Standing, Reef Fish, and Socioeconomic SSC And GMFMC Independent Consultants Review of *The Great Red Snapper Count* Webinar Meeting Summary March 30 – April 1, 2021

The webinar meeting of the Gulf of Mexico (Gulf) Fishery Management Council's (Council) Standing, Reef Fish, and Socioeconomic Scientific and Statistical Committees (SSC), and the Council's independent consultants, was convened at 9:00 AM EDT on March 30, 2021. The agenda for this webinar meeting was approved as modified. Verbatim minutes from past SSC meetings can be reviewed here.

The SSC and independent reviewers were provided with a draft of the Great Red Snapper Count (GRSC) project report on March 3rd, 2021, with an updated version received on March 15th, 2021. The independent consultants' preliminary evaluations of the draft GRSC report were received in the days leading up to the review meeting. The GRSC team presentations, which provided information on methods, analyses and results in greater detail than had been available from the project report, were received and posted at the time of presentation (March 30th and 31st, 2021).

For this portion of the report, both SSC members and independent consultants are treated equally as "reviewers", and will be referred to as such throughout this section.

Summary Presentation of the GRSC

Dr. Greg Stunz of the Harte Research Institute presented a preview of the results of the GRSC; formally, *Estimating the Absolute Abundance of Age-2+ Red Snapper (Lutjanus campechanus) in the U.S. Gulf of Mexico*. Red snapper abundance sampling was stratified by habitat type, estimated using direct visual counts, acoustic surveys, depletion surveys, and a Gulf-wide tagging program. Dr. Stunz detailed the technologies used to survey red snapper across varying habitats and depths, and presented descriptions and videos of these technologies. The tagging portion of the GRSC made possible examination of exploitation by region. Tagging was done primarily over artificial and natural bottom; however, future tagging studies should include uncharacterized bottom based on visual survey results. Any areas without reliable habitat characterization were lumped into "uncharacterized bottom" (UCB), which Dr. Stunz stressed were areas where further study was needed as red snapper occupy these areas but have not been previously documented with such detail. Tag returns were incentivized with monetary rewards, varied in rate by region, and accounted for approximately 30% of all tagged fish. The GRSC focused on "age-2" and larger fish, or those fish that were at least 254 mm total length. This determination may result in an overestimate of length at age-2 in some regions (e.g., the eastern Gulf) and an underestimate in others (e.g., the western Gulf). Larger fish make up a greater proportion of fish found over uncharacterized bottom habitat; however, fish from all observed lengths were found over each of the three habitat types.

Abundance estimates from the four regions were reported as follows (approximately): Texas, 23,000,000 fish; Louisiana, 29,000,000 fish; Mississippi and Alabama, 10,000,000; and Florida, 48,000,000 fish. Of the 110,000,000 fish estimated to be present (11% coefficient of variance; CV, as reported), approximately 52% are thought to occur in the eastern Gulf, and 48% in the western Gulf, which is a deviation from what was reported in the latest stock assessment (SEDAR 52).

Presentations

Gulf-wide Uncharacterized Bottom and Pipelines

Dr. Steve Murawski presented an overview of the use of the Camera-Based Assessment Survey System (C-BASS), to estimate red snapper abundance over pipelines and UCB. Prior to use in the GRSC, C-BASS was applied in several studies comparing imaging and acoustic technologies as well as a project to map West Florida Shelf benthic habitats and assess usage by reef fish and turtles. C-BASS was utilized to specifically count red snapper over pipelines, on mud/sand bottom, and on natural hard bottom areas. Despite the utility of towed cameras to map benthic habitats and count fish, challenges remain, such as: attraction/avoidance of fish to the camera system; decreased visibility (primarily in the western Gulf) making it more difficult to identify species composition; calibrating the camera view to estimate density; inference of habitat type while attempting to account for fish that aggregate above and below the camera; and, how to scale the collected information to a population level. Dr. Murawski described in detail the C-BASS design features. C-BASS has six video cameras, DIDSON sonar, an array of environmental sensors, and high-capacity hard drives for video storage. A video relay to the surface provides low resolution images from the cameras in real-time. To determine the position of C-BASS relative to the ship, payback (distance between the towed vehicle and a designated point on the ship) was calculated, then used along with the time delay to sync the multibeam sonar and video images. An experiment was also employed to gather images of C-BASS and the surrounding fish communities by anchoring high resolution video cameras along a pipeline.

Red snapper was fairly easy to discern, but greater uncertainty exists in the numbers of other species, especially in water with lower visibility (predominantly in the western Gulf). Visibility was classified on a spectrum from zero to optimal; fish counts were attempted in videos with marginal visibility or better. Fish were classified into categories based on their behavior to quantify their reaction to C-BASS. Fish were classified as showing a strong or weak positive attraction, a strong or weak negative avoidance, or neutral behavior if stationary or simply in transit. In general, snapper species showed a weak avoidance behavior, amberjacks a strong positive attraction, and lionfish were neutral. Dr. Murawski stated the equation to estimate area swept is delineated in the GRSC report with assumptions of 100% animal detectability and no degradation of view from turbidity made for transect width. A combination of commercial fishing vessel monitoring system (VMS) and commercial logbook datasets, and data from a previous longline study, were used to generate site-specific catch-per-unit-effort (CPUE) in target areas of pipelines and UCB, which were stratified into two depth strata: 30 – 100 m, and 100 – 200 m. Pipelines were also separated into “hard” and “mud” bottom transects.

Dr. Murawski stated that C-BASS tows were conducted from July 2018 through 2020. Pipeline transects were segmented to discern red snapper densities, using a combination of species composition data and video and hydroacoustics to discern fish density. Red snapper densities over pipeline habitats were an order of magnitude greater than over adjacent mud habitats. Pipeline transects were analyzed in 15-second segments, with over 16,000 segments recorded in total. All segments have been reviewed for species composition and density; however, these data are not available for all segments. Segments were stratified by depth bin (two strata) and pipeline diameter (three strata). Estimates of red snapper abundance over pipelines showed higher densities off Texas compared to other regions. The reviewers asked about the sampling fraction of the UCB against the total area for which an expansion factor will be applied for estimating absolute abundance. Dr. Murawski acknowledged the small fraction of area visible to the C-BASS array, against the larger total area of UCB throughout the Gulf. The C-BASS data were compared and combined with data collected by other means over UCB to extrapolate to the total estimate. The reviewers discussed the abundances observed by the C-BASS array over the pipelines (10,099) and those over the UCB (255), the linear distances of transects completed over those habitats, and the extrapolation of those data. Dr. Murawski discussed the differences between these habitats surveyed, and the average number of fish observed per linear kilometer, noting that these data were combined with other data collected. Reviewers also asked that the serial autocorrelation plots mentioned in the presentation should be included in the revised final version of the GRSC report.

Reviewers thought that assuming 100% detection of the gear was likely an overestimate, and would affect both the point estimates and the variance estimates. Segments with low visibility likely have greater uncertainty associated with species composition data, and likely underestimate abundance using video detection methods. Each data collection bin was scored based on turbidity; however, these data were not available for presentation. Low visibility sites, predominantly from the western Gulf, were included if fish could be recognized; else, zero visibility sites were excluded. This treatment of sites with low visibility was acknowledged as a likely source of underestimation of abundance. Likewise, hydroacoustic dead zones directly adjacent to the bottom, and against the pipelines, likely resulted in an underestimate of abundance due to those fish therein going undetected by the hydroacoustic survey. Differences in the estimated length composition of red snapper over pipelines versus over UCB were difficult to discern, since length composition collection is affected by visibility. Dr. Murawski added that fish over UCB may in fact be larger, and that examining more life history information on the relationship between animal length and spatial distribution may help better explain differences. Further, field of vision over pipelines, especially in the western Gulf, was limited on either side of the pipelines, resulting in long, thin transects. These thinner transects may have resulted in an underestimate of abundance over these pipelines, depending on assumptions about the effective area of the pipeline habitats. Aspects of the pipeline that could influence abundance included whether the pipeline was buried in sediments, or was covered with protective mats (which could add additional hardbottom habitat to the pipeline).

<u>General Acoustics Methods across Regions</u>

Dr. Kevin Boswell reviewed the manner in which hydroacoustic surveys were employed across the Gulf regions sampled by the GRSC. These hydroacoustic monitoring methods were largely employed in strata where visibility was limited by turbidity (water clarity). Acoustic sampling requires validation through other means, such as visual surveys, due to the behavior of sound near hardbottom and artificial reef habitats. As such, video data from remotely operated vehicles (ROVs) was used to validate counts of red snapper by habitat type.

Post-processing of acoustic data accounted for bottom topography, noise removal, filtering bad data, and target identification. The raw data were filtered, followed by target identification to detect fish. Those data were then segmented to focus on the schools of fish, followed by extraction of the data to identify the target strength and the density of targets by cell. Target strength was able to be correlated to fish length based on the point target backscatter, and the volume of backscatter related to the density of fish observed in a cell.

Some inherent challenges to the acoustic methods include dead zone limitations, with densities near the seabed likely underestimated by hydroacoustic surveys. Species allocation was dependent on accompanying video surveys with the ROVs to inform species composition. Lastly, there were differences between the sampling domains relative to habitat type across regions.

The reviewers asked about the ability to remove flocculants and other suspended materials from the water column, which Dr. Boswell said was a capability of the software used to analyze the hydroacoustic data. The reviewers also asked about the application of the same detection algorithm across regions, and the comparison of the ROV validation data to the hydroacoustic data for the west Florida shelf. Dr. Boswell noted that the hydroacoustic data has now been constrained to the area surveyed with video using the ROVs, which resulted in a reduction of the number of fish estimated from hydroacoustic surveys from 9 times to 4 times that observed in video surveys.

