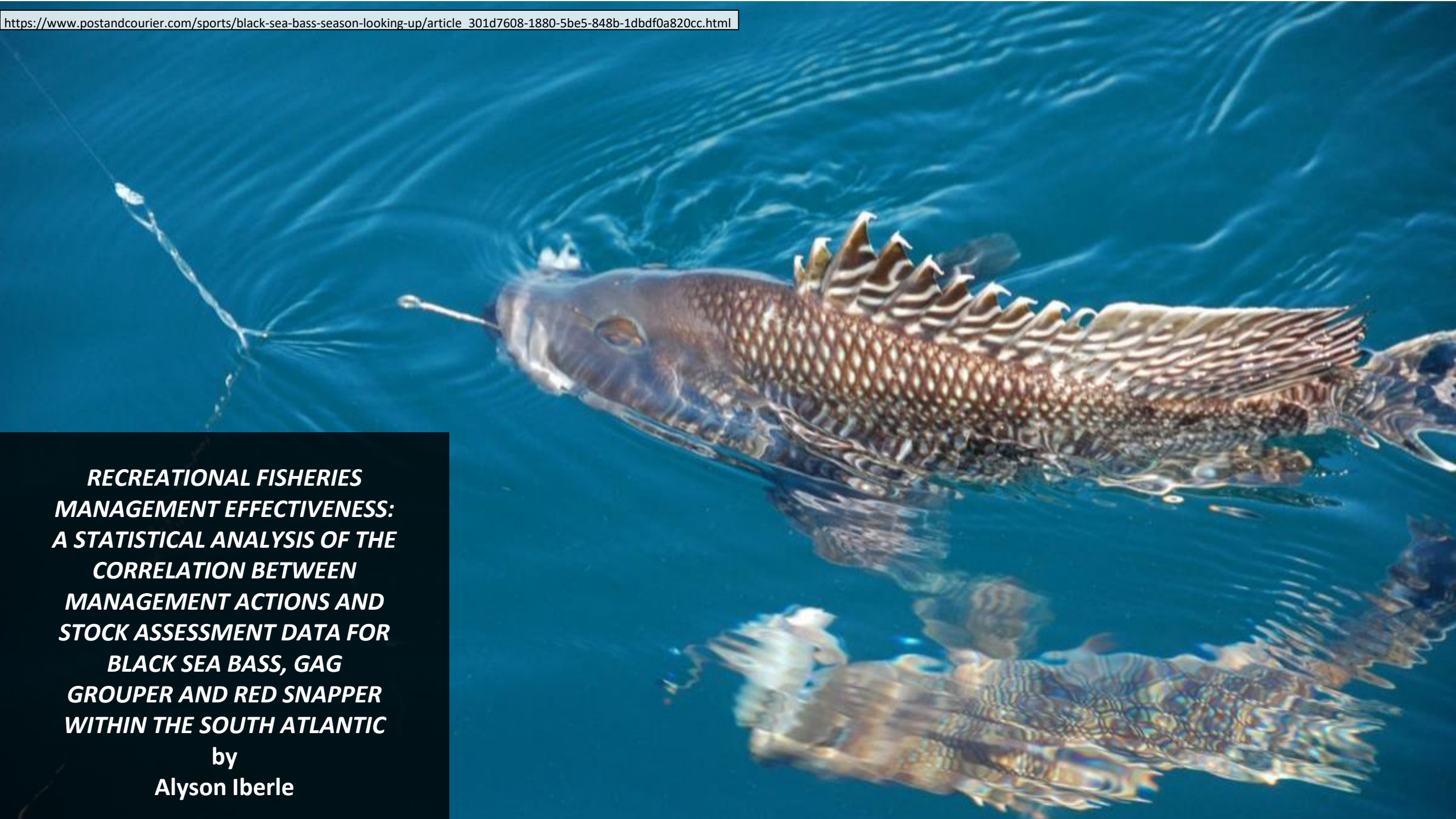
https://www.postandcourier.com/sports/black-sea-bass-season-looking-up/article_301d7608-1880-5be5-848b-1dbdf0a820cc.html



RECREATIONAL FISHERIES MANAGEMENT EFFECTIVENESS: A STATISTICAL ANALYSIS OF THE CORRELATION BETWEEN MANAGEMENT ACTIONS AND STOCK ASSESSMENT DATA FOR BLACK SEA BASS, GAG GROUPER AND RED SNAPPER WITHIN THE SOUTH ATLANTIC

by

Alyson Iberle

Recreational Fishing

Introduction: Recreational Fishing Overview

Why is Effective Management Needed?

- 4,264,951 Recreational licenses sold in 2015
- $73,858,570 spent on licenses in 2015
- 115 billion dollars contributed to the economy in 2015
- 828,000 jobs

(Fishing License Sales Reports - American Sportfishing Association., 2018)

Recreational Fishing

Introduction: Recreational Fishing Overview

Recreational fishermen are not commercial fishermen

- Gear Differences
- Catch Amounts
- Fishing Location

Recreational Fishing

Introduction: Recreational Fishing Overview

Varying goals within the Recreational Fishery

- Trophy fishing
- Harvest fishing
- Catch and release fishing

Recreational and Commercial Fishing Sustainability

- Many species within the South Atlantic have, or are experiencing overfishing

- Overfishing is defined as a scenario in which fishing mortality rate exceeds that of the rate which has been set for the maximum sustainable yield

- Maximum sustainable yield is used to determine an appropriate yield based on current stock assessments

- To determine if a stock is experiencing overfishing the observed fishing mortality rate is divided by the rate of fishing mortality that would occur to attain the maximum sustainable yield. If this ratio is over one then overfishing occurred for that year

Recreational Fisheries Management Effectiveness: A Statistical Analysis of the Correlation Between Management Actions and Stock Assessment Data for Black Sea Bass, Gag Grouper and Red Snapper Within the South Atlantic

Species Selection

South Atlantic Fishery Management Council

Conserving and managing America's fisheries from three to 200 nautical miles off the coasts of North Carolina, South Carolina, Georgia and Florida.

Have recreational management actions impacted sustainability of stocks?

- Stock assessment conducted
- Overfishing occurred
- Regulations changed
- Important to recreational fishermen

Species Included:

- Red Snapper (*Lutjanus campechanus)*
- Black Sea Bass (*Centropristis striata*)
- Gag Grouper (*Mycteroperca microlepis*)

