

2022 Essential Fish Habitat (EFH) 5-Year Review Plan

Iterative Review of Components 1 and 7

NMFS Alaska Region (AKRO) and Alaska Fisheries Science Center (AFSC)

Jodi Pirtle, AKRO, Habitat Conservation Division

Ned Laman, AFSC, Groundfish Assessment Program

Jeremy Harris, AFSC, Groundfish Assessment Program, Lynker

Molly Zaleski, AKRO, Habitat Conservation Division

Gretchen Harrington, AKRO, Habitat Conservation Division

Jim Thorson, AFSC, Habitat and Ecological Processes Research Program



EFH Components of Fishery Management Plans

We have prioritized the eight EFH components in bold for the 2022 5-Year Review and will present progress on [components 1 and 7 today](#):

1. **EFH descriptions and identification (maps)**
2. **Fishing activities that may adversely affect EFH**
3. Non-MSA fishing activities that may adversely affect EFH
4. **Non-fishing activities that may adversely affect EFH**
5. Cumulative impacts analysis
6. **EFH conservation and enhancement recommendations**
7. **Prey species list and locations**
8. **Habitat Areas of Particular Concern (HAPC) identification**
9. **Research and information needs**
10. **Review EFH every 5 years**

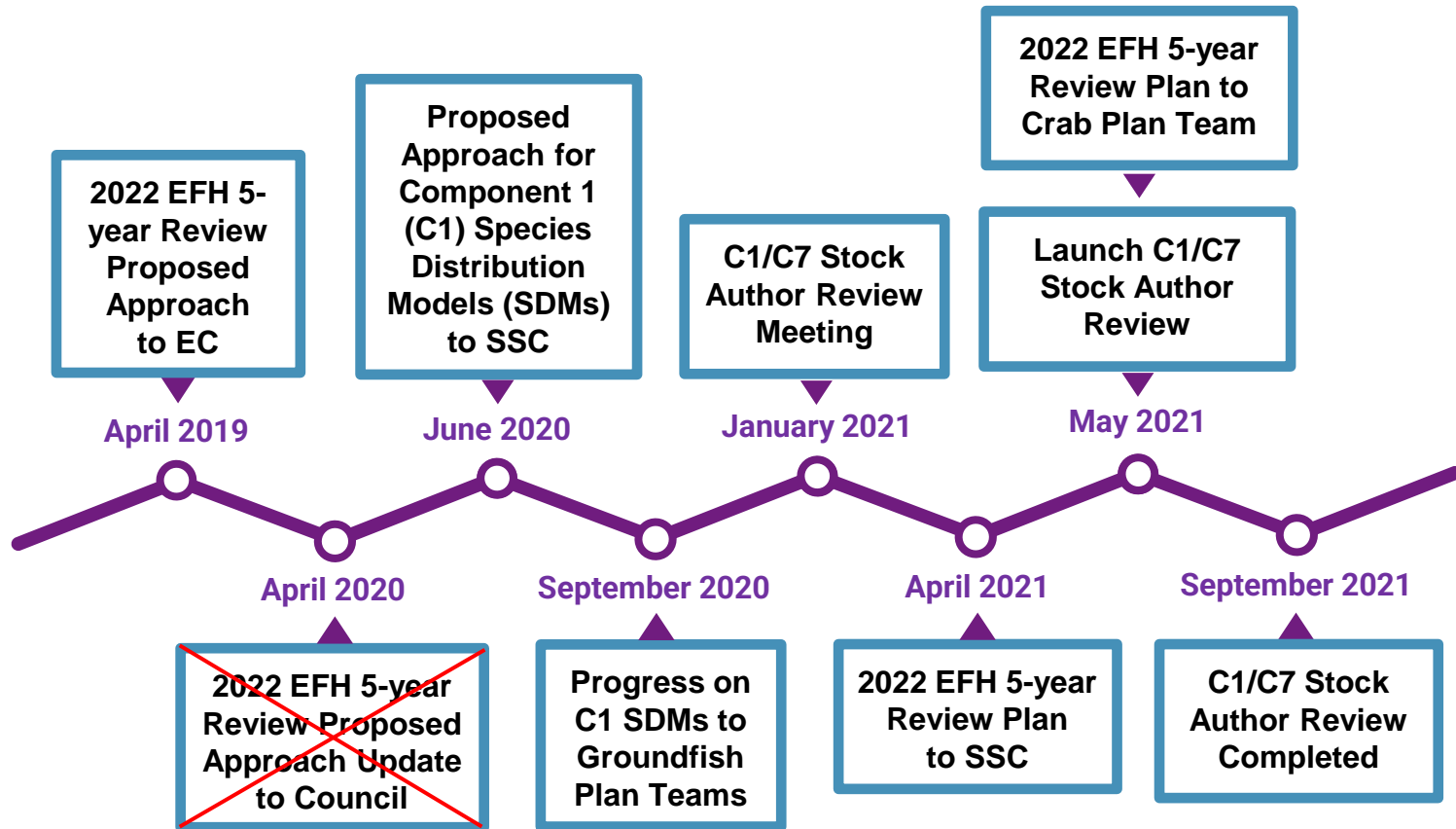
An EFH 5-Year Review Summary Report will be presented to the Council in October 2022 (T).



