

# Essential Fish Habitat Generic Amendment Analyses Overview



# Background

- The Council is mandated to describe and identify EFH for all FMPs by life stage along with reviewing these descriptions every 5-years
  - Life stages: eggs, larvae, post-larvae, early juvenile, late juvenile, adult, spawning adult
  - Currently developing an amendment to address these requirements simultaneously
- Council has requested some more detailed information regarding

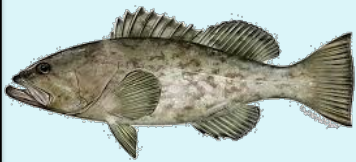


# What draft options look like



**Alternative 1:** No Action – Retain current description and identification of essential fish habitat (EFH) for Gulf of Mexico (Gulf) Fishery Management Plans as outlined in EFH Generic Amendment 3.

**Alternative 2:** Continue to use methods of habitat mapping and life history association tables to describe and identify EFH. Update habitat mapping data from the National Oceanic and Atmospheric Administration (NOAA) Atlas to a more contemporary source. Update species life history and habitat attribute tables to include primary research and technical literature sources through 2020. This alternative could be used for any and all managed species.

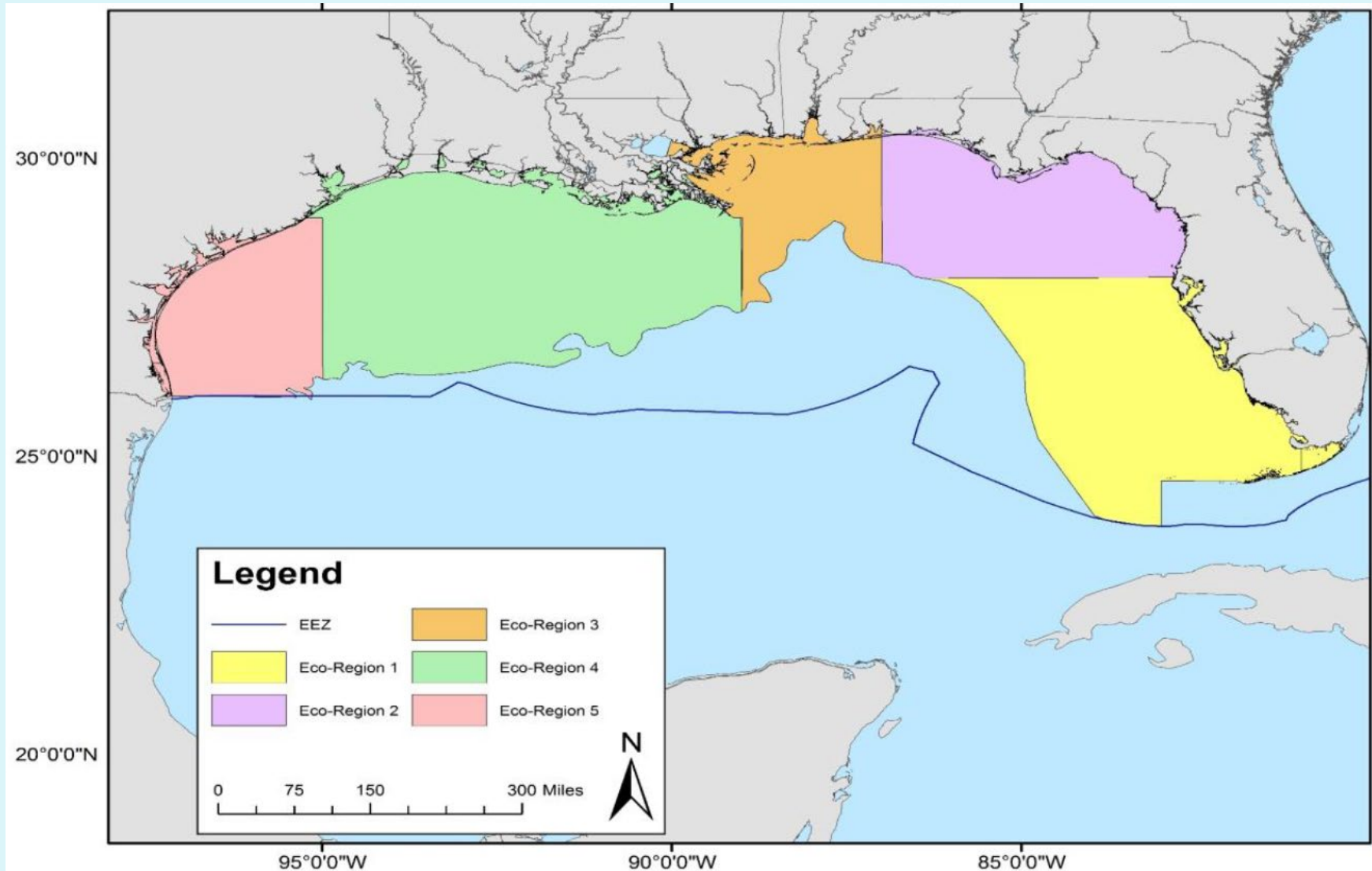


**Alternative 3:** Use a non-parametric kernel density estimate (KDE) approach using various fishery independent sources outlined from Grüss et al. 2018 to describe and identify EFH. This alternative could only be used to describe and identify EFH for species listed in table on slide 13.



**Alternative 4:** Use a boosted regression tree (BRT) modeling approach using various fishery independent sources outlined from Grüss et al. 2018 to describe and identify EFH. This alternative could only be used to describe and identify EFH for species listed in table on slide 13.

