Annual Report: 2021 Bottomfish Fishery-Independent Survey in Hawai‘i

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Executive Summary

The Bottomfish Fishery-Independent Survey in Hawai‘i (BFISH) was designed to provide accurate and precise estimates of size-structured abundance and biomass for fish populations in the Deep7 bottomfish complex of the main Hawaiian Islands (MHI). BFISH data were specifically designed to complement and enhance Deep 7 stock assessments conducted by the Pacific Islands Fisheries Science Center (PIFSC).

BFISH is conducted annually across the eight islands of the MHI using two complimentary sampling gears: (1) Cooperative Research hook-and-line fishing; and, (2) stereo video camera systems. These gears are randomly deployed in a stratified random sampling design in specific habitats across depths ranging from 75–400 m. In 2021, BFISH sampling was conducted from 9 July to 30 October. Sampling effort was purposely increased from approximately 500 primary sample units (PSU) used in earlier surveys to 751in the 2021 BFISH. This was done to facilitate determination of future sampling effort required to achieve a specified coefficient of variation (CV, or precision) for species-specific biomass estimates used in MHI Deep 7 stock assessments. Evolution of the survey design from an initial 9-strata survey (based 2011-2015 Maui Nui experiments) to a refined 24-strata survey (based on 2016-2018 BFISH data), and the increased sampling effort, have greatly improved survey precision.

In 2021, Deep 7 complex biomass was estimated at 7.64 million pounds. Opakapaka, ehu and onaga, the three principal species for which the survey design was developed, comprised approximately 79% total estimated Deep7 complex biomass of the survey. Opakapaka, ehu and onaga stock biomasses were estimated at 2.80, 1.34 and 0.57 million pounds, respectively. The Lehi biomass estimate of 1.467 million pounds was greater than estimated in the previous 5 survey years, but well within the statistical error bounds of estimation. The high estimate was caused by a large school of Lehi (> 100 individuals) seen in a single camera sample.

The 2021 BFISH survey for the Deep 7 complex achieved a high level of precision. CVs for exploited stock biomasses opakapaka, ehu and onaga were 15.4%, 13.3%, and 22.7%, respectively. Survey design analysis of the 2021 data indicate that optimal allocation of survey effort to achieve a 15% CV for opakapaka, ehu, and opakapaka would require 423, 335, and 434 PSUs to be sampled, respectively. Under a composite experimental design that considered tradeoffs between the three primary species, future total sample allocations of approximately 500 PSU are likely adequate to achieve sufficient precision to support the needs of stock assessment and management decision-making.

Complimentary research is recommended to improve BFISH estimate precision and support Deep 7 stock assessments, including: (i) design analyses focused on reducing sampling effort to achieve optimal target CVs (e.g., through refinement of habitat metrics); (ii) linking survey spatial density estimates to those of the Fishermen’s Reporting System (FRS) to improve spatial density estimates useful for BFISH domain stratification, and further, the effective fished area by the bottomfish fleets for FRS CPUE estimation to support stock assessments; and, (iii) analysis of wind stress impacts on effective nominal fishing effort and spatial stock abundance. Technical improvements to BFISH estimation includes determination of effective camera sampling area, and extending the depth range of cameras to those of cooperative fishers using non-obtrusive artificial lighting.

Introduction

Commercial and recreational fishing are important to the economy and culture of Hawai‘i (Haight et al. 1993). The Hawaiian deep-slope (100−400 m) fishery consists of seven high-value bottomfish species (i.e., six snappers and one grouper), hereafter referred to as Deep 7 (Figure 1) that account for more than 50% of the total insular commercial catch (Western Pacific Regional Fishery Management Council 2010).

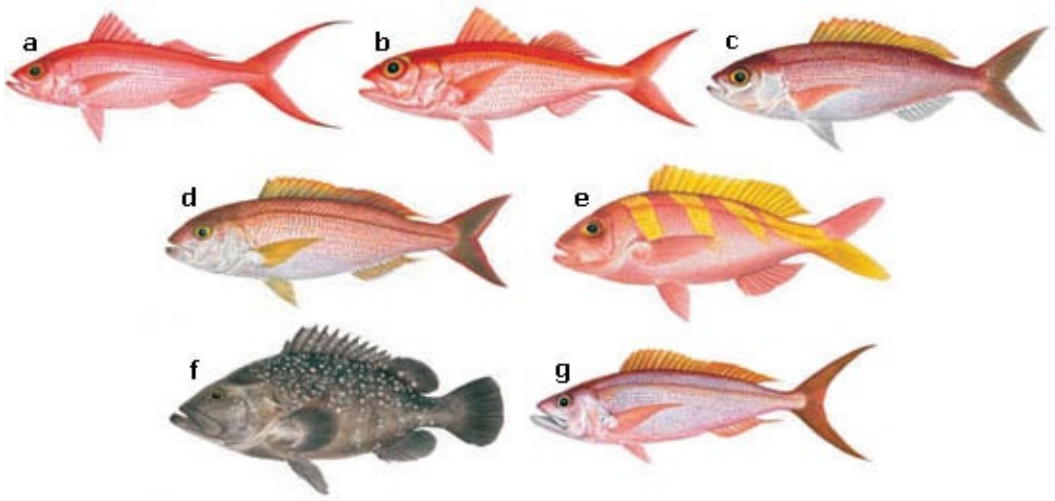


Figure 1. The main Hawaiian Islands "Deep 7" bottomfish complex: (A) Onaga (*Etelis coruscans*), (B) Ehu (*Etelis carbunculus*), (C) Kalekale (*Pristipomoides sieboldii*), (D) Opakapaka (*Pristipomoides filamentosus*), (E) Gindai (*Pristipomoides zonatus*), (F) Hapu‘upu‘u (*Hyporthodus quernus*), and (G) Lehi (*Aphareus rutilans*). Artwork by Les Hata (Hawai‘i DAR/DLNR).

Under the Magnuson-Stevens Fishery Conservation and Management Act (United States Congress, 2007), the National Oceanic and Atmospheric Administration's (NOAA) Pacific Islands Fisheries Science Center (PIFSC) is responsible for conducting stock assessments of the Deep 7 complex. These assessments determine stock status from which the Western Pacific Regional Fishery Management Council (WPRFMC) recommends annual fishery catch limits.

