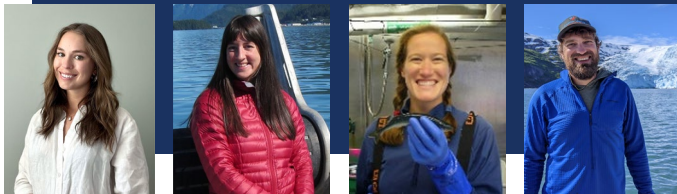# 2022 Essential Fish Habitat (EFH) 5-Year Review

SARAH RHEINSMITH (NPFMC), DR. JODI PIRTLE, MOLLY ZALESKI (NMFS)
SCOTT SMELTZ (Alaska Pacific University)

Ecosystem Committee, October 3, 2022

Scientific and Statistical Committee, October 5, 2022

OUTLINE

1. Introduction to EFH Council process and timeline
2. Review additional information on the EFH species distribution models (SDMs) in response to SSC feedback in February 2022
3. Review EFH Fishing Effects (FE) Evaluation
   a. FE model and results
   b. Stock author assessment of fishing effects on EFH for Fishery Management Plan (FMP) species
4. Plan teams discussion summary
5. Fishing Effects Evaluation big picture summary and request for feedback

1. EFH 5-YEAR REVIEW

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**
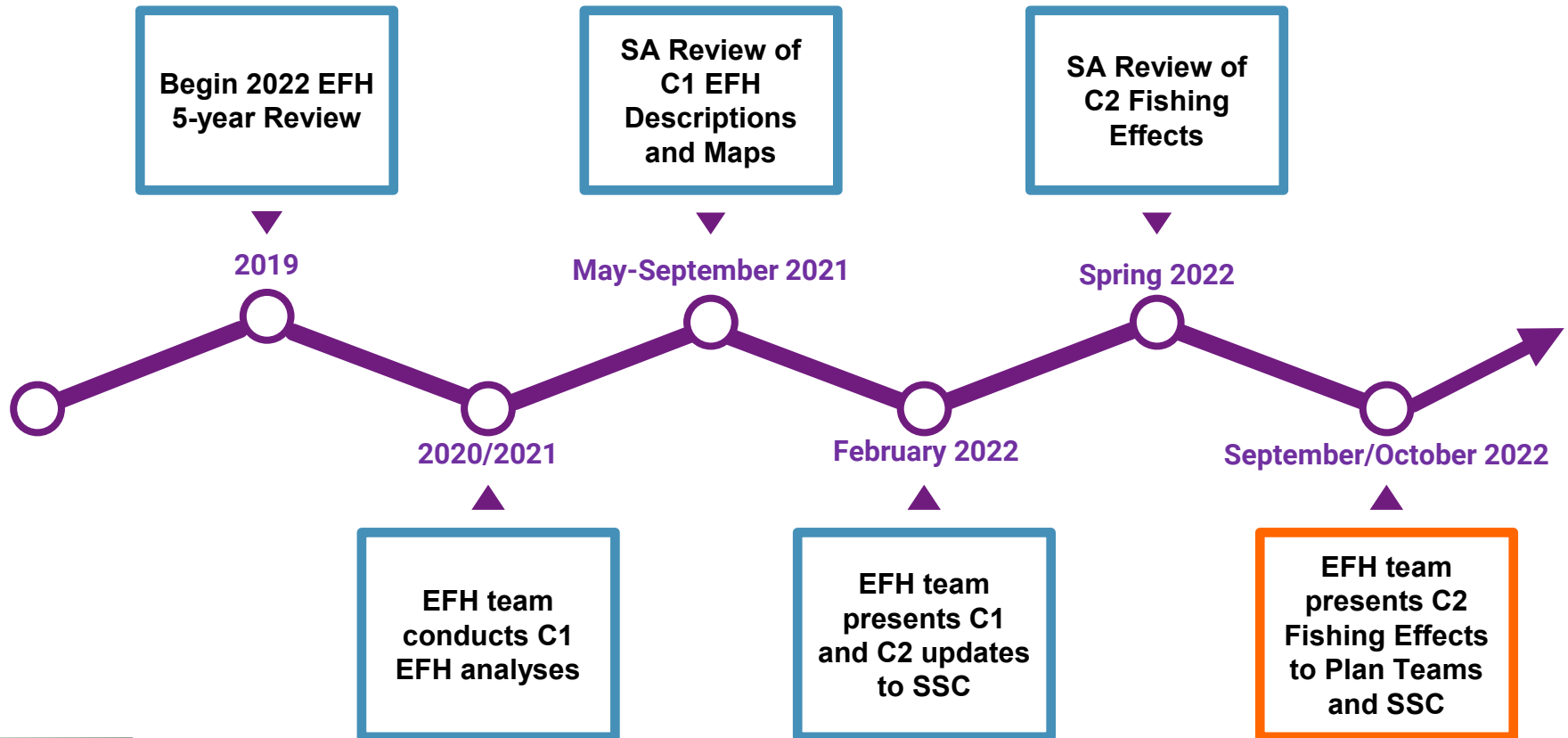10. **Review EFH every 5 years**

EFH 5-YEAR REVIEW

- The objective of an EFH 5-year Review is to review the ten EFH components of FMPs and revise or amend the 10 EFH components as warranted based on available information (50 CFR 600.815(a)(10)).

- The EFH 5-year Review is a mechanism to ensure NOAA Fisheries and Fishery Management Councils incorporate the **most recent and best science available into fishery management for EFH.**

- The current 2022 EFH 5-year Review encapsulates the recent habitat related literature and research developed in the North Pacific.

2022 EFH 5-YEAR REVIEW TIMELINE

Begin 2022 EFH 5-year Review

SA Review of C1 EFH Descriptions and Maps

SA Review of C2 Fishing Effects

2019

May-September 2021

Spring 2022

2020/2021

February 2022

September/October 2022

EFH team conducts C1 EFH analyses

EFH team presents C1 and C2 updates to SSC

EFH team presents C2 Fishing Effects to Plan Teams and SSC

2. EFH Component 1 Descriptions and Identification

Jodi Pirtle, AKRO, Habitat Conservation Division
Ned Laman, AFSC, Groundfish Assessment Program
Jeremy Harris, AFSC, Groundfish Assessment Program, Lynker
Megsie Siple, AFSC, Groundfish Assessment Program
Jim Thorson, AFSC, Habitat and Ecological Processes Research Program
Gretchen Harrington, AKRO, Habitat Conservation Division

EFH COMPONENT 1 DESCRIPTIONS AND IDENTIFICATION

- **Essential fish habitat (EFH)** means those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (50 CFR 600.10).

- **EFH component 1** descriptions and identification (maps):
  - FMP text and tables, and
  - FMP maps based on species distribution models (SDMs) established in the 2017 EFH 5-year Review.

- EFH component 1 requires individual **species maps** for the fishery management unit of the FMP (50 CFR 600.805(b)), where *some or all portions* of the species' geographic range is mapped (50 CFR 600.815(a)(1)(iii)(1)).

- EFH may also be designated **with justification for assemblages** of species or life stages (50 CFR 600.815(a)(1)(iv)(E)).

SDM EFH Supplemental Analysis, Executive Summary (page 4)

EFH MAPS

- **EFH component 1** requires species maps for the fishery management unit of the FMP (50 CFR 600.805(b)), where some or all portions of the species' geographic range is mapped (50 CFR 600.815(a)(1)(iii)(1)).

- Species distribution model (**SDM**) ensemble EFH maps for the 2022 5-year Review.

- **EFH** is the upper 95% of the spatial domain of occupied habitat.

- Core EFH area (**CEA**) is the upper 50% of the area of occupied habitat applied to the **EFH component 2 Fishing Effects Analysis**.

Figure 1. GOA adult Pacific ocean perch EFH Map
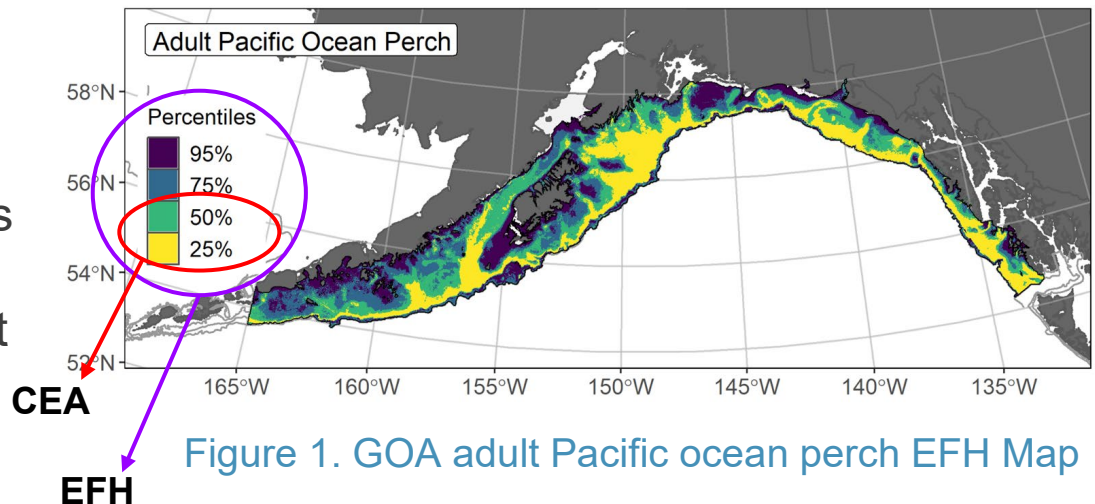
SDM EFH Discussion Paper, section 3.2.8 (page 38)

8

SDM ENSEMBLE EFH MAPS OVERVIEW

- 229 new and revised EFH descriptions and maps for the BSAI, GOA, and Crab FMPs.

- The SDM ensemble approach is a foundational improvement to the single SDM method of 2017:
  - Reduced model-dependent prediction bias,
  - Improved overall model performance, and
  - Robust modeling framework for future EFH mapping and other applications.

- **SSC noted** that a large majority of the new EFH maps reflect the best available science for characterizing EFH component 1 (February 2022).

- Additionally, **SSC requested** clarification for a subset of species/region combinations (N = 34) where reviewing stock authors reported concerns and future recommendations.

