RESPONSE COMMENTS EXTERNAL REVIEWER 1

Review of "of "Estimation of Total Red Snapper Abundance in Louisiana and Adjacent Federal Waters" by LGL Ecological Research Associates, Inc., 4103 South Texas Avenue, Suite 211, Bryan, TX 77802.

From: David L. Nieland
11833 Oak Haven Avenue Baton Rouge, LA 70810
To: Andrew Fischer
Louisiana Department of Wildlife and Fisheries 2000 Quail Drive
Baton Rouge, LA 70898

Reviewer #1

Comment:

Overall, this project report is a fine piece of work; I had worked with LGL personnel previously, so I was not surprised by its quality. However, I did not expect the breadth of the study (106 sampling sites border to border) and the number of sampling techniques employed (from traditional to state of the art). There were large expenditures of time both in gathering the data and in examining the data. Had I designed this study, I would have used the same methods.

> Response: **We appreciate the Reviewers comment, especially given his long history of similar research in the Gulf of Mexico.**

Comment:

To complete my review, I will expand on a few of the many comments (some important, some not so much) contained in the hard copy of the report that I return to you. Many of my written comments will not be expanded upon, but you will get the gist. I will provide a page number directing you to the subject on which I have expanded commenting below.

> Response: **Each individual comment contained in the hard copy of our report has been addressed. These comments and our responses are attached at the end of this section.**

Comment:

Hydroacoustic Data Processing Methods, pages 12-18. My apologies, but this is largely out of the realm of my knowledge and experience. However, from the bit I do know, their methodologies seem to be scientifically sound. However, the Dr. James Cowan lab at LSU has been doing hydroacoustics in the offshore areas of the Louisiana Gulf for several years, but I can find mention only of Emily Reynolds' and Kirsten Simonsen's efforts. Much of the data processing methods (like noise removal) were developed by Dr. Kevin Boswell while here at LSU and subsequently; no mention of him either.

Response: **This is a fair comment and apologies for neglecting reference to these studies. Additional studies have now been referred to in the revised version of the document.**

Comment:

Camera Surveys, page 18: Were there any lights on any of the camera arrays, either stationary or towed? Were the camera arrays baited, as is common in such efforts? Were the camera arrays deployed both day and night?

Response: **Sampling occurred during daylight hours. Both camera arrays, stationary and towed, were not baited and without light systems.**

Comment:

Vein vs. Vane, page 19: This one is self-evident.

Response: **Noted.**

Comment:

Vertical Hook-and-Une Effort, pages 21-22: It has been my long experience that, depending on how one ties up (either bow or stem) to a standing rig and the length of the vessel, red snapper catches can vary quite a bit among bandit rig deployments. If nothing else, I would have had one bandit rig each with squid and menhaden at the stern and one of each farther forward.

Response: **Vessel used at discrete sampling sites utilized a dynamic positioning trolling motor to hold position. Orientation of vessel to sampling sites was dictated by prevailing wind and wave directions. Bait and hook deployments shifted around and were not held static as depicted in Figure 12.**

Comment:

Statistical Analyses and Modeling, pages 26-31: I am a fish biologist and not a fisheries management person, so most of this section was once again largely beyond my ken.

Response: **N/A. Appreciate the Reviewers candor on this issue.**

Comment:

Growth and Condition, pages 32-33: The authors should have forced their von Bertalanffy growth models through the origin by designating to= 0. The lack of small, young Red Snappers offshore means that your model will not be able to adequately describe early growth; this will affect other areas of the growth curve and your growth coefficients.

Response: **Length at age was modeled with a three parameter Von Bertalanffy growth equation, where to was estimated. Two-parameter versions of this model**

(i.e., fixing to=0 and estimating only K and L∞) have been applied in the literature and justified with the argument that the age when length is zero (to) lies outside the range of observed data and therefore cannot be well defined. However, Knight (1968) as well as Schnute and Fournier (1980) warn of the misinterpretations that occur when these parameters are regarded as facts of nature rather than mathematical artifacts of a model. As the reviewer points out, to, K, and L∞ are highly correlated; thus, fixing one parameter constraints estimation of the others. Sebastian et al. (2013) demonstrated that fixing to actually increases the risk of biasing K while providing little reduction in variance. In short, biological interpretation of any single Von Bertalanffy parameter in isolation has always been nebulous; using all three to estimate the average length at a given age within the range of the data is still an accepted approach.

Knight, W. (1968) Asymptotic growth: an example of nonsense disguised as mathematics. Journal of the Fisheries Research Board of Canada, 25, 1303–1307.

Schnute, J., and D. Fournier. 1980. A new approach to length-frequency analysis: Growth structure. Canadian Journal of Fisheries and Aquatic Sciences 37:1337–1351.

Pardo, Sebastián & Cooper, Andrew & Dulvy, Nicholas. (2013). Avoiding fishy growth curves. Methods in Ecology and Evolution. 4. 353-360. 10.1111/2041-210x.12020.

Comment:

Discrete Habitats Natural Banks. page 37: Once again based on my extensive experience, Red Snapper populations on the shelf edge natural banks off Louisiana are quite variable both among banks based on depth and location and spottily distributed within a given bank based largely on preferred habitat. I believe the estimate of 39.556 Red Snappers on all the shelf edge banks, dependent on three surveys at three different banks, is a severe underestimate. The 157,151 estimate is more realistic. And I may as well get it off my chest right now: Calling 10-17-year-old Red Snappers "old" (as is done throughout) is just plain wrong! Where are the truly old (30-55 years) Red Snappers? I guess after being overfished for so many years, it will take some years, perhaps decades, until we see any authentic "old" Red Snappers once again.

Response: We agree with reviewer. Red Snapper in this study are only relatively old or middle aged in the context of their life history. Text modified as suggested. These numbers do seem low for natural banks; however, they were based on just the observed averages. Our modeled estimate for total Red Snapper on Natural Banks was 621,133 (Table 7) and is the value we recommend.

Yes, everything is relative, and the definition of an "old" Red Snapper is no exception.

Comment:

Reefed Platforms. page 43: When platforms are decommissioned and removed, the explosives used in their demolition at the bottom knocks off all the biota growing on the legs, crossbeams, etc. Really, the rigs look very clean when they are craned up on to the barge that will haul them off and perhaps reefed. Until a reefed platform can grow back this diverse biota, the platform will remain marginal habitat for Red Snappers. Not surprising that there are fewer of them found at artificial reefs.

Response: We agree with the reviewer. Makes sense.

Comment:

Uncharacterized Bottom Habitat, pages 49-54: Even going back to the Great Snapper Count (GRSC), I have been uneasy with how free and fast some are playing with extrapolating a relatively few Red Snapper observations to the vast expanse of the UCB. However, in the early 2000s Chuck Wilson and I proposed that after a few years of residence, Red Snappers would emigrate away from platforms and other high-profile habitats to move to oil pipelines, depressions in mud/sandflats. natural banks, and such (see attached reprint).

Response: We agree that more uncharacterized bottom needs to be sampled. Nevertheless, the sampling afforded by this study produced an estimate of essentially "unfished" Red Snapper abundance that is within reason.

Comment:

SUMMARY AND CONCLUSIONS, page 77: I am very much more comfortable With the LGL estimate of 6 million Red Snappers off the Louisiana coast than I am with the GRSC estimate of 26-28 million Red Snappers. However, both estimates are one shot efforts based on data collected over a very short time span. Then again, the GRSC had very little data from the waters off Louisiana; much of the results was based on extrapolating data from supposedly similar habitats in adjacent Texas waters. I suspect both estimates would converge somewhat were the sampling to continue in Louisiana waters over several more years. The GRSC was also, in my opinion, funded at the behest of politicians to generate, by any means possible, very much higher numbers of Red Snappers in the Gulf than those proposed by NOAA Fisheries. I suspect that part of the mission of the GRSC also was to undermine and embarrass NOAA Fisheries.

Response: No response.

Comment:

LIERATURE CITED: I get the   feeling that the authors could have expanded their literature search to update some of their methods for analyzing their data. For instance, they use the growth performance index (φ) to compare Red Snapper von Bertalanffy growth parameters among habits and among regions.

A more recent alternative would be to apply Akaike's Information Criterion https:/ / www.scribbr.com /stat istics/ akaike-in fornation-criterion/. This is what I always used after it was suggested by a reviewer of one of my publications. There are also few recent hydroacoustic articles cited, especially those coming out of LSU. The three articles cited from Stanley and Wilson are of dubious merit.

> Response: **We agree that use of the growth performance index to compare growth parameters is antiquated and that AIC is a better approach. The growth index results have been removed from the report. However, a more robust statistical analysis comparing growth and condition will be performed at a later time. For now, visual inspection of differences in growth for various comparisons should suffice. We have amended/added respective graphs to facilitate these comparisons.**

Comment:

Again, LGL has provided a very, very good report on their activities relative to Purchase Order Number 20004617881 It certainly fills the Louisiana hole in the GRSC, as I am sure you intended it to do! Thank you for this opportunity to be of service to LDWF!

