

Center for Independent Experts (CIE) Independent Peer Review Report
SEDAR 94 Florida Hogfish Assessment: West Florida Shelf Stock and East Florida/Florida Keys
Stock

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Executive Summary

SEDAR 94 was a CIE assessment review conducted for two stocks of Hogfish: the West Florida Shelf Stock and the East Florida/Florida Keys Stock. The review workshop provided an independent peer review of these SEDAR stock assessments.

The treatment of hogfish as two distinct stocks was sound. Assessment models using Stock Synthesis 3 (SS3) for each stock were reviewed. These models incorporated commercial and recreational removals, fishery-independent indices of abundance, length-composition and conditional age-at-length data, and biological information appropriate for the protogynous life history of hogfish. Data decisions for the West Florida Shelf (WFS) stock were sound and robust. Most data decisions for the Florida Keys/East Florida (FLK/EFL) stock were well documented and appropriate. The exception was the reconstructed recreational removals, which the Review Panel concluded were not sufficiently robust for inclusion in the model. The values of M used in the assessments for both stocks were based on sound rationale.

The WFS assessment model was appropriately configured and applied, and the resulting population estimates were sufficiently reliable and consistent with the available fishery-dependent and fishery-independent data, and the known biology of hogfish. The review recommended replacing the FLK/EFL base model with a revised Review Workshop base model (KEYS_RW_Base model) based on the high uncertainty in the landings data from 1950-1985. The population estimates from the KEYS_RW_Base model were sufficiently reliable and useful for stock-status inference. The WFS and FLK/EFL models were reasonably consistent with input data, with no major lack-of-fit apparent.

The WFS hogfish stock is not overfished nor undergoing overfishing. Recent spawning stock biomass was estimated to be well above the minimum stock size threshold (MSST), and recent fishing mortality was estimated to be below the maximum fishing mortality threshold (MFMT). The uncertainty analyses strongly supported this conclusion. An informative stock-recruitment relationship could not be estimated and SPR-based proxies (SPR30%) were used as the basis for stock-status reference points.

The East Florida–Florida Keys hogfish stock is not overfished nor undergoing overfishing, which was also based on SPR-based proxy (SPR30%) reference points. This was only based on a deterministic stock-status evaluation because the associated probabilistic characterization of uncertainty for the revised model was not available during the Review Panel meeting. This revised model could not reliably estimate steepness, which was consequently fixed at 0.99. Management should consider whether SPR of 40% is a better basis for management reference points for this stock.

The methodology used for stock projections for both stocks was considered appropriate, informative, and suitable for management consideration. Although important projection assumptions and uncertainties were acknowledged, the projections did not directly estimate probabilities of future biomass or fishing mortality crossing management reference points. The WFS hogfish projections were useful for evaluating probable future stock conditions and developing management advice. The degree of robustness to alternative biological assumptions could not be fully evaluated because projections were not accompanied by sensitivity analyses for all potentially important inputs. Final projections corresponding to the KEYS_RW_Base model were not available for evaluation during the Review Workshop.

Many research recommendations were provided during the SEDAR 94 review process. The most important ones are:

- Improve understanding and modeling of protogynous hermaphroditic population dynamics.

- Improve life-history, age, length, and discard information.
- Improve recreational fishery information.
- Develop stochastic projections that propagate assessment uncertainty.

Overall, The SEDAR 94 East Florida-Florida Keys and West Florida Shelf hogfish assessments are scientifically sound, use the available data appropriately, and provide a suitable basis for management advice.

Background

NOAA Fisheries science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest.

The Southeast Data, Assessment, and Review (SEDAR) is the cooperative process by which stock assessment projects are conducted in NOAA Fisheries' Southeast Region. SEDAR 94 was a CIE assessment review conducted for two stocks of Hogfish: the West Florida Shelf Stock and the East Florida/Florida Keys Stock. The review workshop provided an independent peer review of SEDAR stock assessments. Two models were reviewed during the workshop. The review panel is responsible for strengthening the scientific basis of the assessment through the SEDAR process.

NOAA Fisheries required three reviewers to conduct an impartial and independent peer review in accordance with a Performance Work Statement (PWS), OMB Guidelines, and the ToRs below. The reviewers were required to have a working knowledge in stock assessment, statistics, fisheries science, and marine biology sufficient to complete the primary task of providing peer-review advice in compliance with the workshop Terms of Reference. Expertise with the Stock Synthesis modeling platform, and the associated model diagnostics would be helpful. Experience with assessments of reef-associated species, particularly those exhibiting complex life histories (e.g., hermaphroditism), and familiarity with evaluating length-and-age composition data, selectivity patterns, and model diagnostics in data-moderate or data-limited contexts was preferred.

I have worked in fisheries science for 36 years. I have a PhD in Statistics (Survey methods). My research focuses on statistical methods to improve fish stock assessment and state-space stock assessment models (SSAMs). I have led or participated in the development of many assessments and several operational SSAMs for eastern Canadian fish stocks. I have substantial review background with the Stock Synthesis modeling platform. I have experience with the assessment of hermaphroditic shrimp species.

The Review Panel consisted of Drs. Luiz Barbieri (Chair), Lisa Chong (Center for Independent Experts, CIE), Noel Cadigan (CIE), Joe Powers (CIE), Marcel Reichert (South Atlantic Fisheries Management Council's Scientific and Statistical Committee, SAFMC SSC), Alexei Sharov (SAFMC SSC), Challen Hyman (Gulf Fisheries Management Council's (GFMC) SSC), and Steve Saul (GFMC SSC; via webinar). The Review Panel was assisted by Southeast Data, Assessment, and Review (SEDAR) staff Julie Neer, Emily Ott and various SAFMC/GFMC staff.

Each CIE reviewer was required to write an individual review report in accordance with the Performance Work Statement (PWS), Office of Management and Budget (OMB) Guidelines, and the Terms of Reference (ToRs) below. All TORs must be addressed in each reviewer's report. Review documents are listed in Appendix 1. TORs for this peer review are provided in Annex 1 of Appendix 2. The draft

meeting agenda is provided in Annex 2 (of Appendix 2). Annex 3 (of Appendix 2) describes the Individual Independent Review Report Requirements.

Role of reviewer in the review activities

The main report for the SEDAR 94 Florida Hogfish (West Florida Shelf (WFS) stock and Florida Keys/East Florida (FLK/EFL) stock) assessment process (WP #1 in Appendix 1) was provided on June 29, 2026, via the SEDAR website, along with other supporting documents from data and assessment workshops. The full list of documents provided is given in Appendix 1. Presentations for the peer review were made available during the peer review workshop.

I reviewed the background documents I was provided with and compiled a list of issues for clarification during the Review Panel meeting. I attended the entire Review Panel meeting. I reviewed presentations and reports and participated in the discussion of these documents, in accordance with the SoW and ToRs (see Annex 2). During and after the meeting I contributed to drafting the panel summary report.

This CIE report is structured according to the required format and content described in Annex 3 of Appendix 2. I provide a summary of findings for each TOR in which the weaknesses and strengths are described, and conclusions and recommendations in accordance with the TORs. My report will provide greater detail than the Peer Reviewer Summary Report on some ToRs. Note that only a draft of the final Panel Summary Report was available when I wrote this CIE report.

Summary of findings

The Review Panel (i.e., the Panel) much appreciated the very collegial nature of the review deliberations. The Panel thanked the Analytic Team for the incredible amount of work and the streamlined report, and the presentations during the review. The Review Panel also thanks staff from SEDAR, the South Atlantic Fisheries Management Council, and the Gulf Council for their invaluable assistance during the review process. I fully support these statements.

I particularly appreciated the effective documentation of the two stock assessments that were reviewed. The Analytic Team directly addressed almost all the ToRs.

ToR 1. Evaluate the data used in the assessment, including discussion of the strengths and weaknesses of data sources and decisions, and consider the following.

a. Are data decisions made by the Data Workshop (DW) and Assessment Workshop (AW) panels sound and robust?

I agree with the Review Panel conclusion that, overall, the data decisions made by the DW and AW for the West Florida Shelf (WFS) stock were sound and robust given the available information and the data limitations associated with this stock. The assessment incorporated the principal data streams typically available for Gulf reef fish assessments, including commercial and recreational landings, reconstructed historical landings, fishery-independent abundance indices, length compositions, and conditional age-at-length (CAAL) data. Fishery-dependent indices, including the MRIP hook-and-line CPUE index, were explored during assessment development but were not recommended for inclusion in the final model. The rationale for major data inclusion and exclusion decisions was adequately considered and documented.

I agree with the Review Panel conclusion that most data decisions made during the DW and Assessment Workshop (AW) for the Florida Keys/East Florida (FLK/EFL) stock were well documented and

appropriate. Decisions to aggregate commercial gears into a single commercial fleet, combine SRHS landings and discards with SRFS hook-and-line estimates, and aggregate the recreational fishery data into a single fleet were considered reasonable given the available data and assessment objectives. The Panel did not consider the reconstructed recreational removals sufficiently robust for inclusion in the model used for management advice. The Panel concluded that uncertainty in the reconstruction had potentially important consequences for model results. Accordingly, the Panel recommended that the model used as the Review Workshop base model begin in 1986, when recreational catch information becomes more reliable. I agree with this and I expand on the conclusion about recreational removals at the end of this section.

I conclude that treatment of hogfish as two distinct stocks was sound. Genetic data and analyses supported the treatment of Hogfish as distinct stocks, the same as in previous assessments (SEDAR 37 2014, SEDAR 37U 2017). Maturity and growth information also differed between these two components, which further supported that they behave as different stocks within time-frames relevant for fisheries management. Various studies have demonstrated that hogfish have high site fidelity.

An external growth model was fitted to age-length data for carefully selected random sampled fish using a size-truncated von Bertalanffy growth model. Excluding size-selected samples makes sense because they can produce seriously biased growth information. I appreciated the use of the size-truncated growth model to account for the impacts of minimum size restrictions. However, model diagnostics should include residual boxplots versus age for each sex, and sex-combined residual box plots versus year. I also recommend fitting growth models separately for each sex to provide a likelihood ratio test that growth is the same for each sex, which was only assumed in the SS assessment models for each stock.