SDM EFH Discussion Paper and Supplemental Analysis, Chapter 2 (page 8)

EFH COMPONENT 1 DOCUMENTS

Supplemental Analysis for the SDM Ensemble EFH Maps:

- **Chapter 1** Introduction to the document
- **Chapter 2** Overview of methods and results
  - Attachment: Discussion Paper presented to SSC February 2022 and revised March 2022
- **Chapter 3** Iterative review
- **Chapter 4** Updates and progress since February 2022
  - 4.1 Survey area offset correction
  - 4.2 Publications
    - Attachments: Three regional NOAA Technical Memoranda in process
- **Chapter 5** Addressing SSC and stock author reviews
  - 5.1 Stock author review
  - 5.2 Addressing reviewer concerns and recommendations
  - 5.3 Species exceeding FE evaluation threshold due to EFH map changes
- **Appendices**
  - Appendix 1 EFH Summary Table for the stock author FE assessments
  - Appendix 2 EFH area and AFSC longline survey overlay maps
  - Appendix 3 Supporting documents list and descriptions

UPDATES AND PROGRESS

- **Survey area offset correction** (section 4.1)
  - Error of untransformed effort variable detected in packaging R code following SSC review in February 2022.
  - Effect of error was minimal in most cases (Tables 1 and 2).
    - 16 of 211 species/region ensembles with > 10% CEA change.
  - Decision to run comprehensive update to SDM ensemble EFH maps.
  - Revised results provided for EFH Fishing Effects Evaluation.
  - Revised publications, including the Discussion Paper reviewed by SSC in February 2022, providing a comprehensive methods and results overview.

- **Publications by Laman et al. study** (section 4.2)
  - Three regional NOAA Technical Memoranda in process (eAgenda links).
  - R repository available on GitHub (https://github.com/alaska-groundfish-efh).
  - Manuscript: *Ensemble models mitigate bias in area occupied from commonly used species distribution models* by Harris et al. in preparation.

SDM EFH Supplemental Analysis, sections 4.1 (page 15), and 4.2 (page 19)

ADDRESSING REVIEWS

- **SSC requested** clarification for a subset of species/region combinations (N = 34 out of 211) where reviewing stock authors reported concerns and future recommendations in their 2021 review (February 2022).

- **EFH Summary Table (Appendix 1)** provides an SDM ensemble performance score in plain language (excellent, good, fair); the NOAA Technical Memoranda species results chapters also provide this score, which can be included in other reporting from the 5-year Review.

- **Questionnaire** for the Stock Author EFH Fishing Effects (FE) Evaluation:
  - Qualitatively rank (high, medium, low) and explain the concern, and
  - Identify additional data sources if available for future SDM EFH mapping.
  - Questionnaire in FE Evaluation Discussion Paper Appendix 4.

- Results are summarized in **Chapter 5 and Table 3** and reported in detail in the FE Evaluation Discussion Paper Appendix 5.

- Improving EFH mapping is possible through research leading up to a future EFH 5-year Review; by design an iterative process occurring at least every five years (50 CFR 600.815(a)(10)).

SDM EFH Supplemental Analysis, Chapter 5 (page 19), Table 3 (page 39), Appendix 1 (page 50), and FE Discussion Paper, Appendix 4 (page 126), Appendix 5 (page 135)

Add Species Data

- 24 responses out of 108 total under the theme add species data.

- 16 low, 8 medium, and 0 high concerns.

- EFH component 1 requirements are that *some or all* portions of the geographic range of the species are mapped (50 CFR 600.815(a)(1)(iii)(1)).

- Recommended adding data from longline surveys, fishery observers, and untrawlable habitats if possible in future SDM EFH mapping; we advanced this research recommendation.

- We added caveat statements to reporting to communicate these species data concerns in plain language.

- We mapped overlays of EFH maps and NMFS longline survey haul locations as an interim step to understand this recommendation (Appendix 2).
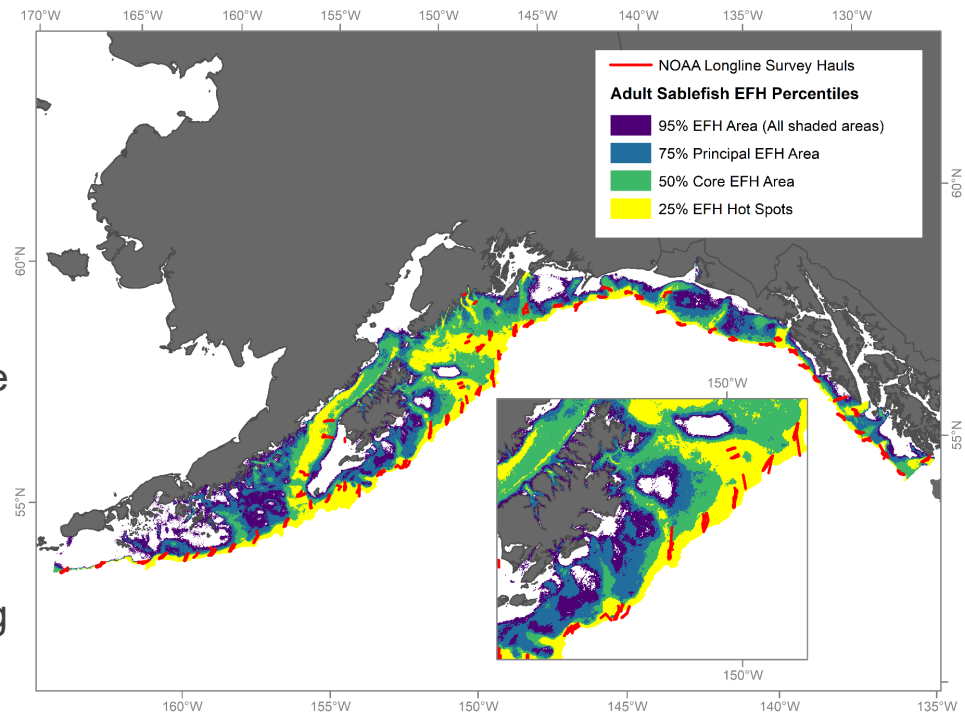

Figure 1. GOA adult sablefish SDM ensemble EFH Map and NMFS longline survey historic haul locations overlay without attribution to sablefish catch locations.

SDM EFH Supplemental Analysis, section 5.2.1 (page 21), Table 3 (page 39), and Appendix 2 (page 54)

Life History

- 5 responses out of 108 total under the theme life history.

- Crabs (3 low and 1 high concerns); recommended a) future EFH mapping for crab life stages/sexes, b) add other species data sources where possible, and c) supplemental SDMs at the spatial scale of stock management areas.

- Flatfishes with spatially varying growth (1 high concern); recommended integrating updated spatially explicit life history information when available.

- We added caveat statements to reporting to communicate information uncertainties for these species in plain language.

- We continued conversations with stock authors to understand their concerns and recommendations.

- Improving crab EFH is a priority; we funded two multi-year studies now in progress through the NMFS Alaska EFH Research Plan RFP.

- Flatfish spatially varying growth studies are underway by AFSC stock authors.

RKC juveniles (J. Pirtle)

SDM EFH Supplemental Analysis, section 5.2.2 (page 26) and Table 3 (page 39)

Ongoing Data Issues

- 14 responses out of 108 total under the theme ongoing data issues; often combined with the theme add species data.

- 8 low, 4 medium, and 2 high concerns; **all data limited species**

- The requirements for EFH component 1 are that *some or all* portions of the geographic range of the species are mapped (50 CFR 600.815(a)(1)(iii)(1)).

- Recommended adding data from longline surveys, fishery observers, and untrawlable habitats if possible in future SDM EFH mapping; we advanced this research recommendation.

- Many species are data limited in this part of their geographic range and additional data sources could not be identified for some species under this theme.

- We added caveat statements to reporting to communicate these species data concerns in plain language.

- We continued conversations with stock authors to understand their concerns and recommendations.

- We made revisions where possible now:
  - GOA OR slope subgroup complex mapped; SDM ensembles revised for GOA adult Atka mackerel and GOA spiny dogfish; Summary (page 37).
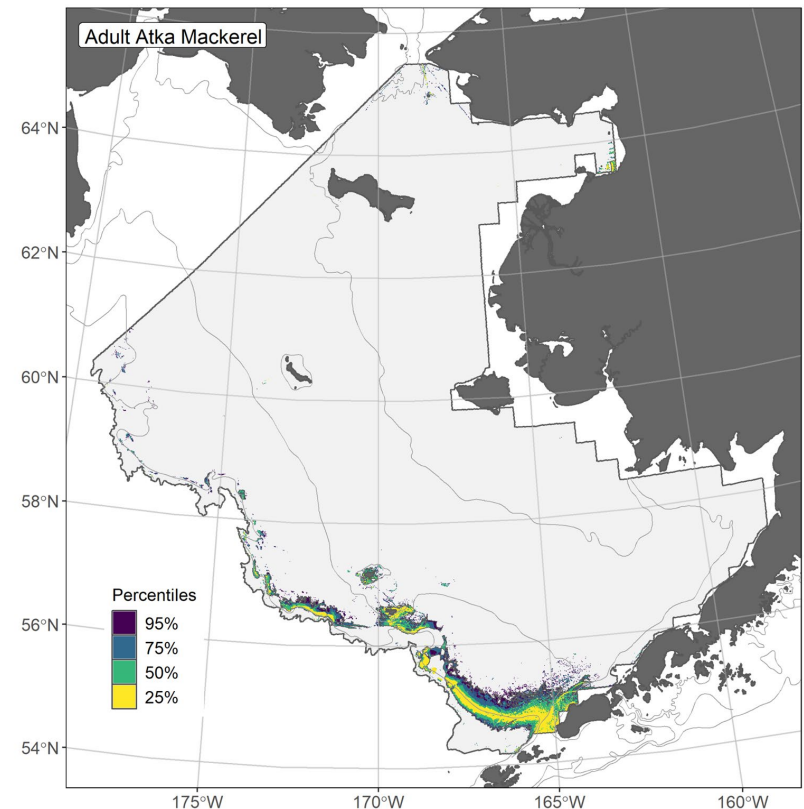

Figure 1. EBS adult Atka mackerel SDM ensemble EFH Map.

SDM EFH Supplemental Analysis, section 5.2.3 (page 30), and Table 3 (page 39)

NMFS Recommendations for GOA Other Rockfish Complex Slope Sub-group

- EFH component 1 requires individual species maps (50 CFR 600.805(b)). EFH may also be designated with justification for **assemblages of species or life stages** (50 CFR 600.815(a)(1)(iv)(E)).

- Some GOA Other Rockfish (OR) Complex slope sub-group species with SDM ensemble EFH maps; an additive composite map was developed from the species' maps; also mapped by this approach for the 9 other species complexes and sub-groups in the BSAI and GOA FMPs.

- **NMFS recommends** the following approach for the GOA OR Complex slope sub-group (and other species complexes and sub-groups) for the 2022 EFH 5-year Review:

  - Use the new EFH maps available for individual species (harlequin, greenstriped, pygmy, redbanded, redstripe, sharpchin, and silvergray rockfishes).