Regional Sampling Framework

Overall Design Framework

Dr. Robert Ahrens provided an overview for the methodology used to construct a stratified random sampling design and sample size requirements for assessing UCB and artificial reef habitats. Sampling locations were determined by constructing a random forest (RF) model which related a suite of habitat characteristics with red snapper observations obtained from both fishery-independent and -dependent sources. Additionally, locational CPUE data of red snapper was derived from commercial handline vessel monitoring systems (VMS) data collection programs. These data were formatted into a binomial presence/absence response variable and related to a number of habitat characteristic data (i.e., bathymetry, distance to hardbottom, mean bottom temperature). Habitat data were obtained from the United States Geological Survey. Sampling strata were defined based on region, depth, and the probability of red snapper presence based on the results of the RF model. The basic sampling unit represented an approximately 90m by 90m grid. To estimate strata-specific density and variability in the UCB, area under the curve analysis informed further characterization into low (<0.53), medium (0.53 to 0.86), and high (>0.86) quality. Low, medium, and high-quality habitats were assumed to have mean-densities at the 5%, 50%, and 95% quantiles, respectively. A minimum of ten samples were allocated to each strata. For the artificial reef habitat, the sampling frame was taken from available public location records and each unit was characterized into five levels based on weight of material or physical description. Results from previous scientific surveys were used to estimate density per structure and the variability, with the assumption that 10% of the population resides on artificial structures. Similar to the uncharacterized bottom sampling, a minimum of ten samples were identified in each strata if they existed in the region and depth.

Dr. Mary Christman inquired whether the previous generalized additive model (GAM) approach to construct a sampling design was compared to the RF model. Dr. Ahrens responded that the GAM results were quite different and likely influenced by strong biases in predicted areas in the southernmost portions of the Gulf. He stated that the RF gave results that were more reflective of observations from fishery-independent and -dependent data streams. Dr. Christman asked if the transformed presence/absence response was related to density, and if presence was related to the probability of a fish being detected. Dr. Ahrens stated that areas of greater density of red snapper would likely be attracted to gear such as hook-and-line, which would increase the probability of detection by sampling gear; however, he acknowledged differences in the detection methods of the gears employed in the study. Dr. Christman stated that if that was the case, then the sampling regime was not random, since the different gears represented non-random effects. She then asked what mechanism constrained sampling in Texas and Florida for the UCB, since the sampling map encompassed most of the Texas coast. Dr. Ahrens clarified that 624 sites were identified for the Texas continental shelf. Dr. Christman reiterated that estimated means and variances were calculated for each sampling strata (in both UCB and artificial reef) and inquired whether the investigators thought those values aligned with expectations. Dr. Ahrens answered that the CV assigned for each strata represented the high end of the distribution, assuming a sampling of high-density sites. In high density sites, CVs can range from 200% to 1,000%, therefore, sample sizes did not reflect the true variability of what exists in the data. Dr. Christman asked if each single artificial reef was considered a sampling unit, and Dr. Ahrens confirmed that they were.

Given the difference in sampling methods between habitat types, Dr. Kai Lorenzen asked whether researchers had made any considerations regarding the inherent differences in detection probability and variance between the approaches, and if any efforts to calibrate the methods had been conducted. Dr. Luiz Barbieri stated that study results indicated (Table 6 of the GRSC report[1]) that sampling was focused on high density habitat, in some cases, more than 20 times as much. He then asked whether any type of weighting was applied to generate those results. Dr. Ahrens stated that the original design was to allocate sampling to achieve an estimated CV of 30% or less; however, as field sampling continued, it was revealed that pipelines were important habitats that were not originally included in the sampling design. The example of the pipelines being included after field sampling commenced was one example of the study design modifications necessary to accommodate differences in the initial study design and that deemed necessary through field observations.

Dr. David Eggleston inquired as to what researchers would redesign or revisit about the RF model now that the study had been completed. Dr. Ahrens indicated that the data collected from the study would be helpful to ground truth and improve the RF model, but also stated that the RF model did a fair job of determining the type of habitats that could be found in a given location. He also stated that the original sampling program still is affected by the uncertainty about the variance

[1] https://gulfcouncil.org/wp-content/uploads/02a.-GRSC-Report-for-GMFMC-SSC_filesizereduced_03152021.pdf

for the individual samples, which might benefit from simulations to determine the number of additional samples necessary to reduce the variance of the final estimate. Additionally, he noted that the design did not randomly sample with towed gears, and it would be better to look at a systematic cluster analysis with an examination for autocorrelation. Dr. Christman asked for clarification about a validation analysis checking the Florida low, medium, and high boundaries which seemed to either indicate a regional effect of red snapper behavior, or that the RF model was not adequately capturing all the variability for that region. Dr. Ahrens responded that he thought the RF model did not perform as well in accounting for areas with much higher density.

Reviewers asked for clarification regarding the high sample size numbers related to surveying pipeline habitat. Dr. Ahrens answered that pipeline survey videos were broken into 15 second segments and that those segments were considered independent samples. For pipelines, a two-stage bootstrapping approach was implemented. A pipeline was randomly selected, then a starting point along the pipeline was selected and every 40^{th} 15-second video segment along that transect was selected for sampling. Dr. Eggleston asked for clarification on sample weighting, as he thought it was based on the proportion of areas sampled. Dr. Ahrens indicated, for the pipeline habitat, it would be difficult to define how much space outside the pipeline would be needed to be directly comparable to UCB habitat; thus, they were kept separate. Reviewers also asked about the considerable sample sizes shown for UCB habitat. Dr. Ahrens noted that the number of UCB samples was greatest for Texas and Louisiana, and was a function of the towed sled systems (C-BASS and TARAS), and coverage by those systems over those areas. Reviewers suspected that the UCB point estimates of absolute abundance may be too high, and that sampling by the C-BASS and TARAS sleds should not have been combined *a priori* because they represent different sampling strategies. Dr. Ahrens replied that the deeper areas off Texas were sampled primarily using C-BASS, while both sled systems were used in shallower waters. All samples were then reapplied post-hoc over the original sampling strategy (*a posteriori* post-stratification), irrespective of density or habitat observations. Lastly, the reviewers noted that the sample site selection was best represented by a two-stage cluster design, and asked whether the variance could be estimated for both stages; Dr. Ahrens noted that it could only be accounted for in the second stage.

Florida

Dr. Will Patterson presented the results from the Florida-focused sampling efforts to estimate the absolute abundance of red snapper and the directionality of any biases therein. The methodologies used in this study focused heavily on the use of remotely operated technology, including ROVs, towed camera vehicles (TCV), towed aquatic sleds (TAS), and sonar. Validation studies were also conducted in Florida waters that were used elsewhere in the Gulf to compare and combine the data collected by these various gears.

Behavioral Experiment

Artificial reefs were selected in an area of the Florida Panhandle known to the investigators for testing the behavior of fish, specifically red snapper, to the different mobile sampling gears to be used in estimating abundance. Each site was assessed with various gears: SCUBA diver (diver), ROV, TCV, and TAS. Fish behavior data were collected for one hour pre- and post-deployment.

The study assumed 100% detectability of red snapper, and that red snapper inhabiting these sites were all age 2+, given the depths and habitat in which the fish were observed.

Fish were tagged with acoustic transmitters and given 24 hours to acclimate to the tag. When comparing fish behavior in response to the presence of mobile sampling gears, data suggest a significantly higher amount of fish movement in the water column associated with diver presence. Less fish movement was associated with ROV, TCV, and TAS gears, with TAS being associated with the least amount of movement. This could be a result of the camera being higher in the water column, thus possibly influencing fish behavior where individuals would swim off the bottom habitat to explore this gear. The mean acclimation period following the deployment of the sampling gear was similar among all four gear types.

A reviewer asked about the difference in the number of acoustic "pings" among the various sampling techniques, pointing out how those attributed to TAS were much fewer than other gears. Dr. Patterson explained that this could be due to the distance between the habitat and the placement of the device within the water column. In the case of the camera systems, it could be a result of the camera resolution and the distance between the fish and the device.

A reviewer asked about the transformation for the generalized linear mixed model, and recommended a different way to represent data variability instead of symmetric standard error bars, especially when the data are not normally distributed. She also asked about how the age of the fish might influence behavior. Dr. Patterson responded that fish tend to have a similar response when a feeding opportunity arises (such as sediment disturbance as a result of gear deployment) and that he did not expect the age of the fish to have a significant effect in this study.

Dr. Simmons (Council Staff) asked about the higher mean counts for the diver method versus the other mobile gears. Dr. Patterson acknowledged the difference and responded that in hindsight, the other mobile gear types could have been deployed near the artificial reef on the previous day to allow for more acclimation time, instead of putting the diver in the water first. This was not possible at the time of the study, given time and funding limitations. He also reiterated that fish tended to settle down after approximately 45 minutes, and resumed similar movement to that reported during the pre-deployment period.

ROV and Hydroacoustics

There were 749 sampling sites selected throughout Florida characterized as natural bottom (i.e., known and uncharacterized) and 65 artificial reef sites. Sites were selected using a stratified random design, and video sampling was conducted at each site with an ROV to estimate red snapper abundance and density. Split-beam sonar was also used to sample some of the sites. Natural hardbottom sites tended to have a higher diversity of fish compared to artificial reef sites.

The Florida study counted 148,644 individual fish, with 3,850 being identified as red snapper. When comparing hydroacoustic to ROV estimates of red snapper, the data suggest the counts from ROVs were 9 times higher than estimates from the hydroacoustic gear. This could be due to the spatial distribution of the habitat, especially on patchy hardbottom with large sandy areas which make it difficult to encounter fish compared to areas of continuous hardbottom.

Fish that were equal to or larger than 250 mm TL were considered to be age 2+. A total of 637 red snapper individuals were measured, with the majority of individuals measuring between 300- and 400-mm total length (TL); of note, however, was that some larger individuals measured in the range of 600 – 1000 mm TL. Dr. Patterson noted that the length composition points to a greater number of younger fish in Florida; thus, the population may not be spawning to the same degree as the larger individuals in other parts of the Gulf.

