

## Coastal Pelagic Species Essential Fish Habitat Review – Final Preferred Alternative

### Introduction

The coastal pelagic species (CPS) fisheries in the Exclusive Economic Zone (EEZ) off the West Coast of the United States are managed under the Pacific Fishery Management Council’s (Council) CPS Fishery Management Plan (FMP). The FMP was prepared by the Council and approved and implemented by the National Marine Fisheries Service (NMFS) under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (18 U.S.C. 1801 et seq.). The CPS FMP includes four finfish species, market squid, and all krill species occurring in the U.S. West Coast EEZ in the Fishery Management Unit (FMU). CPS finfish and market squid are harvested typically with purse seine gear, and harvest of krill species is prohibited. This document describes potential modifications to CPS essential fish habitat (EFH) resulting from the current EFH periodic review. EFH requirements and the process for periodic EFH reviews are described in the EFH regulations at 50 CFR 600.815(a)(10).

The MSA mandates that each FMP describe and identify EFH for the fishery (16 U.S.C. 1853(7)). EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity” (16 U.S.C. 1802(10)). Under this authority, NMFS and the Council have developed a comprehensive strategy to conserve EFH. This includes incorporating EFH into each of the Council’s FMPs, identifying fishing and non-fishing impacts and associated conservation recommendations, and other required EFH elements. In addition to the EFH regulations, further guidance was issued from the NMFS Office of Habitat Conservation on conducting EFH reviews (NMFS 2000).

[Council Operating Procedure 22](#) (PFMC 2023) describes the Council’s EFH review process, which consists of two phases. The CPS EFH review is now in the second phase, which concludes in presenting alternatives for Council consideration and final action for revising EFH.

This document describes the timeline and process of the EFH review, summarizes proposed modifications of CPS EFH, and provides information to support Council decision making in the context of CPS EFH. A new EFH Appendix (G.3, Attachment 2) to the CPS FMP contains the detailed EFH information including identification and description, fishing and non-fishing impacts, life history summaries, maps, etc. Proposed FMP language is also provided for Council consideration (G.3, Attachment 3).

### History of CPS EFH

The CPS FMP originated as the Northern Anchovy FMP, adopted by the Council in 1978. In 1998, the Council adopted and NMFS approved CPS FMP Amendment 8, which added Pacific sardine, Pacific mackerel, jack mackerel, and market squid to the FMP. EFH for all species in the FMP was established as part of Amendment 8 and is described in [Appendix D](#) to that document (PFMC 1998). In 2005 the Council adopted Amendment 12 to the CPS FMP, adding all species of krill (euphausiids) occurring in the Pacific Coast EEZ with the express purpose to prohibit krill harvest.

Amendment 12 also included detailed descriptions of krill EFH. Although all krill species in the West Coast EEZ are included in the CPS FMP, substantial information with respect to abundance, distribution, and life history characteristics were available for two predominant species: *Euphausia pacifica* and *Thysanoessa spinifera*. EFH is currently defined for finfish and market squid in one assemblage and krill EFH is defined for *E. pacifica*, *T. spinifera*, and the other krill species. The CPS FMP includes several Ecosystem Component Species that are not in the FMU and for which EFH requirements do not apply. A review of CPS EFH was conducted in 2010, however, no modifications were recommended at the time. The 2010 EFH review is documented in the 2011 [SAFE document](#) (PFMC 2011).

**CPS EFH Review Timeline**

At its April 2020 meeting, the Council was scheduled to initiate scoping for the CPS EFH review, but the item was removed from that agenda due to the Covid-19 shut down. The Coastal Pelagic Species Management Team (CPSMT) recommended initiating the EFH review in its April 2020 future workload planning [report](#). Although the Council did not have the opportunity to formally adopt a process and schedule for Phase 1, the CPSMT, NMFS, and the SWFSC moved forward with planning the CPS EFH review, following COP 22. Other key dates and activities included the following:

June 2020	CPSMT provided an <a href="#">update</a> under future workload planning.
September 2020	CPSMT provided an <a href="#">update</a> under future workload planning.
October 2020	Call for Information issued.
April 2021	The Council considered the <a href="#">Phase 1 report</a> and literature review, and agreed to move forward with Phase Two of the review.
June 2022	The Council adopted Phase Two <a href="#">Action Plan</a> June 2022
April 2023	The Council adopted a ROA and selected a PPA
June 2023	The Council is scheduled to take final action on CPS EFH modifications

**Alternatives**

At the April 2023 meeting, the Council adopted a ROA that includes updated information and EFH provisions listed in Alternative 1 below. The Council elected to remove Alternative 2 (market squid Habitat Areas of Particular Concern (HAPC)) from the ROA. This document describes the proposed EFH revisions for species in the CPS FMP and presents two Alternatives: 1a (No Action) and 1b (Adopt New EFH Appendix). This document also describes Alternatives considered but rejected. If the Council selects Alternative 1b, all components of CPS EFH (identification and description, non-fishing impacts, life history summaries, etc.) would be included in a new EFH Appendix to the CPS FMP (G.3, Attachment 2), and an FMP amendment process would be initiated.

Alternative 1: New EFH Appendix

Alternative 1a: No Action

Alternative 1b: Adopt New EFH Appendix

- Identification and Description, including three species/assemblage groups (see Table 1)
- Maps
- Fishing Impacts
- Non-fishing impacts and associated conservation recommendations
- Life history summaries, including prey species
- Research and Information Needs

### ***Alternative 1a: No Action***

Adoption of this Alternative would mean CPS EFH will remain as is currently described in Appendix D to Amendment 8 of the CPS FMP, in Amendment 12, and in the main FMP document.

