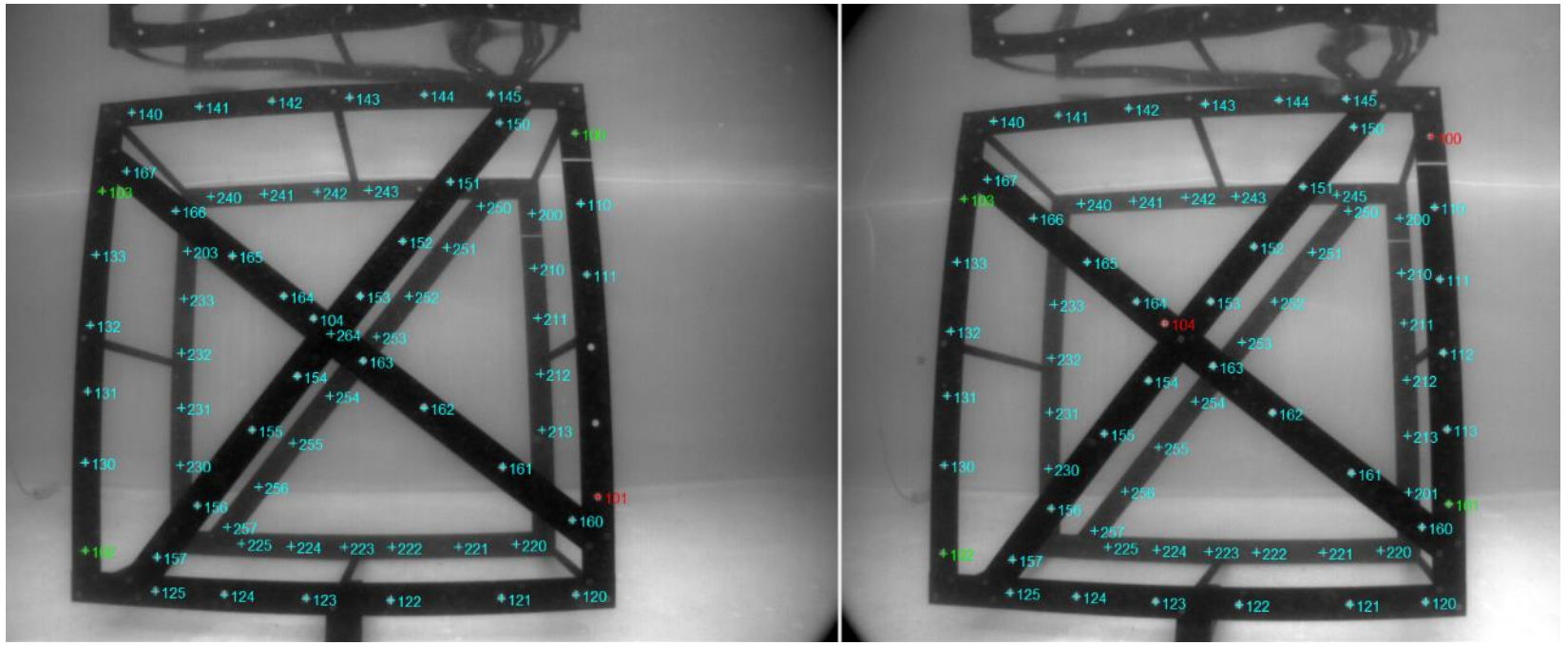


Video Annotation Methods

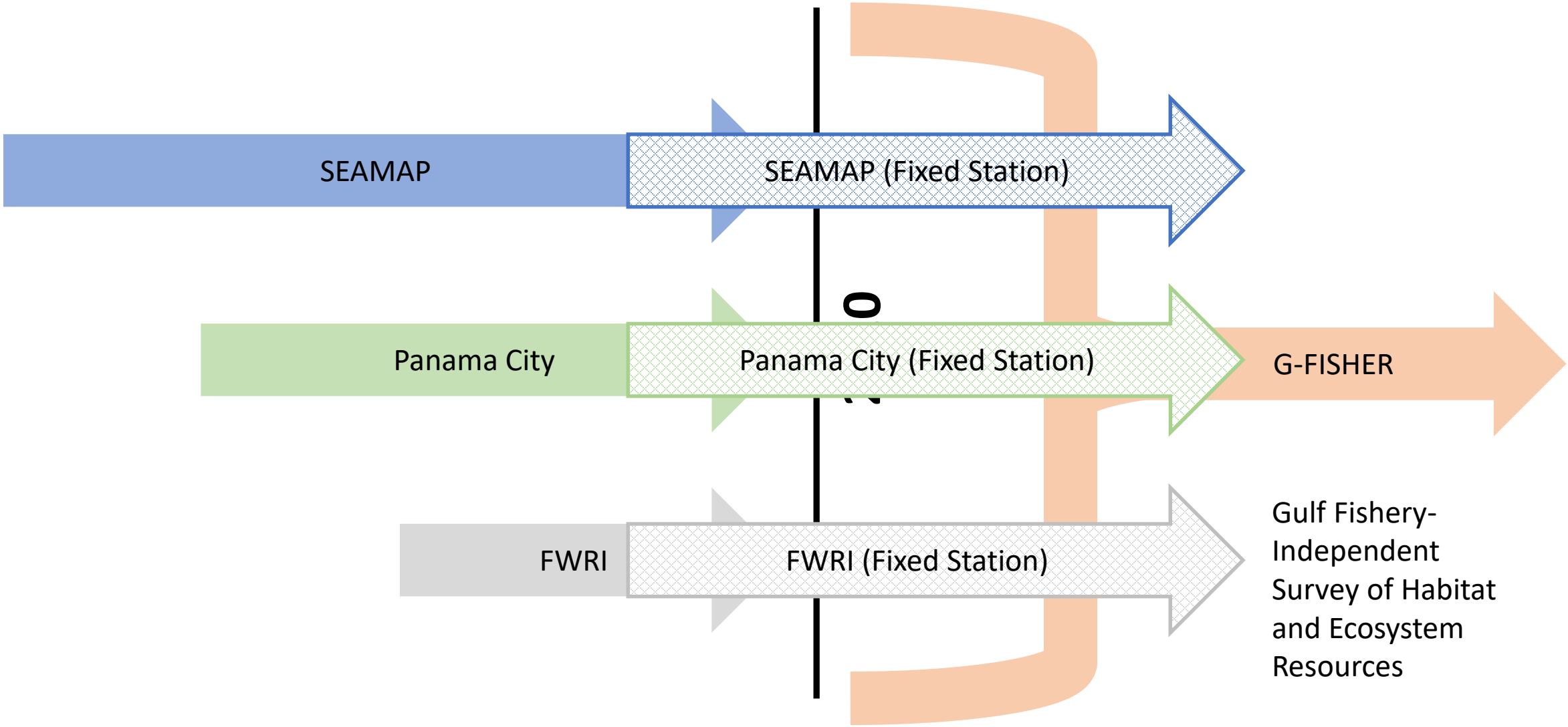
- Single camera processed for abundance (utility of full spherical counts being explored)
- MaxN – maximum count on single screen shot
- Habitat metrics (type and composition of substrate and attached biota) quantified

Video Measurement Methods

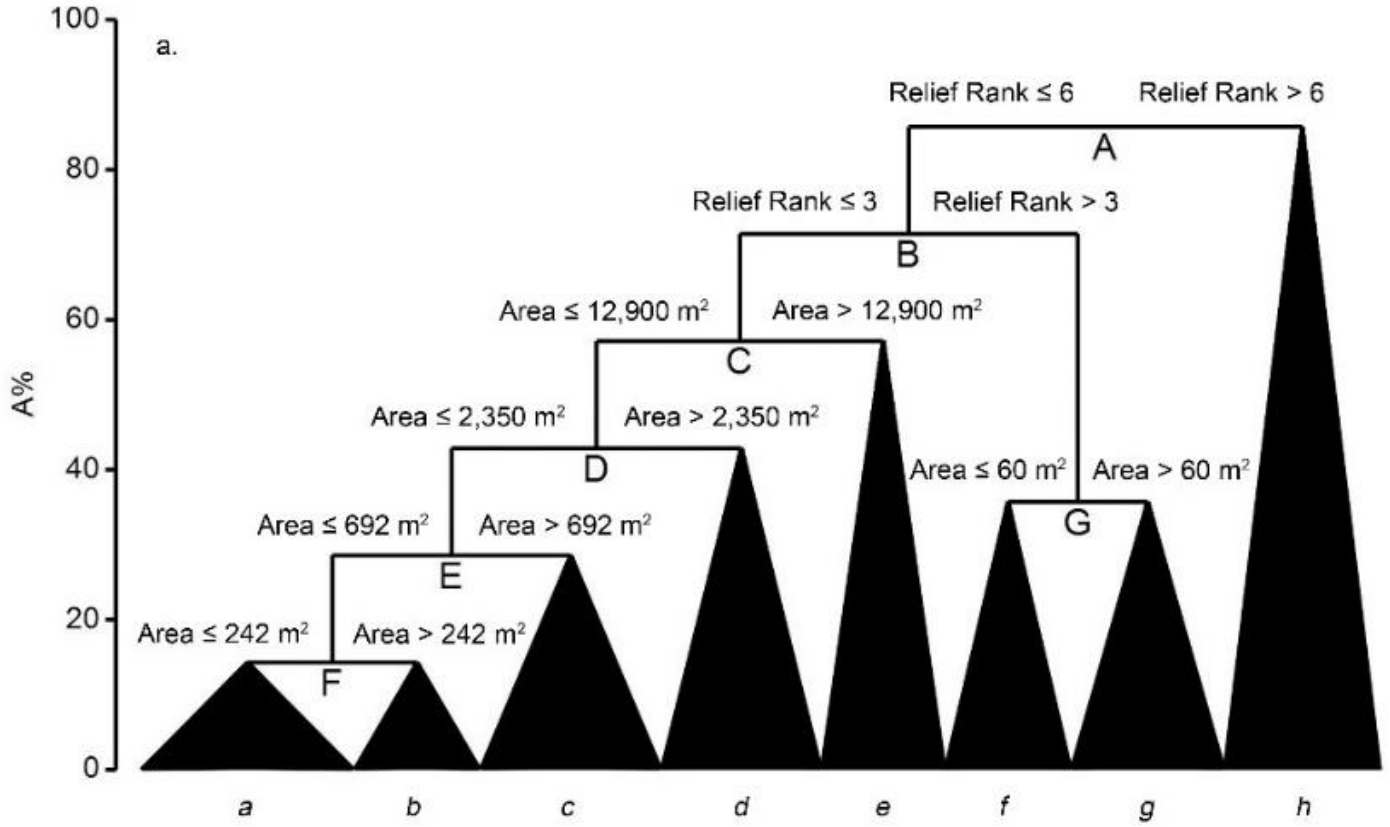
- SeaGIS Software
- Quality assurance:
  - Pre- and post-season calibrations
  - Measurement diagnostics
- Measurements ~ fork length



Survey Integration Under Unified Design (2020)

