Standing, Reef Fish, Ecosystem, and Socioeconomic SSC Hybrid Meeting Summary September 27 – 30, 2021

The hybrid meeting of the Gulf of Mexico (Gulf) Fishery Management Council's (Council) Standing, Reef Fish, Ecosystem, and Socioeconomic Scientific and Statistical Committees (SSC) was convened at 8:30 AM EDT on September 27, 2021. The agenda for this meeting was approved with the addition of a discussion about the 2022 National SSC meeting, and the minutes from the August 9 – 11, 2021, webinar meeting were approved as corrected. Verbatim minutes from past SSC meetings can be reviewed here.

SSC Representative to the October 2021 Council Meeting

Dr. Jim Nance will serve as the SSC Representative at the Council's October 25 – 28, 2021, hybrid meeting in Orange Beach, Alabama.

Final Draft – Scientific and Statistic Committee's Best Practices and Voting Procedures

Mr. Ryan Rindone (Council staff) reviewed the final draft of the SSC's best practices and voting procedures, which are designed to guide the SSC's adherence to National Standard 2 (NS2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). NS2 specifically addresses the peer-review process for the SSC and its recommendation of the best scientific information available (BSIA). This final draft was developed in consultation with NOAA General Counsel and provides flexibility should SSC members recuse themselves from voting on whether a stock assessment or research project constitutes BSIA and is appropriate for management advice. An SSC member asked whether co-principal investigators for the Great Red Snapper Count (GRSC) should vote on whether the LGL Ecological Associates study (Item XIII) should be considered the BSIA for that region. The SSC agreed that the GRSC co-principal investigators should be able to vote unencumbered on the LGL Ecological Associates study.

> **Motion: To adopt the SSC Best Practices and voting procedures as written.**
>
> ***Motion carried with no opposition.***

Decision Tree for Making Informed Decisions on Parameters for Yield Projections

Dr. Katie Siegfried (Southeast Fisheries Science Center [SEFSC]) presented a decision tree for determining projection settings more explicitly. Example projection runs using greater amberjack as a case study were demonstrated using new R statistical code to supplement Stock Synthesis forecasting capabilities and considering differing allocation scenarios.

Projections require several decisions to be made: years over which to average fishing mortality and selectivity, retention parameters, treatment of recruitment and interim landings, and computation of a sector allocation ratio, if applicable. Forecasted recruitment estimates can be calculated within the model or measured by steepness observed using the stock-recruitment curve. In the model-based scenario, the time period used to inform recruitment forecasting must be determined. This decision can be difficult if observed contemporary recruitment greatly varies from historical recruitment which could indicate a variety of stock states (e.g., overfishing, regime shift).

When exploring whether to use maximum sustainable yield (MSY) or a proxy, the SSC considers whether the model is using a well-estimated steepness value. If a spawning potential ratio (SPR) proxy for MSY is specified and a new assessment can estimate steepness, the SSC may make a recommendation about the use of a proxy. Diagnostics such a likelihood profiles or contour plots (two-dimensional likelihood profiles) can be used to validate this decision by considering the three stock recruit parameters: steepness (h), virgin recruits (R_0), and the uncertainty of the estimates of recruits (sigma_R) with the goal of identifying a global minimum in the likelihood phase space that would be similar to the model estimate of steepness.

In past, the SEFSC used the spawning stock biomass (SSB) ratio (SSB/SSB_0) or the SPR ratio ($SSB/SSB_{SPR30\%}$), acknowledging that there has been very little discussion of the differences or merits of each approach. When projected recruitment is close to R_0, these two targets yield similar results. Affected parameters from these decisions include changes to benchmarks and expected stock size, expected short term and long-term yield, revision of any rebuilding target, and consideration of how changes to allocations can change benchmarks and the resulting yield.

The SSC asked about the incorporation of discards and bycatch in the projections and the incorporation of any economic effects. Dr. Siegfried replied that discard mortality and bycatch are considered in model-generated projections; however, the incorporation of economic effects are not presently informing the models. Discussions are expected later at this SSC meeting to better inform allocation decisions considerate of economic data.

The SSC asked about the use of recruitment data in projections and whether the use of the stock recruit curve, with its standard deviations, would improve understanding of uncertainty inherent to the model in the absence of a robust stock-recruit relationship. The SEFSC replied that when the stock-recruitment relationship is poorly understood, the projections have typically used a fixed value of steepness, which constrains the estimated uncertainty.
An SSC member commented that climate change is likely to have a primary influence on recruitment estimates earlier in the time series; therefore, consideration of years for calculating average recruitment over a longer time period may be necessary to capture those broader effects. Dr. Siegfried agreed and reiterated that modeling the differences between the decisions related to the recruitment timeline used in the projections was important for understanding these effects.

Dr. Nathan Vaughan (Vaughan Analytics) presented new R statistical code for determining yield projections for stocks with sector allocations. There are several assumptions which are highly influential to stock assessment forecasting for greater amberjack: future recruitment patterns define stock productivity and variability; fleet selectivity and retention functions; fishing sector allocations; and, benchmark targets (e.g., fishing mortality (F) at MSY, MFMT, F at the rebuilding target of 2027 ($F_{Rebuild}$), F at optimum yield (F_{OY}), and the minimum stock size threshold (MSST)). The new code achieves multiple objectives: achieves target benchmarks for yield or stock status such as MSY or SPR30%; estimates a static F that achieves benchmarks at equilibrium; projects fishery at MFMT in every year; project and catch with constant sector allocation and fleet-specific effort. For greater amberjack, fishing to a target of $SSB_{30\%SPR}$ under different recruitment scenarios results in variable estimates of forecasted recruitment, SPR, and allowable future fishing mortality. An SSC member asked for a comparison analysis to ascertain how the different projection approaches affect stock benchmarks. Dr. Vaughan said, in the case of greater amberjack, the effect is considerable, and such a magnitude of effect may not be as pronounced for other species, or for species for which steepness is fixed.

Dr. Vaughan commented that if equilibrium catch projections were calculated separate from benchmark calculations, additional considerations would be needed to avoid unanticipated effects. Council staff asked about the effect of recent recruitment estimates that were higher than the long-term average. Dr. Vaughan replied that doing so would provide an inverse result, in that increases in catch could be estimated to drive recruitment down, resulting in lower catch limits in time.

Dr. Vaughan reviewed the default (constant annual fleet-specific effort) approach to addressing sector allocations in Stock Synthesis (SS). The SEFSC's previous approach to achieve the benchmark target used an iterative search for the target benchmark on top of the base SS allocation adjustment by adjusting the target benchmark input in SS until the achieved benchmark equals the true target benchmark. Dr. Vaughan cautioned that MSY or F_{MAX} (MSY per recruit) benchmarks cannot be achieved with this approach and noted that this approach does not ensure that annual F targets are achieved.

Dr. Vaughan next detailed the new approach for projecting yields from the base model, which uses SS to input fixed fleet- and year-specific Fs by iteratively adjusting fleet-specific annual F for 100 years of projections to achieve all forecasting targets. This new approach achieves the benchmark target, annual F targets, allocation targets, and relative effort targets simultaneously, and is functional for all benchmark targets (SSB%, SPR%, MSY, F_{MAX}). A combined all-target multiplier is then used to adjust SS input values and the forecast is re-run before again comparing achieved and target outcomes; it is at this point that the benchmark are modified by the application of the code. The new approach can achieve multiple forecasting targets, including the overfishing limit (OFL), acceptable biological catch (ABC), and $F_{Rebuild}$.

Review of SEDAR 70: Gulf of Mexico Greater Amberjack Stock Assessment

Dr. Siegfried provided an overview of the projection settings for greater amberjack from the January 2021 SSC meeting:

Parameter	Value	Comment
Relative F	Average from 2016 – 2018	Average relative fishing mortality over terminal three years (2016-2018) of model
Selectivity	Average from 2016 – 2018	Average fleet specific selectivity estimated over terminal three years (2016-2018) of model
Retention	Average from 2016 – 2018	Average fleet specific retention estimated over terminal three years (2016-2018) of model
Recruitment	Average from 2009 – 2018	Average recruitment over last 10 years
2019 and 2020 Landings	158.11 mt (Commercial Vertical Line), 12.4635 mt (Commercial Longline), 44.9437 thousands of fish (Charter/Private), 1.3209 thousands of fish (Headboat)	Average 2017-2019 landings
Allocation Ratio	27:73	commercial:recreational

In the SEDAR 70 model, the steepness profiles indicated that the model-identified lower likelihoods for steepness showed that values between 0.7 and 0.8 were equally likely. The lowest likelihood was at a steepness value of 0.777. Numerous retention blocks were used for greater amberjack to accommodate management modifications through time. Specific to the revised projections for greater amberjack, the recruitment facets of the projections settings that are being reconsidered are the timeline for fixing recruitment and the treatment of recent landings. For the latter, excluding terminal years of data has an effect on the projections; this decision may have merit if the year(s) to be excluded represent some atypical retention scenario (e.g., due to a change in effort unrelated to management, like COVID).

Differences in the estimated numbers of recruits (millions of fish) varied based on the time series of recruitment used. If using the most recent 10 years (2009 – 2018), the assumption becomes that the stock is now less productive than in the past, and recruitment is estimated at 1,650 million fish. If using the long-term average (1970 – 2018), recruitment is estimated at 2,805 million fish. If using the "data rich" time period (1984 – 2018), recruitment is estimated at 2,156 million fish. High uncertainty is observed in the annual recruitment estimates pre-1984 and from 2016 – 2018.