I did not have time to read the paper on the size-truncated von Bertalanffy growth model, but I have used similar models. One issue that should be verified is that the residuals account for the size-truncation; that is, they are based on the expected size-at-age for the size-truncated sampling. Otherwise, some false patterns could appear in the residuals, especially at young ages.

The data workshop report did not indicate how maturity samples were collected. However, if they are also affected by minimum size limits then this should be accounted for when fitting maturity-at-age models (e.g., Morgan and Hoenig, 1997¹), as done in the growth models. However, when the maturity ogive is approximately knife-edged then the impacts of size-selective sampling will not be large, unlike in growth models. Size-truncated sampling is not a problem for maturity-at-length models because length is treated as a covariate in that case.

I agree with the values of M that the Panel reviewed and accepted for both stocks. Sensitivity analyses were conducted for reasonable alternative values of M . I recommend a full profile analysis of M be provided in future assessments to better understand how informative the assessment data are about this parameter that is broadly recognized as difficult to estimate unless there is high contrast in fishing mortality (F) and good survey indices.

Recreational landings of Hogfish were compiled from 1981 through 2024 for the U.S. Atlantic and Gulf of America, although the early years of the MRIP survey (e.g., 1981-1985) were highly variable and

¹ Morgan, M.J. and Hoenig, J.M., 1997. Estimating maturity-at-age from length stratified sampling. *Journal of Northwest Atlantic Fishery Science*, 21.

tended to result in higher CVs than those estimated in subsequent years. Hence, the DW felt that starting assessment models in 1986 was justified, but the DW was also not opposed to using the recreational catch statistics for 1981-1985. This seemed reasonable to me. However, preliminary runs by the AW using models with 1986 start years indicated that either 1) steepness could not be estimated or 2) R_0 hit an upper bound. Hence, the AW investigated using historical catch reconstructions in models to see if this provided useful information about the stock-recruit relationship. These reconstructions were based on effort estimates of the number of saltwater anglers during 1950-1980.

In the FLK/EFL region CPUE was calculated only using years 1982, 1983, and 1985 (CPUE = 0.263904) as landings estimates for 1981 and 1984 were flagged by the Data Workshop and, when incorporated, egregiously inflated CPUE values. This CPUE was applied to the effort data for 1950-1980 to reconstruct recreational catch in those years. I felt this was not sound and not robust for two reasons: 1) uncertainty in 1950-1980 effort was not provided and I had no idea how reliable this information was; 2) between year variability in CPUE was not assessed and the factors that contribute to variability were not considered. This is important to decide how to apply this to historical effort estimates.

To further investigate the second issue for the FLK/EFL stock I fit a simple random walk (RW) model to CPUE for 1980-2012 but excluding DW flagged catch estimates for 1981 and 1984. I fit the model using RTMB and the code is freely available upon request. I used this to hindcast recreational catch based on the 1950-1980 effort estimates. I assumed the observation error CV for CPUE was the same as the CV for the recreational catch, which was provided in Table 3.5 of WP #1. Only the mean and variance of the CPUE RW model were parameters to estimate.

Results are shown in Figure 1. Because the observation error CV's were large the RW model estimates of CPUE were fairly flat. The hindcasted CPUE was 0.295, which is similar to the 0.264 value for 1982, 1983, and 1985. The hindcasted catches are also similar to the values in Figure 3.16 of WP#1. An advantage of the RW approach is avoiding a subjective selection of years to base CPUE on. Another advantage is the uncertainty in CPUE is included in the catch reconstruction (Panels B and C of Fig. 1).

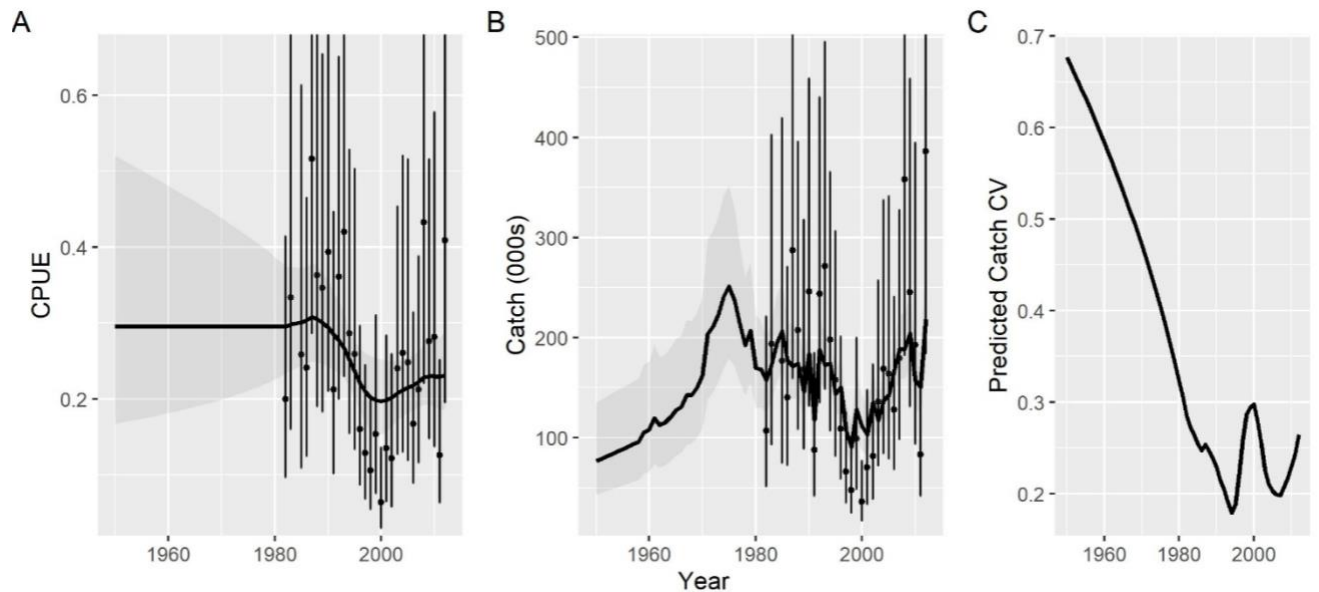


Figure 1. Panel A: The solid line indicates a random walk (RW) model estimate of annual mean recreational CPUE for the FLK/EFL stock. Shaded regions indicate 95% confidence intervals (CIs) for the mean. Points indicate CPUE estimates, and vertical bars indicate 95% CIs based on the observation error (CVs). Panel B: RW model estimate of annual mean recreational catches. Panel C: The CVs of recreational catch reconstructions for the FLK/EFL stock based on the RW CPUE model.

If the catch observation error CVs were smaller than the RW CPUE will follow the estimates more closely. I illustrate this in Figure 2 by fixing all observation error CVs to be 0.4. In this case the model estimates more between-year variability in CPUE and the hindcasted catches have a higher CV (compare Figure 2 with Figure 1). The hindcasted RW mean CPUE was 0.263, which is almost identical to the value (0.264) derived by the Analytical Team.

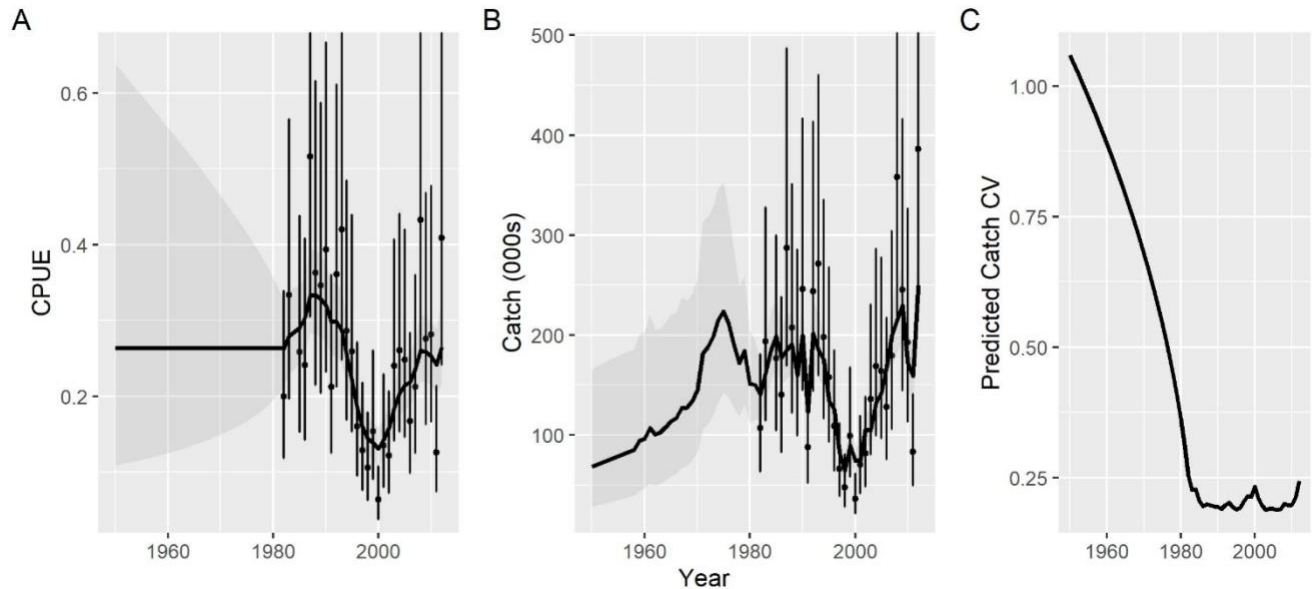


Figure 2. Random walk (RW) results for the FLK/EFL stock based on fixing CPUE observation error CV=0.4. Panel A: RW estimate of annual mean recreational CPUE. Panel B: RW model estimate of annual mean recreational catches. Panel C: The CV's of recreational catch reconstructions. See Figure 1 for other details.

