# SEDAR 51 Stock ID Working Paper

## S51 Stock ID Working Group

SEDAR51-DW-09

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**Introduction:**
A working group appointed by the Gulf and South Atlantic Councils, SERO, and the SEFSC was convened to review the information available for gray snapper with regards to biological stock structure within the Gulf of Mexico and South Atlantic Fishery Management Council jurisdictions prior to the start of the SEDAR 51 assessment process. The discussions were conducted via webinars, held in November and December 2016.

**Overall Recommendations:**

- *Recommend that Gulf of Mexico and South Atlantic should not be combined into one assessment.*
- *Recommend that all Monroe County data be included in the Gulf*
- *Recommend not to split Gulf of Mexico into separate east/west assessments*

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To facilitate the review of the available reference and working papers, the working group was divided into smaller groups to focus on specific topics: Life History, Recruitment, Genetics, and Tagging and Movements. Each sub-group was assigned a selection of papers to review and then summarize the papers to the entire working group, focusing on how those papers might inform our discussions on stock structure. A short summary of the sub-group reviews can be found below.

During the webinars, the working group discussed the available information, in relation to stock structure for gray snapper, and provided recommendations for the biological stock to be considered for the SEDAR 51 assessment process. The webinar summaries, along with those recommendations, can be found in this document.

**Life History:**

| **Reference Documents Reviewed By Life History Group** | | |
|---|---|---|
| SEDAR51-RD06 | Age, growth, and mortality of gray snapper, *Lutjanus griseus*, from the east coast of Florida | Michael L. Burton |
| SEDAR51-RD10 | Recruitment dynamics and otolith chemical signatures of juvenile gray snapper, *Lutjanus griseus,* among West Florida estuarine and coastal marine ecosystems | Cecelia Lounder |
| SEDAR51-RD11 | Reproductive biology of gray snapper (*Lutjanus griseus*), with notes on spawning for other Western Atlantic snappers (Lutjanidae) | M.L. Domeier, C. Koenig, and F. Coleman |
| SEDAR51-RD14 | Variation in the isotopic signatures of juvenile gray snapper (*Lutjanus griseus*) from five southern Florida regions | Trika Gerard and Barbara Muhling |
| SEDAR51-RD15 | Temporal and spatial dynamics of spawning, settlement, and growth of gray snapper (*Lutjanus griseus*) from the West Florida shelf as determined from otolith microstructures | Robert J. Allman and Churchill B. Grimes |
| SEDAR51-RD16 | Regional variation in the population structure of gray snapper, *Lutjanus griseus,* along the West Florida shelf | R.J. Allman and L.A. Goetz |

*Life History Paper review Summary:*

Two life history papers (RD06 and RD16) pertaining to adult gray snapper growth generally agreed in their analyses. The longevity of the gray snapper was 24 – 26 years. There were differences in the sizes and ages of fish landed in the recreational fishery compared to the commercial fishery. The most important piece of information from both studies was the latitudinal shift in size-at-age along both the west and east coasts of Florida. Both studies concluded that gray snapper from northwest and northeast Florida were larger at age than those from South Florida. It was hypothesized that this was due to greater exploitation in South Florida. Age has been validated using bomb radiocarbon, gray snapper have a longevity of at least 28 years and it was noted gray snapper have low exploitation for fish caught off Louisiana (RD19- not listed above)

Two studies focused on the otolith chemistry of juvenile gray snapper (RD10 and RD14) from various areas of Florida, one study area ranged from Biscayne Bay to the Dry Tortugas up to Ten Thousand Islands and the other study along western Florida from the panhandle to Florida Bay, both studies found significantly different chemical signatures by area. These studies are useful in distinguishing nursery habitats, but further research is needed to make any conclusions in regards to the linkages between nursery and adult habitats.