# Habitat and life history tables



# Habitat and life history tables

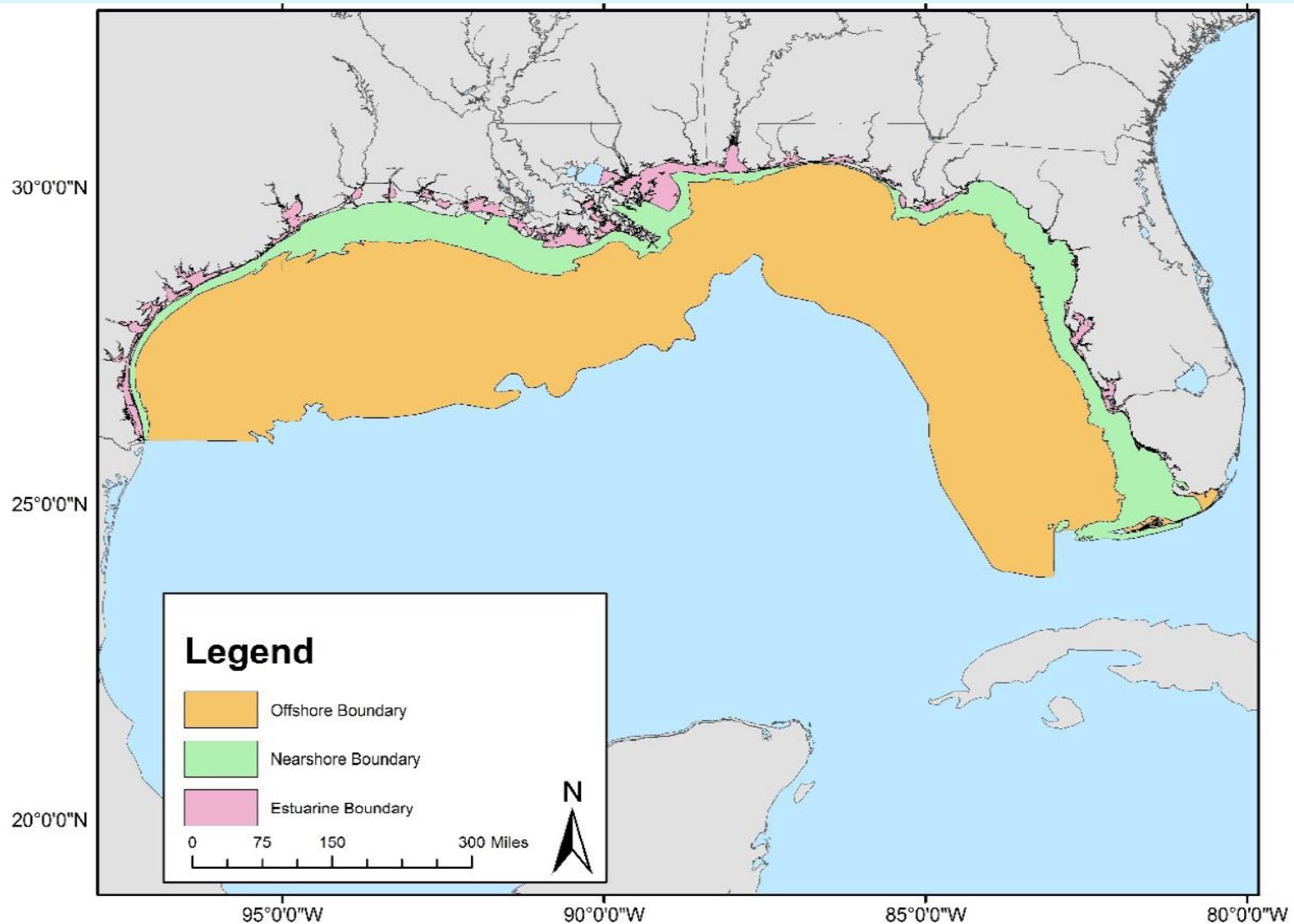


Habitat Type	Related Terms
Submerged Aquatic Vegetation (SAV)	Seagrasses, benthic algae
Mangroves	
Drifting algae	<i>Sargassum</i>
Emergent marshes	Tidal wetlands, salt marshes, tidal creeks, rives/streams
Sand/shell bottoms	Sand
Soft bottoms	Mud, clay, silt
Hard bottoms	Hard bottoms, live hard bottoms, low-relief irregular bottoms, high-relief irregular bottoms
Oyster reefs	
Banks/shoals	
Reefs	Reefs, reef halos, patch reefs, deep reefs
Shelf edge/slope	Shelf edge, shelf slope
Water Column Associated (WCA)	Pelagic, planktonic, coastal pelagic

Note: low-relief irregular bottoms include low ledges, caves, crevices, and burrows; high-relief irregular bottoms include high ledges & cliffs, boulders, and pinnacles.



# Habitat and life history tables



# Habitat and life history tables



Life stage	Eco-region	Habitat Zone	Habitat Type	Season	Temp (°C)	Depth (m)	Prey	Predators	Mortality	Growth
eggs <sub>4,5,7,9,13,19,24</sub>	ER-1, ER-2	offshore	WCA	Dec-Apr		50-120				hatch in 45h at 21°C
larvae <sub>13, 19, 21, 24, 31</sub>	ER-1, ER-2	offshore	WCA	early spring		50-120				pelagic larval duration = 29-52 d
postlarvae <sub>10, 13, 21, 31</sub>	ER-1, ER-2	offshore	WCA			50-120				pelagic larval duration = 29-52 d
early juveniles <sub>1, 2, 3, 6, 7, 13, 21, 23, 24, 28, 32</sub>	ER-1, ER-2	estuarine, nearshore	SAV, mangroves	late spring-early fall	22-32	0-12	crustaceans (amphipods, copepods, grass shrimp)		minimal while in SAV	rapid during association with SAV
late juveniles <sub>2, 3, 7, 11, 13, 15, 21, 23, 24, 26, 28, 32</sub>	ER-1, ER-2	estuarine, nearshore, offshore	SAV, hard bottom, reefs, mangroves	recruit to reefs offshore in fall	22-32	1-50	decapod crustaceans and fish	cannibalistic, larger fishes	recreational fishery, shrimp fishery bycatch	
adults <sub>2, 6, 9, 13, 15, 16, 18, 20, 22, 23, 24, 29, 34, 35</sub>	ER-1, ER-2, ER-3, ER-4, ER-5	nearshore, offshore	hard bottom, reefs	year-round	14-24	13-100	fish, crustaceans, cephalopods	sharks	sudden low temps, fishing mortality; $M = 0.1342$	$L_{inf} = 1277.95$ mm FL, $k = 0.1342$ , $t_0 = -0.6687$ , max. age = 31 yrs
spawning adults <sub>2, 4, 8, 9, 13, 14, 18, 19, 25, 27, 30</sub>	ER-1, ER-2, ER-3, ER-4, ER-5	offshore	shelf edge/slope, hard bottom	Dec-May peak: Feb-Mar	21-30	50-120			spawning aggregations vulnerable to fishery	

