WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Options for Refining Essential Fish Habitat for Uku (*Aprion virescens*) under the Hawaii Archipelago Fishery Ecosystem Plan

DRAFT

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Contents

CHAPTER 1. Background Information

As authorized by the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the Western Pacific Regional Fishery Management Council (WPFMC, or the Council) and the National Marine Fisheries Service (NMFS) manage the fisheries for bottomfish in federal waters (the U.S. Exclusive Economic Zone, or EEZ) around the Hawaiian Islands in accordance with the Fishery Ecosystem Plan for the Hawaii Archipelago (Hawaii FEP) and implementing regulations under Title 50 Code of Federal Regulations, Part 665 (50 CFR 665). The proposed action pertains to the management of uku (gray jobfish; *Aprion virescens*), a bottomfish species commonly harvested in Hawaii. Currently, the only active fisheries for uku in Hawaii occur in the Main Hawaiian Islands (MHI), as historical bottomfish fisheries in the Northwestern Hawaiian Islands (NWHI) were closed by NMFS in 2009 in accordance with the provisions of Presidential Proclamation establishing the Papahānaumokuākea Marine National Monument and prohibiting commercial fishing therein (71 FR 51134, August 29, 2006).

Prior to 2019 and after bottomfish fishing closed in the NWHI, the Council and NMFS managed bottomfish management unit species (BMUS) in the MHI under two separate multi-species complexes[1], the MHI Deep 7 bottomfish stock complex and non-Deep 7 bottomfish stock complex. In 2019, NMFS published a final rule (84 FR 2767, February 8, 2019) associated with Amendment 5 to the Hawaii FEP (WPFMC 2018) that reclassified certain management unit species (MUS) as ecosystem component species (ECS).[2] This rule reclassified all of the non-Deep 7 bottomfish species as ECS except uku. Thus, management of uku alone began in 2019, and pursuant to Section 303(a) of the Magnuson-Stevens Act, management of uku under the Hawaii FEP requires the identification and description of essential fish habitat (EFH) for the species.

The MSA defines EFH as "those waters and substrate that are necessary for fish spawning, breeding, feeding, and growth to maturity." This includes marine areas and their chemical and biological properties that are utilized by inhabiting organisms. Substrate includes sediment, hard bottom, and other structural relief underlying the water column as well as their associated biological communities. In 1999, the Council developed and NMFS approved Amendment 6 to the Bottomfish and Seamount Groundfish FMP (74 FR 19067, April 19, 1999) that defined EFH for Hawaii bottomfish, inclusive of uku.

As a part of the 2009 reorganization of the Council's species-based fishery management plans (FMP) into spatially-oriented FEPs (75 FR 2198, January 14, 2010) in which EFH definitions and provisions were carried forward, the Council described Habitat Areas of Particular Concern (HAPC) in addition to and as a subset of EFH. The Council's descriptions of HAPC were based on whether ecological function of the habitat is important, habitat is sensitive to anthropogenic degradation, development activities are or will stress the habitat, and/or the habitat type is rare.

[1] The MSA defines the term "stock of fish" to mean a species, subspecies, geographic grouping, or other category of fish capable of management as a unit. Federal regulations at 50 CFR 660.310(c) defines "stock complex" to mean a group of stocks that are sufficiently similar in geographic distribution, life history, and vulnerabilities to the fishery such that the impact of management actions on the stocks is similar.

[2] ECS remain in the FEP but are not subject to annual catch limits or accountability measures.

In 2016, the Council developed and NMFS approved Amendment 4 to the Hawaii FEP (81 FR 7494, February 2, 2016), which refined the descriptions of EFH and HAPC for Hawaii Archipelago BMUS by categorizing them into three assemblages (i.e., shallow, intermediate, and deep) and identifying EFH and HAPC for each group by life stage (WPFMC 2016). This review and revision occurred over seven years ago, and there have been recent studies furthering the foundational knowledge regarding uku habitat in the waters surrounding the Hawaii Archipelago (e.g., Franklin 2021; Tanaka et al. 2022). NMFS regulatory guidelines (67 FR 2376, January 17, 2002) and implementing regulations at 50 CFR 600.815(a)(10) recommend the Council to review the EFH provisions of its FEPs and revise them as needed based on available information, at least every five years.

1.1 Purpose and Need for Proposed Action

The purpose of this action is for NMFS to refine EFH designations and associated provisions for MHI uku in the Hawaii FEP as recommended by the Council using the best scientific information available. The need for this action is to ensure the Hawaii FEP complies with the NMFS regulatory guidelines (67 FR 2376, January 17, 2002), implementing regulations (50 CFR 600.815(a)(10)), and National Standard 2 (16 USC 1851(a)(2)) that recommend the Council and NMFS periodically review the EFH provisions of the FEPs and revise or amend EFH provisions as warranted based on the best scientific information available. This action is also needed to further support the economic and social benefits of MHI uku fisheries and other activities that take place around uku EFH while ensuring long-term sustainability of the MHI uku stock and habitat.

1.2 Species Description

The ukupalu snapper, commonly known as uku, is a reef-associated snapper of the family Lutjanidae that is an important species in the bottomfish fisheries of Hawaii. Its habitat includes open waters of tropical, coastal Indo-Pacific deep lagoons, channels, or seaward reefs at depths of 14 to 240 m above both hard and soft bottom (Allen 1985; WPFMC 2016; Asher et al. 2017; Nadon et al. 2020). While many bottomfish species harvested in the Pacific Islands Region are caught along the steep drop-offs and slopes adjacent to the islands and banks, uku is primarily caught in shallower water on the tops of these banks, typically with surface trolling lures (Haight et al. 1993a, b; Kelley and Ikehara 2006; Meyer et al. 2007).

Unlike benthic species of deepwater lutjanids, the feeding habits of uku do not limit the species to substrate, and this species forages throughout the water column from the surface down to almost 200 m (Parrish 1987). Uku generally feed during daytime hours, and the diet of individuals collected from the Penguin Bank included mostly fish (Haight 1989).

A majority of uku habitat in the MHI (i.e., 58%) is likely situated around Maui Nui, with Hawai‘i Island (23%), Oahu (11%), and Kauai-Niihau (8%) contributing the remaining habitat (Nadon et al. 2020). While interisland movements were not detected for tagged uku (Meyer et al. 2007), the level of connectivity of the uku sub-populations around the MHI and the significance of larval exchanges or adult movements between the different Hawaiian Islands are still not well known (Nadon et al. 2020).

Uku may live up to 32 years old around Hawaii, and their reproductive strategy is characterized by external dioecism in open waters around the MHI where eggs are scattered throughout their depth range (Allen 1985; Everson and Williams 1989). In Hawaii, uku spawning aggregations occur in the late spring early summer, which coincides with peak landings (Everson and Williams 1989; WPFMC 2022a); however, egg and larval development in this species is not well known. Identifying characteristics of uku larvae appear to be more similar to larvae from species of the genera *Etelis* rather than *Aphareus* or *Pristipomoides*, and uku larvae are pelagic until growing until at least 18 mm before settling prior to reaching 20 mm (Leis and Lee 1994). Uku typically grow to approximately 75 cm in fork length, but large individuals of over a meter have been reported around Hawaii (Sundberg and Underkoffler 2011). Individuals of this species reach maturity at roughly 45 cm in length in Hawaii, coinciding with three to five years in age (Grimes 1987; Everson and Williams 1989).

1.3 Fishery Description

Uku are a popular food fish in Hawaii and are valued by both commercial and non-commercial fishers. As a food fish, uku are similar to some MHI Deep 7 bottomfish species that are sought after for their firm and flavorful white flesh that can be cooked or consumed raw (WPFMC 2022a). However, unlike the Deep 7 bottomfish, fishers do not typically harvest uku to fill the seasonal demand for whole fish during the holidays in Hawaii due to the public's preference for red colored flesh. Uku are commonly consumed by the hotel and restaurant industries that utilize it as a low-price alternative to Deep 7 bottomfish (WPFMC 2022a). The uku fishery was previously managed as a member of the non-Deep 7 BMUS complex, grouped together with the white ulua (*Caranx ignobilis*), black ulua (*Caranx lugubris*), pig-lip ulua (*Pseudocaranx dentex*), and yellowtail kalekale (*Pristipomoides auricilla*) before these four species were reclassified from MUS to ECS in the Hawaii FEP in 2019 (84 FR 2767, February 8, 2019).

In Hawaii, the uku fishery is important for both beginner and veteran fishers, with many targeting the species opportunistically during good weather, when they have live bait, or via trolling when transiting to or from a fishing ground (Ayers 2022). The MHI uku fishery utilizes several different gear types due to the wide range of depths and habitat types frequented by the species (WPFMC 2022a). Uku are both preferentially targeted and caught incidentally by gears including deep-sea handlines, inshore handlines, trolling with bait, spearfishing, shore-based casting, and cast nets, with deep-sea handline being the historically dominant gear and especially in the commercial sector (WPFMC 2022a). However, since 1965, catch using deep-sea handline gear has proportionally decreased as other gears have become more commonly reported; this may be indicative of a shift to fishers directly targeting of uku with unique gears and/or techniques specifically aimed at the species (WPFMC 2022a). Uku are typically targeted and harvested most heavily in May and June of each year during annual spawning aggregations along the Penguin Banks (Nadon et al. 2020), though fishers are still known to catch them year-round in relatively high numbers (WPFMC 2022a).

Following an 1989 peak in commercial uku catch, reportedly due to the sudden appearance of large adult uku in Hawaiian Waters, catch quickly decreased to a relative low in 1996 (WPFMC 2022a). Uku catch began increasing in 2003 until its peak in 2017 and declined thereafter, which is notably similar to trends in the Deep 7 bottomfish fishery. Prior to 2009, a large proportion of landed uku were caught in the NWHI, but the closure in 2009 resulted in fishers shifting their

effort into the waters of the MHI. Several factors likely contributed to the increase in the uku fishery in the 2000s, including high market demand associated with a decrease in NWHI catch, closures of the Deep 7 bottomfish fishery due to exceedance of the ACL causing fishers to switch targets, increased numbers of fishery entrants associated with the economic recession around 2008, and increased demand from the hotel and restaurant industries. However, similar to Deep 7 bottomfish, MHI uku commercial fishery landings and effort have been in a state of decline following a recent peak in 2017 (WPFMC 2022a).