Dr. Steve Cadrin requested clarification between the SEDAR 52 (2018) and GRSC length estimates related to determining age 2+ abundance. He also asked if the comparisons between the ROV and hydroacoustic techniques can be used to estimate detectability. Dr. Patterson responded that this would not be possible given the inherent difference in sampling design and limitations, and commented on how more recent studies are combining different sampling techniques with novel modeling approaches to generate estimates of abundance. Questions were raised regarding the characterization of bottom type, which for Florida was divided into two categories: natural bottom (which includes natural reefs and uncharacterized bottom) and artificial reefs. In relation to the GRSC, this "natural bottom" classification, excluding natural hardbottom reef habitat, is considered uncharacterized bottom (UCB); although, some regions had been previously mapped, and the bottom type was known in those areas. The reviewers also requested clarification of the number of sites sampled, as it did not match was what listed on some of the tables in terms of numbers of observations.

The SSC asked about the 9-fold difference between ROV and hydroacoustic estimates, and if this difference was applied in other regions of the Gulf. Dr. Stunz responded that this was not applied to other regions. The reviewers also commented on the difficulty of integrating different sampling methods to account for estimates of absolute abundance. Although effort was taken to encompass a large area of the west Florida shelf, it still accounts for a small fraction of potential habitat and caution should be taken when interpreting the results.

Alabama and Mississippi

Dr. Sean Powers reviewed the sampling approaches and data collected for Alabama and Mississippi. Habitat was broken into three strata: natural hardbottom, artificial reefs, and UCB. ROVs were used over natural and artificial habitats, with a depletion survey also conducted on artificial reefs. UCB habitat was surveyed using the C-BASS sled. The composition of materials in the Alabama Artificial Reef Zone (AARZ) was assumed to be known; data about Mississippi artificial reefs are sparser, and the total number of artificial reefs in Mississippi may be 10-times greater than the amount reported in the GRSC. Sample sites in Mississippi were randomly selected from the number of known artificial reefs but, due to the thought that there may be many more suspected, yet unpublished reefs in Mississippi and western Alabama area outside of the registered reef zone, another abundance estimate was calculated using the assumption that there were the same number of artificial reefs in Mississippi as there were in the area outside of the AARZ. Dr. Sean Powers explained that a simple random sample of available sample sites was taken from previously sampled grid cells, with index-removal data collected from each site. Two types of site classifications were used: calibration and production. Calibration sites were used to calibrate survey gears to one another, while production sites were used to estimate abundance with 117 sites in Alabama and 13 sites in Mississippi. Two types of site classifications were used: calibration and production. Calibration sites were used to calibrate survey gears to one another, while survey sites were used to estimate abundance with 117 sites in Alabama and 13 sites in Mississippi. For the depletion surveys, a combination of ROV and vertical longline (VLL) sampling was completed, with the VLL sampling. Production site counts were then expanded by a calibration factor to generate abundance estimates.

Reviewers asked how habitat type was assigned in the area where the AARZ and natural hardbottom areas overlap. Dr. Sean Powers replied that contact with sites verified the habitat type, but also that deeper sites in the AARZ co-occurring over natural hardbottom very rarely ever have artificial reefs. A reviewer asked about the absence of oil and gas structures in the artificial reef sites. Dr. Sean Powers noted that those structures, while available in the survey area and equally vulnerable to sampling, were not drawn by the RF model for selecting sample sites.

Reviewers asked about the disproportionate intensity of sampling of artificial and natural reefs with higher density compared to those of lower density. Drs. Sean Powers and John Hoenig noted that they lacked the resolution of habitat and fish density data *a priori*, and in hindsight, would have sampled a greater number of sites. The estimated number of artificial reefs in Alabama coastal waters was stratified into depth strata. Data for both states were augmented by surveys completed for SEAMAP in 2014 and 2015.

A reviewer noted that vertical line gear tends to select for larger fish than those observed by the ROVs. Dr. Sean Powers replied that these data were combined with those from ROV surveys, which allowed for sampling of the length composition present on the reefs; a reviewer added that using two gears on the same sampling site would result in correlation in the data.

Reviewers then discussed the density estimates as they differed between Louisiana and Alabama artificial reefs. Dr. Sean Powers pointed out that the reefs in Louisiana are much larger (oil rigs) than those typical of Alabama (chicken coops), and so the per-reef density estimates would be expected to be quite different. Though many of the materials used in the AARZ are assumed to be known, Dr. Sean Powers added that the ability to map the unknown areas therein would have been beneficial to the study and the understanding of the composition of the sampling sites.

Regarding results of the depletion study, Dr. Sean Powers stated that using the mean depletion rate better demonstrated a decline, and therefore mean abundance. The number of instances where depletion surveys actually showed an increase in harvest of the second VLL set were few (approximately 20%). In most instances, depletion works in the aggregate, as the relative abundance present before the fishery begins fishing a reef is comparatively high, followed by a reduction in abundance in the wake of fishing pressure, which then reduces the CPUE, causing effort to shift elsewhere. Dr. Sean Powers noted that the means over all sites were combined, with the variance of the combined means estimated to account for the inter-site variance. A reviewer pointed out that artificial reefs were sampled much more frequently (n = 198) than natural reefs (n = 32), and that densities on artificial reefs were much higher than on natural reefs. Dr. Sean

Powers said, in hindsight, better habitat data would have likely helped prevent oversampling of the artificial reef stratum compared to the natural hardbottom. Weighting of the means by strata was discussed as a way to account for the asymmetrical sampling effort between these two habitat strata.

Texas

Dr. Jay Rooker presented the Texas portion of the GRSC study. UCB is the primary bottom type off Texas, accounting for over 95% for the seabed of this region. The goal of this portion of the study was to determine if UCB played an important role as a red snapper habitat. UCB habitats were surveyed using hydroacoustics with visual surveys from a towed camera. Towed gear allowed for surveying a large area, and increased the probability of recording a fish-sighting given the assumption of low fish density over UCB. Gear was towed 5 – 10 m off the seabed. Actual starting points and headings of the transects were randomly selected, although some reviewers noted that the points on the map looked uniform and not random. Dr. Rooker explained that this was because of the way data were visualized, as points versus transect lines with directionality. Dr. Rooker mentioned having similar results to Dr. Patterson in Florida, having observed many areas without fish (i.e., zeros). Visuals from the ARIS sonar suggested mostly low relief habitat, with approximately 10% of the survey cells having relief anomalies. Species composition was separated by region: north Texas, central Texas, and south Texas. South Texas showed the largest percent composition of red snapper (50%). Overall, red snapper represented 37% of the taxa reported for Texas UCB habitat across depth strata. Dr. Rooker also noted the limitations of the study as many of the UCB cells had low visibility, making it difficult to determine species composition with video sampling gear. He also noted that regional species composition estimates of total red snapper counts likely underestimated the natural variability of this species on UCB in general.

A reviewer asked about the similarities between this study and the one by Dr. Murawski's team. Although the project in Florida was focused on habitats in comparatively deeper water, there was some overlap with the type of strata surveyed in Texas. Reviewers asked about trends in water clarity, and if it was common for visibility to be so low. Dr. Rooker responded that it was common to have low visibility off Texas, and that it was difficult to predict water clarity on the bottom from the surface.

Reviewers also asked why red snapper were so dominant compared to other taxa. Dr. Rooker did not have a definitive explanation, but noted that it is not uncommon for areas of the northern Gulf to have less fish diversity, especially when compared to Florida; previous studies corroborated this observation.

Dr. Mary Christman asked about the transects in relation to water clarity and the assumption that deep sites will have the same fish distribution as shallower sites. Dr. Rooker recognized the small sample size in shallower sites given poor visibility, and suggested that this was a conservative approach when making comparisons among depth strata. Dr. Lorenzen commented that species composition data had been derived mostly from ROV surveys near the shelf edge where visibility was highest, and that an average of those composition data had then been applied to hydroacoustic abundance estimates obtained in waters closer to shore where visibility was lower. He noted that this was likely done out of necessity, but that there was a question over applicability of species composition data from the shelf edge to samples taken in lower visibility habitats closer to shore.

A reviewer asked about the deviation from the original sampling design established before field sampling commenced. Dr. Rooker replied that given the high probability of encountering sites without many fish, they decided to increase the sample size to capture a more accurate picture of habitat use and reduce some of the variability that may have strongly influenced the overall abundance estimate of red snapper.

Reviewers also asked about the characterization of relief anomalies, where the hard bottom can be exposed or covered by shifting alluvial sediments. Dr. Rooker responded that at this time, the study was not able to categorize the sediment in that way. Dr. Rooker also clarified that when looking at depth strata, "shallow" does not necessarily mean nearshore waters, which is especially true for those states with an expansive continental shelf.

Dr. Stunz presented data collected on Texas' natural and artificial reef habitats. The three-dimensional structure of artificial reefs in Texas can be dominated by decommissioned oil rigs, compared to smaller concrete modular reefs or rubble in the eastern Gulf. The region's very few natural banks are very high in relief.

Study sites were randomly selected and surveyed with ROVs equipped with GoPro cameras for species composition, and with hydroacoustic equipment to estimate fish density. Artificial reefs allowed for more vertical distribution of red snapper, with fish observed to be in close proximity to structure. Species composition was applied by site and depth, with each layer having a different total fish composition.

Natural reefs were estimated to have a higher number of red snapper compared to artificial reefs, with counts thought to be underestimated due to poor water clarity. Additionally, fish that were closer to the bottom and below the ROV would be out of the camera's field-of-view and not observed, possibly contributing to underestimation. Similarly, fish within the artificial reef structure or very near the bottom could not be accurately captured by hydroacoustic sampling because of the "shadow effect". This effect is caused when sound waves bounce off other sound-reflective surfaces, which can vary with target (fish) density and with the composition of surfaces around the target (e.g., concrete or steel of artificial reefs; mud, sandy, or rocky bottom).

