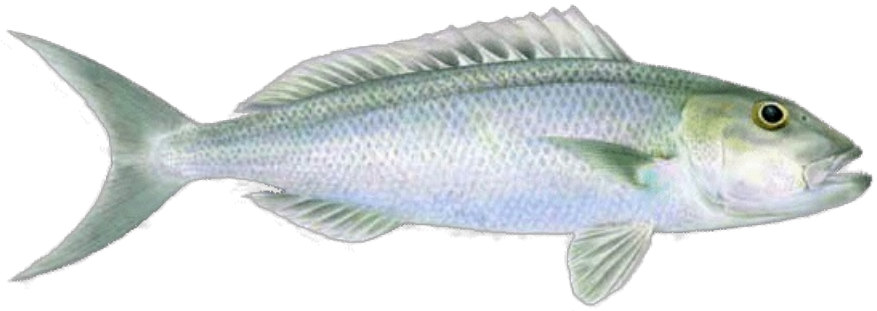
Green Jobfish

Aprion virescens



Hawaii: Eastern Central Pacific

Handlines and hand-operated pole-and-lines, Troll/Pole

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Seafood Watch Standard used in this assessment: Fisheries Standard v4

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About Seafood Watch

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Seafood Watch's science-based ratings are available at www.SeafoodWatch.org. Each rating is supported by a Seafood Watch assessment, in which the fishery or aquaculture operation is evaluated using the Seafood Watch standard.

Seafood Watch standards are built on our guiding principles, which outline the necessary environmental sustainability elements for fisheries and aquaculture operations. The guiding principles differ across standards, reflecting the different impacts of fisheries and aquaculture.

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.

- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.

- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

Each assessment follows an eight-step process, which prioritizes rigor, impartiality, transparency and accessibility. They are conducted by Seafood Watch scientists, in collaboration with scientific, government, industry and conservation experts and are open for public comment prior to publication. Conditions in wild capture fisheries and aquaculture operations can change over time; as such assessments and ratings are updated regularly to reflect current practice.

More information on Seafood Watch guiding principles, standards, assessments and ratings are available at www.SeafoodWatch.org.

Guiding Principles

Seafood Watch defines sustainable seafood as originating from sources, whether fished[1] or farmed, that can maintain or increase production in the long term without jeopardizing the structure or function of affected ecosystems.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered, or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function, or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard.Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and rating

Once a rating has been assigned to each criterion, Seafood Watch develops an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guides and online guide:

Best Choice/Green: Buy first; they're well managed and caught or farmed responsibly.

Good Alternative/Yellow: Buy, but be aware there are concerns with how they're caught, farmed or managed.

Avoid/Red: Take a pass on these for now; they're caught or farmed in ways that harm other marine life or the environment.

[1] "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

Summary

This report evaluates the ecological sustainability of green jobfish (*Aprion virescens*), known locally as uku, in the Main Hawaiian Islands (MHI); we use the Hawaiian name throughout the report. Seafood Watch considers uku caught with handline and troll gear as a Best Choice. Uku is targeted by a small number of fishers, but many uku are opportunistically retained in fisheries targeting other species. While there are several species included in Criterion 2, the impact from uku fisheries is very low, relative to other fisheries. Species included in Criterion 2 are those that account for >5% of the catch on fishing trips in which uku constitutes at least 5% of the overall catch. We have combined the deepsea handline, inshore handline, pelagic handline, and rod & reel trips into the "handline fishery." We refer to troll trips in which uku constitutes at least 5% of the overall catch as the "troll fishery."

Beginning in 2019, uku became managed under its own Annual Catch Limit (ACL), and separately from the Main Hawaiian Islands (MHI) "Deep 7" bottomfish complex. Prior to the separation of uku from the Deep 7 complex, all the species within the complex were managed together under a single ACL. While the Deep 7 bottomfish species fetch a higher market price, fisherman have increasingly targeted uku over the last decade resulting in annual uku catches that exceed the majority of the Deep 7 species catches (by biomass), in several years even surpassing opakapaka catch (which has the highest catch of the Deep 7 species). The catch of Deep 7 species peaks in winter, while the majority of uku are caught in late spring.

Uku is caught by handline both deepsea and inshore as well as by trolling. Deepsea handlines account for the largest percentage of annual landings. Both handline and troll capture methods rank as green for SFW Criterion 1, Impacts of the Fishery on the Stock, due to uku's healthy stock status and sustainable fishing levels. Handline caught and troll/pole caught uku rank as yellow for SFW Criterion 2, Impacts of the Fishery on Other Species. These yellow rankings are driven by uncertainty in species composition of incidentally caught sharks, which have high inherent vulnerability to fishing. However, impacts to shark populations from uku fisheries is expected to be low and discards are low by all methods. Although managers have implemented precautionary strategies for uku, Management Strategy and Implementation is considered moderately effective because some of the main species are not managed with appropriate reference points. Uku fisheries have highly effective bycatch strategies and the gears have minimal to very low impact to bottom habitats. Uku is considered an important predator shallow and mesophotic depths within the Hawaiian Archipelago and detrimental food web impacts are possible, but managers have implemented strategies that are likely to be effective at mitigating any potential effects.

Final Seafood Recommendations

SPECIES | FISHERY	CRITERION 1 TARGET SPECIES	CRITERION 2 OTHER SPECIES	CRITERION 3 MANAGEMENT	CRITERION 4 HABITAT	OVERALL RECOMMENDATION
Green jobfish | Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii	5.000	2.236	3.000	3.674	**Best Choice (3.332)**
Green jobfish | Eastern Central Pacific | Trolling lines | United States | Hawaii	5.000	2.236	3.000	3.873	**Best Choice (3.376)**

Summary

Uku or green jobfish (*Aprion virescens*) caught in the Main Hawaiian Islands with handlines and trolling lines is a Best Choice. The Hawaiian uku stock is healthy and fishing levels are sustainable. The amount of bycatch is low, but vulnerable shark species are occasionally caught. Due to uncertainties in management of all main species, management is rated moderately effective overall. Uku fisheries have highly effective bycatch strategies and the gears have minimal impact to bottom habitats. Uku is considered an important predator and detrimental food web impacts are possible, but managers have implemented strategies that are likely to be effective at mitigating any potential effects.

Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

Best Choice/Green = Final Score >3.2, and no Red Criteria, and no Critical scores

Good Alternative/Yellow = Final score >2.2-3.2, and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern2, and no more than one Red Criterion, and no Critical scores

Avoid/Red = Final Score ≤2.2, or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

[2] Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

Introduction

Scope of the analysis and ensuing recommendation

Uku (*Aprion virescens*), also known as green jobfish and grey snapper, is the primary fishery assessed in this analysis. Fishing methods assessed for uku capture are handline (deepsea and inshore) and trolling. Uku is caught as a target species using similar gear used in the Deep 7 bottomfish fishery, it may be targeted using troll during unfavorable conditions, and is opportunistically retained on trips targeting pelagic species and the Deep 7 Complex {WPRFMC 2021}. We have combined the deepsea handline, inshore handline, pelagic handline, and rod & reel trips into the "handline fishery." We refer to troll trips in which uku constitutes at least 5% of the overall catch as the "troll fishery." On average, from 2010-2021 Deepsea handline trips account for roughly two-thirds of uku landings, followed by inshore handline (15%), and troll trips (9%) {HDAR 2022}.

Additional species analyzed here include those that constitute > 5% of the total catch when uku is at least 5% of the overall catch; in the handline fishery, this includes opakapaka/crimson jobfish (*Pristipomoides filamentosus*) and opelu/mackerel scad (*Decapterus macarellus*). In the troll fishery, this includes yellowfin tuna (*Thunnus albacares*), ono/wahoo (*Acanthocybium solandri*), and mahi mahi/dolphinfish (*Coryphaena hippurus*). We have included sharks as a Criterion 2 group in both fisheries because sharks are occasionally caught, species composition is unknown, and species of concern may be caught. The region considered in this assessment is the Main Hawaiian Islands in the Eastern Central Pacific Ocean.

