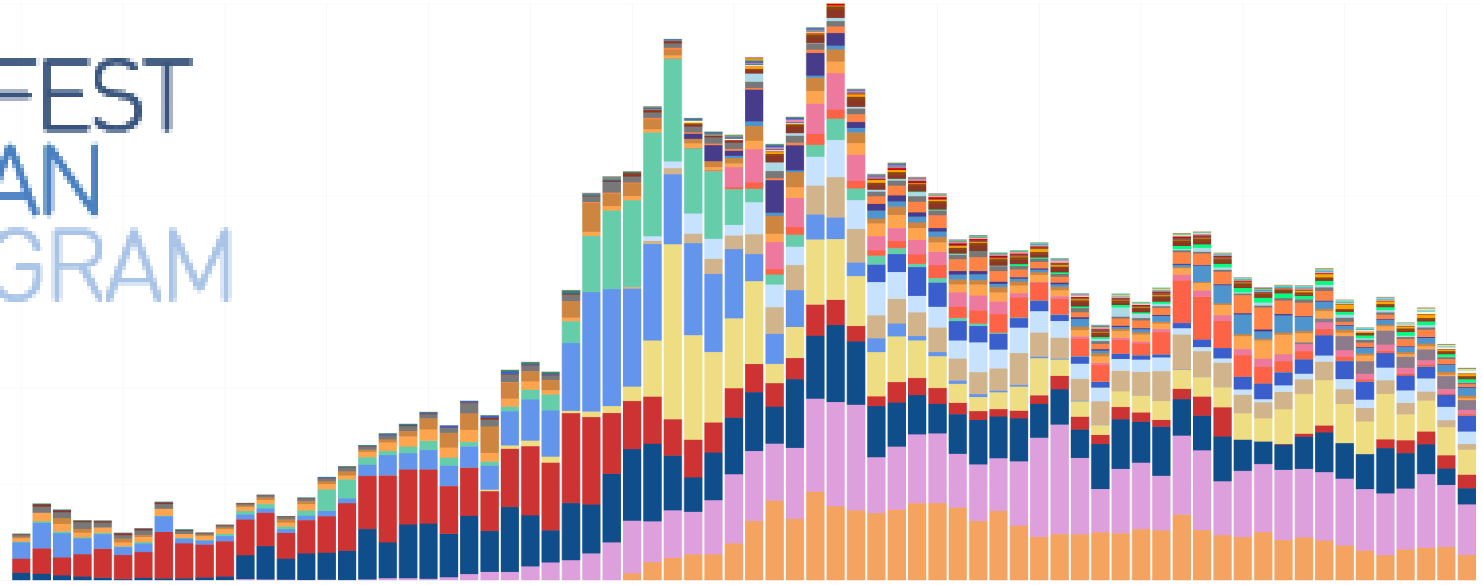
Using Portfolio Theory to Improve the Management of Living Marine Resources: *A Demonstration for the South Atlantic*



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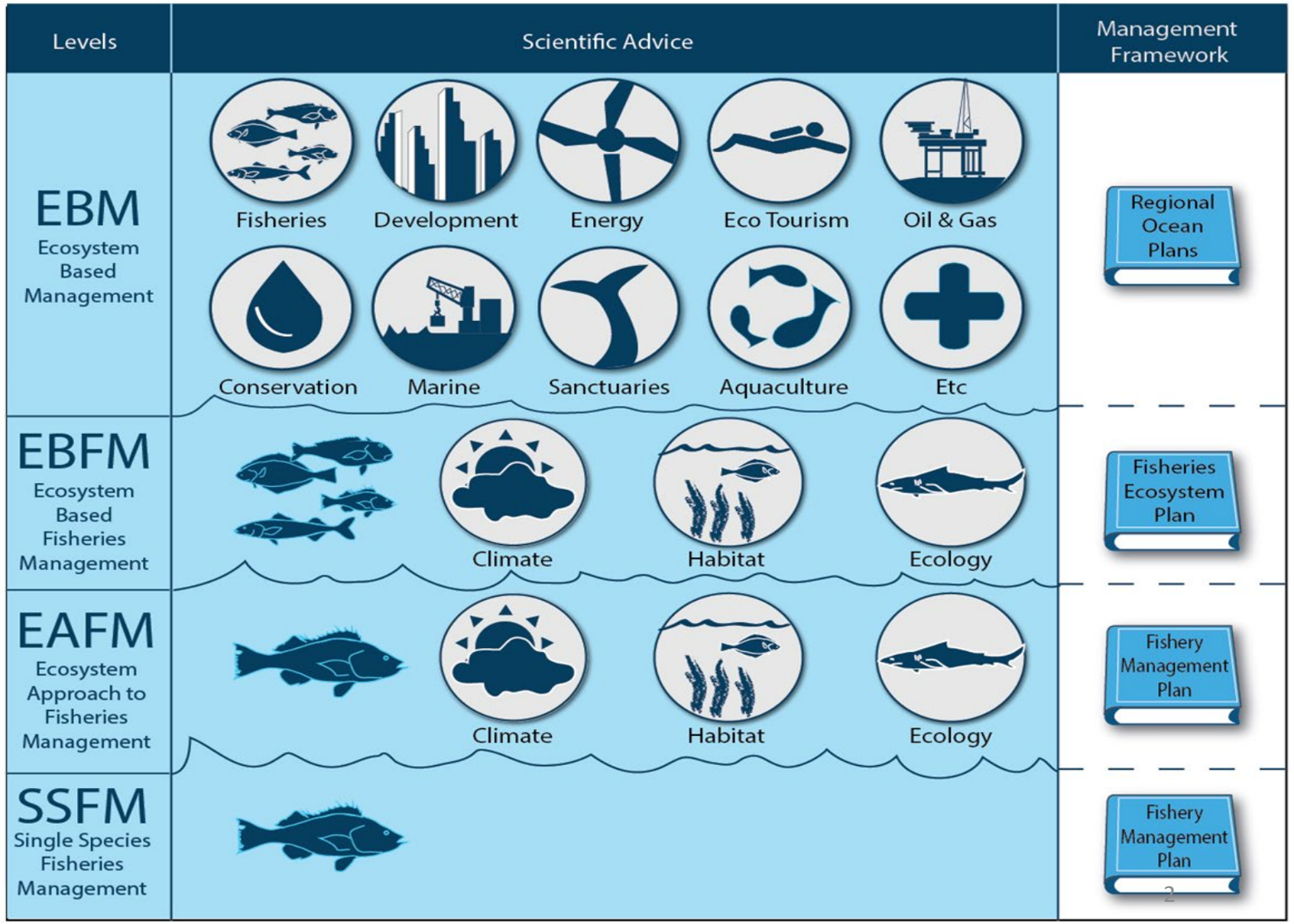
South Atlantic Fishery Management Council, Scientific & Statistical Committee Meeting