The issue I referred to above (uncertainty in effort estimates) could be addressed in the RW model using an error in variables (EV) approach, like the ECOV component of WHAM (<https://timjmiller.github.io/wham/>). In this approach, a simple time-series model (e.g., RW, AR1) is used to model true effort, which is fitted with possibly irregular time-series estimates of effort. Standard errors or CVs of estimated effort can be used directly as part of the likelihood function. All of this can occur jointly with the CPUE RW model. This removes the need to fill in effort for years when surveys did not occur or were incomplete. The EV model will predict true effort for all modelled years. I think this is a statistically “honest” way to account for uncertainty in catch hindcasts.

My analysis above is presented to be only illustrative of an approach that could be further refined. The RW model illustrated in Figure 1 does not reflect the low CPUEs in 1997-2002, although the observation error CVs and between-year variability in CPUE are large. If there are factors (environmental or economic) that are known or suspected to affect CPUE in this period then these factors should be included as covariates in the RW model. If these covariates are also known during 1950-1985 then they could be used to improve historic catch reconstructions. If the main factor affecting temporal variation in CPUE is stock density then reconstructing catches from only effort information may not be possible. In this case, recreational effort may only be proportional to fishing mortality (see my comment for ToR 1c below).

b. Are data uncertainties acknowledged, reported, and within normal or expected levels?

I agree with the Panel conclusions for both stocks that the assessment adequately acknowledged the major sources of data uncertainty. The Review Panel considered these uncertainties generally within the range expected for the available information for this species and region, while recognizing that hogfish can be a relatively rare-event species in several sampling programs.

Some discussion during the review panel involved the lack of sampling of recreational fishers from private docks. If their CPUE is higher than those sampled from public docks and wharfs then this is a potential source of bias, because catches are raised from effort estimates using CPUE, which is primarily obtained from sampling of catches from public docks and wharfs. Some type of sampling to investigate if there are differences in CPUE between private and public docks could address this problem.

I was unsure how reliable the catch and index CVs were. I appreciate that the recreational catch of hogfish is a rare event, which is an important reason why the CPUE and catch CVs are high. The high catch CVs are not common in stock assessment. For the FLK/EFL stock, the RVC index CVs for the Keys and Dry Tortugas regions (0.05 – 0.1) were smaller than the CVs for the Combined Video and much smaller than many surveys I am familiar with. These CVs only reflect within-survey variation for the regions surveyed and do not account for uncertainty because the two RVC indices, particularly the Dry Tortugas, only cover part of the stock area. CVs for WFS indices (Seagrass and SEAMAP trawl, Combined Video) were somewhat larger than the RVC index CVs for the FLK/EFL stock. The SEAMAP trawl and Combined Video indices for the WFS region had broad coverage as well. I provide a research recommendation related to this issue under ToR 2c.

c. Are input data series reliable and applied properly within the assessment model?

Mostly I agree with the Review Panel conclusions that the input data series were appropriately applied within the assessment model for both stocks and were sufficiently reliable to support the assessment conclusions. The principal exception of the Panel conclusion was the reconstructed recreational catch series for 1950–1980. I agree with the Panel conclusion that this series was not sufficiently reliable to inform historical population scale or stock-recruit dynamics in the model used for management advice.

After thinking about more about the RVC index CVs for FLK/EFL stock since the review meeting, I conclude that these CVs should have been applied within SS with an extra variance parameter added to account for additional uncertainty. This is because these surveys, especially in the Dry Tortugas area, did not cover most of the stock range. I recommend that this be explored in the future as a sensitivity run.

I was impressed with the quality of the age measurements. The average percent error (APE) and CV of the Hogfish age dataset ($n = 2,166$ otoliths) was 0.68% and 0.71%, while the quality control subsample ($n = 653$) was 1.8% and 2.5%, respectively. These values are well below benchmarks for acceptable precision standards (APE of 5% and CV of 7.6%; Campana, 2011) indicating that Hogfish age reads were highly precise.

Another way to use historic recreational effort (E) estimates is directly within SS as an index of F; that is, $F_{\text{rec}} = qE_{\text{rec}}$. The SS user manual suggests this is possible. If the effort information also covers a period with catch information, then I presume this would allow the effort q to be estimated. This might possibly allow historic stock size to be estimated. I have not done this before but I suggest this as a research recommendation. If in the future a state-space assessment model is investigated that includes a time-series F model then I think even irregular historic E_{rec} estimates could be included, with associated uncertainty.

ToR 2. Evaluate and discuss the strengths and weaknesses of the methods used to assess the stock, taking into account the available data, and considering the following:

a. Are methods scientifically sound and robust?

I agree with the Review Panel conclusion that the SS model used to assess the FLK/EFL and WFS hogfish stocks were scientifically sound and robust. Stock Synthesis 3 (SS3; version 3.30.24) is a widely

used and extensively tested integrated stock assessment framework capable of incorporating the diverse and intermittent data streams available for these hogfish stocks. Its application to these two assessments was considered appropriate. The Assessment Team conducted an extensive suite of diagnostics and sensitivity analyses. Model convergence was evaluated using final gradients, Hessian properties, parameter-bound checks, and jitter analyses from dispersed starting values. One hundred jitter runs using a relatively broad jitter magnitude did not identify a lower likelihood solution. Likelihood profiles, retrospective analyses, sensitivity runs, parametric bootstrap analyses, and Markov Chain Monte Carlo (MCMC) analyses provided additional evaluation of model behavior and uncertainty. The Panel therefore considered the model to have been competently implemented and adequately diagnosed.

However, SS is primarily a deterministic assessment model with many parameters. As such, it can be prone to over-fitting assessment data, especially catches. If catch uncertainty is low, which is usually the case in most stock assessment, then this is not much of a problem, but when catch uncertainty is high, I feel that SS may over-fit catches. The WFS SS model practically interpolated the recreational spear catches (Fig. 4.14 in WP#1) even though the CVs for these catches ranged between 0.3-0.82. The FLK/EFL base model also fit the recreational landings closely (Fig. 3.16 in WP#1) and more closely than did my simple RW CPUE model (Fig. 1 above). I understand this will happen when fully selected F values are freely estimated each year and fleet. A state-space assessment model with random effects for F may provide more reasonable fitting. Often these models are set up with a random walk or AR1 process for F and with this approach the model will not want F values to change much unless the fit to the data, accounting for their observation errors, indicate that changes in F are needed. Hence, I fully agree with the research recommendation below to investigate using a state-space assessment modelling approach in the future to provide a more robust assessment model than SS.

b. Are assessment models configured properly and consistent with standard practices?

I agree with the Review Panel conclusion that the revised FLK/EFL and base WFS models were properly configured and generally consistent with accepted stock assessment practices. These models appropriately accounted for the protogynous hermaphroditic life history of hogfish within the capabilities of SS3.

The assessment used super-periods for commercial and recreational length-frequency data to address sparse sampling. Although this provided a practical means of reducing estimation problems associated with limited annual samples, the Panel noted that the statistical properties and potential consequences of using super-periods are not well understood by many practitioners and reviewers. In my experience this is not a commonly used SS option. Further evaluation of this approach is recommended.

Wp#1 described that the Florida Reef Tract in southeast Florida and the Florida Keys is largely <30 m depth and is situated towards the edge of the shelf. The absence of available offshore reef habitat may cause Hogfish in this region to experience limited refuge from fishing pressures and, in turn, must rely on management interventions such as areas prohibited from fishing (e.g., marine protected areas) or seasonal closures. This is different from the less accessible Dry Tortugas, which has a much larger length distribution than the Keys area. All of this suggests that there is spatial variation in exploitation rates in the FLK/EFL stock area. The DW reported that hogfish have high site fidelity and restricted home ranges, which suggests the potential for local depletion of parts of the stock. There were size differences in catches close to shore and further offshore in the WFS region. This suggests to me that spatial assessment approaches may be needed for these stocks in the future. These may be simpler 2-box models (i.e., Dry Tortugas and Florida Reef Tract+Keys for the FLK/EFL stock; inshore and offshore for the WFS stock). This should be explored in future research.

c. Are the methods appropriate for the available data?

Overall, I agree with the Review Panel conclusion that the SS model was appropriate for the available data.

Estimating growth internally within the model was appropriate. This approach provides an effective means of accounting for interactions among growth, length selectivity, and size truncation. Conditional age-at-length information was incorporated to improve estimation of growth and selectivity while reducing biases associated with length-stratified or otherwise size-selective age sampling.

I recommend more investigation of the growth rates for this species and how this is affected by the sex-change and maturation. This could affect how the SS model is configured for hogfish.

The external growth model fitting of the DW found that the CV of size-at-age decreased with size or age for the WFS hogfish stock. This indicates that between-individual variation in growth may be more related to variation in growth rates (i.e., VonB k) rather than asymptotic size, Linf. The SS platoon method of accounting for the impacts of size-selective fishing and between-individual variation in growth seems to be based on growth platoons that differ only in terms of Linf. It was not clear to me that the SS platoon method is effective when between-individual variation in growth is predominantly due to variation in growth rates, possibly like the WFS stock. It was also not clear to me that the SS platoon method was required given the primarily domed-shaped KEYS and WFS hogfish fisheries. Lack of fit in single platoon models may have been related to misspecification of variation in size-at-age. These issues should be researched more in the future but do not invalidate the models accepted by the Panel.

I am also concerned that SS over-fits high CV catches, which may be linked to the frequent convergence issues found when conducting parametric bootstrapping for the two hogfish stocks. Bootstrap samples of high CV catches should vary a lot according to the CVs, and if SS is over-fitting catches then the bootstrapped assessments may differ substantially, with various parameters becoming poorly identified with estimates hitting bounds. As outlined above, a solution to this is a state-space assessment model with an F random walk or some similar time-series model. However, this is a long-term research recommendation. These hogfish stocks will require size- and age-structured state-space models. My experience with these models is that they are slow to estimate, but this may improve in the future and is a research area for some state-space assessment experts.

As indicated for ToR 1c, for the RVC index CVs with the FLK/EFL stock, I recommend that an SS model configuration with an extra variance parameter be investigated. SS allows extra variance parameters or ad hoc adjustments (such as adding extra standard error constants) to be added directly to the input standard deviation or CV to account for unmodeled process error or overly precise survey estimates.

