WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

PRELIMINARY DRAFT

Setting the Acceptable Biological Catch for the Main Hawaiian Islands Non-Deep 7 Bottomfish Management Species, *Aprion virescens* (uku)

August 24, 2020

Prepared for the Scientific and Statistical Committee of the Western Pacific Regional Fishery Management Council

Table of Contents

Table of Tables

Table of Figures

1 Background Information

The National Marine Fisheries Service (NMFS) and the Western Pacific Fishery Management Council (Council) manage fishing for bottomfish management unit species (BMUS) in the Exclusive Economic Zone (EEZ, or federal waters, generally 3-200 nautical miles, or nm, from shore) around Hawaii through the Fishery Ecosystem Plan (FEP) for the Hawaiian Archipelago authorized by the Magnuson-Stevens Fishery Conservation and Management Act (MSA).[1] Prior to 2010, the Northwestern Hawaiian Islands (NWHI) bottomfish fishery, which has historically accounted for nearly half of the bottomfish landed in Hawaii, operated under a limited entry system with permit, reporting, and observer requirements. However, in 2009, NMFS closed the NWHI fishery within waters of the Papahanaumokuakea Marine National Monument in accordance with the Presidential Proclamation establishing the Monument (71 FR 51134, August 29, 2006). At present, bottomfish fishing managed under the Hawaii FEP (WPRFMC 2009) only occurs in waters around the main Hawaiian Islands (MHI).

The MHI bottomfish fishery has typically harvested an assemblage of 14 different BMUS managed by NMFS and the Council as two separate stock complexes, the MHI Deep 7 bottomfish stock complex and the MHI non-Deep 7 bottomfish stock complex.[2] The Deep 7 bottomfish stock complex includes onaga (*Etelis coruscans*), ehu (*Etelis carbunculus*), gindai (*Pristipomoides zonatus*), kalekale (*Pristipomoides sieboldii*), opakapaka (*Pristipomoides filamentosus*), lehi (*Aphareus rutilans*), and hapuupuu (*Epinephelus quernus*). The Deep 7 bottomfish are generally found along high-relief, deep slopes, ranging from 80-400 meters. The non-Deep 7 bottomfish stock complex inlcudes uku (*Aprion virescens*), white ulua (*Caranx ignoblis*), black ulua (*Caranx lugubris*), taape (*Lutjanus kasmira*), yellowtail kalekale *(Pristipomoides auricilla)*, butaguchi (*Pseudocaranx dentex*), and kahala (*Seriola dumerili*); uku (i.e., the green jobfish) harvested in the MHI will be the focus of this ABC specification document. Fishermen have been known to typically catch non-Deep 7 bottomfish during Deep 7 bottomfish trips at relatively shallower depths. At the 170th Council Meeting held on June 19-22, 2017 (82 FR 24952), six of the seven non-Deep 7 bottomfish management unit species (MUS) were designated as Ecosystem Component species (ECS), thereby leaving only uku as MUS.

Bottomfish fishing in federal waters is managed though measures implemented by both the State of Hawaii and NMFS. State management measures that apply to non-Deep 7 bottomfish include commercial licensing, reporting requirements, and prohibition on fishing within 12 bottomfish restricted fishing areas (BRFAs). Federal management measures at 50 Code of Federal Regulations (CFR) 665 pertain primarily to non-commercial bottomfish fishing, and they require non-commercial fishermen to obtain a federal non-commercial bottomfish permit, report all catch, and adhere to a bag limit of no more than five Deep 7 bottomfish per trip. Federal requirements also prohibit fishing for BMUS with bottom trawls and bottom set gillnets, and

[1] Nearshore waters, generally within 3 nm of the shoreline around American Samoa, Guam, the Northern Mariana Islands and Hawaii are subject to the respective jurisdiction and management authority of the Territory of American Samoa, the Territory of Guam, the Commonwealth of the Northern Mariana Islands, the State of Hawaii and are not part of the FEP management area.

[2] The Magnuson-Stevens Act 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.

they direct NMFS to specify an annual catch limit (ACL) and implement accountability measures (AM) for each bottomfish stock and stock complex as recommended by the Council in consideration of the best available scientific information about the fishery. Additional regulations implemented by other Federal agencies and/or the State of Hawaii may also apply to bottomfish fishing in the EEZ waters.

1.1 Overview of the ACL Specification Process

Federal regulations at 50 CFR 665.4 (76 FR 37285, June 27, 2011) require NMFS to specify ACLs and AMs for each stock or stock complex of MUS identified in an FEP, as recommended by the Council, and in consideration of the best available scientific, commercial, and other information about the fishery for that stock or stock complex. This section provides an overview of the ACL specification process.

In accordance with the MSA and the FEPs, there are three required elements in the development of an ACL specification. The first requires the Council's Scientific and Statistical Committee (SSC) to calculate an acceptable biological catch (ABC) that is set at or below the stock or stock complex's overfishing limit (OFL). The OFL is an estimate of the catch level above which overfishing is occurring. ABC is the level of catch that accounts for the scientific uncertainty in the estimate of OFL as well as other sources of uncertainty. In determining the appropriate ABC, the SSC follows the ACL mechanism described in the FEPs, which includes a five-tiered system of "ABC control rules" that allows for different levels of scientific information to be considered (WPRFMC and NMFS 2011). Tiers 1, 2, and 3 involve data-rich to data-moderate situations, and they include levels of scientific uncertainty derived from model-based stock assessments. Tiers 4 and 5 involve data-poor situations, and include consideration of scientific uncertainty derived from ad-hoc procedures such as simulation models or expert opinion.