An SSC member commented that the SSC normally recommends catches for three, and not more than five, years into the future. Under these circumstances, looking at the recent recruitment to inform the subsequent three to five years of catch recommendations is appropriate, because it reflects the most recent state of nature for the stock's recruitment patterns. In the short-term, it may not be appropriate to assume a fixed level of recruitment from a longer-term average, as such an estimate may be too optimistic or pessimistic, depending on the data. Specific to greater amberjack, this may mean that a lower equilibrium yield must be accepted in the short-term, as it best reflects the current state of nature; however, as greater amberjack is continually reassessed, the SSC will be able to continually re-evaluate recruitment through time. Dr. Siegfried cautioned that using the more recent recruitment for greater amberjack will result in lower yield projections, and assumes a lower rebuilding threshold because the recent recruitment implies a regime shift to a stock that is no longer as productive as in years past. Implying this regime shift means rebuilding will be faster at the same fishing mortality rate because the stock doesn't have to reach a higher rebuilding threshold. The SSC member cautioned that fixing some model parameters, and also using a model-derived SRR, as a source of considerable uncertainty. Fixing steepness is expected to have a predictable effect with respect to SPR; thus, fixing steepness and using a model-derived SRR may be masking the model's true uncertainty.

An SSC member inquired about the new projection procedure in association with the requirements of the MSA. If there is a regime shift assuming that the stock will not return to its historical productivity, would that conflict with the objectives of MSA for managing stocks? Dr. Siegfried indicated that this aspect had not been yet been discussed. It is unclear how a dynamic R_0, as representative of a regime shift, would integrate within the rebuilding requirements of the MSA. An SSC member asked how the benchmark reference points estimated from the model yield projections can apply to the stock's condition in the future. Dr. Siegfried replied that the SSC needed to determine to what level the stock would be considered rebuilt using the settings applied to the recruitment and other factors for the yield projections.

An SSC member noted that using the approach with a stock experiencing a regime shift presents a special case. There may be merit in projecting an OFL using a long-term time series to inform recruitment when the stock was at a historical state; however, use more contemporary years for forecasting recruitment within a regime shift period to calculate ABC. It is then likely that the recommended OFL may be substantially higher than ABC. These dynamics will need to be accurately communicated to the Council to aid in interpretation of the catch advice.

Dr. Siegfried compared the results of using the revised projections code by Dr. Vaughan versus the previously used method from January 2021. Under the new method, the stock is no longer expected to be overfished relative to the MSST; however, the stock is not expected to completely rebuild to SSB_{MSY} ($SSB_{SPR30\%}$) by 2027. This result contradicts the stock status reviewed by the SSC in January 2021, which found the stock to be overfished and undergoing overfishing. Council staff clarified that the stock can be considered to no longer be overfished, yet not rebuilt, as the latter requires the ratio of the $SSB_{Current}$ to the SSB_{MSY} to be greater than or equal to 1.

SSC members discussed the plausibility of the estimates of $SSB_{Current}$ against the virgin SSB (SSB_0), the MSST, and SSB_{MSY}. The SSC questioned whether the stock could ever rebuild to the rebuilding target at SSB_{MSY}, given the current assumptions about SSB_0 and R_0. Dr. Siegfried noted that the methods in the assessment were accepted, and that if the settings for the projections are modified by the SSC, then adequate justification should be recorded and new projections can be generated. An SSC member asked about the degree to which the data used in the SEDAR 70 assessment focused more so on the eastern or western Gulf. Dr. Siegfried and Council staff replied that the fishery-independent data were solely from the eastern Gulf via several video surveys.

An SSC member noted that the SSB_0 is the same as that calculated in SEDAR 70; however, the ratio of SSB to SSB_0 is less than half of that observed in SEDAR 70. He contended that this scenario may not be a regime shift, but rather recruitment overfishing. Dr. Siegfried referenced a peer-reviewed journal article (Klaer et al. 2015[1]) which has guided the SEFSC's discussion of

[1] dx.doi.org/10.1016/j.fishres.2015.03.021

what constitutes a regime shift and will provide that article to the SSC. SSC members encouraged additional discussion about the probability of a regime shift for greater amberjack at a future meeting.

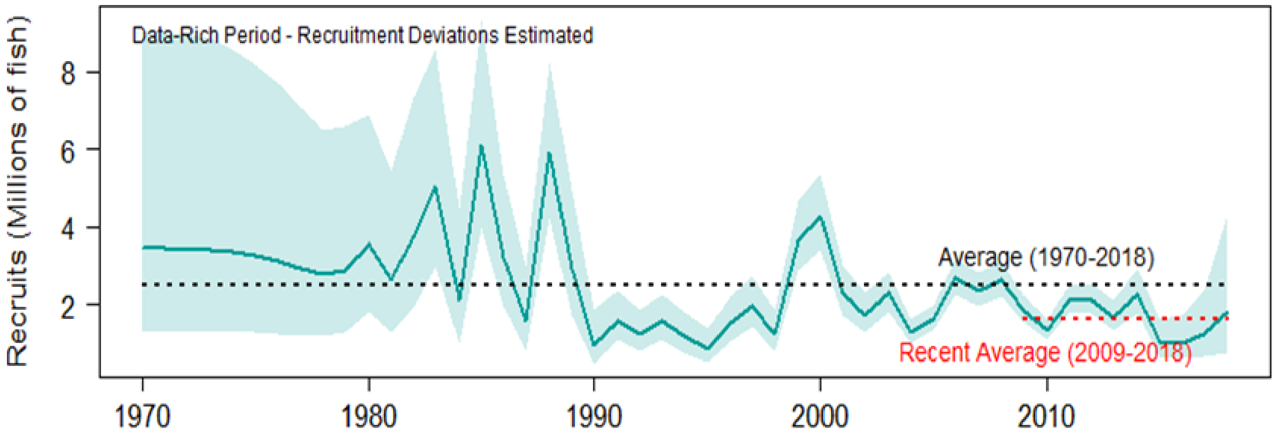

Figure 1. Recruitment for Gulf greater amberjack from SEDAR 70. Dotted lines indicate long-term (black) and short-term (red) averaging periods.

Dr. Siegfried asked that the SSC provide input on how to set up the projections for SEDAR 70 for generating catch advice for greater amberjack and to discuss the treatment of recruitment in the future. Further, the use of SPR proxies as opposed to using a proxy level of depletion as a target should be discussed.

Projections Parameter Definitions for SEDAR 70: Gulf of Mexico Greater Amberjack		
Parameter	**Value**	**Comment**
Relative F	Average 2016-2018	Same as SEDAR 70
F Current	Geometric mean 2016-2018	Same as SEDAR 71
Selectivity	Average 2016-2018	Same as SEDAR 72
Retention	Average 2016-2018	Same as SEDAR 73
Recruitment (OFL)	Average 2009-2018	Same as SEDAR 74
Recruitment (ABC)	75%SPR30	Same as SEDAR 75
Landings	Average 2017-2019	Used in 2020-2021
Allocation ratio	27:73	Plus, allocation ratio requests
Steepness	0.777	-

An SSC member was cautious about assuming future recruitment would increase so optimistically to allow for setting recruitment at a level equivalent to the long-term average. The SSC then drafted a table detailing its preferred projection settings for SEDAR 70, noting which settings would mirror SEDAR 70 and where those settings differed. Discussion of the time period to use for recruitment was discussed, with the SSC noting the consequences of selecting the recent or longer time series of data. Specifically, the SSC did not want to set catch advice which was overly optimistic based on a higher average recruitment than maybe biologically plausible.

The SSC discussed considering recruitment specific to setting the OFL and the ABC separately. An SSC member thought revising the data-rich period from 1984 – 2018 to 1990 – 2018 would be appropriate, as doing so would omit years in the data where recruitment oscillates strongly and data collection methods were more varied. Dr. Siegfried replied that the inclusion of 1984-forward in the "data rich" period was taken from the deliberations from SEDAR 70, in which those years ought to have been modified otherwise if the data merited doing so. An SSC member suggested beginning the recruitment period in 1995 when data collection became species-specific for jacks.

Other SSC members commented that they thought setting the OFL based on a longer-term average recruitment had merit, as that would be the rebuilding goal; in contrast, the ABC could be set to a more recent recruitment level to better reflect contemporary stock dynamics and the associated effects from fleet-specific selectivities and retention parameters. Ultimately, the SSC decided to use the recruitment period of 2009 – 2018 to inform projections of OFL. Dr. Vaughan cautioned that, since the prescribed time period for the OFL is so close to the rebuilding date of 2027, the $F_{Rebuild}$ yield projections are not much decreased from the OFL yield projections. As such, the SSC maintained setting the ABC equivalent to 75% of $SSB_{SPR30\%}$, as was done when the SSC last revised greater amberjack catch limits following its initial review of SEDAR 70.

The SSC further reviewed revised projections for greater amberjack on Thursday, September 30. Dr. Siegfried reviewed the SSC's earlier preferred settings for the projections. OFL and ABC projections based on the sector allocation options requested by the Council were compared, with the ABC projections performed to rebuild the stock under each scenario by 2027. The current rebuilding plan uses the stock recruitment relationship (SRR) curve; deviating from that decision reduces the expected long-term yield and recovery target. Generally, as additional fish are allocated to the recreational sector, the overall predicted yields are reduced. By using recent years of recruitment for greater amberjack, a regime shift to a lower level of stock productivity is inferred. This is expected to result in fewer recruits, a reduced stock size, and lower yields in the long-term. As previously discussed, a lower than expected stock size under a regime shift scenario will be easier to achieve.