  - Use the new composite EFH map for the member species without an EFH map.

- See additional NMFS and Plan Team recommendations (slides 40 and 44).

Figure 1. GOA Other Rockfish Complex slope sub-group EFH map
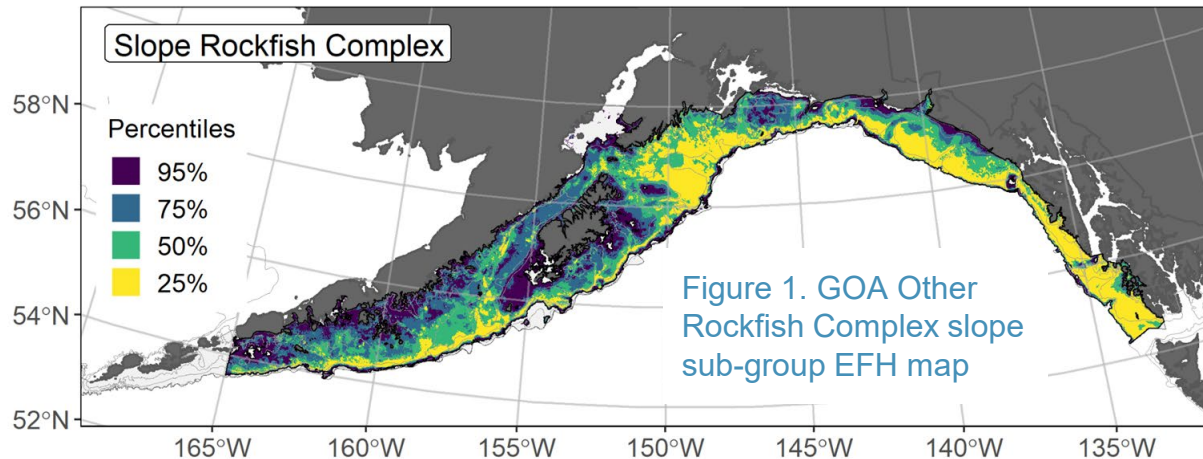
SDM EFH Supplemental Analysis, section 5.2.3.2 (page 34), Table 3 (page 39), Table 4 (page 40), and Appendix 1 Table A1.1 (page 50)

NMFS Recommendations for GOA Spiny Dogfish

- EFH component 1 requires individual species maps (50 CFR 600.805(b)). EFH may also be designated with justification for **assemblages of species or life stages** (50 CFR 600.815(a)(1)(iv)(E)).

- Analysts revised the SDM ensemble EFH maps for spiny dogfish by combining the subadult and adult life stages in a new SDM ensemble in response to stock author concerns.

- **NMFS recommends** that the new combined life stages spiny dogfish EFH map advances for the 2022 Review. Spiny dogfish will be the first shark species with an EFH map.

- See additional NMFS and Plan Team recommendations (slides 41 and 44).

Figure 1. GOA spiny dogfish combined life stages EFH map

SDM EFH Supplemental Analysis, section 5.2.3.3 (page 36)
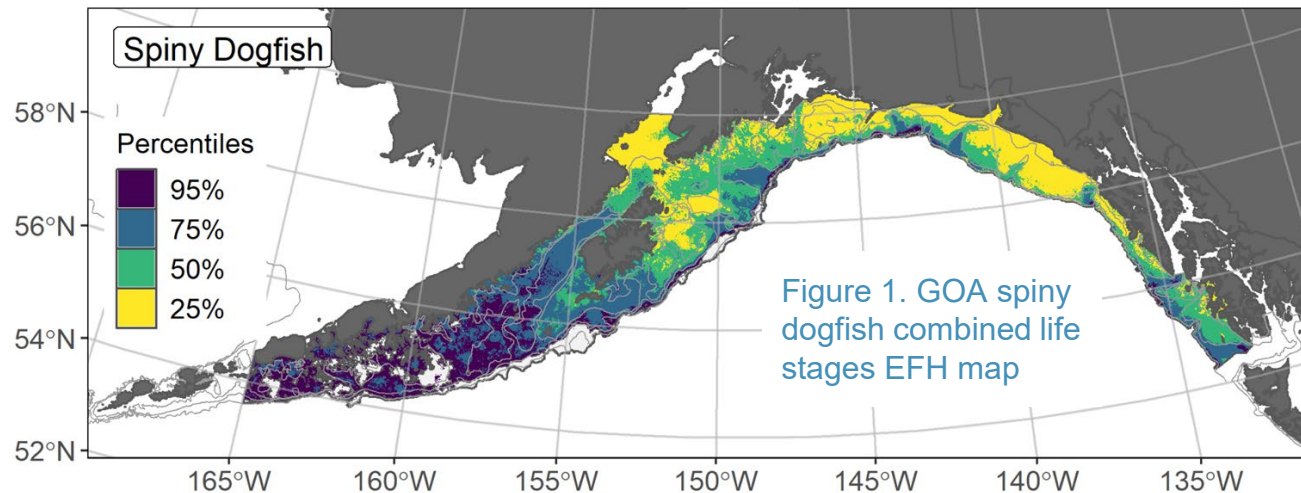
EFH Component 1 Mapping Recommendations

- **NMFS recommends that the complete set of new EFH maps advance for the 2022 5-year Review.** EFH mapping requirements are that some or all portions of the geographic range of the species are mapped (50 CFR 600.815(a)(1)(iii)(1)). These requirements have been comprehensively met for the new maps that represent the best available science for mapping EFH for these species' life stages at this time.

- The SDM ensemble approach is a **foundational improvement** to the single SDM method of 2017. The SDM ensemble reduced model-dependent prediction bias, will likely reduce the magnitude of future EFH area changes due to modeling methods, and provides a universal mapping application across multiple FMPs.

- Additional improvements are possible through research leading up to a future EFH 5-year Review; **by design an iterative process** (50 CFR 600.815(a)(10)).

- **NMFS research recommendations:** Improve EFH maps for **select species** by
    - a) developing methods to add species data sources to the SDM ensemble framework,
    - b) exploring SDM methods to address data limited species (e.g., joint SDMs), and
    - c) continuing to improve life history information (e.g., crabs and flatfishes).

- **NMFS recommends** that the EFH 5-year Review process and communication be collaboratively improved leading up to the next 5-year Review.

SDM EFH Discussion Paper, sections 3.4 and 3.5 (pages 104 and 105), and Supplemental Analysis, Executive Summary (page 4), Chapter 2 (page 8), and Chapter 5 (page 19)

Habitat Science Research Recommendations

- **NMFS research recommendation:** Increase the scope and application of habitat science through EBFM pathways supporting stock assessment and understanding climate change impacts on habitat and species distributions (climate change is habitat change from a species' perspective).

    - SSC "notes immense progress in EFH modeling and hopes that these analyses will be considered in stock assessments and analyses supporting stock assessments" (June 2020), and SSC "encourages further efforts to identify ways in which the EFH information can contribute to the stock assessment process through ESPs (Ecosystem and Socioeconomic Profiles) and other 'on-ramps'" (February 2022).

        - Progress by Shotwell et al. 2022 (DSRII) on developing metrics and indicators from EFH SDMs and other habitat science for the ESPs as a stock assessment on-ramp.

    - Ecosystem Committee recommended addressing "How does/can the EFH review address shifting distributions, resulting from environmental and climate changes" (January 2022).

    - SSC "discussed the need to move to a more dynamic definition of EFH given recent and rapid changes observed in the environment and species distributions" (June 2020), and SSC "recommends that both longer-term average EFH and EFH under contrasting conditions for those species whose distribution is known to be linked to changing ocean conditions be considered in the next 5-yr review" (February 2022).

        - Progress by Rooper et al. 2021 (ICES J Mar Sci) and Barnes et al. 2022 (Ecography) on investigating the SDM EFH time series scale and improving hindcasting/forecasting methods.

        - Upcoming work will be presented in current 5-year Review by the Marsh et al. study for Arctic FMP species with warm and cold year comparisons.

SDM EFH Discussion Paper, sections 3.4 and 3.5 (pages 104 and 105), and Supplemental Analysis, Executive Summary (page 4), Chapter 2 (page 8), and Chapter 5 (page 19)

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3. Component 2 Evaluation of Fishing Effects on EFH

Molly Zaleski, AKRO, Habitat Conservation Division
Scott Smeltz, APU, Fisheries, Aquatic Science, and Technology Laboratory
Sarah Rheinsmith, North Pacific Fishery Management Council
Jodi Pirtle, AKRO, Habitat Conservation Division
Gretchen Harrington, AKRO, Habitat Conservation Division

FISHING EFFECTS EVALUATION

EFH component 2 - Fishing activities that may adversely affect EFH

EFH regulations (50 CFR 600.815(a)(2)):

(i) *Evaluation*: Each FMP must contain an evaluation of the potential adverse effects of fishing on EFH designated under the FMP.

(ii) *Minimizing adverse effects:* Each FMP must minimize to the extent practicable adverse effects from fishing on EFH. Councils must act to prevent, mitigate, or minimize any adverse effects from fishing, to the extent practicable, if there is evidence that a fishing activity adversely affects EFH in a manner that is **more than minimal and not temporary in nature**, based on the evaluation.