ToR 3. Evaluate the assessment findings and consider the following:

a. Are population estimates (model output – e.g. abundance, exploitation, biomass) reliable, consistent with input data and population biological characteristics, and useful to support status inferences?

I agree with the Panel conclusions that the population estimates from the KEYS_RW_Base and WFS base models were sufficiently reliable and useful for stock-status inference. These models were reasonably consistent with input data, with no major lack-of-fit apparent.

b. Is the stock overfished? What information helps you reach this conclusion?

I agree with the Review Panel and assessment conclusion that the WFS hogfish stock is not overfished. Current spawning stock biomass, defined using the geometric mean for 2022–2024, was estimated at approximately 1,086 mt, substantially greater than the minimum stock size threshold (MSST) of approximately 259 mt based on the SPR30% reference point. The uncertainty analysis strongly supported this conclusion. This conclusion is also consistent with the lack of a declining trend in the available fishery-independent abundance indices.

Based on the KEYS_RW_Base model and the applicable SPR-based biomass reference point (SPR30%), the Review Panel agreed with the conclusion that the East Florida–Florida Keys Hogfish stock is not overfished, which I agree with. Although the Panel considered the revised model suitable for this determination, MCMC and parametric bootstrap analyses corresponding specifically to the final KEYS_RW_Base configuration were not available for Panel evaluation during the Review Workshop. Consequently, the Panel could not evaluate the probabilistic robustness of this status.

Although the Panel did not accept the KEYS_BASE model that included reconstructed historic catches, this model did indicate a steepness much less than 1.0. An equilibrium analysis of the KEYS_BASE model indicated that $F_{SPR30\%}$ was much less than F_{msy} and that $F_{SPR40\%}$ was a better proxy for F_{msy} . Hence, management should consider whether SPR of 40% is a better basis for management reference points.

c. Is the stock undergoing overfishing? What information helps you reach this conclusion?

I agree with the Review Panel and the assessment conclusion that the WFS hogfish stock is not undergoing overfishing. The posterior distribution of the fishing mortality status ratio was entirely below 1, with a posterior median of approximately 0.28, also based on the SPR30% reference point.

Based on the KEYS_RW_Base model and $F_{SPR30\%}$, I agree with the Panel that the East Florida–Florida Keys Hogfish stock is not undergoing overfishing. The Panel accepted the deterministic stock-status determination, and the associated probabilistic characterization of uncertainty for the revised model should be completed before subsequent consideration by the SSC.

d. Is there an informative stock recruitment relationship? Is the stock recruitment curve reliable and useful for evaluation of productivity and future stock conditions?

For both the FLK/EFL and WFS stocks, an informative stock recruitment relationship was not supported by the data and accepted assessment models. This conclusion emerged from extensive consideration of the FLK/EFL revised model (KEYS_RW_Base) and alternative model configurations. Attempts to estimate steepness (h) for the WFS stock resulted in estimates near 0.99, effectively indicating little information in the available data regarding the shape of the stock-recruit relationship.

e. Are the quantitative estimates of the status determination criteria for this stock reliable? If not, are there other indicators that may be used to inform managers about stock trends and conditions?

I agree with the Review Panel conclusion that the SPR-based status determination criteria for the WFS stock were appropriate and sufficiently reliable for management to use. Use of SPR proxies was warranted because the data and assessment model did not support estimation of a sufficiently informative stock-recruit relationship for calculation of conventional MSY-based reference points.

I agree with the Review Panel conclusion that SPR-based status determination criteria for the FLK/EFL stock was appropriate for the KEYS_RW_Base model because an informative stock-recruit relationship could not be reliably estimated. The Panel nevertheless emphasized that the choice of SPR proxies does not eliminate uncertainty regarding underlying stock productivity. Model explorations provided some evidence consistent with lower h , and reference points calculated under such assumptions could differ from those obtained using SPR 30% proxies. As indicated for ToR 3c above, $F_{SPR40\%}$ seems like a better proxy for F_{msy} .

ToR 4. Evaluate the stock projections, including discussing strengths and weaknesses, and consider the following:

a. Are the methods consistent with accepted practices and available data?

I agree with the Review Panel conclusions for both stocks that the projection methodology was consistent with accepted practices and appropriate for the available data.

Projections were conducted externally to SS using a projection tool developed by the Southeast Fisheries Science Center (SEFSC) that has been used in previous assessments and reviewed through the regional management process. The assessment presented deterministic projections under multiple fishing mortality/reference-point scenarios.

b. Are the methods appropriate for the assessment model and outputs?

I agree with the Review Panel conclusions for both stocks that the projection methodology was appropriate for the assessment models and their outputs. The forecasting framework was developed specifically for use with SS and therefore provides an internally consistent means of projecting assessment results. The Assessment Team appropriately acknowledged several important caveats and advised that projection results be interpreted carefully.

c. Are the results informative and robust, and useful to support inferences of probable future conditions?

I agree with the Review Panel that the WFS hogfish projections were informative and sufficiently useful for evaluating probable future stock conditions and developing management advice. However, the degree of robustness to alternative biological assumptions could not be fully evaluated because projections were not accompanied by sensitivity analyses for all potentially important inputs, such as natural mortality, discard mortality, and other externally specified parameters. Such analyses are not necessarily standard components of the projection process, and their absence does not invalidate the projections. Nevertheless, sensitivity analyses could provide useful information regarding the dependence of projected outcomes on key fixed assumptions.

Final projections corresponding to the FLK/EFL stock KEYS_RW_Base model were not available for evaluation by the Panel during the Review Workshop. The Panel therefore could not reach a conclusion regarding the informativeness or robustness of the projection results for the revised model. The Panel's endorsement under TOR 4a applies to the projection methodology, not to projection results that were unavailable for review.

d. Are key uncertainties acknowledged, discussed, and reflected in the projection results?

I agree with the Review Panel that important projection assumptions and uncertainties were acknowledged, including assumptions of constant fleet selectivity and allocation, growth, natural mortality, stock-recruitment parameters, other fixed quantities, terminal-year recruitment, and future

recruitment. The projections were deterministic and therefore did not propagate parameter uncertainty or recruitment variability forward through time. Although multiple management scenarios were considered, the projections did not directly estimate probabilities of future biomass or fishing mortality crossing management reference points. Stochastic projections were not in the TORs of the AW, which is why the Assessment Team did not consider uncertainty in the projections.

The MCMC analyses provide a potential mechanism for incorporating this uncertainty. I recommend that future assessments should consider propagating posterior parameter draws through projections to estimate the probability of future stock conditions under alternative fishing scenarios. Such stochastic projections could provide managers with a more explicit representation of risk.

ToR 5. Consider how uncertainties in the assessment, and their potential consequences, are addressed.

a. Comment on the degree to which methods used to evaluate uncertainty reflect and capture the significant sources of uncertainty in the population, data sources, and assessment methods

I agree with the Review Panel conclusion that uncertainty was evaluated extensively in the FLK/EFL and WFS assessments and that the analyses captured many of the important sources of parameter, data, and model uncertainty. However, not all forms of uncertainty were propagated through every component of the analysis. In particular, the deterministic projections did not propagate parameter uncertainty into future stock trajectories.

b. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

I agree with the Review Panel that the implications of parameter uncertainty were clearly communicated, particularly for the stock-status criteria. The posterior distributions associated with current biomass and fishing mortality effectively conveyed the degree of risk relative to the management thresholds.

The sum-to-zero constraint on recruitment deviations used in the base models interferes with efficient MCMC exploration and additional research is needed to address this issue. This could include investigating if simple asymptotic normal or log-normal approximations of the distribution of stock estimates is sufficiently reliable for management purposes, or if other sampling-based approaches like MCMC or bootstrapping are required.

ToR 6. Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted.

a. Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments

The Review Panel supports the research recommendations developed during the Data and Assessment Workshops and identified several additional priorities that could improve future assessments of the East Florida–Florida Keys Hogfish stock. I agree with this and support the Panel’s research recommendations, some of which I contributed during the review meeting:

Review Panel Research Recommendations

1. Improve understanding and modeling of protogynous hermaphroditic population dynamics. I agree with the Review Panel that this represents a high research priority. Future work should investigate the recruitment and reproductive dynamics of protogynous, harem-forming species like hogfish and evaluate how social structure affects sex transition. The current assessment represents sex transition

primarily as an age-dependent process, whereas hogfish sex change may also depend strongly on the local abundance or density of males. Research should evaluate whether the probability of female-to-male transition changes with male density and how fishing-induced changes in population sex ratio affect reproductive output. Simulation studies and explicitly sex-structured population models could be particularly useful for evaluating these processes and the implications of size-selective harvest regulations for protogynous species. Related work should investigate the potential for sperm limitation or male limitation and the prevalence of skip spawning. These processes could influence the relationship between conventional measures of spawning biomass and realized reproductive output and may help explain why a conventional stock-recruit relationship is difficult to estimate for this species.

2. Improve life-history, age, length, and discard information. Improving and updating basic biological and fishery information should remain a high priority. Better age and length information would strengthen estimation of growth, selectivity, mortality, and population age structure. For the KEYS stock specifically, obtaining a more reliable estimate of maximum age is recommended. Maximum age provides important information for evaluating natural mortality-at-age assumptions, and improved information would help validate the natural mortality vector used in future assessments. Discard information also remains limited and should be improved, particularly where sample sizes are insufficient to characterize discard magnitude, composition, and mortality reliably.
3. Improve recreational fishery information. Recreational harvest and discard estimates, particularly for the spear sector, remain relatively uncertain because of low positive-trip interception rates and correspondingly high sampling variability. Improved sampling approaches or supplemental data collection could reduce uncertainty in these removals. The historical catch reconstruction considered during SEDAR 94 also demonstrates the importance of developing and maintaining reliable recreational fishery information. Future historical reconstructions should explicitly characterize uncertainty in both effort and CPUE assumptions and evaluate how those uncertainties affect population-scale and productivity estimates before such data are used to inform initial stock conditions.
4. Evaluate fishery-independent survey coverage and data gaps. All available fishery-independent indices, including those excluded during the Data Workshop, should be evaluated systematically for geographic and habitat coverage, sample size, and availability of age and length information. The differences in selectivity among surveys considered during SEDAR 94 illustrate the importance of understanding survey depth distributions, habitat coverage, fish availability, and spatial patterns of fishing pressure when interpreting fishery-independent indices.
5. Evaluate uncertainty estimation methods. Future research should compare uncertainty distributions obtained from MCMC, parametric bootstrap, and asymptotic normal approximations. Comparisons on both arithmetic and log scales could help determine when conventional asymptotic covariance-based uncertainty estimates provide adequate inference and when computationally intensive MCMC or bootstrap methods materially improve characterization of uncertainty. Alternative MCMC algorithms should be investigated.
6. Attention should be given to the MCMC proxy-model issue identified during SEDAR 94. The implications of removing the recruitment-deviation sum-to-zero constraint for MCMC proxy models should also be examined further. The statistical consequences of removing the recruitment-deviation

sum-to-zero constraint should be investigated, as should alternative methods that permit posterior sampling without requiring changes to the base-model configuration.