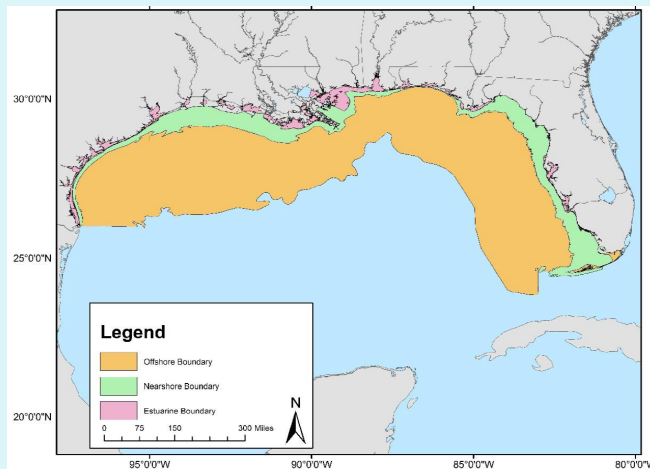
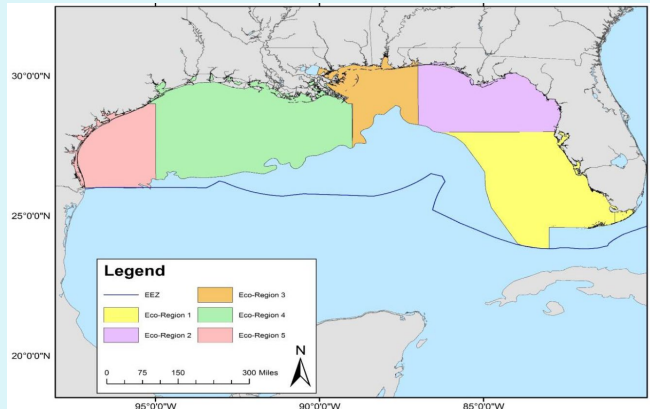
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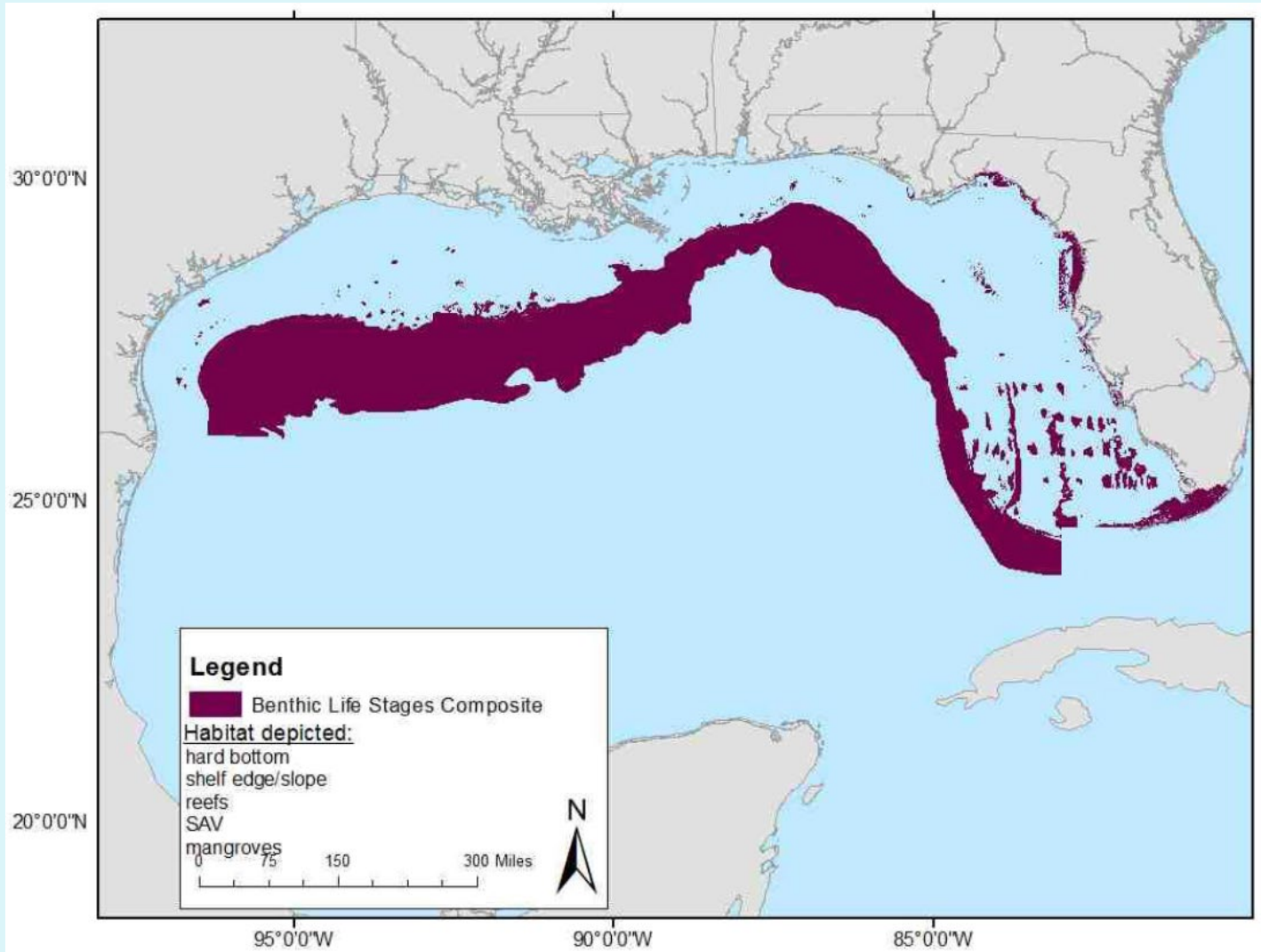


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# Habitat and life history tables: Gag grouper (all life stages)



# Assumptions: Habitat and life history tables

- Species use all available habitat equally
- Species habitat selection completed known and published
- No accounting for physiochemical variables
- Focus on structured features



# Data available: habitat and life history tables

FMP		Data available for all life stages	
Reef fish	<ul style="list-style-type: none"><li>• Alamco jack</li><li>• Banded rudderfish</li><li>• Blackfin snapper</li><li>• Black grouper</li><li>• Blueline tilefish</li><li>• Cobia</li><li>• Cubera snapper</li><li>• Gag grouper</li><li>• Goldface tilefish</li><li>• Goliath grouper</li><li>• Gray snapper</li><li>• Gray triggerfish</li></ul>	<ul style="list-style-type: none"><li>• Lane snapper</li><li>• Lesser amberjack</li><li>• Greater amberjack</li><li>• Hogfish</li><li>• Mutton snapper</li><li>• Queen snapper</li><li>• Red grouper</li><li>• Red snapper</li><li>• Scamp</li></ul>	<ul style="list-style-type: none"><li>• Silk snapper</li><li>• Snowy grouper</li><li>• Speckled hind</li><li>• Vermillion snapper</li><li>• Warsaw grouper</li><li>• Wenchman</li><li>• Yellowedge grouper</li><li>• Yellowmouth grouper</li><li>• Yellowtail snapper</li></ul>
Shrimp	<ul style="list-style-type: none"><li>• White</li><li>• Brown</li><li>• Pink</li></ul>		
CMP	<ul style="list-style-type: none"><li>• King mackerel</li><li>• Spanish mackerel</li></ul>		
Red drum	<ul style="list-style-type: none"><li>• Red drum</li></ul>		