An SSC member asked if the projections had been performed with the long-term recruitment average, expressing some hesitancy in accepting that a regime shift has occurred. The SSB for greater amberjack has oscillated, but remained generally consistent, since the 1990s. The SSC recognized that defining the conditions of a regime shift is difficult. Changing the assumptions about recruitment were noted to affect the decisions to be made regarding how to define the ABC. The SSC thought that it would be more appropriate to continue using the current F_{MSY} proxy of $F_{SPR30\%}$, also using the current SRR curve. The SSC also thought that the recent recruitment period (2009 – 2018) was more appropriate for informing recruitment in the near-term, while still targeting a rebuilding date of 2027. The SSC also recognized the reductions necessary for the fisheries, and thought that careful consideration would be needed in determining future management of catch and effort.

> **Motion: To continue with the 30% SPR reference point rebuilding projections using the spawner curve recruitments and ABC based on the low recruitment scenario (2009-2018) for greater amberjack.**

Motion carried 14-8, with three abstentions.

Motion: the SSC determined that the SEDAR 70 operational assessment of GOM greater amberjack represents the best scientific information available and based on assessment results, as of 2018, the stock is undergoing overfishing and is overfished.

Motion carried 17-5 with three abstentions.

Terms of Reference for Gulf of Mexico Migratory Group Spanish Mackerel Operational Assessment

Mr. Rindone reviewed the terms of reference for the operational assessment for Gulf migratory group Spanish mackerel. The SSC did not have any edits to the terms of reference and approved them as written.

Scope of Work for Gulf of Mexico Migratory Group Cobia Operational Assessment

Mr. Rindone reviewed the scope of work for the Gulf migratory group of cobia (Gulf cobia). An SSC member asked about the market value of cobia and whether it was a highly sought species in the Gulf. Mr. Rindone replied that Gulf cobia is composed of metapopulations throughout its range, and the density of those populations is not directly proportional to the spatial coverage of those metapopulations, thereby affecting market value and species popularity with anglers. It is a desirable species but infrequently caught by anglers. SSC members proposed several edits to the scope of work:

- Include under TOR #2: "Incorporate social and economic information into the stock assessment considerations as practicable."
- Include under TOR #4: "MSY proxy = yield at F_{MSY} or proxy ($F_{SPR30\%}$)".
- Include under TOR #4: "For the purposes of yield projections, for selectivity and retention, use the average of the most recent three fishing years."

Following these edits, the SSC approved the scope of work for Gulf cobia.

Red Tide Ecosystem Modeling

Dr. David Chagaris discussed the findings from the ecosystem model (i.e., Ecospace) to understand the effects of red tide mortality in West Florida Shelf fisheries focusing on gag grouper. Red tide events occur regularly on the Gulf coast of Florida with severe events having negative effects on marine life. Red tide mortality has been incorporated in previous gag and red grouper stock assessments, although there is still uncertainty as to how to account for these effects in Stock Synthesis (SS) and projections. The goal of this study was to improve how to account for the effects of red tide when assessing and managing reef fish stocks.

Model inputs included fisheries independent data, environmental data, habitat information, and satellite-derived ocean-color data. The development of monthly maps accounts for bloom duration, spatial overlap, and food web effects. Red tide maps were created based on satellite-derived imagery and ground-truthed with *Karenia brevis* concentration from Florida Wildlife Research Institute (FWRI) water samples. FWRI's data was also used to estimate bloom severity, keeping in mind that concentration of K. brevis is not correlated with toxicity of the bloom.

When compared to other SEDAR assessments, Ecospace seems to capture similar long-term trends as SS. Model validations runs for blooms in 2005 and 2014 indicate that Ecospace may be potentially over estimating the impacts of red tide during that year, while underestimating the impacts of the 2014 bloom. The extent and location of the bloom may be influencing these results. The 2005 red tide event occurred most of the calendar year and had a larger spatial footprint than the red tide event observed in 2014. The estimated mortality for the 2005 bloom was high for most species and age groups. The 2014 red tide event concentrated in the FL Big Bend region during July and ending in September of the same year, and suggested less mortality of juveniles. Additionally, the 2018 bloom remained mostly in nearshore waters of the southwest Florida coast like influencing relatively higher natural mortality (M) on juveniles. Estimated of the 2019 – 2021 ongoing event also suggest a nearshore bloom. Although M associated with the 2029 – 2021 is lower than the previous examples, the model estimates an increase in M as the bloom persists.

An SSC member asked about foraging and how this was captured by the model. Dr. Chagaris indicated that the model's grid-cells have food web data which can be analyzed, assuming that gag will consume prey species available within the grid even after migrating away from the bloom.

Another SSC member asked Dr. Chagaris' opinion of red tide magnitude and population-level impacts that may affect abundance estimates. Dr. Chagaris discussed the limitations of the fisheries independent monitoring, which are not designed for these types of localized events, and may not provide an accurate snapshot of the bloom effects. The SSC also asked about the uncertainty associated with recreational fleet data. Effort from the recreational fleet tends to be larger nearshore. Dr. Chagaris responded that the model calculated effort dynamics based on profitability of fishing within the grid-cell. The model does not require effort data to be monthly as there is flexibility in how it can be integrated into the model. It was also noted that the model also captures effort variability through time.

Review of SEDAR 72: Gulf of Mexico Gag Stock Assessment Report

Dr. Lisa Ailloud (SEFSC) presented the data inputs, model, results, and projections from the SEDAR 72 operational assessment of Gulf gag grouper. Gag, a protogynous hermaphroditic species, was last assessed in the Gulf in SEDAR 33 Update (2016; SEDAR 33U[2]) using female-only spawning stock biomass, and was determined to be sustainably managed at that time.

Several data inputs used in SEDAR 33U were modified in SEDAR 72. Most notably was the change in the recreational catch and effort data to the Marine Recreational Information Program's

[2] https://sedarweb.org/docs/suar/GagUpdateAssessReport_Final_0.pdf

Fishing Effort Survey (MRIP-FES) from the previous MRIP Coastal Household Telephone Survey (CHTS). Gag is vulnerable to episodic red tide events, and SEDAR 72 accounted for observations of these disturbances directly within the model. Lastly, improvements were made to improve retention and the recreational fleets' selectivities, and better quantify commercial discards by differentiating between black grouper and gag. Updated information on the maturity schedule, sex transition timing and these influences on the observed sex ratio were informed by recent research. The base model for SEDAR 72 found gag to be overfished and undergoing overfishing for both females-only and sexes-combined estimates of spawning stock biomass (SSB).

The model time series ranged from 1963 through 2019. Removal data were collected from the commercial vertical and longline fleets, and the recreational for-hire, private, and headboat fleets. Fishery-independent data came from the Reef Fish Observer Program, the Headboat Observer Program, the Panama City and Pascagoula Laboratories video surveys, and the Age-0 survey were collected from three databases across the Gulf. Maximum age for gag was increased from 31 to 33 years, with the target M calculated using Then *et al*. (2015[3]). Recent examination of sex transition timing indicated the transition of females to males occurs later than previously thought (revised to age 4) with a 50% probability of transition by age 11.6 years. The female-only iteration of SSB was used in the base model, with a sensitivity run completed using sexes-combined.

Recreational catch and effort data were updated to the MRIP-FES data currency, with a coefficient of variance (CV) of 0.2. Historical for-hire catch ratios (charter and headboat) prior to 1981 were recalculated to resolve overestimation issues. For private recreational landings, a marked overestimation was observed in 1983 and was recalculated as the geometric mean of the fishing years 1981, 1982, 1984, and 1985. The migration to MRIP-FES demonstrates considerable increases in the magnitude of private recreational catch and effort (approximately 100%), with substantially smaller differences observed in the for-hire fleets for the years 1985 forward. Recreational discards (in thousands of fish) are dominated by the private vessel fleet, which is estimated to be discarding an order of magnitude more gag grouper than the for-hire fleets. Private vessel discards are estimated to be higher in SEDAR 72 than SEDAR 33U due to the changeover to MRIP-FES and the discard mortality estimate of 12% was retained.

Commercial landings data were largely unchanged from SEDAR 33U, with the exception of some species misidentification corrections updated to resolve differences between black and gag reported landings. The coefficients of variation (CVs) for the commercial landings were set at 0.05 for data from before 2010 (pre-individual fishing quota [IFQ] program implementation), and to 0.01 after 2010. Commercial discards (thousands of fish) have decreased precipitously since 2005 for the vertical line fleet and increased since 2010 for the longline fleet; however, commercial discards remain a small fraction of the total discards for all fleets. The commercial discard mortality of 25% was retained.

Length composition data suggest that the commercial fleets land relatively larger gag grouper than the recreational fleet, while the majority of recreational discards are near or below the minimum size limit of 24 inches total length (TL). Commercial discards occur across a wider length distribution, which is likely due to regulatory effects from the Individual Fishing Quota (IFQ)

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[3] https://academic.oup.com/icesjms/article/72/1/82/2804320

program. Age composition data from the commercial and recreational fleets show patterns of strong age classes moving into and through the fishery beginning in 1992, 1996, 2000, and 2009.

SEAMAP Pascagoula Lab video survey data (n = 148 measured) observed fish between 25 cm (10 inches) and approximately 130 cm (51 inches) TL but are limited by small annual sample sizes. The Panama City Lab video survey data captures smaller fish (n = 122 measured), between 20 cm (8 inches) and 100 cm (39 inches) TL. A red tide episodic mortality index was updated to include all ages (0+), with mortality estimated by age for red tide years between the 2002 and 2018 fishing years; with the greatest mortality observed in 2005.