### ***Alternative 1b: Adopt New EFH Appendix***

Adoption of this Alternative would mean CPS EFH elements would be updated and modified as described below and in the proposed EFH Appendix (G.3, Attachment 2). This section describes proposed CPS EFH information including any proposed modifications.

#### **CPS species and proposed EFH groupings**

CPS finfish and market squid are currently grouped together, sharing the same EFH extent. Given different life histories and the fact that market squid are dependent on benthic habitats for part of their life history, market squid EFH is described here separately from the finfish complex. EFH for two krill species (*Euphausia pacific* and *Thysanoessa spinifera*) is described individually because there is substantial information on their distribution, habitat associations, and life history. EFH for the rest of the krill species (“other krill”) is described separately. Table 1 reflects the proposed grouping of CPS finfish, market squid, and krill separately.

**Table 1: CPS species and proposed EFH groupings.**

<b>Common Name</b>	<b>Scientific Name</b>
<b>Finfish</b>	
Pacific sardine	<i>Sardinops sagax</i>
Pacific mackerel	<i>Scomber japonicus</i>
Northern anchovy (central and northern subpopulations)	<i>Engraulis mordax</i>
Jack mackerel	<i>Trachurus symmetricus</i>
<b>Market squid</b>	<i>Doryteuthis opalescens</i>
<b>Krill or Euphausiids</b> (Including all species in West Coast EEZ)	
<i>Euphausia pacifica</i>	
<i>Thysanoessa spinifera</i>	
<b>Other krill</b> (includes all krill species in the West Coast EEZ other than <i>E. pacifica</i> and <i>T. spinifera</i> . Nine species are listed here)	<i>Nyctiphanes simplex</i> <i>Nematocelis difficilis</i> <i>T. gregaria</i> <i>E. recurva</i> <i>E. gibboides</i> <i>E. eximia</i> <i>T. inspinata</i> <i>Stylocheiron affine</i> <i>E. hemigibba</i>

**Identification and Description**

FMPs are required to describe and identify EFH in text for each life stage of species in an FMU. This should include the physical, biological, and chemical characteristics; the geographic location of habitats described in the FMP; and must include maps of the geographic locations or EFH or the geographic boundaries within which EFH for each species and life stage is found. The regulatory guidance at 50 CFR Part 600 Subpart J provides details on the approach to data and information used to inform EFH, grouping species assemblages when scientifically justified, mapping requirements, and other information.

EFH for CPS is currently described in terms of a species complex, based primarily on the pelagic and migratory nature of species in the CPS FMP. That is, EFH for finfish and squid is currently defined together, and EFH for *E. pacifica*, *T. spinifera*, and the other krill species is defined separately. Ideally, EFH is described and delineated for each species and life stage. However, EFH may be designated by species groups or assemblages, provided there is justification and scientific rationale. After considering updated information compiled in the Draft EFH Appendix and the literature review, in addition to discussions during CPSMT meetings and with subject

matter experts, the CPSMT endorsed describing CPS EFH in five groups: finfish assemblage, market squid, two individual krill species, and other krill. By comparison, CPS EFH is currently divided into two groups: finfish/squid and krill. In other words, Alternative 1b would remove market squid from the finfish assemblage and define EFH separately. Krill EFH groupings would remain as currently described.

The groupings proposed in this action are based on available scientific and other information that describes the behaviors, habitat associations, and distribution of the three CPS groups. CPS finfish are motile, can be widely distributed, especially in periods of high abundance, and do not display dependence with static habitat structures. Market squid also exhibit wide distribution but are dependent on temperature and adequate sand/or mud benthic habitat for spawning and egg incubation. Krill species are also widely distributed but exhibit higher concentrations in areas near the continental shelf break and other areas described below. The proposed descriptions of EFH for the three groupings under Alternative 1b are described below.

### **CPS Finfish**

EFH for all life stages of CPS finfish is primarily based on presence/absence data and sea surface temperatures. CPS finfish abundance and distribution fluctuate greatly, and in periods of low abundance may not be present in areas of suitable habitat. However, in periods of greater abundance, CPS finfish species may occupy most portions of the West Coast EEZ. The definition of EFH for the CPS finfish assemblage is proposed to remain as currently specified and is depicted in Figure 1 :

The east-west geographic boundary of EFH for the finfish assemblage is defined to be all marine and estuarine waters from the shoreline along the coasts of California, Oregon, and Washington (including U.S. waters of the Salish Sea and Puget Sound) offshore to the limits of the EEZ and above the thermocline where the sea surface temperatures range between 10° to 26°C. The northern distributional range of CPS finfish is dynamic and variable due to the seasonal cooling of the sea surface temperature, hence in some seasons the 10°C isotherm can be north of the U.S. EEZ. Similarly, the southern distributional range can extend south of the U.S. EEZ where sea surface temperatures are consistently below 26° C. Therefore, the southern extent of EFH for CPS finfish is the U.S.-Mexico maritime boundary, whereas the northern extent is the U.S.-Canada maritime boundary.

### Discussion

The updated description of CPS finfish EFH incorporates best available science and understanding of the finfish life cycles, habitat needs, non-fishing impacts, and other information. Proposed CPS finfish EFH is overall similar to existing EFH for all life stages, including geographic extent, life history summaries, and trophic relationships. Although EFH for CPS finfish and market squid has been combined to this point, the CPS finfish assemblage is proposed to be treated separately from market squid as well as the krill assemblage. The Draft EFH Appendix includes detailed descriptions of the individual EFH components (temperature, depth, etc.) and distribution for each species and life stage.