# FI data available by species for other modeling methods: Grüss *et al.* 2018

FMP	Data available for juvenile and adult life stages
Reef fish	<ul style="list-style-type: none"><li>• Gag grouper</li><li>• Red grouper</li><li>• Red snapper</li></ul>
Shrimp	<ul style="list-style-type: none"><li>• White</li><li>• Brown</li><li>• Pink</li></ul>
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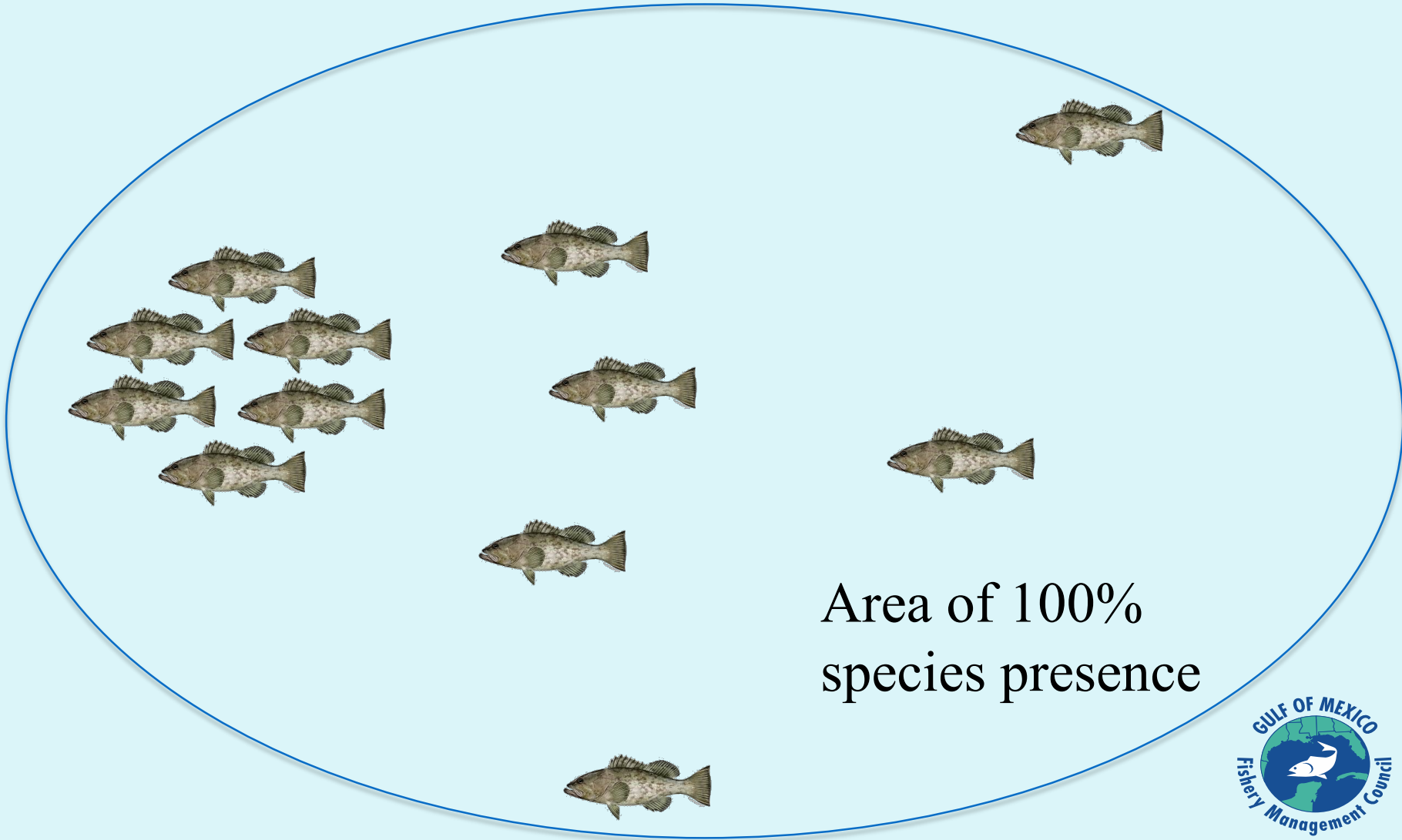


# Data sources and methods

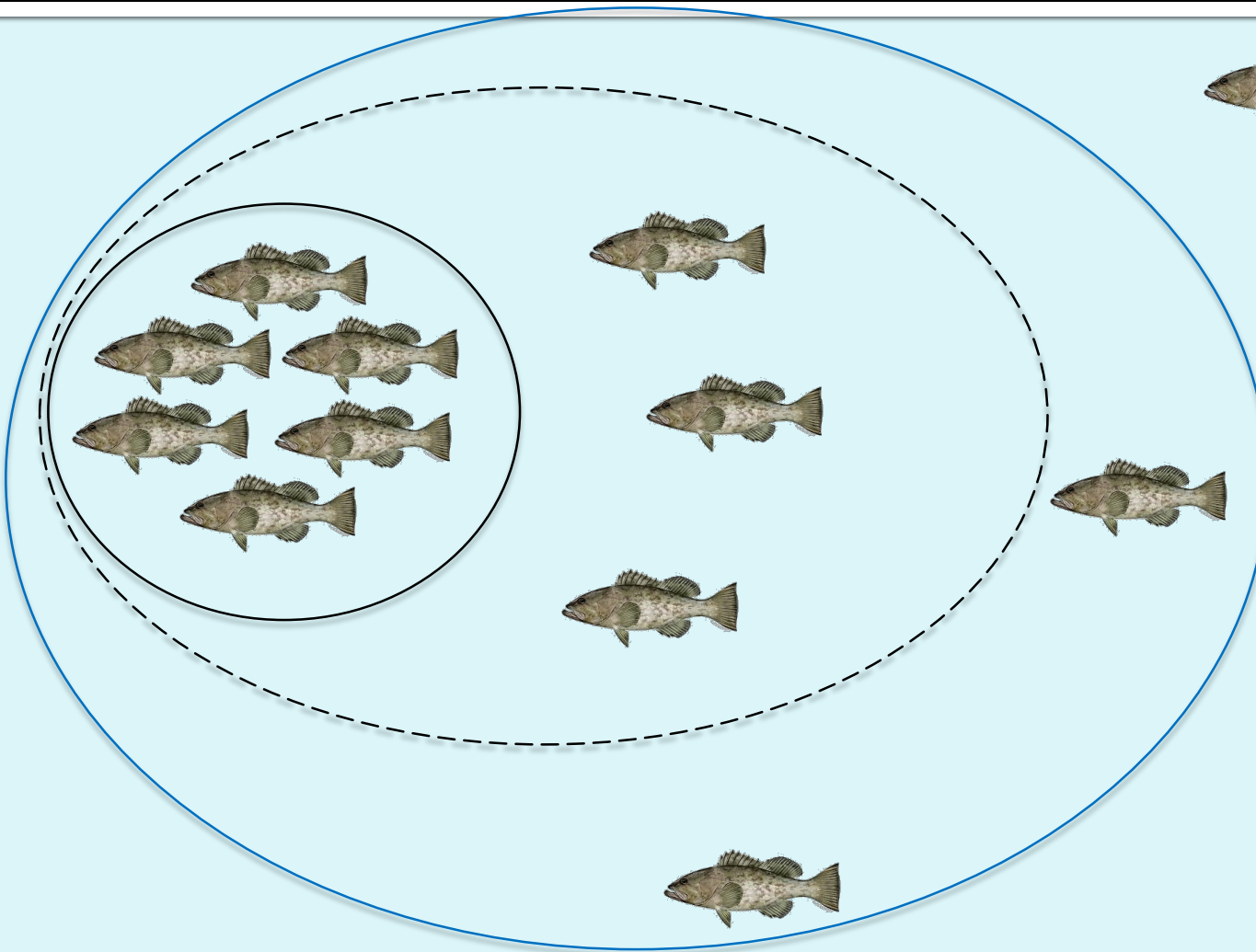
- **Data source (Grüss *et al.* 2018)**
  - 27 fishery independent data sets
  - 7 fishery dependent data sets
  - 2000-2016
  - Video, trawl, seine, vertical line, longline, gillnet, various observer programs
- **Methods considered**
  - Non-parametric kernel density estimator using a nearest neighbor approach (presence only)
  - Boosted regression tree model (presence/absence + habitat)