Species Overview

Uku, a quasi-pelagic top-predator, is a large bodied snapper species (size up to 112 cm total length and 15.4 kg) found in the tropics and subtropics (Randall 1996) between 0 and 180 meters depth in open waters of deep lagoons, channels, or seaward reefs (Lieske and Myers 1994). Uku in Hawaii reach sexual maturity at 4-5 years of age (Everson et al. 1989). The maximum age of uku in the Central Pacific is estimated to be 32 years (Nadon et al. 2020). Occurring in the Indo-Pacific region from East Africa to Hawaii and from southern Japan to Australia (Allen 1985), uku support commercial and subsistence fisheries across its range. Exhibiting daily and seasonal movement patterns (Meyer et al. 2007), uku catches (in Hawaii) are generally larger during the summer (PIFSC 2012a) when they form spawning aggregations (Meyer et al. 2007). Uku appears to have episodic recruitment leading to pulses of large year class cohorts that persist in the fishery for some time (pers comm. D. Kobayashi).

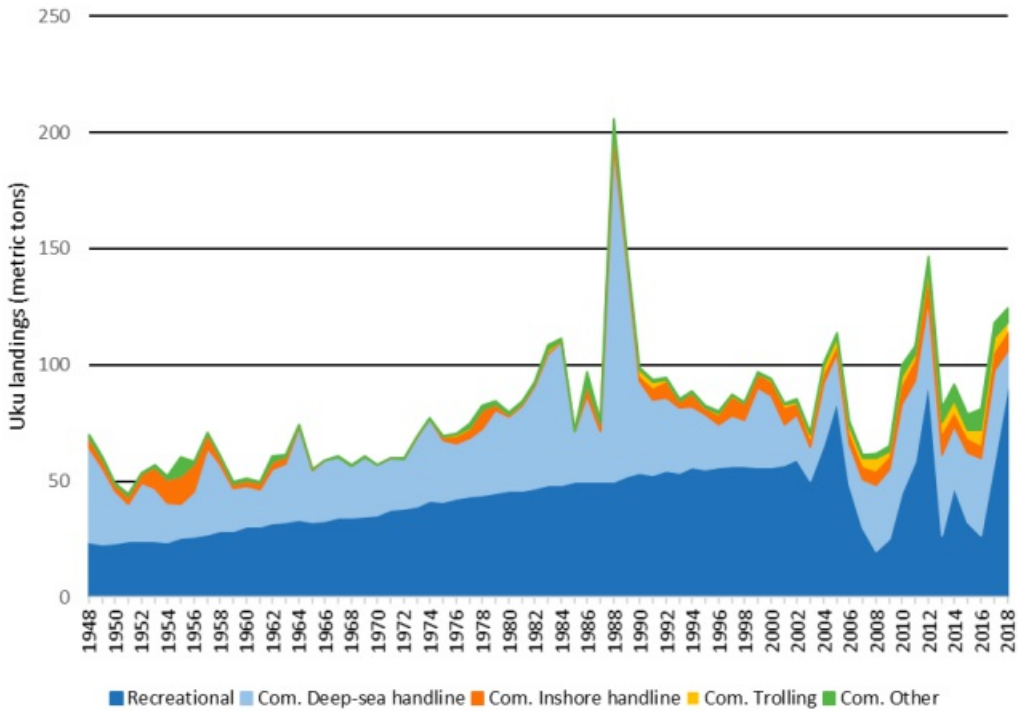
In Hawaii, uku are caught offshore and inshore using baited and weighted handlines that sit over the benthos, and by trolling with lures in surface waters, as they occur near the bottom and in the water column. Approximately 90% of the commercial uku catch is from the handline fishery, and roughly two-thirds of the commercial catch comes from Federal waters (WPRFMC 2021b). Commercial fishers targeting fish in the Deep 7 Complex and other pelagic species will opportunistically retain uku. The Hawaii Department of Land and Natural Resources oversees licensing and catch reporting for state and federal waters. The Western Pacific Fisheries Management Council (WPFMC) manages uku and other fisheries for bottomfish in Federal waters around the Hawaiian Islands. Uku was previously managed within the Deep 7 stock complex, but was split from the complex in 2019 and is now managed separately (WPRFMC 2021b). Uku annual catch limits (ACLs) are established in accordance with the

Magnuson-Stevens Act; the proposed combined commercial and non-commercial ACL for 2022-2025 is 295,419 lb and the annual catch target (ACT) is 291,010 lb (86 FR 73234).

The state of Hawaii closed areas within state waters by creating bottomfish restricted fishing areas in 1998 across the MHI, which were redesigned and re-designated in 2007 to increase their effectiveness by including more essential fish habitat for bottomfish species (specifically for Deep 7 bottomfish species, though their habitat overlaps partially with uku's habitat). All restricted areas were reopened to fishing in 20222. Papahānaumokuākea Marine National Monument was established in 2006 and fisheries were excluded from this area, resulting in the removal of 35% of the domestic bottomfish from Hawaii markets (WPRFMC 2021).

Production Statistics

Although uku is caught across the Indo-Pacific it is difficult to determine its global production based on available data. The FAO global capture production database only contains production statistics on uku for the US, derived from Hawaiian catch data (FAO 2013). ʻOpakapaka typically accounts for 50% of catch from the Deep-7 complex; 118,226 lbs of ʻOpakapaka were caught on average from 2011-2020, and, over the same time period, fishers caught an average 101,071 lbs of uku (WPRFMC 2021). Uku is also caught in the bottomfish fisheries of American Samoa, the Commonwealth of the Northern Mariana Islands (CNMI) and Guam, but these fisheries are much smaller than the MHI fishery (Brodziak et al. 2012).



History of Hawaiian uku catch by sector (recreational and commercial), with the commercial catch further broken down by fishing gear type. Note that the recreational catch pre-2003 is reconstructed. Figure from (Nadon et al. 2020).

Importance to the US/North American market.

The majority of the uku landed in Hawaii are sold and consumed in Hawaii (sold either at auction, to dealers/wholesalers, markets, restaurants or to friends/neighbors) with some fish shipped to the mainland US. While uku is a desirable fish in high demand in Hawaii, the deeper water snappers (namely opakapaka, ehu and onaga) are considered to be of superior quality, are in higher demand, and sell for higher prices. The price per pound for uku steadily increased over the last 15 years, reaching $5.31/lb in 2018 (Nadon et al. 2020).

Fish prices of Deep 7 and Uku of Hawaii bottomfish fishery, 2011-2020.
Figure from (WPRFMC 2021).

In addition to Hawaiian caught fish, demand for snapper in Hawaii is met by imported fish. The National Marine Fisheries Service, Fisheries Statistics and Economics Division track snapper imports, but do not collect information at the species level so we cannot determine the amount of uku imported specifically. The top 5 countries that import snapper (though not specifically uku) to Honolulu, in order of decreasing magnitude are Indonesia, Tonga, Australia, New Zealand, and Fiji. Tonga alone accounts for roughly 50% of imports to Honolulu. In the mid-90's the Solomon Islands was an additional major exporter to Hawaii, but has not accounted for any imports since 1998.