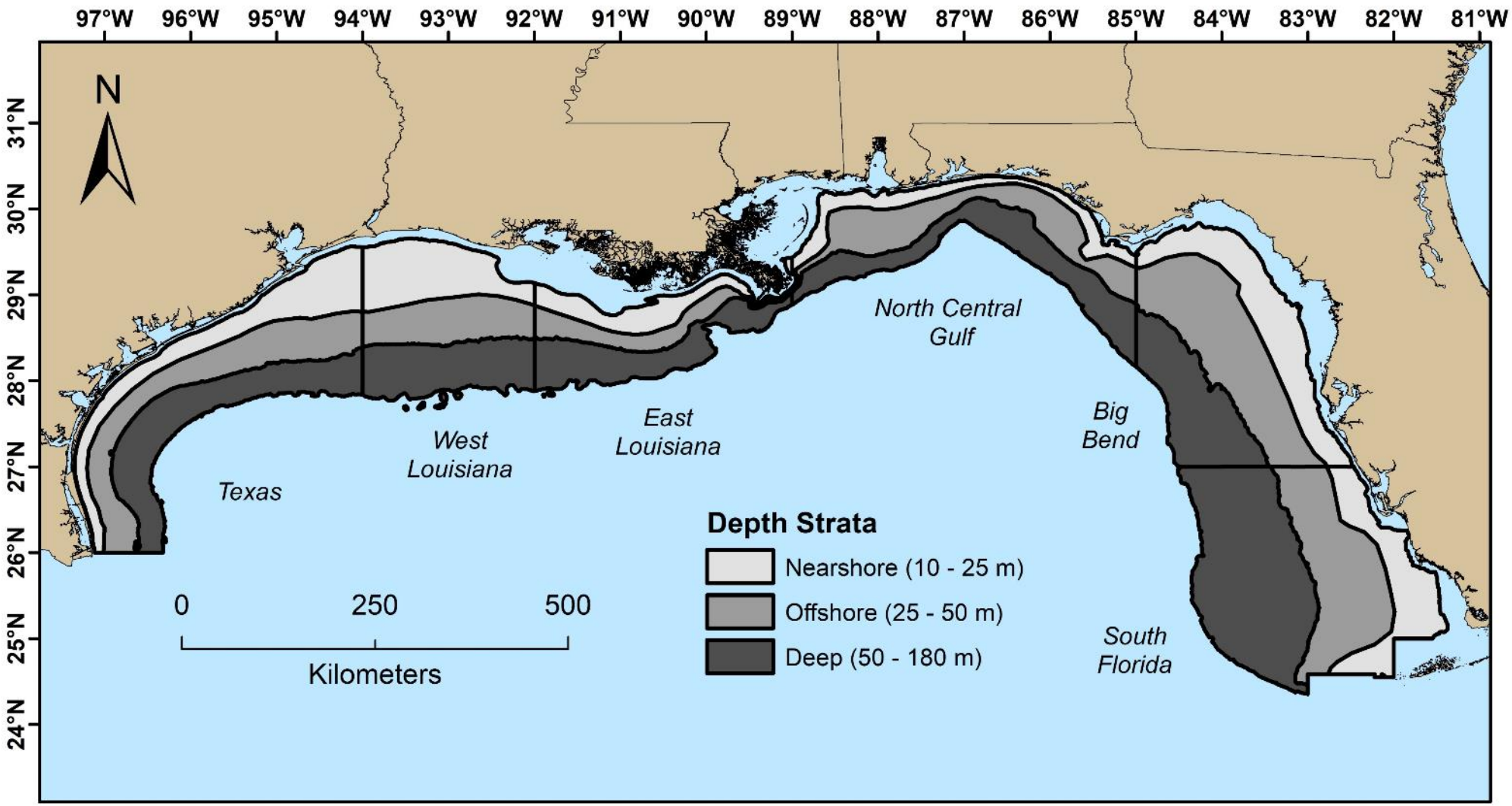


G-FISHER – Defining Sampling Strata

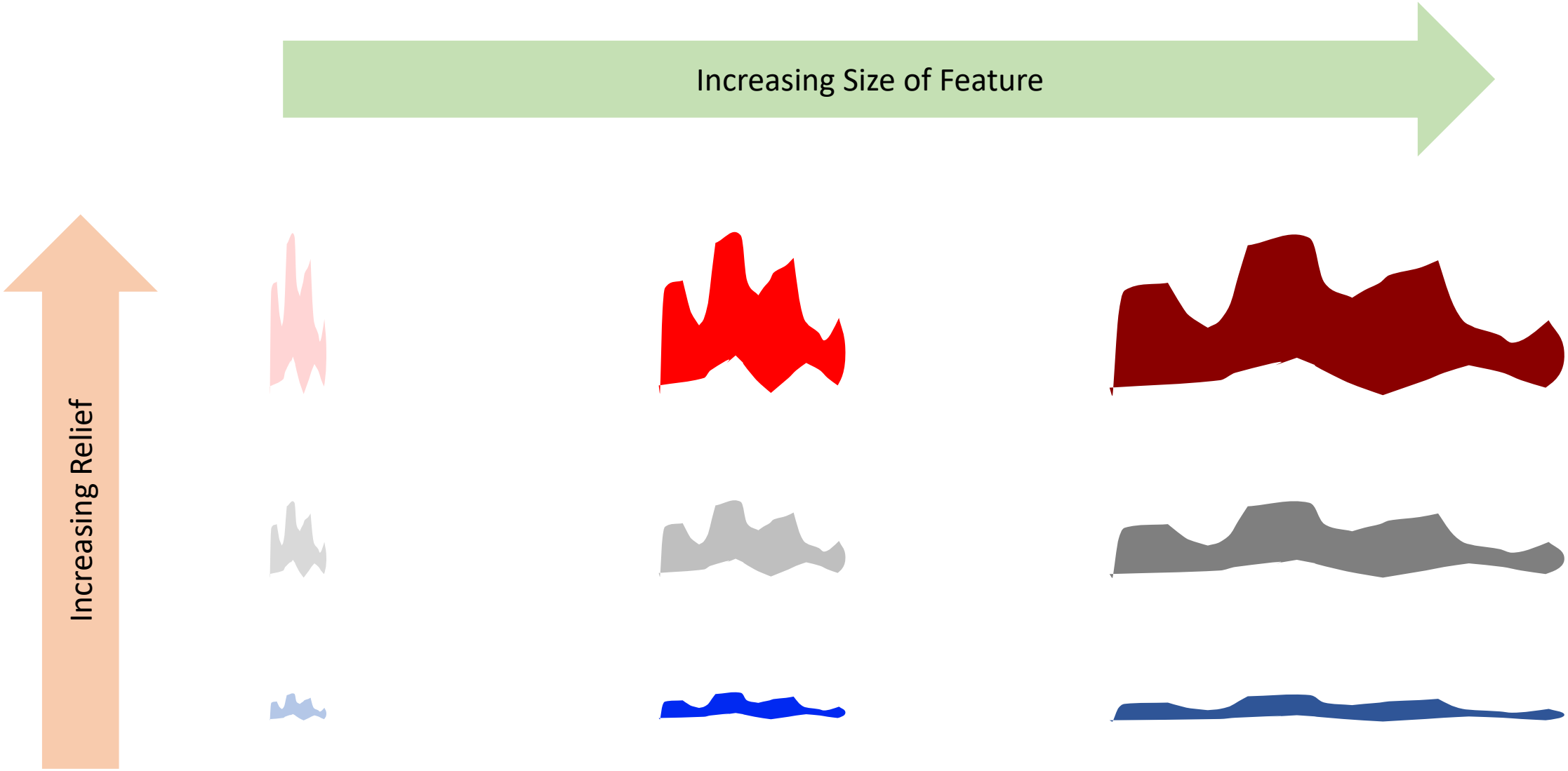


- Multispecies classification and regression tree (CART) analyses conducted to provide guidance to delineate sampling strata:
  - Space and habitat (separate analyses for natural and artificial habitats)

G-FISHER Spatial Stratification

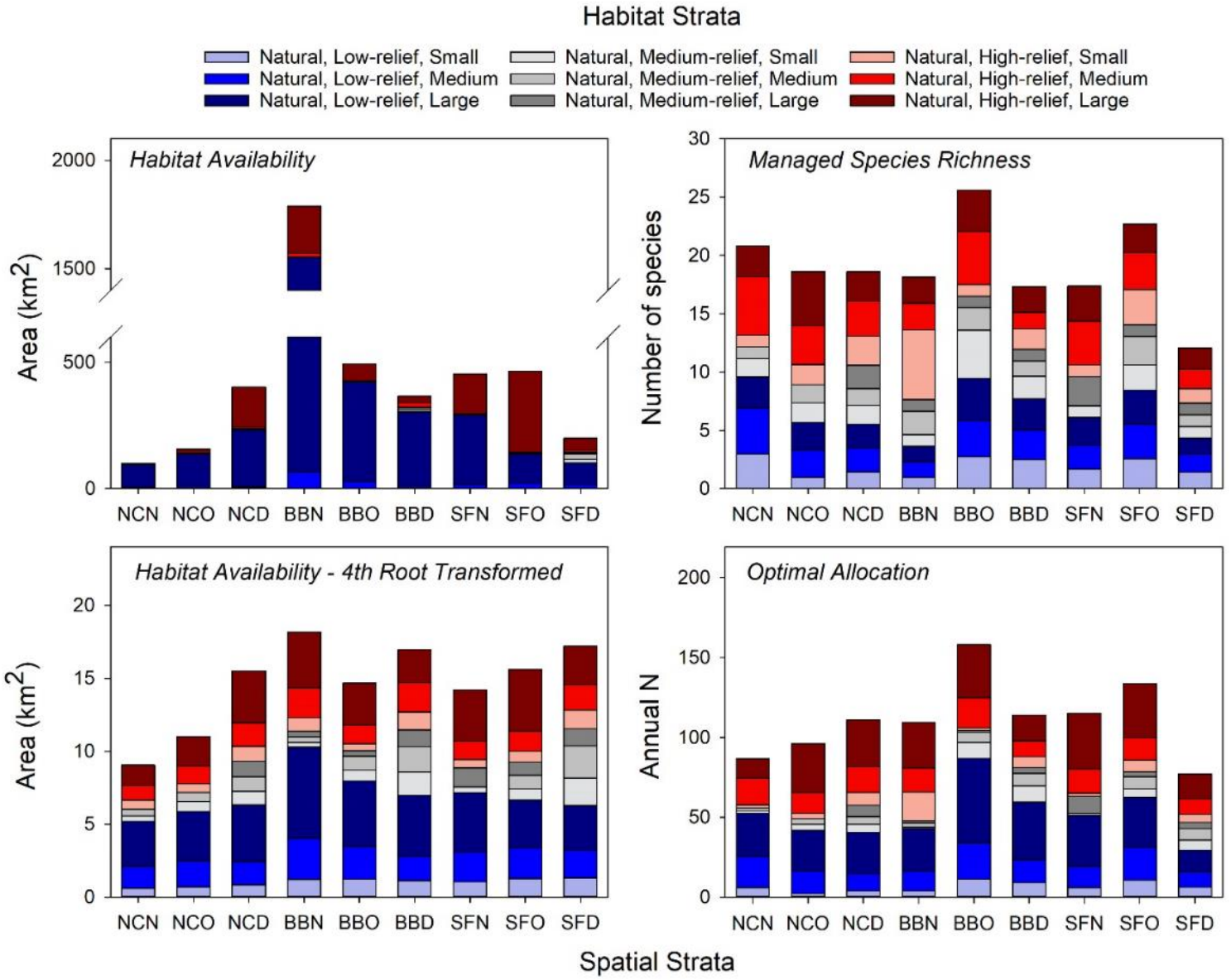


G-FISHER Habitat Stratification (Natural and Artificial)

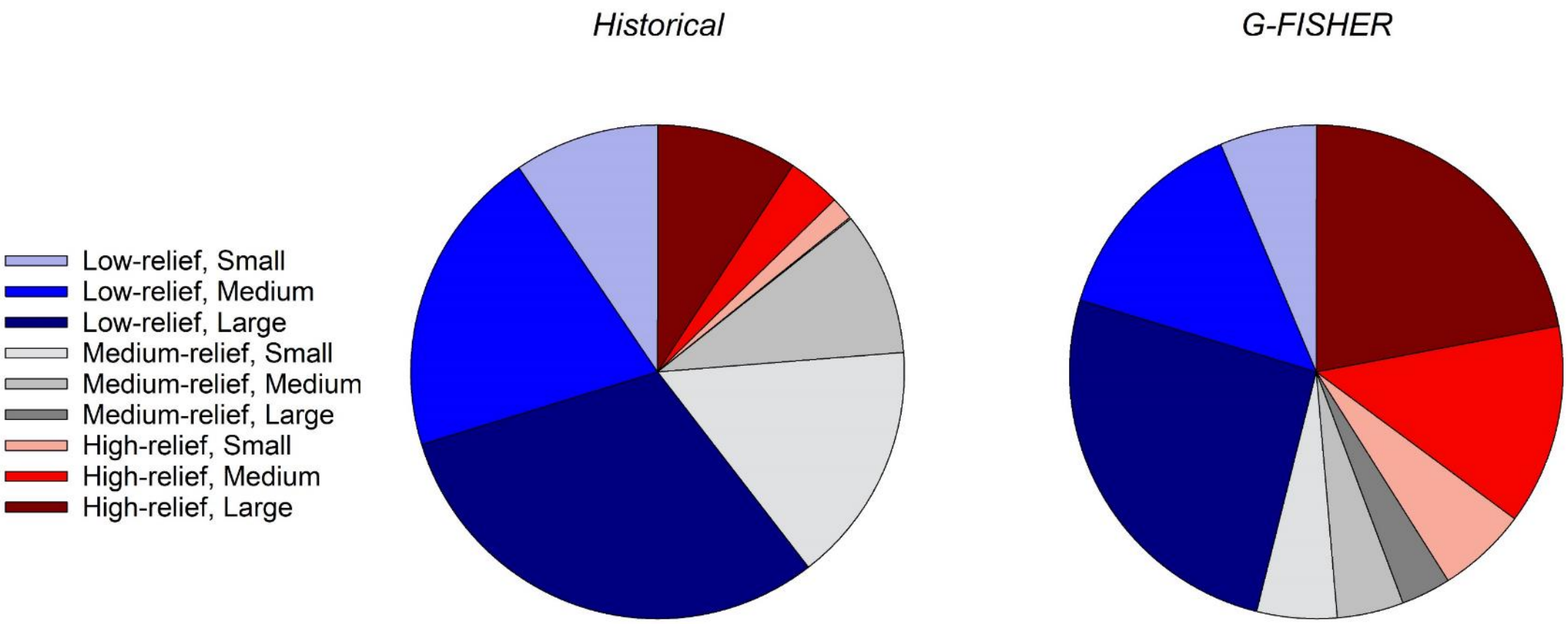


Effort Allocation (Natural and Artificial)

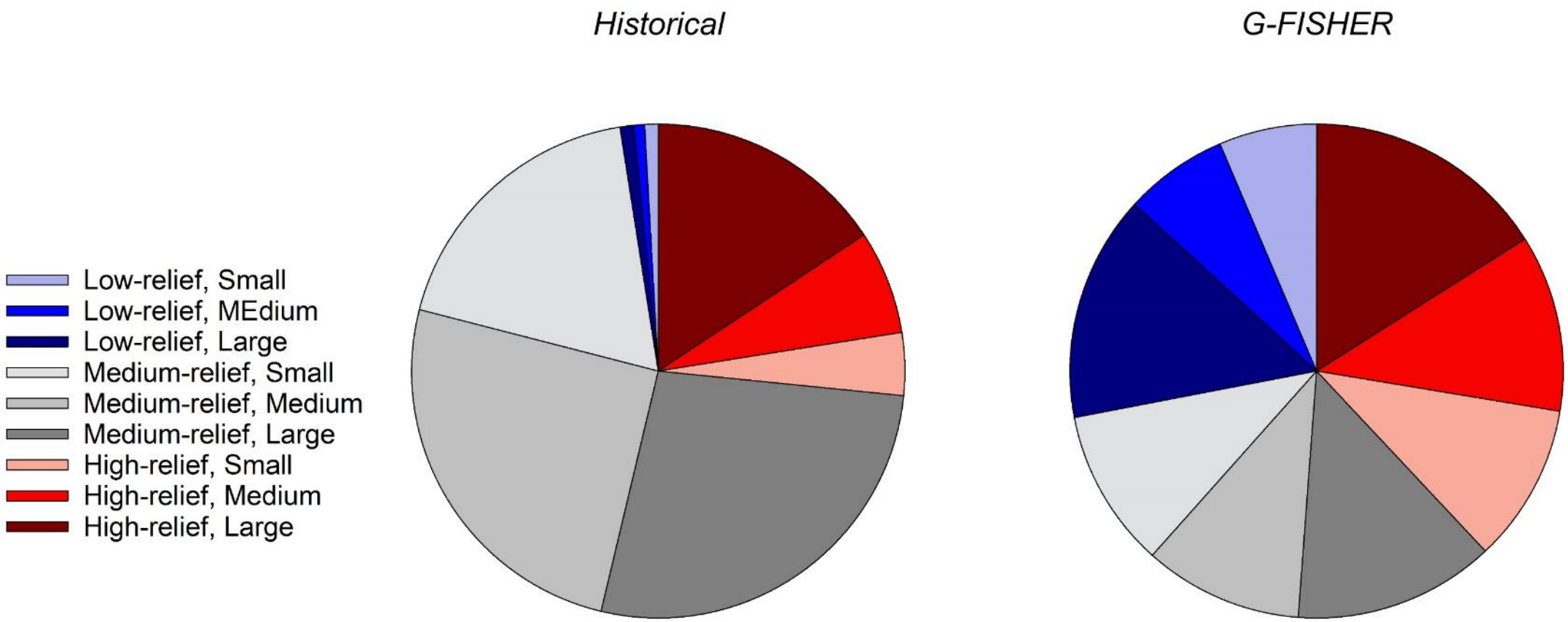
- Proportional to product of:
  - Habitat Availability
  - Managed Species Richness



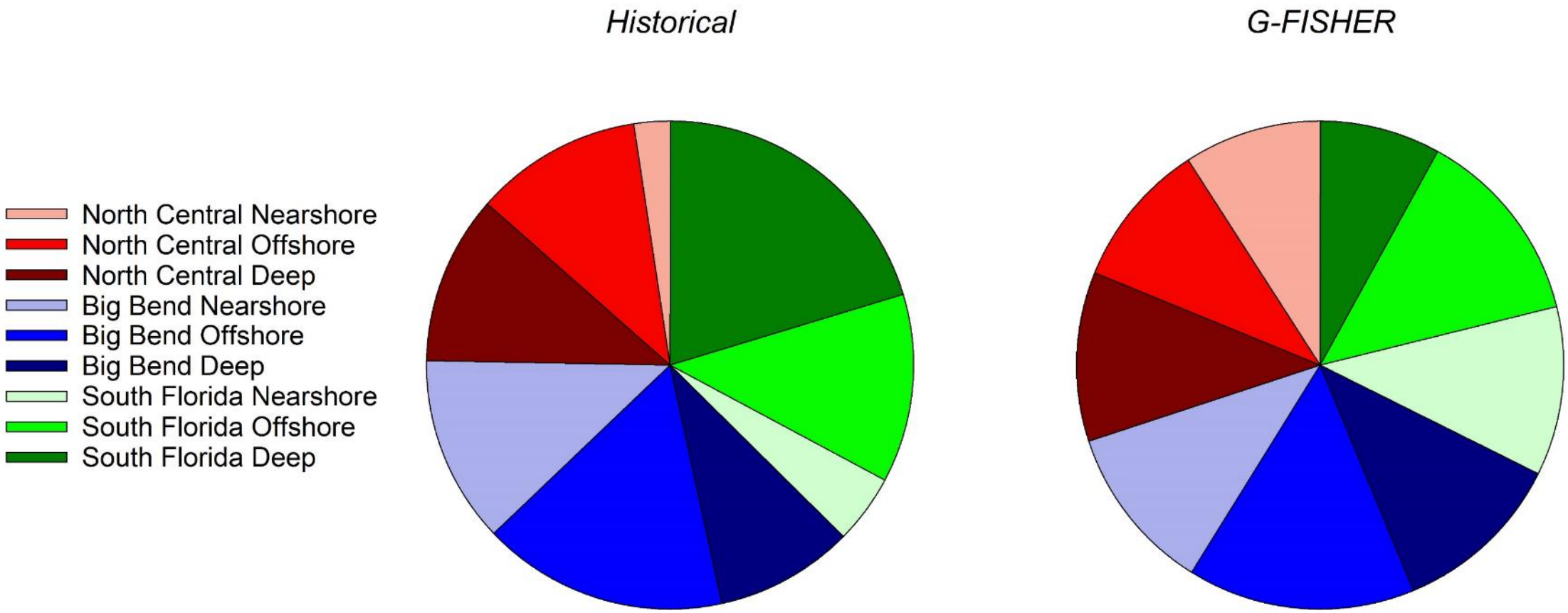
Change in Sampling Proportions – Habitat (Natural)