One reproductive biology study (RD11) conducted off of Key West Florida reported larval planktonic stage of 21 days. In their study sites of two inshore, shallow water reefs and two offshore reefs, they noted what appeared to be a migration of the large adult fish from inshore to offshore for spawning. Sex ratio was 1.2:1 female-male and both sexes were 100% mature by 240 mm SL. Spawning occurred from late May to early September with peaks in July and August. Spawning duration was similar to results from adult gonads collected from the west FL shelf (RD-15).

A study of the juvenile gray snapper age and growth along the West Florida shelf (RD-15) determined a larval planktonic stage of up to 25 days. Back-calculated juvenile otoliths estimated that spawning occurred along the west Florida shelf in the summer months with a peak in mid-July, but juveniles from southwest Florida also had winter spawning dates, suggesting that spawning may have occurred outside the Gulf of Mexico. No significant differences in juvenile growth among areas were detected.

**Genetics:**

| **Reference Documents by the Genetics Group** | | |
|---|---|---|
| SEDAR51-RD04 | Conservation Genetics of Gray Snapper (*Lutjanus griseus*) in U.S. Waters of the Northern Gulf of Mexico and Western Atlantic Ocean | John R. Gold, Eric Saillant, N. Danielle Ebelt, and Siya Lem |

*Genetics Paper review Summary:*

Available data on genetic stock structure consist of the study by Gold J.R., Saillant E., Ebelt D., Lem S. (Copeia 2009 (2) 277-286) who sampled from 6 geographic populations (South Texas Port Isabel, South Texas Aransas, Louisiana Fourchon, West Florida in the area of Tampa, the Florida Keys Marathon, and southeast Florida Jupiter). The design was limited by a moderate number of markers (13 microsatellites and mitochondrial DNA) and small sample sizes (average n = 32.5 per locality). The study revealed very weak level of divergence among regions ($F_{ST} < 0.007$). Spatial Analysis of Molecular Variance indicated that the highest proportion of genetic variance was explained when grouping samples in 3 units (western Gulf, central and eastern gulf, southeast Florida) suggesting an isolation by distance pattern of population structure where genetic distance increases as a function of geographic distance. The hypothesis of isolation by distance was confirmed by spatial autocorrelation analysis of the dataset and is consistent with the life history of gray snapper that are relatively sedentary as adults but disperse pelagic larvae for a period of 30-40 days.

The panel discussed that the study showed that gray snapper populations show some spatial structure within U.S. waters but that the dataset was insufficient to disentangle the effects of isolation by distance and those of genetic discontinuities within the sampling surface if they exist. Accordingly, the occurrence of barriers to gene flow and their location cannot be determined. Also the sampling design was too weak to estimate dispersal parameters and infer the geographic distance between independent demographic stocks. A denser sampling is needed (and warranted) in order to achieve these objectives and delineate management units in U.S. waters.

**Recruitment:**

| **Reference Documents reviewed by the Recruitment Group** | | |
|---|---|---|
| SEDAR51-RD03 | Improved Ability to Characterize Recruitment of Gray Snapper in Three Florida Estuaries along the Gulf of Mexico through Targeted Sampling of Polyhaline Seagrass Beds | Kerry E. Flaherty-Walia, Theodore S. Switzer, Brent L. Winner, Amanda J. Tyler-Jedlund & Sean F. Keenan |
| SEDAR51-RD05 | Developmental patterns within a multispecies reef fishery: management applications for essential fish habitats and protected areas | Kenyon C. Lindeman, Roger Pugliese, Gregg T. Waugh, and Jerald S. Ault |
| SEDAR51-RD07 | Ingress of transformation stage gray snapper, *Lutjanus griseus (*Pisces: Lutjanidae) through Beaufort Inlet, North Carolina | Mimi W. Tzeng, Jonathan A. Hare, and David G. Lindquist |
| SEDAR51-RD10 | Recruitment dynamics and otolith chemical signatures of | Cecelia Lounder |