In addition to recent challenges presented by the COVID-19 pandemic, uku fishers have noted that shark depredation and difficult fishing conditions (e.g., unusual current patterns) have been problematic in recent years. Depredation is reportedly especially frequent when uku are directly targeted in high numbers, such as is the case for the fishery at the Penguin Bank where a sizable proportion of MHI uku are caught annually. As a result, fishers have noted that some fishery participants have moved away from targeting uku in recent years (WPFMC 2022a).

Uku bycatch is typically low (i.e., <2%), as the only regulation limiting commercial catch is a one-pound minimum size (§HAR 13-95 2010) and individuals less than one pound can be retained for personal consumption (WPFMC 2022a). Additionally, bottomfish fishing is relatively target-specific (Kawamoto and Gonzalez 2005). However, bycatch proportions have been generally increasing since 2002, possibly because of the increasing contribution over time of the inshore handline gear type, as noted above. Compared to other species targeted with similar gears, uku are retained at a slightly higher rate; this may be associated with commonly-released species (e.g., kahala, sharks) being caught with similar gear types (WPFMC 2022a).

Despite recent decreases in catch, the best scientific information available indicates that the MHI uku stock is relatively healthy. Unlike its previous stock assessment that was comprised of 27 single-species assessments for reef-associated species around the MHI (Nadon 2017), the most recent stock assessment for uku focused solely on uku (Nadon et al. 2020). This assessment utilized a Stock Synthesis approach and concluded that MHI uku are not overfished nor experiencing overfishing (Nadon et al. 2020).

The Council and NMFS have utilized the results of the 2020 stock assessment in management of the species. In 2022, NMFS issued a final rule implementing an annual catch limit (ACL) of 295,419 lb, an annual catch target (ACT) of 291,010 lb, and accountability measures (AM) for MHI uku in fishing years 2022 through 2025 (87 FR 17195, March 28, 2022). For the first time in the uku fishery, these ACLs and ACTs apply to the total combined commercial and non-commercial catch of uku instead of solely the commercial portion of uku catches. As an in-season AM, if NMFS projects that the total catch will reach the ACT in any given fishing year based on Hawaii commercial marine license (CML) and Hawaii Marine Recreational Fishing Survey (HMRFS) data, NMFS will close commercial and non-commercial uku fisheries in federal waters for the remainder of the fishing year. As a post-season AM, if NMFS determines that the most recent three-year average total catch exceeds the ACL in a fishing year, NMFS would reduce the ACL and ACT for the following fishing year by the amount of the overage.

1.4 Overview of Essential Fish Habitat

Section 303(a)(7) of the MSA and implementing regulations at 50 CFR 600.805 require that EFH be described and identified for federally managed species listed in FMPs (i.e., or FEPs) based on NMFS regulatory guidelines (67 FR 2376, January 17, 2002). As stated previously, the MSA defines EFH as "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity," and it requires NMFS and the Council to minimize adverse fishing impacts on EFH to the extent practicable while identifying other actions to encourage the conservation and enhancement of EFH. Further, the MSA requires that federal agencies that authorize, fund, or undertake actions that may adversely affect EFH to consult with NMFS such that NMFS can provide conservation recommendations to federal and state agencies regarding actions that would adversely affect EFH. The Council maintains the authority to comment on these actions and related conservation recommendations.

NMFS regulatory guidelines pertaining to EFH (50 CFR 600.805) state that "FMPs must demonstrate that the best scientific information available was used in the description of and identification of EFH." These guidelines also define the four-level system (50 CFR 600.815(a)(1)(iii)) used to organize the information necessary to describe and identify EFH:

- Level 1: Distribution data are available for some or all portions of the geographic range of the species.
- Level 2: Habitat-related densities of the species are available.
- Level 3: Growth, reproduction, or survival rates within habitats are available.
- Level 4: Production rates by habitat are available.

Councils should strive to describe habitat based on the highest level of detail, but EFH should not be designated in cases where there is no information available on a given species or life stage and habitat usage cannot be inferred from other means (50 CFR 600.815(a)(1)(iii)(B)) .

Further, the NMFS guidelines recommend the Council identify EFH that is especially important to federally managed species as HAPC to help provide additional focus for conservation and management efforts. Identification of HAPC is based on one or more of the following considerations: the importance of the ecological function provided by the habitat; the extent to which the habitat is sensitive to human-induced environmental degradation; whether, and to what extent, development activities are, or will be, stressing the habitat type; and the rarity of the habitat type (50 CFR 600.815(a)(8)).

1.5 Current Uku Essential Fish Habitat in the Main Hawaiian Islands

In 1999, the Council developed and NMFS approved EFH designations for MUS of the Bottomfish and Seamount Groundfish FMP (64 FR 19067, April 19, 1999). Since the approval of the Council's initial EFH descriptions in 1999, various research programs and scientific investigations by the Council, NMFS, and the State of Hawaii have been undertaken for bottomfish in the Hawaiian Archipelago, which was briefly subject to overfishing in 2005 (70 FR 34452, June 14, 2005). These studies assisted the Council, NMFS, and the State of Hawaii in developing complementary conservation and management measures that effectively ended overfishing of Hawaii bottomfish stocks. In 2008, NMFS Pacific Island Regional Office (PIRO) Habitat Conservation Division (HCD) commissioned a compilation and review of the available

scientific literature, unpublished reports, and other data sources available on Hawaii shallow and deep bottomfish species for the purposes of reviewing and improving EFH descriptions.

In 2009, the Council developed and NMFS approved five new FEPs, including the Hawaii FEP. The FEPs incorporate and reorganize elements of the Council's FMPs from a species- or fishery-specific basis to one that is founded on geography (75 FR 2198, January 14, 2010). As a result, EFH designations and related provisions for all FMP fishery resources, including provisions to conserve and enhance EFH and mitigation measures, were subsequently carried forward into the FEPs. Additionally, to prevent and minimize adverse bottomfish fishing impacts to EFH, the Hawaii FEP prohibits the use of explosives, poisons, bottom trawl, and other non-selective and destructive fishing gear (WPFMC 2009).

In 2016, NMFS refined the Hawaii bottomfish EFH and HAPC by categorizing BMUS into three assemblages (i.e., shallow, intermediate, and deep) and identifying EFH and HAPC for each group by life stage (WPFMC 2016). These 2016 refinements remain the current EFH designations for all life stages of shallow-water bottomfish, which includes MHI uku as the only remaining non-Deep 7 bottomfish in the Hawaii FEP (Table 1; Figures. 1 and 2).

Table 1. Current EFH for shallow-water bottomfish, inclusive of uku, in the Hawaii FEP.

Egg	Post-Hatch Pelagic	Post-Settlement	Sub-Adult/Adult
Water column extending from the shoreline to 50 nmi to a depth of 240 m.	Water column extending from the shoreline to the outer boundary of the EEZ to a depth of 240 m.	Water column and bottom habitat extending from the shoreline to a depth of 240 m isobath from the surface to a depth of 240 m.	

Source: WPFMC (2016).

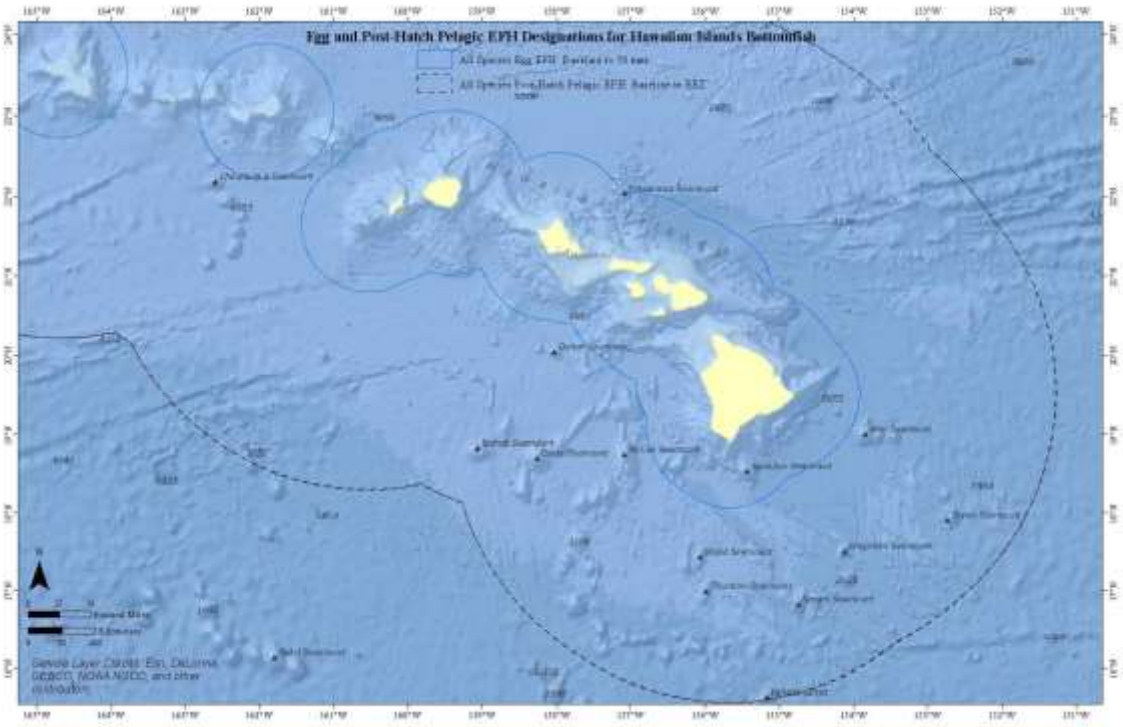

Figure 1. Map of current EFH for egg and post-hatch pelagic phases of MHI bottomfish (Source: WPFMC 2016).