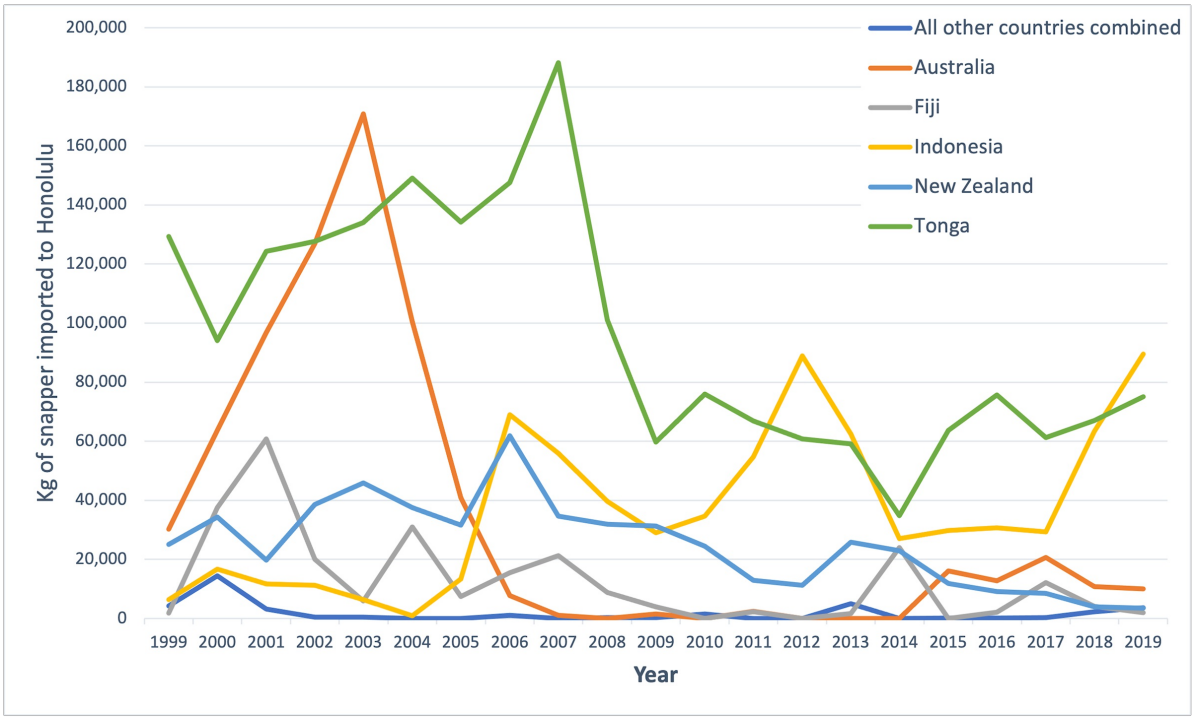


Figure 1: Annual total kilograms of snapper (which includes all fish species from the family Lutjanidae) imported to Hawaii from 1999 to 2019. The top 5 countries of origin are displayed, as well as the annual total imported from all other countries combined. The majority of imports are fresh (fillets or whole fish). Information obtained from the National Marine Fisheries Service, Fisheries Statistics and Economics Division.

Common and market names.

Common and market names: jobfish, green jobfish, grey snapper, blue-green snapper
Hawaiian name: Uku

Primary product forms

Whole (fresh), filet (fresh)(Hawaii Seafood Council NA).

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at www.seafoodwatch.org. The specific standard used is referenced on the title page of all Seafood Watch assessments.

Criterion 1: Impacts on the species under assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical.

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level*

Criterion 1 Summary

GREEN JOBFISH			
REGION / METHOD	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)
Eastern Central Pacific | Trolling lines | United States | Hawaii	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

Criterion 1 Assessments

SCORING GUIDELINES

Factor 1.1 - Abundance
Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*

- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

Factor 1.2 - Fishing Mortality
Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

Green jobfish

Factor 1.1 - Abundance

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii
Eastern Central Pacific | Trolling lines | United States | Hawaii

Very Low Concern

Hawaiian green jobfish (uku) are part of the Hawaii Bottomfish Management Unit, which includes the Deep 7 species, as well as other shallow water species of groupers, snappers, and jacks, but uku is managed separately from the Deep 7 complex. The most recent stock assessment for uku indicated the stock was not overfished relative to the reference point of biomass at the Minimum Stock Size Threshold (B_{MSST} = (1-M)*SSB_{MSY})) (Nadon et al. 2020). The average SSB from 2016-2018 was 272% of SSB_{MSST} and 245% of SSB_{MSY} (ibid). Because the current abundance level of uku is well above the limit reference point and target reference point, we have awarded a "very low concern" score.

Justification:

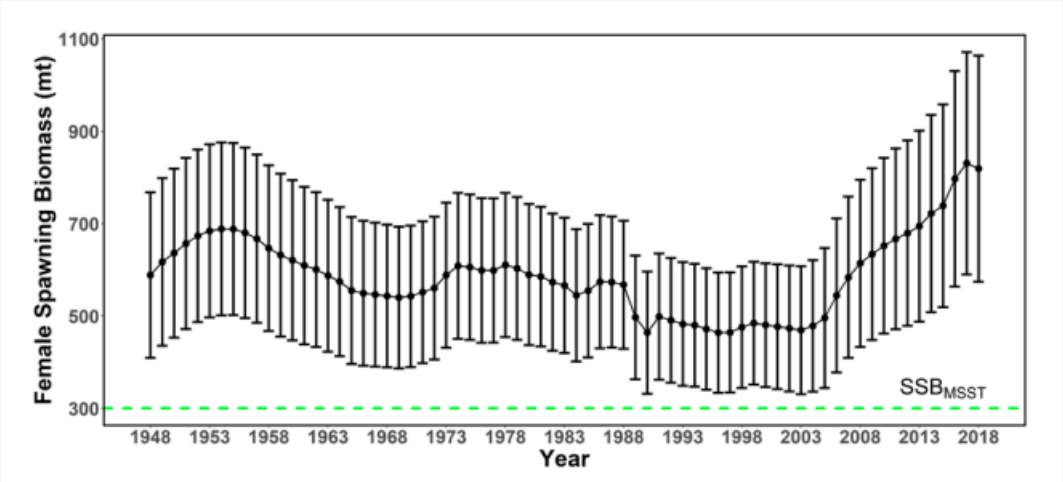


Figure 2: Time series of spawning biomass (metric tons) for uku estimated in the base-case model. The solid line with circles represents the maximum likelihood estimates and the error bars represent the uncertainty of the estimates (95% confidence intervals). The dashed horizontal line shows the spawning biomass to produce the MSST reference point (SSB_{MSST}) (Nadon et al. 2020).

Factor 1.2 - Fishing Mortality

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii

Eastern Central Pacific | Trolling lines | United States | Hawaii

Low Concern

Uku is landed in near equal proportion by recreational/subsistence and commercial fishers. The commercial sector is dominated by deep-sea handlines (63% of commercial catch), followed by inshore handlines (15%) and trolling (10%) (Nadon et al. 2020). Commercial landings have increased in recent years to approximately 50 t annually. Around two-thirds of commercial catch of uku comes from Federal waters, landings peak in late spring and decline as fishers shift to targeting the more valuable yellowfin tuna (WPRFMC 2021).

The recent stock assessment used the Stock Synthesis modeling framework and fishery-dependent (commercial and recreational catch) and fishery-independent survey data sources (Nadon et al. 2020). According to this assessment, fishing mortality was below F_{MSY} in 2018 (Nadon et al. 2020). It is highly likely that overfishing is not occurring (see Figure 43 in Nadon et al. 2020) and this factor is scored as "low concern".

Justification:

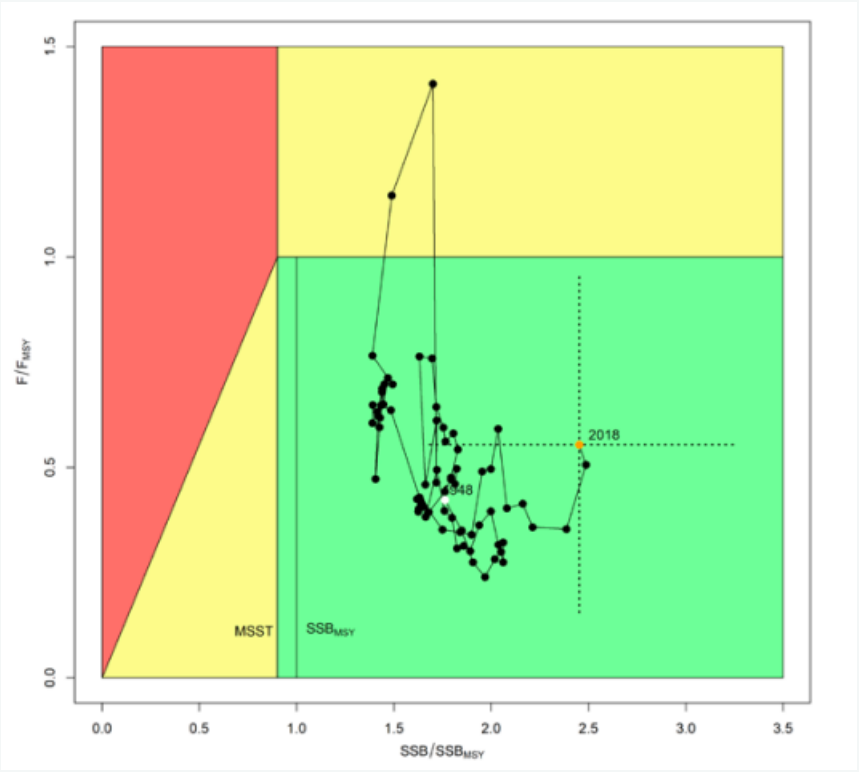


Figure 3: Kobe plot of the trends in estimates of relative fishing mortality (average of age 5–30) and spawning stock biomass of uku from 1948 to 2018 (Nadon et al. 2020).