7. Assessment frameworks capable of incorporating random effects or state-space processes should also be evaluated where appropriate.
8. Develop stochastic projections that propagate assessment uncertainty. The MCMC framework provides an opportunity to propagate parameter uncertainty into future projections. Stochastic projections could quantify probabilities of SSB falling below biomass thresholds or fishing mortality exceeding applicable reference points under alternative management scenarios. Incorporating such approaches more routinely into the SEDAR process could improve communication of management risk and make fuller use of the uncertainty analyses already conducted as part of the assessment.
9. Evaluate super-period assumptions. Additional research should examine the statistical properties of super-periods used to address sparse composition data. The approach was accepted for the current assessment, but its potential effects on parameter estimation and uncertainty are not well understood.
10. Evaluate growth-platoon assumptions. Sensitivity analyses should be conducted for the SS3 growth-platoon specification to identify whether alternative platoon assumptions materially influence growth, selectivity, population scale, or status estimates.
11. Investigate sex-specific growth. Although available residual diagnostics supported the assumption of equal male and female growth for the current assessment, further biological and modeling work should evaluate whether sex-specific growth differences are important for hogfish assessment results.
12. Evaluate environmental effects and stressors. Future research should investigate environmental influences on natural mortality, recruitment, movement, and habitat use. Potential factors include red tides and other harmful algal blooms, cold events, oil spills, and other disturbances that could affect hogfish population dynamics independent of fishing.
13. Revisit the Review Workshop Terms of Reference and alignment among SEDAR stages. The Panel recommended reviewing the structure and wording of the Review Workshop TORs to improve clarity regarding the Panel's expected role. In particular, TORs requiring evaluation of the robustness of projection results may be difficult to address when final projections change following Review Workshop recommendations or when the SSC is expected to request alternative projection scenarios. Greater alignment among Data Workshop, Assessment Workshop, and Review Workshop TORs would also be beneficial. Important Assessment Workshop tasks, such as bridge analyses between previous and current assessments, should be reflected explicitly in Review Workshop TORs when evaluation of those analyses is expected.

My Additional Comments and Recommendations

1. I am not sure how better estimation of maximum age can be achieved, which is a comment related to Panel recommendation #2.
2. Growth model diagnostics should include residual boxplots versus age for each sex, and sex-combined residual box plots versus year. I also recommend fitting external growth models separately for each sex to provide a likelihood ratio test that growth is the same for each sex, which was only assumed in the SS assessment models for each stock.

3. Investigate if growth rates are affected by the sex-change and maturation.
4. Investigate how growth rates vary between individuals. Does between-individual variation affect the Von Bertalanffy growth rate parameter k or just L_{inf} . Investigate if the SS platoon method effectively accounts for between-individual variability for hogfish.
5. If maturity samples are affected by minimum size limits, then this should be accounted for when fitting maturity-at-age models.
6. A full profile analysis of M should be provided in future assessments to better understand how informative the assessment data are about this parameter.
7. I illustrated an approach to account for uncertainty and between-year variability in CPUE in catch reconstructions. Uncertainty in historic effort estimates should also be accounted for. Factors (environmental or economic) that are known or suspected of affecting CPUE should be investigated. If the main factor affecting temporal variation in CPUE is stock density, then reconstructing catches from only effort information may not be possible.
8. Related to the Review Panel's Research Recommendation #3: Modelling of catch and effort time-series may also produce better estimates of contemporary recreational catch, with lower CVs. I illustrated an approach for this in my report.
9. Investigate if historical recreational effort estimates can be used directly within SS as an index of F_{rec} . This is an alternative to historical catch reconstructions to extend the assessment model time-frame to provide more information about recruitment and the stock-recruit relationship.
10. Related to the Review Panel's Research Recommendation #3: Investigate if there are differences in CPUE between trips leaving from private versus public docks. If CPUE at private docks is higher than those sampled from public docks and wharfs, then this is a potential source of bias in recreational catch estimates.
11. The RVC index CVs for FLK/EFL stock are low (i.e., ~7%). Investigate applying these CVs within SS with an extra variance parameter added to account for additional uncertainty because these surveys, especially in the Dry Tortugas area, did not cover most of the stock range.
12. Investigate simple spatial assessment models. This could be a 2-box model (i.e., Dry Tortugas and Florida Reef Tract+Keys for the FLK/EFL stock; inshore and offshore for the WFS stock). Rationales for this approach are presented in my report.
13. I fully agree with the Review Panel research recommendation #7 to investigate using a state-space assessment modelling approach in the future. This may provide a more robust assessment model than SS for reasons I outlined under ToR 2a.

b. Provide recommendations on possible ways to improve the SEDAR process.

The Review Panel commented that some ToRs may need to be revisited or clarified. For example, the text on BSIA may need updating, and the evaluation of the projection results may be a task for the SSC, rather than a Review Panel. Also, the Review Panel noted that the bridging analysis (see TORs for the assessment phase) was not very informative given the length of time between assessments and resulting changes in the data and the model. It was therefore not evaluated by the Review Panel.

I find the SEDAR process is effectively structured and scientifically rigorous. However, the Review Panel was tasked with a relatively large number of ToRs. Also, the Panel meeting was for 4 days. This was an appropriate timeframe given the number of ToRs, but it means there was relatively less time for me to respond to each ToR in this CIE report.

ToR 7. Consider whether the stock assessment is consistent with and represents best scientific information available (BSIA) using the following criteria as appropriate: relevance, inclusiveness, objectivity, transparency, timeliness, verification, validation, and peer review of fishery management information.

I agree with the Review Panel conclusion that the SEDAR 94 East Florida-Florida Keys and West Florida Shelf hogfish assessments are scientifically sound, use the available data appropriately, and provides a suitable basis for management advice.

ToR 8. Provide suggestions on key improvements in data or modeling approaches that should be considered when scheduling the next assessment.

I agree with the Review Panel conclusion that completion of any of the research recommendations provided for ToR 6 is not required before scheduling the next assessment.

Revisions and recalibration of MRIP fishing effort may warrant a new assessment.

ToR 9. Prepare a Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop. Complete and submit the Peer Review Summary Report in accordance with the project guidelines.

This was completed.

Conclusions and Recommendations

ToR 1. Evaluate the data used in the assessment, including discussion of the strengths and weaknesses of data sources and decisions, and consider the following.

a. Are data decisions made by the Data Workshop (DW) and Assessment Workshop (AW) panels sound and robust?

The treatment of hogfish as two distinct stocks was sound.

The data decisions made by the DW and AW for the West Florida Shelf (WFS) stock were sound and robust given the available information and the data limitations associated with this stock.

Most data decisions made during the DW and Assessment Workshop (AW) for the Florida Keys/East Florida (FLK/EFL) stock were well documented and appropriate. The exception was the reconstructed recreational removals, which were not sufficiently robust for inclusion in the model used for management advice.

The values of M used in the assessments were based on sound rationale. Sensitivity analyses were conducted for reasonable alternative values of M.

b. Are data uncertainties acknowledged, reported, and within normal or expected levels?

The assessments for both stocks adequately acknowledged the major sources of data uncertainty, which were generally within the range expected for the available information for this species and region, while recognizing that hogfish can be a relatively rare-event species in several sampling programs

c. Are input data series reliable and applied properly within the assessment model?

Input data series were mostly appropriately applied within the assessment models for both stocks and were sufficiently reliable to support the assessment conclusions. Hogfish age reads were highly precise.

The principal exception was the reconstructed recreational catch series for 1950–1980, which was not sufficiently reliable to inform historical population scale or stock-recruit dynamics in the models used for management advice. This series was not consequential to the WFS assessment, but it was for the FLK/EFL assessment.

ToR 2. Evaluate and discuss the strengths and weaknesses of the methods used to assess the stock, taking into account the available data, and considering the following:

a. Are methods scientifically sound and robust?

The SS models used to assess the FLK/EFL and WFS hogfish stocks were scientifically sound and robust. The Assessment Team conducted an extensive suite of diagnostics and sensitivity analyses. These models were competently implemented and adequately diagnosed.

b. Are assessment models configured properly and consistent with standard practices?

The revised FLK/EFL and base WFS models were properly configured and generally consistent with accepted stock assessment practices. These models appropriately accounted for the protogynous hermaphroditic life history of hogfish within the capabilities of SS3.

An exception for FLK/EFL assessment was the way the input CVs for the two RVC indices were used. These CVs should have been applied within SS with an extra variance parameter added to account for

additional uncertainty. This is because these surveys, especially in the Dry Tortugas area, did not cover most of the stock range.

c. Are the methods appropriate for the available data?

The SS models were appropriate for the available data for both stocks. Estimating growth internally within the model was appropriate.

ToR 3. Evaluate the assessment findings and consider the following:

a. Are population estimates (model output – e.g. abundance, exploitation, biomass) reliable, consistent with input data and population biological characteristics, and useful to support status inferences?

The population estimates from the KEYS_RW_Base and WFS base models were sufficiently reliable and useful for stock-status inference. These models were reasonably consistent with input data, with no major lack-of-fit apparent.

b. Is the stock overfished? What information helps you reach this conclusion?