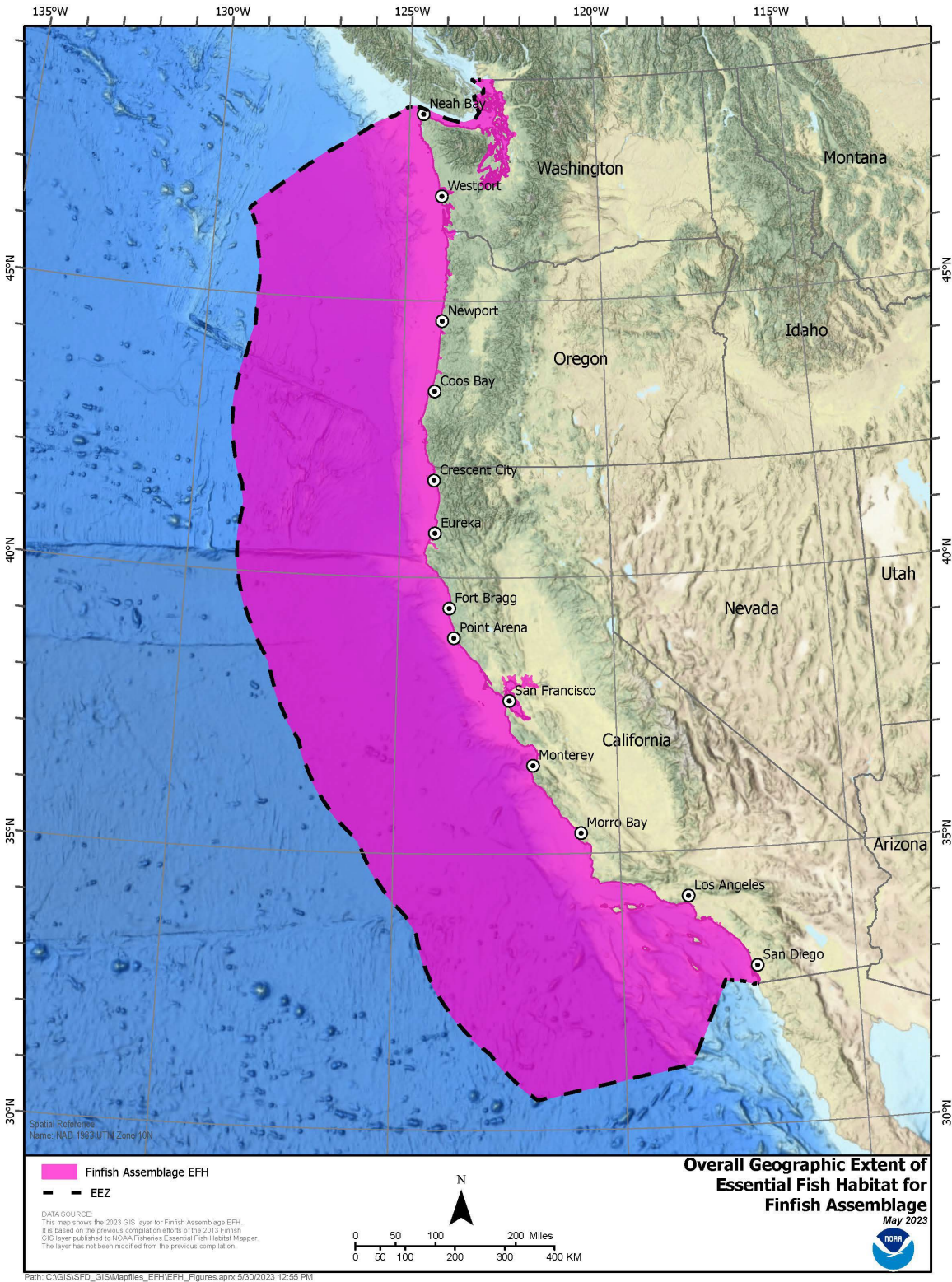


Figure 1. Proposed geographic extent of CPS finfish assemblage EFH.

## **Market Squid**

Market squid, like CPS finfish, are spatially dynamic and can occupy large portions of the West Coast EEZ and beyond, depending on oceanic conditions and population size. Currently, market squid EFH is defined as part of the finfish assemblage (described above). However, based on Detailed descriptions of market squid EFH are found in the Draft EFH Appendix and the proposed EFH description for market squid under Alternative 1b is as follows:

The east-west geographic boundary of Market Squid EFH is defined to be from the shoreline seaward to the extent of the 5.8 percent market squid distribution probability (Figure 2), including waters to a depth of 300 meters, and where the sea surface temperature is between 7° and 24°C along the coasts of California, Oregon, and Washington. This definition includes U.S. waters of Puget Sound and the Salish Sea and excludes other estuarine waters on the Pacific Coast. Market squid EFH also includes soft, sandy substrates 13 m to 93 m of depth for spawning adults and the egg capsule stage. The southern extent of EFH for Market Squid is the U.S.-Mexico maritime boundary, and the northern extent of Market Squid EFH is the U.S.-Canada maritime boundary.

## Discussion

Proposed market squid EFH differs from the existing description primarily by including benthic habitats important for spawning and egg development, by confirming the geographic extent into the Salish Sea, and by refining the geographic extent of market squid EFH, which was previously combined with finfish EFH geographic extent. While market squid can be found in waters seaward of the proposed boundary, occurrence is much less likely and more sporadic than in waters proposed here as EFH. The north-south distribution of market squid extends beyond the U.S. – Canada and U.S. – Mexico maritime boundaries, but the EFH boundaries are necessarily established at the limit of U.S. jurisdiction.