2022 EFH FE EVALUATION DISCUSSION PAPER

- **Chapter 1** Introduction to FE on EFH
- **Chapter 2** 2022 FE Model Description
    - FE model was presented to the SSC in February 2022 and discussed with the JGPT in October 2021
- **Chapter 3** Stock Author (SA) FE Assessment Process
    - The process was presented to SAs in April 2022
- **Chapter 4** Results
    - 4.1 FE analysis results and summary of SA concerns
    - 4.2 Species with reported data limitations
    - 4.3 Species with ≥ 10% core EFH area (CEA) disturbed
    - 4.4 FE assessments for species with ≥ 10% CEA disturbed
- **Appendix 1** FE Model Description
- **Appendix 2** Gear Parameters Table
- **Appendix 3** Susceptibility and Recovery Tables
- **Appendix 4** SA Questionnaire
- **Appendix 5** SA FE Assessment and Responses

2022 EFH FISHING EFFECTS EVALUATION

Fishing Effects (FE) Evaluation Process:

FE model output

→ FE analysis for species-specific core EFH areas

→ Stock author species-specific FE assessment

→ Plan Team and SSC review; Council review

SSC Subcommittee Process (December 2016)

Thresholds for providing FE assessments:
- Stock below MSST
- ≥ 10% CEA disturbed
- Qualitative assessment preferred
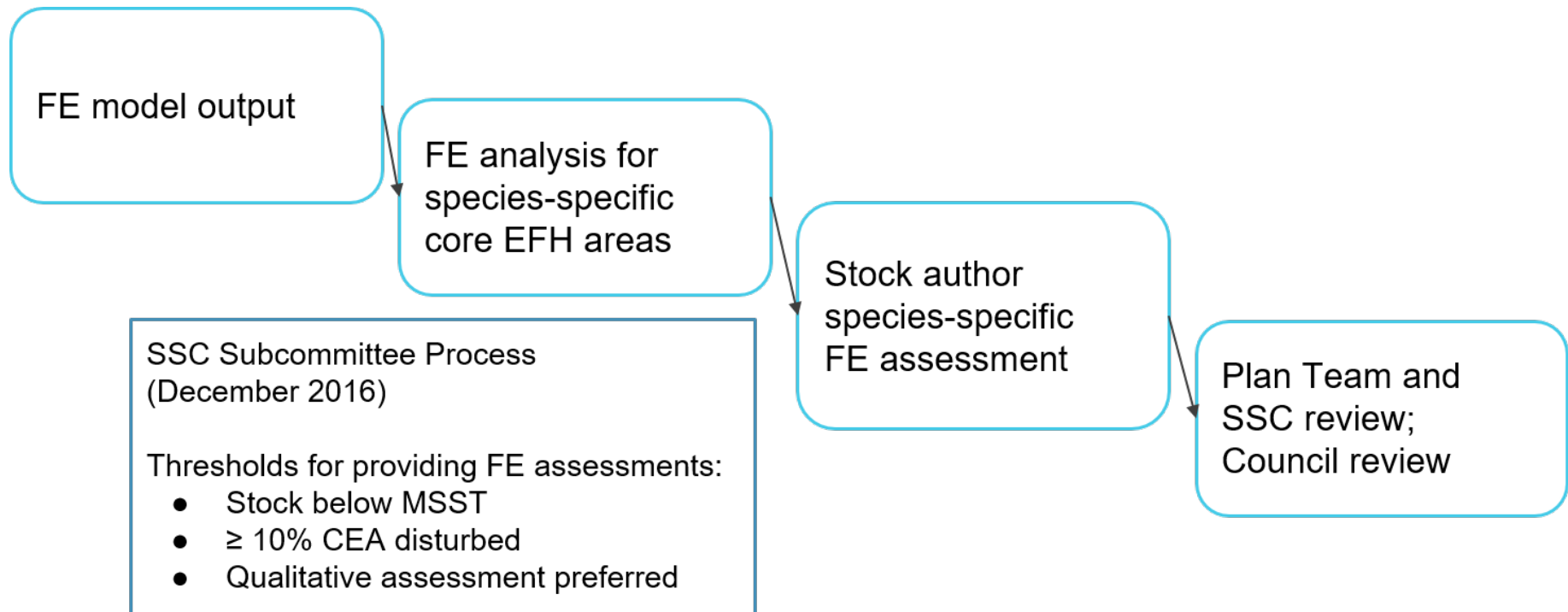
MSST= Minimum Stock Size Threshold

FE Discussion Paper, Chapter 3 (page 29) and Appendix 4 (page 126)
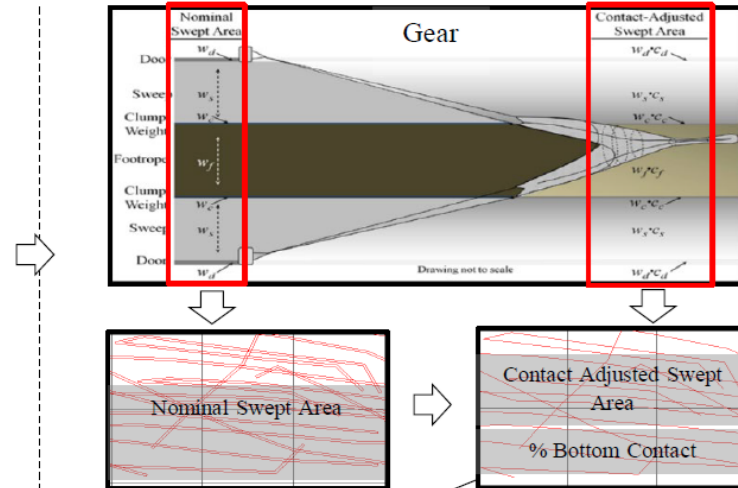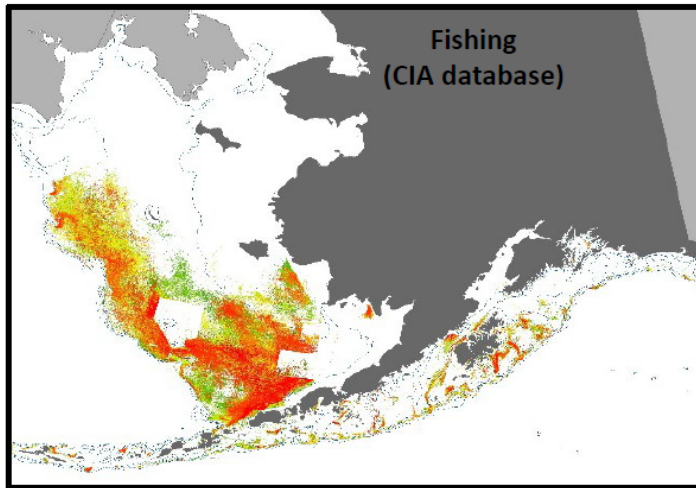
$$H_{t+1} = H_t(1 - I'_t) + h_t\rho'_t$$

H : habitat undisturbed from fishing
h : habitat disturbed from fishing
I' : monthly impact rate
ρ' : monthly recovery rate

FE Discussion Paper, Chapter 2 (page 15)
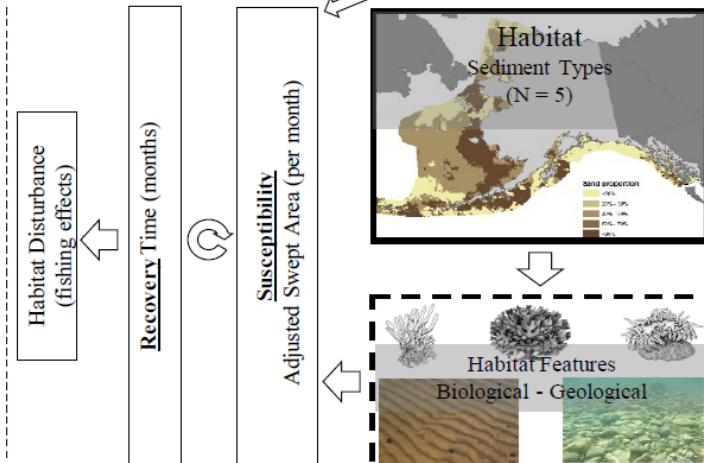
FISHING EFFECTS MODEL OUTPUT

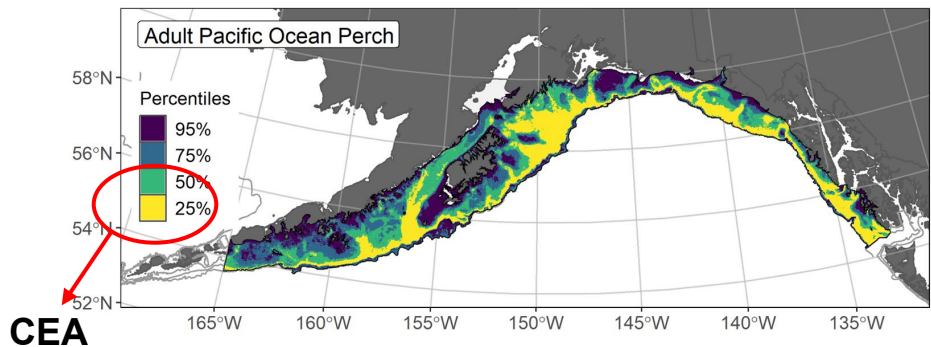FE Discussion Paper, Chapter 2 (page 16)
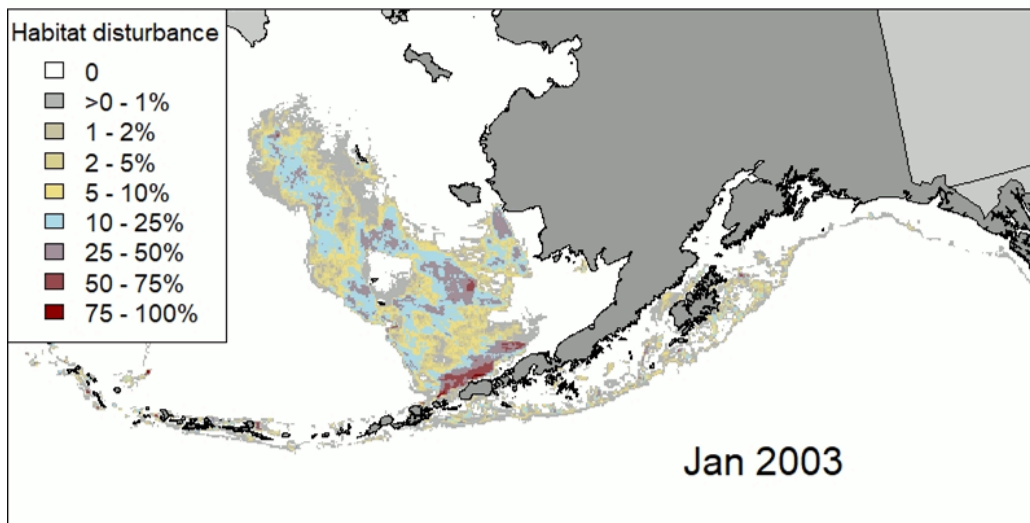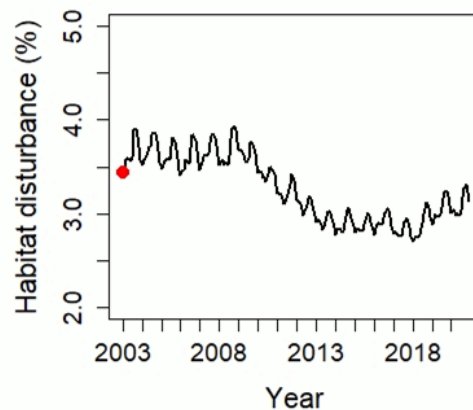
FISHING EFFECTS MODEL CHANGES

Changes to the Fishing Effects model
since the 2017 EFH Review:

- Corrected model code
- Included fishing data up to 2020
- Incorporated new information on gears and habitat recovery
  - Longline nominal width: from 2 m to > 6 m (Welsford et al. 2014)
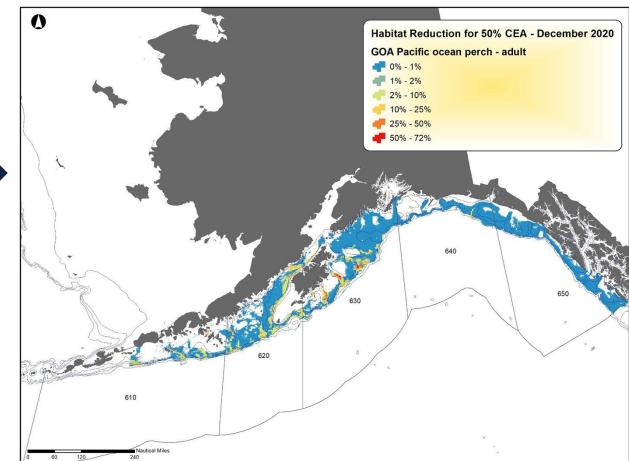 - GOA rockfish trawls contact adjustment: from 0 to > 0.2 (public testimony)

- New EFH maps
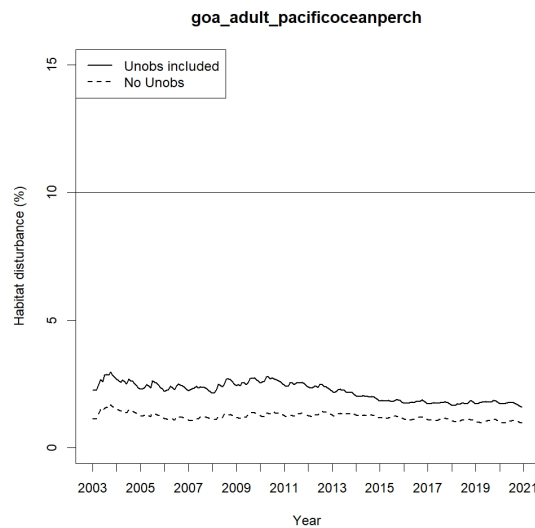
ASSESSING IMPACTS TO STOCKS

CEA from SDM ensemble EFH map

Overlay with Fishing Effects output:

CEA

Habitat disturbance to GOA Pacific ocean perch:
(top solid line = observed and unobserved fishing, bottom dashed line = observed fishing only)

FE Discussion Paper, section 4.4.7 (page 74)

FISHING EFFECTS MODEL RESULTS

16 species with ≥ 10% CEA disturbed (all EBS):

- Arrowtooth flounder
- Atka mackerel
- Blackspotted/Rougheye rockfish complex
- Giant octopus
- Other flatfish complex species: Dover sole, Rex sole
- Northern rockfish
- Pacific ocean perch
- Sablefish
- Shortraker rockfish
- Shortspine thornyhead rockfish
- Skate complex species: Aleutian skate, Bering skate, Mud skate, Whiteblotched skate
- Tanner crab

FE Discussion Paper, section 4.3 (page 42) and section 4.4 (page 43) for stock author FE assessments

FISHING EFFECTS MODEL RESULTS

16 species with ≥ 10% CEA disturbed (all EBS):

- Comparison study to determine why:
    - FE model correction?
    - SDM EFH map changes?
    - Increased fishing effort?
- Compared % disturbance estimated from using the 2017 and 2022 SDMs and the corrected 2022 FE model

FE Discussion Paper, section 4.3 (page 43) and Table 9 (page 46)

FISHING EFFECTS MODEL RESULTS

9 of the 16 species with ≥ 10% CEA disturbed (all EBS):

FE model code correction

- Atka mackerel
- Other flatfish complex species: Dover sole, Rex sole
- Northern rockfish
- Pacific ocean perch
- Skate complex species: Aleutian skate, Bering skate, Mud skate
- Tanner crab

FE Discussion Paper, section 4.3, Table 9 (page 46)

FISHING EFFECTS MODEL RESULTS

2 of the 16 species with ≥ 10% CEA disturbed (all EBS):

Updated SDM EFH maps

- Arrowtooth flounder
- Giant octopus

3 of the 16 species with ≥ 10% CEA disturbed (all EBS):

Increased fishing in CEA

- Shortspine thornyhead rockfish
- Shortraker rockfish
- Sablefish

EBS Whiteblotched skate
EBS Rougheye/ black spotted rockfish complex } Not assessed in 2017 Review, so no comparisons

FE Discussion Paper, section 4.3, Table 9 (page 46)

3b. STOCK AUTHOR FE ASSESSMENT

Launched April 5th:

- Provided FE model results
    - FE disturbance maps
    - Time series graphs and data
    - 2017 to 2022 CEA map comparisons

- Collected responses through a Google Form (Questionnaire) as well as via email and followed up with stock authors and experts to produce the most accurate responses

- Asked for an FE assessment if
    - Stock was below the MSST (2)
    - Species had ≥ 10% CEA disturbance (16)
    - SA preferred a qualitative assessment (11)
    - SA wanted to conduct a quantitative FE assessment (1)

FE Discussion Paper, Chapter 3 (page 28)

FE Evaluation Results by Numbers

- 108 species evaluated

- For 99 species, SAs concluded FE are minimal and temporary and therefore no further action is needed.

- 9 had insufficient information to determine if FE are minimal and temporary.

2022 EFH FISHING EFFECTS EVALUATION

Big Picture Questions:

1. Does the 2022 FE Evaluation incorporate newly available information to provide an appropriate evaluation of the potential adverse effects of fishing on EFH for the 2022 EFH 5-year Review?

2. Does the 2022 FE Evaluation support the continued conclusion that adverse effects of fishing activity on EFH are minimal and temporary in nature?

3. Does the SSC have guidance on evaluating FE beyond what is provided for the species identified with data limitations?

   - We are seeking feedback from the SSC for stocks that were flagged with insufficient information to determine if fishing effects are more than minimal and not temporary.

FE Discussion Paper, Executive Summary (page 3), and Chapter 4 (page 31)

EXAMPLE: EBS ARROWTOOTH FLOUNDER FE ASSESSMENT

- 10.3% CEA disturbed
- No concerns with the SDM map or FE model
- Assessment: no correlations tests were significant
  - A close to significant relationship was between disturbance and the spawning stock biomass, however, ATF spawning takes place in deep water greater than 400 m so the impact would be unlikely to affect spawning
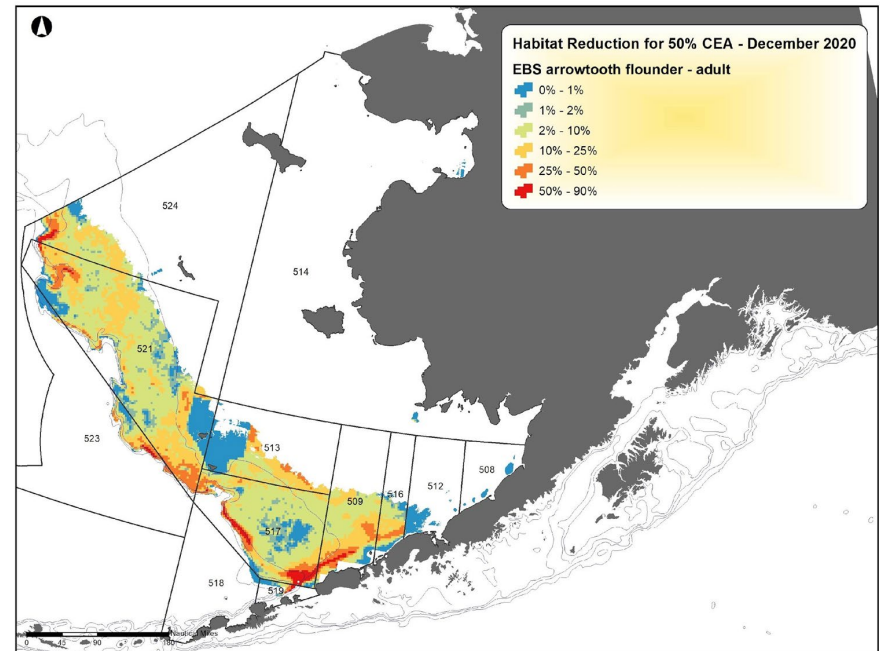
Figure 1. Habitat disturbance in 50% CEA of EBS arrowtooth flounder, December 2020

- **Did not elevate for mitigation measures; no further action**

FE Discussion Paper, section 4.4.1 (page 47) and Appendix 5 section 5.1.1 (page 137)

EXAMPLE: EBS TANNER CRAB FE ASSESSMENT

- 10.9% CEA disturbed
- No concerns with the SDM map or FE model
- Assessment: found correlations with disturbance and life history parameters
  - 2 were negative (immature male and female survey biomass, lagged 1 and 2 years)
  - 3 were positive (recruitment, clutch size, immature male survey biomass lagged 4 years)
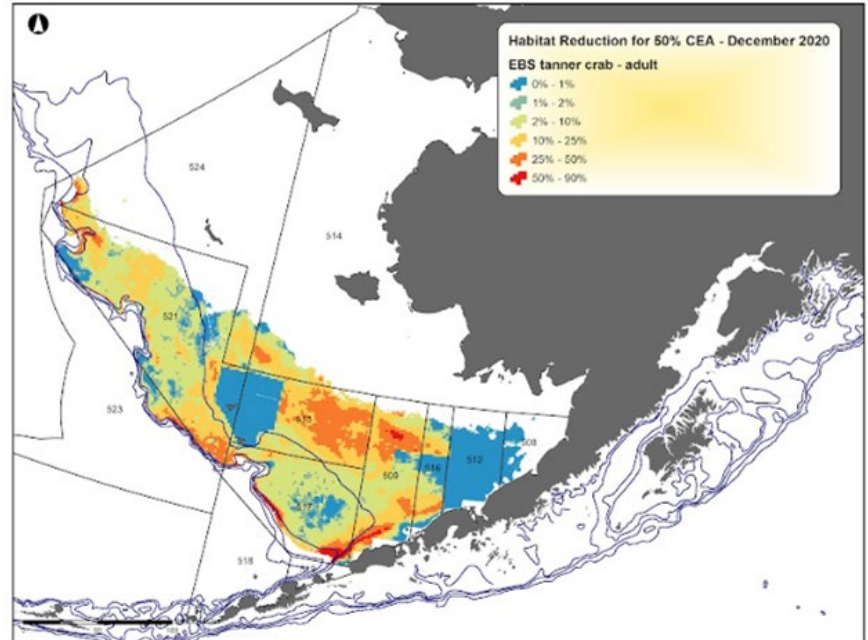- "Difficult to really draw any conclusions"