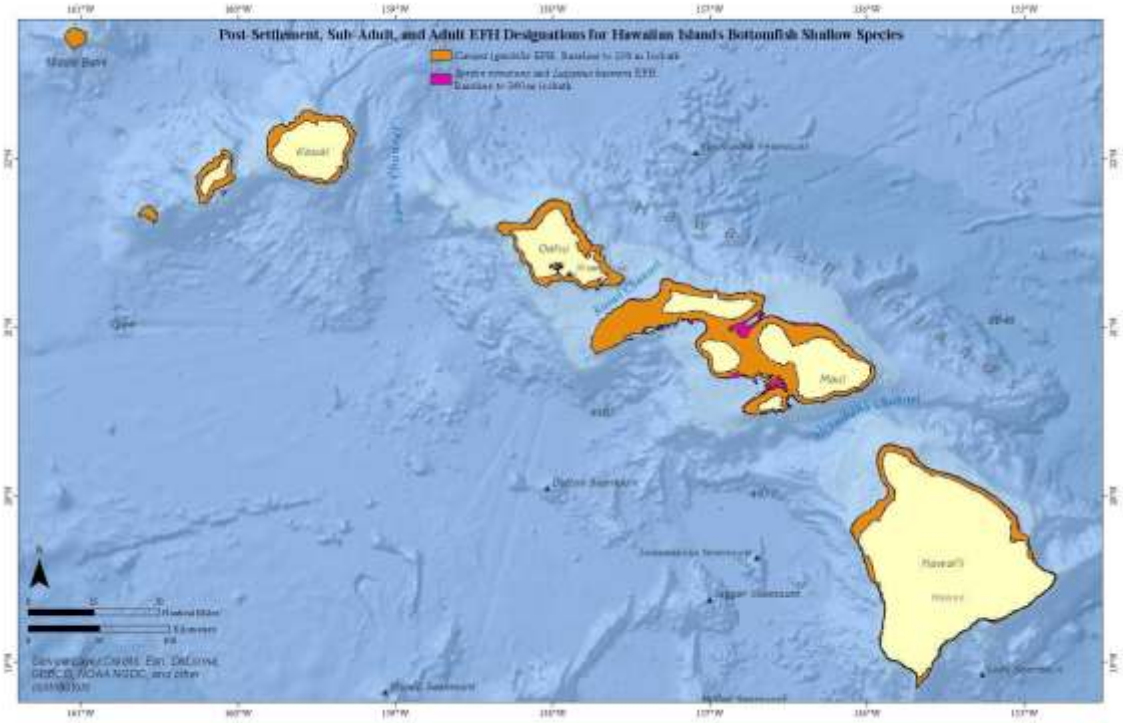

Figure 2. Map of current EFH for post-settlement, sub-adult, and adult life stages of MHI shallow-water bottomfish inclusive of designations for *Caranx ignobilis*, *Lutjanus kasmira*, and *Aprion virescens* (Source: WPFMC 2016).

1.6 Best Scientific Information Available

From July 12-14, 2022, the Council and NMFS convened a Western Pacific Stock Assessment Review (WPSAR) peer-review process for recently developed Level 1 (Franklin 2021) and Level 2 (Tanaka et al. 2022) models to improve the delineations of uku EFH within the MHI (87 FR 38382, June 28, 2022). The WPSAR process represents a cooperative effort between the Council, PIFSC, and PIRO to provide thorough and independent review of stock assessments and other scientific information relevant to fisheries management in the Pacific Islands to ensure the quality and integrity of the science.

The Level 1 products developed by Franklin (2021) provide estimates of uku relative occupancy based on the species' presence-absence data and a species distribution model (SDM) using boosted regression trees (BRT). The BRT model utilized presence-absence data from shallow and deep waters using diver surveys (<30 m) and baited remote underwater videos (BRUV; 30-300 m), inclusive of BotCam and the Modular Optical Underwater Survey System (MOUSS), respectively. In combination, these data streams provide coverage for the vertical habitat range of uku. Thus, the information can be combined with existing published information to improve the delinatation of uku EFH for management purposes; however, there is an issue of spatial discontinuity since two separate BRTs were calibrated independently to estimate uku occurrence in shallow and deep waters (WPFMC 2022b).

The Level 2 products developed by Tanaka et al. (2022) provide estimates of uku density based on a statistical generalized additive mixed model. The fishery-independent diver survey data (2010-2019) was used for Level 2 EFH analysis because it provides the largest spatial domain and also provides standardized uku density (i.e., number of individuals per 100 m^2). No other data source can match the spatial coverage and standardization provided by the diver survey data, making it the only choice for Level 2 analysis. However, this model only generates estimates for shallow-water areas (0-30 m). Thus, while the Level 2 analysis has an acceptable approach for estimating uku density, the source data does not represent the full distribution of the species in the MHI necessary for the delineation of EFH boundaries (WPFMC 2022b). Neither study examined uku egg or larval abundance, instead focusing on EFH for large juvenile, sub-adult, and adult life stages for the species (WPFMC 2022b).

The WPSAR process determined that both the Level 1 and Level 2 approach represent a great improvement over existing literature based descriptions of uku EFH (WPFMC 2005; WPFMC 2016; WPFMC 2022b). However, it was also noted that the fishery independent data sources utilized for the Level 1 and Level 2 modeling approaches generally represent low encounter rates of uku relative to other species and may not necessarily provide estimates at a resolution fine enough to model EFH (WPFMC 2022b).

At its 145th meeting from September 13-15, 2022 (87 FR 53732), the Council's Scientific and Statistical Committee (SSC) received a report on the WPSAR external review of the EFH models for MHI uku. The SSC endorsed the WPSAR recommendations and determined both models to be BSIA. Subsequently, at its 192nd meeting from September 20-22 (87 FR 53732), the Council approved the WPSAR report and directed staff to determine if the models could be used to refine the identification and description of uku EFH in the Hawaii FEP.

CHAPTER 2. Description of the Options

2.1 Development of Options to Refine Essential Fish Habitat for Uku in the Main Hawaiian Islands

The options under consideration by the Council were developed in coordination with NMFS PIFSC, NMFS PIRO, and Hawaii DAR. The EFH definitions and subcategories utilized in this options paper were adopted from the NMFS Alaska Fisheries Science Center (AFSC). The Final Environmental Impact Statement for EFH Identification and Conservation in Alaska defines EFH as the area inhabited by 95% of a species' population and, alternatively, as the area containing 95% of the occupied habitat. To estimate the latter '95% of the occupied habitat' standard, researchers in this study used the areas with predicted species encounter probabilities of ≥5% (NMFS 2005). More recent habitat-based modeling approaches characterize EFH as the area circumscribing the top 95% of the SDM-predicted abundance of the species (Laman et al. 2022, Harris et al. 2022). For the purposes of designating EFH for uku in the MHI, EFH is considered the spatial domain containing 95% of predicted uku occurrence (Level 1) or abundance (Level 2).

Within these EFH designations are more focused partitions of the total EFH area known as subareas, indicative of the top 25% (EFH hot spots), top 50% (EFH core area), and top 75% (principal EFH) of habitat-related, model-predicted occurrence and abundance; these thresholds have also been implemented by the NMFS AFSC (NPFMC 2023). In this way, presented EFH is defined by four quantiles (i.e., 5%, 25%, 50%, and 75%) derived from cumulative distributions of predicted uku occurrence (Level 1; Franklin 2021) and abundance (Level 2; Tanaka et al. 2022). These quantiles are utilized as EFH thresholds to interpret the model predictions, which include predicted occurrence and abundance maps. Areas characterized by predicted uku occurrence or abundance below the 5% quantile were discarded, as these areas are considered to be below the EFH threshold. For example, if the 5% quantile of the predicted probability of uku occurrence is 0.015, then this value represents the threshold for the bottom 5% of the predicted highest occurrence or abundance areas (i.e., the 95% threshold in the EFH maps).

2.2 Options for Refining Essential Fish Habitat for Uku in the Main Hawaiian Islands

The following options are under consideration. Under each option, all MSA requirements other than those pertaining to EFH would be unchanged, including those associated with HAPC, stock status, fishery and bycatch monitoring, human communities, and ACL and AM specifications. Under all options, the EFH designations for egg and post-hatch pelagic (i.e., larval) phases of uku would be retained as they were specified for MHI bottomfish in Amendment 4 to the Hawaii FEP; proposed revisions to uku EFH in the MHI are limited to the sub-adult and adult life stages for the species. Further, the proposed revisions to uku EFH in the Hawaii FEP under each of the presented options would not substantively change the impacts of EFH as analyzed in the 2016 amendment to the Hawaii FEP that revised descriptions and identification of EFH for Hawaiian Archipelago bottomfish because the EFH footprint for the species would not radically change (i.e., except under Option 3).

Additionally, none of the options presented here would identify new HAPC or revise any HAPC currently listed in the Hawaii FEP. If desired, under any option, the Council could initiate a process to implement new or revise existing HAPC designations for MHI uku. The procedures to identify and/or revise HAPC could involve the Council undertaking a more elaborate process based on the four criteria described in implementing regulations (50 CFR § 600.815(a)(8)), NMFS EFH guidance (NMFS 2006), and a WPSAR process, as were the most recent HAPC designations for Hawaii bottomfish (WPFMC 2016). NEPA analyses would be required for each potential action to designate HAPC, though the expected impacts of such designations are not significant.

2.2.1 Option 1: No Action (Status Quo)

Under Option 1, the Council would not recommend amending the Hawaii FEP to refine uku EFH in the MHI associated with the recently developed and peer-reviewed Level 1 (Franklin 2021) and Level 2 (Tanaka et al. 2022) EFH model products. The existing EFH designations for uku that have remained in place since 2016 when they were established for an assemblage of shallow-water bottomfish species in the Hawaii FEP (81 FR 7494, February 12, 2016) would persist with no changes.

Expected Outcomes

The No Action option would result in no changes to EFH for uku in the Hawaii FEP management area around the MHI. Federal agencies authorizing or funding activities in this area that may affect uku EFH would still be required to consult with the NMFS HCD to identify recommended measures, if necessary, to mitigate impacts to EFH that are more than minimal or not temporary. These consultations would be based on uku EFH in the MHI as described in Amendment 4 the to Hawaii FEP (WPFMC 2016).

2.2.2 Option 2: Refine uku EFH in the Hawaii FEP using only Level 1 information

Under Option 2, the Council would recommend amending the Hawaii FEP to refine uku EFH in the MHI according to the products of the Level 1 EFH models developed by Franklin (2021) as provided in Figure 3. This option would revise EFH for the sub-adult/adult life stage for uku in the MHI that was originally designated in 2016 for shallow-water bottomfish, including *Aprion virescens*, *Lutjanus kasmira*, and *Caranx ignobilis* (see Figure. 2; WPFMC 2016). Qualitative, text-based descriptions of EFH (Table 1) would be replaced by model-derived visualizations (Figure 3) and the related data files for the spatial extent of the species' EFH. Descriptions of EFH for other life stages of uku (i.e., egg, post-hatch pelagic, and post-settlement) would remain exactly as they were approved in the Council's Amendment 4 to the Hawaii FEP in 2016. This option would not implement revisions to EFH designations for MHI uku associated with the Level 2 modeling products developed by Tanaka et al. (2022).