I remain at your service!

> Response: **Much appreciated!**

RESPONSE COMMENTS IN TEXT EXTERNAL REVIEWER 1

Review of “Estimation of Total Red Snapper Abundance in Louisiana and Adjacent Federal Waters” by LGL Ecological Research Associates, Inc. 4103 S. Texas Avenue, Suite 211, Bryan, TX 77802.

From: David L. Neiland
11833 Oak Haven Avenue
Baton Rouge, LA 70810

To: Andrew Fischer
Louisiana Department of Wildlife and Fisheries
2000 Quail Drive
Baton Rouge, LA 70898

Subject: In text comments

Comment:

Sampling Sites, page 10: 724 km^2, 211 km^2 – Very Nice!

Response: We appreciate the Reviewers comment.

Comment:

Field Surveys and Sample Processing, page 10: Quite a change from Academia. We never did this.

Response: Safety has become a big issue and priority.

Comment:

Hydroacoustic Field Surveys and Initial Data Processing, page 11: Again, we never did this!

Response: Calibration was critical to insure accurate counts.

Comment:

Hydroacoustic Data Processing Methods, page 12: Very Good!

Response: We appreciate the Reviewers comment.

Comment:

Hydroacoustic Data Processing Methods, page 13: *see below, this goes beyond my knowledge and experience, but I will do what I can.

Response: We appreciate Reviewer 1’s attempts to comment where possible.

Comment:

Hydroacoustic Data Processing Methods, Calibration, page 13: Again, we never did this, Alas!

> **Response:** **The Alas! Comment reflects the reviewers appreciation for our calibration attempts.**

Comment:

Hydroacoustic Data Processing Methods, page 18: The preceding few pages were a very thorough explanation of the handling of the acoustic data, but only those who work closely with acoustics could understand it. However, that is not a bad thing! Also, LSU has been doing (continued below), for many years. Why are their efforts and methods not cited?

> **Response: It is true that this is a difficult process to understand; however the detail is required so that someone familiar with hydroacoustics can see exactly what we did and be able to understand and replicate settings and methods. We most closely followed the more recent and relevant methodology of Reynolds and Simonsen at LSU, but this is a fair point and more references have been added.**

Comment:

Camera Surveys, page 18: Any lights? Did they use bait with this device?

> **Response:** **No lights were mounted on the SRV system and it was not baited.**

Comment:

Camera Surveys, SRV Surveys, page 19: MaxN – MaxN is what is routinely used at LSU.

> **Response:** **We appreciate the Reviewers comment.**

Comment:

Camera Surveys, Towed Video Transects, page 19: Any lights? Vane!, Figure caption – Vane!

> **Response:** **Lights were not mounted on the Towed video sled. Modified text with proper Vane.**

Comment:

Hook and Line Surveys, page 22. Depending on how you tie up (bow vs. stern) and the length of the vessel, catches on bandit rigs can vary quite a bit.

> **Response:** **We appreciate the Reviewers comment. Vessel used at discrete sampling sites utilized a dynamic positioning trolling motor to hold position rather than tying up to standing platforms. Orientation (bow or stern) to structure was dependent upon prevailing wave and wind directions at a given site. Hook and bait stations depicted in figure 12 was not held static throughout sampling but rather they shifted around the vessel from site to site.**

Comment:

Hook and Line Surveys, page 23. I have luckily avoided longline fishing my entire career!

Response: No comment.

Comment:

Mark/Recapture Studies, page 25. Looks a little dangerous!

Response: We appreciate the Reviewers concern for crew safety.

Comment:

Modeled Abundance of Red Snapper, page 29. Good to see they did this!

Response: We appreciate the Reviewers comment.

Comment:

Modeled Abundance of Red Snapper, page 29. This is against the law!! Or at least company regulations!

Response: We agree but it occurs and required our consideration.

Comment:

Mark/Recapture Population Estimates, page 32. Question about Gazed and Staley (1986).

Response: While this approach was developed in 1986, we believe it to be the best approach available today.

Comment:

Growth and Condition, pages 32. Set t_0 the zero! It is (impossible?) difficult to sample the smallest of red snappers while sampling offshore.

Response: Addressed under General Comments above.

Comment:

Growth and Condition, page 33. Why not force models through t_o? I believe there are newer, better methods!

Response: Addressed under General Comments above.

Comment:

Results, page 33. Table 5: Would have been nice to have Table 5 species arranged by Family.

Response: We tend to agree but alphabetical listing helps those who are not fishing types to locate their species of concern or interest.

Comment:

Mean Site Abundance Results, page 36. 4,180,643 fish and older and larger fish are common?

> **Response: Text changed to "large fish were common but consisted mainly of middle-aged fish.**

Comment:

Mean Site Abundance Results, Natural Banks, page 37. All to low, except overall mean density estimate of 157,151 Red Snapper.

> **Response: We appreciate the Reviewers comment. We believe that by stratifying natural banks and using the associated density estimates more accurately described distributions among the banks.**

Comment:

Mean Site Abundance Results, Natural Banks, page 37. These are not old fish!

> **Response: We agree with the Reviewer. Red Snapper in this study were only relatively old or middle aged in the context of their life history. Text modified below as suggested.**

RESULTS

All sites were successfully sampled as planned (Appendix 4) and analysis of all hydroacoustic, SRV, TV, age and mark/recapture samples was completed by the end of April 2021 (Appendix 5). Length and age distribution summaries for Red Snapper are provided in Appendices 6 and 7, respectively. Older Red Snapper, ages 10 – 25 years, encountered only middle-aged given a longevity (50+ years) documented by Wilson and Neiland (2001).

Comment:

Figure 18. page 40. Where are the old fish?

> **Response: We did not encounter "old" fish at natural banks.**

Comment:

Figure 19. page 41. Ditto!

> **Response: We did not encounter "old" fish at natural banks.**

Comment:

Mean Site Abundance Results, Reefed Platforms, page 43. Reefed platforms are a marginal habitat, at least until they mature a bit longer.

> **Response: We appreciate the Reviewers comment and agree.**

Comment:

Mean Site Abundance Results, Pipeline Crossings, page 44. Old Fish?

Response: **Not encountered.**

Comment:

Figure 26. page 48. Old fish?

Response: **Not encountered.**

Comment:

Mean Site Abundance Results, Uncharacterized Bottom Habitat, page 50. Older, yes, but no where near the potential life span.

Response: **We appreciate the Reviewers comment. See previous response. We agree.**

Comment:

Figure 31. page 54. Where are the 20-50 years olds.

Response: **Not encountered. The reviewer is making a good observation that rebuilding is far from being complete.**

Comment:

Age, Growth and Condition, page 61. Use metric system!

Response: **We appreciate the Reviewers comment. As the fishery is managed based** ***on "pounds", we thought our analyses might also be based on pounds.***

Comment:

Figures 37-41. page 62-66. Force through zero! Ditto. Nothing new here!

Response: **Addressed above under General Comments.**

Comment:

Overall Abundance, Natural Banks, page 71. Variability among banks!

Response: **Yes.**

Comment:

Overall Abundance, Artificial Reefs, page 72. Whose numbers do you believe?

Response: **We believe our counts of structures and associated estimates of Red Snapper are more accurate.**

Comment:

Summary and Conclusions, page 77. Offshore oil and gas platforms are the most heavily fished habitat in our study area.

Response: **We appreciate the Reviewers comment. Text changed as suggested.**

Comment:

Literature Cited, page 82-83. Stanley and Wilson, 1996,1997 and 2000. Most of the numbers in these two articles are bogus!

> **Response: Apologies, we were not aware that this was the case. However, since the use of these more classic references is not to examine or compare resultant numbers, but rather to note the historic use of hydroacoustics around platforms and to gauge a drop-off point around platforms of relative fish density only (within 100m distance, as used in the current project), we believe our reference to these studies is appropriate. We have also added an additional study on red snapper hydroacoustics with a similar density drop-off point to corroborate (Szedlmayer et al. 2019).**

RESPONSE COMMENTS EXTERNAL REVIEWER 2

Reviewer #2

An August 2021 Technical Review of:

Estimation of Total Red Snapper Abundance in Louisiana and Adjacent Federal Waters
Draft Final Report
Prepared for the
Louisiana Department of Wildlife and Fisheries (LDWF Purchase Order No. 2000461788)
by
LGL Ecological Research Associates, Inc.
June 2021

Comment:

Scope of Review and Terms of Reference
This document constitutes a technical review of the Draft Final Report; *Estimation of Total Red Snapper Abundance in Louisiana and Adjacent Federal Waters* by LGL Ecological Research Associates, Inc. June 2021 (hereafter referred to as LGL 2021). LDWF asked for this technical review in order to more fully evaluate the strengths and weaknesses of the scientific data and estimates of red snapper abundance in support of management policies for this important species.
LGL 2021 noted that the objectives of their contract were to: 1) determine species composition at 106 sampling sites at predetermined locations in the Gulf of Mexico and offshore Louisiana per approved sampling methodology; 2) conduct hydroacoustic, Submersible Rotating Video (SRV), and composition sampling for finfish at the 106 sampling sites; 3) conduct water column surveys at the 106 sites and 4) conduct a mark/recapture study at a subset of six sites (1 platform and 1 artificial reef site in each of three regions). The study was required to be compatible with Stunz et al. 2021 (*Stunz, G.W., W.F. Patterson III, S.P. Powers, J.H. Cowan Jr., J.R. Rooker, R.A. Aherns, K. Boswell, L. Carleton, M. Catalano, J.M. Dryon, J. Hoenig, R. Leaf, V. Lecours, S. Murawski, D. Portnoy, E. Saillant, L.S. Stokes, and R.J.D. Wells. 2021. Estimating the absolute abundance of age-2+ red snapper (Lutjanus campechanus) in the U.S. Gulf of Mexico. Mississippi-Alabama Sea Grant Consortium, NOAA Sea Grant. 303 pages*). As noted in Stuntz et al. unforeseen circumstances curtailed the plan for sampling in Louisiana by their study. Therefore, they developed an ad hoc estimate based largely on sampling results in waters adjacent to Louisiana in Texas. However, it was determined that sampling directly in Louisiana waters was needed. Thus, the LDWF contract was let to LGL to sample 106 sites during 2020 and provide estimates of La red snapper abundance based on those samples.
It is important to note that the scope of this report is to review the LGL results for Louisiana and *not* to review the results of Stunz et al. The Stunz et al methodologies at both the sampling and overall estimation levels differed (by design) in Texas, AL/MS and Florida from those in LA. While LGL 2021 makes a number of comparisons of their results and methodologies with the Stunz report, the technical review herein focuses on the LGL results using their methodologies. However, since the Louisiana estimates in LGL are based solely on sampling in Louisiana and adjacent Federal waters, whereas Stunz et al. used extrapolated samples from outside that area, this provides some *prima fascia* support for using the LGL results in support of management.

Response: **We agree with all these scope statements, especially the conclusion of this paragraph.**

Comment:

Also, it should be noted that LGL 2021 indicated that they were supplied with the locations of the 106 sampling sites. The implication is that these sites were selected based on a stratified random design and provided to LGL and then LGL sampled those sites and analyzed the results based on that premise. While it does not appear to be within LGL's remit to justify the specific selection of the 106 sites, estimation methods that were used or might be used in the future are contingent upon this premise. So, at some point there should some discussion of that selection by the suppliers of the site locations.

Response: **Additional text added on page 1 of the report and the RFP is now attached as Appendix 9. The RFP provides more detail on site selections.**

Comment:

This technical review will be addressed in three sections. The first section addresses the sampling methodologies associated with acoustic and video sampling to obtain fish density and red snapper proportions, respectively, and the mark/recapture studies. The second section examines the actual estimation of red snapper abundance, how the site samples were expanded to larger strata and comparisons to mark/recapture results. And, the third section is for conclusions and recommendations; in particular whether the LGL estimates of red snapper are useful for integrating into future assessments and management decisions.

Response: **We appreciate this review organization scheme.**

Comment:

Field Sampling for Fish Density and Proportion Red Snapper

The red snapper sampling frame was defined in terms of region (east, west, central), depth zone (shallow, mid, deep and shelf) and then habitat type (uncharacterized bottom (UCB), natural banks and artificial reefs (including artificial reefs, platforms, and pipeline crossings). Of the 106 total sampling sites, 37 were located in the West Region, 33 were in the Central Region and 36 were in the East Region. Of these, 55 were discrete reef sites whereas 51 were UCB sites (of which 39 sites were uniquely sampled and the other 12 sites were paired with pipeline samples. Total area by habitat type was estimated as: natural banks 724 km2, UCB 49,003 km2 whereas there was a count of 1777 artificial sites known. Final estimates of red snapper abundance were made for the aggregate habitat types and not for finer strata (see Estimation section). Tables 1-3 in LGL 2021 are particularly helpful in understanding the relative sampling that has been applied.

Response: **This is an accurate characterization.**

Comment:

Note that this reviewer does not have technical expertise in the physics of acoustic signals and the optics of underwater visual camera systems, therefore the criteria being examined are: is the methodology documented in the report? Is it consistent with standard practices employed by others in the field? And are possible biases noted? In the case of the hydroacoustic sampling, these criteria appear to be fulfilled (see LGL 2021 discussion on pages 12-17.

Comment:

However, from a statistical standpoint I note that there are instances where variance issues are “glossed over”. For example, I am unclear (this may be due to my lack of expertise) about the conversion of signal strength to a number of swim-bladdered fish. LGL 2021 used in situ Target Strength. The methods to determine TS/swim-bladdered fish that were used are not clear. More importantly, is this a source of variance that is measurable and can be integrated into the density estimation? Is it likely to be important? I suspect that these sorts of issues will not impact the point estimate very much but could affect variance estimates.

> **Response: Similar to the Stunz et al. paper, in-situ Target Strength (TS) was indeed used. The methods to determine the in-situ TS of swimbladdered fish involve specified detection parameters within Echoview and a number of analysis steps including the decibel differencing process as described in Hydroacoustic Data Processing Methods section (pages 12-17). The decibel differencing technique assists in the in-situ TS process by essentially helping to filter out acoustic data resultant from non-swimbladdered fish and other particulate matter such as plankton, thereby reducing confounding signals. Stunz et al. also employed this technique in their Florida data but did not in their Texas data, which used only a single frequency echosounder.**
>
> **In terms of the variance, as the data processing uses in-situ TS, a TS value for single echoes is measured after filtering and thresholding the raw data and is used directly in the subsequent density calculations (i.e. echo integration). This differs from when ex-situ TS (in the form of established TS-length equations) is used, in which variance in density can be calculated by applying different sizes of fish, therefore resulting in differing TS estimates. With the in-situ scenario, in theory a change in threshold values and filtering could result in differences in the estimated density and final numbers. The difficulty, however, is that all thresholds and settings are on a sliding scale and are employed at most of the different operators visible in Figure 8. The process of discerning variances due to such changes would therefore become almost infinite, changing each parameter within each operator to determine successive cumulative results. In practice much of the thresholding and filtering is done by subjective scrutinization of the processed echograms by an experienced user and is an iterative process, making changes until signals from obvious non-fish particles are removed while obvious fish remain. Final threshold values are also based on and compared to methods in**

previous studies. This process does preclude calculation of variances within the raw data, which is standardly not reported. Variance estimates may be calculated from subsequent steps in data analysis.

Comment:

Also, the overall goal of the study is to estimate age 2+ red snapper or red snapper approximately greater than 300 mm. I did not see any discussion of the filtering of fish TS relative to size. Again, it may be to my lack of expertise.

Response: The hydroacoustic data processing primarily uses decibel differencing to obtain in-situ TS and a resultant density estimate of all swimbladdered fish, which is then apportioned by all swimbladdered fish observed via camera surveys to obtain numbers of red snapper. The decibel differencing process to discern swimbladdered fish is as far as one can reliably go within hydroacoustics in picking out the fishes of interest in a mixed species community such as this. This process provides a step towards narrowing potential targets other than red snapper, but TS of individual red snapper still overlap with a variety of other fish.

An additional minimum signal threshold is applied to both Sv and TS at -50 dB in the study, which filters out smaller organisms including non-swimbladdered plankton and small swimbladdered fish. Simmonds and MacLennan (2005) describe the range of TS for almost all fish as -60 dB to -20 dB, with the lower end of the range approximating a 4 cm sprat or similar fish. A -50 dB threshold represents a significant change in energy and size from the -60 dB minimum, since TS measurements are on a logarithmic scale, and a difference of 3 dB represents a twofold change in backscattered energy. Additionally, the area of backscatter of a red snapper is attributable to its swimbladder, not the length of the fish as a whole, and very young red snapper are likely to have been filtered out. However, TS remains highly variable depending on size, shape, angle, and tilt of the swimbladder, and consistent filtering of a precise size of fish cannot be done reliably. Furthermore, using in-situ TS entails Sv being scaled by representative TS signals nearby, thereby calculating an appropriate number of fish whether large or small, which is then apportioned using camera species proportions. We believe the possible inclusion of young red snapper in both hydroacoustic and camera surveys is likely to be minimal and have a negligible affect on final numbers of age 2 red snapper.

Simmonds, J. and MacLennan, D., 2005. Underwater sound. Fisheries Acoustics Theory and Practice, 2nd edn. Oxford, England, Blackwall Science.

Comment:

The areal acoustic coverage of each sampling site was done by parallel transects. The choice of the amount of area to be covered at each site was pre-specified for each habitat type. In the case of structures, that area extended beyond the location of the natural or artificial structure. To some extent the choice of how much area to include beyond the structure is arbitrary. More area than the structure itself was included to account for daily movement and attraction of the habitat. Possibly some of that area *could* be classified as UCB rather than structure, but given the large disparity between the total UCB and structure areas, this will be a minor concern. Also, the strength of the LGL approach is that the design is internally consistent. However, I mention this issue because inevitably natural and artificial structure densities arising from LGL will be compared to densities in other areas. In doing so, it should be made clear the exact definitions of the area associated with a structure in LGL's La study versus densities elsewhere.