When calculating an ABC for a stock or stock complex, the SSC must first evaluate the available information and ascribe the stock or stock complex into one of the five tiers. The SSC must then apply the control rule assigned to that tier to determine an ABC. For stocks like MHI non-Deep 7 bottomfish that have an estimate of OFL, maximum sustainable yield (MSY), and other MSY-based reference points (i.e., Tier 1-3 quality data), the ABC is calculated by the SSC based on the Tier 1-3 ABC control rule that accounts for scientific uncertainty in the estimate of the OFL and the acceptable level of risk (as determined by the Council) that catch equal to the ABC would result in overfishing. In simpler terms, the ABC is the maximum value for which the probability/risk of overfishing (P*) is less than 50 percent. In accordance with National Standard 1 (NS1) guidelines of the Magnuson-Stevens Act, the probability of overfishing cannot exceed 50 percent and should be lower if possible (74 FR 3178, January 9, 2011). The process described in the FEPs includes a qualitative analysis by which the P* value may be reduced below 50 percent based on consideration of four dimensions of information, including assessment information, uncertainty characterization, stock status, and stock productivity and susceptibility to overfishing. The FEPs also allow the SSC to recommend an ABC that differs from the results of the ABC control rule calculation based on factors such as data uncertainty, recruitment variability, declining trends in population variables, and other factors determined relevant by the SSC. However, the SSC must explain its rationale.

The second step requires the Council to determine an ACL that may not exceed the SSC-recommended ABC. This process includes methods by which the ACL may be reduced from the ABC based on social, economic, and ecological considerations, or management uncertainty (SEEM). An ACL set below the ABC further reduces the probability that actual catch will exceed the OFL, resulting in overfishing.

The third and final step in the ACL process is the development of AMs. There are two categories of required AMs: in-season AMs, and post-season AMs, both of which make adjustments to an ACL if it is exceeded. In-season AMs prevent an ACL from being exceeded in the midst of the fishing season and may include, but are not limited to, closing the fishery, closing specific areas, changing bag limits, or other methods to reduce catch. An annual catch target (ACT) is the management target of the fishery that accounts for management uncertainty in controlling the actual catch at or below the ACL.

If the Council determines that an ACL has been exceeded, the Council may recommend, as a post-season AM, that NMFS reduce the ACL in the subsequent fishing year by the amount of the overage. Additionally, if an ACL is exceeded more than once in a four-year period, the Council is required to re-evaluate the ACL specificaation process, and adjust the system for setting ACLs, as necessary, to improve relative performance and effectiveness.

Figure 1 illustrates the relationship among the OFL, ABC, and ACLs. For more details on the specific elements of the ACL specification mechanism and process, see Amendment 1 to the PRIA FEP, Amendment 2 to the American Samoa Archipelago FEP, Amendment 2 to the Mariana Archipelago FEP, Amendment 3 to the Hawaii Archipelago FEP (WPFMC and NMFS 2011), and the final implementing regulations at 50 CFR §665.4 (76 FR 37285, June 27, 2011).

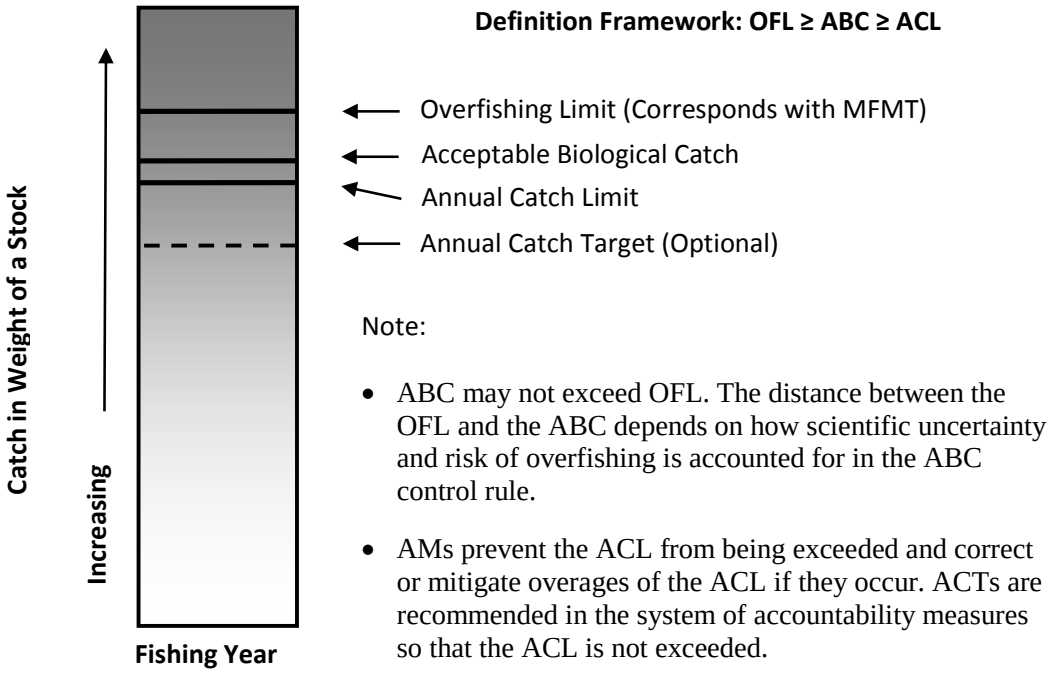

Figure 1. Relationship among OFL, ABC, ACL, ACT, and AMs

1.2 Purpose and Need

The purpose of this action is to comply with the requirements of the Magnuson-Stevens Act and the Hawaii FEP and implementing regulations that require implementation of ACLs and AMs for MHI bottomfish MUS, including uku. The need for this action is to prevent overfishing and to provide for long-term sustainability of the fishery resources while allowing fishery participants to continue to benefit from their utilization. AMs are needed to reduce the potential of exceeding an ACL and are used to correct or mitigate overages of the ACL should they occur. In order to specify the ACL, the SSC must set the Acceptable Biological Catch upon which the ACLs shall be reduced from.

2 Description of the Alternatives

The alternatives considered in this document include a range of possible ABC for the uku fisheries in Federal waters around the MHI. Although estimates of the OFL and calculations of the ABC are part of the ACL mechanism, the establishment of these reference points is not part of the proposed Federal action. A summary of their development is described in this section, however, for informational purposes.

2.1 Development of the Alternatives

This is the fourth year uku would be managed under an ACL developed for the single species stock rather than a multi-species stock complex. NMFS and the Council previously managed the uku fishery as part of the non-Deep 7 bottomfish complex using an ACL that applied to the multi-species complex since 2012. The ACL for the MHI uku will expire on December 31, 2021.