The conventional stock assessment process requires reliable time-series of catches, fishing effort, and life history demographics to estimate stock abundance trends and evaluate sustainability benchmarks (Quinn and Deriso 1999; Haddon 2011). Until recently, stock assessments for the main Hawaiian islands Deep 7 bottomfish complex (Brodziak et al. 2014) relied on trends in fishery-dependent catch per unit effort (CPUE). However, fishery-dependent CPUE abundance index can be biased due to nonrandom spatiotemporal distribution of fishing effort and gears, imposed length and catch regulations, market forces, and fisher behavior (Hilborn and Walters 1992; Maunder and Punt 2004; Ault et al. 2014).

PIFSC has continually strived to improve data used in the Deep 7 stock assessments. To this end, in 2016 PIFSC implemented a multi-gear Bottomfish Fishery-Independent Survey in Hawai‘i (BFISH) (Richards et al. 2016). There are several key advantages of fishery-independent surveys: (1) they employ formal experimental designs; (2) they control the distribution of fishing

effort and gears; (3) they are less influenced by market forces; and, (4) they obtain similar stock size-structured abundance data as fishery-dependent catch sampling programs, but they do so with greater statistical rigor (Ault et al. 1999; Smith et al. 2011). Fishery-independent surveys can be designed to estimate absolute population abundance, thus providing an important independent estimate of stock abundance for use in stock assessment.

The BFISH survey, a flagship PIFSC effort, was developed from 2011 through 2015 using a series of pilot gear calibration studies in the Maui-Nui island region (Richards et al. 2016) and became operational in 2016. BFISH 2016 data, which included estimates of absolute size-structured abundance and biomass (Ault et al. 2018), were incorporated into the 2018 benchmark Deep 7 bottomfish stock assessment for the MHI (Langseth et al. 2018). In this report, we present results from the 2021 BFISH survey.

Methods

BFISH employs a stratified-random sampling (StRS) design conducted throughout the survey domain (Figure 2), comprising mapped bottomfish habitats at depths of ≥75 to 400 m around all eight main Hawaiian islands (MHI). The survey domain ranges ~600 km from the Big Island of Hawai‘i to the island of Ni‘ihau and is divided into 23,613 habitat-classified primary sampling units (PSU) or “grid-cells” of 500 × 500 m.

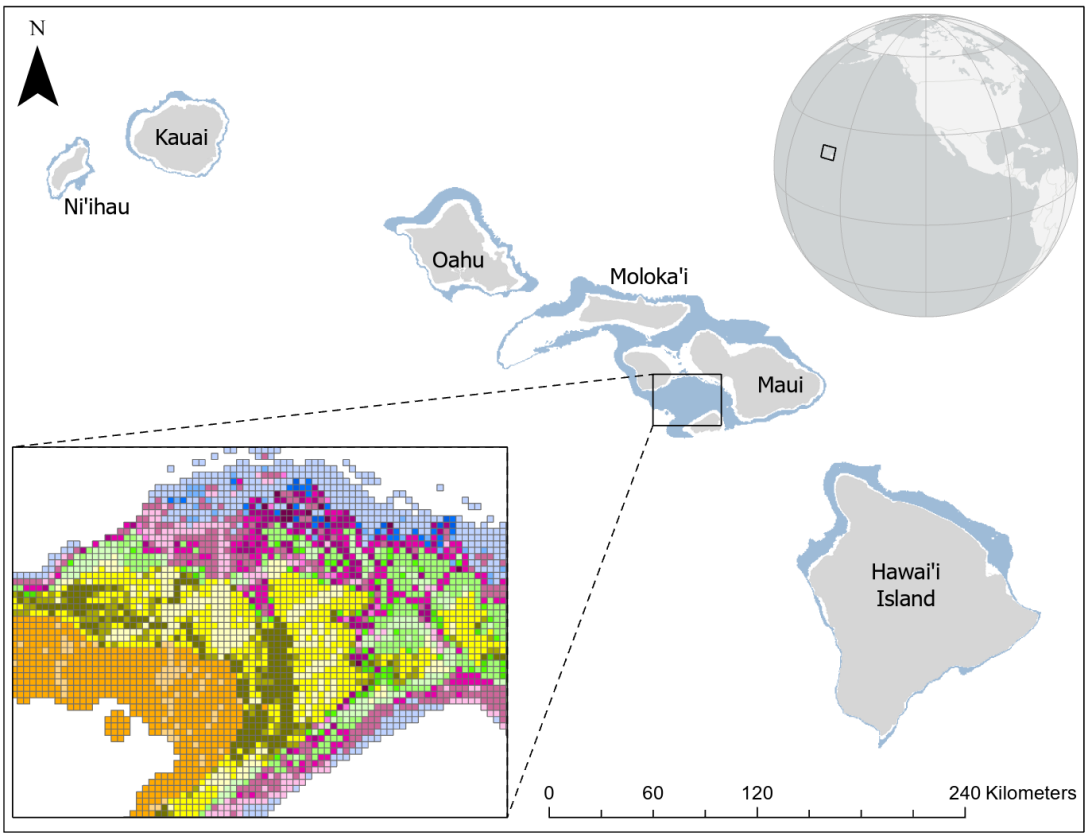


Figure 2. Spatial domain of the Bottomfish-Fishery Independent Survey in Hawaii (BFISH) (blue shaded region) with inset depicting 500 x 500 m grids near the island of Maui.

BFISH uses two survey gears: (1) hook-and-line research fishing parallel to what is used in the commercial fishery; and, (2) remote drop MOUSS stereo-video cameras (Richards et al. 2016; Amin et al. 2017). A standard research fishing sample was 30 minutes of active hook-line fishing within a specified PSU by one vessel using two lines, each with four hooks and two bait types, i.e., squid and fish. Every fish captured was identified to species, and fork length (FL) was measured to the nearest cm. All Deep 7 individuals were retained and transferred to the PIFSC Fisheries Research and Monitoring Division (FRMD) Life History Program (LHP) for age, growth, sexual maturity, and genetic studies. Two randomized replicate 15-minute stationary camera deployments were conducted within each allocated PSU. In-situ footage from each deployment was analyzed to generate species-level counts by the MaxN method (Cappo et al. 2006) with individuals measured to the nearest mm FL. The two replicate counts were averaged for each allocated PSU.