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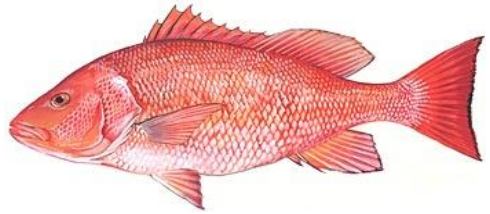
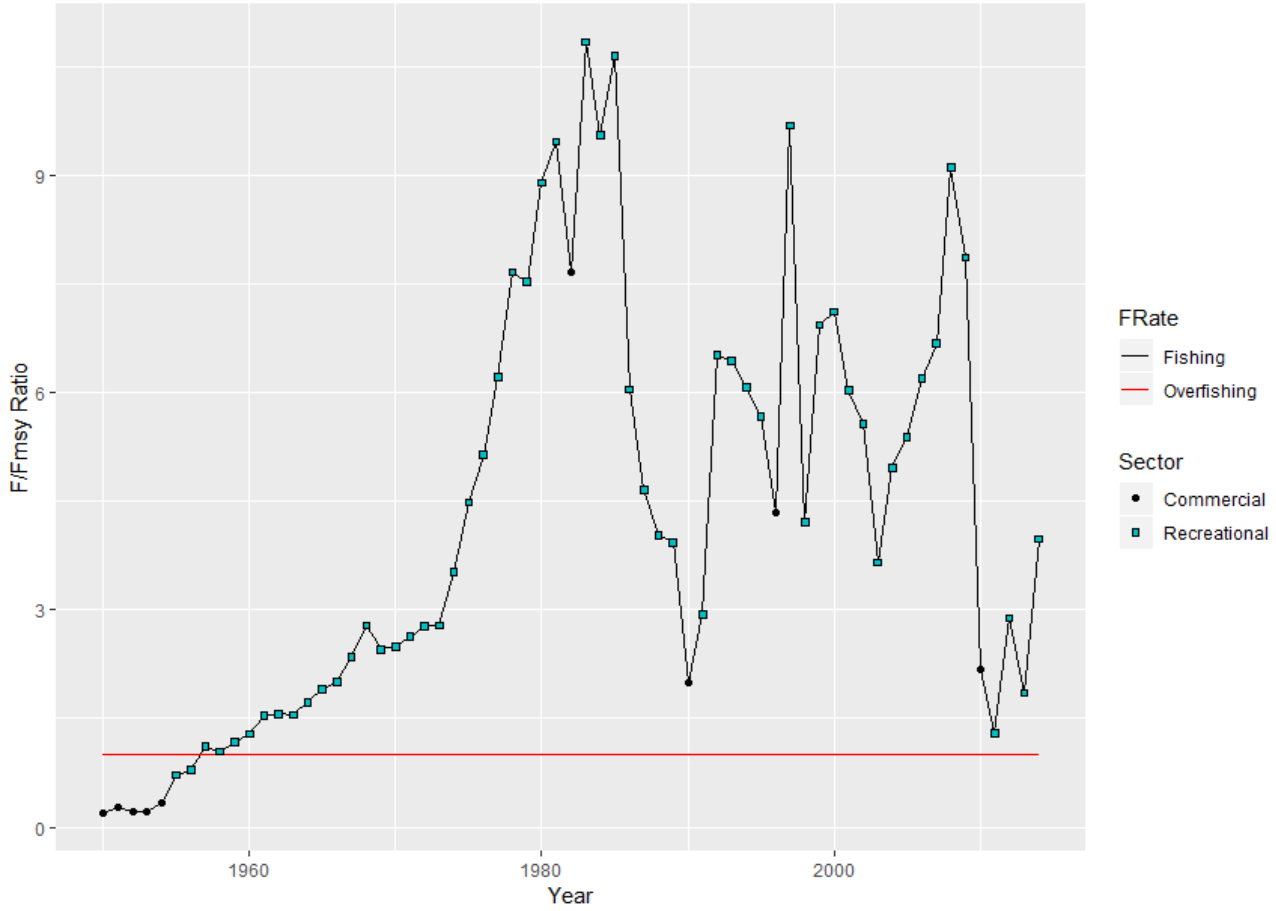
Recreational and Commercial Fishing Sustainability



- Red Snapper (1950-2014)
  - Sustainable: 1950-1957
  - Overfishing: 1958- 2014
  - Comparison of Sector Fishing Mortality for years with Overfishing
    - Rec > Com 54 of 56 yrs
    - Com > Rec 4 of 56 yrs



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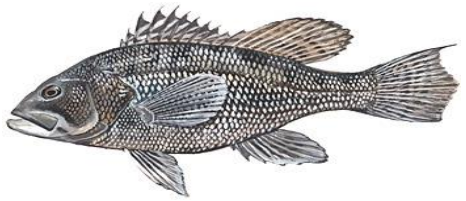
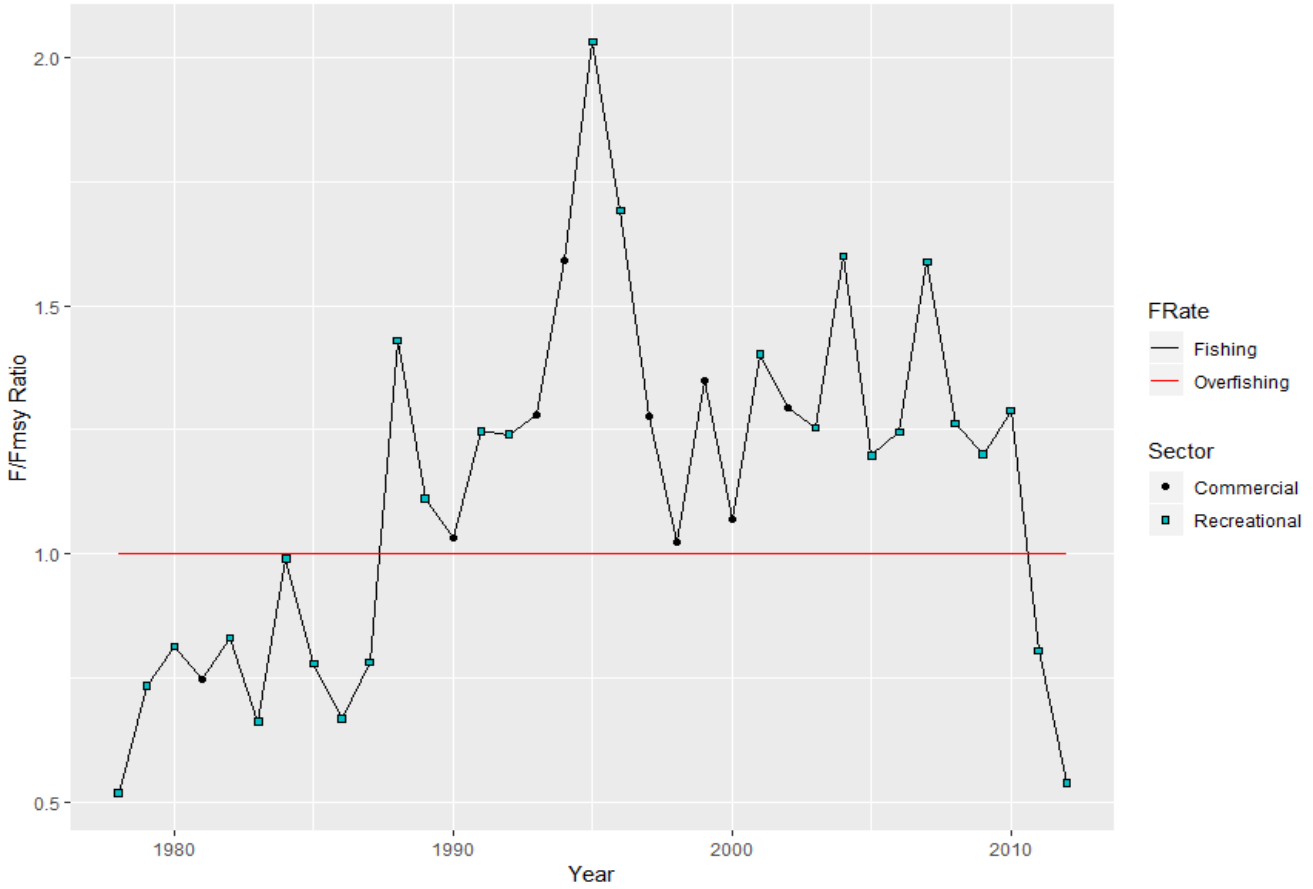
Recreational and Commercial Fishing Sustainability



- Black Sea Bass (1978-2012)
  - Sustainable: 1978-1988, 2011 and 2012
  - Overfishing: 1989-2010
  - Comparison of Sector Fishing Mortality for years with Overfishing
    - Rec > Com 15 of 23 yrs
    - Com > Rec 8 of 23 yrs