To develop its ACL recommendation for the uku fishery ACL for 2022 through 2025, the Council and its SSC used the approved process described in Chapter 1 above and in detail in WPFMC and NMFS (2011). To quickly recap, the process applied in this case started with a new stock assessment based on a variety of fisheries information and uku biology, which resulted in estimation of the overfishing limit. The stock assessment was reviewed through WPSAR and again through the SSC to evaluate whether it contained information suitable for management. The next step was for a working group to assemble and review the scientific uncertainty within the assessment in order to make a recommendation for the P* (probability of overfishing). The SSC then applied the P* to recommend the acceptable biological catch (ABC). Another working group reviewed the social, economic, ecological, and management uncertainties in the fisheries and fisheries management in order to make a recommendation for the P* for the Council to specify the ACL and perhaps set the ACT. The ACL and/or ACT were used as the basis of the action alternatives considered here. The alternatives under consideration are based upon the best available scientific, commercial, non-commercial, and other information about the uku fishery.

2.2 Best Scientific Information Available

The best scientific information available is from the 2020 benchmark assessment of the main Hawaiian island gray jobfish (Nadon et al. 2020). The benchmark assessment builds off these previous efforts and uses catch, catch-per-unit-effort (CPUE), diver surveys, and size composition time-series in the Stock Synthesis modeling framework (Methot & Wetzel 2013). Stock Synthesis 3.30 is an integrated statistical catch-at-age model that fits a population model to

relative abundance and size composition data in a likelihood-based statistical framework to generate maximum likelihood estimates of population parameters, derived outputs, and their associated variability. These outputs are then used to determine stock status and to develop stock projections under different management scenarios.

All available fishery data from recreational and commercial fisheries in the MHI were used for this stock assessment. Total recreational catch for the 2003–2018 period was obtained from the Hawaii Marine Recreational Fishing Survey (HMRFS) and reconstructed for the 1948–2003 period by relating historical catch to human population trends in the MHI. Total commercial catch was obtained from the Division of Aquatic Resources (DAR) fisher reporting system (FRS). Commercial catches for uku were dominated by the deep-sea handline fishing gear although trolling and inshore-handline catches have increased in recent decades. CPUE data were obtained from all three main fishing gears in the FRS while size composition data were obtained for the deep-sea handline gear only, due to limited data availability. Deep-sea handline data were the only CPUE time-series available for 1948–2002, as trolling and inshore handline data were sparse for this period. Additionally, information from NOAA diver surveys was incorporated as a fishery-independent abundance index between 2005 and 2016.

Uku catches increased from 1948 to the late 1980s and have been declining slowly since then. Model estimates of population biomass show a gradual decline from 1948 to the late 1980s, followed by a brief period of stability and a substantial increase in biomass starting in the early 2000s. Fishing mortality on the stock (average F on ages 5-30) is currently 0.08 with an F/FMSY value of 0.57 (Figure S1). Fishing mortality has only been above FMSY (0.14) twice, in 1988 and 1989 when F reached 0.19 and 0.16, respectively. The 2018 spawning stock biomass (SSB) of 819 mt is 272% above the SSBMSST (301 mt). Therefore, relative to the reference points defined by the Fisheries Ecosystem Plan, overfishing is not occurring and the MHI uku stock is not overfished (Figure S1).

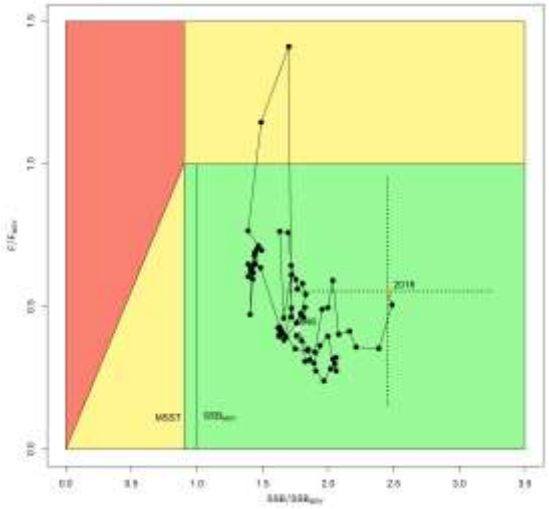

Figure S1. Kobe plot of the trends in estimates of relative fishing mortality (average of age 5–30) and spawning stock biomass of uku from

Stock projections for uku were conducted using the age-structured projection model software AGEPRO (Brodziak et al. 1998). Stochastic projections were conducted using results from the base-case model to evaluate the probable impacts of constant catch quotas on future spawning stock biomass and yield for uku in the MHI. Results show the projected female spawning stock biomasses and fishing mortality rates under each of the constant-catch scenarios. For example, a constant catch limit of 135 mt each year from 2020 to 2026 would result in a 50% chance of overfishing occurring in 2026.

The new benchmark assessment went through a WPSAR (85 FR 5633, January 31, 2020) in accordance with the requirements of National Standard 2 (78 FR 43066, July 19, 2013). Dr. Erik Franklin (chair), Dr. Yong Chen, and Dr. Yan Jiao conducted the review. Pursuant to this review,

PIFSC incorporated the short-term recommendations of the WPSAR panel and produced the final assessment (Nadon et al. 2020). The SSC at its 136th meeting heard the results of the WPSAR review and the peer-reviewed stock assessment. As described in its 136th SSC meeting report, the SSC found the stock assessment to represent the best scientific information available for development of harvest limits and overfishing status determination for uku. Similarly, on August XX, 2020 PIFSC also determined that the assessment was BSIA.

2.2.1 Estimation of OFL

The 2020 benchmark stock assessment (Nadon et al 2020) provided the Council and NMFS with new scientific information about uku stock status, and with tables detailing the estimated risk of overfishing at various levels of catch (Table 1). Fisheries scientists from NMFS PIFSC compiled data from various information sources (i.e. life history information, catch data for the commercial and non-commercial fisheries, length data from catch and underwater census surveys, or UVS) to produce a stock assessment that describes the current status of uku. The assessment produced the catch level associated with various levels of overfishing risk at 1 percent intervals based on analysis of catch data (Table 1). The analysis used the total catch in 2019 to be the status quo catch based on the assumption that 2019 catches would likely be similar to recent catch amounts. The maximum catch was set to give a 50 percent probability of overfishing in the final year of the projections.

Table 1. Probability of overfishing uku for various catch levels based on analyses using commercial and non-commercial catch data from FRS and HMRFS, respectively (Nadon et al. 2020).