Criterion 2: Impacts on Other Species

All main retained and bycatch species in the fishery are evaluated under Criterion 2. Seafood Watch defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait score. The Criterion 2 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Factor 2.3 (Fishing Mortality) is Crtitical

Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

Criterion 2 Summary

Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

GREEN JOBFISH			
REGION / METHOD	**SUB SCORE**	**DISCARD RATE/LANDINGS**	**SCORE**
Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii	2.236	1.000: < 100%	Yellow (2.236)
Eastern Central Pacific | Trolling lines | United States | Hawaii	2.236	1.000: < 100%	Yellow (2.236)

Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

EASTERN CENTRAL PACIFIC | HANDLINES AND HAND-OPERATED POLE-AND-LINES | UNITED STATES | HAWAII			
SUB SCORE: 2.236	DISCARD RATE: 1.000		**SCORE: 2.236**
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Sharks	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Mackerel scad	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Crimson jobfish	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Green jobfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

EASTERN CENTRAL PACIFIC | TROLLING LINES | UNITED STATES | HAWAII			
SUB SCORE: 2.236	DISCARD RATE: 1.000	**SCORE: 2.236**	
SPECIES	**ABUNDANCE**	**FISHING MORTALITY**	**SCORE**
Sharks	1.000: High Concern	5.000: Low Concern	Yellow (2.236)
Dolphinfish	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Wahoo	2.330: Moderate Concern	5.000: Low Concern	Green (3.413)
Yellowfin tuna	3.670: Low Concern	5.000: Low Concern	Green (4.284)
Green jobfish	5.000: Very Low Concern	5.000: Low Concern	Green (5.000)

Catch data presented within this report is based on trips in which uku constitutes at least 5% of the overall catch, and we have combined data from the deepsea handline, inshore handline, pelagic handline, and rod & reel trips into the "handline fishery." We refer to troll trips in which uku constitutes at least 5% of the overall catch as the "troll fishery." The species assessed under Criteria 2 were selected based on their occurrence in logbook data for fishing trips in which uku comprised at least 5% of the catch. SFW obtained this logbook data from Hawaii Department of Aquatic Resources (HDAR). Due to the multispecies nature of these fisheries, combined with low discard rates, bycatch levels in the fisheries under assessment are considered relatively low (WPRFMC 2021). Discarding occurs when either there is shark damage to a target species or because of concerns regarding ciguatoxins (NMFS 2015b). We score fishing mortality as "low concern" for all main species because the uku fishery is not a substantial contributor to total fishing mortality for these species and/or total fishing levels are sustainable.

Sharks may be incidentally hooked in the handline fishery (particularly on deepsea trips), but encounters are not believed to result in mortality (NOAA 2019) (WPRFMC 2021b). From 2010-2021, a total 87 sharks were caught in the troll fishery, while 734 sharks were caught in the handline fishery; 89% of shark catch in the handline fishery occured on deepsea handline trips (HDAR 2022). Shark bycatch in these fisheries is often reported as "misc. sharks", making it difficult to assess the species-level impacts from the fishery under assessment. Therefore, we use the Seafood Watch Unknown Bycatch Matrix (UBM) to assess the impact of bycatch on sharks (although there is limited species-level information for some shark species). For example, one species of concern, oceanic whitetip shark (*Carcharhinus longimanus*) was recently listed by the ESA as Threatened, but incidental captures of this species in the Hawaii bottomfish fisheries are rare and the fishery is not likely to adversely affect oceanic whitetip sharks (NMFS 2021). Based on logbook data and voluntary reports, Hawaii bottomfish fishermen have documented interactions with oceanic whitetip sharks at a rate of 0.236 per year from 2000-2017 (WPRFMC 2021). Similarly, shortfin mako shark (*Isurus oxyrinchus*) is currently under consideration for ESA listing, but the species is not known to interact with the Hawaii bottomfish fishery (ibid).

We note here that we did not include the ESA listed endangered Hawaiian monk seal in our assessment. There have been observed interactions with monk seals that take or damage bottom-caught fish. These were attributed to the bottomfish fishery because the monk seals were observed (alive) with hooks caught in their mouths (WPRFMC 2009), and the bottomfish fishery is the most prominent demersal

hook and line fishery. The fishery is listed as a Category III fishery under the requirements of the Marine Mammal Protection Act, meaning the fishery has a remote likelihood or no known incidental mortality and serious injury of marine mammals. According to the 2020 monk seal stock assessment, no mortality or serious injuries have been attributed to the MHI bottomfish handline fishery (NOAA 2021), and under section 7 of the Endangered Species Act, NMFS has determined that the bottomfish fishery does not adversely impact ESA- listed species or their habitat (WPRFMC 2009) (WPRFMC 2021b).

Criterion 2 Assessment

SCORING GUIDELINES

Factor 2.1 - Abundance
(same as Factor 1.1 above)

Factor 2.2 - Fishing Mortality
(same as Factor 1.2 above)

Factor 2.3 - Modifying Factor: Discards and Bait Use
Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.

Ratio of bait + discards/landings	Factor 2.3 score
<100%	1
>=100	0.75

Crimson jobfish

Factor 2.1 - Abundance

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii

Low Concern

The six snappers and one grouper that make up the "Deep 7" bottomfish complex are all assessed together as a unit. The most recent population assessment for the Deep 7 species was conducted in 2021. According to this assessment, the abundance of the Deep 7 bottomfish declined starting in the 1960s, but since 1990 has steadily increased through 2017 (Syslo et al. 2021). Currently, abundance is estimated to be well above maximum sustainable yield (B_{MSY}) reference point.

Therefore, the Deep 7 bottomfish complex was not overfished/depleted in 2018. In this same stock assessment, opakapaka (crimson jobfish) was assessed separately, as well as part of the complex, and found to not be overfished with overfishing not occurring (Syslo et al. 2021).

There is currently not a 'target' reference point for abundance of this complex. Because opakapaka abundance was determined to be at a sustainable level in the most recent stock assessment, we have rated this factor "low concern."

Factor 2.2 - Fishing Mortality

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii

Low Concern

According to the latest stock assessment, fishing mortality estimates for the Hawaiian "Deep 7" bottomfish complex was well below the reference point corresponding to maximum sustainable yield (H_{MSY}) in 2018 (Syslo et al. 2021). Therefore it was concluded that overfishing is not occurring. In this same stock assessment, opakapaka was assessed separately, as well as part of the complex, and overfishing was not occurring (Syslo et al. 2021).

Because it probable that current fishing mortality rates for Opakapaka were determined to be at sustainable levels in the most recent stock assessment, we have awarded a "low concern" score.

Dolphinfish

Factor 2.1 - Abundance

Eastern Central Pacific | Trolling lines | United States | Hawaii

Moderate Concern

Data are limited for dolphinfish (also known as mahimahi and dorado) in the EPO. An exploratory stock assessment was conducted on dolphinfish in the southern EPO in 2016. The SSB has remained fairly stable since 2007, with a slight decrease during 2010. Some common reference points used for species such as tuna were assessed for dolphinfish. The spawning biomass ratio to that of the unfished stock averaged 0.20 for the time series (IATTC 2016). The IUCN assessed dolphinfish as a species of Least Concern (Collette et al. 2011b). There is a high degree uncertainty surrounding reference points for dolphinfish, however the IUCN rates this species as Least Concern; therefore, dolphinfish receive a "moderate concern" score for abundance due to data limitations.

Factor 2.2 - Fishing Mortality

Eastern Central Pacific | Trolling lines | United States | Hawaii

Low Concern

On trips in which uku constituted at least 5% of the catch, dolphinfish comprised approximately 7% of the catch (HDAR 2022), but the number of dolphinfish caught in the troll fishery is negligible compared to other fisheries. For example, in 2019, 1.5 million lbs of dolphinfish were landed in Hawaii (DLNR 2021), but only 91 individual dolphinfish were caught in the troll fishery in the same year (HDAR 2022). Similarly, the Hawaii deep-set longline fishery caught approximately 44,000 dolphinfish in 2018 (WPRFMC 2018), compared to 77 dolphinfish in the troll fishery (HDAR 2022).

Dolphinfish are caught as bycatch and targeted in longline fisheries in the Eastern Pacific Ocean. The IUCN does not consider there to be any major threats to dolphinfish from commercial fishing (Collette et al. 2011b). Preliminary analysis shows variable, but somewhat steady, catch per unit effort trends in abundance. Commercial fishing does not appear to be a major threat, the catch per unit effort has been somewhat stable over time, and the preliminary stock assessment states that current fishing mortality rates of 50% of the maximum sustainable yield. We score this factor as "low concern" because the fishery under assessment is not a substantial contributor to fishing mortality.