Dr. Ailloud reviewed the stepwise progression from SEDAR33U to SEDAR 72, including the updated data inclusions, adjustments to selectivities, red tide analyses, and model variability. This stepwise approach was critical to ascertain and compare the influence of model parameters on resulting outputs.

Model fits to recreational landings data oscillate around the observed values, largely due to the setting of a more liberal CV of 0.2 than applied in SEDAR 33U. Model fits to the commercial data are more precise as well (CV = 0.05 pre-2010, 0.01 for 2010+). Landings from both fishing sectors have decreased since the 2000s. Model fits to recreational discard data are improved, though values are approximately twice that observed for SEDAR 33U. Commercial vertical line discards are slightly overestimated, and longline discards underestimated; however, commercial discards are a small fraction of the total discards, which come predominantly from the private recreational fleet.

Fleet-specific selectivities were modified from SEDAR 33U, allowing the model to freely estimate these selectivities by fleet. The for-hire fleets were found to be selecting for somewhat smaller fish than observed in SEDAR 33U. Gag is initially selected by the commercial vertical line fleet at a smaller size than the longline with both following a logistic pattern. The charter and headboat fleet selectivities are dome-shaped, suggesting that deep offshore habitats may serve as refugia from these fleets. Private recreational selectivity was constrained to be dome-shaped, decreasing to zero at the largest and oldest length bins to reflect the lack of samples from that fleet in those length and age ranges. However, the assumption of zero selectivity at the largest sizes is likely incorrect as recreational anglers with capable large offshore vessels likely launch from private docks which are not sampled by the MRIP Access Point Angler Intercept Survey.

Length fits were improved for the Pascagoula Lab video survey. Generally, fits to length and age composition data can be poor when sample sizes are very low. Fits to age composition data were similar between SEDAR 72 and SEDAR 33U. Annual exploitation peaks in 2005, 2014, and 2018 with red tide events contributing to those removals as a “bycatch” fleet. Total exploitation is predominantly from the private recreational fleet, with annual peaks of red tide mortality of 13.67 million fish in 2010, 3.34 million fish in 2014, and 1.3 million fish in 2018.

Estimates of total biomass and female-only SSB were both observed to be depleted to previously unseen levels in the model terminal year of 2019. Recruitment has remained depressed for gag since the mid- to late-2000s with steepness fixed at 0.855. Further, the male proportion of the gag stock is estimated to comprise just 1.4% of the total population; whereas, the virgin condition of the stock is estimated to have been comprised of approximately 32% males.

An SSC member questioned the benefit of going further back in time beyond 1986 to generate historical estimates of catch and effort which is considered to be a period of less precise and accurate data. Dr. Ailloud replied that modification to the time series was beyond the scope of an operational assessment. She acknowledged that the recreational data prior to the MRIP period (pre-1981) were not thought to be accurate; however, commercial data from that early period are thought to be known with acceptable precision. Lastly, beginning the time series in 1986 would result in the modeling of a stock subjected to decades of fishing and certain assumptions previously made may be invalidated.

Dr. Ailloud continued with the model diagnostics. The jitter (10%) analysis produced robust results. The retrospective pattern analysis showed similar trends in SSB trajectory as the terminal year of data was walked back from 2019 through 2014. An analysis of Mohn's ρ generated a value of -0.002, which is within the range of values considered appropriate for gag grouper.

Sensitivity analyses were reviewed, with a run using the SEDAR 33U vector for M generating similar model results to those from the base model. Several sensitivity analyses were conducted to explore any improvement in model by combing the various fishery-independent video surveys; however, no improvement was realized and the indices were considered separately. A sensitivity run examining red tide selectivity-at-age yielded exploitation rates that were difficult to interpret; another attempt was made using time blocks on M to better capture red tide mortality. As a result, fits to the age-0 index were improved most, with discernible improvements to fits to the other indices also. However, estimated landings and discards for 2013 generated by the model were inexplicably high; thus, this sensitivity run was not included in the model.

An SSC member asked if the spikes in recruitment following red tide were appropriate. Dr. Ailloud replied that a density-dependent release was plausible and were supported by the red tide modeling in Ecopath/Ecosim. Another SSC member postulated sperm limitation becoming a more prevalent issue in the gag grouper stock, since recruitment does not appear to have rebounded to a level commensurate with that observed before the mid-2000s.

A sensitivity run was conducted to examine the recreational catch and effort data generated by the FWC Gulf Reef Fish Survey (now the State Reef Fish Survey). Hindcasting for the data were available back to 1981. Prior to 1981, mean catch per unit effort (CPUE) for 1981 – 1985 was used to estimate the historical CPUE. Trends in model outputs are commensurate using Gulf Reef Fish Survey (GRFS) data (which is now called the State Reef Fish Survey [SRFS]); however, the lower level of landings reported through SRFS compared to MRIP-FES does result in a lower estimate of SSB, exploitation rate, and age-0 recruits.

Dr. Ailloud referenced literature stating that female-only SSB provides the best estimates of biological reference points if the potential for decreased fertilization is weak; whereas, a sexes-combined SSB is best when the potential for decreased fertility is moderate or unknown (Brooks et al. 2008). Increasingly skewed sex ratios may result in reduced fertilization rates and, as a consequence, reduced population growth (e.g., sperm limitation, reduced genetic diversity or resilience). Recent research estimates that males account for ~1% in the fished stock and ~5% in the Madison Swanson Marine Protected Area (Barbieri et al. 2021). The last strong year class was in 2006/2007, and the relationship between sex ratio and fertilization success is poorly understood.

Relative F is set at the average of the 2017 – 2019 fishing years. Selectivity and retention are set at the 2019 values, and recruitment follows the Beverton-Holt stock-recruit relationship from the model. Landings data for 2020 are input as is, and data for 2021 and 2022 use the three-year average of landings from 2018 – 2020. The sector allocation ratio used represents the current allocation ratio of 39% commercial, 61% recreational. An SSC member asked about the difference between the F_{MSY} proxy, F_{MAX}, and a proxy value using a spawning potential ratio. Another SSC member recounted, that in the review of SEDAR 33 (2014), the SSC thought that the estimates of virgin biomass using an F_{MSY} proxy of $F_{SPR30\%}$ were unreasonably high. Further, at that time, the sexes-combined estimated SSB seemed to be outside of what was plausible for the stock. An SSC member suggested using 2018 and 2019, instead of only 2019, for informing retention and selectivity in the projections to account for management changes related to the change in the minimum size limit. Another SSC member added that red tide mortality should not be included in any calculation of F since these events directly affect natural mortality estimates of M. Dr. Ailloud stated that incorporating deaths due to red tides events as a "bycatch" fleet in the base model only contributed to total removals; however, the projection analyses would specify removal from red tide events as contributing to estimation of M.

Dr. Ailloud stated that, under the females-only and sexes-combined scenarios for SSB, gag grouper has been overfished since 2006, with overfishing occurring since 2001. An SSC member proposed using the sexes-combined estimate for SSB, considerate of the reality of the currently skewed sex ratio and the potential problems with fertilization and recruitment since 2006/2007. Further, he thought that consideration should be given in the future to exploring an alternate proxy for F_{MSY} in $F_{SPR30\%}$, since F_{MAX} may not be appropriate moving forward. Council staff noted that, ultimately, the decision to modify the F_{MSY} proxy would be under the Council's purview at this time. Council staff further recommended providing rationale to any revised recommendation for an F_{MSY} proxy.

The SSC discussed the merits and feasibility of using SRFS for monitoring recreational catch and effort for gag grouper in the future. The SSC heard from a Council member that the estimates of precision for the SRFS were better than those generated by MRIP-FES. Another SSC member contended that data estimated prior to the MRIP time period (pre-1981), which include data beyond to which the SRFS data used in the sensitivity are calibrated, should be excluded due to their lack of precision and plausibility. The SEFSC replied that removing the pre-1981 recreational catch and effort data does not have a substantial effect on the stock status, but does help with tuning the model to the initial estimates of exploitation rate. The SEFSC added that removing those recreational data is not easily accomplished within the bounds of the current assessment and that the commercial data for that time series are thought to be plausible. An SSC member asked about the virgin condition of the stock, which Dr. Ailloud acknowledged was not actually in 1963 (the start date for the model). Rather, the model internally estimates an offset for each directed fleet to estimate what the virgin condition of the stock.

Motion: The SSC determined that the SEDAR 72 operational assessment of Gulf of Mexico Gag (based on the combined sexes SSB) represents the best scientific information available.

Motion carried with one opposed and one absent.

The SSC discussed the projection settings for gag grouper. The projection setting offered in the current draft of the SEDAR 72 stock assessment report constitute a starting point; however, the SSC may choose to modify the definitions used for the parameters in the projections. The SEFSC contended that exploring the GRFS data further for gag was most appropriately done in a research track assessment. The SSC decided the selectivity and retention will both represent values from 2019. Steepness is externally informed and fixed at 0.855 with the sigma-r set at 0.6. Recruitment will be derived from the model estimated Beverton-Holt stock-recruit relationship. Landings for 2020 will be input as-is, and landings from 2021 and 2022 will use the average landings from 2018 – 2020. The sector allocation will be fixed at the status quo value of 39% commercial, and 61% recreational.