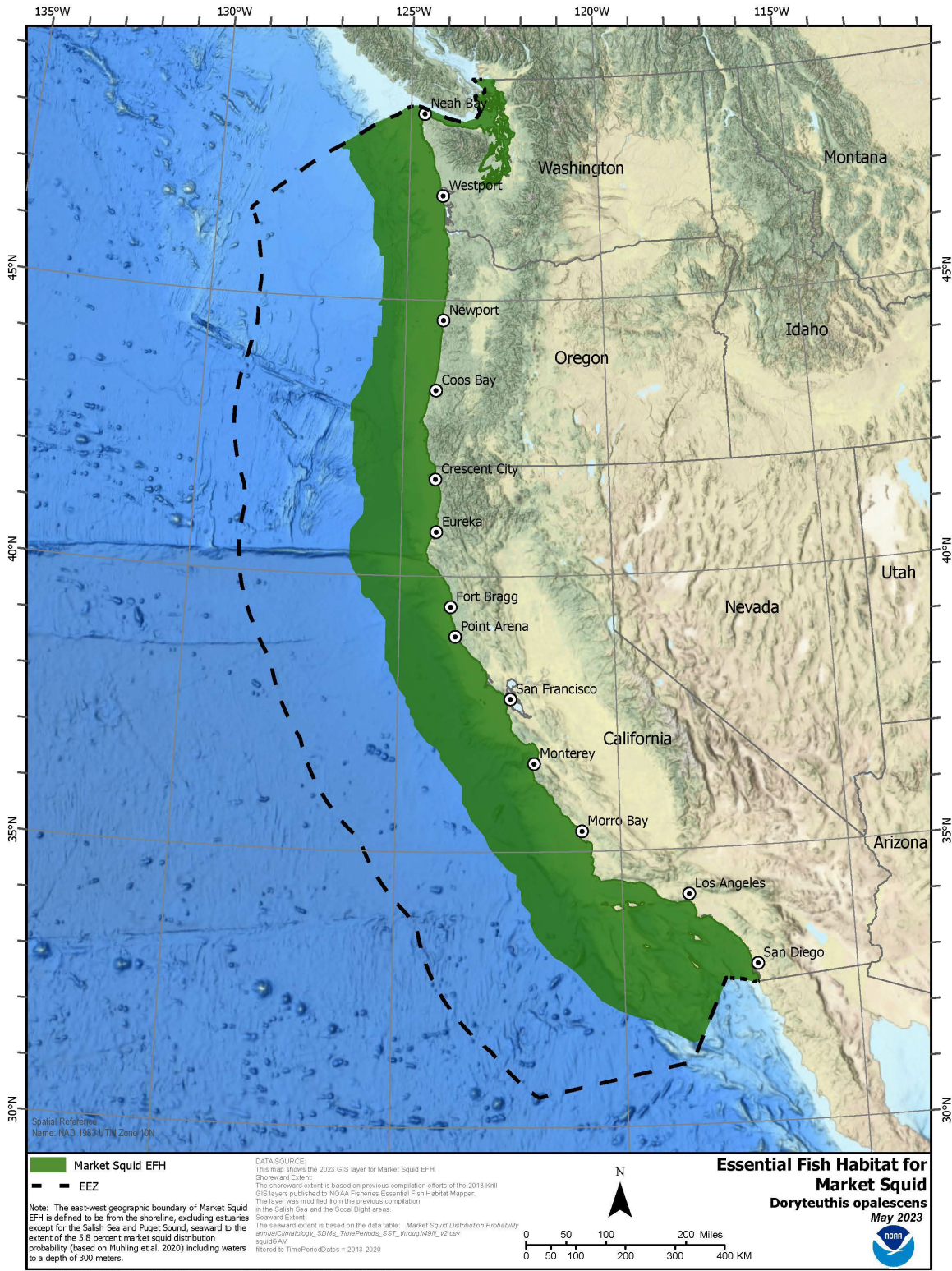


Figure 2. Proposed market squid EFH based on distribution probability greater than 5.8 percent (based on Muhling et al 2020).



## **Krill**

All krill species occurring in the West Coast EEZ are included in the CPS FMP. Although much new information exists on krill in West Coast EEZ waters, information on species-specific distributions and habitat throughout the entire California Current Ecosystem is not sufficient to warrant modifying the current EFH descriptions and spatial extent for *E. pacifica*, *T. spinifera*, and other krill. The definitions of krill EFH are proposed to include the current geographic distribution, including U.S. marine waters of Puget Sound and the Salish Sea:

### **E. pacifica**

The east-west geographic boundary for *E. pacifica* EFH, including larvae, juveniles and adults, is defined as U.S. West Coast EEZ waters from the shoreline, excluding estuaries except for the Salish Sea and Puget Sound, to the 1000 fm (1,829 m) isobath, from the surface to 400 m deep. The north-south geographic boundary extends from the U.S. – Canada maritime boundary to the U.S. – Mexico maritime boundary (Figure 3).

### **T. spinifera**

The east-west geographic boundary for *T. spinifera* EFH, including larvae, juveniles and adults, is defined as U.S. West Coast EEZ waters from the shoreline, excluding estuaries except for the Salish Sea and Puget Sound, to the 500 fm (914 m) isobath, from the surface to 100 m deep. The north-south geographic boundary extends from the U.S.- Canada maritime boundary to the U.S.-Mexico maritime boundary (Figure 4).

### **Other krill species**

The east-west geographic boundary for other krill species EFH, including larvae, juveniles and adults, is defined as U.S. West Coast EEZ waters from the shoreline, excluding estuaries except for the Salish Sea and Puget Sound, to the 1000 fm (1,829 m) isobath, from the surface to 400 m deep. The north-south geographic boundary extends from the U.S. – Canada maritime boundary to the U.S. Mexico maritime boundary (Figure 5).

## **Discussion**

The updated description of krill EFH incorporates recent scientific information and understanding of the krill species' life cycle and geographic distribution. The Draft EFH Appendix includes substantial new information about krill life history and distribution and indicates that extending krill EFH into the Salish Sea is warranted. In addition, new research recommendations are proposed, which would provide more information to be considered during the subsequent EFH review process. Three other species of krill are proposed to be included in the list of dominant krill species present in the West Coast U.S. EEZ: *Thysanoessa inspinata*, *Stylocheiron affine*, and *Euphausia hemigibba* (Table 1).