Dr. David Eggleston asked about the ecological drivers for the observed red snapper-dominated species composition. He mentioned that many studies focus on the response of red snapper to the sampling gear (e.g., presence of ROV), yet not much is discussed about the response of other fish species in the same habitat. He posed the question if these methods may be overestimating red snapper presence and not accounting for skittish fish that may avoid the camera equipment. Dr. Stunz commented that the literature suggests that if there is relief, there are red snapper and that visuals from the ROV did not show other fish fleeing the field of view. Dr. Stunz also noted that the general behavior of fish was generally unresponsive to the ROV, except when a laser was used for estimating length. Dr. Stunz mentioned sightings of other snapper species, large cobia, some grouper, and greater amberjack were relatively uncommon. He noted some stratification in the use of artificial reefs, where certain species preferred to aggregate at specific depths. A reviewer asked about other species that predate on red snapper, to which Dr. Stunz replied that red snapper can be prey for greater amberjack, some goliath and warsaw grouper, and sharks.

Another reviewer asked about the density of red snapper throughout the banks, and whether there was a propensity of the species to aggregate to the crest, shelf-edge, or slope. Dr. Stunz responded that this study does not answer that question, but could be explored later. Another reviewer noted the similarities in the proportions of red snapper in UCB among the five Gulf states. Dr. Stunz suspects that there is much unknown about the relief anomalies of UCB, and that future studies should focus on characterizing those bottom types.

Louisiana

Dr. Stunz characterized sampling efforts and challenges for sampling in Louisiana. North and central Texas have similar habitat characteristics with respect to natural hardbottom and artificial structures compared to Louisiana. As such, north and central Texas shelf surveys were integrated and imputed for generating the abundance estimate for Louisiana. Natural hardbottom habitat is largely limited to the continental shelf break off Louisiana. Compared to areas of the eastern Gulf, there are many more large, complex artificial reef sites available off Louisiana due to presence of oil and gas industry infrastructure. Investigators profiled species composition by depth and habitat using ROVs. Species composition was then compared to fish density estimates from hydroacoustic surveys to determine the number of red snapper by habitat and depth. Hydroacoustics followed the “flower” survey pattern with a central point for the transects, similar to hydroacoustic survey methods implemented in other parts of the Gulf. The “zone of influence” around the artificial structures is thought to be 50-100m, depending on the literature; however, most fish were observed proximal to structure. Hydroacoustic data processing followed approaches previously described for other regions. Fish within artificial structures are inherently excluded from acoustic echograms. Also, fish very near the bottom may also be subject to dead zone exclusion, resulting in a conservative bias to abundance estimates and affecting the variance of those estimates.

Species composition analyses indicated approximately 15% of fish detected on natural and artificial reefs off Louisiana were red snapper. The estimate of red snapper on natural reefs in Louisiana was measured as the mean density per 100 m^2, and was expanded to known natural hardbottom habitat area. The estimate of red snapper on artificial reefs in Louisiana was measured as the mean density per structure, and was expanded to the presumed universe of artificial reef habitat.

Reviewers asked about the year used to determine the number of artificial reefs, including oil and gas platforms, as it may affect the total number of artificial reefs present due to oil rig placement and removal. Dr. Stunz thought the year used for those data was 2019, and information could be provided to differentiate between oil and non-oil associated artificial structures. Dr. Benny Gallaway noted that less than 1,000 oil and gas structures remain off Louisiana, and thought the number of structures estimated to be present in that region may be overestimated.

Gulf-wide Tagging Initiative

Dr. Matthew Catalano presented results of the mark-recapture portion of the GRSC project. The main objectives were to estimate region- and sector-specific recreational (private and charter) exploitation rates, assess the effect of distance from nearest port on capture rates, examine any size-based vulnerability to capture, estimate tag shedding, and determine discard rates. Tagging was conducted from January to June 2019 in western and eastern Texas, Alabama, and the Florida Panhandle. Effort was distributed with a target of 300 tagged fish per region across 30 sites, and every third fish was double tagged to assess the tag shedding rate. Additionally, a monetary award of $250 was given to every fisherman that reported a tagged fish, with that angler given a survey inquiring about their awareness of the GRSC. The tag return model was conducted using a Bayesian approach, and measured probabilities related to the five possible fates of a fish after tagging, as well as a post-capture fate. The model required a number of assumptions such as a 100% angler reporting rate, negligible movement among regions, and that vulnerability to harvest was not sector-specific. Results from the model indicated high exploitation at nearshore shallow reef sites, as there was a modest negative effect of distance to nearest port and vulnerability to harvest was determine to be dome-shaped. The majority of anglers (~60%) surveyed indicated they had no awareness of the GRSC until contacting a researcher to report a tagged fish.

Mr. Douglas Gregory inquired as to how days of freedom might affect return rate since tagging began at the beginning of the recreational season and indicated that commercial fishermen were likely to report a tagged fish. Dr. Catalano indicated that he had examined days-at-large as it related to tag shedding, but not harvest rate. He stated that the goal of the project was to determine red snapper vulnerability to capture; therefore, the study focused on highly exploited areas during the open recreational season. He also said that there was some uncertainty as to whether commercial vessels may be too busy during operations to noticed a tagged fish, so commercial returns were not included in the model. Mr. Bob Gill mentioned that in his previous experience operating a commercial fish house, commercial fishermen were likely to report tagged fish, especially with a monetary award. Dr. Catalano responded that he could integrate commercial tag returns in the model, but pointed out that there were not very many commercial returns.

<u>Abundance Estimate and Supporting Analyses</u>

Primary Analysis

Dr. Ahrens described the primary analysis of the data collected, and began by stating that samples at the strata level (region, depth, and habitat classification) were assumed to be simple random samples with no measurement error and strata level means and variances were calculated accordingly. Samples were assigned to depth and habitat category as necessary, based on geographic location post-hoc. Regional and Gulf-wide estimates of abundance were calculated as expanded means and variances derived using the appropriate calculations for a stratified mean and variance. Sample sizes were calculated using the Satterthwaite approximation for degrees of freedom.

Data were not collected for some regions, depths, and habitat categories for a variety of reasons. This occurred for two strata in Florida, and the mean and variance from the most similar strata was used. For Mississippi and Alabama, all missing strata (4) were assigned the mean and variance from the deepest most probable habitat category. Approximately 88% of observations returned zero observations of red snapper.

For artificial reefs, Texas data came from acoustics and species composition, with Louisiana data imputed from Texas due to sample coverage issues. Mississippi and Alabama data came from corrected MaxN counts. Florida data came from ROV surveys. Data, by region and depth, were assumed to come from simple random samples with no measurement error. In Florida, stratification provided no benefit, so structure category was not used. In Texas, estimates were made for "small" and "extra-large" categories. Louisiana imputed data were assumed from Texas "extra-large" structures. Mississippi/Alabama data were from small structures and had a correction factor of 0.06. Total population values were estimated from expanded means and variances. Total estimates for the number of sampling units in each category were obtained from state and federal records.

For natural hardbottom habitat, samples from each region were assumed to be simple random samples with no measurement error, and mean and variances were calculated accordingly. For Texas, density from hydroacoustics was paired with video species composition data, with Louisiana data imputed from Texas. Mississippi and Alabama estimates were derived from corrected MaxN counts per habitat unit. Total population values were estimated from expanded means and variances.

Pipeline habitat was classified into three categories by pipeline diameter: 8"-12", 12"-24", and 24"+. Total pipeline distance was calculated from the Bureau of Ocean Energy Management (BOEM) georeferenced database of active pipelines. Data were subsampled to account for potential spatial autocorrelation, and were composed of counts from segmented continuous towed video (15-second intervals). Video segments per-tow were subsampled by every 40th segment from a random starting point within the first 100 observations. For each pipeline diameter category, a mean density per linear distance was calculated. Total population values for each pipe category were estimated from expanded means and variances.

The reviewers noted that the samples were all being treated as random, but did not functionally appear to be random. Dr. Ahrens agreed that the non-random selection of sample locations would inflate the variance. Any bias as a result of the difference in sample site selection is not expected to result in a substantial difference in the point estimate of abundance but would affect the variance estimate. A reviewer inquired about how most of the UCB was sampled. Dr. Ahrens indicated that most samples were collected using C-BASS in depth regions 2 and 3. There was discussion about the treatment of replicates within the pipeline samples as being independent observations. Reviewers were concerned that the choice of sampling in 15-second segments was arbitrary, and recommended that a cluster analysis approach should be conducted and compared to the original method.

Dr. Christman inquired why some strata reported no abundance estimation and why non-integer values were reported for reefs. Dr. Ahrens replied that it was possible those strata did not exist, as they could have possibly been deeper than the depth cut-off, and that strata with zero observations were included in calculating the overall estimate averages. He also clarified that the non-integer values for small artificial reefs in Texas was the result of averaging a number of reefs in a discrete area. Dr. Christman expressed concern about some of the analytical process that could influence and potentially deflate the overall variance. She suggested that rather than assuming no sampling bias, species composition averages, along with those associated variances, could be measured and used to interpret study results. Dr. Christman added that the samples as collected from transects and pipelines are not independent of one another, and also do not follow a two-stage cluster approach. The sample size being used is considered artificial, due to the use of 15-second video grabs from the same transect. Considering these transects in total could reduce the variance about these data, since the only remaining considerations would be the total length of the transects, their location, and their orientation to other transects.