Expected Outcomes

Option 2 would result in the EFH designations for the sub-adult/adult life stage of MHI uku being revised consistent with the BSIA for Level 1 EFH (i.e., Franklin 2021), effectively

improving the existing text-based EFH descriptions for the species by basing updated EFH designations on new data and models that identify EFH based on uku occurrence. The application of the Franklin (2021) Level 1 model products would not result in a reclassification of EFH data, as the EFH designations for uku are currently considered Level 1. The proposed revisions to EFH under Option 2 would require no regulatory changes, and changes to management resulting from the refinement of uku EFH are not expected; the total area defined as EFH for uku in the MHI is relatively similar to the current footprint of uku EFH in the MHI with additional spatial delineation that allows for areas that are more ecologically meaningful to uku to be identified. Federal agencies that conduct, authorize, or fund activities in the area would still be required to consult with NMFS HCD to identify recommended conservation measures, if necessary, to mitigate impacts to EFH that are more than minimal or not temporary. The Council does not expect Option 2 to result in significant overall impacts.

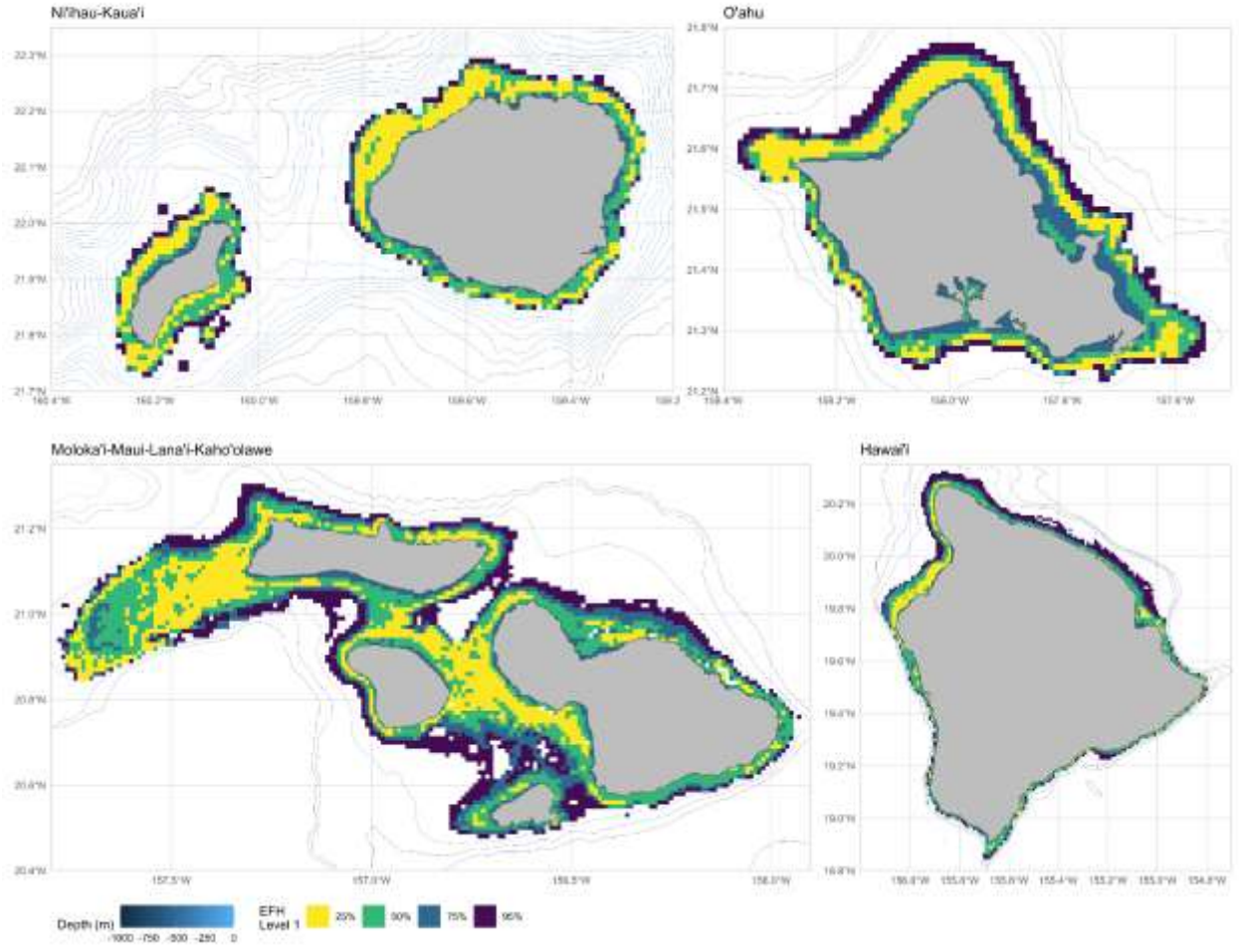

Figure 3. Map of uku EFH in the MHI derived from Level 1 boosted regression tree modeling products (Franklin 2021)

2.2.3 Option 3: Refine uku EFH in the Hawaii FEP using only Level 2 information

Under Option 3, the Council would recommend amending the Hawaii FEP to refine uku EFH in the MHI according to the products of the Level 2 EFH model developed by Tanaka et al. (2022) as provided in Figure 4. Similar to Option 2, this option would revise the 2016 shallow-water bottomfish EFH designations (i.e., *Aprion virescens*, *Lutjanus kasmira*, and *Caranx ignobilis*) for the sub-adult/adult life stage for uku in the MHI (see Figure. 2; WPFMC 2016). The spatial extent of uku EFH in the MHI would be described using model-derived visualizations and related data files (e.g., Figure. 4) that would replace the qualitative text descriptions of EFH that currently exist. Descriptions of EFH for other life stages of uku (i.e., egg, post-hatch pelagic, and post-settlement) would remain exactly as they were approved in the Council's Amendment 4 to the Hawaii FEP in 2016. This option would not implement revisions to EFH designations for MHI uku associated with the Level 1 modeling products developed by Franklin (2021).

Expected Outcomes

Option 3 would result in the Hawaii FEP being amended to revise the EFH designations for the sub-adult/adult life stage of uku in the MHI consistent with the BSIA for Level 2 EFH (i.e., Tanaka et al. 2022). These revisions would represent an improvement to the current qualitative, text-based descriptions of EFH for shallow-water bottomfish designated by the Council in 2016 that applied to uku (WPFMC 2016) by basing updated descriptions on new data and models that identify and describe EFH based on uku abundance (i.e., density). The proposed action to revise EFH under this option would require no regulatory changes. Thus, the Council does not expect Option 3 to result in significant direct impacts to the uku stock or its associated fishery.

There may be administrative or management changes associated with Option 3. The notable reduction in the EFH footprint area from the current designations (i.e., Figure. 2) to the proposed designations (i.e., Figure. 4) would reduce the area in which federal agencies that authorize, fund, or undertake actions that may adversely affect EFH would be required to consult with NMFS HCD regarding impacts to uku habitat and related conservation recommendations. Additionally, the EFH data for MHI uku would be reclassified from Level 1 to Level 2 over the area for which the model has data to describe habitat (i.e., from the shoreline seaward to a depth of 30 m).

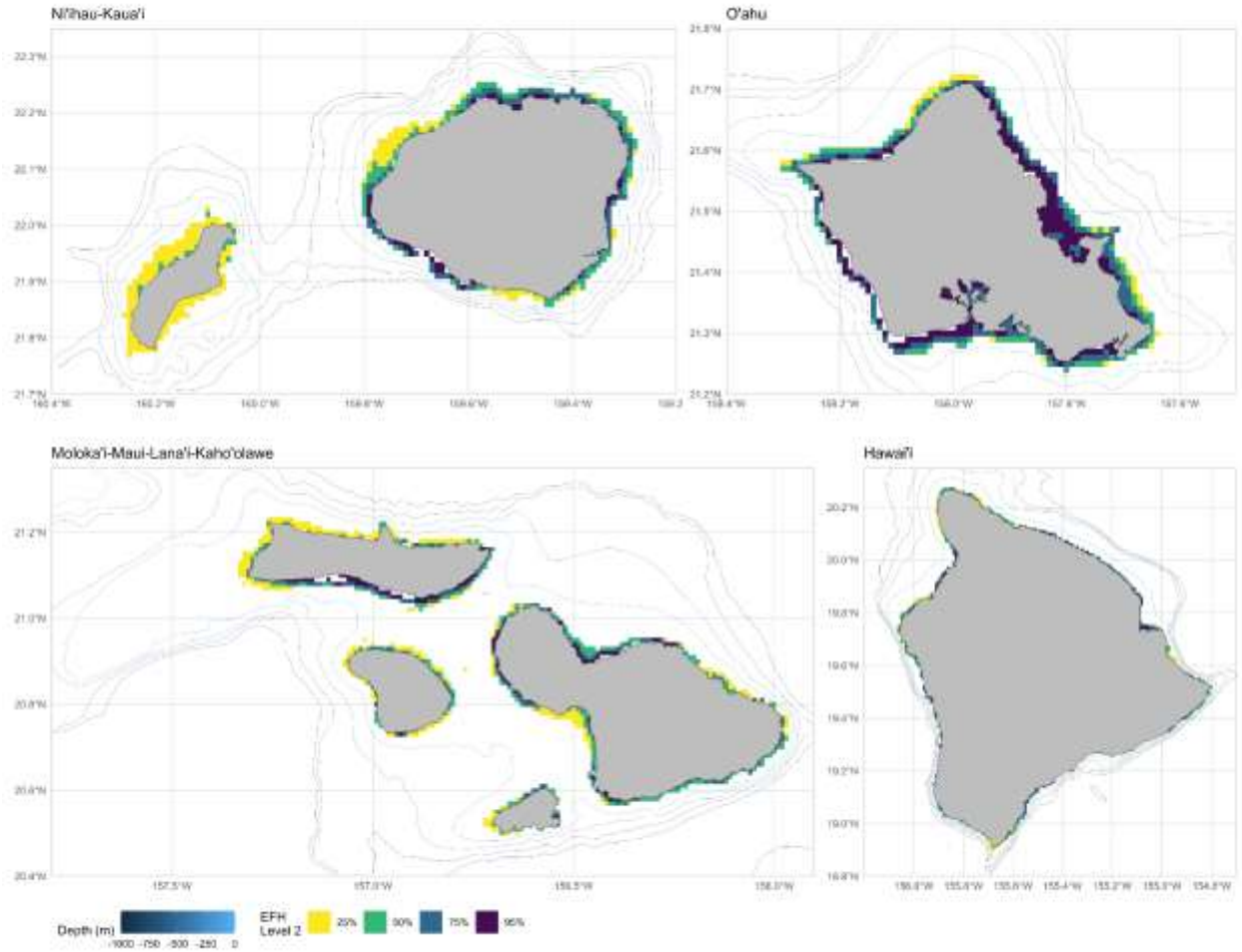

Figure 4. Map of uku EFH in the MHI derived from Level 2 generalized additive mixed modeling products (Tanaka et al. 2022)