The 2021 BFISH was conducted from 9 July to 30 October, 2021, and employed a newly refined 24-strata sampling scheme dependent on three principal environmental characteristics: (1) depth; (2) benthic habitat complexity; and, (3) seafloor hardness (Table 1). Depths and seafloor hardness were obtained from 5-m resolution multibeam bathymetry (Hawaii Mapping Research Group 2016). Habitat complexity was defined using computed arc chord ratio (ACR) values derived from the multibeam bathymetry. Seafloor habitat hardness was obtained from associated multibeam backscatter (Richards et al. 2019).

Survey sampling effort survey requirements were evaluated for optimal allocations amongst the 24 survey strata using a theoretical Neyman allocation method (Cochran 1977). Sample allocation was carried out in two steps: (1) determination of optimal allocation across a range of possible CVs for each of the three design species (ehu, opakapaka, onaga) that comprise more than 85% of the MHI commercial catches; (2) then these species-specific allocations, evaluated at a target CV, were compared to generate a composite allocation for the 2021 BFISH survey, paying particular attention to strata common to all species while also incorporating strata important to any one of the three design species.

Table 1a. Strata depth-habitat components and island-based PSU allocations of 2021 BFISH based on the refined 24-strata design.

Stratum	Substrata			2021 Island PSU Allocation					
	Depth	Complexity	Hardness	Niihau	Kauai	Oahu	Maui Nui	Big Island	Total
S01	D1	MA1 or MA2	HB1 or HB2 or HB3	7	2	2	7	4	22
S02	D1	MA3	HB1	2	2	4	4	9	21
S03	D1	MA3	HB2		2	2	3	2	9
S04	D1	MA3	HB3			2	2	4	8
S05	D2	MA1	HB1 or HB2	2	1	2	27	6	38
S06	D2	MA1	HB3		2	2	4	2	10
S07	D2	MA2	HB1	6	2	4	21	14	47
S08	D2	MA2	HB2			2	5	5	12
S09	D2	MA2	HB3		2	2	3	3	10
S10	D2	MA3	HB1	2	4	7	40	30	83
S11	D2	MA3	HB2		2	5	13	8	28
S12	D2	MA3	HB3	2	2	4	2	25	35
S13	D3	MA1 or MA2	HB1 or HB2 or HB3		2	2	7	2	13
S14	D3	MA3	HB1	2	2	2	14	6	26
S15	D3	MA3	HB2			2	7	2	11
S16	D3	MA3	HB3	2	2	2	7	10	23
S17	D4	MA1 or MA2	HB1 or HB2	2	3	2	7	2	16
S18	D4	MA1	HB3				3	2	5
S19	D4	MA2	HB3			3	12	2	17
S20	D4	MA3	HB1	2	4	9	35	24	74
S21	D4	MA3	HB2	2	2	6	14	9	33
S22	D4	MA3	HB3	2	12	37	62	18	131
S23	D5	MA1 or MA2	HB1 or HB2 or HB3		2	2	6	2	12
S24	D5	MA3	HB1 or HB2 or HB3	3	4	12	21	27	67
		Grand Total		**36**	**54**	**117**	**326**	**218**	**751**

Table 1b. Habitat-based substrata components used in the 24-strata design.

Depth Substrata	Median Depth (m)	Complexity Substrata	Median ACR	Hardness Substrata	% of PSU px above multibeam backscatter value 136
D1	≥ 75 & < 110	MA1	< 4	HB1	< 0.24
D2	≥ 110 & < 170	MA2	>= 4 & < 9	HB2	>= 0.24 & < 0.46
D3	≥ 170 & <220	MA3	>= 9	HB3	>= 0.46
D4	≥ 200 & < 330				
D5	≥ 330 & < 400				

PSU within strata were randomly selected without replacement from a discrete uniform probability distribution to ensure an equal probability of selection (Law and Kelton 2000). The *effective survey sample size* used in abundance and biomass computations is the number of PSUs sampled within the preferred depth range for a given species. Domain mapping and survey sample site selection were conducted using ArcGIS (ESRI Inc. 2017) and R (R Development Core Team 2020). Gears were allocated to specific PSUs based on a combination of effective operational gear-depths (e.g., cameras ineffective >250 m), logistical constraints, and regulatory restrictions (i.e., cameras allocated to PSUs where extractive fishing was prohibited). The relative effective fishing power of the two survey gears were inter-calibrated with a novel two-stage generalized linear regression model parameterized from comparative field data experiments where the two survey gears were simultaneously fished in the same time-space PSUs (Robson 1961; Richards et al. 2016). The observations were standardized relative to the camera gear.

The number of fish either caught (fishing) or seen (cameras) per unit sample area searched (i.e., density) was the principal metric used to develop the sampling design. Deep 7 species' population abundance and biomass estimation procedures followed statistical protocols for stratified random sampling designs (Cochran 1977; Ault et al. 1999; Lohr 2010; Smith et al. 2011; Ault et al. 2018). In general, estimation of population biomass *B* entailed expanding the mean biomass obtained per unit area searched $\overline{U}_B$ to the full survey frame (Ault et al. 2018),

$$\boldsymbol{B} = \boldsymbol{\overline{U}_B \frac{A_i}{a_i} G} \qquad (1)$$

where, A_i is the area of a grid cell sample unit, a_i is the effective sampling area (Ault et al. 2018) of the camera gear, and *G* is the number of grid cells in the survey domain. Mean biomass per sampled PSU was obtained by converting all lengths in the frequency distribution to weight following an allometric weight-length function, and then summing the weights for all observed fish by species. Allometric weight dependent on length equations were developed for each Hawaiian Deep 7 species by scientists at the PIFSC (Schemmel et al. 2022). All computations were carried out using the R software package (R Development Core Team 2020).

Results

Sampling effort for the 2021 BFISH was increased from approximately 500 in previous years to 751 PSU to facilitate determination of future sampling effort required to achieve as desired coefficient of variation (CV) for the three design species. In 2021, Pacific Islands Fisheries Group (PIFG) research fishing was conducted at 651 (Figure 3) sampled PSUs from July 9 to October 30, 2021 (Appendix 2). In addition, camera samples were also obtained at another 100 PSU around all islands except Niihau and Kauai by PIFG from 10 July to 7 September, 2021 (Appendix 3). Practically, this meant that total survey sampling effort (n = 751) covered approximately 3.2% of the entire MHI domain.