Dr. Cadrin asked whether researchers had any input on the low observation level of red snapper in the UCB, given the result of a zero-inflated distribution of counts and how it might affect the overall estimate. Dr. Ahrens stated that it was difficult to know what observations could be construed as "real" zeros, but added that weighting of the strata would possibly affect the final estimate. Dr. Ahrens also noted that only one observation, from Florida, was not used because of the effect that one observation had on the population estimate for that strata. Dr. Cadrin then asked how the geolocations of the samples were assigned to each strata. Dr Ahrens noted that he was provided with the geolocations of each sample, and then assigned them post-hoc to their respective strata. Dr. Cadrin replied that the post-hoc assignment of samples to a strata likely had an effect on the per-strata, and total, variance. Dr. Eggleston requested that slide 5 of the presentation, which detailed the UCB population estimates by region and depth, be included in an appendix to the GRSC report, as it helps to interpret Tables 6 and 7 of the report.

The reviewers expressed concern with imputing information from large reefs in Texas directly to the estimate for Louisiana. Specifically, Dr. Gallaway contended that the number of large functioning reefs in Louisiana maybe a quarter of what is being reported in the GRSC, due to the continued removal of aged oil and gas infrastructure off Louisiana. That determination could greatly influence and reduce the estimate of red snapper adjacent to Louisiana. The reviewers stated that the amount of data that were re-stratified post-hoc from the original sampling plan should be addressed, and asked what proportion of reefs in Louisiana were considered large, as there is a difference in mean fish counts between small and large reefs. Dr. Stunz answered that approximately 1,000 large structures are present in Louisiana, and that the state has a program to convert old oil rigs into reefs.

Dr. Lorenzen asked whether the need for intercalibration of the different survey methods used in different habitats and regions had been considered in the design stage of the project. Dr. Ahrens responded that it had not been considered and that at that stage, the investigators had been optimistic that results of different methods would be comparable.

A reviewer asked about the influence of the RF model classification. He pointed out that there was a lot of information to develop the model in the eastern Gulf, but not in the west. Dr. Ahrens stated that he did not investigate how a threshold shift of the three sampling categories would affect the overall estimate. He stated that regions and areas that have a higher density were jittered slightly to observe changes in weightings, but doing so would affect the mean. For the development of the RF model, there was a heavy reliance on longline data, but that the RF model also incorporated some information on relative abundance of red snapper for the western Gulf. Dr. Ahrens stated that a "leave-one-out" analysis with the data sets could be used to see how they may be influencing the RF results. Dr. Eggleston asked how sensitive the population estimate is to the strata weights. Dr. Ahrens replied that the weights per strata would only change if the classifications within the RF model changed, since the weights are determined as the individual strata's areal coverage divided by the areal coverage of all strata.

Dr. John Hoenig asked if it was possible to further divide the UCB sampling transect characterization between those that contain structure versus those that do not. Dr. Ahrens stated that was not possible, due to unknowns associated with measuring the total size of those strata. Dr. Barbieri asked if the sampling frame design used, which was not proposed at the beginning of the study, still achieved the original precision requirements. Dr. Ahrens responded that it was likely that the goal of a 30% or lower CV was not achieved, due to the observation of red snapper on the expansive UCB habitat. Another reviewer asked, noting that the variance for the total population estimate was likely underestimated, if it would be possible to generate a revised estimate of absolute abundance. Dr. Ahrens stated that the quick approach would be to combine the segments from each video transect together to sum to the total for each transect, with the strata size being a function of area covered. A reviewer commented that it was difficult to determine from the samples in the tables provided in the GRSC report the proportion of the sample frame sampled by the GRSC teams in each region. The reviewer was concerned that the sample fraction may not be sufficient to fully characterize the abundance of red snapper in each strata. Dr. Ahrens noted that there were cost and logistical constraints to implementing the sample coverage intended at the beginning of the GRSC.

Validation Analysis

Dr. Lynne Stokes presented the details of the validation analyses, which estimated the variance of the estimates generated by strata. The planned sample design was a stratified random design with three stratification variables: region (FL, AL/MS, LA, TX), habitat (UCB, Natural hardbottom, Artificial reefs), and depth (Shallow, Mid, Deep). Not all strata were present in all regions, so the number of strata varied by region. Estimation of total abundance was carried out with a standard stratified sampling estimator. The variance of the stratified estimator was estimated by the sum of the estimated variances of the total estimates in each stratum. Of note, the ratio estimator is a function of the estimated number of units in the entire population.

Changes to the original sample design and analysis plan included changes to sample sizes due to the complexities of data collection (e.g., malfunctioning gear, technical glitches on video). Sampling adjustments were made for reduced sample size, but not non-response. The sample design was adapted when new information was discovered about the habitat (e.g., pyramids in Texas). After a stratum was added to the analyses, the design was adapted to a cluster design, with the first stage being the sampling grids. The ratio estimator, e.g., where the number of pyramids in a grid was a measure of size, was used. Poststrata classifications were added beyond the original plan (e.g., Florida was divided into three regions [NW, mid, south]). These were treated as strata for estimation purposes.

Data from Louisiana were largely unavailable and were imputed from Texas, making a Gulf-wide estimate of variance (or standard error) incalculable because the formula for summing variance across strata was not in fact additive. Instead, two estimates of standard error were calculated: one for Louisiana, and another for the Gulf excluding Louisiana.

For the variance estimation, several reviewers commented that the GRSC total variance estimate is likely to be biased low, due to ignoring measurement error and autocorrelation between observations. Under certain models, measurement error actually does not cause an underestimation of variance. Autocorrelation within a cluster (e.g., a ship transect) does not bias the variance estimate in a cluster design when variances are based on transect-to-transect variability. The reason that measurement error variance is captured in the observed values is similar to the reason that variance for a multi-stage sample design can be estimated almost without bias while the between-primary sampling unit (PSU) variance can be determined. This is why survey sampling software computes variance for multi-stage designs by measuring variability among PSU's.

Generally, autocorrelation has not been neglected by the model in determining the variance. The fact that the data are autocorrelated within transects is not relevant, since the observations are transect totals, and transects are independently selected. Transects were standardized with transect length independent of observed red snapper and sampled pipelines were not selected based on proximity. If there is a two-stage sample, in which transect grids are subsampled, then the standard error of the final estimate would be larger. However, a nearly unbiased estimate of this larger variance can be made from transect to transect estimated totals, to capture variance from both stages.

Dr. Stokes continued, stating that treating the pipeline data as a stratified random sample may be slightly inaccurate, but not due to autocorrelation. Instead, it is due to the fact that all transects along the pipeline are treated as having the same probability of selection. Those transects beginning within a half transect of the end of a pipeline have a smaller probability of selection than others. This means those sections of transects should have differing weights, which could affect variance and abundance estimates themselves. However, this has the potential of affecting a very small number of sample units. However, the contribution to total abundance is a small fraction of the total, and so will likely be a small contributor to variance.

A question was raised about whether a small sampling rate causes an underestimate of abundance estimate. The estimators used were either unbiased (mean-per-unit estimator) or asymptotically unbiased (ratio estimator). However, the CV of the abundance estimate can be large. This means that the estimate can be far from the true value, but the direction is not predictable. Poor allocation to strata in a design likewise does not affect bias, but increases the variance.

A reviewer asked whether the number of pyramids included in the artificial reef habitat type for Texas was accurate. Dr. Stokes noted that the sample size of 4 does not correspond to the number of structures sampled, but rather the number of grid squares in which that structure occurred that were samples. The reviewer also said that the number of transects over UCB represents the sample size per region for that strata, as opposed to the segments from the transects that were extracted and analyzed. The same is true for the pipeline data, for which each pipeline should be treated as its own sample, rather than the recorded number of video segments. The reviewer thought that the areas in which variance could be addressed, they should be, and that although individually some issues may seem to have little to no effect, in aggregate, the total effect on the estimate of variance could be more substantial.

Dr. Eggleston asked about potential autocorrelation related to clustering of areas with high observed density. He continued that he was concerned about the UCB strata classification not adequately capturing these observations. Dr. Stokes responded that patchiness would not affect the variance estimate so long as the samples were randomly selected.

Final Estimate of Absolute Abundance; Sampling Biases; and Discussion, Conclusions, and Key Takeaways

Dr. Stunz addressed several key points in summary of the materials presented on the GRSC. The investigators explicitly detailed the scope, goals, objectives, and general sampling methodologies by strata, with particular attention paid to statistical analyses, target CVs, *a priori* and *a posteriori* decisions about sampling and analyses, the tagging study, and the efforts to engage stakeholders.

Dr. Stunz stated that the directionality of the biases inherent to the GRSC and its analyses is thought to be conservative, and suggested that the published absolute abundance estimate is thought to be an underestimate of the true absolute abundance. He further stated that the detectability of fish by the sampling gears used also leads to underestimation, in both the species composition estimates and the density estimates used to determine abundance. Habitat types identified *a priori* were not known with certainty, and sampling of those areas validated the GRSC team's uncertainty about what they might find in practice. To this point, improved mapping of these habitats throughout the Gulf would benefit this study and those to come, and would be of great value to science. The GRSC team stated that known populations of red snapper occur outside of the defined study area, further biasing the estimate of absolute abundance in a conservative manner. The need for rigorous calibrations of existing surveys to these data, and the incorporation of new survey methods, has been shown to be necessary, especially given such diverse habitats and regional differences in the Gulf.

Dr. Stokes added that she ran additional analyses for Mississippi and Alabama using the variance of the product of the random variables, instead of ignoring the variance of the individual reefs. She noted that the order of the magnitude of the standard error is smaller than the variance itself. Thus, the change in the variance will be smaller than the variance itself for Mississippi and Alabama. Dr. Stokes will need to examine the data further for Texas, but she thinks that the same result will be seen for that state as well. Because the variance is based on the many observations per strata, the variance will be lower.