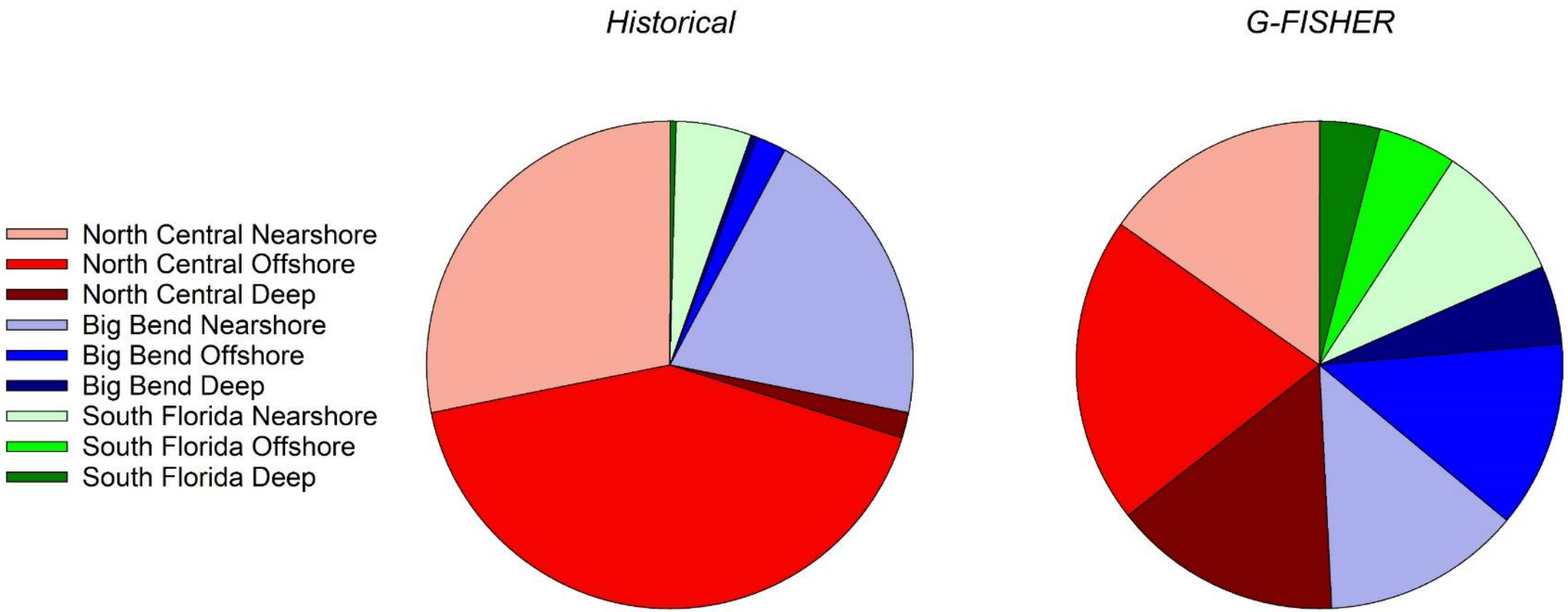
Change in Sampling Proportions – Habitat (Artificial)



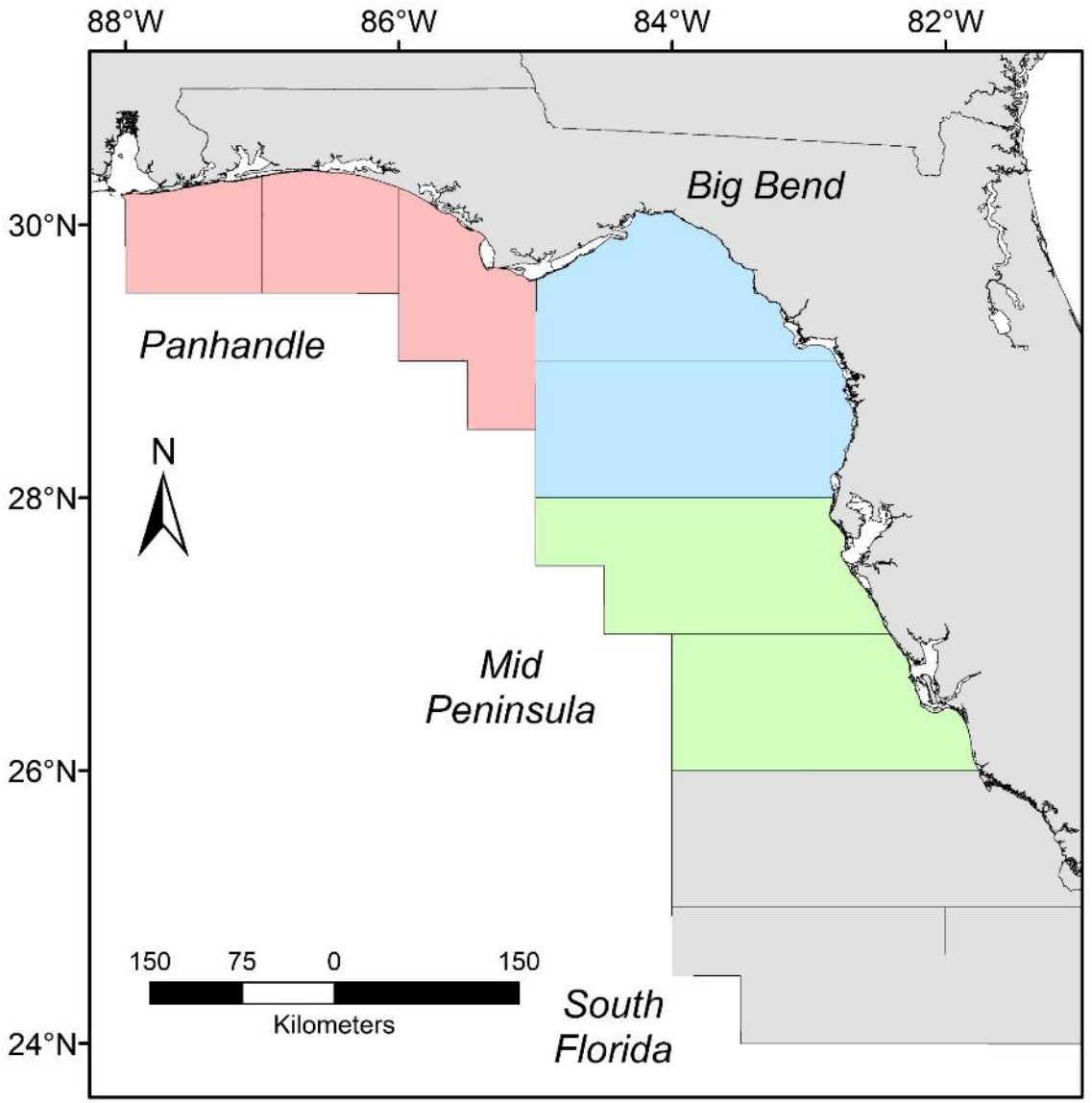
Change in Sampling Proportions – Spatial (Natural)



Change in Sampling Proportions – Spatial (Artificial)

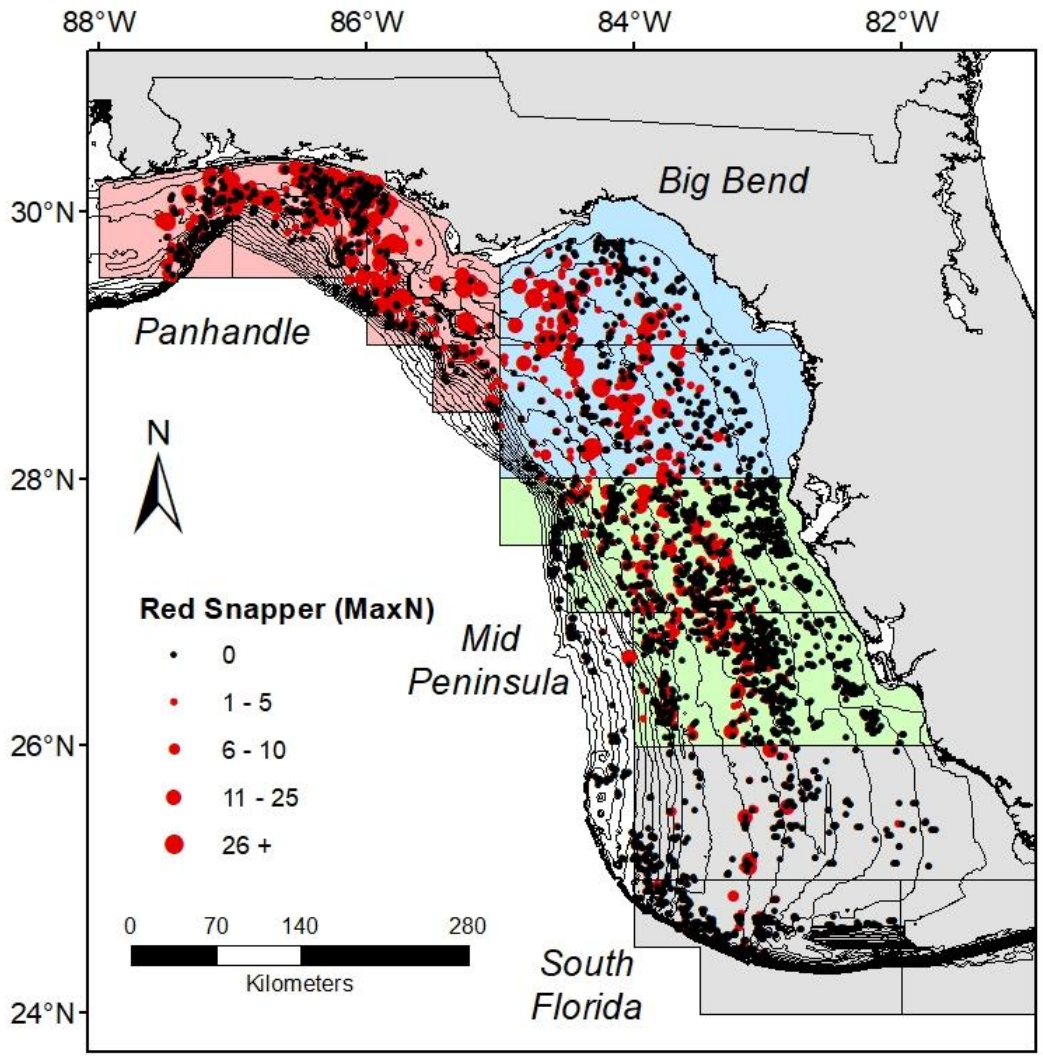


Red Snapper Data Summaries

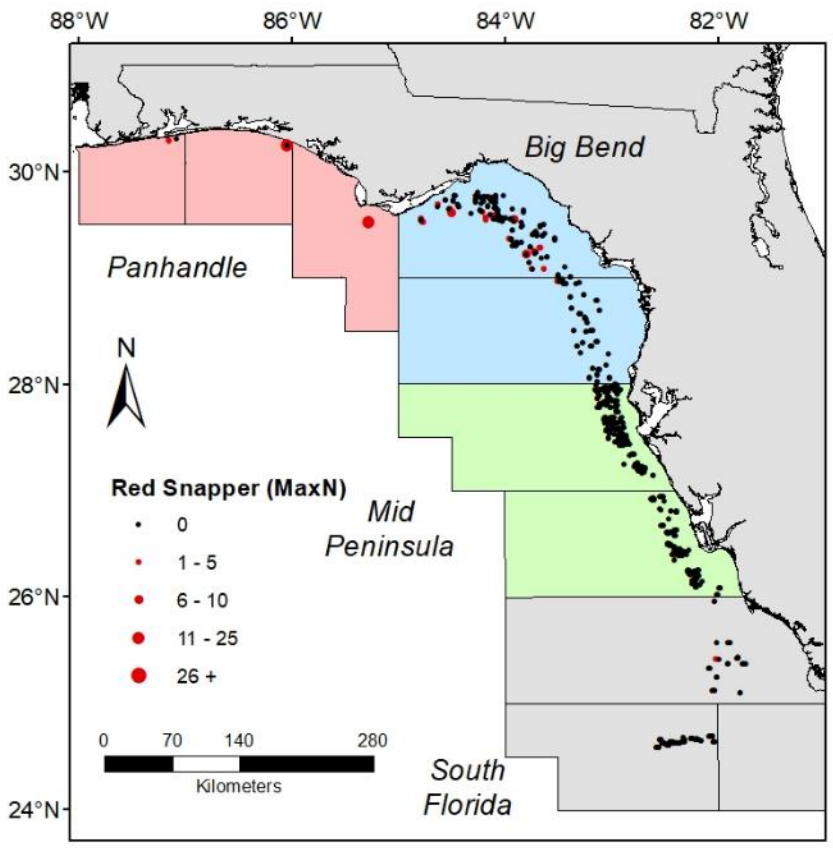


- Summaries of FWRI video data (2010 – 2020):
  - Natural (N = 5,060) and artificial (N = 662) habitats
  - Spatial distribution, by depth
  - CPUE, proportion positive, and size composition by depth and region
  - Annual CPUE modeled by region