> Response: **On pages 31 and 32, the areas sampled for each habitat type are made clearer.**

Comment:

Submersible Rotating Videos (SRVs) were conducted over structure sites and UCB transects. Additional composition data was collected by hook and line over structure sites and towed video and longline sets over UCB transects. Most of the observations came from the SRVs (LGL 2021 Table 5). The methodologies were consistent with standard practices and assumed no catchability variation due to sampling. While there may be biases in the sampling, the protocols were consistent and thus, it was felt that catchability effects on red snapper composition would be minimal.

> Response: **We agree.**

Comment:

Estimation of Red Snapper Abundance
The basic estimation method to obtain red snapper abundance estimates was to obtain a density estimate of swim-bladdered fish from acoustic methods from a site, then multiply it by the proportion of red snapper from the SRV (and other sampling methods) samples from that site, then get the "average" red snapper density from all sampling sites within a habitat strata and then finally multiplying that density by the total area of that habitat strata (UCB) or the total number of structures for artificial and natural structures. However, there often was a mismatch of sampling of composition versus fish density in some sites leading to very skewed data. There was a concern that this could lead to bias in the estimates. Therefore, LG modified the estimation methodology in several ways and presented the results for each.

> Response: **Accurate characterization.**

Comment:

LGL's two basic methods were referred to as: 1) Mean Site Abundance and 2) Modeled Site Abundance. The Mean Site Abundance methodology is the basic estimation design outlined in the 1st paragraph of this section. In the case of the estimates for artificial structures, this was the exact methodology used. However, for natural structures and UCB sites the worries about skewness and composition-density mismatch induced LGL

to utilize the geometric mean as the point estimates of density and composition. Then these point estimates were carried forward into the expansion to total abundance, as with artificial structures.
The Modeled Site Abundance protocols modeled density within a strata as:
ln(density)=BX + DZ
where ***B*** and ***X*** were vectors of parameters (including an intercept) and fixed effects, respectively; and where ***D*** and ***Z*** were vectors of parameters and random effects. Then red snapper composition was modeled as
*ln(Proportion RS/(1-Proportion RS))=**BX***

The suite of fixed effects included oceanographic data specific to the site, depth and and region. Final models were chosen using AIC and in the end, the random effects in the ln(density) model were not significant and not included. Total abundance for a strata was the product of the predictions appropriately weighted by the proportions.

> **Response: We are glad to see the reviewer was able to follow our methodology.**

Comment:

The basic results by strata of the two methods are given in LGL Tables 6 and 10, respectively.
I am uncomfortable with the use of the geometric mean (GM) in the Mean Site methods. While I understand the reasons for this approach, including it as a point estimate for a strata introduces some inconsistency in interpreting the results. Through the geometric mean inequality, we know that the GM is <= the arithmetic mean (AM). So, mixing some strata with AM's and some with GM's confuses the issue. I would have preferred a presentation of AM results for all strata then if inconsistencies showed (which I expect they did), then that creates support for the Modeled Site method. LGL did not explicitly recommend that the Modeled Site method was preferred to the Mean Site, but their final conclusions focused on the Modeled Site. So, the implications are that the results from that method are preferred. And I agree with that conclusion.

> **Response: Apologies for the confusion. Yes, we are recommending that the modeled estimates be used for any decision support made possible by this study. The "raw" arithmetic or geometric mean estimates was more or less a back-of-the-envelope verification that the model was not grossly mis-specified.**

Comment:

Interestingly, the Mean Site result for artificial structures which used the AM was close to the estimate of the modeled site (1.5 million versus 1.6 million Tables 6 and 10). This is comforting and somewhat expected because the sampling frame for this stratum was reasonably well known and the sample sizes were reasonable. However, the Mean Site estimates using the GM were substantially lower than the Modeled Site.
I expect that the Modeled Site variances would be substantially lower than those arising from AM Mean Site variances for natural structures and UCB. Indeed, the reason for using the Modeled Site method was to stabilize the estimates, both point and variance.

However, the estimation of variance should be explored further. Variance estimates may become important if the results of this study are to be integrated into variance weighted stock assessment models such as Stock Synthesis.

Response: We agree and will address further as necessary.

Comment:

Finally, I will comment on the mark/recapture results. These studies were conducted at selected sites so the results should be viewed as demonstrations of the degree of congruence between the M/R methods and the Acoustic/Video methods for specific sites. In examining the M/R results I could find nowhere in the report what the elapsed time between release and recapture. Was it hours? Days? Weeks? Nevertheless, the results are not out of line between the M/R estimates and the AM estimates for the specific sites as shown in Figures 20 and 21. The M/R estimates were generated with the sequential Bayesian algorithm. I am interpreting the distributions plotted in Figures 20-21 as the estimated posteriors. In that case the MR point estimates noted on the plots are the modal values. Whereas, the other point estimate on the plots are the acoustic AM estimates. Judging from the implied probability distributions, the modal MR estimates are not inconsistent with the expected values (AMs) from acoustics.

Response: We agree with the comments and conclusion expressed by this reviewer. The elapsed time between mark and recapture are provided in the last two columns of Appendix 4. Elapsed days ranged from 16 (2 sites) to 19 (2 sites) to 28 total days for 2 sites. Also we have added M/R data to the report in new Tables 5 and 8.

Comment:

Conclusions and Recommendations
As in any study there were a number of data analytic filtering choices made especially when determining site densities from acoustics data. Another set of scientists might have made alternative decisions. In LGL 2021 Appendices they mention some of these decisions and alternatives. However, the LGL approach was internally consistent and well documented. Thus, it would be possible to reevaluate at some later time if further research limits the acceptable approaches. Ideally, this sort of survey should be conducted periodically (perhaps every 3 to 5 years?). This would allow results to be viewed as indices with consistent biases (catchabilities) over time and/or provide the research to address and minimize those biases. However, experience shows us that regular periodic surveys of this type are not likely. Therefore, the current results are to be interpreted as absolute abundance estimates for 2020.
Given that, I recommend that the preferred estimates of La red snapper absolute abundance ***at this time*** be those generated by the Modeled Site method as summarized in Table 10. These estimates were generated from La data using consistent and documented methodologies and not extrapolated from adjacent areas. This provides further support for using these estimates.

Response: **We now have added text on page 28 recommending the modeled site abundance estimates as being the best estimates.**

Comment:

As we go forward, I would recommend that further exploratory analyses be conducted to better define the uncertainty and variance in the estimates. I suspect that the variance is underestimated both in terms the modeled site approach and the incorporation of variance components in the density estimation (TS-> # fish; % red snapper, etc). Having a reliable variance will be useful in future stock assessments as well as in planning for future surveys. Also, within this uncertainty framework there should be an evaluation of the original site selections as they relate to purported random designs.

Response: **We agree that further exploratory analyses should be conducted as we go forward. All good recommendations!**

RESPONSE COMMENTS EXTERNAL REVIEWER 3

Reviewer 3: (See pdf document)

Text for Comment from pdf:
On 1 November 2019, the Louisiana Department of Wildlife and Fisheries (LDWF) entered into a Contract (Purchase Order No. 2000461788) with LGL Ecological Research Associates, Inc. (LGL) to estimate total Red Snapper Lutjanus campechanus abundance in Louisiana waters.

Comment:
For context, when this is communicated to the SSC or other external reviewers, we'll need to have the results of the prior analysis where the sites were selected, and maybe a short cover document linking the two sets of analyses.

> Response: **This has been addressed with a new sentence on page 1 which references the New Appendix 9: The RFP which provides the additional detail. A great deal effort took place between LADF and leading Gulf researchers before sites were finalized.**

Text for Comment from pdf:
Locations of standing oil and gas platforms (Fixed leg, Well Protectors and Caissons) were obtained from the Bureau of Ocean Energy Management (BOEM 2021, accessed March 2021). This database includes all historical installations of offshore structures and was filtered to remove those platforms that had a removal date prior to January 1, 2021 in its attribute table. The remaining structures are considered standing structures. Artificial reef locations were obtained from the Louisiana Department of Wildlife and Fisheries (LDWF 2021). Pipeline locations were obtained from the Bureau of Ocean Energy Management (BOEM 2018) and were filtered to identify and quantify the intersections of pipelines 20 inches in diameter or greater. Wrecks and Obstructions were accessed from the National Oceanic and Atmospheric Administration Office of Coast Survey (NOAAOCS 2021).

Comment:
One difference between the LGL study and the GRSC is that the LGL study looked at pipeline intersections (essentially point structures) and the GRSC looked at pipelines (essentially linear structures). [Pipeline intersections might have been considered in the GRSC as small artificial reefs - need to check on that.] That difference may be able to be adjusted for, as there is some information from the GRSC from off Louisiana for pipeline habitats. In the GRSC report (p. 83, table 6), the estimate for pipelines for the entire GOM is 640k fish, so not a major portion of the overall estimate. It won't make a lot of difference, but should be examined.