Dr. Cadrin acknowledged the work done by the GRSC team. He outlined the three main points from his review: he expressed concerns about the point estimates of absolute abundance, and about the underestimation of variance. Dr. Cadrin added that the assumption of 100% detectability of red snapper by the video and hydroacoustic gear is likely to underestimate abundance. Lastly, he said that he didn't think regional estimates of abundance are additive, due to biases inherent to each region. Dr. Cadrin thought that an 11% CV for absolute abundance across a large region doesn't seem realistic, especially given the differences in confidence in species composition and gear detectability between regions. For assessments, CVs are important for determining how to weight the data therein for determining abundance. The 17 of the 54 strata with zero abundance may not contribute to the estimate of absolute abundance, but they do contribute to the stratified variance. Stratified sampling with a high frequency of zero-count observations and low replication from over-stratification tends to produce underestimates of variance (Tu 2006[2]). Thus, those strata represent apparent suitable red snapper habitat, and should be considered. Dr, Cadrin continued with concern that several hydroacoustic measurement errors do not constitute white noise. Acoustic errors assume no red snapper in dead zones (areas very near or adjacent bottom habitat), which would bias abundance low, and would underestimate the variance for that sample. A number of deterministic decisions made may be contributing an underestimate of variance. Dr. Cadrin doesn't think that the collective abundance estimate can be directly used for assessment, but perhaps the estimates from the eastern Gulf may be of use with a more realistic variance estimate. A regional approach to applying the strata-specific abundance estimates may be more appropriate, given regional differences in habitat, species composition, and distribution throughout the Gulf.

Dr. Christman noted the impressive body of work completed by the GRSC team. She thought there was some post-stratification with the Florida and pipeline data, based on the thought that the species composition varied by the post-stratification classifications, which would have artificially reduced the variance. Dr. Murawski noted that in doing the surveys, the team noticed the differences in pipeline diameters, and so that difference was incorporated into the analyses. Dr. Christman noted that such a post-stratification would artificially reduce the variance, and that post-stratification should be removed and the analyses redone. Dr. Christman further explained that the initial sampling design was not followed by Dr. Ahrens' RF model, but was partially followed by Dr. Stokes, who identified that the sampling actually followed a three-stage cluster design. Dr. Christman asked that the variance be acknowledged in tables detailing the abundance estimates by strata to more accurately report the results. Dr. Christman asked for clarity in the report about the actual sample sizes which frequently differed in the results. She recommended that Table 1.0 of the GRSC report be amended to include confidence intervals, so the reader understands these are not absolute numbers of fish without variance. Dr. Christman requested there was some confusion of what was actually done compared to the results and recommend that the report be modified to address errors such as different sample sizes, depending on where you look throughout.

Dr. Eggleston commended the GRSC team on the tremendous effort given to the project. He noted that he would like the report to be modified to better detail the changes made between the study's design and execution. He also commended the work done to prioritize stakeholder involvement in the GRSC, which created additional buy-in for the project. Dr. Eggleston noted significant savings in future studies would likely be realized through lessons learned herein. He agreed with other reviewers that future work should pay particular attention to UCB, which may be serving as *de*

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[2] Tu, W. 2006. Zero-Inflated Data. In: A.H. El-Shaarawi and W.W. Piegorsch, Editors. Encyclopedia of Environmetrics. Wiley & Sons.

facto marine reserves for spawning stock biomass. Dr. Eggleston suggested that the report should include a life history diagram to better describe the life history of red snapper for the reader, with particular attention paid to age 2+ red snapper; perhaps, a schematic would be helpful at the beginning of the report as an educational tool. He thought the sections of the report detailing the RF model and subsequent analyses should be better described in a roadmap format to understand the progression from initial study design to how the study was actually completed. Dr. Eggleston thought that strata with zeroes may have had fish but were just under-sampled. He recommended that an Excel spreadsheet containing the data by strata, added as an appendix, would be extremely useful to understand the process, to eliminate confusion over the current column format that mixed mean density (100 m^2) by structure. He also suggested adding in a column for absolute abundance. In conclusion, Dr. Eggleston thought the absolute abundance estimates for red snapper were realistic but likely an underestimate, due to the hydroacoustic sampling assumptions and challenges in the western Gulf.

The SSC commended the GRSC team on the immense amount of work that went into this effort. Dr. Murawski also highlighted the discrepancies between the estimated fishing effort determined from the GRSC tagging data, which is higher than that determined by the SEDAR 52 stock assessment. An SSC member also asked about how to incorporate the SSC's recommendations into the final GRSC report. Dr. Stunz replied that he appreciated the feedback and guidance provided, and that the GRSC team would use it to improve the report. Dr. Joe Powers added that this review effort was designed to mimic a SEDAR review, but collapsed into a shorter time frame. Much of the discussion and conclusions of the reviewers focused on the uncertainty of red snapper in UCB, the underestimation of variance by strata and in total, and the directionality of the biases of the data and methods. Staff reminded the SSC that not only the consultants but the SSC was asked to provide advice on the GRSC regarding the Terms of Reference. Specifically, "The primary objective of the review is to determine whether the absolute abundance estimate and its variance is reliable and consistent with input data and population biological characteristics for red snapper". In summary, to determine what information can be taken from the GRSC and carried forward to the next part of the meeting. Dr. Joe Powers suggested the reviewers consider making a consensus statement on whether the GRSC estimates are useful, and whether they should be considered for use in catch analyses. The SSC generally agreed with a majority of the concerns identified by the independent reviewers, and overall did not think it was necessary to go back through each one of the terms of reference.

Mr. Harry Blanchet asked why no pipelines less than 8" in diameter were considered in the study. He also asked about the interaction between the biomass on the UCB habitat, and the biomass on natural and artificial structure. Other reviewers added that, in the western Gulf, a hurricane effect has been repeatedly observed, whereby a spot which is constantly fished and likely fished out can be visited after a hurricane, after which the spot is repopulated with red snapper.

Dr. Gallaway noted that the assumption of perhaps substantial biomass over the UCB is not a novel theory. He remained concerned about the sample sizes being used to extrapolate absolute abundance over very large areas. Dr. Gallaway concluded that the GRSC made a great contribution to science and the understanding of red snapper in the Gulf, but that he would like to see the modifications recommended by the reviewers implemented in the GRSC report before adjusting catch advice. Dr. Barbieri agreed, adding that the review of the GRSC was designed to mirror the combination of a Data and Review Workshop of a SEDAR stock assessment, and tried to abide by the criteria considered therein. He thought that the expertise present for the peer-review of the GRSC was greater in quantity, and of comparable quality, to that offered in the SEDAR process. Speaking to the determination of the best scientific information available (BSIA), Dr. Clay Porch (Southeast Fisheries Science Center; SEFSC) suggested that the reviewers should not set the bar too high, adding that no study is perfect, while also highlighting the discoveries of the GRSC.

Substitute Motion: The review team (external consultants and SSC) considers that the great red snapper count provides a representative estimate of abundance for the eastern Gulf and a highly uncertain estimate for the Western Gulf. However, the review team also considers that the true uncertainty in both estimates is substantially larger than implied by the 11% CV stated in the report, and that the estimate for uncharacterized bottom is particularly uncertain.

Substitute Motion carried 21-1 with 5 abstentions.
Abstentions: Sean Powers, Judd Curtis, Robert Leaf, Will Patterson, Steven Scyphers

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Standing, Reef Fish, and Socioeconomic SSC
Webinar Meeting Summary
April 1 – 2, 2021

The webinar meeting of the Gulf of Mexico (Gulf) Fishery Management Council's (Council) Standing, Reef Fish, Mackerel, Ecosystem, and Socioeconomic Scientific and Statistical Committees (SSC) was convened at 1:00 PM EDT on April 1, 2021. The agenda for this webinar meeting was approved as modified, and the minutes from the Gulf SSC's January 5-7, 2021, webinar meeting were approved as written. Verbatim minutes from past SSC meetings can be reviewed here.

Dr. Kai Lorenzen will develop the materials to present to the Council at its April 12-15, 2021, virtual meeting.

Discussion: GRSC-informed Catch Analysis

Mr. Matt Smith (SEFSC) presented the interim catch analysis using the GRSC data. He echoed previous comments by others, on behalf of the SEFSC, about the considerable contribution to science conducted by the GRSC team. Mr. Smith noted that the GRSC has changed the understanding of red snapper abundance, distribution, and habitat utilization in the Gulf. The need to determine whether the difference in abundance estimated by the GRSC supports additional removals is of paramount importance to fisheries management; however, catch advice would typically be determined through a full stock assessment. The SEDAR 74 research track will
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address this objective, but will not provide actionable management advice until at least 2024. The social and economic importance of red snapper to the Gulf region warranted an interim analysis to provide possible alternatives for the 2021 and 2022 fishing seasons.

The last stock assessment (SEDAR 52) was completed in 2018 with a terminal data year of 2016. The stock was determined to not be overfished, nor experiencing overfishing. The spawning potential ratio (SPR) was estimated to be 18% in 2016 for the Gulf and rebuilding. Projections began with the 2019 fishing year. The fishing mortality (F) at which the stock would rebuild by 2032 ($F_{26\%SPR}$) resulted in an overfishing limit (OFL) of 15.5 million pounds, whole weight (mp ww). The acceptable biological catch (ABC) was set at 15.1 mp ww. Both the OFL and ABC were fixed for the fishing years 2019 – 2021. Data from SEDAR 52 projected that the Gulf red snapper stock was comprised of ~41 million age 2+ fish, as of 2017.