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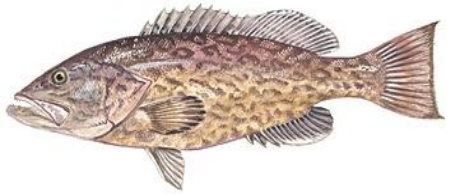
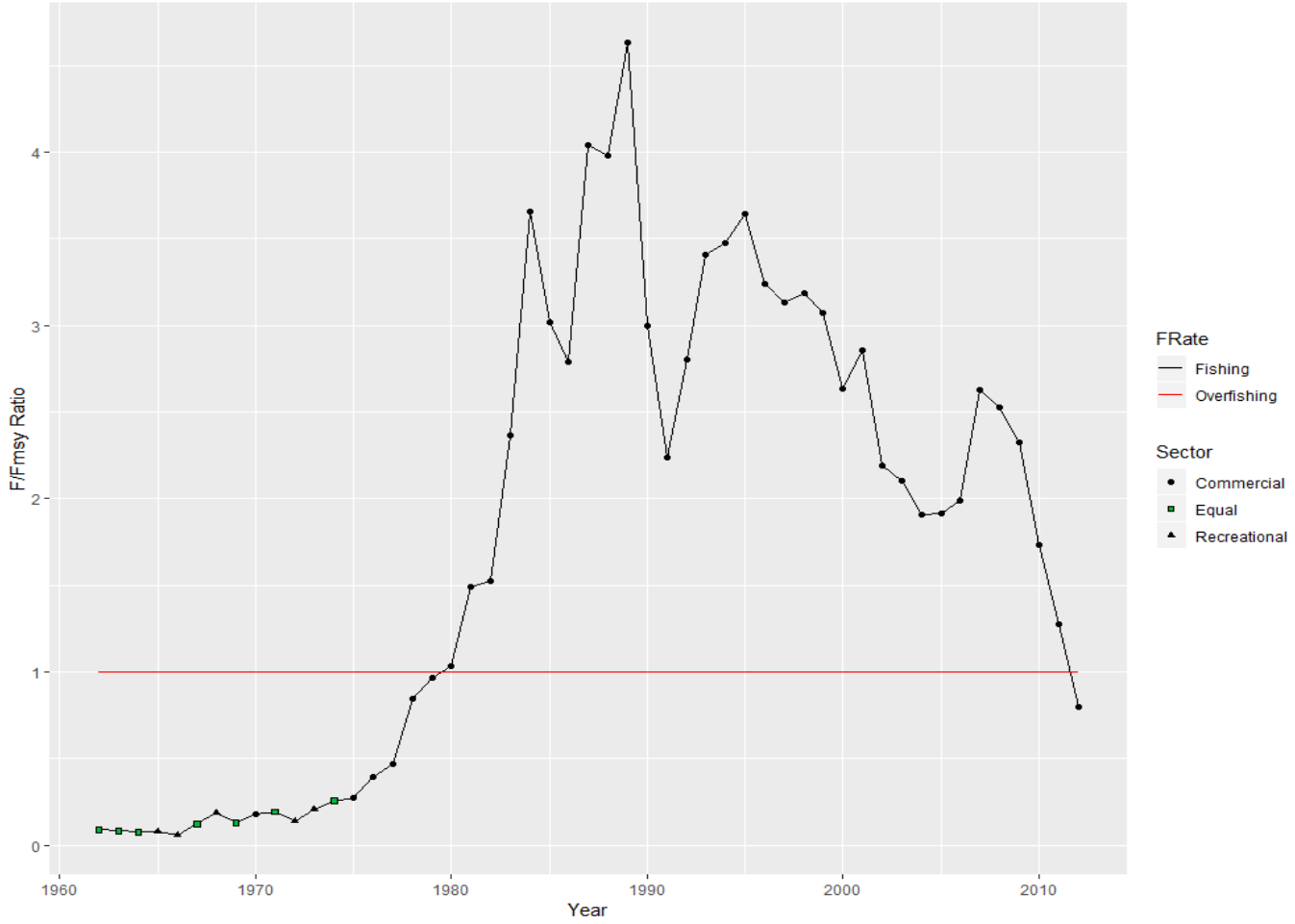
Recreational and Commercial Fishing Sustainability



- Gag Grouper (1962-2012)
  - Sustainable: 1962-1980, 2012
  - Overfishing: 1981-2011
  - Comparison of Sector Fishing Mortality for years with Overfishing
    - Rec > Com 0 of 30 yrs
    - Com > Rec 30 of 30 yrs



Recreational Fisheries Management Effectiveness: A Statistical Analysis of the Correlation Between Management Actions and Stock Assessment Data for Black Sea Bass, Gag Grouper and Red Snapper Within the South Atlantic

Partnership and Study Area

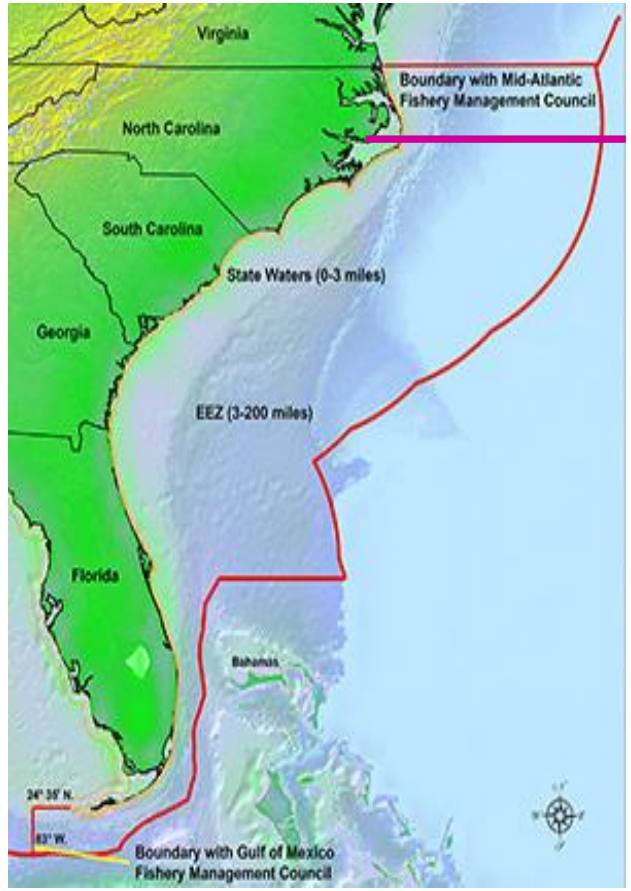
South Atlantic Fishery Management Council

Conserving and managing America's fisheries from three to 200 nautical miles off the coasts of North Carolina, South Carolina, Georgia and Florida.

Study Area and Scope

- This study examines the effectiveness of management actions within the SAFMC's area of work: the exclusive economic zone (EEZ) from the northern North Carolina border to the Florida Keys. It is also noted that there is a genetic separation of black sea bass stocks above and below Cape Hatteras (shown to the left as a purple line) within the study area.
    - Assumption: because the species examined are not considered highly migratory the project assumes no influxes of individuals from other populations is occurring

- **Catch:** Defined by **total landings (1000 lbs.)** which is the amount of fish removed from the population and **discards (1000 lbs.)** which is the amount of fish released after capture
- **Fishing Mortality:** Defined as the total **fishing mortality rate** which is the rate of removal of fish from the population, a function of landings and population and **fishing mortality rate from releases** which is the rate of mortality of fish that are released after capture
- **Management actions** – include size minimums, bag limits, and season/spawning closures.



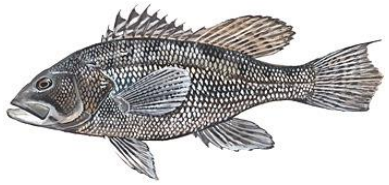
http://safmc.net/

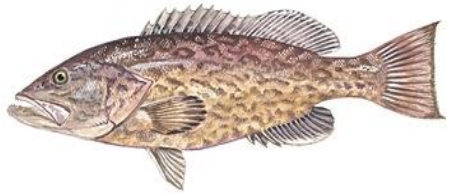
Hypothesis

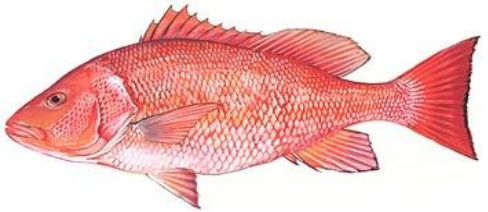
South Atlantic Fishery Management Council

Conserving and managing America's fisheries from three to 200 nautical miles off the coasts of North Carolina, South Carolina, Georgia and Florida.