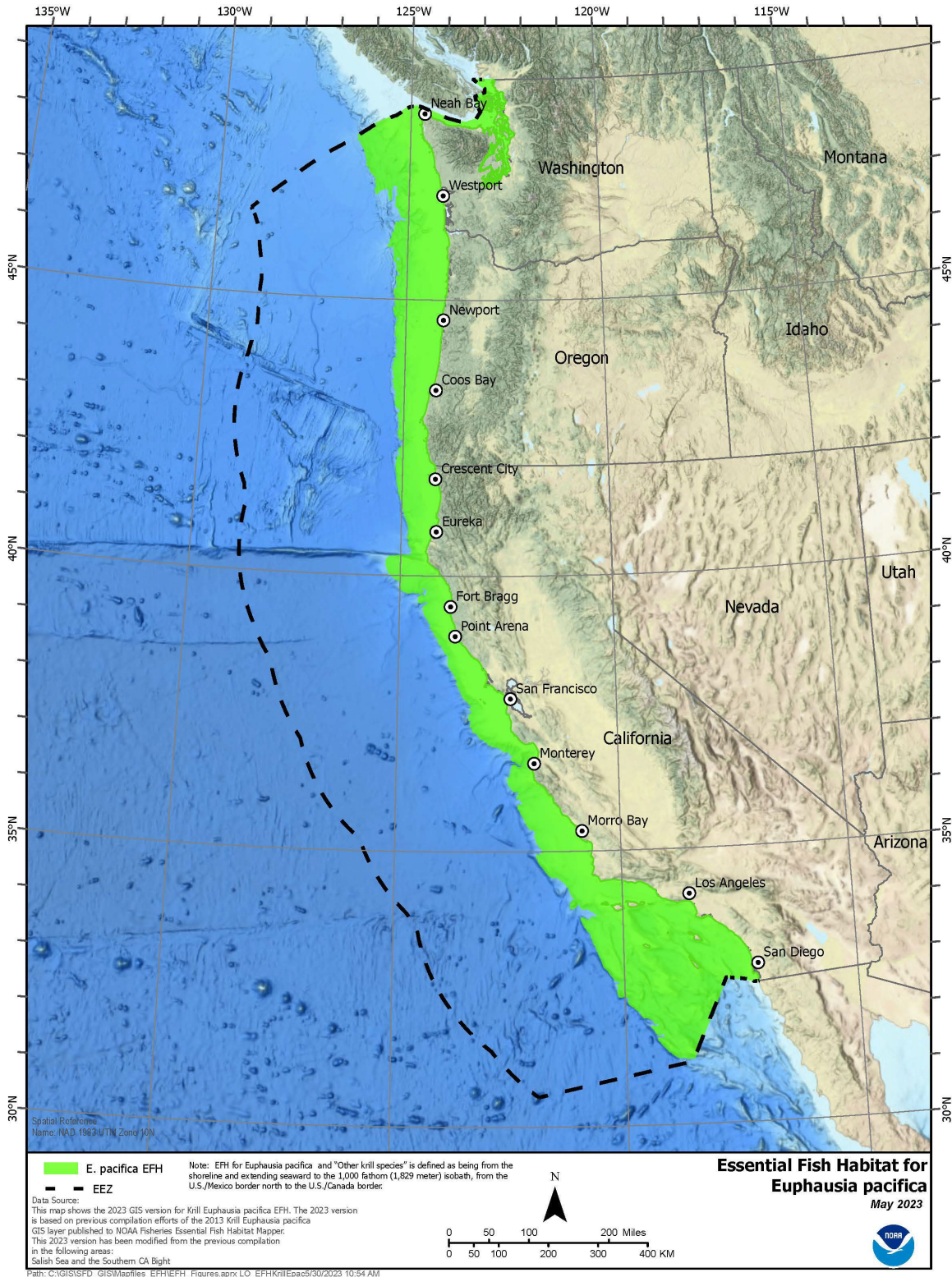


Figure 3. Proposed geographic extent of EFH for *E. pacifica*.