Probability of overfishing	2022	2023	2024	2025
0.50	144	141	139	137
0.49	144	141	139	137
0.48	144	141	138	136
0.47	143	140	138	136
0.46	143	140	13	136
0.45	142	139	137	135
0.44	142	139	137	135
0.43	142	139	136	135
0.42	141	138	136	134
0.41	141	138	136	134

Probability of overfishing	2022	2023	2024	2025
0.40	140	138	135	133
0.39	140	137	135	133
0.38	140	137	135	133
0.37	139	136	134	132
0.36	139	136	134	132
0.35	138	136	134	132
0.34	138	135	133	131
0.33	138	135	133	131
0.32	137	135	132	131
0.31	137	134	132	130
0.30	136	134	132	130
0.29	136	133	131	129
0.28	135	133	131	129
0.27	135	132	130	129
0.26	135	132	130	128
0.25	134	132	129	128
0.24	134	131	129	127
0.23	133	131	129	127
0.22	133	130	128	127
0.21	132	130	128	126
0.20	132	129	127	126
0.19	131	129	127	125
0.18	130	128	126	125

Probability of overfishing	2022	2023	2024	2025
0.17	130	127	126	124
0.16	129	127	125	124
0.15	128	126	124	123
0.14	127	125	124	122
0.13	126	125	123	122
0.12	126	124	122	121
0.11	125	123	122	121
0.10	124	122	121	120
0.09	122	121	120	119
0.08	141	120	119	118
0.07	120	119	118	117
0.06	119	118	117	116
0.05	117	116	116	115
0.04	116	115	114	114
0.03	114	113	112	112
0.02	111	111	110	110
0.01	108	107	107	107

The 2020 stock assessment provided estimates used by the SSC and the Council in developing their recommended OFL. Consistent with National Standard 1 guidelines, the Council sought to set the OFL for uku equal to the level of catch associated with a 50 percent probability of exceeding MSY (i.e., a 50 percent chance of overfishing). Table 2 presents a range of catches and their associated probabilities of overfishing. The Council utilized the risk of overfishing estimates on the terminal year of specification, 2025 for uku to establish an OFL of 137 mt (302,003 pounds) for the fishing years 2022–2025.

2.2.2 SSC's Calculation of ABC

According to the established ACL process, the ABC is the acceptable level of catch that accounts for the scientific uncertainty of the information used in the assessment. In essence, the OFL is reduced to account for uncertainty, and the result is the ABC (**Error! Reference source not ound.**). The computation of the ABC used in the proposed alternatives followed the previously approved process described in the Hawaii FEP. The calculation of ABC begins with a P* working group that systematically addresses scientific uncertainty in the stock assessment. The P* process evaluates four aspects of the stock assessment: assessment information, assessment uncertainty, stock status, and stock productivity and susceptibility to fishing. The working group gives a score of 0–10 to each aspect, where a higher score indicates greater uncertainty. These scores are summed and subtracted from 50 to calculate P*.

The Council, at its 182nd meeting, directed staff to convene the P* working group to quantify the scientific uncertainties in the new assessment, and to provide their recommendations for the SSC to consider in developing the ABC. This group met online hosted at the Council Office on July 21, 2020. The working group quantified the following reduction scores for each of the four dimensions: 0.7 for assessment information, 2.5 for uncertainty characterization, 0.0 for stock status, and 4.2 for productivity and susceptibility. P* was reduced for assessment information because of uncertainties in the non-commercial data from HMRFS and the lack of tagging and spatial analysis. Uncertainty received a score of 2.5 because of uncertainties in available reproduction and environmental information. No reduction from stock status because the assessment did not indicate that uku was in a state of overfishing. The score for productivity and susceptibility was 4.2 because uku has moderate productivity and low susceptibility. In total, the P* analysis indicated that overfishing risk should be reduced to 42.6 percent, which rounded to up to 43 percent.

The report from the P* meeting will be presented at the SSC and Council at their 137th and 183rd meetings, respectively and will enable the SSC and Council to use the information for the Council's recommendation on ABC, ACL and AMs. The P* scores will be the basis for the SSC recommending an ABC associated with a risk of overfishing levels of 43 percent or lower in fishing year 2022-2025 (rather than on the highest acceptable limit of 50 percent risk of overfishing).

2.3 Description of the Alternatives Considered

This section describes the range of ABC alternatives for MHI uku and related probability of overfishing values for 2022 through 2025 based on the best scientific information available.

2.3.1 Alternative 1: No ACL or AM Management (No Action)

Under Alternative 1, the SSC would not recommend an ABC-level for the Council to specify for uku harvested in the MHI in fishing years 2022 through 2025. This alternative would not comply with the Magnuson-Stevens Act or the provisions of the Hawaii FEP, which require NMFS to specify an ABC for all stocks and stock complexes in a given fishery.

Expected Fishery Outcome

Under this alternative, the MHI uku fishery would fish year-round. NMFS would not implement an ACL and there would not be regulatory discards of uku due to a fishery closure.

Under Alternative 1, we expect the fishery would continue in the manner in which it was conducted in recent years. Not implementing an ACL or AMs is not expected to result in large changes to the conduct of the fishery, including gear types used, areas fished, level of catch or effort, target and non-target stocks, or protected species. This continuity is expected because catches of uku (as part of the non-Deep 7 species complex) have not been constrained by ACLs and AMs (Table 2). Since there has not been an in-season accountability measure such as a fishery closure as part of the non-Deep 7 bottomfish fishery, annual catch was a result of fishery dynamics and not due to external limitations from management. Since ACLs were first implemented for the non-Deep 7 bottomfish fishery, catch exceeded the ACL only in 2012. Non-deep 7 catch in recent years has been lower than ACLs (Table 2). Uku catch during these years would have been less than the ACL proposed.