The SSC discussed the potential F_{MSY} proxy to use for gag grouper, given that steepness is fixed in the model, and asked to see the corresponding SPR proxy for that steepness value of 0.855. In the past when a stock recruitment relationship is unknown, steepness if fixed at or near 1 and a proxy for MSY is used. An SSC member thought the SSC may not be able to make an informed decision on OFL and ABC without seeing the results based on different F_{MSY} proxies based on fixed steepness values. An SSC member expressed concern about using an uncertain stock-recruit relationship in projections. Another SSC member agreed, and asked whether it was reasonable to fix steepness while allowing the recruitment deviations to vary naturally around the mean, without fixing sigma_R. Dr. Ailloud replied that doing so would require re-running the model and all diagnostics. Ultimately, the SSC specified that steepness be fixed at 0.855, and F_{MAX} be used as a proxy for F_{MSY}. The merits of also considering $F_{SPR40\%}$ were also discussed but ultimately the SSC requested additional runs using an F_{MSY} proxy of $F_{SPR30\%}$.

With respect to red tide mortality, the SEFSC recommended a correction for the observed 2021. The red tide Ecospace model used to generate that mortality index for SEDAR 72 could be used to develop an estimate of mortality for 2021 since the model could account for event severity by age and year. The SSC asked to see a range of red tide severity, along with an estimate from the Ecospace model, for consideration for the 2021 projection year.

The SSC further reviewed the projections for gag grouper on Thursday, September 30. An SSC member began discussions around the increased precision and reporting frequency of the more specialized GRFS (now, SRFS) survey. He thought SRFS to be more appropriate for monitoring private angler landings for gag grouper, especially given that the stock is a Florida-centric stock, and almost all harvest of gag grouper would be recorded by SRFS. He recommended that the sensitivity run for SRFS be run through the full suite of model performance and diagnostics, just as had been performed for the base model run for SEDAR 72. The SEFSC replied that it hasn't yet discussed how to treat the SRFS data as a component of a base run. A scalar may be possible to apply to the current base model; however, that method may present its own challenges. The SSC discussed the possibility of using that scalar approach to convert the recreational portion of the recommended catch limits into SRFS currency. The SEFSC expressed concern, stating that the evolution of such a modeling effort would need to occur within the SEDAR process. The SSC requested that the scalar approach be described by the SEFSC for its review by the SSC.

Dr. Ailloud reviewed the previously parameterized projections using the sexes-combined estimate of SSB. Three red tide scenarios were developed: 10% of the intensity of the 2005 red tide (low), 30% (medium), and 72% (high), expecting that the 2021 red tide would dissipate in mid-November 2021, based on historical patterns and Ecospace modeling. All scenarios predict that gag grouper is still overfished and undergoing overfishing; however, at $F_{SPR30\%}$, the degree to which the stock is overfished is much greater than at F_{MAX}. Under $F_{SPR30\%}$, gag grouper is thought to have been overfished since the 1970s.

The SSC discussed the severity of the 2021 red tide event with respect to the next most recent red tide event in 2018, with the general sentiment being that the 2021 red tide has not been as expansive or severe as the 2018 red tide event. The SEFSC added that hypoxic events are not being detected in 2021 in offshore sampling as were detected during 2018.

Dr. Ailloud added that there is not guidance with respect to the F_{MSY} proxy when using sexes-combined SSB for a hermaphroditic species. The SSC replied that it has normally made recommendations to the Council with respect to F_{MSY} proxies when appropriate. The SEFSC added that it supports the use of $F_{SPR30\%}$ as a proxy for gag grouper.

Dr. Ailloud reviewed the guidelines for rebuilding under the MSA. For the $F_{SPR30\%}$, the low red tide scenario shows the stock rebuilding within 10 years; however, fishing mortality would need to be reduced to zero to achieve the rebuilding date of 2033. Because the minimum time to rebuild for $F_{SPR30\%}$ is within 10 years, the only rebuilding scenario under $F_{SPR30\%}$ would be to set F equal to zero. For the F_{MAX} scenario, the stock would rebuild by 2029 in the absence of fishing mortality, with some yield allowed annually under an $F_{Rebuild}$ target of 2033. The SEFSC replied that rebuilding yields account for discards, and as such, the retained yields would be a portion of the total listed yields by year.

The SSC recognized that a complete closing of the fishery would result in the loss of critical fishery-dependent and biological information needed to monitor stock rebuilding. The SSC acknowledged that the current F_{MSY} proxy is F_{MAX}, and that changing that proxy would require a plan amendment. The SSC discussed further its consideration for using $F_{SPR30\%}$, and was supportive of using the medium severity red tide scenario based on the Ecospace model. The medium value of red tide severity (30%) was viewed as more precautionary than the low severity value (10%), the latter which the Ecospace model demonstrated as a lower bound of severity for the 2021 red tide event. The SSC thought that the medium red tide intensity demonstrated an adequate perception of the 2021 red tide. Further, the SSC noted that the base M estimate in the base model likely is underestimating natural mortality by not accounting for red tides.

Given the lack of time remaining in the meeting, the SSC decided to revisit the gag grouper projections at its next meeting.

Presentation: Using Field Experiments to Assess Alternative Mechanisms for Distributing Fish to the Recreational Sector

Dr. Alexander Gordan of the SEFSC noted that recreational fishing quotas are typically managed using season lengths, bag limits, and size limits. Dr. Gordan stated that this one-size-fits-all approach could be improved upon by exploring alternative management approaches accounting for the heterogeneity in the angler population. Dr. Gordan noted that the exploration of alternative approaches is consistent with recommendations included in the NAS report on LAPP.

Dr. Gordan described a proposed pilot program that would allow private anglers to fish outside the regular fishing season in exchange for participation in a data collection program. The pilot would initially be limited in scale and cover a small number of recreational anglers. Day passes would be distributed via a lottery among interested anglers. Fisheries resources needed to conduct the experiment could potentially be provided by quota retained by NMFS or by setting aside a small portion of future quota increases. He noted that the experiment is not envisioned to reduce fishing opportunities for non-participating anglers.

Dr. Gordan presented a conceptual diagram explaining the broad contours of the pilot program and discussed next steps. He indicated that a draft exempted fishing permit (EFP) application is in development. A copy of the draft EFP was shared with the SSC. Dr. Gordan noted that outreach efforts are planned and feedback from user groups will be solicited through focus groups. He also noted that the development of a phone app will be considered to facilitate data collection from participating anglers.

SSC members expressed their interest in this type of experiment and their appreciation for Dr. Gordan's presentation. SSC members inquired about the type of data expected to be collected. Dr. Gordan indicated that data collected would include catch, location, and discards. Dr. Gordan and SSC members concurred that there is a balance between collecting appropriate data and placing an undue burden on anglers. SSC members discussed the reporting burden and cautioned that very avid anglers may quit because they may consider the reporting burden to be too high. SSC members noted that if the experiment became a multi-year program, lack of reporting and the risk of attrition should be mitigated. SSC members suggested that mandatory, rather than voluntary reporting should be considered to that effect.

SSC members inquired about data validation methods for the experiment. Dr. Gordan suggested that the use of cellphone cameras could be considered. SSC members expressed their hesitancy relative to scaling up the experiment. SSC members indicated that implementing a Gulf-wide pilot would be intractable and recommended an experiment limited to small portions of the Gulf of Mexico. SSC members noted that a localized pilot, potentially developed in collaboration with smaller Gulf states, would be beneficial.

SSC members stated that the type of experiment proposed could be useful, inquired about the identification of would-be participants, and cautioned about selection bias. In response, Dr. Gordan stated that the pilot will be open to all anglers. The SSC asked about the quota that will be used to run the pilot. SSC members noted that incentives to cheat would exist. Dr. Gordan indicated that a hail out and hail in system requiring data to be submitted before landing could be considered. He further indicated that working with Gulf states would be helpful. Dr. Gordan concurred with SSC members in stating that the pilot should initially be conducted within limited geographic areas.

SSC members asked where the idea for the pilot came from. Dr. Gordan answered that the idea for the pilot went through several iterations. The idea slowly evolved for the last few years and is a part of NMFS' internal research agenda. Drs. McPherson and Walter of the SEFSC indicated this project is a part of a wider initiative of NMFS to better address the needs of recreational anglers and that the observed increases in fishing pressure would justify a search for alternative management approaches. They further noted that the idea originated from an advisory group including social scientists from around country.

Ms. Guyas, the Council's representative, inquired about the project funding and species under consideration for the pilot. Dr. Gordan indicated that the SEFSC plans to fund the pilot program and stated that gag, red grouper, and red snapper are the species currently considered. Dr. Gordan further noted that the SEFSC could either submit the EFP application of work with Gulf states interested in pursuing the experiment in collaboration with the SEFSC. Ms. Guyas also asked whether the pilot would include the South Atlantic Council. Dr. Gordan indicated that the initial phase of the experiment focuses on the Gulf region.

SSC members cautioned that lags in data collection, e.g., MRIP, should be considered. SSC members were concerned that, for the species selected, the recreational ACL may be exceeded before anglers can have opportunities to use fishing passes. SSC members suggested that trip identification numbers, as used in Mississippi, could be considered to identify duplicates in the data collected.

LGL: Introduction: Estimating Absolute Abundance of Red Snapper off Louisiana

Dr. Gallaway (LGL) presented an introduction to a project funded by the Louisiana Department of Wildlife and Fisheries (LDWF) to estimate absolute abundance of red snapper off Louisiana. This study was requested by the state as a mean to enhance the results from the Great Red Snapper Count ([GRSC], Stunz et al. 2021). The draft report GRSC determined more sampling was needed in waters offshore Louisiana as the original study largely estimated abundance in Louisiana from imputed Texas data.