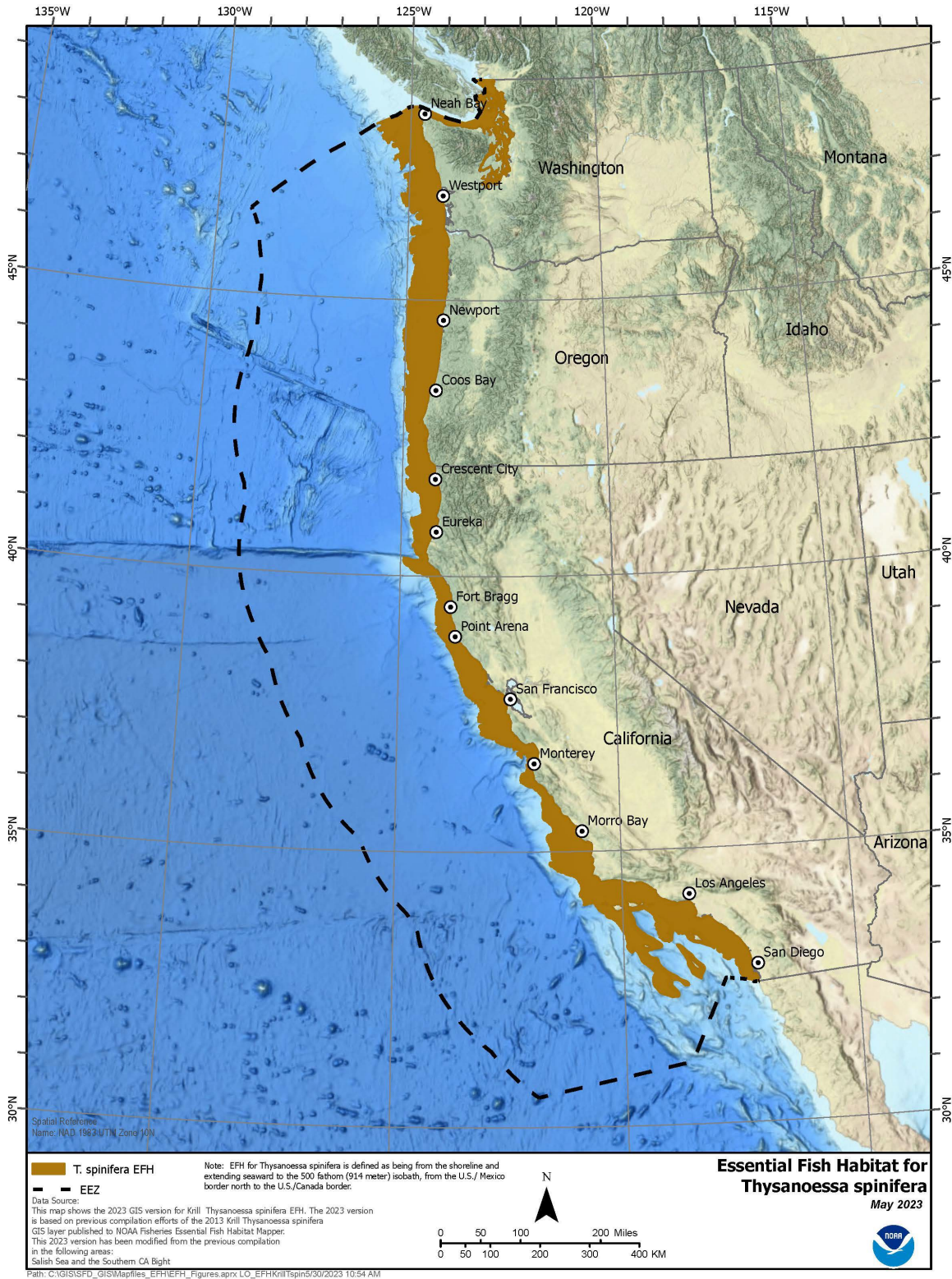


Figure 4. Proposed geographic extent of EFH for *T. spinifera*.

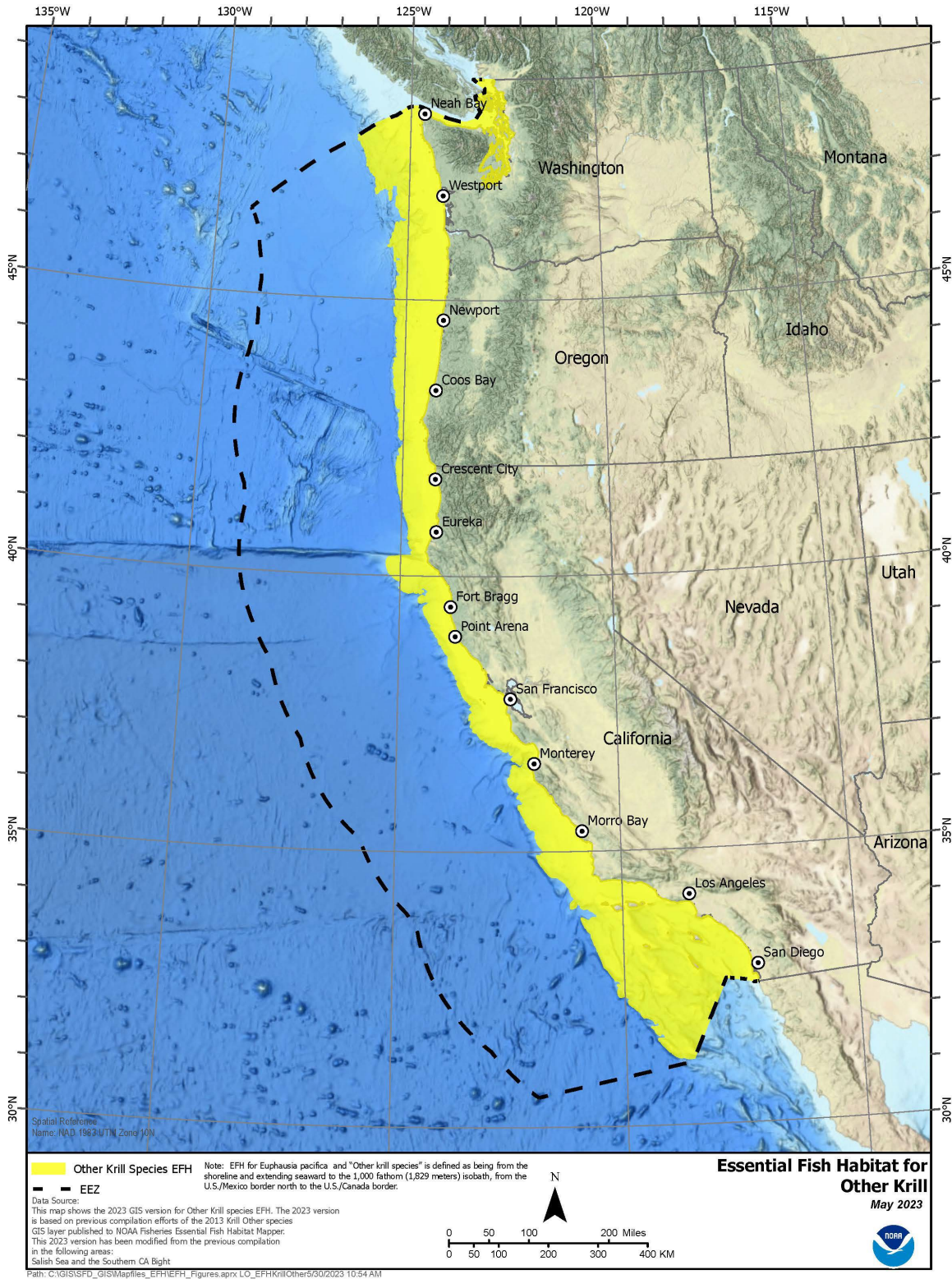


Figure 5: Proposed geographic extent of EFH for other krill.