Table 2. Harvest limit reference points (in lb) comparing non-Deep 7 bottomfish catch with the ACL and the proportion of the ACL (percent) caught over the past eight years in the MHI

Year	OFL	ABC	ACL	Non-Deep 7 Catch	Proportion of ACL	Uku catch	Proportion of total
2012	192,000	135,000	135,000	139,209	1.03	116,764	0.84
2013	192,000	140,000	140,000	135,945	0.97	121,143	0.89
2014	192,000	140,000	140,000	108,604	0.78	96,813	0.89
2015	259,200	187,100	178,000	112,355	0.63	101,954	0.90
2016	259,200	187,100	178,000	127,254	0.71	119,175	0.94
2017	259,200	-	-	142,399	0.80 of 2016 ACL	131,841	0.93
2018		-	-			69,496	
2019	132,277	127,205	127,205	NA	NA	82,760	NA

Source: Catch data from WPacFIN. Data for 2018 and 2019 accessed on August 17, 2020

Table 3 shows the yearly catch of uku since 1948. Uku catches have generally increased since catch limits were first implemented for MHI Deep 7 bottomfish in 2007, and the highest uku landings since this time were reported in 2017. Anecdotal information suggests that the increase after 2008 was likely a result of NMFS implementing an ACL system in fishing year 2007–08 for Deep 7 bottomfish. In fishing years 2007–08 through 2010–11, NMFS closed the MHI Deep 7 bottomfish fishery to prevent the fishery from exceeding its ACL. This resulted in an increased catch of uku to meet market demand as a substitute for Deep 7 bottomfish, and appears to have led to a new market for uku as annual catches of uku have generally remained higher. However, uku catch was lower in 2018 and 2019 than in recent years, and similar to catch levels from 2004–2008. Reasons for this difference are not known, though uku is often considered to be a "pulse" fishery, and catch and effort in the uku fishery has historically varied based on weather and influences of fishing conditions in other local fisheries (e.g. ahi and Deep 7).

Since ACLs were first implemented for the non-Deep 7 stock complex in 2012, catches of uku have been below the OFL of 302,003 lb in each year (Table 3). The fishery is not expected to perform differently than recent years in part because a closure of the Deep 7 fishery is not expected. The ACL for the Deep 7 fishery for the duration of the proposed uku action is more than double the average of recent catches (NMFS 2019a), so there is very little chance the fishery will close and redirect effort to uku fishing as it did in 2007 and 2010. In fishing years 2022, 2023, 2024, and 2025, without an ACL, the total reported uku catch is expected to be within the range of catches in recent years, and is not expected to exceed the OFL.

However, uku catch did exceed the ABC/ACL level specified for 2019 (127,205 pounds) in 2017 (catch = 131,841 pounds). This ACL takes into account scientific and management uncertainty, and provides a buffer to ensure that overfishing is not occurring. If the fishery were to perform in 2022, 2023, 2024, and/or 2025 at the same level as 2017, the lack of an ACL and AMs under Alternative 1 would not provide regulatory ability to ensure the long-term sustainability of the resource.

If we are to utilize the OFL in the 2020 benchmark stock assessment (Nadon et al 2020) of 302,003 pounds and assume that the commercial component is 50 percent of the OFL (151,001 pounds), none of the catches since the implementation of the catch limit exceeded the OFL. Therefore, the lack of an ACL and AMs under Alternative 1 would still ensure the long-term sustainability of the resource.

Table 3. Annual catch of uku (lb) from 1948 to 2019

Year	Catch	Year	Catch	Year	Catch	Year	Catch	Year	Catch
1948	101,540	1963	63,562	1978	84,252	1993	69,966	2008	92,576
1949	83,062	1964	89,858	1979	87,128	1994	71,832	2009	87,987
1950	57,880	1965	49,882	1980	74,723	1995	60,128	2010	120,764
1951	45,015	1966	57,849	1981	85,084	1996	53,306	2011	109,306
1952	64,847	1967	58,556	1982	100,929	1997	67,975	2012	116,764
1953	63,890	1968	49,677	1983	132,386	1998	61,105	2013	121,143
1954	61,937	1969	57,542	1984	138,913	1999	89,835	2014	96,813
1955	76,067	1970	47,418	1985	49,307	2000	83,341	2015	101,954
1956	70,751	1971	48,710	1986	104,061	2001	58,451	2016	119,175
1957	96,442	1972	48,077	1987	56,759	2002	56,415	2017	131,841
1958	72,517	1973	66,875	1988	344,487	2003	46,230	2018	74,614
1959	46,040	1974	77,941	1989	208,393	2004	77,044	2019	89,836
1960	45,426	1975	61,951	1990	102,881	2005	63,565		
1961	42,200	1976	62,165	1991	91,258	2006	59,585		
1962	63,700	1977	68,388	1992	88,813	2007	69,125		

Note 1: Source: WPacFin data request 112834.
Note 2: Recent 5-year average from 2015–2019 = 103,484 lb uku.

2.3.2 Alternative 2: Roll over the previously specified ABC at 127,205 (Status Quo)

Under Alternative 2, the Council would recommend that NMFS implement an ACL of 127,205 lb of uku each year for the 2022, 2023, 2024, and 2025 fishing years. The ACL in this alternative utilizes information from Nadon (2017) and the P* working group meeting in 2016 that accounted for scientific uncertainties following the process described in the Hawaii FEP and summarized above in section **Error! Reference source not found.**. This would roll over the CL used in fishing year 2019, 2020, and 2021 to fishing year 2022, 2023, 2024, and 2025.

The 2016 benchmark stock assessment estimated an OFL of 132,277 lb for uku. This was the BSIA used for the ACL specification for fishing years 2019, 2020, and 2021. As noted above, the SSC previously recommended an ABC of 127,205 lb based on a reduction from the OFL to account for scientific uncertainty. Based on the probability of overfishing projections in the 2016 stock assessment, an ACL of 127,205 lb of uku is associated with a 42 percent risk of overfishing.

However, at the 132nd SSC meeting, the SSC endorsed the Nadon et al. 2020 as the best scientific information available. Taking that into consideration, Alternative 2, although it may comply with the requirements of MSA, NS1 and the Hawaii FEP, does not comply with the requirements of NS2 on the use of BSIA in setting the ABC.

Expected Fishery Outcome

The expected fishery outcome of this alternative is the same as it would be under the No Action Alternative in that neither are expected to result in changes in the behaviors of participating fishermen or other fishery conduct, including gears used, areas accessed and fished, and relative levels of catch and effort. It is expected that the average annual Hawaii uku catch in fishing years 2022 to 2025 will be similar to recent years and remain below the proposed ABC and ACL.