2.2.4 Option 4: Refine uku EFH in the Hawaii FEP by overlaying Level 1 and Level 2 information

Under Option 4, the Council would recommend amending the Hawaii FEP to refine uku EFH in the MHI using an overlay of products from both the Level 1 EFH models developed by Franklin (2021) as well as the Level 2 model developed by Tanaka et al. (2022) as shown in Figure 5. In addition to identifying and describing uku EFH in the MHI in this way, additional thresholds of EFH for the species would be identified (i.e., top 25% and 50%, EFH hot spots and core EFH, respectively, see Figure. 6 and 7) to better describe ecologically-meaningful areas for which mitigation of adverse impacts to uku and its habitat could be prioritized during federal agency consultation. This option would revise the current EFH designation for the sub-adult/adult life stage of MHI uku implemented in 2016 for Hawaii's shallow-water bottomfish (see Figure. 2; WPFMC 2016). Similar to Options 2 and 3, the current text descriptions (Table 1) would be replaced with model-based descriptions and visualizations of uku EFH in the MHI (e.g., Figure. 5 through 7). Descriptions of EFH for other life stages of uku (i.e., egg, post-hatch pelagic, and

post-settlement) would remain exactly as they were approved in the Council's Amendment 4 to the Hawaii FEP in 2016.

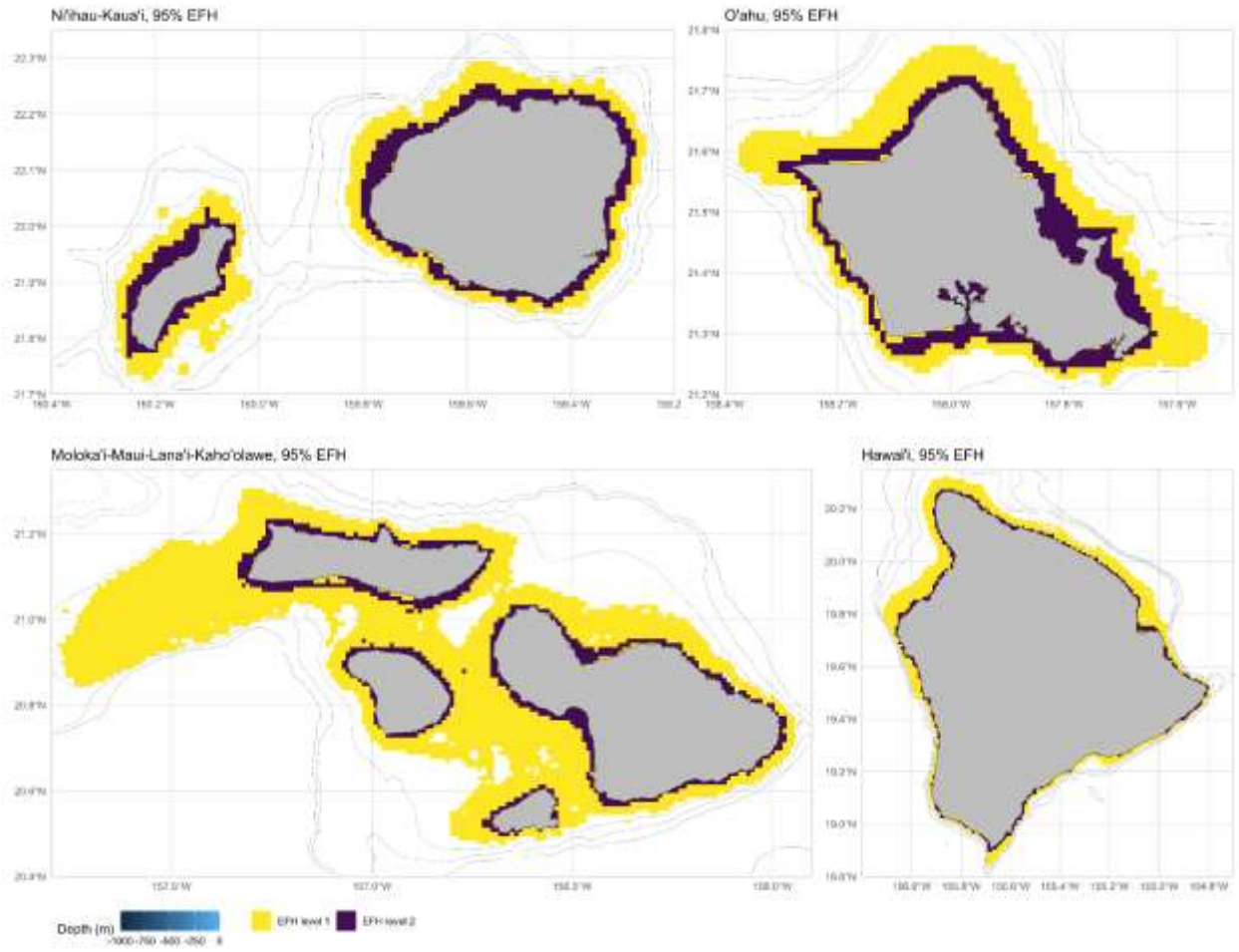

Figure 5. Map of uku EFH in the MHI derived from overlaying Level 1 (Franklin 2021) and Level 2 (Tanaka et al. 2022) modeling products for the area containing the top 95% of uku occurrence and abundance, respectively

Expected Outcomes

Under Option 4, the EFH designations for the sub-adult/adult life stage of uku in the MHI would be amended in the Hawaii FEP preferentially utilizing Level 2 model products in the spatial domain over which they are available (i.e., typically from the shoreline extending seaward to a depth of 30 m), supplemented by Level 1 products in the offshore areas (i.e., generally 30 to 300 m depth) as well as in nearshore areas for which Level 2 data was not indicative of EFH. The proposed refinements to uku EFH in the MHI would represent an improvement over the current text descriptions of EFH (WPFMC 2016) by implementing descriptions and visualization of EFH for the species based on new data and model products based on uku occurrence and abundance that have been determined to be the BSIA. The proposed action under Option 4 would require no

regulatory changes, and the Council does not expect this option to result in significant impacts to the uku stock or fishery.

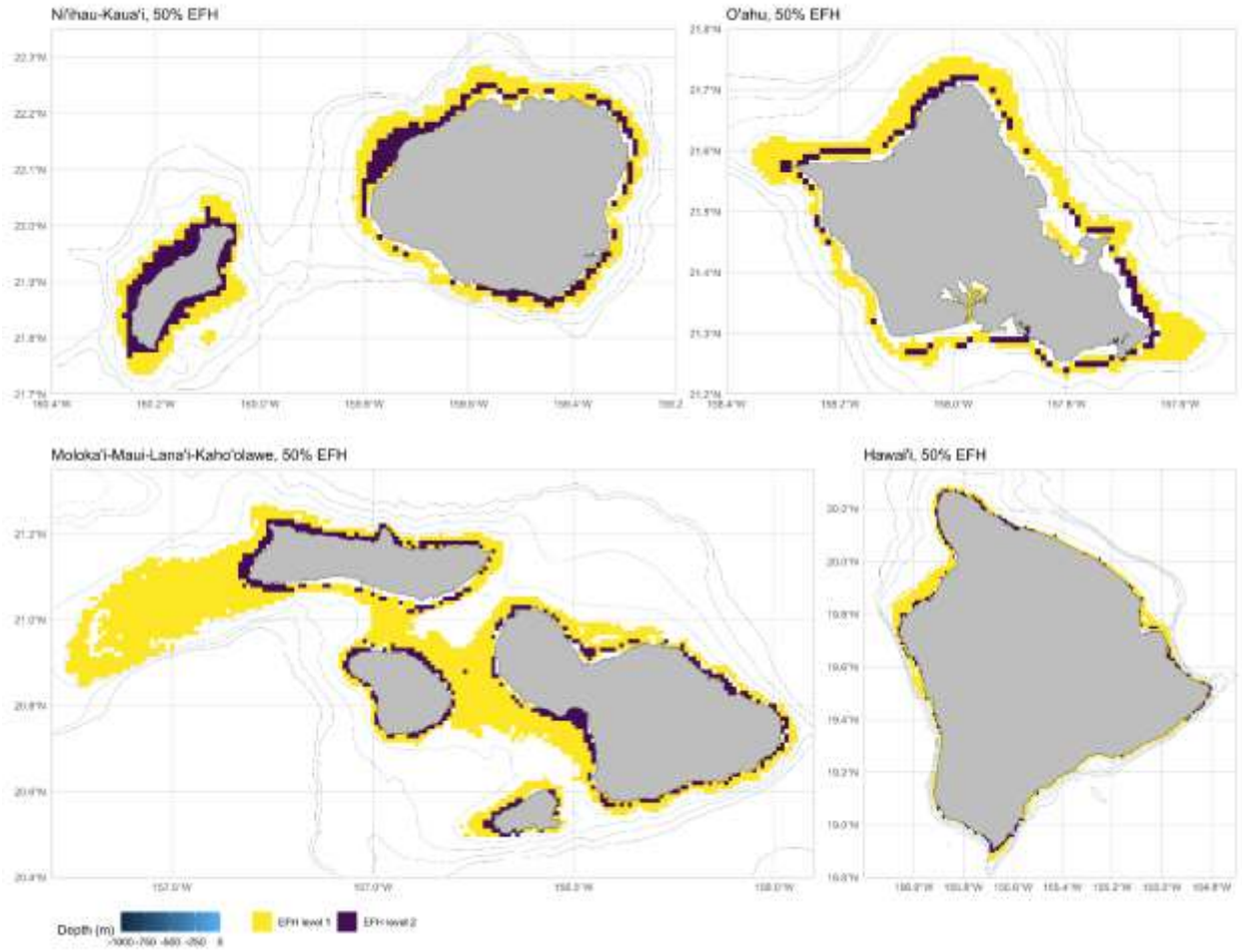

Figure 6. Map of uku EFH in the MHI derived from overlaying Level 1 (Franklin 2021) and Level 2 (Tanaka et al. 2022) modeling products for the area containing the top 50% of uku occurrence and abundance, respectively