# Presence only



# Presence only



50% occurrence  
(solid black line)

75% occurrence  
(dashed black line)

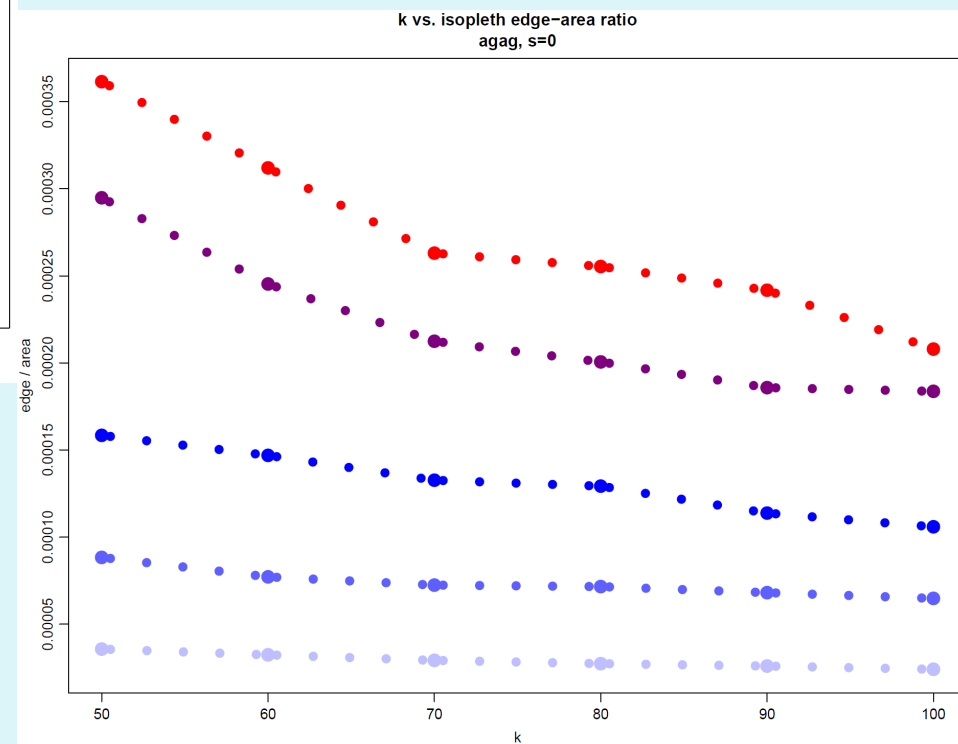
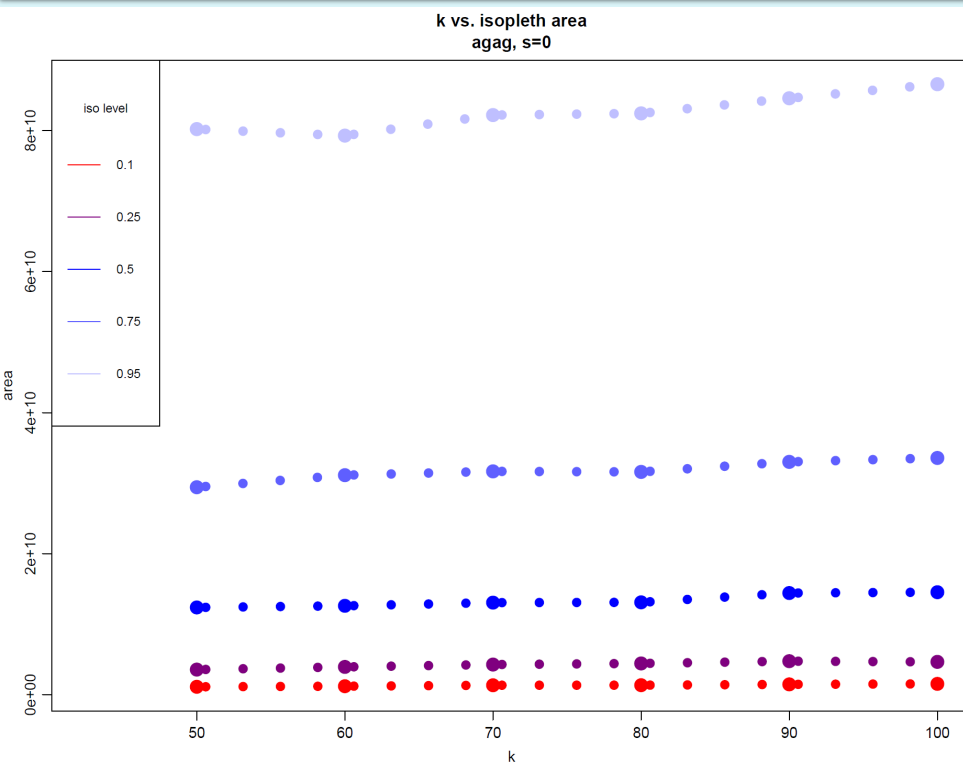
95% occurrence  
(solid blue line)