> Response: **We also looked at linear sectors pipelines per se comparing a section of covered pipeline to a nearby bottom on the same substrate but without a pipeline embedded. The direct comparison did not result in a big difference. Appendix 8 provides a direct comparison to our study to the GRSC study.**

Text for Comment from pdf:
The 12 sites where samples were taken included site numbers 41 and 42 (West Shallow), 46 and 47 (West Mid), 52 and 53 (WestDeep), 56 and 57 (West Deep), 61 and 62 (Central Shallow), 64 and 65 (Central Mid), 66 and 67 (Central Deep), 70 and 71 (Central Deep), 73 and 74 (East Shallow), 82 and 83 (East Mid), 85 and 86 (East Deep) and 88 and 89 (East Deep).

Comment:
Paired

> **Response:** **Text revised on page 8 to make this more clear that these are the paired pipeline segments on UCB compared to the same substrate without pipelines.**

Text for Comment from pdf:
Table 2. Total area of natural bank habitats in the study area.

Comment:
and sampled area (in parentheses)

> **Response:** **Legend revised on Table 2 as suggested (page 9 of draft).**

Text for Comment (Table 2) from pdf:
Natural Bank Region Total
West Mid/Deep (Sonnier) 45.85 (0.48)
West Shelf/Deep (Bright) 133.97 (0.48)
Central East Deep/Shelf 544.42 (1.44)
T otal 724.25 (2.4)
% Sampled = 0.33

Comment:
Not sure if there's reason that some of these designations are [shallower]/[deeper], while others are [deeper]/[shallower]. If so, please explain in prior paragraph. If not, please use one direction.

> **Response:** **That's where they occurred within the overall depth zone as described. Text revised in prior paragraph (page 8 of the draft).**

Text for Comment Table 3 from pdf:
Depthzone West Central East
Shallow 62 (1+3=4) 118 (1+3=4) 182 (1+4=5)
Mid 25 (1+5=6) 133 (1+9=10) 58 (1+2=3)
Deep 45 (2+2=4) 107 (2+8=10) 55 (1+1=2)
Shelf 7 (0) 10 (0) 19 (0)
Region Total 139 (14) 368 (24) 314 (10)
T otal 821 (48)
% Sampled= 5.8
Depthzone West Central East
Shallow 24 (1) 93 (1) 18 (1)
Mid 28 (1) 70 (1) 49 (1)

Deep 61 (2) 50 (2) 61 (3)
Shelf 2 (0) 50 (0) 8 (0)
Region Total 115 (4) 263 (4) 136 (5)
T otal 514
% Sampled=2.3
Depthzone West Central East
Shallow 0 (0) 0 (0) 0 (0)
Mid 5 (1) 35 (1) 57 (3)
Deep 117 (3) 129 (6) 59 (2)
Shelf 4 (0) 31 (0) 5 (0)
Region Total 126 (4) 195 (7) 121 (5)
T otal 442
% Sampled=3.6

Comment:

Note to self: neither the UCB nor the artificial reefs were sampled in the "shelf" region. Lack of UCB sampling noted in text. Review estimation procedure for this habitat [when I get to it]

Response: **Correct understanding.**

Text for Comment from pdf:
In comparison to the GRSC study, our overall sampling intensity is relatively robust. For example, we sampled 0.33% of the total 724 km2 of Natural Bank Habitat within the study area. In comparison, the total area of Natural Bank Habitat offshore Mississippi/Alabama was reported by Stunz et al. (2021) to be 211 km2. A total of 32 sites were sampled, each site consisting of an average area of 417 m2. This reflects a sampling intensity of 0.0063%, two orders of magnitude less than our sampling intensity for Louisiana.

Comment:

Primary reason for "robustness" is that the artificial reefs are larger in LA. Still don't impact the number of point estimates, or fraction of the total number of sites identified. Those values make up a significant portion of what I consider robust sampling.

Response: **We agree.**

Text for Comment from pdf:
FIELD SURVEYS AND SAMPLE PROCESSING

Comment:

SURVEY PROCEDURES

Text for Comment from pdf:
Water column measurements were taken in conjunction with each type of sampling using a YSI EXO3 CTD which measured dissolved oxygen saturation (ODO %), dissolved oxygen concentration (ODO mg/L), specific conductance (SpCond µS/cm), conductivity (µS/cm), salinity (psu), total dissolved solids (TDS mg/L), turbidity (FNU), total suspended solids (TSS mg/L), and temperature (°C) (Figure 6). All data were downloaded to a notebook computer, converted to .csv files and backed up on an

external hard drive on board, immediately after being recorded. These data were used for the calibration of the echosounders applied in the hydroacoustic analyses and for the statistical model of Red Snapper abundance, as described below.

Comment:

unclear whether there were discrete data points taken at specified intervals or whether the sonde has other capabilities for data gathering. Without knowing the specifics of the unit, it's not possible to know how many hydro samples were binned in the 10-meter bins described. Knowing the dynamic nature of the shelf, especially in the area of the major river plumes and in hypoxic areas, this could be important.

> **Response: Text was revised in the following paragraph to indicate that actual measurements were taken at 1-m intervals before binning by depth zone (page 10 of draft).**

Text for Comment from pdf:

In hydroacoustic fish surveys, adequate coverage of the survey area is needed to achieve a reliable estimate of fish abundance. Degree of coverage (Λ) is defined as: $\Lambda = D/\sqrt{A}$, where D is the cruise track length, and A is the size of the survey area. Empirical data from Aglen (1989) showed the ratio needs to be 6:1 or greater. This was planned and achieved at all survey sites (Table 4).

Comment:

where does the width of the path come into the estimate? And is the 5-degree width of the narrowest beam used as the effective path width? Is there any edge effect, where there needs to be some reduction from the received data to come to what is the usable data? Not my field, so maybe silly questions.

> **Response:**
> **This is an interesting point. Although the beam footprint and width does vary with beam angle and depth of the water column, this is not incorporated into this established equation. We are not aware of any papers that have addressed this, but this could be a worthy field of future research. It is safe to say however, that our coverage was definitely above the minimum requirements according to this accepted guideline since we conducted transects well above that minimum length.**
>
> **There are indeed edge effects in the acoustic beam, with target signals diminishing the further from center they are, so data from these edges must be treated with caution. In order to deal with this, such data is filtered out in the data processing steps at a certain radius of signal reduction. This essentially limits the width of the beam.**

Text for Comment from pdf:

Noise removal - Prior to the decibel differencing, data at all frequencies were cleaned to remove any noise that can come from a variety of sources. In order to do this the following steps were taken:

Comment:
I read over the following section, but have to say that I just don't have the background to know if this is accurate, appropriate, standard or unique processes. So not really reviewed in any depth.

Response:
Different studies take different measures for noise removal, and the choices depend largely on the nature of the data collected. For example, noisy data with lots of 'spikes' resultant from other sources (e.g. intermittent electrical interference) will require greater 'cleaning'. The steps we use follow published research and are thought of as best practice.

Text for Comment from pdf:
Decibel differencing - Next decibel differencing techniques were used to mask all but the data related to swimbladdered fishes.

Comment:
Same comment as prior section

Response:
Similar to above, different studies do different things dependent on the nature of the data and the aims of the studies. Decibel differencing is a relatively new technique, and all relevant studies were examined to determine the most appropriate approach with our data and aims and cited in the text.

Text for Comment from pdf:
In order to avoid masking valid fish data, data were acceptable that satisfied either decibel differencing criteria (Sv 120-38 <3dB or Sv 120-70 <2dB). (Initially the plan was for the data to have to satisfy Sv 120-38 <3dB AND Sv 120-70<2dB; however, this was seen to be too conservative and some valid data were masked. Scrutiny of the data showed Sv 120-38 <3dB OR Sv 120-70<2dB to be more appropriate.)

Comment:
This does seem to be non-standard procedure, and might worth going into more detail (maybe in an appendix) in terms of how these decisions were made, and the support for them. It may also (I expect) have significant impact on the final values of numbers of fish, so the actual differences from making those choices would be useful to be part of that discussion, if not done elsewhere.

Response:
This is a fair point. However, there is not yet an established standard procedure due to the novelty of the decibel differencing methodology. Additionally, while final threshold values are largely based on and compared to those in previous studies, in practice much of the thresholding and filtering is established by subjective scrutinization of the processed echograms by an experienced user and is an iterative process, with the user making changes until signals from obvious non-fish particles are removed while obvious fish remain. This

subjectivity is part of standard procedure. In this case there were two different approaches on how to handle the decibel differencing (Sv subtraction of 120-38 kHz and Sv subtraction of 120-70 kHz) that previously published studies have employed using the same frequencies of echosounder that we used. However, when both were employed (so that only data that satisfied Sv 120-38 <3dB AND Sv 120-70<2dB was allowed through), it was clear after scrutinization that this was too strict, and valid fish data were being erased. The use of either of these criteria (OR statement, rather than AND) showed results which did not mask obvious fish.