The GRSC estimated approximately 110 million age-2+ fish, distributed 47% in the western Gulf (Texas and Louisiana), and 53% in the eastern Gulf (Mississippi, Alabama, and Florida). The results from SEDAR 52 were perceived to be based on data collected mainly from current fishing grounds, with some coverage of the areas currently referred to as UCB in the GRSC. The SEFSC was asked to provide interim catch advice using the new abundance estimates from the GRSC. This was done by converting the GRSC estimate of age 2+ fish into numbers-at-age by region (east/west). Fs were then re-estimated through spreadsheet projections to estimate F-at-age by region. The model uses numbers-at-age, F-at-age, and mean landed weight-at-age to estimate catch. Mr. Smith clarified that all red snapper in the Gulf are not equally vulnerable to fishing, and that if only a subset of the stock is vulnerable, setting catch levels based on total abundance would likely lead to localized depletion on the fishing grounds.

Three scenarios were developed to project future catches: using only natural and artificial reef abundance (All Structure); using natural and artificial reef abundance plus 15% of the abundance over the UCB areas commonly targeted by fishermen (All Structure+; see "Gardner et al. Analysis", below), and total abundance from the GRSC (Total). Assuming that the proportion of the stock vulnerable to the recreational fleets is less than or equal to that vulnerable to the commercial fleets, between 40 – 70% of the stock experiences little to no fishing pressure annually; conversely, 30 – 60% of the stock is annually exploited by the fishery. The All Structure subset (38% of total abundance of age-2+ fish) represents a reasonable proxy for the lower end of vulnerable biomass, while the All Structure+ subset (47% of total abundance of age-2+ fish) represents a reasonable proxy for the average vulnerable biomass. The GRSC estimate of absolute abundance needed to be separated by age; thus, the age composition data from 2016 from SEDAR 52 were used to construct age frequency distributions (AFDs) by area. AFDs were then multiplied by subsets of the GRSC estimate by strata to create vectors of GRSC numbers-at-age. AFDs also informed recruitment (estimate of area-specific age 2+ fish) in the projections. Recruitment is fixed in the projections and set equal to the number of age 2+ fish by area for each subset. The SEDAR 52-estimated recruitment distribution skews to the western Gulf, likely due to shrimp bycatch. The GRSC-informed recruitment is determined by the age composition data used to create AFDs.

To generate projections, the virgin biomass estimate used the predicted SPR from 2019 from the SEDAR 52 projections as a proxy (0.207). Fs would normally be derived from an updated assessment model, which was not possible to complete for SEDAR 52 in the time available. Spreadsheet projections were completed using the GRSC numbers-at-age; SEDAR 52 life history, selectivity, and retention relationships; SEDAR 52 relative Fs for the directed fleets (e.g., commercial, recreational fleets); and, SEDAR 52 absolute Fs for discard and bycatch fleets (e.g., Shrimp, closed season discards). $F_{SPR26\%}$ (the F_{MSY} proxy) and $F_{SPR40\%}$ (the F_{MSY} proxy recommended for snapper and grouper from Harford et al. 2019[3]) were estimated for each of the three GRSC abundance subsets. The SEFSC used the SEDAR 52 fleet-specific relative Fs as the starting point for the directed fleets, and fixed discard and bycatch fleets at their apical Fs from SEDAR 52. With the relative relationship between the directed fleet Fs fixed, projections were used to adjust the magnitude of the Fs to achieve SPR targets in the equilibrium yields. Catch was calculated using Baranov's catch equation with the estimates of F-at-age, natural mortality (M)-at-age, GRSC numbers-at-age, and mean landed weight-at-age. All three scenarios tested produced increased catch advice relative to the current catch limits. Catches are defined as landings and observed dead discards (i.e., no unobserved dead discards).

The rates assumed in SEDAR 52 for M, fecundity and maturity, selectivity, retention, weight-at-age are assumed appropriate irrespective of total abundance. Using a relative allocation of F across fleets, rather than apical Fs estimated in SEDAR 52, is also assumed appropriate, as is the estimated depletion level in 2019 from SEDAR 52. The SEDAR 52 estimate of age composition by region is assumed to represent the true age composition of the stock, despite differences in sampling between the survey methods used in SEDAR 52 and those used in the GRSC. Recruitment and virgin spawning stock biomass estimates were derived solely from the GRSC abundance subsets (All Structure, All Structure+, Total). Mr. Smith was clear that the results as presented were contingent upon the acceptance of the GRSC as is; however, the process used to create this catch advice is flexible, in that several factors can be modified (e.g., the percent of the exploitable population, the F_{MSY} proxy, how the ABC is calculated, another subset of the GRSC UCB, and the P* approach).

Dr. Lorenzen acknowledged the large amount of new information generated by the GRSC. He also pointed out that stock assessments such as SEDAR 52 involve data collection and analysis efforts of comparable magnitude and that, since such efforts have been repeated and integrated over multiple decades, stock assessments such as SEDAR 52 are in effect based on a much larger body of information than the GRSC. He further elaborated that the stock assessment essentially provided a synthesis of experience gained from managing the fishery, including levels of fishing that led to the depletion of the fishery to very low abundance in the 1980s and the much-reduced levels of fishing that allowed the stock and the fishery to rebuild following management intervention. The GRSC provides a snapshot of absolute abundance that is very valuable for informing future assessments. However, Dr. Lorenzen thought the abundance estimate needs to be integrated with other information, derived mostly from the stock assessment and from life history studies, in order to determine sustainable catch levels. This integration will be accomplished in the ongoing research track assessment (SEDAR 74; underway). While the results of this assessment will not be known for some time, Dr. Lorenzen cautioned that the resulting changes in sustainable catch levels are likely to be moderate compared to the difference in absolute abundance estimates derived from the GRSC and the SEDAR 52 assessment.

[3] Harford, W.J., S.R. Sagarese, and M. Karnauskas. 2019. Coping with information gaps in stock productivity for rebuilding and achieving maximum sustainable yield for grouper-snapper fisheries. Fish and Fisheries 20:303-321.

The SSC acknowledged that interpretation of a GRSC-informed interim analysis was difficult without being able to compare the stock status determination criteria typically generated from a stock assessment. The SSC stressed the importance of only recommending catch advice for one year (2021), as the abundance estimate and variance from the GRSC will be adjusted after peer-review. An SSC member inquired if any of the scenarios that incorporated abundance estimates from the UCB habitat assumed any change in fishing behavior. Mr. Smith replied that there was no explicit decision about changing fleet behavior. Mr. Smith also stated that genetic studies have indicated localized recruitment is prevalent throughout the Gulf, and that process may not translate to fish in the UCB quickly replenishing nearshore exploited areas. The SSC recognized that localized depletions have been realized in the past, likely due to red snapper exhibiting metapopulation dynamics. Dr. Will Patterson added that genetic studies have supported a more localized structure than originally thought. Dr. Lorenzen reiterated that results of the GRSC modified the previous dogma of a small, highly-productive stock to a large, less-productive one.

Dr. Lorenzen cautioned against rushing to the conclusion that the SEDAR 52 stock assessment corresponded to the stock component on structured habitat, and that the biomass of fish on UCB represented a cryptic biomass largely removed from the impact of fishing and invisible to the stock assessment. While this may be a plausible hypothesis, Dr. Lorenzen stated it is only one possible hypothesis, and others such as the use of a conservative natural mortality estimate in the SEDAR 52 assessment, may also be plausible. He further noted that the close correspondence between the SEDAR 52 abundance estimate and the GRSC estimate for structured habitat may be coincidental and may not hold if GRSC estimates were calibrated to account for differences in detection probability between methods used in different habitats and regions. He further stated that the NMFS bottom longline index, thought to be representative of relative abundance trends in the UCB, showed a historical pattern of depletion and rebuilding similar to that seen in other indices of abundance. This suggests that the biomass in the UCB is not insusceptible to the influence of fishing.

Gardner et al. Analysis: Percent Habitat Used by Directed Fleets

Dr. John Walter presented information concerning the spatial distribution of commercial and recreational red snapper catch over the UCB, from which the 15% value from the All Structure+ subset was determined. The researchers took the relative biomass maps from Karnauskas et al. (2017[4]), and raised those values to the GRSC abundance estimate. VMS data were input into algorithms used to predict fishing and vessels underway. These VMS data were restricted to the Gulf commercial vertical line fishery, which accounts for ~96% of commercial red snapper landings). These data were then merged in GIS with structure (natural hardbottom or artificial [reef, platform, wreck or pipeline]). The researchers then queried the data to match to any habitat

[4] Karnauskas M., J. F. Walter III, M. D. Campbell, A. G. Pollack, J. M. Drymon, and S. Powers. 2017. Red snapper distribution on natural habitats and artificial structures in the northern Gulf of Mexico. Marine and Coastal Fisheries 9(1):50-67.

within 250 meters (or within 100 meters of an artificial reef; Reynolds 2018[5]), and added an additional buffer for inaccuracies in VMS and mapping products.

Commercial catch in space was matched to VMS data (proportion of habitat fished) with dockside TIP landings. Trip-level CPUE was then calculated and applied to individual fishing points in 10x10 km blocks, with landings estimated by the proportion of the trip occurring per block. Relative exploitation rate per block was then calculated by dividing the estimated catch per block by the biomass estimated for that block. If a commercial cell had an exploitation rate of less than 0.01%, then it was considered "unfished". Recreational catch estimates used estimated starting values and increased UCB habitat availability with increasing distance from the nearest pass along the most adjacent shoreline.

The researchers' estimate that the amount of the overall UCB vulnerable to the status quo distribution of fishing pressure can be described using the percentage of the commercial (26%) and recreational (17%) effort over UCB, multiplied against that fishing sector's allocation of the red snapper stock ABC (51% commercial, 49% recreational). This yields an estimate that 21.59% of the UCB is vulnerable to the status quo distribution of fishing pressure on red snapper in the Gulf. Key assumptions to this analysis are that the Karnauskas et al. (2017) mapping of relative biomass is representative, that any exploitation rate less than 0.01% represents a presently unfished condition, and that recreational effort and UCB biomass available vary by distance from shore.