Under this alternative, uku catch in 2022-2025 is expected to be similar to the recent catch which averages to 98,764 lb (fishing year 2017-2019) and remain below the ABC at 127,205 lb Alternative 2 is not expected to result in changes in the conduct of the fishery, including gear types used, areas fished, level of catch or effort.

The catch statistics are not available until at least 40 days at a minimum because the data to monitor the commercial fisheries are from the monthly reports from the State of Hawaii. In-season tracking of catch is plausible on a monthly level.

This Alternative is more precautionary than the No action Alternative, which would not implement an ACL, an in-season fishery management measure in the form of a closure to prevent the fishery from exceeding the ACL, or call for an overage adjustment if the fishery does exceed the ACL. However, this alternative do not comply with the National Standards 2 on the use of the best scientific information available.

2.3.3 Alternative 3: Set ABC based on the updated 2020 benchmark stock assessment at P* level from the working group analysis at P*=43 percent equivalent to 135 mt (297,624 lb)

Under Alternative 3, the SSC will set the ABC at 297,624 lb for uku in the MHI for the 2022, 2023, 2024, and 2025 fishing years. This alternative is based on the best scientific information available (Nadon et al 2020) and the evaluation by the P* working group (WPRFMC 2020. This corresponds to a risk of overfishing of 43 percent in the 2020 stock assessment.

Under Alternative 3, this utilizes the best scientific information available (Nadon et al. 2020) and the P* Analysis to derive the ABC. This complies with the MSA and NS1 requirements of setting the ABC, and the NS2 on the use of the best scientific information available.

This level of ABC is higher than Alternative 2 because it reflects both the commercial and non-commercial catches. To determine the likelihood of recent catches would reach the ABC, we have to look at the only commercial component of the ABC. Table 4 shows the commercial catch derived from the FRS and non-commercial catch from HMRFS in the past 16 years. The ratio of commercial to non-commercial is 51 percent and 49 percent respectively. Therefore, if the ABC is to be split into commercial and non-commercial it would be 151,788 lb for commercial and 145,836 lb for non-commercial.

The commercial component of the ABC under Alternative 3 is 24,583 lb higher than ABC under the Alternative 2 and is associated with a probability of overfishing that is 43 percent, 1 percent higher than the P* value associated with the Alternative 2 from Nadon (2017). Comparing the 127,205 lb (57.7 mt) to the catch in Table 2 adjusting it by the 0.51 commercial ratio, this level of catch is about 3-4 percent risk of overfishing. Thus, this Alternative is higher in catch than Alternatives 1 and 2 but the best scientific information available indicates that this level of catch will support sustainable fishing of the stock.

Table 4. Commercial and non-commercial catch estimate of uku from 2003 to 2018. The percent commercial and non-commercial shows the ration per year. The avarage from 2015 to 2018 is about 51 percent commercial to 49 percent non-commercial

Year	Commercial (lb)	Non-Commercial (lb)	Percent Commercial	Percent Non-Commercial
2003	45,894	110,635	0.29	0.71
2004	77,044	145,098	0.35	0.65
2005	63,565	186,986	0.25	0.75
2006	59,585	107,400	0.36	0.64
2007	69,125	66,188	0.51	0.49
2008	92,535	43,705	0.68	0.32

2009	87,987	55,408	0.61	0.39
2010	120,764	99,731	0.55	0.45
2011	109,306	129,166	0.46	0.54
2012	116,764	206,715	0.36	0.64
2013	121,143	59,215	0.67	0.33
2014	96,813	105,659	0.48	0.52
2015	101,954	72,050	0.59	0.41
2016	119,175	59,122	0.67	0.33
2017	131,841	129,191	0.51	0.49
2018	74,614	199,905	0.27	0.73
Average$_{15\text{-}18}$			0.51	0.49

Expected Fishery Outcome

Under Alternative 3, the commercial and non-commercial fishery will have a biological limit up to 297,624 lb of uku per year. The fishery will not reach this ABC if the fishery performance is similar to recent years (Table 3). Since ACLs were first implemented for the non-deep 7 fishery in 2012, uku catch did not exceed the commercial component of the ABC under this Alternative at 151,788 lb (Table 5). In years prior to ACL implementation, uku catch has not received this level since 1989 (Table 3). At this level of catch, it is unlikely that the fishery will close. In case that the catch accumulation rate is higher, it is likely that the ACL will be reached on the last month of the fishing year. The Council expects that fishermen would continue to fish for pelagic fish and other bottomfish in the same way as they already are fishing for these MUS, and any uku caught incidental to these other fisheries within Federal waters, would be discarded. Uku catch from State waters during a Federal fishery closure could be sold, and all fish reported would be counted toward an ACL exceedance, if applicable.

Table 5. Cumulative catch of uku (lb) by year and month.

Year	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
January	12,175	11,090	6,731	13,230	12,169	11,432	11,465
February	20,137	15,520	12,033	21,879	18,080	18,510	18,976

Year	2012	2013	2014	2015	2016	2017	2018
March	24,572	24,346	18,197	29,459	23,378	28,222	25,238
April	33,497	40,536	23,610	35,036	31,870	45,602	28,183
May	44,203	66,581	39,945	47,711	57,863	58,337	34,373
June	57,287	79,505	49,222	65,116	73,895	73,380	44,984
July	68,882	85,450	52,440	73,112	83,022	85,995	53,569
August	79,645	94,476	58,165	80,753	98,763	99,204	56,935
September	92,009	102,253	71,111	87,574	104,294	111,840	62,049
October	103,043	110,556	76,921	91,733	107,526	119,784	66,393
November	108,877	115,809	84,399	95,379	113,024	122,835	71,250
December	116,764	121,143	96,813	101,954	119,175	131,841	74,614

Figure 2 shows cumulative monthly catches of uku from 2009 to 2018. The OFL and OBC for total catches are the solid blue and green lines. The commercial and non-commercial components of the ABC are based on the 0.51:0.49 ratios from Table 4. Based on the recent historical performance, this level of ABC will not be reached. The highest level of commercial catch was from 2017 at 131,841 lb which was 19,947 lb below the commercial ABC. This alternative allows for preventing the ABC from being exceeded thereby preventing overfishing from occurring.