| | | |
|---|---|---|
| | juvenile gray snapper, *Lutjanus griseus,* among West Florida estuarine and coastal marine ecosystems | |
| SEDAR51-RD13 | Response of coastal fishes to the Gulf of Mexico oil disaster | F. Joel Fodrie and Kenneth L. Heck Jr. |
| SEDAR51-RD15 | Temporal and spatial dynamics of spawning, settlement, and growth of gray snapper (*Lutjanus griseus*) from the West Florida shelf as determined from otolith microstructures | Robert J. Allman and Churchill B. Grimes |
| SEDAR51-RD18 | Growth variation, settlement, and spawning of gray snapper across a latitudinal gradient | Kelly Denit and Su Sponaugle |

*Recruitment Paper Review Summary:*
No summary was provided

Tagging and Movements:

| **Reference Documents Reviewed by the Tagging & Movement Group** | | |
|---|---|---|
| SEDAR51-RD02 | Regional Correspondence in Habitat Occupancy by Gray Snapper (*Lutjanus griseus*) in Estuaries of the Southeastern United States | Kerry E. Flaherty & Theodore S. Switzer & Brent L. Winner & Sean F. Keenan |
| SEDAR51-RD08 | Biological response to changes in climate patterns: population increases of gray snapper (*Lutjanus griseus*) in Texas bays and estuaries | James M. Tolan and Mark Fisher |
| SEDAR51-RD09 | Returns from the 1965 Schlitz tagging program including a cumulative analysis of previous results | Dale S. Beaumariage |
| SEDAR51-RD12 | Climate-related, decadal-scale assemblage changes of seagrass-associated fishes in the northern Gulf of Mexico | F. Joel Fodrie, Kenneth L. Heck, Jr., Sean P. Powers, William M. Graham, and Kelly L. Robinson |
| SEDAR51-RD17 | Evaluating juvenile thermal tolerance as a constraint on adult range of gray snapper (Lutjanus griseus): A combined laboratory, field and modeling approach | Mark J. Wuenschel, Jonathan A. Hare, Matthew E. Kimball, and Kenneth W. Able |

*Tagging and Movement Paper review Summary*:
In preparation for the SEDAR 51 benchmark assessment, a tagging and movements working group was convened and tasked with reviewing five reference documents for information pertinent to determining unit stock of gray snapper. Summaries of the reference documents and the working groups' recommendations, as pertaining to gray snapper stock ID, are as follows:

**SEDAR51-RD02: Regional correspondence in habitat occupancy by gray snapper (*Lutjanus griseus*) in estuaries of the southeastern United States. Flaherty et al. 2014.**

The goal of this study was to characterize gray snapper habitat utilization throughout ontogeny in the estuarine systems along the Gulf and Atlantic coasts of Florida. To do so, they used long term (14 yrs) fishery independent monitoring data to construct indices of abundance and habitat suitability which were used to determine size-specific relationships between abundance, habitat, and environmental conditions. The key findings of the study were that juvenile and subadult gray snapper were only present in northern latitude estuaries when water temperatures were high (July through December) and that overall abundance also varied with latitude (increased abundance at warmer water latitudes).
Relevance to Stock ID: Study adds to the body of evidence that gray snapper are warm water species that do not tend to permanently occupy estuarine environments that experience prolonged periods of cold water; however, they will make seasonal use of cooler water habitats (Northern Gulf and South Atlantic estuaries) for spawning. The findings of this study provide some evidence to suggest that over winter water temperatures in the Northern Gulf of Mexico may produce a seasonal separation of the eastern and western portions of the stock, but one cannot conclude from this study that the Gulf of Mexico contains more than one stock of gray snapper. The disconnect between years of peaks in abundance of juveniles along the two coasts of Florida may indicate a lack of connectivity between the regions. Not definitive evidence of independent stocks, but it does reinforce the genetic data to separate the east and west coast of Florida.