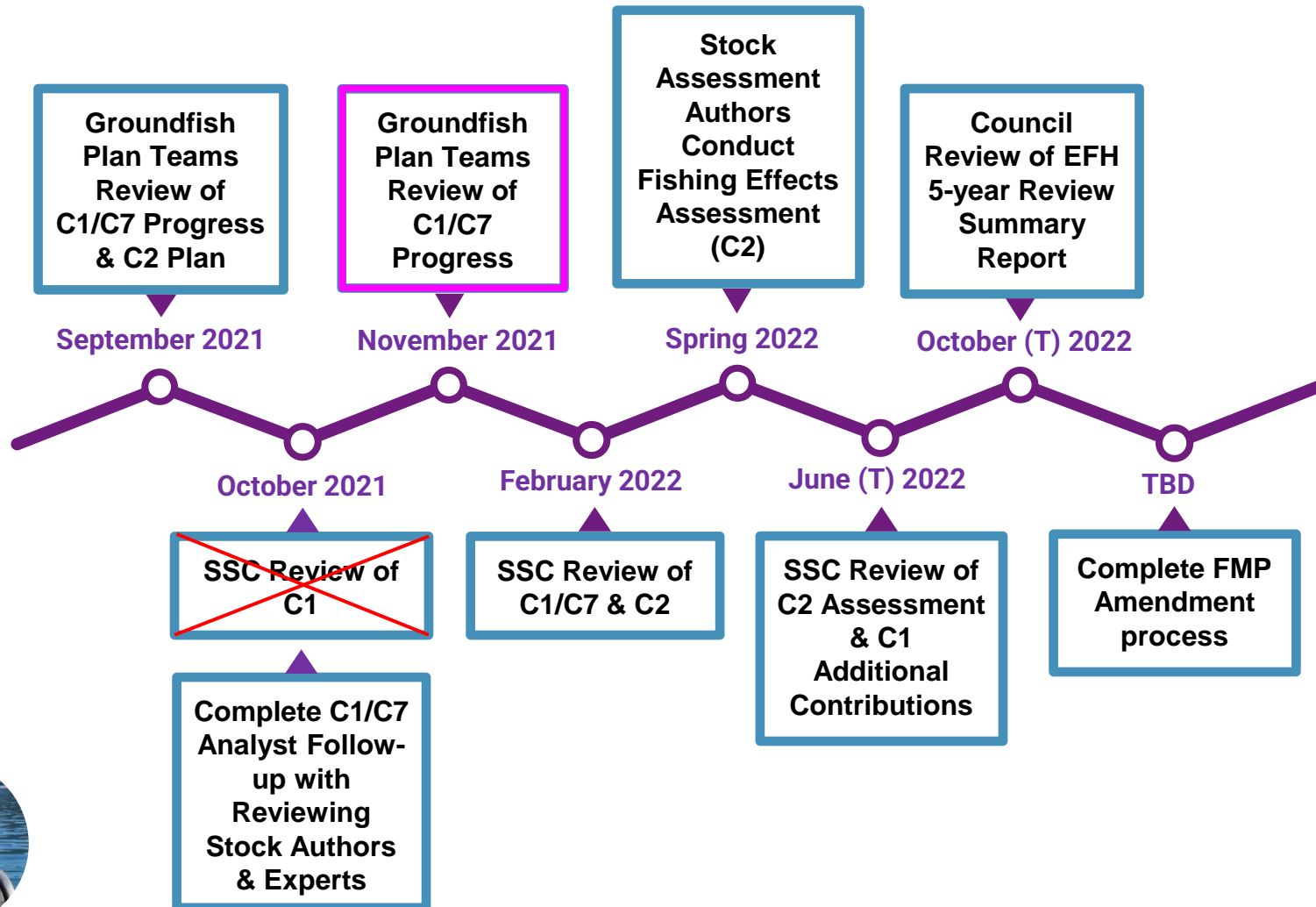
Draft Report of Stock Assessment Author Review of EFH Components 1 and 7