Mackerel scad

Factor 2.1 - Abundance

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii

Moderate Concern

A population assessment for Hawaii mackerel scad (opelu) was conducted in 2000. The assessment utilized fisheries' catch rate data (catches per unit of fishing effort) to estimate abundance. However, there hasn't been a stock assessment for mackerel scad since and current abundance is considered unknown. Both mackerel scad and big eye scad (*Selar crumenophthalmus*) were classified as "ecosystem component species" in 2019, which means that stock assessments are no longer required but catches are still closely monitored (WPRFMC 2021c). Since 2017, collaborative research has been conducted between resource managers and traditional Hawaiian fishing communities to gather key biological and behavioral data within important opelu spawning grounds (Hurt et al. 2020). The species is assessed by the IUCN as Least Concern (Smith-Vaniz et al. 2015). Because current abundance is unknown, we score abundance as "moderate concern" based on the IUCN assessment.

Factor 2.2 - Fishing Mortality

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii

Low Concern

Fishing for mackerel scad has a long cultural history in Hawaii, the species is commercially targeted, and is primarily caught with hoop nets and handlines (Hurt et al. 2020). On trips in which uku constituted at least 5% of the catch in the inshore handline fishery, mackerel scad comprised approximately 19% of the catch (HDAR 2022), but the number of mackerel scad caught in the fishery under assessment is negligible compared to other fisheries. For example, in 2019, Hawaiian commercial fishers landed 121,984 lbs of mackerel scad (DLNR 2021). The same year, the fishery under assessment caught 1,788 fish (HDAR 2022). Using the mean weight of handline caught fish of 304.42 g (0.67 lbs) from (McNaughton 2008), an estimated 1,200 lbs of mackerel scad were caught by the fishery under assessment, representing <1% of the reported landings of this species in 2019. We score this factor as "low" concern because the fishery under assessment is not a substantial contributor to fishing mortality.

Sharks

Factor 2.1 - Abundance

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii
Eastern Central Pacific | Trolling lines | United States | Hawaii

High Concern
According to the Seafood Watch unknown bycatch matrix, Factor 2.1 is automatically ranked as "high concern" for unknown species from highly vulnerable taxa (e.g. sea turtles, seabirds, marine mammals, and sharks).

Factor 2.2 - Fishing Mortality

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii
Eastern Central Pacific | Trolling lines | United States | Hawaii

Low Concern
Between 2010 and 2021, 734 sharks (classified as "misc. sharks') were caught in the deepwater bottomfish handline fishery when uku comprised at least 5% of the total catch (HDAR 2022). Over the same time period, 87 sharks were caught in the troll fishery (ibid). According to the US National Bycatch Report, shark bycatch in the MHI bottomfish fishery is thought to be low and post-hooking survival rates for sharks are believed to be high (because sharks do not experience barotrauma) (NMFS 2011b). Given this information, shark bycatch in the MHI bottomfish fishery is unlikely to adversely affect shark populations. The UBM score for sharks caught by handline and troll in the Eastern Pacific is 3.5 (see page 75 of the Seafood Watch Fisheries Standard v4f). Therefore, we score this factor as "low concern."

Wahoo

Factor 2.1 - Abundance

Eastern Central Pacific | Trolling lines | United States | Hawaii

Moderate Concern

Wahoo are listed as a species of Least Concern by the IUCN (Collette et al. 2011). No population assessments have been conducted for this species in the Pacific Ocean. Data limitations coupled with an IUCN Least Concern rating yield a "moderate concern" score for wahoo.

Factor 2.2 - Fishing Mortality

Eastern Central Pacific | Trolling lines | United States | Hawaii

Low Concern

On trips where uku was at least 5% of the catch, wahoo comprised approximately 7% of the catch (HDAR 2022), but the number of wahoo caught in the troll fishery is negligible to total fishing mortality. For example, in 2018, the troll fishery caught 77 wahoo (HDAR 2022), compared to 32,871 wahoo in the Hawaii deep-set longline fishery. Wahoo support significant recreational fisheries across the Pacific Islands regions as well, in addition to being important components of the commercial catch in island territories (WPRFMC 2018). Catches of wahoo the EPO have been increasing over the past 20 years, with a particularly sharp uptick around 2006. Higher catches of wahoo are likely related to changes in longline data reporting and an increasing number of floating object purse seine sets (IATTC 2018). Roughly 368 t and 243 t of wahoo were caught in 2017 in purse seine and longline fisheries, respectively (IATTC 2018). Although the sustainability of total fishing levels on wahoo is unknown, we score this factor as "low concern" because the fishery under assessment is not a substantial contributor to fishing mortality.

Yellowfin tuna

Factor 2.1 - Abundance

Eastern Pacific Stock | Eastern Central Pacific | Trolling lines | United States | Hawaii

Low Concern

Annual recruitment of yellowfin has been near or below average since 2003 (IATTC 2019a) The 2020 full assessment for yellowfin tuna estimated that SB_{2020} ranged from 49% - 219% of the target reference point SB_{MSY}. The probability that the spawning biomass at the beginning of SB_{2020} is lower than SB_{MSY} is 50% or less for 13/48 models. The risk analyses for yellowfin with model estimates aggregated indicate there is a 12% chance overall that SB_{2020} is lower than SB_{MSY} (IATTC 2020b), and the probability that the SB_{2020} is below the SB_{LRP} ranges from 0% - 2% ({ATTC 2020c}

There are considerable discrepancies in results depending on selected model attributes and the steepness of the stock-recruit curve. Additional uncertainty relates to spatial structure and differing trends by fishery (longline, purse seine type, etc.) There are still models that estimate the yellowfin stock may be overfished {IATTC 2019c}, however most model runs in aggregate indicate this is highly unlikely {IATTC 2020b; IATTC 2020c}. In summary, there is some conflicting information about stock status; however the majority of models indicate this stock is not overfished, and yellowfin tuna receive a "low concern" score for abundance in the EPO.

Factor 2.2 - Fishing Mortality

Eastern Pacific Stock | Eastern Central Pacific | Trolling lines | United States | Hawaii

Low Concern

On trips where uku was at least 5% of the catch, yellowfin tuna comprised approximately 7% of the catch (HDAR 2022), but the biomass of yellowfin tuna caught in the bottomfish fishery (usually by trolling) is negligible compared to the global yellowfin tuna biomass harvested in a year. For example, the global catch of EPO yellowfin tuna in 2020 was estimated at 219,078 t; in the same year, only 132 individual yellowfin were caught on trips in which uku constituted >5% of the catch (HDAR 2022). The recent stock status of EPO yellowfin tuna is provided below. We score this factor as "low concern" because the fishery under assessment is not a substantial contributor to fishing mortality.

Justification:

The average fishing mortality rate has been increasing for all age classes of yellowfin tuna in the EPO since 2009 (IATTC 2019a), in large part due to increasing effort from object associated purse seine fisheries. The point estimate of the fishing mortality in 2017-2019 ranged from 40% - 168% of the F_{MSY} (IATTC 2020c). The probability that the fishing mortality of yellowfin in 2017-2019 is

higher than the F_{MSY} level is 50% or more for only 14/48 models. The risk analyses with aggregated model runs indicates that there is only 9% chance that $F>F_{MSY}$ (IATTC 2020b). Additionally, the point estimate of the $F_{2017\text{-}2019}$ ranged from 22% - 65% of the LRP (IATTC 2020c). The probability that the fishing $F_{2017\text{-}2019} > F_{LRP}$ was estimated to be zero for all models (IATTC 2020b). In summary, the majority of models indicate that F is within target and limit reference points, and yellowfin tuna receive a "low concern" score for fishing mortality.