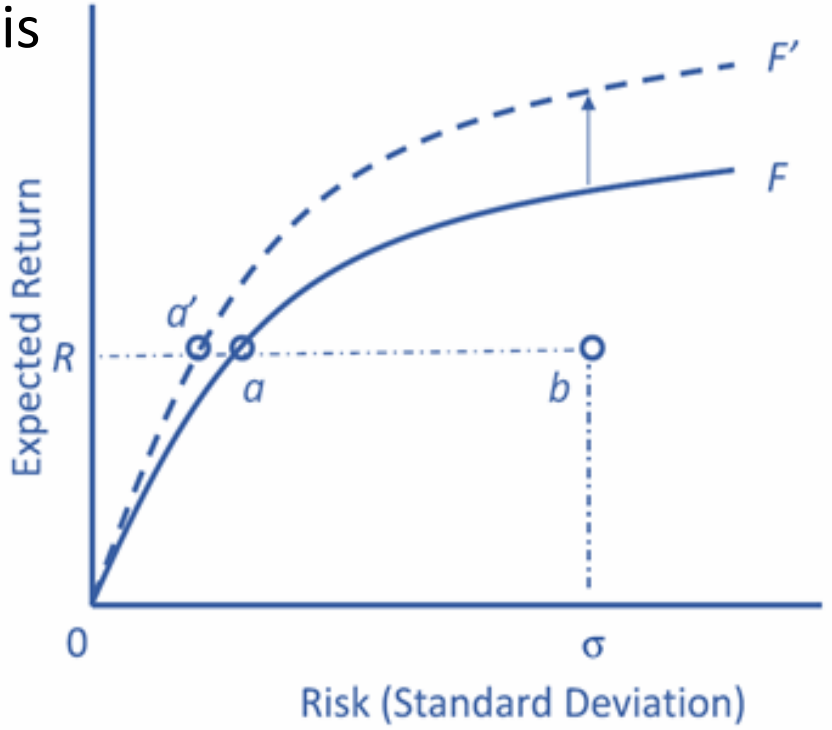
Fishery Management based on Single Species

- Fishery management usually focuses on single species or populations with limited or no consideration of the entire fishery system.
- This approach has resulted in many positive outcomes, but it ignores species interactions.
- Species interactions affect economic, social and governance.



Multispecies Portfolio Management

- Theoretical studies demonstrate that the further away from the "efficiency frontier" that a set of aggregated landings is, the more risk is incurred, and the less economic yield is obtained.
- More aggregated estimates of efficiency frontier (F') outperform single stock-based approaches (F).
- We're using publicly available data to demonstrate how multispecies portfolios can be evaluated using frontier analysis

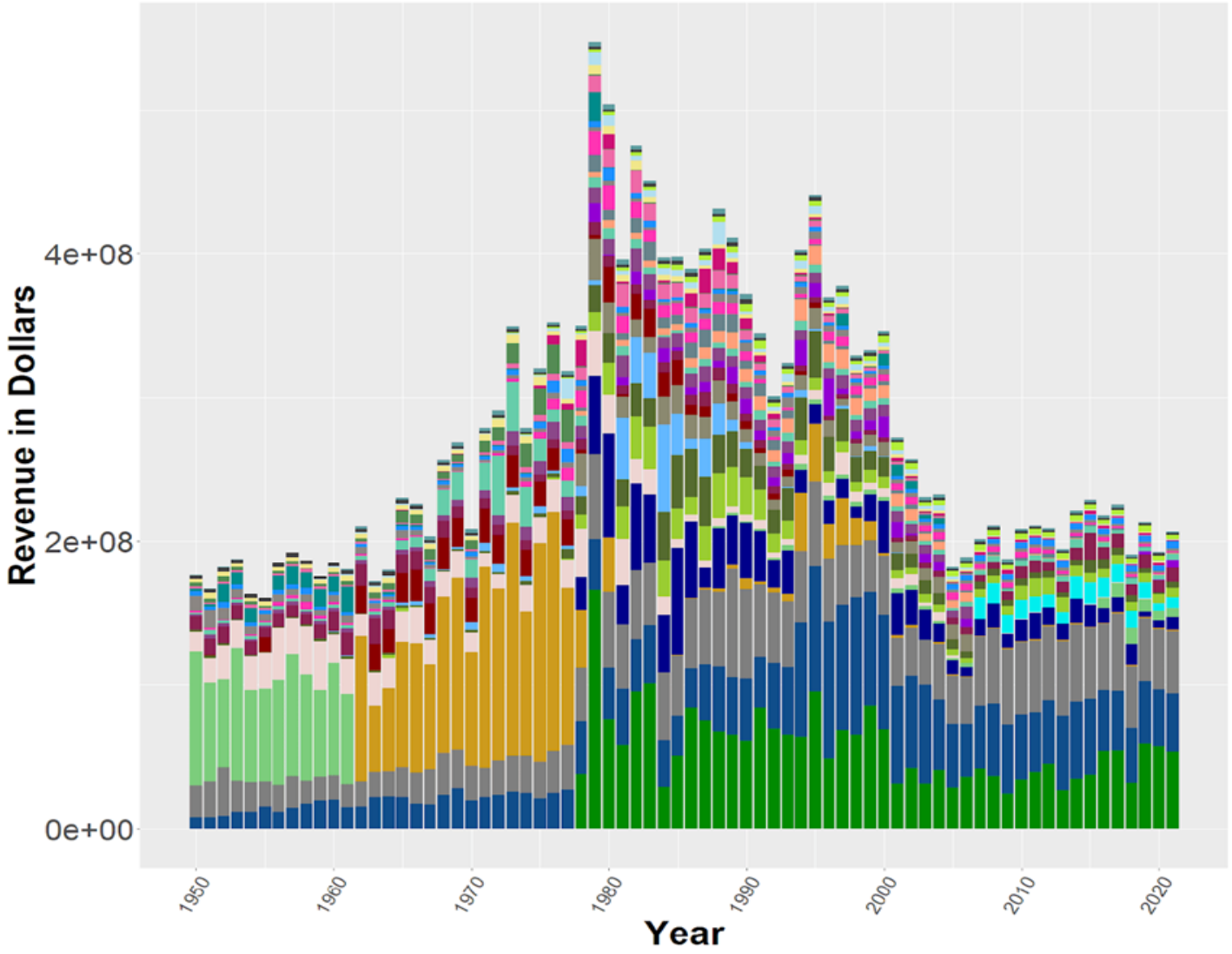


Jin et al. 2016

Publicly Available Data

- Data available for download: https://www.fisheries.noaa.gov/foss/f?p=215:200:9126899293308:Mail:NO:::
- Data Download Parameters:
  - Data Set: **Commercial**
  - All Years: 1950–2021
  - Region Type: NMFS Regions
  - Region: South Atlantic
  - Species: All Species
  - Report Format: Totals by Year/State/Species