The WFS hogfish stock is not overfished. Current spawning stock biomass was substantially greater than the minimum stock size threshold based on the SPR30% reference point. The uncertainty analysis strongly supported this conclusion. This conclusion is also consistent with the lack of a declining trend in the available fishery-independent abundance indices.

The East Florida–Florida Keys Hogfish stock is not overfished based on the KEYS_RW_Base model and the applicable SPR-based biomass reference point (SPR 30%). MCMC and parametric bootstrap analyses corresponding specifically to the revised KEYS_RW_Base configuration were not available during the Review Workshop. Consequently, the Panel could not evaluate the probabilistic robustness of this status. Management should consider whether SPR of 40% is a better basis for management reference points for this stock.

c. Is the stock undergoing overfishing? What information helps you reach this conclusion?

The WFS hogfish stock is not undergoing overfishing. The posterior distribution of the fishing mortality status ratio was entirely below 1.

The East Florida–Florida Keys Hogfish stock is not undergoing overfishing, although this was only based on a deterministic stock-status determination, and the associated probabilistic characterization of uncertainty for the revised model should be completed before subsequent consideration by the SSC. Similar to ToR 3b, management should consider whether SPR of 40% is a better basis for management reference points for this stock.

d. Is there an informative stock recruitment relationship? Is the stock recruitment curve reliable and useful for evaluation of productivity and future stock conditions?

For both the FLK/EFL and WFS stocks, an informative stock recruitment relationship was not supported by the data and accepted assessment models. This conclusion emerged from extensive consideration of both the FLK/EFL original AW Base model and alternative model configurations. Attempts to estimate steepness (h) for the WFS stock resulted in estimates near 0.99, effectively indicating little information in the available data regarding the shape of the stock-recruit relationship.

- e. Are the quantitative estimates of the status determination criteria for this stock reliable? If not, are there other indicators that may be used to inform managers about stock trends and conditions?*

The SPR-based status determination criteria for the WFS stock were appropriate and sufficiently reliable for management to use. Use of SPR proxies was warranted because the data and assessment model did not support estimation of a sufficiently informative stock-recruit relationship for calculation of conventional MSY-based reference points.

SPR-based status determination criteria for the FLK/EFL stock was appropriate for the KEYS_RW_Base model because an informative stock-recruit relationship could not be reliably estimated. As indicated for ToR 3c above, FSPR40% seems like a better proxy for Fmsy.

ToR 4. Evaluate the stock projections, including discussing strengths and weaknesses, and consider the following:

- a. Are the methods consistent with accepted practices and available data?*

The projection methodology was consistent with accepted practices and appropriate for the available data.

- b. Are the methods appropriate for the assessment model and outputs?*

The projection methodology was appropriate for the assessment models and their outputs.

- c. Are the results informative and robust, and useful to support inferences of probable future conditions?*

The WFS hogfish projections were informative and sufficiently useful for evaluating probable future stock conditions and developing management advice. The degree of robustness to alternative biological assumptions could not be fully evaluated because projections were not accompanied by sensitivity analyses for all potentially important inputs, such as natural mortality, discard mortality, and other externally specified parameters. Nevertheless, sensitivity analyses could provide useful information regarding the dependence of projected outcomes on key fixed assumptions.

Final projections corresponding to the FLK/EFL stock KEYS_RW_Base model were not available for evaluation by the Panel during the Review Workshop.

- d. Are key uncertainties acknowledged, discussed, and reflected in the projection results?*

Although important projection assumptions and uncertainties were acknowledged, the projections did not directly estimate probabilities of future biomass or fishing mortality crossing management reference points.

ToR 5. Consider how uncertainties in the assessment, and their potential consequences, are addressed.

- a. Comment on the degree to which methods used to evaluate uncertainty reflect and capture the significant sources of uncertainty in the population, data sources, and assessment methods*

Uncertainty was evaluated extensively in the FLK/EFL and WFS assessments and the analyses captured many of the important sources of parameter, data, and model uncertainty. However, not all forms of uncertainty were propagated through every component of the analysis. In particular, the deterministic projections did not propagate parameter uncertainty into future stock trajectories.

b. Ensure that the implications of uncertainty in technical conclusions are clearly stated.

Implications of parameter uncertainty were clearly communicated, particularly for the stock-status criteria. The posterior distributions associated with current biomass and fishing mortality for the WFS stock effectively conveyed the degree of risk relative to the management thresholds.

ToR 6. Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted.

a. Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments

These are summarized for ToR 6 above. The most important ones are

- Improve understanding and modeling of protogynous hermaphroditic population dynamics.
- Improve life-history, age, length, and discard information.
- Improve recreational fishery information.
- Develop stochastic projections that propagate assessment uncertainty.

b. Provide recommendations on possible ways to improve the SEDAR process.

Some ToRs may need to be revisited or clarified. For example, the text on BSIA may need updating, and the evaluation of the projection results may be a task for the SSC, rather than a Review Panel. Also, the Review Panel noted that the bridging analysis (see TORs for the assessment phase) was not very informative given the length between assessments and resulting changes in the data and the model.

ToR 7. Consider whether the stock assessment is consistent with and represents best scientific information available (BSIA) using the following criteria as appropriate: relevance, inclusiveness, objectivity, transparency, timeliness, verification, validation, and peer review of fishery management information.

The SEDAR 94 East Florida-Florida Keys and West Florida Shelf hogfish assessments are scientifically sound, use the available data appropriately, and provide a suitable basis for management advice.

ToR 8. Provide suggestions on key improvements in data or modeling approaches that should be considered when scheduling the next assessment.

Completion of any of the research recommendations provided for ToR 6 is not required before scheduling the next assessment. Revisions and recalibration of MRIP fishing effort may warrant a new assessment.

ToR 9. Prepare a Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop. Complete and submit the Peer Review Summary Report in accordance with the project guidelines.

This was completed.

Appendix 1: Bibliography of materials provided for review

Main Report

SEDAR 94. Florida Hogfish SECTION III: Assessment Report. June 2026. 236 pp.

Other Documents

Document #	Title	Authors	Date Submitted
Documents Prepared for the Data Workshop			
SEDAR94-DW-01	Standardized video counts of southeast US Atlantic hogfish (<i>Lachnolaimus maximus</i>) from the Southeast Reef Fish Survey	Nathan Bacheler, Rob Cheshire, and Kyle Shertzer	25 March 2025
SEDAR94-DW-02	Headboat Data for Hogfish in the Southeast U.S. Atlantic and Gulf of America	Robin T. Cheshire and Matthew E. Green	21 May 2025
SEDAR94-DW-03	Florida Keys and East Florida Hogfish Fishery Performance Report March 2024	SAFMC Snapper Grouper Advisory Panel	29 April 2025
SEDAR94-DW-04	Standardized catch rates of Hogfish (<i>Lachnolaimus maximus</i>) from the Southeastern U.S. commercial spear fishery, 1993-2024	Michaela Pawluk and Kevin Thompson	11 July 2025
SEDAR94-DW-05	General Recreational Survey Data for Hogfish in the Gulf of America and South Atlantic	Samantha M. Binion-Rock	11 July 2025
SEDAR94-DW-06	Historical Commercial Fishery Landings of Hogfish in the Southeastern U.S.	Christopher Bradshaw	8 July 2025 Updated: 1 August 2025
SEDAR94-DW-07	Length frequency distributions for Hogfish collected by TIP in the Southeast from 1984 to 2024	Christopher Bradshaw	8 July 2025
SEDAR94-DW-08	Social Dimensions of Hogfish (<i>Lachnolaimus maximus</i>)	David Griffith	8 July 2025
SEDAR94-DW-09	Commercial discard data limitations for Hogfish (<i>Lachnolaimus maximus</i>) in Florida for the Vertical Line and Spearfishing fleet	Kevin Thompson, Sarina Atkinson, Gary Decossas	11 July 2025
SEDAR94-DW-10	A Summary of Florida Hogfish Discard Length Data Collected from At-Sea Observers in For-Hire Fishery Surveys in Florida 2005-2024	Ellie Corbett and Leonardo Eguia	10 July 2025 Updated: 24 July 2025
SEDAR94-DW-11	Length and age composition of Florida Hogfish, <i>Lachnolaimus maximus</i> , collected in association with fishery-dependent projects	Maria McGirl, Jessica Carroll, and Bridget Cermak	17 July 2025 Updated: 24 July 2025

SEDAR94-DW-12	Hogfish Discard Mortality and Habitat Ecology on the West Florida Shelf	Robert D. Ellis, B. James Williams, Kerry Flaherty-Walia, and Philip Stevens	18 July 2025
SEDAR94-DW-13	Hogfish Index of Abundance from the Annual FWRI-SEAMAP Trawl Survey along the West Florida Shelf	Brian Klimek and Theodore Switzer	21 July 2025 Updated: 3 September 2025
SEDAR94-DW-14	Young of Year Hogfish Index of Abundance from Seagrass Trawl Surveys of the Florida Big Bend	Brian Klimek and Theodore Switzer	21 July 2025 Updated: 3 September 2025
SEDAR94-DW-15	Standardization of commercial catch per unit effort of Hogfish (<i>Lachnolaimus maximus</i>) from Florida Trip Ticket landings, 1994-2024	Dustin Addis	22 July 2025
SEDAR94-DW-16	Recreational For-Hire Trends in Release Methods and Barotrauma Assessment of Hogfish (<i>Lachnolaimus maximus</i>) using a Fisheries-Dependent At-Sea Observer Program	Leonardo Eguia, Zachary Siders, Debra Murie	18 July 2025 Updated: 31 July 2025 Updated: 2 September 2025
SEDAR94-DW-17	Standardized Catch Rates of Hogfish (<i>Lachnolaimus maximus</i>) from the Marine Recreational Information Program (MRIP) for West Florida and the Keys-East Florida, 1991-2024	Shanae Allen	23 July 2025 Addendum added: 22 August 2025
SEDAR94-DW-18	Hogfish (<i>Lachnolaimus maximus</i>) Lengths Sampled in the Biscayne National Park Creel Survey, 1993-2022 Updated Title: Hogfish (<i>Lachnolaimus maximus</i>) Lengths Sampled in the Biscayne National Park Creel Survey, 1993-2024	Shanae Allen	25 July 2025 Updated: 22 August 2025
SEDAR94-DW-19	Indices of abundance for Gulf and Atlantic Hogfish (<i>Lachnolaimus maximus</i>) using data from multiple video surveys	Justin Lewis, Heather M. Christiansen, Sean F. Keenan, Katherine E. Overly, Matthew D. Campbell, Theodore S. Switzer	28 July 2025
SEDAR94-DW-20	Fisherman Feedback Report - Hogfish	Gulf Council Staff	29 July 2025