## **Life History Summaries**

The Draft EFH Appendix provides updated life history information on all species and life stages in the CPS FMP, based on recent published and unpublished literature, and from engagement with subject matter experts. Life history summaries are intended to provide a thorough description of the habitats utilized by each life stage, primary prey species, distribution, trophic relationships, and other information, used to inform the designation of EFH elements.

## **Fishing Impacts**

FMPs must contain an evaluation of the potential adverse effects of fishing activities on EFH designated under the FMP and describe actions that could be taken to minimize adverse effects to EFH. This includes effects from fishing activities regulated under this FMP as well as other Federal FMPs. FMPs must also identify any fishing activities not managed under the MSA that may adversely affect EFH. The CPS EFH review process, including the literature review and subsequent discussions with the CPSMT, did not identify any new fishing activities or gear different than what is currently included in the CPS FMP. Thus, the fishing impacts section is proposed to remain essentially status quo, with no new fishing effects identified and no minimization measures proposed. The Fishing Impacts section in the EFH Appendix contains descriptions of MSA and non-MSA fishing activities and gears, potential conservation measures, and other information, as required by the EFH regulations.

## **Non-fishing impacts**

FMPs are required to identify non-fishing activities that may adversely affect EFH. The EFH regulations suggest that “*such activities include, but are not limited to: dredging, filling, excavation, mining, impoundment, discharge, water diversions, thermal additions, actions that contribute to non-point source pollution and sedimentation, introduction of potentially hazardous materials, introduction of exotic species, and the conversion of aquatic habitat that may eliminate, diminish, or disrupt the functions of EFH.*” FMPs are required to describe known and potential impacts to EFH, and to provide conservation recommendations to avoid, minimize, or compensate for adverse effects.

The description of non-fishing activities and conservation measures are used primarily as a reference in non-fishing activity consultations by NMFS biologists, for federally-permitted activities that may adversely affect EFH. Consulting biologists use the document(s) to develop conservation recommendations, which are then conveyed to the action agency. It is important to note that while the descriptions of non-fishing impacts and associated conservation recommendations are designed to assist in the consultation process, consulting biologists are not bound by those specific activities or conservation recommendations. Other literature, subject matter expertise, and professional judgment are used in EFH consultations. The EFH regulations provide further details on conducting EFH consultations.

The CPS FMP currently describes several non-fishing activities and provides conservation recommendations. A recent NMFS White Paper (Kiffney et al. 2022) identifies a wide range of non-fishing activities, several of which would potentially adversely affect CPS EFH. Table 2

below lists both sets of non-fishing activities, which are proposed for incorporation into the CPS FMP.

**Table 2: Non-fishing activities proposed for inclusion in the CPS FMP**

Currently in CPS FMP	Kiffney et al. 2022
<ul style="list-style-type: none"> <li>● Dredging</li> <li>● Dredge material disposal/fill</li> <li>● Oil and gas exploration</li> <li>● Water intake</li> <li>● Aquaculture</li> <li>● Wastewater discharge</li> <li>● Discharge of oil/hazardous substances</li> <li>● Coastal development impacts</li> </ul>	<ul style="list-style-type: none"> <li>● Climate change</li> <li>● Upland and urban development</li> <li>● Road construction and operation</li> <li>● Stormwater and urban runoff</li> <li>● Silviculture</li> <li>● Dam operations and removal</li> <li>● Mineral mining</li> <li>● Oil extraction, shipping, and production</li> <li>● Energy-related activities (wave/tidal, OSW, cables &amp; pipelines, LNG)</li> <li>● Agriculture and grazing</li> <li>● Shoreline and bank stabilization</li> <li>● Marine and freshwater transportation</li> <li>● Coastal development</li> <li>● Dredging</li> <li>● Aquaculture</li> <li>● Overwater structures</li> <li>● Water intake and discharge facilities</li> <li>● Pile driving and removal</li> <li>● Noise pollution</li> </ul>

Discussion

The proposed list of non-fishing impacts and conservation measures differs from the existing non-fishing impacts by adding several activities not previously included. While some overlap with the existing list (e.g., dredging, aquaculture), most are completely new to the CPS FMP. By adding the impacts and conservation measures described in Kiffney, et al (Kiffney 2022), consulting biologists will have an improved library of information to develop recommendations to minimize habitat impacts resulting from non-fishing activities.

### ***Alternatives Considered but Rejected: HAPCs for Market Squid***

The EFH regulations encourage the Councils to identify specific types or discrete areas of habitat within EFH as HAPCs, based on one or more of the following considerations:

1. the importance of the ecological function provided by the habitat.
2. the extent to which the habitat is sensitive to human-induced environmental degradation.
3. whether, and to what extent, development activities are, or will be, stressing the habitat type.
4. the rarity of the habitat type.

The intended goal of identifying such habitats as HAPCs is to provide additional focus for conservation efforts. While the HAPC designation does not add any specific regulatory process, it highlights certain habitat types as ecologically very important. This designation is manifested in EFH consultations where federally permitted projects with potential adverse impacts to HAPC are more carefully scrutinized during the consultation process. Councils may develop regulations to protect HAPCs from fishing activities, as with the Pacific Coast Groundfish FMP, which includes numerous areas closed to bottom trawl or all bottom contact fishing gear to protect particularly important groundfish habitats. HAPCs should be spatially discrete, with clearly defined geographic boundaries. Councils may implement conservation actions such as time/area closures, gear restrictions, or other mechanisms to protect designated HAPCs.