Text for Comment from pdf:
In areas of the echogram where there were no data, for example within the matrix of a platform, then the mean value of horizontally adjacent cells was used.

Comment:
Here's another point where additional information might be useful. This might be worth discussing with the Marine Lab divers that did the rig surveys of reef fishes in the early 2010's, if they are still available, just to see if it's a reasonable assumption in their opinion.

Response:
This is a good point, and we thought this was the most logical and transparent approach, according to practical options and to our own visual surveys from this and past studies. Furthermore, this approach looked to be the most appropriate from the fish distribution visible on the acoustic record.

Text for Comment from pdf:
The towed video sled was custom built by LGL Animal Care Products. The sled frame was constructed from 1/2" aluminum 6061 T6511 rod and the vein from 0.080" aluminum 5052 H32 Sheet and fitted with a ¼" x 2" stainless steel eyebolt for attachment.

Comment:
what was the type and diameter of the tow cable? A larger diameter tow cable (e.g. 1/2" nylon line) will provide more resistance when towed through the water, resulting in the camera running higher in the water column than if the cable were 1/8" stainless, as an example. There's also a difference in the in-water weight of the total gear, that will influence that elevation off the bottom.

Response: **The tow cable was made of 1400 lb. test monofilament that, when new, has a diameter of ~4mm but stretches (and diameter is reduced) under load over time.**

Text for Comment from pdf:
The sled was designed to be towed from the surface to record video in straight, near-bottom transects while avoiding bottom snags and turbidity within 1 m of the bottom, where visibility was assumed to negligible and hydroacoustic methods were unable to distinguish fishes from the bottom (Figure 11). The video camera angle was gradually

adjusted to account for deployment depth whereby the camera was near forward-looking in shallower waters and near downward-looking in deeper waters (Figure 11). All videos were downloaded to a computer and backed up to an external hard drive onboard the vessel, immediately after recording.

Comment:

Was there any measurement of the angle of the towed line? It would seem that with deeper tows, especially at the relatively fast speeds used here, that the deeper water tows might be far enough off the bottom that they could be observing a different, possibly more vertically complete, field. Depending on the angle of the line, the camera could also be far enough from the bottom that visibility would limit observation of the bottom-most layers of fishes. The camera setup seems like a good, heavy, low-resistance design, but it still will be lifted off the bottom by friction of the system moving through the water, as well as the friction of the tow cable moving through the water.

> **Response: You raise concerns that we also considered. We did not measure the angle of the towed line. The vertical bounce of the moving boat would render such measurements difficult and inaccurate. In an attempt to mitigate the impacts of variable camera depth, we compensated, adaptively, by adjusting camera angle, as stated in simpler terms, more down towards the bottom in deeper water, more straight ahead in the shallower water. All deployments were consistent in that the sled was dropped vertically to the bottom, no scope was added, and the tow speed was relatively constant. When the vessel was put in neutral, the camera (with 25 lbs. of lead) sunk fast to the bottom. Since the hydroacoustic measurements could not discriminate fishes in the bottom meter of the water, we did not intend to sample there either. Finally, our selected video camera settings offered further compensation for tow height by using a wide field of view (FOV), ". . . directional FOV angles as follows: Vertical FOV 94.4°, Horizontal, FOV 122.6° and Diagonal FOV of 149.2°." Based on observing all of the videos, water transparency (or lack of it) likely had a greater impact on visibility than tow height from the bottom.**

Text for Comment from pdf:

All videos were analyzed in full using a VLC video player on an ASUS notebook computer with an external 27" Apple thunderbolt flat panel display with a resolution of 2560 × 1440 pixels. The videos were generally reviewed at 1x speed. When possible images of fish came into view, the video was carefully reviewed at 0.25x speed. The maximum number of fish of each species observed in each video was derived using MaxN by enumerating every observed fish with time stamps. All fish were subsequently identified to the level of species or the lowest taxonomic level possible or, if unknown, recorded as unidentified. Still images of most fish detected were extracted and saved to confirm identifications. One viewer analyzed all videos and two additional observers analyzed three of the videos independently for verification. Finally, all species identifications were confirmed by three biologists.

Comment:

May want to note whether these were identifications by 3 biologists reviewing the data independently or as a group.

Response: **Both were done from time-to-time, all three reviewed data together where there was a disagreement, our team comes to consensus as a group.**

Text for Comment from pdf:
Figure 11: (A) Towed video cameras were deployed by (1) lowering the camera sled straight to the bottom from a stationary vessel, (2) towing the sled along the 1 le transact at speeds of 3-5 knots without adding additional scope to the tow line, (3) allowing the sled to touch bottom at the end the transect and retrieving vertically. (B) The field of view captured the survey focal depth in shallow waters by angling the GoPro straight ahead and in deeper waters by angling the camera downwards at ˜ 45°.

Comment:
1 mile (?)

Response: **Yes. Legend changed.**

Text for Comment from pdf:
Figure 12. Diagram of vessel setup for sampling at discrete sampling sites.

Comment:
were the stations on the vessel randomized? That is, was the 6/0 menhaden station always port transom, or did it move around? You could get some randomization by sometimes having stern of vessel upstream, sometimes downstream, but that's not quite the same thing. I'm not too concerned about it, but you may get some comments from folk about whether randomization was needed here.

Response: **Vessel position was maintained using a trolling motor to be able to contend with changes in wind and wave direction. As a result, the vessel moved around while in position.**

Text for Comment from pdf:
Longlines were soaked for approximately one hour from the start of the deployment to the time the entire line was back on deck.

Comment:
So it takes 9-21 minutes to deploy the gear. Assume it takes at least that long to retrieve it. Is "total soak time" the time from when the first hook hits the water until the last hook is retrieved, or is it some other measurement (say, when the first hook is retrieved). If the latter, then another statement about the length of time taken to retrieve the gear would be useful.

Not sure how SEAMAP longline sampling measures soak times, but would be useful if the two metrics were either known to be comparable, or if there were a difference between them. A clarification of this paragraph could make it clear how the two sampling programs compare.

Response: **We measured soak time from when the first hook hits the water to until the first hook is retrieved. Our protocol stipulated one-hour soak times. The longline was always retrieved in the same direction that it was deployed so each hook was soaked for approximately one hour. Retrieval times were not recorded**

but were generally about the same time as deployment, with variations dependent on depth, the number of fish captured, windage, etc. The SEFSC Bottom Longline Survey deploys one hundred hooks along a one mile, 4mm monofilament line and "soaked for one hour", defined as the time between the deployment of the second highflyer to the time of the retrieval of the first. The studies are highly comparable.

Text for Comment from pdf:
Site abundances were stratified by structure type (reefed platforms, pipeline crossings, and standing platforms) and depth zone (shallow, mid, and deep) (Table 3).

Comment:
no shelf zone - it might be worth making a less cryptic note here that the platforms and the artificial reefs in the shelf zone were not sampled. The estimation process for platforms in the shelf zone is described below (use BOEM study), but not for artificial reefs (not included in BOEM study). Not sure if pipeline crossings were included in that study.

A lot of the artificial reefs in the shelf region are pretty heavily populated with reefed structures, so those could add to the number of structures in that zone. Not sure if the "reef" is a permit area (1-20 or so structures currently in place) or each specific reefed platform.
OK, first paragraph question addressed next paragraph down.

Response: We agree.

Text for Comment pdf:
For platforms on the shelf edge depth zone, we used the modeled median and confidence limits presented in Gallaway et al. (in revision). Given the low sample size for this depth stratum (n=3 structures) and highly variable abundance estimates (0 Red Snapper on two platforms and 12,926 on the other platform) we decided that the more conservative modeled abundance value (median = 133 Red Snapper) was more appropriate to use than the observed value (mean = 4,309 Red Snapper).

Comment:
I'm not sure you want a conservative value - you want the most representative. There would be other methods (e.g. ls means, log-normal mean, geometric mean, etc.) that could be used to approach that.

Response: We selected the more published value as being the more representative. Text changed on page 27 of the draft.

Text for Comment from pdf:
For this reason, site-specific estimates were not reported. Instead, we modeled the average proportion of the assemblage structure comprised of Red Snapper for a given habitat type, region, depth zone, and vertical depth band given average environmental variables.

Comment:

reported, or estimated? Seems like the approach described earlier was a habitat/depth zone approach, not a site-specific estimation. If that's the case, this point could be made much earlier in the methods section, not here.

> **Response: Changed text on page 29 of draft from reported to estimated. Did not change location given the short time frame for presenting to SSC.**

Text for Comment from pdf:
Possible fixed effect variables included the categorical variables DepthZone (10-25 m, 25-45 m, or 45-150 m), Region (East, Central, and West), and HabitatType (Artificial Reef, Natural Bank, Uncharacterized Bottom, Pipeline Crossing, or Standing Platform).

Comment:
is this deep + shelf? Why the separate discussion in prior sections, if they're gong to be combined at this point? I didn't see any discussion prior to this about combining those zones, other than in the natural bank discussion, where it was alluded to.