# Presence only



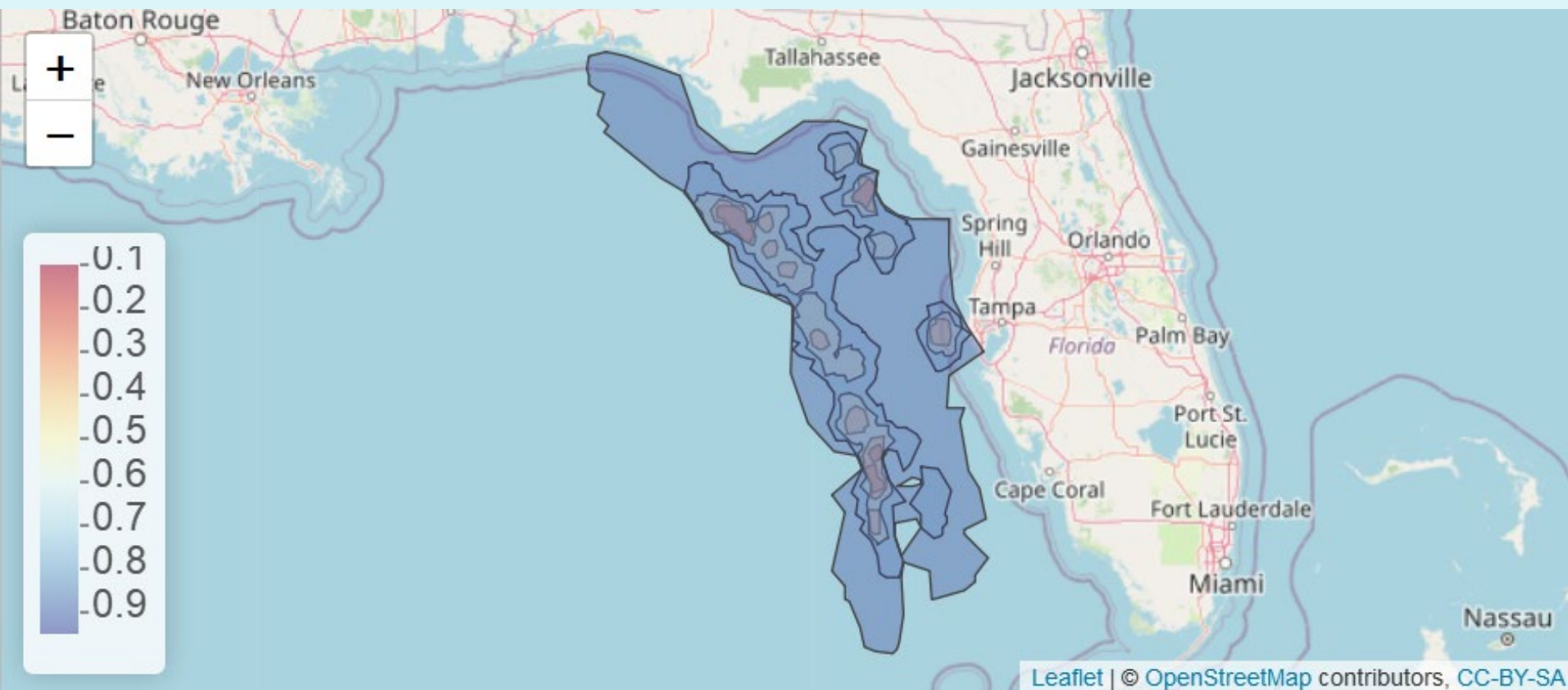
- Analysis performed using R statistical software
  - (T-LoCoH package)
- Apply smoothing parameter
  - k-method; finds the  $k^{\text{th}}$  nearest neighbor
- Examine isopleth area curves and isopleth edge:area curves for each k value

# Presence only





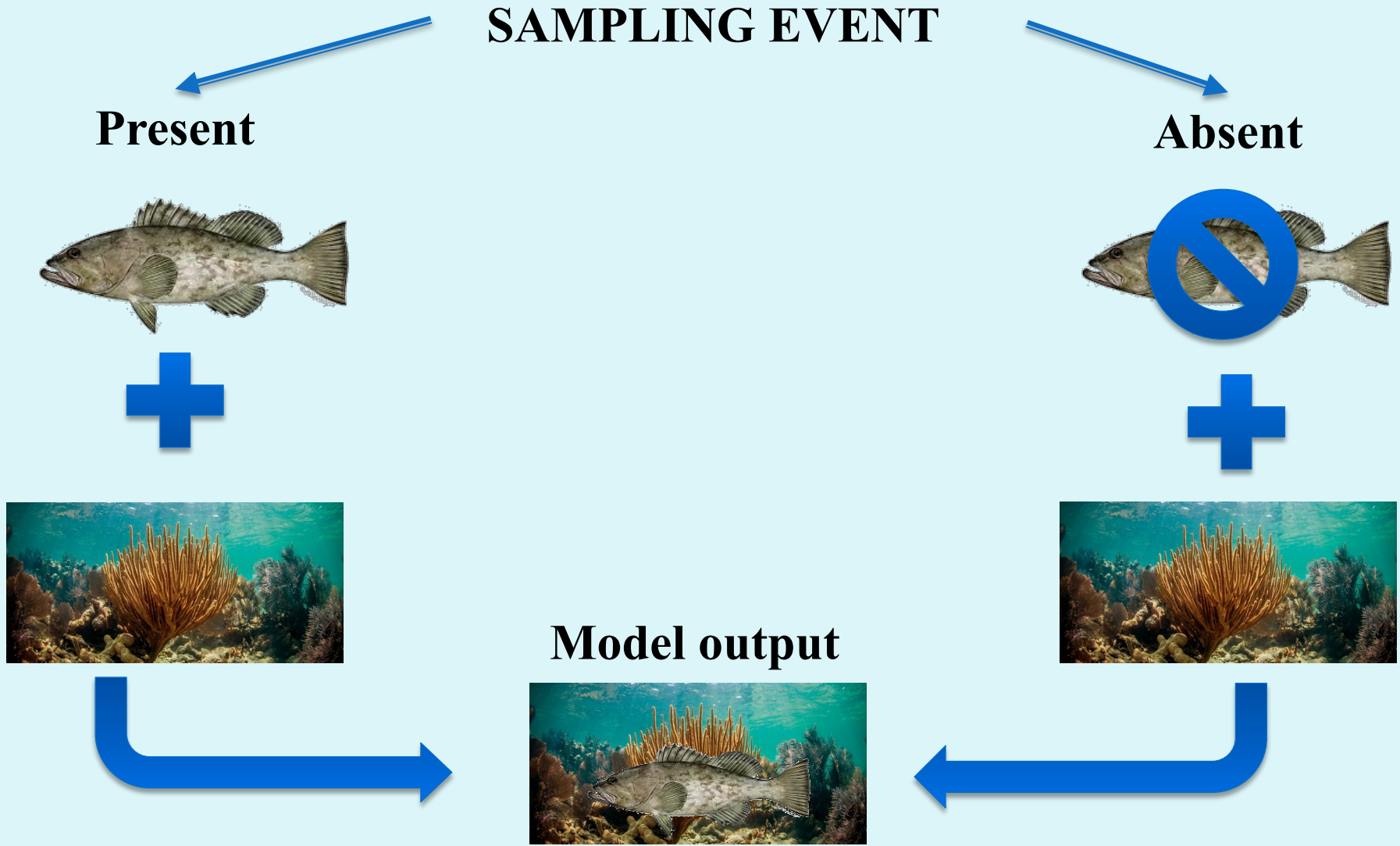
# Presence only: Adult Gag grouper



# Assumptions: Presence only

- No habitat linkage
- No major difference in sampling gear selectivity
- Catchability equal across habitat types
- An absence is a “true” zero (presence only)

# Presence/absence and habitat model



# Presence/absence and habitat model

## Boosted regression trees: model overview

- Regression model approach but objective is not to identify “best” model
- Instead, recursive bifurcations (trees) are constructed to identify regions that have most homogenous response to predictors
- Regression model where each term is a tree
- Model can fit a variety of response types
  - Presence/absence observations and data set best suited for fitting a binomial distribution for EFH analysis
- gbm package in R statistical software