HAPCs for CPS were not established under Amendment 8, when CPS EFH was initially designated. HAPCs were considered for krill under Amendment 12 and during the 2010 CPS EFH review. However, in both cases, the Council did not designate HAPCs, citing the highly mobile nature and lack of dependence on any single habitat type or discrete location.

At its January 2023 meeting, the CPSMT discussed the potential for establishing HAPCs for CPS FMP species. The CPSMT agreed that because of the dynamic distribution and lack of association with spatially discrete geographic areas, CPS finfish are not good candidates for establishing HAPCs. At the same meeting, the CPSMT discussed the potential for designating a HAPC for squid spawning habitat and for krill species and asked to further consider the issue.

At its April 2023 meeting, the Council considered a potential HAPC for market squid described as “Designate a HAPC for squid spawning that would include areas within the SCB and possibly Monterey Bay with sand or mud benthic habitat within a depth range of 13 – 93m.” Spawning behavior for market squid is typically dictated by temperature, occurring in relatively shallow nearshore areas with sandy or mud substrates and can include deeper waters along submarine canyon sides. Fishery-dependent data indicate routine and prolific spawning areas in the Southern California Bight (SCB) and, to a lesser extent, off Monterey Bay. Although squid are known to spawn in areas further north (northern California Coast and off Oregon), market squid presence and spawning is much more sporadic than in areas off Monterey and the SCB. For example, under warmer oceanographic conditions, nearshore spawning declines dramatically in the SCB, whereas areas north of Point Conception experience higher recruitment and more prolific spawning activity.

Noting that squid spawning occurs throughout the California Current Ecosystem, is not limited to the areas encompassed by the proposed HAPCs, and that there is a lack of sufficient information on which to base HAPCs, the Council concluded that a market squid HAPC is not warranted at

this time and removed the alternative from further consideration. Therefore, Alternative 2, including 2a and 2b, were removed from the ROA and thus removed from further consideration.

## Research and Information Needs

The EFH regulations state that FMPs should identify research and information needs for “*research efforts that the Councils and NMFS view as necessary to improve upon the description and identification of EFH, the identification of threats to EFH from fishing and other activities, and the development of conservation and enhancement measures for EFH.*” The new EFH Appendix includes the following Research and Information Needs:

- Support efforts to better evaluate the effects of fishing on habitat for CPS species.
- Determine whether climate change and ocean acidification pose differential risk to invertebrates (squid and krill) compared to finfish in the CPS group.
- Further investigate habitat features as potential HAPC for *E. pacifica*, *T. spinifera*, and market squid.
- Evaluate the importance of krill habitat compression to restricted geographic areas during environmentally stressful conditions and whether a HAPC designation should be considered, especially where subject to human-induced environmental degradation.
- Determine the optimal range of carbon chemistry for krill life stages as a component of EFH.
- Prioritize coastwide (Mexico to British Columbia) synoptic surveys of CPS biomass, distribution, and environmental parameters that could increase understanding of CPS distribution, abundance, and habitat associations.
- Evaluate the trophic role of CPS resources in the ecosystem, the influence of climatic/oceanographic conditions on CPS, and define predator-prey relationships
- Investigate energetic value of krill species to predators in terms of carbon to nitrogen ratio, total lipids, etc, to better understand the relative value of individual krill species as prey items.
- Continue research efforts to better understand finfish distribution and habitat use, to improve and refine EFH definitions and identification of EFH spatial extent.
- Additional research and data needs could include efforts to better understand and describe the dynamic nature of CPS habitats, species shifts in response to changing climate and oceanic conditions, and a better understanding of krill species distribution and habitat associations.

## Amended FMP text

CPS FMP section 2.2.1.2 describes EFH for species in the CPS FMU. Proposed FMP text revisions are included as G.3, Attachment 3.

## References

Kiffney, P., J. Thompson, B. Blaud, and L. Hoberecht. 2022. Nonfishing Impacts on Essential Fish Habitat. U.S. Department of Commerce, NOAA White Paper NMFS-NWFSC-WP-022-01.



- Muhling B.A., Brodie S., Smith J.A., Tomassi, D., Gaitan, C.F., Hazen, E., Jacox, M.G., Auth, T.D., and Brodeur, R.D. 2020. Predictability of species distributions deteriorates under novel environmental conditions in the California current system. *Frontiers in Marine Science*. 2020. doi: <http://dx.doi.org/10.3389/fmars.2020.00589>.
- NMFS 2000. Guidance on Essential Fish Habitat Conservation Recommendations, Procedure 03-201-15. National Marine Fisheries Service, Silver Spring, Maryland.
- NMFS 2002. Essential Fish Habitat Regulations. 50 CFR Chapter 6, Subpart J. National Marine Fisheries Service, Silver Spring, Maryland
- PFMC 1998. Appendix D to Amendment 8 of the Coastal Pelagic Species Fishery Management Plan. Pacific Fishery Management Council, Portland, Oregon.
- PFMC 2011. Coastal Pelagic Species Stock Assessment and Fishery Evaluation Document. Pacific Fishery Management Council, Portland, Oregon.
- PFMC 2019. Appendix C Part 1 to the Pacific Coast Groundfish Fishery Management Plan: The Effects of Fishing on Groundfish Habitat: A West Coast Perspective. Pacific Fishery Management Council, Portland, Oregon.
- PFMC 2023. Council Operating Procedures. Pacific Fishery Management Council, Portland, Oregon.