Hypothesis: Management actions were sufficient to significantly change recreational catch and fishing mortality estimates among regulation periods based on the recent stock assessment of C. striata, L. campechanus and M. microlepis.



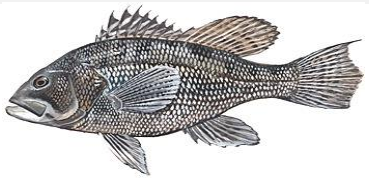




https://www.carolinasportsman.com/fishing/offshore-fishing/black-sea-bass/black-sea-bass-give-little-river-a-great-bottomfish-option/

Black Sea Bass

Centropristis striata



- **Classification**
  - Black sea bass are a member of the serranid family, perciformes order
  - “perch-like” fish

  (Black Sea Bass. (n.d.). Retrieved from https://www.fisheries.noaa.gov/species/black-sea-bass)
- **Habitat and Range (within the current study)**
  - Demersal – bottom dwelling fish
  - North Atlantic from Massachusetts to the Gulf of Mexico

  (*Complete Assessment and Review Report of South Atlantic Black Sea Bass*, 2013)
- **Stock Structure**
  - There is a genetic differentiation of this species above and below Cape Hatteras, North Carolina

  (McCartney et al., 2013)
- **Sexual Maturation**
  - Black sea bass are protogynous hermaphrodites, where individuals are born female and transition to males throughout different stages of life
  - Females sexually mature around 7.5 in. total length
  - Males transition at around 9 in. total length (2-5 years)

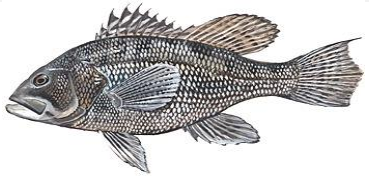
  (McGovern et al., 2002)
- **Spawning Season**
  - Within the southern U.S. Atlantic spawning occurs January to July with a peak from March to May

  (*Complete Assessment and Review Report of South Atlantic Black Sea Bass*, 2013)

https://www.carolinasportsman.com/fishing/offshore-fishing/black-sea-bass/black-sea-bass-give-little-river-a-great-bottomfish-option/

Black Sea Bass

Centropristis striata



- **Classification**
  - Black sea bass are a member of the serranid

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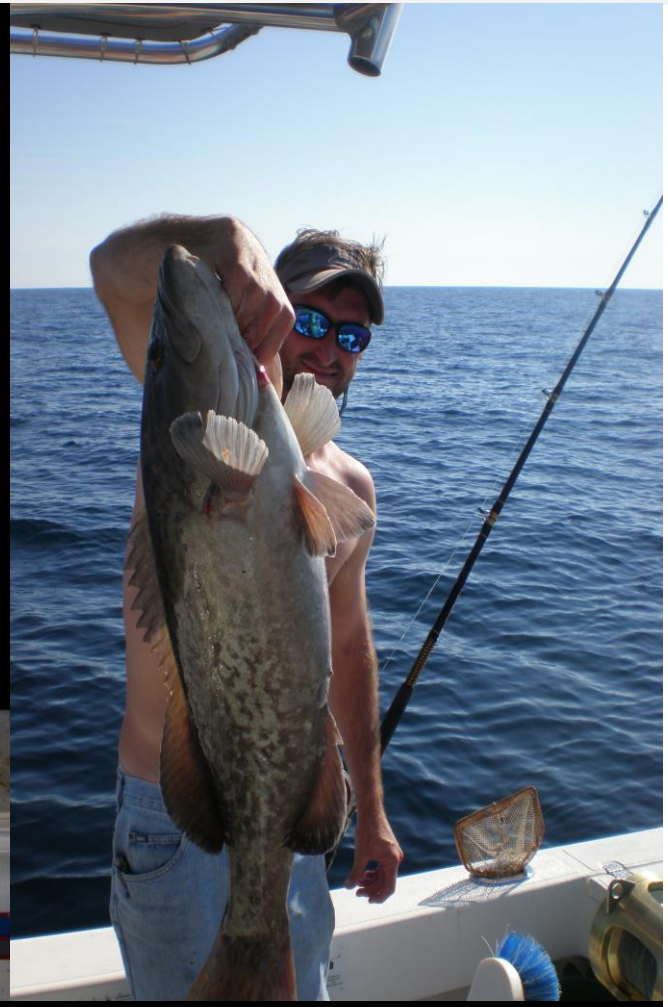
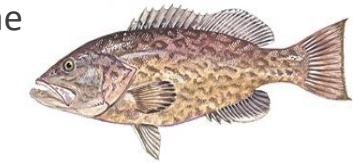
(*Complete Assessment and Review Report of South Atlantic Black Sea Bass*, 2013)

Recreational Fisheries Management Effectiveness: A Statistical Analysis of the Correlation Between Management Actions and Stock Assessment Data for Black Sea Bass, Gag Grouper and Red Snapper Within the South Atlantic



Gag Grouper

Mycteroperca microlepis

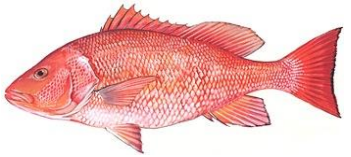


- **Classification**
  - Gag grouper are a member of the epinephelidae family
  - The epinephelidae family includes 159 species of grouper (Grouper Ecology, n.d.)
- **Habitat and Range (within the current study)**
  - Demersal – bottom dwelling fish
  - Juvenile life stages use estuarine seagrass beds and oyster reefs
  - Range is the North Atlantic from Massachusetts to the Gulf of Mexico (Gag Grouper Regulations, n.d.)
- **Misidentification**
  - Because of the coloration of gag grouper, they are often mis-identified as black grouper *Mycteroperca bonaci* (Gag Grouper Regulations, n.d.)
- **Sexual Maturation**
  - Gag grouper are protogynous hermaphrodites, where individuals are born female and transition to males throughout different life stages
  - Females sexually mature around 25 in. total length, around age 4,transition occurs when females reach approximately 31 in. total length and most fish have completed transitioning by 51 in. total length, around 10.5 years old (McGovern et al. 1998)
- **Spawning Season and Area**
  - Within the southern U.S. Atlantic spawning occurs from January to May, peaking from March to April
  - Gag grouper spawn offshore along the edge of the continental shelf in massive groups (*SEDAR 10 Stock Assessment Report South Atlantic Gag Grouper*, 2006)

https://www.fisheries.noaa.gov/feature-story/noaa-enforcement-state-partners-focus-red-snapper-enforcement-operations

Red Snapper

Lutjanus campechanus



- **Classification**
  - Red snapper, like black sea bass are in the perciformes order of "perch-like" fishes (Allen, 1985)
- **Habitat and Range (within the current study)**
  - Red snapper do not exhibit an estuarine phase. Little is known about their movement within the Atlantic particularly with regards to spawning
    - Found at depths of 30 to upwards of 600 ft (Allen, 1985)
  - Range from Gulf of Mexico through North Carolina. Fish are rarely found north of North Carolina

(Red Snapper, n.d.)

- **Sexual Maturation**
  - Sexual maturity is reached quickly at around age 2, however red snapper can live to be 50 yrs. old
  - Females sexually mature around 14.8 in. total length and males around 8.7 in. total length

(White and Palmer, 2004)

- **Spawning Season**
  - Spawning occurs April to October and peak spawning activity is from June to August
  - Red snapper are gonochoristic, which indicates they do not change sex during their lifetime

(*Stock Assessment Report- Revision 1: South Atlantic Red Snapper* [SEDAR 41], 2017)

Fisheries Amendments

Color Key: **Black Sea Bass, Gag Grouper, Red Snapper**

Amendment 4 (1992)

Established an 20 in. total length min. and a bag limit of 5/person/day for **gag grouper**

Established a 20in. Total length min. and bag limit of 10/person/day for **red snapper**

Amendment 13C (2006)

Established an 11 in. TL (first year) and 12 in. TL (second year onward) min. size limit, bag limit of 15/person/day, and shifted season from the calendar year to June through May season for **black sea bass**

Red Snapper Intermediate Rule (2009)

Established a "no harvest" rule from Jan. 4th 2010 to June 2nd 2010 for **red snapper**

Amendment 17A (2010)

Prohibited all harvesting of **red snapper**

Red Snapper Emergency Rule (2012)

Established a bag limit of 1/person/day with no min. size, and a start date for the season if allowed

red snapper

Amendment 28 (2013)

Established a bag limit of 1/person/day with no min. size, and a start date for the season if allowed. for **red snapper**

Amendment 43 (2018)

Established an annual catch limit with a 1/person/day bag limit and no min. size limit for **red snapper**

Original FMP Established (1983)

Established a 12 in. total length size minimum for **red snapper,**

Established a 8 in. total length minimum size for **black sea bass**

The original FMP also designated modified habitats or artificial reefs as Special Management Zones (SMZs).