Members of the SSC inquired about the selection of the 106 sites that were sampled, as these were previously selected by LDWD staff and provided to the consultant. Details on the methodology of site selection was not presented during the discussion, but LDWF staff recalled the sites were randomly selected within strata for various habitat types.

<u>Introduction</u>
The Louisiana Red Snapper Management Area (study area) was divided into three regions (West, Central, and East) and each zone was divided into four depth zones (10 – 25 m, 25 – 45 m, 45 – 100 m, and 100 – 150 m). Sampling of 106 sites (37 sites on the West, 33 on the Central, and 36 on the East Region) occurred during the summer and fall months of 2020. The study area was

dominated by mud with much lesser amounts of sand and gravel substrate. Uncharacterized bottom (UCM) in Louisiana was estimated to be 49,000 km^2, approximately 10% less than the estimations from the GRSC (i.e., 53,052 km^2). Natural bank habitat was estimated to be 724 km^2, which was 12% less than suggested by the GRSC (i.e., 821 km^2). The artificial reef category (n=1,777 discrete sites) included oil platforms, pipeline crossings, and reefed platforms.

An SSC member asked about the sampling design (three regions, four depth zones, and three habitat types) and what was the level of replication. Dr. Gallaway referred the members to the data included in the tables for each habitat type. The SSC recommended providing a table that would summarize the overall number of samples by each of the zones. Another SSC member asked about the intent of the sampling design, as it appeared the sites were selected based on the possibility of fish being present, while large portions of sand were avoided and this may not be statistically appropriate. This type of site selection is considered directed and not randomized sampling. Along the same lines, another SSC member asked how was sample allocation selected. LGL staff recognized that sampling allocation was unbalanced and that this was considered during the statistical analyses. The SSC recommended down-weighting those sites with higher density, especially if the site was known to have fish presence. An SSC member referenced the information included in the request for proposal, as it indicated the 106 sampling sites were provided to the consultant. The SSC requested clarification on how these sites were selected by LDWF and if it was consistent with the site-selection methodology from the GRSC.

LGL: Field Surveys and Sample Processing

<u>Hydroacoustic Sampling</u>
Dr. Jack Egerton reviewed the hydroacoustic sampling methods. Observations and analyses were focused on target species assemblages (reef fish), and excluded sharks and non-target species which could possibly confound results. Smoothing followed methods in Korneliussen et al. 2009, including smoothing and treatment of data at the 3-meter exclusion zone on the seafloor. Decibel differencing was used between transducer frequencies to identify specific fish. Fish density was measured as the number of fish per cubic meter, per each acoustic 20-meter by 10-meter cell. Bait schools were defined and filtered. Final density values per m^3, per analysis cell were calculated and converted to density per m^2 by multiplying by acoustic cell thickness, after treating blank cells. Cells were then joined in QGIS. Similar to the GRSC, fish density was calculated and converted to abundance using the volume of water investigated, with the proportioned abundance determine using camera data and the MaxN metric.

<u>Submersible Rotating Video Sampling</u>
Dr. Gallaway reviewed the submersible rotating video sampling (SRV), which was deployed at discrete sites near structure for 5 minutes for every 10m layer of water column at predetermined depths to match hydroacoustic sampling. Target drops were used to opportunistically capture fish assemblages at points of interest at discrete and UCB sites. All fish were identified to the lowest possible taxon, and the relative abundance of each species was determined using MaxN for every 10m depth layer. Relative species abundances were converted to composition percentages to apportion hydroacoustic abundances, with proportions applied to fish abundances by 10m depth layer.

Vertical Hook-and-Line Sampling
Vertical hook-and-line sampling was conducted at each discrete habitat (platforms, artificial reefs, pipeline crossings, and natural banks). "Larger" fish were not observed to be rare, and were commonly caught at pipeline crossings and artificial reefs. All fish were processed for weight, length, and sex, and otoliths for red snapper were extracted. Mark-recapture sampling was performed at 6 sites (3 oil and gas platforms and 3 artificial reefs). Fish were double-tagged dorsally, caged, and released at depth to mitigate the effects of barotrauma.

Towed Underwater Video Methods
The video survey was performed using a GoPro camera in a steel towed sled with a stabilizing fin. Tows were performed at 3 – 5 knots, filming 0 – 10 meters above the seafloor. The camera sled was towed without additional scope to avoid bottom snags and to maintain focal depth across the bottom.

Bottom Longline Sampling
A total of 183 red snapper were collected via longline and used for age and length composition sampling. These collected red snapper ranged in age between 2 and 25 years, with an observed mean weight of 9.4 lbs, a maximum weight of 18.4 lbs, and a mean length of 25.57 inches total length (TL).

The SSC discussed that red snapper do not occur uniformly around structure, and questioned the random nature of sampling around structure. Water clarity issues were also discussed, with the SSC asking how turbidity was addressed. Dr. Raborn replied that the SRV was used to evaluate each site with a standardized drop, followed by targeted sampling if fish were observed. Dr. Raborn indicated that species composition was not evaluated between the standardized and discrete sampling sites. Visibility at all sites was never observed to be "zero" but turbidity was not a factor in the SRV analysis. An SSC member also asked about correcting for behavioral biases to gear. An LGL researcher indicated that behavioral biases were not addressed as they were not thought to be confounding. Dr. Raborn stated that hydroacoustic and SRV data were treated separately before ultimately being combined, and the results of those efforts were ultimately supported by the species observed in the vertical line sampling. The SSC thought more exploration of the data for biases should be considered, noting that so long as the biases were not all in a single direction, they could be accounted for in the model.

LGL: Statistical Analyses and Modeling

Dr. Scott Raborn reviewed the study statistical modeling methods. A generalized additive model (GAM) was used to quantify total fish density while a generalized additive mixed model (GAMM) was constructed to quantify the proportional density of red snapper. Strata were defined as a combination of region, depth zones, and habitat type (further delineated by natural or man-made categories). Several environmental covariates were input along with a calculated continuous z-score adjusted term to account for the distance from bottom of the sample. This approach allowed for estimation of total fish density and proportional red snapper separately for each stratum before being combined and extrapolated which aided in minimizing the sampling error from magnification. Model outputs could then be multiplied for each stratum and random error in red snapper estimates could be estimated across sites before multiplied by the total fish density. For the red snapper GAM, a model constructed using region, water temperature, habitat type as a function of the term accounting for distance from bottom had the most support using AIC criteria. Similarly, a GAMM model including dissolved oxygen, temperature, habitat type, region, and depth zone was the most supported model for total fish density. The results of the GAMM allowed for measuring density of fish by cubic meter. A subsequent measure of red snapper by cubic meter was estimated as the product the proportional red snapper and total fish density model outputs. This estimator was used to calculate the arithmetic variance of the total fishery density and added to the uncertainty estimates of red snapper density. To extrapolate, red snapper per cubic meter were converted to red snapper per square meter based on the average width of each vertical depth band for each stratum combination with variances expanded accordingly. Diagnostic results indicated that model tended to overpredict red snapper estimates especially at deep depths.

An SSC member pointed out that the residual diagnostic plots seemed to indicate more samples points than the originally presented 106 samples. Dr. Raborn explained that the effective sampling unit was defined as the number of depth bands per site. The SSC member commented that constructing the model this way could be inflating the sample size determination and would influence the interpretation of the variance estimates. He continued that the depth bins at each site were inherently spatially autocorrelated and should not be treated as independent observations. Dr. Raborn replied that the z-scored term input in the model corrected for the effect of distance from the bottom for each sample.

LGL: Results

This study estimates an absolute abundance of 6,027,890 red snapper in Louisiana offshore waters (95% CI: 4,665,675 – 7,787,825 red snapper). The standard error for this estimate was 791,199 red snapper, corresponding to a CV of 13.1%. Most red snapper are thought to occur over the UCB (approximately 63%), followed by standing platforms (22%), natural banks (10%), pipeline crossings (3%), and lastly, artificial reefs (2%). Within the UCB, red snapper was thought to not be uniformly distributed, but rather seemed to aggregate around small bottom relief features. Red snapper over the UCB were least abundant in the west region, were generally larger and older than observed over other habitat types, and were observed to have fully developed gonads. Approximately 22% of red snapper are estimated to occur on the 821 oil and gas platforms present off Louisiana in the summer of 2020, with approximately 3,000 fish (including, but not limited to red snapper) estimated to occur per platform, on average. Red snapper on platforms were observed to be between 3 and 8 years old. Over natural banks, regional densities of red snapper were not markedly different; the main difference was related to an area of habitat available within region. Red snapper on natural banks were observed to be between 5 and 9 years old. Red snapper on pipeline crossings were observed to be between 2 and 8 years old, and between 3 and 6 years old on artificial reefs.

The population estimates for an individual artificial reef in the mid-depth zone in the LGL study area was estimated to be about 1,491 red snapper, based on mean count estimates. This estimate contrasts with the population estimates ranging from 608 to 902 fish and the modeled estimates ranging from 261 to 908 fish based on tag-recapture data from that site. Growth parameters were estimated to be lower than those observed in SEDAR 52 (2018). The estimate of absolute abundance from the LGL study is estimated to correspond to a biomass estimate of approximately 47 million lbs. Dr. Gallaway stated that differences between the LGL and GRSC studies were largely attributable to catch rates by deployed gears, as opposed to differences in the area of, or number of, habitats.