- **DRAFT** Report of Stock Assessment Author (SA) Review of Essential Fish Habitat (EFH) Components 1 and 7 for the 2022 EFH 5-Year Review
 - THANK YOU to ALL STOCK AUTHORS and EXPERT REVIEWERS!!!
- Prepared ahead of the November 2021 JGPT Meeting
- An **eAgenda attachment** for this EFH presentation **posted on 11/9/21**
- The goal of this report is to present a complete picture of the SA Review of EFH components 1 and 7
- What is in the report?
 - Description of EFH components 1 and 7, new information developed for EFH component 1 (**CH1**), and the review of components 1 and 7 by SAs at this stage of the iterative EFH 5-Year Review process (**CH2**)
 - Summary of communications between **all SAs and EFH analysts** receiving reviews and **responding to concerns**, questions, and comments (**CH3**)
 - Details of the changes made to the component 1 information based on the SA review (**CH3**)
- Report will be finalized (in addition to other EFH component 1 reporting) and presented as requested by SSC in February 2022

Timeline – Progress to Date



Timeline – Progress and Next Steps



Iterative Review Process to Develop Methods

- Iterative review of EFH components 1 and 7 began in April 2019 with presentation of the DRAFT 2022 EFH 5-year Review Plan to the Council's Ecosystem Committee (EC) for review and input.
- Next, the EFH component 1 DRAFT plan and proposed methods for the ensemble SDM EFH study (Laman et al. *in prep*) and three other studies was presented to SSC in June 2020 and to JGPT in September 2020 for review and input with additional stakeholder participation.
- SSC review of the methods was comprehensive and JGPT also provided helpful recommendations, where the Laman et al. study responded by modifying our approach, which led to improvements.
- Following these early reviews, the Laman et al. study refined the modeling code and produced the first draft of ensemble SDM EFH methods and results for the SA Review.
- SA Review of component 1 draft methods and results is a new and co-developed approach in this 5-Year Review.

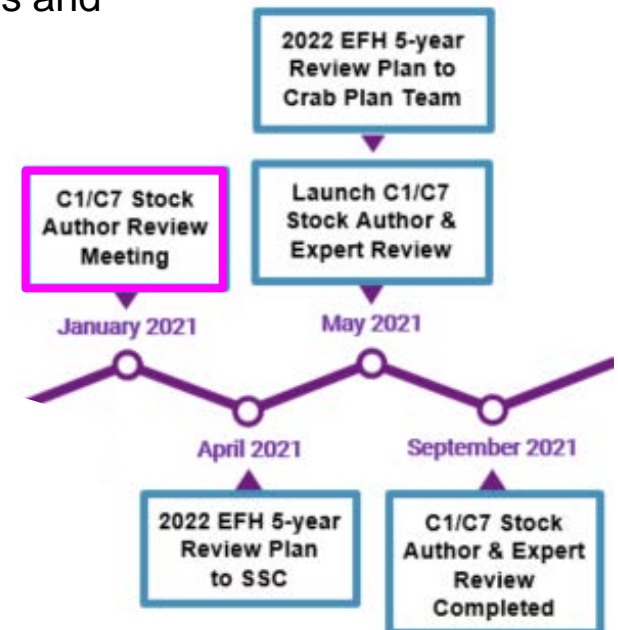


SSC June 2020 and JGPT September 2020 Minutes on SDM Methods and Results Development with EFH Component 1 Analyst Responses