Accurate length measurements were obtainable for all 632 Deep 7 individuals captured during research fishing operations and for 265 of the 360 (74%) fishes observed by the cameras (Table 2). A complete list of species captured during research fishing is provided in (Appendix 1).

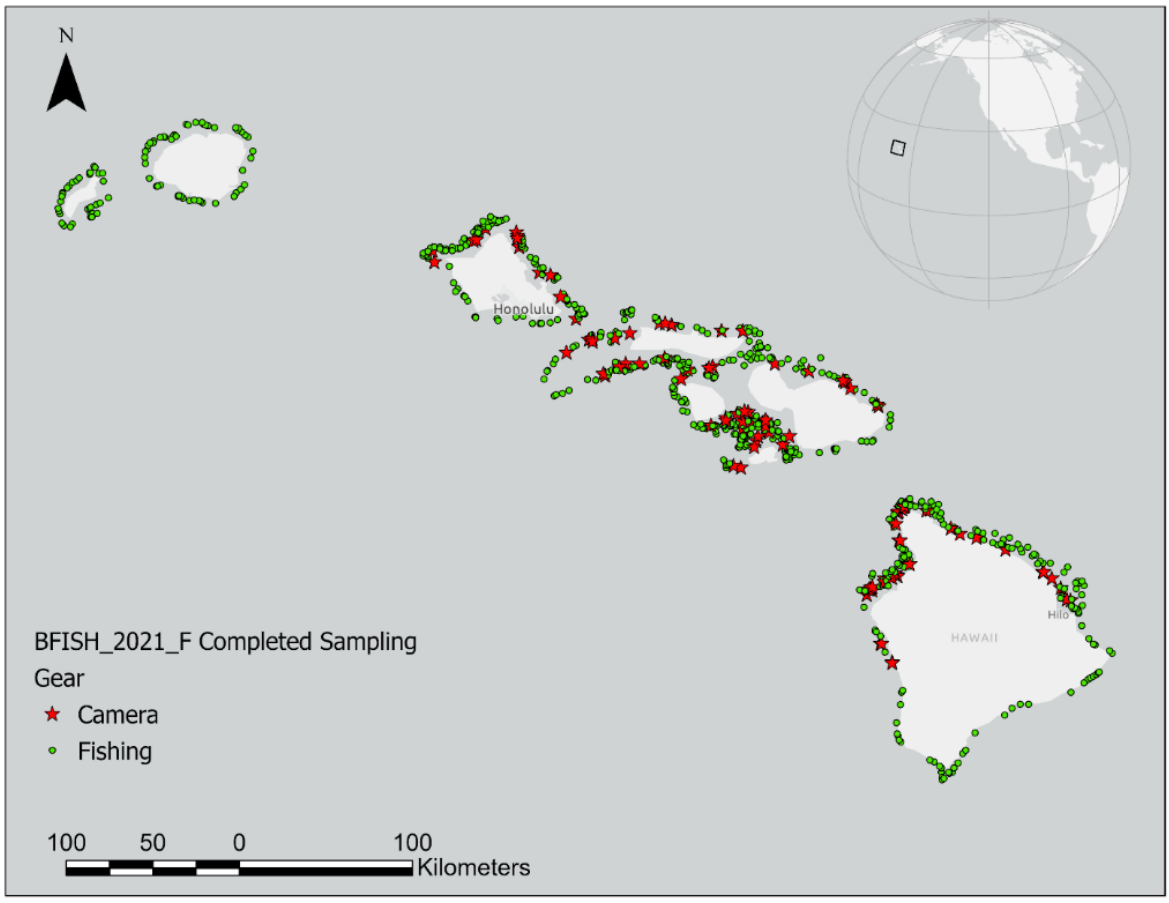


Figure 3. Map of 2021 BFISH sampling locations by gear type. Research fishing operations (green circles, *n* = 651) that extended from the big island of Hawai'i in the southeast to Ni'ihau in the northwest. Camera operations (red stars, *n* = 100) were conducted around all islands except Niihau and Kauai.

Table 2. Deep 7 species size ranges (cm FL) caught by research fishers or observed by cameras during the 2021 BFISH survey.

		RESEARCH FISHING				MOUSS CAMERA					
Species	**n**	**Min**	**Mean**	**Max**	**SD**	**MaxN**	**measured**	**Min**	**Mean**	**Max**	**SD**
Ehu	303	16.0	32.8	59.0	8.1	1	1	48.6	48.6	48.6	-
Gindai	60	17.5	33.1	40.0	4.0	5	3	28.5	30.2	32.3	1.9
Hapu'upu'u	10	36.0	59.4	90.0	17.2	1	1	70.3	70.3	70.3	-
Kalekale	64	17.0	33.8	41.0	5.2	62	26	11.7	35.3	58.9	8.1
Lehi	2	48.0	59.5	71.0	16.3	122	104	15.6	69.5	99.5	13.9
Onaga	41	21.0	43.6	76.0	14.0	0	0	-	-	-	-
Opakapaka	152	10.0	35.3	68.0	10.9	169	130	15.7	43.3	77.0	15.0
TOTAL Deep 7	**632**					**360**	**265**				

Table 3. Estimates of stock sizes for Deep 7 species from the 2021 BFISH survey: stock density (numbers per unit search area), and exploited phase (≥ 29 cm FL) abundance (numbers) and biomass (pounds).

Species	Density	SE	Abundance	SE	Biomass	SE	CV (%)
Opakapaka	0.2710	0.0416	668,353.3	102,626.4	1,267,922.2	248,822.0	15.36
Lehi	0.0576	0.0454	142,114.5	111,901.6	665,447.5	558,569.0	78.74
Ehu	0.2541	0.0337	626,640.4	83,141.1	607,138.1	94,504.7	13.27
Kalekale	0.2708	0.0840	667,778.4	207,094.3	540,709.4	168,723.4	31.01
Onaga	0.0553	0.0125	136,324.5	30,921.8	260,302.6	59,886.0	22.68
Hapu‘upu‘u	0.0060	0.0021	14,832.0	5,080.1	68,828.2	25,343.0	34.25
Gindai	0.0258	0.0051	63,603.2	12,640.7	55,141.8	11,346.2	19.87
TOTAL					**3,465,489.9**	**644,723.0**	**18.60**

Trends in exploited phase stock biomass varied among species, but had little variation among years within species (Table 4, Figure 4 & 5) and little change in species-specific size distributions (Figure 6). Survey precision ranged from a CV of 13.3% for ehu to 78.74% for lehi, with CVs of 15.36% and 22.68% for opakapaka and onaga, respectively (Table 3, Figure 7). The principal conclusion remains that the year-to-year variance in biomass estimates is decreasing (likely due to refinement of the experimental design), within-year variance is decreasing, and overall survey precision is increasing. Additionally, the composition of the Deep 7 bottomfish community in terms of stock biomass is generally equally balanced between the 3 design species.

