SEFSC response to SAFMC 2019 Research Recommendations

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NOAA FISHERIES
SouthEast Fisheries Science Center

Outline

1. ***Research takes a community and SEFSC is far from alone in this response- numerous state, academic and federal partners***

2. ***Overview of status on 2019 Research Plan***

3. ***Highlight several key projects***

Research progress

needs	complete	ongoing: research in progress or routine	delayed/not planned	total	complete or ongoing rate
I. Short Term stock assessments need 2020-2023	7	9	10	26	62%
II. Long Term research stock assessments needs 5 years.		4	7	11	36%
III. Short Term Spawning Special Management Zones 5 years.		4	1	5	80%
IV. Short Term MPA monitoring 5 years.		3	3	6	50%
V. Long Term other Needs 5 years.		11	1	12	92%
VI. Habitat Research and Monitoring Needs		2		2	100%
VII. Specific Monitoring Priorities		12		12	100%
VIII. SPECIFIC ANNUAL REPORTING REQUESTS			3	3	0%
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total	**7**	**45**	**25**	**77**	68%

Covid and SEDAR Steering Committee decisions have caused several delays.

heading	topic
I. Short Term stock assessments need 2020-2023	o (Spanish mackerel) Evaluate stock structure using updated data and modern techniques, such as genetics. In particular evaluate if there is newer data available on steepness from other analyses of S-R for pelagic stocks with similar reproductive strategies.
I. Short Term stock assessments need 2020-2023	• Gray Triggerfish Research Track Assessment 2022:
I. Short Term stock assessments need 2020-2023	o Address age determination issues for Gray Triggerfish by January 2020 so age structures can be evaluated for a research track assessment tentatively scheduled for 2021, including re-aging of the spines by the start of the RT.
I. Short Term stock assessments need 2020-2023	• Black Sea Bass Operational Assessment 2021:
I. Short Term stock assessments need 2020-2023	o Recommend the use of more direct methods of estimating M, such as Tag-Recapture studies.
I. Short Term stock assessments need 2020-2023	• Red Grouper Operational Assessment 2021:
I. Short Term stock assessments need 2020-2023	• White Grunt Research Track Assessment, 2023
I. Short Term stock assessments need 2020-2023	o Conduct stock identification studies for White Grunt.

Several delays due to really challenging questions often beyond simple (or 2 year) solutions

II. Long Term research stock assessments needs 5 years.	§ Investigate possible effects of hermaphroditism on the steepness parameter.
II. Long Term research stock assessments needs 5 years.	§ Investigate temporal patterns in sexual transition and develop explanations for any patterns identified.
II. Long Term research stock assessments needs 5 years.	§ Investigate methods for incorporating the dynamics of sexual transition in assessment models.
II. Long Term research stock assessments needs 5 years.	o Examine how schooling or migratory dynamics may influence the catchability of the species. In particular, research the assumption of the hyperstability of indices that sample the schooling portion of the stock.
II. Long Term research stock assessments needs 5 years.	o Evaluate otolith chemistry as an approach to define Gag population structure.
II. Long Term research stock assessments needs 5 years.	o Compare genetics of spawning Gag captured by commercial fishermen to juveniles collected in different areas in subsequent months to determine the source of recruits. Consider expanding research to include samples from Mexico to explore gene flow and connectivity.

A number of delays/non-starts due to MPA research limitations (some call for invasive techniques that are not preferred in MPAs)

III. Short Term Spawning Special Management Zones 5 years.	o Design a multi-year study to collect age and gonad samples at spawning sites during the spawning season. This should entail identifying the diurnal usage patterns at spawning sites during the year.
III. Short Term Spawning Special Management Zones 5 years.	• Document spawning within Spawning SMZs by priority species in the Snapper Grouper complex.
IV. Short Term MPA monitoring 5 years.	• Characterize spawning by managed species within the MPAs.
IV. Short Term MPA monitoring 5 years.	• Evaluate the sampling program of the SAFMC MPAs. The evaluation should review data on compliance, species abundance and diversity, and determine if current sampling targets are sufficient.
IV. Short Term MPA monitoring 5 years.	• Develop methods for incorporating the impacts of MPA on management actions and stock status.
V. Long Term other Needs 5 years.	• Investigate juvenile habitat and abundance of shallow water groupers (such as Gag and Red Grouper), to evaluate the effectiveness of current regulations in protecting these species, by looking at changes in abundance and frequency of occurrence.