The Top-Ranking Revenue



Top 30 Species by Landings Revenue in Dollars Standardized to 2021 Value, plus "Others".

Example Portfolio Selection: Snapper-Grouper FMP

Amberjack
- Amberjack, Greater
- Amberjack, Lesser

Jack
- Jack, Almaco
- Jack, Bar

Rudderfish
- Rudderfish, Banded

Grunts
- Grunt, Cottonwick
- Grunt, Margate
- Grunt, Sailors Choice
- Grunt, Tomtate
- Grunt, White

Spadefish
- Atlantic Spadefish

Hogfish
- Hogfish

Bass
- Sea Bass, Bank
- Sea Bass, Black
- Sea Bass, Rock

Porgies
- Porgy, Jolthead
- Porgy, Knobbed
- Porgy, Longspine
- Porgy, Red
- Porgy, Saucereye
- Porgy, Scup
- Porgy, Whitebone

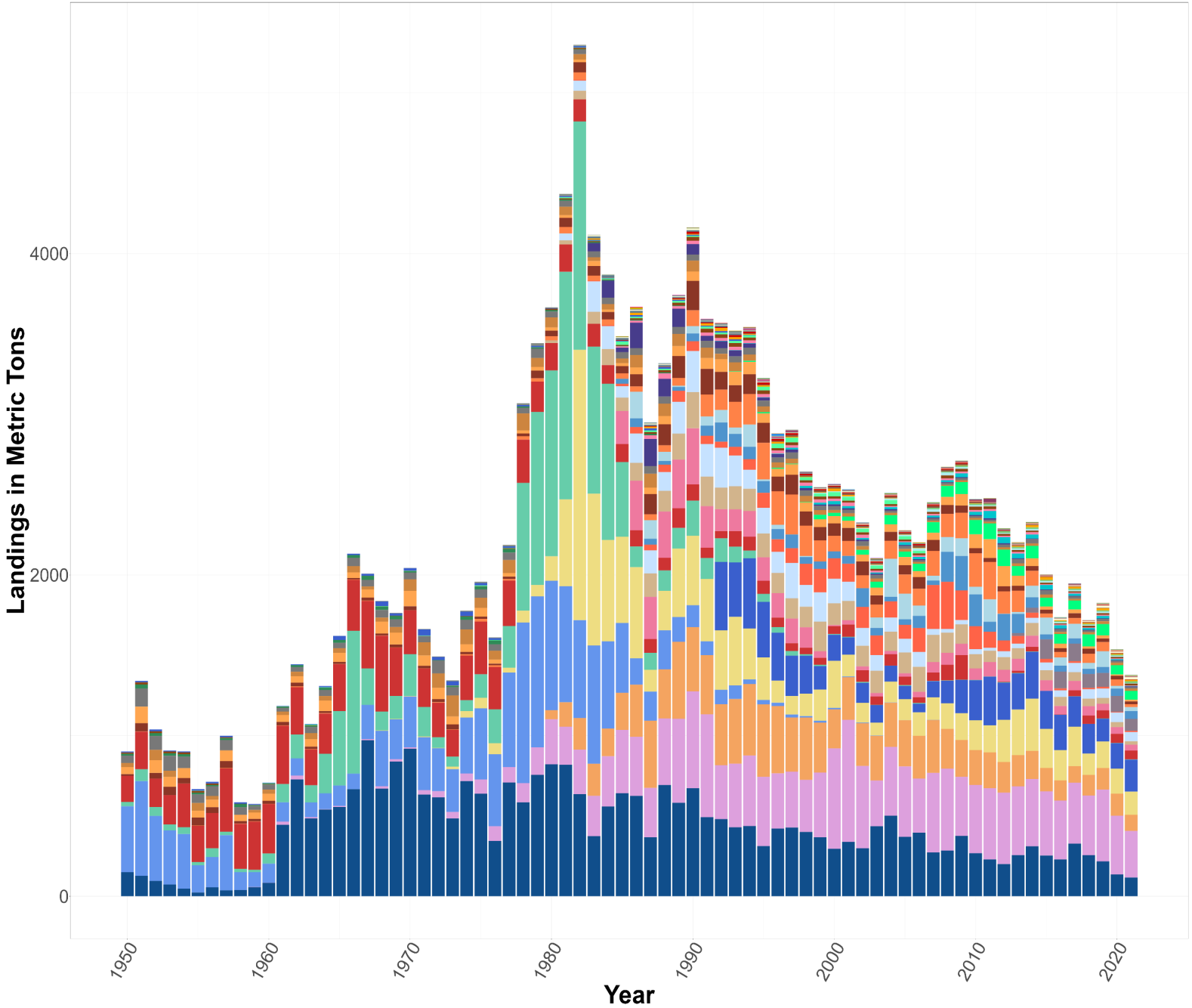
Groupers
- Grouper, Black
- Grouper, Coney
- Grouper, Gag
- Grouper, Goliath
- Grouper, Graysby
- Grouper, Misty
- Grouper, Nassau
- Grouper, Red
- Grouper, Red Hind
- Grouper, Rock Hind
- Grouper, Scamp
- Grouper, Snowy
- Grouper, Speckled Hind
- Grouper, Warsaw
- Grouper, Wreckfish
- Grouper, Yellowedge
- Grouper, Yellowfin
- Grouper, Yellowmouth

Snappers
- Snapper, Blackfin
- Snapper, Cubera
- Snapper, Gray
- Snapper, Lane
- Snapper, Mutton
- Snapper, Queen
- Snapper, Red
- Snapper, Silk
- Snapper, Vermilion
- Snapper, Yellowtail