This option would also represent improvements over the expected outcomes of Options 2 and 3. Relative to Option 2, Option 4 would provide Level 2 EFH in the spatial domain from 0 to 30 m depth in lieu of only having Level 1 EFH information, which would be consistent with implementing regulations at 50 CFR 600.815(a)(1)(iii)(B) that recommend the Council to describe habitat based on the light level of detail. Relative to Option 3, Option 4 would provide Level 1 EFH descriptions in the offshore areas (i.e., in waters with depths greater than 30 m) for which Level 2 information is not available. Thus, under this option, the EFH footprint for MHI uku would remain relatively comparable to as it currently exists, similar to Option 2, and the area in which federal agencies would need to consult with NMFS HCD with respect to uku habitat impacts would be similar. Therefore, impacts to administration or management in consideration of uku EFH would not be as large as they are under Option 3 and would be analogous to Option 2. The additional thresholds provided (e.g., 25% and 50%, Figure. 6 and 7, respectively) could be utilized during consultations at the discretion of NMFS HCD indicative of areas that are

relatively more important to the species. Additionally, EFH data for MHI uku would be reclassified from Level 1 to Level 2 over the area which the Tanaka et al. (2022) model has data to describe habitat (i.e., generally from the shoreline offshore to a depth of 30 m).

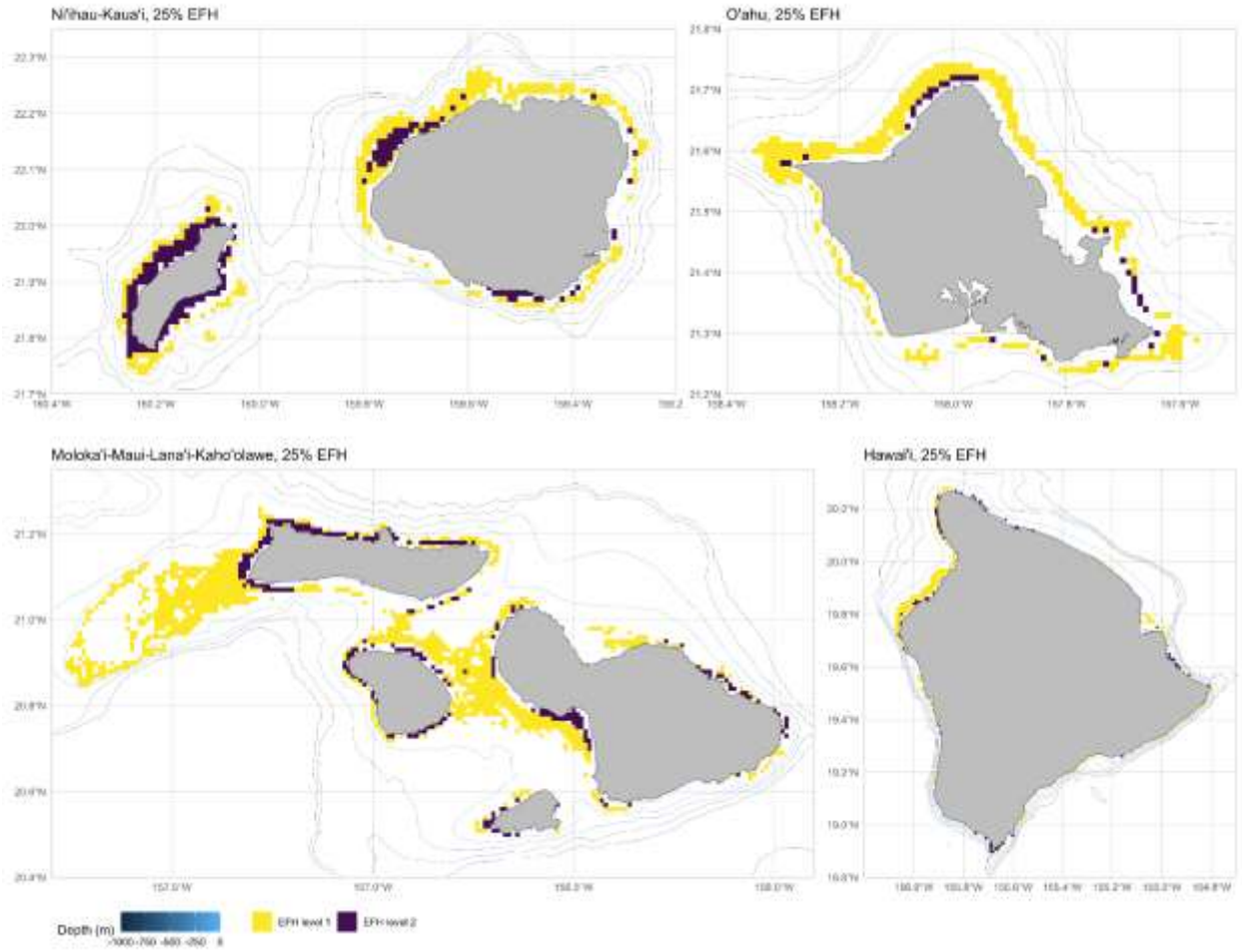

Figure 7. Map of uku EFH in the MHI derived from overlaying Level 1 (Franklin 2021) and Level 2 (Tanaka et al. 2022) modeling products for the area containing the top 25% of uku occurrence and abundance, respectively

2.2.5 Option 5: Refine uku EFH in the Hawaii FEP by averaging Level 1, Level 2, and standardized CPUE information

Under Option 5, the Council would recommend amending the Hawaii FEP to refine uku EFH in the MHI using products from the Level 1 EFH models developed by Franklin (2021) (Figure 9), the Level 2 model developed by Tanaka et al. (2022) (Figure 10), and the standardized catch per unit effort (CPUE) model outputs used in the most recent uku stock assessment (Nadon et al. 2020) (Figure 11) using the mean across all three percentile maps for each grid cell as shown in Figure 12. The standardized CPUE model outputs derived from Nadon et al. (2020) uses commercial data from the State of Hawaii Division of Aquatic Resources (DAR) Fisher

Reporting System from 1948 to 2019, with summer defined as the months from May August (i.e., peak months for uku CPUE) and winter defined as all remaining months.

In addition to identifying and describing uku EFH in the MHI in Figure 12, additional subareas of EFH for the species would be identified (i.e., top 25%, 50%, and 75% of EFH derived from the average of the three modeling products, EFH hot spots, core EFH, and principal EFH, respectively) as shown in Figure 13. These EFH partitions could serve to better describe ecologically-meaningful areas that could be used when devising approaches related to the mitigation of adverse impacts to uku and its habitat during federal consultations by action agecnies. Other than the EFH visualization provided in Figure 13, these EFH partitions would only be qualitatively described in the FEP due to their model-derived nature.

Option 5 would result in the revision of the current EFH designation of the sub-adult/adult life stage of MHI uku implemented in 2016 for Hawaii's shallow-water bottomfish (see Figure 2; WPFMC 2016). Similar to Options 2 through 4, the current text descriptions (Table 1) would be replaced with model-based text descriptions and mapping visualizations of uku EFH in the MHI (e.g., Figures 5 through 7). Descriptions of EFH for other life stages of uku (i.e., egg, post-hatch pelagic, and post-settlement) would remain exactly as they were approved in the Council's Amendment 4 to the Hawaii FEP in 2016.

Expected Outcomes

Under this option, MHI uku EFH designations would be amended in the Hawaii FEP for the sub-adult/adult life stage. Option 5 would utilize an average across Level 1, Level 2, and standardized CPUE model products according to the spatial domain for which the products are available. For example, in grid areas where all three products are available, the final product would utilize a mean of all three, but the average would only cover Level 1 and CPUE model products in areas where only those data are available (i.e., offshore areas, generally 30 to 300 m depth, and nearshore areas for which Level 2 data was not indicative of EFH). The proposed action to refine uku EFH in the MHI would represent an improvement over the current text-based descriptions of uku EFH (WPFMC 2016) in which EFH is described similarly for multiple species based on their known depth distributions. The Council would preferentially utilize BSIA by implementing new EFH mapping visualizations as well as associated text descriptions of these maps based on data and model products for uku occurrence, abundance, and CPUE made recently available. The proposed refinement to uku EFH under Option 5 would require no regulatory changes, and the Council does not expect this option to result in significant impacts to the uku stock or fishery because it would not impact fishery operations.

Option 5 would represent an improved approach relative to those described under Options 2, 3, and 4 due to the consideration of fishery-dependent data that emphasize additional areas of importance when considering habitats necessary for the spawning, breeding, feeding, and growth of the species (e.g., spawning aggregations on Penguin Bank). Relative to Option 2, Option 5 would provide Level 2 EFH information in the spatial domain from 0 to 30 m depth and add considerations for uku CPUE throughout the species' spatial domain instead of solely utilizing on Level 1 EFH information; this would be consistent with implementing regulations at 50 CFR 600.815(a)(1)(iii)(B) that recommend the Council to describe habitat based on the light level of

detail. Relative to Option 3, Option 5 would provide Level 1 EFH descriptions in the offshore areas (i.e., in waters with depths greater than 30 m) for which Level 2 information is not available as well as CPUE information across the spatial domain of the species. Relative to Option 4, Option 5 provides additional considerations for fishery-dependent data given the relative importance of uku to Hawaii small boat fisheries. The inclusion of CPUE information on top of the Level 1 and Level 2 modeling products allows for additional areas of importance to the species to be emphsized, such as the known spawning aggregations of the species on Penguin Bank to the southwest of Molokai (Nadon et al. 2020).