Conclusions

Since 2019 of 77 research priorities 68% are completed or in progress

MARFIN, S-K, CRP and CRCP has funded approximately 6 of these projects, the remainder comes from (*recently level*) NOAA-fisheries base funding or state partner contributions

We look forward to working to further align research with NOAA and SEFSC strategic priorities

Research highlights (additional material, not presented, if requested we can schedule additional presentations)

Research Highlights (acoustic tagging)

scientific reports

OPEN

Environmental conditions, diel period, and fish size influence the horizontal and vertical movements of red snapper

Nathan M. Bacheler[1,2], Kyle W. Shertzer[1], Brendan J. Runde[2], Paul J. Rudershausen[2] & Jeffrey A. Buckel[2]

Most demersal fishes are difficult to observe and track due to methodological and analytical constraints. We used an acoustic positioning system to elucidate the horizontal and vertical movements of 44 red snapper (*Lutjanus campechanus*) off North Carolina, USA, in 2019. Mean movement rate and distance off bottom varied by individual, with larger red snapper generally moving faster and spending more time farther off the bottom than smaller individuals. We used generalized additive mixed models that accounted for temporal autocorrelation in the data to show that mean hourly red snapper movement rate was lower during the day than at night and was negatively related to bottom water temperature. Moreover, red snapper spent more time off the bottom during the day than at night, and vertical movements were mostly related to bottom upwelling events that sporadically occurred in May–July. Our results and previous observations suggest that red snapper feed primarily on benthic organisms at night, and display diel vertical migration (i.e., thermotaxis) up to warmer waters (when present) during the day to aid digestive efficiency. Movement is a central organizing feature in ecology, and the sustainable management of fish will benefit from a better understanding of the timing and causes of fish movement.

SCIENTIFIC REPORTS

OPEN

Tropical storms influence the movement behavior of a demersal oceanic fish species

Received: 6 September 2018
Accepted: 23 November 2018
Published online: 06 February 2019

Nathan M. Bacheler[1], Kyle W. Shertzer[1], Robin T. Cheshire[1] & Jamie H. MacMahan[2]

Extreme weather events strongly influence marine, freshwater, and estuarine ecosystems in myriad ways. We quantified movements of a demersal oceanic fish species (gray triggerfish *Balistes capriscus*; $N = 30$) before, during, and after two hurricanes in 2017 using fine-scale acoustic telemetry at a 37-m deep study site in North Carolina, USA. During storms, gray triggerfish movement and emigration rates were 100% and 2550% higher, respectively, than on days with no storms. We found that increased movement rates were much more strongly correlated with wave orbital velocity (i.e., wave-generated oscillatory flow at the seabed) than either barometric pressure or bottom water temperature, two covariates that have been demonstrated to be important for organisms in shallower water. Higher movement rates during storms were due to increased mobility at night, and emigrations typically occurred at night in the direction of deeper water. Overall, we found significant storm effects on the movement behavior of a demersal fish species in the open ocean, despite our study occurring in deeper water than previous studies that have examined storm effects on animal movement. We conclude that tropical storms are a driving force behind the structure of marine ecosystems, in part by influencing movements of mobile animals.

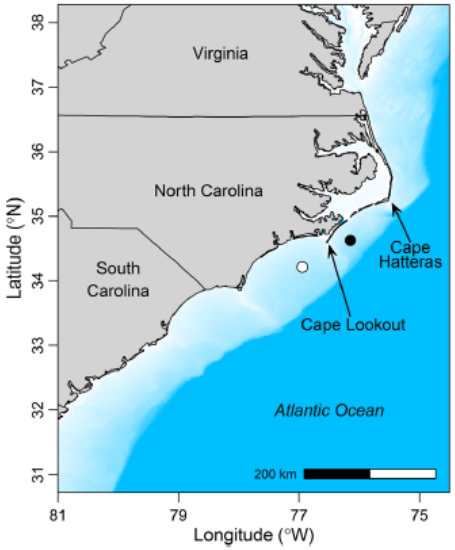

Figure 1. Location of the red snapper (*Lutjanus campechanus*) tracking study (filled black circle) between Cape Hatteras and Cape Lookout, North Carolina, USA, in 2019. Some environmental data used in this study came from NOAA buoy 41159, the location of which is indicated by the filled white circle. Water depth is shown in blue (lightest blue < 5 m; darkest blue > 100 m).