Table 4. Exploited phase (≥ 29 cm FL) abundance (numbers) and biomass estimates for Deep 7 species from 2016–2021 BFISH surveys.

Species	Year	No. of Strata	n	CPUE, number		CPUE, biomass (kg)		Abundance (number)		Biomass (kg)		CV%
				Mean	SE	Mean	SE	Total	SE	Total	SE	
Ehu	2016	9	319	0.3821	0.0711	0.3728	0.0737	942,393	175,428	919,452	181,683	18.62
	2017	9	449	0.3145	0.0901	0.3496	0.1020	775,717	222,139	862,203	251,494	28.64
	2018	9	437	0.2198	0.0565	0.2508	0.0721	541,935	139,395	618,476	177,760	25.72
	2019	9	470	0.3848	0.0683	0.3938	0.0769	948,935	168,360	971,152	189,688	17.74
	2020	24	499	0.3797	0.0680	0.3577	0.0616	936,341	167,740	882,078	151,840	17.90
	2021	24	747	0.2541	0.0337	0.2462	0.0383	626,640	83,141	607,138	94,505	13.27
Gindai	2016	9	326	0.0213	0.0072	0.0209	0.0076	52,590	17,855	51,604	18,835	33.95
	2017	9	448	0.0132	0.0043	0.0137	0.0044	32,508	10,489	33,816	10,847	32.27
	2018	9	441	0.0118	0.0050	0.0128	0.0052	29,186	12,215	31,641	12,907	41.85
	2019	9	475	0.0212	0.0063	0.0227	0.0078	52,354	15,459	55,896	19,149	29.53
	2020	24	499	0.0694	0.0167	0.0707	0.0184	171,151	41,152	174,479	45,378	24.00
	2021	24	746	0.0258	0.0051	0.0224	0.0046	63,603	12,641	55,142	11,346	19.87
Hapu‘upu‘u	2016	9	327	0.0067	0.0040	0.0556	0.0330	16,507	9,918	137,132	81,386	60.09
	2017	9	447	0.0070	0.0028	0.0389	0.0173	17,240	6,938	95,833	42,768	40.24
	2018	9	441	0.0198	0.0082	0.1018	0.0408	48,949	20,183	251,133	100,586	41.23
	2019	9	475	0.0047	0.0026	0.0226	0.0119	11,607	6,433	55,660	29,226	55.42
	2020	24	499	0.0141	0.0053	0.0861	0.0348	34,655	13,051	212,322	85,781	37.70
	2021	24	747	0.0060	0.0021	0.0279	0.0103	14,832	5,080	68,828	25,343	34.25
Kalekale	2016	9	319	0.1636	0.0459	0.1500	0.0435	403,394	113,100	369,934	107,307	28.04
	2017	9	441	0.5378	0.1088	0.4653	0.0948	1,326,264	268,416	1,147,403	233,870	20.24
	2018	9	440	0.2534	0.0706	0.2301	0.0638	624,930	174,137	567,353	157,460	27.86
	2019	9	475	0.2306	0.0824	0.2007	0.0742	568,660	203,191	495,057	182,942	35.73
	2020	24	499	0.4152	0.1383	0.3171	0.1008	1,024,052	341,019	781,899	248,643	33.30
	2021	24	747	0.2708	0.0840	0.2193	0.0684	667,778	207,094	540,709	168,723	31.01
Lehi	2016	9	325	0.0185	0.0123	0.0690	0.0514	45,733	30,332	170,059	126,670	66.32
	2017	9	444	0.0285	0.0158	0.0746	0.0441	70,270	38,934	184,039	108,741	55.41
	2018	9	438	0.0181	0.0137	0.0561	0.0425	44,580	33,811	138,280	104,872	75.84
	2019	9	475	0.0033	0.0020	0.0130	0.0084	8,110	4,936	32,018	20,629	60.87
	2020	24	499	0.0035	0.0025	0.0096	0.0066	8,751	6,281	23,624	16,358	71.80
	2021	24	747	0.0576	0.0454	0.2698	0.2265	142,114	111,902	665,448	558,569	78.74
Onaga	2016	9	326	0.0728	0.0269	0.1830	0.0872	179,630	66,349	451,310	214,947	36.94
	2017	9	444	0.1720	0.0594	0.4290	0.1599	424,187	146,603	1,057,903	394,391	34.56
	2018	9	441	0.0665	0.0244	0.1654	0.0701	164,059	60,274	408,004	172,812	36.74
	2019	9	475	0.0509	0.0230	0.2163	0.1049	125,554	56,670	533,442	258,800	45.14
	2020	24	499	0.0762	0.0193	0.1360	0.0404	188,001	47,576	335,386	99,570	25.30
	2021	24	747	0.0553	0.0125	0.1056	0.0243	136,324	30,922	260,303	59,886	22.68
Opakapaka	2016	9	319	0.6877	0.2293	1.5231	0.5297	1,695,941	565,522	3,756,272	1,306,338	33.35
	2017	9	438	0.4057	0.0901	0.8600	0.1659	1,000,451	222,237	2,120,883	409,208	22.21
	2018	9	436	0.2435	0.0715	0.5633	0.1579	600,414	176,402	1,389,282	389,363	29.38
	2019	9	472	0.2730	0.0627	0.5984	0.1454	673,334	154,681	1,475,671	358,653	22.97
	2020	24	499	0.2796	0.0902	0.4295	0.1182	689,596	222,375	1,059,126	291,476	32.30
	2021	24	747	0.2710	0.0416	0.5141	0.1009	668,353	102,626	1,267,922	248,822	15.36
Deep 7	2016	9								5,855,762	1,349,173	23.04
	2017	9								5,502,080	674,323	12.26
	2018	9								3,404,169	509,060	14.95
	2019	9								3,618,897	516,435	14.27
	2020	24								3,468,915	435,243	12.55
	2021	24								3,465,490	644,723	18.60