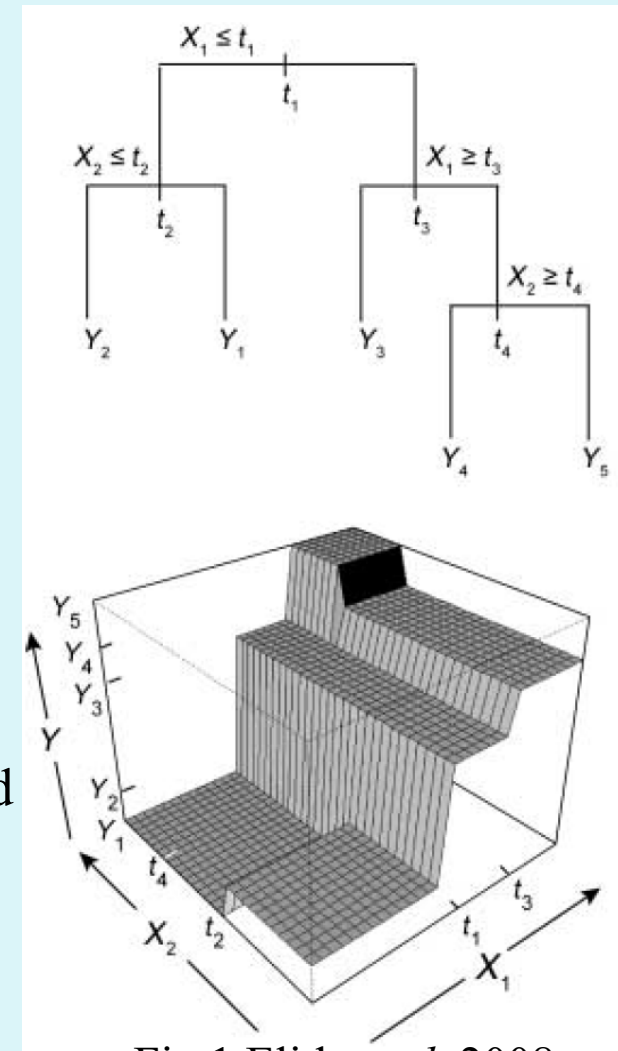
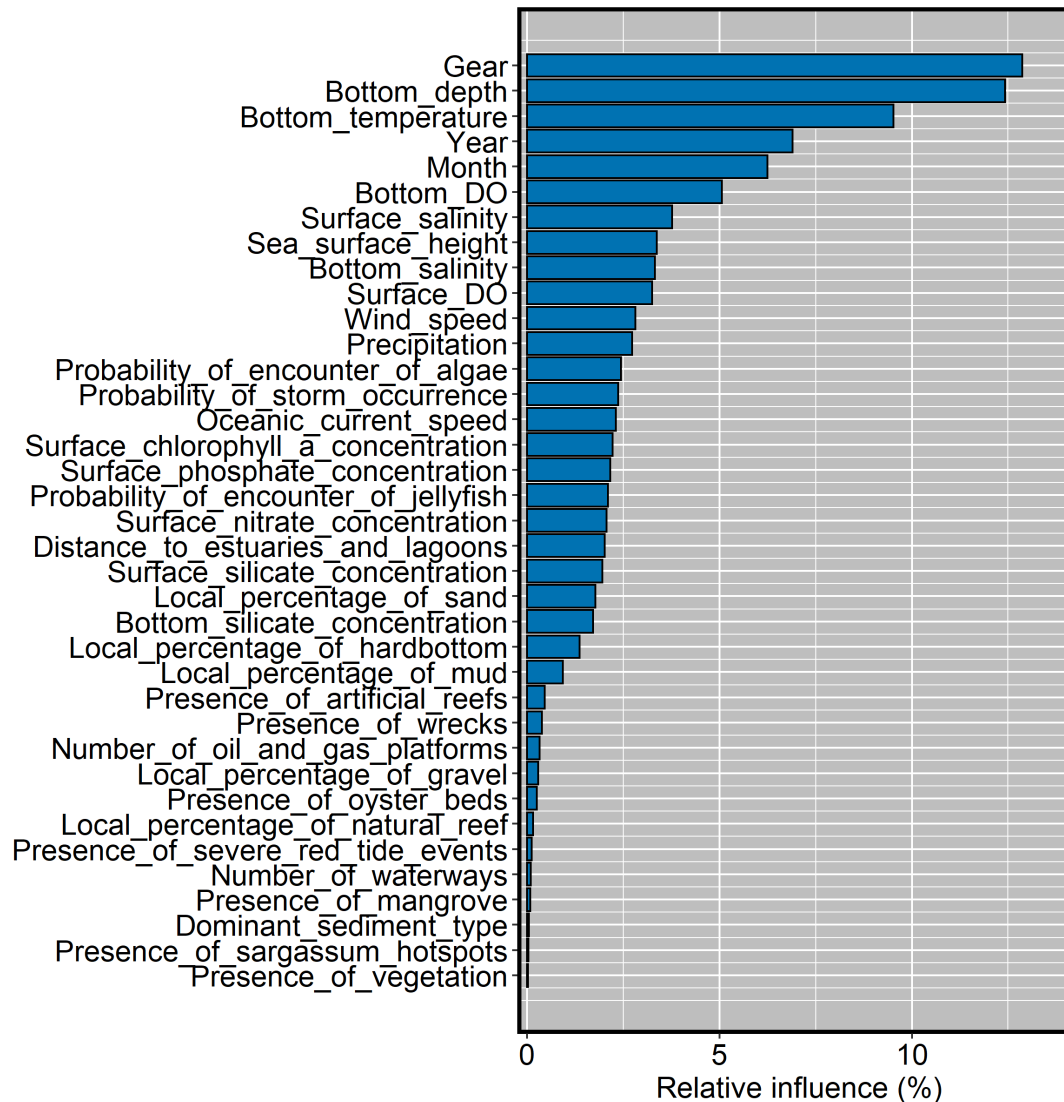