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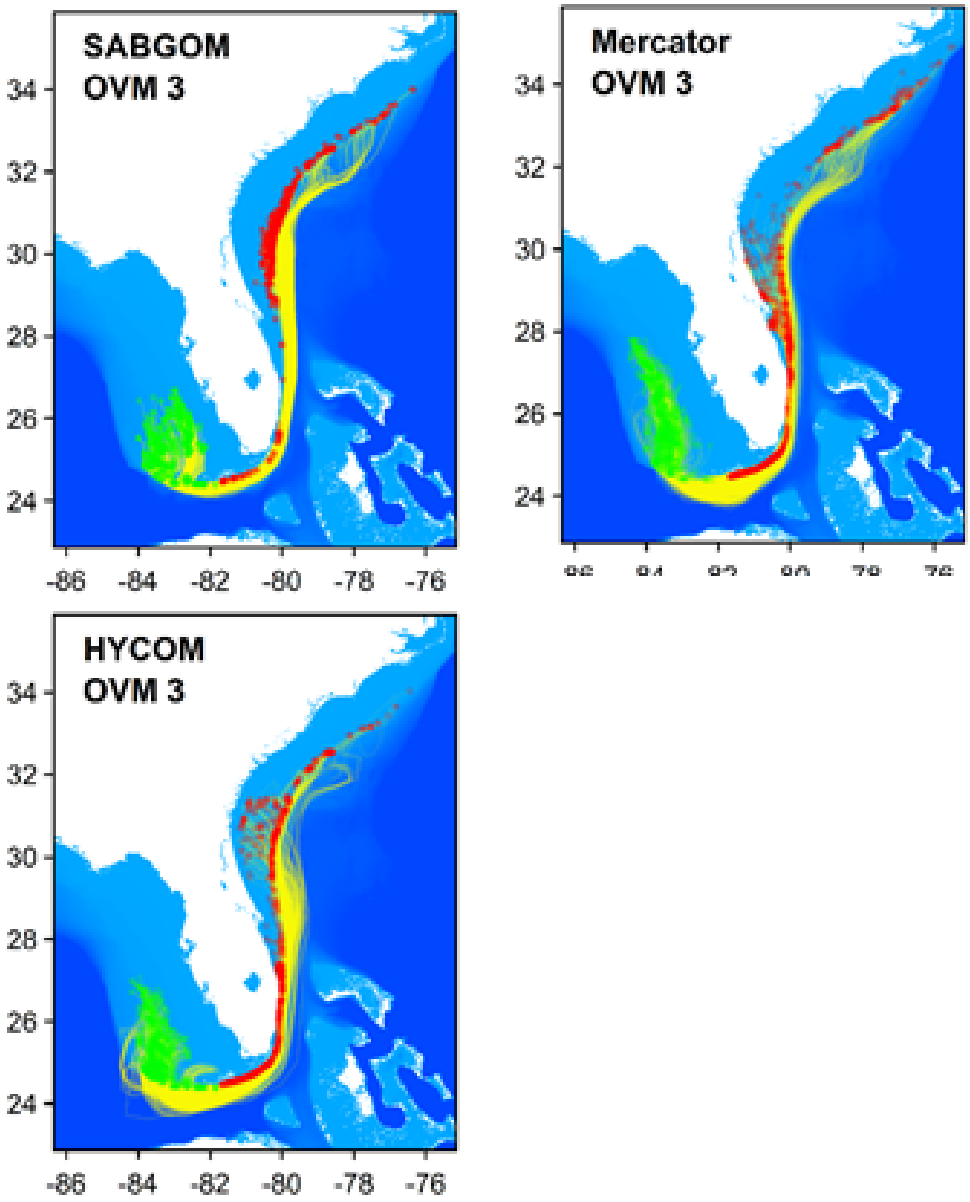
Connectivity modeling



Source-sink recruitment of red snapper in the U.S.: Connectivity between the Gulf of Mexico and Atlantic Ocean