Triggerfish
- Triggerfish, Gray
- Triggerfish, Ocean

Tilefish
- Tilefish, Blueline
- Tilefish, Golden
- Tilefish, Sand

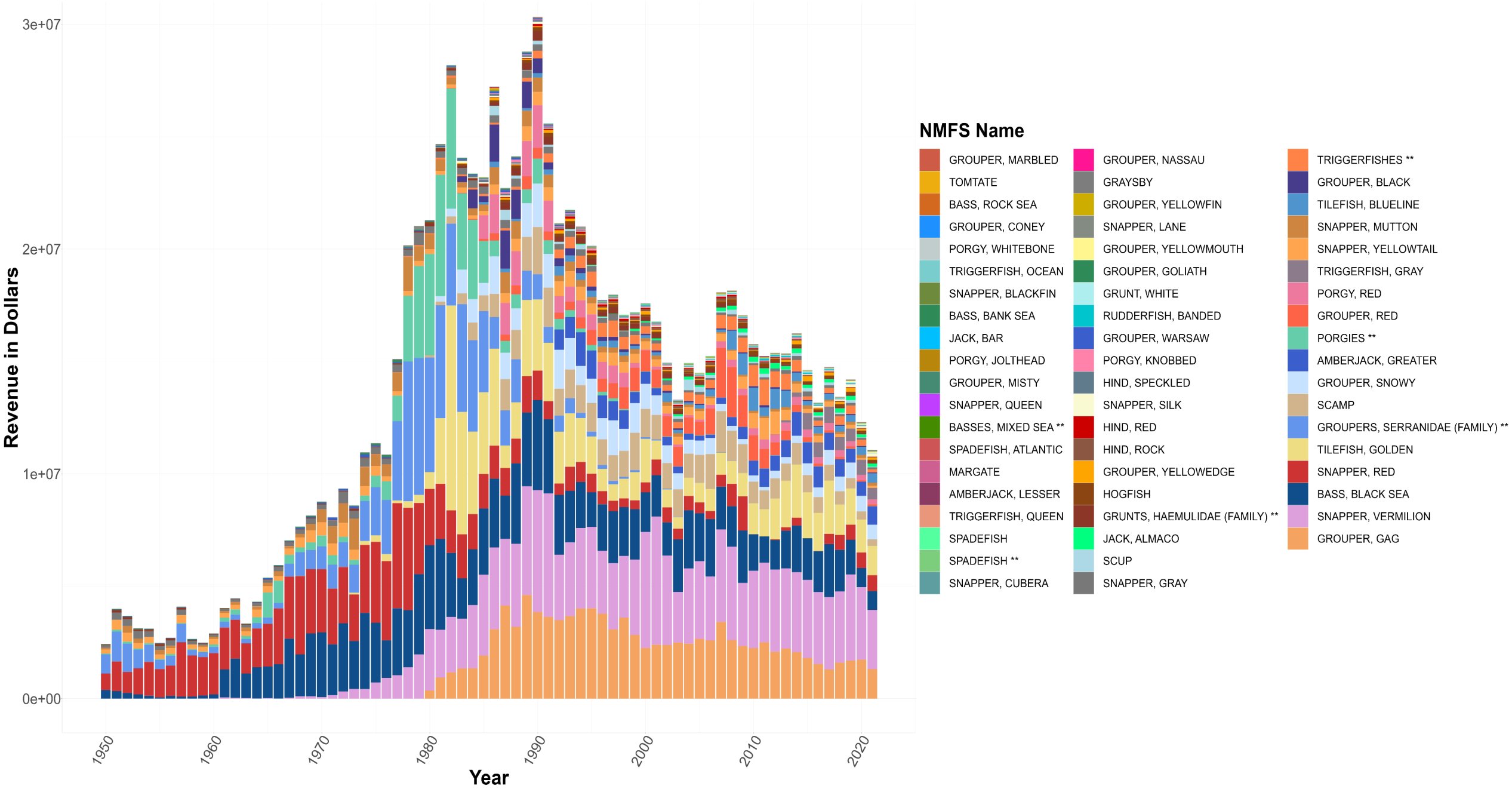
Landings (Metric Tons) of Species Managed by the Snapper-Grouper Fishery Management Plan