Factor 2.3 - Discard Rate/Landings

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii
Eastern Central Pacific | Trolling lines | United States | Hawaii

< 100%
The discard rate/landings for both fisheries is low. Using data from 2003 to 2012, the mean number of discards of any species in deepsea handline fishery (when uku is > or = to 5% of the total catch) was 594 fishes, and in the inshore handline fishery (when uku is > or = to 5% of the catch) it was 127 fishes. Although the number of total fish landed is not available, the number discarded is small relative to the mean biomass of all fish species landed, which averaged 136,906 lbs. (62,230 kgs.) for deepsea handline and 34,911 lbs. (15,869 kgs.) for inshore handline. Using trolling data from 2003 to 2012, the mean number of discards of any species when uku is > or = to 5% of the total catch was 94 fishes. Although the corresponding total number of fish landed is not available, the number discarded is small relative to the mean biomass of all fish species landed, which averaged 15,931 lbs. (7,242 kgs). These figures were calculated from Hawaii Division of Aquatic Resources commercial logbook data (HDAR 2013). Fishers typically use squid as bait in the uku fishery, but aku (*Katsuwonus pelamis*) and opelu are also sometimes used (WPRFMC 2021b). We note that that logbook data is believed to underreport catches and discards compared to observer data (NMFS 2011b), however, it still is likely that discard rate is <100%.

Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- *5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.*
- *4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.*
- *3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.*
- *2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'*
- *1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'*
- *0 (Critical) — Management Strategy and Implementation is 'critical'.*

The Criterion 3 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Rating is Critical if Management Strategy and Implementation is Critical.

Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

Criterion 3 Summary

FISHERY	MANAGEMENT STRATEGY	BYCATCH STRATEGY	DATA COLLECTION AND ANALYSIS	ENFORCEMENT	INCLUSION	SCORE
Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii	Moderately Effective	Highly effective	Highly effective	Moderately Effective	Highly effective	**Yellow (3.000)**

Eastern Central Pacific | Trolling lines | United States | Hawaii	Moderately Effective	Highly effective	Highly effective	Moderately Effective	Highly effective	**Yellow (3.000)**

Factor 3.1 is scored for all retained species, including those species that are subject to much larger directed fisheries (i.e. yellowfin tuna). Although there are appropriate and highly effective management strategies in place for uku, factor 3.1 scores "moderately effective" for both fisheries because current strategies for other main targeted and retained species do not meet the threshold for a "highly effective" score. Strategies for preventing catch of discarded species are accounted for in Factor 3.2.

Factor 3.1 is scored for all retained species, including those species that are subject to much larger directed fisheries (i.e. yellowfin tuna). Although there are appropriate and highly effective management strategies in place for uku, subfactors 3.1 and 3.3 score "moderately effective" for both fisheries because current strategies for other main targeted and retained species do not meet the threshold for a "highly effective" score.

while strategies for preventing catch of discarded species are accounted for in Factor 3.2.

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Management Strategy and Implementation
Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? Do manages follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.

Factor 3.2 - Bycatch Strategy
Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.

Factor 3.3 - Scientific Research and Monitoring
Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.

Factor 3.4 - Enforcement of Management Regulations
Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly

Effective rating, there must be regular enforcement of regulations and verification of compliance.

Factor 3.5 - Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent, if high participation by all stakeholders is encouraged, and if there a mechanism to effectively address user conflicts.

Factor 3.1 - Management Strategy And Implementation

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii
Eastern Central Pacific | Trolling lines | United States | Hawaii

Moderately Effective

Catch limits and accountability measures for uku have been in place since 2012 (WPRFMC 2021b). While uku was previously managed under a stock complex ACL, the species has been managed under its own ACL since 2019. The ACL for 2019-2021 of 127,205 lb only applied to the commercial fishery, but managers have recommended that non-commercial catch be included in uku management beginning in 2022 (86 FR 73234). The proposed ACL and ACT for 2022-2025 is 295,419 lbs and 291,010 lbs for commercial and non-commercial catch combined (86 FR 73234), which corresponds to a 41% and 36% risk of overfishing, respectively (WPRFMC 2021b). The ACT addresses management uncertainty and incorporates a probability analysis as required under the Magnuson-Stevens Act (ibid). Under the proposed action, the fishery would be closed in Federal waters when the ACT is projected to be reached. In addition to the ACL, management measures include gear and spatial restrictions, a one pound size limit for uku, logbook requirements and annual vessel registration (WPRFMC/NMFS/HDAR 2013).

Uku is managed with harvest control rules that account for uncertainty and there is evidence that the strategy is being implemented successfully. However, to score highly effective for Factor 3.1, at least 70% of the fishery's main targeted and retained species must have appropriate management targets (e.g. reference points) defined. We have awarded a "moderately effective" score for the troll fishery to account for management measures that are currently in place for uku and yellowfin, while recognizing that target reference points and harvest control rules are not in place for wahoo and dolphinfish. Similarly, two of the three main species in the handline fishery (uku and opakapaka) are managed with harvest control rules that account for uncertainty and there is evidence that the strategy is being implemented successfully (as described in Criteria 1 and 2). Appropriate management targets haven't been defined for opelu, but management measures still exceed those for an "ineffective" score, resulting in a "moderately effective" score for the handline fishery.

Justification:

Management of other retained species in the Handline Fishery

Opakapaka

Bottomfish species also occurs in Hawaii state waters. In state waters the Hawaii Division of Aquatic Resources (HDAR) part of the Department of Land and Natural Resources, is responsible for fisheries management. Management measures in state waters include annual vessel registration, catch reporting, gear restrictions, trip reporting, minimum sizes (onaga and opakapaka) and closed fishing areas (WPRFMC 2006). If the fishery for the Deep 7 is closed in federal waters because the annual catch limit is reached, the State may close their waters to fishing for the Deep 7 species as well. Management goals for abundance and fishing levels have been established for the Deep 7 complex as a whole but not for individual species, with the exception of opakapaka {Langseth et al. 2018}.

Opelu

In federal waters, the Western Pacific Regional Fishery Management Council (WPRFMC) manages mackerel scad and big-eye scad under the Hawaii Fishery Ecosystem Plan (WPRFMC 2009). In Hawaii state waters, the Hawaii Division of Aquatic Resources (DAR) manages these species. All fishing takes places in the Main Hawaiian Islands. The Northwest Hawaiian Islands (NWHI) was declared a National Monument and closed to fishing in 2010.

Under the federal management plan, mackerel scad and big-eye scad are managed as part of the Hawaii coral reef ecosystem management unit species. Management regulations include prohibitions on the use of destructive fishing gears and annual catch limits for mackerel scad and big-eye scad since 2012. In Hawaii State waters, where most fishing for these species occurs, there are minimal regulations in place. Permits are required and there are some gear restrictions, such as a prohibition on fishing for mackerel scad with animal bait, except with handline, in waters off the coast of South Kona {DAR 2013a}. The only restrictions for big-eye scad apply to the net fishery. There is size limit of 8 1/2 inches for big-eye scad caught in nets from July through October and there are restrictions on the size of the net that can be used. There are no regulations in place for the handline fishery (WPRFMC/NMFS/HDAR 2013){DAR 2013c}.

Recent population assessments have not been conducted for this species and no abundance targets/conservation goals have been established, it is unclear if current management measures are sufficient to sustain the mackerel scad populations, but the instruments to ensure effective implementation of management exist.

Management of other retained species in the Troll Fishery

Yellowfin tuna, wahoo, and mahi mahi

There are no total allowable catch (TAC) or allowable catch limit (ACL) restrictions for mahi mahi or wahoo in the Western Central Pacific including the U.S. EEZ. The State of Hawaii similarly has no size restrictions, bag limits, or seasonal closures of the commercial mahi mahi and wahoo fisheries. But both species are managed under the Pacific Pelagic Fisheries Ecosystem Plan (FEP), meaning that the management infrastructure and landings data are being collected and analyzed (e.g., CPUE). The FEP regulates harvest of pelagic species in U.S. waters through adaptive management (WPRFMC 2009b). Troll fishing regulations detailed in the FEP include requiring federal permits and logbooks. Many of the fish managed under the Pelagic FEP are also managed under the international agreements governing the WCPFC and/or the IATTC, to which the US is a

party. The Pelagic FEP includes overfishing thresholds for yellowfin, but there are no target or rebuilding control rules or reference points for mahi mahi or wahoo. We have awarded a moderately effective score to account for There are management measures that are currently in place, but target reference points and harvest control rules are not in place for all retained species.