Amendment 9 (1999)

Established an 10 in. total length min. and a bag limit of 20/person/day for **black sea bass**

Established an 24 in. total length min. and a bag limit of 2/person/day within the 5-grouper aggregate for **gag grouper**

Amendment 16 (2009)

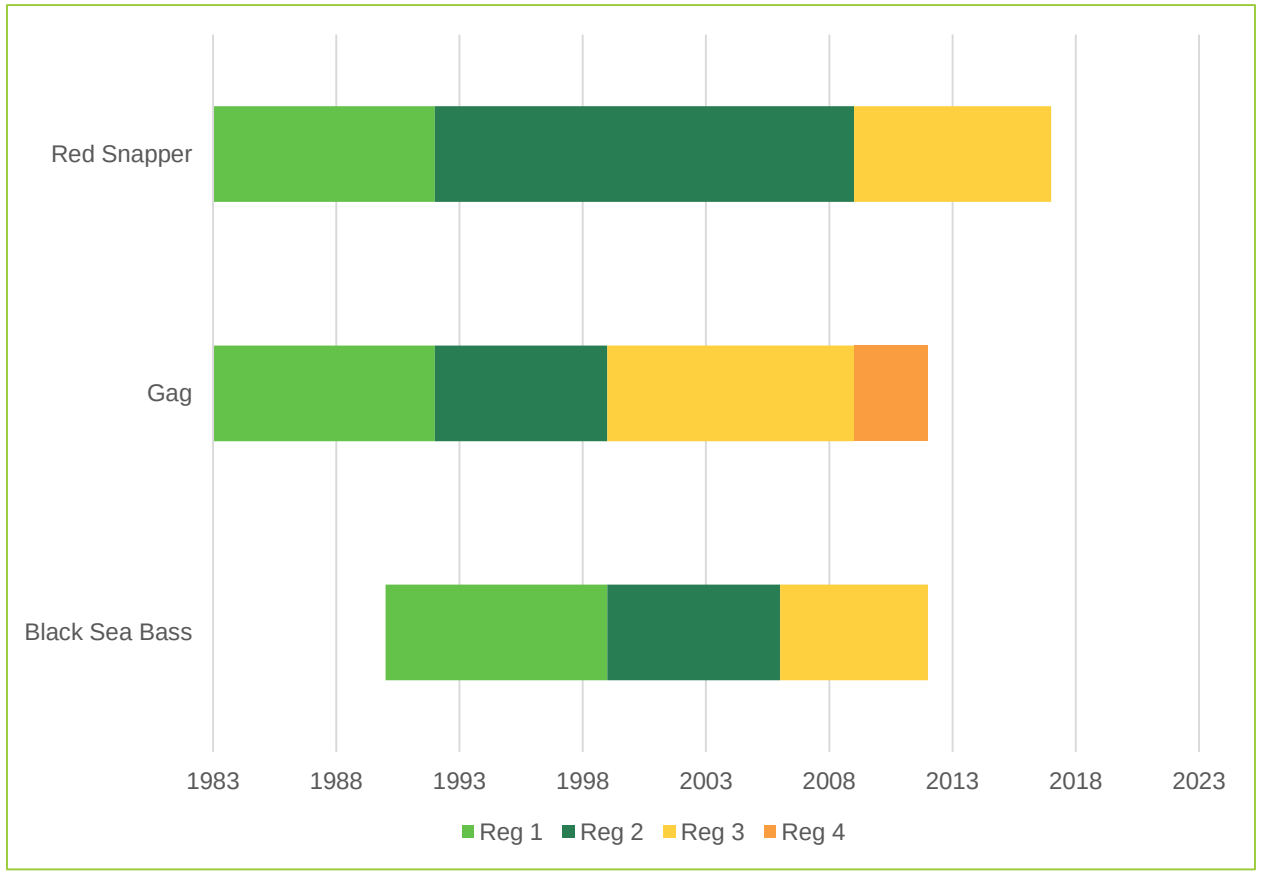
Established a shallow water grouper spawning season closure and reduced the 5-grouper aggregate to a 3-grouper aggregate, limit 1 **gag grouper**

Amendment 18A (2012)*

Increased the minimum size limit from 12 in. total length to 13 in total length for **black sea bass**

*This amendment was not statistically analyzed within this project due to the span of the stock assessment data, however it will be incorporated within future analysis

Methods: Regulation Periods



- Regulation Periods
  - The data for each species were then segmented into different regulation
  - Red Snapper and Gag Grouper timelines start in 1983 when the fishery management plan started.
  - Black Sea Bass timeline starts in 1990 after the landings were at a more stable time period.

https://github.com/pipemg/rstudio-microarrays

Methods

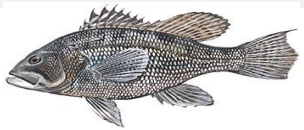
- Comparing all regulation periods for catch (landings and discards) and total fishing mortality rate (fishing mortality rate and fishing mortality rate from releases)
  - Normal Data – ANOVA post-hoc Tukey
  - Non-Normal Data – Kruskal Wallis post-hoc Dunn

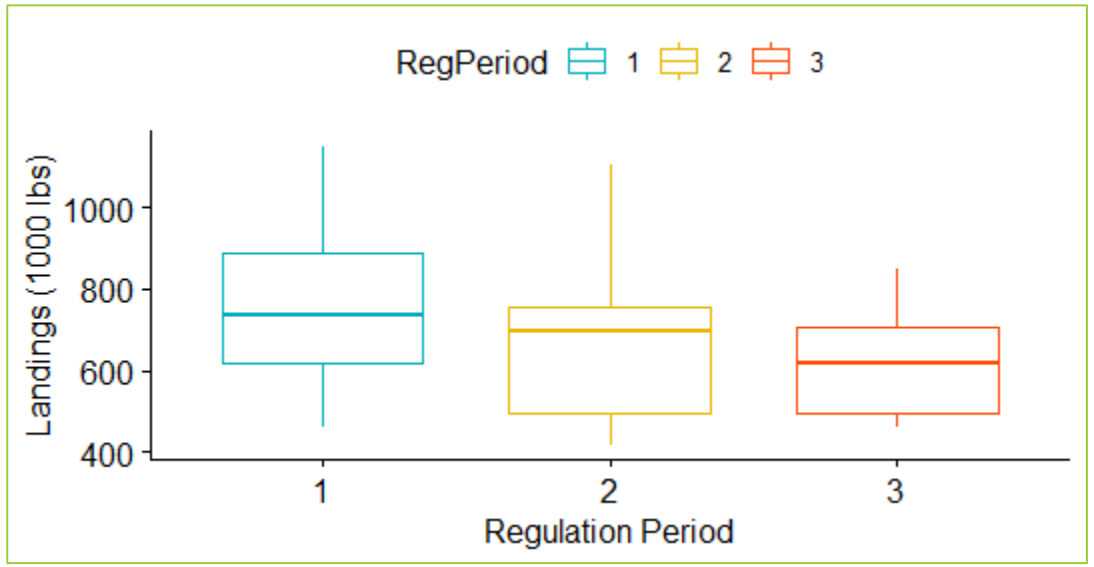
- **Spearman Correlation:** analyzing the relationship between catch, fishing mortality, and population biomass across all regulation periods