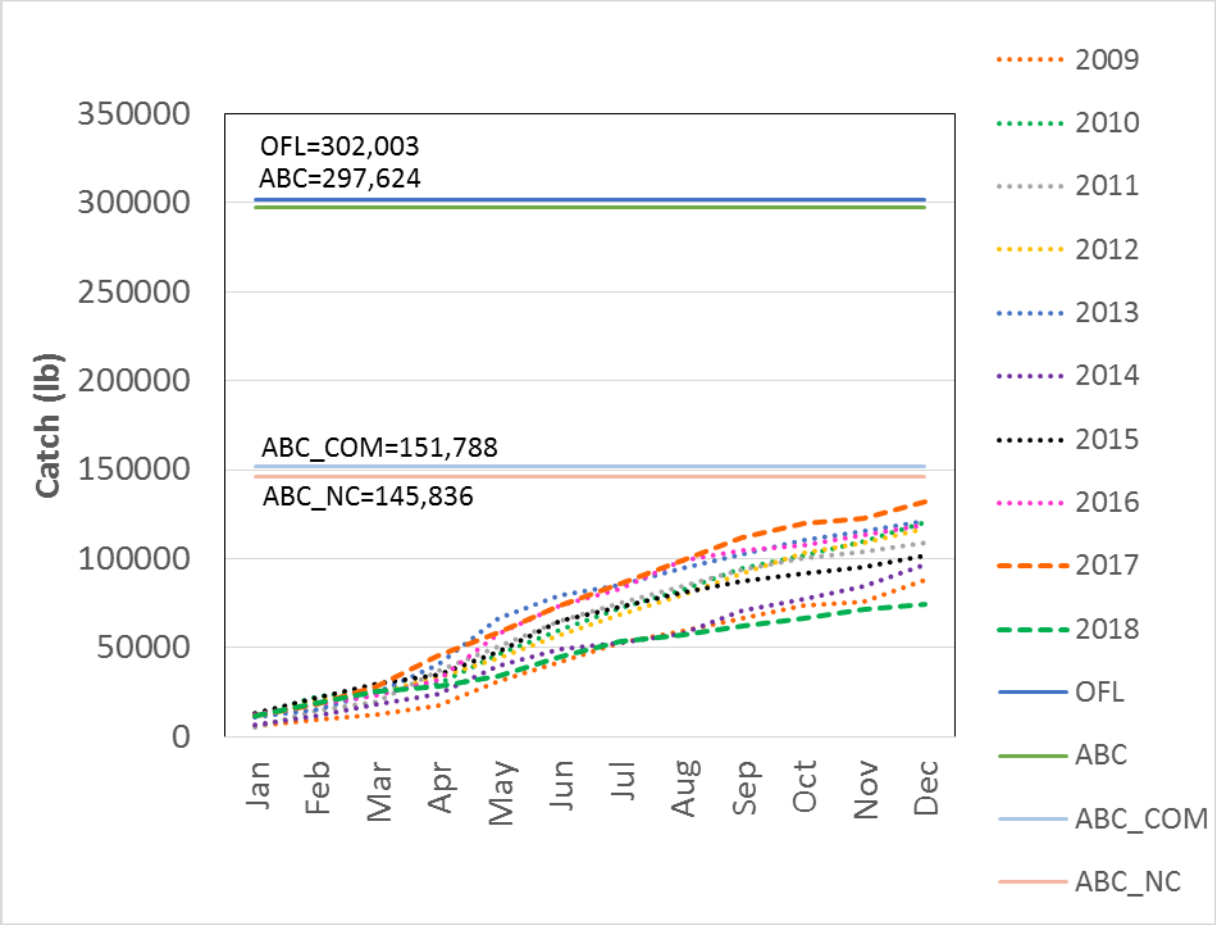

Figure 2. Monthly cumulative catch of uku from 2009 to 2018. Horizontal lines show the various harvest reference limits: OFL, ABC commercial and non-commercial catches combined and the commercial and non-commercial component of the ABC using a 0.51:0.49 ratio.

2.4 Considerations for Applying the Accountability Measures

2.4.1 Allocate ACLs to the Commercial and Non-Commercial Sector and Apply In-season Accountability Measures

The ABCs analyzed are based on total catch. The ABC could be allocated to the commercial and non-commercial sector of the uku fishery. In doing so, each sector will have to be monitored separately. The commercial fisheries will be monitored using the monthly fishers report by the State of Hawaii. Commercial fishermen are required to secure a commercial fishing license and the license requires fishermen to report their catch every month. There is a 10 day grace period at the end of each month for fishermen to submit their reports. If the Council and NMFS will monitor the commercial catch in-season, there is a 40-day lag in the Fisher Reporting System.

The non-commercial sector will be monitored using the HMRFS conducted by the State of Hawaii in collaboration with MRIP. HMRFS conduct mail survey to get fishing effort estimate

and an Access Point Angler Intercept Survey to sample catch and CPUE information. The data is sent to MRIP and the catch estimate is generated every two months. As noted in the 2020 benchmark assessment, there is a large variation on the annual non-commercial catch estimate for uku demonstrated by the large fluctuation in catch from 2003 to 2018. This would be exacerbated if the resolution is increased to a bi-monthly level. If the Council and NMFS will monitor the non-commercial catch in-season, there is a minimum of 60-day lag in the MRIP estimate. The Council and NMFS would also take into account the large fluctuation in non-commercial catches of uku.

The State of Hawaii currently does not have regulatory measures in place to limit the catch of uku and close the fishery in State waters should the commercial and non-commercial ABC are projected to be reached. This leaves 34 percent of the fisheries not managed that adds to the uncertainty that the ABC will not be exceeded.

2.4.2 Apply In-Season Accountability Measures to the Commercial Fisheries Only

The Council, NMFS, and State of Hawaii have decades of experience in managing the commercial BMUS fisheries particularly the Deep 7 bottomfish. This fishery sets the standards for Federal-State parallel fisheries management. If the Council recommends applying the accountability measure to only the commercial fisheries, this creates a disproportional management burden on the uku commercial fishery sector while the non-commercial sector is not managed. Unlike the Deep-7 bottomfish, State rules are in place for the non-commercial sector once the commercial ACL is reached where possession of Deep-7 bottomfish (for both non-commercial and commercial) and commercial sales of bottomfish are prohibited. This rule does not apply to the uku fishery.