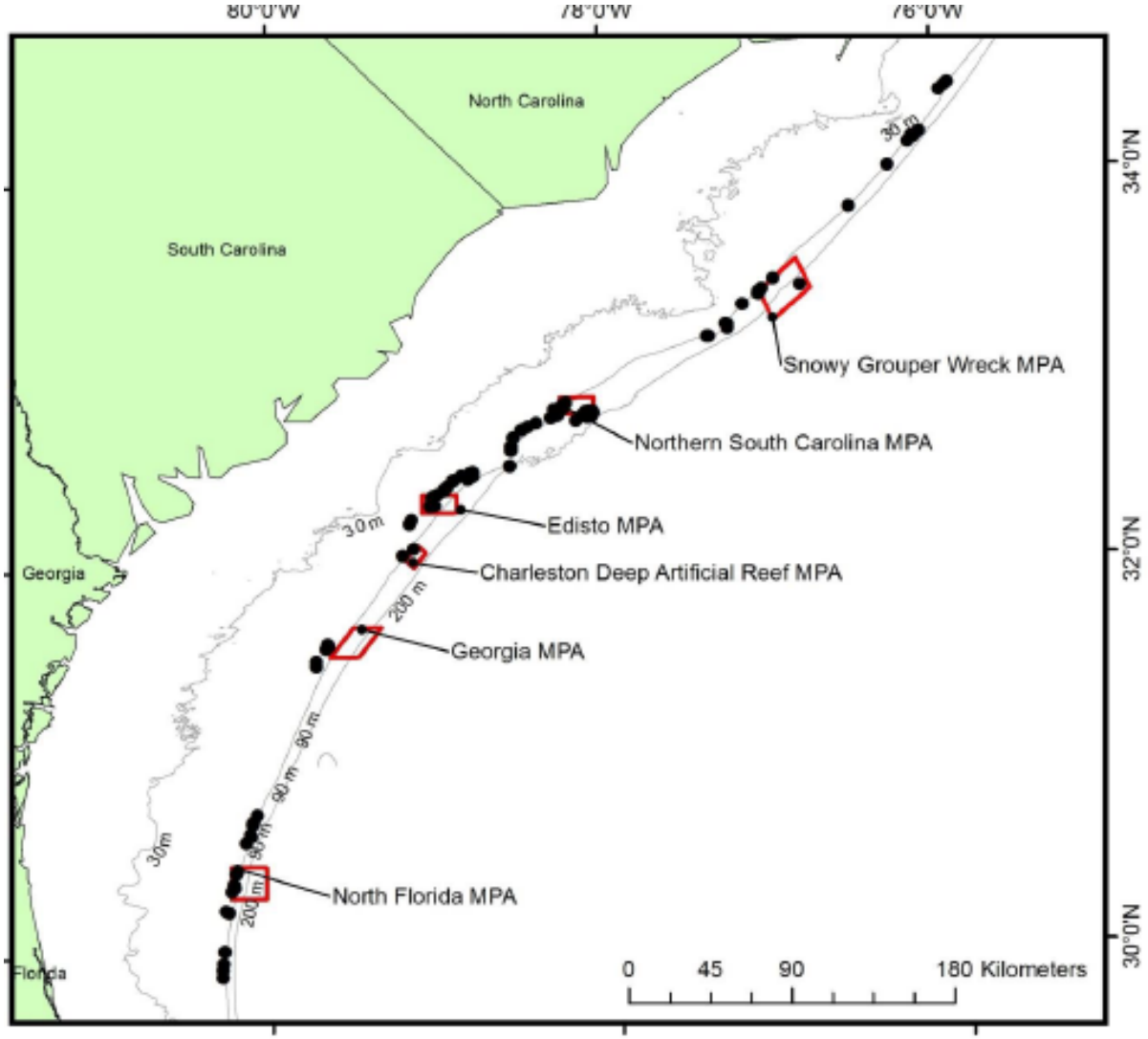
Oceanographic modeling indicates connectivity between Gulf and south Atlantic.

Trajectories of larvae spawned in the Gulf that successfully recruited to the Atlantic, for different assumptions regarding oceanographic forcing (in panel rows) and ontogenetic vertical migration (OVM; in panel columns). Spawning locations are represented by green points and settlement locations are represented by red points. Points are transparent such that darker colors represent greater numbers of larvae spawning or settling in those areas

Karnauskas, Shertzer, Kellison, Farmer, He, Lowerre-Barbieri, Paris, Switzer, Vaz *in prep*.