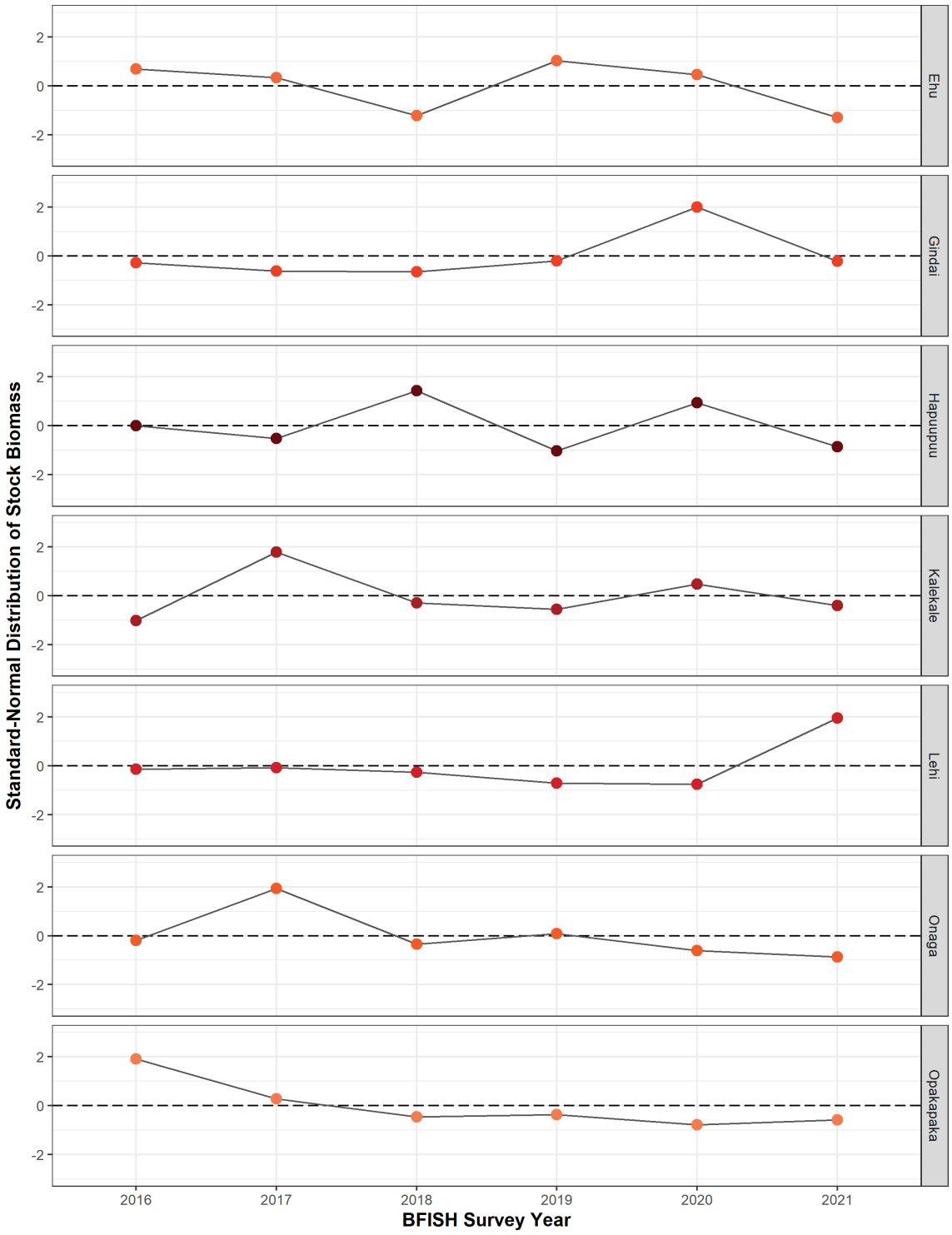


Figure 4. Standard-normal distribution of exploited phase (≥ 29 cm FL) stock biomass for the Deep 7 complex by species and year.

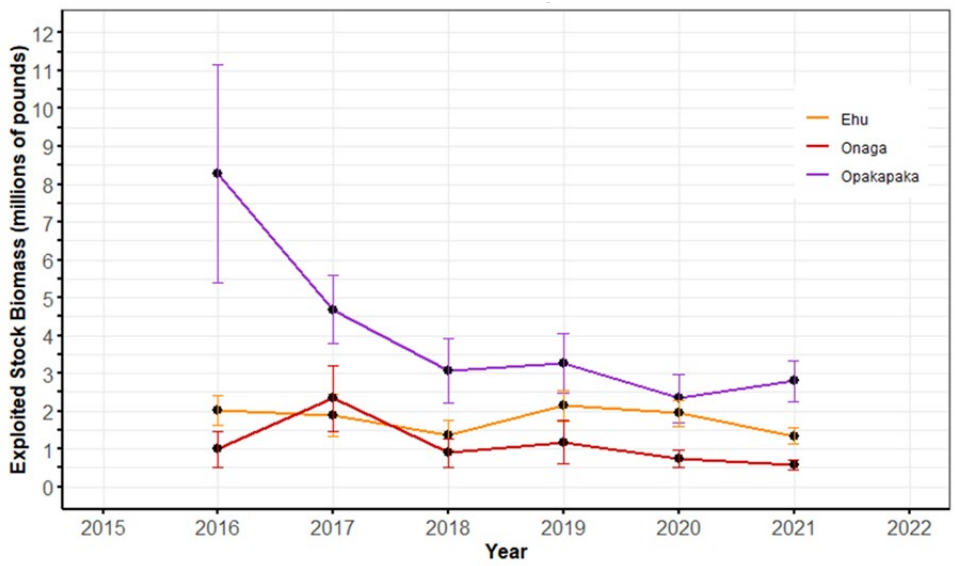


Figure 5. Annual survey estimates of exploited phase (≥ 29 cm FL) stock biomass (± SE) for the three design species.