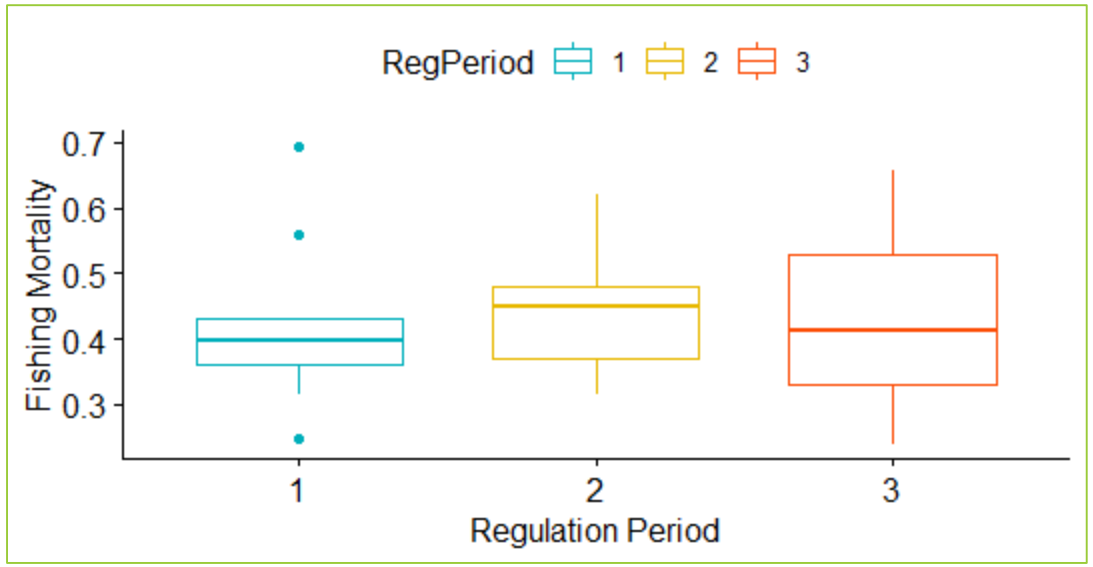
- **Pearson Correlation** - analyzing the relationship between catch, fishing mortality, and population biomass across all regulation periods

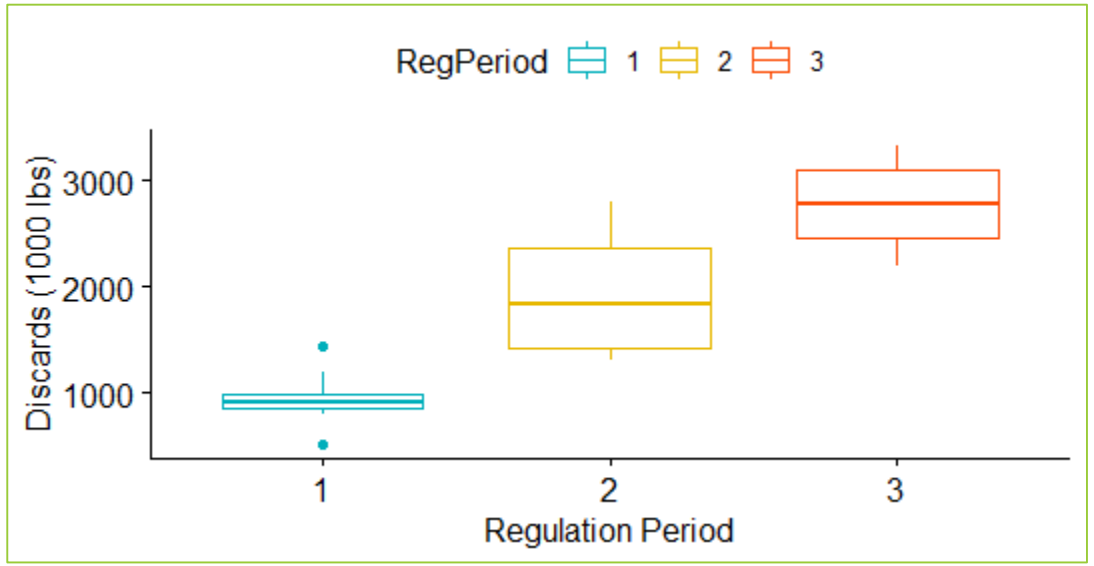
- **R-Studio** used to perform statistical analysis