Factor 3.2 - Bycatch Strategy

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii
Eastern Central Pacific | Trolling lines | United States | Hawaii

Highly effective
Bycatch levels from trolling and handline capture methods for bottomfish are low because this gear types and fishing strategy is highly selective for targeted species and sizes (WPRFMC 2006) (WPRFMC 2021b). Based on 2004 MHI data—the last year such data were available—the bycatch rate in the bottomfish fishery (all gear types) was 8.5% (WPRFMC 2006). Discarding occurs because of concerns regarding ciguatoxins or when there is shark damage (NMFS 2015b). Incidental capture of sharks is thought to rarely result in mortality, fishermen release hooked sharks alive by cutting their fishing gear, sharks generally do not experience barotrauma, and fishers will generally move to other areas to avoid losing more fish (WPRFMC 2021b). NOAA, the Pacific Islands Fisheries Science Center (PIFSC) and other partners recently conducted research with members of the West Hawai'i small boat fishery to better understand fishery perspective, shark interactions, and fisheries management (Iwane et al. 2019).

Monk seals are protected under the US Endangered Species Act, the Marine Mammal Protection Act and under Hawaiian state law. In the bottomfish fishery, fishermen are encouraged to use barbless circle hooks and required to report any interactions with endangered species (NMFS 2013). Any potential interactions are thought to be very low, and, according to the 2020 monk seal stock assessment, no mortality or serious injuries have been attributed to the MHI bottomfish handline fishery (NOAA 2021). Under section 7 of the Endangered Species Act, NMFS has determined that the bottomfish fishery does not adversely impact ESA-listed species or their habitat (WPRFMC 2009) (WPRFMC 2021b).

Fishermen are required to fill out logbooks which record information on fishing effort, fishing participants, fishing locations, number and species of fish caught, whether fish were kept or released, the condition of any released fish, and interactions with protected species such as sea turtles, Hawaiian monk seals, other marine mammals, and seabirds (NMFS 2011a). Other measures that have been implemented to reduce bycatch in this fishery include the prohibition of non-selective gears, like gillnets and bottom trawls, as well as outreach and training to fishermen on how to reduce bycatch and bycatch mortality (WPRFMC 2009). Because bycatch measures are in place and there are no significant bycatch concerns in this fishery, we have rated this factor "highly effective".

Factor 3.3 - Scientific Data Collection and Analysis

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii
Eastern Central Pacific | Trolling lines | United States | Hawaii

Highly effective
Uku was assessed in 2017 and 2020, and the results of stock assessments have informed management decisions. The decision to assess uku independently of a stock complex follows the WPRFMC's SSC recommendation from 2013 (WPRFMC 2013). The most recent stock assessment improved upon the previous assessment, includes fishery-dependent and fishery-independent data, and provides estimates of non-commercial catch (Nadon et al. 2020). Managers used the results of this stock assessment to set commercial and non-commercial ACT and ACL and propose accountability measures for the 2022-2025 fishing seasons (WPRFMC 2021b). Observer programs are not in place for this fishery, but fishermen are required to fill out logbooks which record information on fishing effort, fishing participants, fishing locations, number and species of fish caught, whether fish were kept or released, the condition of any released fish, and interactions with protected species such as sea turtles, Hawaiian monk seals, other marine mammals, and seabirds (NMFS 2011a). For these reasons, we award a "highly effective" score.
Justification:

Scientific Data Collection and Analysis of other retained species

Handline Fishery

The Deep 7 complex was assessed in 2018 and again in 2021, along with opakapaka under a single-species assessment model (Syslo et al. 2021). Managers used the results of this stock assessment to set commercial and non-commercial ACLs and propose accountability measures for the 2021-2024 fishing seasons (87 FR 3045). Opelu has not been recently assessed, but there are strategies underway to better understand and manage this culturally significant resource (Hurt et al. 2020), including the factors that affect abundance and catchability (WPRFMC 2021).

Troll Fishery

WPRFMC uses the results of stock assessments conducted by the WCPFC and the IATTC (and their associated scientific bodies) to inform their management strategy. Yellowfin tuna stocks are regularly monitored and assessed, though tuna assessments tend to have a degree of uncertainty surrounding the results (IATTC 2018). Wahoo and mahi mahi are not regularly assessed, but some data is collected related to stock abundance.

Factor 3.4 - Enforcement of and Compliance with Management Regulations

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii
Eastern Central Pacific | Trolling lines | United States | Hawaii

Moderately Effective
The state of Hawaii Department of Land and Natural Resources, Division of Aquatic Resources requires all commercial fishermen who fish in state waters to submit monthly logbooks, state catches are monitored through the commercial fishing reporting system, and non-commercial catch estimates are provided via the Hawaii Marine Recreational Fishing Survey (HMRFS) (WPRFMC 2021b). If a fisherman holds a state license and also fishes in federal waters, he/she must include information about those catches in their state logbook data (NMFS 2011a). Underreporting of commercial catch is likely to occur in these logbooks (Zeller et al. 2007). Commercial logbook data on uku and Deep 7 bottomfish catch are monitored throughout the fishing season, ensuring that the Deep 7 fishery will close if the ACL is reached (WPRFMC 2021) (WPRFMC 2021b). There are monitoring programs in place, but regulations are enforced by the fishing industry without regular independent scrutiny. Therefore, this subfactor is scored as "moderately effective".

Factor 3.5 - Stakeholder Inclusion

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii
Eastern Central Pacific | Trolling lines | United States | Hawaii

Highly effective
Before Federal management measures are enacted (which also affect fishing in state waters, such as ACLs), they are published in the Federal Register so the general public has time to comment. The public may also comment on any agenda items at a Western Pacific Regional Fisheries Management Council (WPRFMC) meetings. Stakeholder recently had the opportunity to comment on issues relevant to uku ACLs, ACTs, and AMs (WPRFMC 2021b). Because WPRFMC makes transparent decisions and uses a process that allows for stakeholder input from all user groups, we award a "highly effective" score.

Criterion 4: Impacts on the Habitat and Ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment. The final score is the geometric mean of the impact of fishing gear on habitat score (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 rating is determined as follows:

- ***Score >3.2=Green or Low Concern***
- ***Score >2.2 and ≤3.2=Yellow or Moderate Concern***
- ***Score ≤2.2 = Red or High Concern***

Guiding principles

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

FISHERY	FISHING GEAR ON THE SUBSTRATE	MITIGATION OF GEAR IMPACTS	ECOSYSTEM-BASED FISHERIES MGMT	FORAGE SPECIES?	SCORE
Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii	4	+.5	Moderate Concern		**Green (3.674)**
Eastern Central Pacific | Trolling lines | United States | Hawaii	5	0	Moderate Concern		**Green (3.873)**

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate
Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*
- *4 - Vertical line gear*
- *3 - Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.*
- *2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.*
- *1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 - Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl) Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.*

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts
Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- *+1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.*
- *+0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.*
- *0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1*

Factor 4.3 - Ecosystem-Based Fisheries Management
Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- *5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.*

- *4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have not proven to be effective and at least some spatial management is used.*
- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

Factor 4.1 - Physical Impact of Fishing Gear on the Habitat/Substrate

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii

4
Uku is found in hard and soft bottom habitat (Nadon et al. 2020) and seaward reefs (WPRFMC 2021b). The vertical handlines used in the Hawaiian bottomfish fishery are weighted and use baited circle hooks. Lines are deployed manually or with power reels to sit just above the benthos. This gear (specifically the terminal weight) does not routinely stay in contact with the substrate, depending on the individual fishing style. In addition to being highly selective for targeted species, this gear type is thought to have minimal impacts on the benthos because circle hooks are flat so are not as prone to snagging on rocky or other hard substrates unlike typical J shaped hooks (WPRFMC 2006). We award a score of "4" because handline fishery employs vertical lines to fish for benthic/demersal or reef-associated species.

Eastern Central Pacific | Trolling lines | United States | Hawaii

5
Trolling line gear does not come into contact with the ocean floor.

Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii

+.5
Uku is primarily caught on the tops of steep drop-offs and slopes that surround the islands (WPRFMC 2021b). Although the fishery operates in areas that include vulnerable habitats, the

vertical handlines used in the bottomfish fishery are thought to have minimal impacts on the benthos and vulnerable habitats (WPRFMC 2006) (WPRFMC 2021b), and the Fishery Ecosystem Plan prohibits the use of bottom trawl and other non-selective and destructive fishing gear in order to minimize the impact to bottom habitats (WPRFMC 2021b).