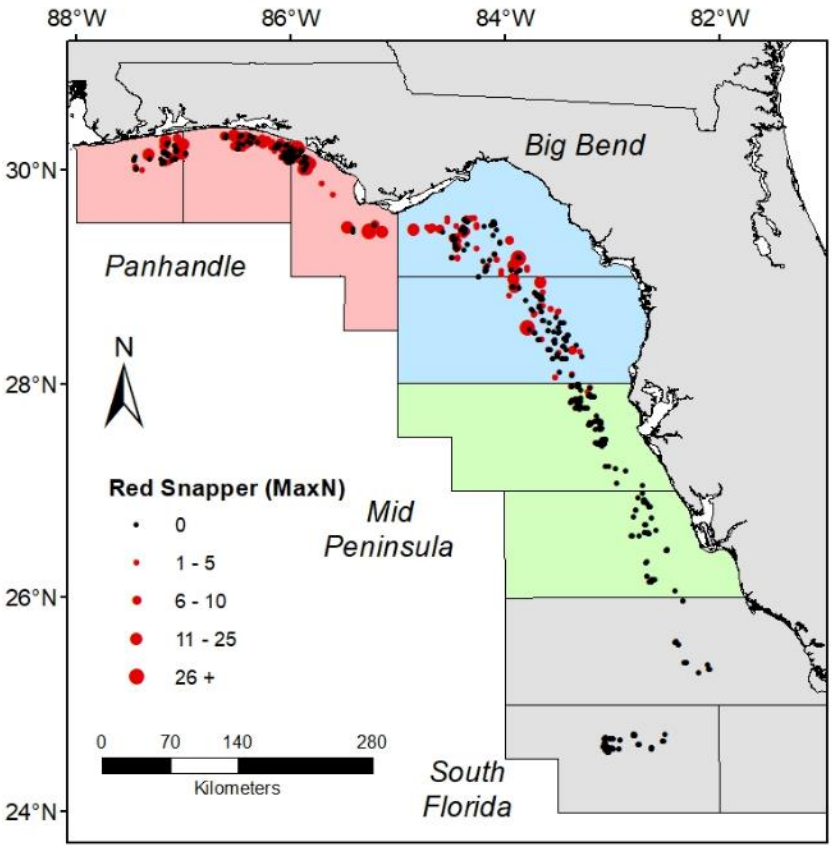
Distribution – Natural Habitat (FWRI)



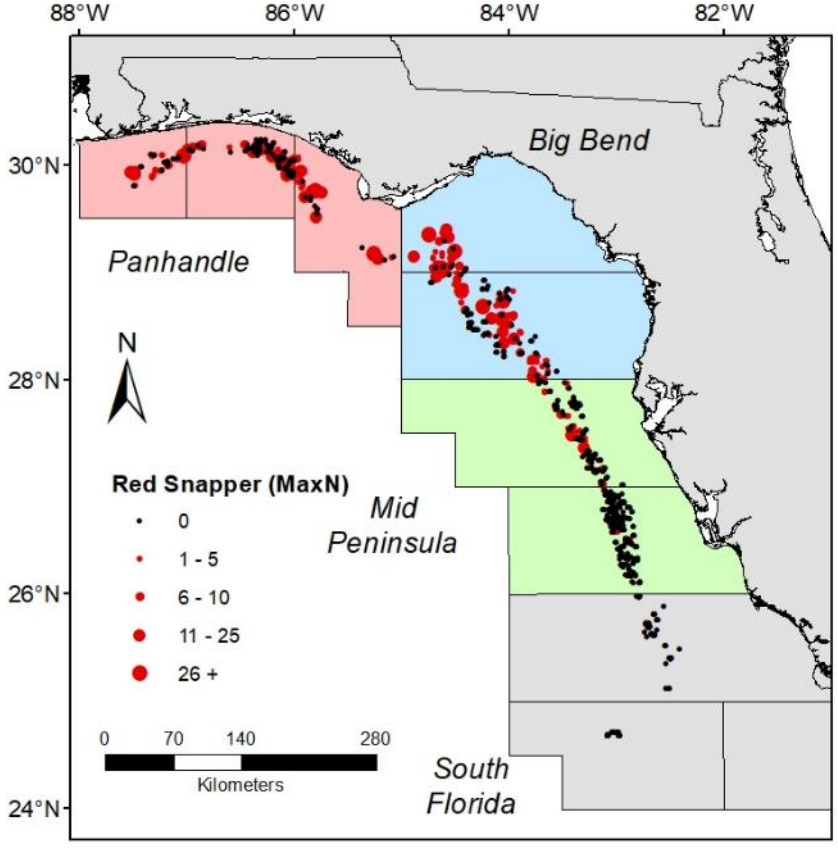
Distribution – Natural Habitat By Depth (FWRI)



10 – 20 m

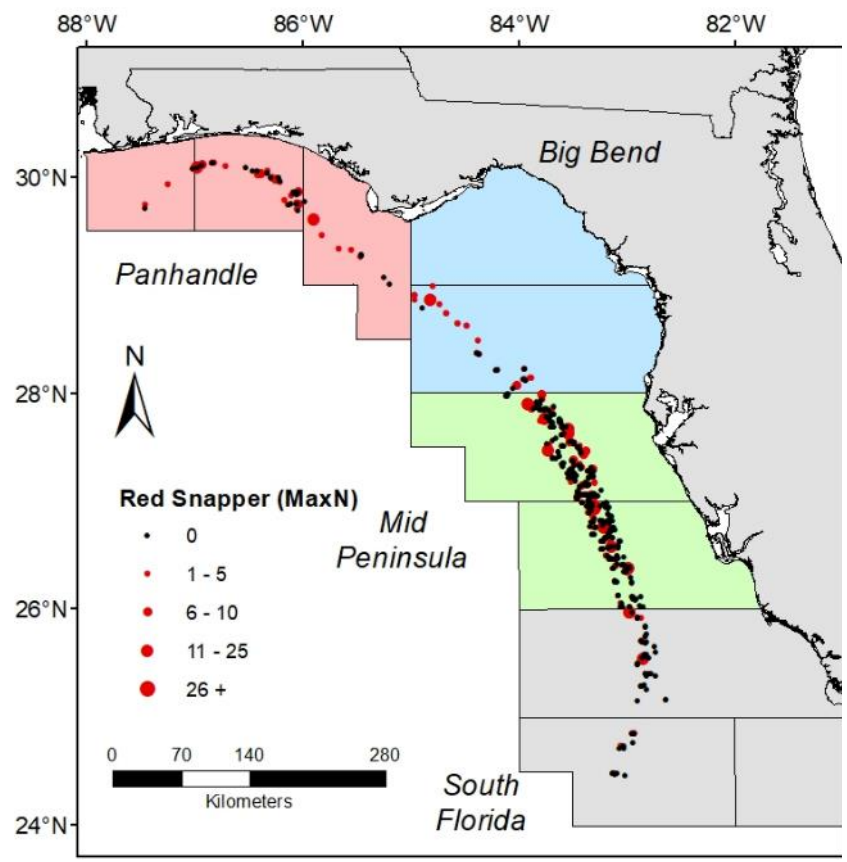


20 – 30 m

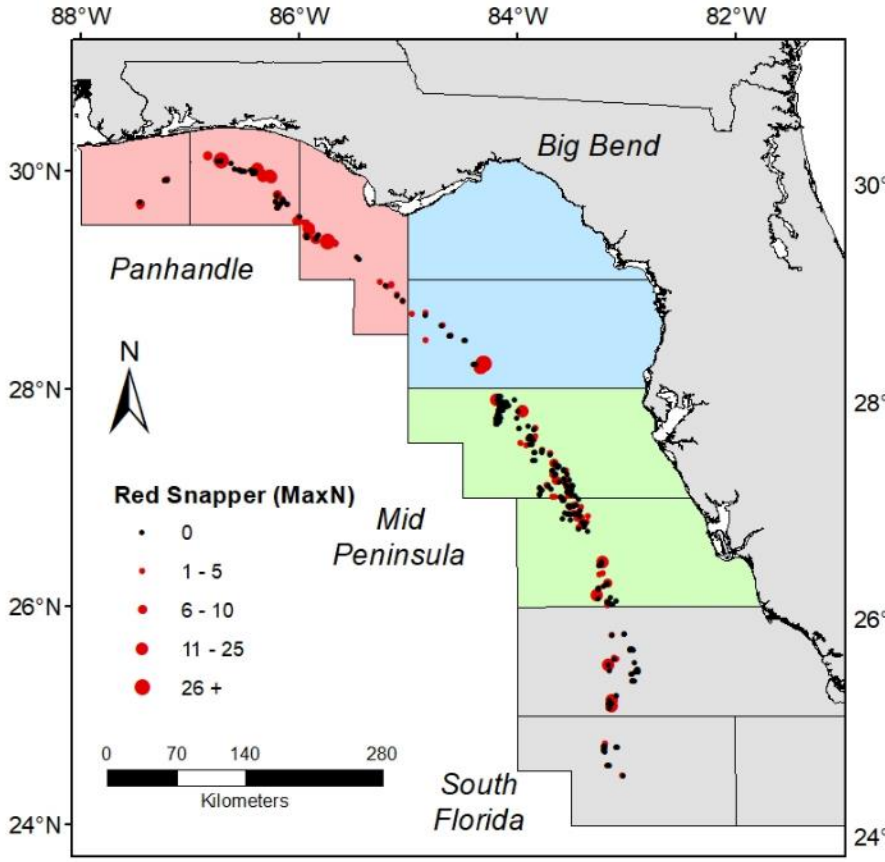


30 – 40 m

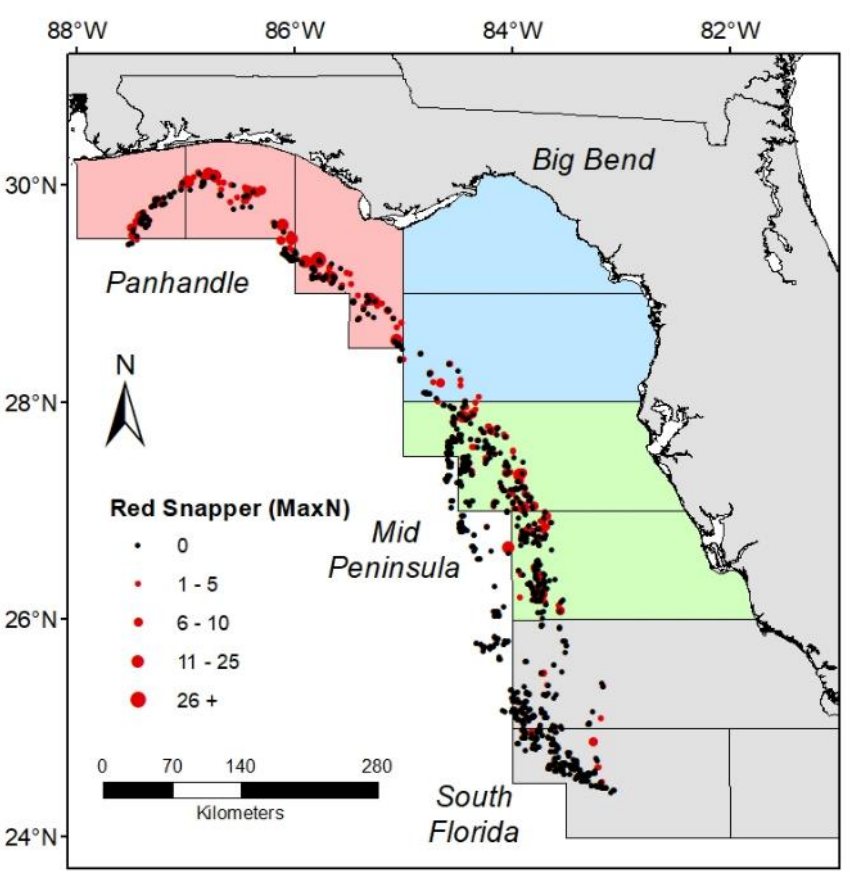
Distribution – Natural Habitat By Depth (FWRI)