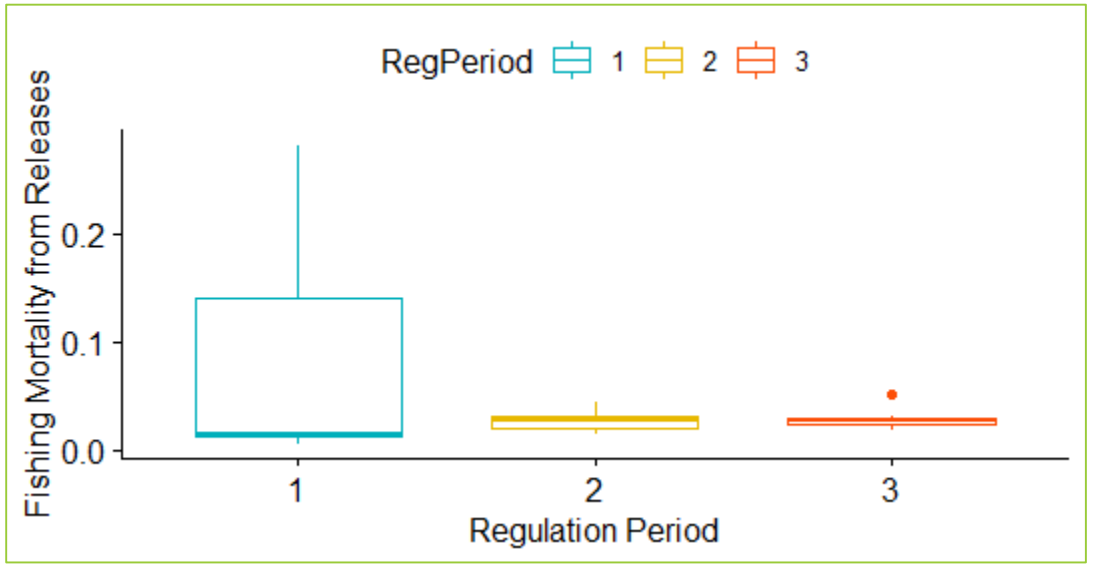
Results: Black Sea Bass











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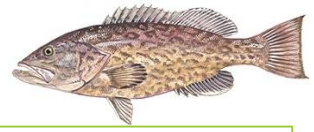
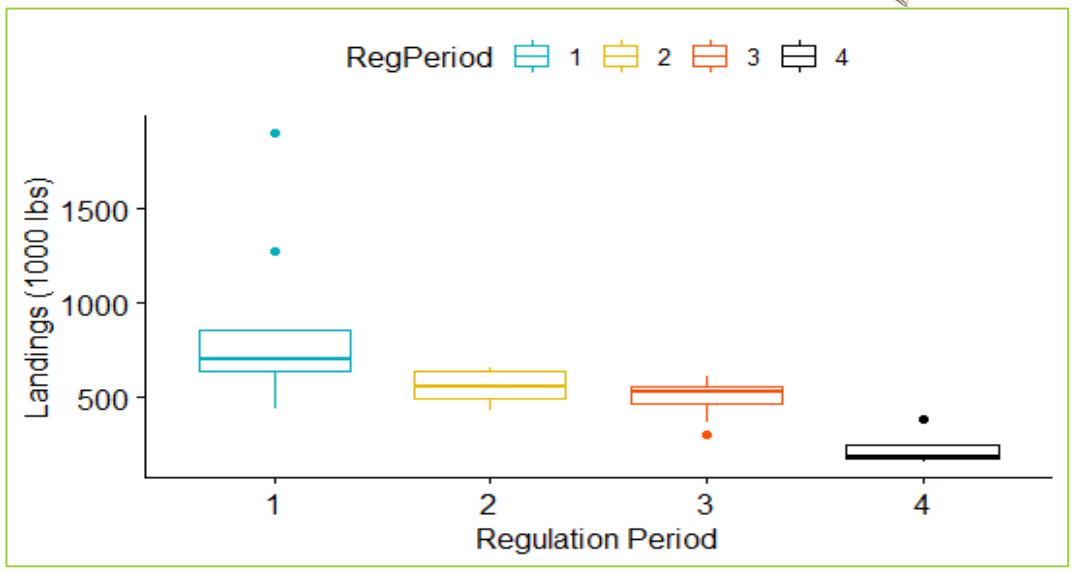
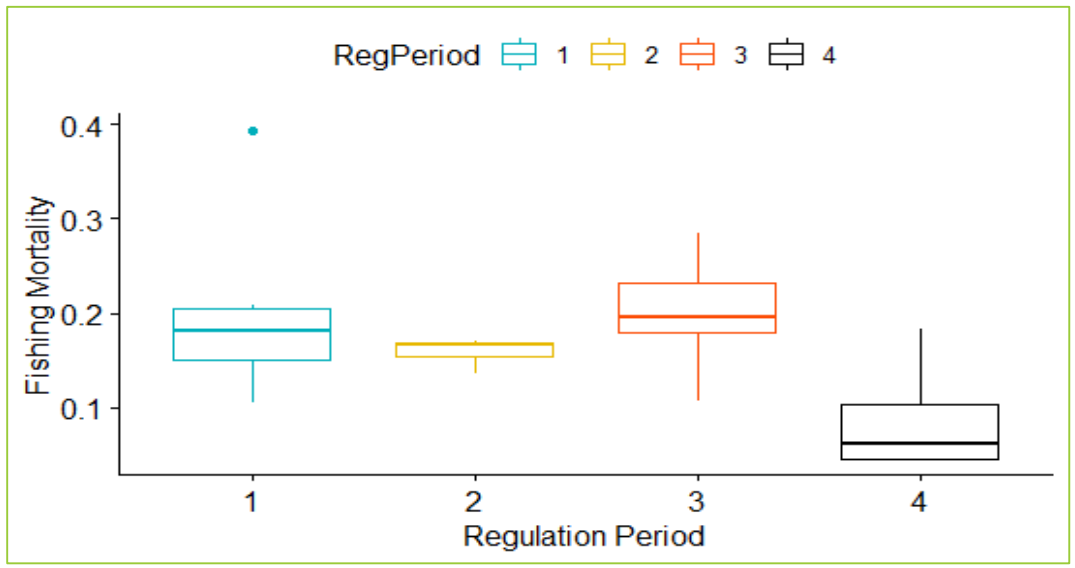
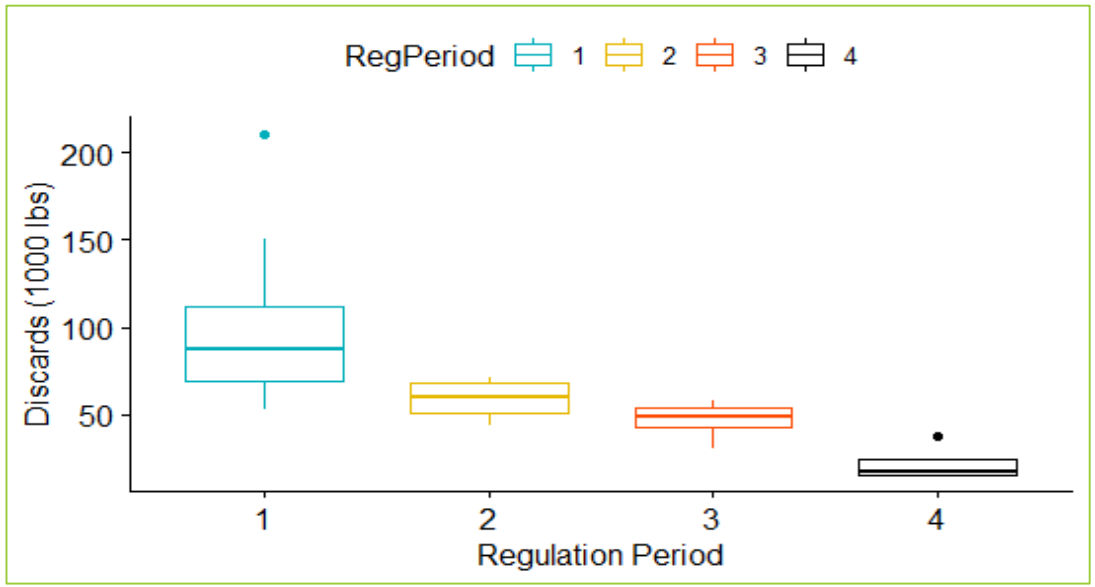
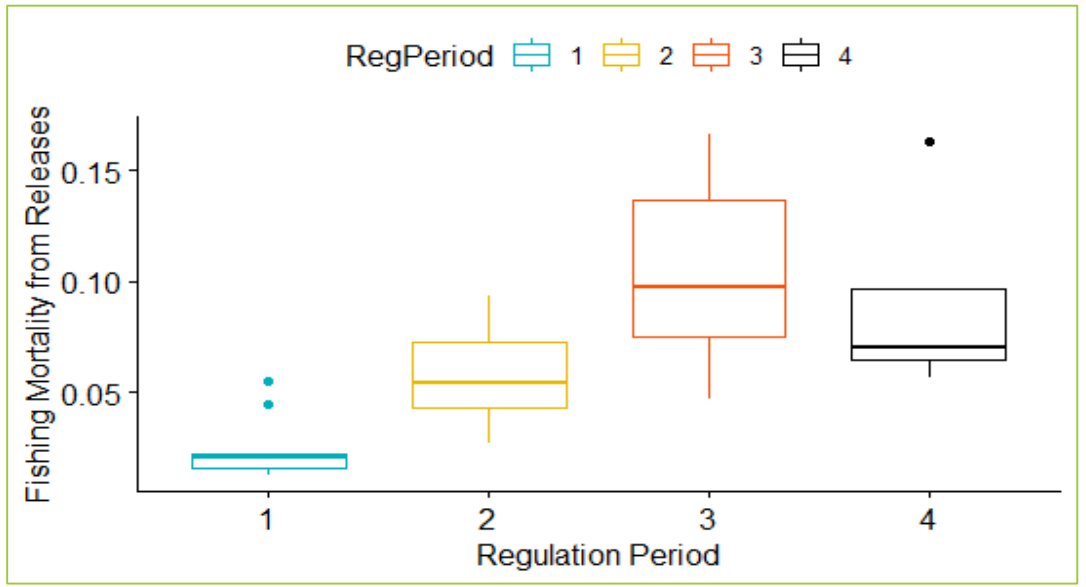
Results: Gag Grouper