The entire Northwest Hawaiian Islands (NWHI) were closed to bottomfish fishing in 2010 (Commercial fishing is prohibited within the 582,578 mi^2 area protected by the Papahanaumokuakea Marine National Monument (NOAA Office of National Marine Sanctuaries 2020)), so now all fishing occurs within the waters surrounding the Main Hawaiian Islands. Additionally, Kahoolawe Island Reserve, State of Hawaii marine protected areas, and precious coral Habitat Areas of Particular Concern (HAPCs) are also closed to bottomfish fishing (WPRFMC 2021b). Finally, the state has committed to the *Holomua: Marine 30x30* initiative to effectively manage at least 30% of nearshore waters as marine managed areas (MMAs) by 2030; current MMAs cover 6% of nearshore waters, and each MMA is managed under a specific set of rules which may include fishing regulations (HDAR 2022c).

Because a substantial proportion of all representative habitats are protected from all bottom contact and vulnerable habitats are strongly protected, we award a mitigation credit of +0.5.

Justification:

In the Main Hawaiian Islands, there were 12 Bottomfish Restricted Fishing Areas (BRFAs) in state waters {NOAA 2011} which protected less than 20% of suitable bottomfish habitat (Parke 2007). These areas were set up to protect Deep-7 bottomfish species, whose habitat does not always overlap with uku's habitat. However, all previously closed BRFAs were reopened in 2022 following the 2021 deep-7 complex stock assessment, which indicated that the stock complex is being fished at sustainable levels (HDAR 2022b).

Eastern Central Pacific | Trolling lines | United States | Hawaii

0

Not applicable because this gear does not make contact with the substrate.

Factor 4.3 - Ecosystem-based Fisheries Management

Eastern Central Pacific | Handlines and hand-operated pole-and-lines | United States | Hawaii

Eastern Central Pacific | Trolling lines | United States | Hawaii

Moderate Concern

In the Hawaiian Archipelago, large-bodied roving predators are represented by species of sharks, jacks, and snappers (Asher et al. 2017). Uku is a piscivore/top predator (Sandin and Williams 2010) (Dale et al. 2011) (Friedlander and DeMartini 2002), that also feeds on shrimps, crabs, and cephalopods (Meyer et al. 2007). Uku, along with bluefin trevally (*Caranx melampygus*), giant

trevally (*C. ignobilis*), whitetip reef sharks (*Triaenodon obesus*), and gray reef sharks (*Carcharhinus amblyrhynchos*) are reef predators that play important roles in marine ecosystems, while also supporting Hawaii's coastal fisheries (Filous et al. 2016).

The Hawaiian bottomfish fishery, along with other fisheries managed by the Western Pacific Regional Fishery Management Council, have been managed under a Fishery Ecosystem Plan that aims to address fishery effects on other species, habitats and the ecosystem as a whole since 2010 (WPRFMC 2009). The entire Northwestern Hawaiian Islands have been declared a Marine National Monument and fishing is no longer permitted there (NOAA Office of National Marine Sanctuaries 2020). However, studies indicate there may not be spill over from the protected Northwestern Hawaiian Islands to the Main Hawaiian Islands (Toonen et al. 2011) (Wren et al. 2016). Large protected areas like Papahanaumokuakea likely provide full protection of resident populations of NWHI uku, but smaller scale MPAs with conventional fishery management measures is more appropriate for MPAs intended as fisheries management tools (Meyer et al. 2007). While small-scale MPAs may be more practical from a management perspective, but are less effective at protecting uku and other highly mobile predators (Filous et al. 2016) and networks of small MPAs that protect spawning aggregations are likely to be more effective (Meyer et al. 2007). The majority of uku landings coincides with uku spawning aggregations in the late spring and early summer (Nadon et al. 2020).

The fishery does not have known indirect effects on ecosystem function (WPRFMC 2021b), but we were unable to find evidence in peer reviewed literature that suggests current management measures are appropriate to the scale of the fishery and the ecology of the stock, precluding a "low concern" score. Because detrimental food webs impacts are possible, but there is spatial and temporal management that is appropriate to the scale of the fishery and the ecology of the stock that is *likely* to be effective, we award a score of "moderate concern" score

Justification:

Management of other retained species

Although there other main species included in this report, the fisheries under assessment are not substantial contributors to fishing mortality for the following species: opelu, yellowfin tuna, mahi mahi, and wahoo. Therefore, EBFM is not considered for those species.

Opakapaka

Opakapaka on Penguin Bank, Hawaii were classified as zooplanktivores, but opakapaka from the NWHI showed greater piscivory (Haight 1993). Similar to the uku fishery, there have been no identified impacts to ecosystem function from the Deep-7 bottomfish fishery (NMFS 2021). There is evidence that BRFAs were successful in providing conservation benefits to opakapaka and other members of the Deep-7 complex, but the closures were always controversial among fishers, who lobbied managers to remove some or all protected areas (Scherrer and Weng 2020). According to DAR, "the most recent (2021) update to the 2018 stock assessment again found the Deep-7 complex is being fished at sustainable levels. Therefore, DAR is comfortable taking an adaptive management approach to co-management by opening the BRFAs and relying on other conservation tools to sustain the fishery" (DLNR 2022).

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Scientific review does not constitute an endorsement of the Seafood Watch® program, or its seafood recommendations, on the part of the reviewing scientists. Seafood Watch® is solely responsible for the conclusions reached in this report.

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Appendix

Appendix A

Updates to the Hawaii Green Jobfish Report :
Updates to the January 23, 2014 Green Jobfish (previously called "Gray Snapper") report were made on June 1, 2022. The report was also updated from v2 of the Seafood Watch Fisheries Standard to v4. **Overall recommendations for the Green Jobfish (uku) handline and troll/poll fisheries in Hawaiian Islands upgraded from "Good Alternative" to "Best Choice."** This change was due to new information on status of this stock. Additional updates are described below.

Criterion 1

Green jobfish (uku) upgraded from "high" to "very low" concern (Factor 1.1) and from "moderate" to "low" concern (Factor 1.2) due to an updated stock assessment showing the stock was not overfished and overfishing was not occurring.

Criterion 2

Crimson jobfish (opakapaka) abundance (Factor 2.1) upgraded from "moderate" to "low" concern due to information in the most recent stock assessment specific to this species that indicated abundance and fishing morality were at sustainable levels.

Yellowfin tuna (ahi) abundance (Factor 2.1) downgraded from "very low" to "low" concern because there is some conflicting information about stock status; however the majority of models indicate this stock is not overfished.

Several changes were made based on updated catch composition data through 2021. Specifically, species that no longer fit the threshold for inclusion as a "main species" were removed from the report, while those that now constitute > 5% of the total catch in the fishery under assessment were added to the report.

Species removed

- Greater amberjack (kahala) and yellowstripe snapper (onaga) were removed from both fisheries because catch of these species no longer constitutes >5% of the total catch in the fishery under assessment.
- Hawaiian grouper (hapu'upu'u) was removed as a main species from the handline fishery because the fishery no longer accounts for >20% of the overall fishing mortality of Hawaiian grouper. Additionally, the IUCN has recently updated the status of Hawaiian grouper from Near Threatened to Least Concern (Craig 2018).

Species Added

Dolphinfish (mahimahi) and wahoo (ono) were added as main species in the troll fishery because catch of these two species now constitutes > 5% of the total catch in the fishery under assessment.

Mackerel scad (opelu) was added as main species in the handline fishery because catch of this species now constitutes > 5% of the total catch in the fishery under assessment.

Criterion 3

Scientific Data Collection and Analysis (Factor 3.3) upgraded from "moderately" to "highly" effective because the management process now involves regular up-to-date scientific stock assessments for uku.

Appendix B

Rating Review Summary Table :

Report: Green Jobfish/Uku (Hawaii)		
Criteria	**Previous Report (2014)**	**Current Review (2022)**
Who conducted the stock assessment?	NA	NMFS/PIFSC (Nadon et al. 2020)
When was the stock assessment conducted?	NA	2020 (Nadon et al. 2020)
Where/what are the catch composition data source(s)?	HDAR	Jason Helyer, HDAR
Who manages the fishery?	HDAR, WPRFMC	Same as previous
What is the date of the published management plan?	Hawaii FEP codified in 2010.	Most recent draft ACLs and AMs published in 2021 (WPRFMC 2021b)
Are there any amendments?	• Amendment 3 Omnibus amendment for the western Pacific region to establish a process for specifying annual catch limits and accountability measures (WPFMC and NMFS 2011).	• Previously managed with the Deep-7 Complex, but became managed independently in 2019 (described in (WPRFMC 2021b)) • Amendment 4 Revised Descriptions and Identification of Essential Fish Habitat and Habitat Areas of Particular Concern for Bottomfish and Seamount Groundfish of the Hawaiian Archipelago (WPRFMC 2016)