Under Option 5, the overall EFH footprint for MHI uku would be similar with the current EFH footprint, similar to Option 2 and Option 4, with some small spatial areas off of the Hilo coast of the Big Island not meeting the EFH thresholds (see Figure 13). Thus, the area in which federal agencies would need to consult with NMFS HCD with respect to impacts to uku habitat would be relatively comparable. Administrative and management impacts associated with uku EFH would not be as large as expected under Option 3 and would align with expected outcomes under Option 2 or Option 4. Like these options, the inclusion of addition EFH subareas (e.g., EFH hot spots and core EFH) would allow for NMFS HCD, at their discretion, to utilize these more detailed habitat descriptions to emphasize ecologically-meaningful areas during the consultation process. Further, Option 5 would be similar to Option 4 in that EFH data for MHI uku would be reclassified from Level 1 to Level 2 over the area which the Tanaka et al. (2022) model has data to describe habitat (i.e., generally from the shoreline offshore to a depth of 30 m).

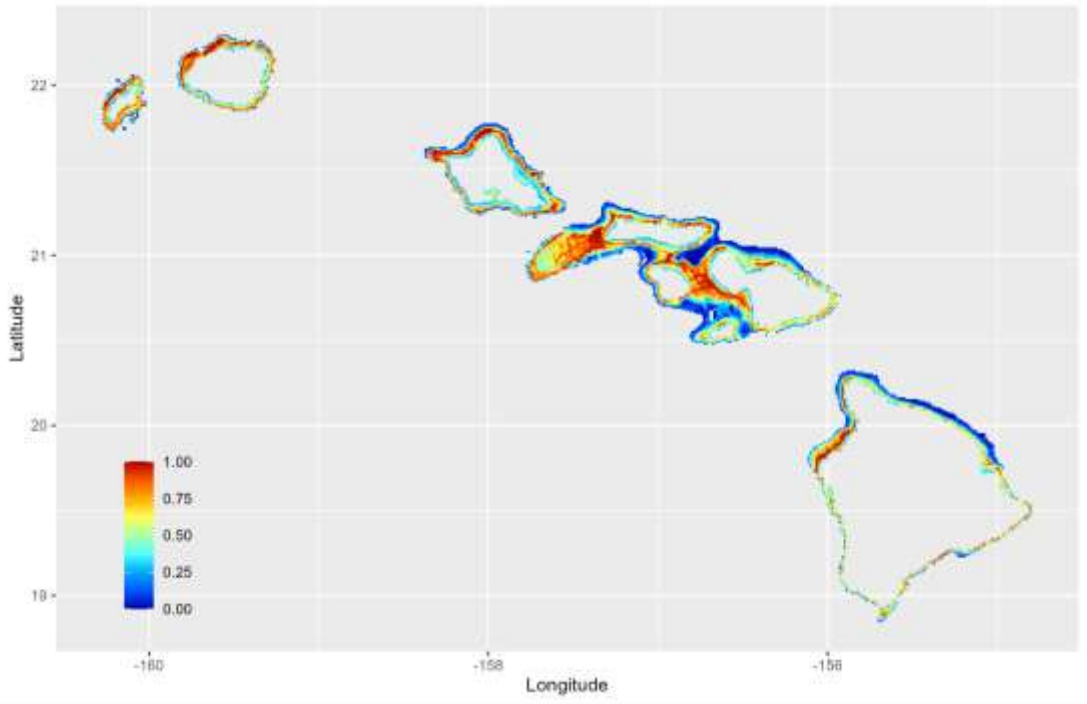

Figure 9. Map of uku EFH in the MHI derived from Level 1 boosted regression tree modeling products (Franklin 2021) showing the percentile of model-predicted probability of occurrence for the species by grid area.

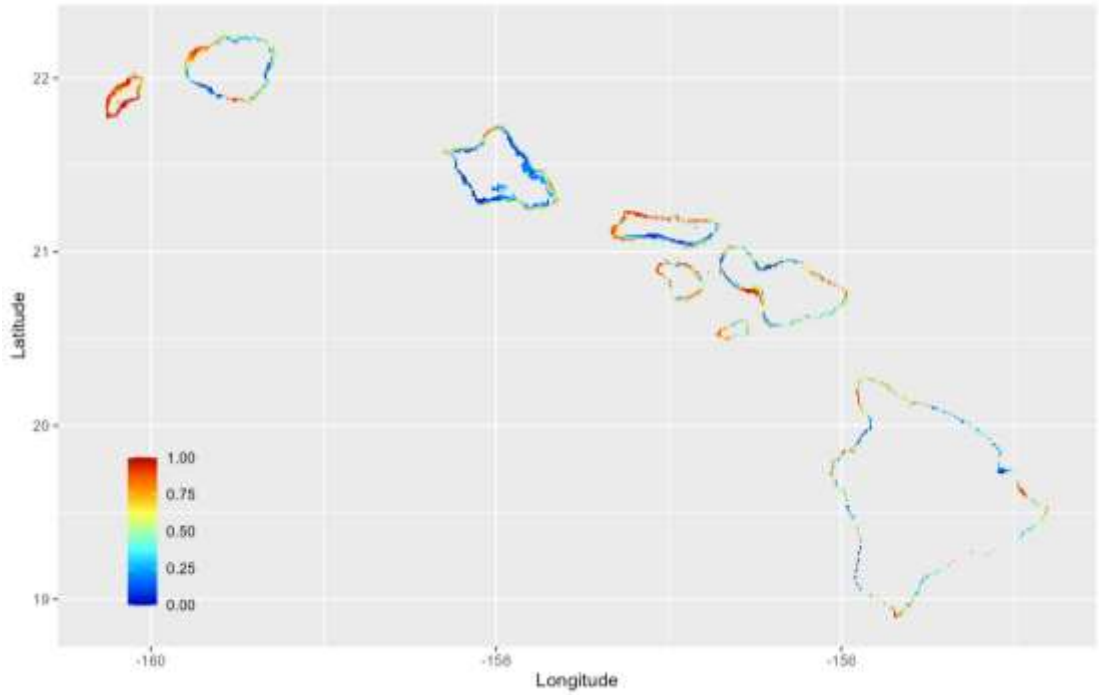

Figure 10. Map of uku EFH in the MHI derived from Level 2 generalized additive mixed modeling products (Tanaka et al. 2022) showing the percentile of model-predicted abundance for the species by grid area.

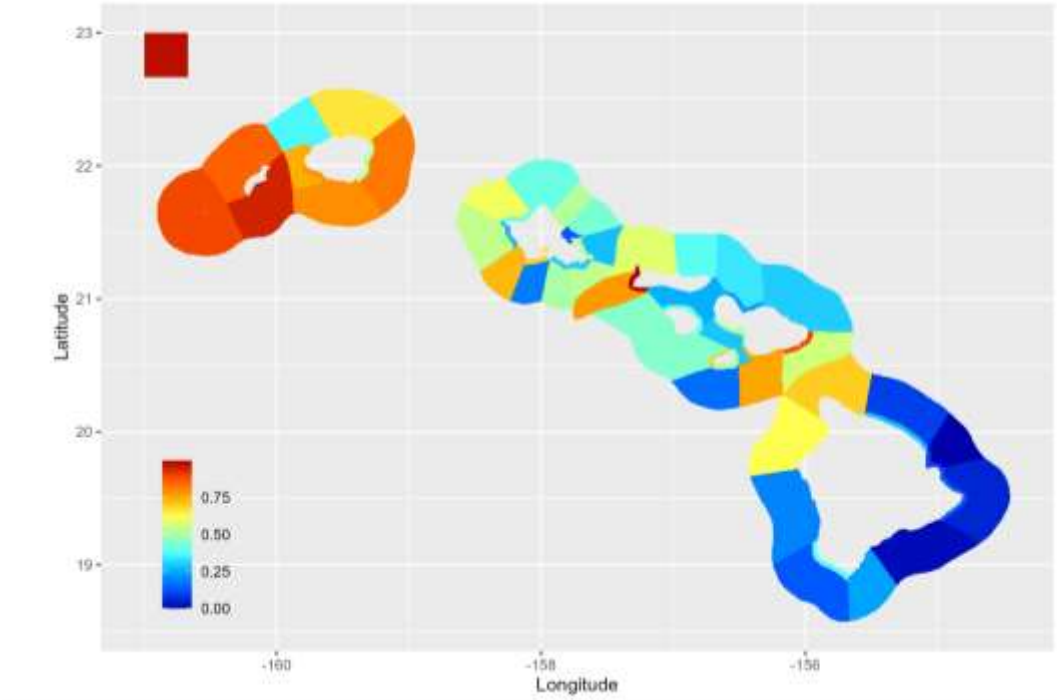

Figure 11. Map of standardized commercial summer and winter CPUE for the harvest of uku around the MHI from the most recent uku stock assessment (Nadon et al. 2020) showing the percentile of CPUE for the species by reporting area.