Marine Protected Area Research

- Conducted by request of Fishery Management Councils
  - Funded through FMC-allocated funds from CRCP
    - Gulf of Mexico (2001-2014)
      U.S. South Atlantic (2004-Present)
      Oculina HAPC (2015-Present)
      - Non-destructive video survey of all fishes using stationary camera arrays and ROVs. Major invertebrate / habitat component added in 2010



Locations of shelf-edge MPA sites and ROV dive sites off southeastern U.S. (only 3 of 15 years shown).

Red polygons = SAFMC MPA sites;

Solid dots = ROV dives.

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Age validation of Red Porgy (manuscript in prep)

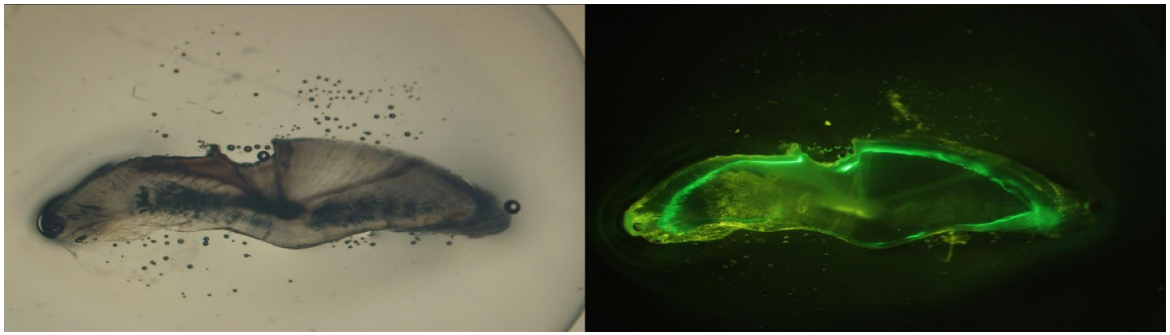

Figure 1. One year old Red Porgy. Left image of otolith section with white light. Right image of otolith section with epi-fluorescent light showing chemical mark near the first annulus.

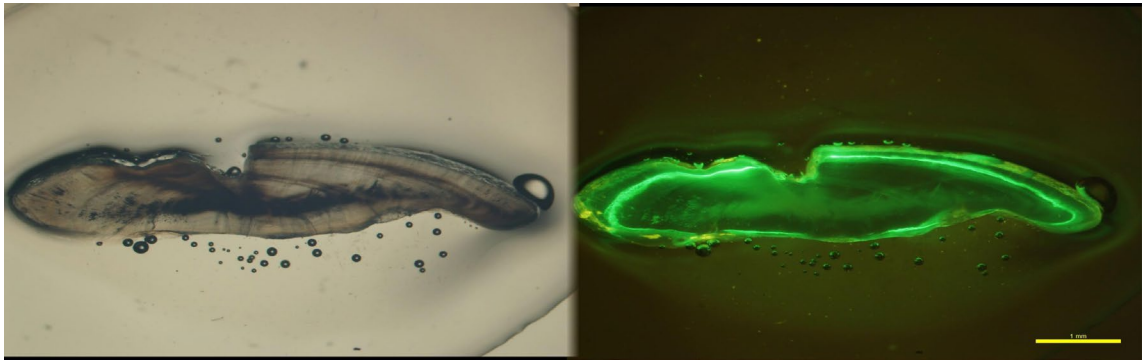

Figure 2. One year old Red Porgy showing a strong opaque check mark inside of the true first annulus. Left image of otolith section with white light. Right image of otolith section with epi-fluorescent light showing chemical mark near the first annulus.

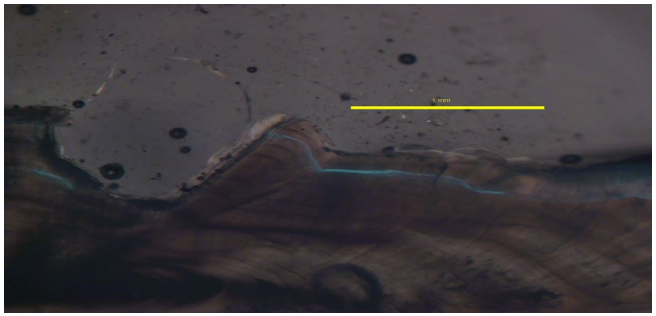

Figure 3. 9 year old Red porgy. Otolith section picture taken with white and epi-fluorescent lights simultaneously. Chemical mark is associated with the 7th annulus (opaque zone) with two annuli following - last annulus on margin. Fish was a held for 2.0 years after marking.