40 – 50 m

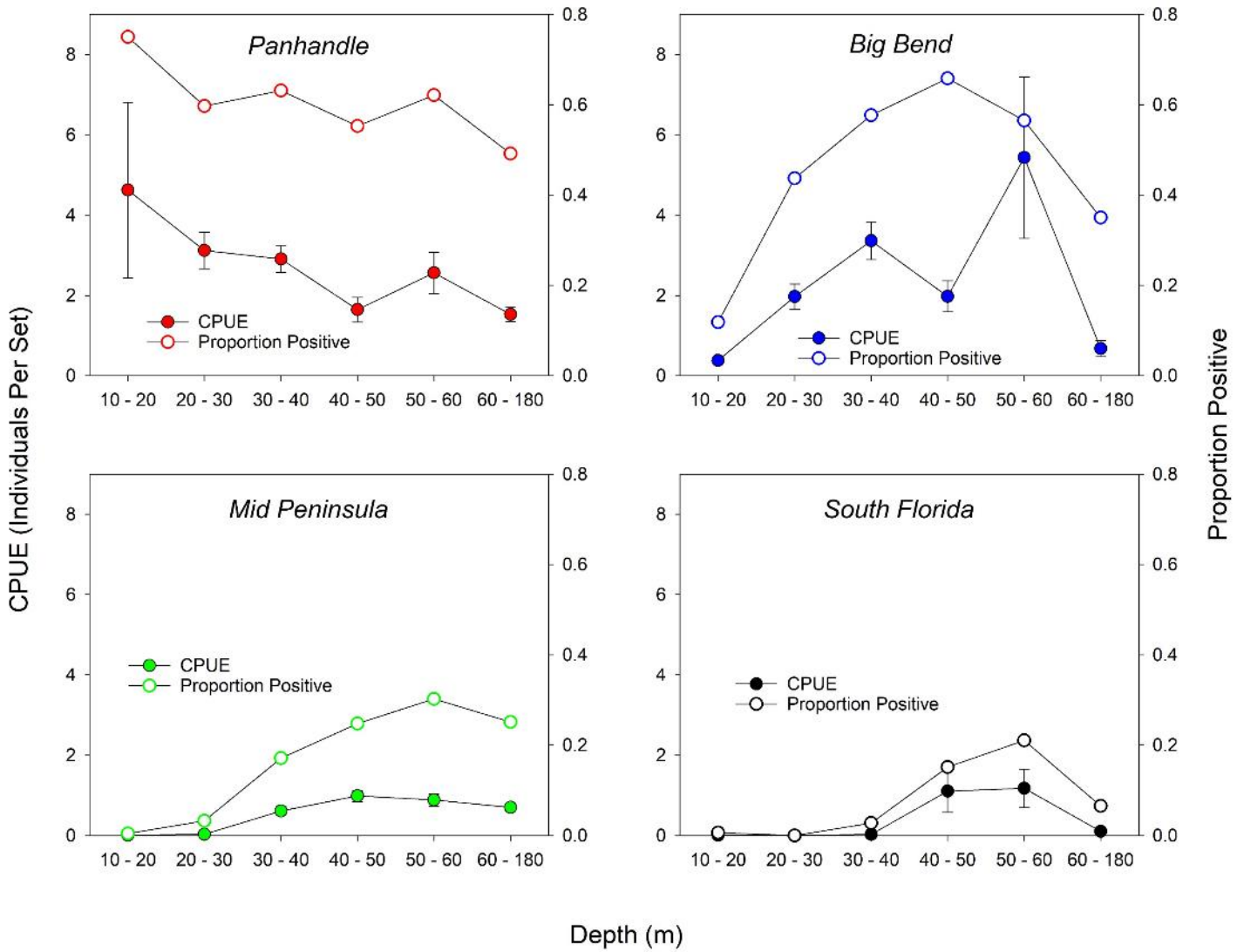


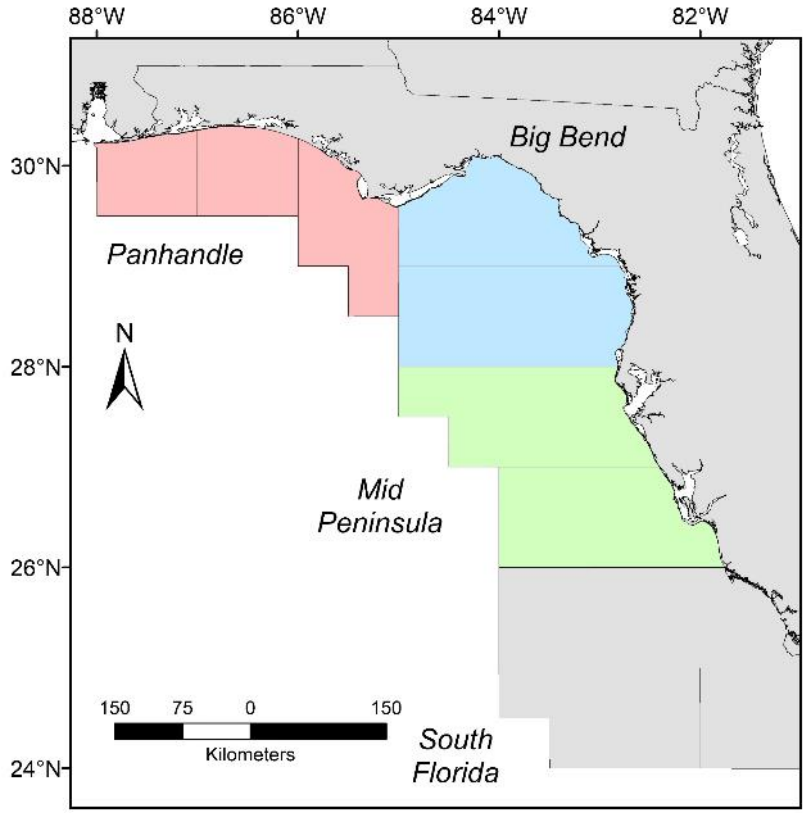
50 – 60 m



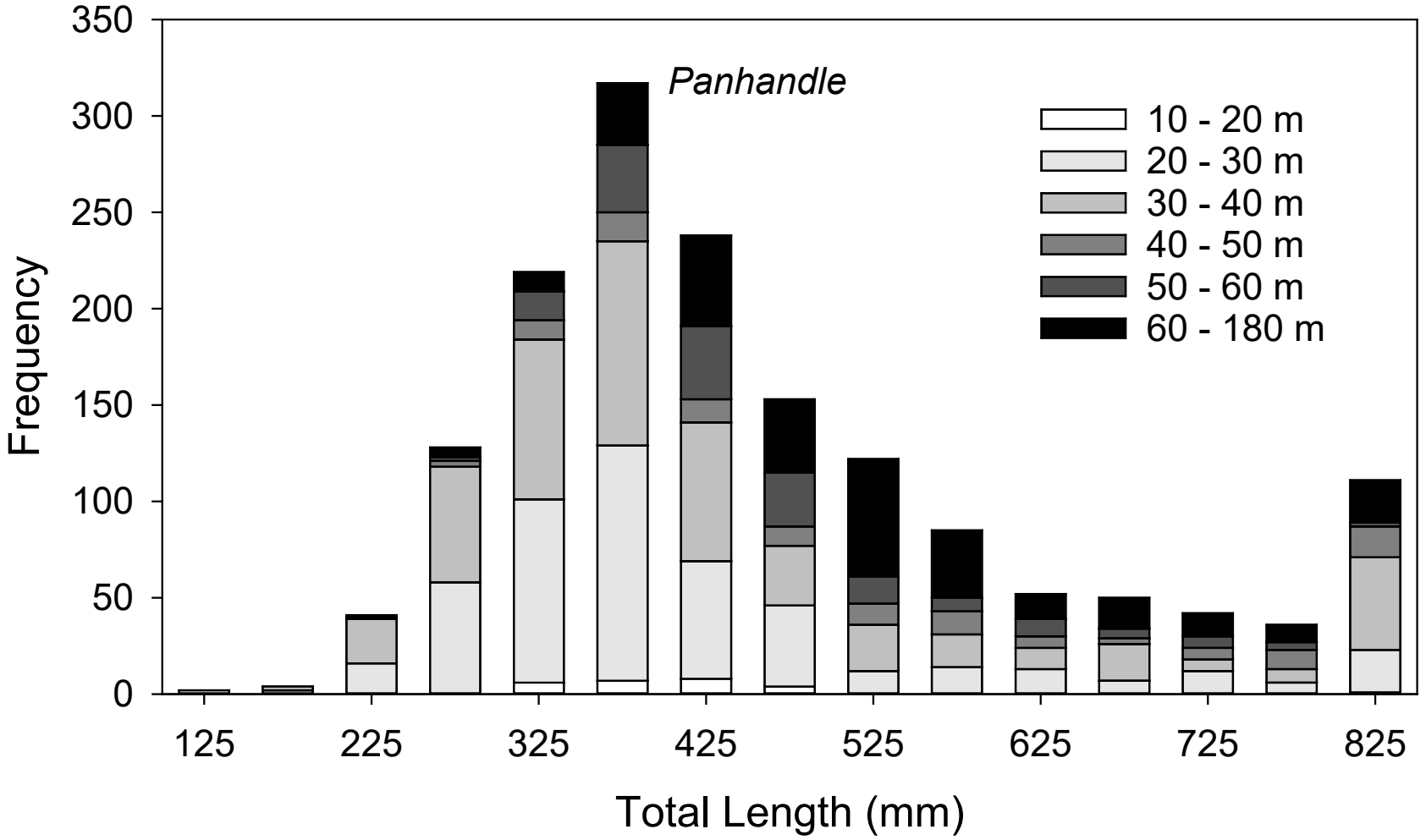
60 – 180 m

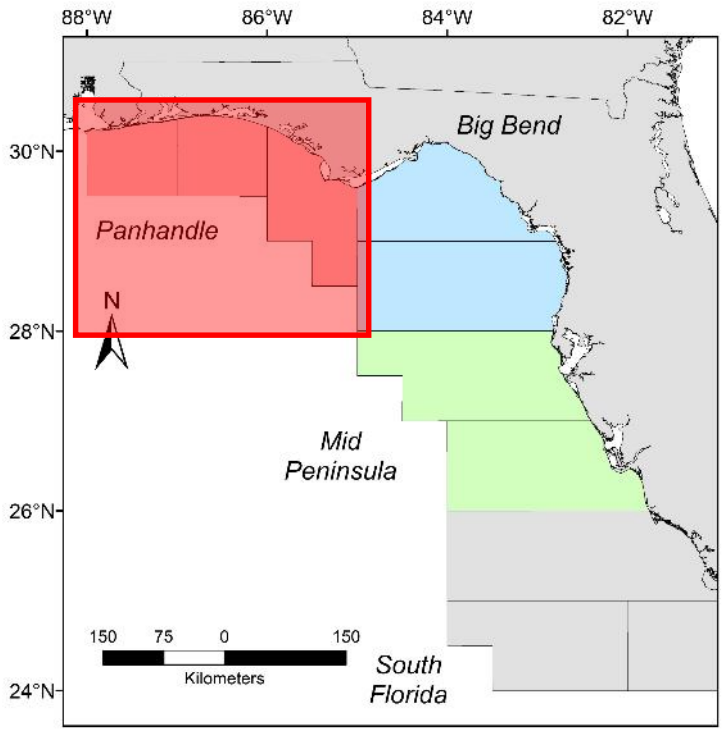
CPUE and Proportion Positive – Natural Habitat (FWRI)





Size Composition – Natural Habitat By Depth (FWRI)





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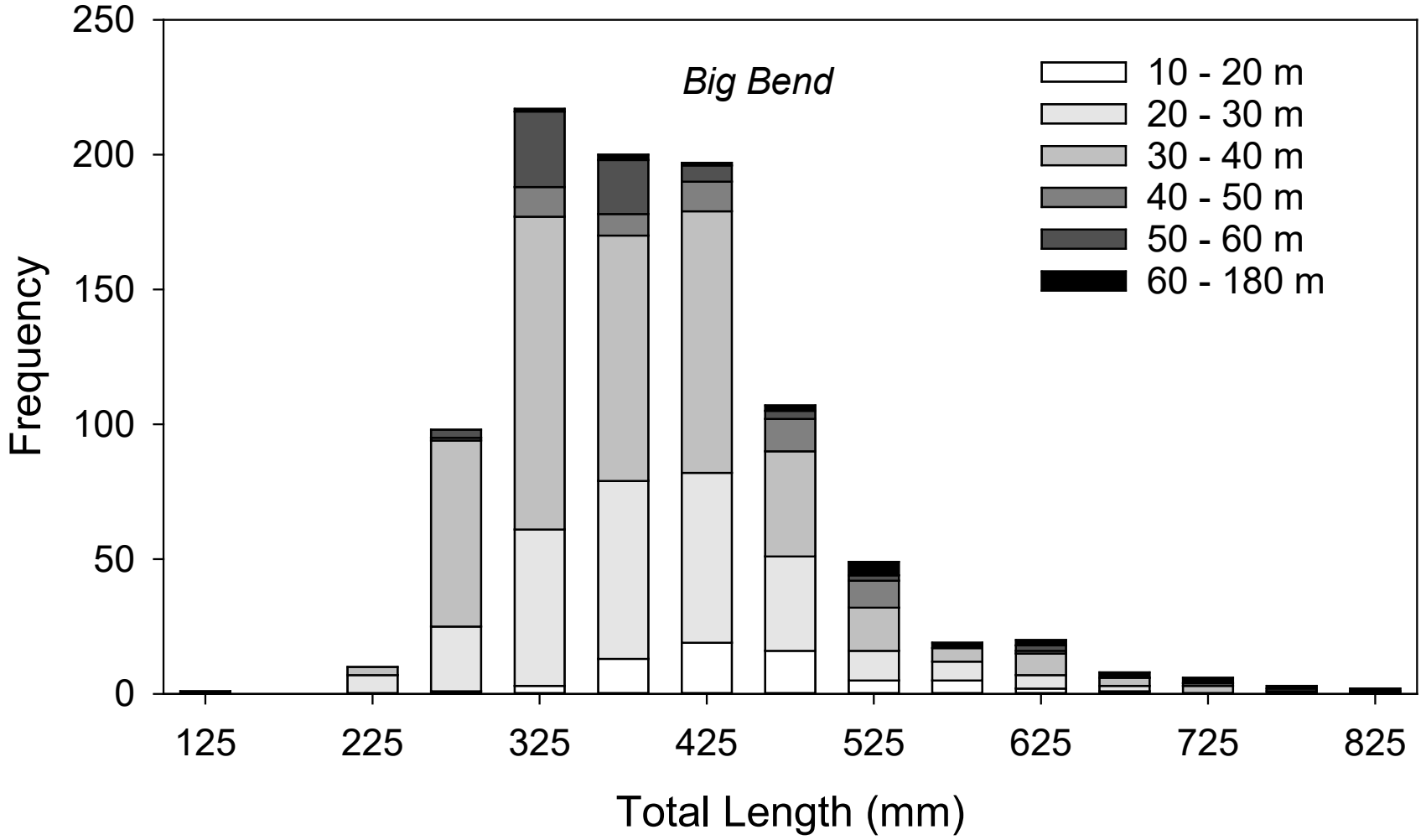
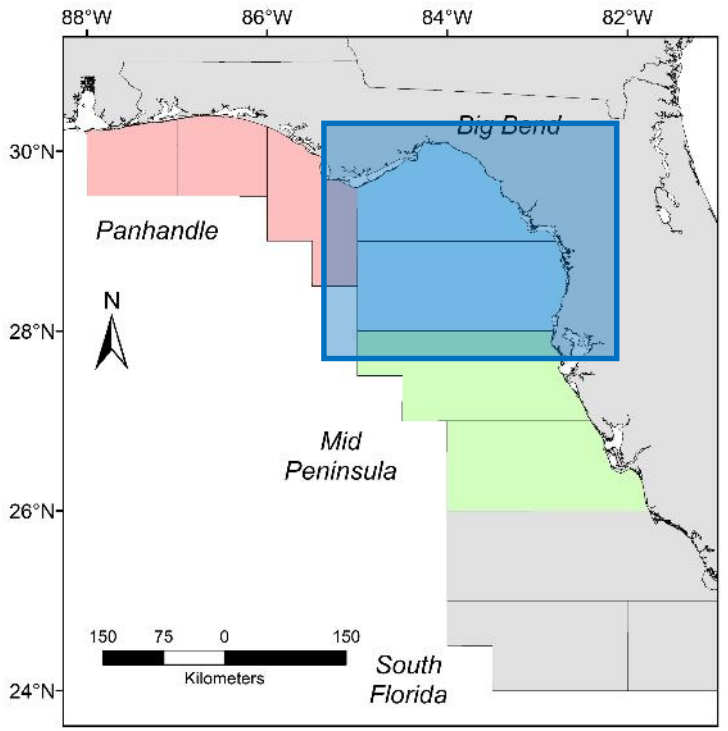
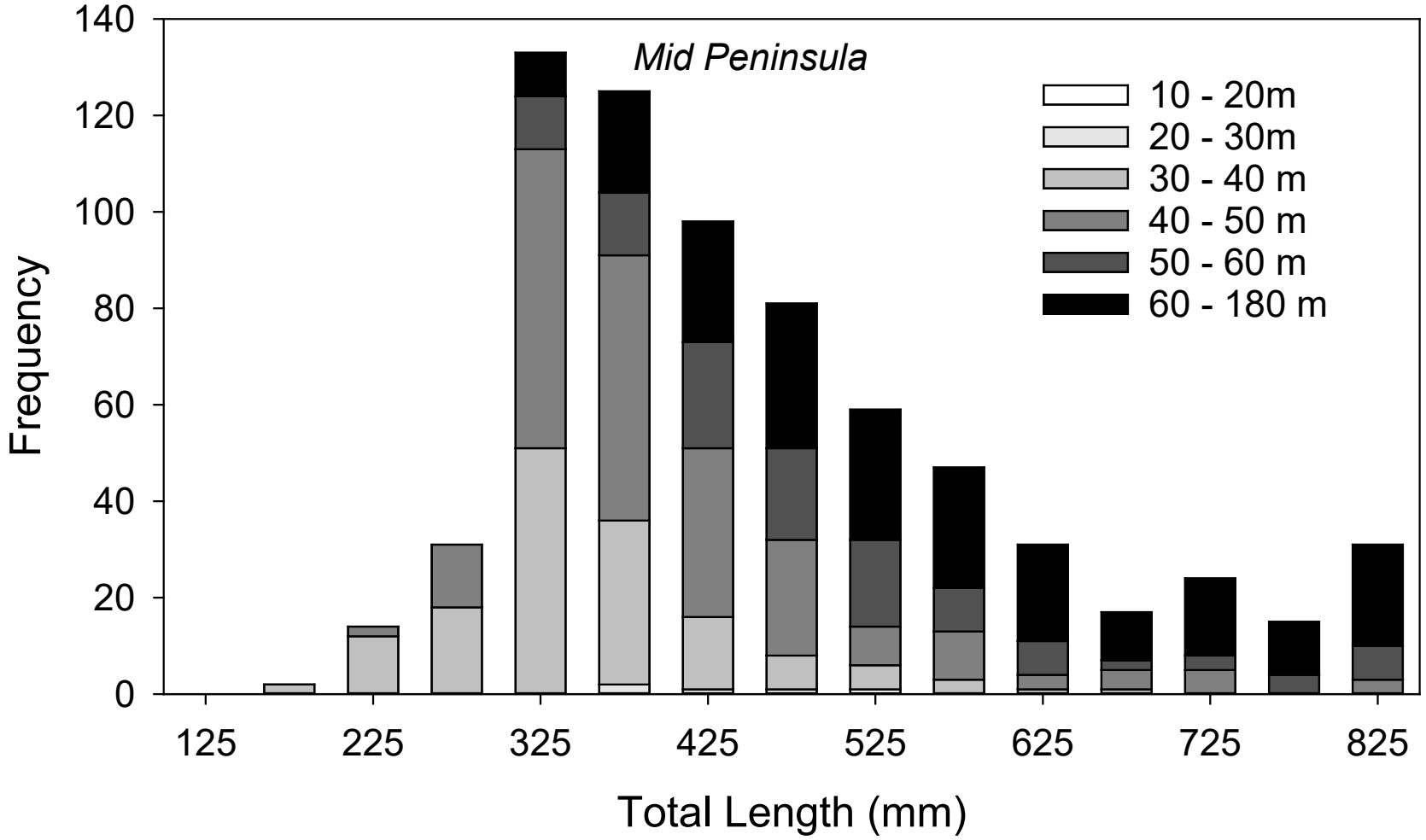
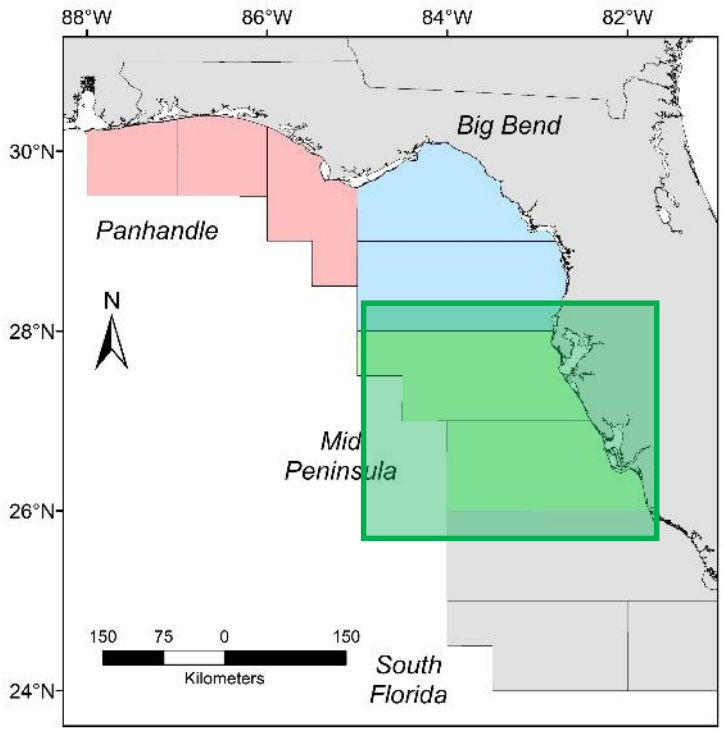