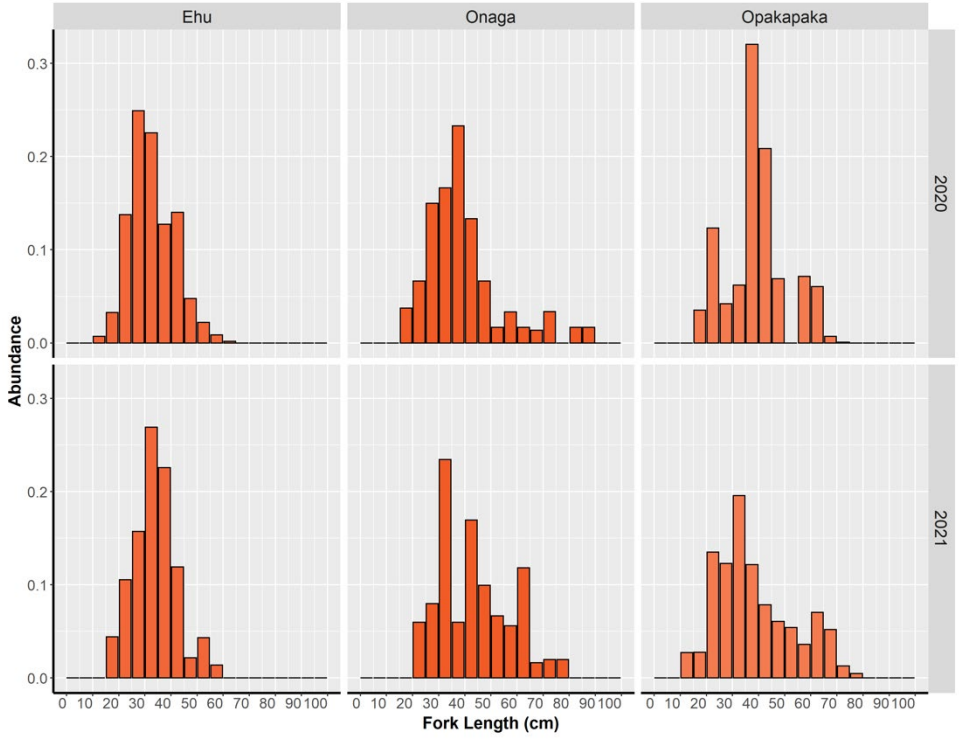


Figure 6. Length frequencies for opakapaka, onaga, and ehu from the 2020–2021 BFISH surveys based on combined research fishing and MOUSS camera data, under the revised 24-strata design. Exploited phase is ≥ 29 cm FL.

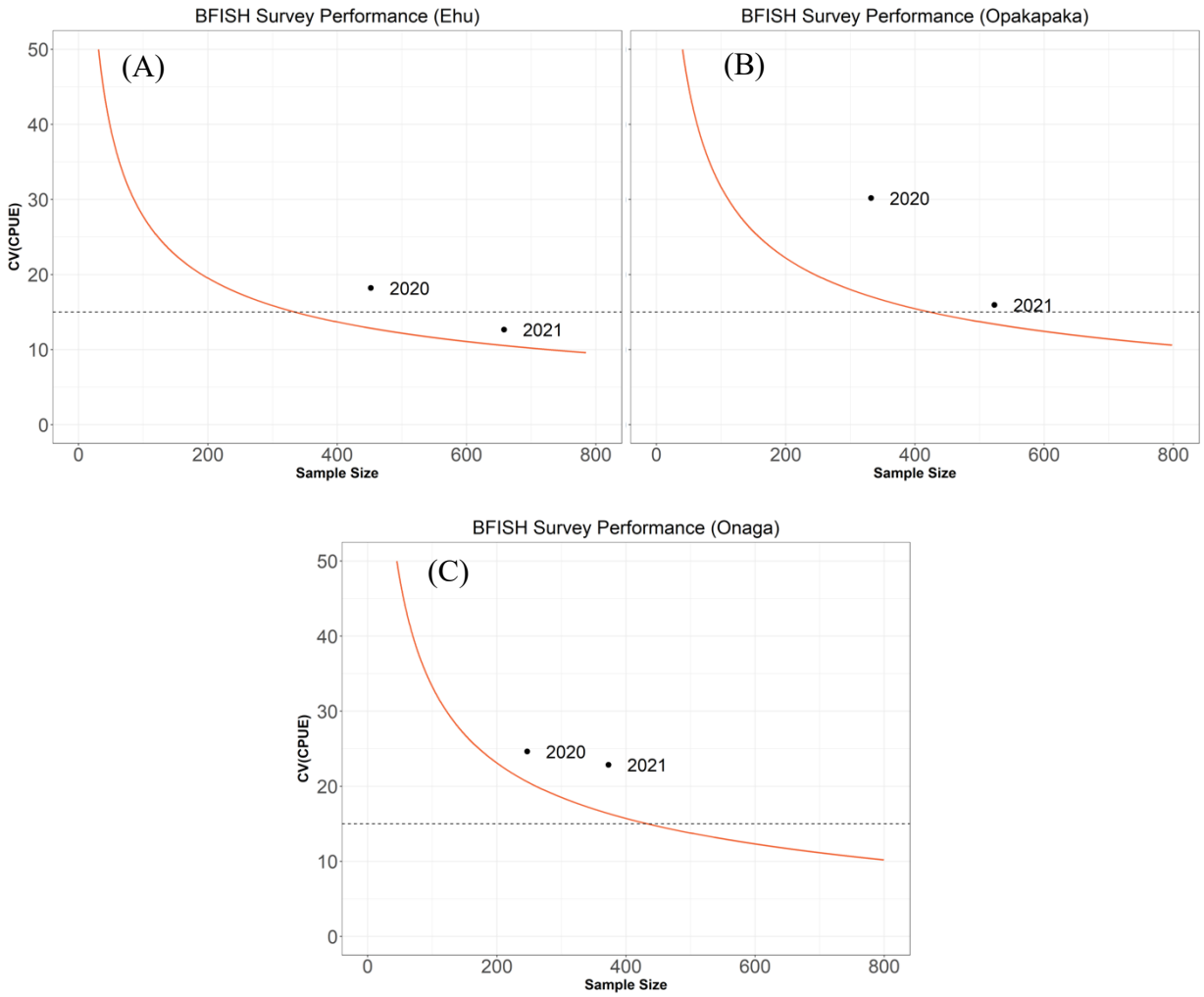


Figure 7. Yearly species-specific survey performance (coefficient of variation (CV) of population density) versus required sample size using Neyman allocation (orange curve) for the three BFISH design species: (A) ehu; (B) opakapaka; and (C) onaga. Target CV of 15% is indicated by the dashed horizontal line.