SEDAR94-DW-21	A ratio-based method for calibrating estimates of total landings (numbers and pounds of fish), and releases (numbers of fish) from MRIP-FCAL to SRFS for Hogfish (<i>Lachnolaimus maximus</i>) in Florida	Chloe Ramsay Updated Authors: Chloe Ramsay and Maria McGirl	31 July 2025 Updated: 17 August 2025
SEDAR94-DW-22	Standardized Reef Visual Census indices for Hogfish, <i>Lachnolaimus maximus</i> , for Southeast Florida (2013 - 2024), the Florida Keys (1997 – 2024), and Dry Tortugas (1999 - 2024)	Robert G. Muller and Halie O’Farrell	10 September 2025
SEDAR94-DW-23	Summary of Southeast For-Hire Integrated Electronic Reporting Program Records for Hogfish Catch in Southeast Region	LAPP/DM Branch, SERO	19 September 2025
SEDAR94-DW-24	Public comments received via the online comment form during the data process		10 October 2025
Documents Prepared for the Assessment Process			
SEDAR94-AP-01	A Unified Reef Visual Census (RVC) and REEF Citizen Science Index	Brice X. Semmens and Dan A. Greenberg	26 March 2026
SEDAR94-AP-02	Weighted Length Compositions for Recreational FL Keys-EFL Hogfish Landings Using MRIP, Biscayne National Park Creel Survey, and Headboat Data	Shanae D. Allen	15 May 2026
Reference Documents			
SEDAR94-RD01	Life history through the eyes of a hogfish trophic growth and differential juvenile habitat use from stable isotope analysis	Meaghan E. Faletti, Christopher D. Stallings	
SEDAR94-RD02	Assessing the value of citizen scientist observations in tracking the abundance of marine fishes	Dan A. Greenberg, Christy V. Pattengill-Semmens, Brice X. Semmens	
SEDAR94-RD03	Modeling protogynous hermaphrodite fishes workshop	Gary Shepherd, Kyle Shertzer, Jessica Coakley, Megan Caldwell	
SEDAR94-RD04	Stock assessment of protogynous fish: evaluating measures of spawning biomass used to estimate biological reference points	Elizabeth N. Brooks, Kyle W. Shertzer, Todd Gedamke, and Douglas S. Vaughan	

Appendix 2: CIE Statement of Work

**Performance Work Statement (PWS)
National Oceanic and Atmospheric Administration (NOAA)
NOAA Fisheries
Center for Independent Experts (CIE) Program
External Independent Peer Review**

**SEDAR 94 Florida Hogfish Assessment: West Florida Shelf Stock and East Florida/Florida Keys
Stock**

July 14- 17, 2026

Background

NOAA Fisheries is mandated by the Magnuson-Stevens Fishery Conservation and Management Act, Endangered Species Act, and Marine Mammal Protection Act to conserve, protect, and manage our nation's marine living resources based upon the best scientific information available (BSIA). NOAA Fisheries science products, including scientific advice, are often controversial and may require timely scientific peer reviews that are strictly independent of all outside influences. A formal external process for independent expert reviews of the agency's scientific products and programs ensures their credibility. Therefore, external scientific peer reviews have been and continue to be essential to strengthening scientific quality assurance for fishery conservation and management actions.

Scientific peer review is defined as the organized review process where one or more qualified experts review scientific information to ensure quality and credibility. These expert(s) must conduct their peer review impartially, objectively, and without conflicts of interest. Each reviewer must also be independent from the development of the science, without influence from any position that the agency or constituent groups may have. Furthermore, the Office of Management and Budget (OMB), authorized by the Information Quality Act, requires all federal agencies to conduct peer reviews of highly influential and controversial science before dissemination. Specifically, science products that the agency can reasonably determine that will have, when disseminated, *"a clear and substantial impact on important public policies or private sector decisions."* Additionally, peer reviewers must be deemed qualified based on the OMB Peer Review Bulletin standards².

Scope

The **SouthEast Data, Assessment, and Review (SEDAR)** is the cooperative process by which stock assessment projects are conducted in NOAA Fisheries' Southeast Region. SEDAR was initiated to improve planning and coordination of stock assessment activities and to improve the quality and reliability of assessments.

SEDAR 94 will be a CIE assessment review conducted for two stocks of Hogfish: the West Florida Shelf Stock and the East Florida/Florida Keys Stock. The review workshop provides an independent peer review of SEDAR stock assessments. The term review is applied broadly, as the review panel may request additional analyses, error corrections and sensitivity runs of the assessment models provided by

² https://www.whitehouse.gov/wp-content/uploads/legacy_drupal_files/omb/memoranda/2005/m05-03.pdf

the assessment panel. There will be two models to be reviewed during the workshop. The review panel is ultimately responsible for ensuring the scientific basis of the assessment through the SEDAR process. The specified format and contents of the individual peer review report are found in **Annex 1**. The Terms of Reference (ToRs) of the peer and review are included in **Annex 2**. The tentative agenda of this virtual panel review and process review meetings is included in **Annex 3**.

Requirements

NOAA Fisheries requires three reviewers to conduct an impartial and independent peer review in accordance with this Performance Work Statement (PWS), OMB Guidelines, and the ToRs below. Modifications to this Performance Work Statement (PWS) and ToRs cannot be made during the peer review, and the Contracting Officer's Representative (COR) and the CIE contractor shall approve any modifications prior to the peer review. All ToRs must be addressed in each reviewer's report.

The reviewers shall have a working knowledge in stock assessment, statistics, fisheries science, and marine biology sufficient to complete the primary task of providing peer-review advice in compliance with the workshop Terms of Reference fisheries stock assessment. Expertise with the Stock Synthesis modeling platform, and the associated model diagnostics would be helpful. Experience with assessments of reef-associated species, particularly those exhibiting complex life histories (e.g., hermaphroditism), and familiarity with evaluating length-and-age composition data, selectivity patterns, and model diagnostics in data-moderate or data-limited contexts is preferred.

The chair, who is in addition to the panel of three reviewers, will not be provided by the CIE. Although the chair will be participating in this review, the chair's participation (e.g., labor and travel) is not covered by this contract.

Tasks for Reviewers

Each CIE reviewer shall complete the following tasks in accordance with the PWS and Schedule of Milestones and Deliverables herein.

Pre-review Background Documents: Two weeks before the peer review, the NOAA Fisheries Project Contact will send (by electronic mail or make available at an FTP site) to the CIE reviewers the necessary background information and reports for the peer review. In the case where the documents need to be mailed, the NOAA Fisheries Project Contact will consult with the CIE on where to send documents. The CIE reviewers are responsible only for the pre-review documents that are delivered to the reviewer in accordance with the PWS scheduled deadlines specified herein. The CIE reviewers shall read all documents in preparation for the peer review.

Documents to be provided to the CIE reviewers prior to this review include:

S94 Data Workshop Report (<https://sedarweb.org/documents/sedar-94-florida-hogfish-data-workshop-report/>)

S94 Assessment Process Report (to be provided two weeks prior to review)

S94 Working papers and Reference documents (<https://sedarweb.org/assessments/sedar-94-florida-hogfish/>)

Panel Review Meeting: The CIE reviewers shall conduct the independent peer review in accordance with the PWS and ToRs and shall not serve in any other role unless specified herein. The CIE reviewers shall attend and actively participate in a professional and respectful manner as members of the meeting review panel, and their peer review tasks shall be focused on the ToRs as specified herein. The NOAA Fisheries Project Contact is responsible for any meeting arrangements (e.g., conference room reservations, video conferencing logistics, etc.).

Chair Summary Report: The reviewers shall assist the Chair of the meeting with contributions to the summary report.

Contract Deliverables - Independent CIE Peer Review Report: The CIE reviewers shall complete an independent peer review report in accordance with this PWS. Reviewers are not required to reach a consensus. The CIE reviewer shall complete the independent peer review according to required format and content as described in **Annex 1**. The CIE reviewer shall complete the independent peer review addressing each ToR as described in **Annex 2**. The tentative agenda of the panel review meeting is attached in **Annex 3**.

Foreign National Security Clearance

When reviewers participate during a panel review meeting at a government facility, the NOAA Fisheries Project Contact is responsible for obtaining the Foreign National Security Clearance approval for reviewers who are non-US citizens. For this reason, the reviewers shall provide requested information (e.g., first and last name, contact information, gender, birth date, passport number, country of passport, travel dates, country of citizenship, country of current residence, and home country) to the Project Contact for the purpose of their security clearance, and this information shall be submitted at least two weeks in advance. For additional information, please see the following link: <https://www.commerce.gov/osy/programs/foreign-access-management>. All CIE reviewers must have a REAL ID-compliant form of identification to access Federally owned or leased facilities. The contractor is required to use all appropriate methods to safeguard Personally Identifiable Information (PII).

Place of Performance

The place of performance shall be the Charleston, SC.

Period of Performance

The CIE reviewers' duties shall not exceed **14** days to complete all required tasks.

Schedule of Milestones and Deliverables

The contractor shall complete the tasks and deliverables in accordance with the following schedule:

Schedule	Milestones and Deliverables
Within two weeks of award	Contractor secures participation of the CIE reviewers.
At least two weeks prior to the panel review meeting	Pre-review documents are provided to the reviewers.

July 14- 17, 2026	The reviewers participate and conduct an independent peer review during the panel review meeting.
Approximately 2 weeks later	Contractor receives draft reports
Within 3 weeks of receiving draft reports	Contractor submits final reports to the Government

* The Peer Review Summary Report will not be submitted to, reviewed, or approved by the Contractor.