Size Composition – Natural Habitat By Depth (FWRI)





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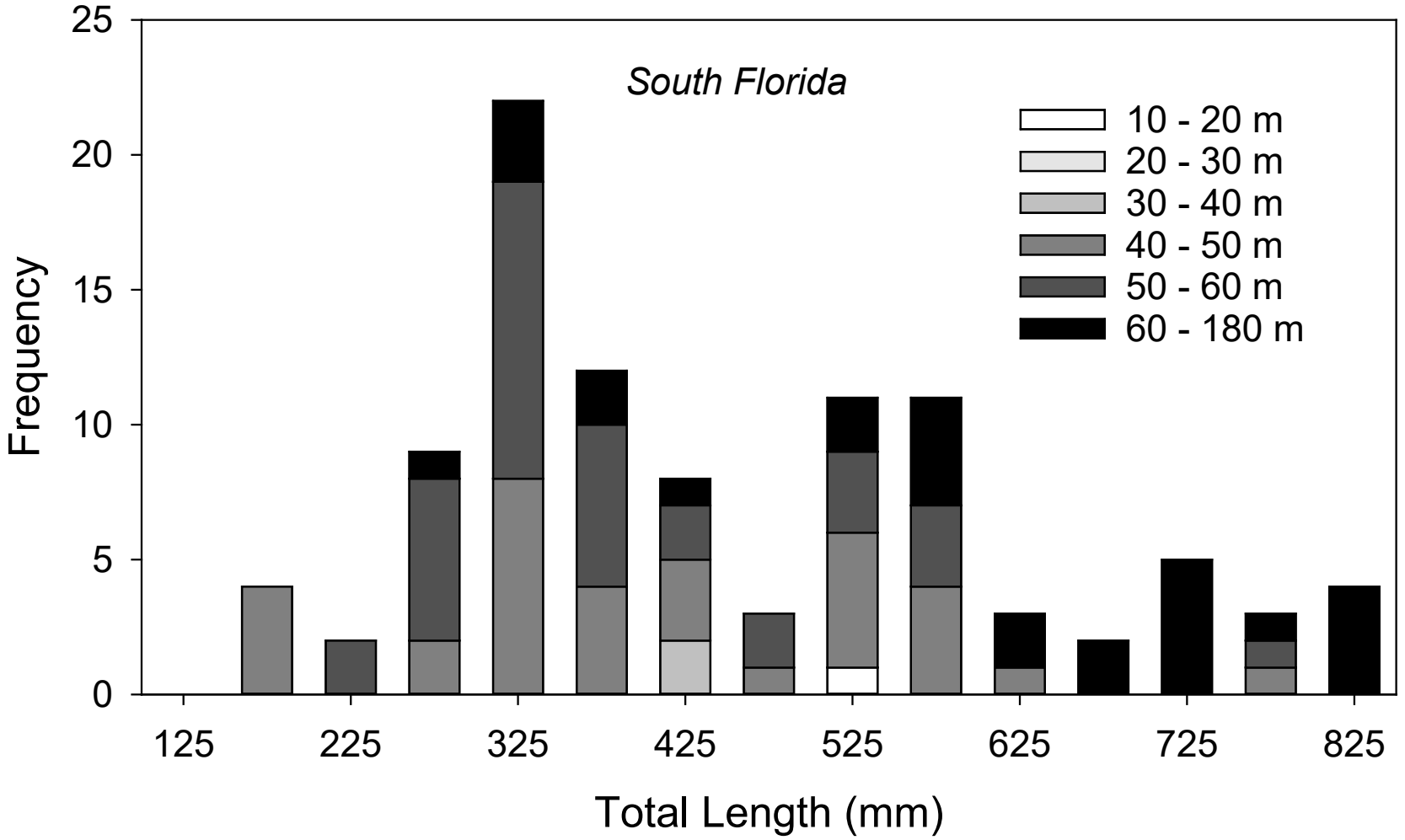
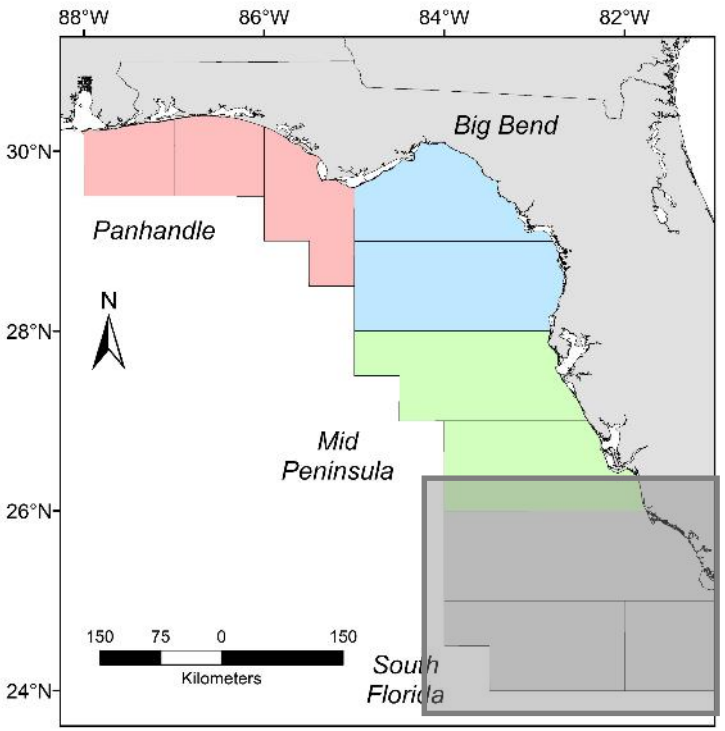
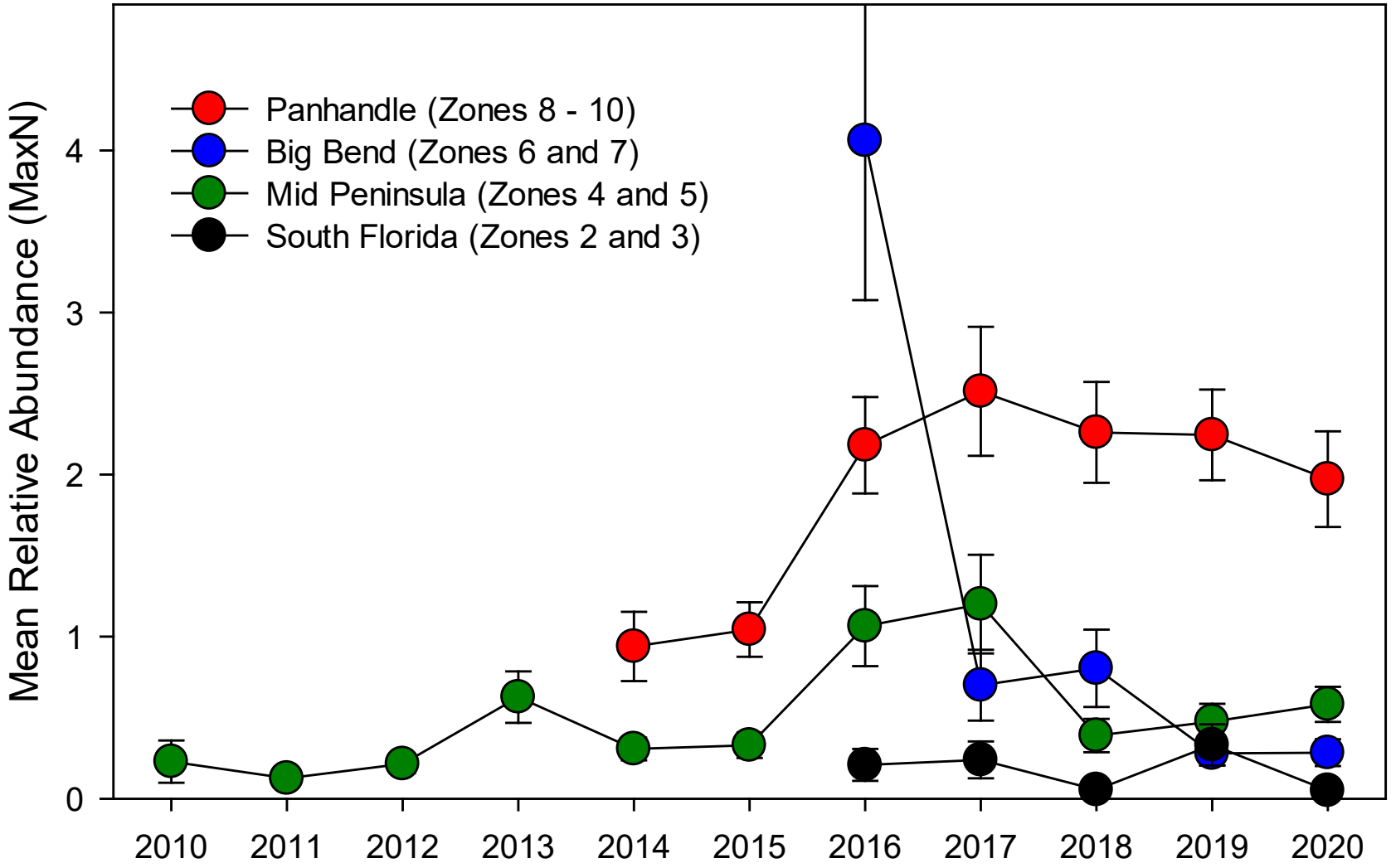
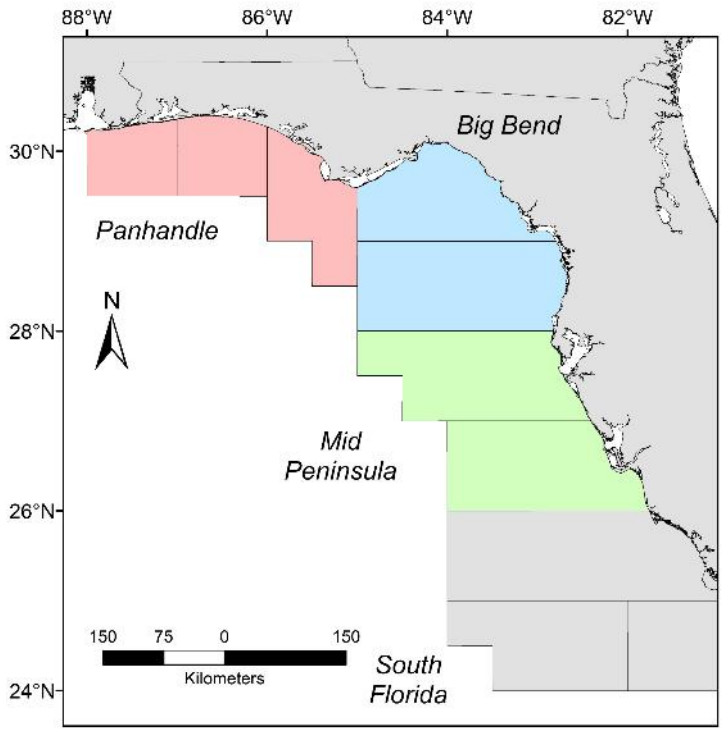