Just looking for consistency.

> **Response: Yes, the shelf and deep strata were pooled before modeling the data. The actual estimated was based on deep only. This estimate has then used as an overall estimated.**

Text for Comment from pdf:
Temperature was included as extraneous/nuisance variable to reduce noise and confounding influences.

Comment:
Not clear to me - there probably is also a relationship between temperature and DO, as well as between those and salinity. I'd expect DO to actually have more effect on fish abundance than temperature, so wonder what the difference would be if DO were used instead of temperature as the "extraneous" variable. I understand it would increase the AIC - but by how much? So 2 questions - relation between T and DO, and change in AIC between using those variables.

> **Response: Salinity was highly correlated with dissolved oxygen and moderately so with temperature. To preclude collinearity, we only chose DO and Temp. However, DO did little to affect the %RS binomial response and was dropped from the final model; this in turn, lowered the AIC diagnostic. DO did find its way in to the final model for TFA (see below).**

Text for Comment from pdf:
The hydroacoustic surveys provided observations of total fish density (TFD; fish per m3) for each site-depth band combination. This response was assumed to be from a Tweedie distribution, which uses the log link function:

Comment:

Not typical to see mention of Tweedie distributions in fisheries - no issue with it, just a note. Surprised me. Also, if there's a specific Tweedie distribution that is considered, then maybe that should be mentioned, along with the more generic term?

> **Response: The choice of this distribution was in large part based on the recommendation of Shono (2008), and its use in other works since (Xue et al. 2018; Tate et al. 2019; Ebango Ngando et al. 2020; Mesquita et al. 2020). The specific distribution was of the compound Poisson form, which can handle continuous data in the presence of zeroes.**

> **Shono, Hiroshi. (2008). Application of the Tweedie distribution to zero-catch data in CPUE analysis. Fisheries Research. 93. 154-162. 10.1016/j.fishres.2008.03.006.**
>
> **Xue, Ying & Tanaka, Kisei R. & Yu, Huaming & Chen, Yong & Guan, Lisha & Li, Zengguang & Yu, Haiqing & Xu, Binduo & Ren, Yiping & Wan, Rong & Josefson, Alf. (2018). Marine Biology Research Using a new framework of two-phase generalized additive models to incorporate prey abundance in spatial distribution models of juvenile slender lizardfish in Haizhou Bay, China View supplementary material Using a new framework of two-phase generalized additive models to incorporate prey abundance in spatial distribution models of juvenile slender lizardfish in Haizhou Bay, China. Marine Biology Research. 508-523.**
>
> **Tate, Alissa & Lo, Johnny & Mueller, Ute & Hyndes, Glenn & Ryan, Karina & Taylor, Stephen & Tate, A & Lo, J & Mueller, U. (2019). Contribution to the Themed Section: 'Marine recreational fisheries -current state and future opportunities' Standardizing harvest rates of finfish caught by shore-based recreational fishers. ICES Journal of Marine Science. 77. 10.1093/icesjms/fsz228.**
>
> **Ebango Ngando, Narcisse & Song, Liming & Cui, Hongxing & Xu, Shuangquan. (2020). Relationship Between the Spatiotemporal Distribution of Dominant Small Pelagic Fishes and Environmental Factors in Mauritanian Waters. Journal of Ocean University of China. 19. 393-408. 10.1007/s11802-020-4120-2.**
>
> **Mesquita, Carlos & Dobby, Helen & Pierce, Graham & Jones, Catherine & Fernandes, Paul. (2020). Abundance and spatial distribution of brown crab (Cancer pagurus) from fishery-independent dredge and trawl surveys in the North Sea. ICES Journal of Marine Science. 78. 10.1093/icesjms/fsaa105.**

Text for Comment from pdf:

[15] $TFDi = zDO + zTemp + HabitatType|\ s(zDistFromBottom) + Region|s(zDistFromBottom) + DepthZone|\ s(zDistFromBottom)$

Comment:
As in prior note, to me it seems that T (while it might have the best fit) may not be the driver of the distribution (I'd think DO would be). So consider effects of using the more physiologically apparent variable in the function.

> **Response: When modeling TFD, including both DO and Temp gave the lowest AIC and thus both were included.**

Text for Comment from pdf:
A total of 55 discrete sites were sampled in our program, and these efforts resulted in 154 km of hydroacoustic survey transects and 72 individual SRV surveys. The SRV surveys yielded a total of 39,014 fish counted of which 2,813 were Red Snapper. A total of 69 h of hook-and-line fishing effort was expended at discrete sites. These efforts yielded a total of 996 Red Snapper of which 993 were used for age composition.

Comment:
Elsewhere, the BOEM study was mentioned. Is that part of the 55 sites sampled, or in addition? If the latter, then that should be further described in this paragraph.

> **Response: No these are from the LA 109 sites per se. See pages 7 and 8 of the draft.**

Text for Comment Panel B from pdf:
Panel B. Arti ficial Reefs
Habi tat T ype Structure
Count
Number/
Structure
Abundance Biomass (lbs.)
Arti ficial Reefs 1,777 1,535,390 7,567,542
(413,921 - 2,649,435)
Standing Platforms (821) 1,322,670 6,722,541
(411,623 - 2,235,588)
Shallow 362 678 245,343
(139 - 1216) (50,413 - 440,273)
Mid 216 2734 590,481
(905 - 4562) (195,558 - 985,405)
Deep 207 2329 482,057
(788 - 3870) (163,060 - 801,055)
Shelf 36 133 4,788
(72 - 246) (2592 - 8,856)
Reefed Platforms (442) 170,363 613,652

Comment:
I didn't think these were sampled. Does this come from the BOEM study? If so, how were they incorporated? Were study parameters similar, or were results just imported from other study? That should be in the text related to this table, earlier.

Response: **Only BOEM results used were for standing platforms. The estimate in this table used the BOEM results as described in the text.**

Text for Comment from pdf:
Recaptures of marked fish were observed

Comment:
Need more information on the data and results of this portion of the study. I did not find any information on numbers of fish tagged per site, days between mark and recapture events, numbers of marked and unmarked fish taken in the recapture survey, etc.

In the discussion section, it would also be useful to compare these results to those that would have been estimated from other commonly used mark-recapture estimation procedures (e.g. Chapman estimate, with reference to the caveats on size issues noted in the methods section). Also, if there are two estimates, and both fall below the estimate from the hydroacoustic survey, is that an argument for considering further constraints in some of the methods that were used in the hydroacoustic study?

Response: **Mark/Recapture data in new Tables 5 and 8. The Gazey-Staley MLE estimate yield the Chapman estimate. We have added this mean estimate to figures showing population estimates.**

Text for Comment from pdf:
at 2 of the 3 platforms chosen for
mark/recapture studies.

Comment:
how was the other site treated? Just accepted the SRV estimate? Also, more information on numbers of fish tagged and recapture information (days at large, etc.). Or did I miss that somewhere?

Response: **Yes, we had no recaptures. The population estimates we used were the hydroacoustic/SRV estimates, which were used as the base in all cases.**

Text for Comment from pdf:
Figure 20. Comparison of the respective hydroacoustic population estimate to the mark/recapture population estimate for the Platform Site 3.

Comment:
Not sure that the most likely estimate is the best estimate to compare to the hydroacoustic estimate. Maybe the mean or median tag/recapture estimate?

Response: **We chose the MLE but the mean and median estimates are also shown on the graphs. We also plotted the mean estimate on the graphs.**

Text for Comment from pdf:
A total of 51 total samples were taken from 39 unique UCB sites. These surveys included 702 km of hydroacoustic transects supplemented by 90 linear miles of towed video transects

Comments:
add metric equivalent

> **Response:** **The metric equivalent was calculated to be 48.6 nautical miles. We rounded to 50 km. On a similar note, 51 miles was converted to 28 km.**

Text for Comment from pdf:
and 51 miles of bottom longline sets.

Comment:
add metric equivalent

> **Response:** **Noted above.**

Text for Comment from pdf:
Review of the individual site data presented for individual blocks within a site also varied greatly—from 0 to as high as 3.66974 Red Snapper per 100 m2. As can be seen, the data are quite "patchy".

Comment:
2km x 2km blocks (the size for UCB blocks, p. 17) are still a pretty large area. The issue of patchiness seems to be something at several scales, might be better reviewed at the cell size. That seems to be what is being done in the following figures. Should this be "cells within a site"?
The discussion seems to have these "blocks" as cells, rather than blocks. There seems inconsistency between the use of site, block and cell between the discussion on page 17, here, and in the following figures.
Upon further review - the use of "block" should not be used outside of page 17. The term "site" seems more appropriate, certainly would have been clearer to me.

> **Response:** **Text changed to reflect these comments.**

Text for Comment from pdf:
Overall, density of Red Snapper in UCB was low as compared to Texas. In Texas, the overall estimate was 0.03 Red Snapper/100 m2 (Stunz et al. 2021).

Comment:
was an order of magnitude lower when compared to Texas.