The proportion of the non-commercial catch is significant (49 percent based on Table 4) and focusing only on the commercial sector ignores the significant proportion of the non-commercial sector.

2.4.3 Utilize Post-Season Accountability Measure

Given that the monitoring and the State management structure are not up to standard for the application of an in-season AM, the Council may consider the post-season AM where at the end of the fishing year the catch from the commercial and non-commercial uku fisheries will be compared to the ACL or ACT. A three-year average will be used for the commercial catch while a five-year average will be used for the non-commercial catch. The SEEM working group discussed the utility of the five-year average applied to the non-commercial catch data from HMRFS for the post-season accountability measure. Using data from the stock assessment, the five-year moving average smooths out the large variability in the non-commercial data better than a 3 or 4-year averaging (Figure 3). The average catches will be summed and compared to the ACL/ACT. If the averaged total catch exceeded the ACT then no overage adjustment will be done in the following fishing year. If the averaged total catch exceeded the ACL then the ACL will be reduced by the amount of the overage and the associated ACT will be reduced accordingly to maintain that buffer.

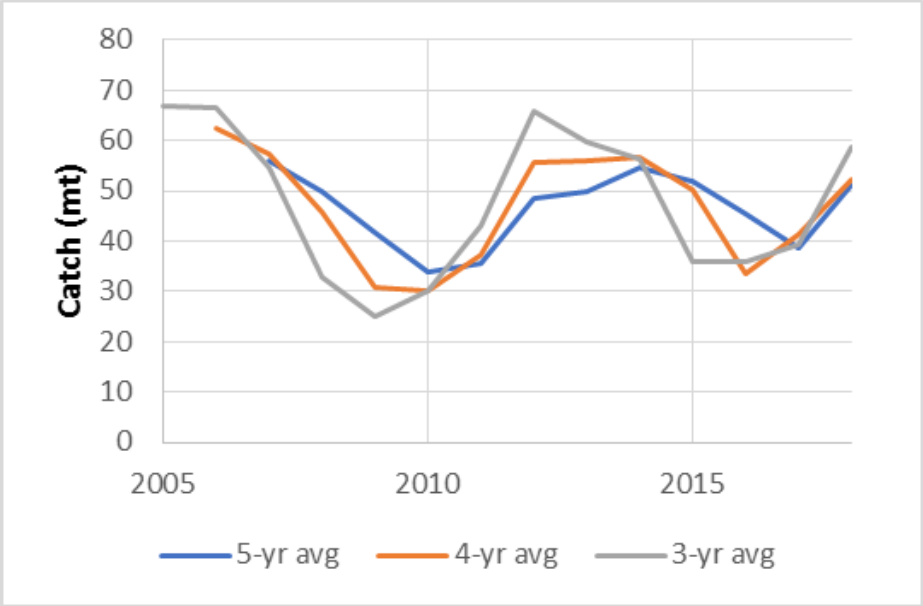

Figure 3. Comparison of the 3-year, 4-year, and 5-year moving average for the non-commercial catch data from HMRFS.

3 References

Harvey, H.T. and Associates. 2017. Identifying Fish Stocks Requiring Federal Conservation and Management in Hawaii. National Marine Fisheries Service (NMFS), Pacific Islands Regional Office, Honolulu, HI. 64 pp. http://www.wpcouncil.org/wp-content/uploads/2018/03/FINAL-Hawaiian-Fish-Stocks-Requiring-Management-Oct-10.pdf

Nadon, M.O. 2017. Stock assessment of the coral reef fishes of Hawaii, 2016. NOAA Technical Memorandum NMFS-PIFSC-60, NOAA PIFSC, Honolulu, HI. https://www.pifsc.noaa.gov/library/pubs/tech/NOAA_Tech_Memo_PIFSC_60.pdf.

Nadon MO, Sculley M, Carvalho F. 2020. Stock assessment of uku (Aprion virescens) in Hawaii, 2020. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-100, 120 p. doi:10.25923/57nb-8138

NMFS. 2015. Environmental Assessment for the Specification of an Annual Catch Limit and Accountability Measures for Main Hawaiian Islands Non-Deep 7 Bottomfish Fisheries in Fishing Years 2015 through 2018. NMFS PIRO, Honolulu, HI. July 1, 2015. 86 pp.

NMFS. 2019a. Final Environmental Assessment Annual Catch Limits and Accountability Measures for Main Hawaiian Islands Deep 7 Bottomfish Fisheries. NMFS PIRO, Honolulu, HI. May 22, 2019. 113 pp.

WPFMC (Western Pacific Fishery Management Council). 2009. Fishery Ecosystem Plan for the Hawaiian Archipelago. Western Pacific Regional Fishery Management Council, Honolulu, HI.

WPFMC. 2016. Amendment 4 to the Fishery Ecosystem Plan for the Hawaii Archipelago: Revised Descriptions and Identification of Essential Fish Habitat and Habitat Areas of Particular Concern for Bottomfish and Seamount Groundfish of the Hawaiian Archipelago. Western Pacific Regional Fishery Management Council, Honolulu, HI.

WPFMC. 2018. 2017 Annual Stock Assessment and Fishery Evaluation Report for the Hawaii Archipelago. Western Pacific Regional Fishery Management Council, Honolulu, HI. http://www.wpcouncil.org/fishery-plans-policies-reports/fishery-reports-2/.

WPFMC 2020a. P* Working Group Report on the Main Hawaiian Island Uku Fishery. Western Pacific Regional Fishery Management Council, Honolulu, HI.

WPFMC 2020b. SEEM Working Group Report on the Main Hawaiian Island Uku Fishery. Western Pacific Regional Fishery Management Council, Honolulu, HI.

WPFMC and NMFS. 2011. Omnibus amendment for the western Pacific region to establish a process for specifying annual catch limits and accountability measures, including an environmental assessment. Amendment 1 to the PRIA FEP, Amendment 2 to the American Samoa Archipelago FEP, Amendment 2 to the Mariana FEP, Amendment 3 to the Hawaii Archipelago FEP. Western Pacific Regional Fishery Management Council and the National Marine Fisheries Service, Honolulu, HI.