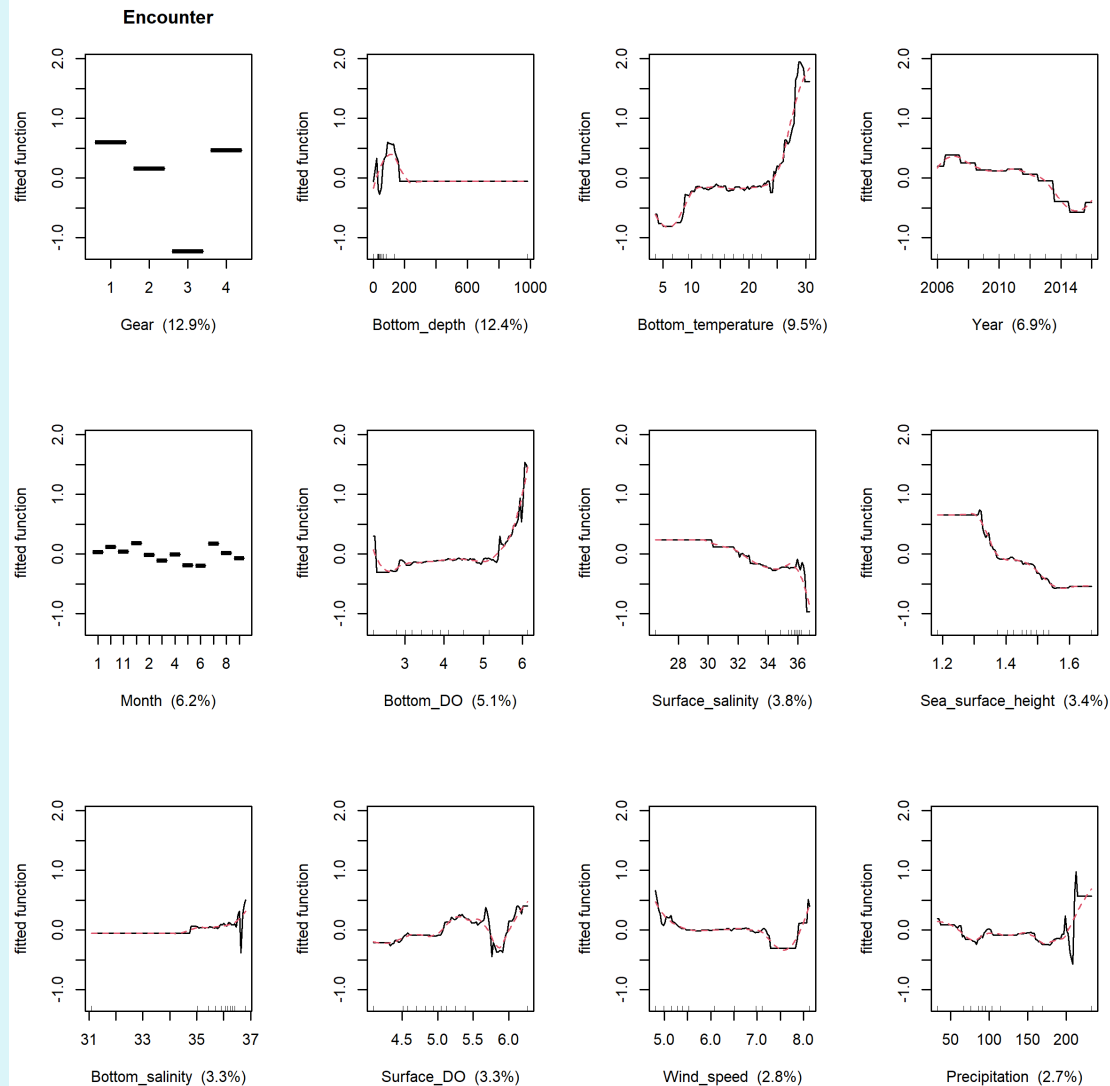
Fig 1 Elith *et al.* 2008

# Presence/absence and habitat model: Adult gag grouper

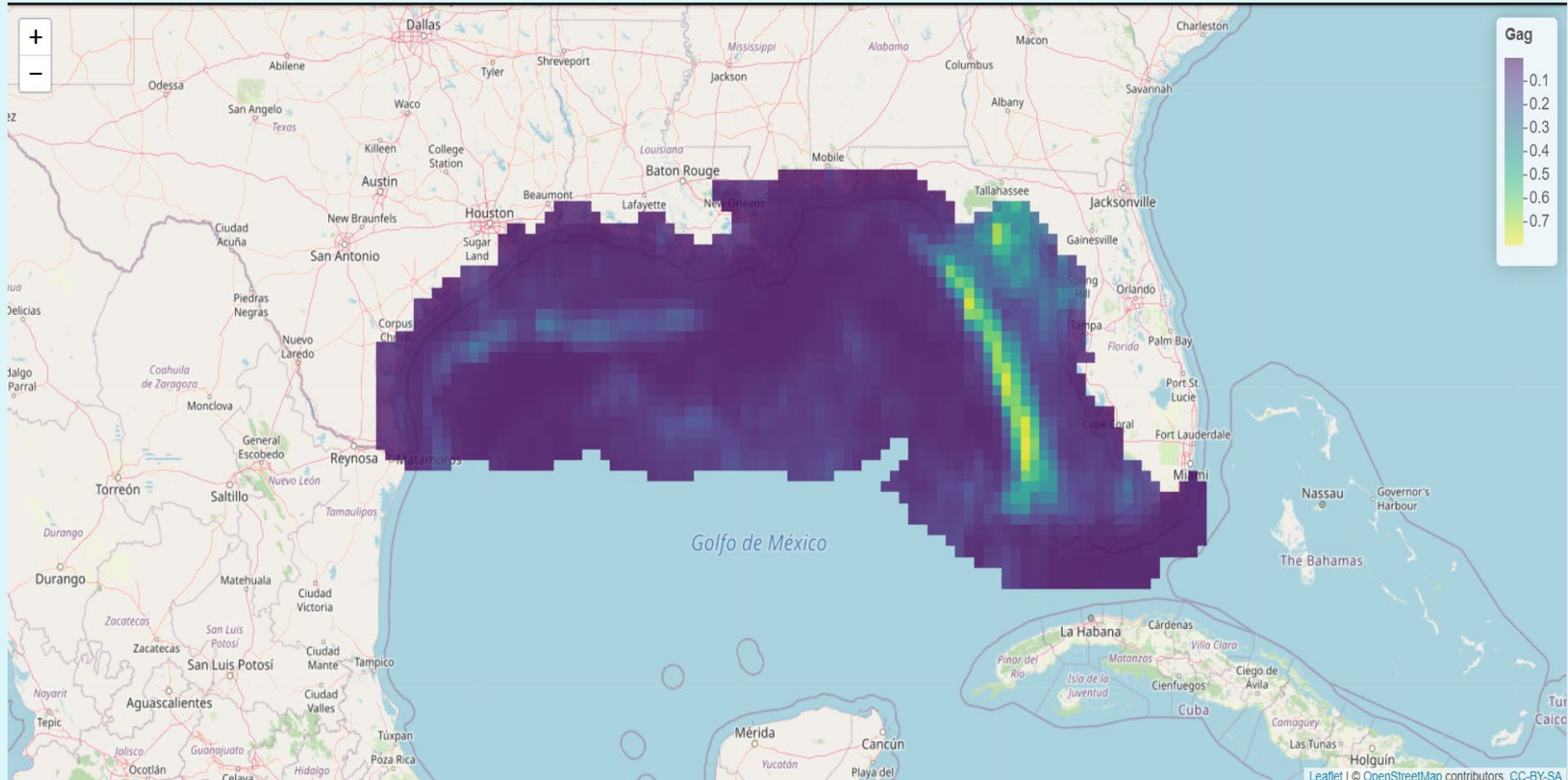




# Presence/absence and habitat model: Adult gag grouper



# Presence/absence and habitat model: Adult gag grouper



# Assumptions: Presence/absence and habitat model

- Uncertainty is adequately captured and correctly quantified
- All appropriate model variables are included and independent
- Absence is a true zero

# Review

- EFH descriptions for most species will have to use habitat association tables approach
- A few species have data available for some more technical approaches
- All three of the approaches have a number of assumptions
- Habitat spatial layers metadata, paper aggregating species surveys, and EFH methods from other regions available as “Background”



# Next steps

- Complete webtool visualizing EFH for species/life stages considered and raw spatial data layers (habitat types and species observations)
- Present webtool to SSC
- Council could provide some insight on structure of alternatives for IPT
  - Does the Council want to consider these other approaches (i.e. presence only and presence/absence models)?





# Questions?