The SSC noted that a direct comparison of the LGL study and the GRSC study was not appropriate due to differences in methods. An SSC member noted that the LGL study may be underestimating the number of small fish substantially, and may also be underestimating the number of large fish to some degree, especially when comparing stereo camera surveys to hook-and-line surveys. Dr Raborn acknowledged that gear selectivity is occurring with the hook-and-line fishing gear; however, this selectivity has not been accounted for in the modeling or results for the LGL study. Dr. Gallaway added that smaller fish are expected to be more prevalent in shallower zones, which were not sampled as intensively as deeper zones in the LGL study. The SSC recommended examining the differences in the sampling gears and their selectivities, to better determine the degree to which the study may have under-sampled and underestimated those smaller fish. He reiterated that the approaches used by LGL for Louisiana are not comparable to those for Florida, due to several differences in methods used.

Another SSC member asked about any data available on tag returns from fishermen from the mark-recapture study. Dr. Raborn replied that those tags, if any, were not incorporated and counted as tag loss. The SSC member asked about the number of tags per site, and the total number of tags overall. Dr. Gallaway showed a table with tags by region and habitat type, noting a small sample size and small number of tag returns. The SSC member then asked about the proportion of unidentifiable fish sampled. LGL researchers noted the presence of unidentifiable fish, which are discussed in the report.

An SSC member commented that the stock assessment for red snapper is not broken down by state, but rather by region (eastern and western Gulf). Different methods were deployed in the GRSC by geographic area. The SSC member noted that none of the estimates are "accurate", but rather are estimates with a certain level of precision. A reconciliation of these data, and all other data included in the stock assessment, is likely necessary to better understand and consider all the data available. Further, several potential sources of bias have been identified by the SSC, which the LGL team will need to address. Based on these factors, the SSC member did not think the SSC would be able to decide on how to proceed with these data in considering red snapper catch limits at the SSC's November 2021 meeting. Other SSC members agreed, that the best method of review and consideration of the universe of all these data would be through the SEDAR process.

LGL: Discussion

Red snapper abundance and biomass estimates from the LGL study were markedly less than the Great Red Snapper Count (GRSC) for the state of Louisiana. The LGL study agreed with the GRSC that relatively larger older fish are generally observed more in the western Gulf and in deeper offshore habitats. However, several SSC members commented that the difference was likely heavily influenced by the catch rates observed between the two studies. Longline gear exhibits a dome-shaped selectivity, which may account for underestimation of red snapper at the extremes of the length distribution. Additionally, the presented comparisons between length distribution in the LGL study with those reported from Florida are not directly comparable since the Florida length distributions were obtained using stereocams.

The SSC questioned why abundance estimates were so dissimilar between Texas and Louisiana. The LGL team stated that while estimates were similar along the state boarder, likely due to similar available habitat within that area, those estimated differences were starker as sampling expanded from the state line. The SSC discussed how methods for estimating abundance between benthic habitats (quantified in square area) and platforms (quantified as count). Dr. Raborn stated that red snapper per cubic meter estimated on platforms had been converted to red snapper per square meter which made the abundance estimate comparable across habitat types.

The SSC discussed the limitations of interpreting the LGL studies results without fully understanding the rationale of the sampling design. The 106 sites used were proffered by staff from the LDWF but no documentation for that decision had been made available. The SSC requested a written document from the LDWF that would detail the rationale for the selection of these sites. The SSC agreed the next steps for determining if the LGL study could be used to supplement the GRSC and compare these independent study abundance estimates with the NMFS bottom longline survey would require a future dedicated meeting. There was some discussion of whether these discussions should take place during the first SEDAR 74 data workshop scheduled for May 2021. The consensus was that the data workshop schedule was already full; further justifying a proposed separate dedicated meeting. An SSC member suggested submitting white papers, such as the technical document requested from LDWF, in preparation for the meeting and other members agreed.

An SSC member disagreed with the main differences between the LGL and GRSC studies, and stated their resulting estimates of absolute abundance, were attributable to catch rates. He thought that the sample design and treatment of biases were likely sources of difference, and required further exploration. He added that it seemed unlikely that there would be strong differences between the eastern Texas and western Louisiana natural banks, and asked why those numbers appeared so disparate. Dr. Gallaway replied that catch rates at some banks showed similarities with those in eastern Texas but others varied. He continued that catch rates change considerably as sampling moves eastward from western Louisiana across the 15 sites sampled by LGL across 5 natural banks.

The SSC asked how the sample sites were selected. Dr. Gallaway replied that the dominant habitat type was petroleum platforms which were selected through stratified random sampling. The other sites were more or less selected by depth strata and region; he could not speak to whether those non-platform sites were randomly selected. An SSC member identified the potential non-random nature of the site selection of the non-platform sampling sites as a major issue that needs clarification. He asked whether an assumption was made about the randomness of the non-platform sample sites, to which Dr. Raborn replied that non-platform sites were assumed to be randomly selected. Another SSC member added that understanding the details of the sample site design was critical. Mr. Harry Blanchet (LDWF) replied that a synthesis of the sample site selection could be drafted and provided at a later date. The SSC also asked that the sampling allocation (e.g., the number of samples compared to the total number of samples taken) by strata be detailed in any synthesis of sample site selection. Details like whether a gridded system was used to determine starting points for transects, proportional sampling by strata areal coverage, and selection reefs and of banks, will also be informative.

An SSC member asked whether differences have been identified between the work done by LGL in 2017 (BOEM study) and the current study. Dr. Egerton noted that decibel differencing was not possible in the BOEM study due to the use of a single echosounder. Dr. Raborn added that the BOEM study included some species not included in the current LGL study from the SRV survey, due to the unavailability of the decibel differencing to remove those species from analysis. Dr. Raborn added that an additional 37 platform sites were included in the LGL study from the 2017 BOEM study; however, these data were not discussed separately.

An SSC member revisited the question about the underestimation of the smaller size classes by the methods used in the LGL study, and asked whether that issue could be investigated. Dr. Raborn replied that the age- and length-frequency histograms may be underestimating the smaller fish; however, the SRV and hydroacoustic surveys would have captured those fish. Another SSC member asked whether the hydroacoustic survey was size selective. Dr. Raborn affirmed that to be true; Dr. Egerton added that any target with a swim bladder was picked up by the hydroacoustic survey. The SSC member then asked if the species composition information from the camera surveys were also picking up those small fish, and whether the 2 – 4-year-old red snapper are being adequately captured by those gears. Dr. Gallaway replied that the size distribution of fish by strata is discussed in the appendix of the report.

Specific to the LGL study, the SSC thought more information was needed before it could be considered for informing management. Generally, SSC members discussed the utility of a specific workshop to discuss both the GRSC and LGL studies, and reconcile the differences therein.

Review: SEDAR Schedule

Mr. Rindone discussed the SEDAR schedule with the SSC, which discussed opportunities to conduct a research track for gag grouper. The 2025 operational assessment for cobia could be moved up to 2024, to make room for gag grouper to be assessed as a research track in 2025. Dr. Julie Neer (SEDAR) noted that the SEFSC has indicated not more than two research tracks can be co-occurring in a region. She added that there were several research recommendations from SEDAR 72 for gag that the SEFSC thought were best addressed by a research track, including MSY proxies, incorporation of red tide, and other issues.

> **MOTION: Motion: The SSC recommends to the Council that the Cobia Operational Assessment currently scheduled in 2025 be moved to 2024 and a Gag Research Track be added to 2025.**
>
> ***Motion carried with no opposition.***

Mr. Rindone discussed the Council's desire to assess the tilefish complex and the SSC's request for the SEFSC to conduct a data triage for the tilefish species. The SEFSC has already responded that they could not conduct that data triage outside of a research track assessment, as it likely would involve stock identification issues. Such a research track effort would need to be conducted separately for each of the three tilefish species. Alternatively, Council staff indicated that they would conduct a review of the available literature for the three tilefish species, to allow the SSC to consider the data available and how best to approach a future assessment of Gulf tilefish species.

The SSC noted that greater amberjack is listed as an operational assessment on the Council's SEDAR schedule. Dr. Neer replied that SEDAR has it noted as a possible research track, depending on the availability of the greater amberjack absolute abundance research being conducted in the Gulf and the South Atlantic.

An SSC member asked about the possibility of doing a data-limited assessment of midwater snappers. The SEFSC replied that its current data-limited approaches could be applied to midwater snappers, but doing so will require a stock assessment slot. An SSC member asked for a presentation about increases in recent landings of midwater snappers, including information about data imputation in 2020, and the quality assurance and quality control associated with those data. Council staff recommended investigating the data more before dedicating an assessment slot for midwater snappers.

Review: Interim Analysis Schedule

Mr. Rindone reviewed the interim analysis schedule with the SSC. He noted that for red grouper in 2022, the inclusion of the SEAMAP Fall Groundfish survey necessitates that analysis being delayed until March 2022.

Review of Finalized Great Red Snapper Count Report

Dr. Greg Stunz reviewed the results of the GRSC[4] and the response to reviewer comments received in April 2021. A full summary of the methods used in the study is available in the March/April 2021 SSC Meeting Summary[5]. Generally, the peer-review requested explicitly describing the stratified random sampling design; capturing as much additional variability as possible (including adding 'variance buffer'); improving estimators, calibrations, and modification of post-strata based on suggestions; re-evaluating the contribution of the UCB; development of an alternate estimator of variance to capture additional uncertainty; and, development of an alternate estimator to reduce bias. The final results indicate an absolute abundance estimate of 118 million red snapper in the Gulf, with a CV of 15%.