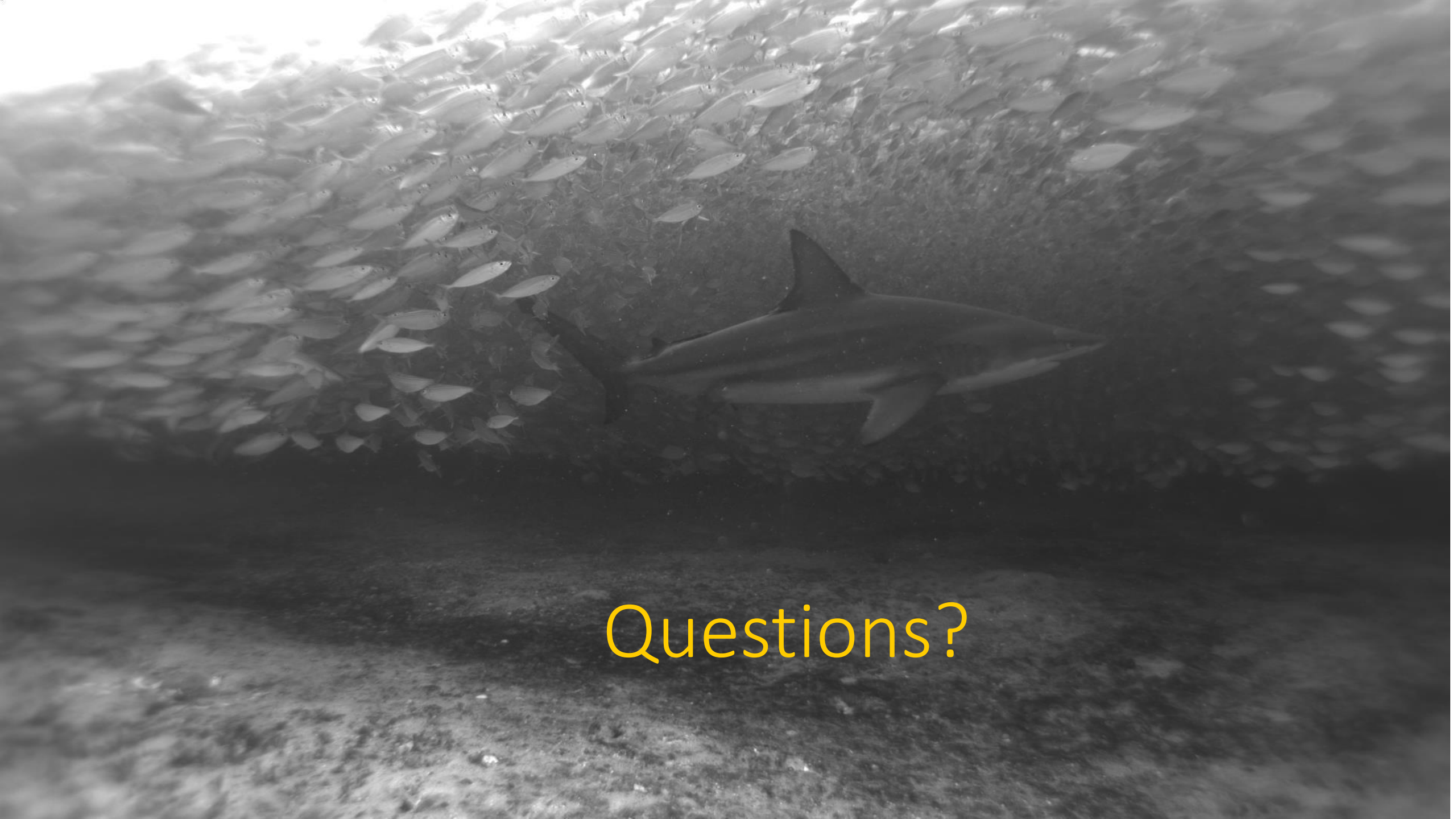
Annual IOAs – Natural Habitat (FWRI)





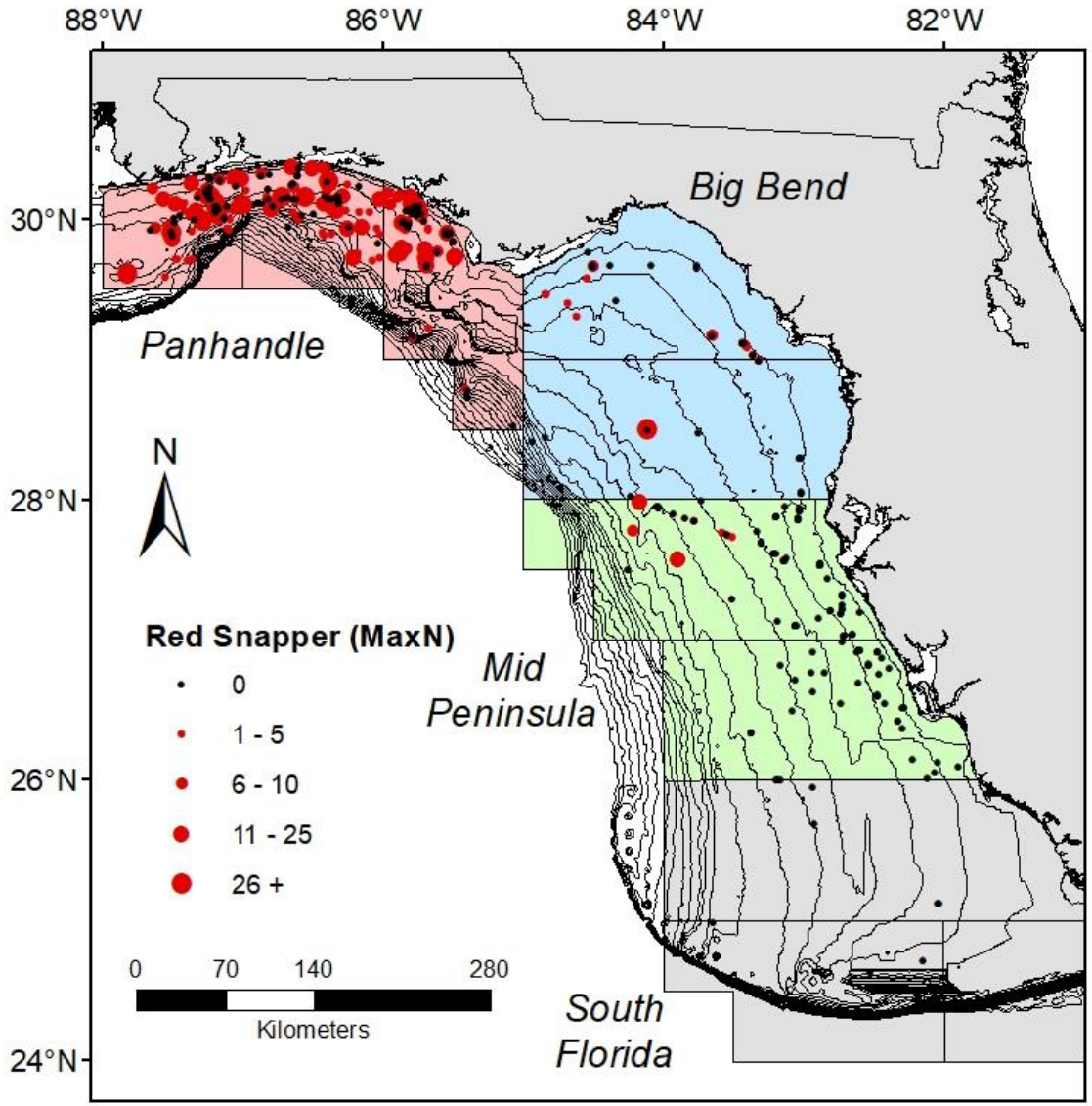
G-FISHER: Conclusions and Future Efforts

- Analyses provided insight into spatial and temporal dynamics of red snapper in eGOM
- Comprehensive G-FISHER survey positioned to provide robust habitat and multispecies abundance / size composition data for the next 5 – 10 years
- Ongoing efforts to develop analytical and technological improvements to survey enterprise

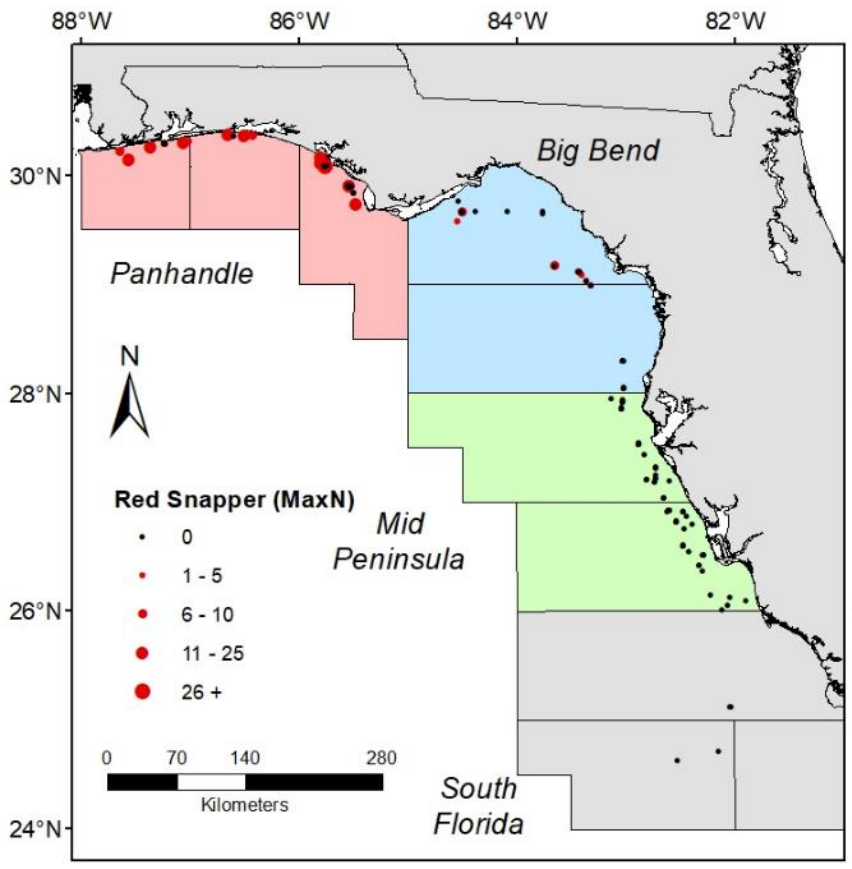

Questions?

Supplementary Material

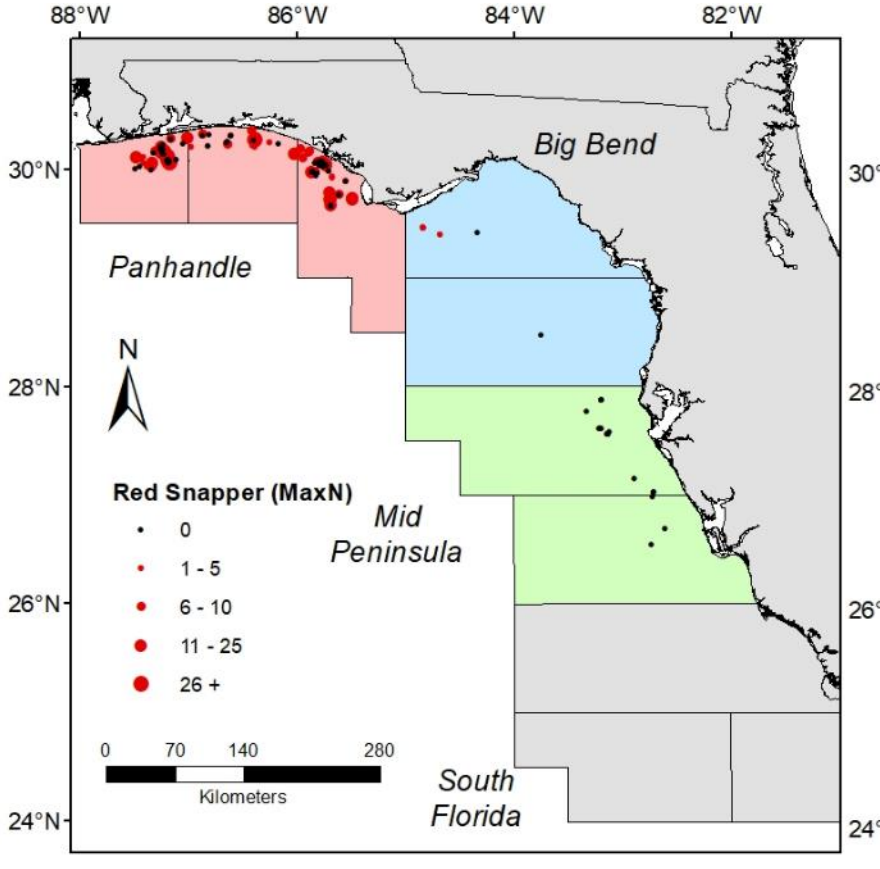
Distribution – Artificial Habitat (FWRI)



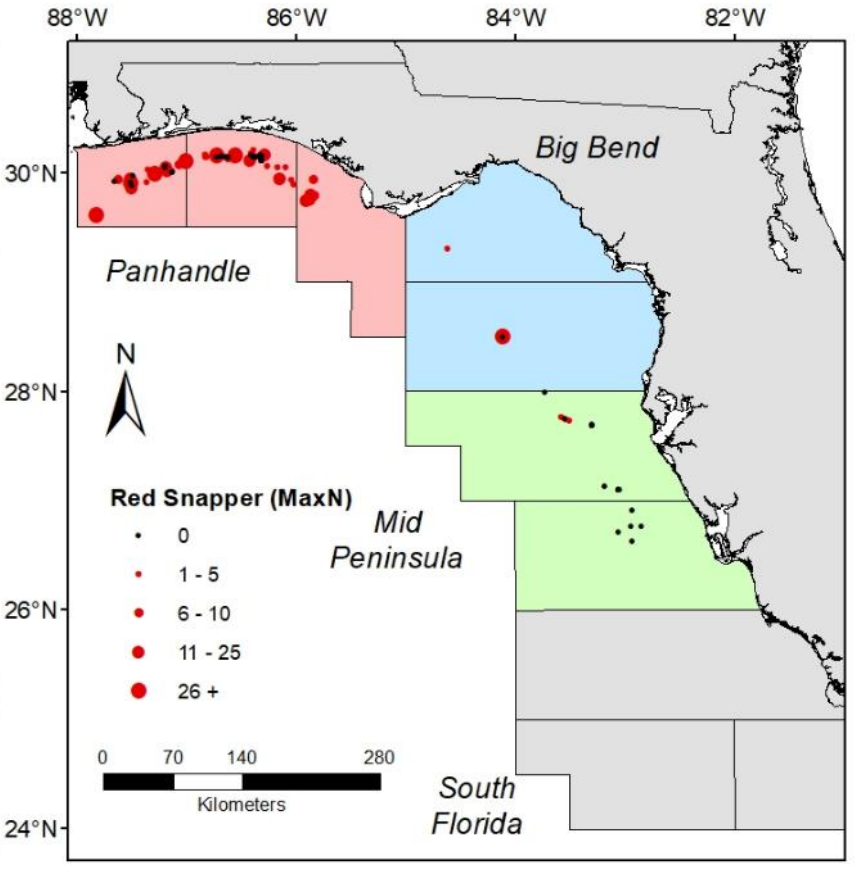
Distribution – Artificial Habitat By Depth (FWRI)