Figure 1. Habitat disturbance in 50% CEA of EBS Tanner crab, December 2020

- **Insufficient information to make a determination to elevate for mitigation measures**

FE Discussion Paper, section 4.4.12 (page 101), and Appendix 5 section 5.3.5 (page 198)
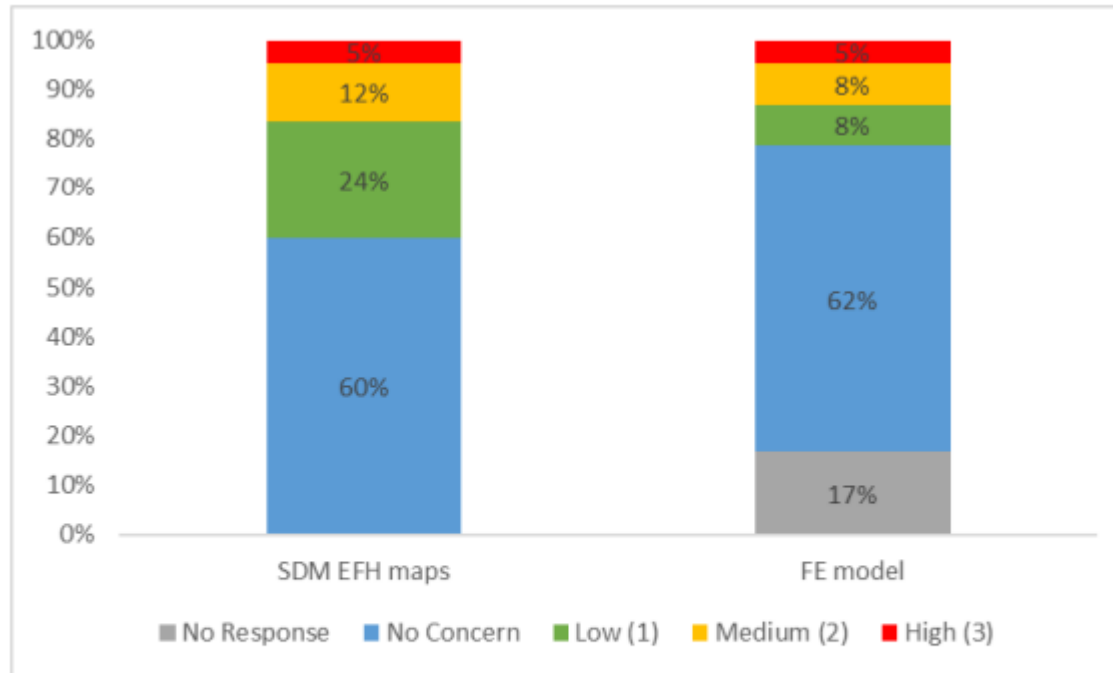
STOCK AUTHOR FE ASSESSMENT

Figure 8: Ranked concerns by qualitative score (low (1), medium (2), high (3)) reported by stock authors for the SDM ensemble EFH maps representing the summer distribution of adults (or all life stages combined) for their species (or species complexes) (left), and the FE model results representing the effects of fishing on their species' habitat (core EFH area (CEA)) (right).

FE Discussion Paper, section 4.1 (page 31), and Figure 8 (page 38)

STOCK AUTHOR FE ASSESSMENT

Main Fishing Effects Evaluation Concerns:

- Spatial scale of FE evaluation:
  - Groundfish: EFH maps were developed for the EBS and AI due to available data. However, some stocks are managed at the BSAI level (e.g., sablefish). Future work is required to combine areas for BSAI EFH maps.
  - Crab: EFH is based on FMP species and is developed regionally for the fishery management unit of the FMP versus sub-regionally by crab stock area.

- Temporal scale of FE evaluation: SSC process evaluates FE to EFH based on EFH maps for the summer season over a multiyear time series (e.g., GOA 1993-2019). Impacts may differ based on temporal scale but we lack methods and data to address this now.

- Life history stages: Impacts on adults may differ from impacts on juvenile fish and crabs (e.g., extend FE evaluation to other life stages and improve life history information for EFH maps).

- Complexes vs. individual species: There was concern that estimating impacts at the complex level may dilute impacts to individual species (e.g., GOA OR complex slope sub-group), although evaluating FE for species groups is a path ahead until more information is available.

Summarized here and reported in FE Discussion Paper, Chapter 4 and the full SA comments in Appendix 5

SPECIES WITH INSUFFICIENT INFORMATION

Species	% Habitat disturbed	FE Assessment?	Evaluation in Appendix 5
AI Golden king crab	4.7%	Quantitative	p. 191
EBS Red king crab	4.9%	No	p. 192
EBS Snow crab	3.8%	Quantitative	p. 195
EBS Tanner crab	**10.9%**	**Quantitative**	**p. 198**
GOA Greenstriped rockfish	0.0%	Qualitative	p. 177
GOA Pygmy rockfish	0.3%	Qualitative	p. 180
GOA Redbanded rockfish	1.3%	Qualitative	p. 181
GOA Silvergray rockfish	0.7%	Qualitative	p. 183
GOA Spiny dogfish	0.0%	Qualitative	p. 185

FE Discussion Paper, section 4.1 (page 31), Tables 4-6 (pages 35-38), and Appendix 5 (page 135)

NMFS Recommendations for
# GOA Other Rockfish Complex Slope Sub-group

To evaluate FE:

- Use the CEA from the species maps for Harlequin, Redstripe, and Sharpchin rockfishes,

- Use the CEA from the sub-group map for Greenstriped, Pygmy, Redbanded, and Silvergray rockfishes, and

- Use the CEA from the sub-group map for slope sub-group species without an EFH map (e.g., darkblotched rockfish).

GOA Other Rockfish Complex, slope sub-group species	% Habitat disturbed	Recommendation
Harlequin rockfish	1.1%	Individual FE evaluation - No further action
Redstripe rockfish	1.2%	Individual FE evaluation - No further action
Sharpchin rockfish	1.2%	Individual FE evaluation - No further action
All other rockfish species in the slope sub-group	1.1%	Complex FE evaluation - No further action

NMFS Recommendations for GOA Spiny Dogfish

- Evaluate fishing effects to GOA spiny dogfish EFH using the FE model and the 50% CEA from the new subadult and adult EFH map.

- New FE results were provided to the stock author after the recommendation was accepted by the Joint Groundfish Plan Team.

- Change: **0.02% to 0.8% CEA disturbed, No further action**.

Figure 1. GOA spiny dogfish combined life stages EFH map
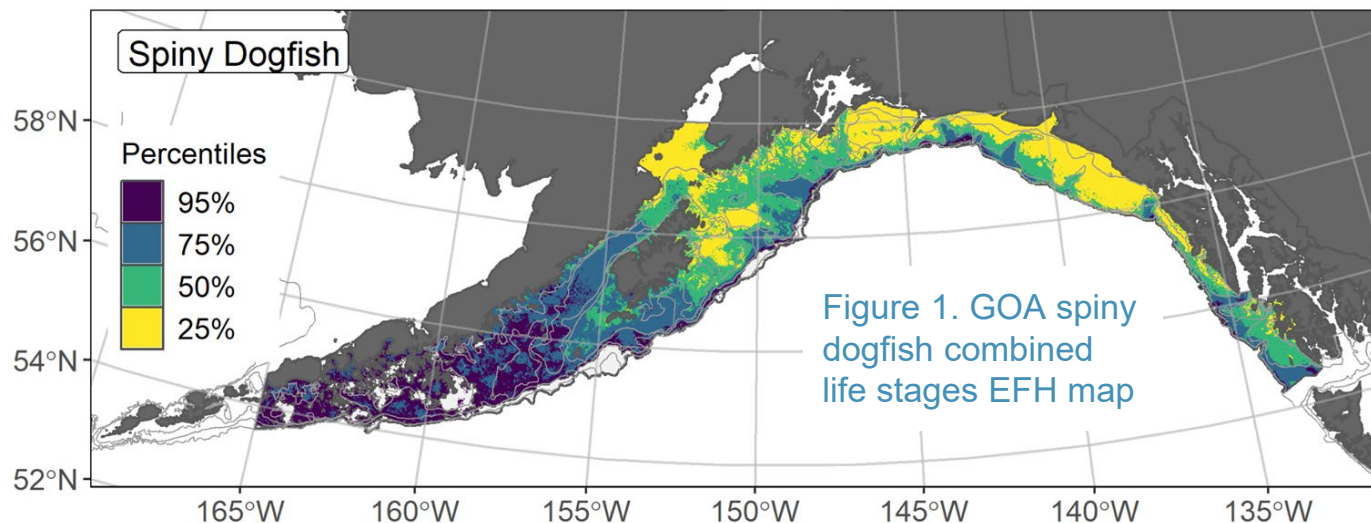
FE Discussion Paper, section 4.2.3 (page 42), and SDM EFH Supplemental Analysis, Chapter 5 (page 36)

How do we evaluate Fishing Effects for BSAI Crab with insufficient information?

- Stock author concerns:
  - Timing, spatial scale, and life history stages
- *Requires extensive research and work to address these concerns and changes to SSC subcommittee FE evaluation process from 2017.*
- SSC input on how to evaluate the crab species with the data available now:
  - Are fishing effects more than minimal and not temporary?
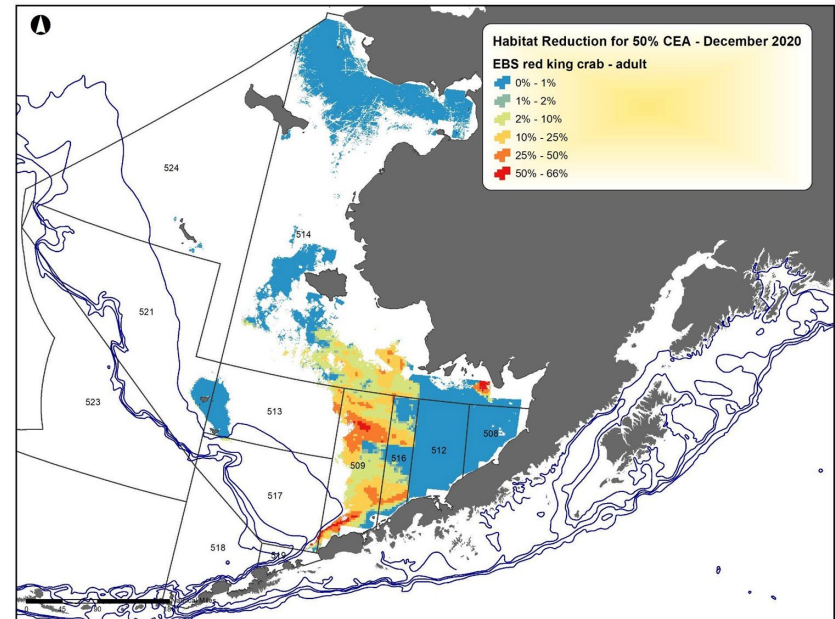 - Are there areas that need HAPC consideration?