NMFS Name

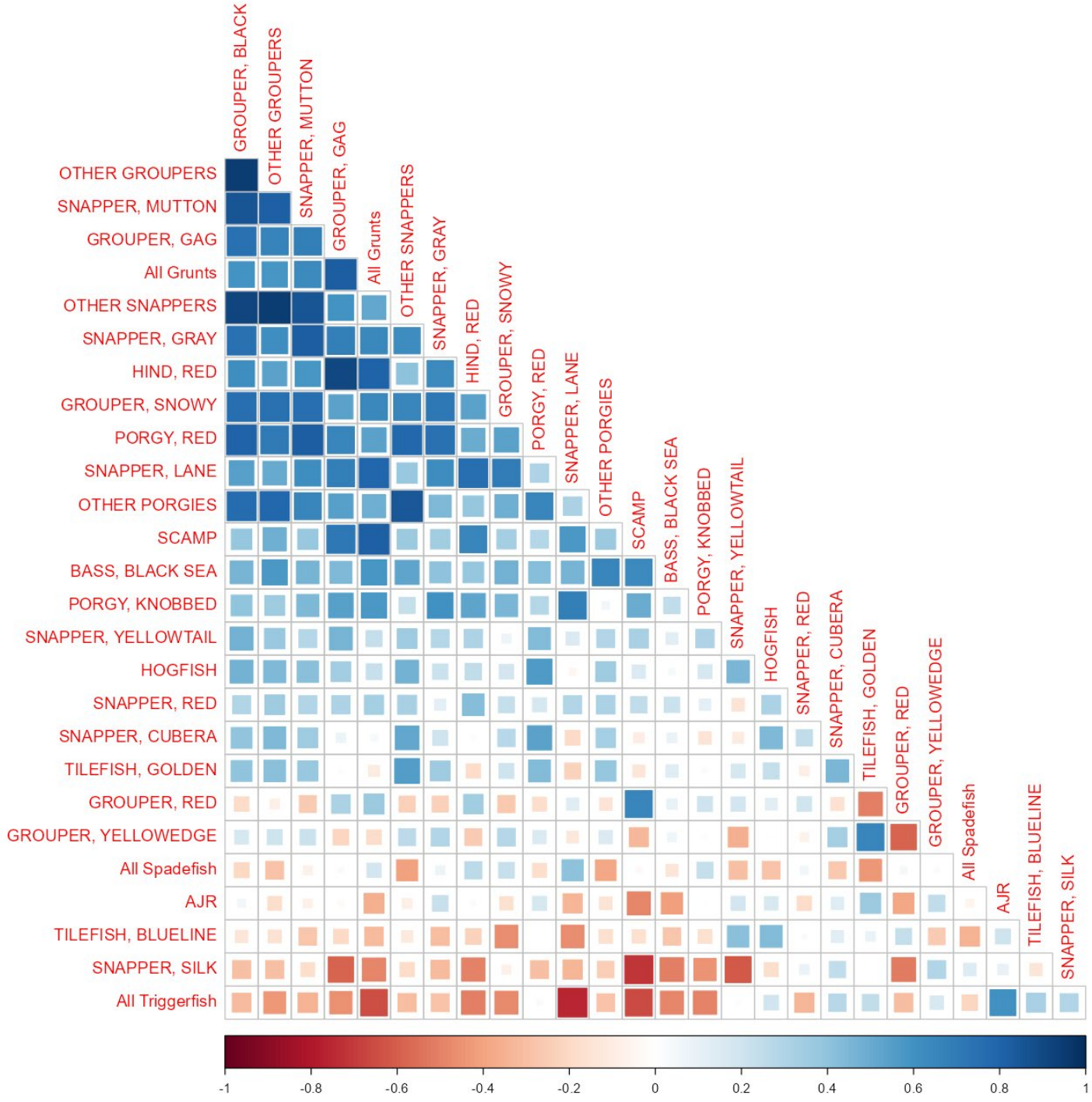
- GROUPER, MARBLED
- TOMTATE
- TRIGGERFISH, OCEAN
- SNAPPER, BLACKFIN
- SNAPPER, QUEEN
- BASS, ROCK SEA
- BASS, BANK SEA
- GROUPER, MISTY
- PORGY, WHITEBONE
- BASSES, MIXED SEA **
- PORGY, JOLTHEAD
- JACK, BAR
- GROUPER, NASSAU
- GROUPER, CONEY
- TRIGGERFISH, QUEEN
- GROUPER, YELLOWFIN
- GRAYSBY
- SNAPPER, CUBERA
- GROUPER, YELLOWMOUTH
- MARGATE
- AMBERJACK, LESSER
- SNAPPER, LANE
- SPADEFISH, ATLANTIC
- SNAPPER, SILK
- HIND, SPECKLED
- HIND, RED
- HIND, ROCK
- GROUPER, YELLOWEDGE
- SPADEFISH **
- GRUNT, WHITE
- GROUPER, WARSAW
- SPADEFISH
- HOGFISH
- GROUPER, GOLIATH
- PORGY, KNOBBED
- RUDDERFISH, BANDED
- GROUPER, BLACK
- SNAPPER, GRAY
- SNAPPER, MUTTON
- JACK, ALMACO
- SNAPPER, YELLOWTAIL
- GRUNTS, HAEMULIDAE (FAMILY) **
- TRIGGERFISHES **
- SCUP
- TILEFISH, BLUELINE
- TRIGGERFISH, GRAY
- GROUPER, RED
- GROUPER, SNOWY
- SCAMP
- PORGY, RED
- SNAPPER, RED
- PORGIES **
- AMBERJACK, GREATER
- TILEFISH, GOLDEN
- GROUPERS, SERRANIDAE (FAMILY) **
- GROUPER, GAG
- SNAPPER, VERMILION
- BASS, BLACK SEA

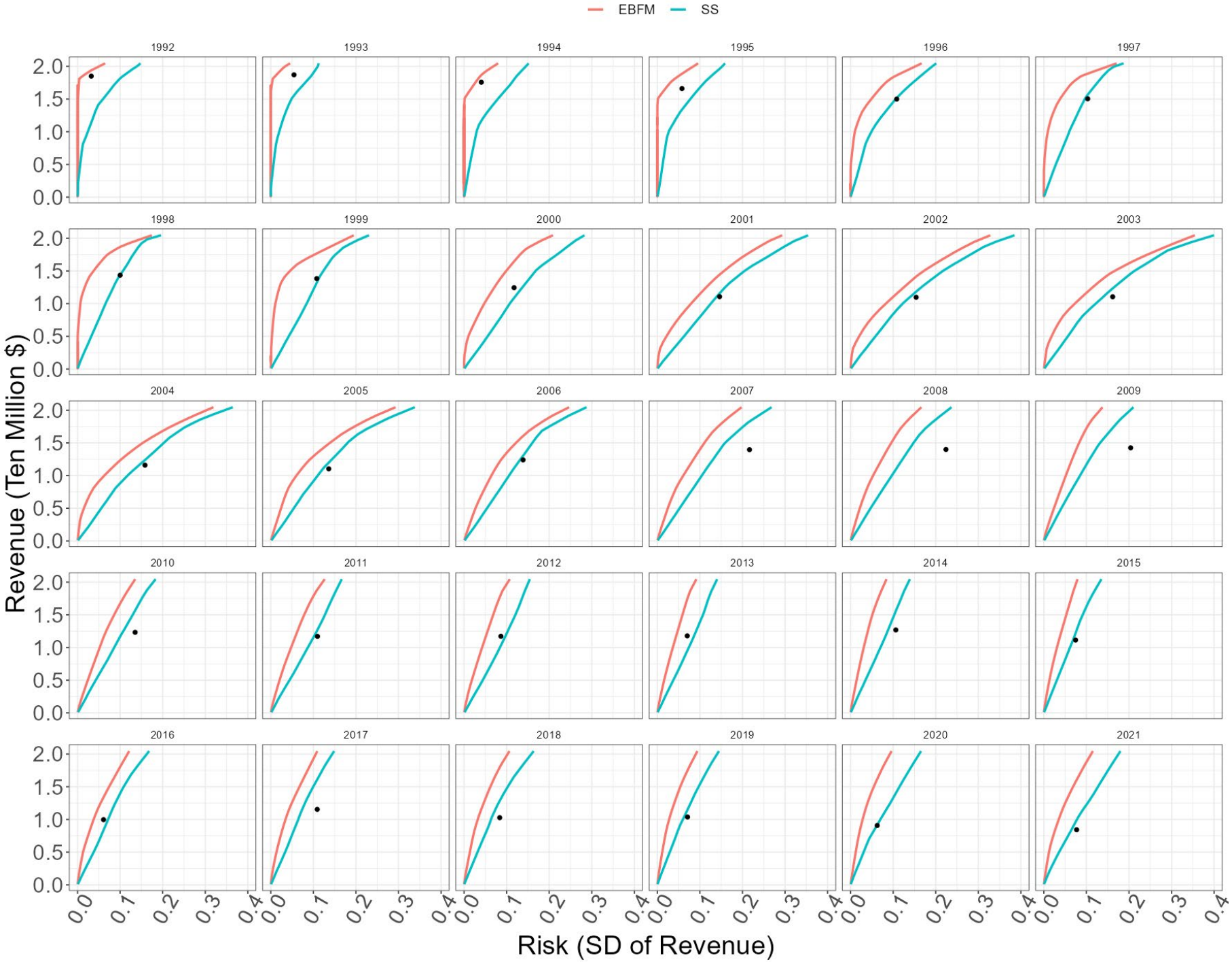
Revenue ($ 2021) of Species Managed by the Snapper-Grouper Fishery Management Plan