- **SSC suggested consideration of ensemble methods** that weight EFH prediction across candidate SDMs with similar out-of-sample predictive performance.
 - Response: Out of sample skill testing is now used to select the best performing models and relative RMSE weighting for constituent inclusion in the ensemble.
- **SSC supported continued exploration of alternative SDM approaches** across species, regions, and life stages (e.g., GAMs and MaxEnt models.)
 - Response: A negative binomial model was added to address overdispersion and the new ensemble method is now applied and skill tested with the constituent models.
- **SSC supported the following:** Response variable of numerical abundance with area swept (effort) as an offset in the SDM; Out-of-sample skill testing for arbitrating among candidate SDMs; Cross-validation through repeated sampling of testing and training datasets; Use of the complementary log-log link to relate abundance to occurrence, which facilitates skill testing; Use of RMSE for skill testing.
 - Response: All of these supported methods are utilized in the Laman et al. (*In prep*) ensemble SDM EFH approach for the 2022 EFH 5-year Review and SSC's support is appreciated.
- **JGPT supported the ensemble modeling approach and requested** presentation of each ensemble member so that reviewers can see the influence, contribution, and variability associated with each.
 - Response: Results chapters provided for stock assessment author review included a table (Table 1) of ensemble member results for evaluation of influence or contribution and variability.
- **JGPT noted** that in the example of the sablefish EFH, it would be useful to see the iterative changes that result from each change or addition.
 - Response: Bridging figures that show the iterative changes, such as presented for sablefish, will be presented for a selection of species life stages at the SSC February 2022 Meeting to support evaluation of EFH component 1.

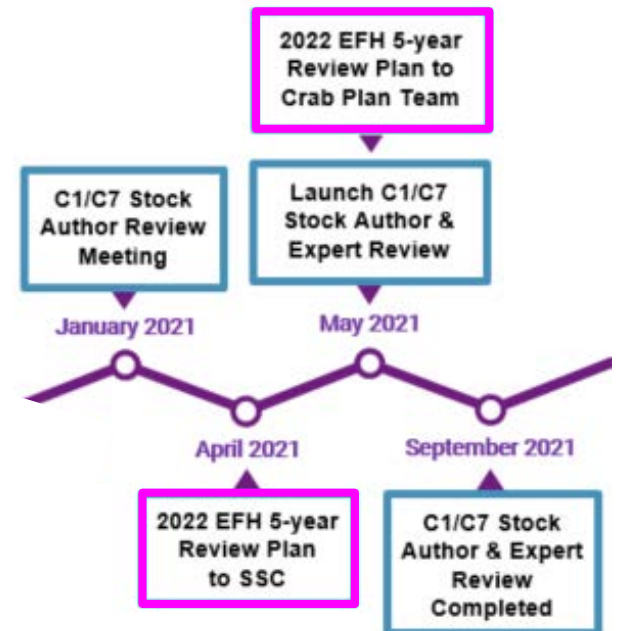
Stock Assessment Author Review Process

- **Chapter 2** of the attached DRAFT stock assessment author (SA) review report describes the SA review process for EFH components 1 and 7 and **Section 2.2** lists what the EFH analysts provided the SAs for their review (e.g., FMP EFH text and tables; 2017 SDM EFH maps and new ensemble SDM EFH maps for comparison)
- Iterative review by SAs and other experts is a critical element of the EFH 5-Year Review process
- We initiated the SA review of components 1 and 7 with the January 2021 Workshop to co-develop the review process with focus on expectations and timing (**Section 2.1**)
- We provided the SAs with the ensemble SDM EFH draft methods and first set of results with the plan of working iteratively with all participating and interested SAs
- Addition of SA review of draft methods and results was an innovation of this EFH 5-Year Review that strengthened the research products, process, and collaboration.
- Attached draft report will be finalized and presented as requested by SSC in February 2022. THANK YOU to EVERYONE who has engaged in this process!!!



Iterative Review Process Milestones

- In 2021, as the ensemble SDM EFH study (Laman et al. *in prep*) was finishing the first set of draft results for the EFH component 1 SA Review, two additional iterative review milestones were completed that improved the SA Review process.
- SSC review and input on the EFH 5-year Review Plan presented in April 2021 with a discussion paper.
 - Discussion paper included EFH component 1 analyst responses to SSC June 2020 review and input on ensemble SDM EFH draft methods and results examples.
 - SSC provided guidance for analysts to prepare for SSC component 1 evaluation in October 2021 (now February 2022).
- CPT review and input on EFH 5-year Review Plan presented in May 2021.
 - Presented ensemble SDM EFH draft methods and results examples for crabs and discussed the plan for SA review of EFH components 1 and 7.
 - CPT requested that crabs be reviewed first due to assessment timing and to add species experts as reviewers, which we accommodated.