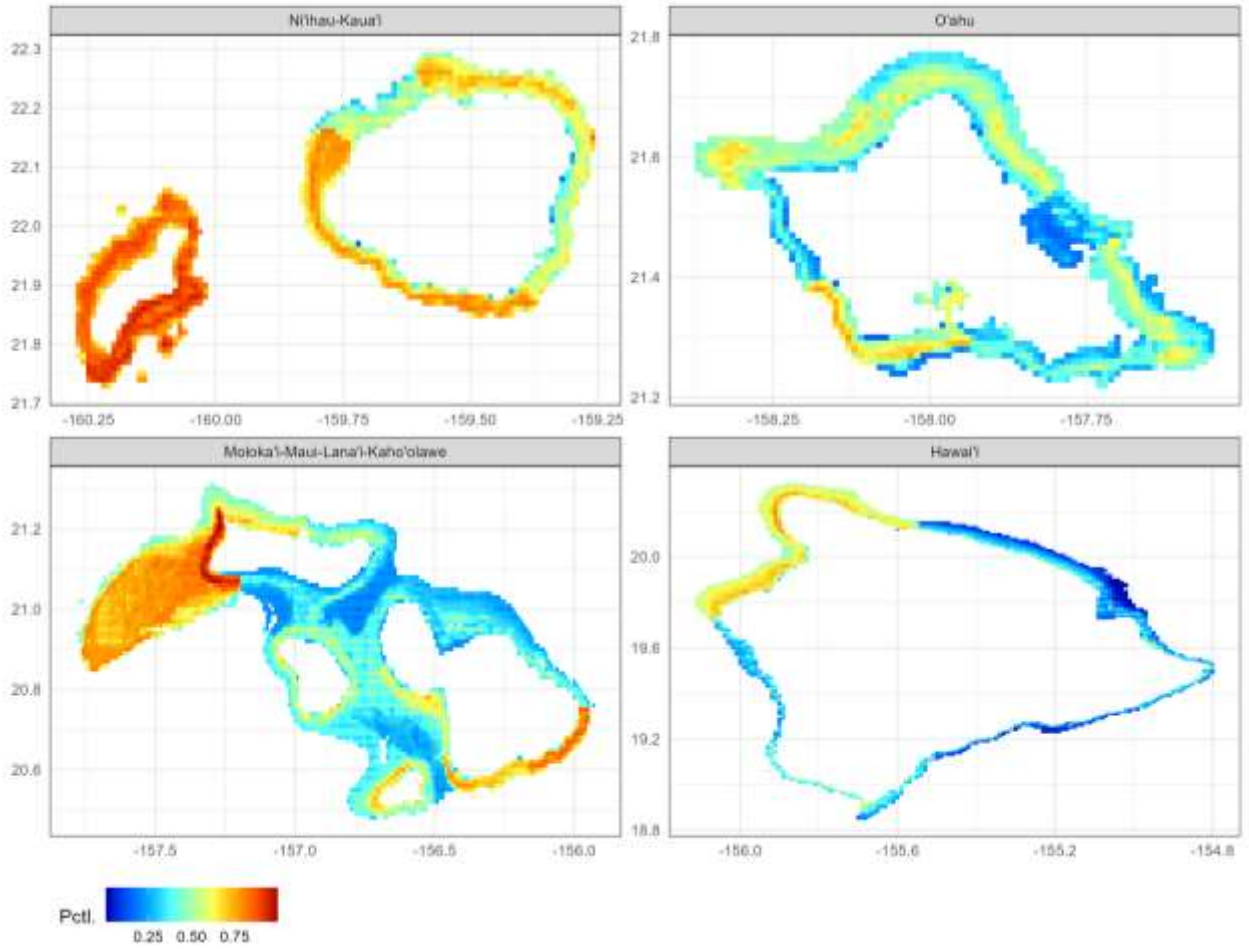

Figure 12. Map of mean percentile from the Level 1 EFH model product in Figure 9, Level 2 EFH model product in Figure 10, and standardized CPUE model in Figure 11, bounded by Level 1 data footprint.

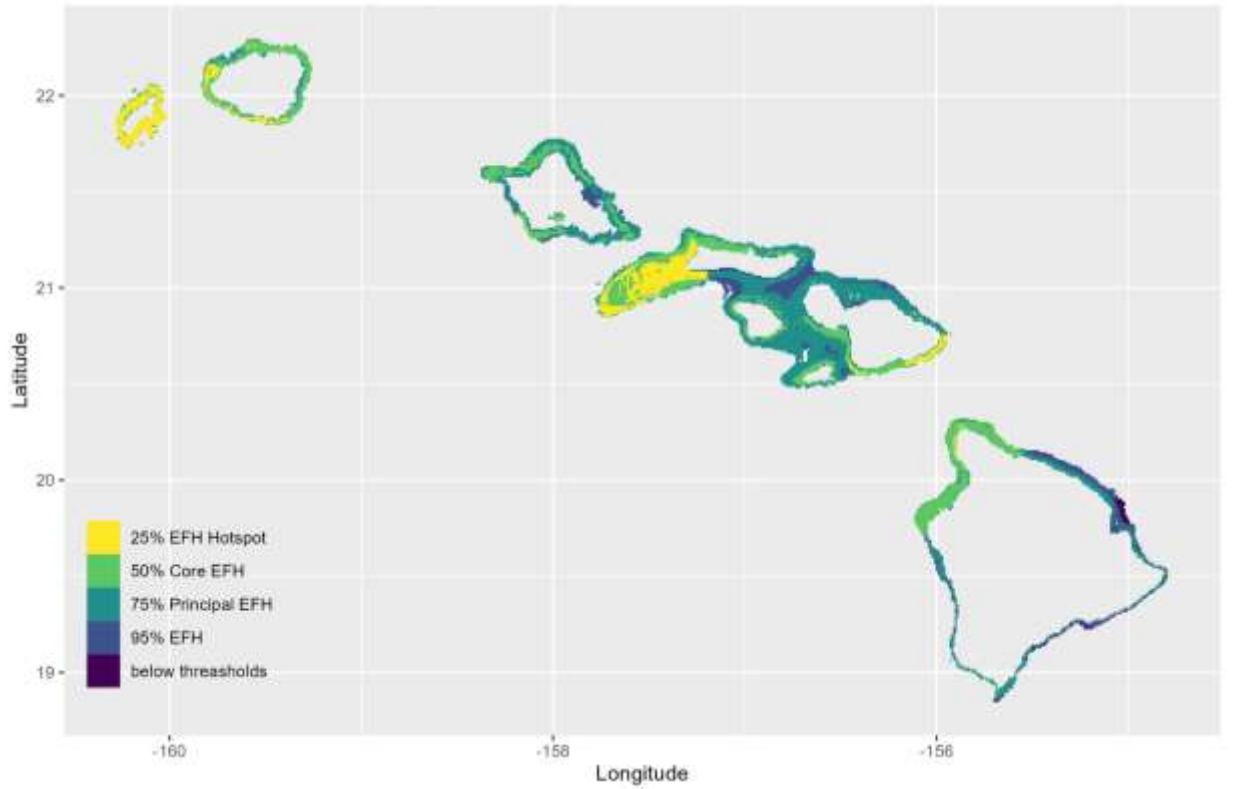

Figure 13a. Map of uku EFH in the MHI derived from averaging Level 1 EFH modeling products (Franklin 2021), Level 2 EFH modeling products (Tanaka et al. 2022), and standardized CPUE modeling products (Nadon et al. 2020) showing the area containing the top 95% of uku occurrence, abundance, and CPUE, with additional EFH subareas for EFH hot spots (i.e., the top 25% of averaged model-predicted occurrence, abundance, and CPUE), core EFH (i.e., the top 50%), and principal EFH (i.e., the top 75%)

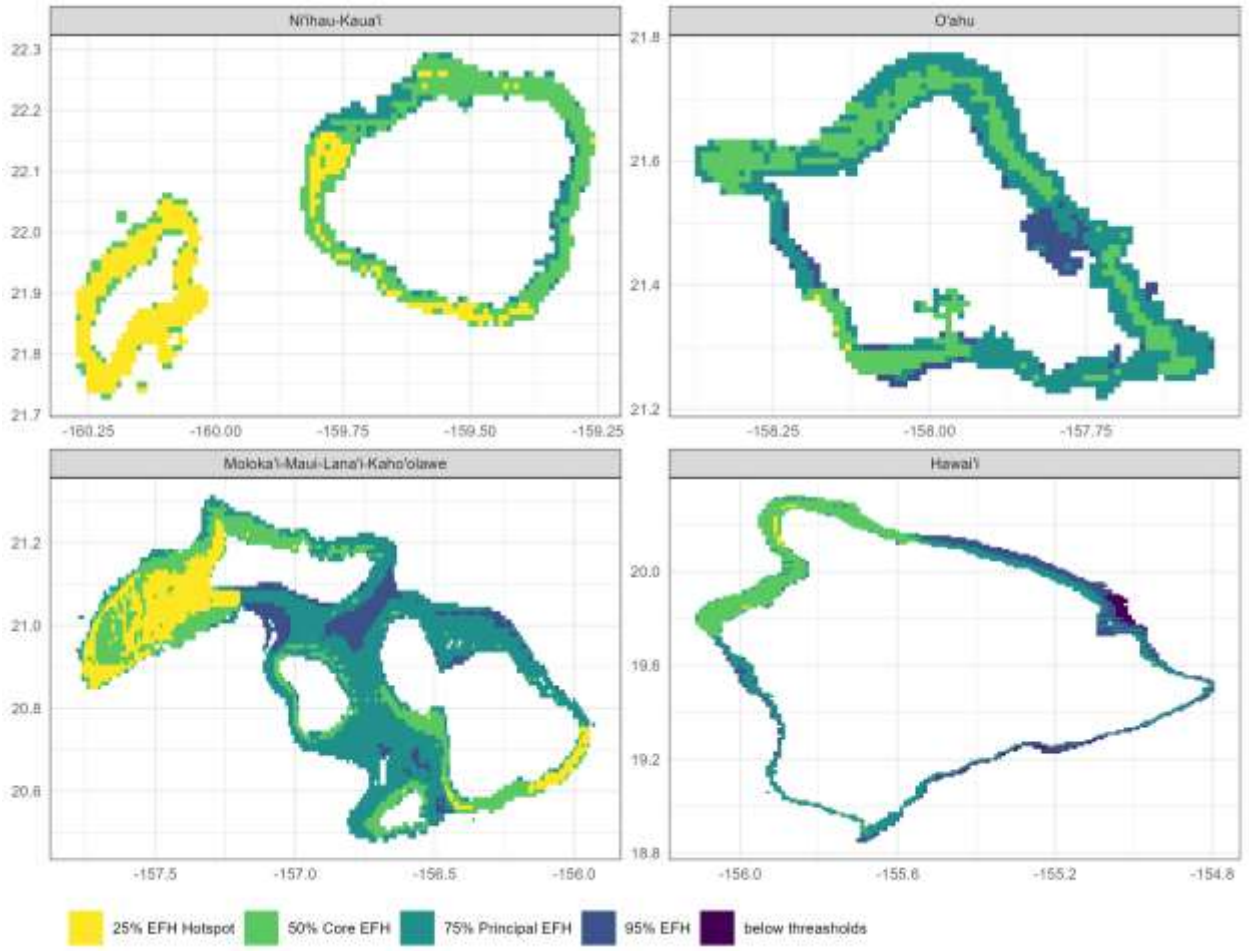

Figure 13b. Island-based map of uku EFH in the MHI with identical data as Figure 13a

2.3 Advisory Group Action

The Council Advisory Groups will discuss the viability of each of these options and provide input on refining EFH for uku in the Hawaii FEP management area around the MHI before making a recommendation to the Council.

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