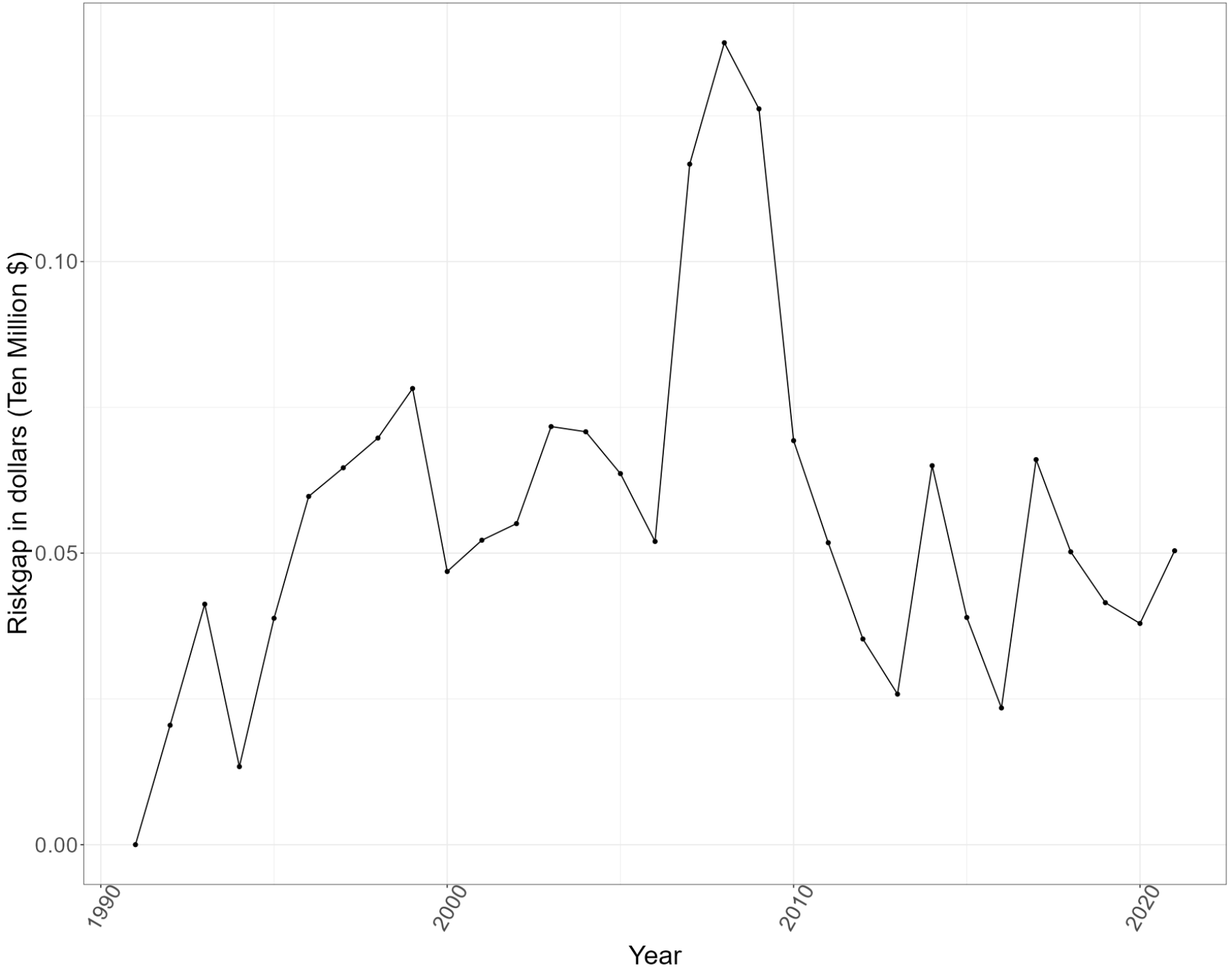


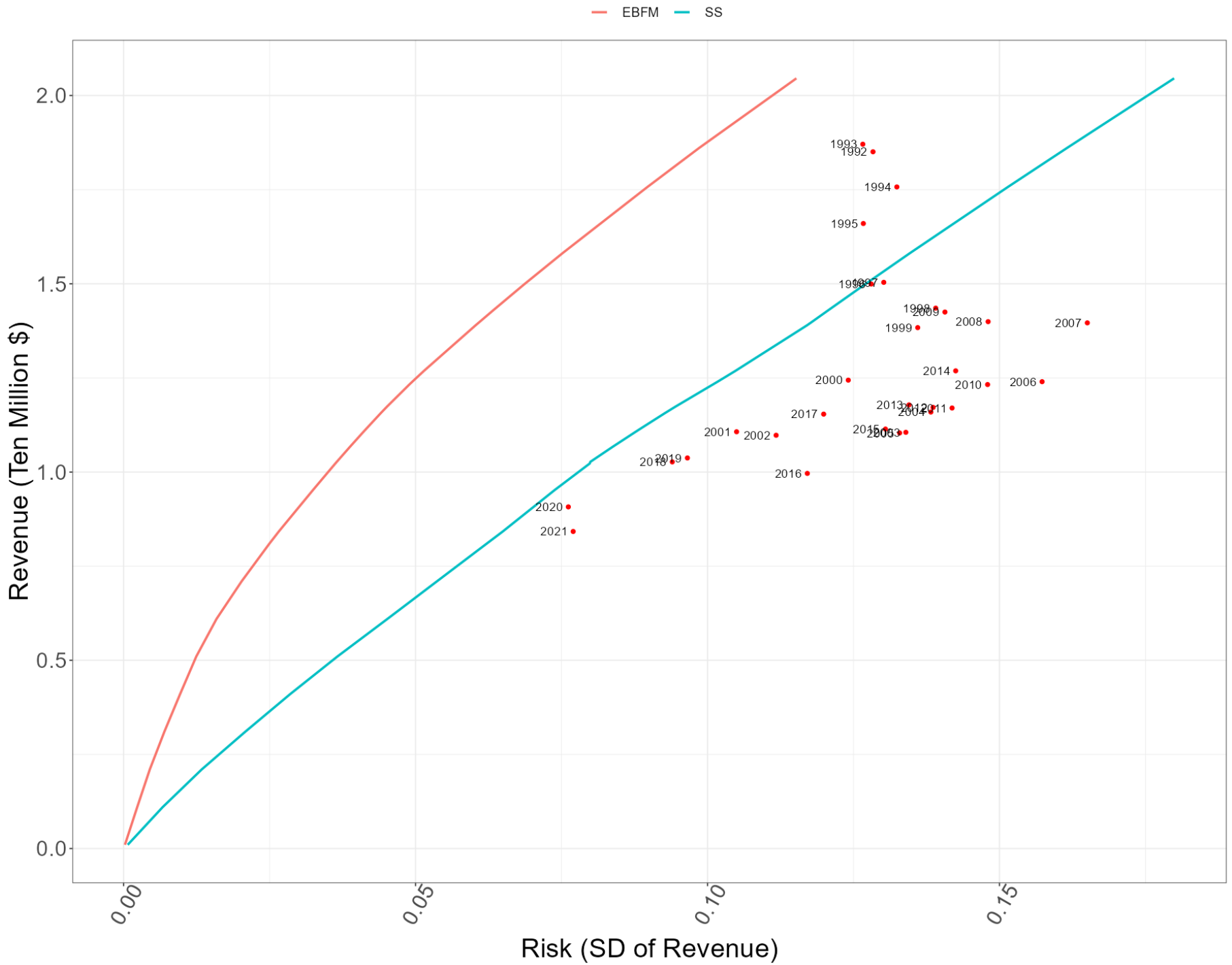
Correlation

- Efficiency frontier is derived from covariance in revenue among species.



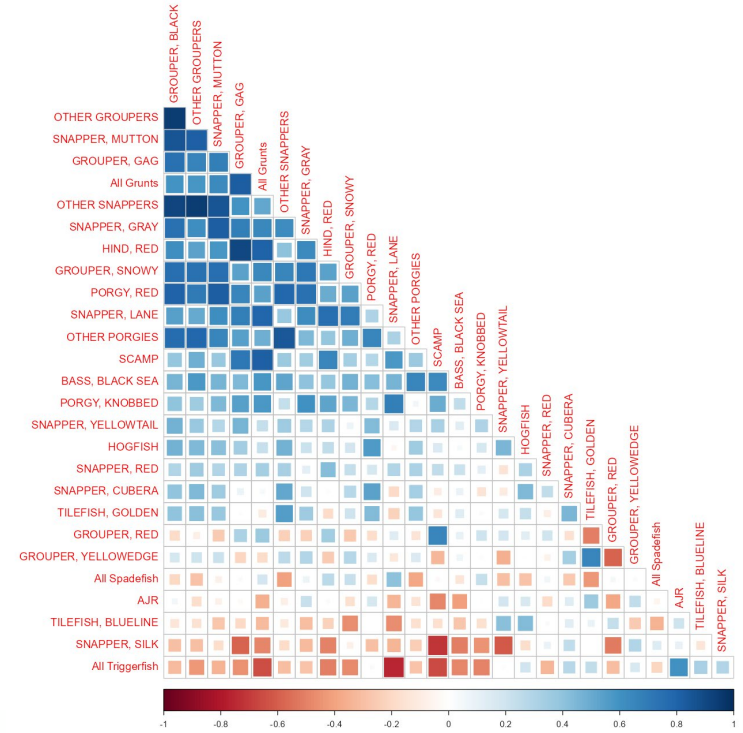

EBFM
SS
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Revenue (Ten Million $)
Risk (SD of Revenue)
0.0
0.5
1.0
1.5
2.0
0.1
0.2
0.3