Stock Assessment Author Review

- We launched the SA Review of components 1 and 7 in May 2021 (**Chapter 2**)
 - Reviewed current FMP EFH maps, text, and tables for components 1 and 7
 - Reviewed the component 1 ensemble SDM EFH draft methods and species draft results chapters with new EFH maps
 - Completed September 1, 2021 with 100% engagement

- **Chapter 3** presents the SA Review Results:
 - **30 SAs** reviewed **3** regional methods sections and **125** ensemble SDM EFH species or species complex draft **results chapters** with **1-3 life stages each**
 - 60 individual species in the 3 regions modeled:
 - 27 species received model re-runs as determined by our internal evaluation or by SA review (e.g., revise life stage breaks = 22 species; reevaluate ensemble constituents and revise EFH map = 1 species)
 - SAs and other experts provided input as comments, questions, and concerns:

- **We responded to all SAs. Revisions are now available for SAs. THANK YOU for your engagement and collaboration.**



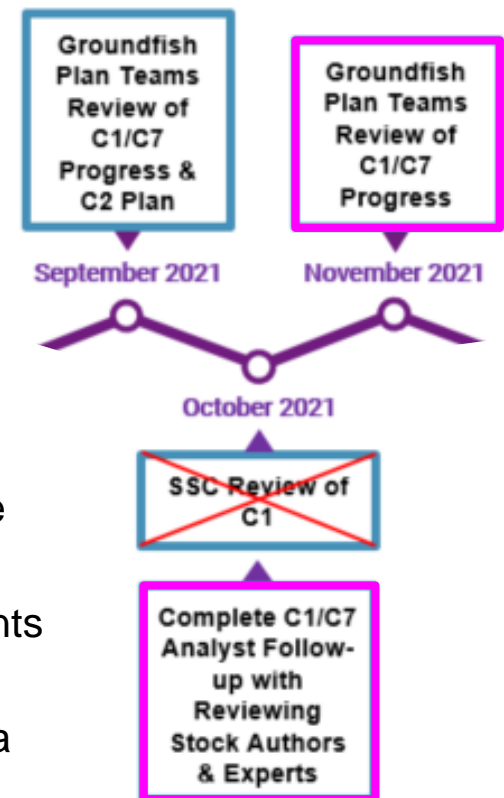
Stock Assessment Author Review

- September 2021 JGPT:
 - Provided an ensemble SDM EFH project update and summarized main areas of SA review concerns and our overall plan to address those.
 - Previewed our initial responses to common issues raised (e.g., remove Spearman's rho-squared as a single metric and use 3 conventional metrics to more comprehensively assess ensemble performance, which was reevaluated and revised for all ensembles).
 - Communicated that we would work with individual SAs.
- Post-Sept. 2021 JGPT:
 - Continued to respond to **all SAs** on their reviews largely completing that process by November 1.
 - Discussed concerns, answered questions, offered future research recommendations when applicable, and indicated that revised species results chapters would be provided when completed.
 - Addressed ensemble performance concerns with 8 SAs requiring more in-depth communication by providing revised ensemble performance methods/results for discussion and requesting agreement that resolution had been reached.
 - Communication is documented in **Chapter 3**.



Stock Assessment Author Review

- Examples of EFH analyst consultations to address larger concerns (**Chapter 3**)
 - Ensemble and EFH map was revised for 1 species
 - EFH analysts investigated options and removed an ensemble member
 - EFH analysts and SA engaged in further iterative communication and reached resolution for this 5-Year Review.
 - EFH maps for 3 species were not advanced by EFH analysts
 - EFH analysts met with SA and reached resolution for this 5-Year Review
 - These were all data-limited species that did not have an SDM EFH map in 2017
- Data caveat statements were added to revised species results chapters where an SA had recommended using additional catch data sources in future EFH mapping efforts
- Future research recommendations will be included to address e.g., data limited species and combining catch data sources in the ensemble SDM framework
- Thank you all SAs for your collaboration, which led to improvements
- Revisions are **available as of 11/8** upon request by SAs for their species ([email Ned.Laman](mailto:Ned.Laman) or Jodi.Pirtle) and will be provided as a complete set for the SSC February 2022 Meeting



Future Research Directions

- Future Research Directions:
 - Data
 - Leverage additional existing species distribution data, combining disparate data sets
 - Explore additional/new environmental variables
 - Modeling
 - Focus on data-limited species
 - Develop methods to combine disparate data sets in the ensemble SDM framework
 - Explore static and long term vs more temporally dynamic SDMs in mapping EFH (e.g., climate change and species distribution shifts)
- Future EFH Process Recommendations:
 - Automation
 - Reproducible code
 - Automated reports