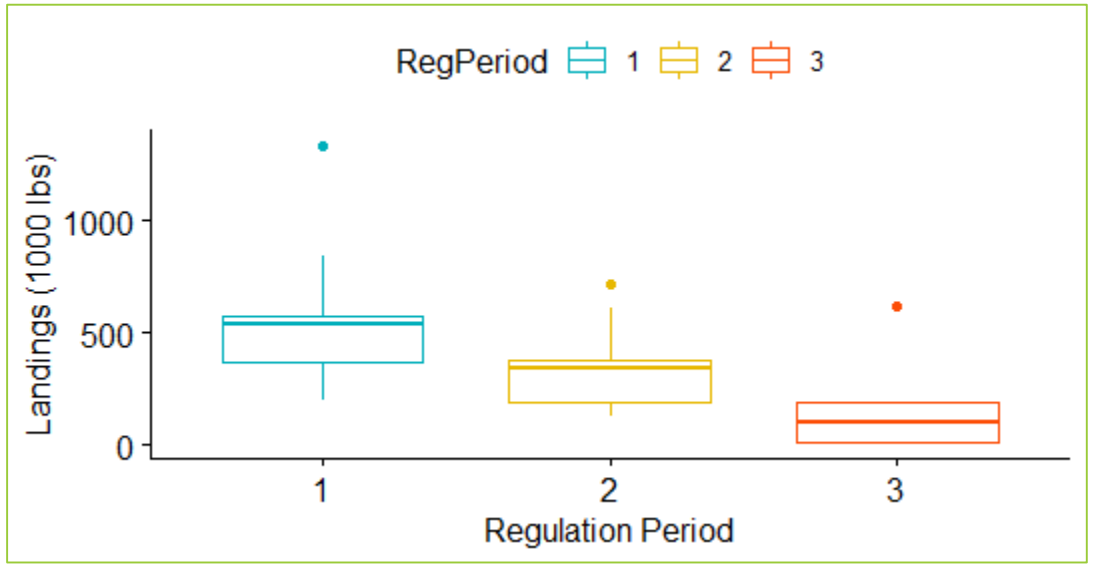


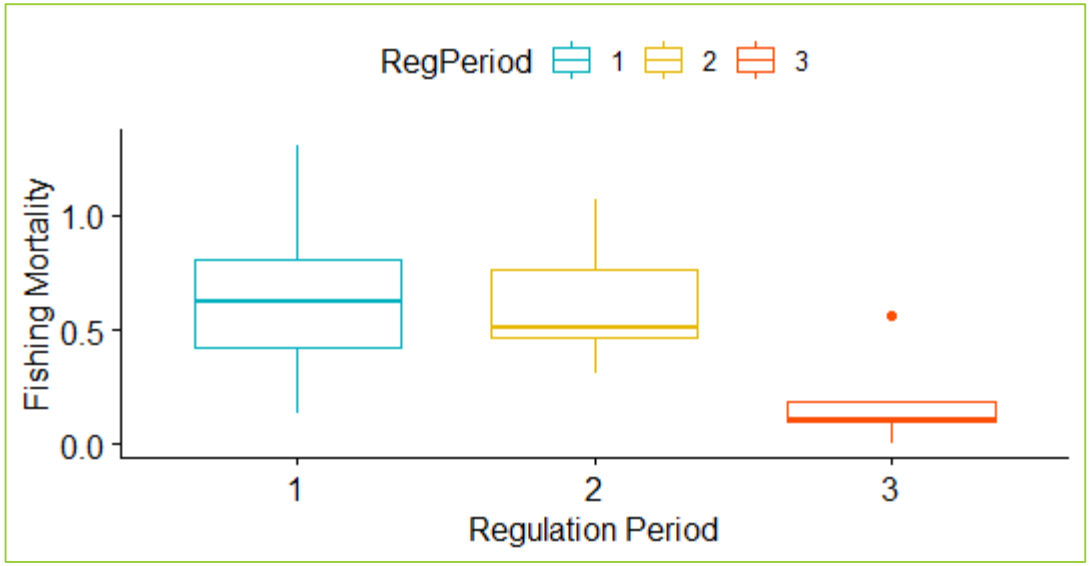


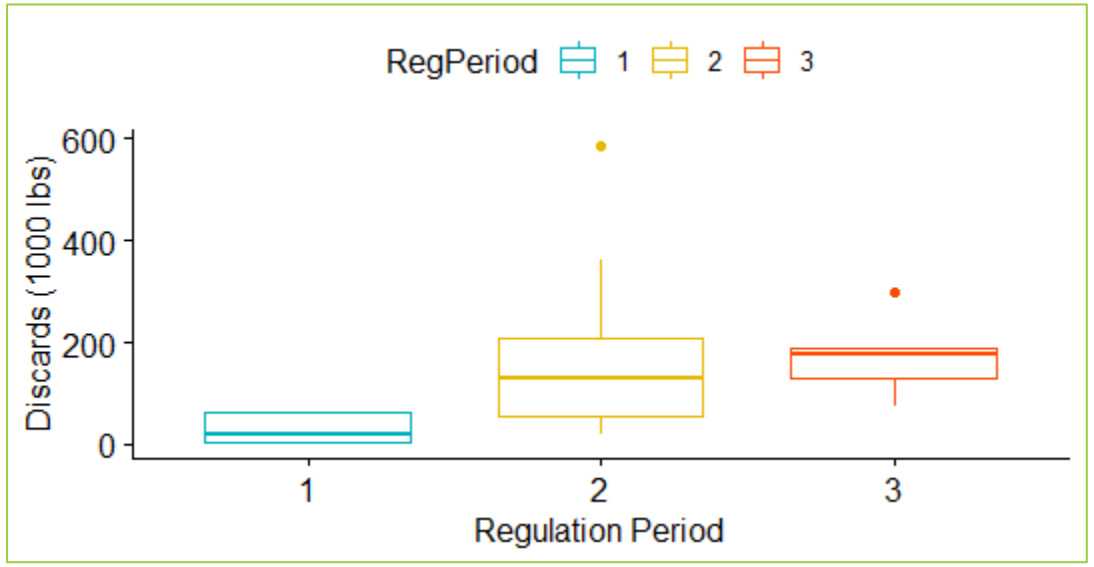


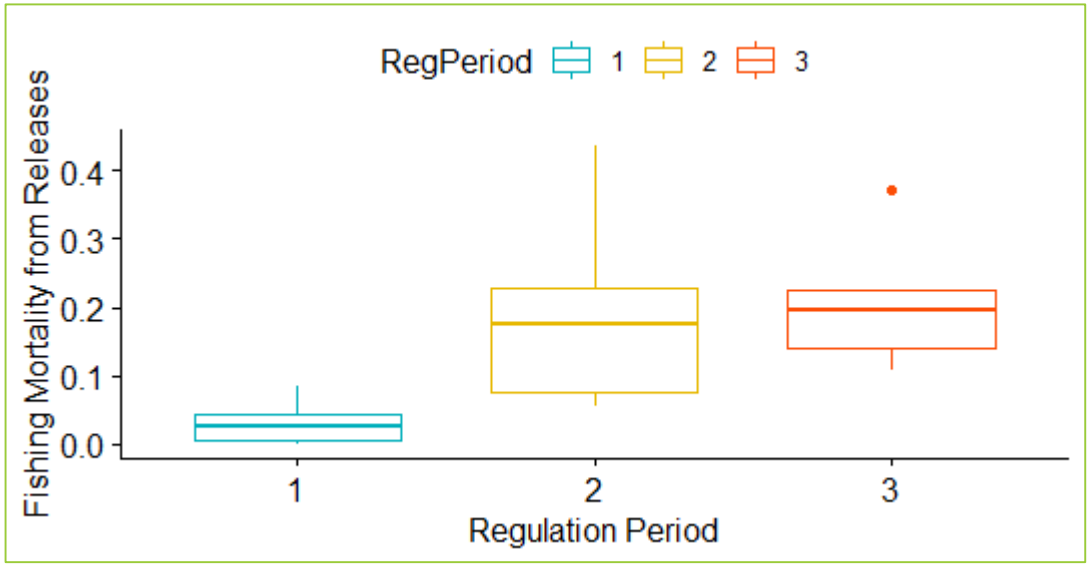
Recreational Fisheries Management Effectiveness: A Statistical Analysis of the Correlation Between Management Actions and Stock Assessment Data for Black Sea Bass, Gag Grouper and Red Snapper Within the South Atlantic

Results: Red Snapper









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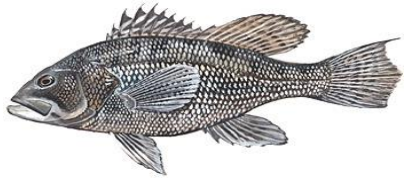
Results: Black Sea Bass



Additional results will be provided at the meeting.

https://www.purenaplesfishing.com/head-boats/