Figure 1. Habitat disturbance in 50% CEA of EBS red king crab, December 2020

FE Discussion Paper, section 4.2.2 (page 42)

4. Crab Plan Team Discussion

- **CPT members noted that the EFH team has produced a rich base of information on which to expand the analysis in this direction,** but that it was unclear that individual SAs or the CPT as a whole would have adequate resources to perform this level of analysis within the EFH process as it is currently structured.

- The CPT recognized that the EFH process as currently established does not allow FE determinations to be made on the basis of stock boundaries or smaller sub-regions, but reiterated the need to focus more specifically on fishing effects in critical habitat areas for individual crab stocks and biologically meaningful spatial and temporal scales to capture impacts on specific life-history stages.

- HAPC consideration of specific areas, in addition to those identified in the SA review (the Petrel Bank area identified for Aleutian Islands RKC, and BKC nursery habitats around the Pribilof Islands, St. Matthew Island, and St. Lawrence Island).

4. Joint Groundfish Plan Team Discussion

- **The Teams agreed that the 2022 EFH FE Evaluation incorporated newly available information and supported the continued conclusion that adverse effects of fishing activity on EFH are minimal and temporary in nature for all species.**

- The Teams recommended that the SSC provide input on the process for the evaluation of FE on data limited stocks.

- The Teams and authors recommended (1) using the sub-group map as a proxy for the identified rockfish species and (2) an evaluation of fishing effects on GOA spiny dogfish EFH using the FE model and the 50% CEA from the new EFH map and providing this analysis for the SSC meeting.

- The Teams discussed and emphasized the value of the longline data set.

5. 2022 EFH FE Evaluation Summary

Big Picture Questions:

1. **Does the 2022 FE Evaluation incorporate newly available information to provide an appropriate evaluation of the potential adverse effects of fishing on EFH for the 2022 EFH 5-year Review?**

   i.   The CEA maps, the FE model, and the SA assessments for each species used the best available science.

2. **Does the 2022 FE evaluation support the continued conclusion that adverse effects of fishing activity on EFH are minimal and temporary in nature?**

   i.   No species were identified as having fishing effects that are more than minimal and not temporary.

   ii. 5 groundfish species and 4 crab species were identified with insufficient information to make that decision.

FE Discussion Paper, Executive Summary (page 3)

5. 2022 EFH FE Evaluation Summary

Big Picture Questions:

3. **Does the SSC have guidance on evaluating FE beyond what is provided for the 9 species with data limitations?**

    i. Does the SSC have input on the options for meeting the FE Evaluation requirements for the 5 groundfish species with data limitations?

        1. See NMFS recommendations on slides 40 and 41 and sections 4.2.1, 4.2.2, and 4.2.3 of the FE Discussion Paper.

    ii. Does the SSC have recommendations for meeting the FE Evaluation requirements for the 4 crab species with data limitations?

        1. See slide 42.

    iii. Are there data limited groundfish or crab stocks where fishing effects are potentially more than minimal and not temporary (and should be elevated to the Council for possible mitigation)?

FE Discussion Paper, Executive Summary (page 3)

THANK YOU

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Ongoing Data Issues - Atka Mackerel

- SA reported EFH mapping concerns for Atka mackerel in the AI (low), EBS (medium), and GOA (high).

- GOA adults example: data limitation concerns reported due to the species geographic range and temporal scale of mapping EFH with a long time series.

- We revised SDM ensemble to remove MaxEnt SDM.

- We continued conversations with SA to understand their concerns and recommendations.

- < 10% CEA disturbed; SA recommended no further action with respect to FE to EFH.
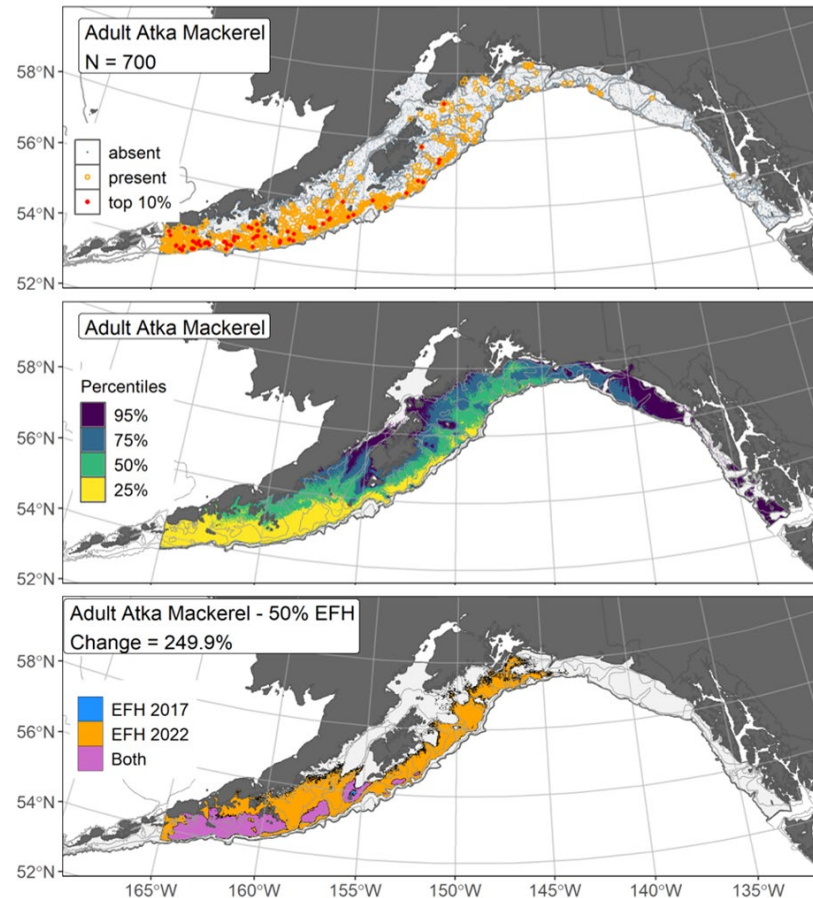
Figure 1. GOA adult Atka mackerel catches in RACE GAP bottom trawl surveys 1993-2019.

Figure 2. GOA adult Atka mackerel SDM ensemble EFH map.

Figure 3. GOA adult Atka mackerel CEA change between 2017 and 2022 EFH maps.

SDM EFH Supplemental Analysis, section 5.2.3 (page 31)

EFH Map Changes and ≥ 10% CEA Disturbance

- EBS adult arrowtooth flounder was 1 of 2 species where habitat disturbance due to fishing in the CEA exceeded the 10% threshold in the 2022 Review (10.3%) but not in the 2017 Review attributed to SDM EFH map changes.

- -15.5% CEA change between 2017 and 2022 EFH maps.

- Shifting the SDM ensemble response variable from 4th root transformed CPUE (a highly derived abundance index) in 2017 to numerical abundance in 2022 had the largest effect on reducing the CEA in 2022.

- SA reported no concern with the EFH map and no further action with respect to FE to EFH.
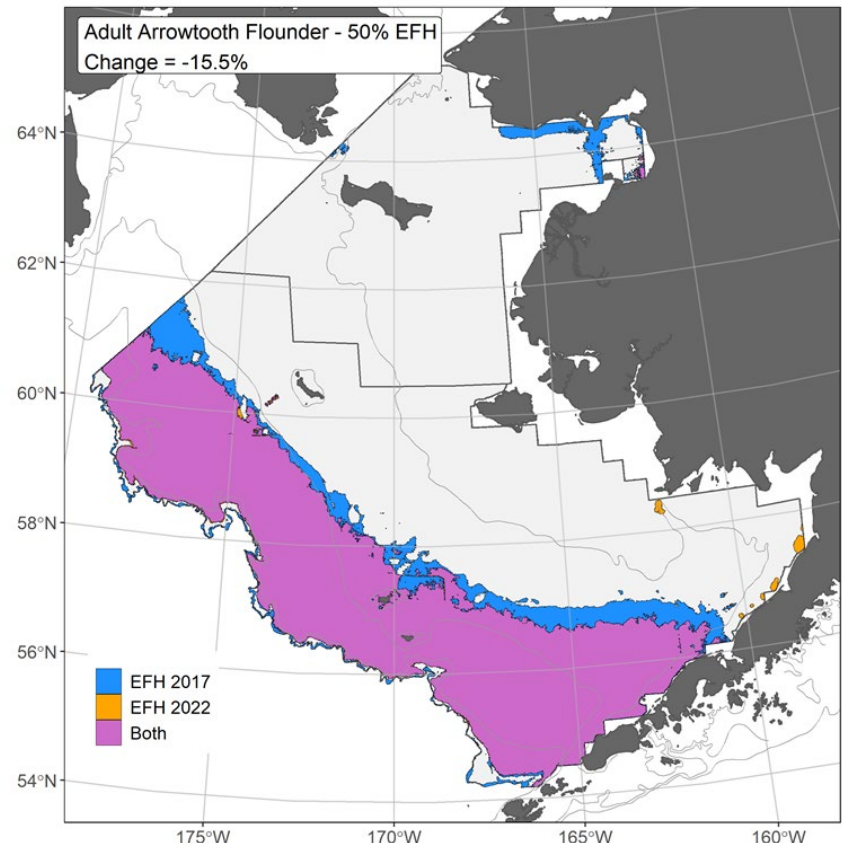
Figure 1. EBS adult ATF 50% CEA change between 2017 and 2022 EFH maps.

SDM EFH Supplemental Analysis, section 5.3 (page 41)

EFH Map Changes and ≥ 10% CEA Disturbance

- EBS giant octopus was 1 of 2 species where habitat disturbance due to fishing in the CEA exceeded the 10% threshold in the 2022 Review (13.5%) but not in the 2017 Review attributed to SDM EFH map changes.

- -38% CEA change between 2017 and 2022 EFH maps.

- Shifting from a single presence-only MaxEnt SDM in 2017 to the SDM ensemble in 2022 had the largest effect on reducing the CEA in 2022.