Iterative Review Process Next Steps

- SSC Review of EFH component 1 in February 2022 is scheduled
 - Ensemble SDM EFH Levels 2 and 3 for GOA and BSAI Groundfish and BSAI Crabs (Laman et al. *in prep*) will be presented as three regional Technical Memorandums for the AI, EBS, and GOA.
 - Additional SSC and JGPT minutes requests from April, September, and October 2021 Meetings will be addressed, such as providing the final version of the SA Review of Components 1 and 7 Report, and more in depth comparisons of the ensemble SDM EFH maps and 2017 SDM EFH maps.
- We have requested January CPT and EC presentations as added review opportunities for stakeholders
- SSC review of remaining C1 information in this 5-Year Review will be presented in June (T) 2022:
 - Arctic SDM EFH Levels 2 and 3 with warm/cold year comparisons (Marsh et al. *in prep*)
 - GOA juvenile pollock overwintering EFH Level 3 (Laurel et al. *in prep*)
 - GOA sablefish and Pacific cod IBM-based pelagic early life stage EFH Levels 2 and 3 (Shotwell et al. *in prep*)



THANK YOU



JODI PIRTLE

JODI.PIRTLE@NOAA.GOV

NED LAMAN

NED.LAMAN@NOAA.GOV

ADVANCING EFH FOR THE 2022 5-YEAR REVIEW

(Laman, Pirtle, Harris, Rooper, Hurst, Conrath)

Main Topics of Feedback from Stock Author Review:

- 1. Looks Good** (e.g., “*maps are useful and informative*” “*AMAZING job all of you for putting all that together for all the stocks*” “*Wow--that is a truly impressive modeling effort. Congratulations!*”).
 - **Response:** Thank you, we value your input, greatly appreciate your effort, and hope that this information is also useful to stock assessment.
- 2. Add Data from Other Sources** (e.g., “*add longline survey data for sablefish*” “*this survey alone is ineffective for sleeper sharks... explore adding longline survey data*”).
 - **Response:** Should be explored leading up to the next EFH 5-year Review. Ideas e.g., use crab maturity information to model crab life stages, add longline survey data (e.g., sablefish, shortrakers, sleeper sharks), add untrawlable habitat data. *Invitation for stock assessment scientists and others to work with HEPR to collaboratively develop EFH proposals for the next 5-year cycle.*



ADVANCING EFH FOR THE 2022 5-YEAR REVIEW

(Laman, Pirtle, Harris, Rooper, Hurst, Conrath)

Main Topics of Feedback from Stock Author Review (con't):

3. **Concerns of Model Performance** (e.g., concern expressed over ensembles with low fit for specific species; recommendations to revisit our fit metric and to understand model performance more comprehensively)

■ **Response:**

- We added multiple common fit metrics (*rho*, AUC, Deviance Explained) to provide a more comprehensive interpretation of model performance and applied these to all species ensembles.
- **We are working with stock authors to diagnose issues.**
- We are considering alternative approaches for a small set of species (e.g., by addressing misbehaving SDMs in ensembles for species with an existing EFH map (i.e., GOA Atka mackerel) and by moving “boundary” species without previous EFH maps to be addressed in next 5-year cycle (e.g., sleeper sharks).



SDM EFH Methods Overview

2022 Ensemble SDM

Response Variable

- Fish numerical abundance (1982-2019 catches)

Models

- MaxEnt, paGAM, hGAM, Poisson GAM, Negative Binomial GAM
- Constituents applied comprehensively

Ensemble:

- Constituent models retained based on RMSE

Fit Metrics: (applied to all)

- k-fold cross validation to generate RMSE and other fit metrics
- Provided for Stock Author review of methods/results = Spearman's ρ -squared
- Added based on Stock Author review to improve comprehensive results communication = Spearman's ρ , AUC, Deviance Explained

2017 SDM

Response Variable

- 4th root transformed CPUE (1982-2014 catches)

Models

- MaxEnt, hGAM, GAM
- Selected *a priori*

Ensemble:

- *New for 2022*

Fit Metrics

- Applied based on model
- MaxEnt (AUC); GAMs (Deviance Explained)
- 80/20 training/testing data fit metrics examined for out of sample comparison
- Provided for Stock Author review = *None*