Dr. Stunz also noted that additional requests from the SEFSC were submitted on the Friday prior to the SSC's September meeting, which the GRSC team has addressed.

[4] https://www.harte.org/sites/default/files/inline-files/Great%20Red%20Snapper%20Count_Final%20Report.pdf
[5] https://gulfcouncil.org/wp-content/uploads/Gulf-SSC-Summary-March-April-2021-04092021.pdf

Uncharacterized Bottom
For Texas and Louisiana, the mean and standard deviation (SD) of fish density was calculated across random start point acoustic transects for mid- and shallow depths. Red snapper density was estimated as fish density times the region-specific mean proportion of red snapper. Variance combined uncertainty was performed across transects and in the proportion. Lastly, the mean and SD of red snapper density for the deep depth strata was calculated using transects from randomly selected locations using camera-based assessment survey system (CBASS) visual counts. For Mississippi and Alabama, the mean and SD of red snapper density for the all depths was calculated using transects from randomly selected locations using CBASS visual counts. For Florida, the mean and SD of red snapper density for 3 regions and all depths was calculated from randomly selected ROV visual transects.

Hardbottom
For Texas and Louisiana, the mean and SD of red snapper density was calculated across random start point hydroacoustic transects, with paired species composition for areas of known hardbottom. Data for Louisiana were imputed based on Texas observations. For Mississippi and Alabama, the mean and SD of red snapper density was calculated across random selected features using camera MaxN counts and a fixed area surveyed. Hardbottom in Florida was not separated out from natural bottom, given the composition of those habitat strata on the west Florida shelf.

Artificial Reefs
In Texas, and as imputed for Louisiana, the mean and SD of red snapper density was calculated across random hydroacoustic surveys of a structure with paired species composition for platform structures and clusters of smaller structures. In Mississippi and Alabama, the mean and SD of red snapper density was calculated for each depth across random selected sites. Red snapper density was combined with the stratified estimated total number of structures within each depth to obtain total numbers per depth category, with uncertainty from both estimates combined. For Florida, the mean and SD of red snapper density per structure for each depth was calculated from randomly selected remotely operated vehicles (ROV) visual point counts.

Pipelines
For all regions, the mean and SD of red snapper density were calculated across transects from randomly selected pipeline arcs from data provided by the Bureau of Ocean Energy Management.

Revised Estimations
Dr. Lynn Stokes stated that, in the secondary analysis, revisions were made in each state estimate. For Florida, post-strata were eliminated as recommended by the independent reviewers. In Mississippi and Alabama, the variance was adjusted to account for estimation of the artificial reef population size. The variance estimate for Texas was increased to include a variance component due to calibration in the UCB stratum; post-strata were added to the UCB due to separate calibration factors; an error in identifying transects was corrected, resulting in fewer transects in the UCB. These Texas changes also affect imputed data for Louisiana. In total , the estimate of absolute abundance was reduced by ~ 4.9 million red snapper, and the Gulf-wide CV was similar to that calculated before these changes were made.

For the Texas UCB, in the mid-and shallow depth strata, calibration factors were estimated from independent experimental data. An unbiased estimate of the variance of a product of two independent random variables has a closed form (Goodman 1962). This estimator was used for the variance for all mid-and shallow depth strata for the UCB. A calibration method was also applied to the natural bottom strata in Texas, but the data on which the calibration was based was not readily available; thus, a "worst case scenario" approach was used to examine the effects. The multiplicative increase in the variance of the red snapper abundance estimate due to calibration for each of the six post-strata of the UCB in Texas was calculated, and ranged from 1.01 to 2.77. Next, the maximum value was applied to the remaining post-strata using the calibration for Texas and Louisiana, which increased the variance estimates as shown in the report.

An SSC member asked about the spatial delineation of strata in Florida. An investigator with the GRSC indicated that the UCB area off of central Florida was extensive and likely contributing to the high abundance estimates for that region. The investigator continued that, as a results of the GRSC, more information about red snapper abundance within the UCB is known and it is likely that future studies will approach quantifying these areas differently because of these study results. Dr. Stokes added that if the strata were drawn differently, this would affect the variance but would not the final estimate or any bias, and the probability of error is directionally equal.

An SSC member questioned how the estimates of abundance can be so skewed to the eastern Gulf in the GRSC and to the western Gulf in SEDAR 52. Dr. Patterson replied that the samples collected were randomly taken, and the CVs appropriately determined, noting that the UCB off Florida often is composed of more than just sand or mud (e.g., low relief, sponges).

An SSC member asked about the application of a power analysis to examine the ability to adequately sample these new areas. Dr. Stunz reiterated that the unforeseen UCB habitat selection of red snapper was not originally anticipated and therefore could not be explicitly accounted for using the original sampling design approach. Dr. Stokes stated that generally power analyses are generally more appropriate when developing hypothesis testing before conducting a study. She did add that better variances can be applied to determine appropriate sample sizes by strata in the future. Dr. Patterson added that in the original proposal, the number of natural and UCB sites was about half of that ultimately sampled in the final sample design. He affirmed the random nature of the Florida design, with a predicted CV of less than 30% (in reality, 22%).

An SEFSC staff member asked to see a comprehensive map of the samples in space to better interpret the spatially-explicit abundance estimate. The counts put most of the fish in the shallower depth bins. Dr. Stunz said a heat map of the samples in space is provided in the GRSC report. He added that perhaps "shallow" wasn't the appropriate term; in some places in the Gulf, that stratum (10 – 40 m) extends well into federal waters. The SEFSC staff added that the 10 – 20m portion of the 10 – 40m depth bin appears under-sampled; however, surveys of this depth band observed no red snapper (age 2 or older). Dr. Ahrens added that because the sample size in that 10 – 20m range is low (n = 26), if those samples are truly random, then the mean for that stratum is unbiased. He added that there are significantly more samples in the 20 – 40m range of the shallow water stratum off FL.

The SSC discussed how to get from an estimate of absolute abundance to a point where a catch level could be recommended. SSC members thought that having the GRSC move through the SEDAR process for thorough consideration was most appropriate. Further, the SSC discussed how it might proceed at its November 2021 meeting, given that it cannot move forward with a recommendation of which data to use for the estimate of absolute abundance for Louisiana.

The SSC discussed the abundance estimate from the 10 – 40 m UCB stratum off Florida. Specifically, the SSC discussed that the estimated abundance estimate is equal across all depths within this stratum yet, this may not align closely with existing empirical data that suggest that red snapper is more abundant in depths from 25 – 40 m than the 10 – 25 m portion of the stratum. Council staff suggested that the predicted probability of occurrence across the range of sampled depths could be evaluated by examining the partial effects depth plot from the fitted random forest model. This may inform whether a uniform estimate across the 10 – 40 m stratum is an appropriate assumption or if a more refined estimate should be considered by splitting the stratum into smaller depth bins.

The SSC was clear that the GRSC and LGL studies should be treated completely separately, and not be directly compared. SSC members discussed the accessibility of UCB red snapper by the directed fishing fleets, noting that current fishing technology and practices likely allow all of the UCB to be accessed by fishermen, though at varying intensities or susceptibilities. An SSC member added that the GRSC was not designed to partition portions of the UCB by their estimated susceptibility to fishing pressure, and should not be assumed to directly inform that effort.

> **Motion: SSC recommends the design and data from the GRSC are suitable for consideration in the SEDAR 74 process. SSC also recommends further evaluation of the estimates of absolute abundance and the methods and analysis used for estimation of the red snapper population.**
>
> ***Motion carried with no opposition.***

Presentation on EFH Consultation Process

This agenda item was not covered due to time constraints.

Public Comment

A member of the public criticized the Council's risk policy, and thought that a more conservative approach to setting catch recommendations was warranted. A member of the public expressed support for the consideration of the GRSC in SEDAR 74, and in the consideration of SRFS in SEDAR 72, but questioned the purpose of the proposed EFP for recreational fish tags. A member of the public thought additional outreach was needed for the public to understand the effects of the GRSC, and that the proposed EFP for recreational fish tags was poorly informed and needed far more research before it should be considered. A Council member asked about the adjustment of the GRSC estimates for buried pipelines, and the total count of petroleum platforms included in the study, and asked that the Texas portion of the GRSC be presented for contrast.

Other Business

Discussion Topics for the 2022 National SSC Meeting

Dr. Nance discussed the request by the Science Coordination Subcommittee for case studies for the 2022 National SSC Meeting. Dr. Nance requested that the SSC review the subject matter requests for the case studies and that SSC members submit ideas to himself and Mr. Rindone.

The meeting was adjourned at 5:00 pm eastern time on September 30, 2021.

Meeting Participants

Standing SSC
Jim Nance, *Chair*
Luiz Barbieri, *Vice Chair*
Lee Anderson
Harry Blanchet
Dave Chagaris
Roy Crabtree
Benny Gallaway
Doug Gregory
David Griffith
Paul Mickle
Trevor Moncrief
Will Patterson
Sean Powers
Steven Scyphers
Jim Tolan
Richard Woodward

Special Reef Fish SSC
Jason Adriance
Mike Allen
John Mareska

Special Ecosystem SSC
Mandy Karnauskas
Josh Kilborn
Steve Saul

Special Socioeconomic SSC
Luke Fairbanks
Cindy Grace-McCaskey
Jack Isaacs

Council Representative
Martha Guyas

A list of all meeting participants can be viewed here.