> **Response:** **Yes, 0.005 in Louisiana as compared to 0.03 in Texas.**

Text for Comment from pdf:
Figure 28. UCB Hydroacoustic site heat maps in the West Region, illustrating Red Snapper density (fish per 100 m2). ST designates areas with little or no shrimping effort. Each sampling site is represented by a 2 km x 2 km square. Within a site, each cell represents a 400 m x 400 m sampling polygon. Colors indicate
the relative density of Red Snapper within each of the polygons (light yellow = polygons are in the bottom 10th percentile of sampled densities; orange = polygons are within the 50th percentile of sampled densities,
red = polygons are in the upper 99th percentile of sampled densities).

Comment:
numeric values in this table not readable in the PDF version. May need to go back to the zip file for original values.

> ## Response: **Data are provided in the zip files.**

Text for Comment from pdf:
We directly measured the density of Red Snapper at Sonnier Bank to be 0.06, Red Snapper/100 m2, much lower than the 0.45 fish/100 m2 estimate assigned to this site based on Texas Banks.

Comment:
remove comma

> ## Response: **Comma removed.**

Text for Comment from pdf:
The largest disparity between the two studies related to the Artificial Reef category is that Stunz et al. (2021) estimated a total of 4,573 structures in this category harboring some 10,697,069 Red Snapper whereas we estimated that only 1,777 structures were present which held 1,624,225 Red Snapper.

Comment:
There are two parts to the disparity. The following two paragraphs contain some duplication, but only really discuss the difference in numbers of structures. The estimated numbers of fish per structure are also significantly different between studies, and that needs to be addressed here. That same issue of lower estimates of biomass (or numbers) per unit area is important throughout the comparison between the two studies' results, across all strata and habitat types. I haven't yet seen the discussion on that issue.
check for discussion on CPUE differences between GRSC and LGL studies.

> ## Response: **Agree, however, we provided both the abundance and number of total structures for this purpose.**

Text for Comment from pdf:
We acknowledge that we did not include estimates for an additional 335 artificial reefs known to be present but that were not sampled, namely 147 caissons, 132 charted bottom obstructions and 56 chartered wrecks. Including these raises our estimate to 2,112 Artificial Reefs, still roughly only one half of the Stunz et al. (2021) estimate.

Comment:
The difference in the per-structure estimates of RS between studies is the other part of this that need to be addressed. Some of this might be due to differences in methods of inclusion or estimation within the hydroacoustic analysis, but there might be other issues as well, that I missed.

> ## Response: **This could not be addressed at this time because of time constraints but is worth looking into; the answer will be complex.**

Text for Comment from pdf:
If we assume that each of these structures had a population of 385 Red Snapper (the overall mean abundance of Red Snapper at reefed platforms) our estimate would be raised by 128,975 Red Snapper.

Comment:
As noted elsewhere, this value should be compared to the Stunz et al. value, with some discussion of the possible source of these density differences. Based on the values cited for Stunz et al. earlier in the paragraph, they estimated about 2,339 snapper per structure, 6 times higher than the present study.

> **Response: We have claimed the difference is between Louisiana (we sampled, the GRSC study basically did not) and Texas (the GRSC Texas study was well done).**

Text for Comment from pdf:
The resulting total number of Red Snapper within the study area would thus be 6,156,865 fish as opposed to 6,027,890 fish.

Comment:
more significant is perhaps the change in RS in artificial reef habitats, rather than overall study estimate. Use of that latter value minimizes the impact of the difference in artifical habitat numbers (the value being changed).

> **Response: Agree.**

Text for Comment from pdf:
This discrepancy accounts for a large part of the difference between the artificial reef estimates obtained by this study (1,624,225 Red Snapper on 1,777 artificial reefs) versus 10,697,069 Red Snapper on 4,573 artificial reefs (Stunz et al. 2021).

Comment:
This is probably the data point where the most analysis could be done. Much of the recreational and commercial harvest of RS comes from this component - the private vessel recreational harvest from standing and near-to-port toppled artificial structures, the commercial component from smaller, unmarked structures such as pipeline crossings, wrecks, etc. Additional harvest from both components does occur, but that is likely well under one-third of the total harvest. What we have observed over time is the continued increase in numbers of older-aged fish in our dock-side samples, indicating a stock that is increasing in survival over the long haul. But if we're taking 10% or more of the standing biomass from those artificial reefs, as these data indicate, it would result in a decline in survival over time for fish on those habitats, or at best a stable population. There are a few ways this could be ameliorated, including relatively high exchange of fish between artificial habitats and other habitats, but could also be interpreted to indicate that we're pretty much where we need to be in terms of allowable harvest of red snapper in our region (within the current constraints of the MSA as interpreted by NS-1 Guidelines).

Response: **We agree, but fall back on time constraints for the present report. This again is a complex subject beyond the immediate goals of this study.**

Text for Comment from pdf:
We suggest that the site-specific estimates of density from this study are more representative than the Texas proxy data, and that the overall numbers of standing and reefed oil platforms were greatly overestimated by Stunz et al. (2021).

Comment:

This statement needs some discussion to better back it up. There may be reasons for the LA sites to be different than the TX sites to the west of there, but it's really not discussed here.

This issue is probably one of the areas that needs the most additional discussion in the document.

As this is really where the core of the fisheries operate (artificial structures of one kind or another), it's hugely important to the management of the fishery. The numbers of fish on natural banks and (especially) uncharacterized bottom are important in terms of scaling the stock size for purposes of stock/recruit relationships, but unless there's a lot more exchange between local populations than I've seen estimated, then the population on artificial reefs will be bearing the brunt of the fishing pressure.

Response: **However, most of the fish occur on UCB (3,782,532) versus a total of 6,027,890 fish) and these are not as heavily fished as artificial reefs.**

RESPONSE ADDITIONAL COMMENTS EXTERNAL REVIEWER 3

Reviewer 3

Comment:

Additional comments from LDWF internal review

Three primary issues for me:

1) Not enough presentation of the actual data or summary of the information that the final estimates are derived from. Those could be in appendices, but the appendices that I reviewed did not have what I was looking for in order to be able to validate the estimates. The results are presented, but not the data that are compiled to derive those values.

   Response: **The actual data were required by the contract to be submitted under separate electronic cover. A hard drive of the data were submitted and accepted by the LDWF. We understood this requirement to mean that LDWF wanted control of data distribution or availability.**

Comment:

2) The goal was to get comparable data to compare across the two studies. But the LGL hydroacoustic work used different thresholds than the Stunz et al. work, and though that's mentioned, it's not evaluated to see what difference that would make in the final estimates. It's kind of like using MRIP and LA Creel data without having any calibration between them. I don't think LGL needs to match the Stunz et al. process completely, if they have professional reasons to take a different approach. But they should try to explain what those different approaches mean in terms of the resulting stock size.

   Response: **The LGL study was not informed of detailed methodology of the Stunz et al. study to enhance comparability prior to conducting data analysis, but did use similar methods to those used by the Stunz et al. study in Florida, including multi-frequency decibel differencing techniques which assist in removing non-swimbladdered organisms and other particulate matter from the data. These methods were not employed in Texas in Stunz et al., from which Louisiana data were extrapolated. Exact thresholds for decibel differencing filtering could not coincide between the two studies, as Stunz et al. used four frequencies and the LGL study used three.**

   We did indeed use slightly different minimum signal thresholds from those used in parts of the Stunz et al. study, and the choice of these depends largely on the nature of the data. A -50 dB threshold was applied to TS echograms in both studies in order to exclude smaller organisms that were not of interest. Simmonds and MacLennan (2005) describe the range of TS for almost all fish as -60 dB to -20 dB, with the lower end of the range approximating a 4 cm sprat or similar fish. The LGL study also applies a -50 dB threshold to Sv echograms for

the same reasons (i.e., to prevent more signal returns being allowed through than were from fish of interest), whereas the Stunz et al. study uses a -60 dB threshold in this case to help retain fish aggregations while still filtering out a portion of acoustic backscatter from plankton and small fish. This is a rather nuanced matter of methodology, with threshold values being set partly by subjective scrutinization of the processed echograms by an experienced user in an iterative process to obtain targets of interest. As small fish and other targets are not of interest in this study and were not captured in camera surveys used to apportion hydroacoustic data, we found it appropriate to use a stricter threshold. A lower threshold as used in the Stunz et al. study would lead to a slightly higher overall estimate.

More detail has been provided and the text has been revised to make this clear.

Comment:

3) The discussion of the differences between the Stunz et al. estimates of red snapper on artificial structures and the LGL estimates needs more explanation / review of those differences. It’s not possible to compare the two studies, and this is the part of the stock that the fisheries really target most directly. So having a 6-fold difference in those two numbers deserves more analysis than the couple lines that it gets in the report. Some of this might have to do with the prior point on hydroacoustic techniques, but not sure if that’s the whole issue.

Response: More detail has been provided. Reviewer 1 commented that he is much more comfortable with our estimates for Louisiana than those estimated based on north Texas data with the Final GRSC report estimates provided for Florida, Mississippi/Alabama and Texas.