**SEDAR51-RD08: Biological response to changes in climate patterns: population increases of gray snapper (*Lutjanus griseus*) in Texas bays and estuaries. Tolan and Fisher 2009.**

This study utilized long term (1978 – 2006) fishery independent monitoring data from the seven major Texas estuaries to explore how trends in gray snapper abundance relate to changes in climate patterns throughout the time series. The Study found that water temperatures in Texas estuaries have increased over the course of the monitoring program. The most significant changes to coastal water temperature were associated with higher winter minimum temperatures. Increased winter minimum temperatures were correlated with trends in gray snapper

abundance believed to be due to increased recruitment success and overwintering success of the cold water vulnerable gray snapper.
Relevance to Stock ID: Study adds to the body of evidence that gray snapper are warm water species that do not tend to permanently occupy environments that experience prolonged periods of cold water. In addition this study demonstrates that gray snapper abundance and range have expanded in the western Gulf of Mexico coincident with increasing water temperatures, with the increase in overwinter minimum temperature driving the range expansion. This study does not provide any direct evidence that eastern and western Gulf of Mexico gray snapper are separate stocks and provides no insight into whether Gulf and Atlantic gray snapper are independent stocks.

**SEDAR51-RD09: Returns from the 1965 Schlitz tagging program including a cumulative analysis of previous results. Dale S. Beaumariage 1969.**

This paper summarized the returns and any resulting analysis stemming from the 1965 Schlitz tagging program which tagged and released 58 species of fish in the Gulf and Atlantic coastal waters of Florida. Of primary interest to the study was estimating growth and movement of the species tagged. Fish were tagged and released in 4 Areas. Area A included southwest Florida from Hernando County to Everglades City, Area B was the southeast coast of Florida from Cape Canaveral to Key West, including Florida Bay, Area C was made up of the northeast coast from Fernandina Beach through Cape Canaveral and Area D encompassed the panhandle from Pensacola to Citrus County. Through the course of the study 176 gray snapper were tagged and released. Of these 50 were release in Area A, 119 in Area B, 4 in Area C, and 3 in Area D. Fifteen fish were returned with a mean time at liberty of 94.2 days. Only one of the returned fish showed any significant movement. This fish was released at the MacArthur Causeway in Miami and recaptured 30 nm south in a canal on the east side of Card Sound Road (Barnes Sound).
Relevance to Stock ID: Tagging data from the Schlitz study demonstrate that for the most part gray snapper do not undergo large scale movements and are likely to demonstrate strong site fidelity once they reach adulthood. This paper provided no evidence to support separating the Gulf into eastern and western stocks and no evidence for or against combining the Gulf and Atlantic populations into a single stock.

**SEDAR51-RD12: Climate-related, decadal-scale assemblage changes of seagrass-associated fishes in the northern Gulf of Mexico. Fodrie et al. 2010.**

This paper provided a comparative analysis of data collected on seagrass meadows in the northern Gulf of Mexico obtained during the 1970's and 2006-2007. Comparison of the datasets revealed numerous additions to the northern Gulf fish fauna as well as sizable increases in abundance for some previously observed species, including gray snapper. The paper hypothesized, and demonstrated through correlative analysis, that increases in faunal diversity and abundance in the northern Gulf was due to primarily tropical and sub-tropical species expanding

their ranges coincident with increasing trends in sea surface temperature associated with global climate change. Survey and temperature data from this study were collected in the summer and fall so it could not be determined if gray snapper are now overwintering in the northern gulf or undergoing seasonal expansions and contractions of range.

Relevance to Stock ID: Study adds to the body of evidence that gray snapper are warm water species that do not tend to permanently occupy environments that experience prolonged periods of cold water. In addition this study demonstrates that gray snapper abundance and range have expanded in the eastern Gulf of Mexico coincident with increasing water temperatures. This study does not provide any direct evidence that eastern and western Gulf of Mexico gray snapper are separate stocks and provides no information pertinent to determining stock ID between the Atlantic and Gulf portions of the gray snapper stock.