0.4

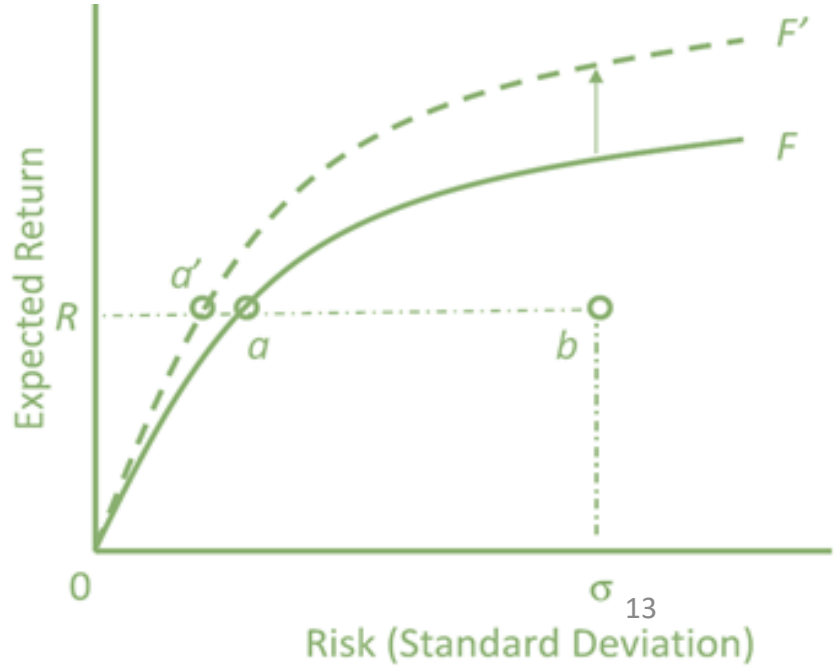

Riskgap in dollars (Ten Million $)
0.10
0.05
0.00
1990
2000
2010
2020
Year


EBFM
SS
Revenue (Ten Million $)
2.0
1.5
1.0
0.5
0.0
0.00
0.05
0.10
0.15
Risk (SD of Revenue)
1993
1992
1994
1995
1998
2009
2008
2007
1999
2014
2000
2010
2006
2013
2012
2011
2004
2017
2001
2002
2015
2003
2019
2018
2016
2020
2021