- SA reported medium concern with the EFH map due to data limitations and was not able to recommend other species data sources to include future EFH mapping; they reported no further action with respect to FE to EFH.
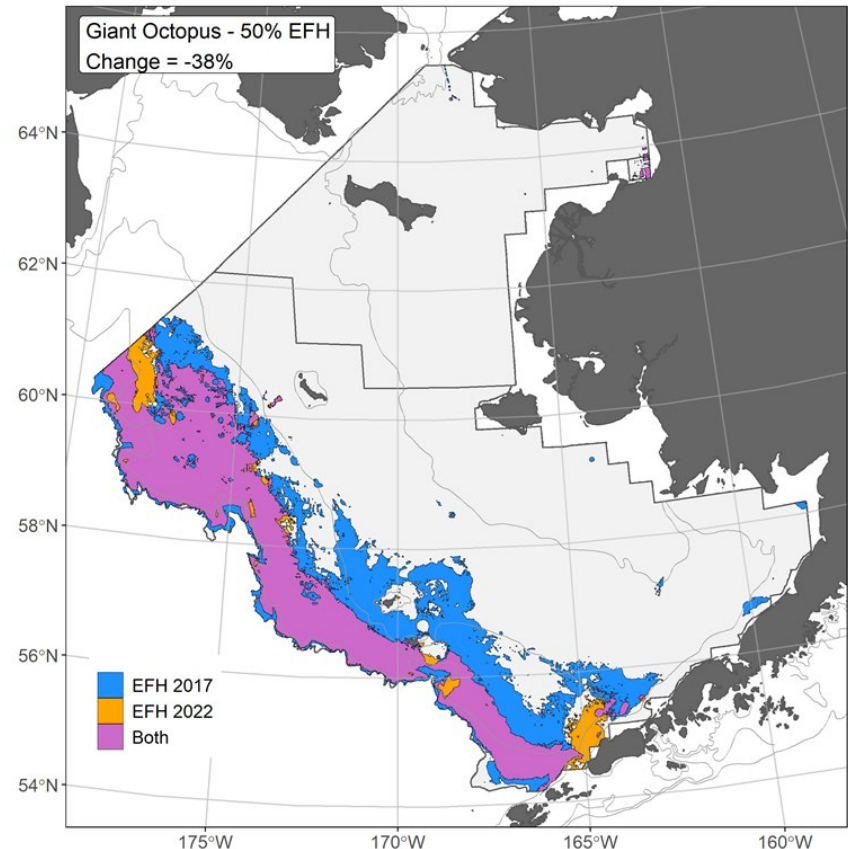

Figure 1. EBS giant octopus 50% CEA change between 2017 and 2022 EFH maps.

SDM EFH Supplemental Analysis, section 5.3 (page 45)

EBS Sablefish FE Assessment

- 12.4% CEA disturbed
- Concerns with regional vs. population-wide determinations
- Suggested incorporating longline survey data in EFH mapping
- Assessment: "[T]he impact of BS fisheries on the sablefish population were generally limited to juvenile fish and unlikely to exceed the impact of natural mortality in the region."
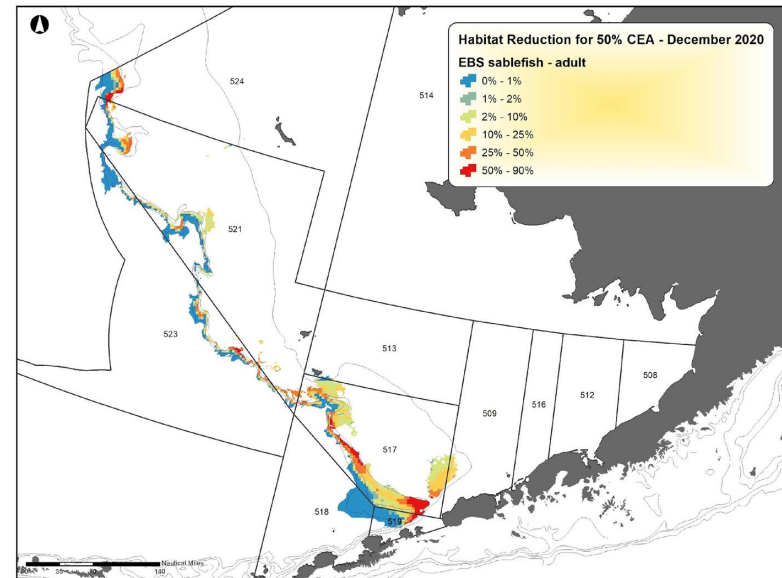- Note: the impact of fishery disturbance on potential sablefish juvenile nursery areas should not be discredited

Figure 1. Habitat disturbance in 50% CEA of EBS sablefish, December 2020

- **Did not elevate for mitigation measures – no further action**

FE Discussion Paper, section 4.4.8 (page 78), Appendix 5 section 5.1.13 (page 159)

Snow Crab FE Assessment

- **Below MSST**
- 3.8% disturbed
- Concern of including the NBS data may dilute meaningful fishing effects results in more important snow crab areas
- Assessment: no significant correlations were identified
  - The SA noted a longer time series would have been better (1990s data).
  - Key variables that weren't considered: "where" and "when" disturbance occurs
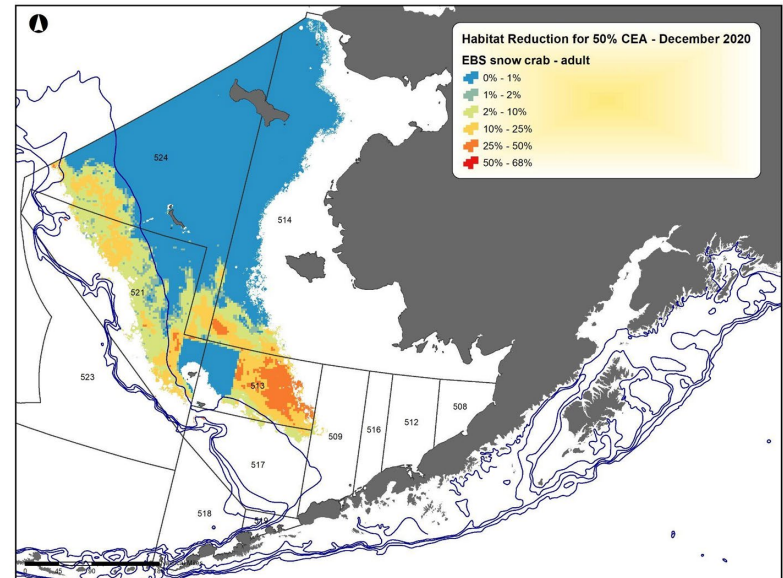

Figure 1. Habitat disturbance in 50% CEA of EBS snow crab, December 2020

- **Insufficient information to make a determination to elevate for mitigation measures**

FE Discussion Paper, Appendix 5 section 5.3.4 (page 195)

Blue King Crab FE Assessment

- **Below MSST**
- 2.3% disturbed
- HAPC consideration (reported on the next slide)
- Assessment: found correlations with disturbance and life history parameters
    - 6 were negative
    - 2 were positive
- "Given the minimal amount of fishing-related habitat disturbance estimated in the core EFH area, I see no need for further mitigation measures for BKC beyond those currently-implemented."
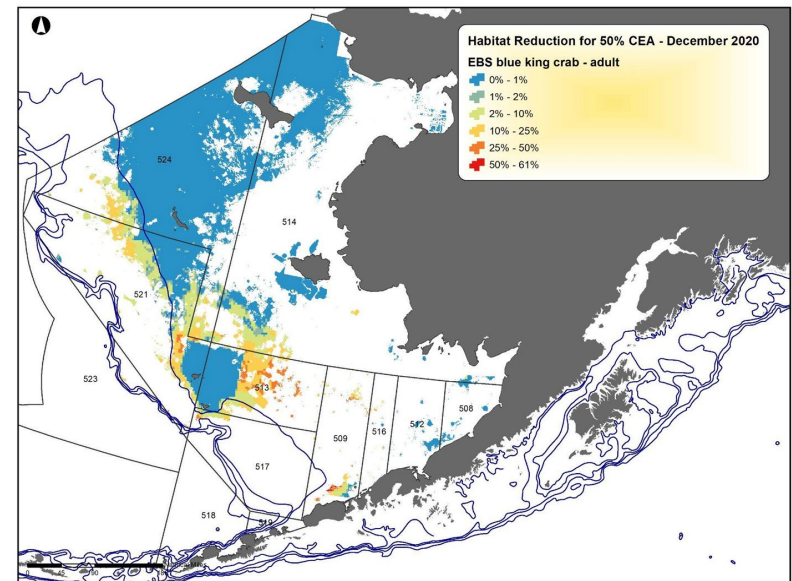

Figure 1. Habitat disturbance in 50% CEA of EBS blue king crab, December 2020

- **Did not elevate for mitigation measures - No further action**

FE Discussion Paper, Appendix 5 section 5.3.1 (page 187)

HAPC CONSIDERATIONS

Red King Crab:

- EBS: 4.9%, AI: 2.3% disturbed
- Possible HAPC consideration for Petrel Bank (AI)

Figure 1. Habitat disturbance in 50% CEA of AI red king crab, December 2020.

Blue King Crab:

- **Below MSST**
- EBS: 2.3% disturbed
- Possible HAPC consideration for important nursery habitats around the Pribilof Islands, St. Matthew Island, or St. Lawrence Island
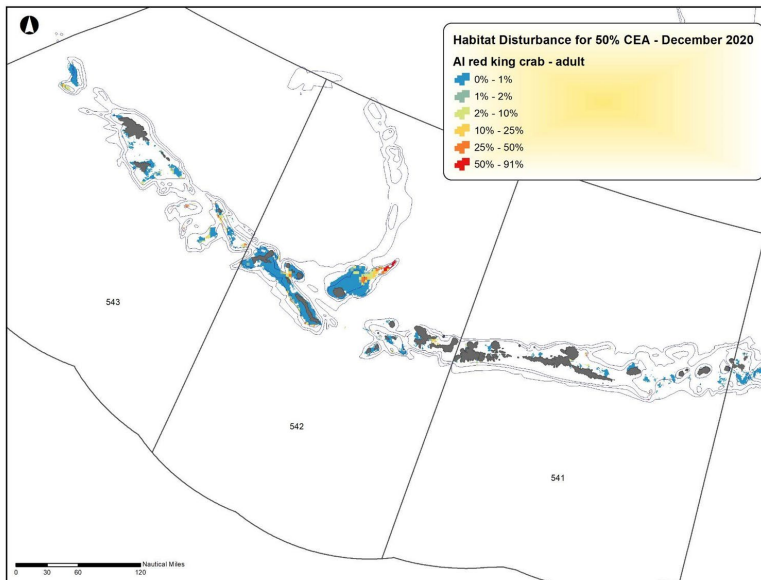
FE Discussion Paper, Appendix 5 sections 5.3.3 and 5.3.1 (pages 192 and 187)