**SEDAR51-RD17: Evaluating juvenile thermal tolerance as a constraint on adult range of gray snapper (*Lutjanus griseus*): A combined laboratory, field and modeling approach. Wuenschel et al. 2012.**

The goal of this paper was to evaluate the hypothesis that juvenile thermal tolerance determines the northern limits of gray snapper range using a combined laboratory, field and modeling approach. In the laboratory, the study looked at both chronic and acute effects of cold water exposure to gray snapper. Acute expose to cold water resulted in death occurring around 7 degrees centigrade. The effects of chronic exposure to cold water were measured using cumulative degree days below 17 degrees (CDD17). When held in ambient temperature water, death occurred on average at 10.2 degrees centigrade and fish survived between 61.9 and 138.8 CDD17. The amount of time an individual survived was found to be positively correlated with size and it was estimated that the longest a juvenile could survive was 210 CDD17. Using the laboratory measured thermal thresholds and winter estuary temperature data, it was determined that the chronic threshold of 210 CDD17 was more limiting to gray snapper range than the acute threshold of 7 degrees.

Relevance to Stock ID: This study provided insight into the mechanism by which thermal stress limits gray snapper range; however, it did not provide any useful information for determining whether the Gulf and Atlantic populations of gray snapper are separate stocks or whether the eastern and western Gulf populations should be separated or combined.

## Webinar Summaries:

*Summary of the November 14, 2016 Stock ID webinar*

**Life History:**

*Age and Growth:*

- Latitudinal differences in growth were determined along both Florida west and east coasts
- Age samples collected through TIP and MRIP can be divided at the County of landing level, but by larger areas when collected through the Headboat Survey if needed
- Fishing area grids used for determining where fish are caught are complicated and vary between data sources
- Results from an updated age validation study will be available for data workshop.

*Reproduction:*

- Little new information on reproduction is available; any reproductive parameters will be updated for data workshop
- CMS modeling may be possible if spawning aggregation locations are known
- There is evidence that adults move from inshore to offshore reefs to form spawning aggregations but it is not known which direction

*Otolith Microchemistry:*

- Studies did find regional signatures
- There is limited information from these studies to aid in Stock ID, as studies focused on juveniles with limited linkages to adults

***Recommend do not split Monroe County

**Genetics:**

Relatively low sample sizes in study
Study indicated three units:

- Western Gulf
- Central/Eastern Gulf
- East Florida

Split maybe due to distance alone; more sampling is needed to further examine this possibility

***Data suggest that, given the info in hand, there is a difference between the Gulf of Mexico and the east coast of Florida.

***Genetics data does not give a clear picture where the split occurs between the Florida Keys and Tequesta, FL nor between Port Fourchon, LA and Port Aransas, TX

**Tagging and Movements:**

- Studies indicated that there is little movement by adult fish
    - Only one fish had any significant movement (from Miami/Dade toward Monroe County)
- Recent FWC tagging data also indicate little long distance movement

- Many of the studies were focused on range expansion or thermal tolerances
- One study noted that there was a disconnect between years of peaks in abundance of juveniles along the two coasts of Florida; may indicate a lack of connectivity between the regions

**Recruitment:**
Papers available for review contained little information pertinent to the discussion of Stock ID, particularly the issue of regional differences between the Gulf of Mexico and South Atlantic.
Papers did contain information that may prove useful in providing ways to handle recruitment in the assessment.