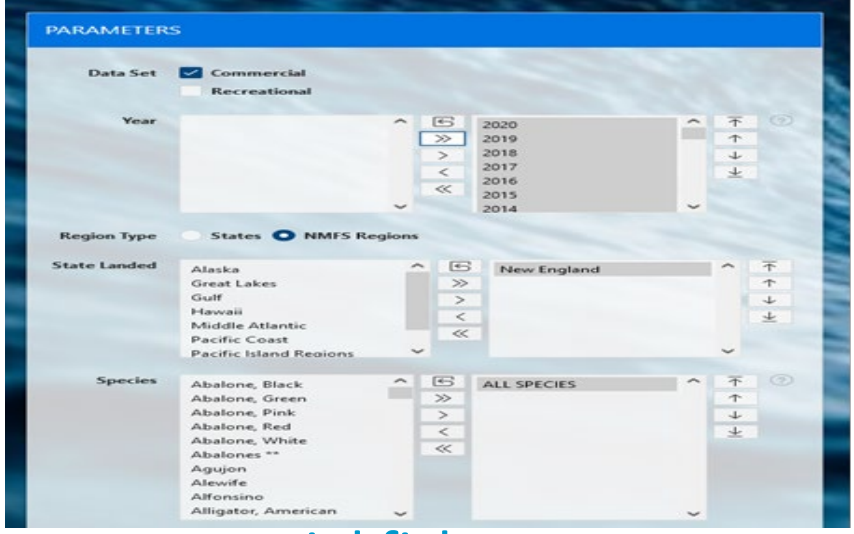
Conclusions

- Results suggest that portfolio diversity relies on coordinated management of snapper-grouper and other species.
  - strong positive covariance in revenue among snapper-grouper species
  - negative covariance with jacks, triggerfish, blueline tilefish, red grouper, silk snapper, spadefish.
- Frontier analysis of the snapper-grouper complex indicated that the same revenue could have been achieved with less risk of foregone yield.
- The results demonstrate that management systems benefit by allowing for flexibility to harvest abundant species by considering constraints of management strategies and tactics.

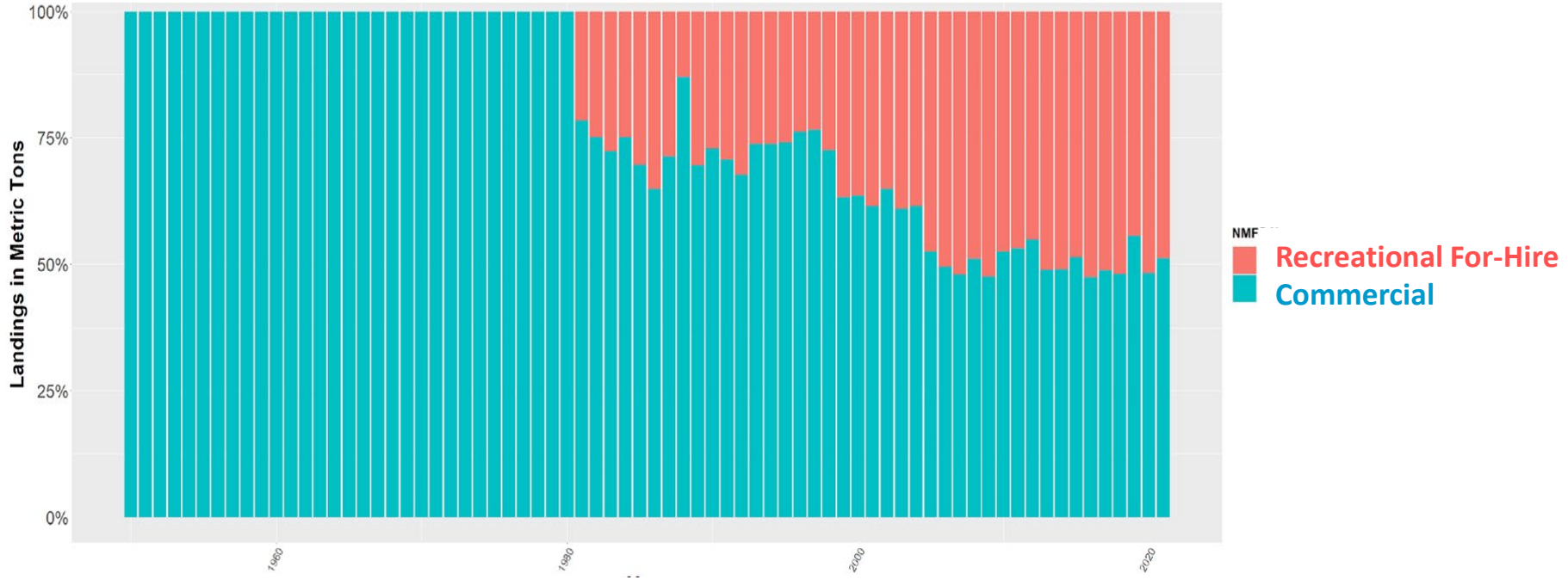




Data Challenges



- Publicly available data needed extensive processing:
  - Inconsistent taxa labels (phased out species aggregations)
  - Years with no landings or revenue for some taxa
  - Some records masked for confidentiality
- The demonstration was limited to landings and revenue from the commercial fishery.
- Therefore, a next step for evaluating Council managed species would be to include estimates of total recreational catch and its economic value.



Discussion on Data, Modeling, Next Steps… & Thanks

- Technical suggestions (e.g., portfolio selection, data, model specifications)?
- How the SSC and Council can consider portfolio analysis results (e.g., catch advice, other management actions)?
- Acknowledgments:
  - Funding from the Lenfest Ocean Program
  - Steering Committee: Howard Townsend, Geret DePiper, Lisa Kerr, Jeffrey Buckel, Douglas Lipton, John Walden, Chip Collier, Christopher Dumas, Scott Crosson, Michael Ruccio, and Rob Griffin.
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