Applicable Performance Standards

The acceptance of the contract deliverables shall be based on three performance standards: (1) The reports shall be completed in accordance with the required formatting and content in **Annex 1**; (2) The reports shall address each ToR as specified **Annex 2**; and (3) The reports shall be delivered as specified in the schedule of milestones and deliverables.

Travel

All travel expenses shall be reimbursable in accordance with Federal Travel Regulations ([Travel resources | GSA](#)), and all contractor travel must be approved by the COR prior to the actual travel. Any travel conducted prior to the receipt of proper written authorization from the COR will be done at the Contractor's own risk and expense. International travel is authorized for this contract. Travel is not to exceed 17,000.

Confidentiality and Data Privacy

This contract may require that services contractors have access to Privacy Information. Services contractors are responsible for maintaining the confidentiality of all subjects and materials and may be required to sign and adhere to a Non-disclosure Agreement (NDA).

NOAA Fisheries Project Contact:

Roldan Munoz
 NOAA Fisheries, Southeast Fisheries Science Center
 101 Pivers Island Rd, Beaufort, NC 28516
Roldan.munoz@noaa.gov

Annex 1. Terms of Reference for the Peer Review

SEDAR 94 Hogfish Assessment: West Florida Shelf Stock and East Florida/Florida Keys Stock

CIE reviewers are contracted to complete their independent peer review based on the ToRs. Therefore, the CIE-NOAA Fisheries review and approval process is based on whether the CIE independent reports addressed each of the ToRs.

Review Workshop Terms of Reference

1. Evaluate the data used in the assessment, including discussion of the strengths and weaknesses of data sources and decisions, and consider the following:
 - a) Are data decisions made by the Data Workshop (DW) and Assessment Workshop (AW) panels sound and robust?
 - b) Are data uncertainties acknowledged, reported, and within normal or expected levels?
 - c) Are input data series reliable and applied properly within the assessment model?
2. Evaluate and discuss the strengths and weaknesses of the methods used to assess the stock, taking into account the available data, and considering the following:
 - a) Are methods scientifically sound and robust?
 - b) Are assessment models configured properly and consistent with standard practices?
 - c) Are the methods appropriate for the available data?
3. Evaluate the assessment findings and consider the following:
 - a) Are population estimates (model output – e.g. abundance, exploitation, biomass) reliable, consistent with input data and population biological characteristics, and useful to support status inferences?
 - b) Is the stock overfished? What information helps you reach this conclusion?
 - c) Is the stock undergoing overfishing? What information helps you reach this conclusion?
 - d) Is there an informative stock recruitment relationship? Is the stock recruitment curve reliable and useful for evaluation of productivity and future stock conditions?
 - e) Are the quantitative estimates of the status determination criteria for this stock reliable? If not, are there other indicators that may be used to inform managers about stock trends and conditions?
4. Evaluate the stock projections, including discussing strengths and weaknesses, and consider the following:
 - a) Are the methods consistent with accepted practices and available data?
 - b) Are the methods appropriate for the assessment model and outputs?
 - c) Are the results informative and robust, and useful to support inferences of probable future conditions?
 - d) Are key uncertainties acknowledged, discussed, and reflected in the projection results?

5. Consider how uncertainties in the assessment, and their potential consequences, are addressed.
 - Comment on the degree to which methods used to evaluate uncertainty reflect and capture the significant sources of uncertainty in the population, data sources, and assessment methods
 - Ensure that the implications of uncertainty in technical conclusions are clearly stated.
6. Consider the research recommendations provided by the Data and Assessment workshops and make any additional recommendations or prioritizations warranted.
 - Clearly denote research and monitoring that could improve the reliability of, and information provided by, future assessments.
 - Provide recommendations on possible ways to improve the SEDAR process.
7. Consider whether the stock assessment is consistent with and represents best scientific information available (BSIA) using the following criteria as appropriate: relevance, inclusiveness, objectivity, transparency, timeliness, verification, validation, and peer review of fishery management information.
8. Provide suggestions on key improvements in data or modeling approaches that should be considered when scheduling the next assessment.
9. Prepare a Peer Review Summary summarizing the Panel's evaluation of the stock assessment and addressing each Term of Reference. Develop a list of tasks to be completed following the workshop. Complete and submit the Peer Review Summary Report in accordance with the project guidelines.

Reviewers must provide details on the basis of their responses to the review questions.

Annex 2. Tentative Agenda

SEDAR 94 Florida Hogfish Assessment Review: West Florida Shelf Stock and East Florida/Florida Keys Stock

**July 14-17, 2026
Charleston, South Carolina**

Tuesday:

8:30 a.m.	Introductions and Opening Remarks <i>- Agenda Review, TOR, Task Assignments</i>	Coordinator
9:00 a.m. – 12:00 p.m.	Assessment Presentations <i>- Assessment Data & Methods</i> <i>- Identify additional analyses, sensitivities, corrections</i>	Analytic Team
12:00 p.m. – 1:30 p.m.	Lunch Break	
1:30 p.m. – 4:30 p.m.	Assessment Presentations (continued) <i>- Assessment Data & Methods</i> <i>- Identify additional analyses, sensitivities, corrections</i>	Analytic Team
4:30 p.m. – 5:30 p.m.	ToR Review and Daily wrap up	Chair
5:30 p.m. – 6:00 p.m.	Public comment	Chair

Tuesday Goals: Initial presentations completed, sensitivity and base model discussion begun.

Wednesday:

8:30 a.m. – 12: p.m.	Panel Discussion <i>- Assessment Data & Methods</i> <i>- Identify additional analyses, sensitivities, corrections</i>	Chair
12:00 p.m. – 1:30 p.m.	Lunch Break	
1:30 p.m. – 5:00 p.m.	Panel Discussion/Panel Work Session <i>- Continue deliberations</i> <i>- Review additional analyses</i> <i>- Recommendations and comments</i>	Chair
5:00 p.m. – 5:30 p.m.	ToR Review and Daily wrap up	Chair
5:30 p.m. – 6:00 p.m.	Public comment	Chair

Wednesday Goals: sensitivities and modifications identified, preferred models selected, projection approaches approved, Report drafts begun.

Thursday

9:00 a.m. – 12: p.m.	Panel Discussion <i>- Assessment Data & Methods</i> <i>- Identify additional analyses, sensitivities, corrections</i>	Chair
12:00 p.m. – 1:30 p.m.	Lunch Break	
1:30 p.m. – 4:30 p.m.	Panel Discussion/Panel Work Session <i>- Continue deliberations</i> <i>- Review additional analyses</i> <i>- Recommendations and comments</i>	Chair
4:30 p.m. – 5:00 p.m.	ToR Review and Daily wrap up	Chair

5:30 p.m. – 6:00 p.m. Public comment Chair

Thursday Goals: sensitivities and modifications identified, preferred models selected, projection analysis reviewed, Report draft continued

Friday

8:30 a.m. – 11:30 a.m. Panel Discussion or Work Session Chair

- *Final sensitivities reviewed.*

- *Projections reviewed.*

Chair

- *Review Reports*

11:30 a.m. – 12:00 p.m. Public comment Chair

12:00 p.m. ADJOURN

Friday Goals: Complete assessment work and discussions, final base configuration available. Draft Reports reviewed.

Annex 3. Individual Independent Peer Reviewer Report Requirements

1. The CIE independent report shall be prefaced with an Executive Summary providing a concise summary of the findings and recommendations as specified in the ToR.
2. The main body of the reviewer report shall consist of a Background, Description of the Individual Reviewer's Role in the Review Activities, Summary of Findings for each ToR in which the weaknesses and strengths are described, and Conclusions and Recommendations in accordance with the ToRs.
 - a. Reviewer should describe in their own words the review activities completed during the panel review meeting, including providing a brief summary of findings, of the science, conclusions, and recommendations.
 - b. Reviewer should discuss their independent views on each ToR even if these were consistent with those of other panelists, and especially where there were divergent views.
 - c. Reviewer should elaborate on any points raised in the Summary Report that they feel might require further clarification.
 - d. The CIE independent report shall be a stand-alone document for others to understand the weaknesses and strengths of the science reviewed, regardless of whether or not they read the panel summary report. The CIE independent report shall be an independent peer review of each ToRs and shall not simply repeat the contents of the summary report.
3. The reviewer report shall include the following appendices:
 - Appendix 1: Bibliography of materials provided for review
 - Appendix 2: A copy of the CIE Performance Work Statement
 - Appendix 3: Panel Membership or other pertinent information from the panel review meeting.

Appendix 3: Panel membership or other pertinent information from the panel review meeting.

The Panel included a chairperson, three independent scientists selected by the Center for Independent Experts (CIE), and scientists from the GFMC and SAFMC SSC's:

- | | |
|-----------------------------|----------------|
| 1. Luiz Barbieri (Chair) | SAFMC/GFMC SSC |
| 2. Lisa Chong | CIE Reviewer |
| 3. Noel Cadigan | CIE Reviewer |
| 4. Challen Hyman | GFMC SSC |
| 5. Joe Powers | CIE Reviewer |
| 6. Marcel Renchert | SAFMC SSC |
| 7. Alexei Sharov | SAFMC SSC |
| 8. Steve Saul (via webinar) | GFMC SSC. |

All Panel members have extensive experience fisheries surveys and stock assessments. The analytical team were:

- | | |
|-------------------------|--------------|
| 1. Chris Swanson | USF/FWC-FWRI |
| 2. Dustin Addis | FWC-FWRI |
| 3. Heather Christiansen | FWC-FWRI |

The panel focused their questions and discussions by following the ToRs listed in Annex 1 of Appendix 2 of this report.

The Panel was assisted by various staff:

- | | |
|-------------------|-------------|
| 1. Julie A Neer | SEDAR |
| 2. Chip Collier | SAFMC Staff |
| 3. Leonardo Eguia | GFMC Staff |
| 4. Emily Ott | SEDAR |
| 5. Ryan Rindone | GFMC Staff |
| 6. Rachael Silvas | SAFMC Staff |

Other information from the panel review meeting is described under ToR 7 above.