- Habitat descriptions
- Differences in growth of pre-recruits with latitude

**General Recommendations**

**Recommend that Gulf of Mexico and South Atlantic should not be combined into one assessment.**

- Genetics study indicates difference between Gulf of Mexico and the South Atlantic
- Tagging data indicates limited movement of adult fish

**Recommend that all Monroe County data be included in the Gulf**

- Genetics study indicates difference between Gulf of Mexico and the South Atlantic
- Issues with separating/classifying life history samples in Keys (fish landed in Monroe County) to Gulf of Mexico or South Atlantic; based on where the fish was reported to have been caught and how the fish landed data field (grid/area/etc.) is categorized
- MRIP places all Monroe County in Gulf for reporting, even though the landings can be separated out from info from State of Florida

Issue of potential East/West Gulf of Mexico Split to be discussed on next webinar: December 7th, 1pm eastern

*Summary of the December 7, 2016 Stock ID webinar*

The working group revisited the recommendation from the November 14th webinar regarding conducting a separate Gulf of Mexico assessment. Issues that were raised were:

- Uncertainty where to "draw the line" between the Gulf of Mexico and South Atlantic

- Genetics study had small sample size/inadequate spatial coverage to define where the differences between Gulf of Mexico and South Atlantic occur
- Known spawning aggregations south of Key West which may provide larvae to both regions
- Concern that including all of Monroe County in the Gulf of Mexico was more for convenience rather than stock information
- Concern of moving away from Council boundaries without strong statistical inference and how that will affect allocations of the resource

An alternative recommendation was put forward:
***Since we can not differentiate the biological stock between the Gulf of Mexico and South Atlantic, assume one biological stock throughout the range of gray snapper, leading to one assessment using all of the available data and allowing the managers to partition the resource after the assessment as they see fit.***

The following points were raised during the discussion of this alternative recommendation:

- The analysts cautioned that we need to be mindful of how the data can be partitioned
- Biological information needs to be strong to imply stock structure
- Larval supply for western Gulf comes from Mexico; no data from Mexico are not included in the assessment, so not sure how important any "jurisdictional line" is with regards to recruitment
- Need to create an assessment that is supportable with the data we have, and captures to the best of our ability, our understanding of the biology of the stock.
- The decision for putting Monroe County in the Gulf followed the genetics information that indicated that the bulk of the Keys belonged to the Gulf of Mexico "stock".
- Some Panelists indicated that there seems to be a lack of biological data and we may not be able to do an adequate assessment for either stock if we split Gulf and South Atlantic
- The only reason to split stocks is if we think there are different exploitation levels that may lead to different MSY and spawning stock biomass estimates
- It was pointed out that if the one stock, one assessment recommendation is carried forward, it would most likely cause a delay in the assessment as the South Atlantic Council had not been involved in preparation stages of the assessment thus far (approval of Terms of Reference, Schedule, appointment of participants)
- Group was concerned about delaying the assessment to include Atlantic data
- Information indicated that there were differences in juvenile recruitment patterns on the east and west coast of Florida, so something different may be going on and connectivity may not be that strong

A second alternative recommendation to do a Gulf of Mexico assessment with the split being along the Council boundary was briefly discussed. Given that the two previous recommendations (Gulf assessment including all Monroe County data and one assessment encompassing all available data from Gulf of Mexico and Atlantic) indicated that the current Council boundary may not be appropriate, this recommendation was not given a great deal of consideration.

***After much discussion, the Working Group decided to retain the original recommendation from the November webinar: Gulf of Mexico assessment with all of Monroe County included in the Gulf assessment.***

- Different pulses in juvenile recruitment on the east and west coast of Florida
- Genetics information
- Small home ranges
- Lack of additional information to confirm the need for a single stock assessment
- Don't have enough evidence to depart from the previous recommendation

**East/West Gulf of Mexico Split**

The Working Group also discussed whether the Gulf of Mexico information should be split into two separate assessments.

- little biological information is available in the western region
- few landings in the western Gulf of Mexico
- It is believed that most gray snapper in Texas come from Mexican
- no information on recruitment from Mexican waters

**Recommendation: The information we have in hand does not support splitting Gulf of Mexico into east/west assessments**

**Research Recommendations**

- Further genetics research is needed to determination where along the east coast of Florida the difference occurs
- Additional information on spawning aggregations and larval patterns would be informative