The SSC requested that the biomass estimate from GRSC minus two standard deviations (85 million age-2+ fish) be used to inform the analysis and then compared to the 13% estimate of the UCB vulnerable to fishing pressure (Karnauskas et al. 2017), and assuming a 22% population vulnerability. An SSC member was concerned, however, that the western Gulf was underrepresented in the RF model prediction of the percent of the UCB vulnerable to fishing, since the majority of the data for Louisiana were imputed from Texas data. Dr. Lorenzen asked about the currency in which the GRSC-informed interim analysis catch recommendations were reported. Staff clarified that the units in the GRSC-informed interim analysis are in the Marine Recreational Information Program (MRIP) Coastal Household Telephone Survey -equivalent units. Any change to a different data currency would require a stock assessment.

Dr. Barbieri asked if the Gardner et al. analysis was solely based on harvest, which Dr. Walter confirmed. Dr. Carrie Simmons asked if it would be possible to examine effort in the commercial bottom longline fishery, as individual fishing quota restrictions can lead to high discards; she also inquired as to what years of data were used. Dr. Walter indicated that it would be possible to examine data from the bottom longline fishery as they may also be fishing in the UCB. He also stated that commercial data used were from the four most recent fishing years, and that the recreational data was obtained from 2019.

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[5] Reynolds, E. M., J. H. Cowan, Jr., K. A. Lewis, and K. A. Simonsen. 2018. Method for estimating relative abundance and species composition around oil and gas platforms in the northern Gulf of Mexico, U.S.A. Fisheries Research 201:44-55.

Discussion: Red Snapper Interim Analysis using the NMFS Bottom Longline Survey

Dr. LaTreese Denson presented the red snapper interim analysis using the NMFS Bottom Longline (BLL) survey, with data from 2000 – 2020. From the SEDAR 52 stock assessment, the SSC set the OFL at 15.5 mp ww, and the ABC at 15.1 mp ww, given constant catch projections for 2019 – 2021 and subsequent years. The NMFS BLL survey index, including 2020 or excluding 2020 (due to reduced sampling from COVID-19), shows that the highest Gulf-wide abundance of red snapper was in 2016 and has declined since. Similar trajectories in biomass in the eastern Gulf with reduced area from 2020 indicate that reduced sampling had little effect on abundance estimates in the eastern Gulf. The decline in the 2020 index value was likely due to no sampling in the western Gulf in 2020, due to COVID-19. Two main decision points are necessary for selecting catch advice for this interim analysis: the selection of an index terminal year (2019 or 2020), and the selection of a three- or five-year average for the harvest control rule. An SSC member thought that 2020 data should not be used for this interim analysis, given the low sample size and high CV for the data for that year.

Discussion (continued): GRSC-informed Catch Analysis with Additional Runs

Mr. Smith presented revised options for projected yields from the GRSC-informed interim analysis using a point estimate of 85 million age 2+ red snapper, and revising the amount of UCB included in the All Structure+ subset to 13% (estimated from the RF model) and 22% (estimated from the Gardner et al. analysis). The SSC discussed the possible methods for determining OFL and ABC, and what methods could be considered for those catch levels. Given the uncertainty about the data used for the GRSC-informed interim analysis, the SSC was uncertain about the probability of overfishing in reality. Mr. Smith added that, presuming the assumptions made are valid under the scenarios provided, the projected harvest levels should be sustainable in the near-term. An SSC member recommended using the All Structure subset to set a three-year averaged ABC at $F_{26\%SPR}$, considerate of the greater (albeit uncertain) biomass estimated by the GRSC. Staff identified that an OFL would still need to be set, and that the SSC could provide more than one OFL/ABC combination for the Council to consider, with justification provided for each. An SSC member thought that $F_{26\%SPR}$ more closely represented OFL, given how the fishery has operated in recent history. Staff added that the SSC could also establish an OFL, and then provide options for an ABC based on caveated criteria for the Council to consider. Several SSC members were not in favor of multiple options for each catch limit.

The SSC discussed the OFL and how to establish some measure of confidence that a recommended OFL would not result in overfishing. Some SSC members expressed continued reservation with the GRSC estimate of absolute abundance, but others pointed to the GRSC's identification of more fish over previously under-surveyed UCB habitat. Some SSC members thought it best to fix the OFL and ABC for 2021 only, and to re-evaluate the data for 2022 when the GRSC report is revised and in its final form in June 2021. Perceptions about the abundance of red snapper in the eastern Gulf, particularly off Florida, were changed by the GRSC study; however, in the eastern Gulf, the age composition of red snapper is still generally skewed towards younger ages than in the western Gulf. Some SSC members thought it more biologically appropriate to manage the eastern and western Gulf as separate entities. The SSC debated the amount of UCB being accessed by the fishery and thought it best to include that habitat in consideration of the OFL.

> **<u>Substitute Motion</u>: The SSC defines the OFL for Gulf of Mexico red snapper for 2021 as 25.6 mp ww in CHTS units based on the GRSC interim analysis, using 13% of the UCB, and using a three-year average at $F_{SPR26\%}$ on the structured bottom representing the exploited fishery.**
>
> ***Substitute motion carried 13 – 8 with 2 abstentions and 1 absent***

The SSC thought it important, with respect to the motion on recommending the OFL, to convey to the Council the SSC's deliberations regarding trying to achieve a balance between recognizing the increase in biomass estimated by the GRSC, the uncertainty in those estimates, and the declining trend observed recently in the NMFS BLL survey. Some SSC members thought, given these points, that the ABC recommendation should be considerably more conservative than the current difference between the OFL and ABC in place at present (15.5 mp ww and 15.1 mp ww, respectively). The SSC then discussed a modest increase in the ABC compared to the status quo, with some members again acknowledging the uncertainty in the GRSC estimate of absolute abundance and the declining trend in the NMFS BLL survey; others emphasized the considerable biomass discovered by the GRSC, and the asymmetry of the modest ABC increase proposed to the OFL recommended by the SSC in the previous motion. Dr. Sean Powers clarified for the SSC that the increase in biomass in the eastern Gulf was mostly attributable to the data collected off the west Florida shelf. Some SSC members thought that although the stock size may be larger than predicted by SEDAR 52, the productivity is likely much less than previously thought, which may indicate a lower threshold for sustainable harvest than that inferred from the increased stock size from the GRSC.

> **<u>Motion</u>: The SSC defines the ABC for Gulf of Mexico red snapper for 2021 as 15.4 mp ww in CHTS units based on the SEFSC Interim Analysis informed by the NMFS BLL survey (based on terminal year 2019, and the HCR 5-year moving average).**
>
> ***Motion carried 11-10 with 1 abstention and 2 absent.***

The SSC thought it important to note, as with the motion on recommending the OFL, that the motion recommending an ABC divided the opinions of the SSC members trying to achieve a balance between recognizing the increase in biomass estimated by the GRSC, the uncertainty in those estimates, and the declining trend observed recently in the NMFS BLL survey. Staff clarified that management decisions must be made based on BSIA under National Standard 2, and catch recommendations made to the Council by the SSC are presumed to be made using BSIA. SSC members indicated that this was understood, and that their previous deliberations on the catch limit recommendations detailed their sentiments regarding the use of two separate data sources (GRSC for the OFL, and the NMFS BLL survey for the ABC) for the respective catch limits. The SSC thought it appropriate to revisit these catch limits in the near-term. Further, the SSC noted that the impetus for the review of the GRSC, and the evaluation of the interim analyses, came about in an expedited fashion atypical of how these products are normally evaluated in both time and process.

Dr. Joe Powers concluded the review and catch advice deliberations by acknowledging the outstanding efforts made by the SSC and independent reviewers to provide constructive criticism and develop science and management advice. He noted that the preliminary abundance estimates derived from the GRSC were presented to the public in October 2020, and the SSC requested an independent review at its January 2021 meeting, after receiving a summary presentation of the GRSC findings.

Public Comment

The public was given the opportunity to provide comment twice: at the end of day two, and the start of day four. All public comments for both days are summarized below.

All public commenters applauded the GRSC team on the completion of a groundbreaking study and thanked them for the amount of time, effort and dedication it took to finish the project. Public commenters also stated they appreciated the time and effort of the reviewers and the thoroughness of their investigation, and recognized the review process will be ongoing as the magnitude of the GRSC is unprecedented when trying to integrate into the management process. One commenter lauded the results of the study, but heeded caution in integration into management given the importance of the results and the magnitude of potential changes in allowable harvest. He recommended that this information should be integrated into management through a research track stock assessment and this approach is warranted given the amount of time the stock has been under a rebuilding plan. Another commenters thought decisions should be made to balance sustainability of the resource with angler opportunity.

Other Business

Staff reminded the SSC that the three-year term appointments of SSC members are expiring this summer (2021), and that current SSC members who wish to be considered for continued appointment will need to reapply. Applications for new and current SSC members will be due by April 30, 2021.

The meeting was adjourned at 12:50 pm eastern time on April 2, 2021.

Meeting Participants

Standing SSC
Joe Powers, *Chair*
Kai Lorenzen, *Vice Chair*
Lee Anderson
Luiz Barbieri
Harry Blanchet
Dave Chagaris
Benny Gallaway
Bob Gill
Doug Gregory
Walter Keithly
Robert Leaf (*GRSC co-PI*)
Camp Matens
Jim Nance
Will Patterson (*GRSC co-PI*)
Sean Powers (*GRSC co-PI*)
Ken Roberts
Steven Scyphers (*GRSC co-PI*)
Jim Tolan

Special Reef Fish SSC
Jason Adriance
Judd Curtis (*GRSC co-PI*)
John Mareska

Special Socioeconomic SSC
Kari Buck
Jack Isaacs
Andrew Ropicki

Independent Consultants
Steve Cadrin
Mary Christman
Dave Eggleston

Council Representative
Tom Frazer

A list of all meeting participants can be viewed here.