10 – 20 m

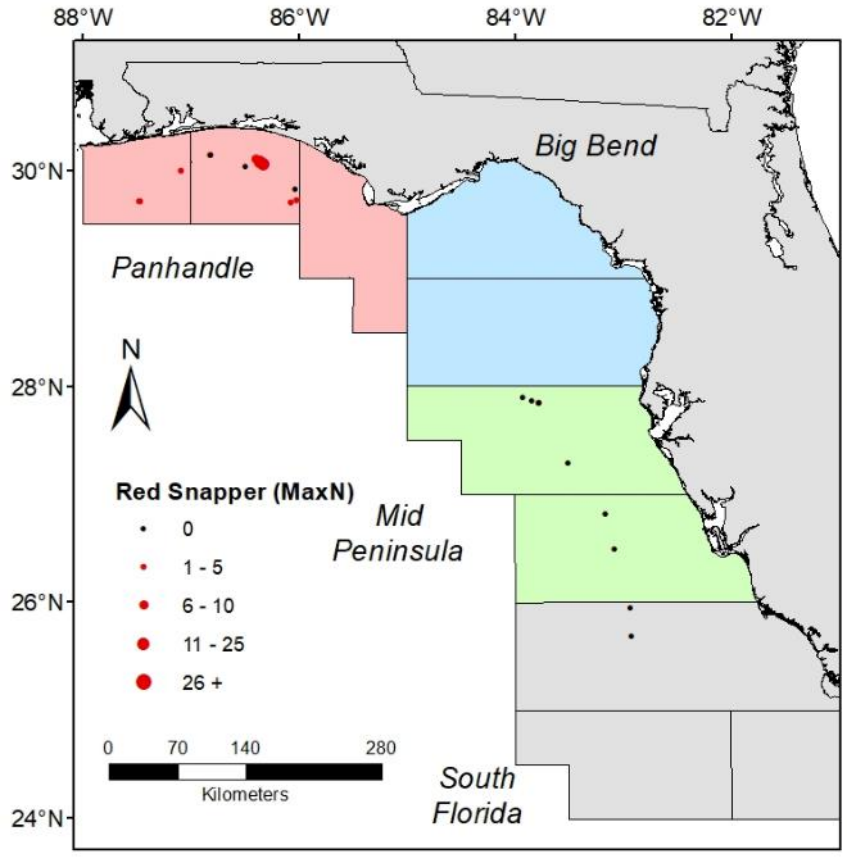


20 – 30 m

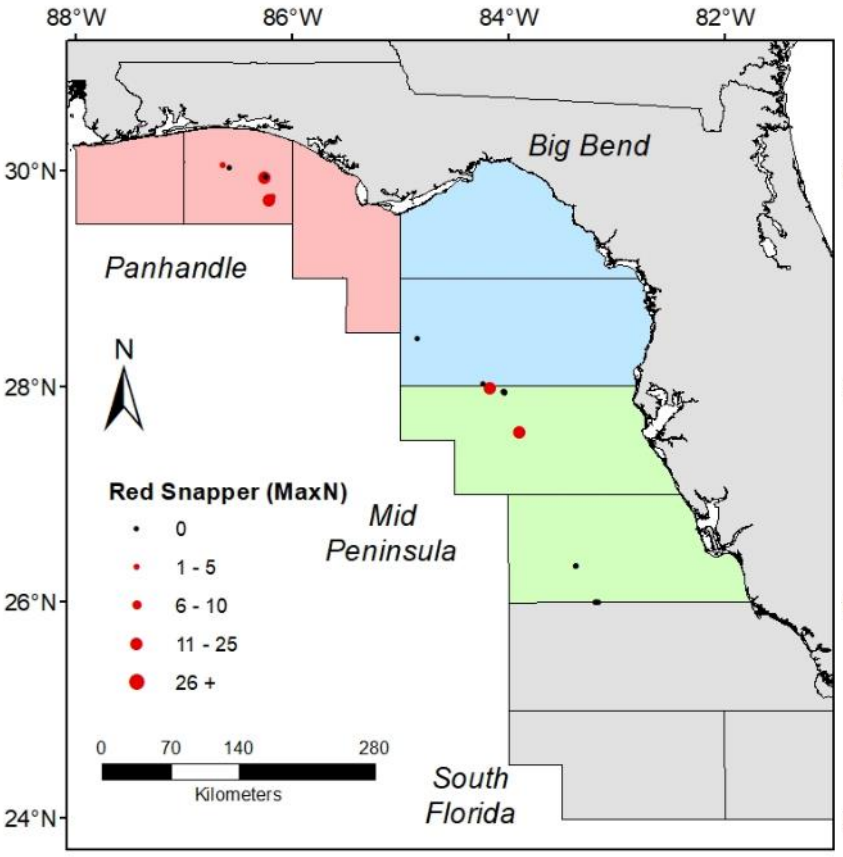


30 – 40 m

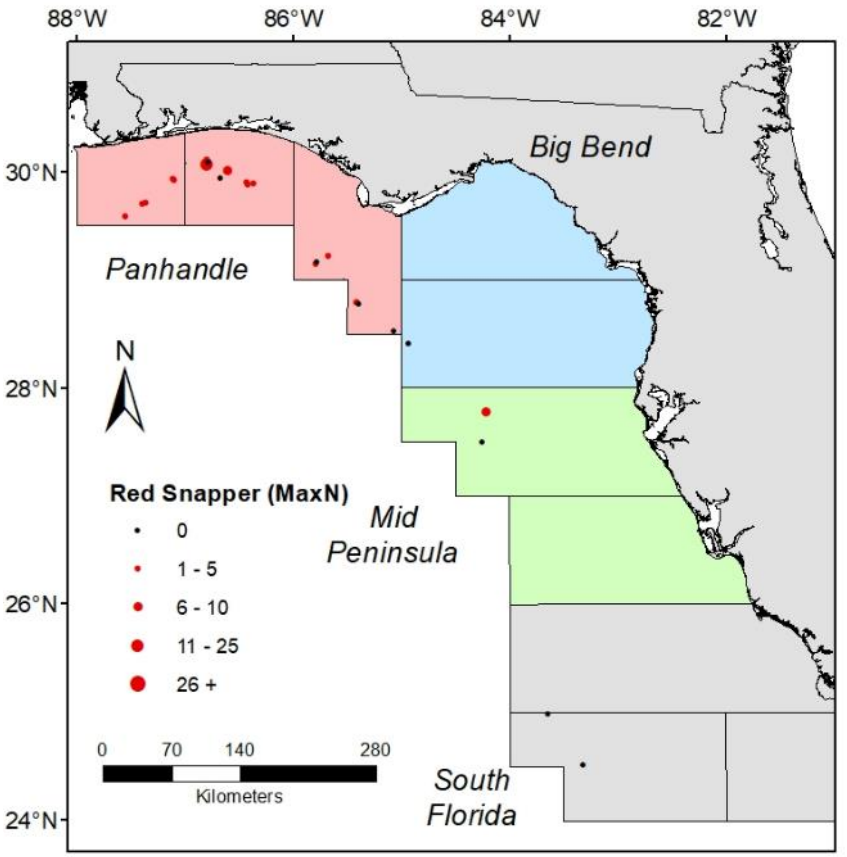
Distribution – Artificial Habitat By Depth (FWRI)



40 – 50 m

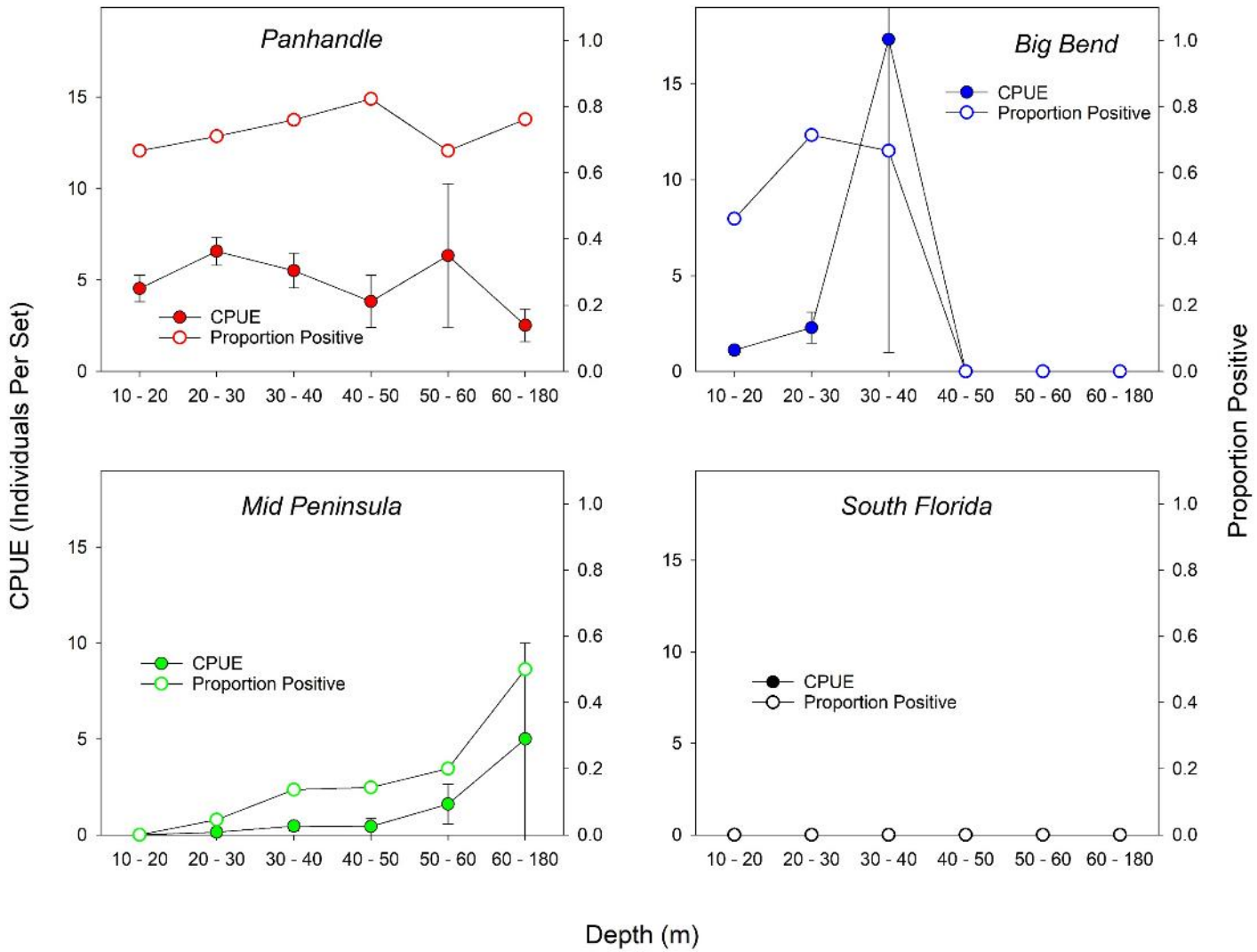


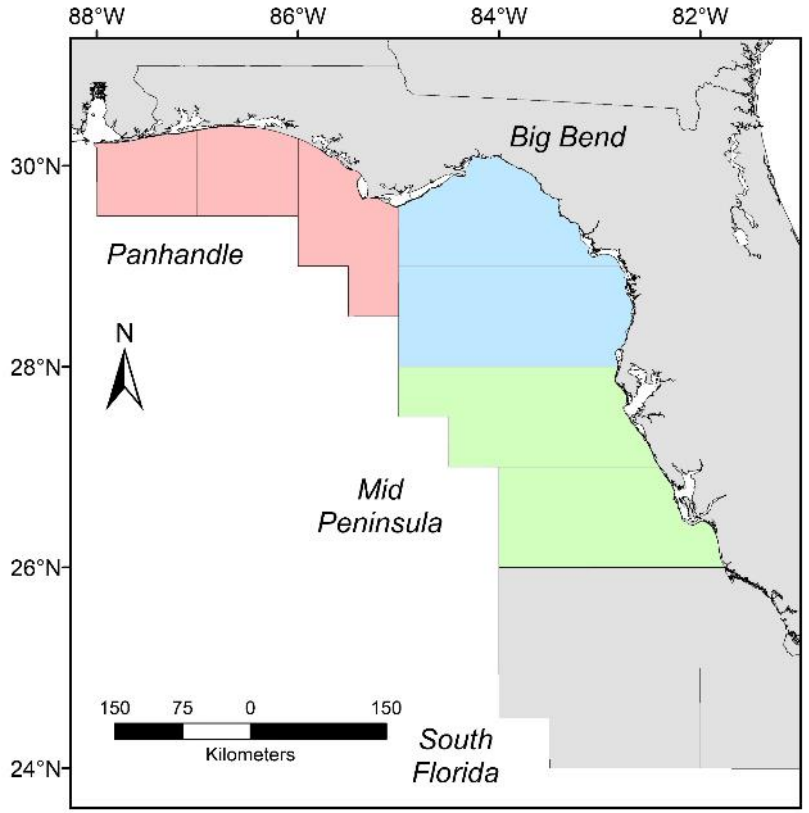
50 – 60 m



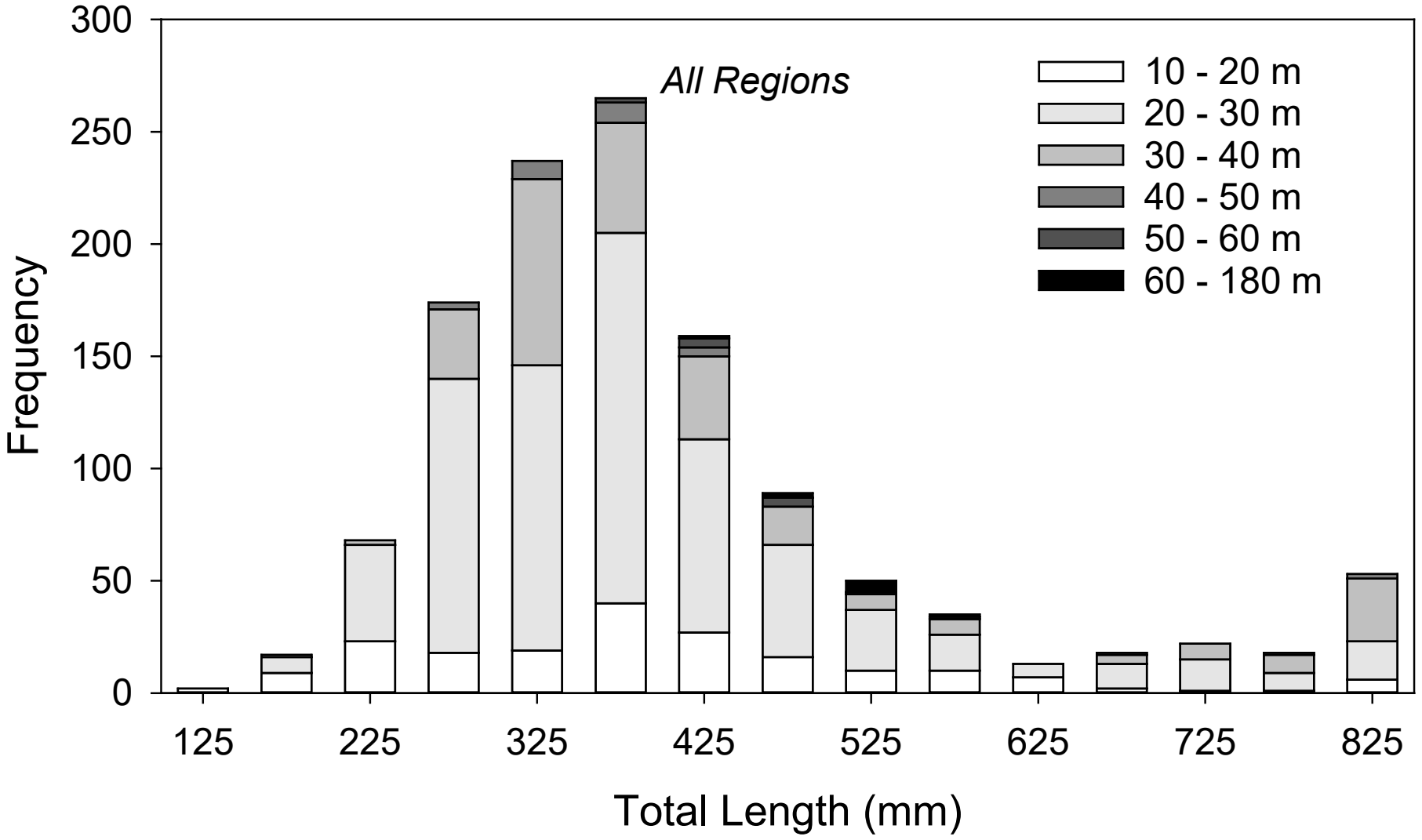
60 – 180 m

CPUE and Proportion Positive – Artificial Habitat (FWRI)





Size Composition – Artificial Habitat By Depth (FWRI)



Annual IOAs – Artificial Habitat (FWRI)