Discussion

The 2021 BFISH mission marks the sixth year of the operational survey that provides accurate and precise fishery-independent estimates of size-structured abundance and biomass for use in Deep 7 bottomfish stock assessments. Over the years, BFISH has been conducted by a public-private and cooperative-research team consisting of the Pacific Islands Fisheries Science Center (PIFSC), the Pacific Islands Fisheries Group (PIFG), and the University of Miami (UM). The collaboration has resulted in a longstanding and robust partnership, culminating in successful completion of the 2021 survey. Due to ongoing concerns with COVID 19, both the 2020 and 2021 BFISH surveys were conducted entirely by PIFG cooperative research fishers, without direct field support by PIFSC staff or NOAA Research Vessels.

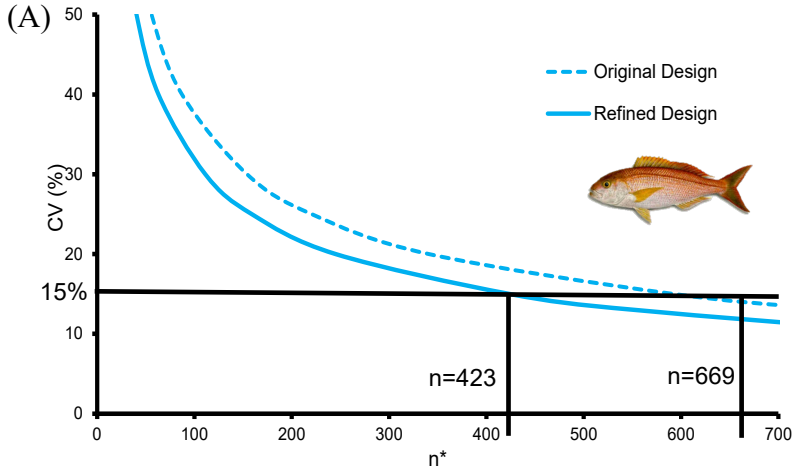
BFISH 2021 estimated the exploited Deep 7 complex biomass as 7.64 million lb, suggesting that the 492,000 lb 2021 ACL allocated by the WPRFMC could represent approximately 6.4% of the

exploited biomass. While there have been some fluctuations in Deep 7 biomass over the 2016–2021 survey years, trends in the principal fishery species (opakapaka, ehu and onaga) have been relatively stable (Figure 4). The lehi biomass estimate of 1.467 million lb was greater than estimated in the previous 5 survey years, but well within the statistical error bounds of estimation. The high estimate was caused by a large school of lehi (> 100 individuals) seen in a single camera sample. Overall, trends in Deep 7 species-specific biomass are consistent with commercial Fishery Reporting System data.

Since its inception, the strategy of the BFISH sampling design has been focused on achieving a good precision for the three principal design species (i.e., ehu, opakapaka, and onaga). This is because these 3 species constitute 85% of the reported commercial catches. Between 2016 and 2019 using the 9-strata survey design, CVs averaged 22.68%, 38.35%, and 26.98% for ehu, onaga, and opakapaka, respectively. In 2020, the survey was refined to a 24-strata design which has resulted in significant reductions in sampling effort required to achieve a particular CV.

In 2021, BFISH sampling effort increased to 751 PSU (or "grid-cells"), expressly to facilitate determination of future sampling levels required to achieve a desired CV of leadership and assessment decision-makers. For the three design species (ehu, opakapaka, and onaga), the 2021 BFISH achieved CVs of 13.27%, 15.36%, and 22.68%, respectively (Table 3, Figure 7).

The refinement of the survey design over time using a strategy of "iterative learning" (Ault et al. 2005) has allowed substantial improvements in survey precision at reduced costs (i.e., less sampling effort), evidenced by the left and downward shifts of the species-specific Neyman curves (Figure 7 & 8). Analysis of the 2021 BFISH suggest that 335, 423, and 434 PSU are needed to achieve a 15% CVs for ehu, opakapaka, and onaga, respectively, representing a 34–57% reduction in sampling effort and cost savings (Figure 8, Table 5). It would appear that use of the current composite survey design, and sample allocation of approximately 500 PSU, are likely sufficient for future surveys to achieve a 15% CV.



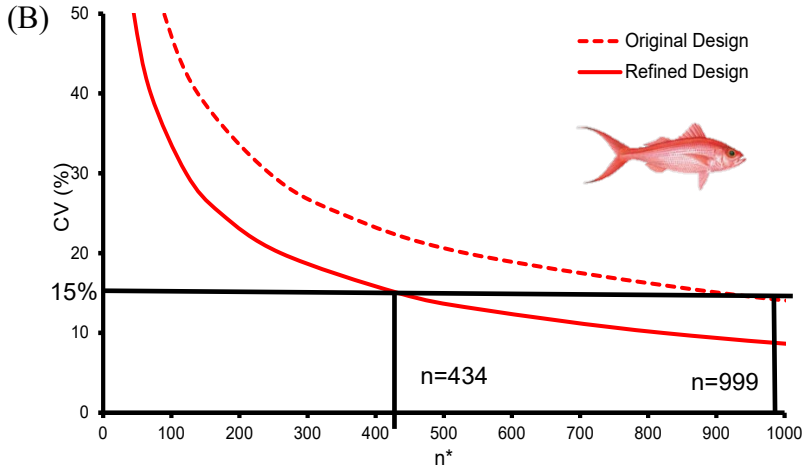


Figure 8. Comparison of Neyman allocation curves (blue and orange curves) for the original 9-strata (used in 2016–2019) and refined 24 strata (2020–2021) survey designs. Horizontal line shows the number of PSU samples (*n) required to achieve 15% CV for each design: (A) opakapaka; and, (B) onaga.**

Table 5. Number of PSU samples required to achieve a 15% CV for each primary species under the original 9- and refined 24-strata BFISH designs.

	BFISH Design Strata		%
Species	9	24	Reduction
Ehu	508	335	34
Opakapaka	669	423	37
Onaga	999	434	57

BFISH should remain a continual iterative learning and design process, focused on reducing sampling effort and cost to achieve optimal target CVs. We recommend complimentary research on refinement of habitat metrics as well as on the impact of wind stress on nominal fishing effort and spatial stock abundance. Innovations that involve inclusion of spatial catch-effort information from the Fishermen's Reporting System (FRS) could likely reduce survey costs by even more substantial amounts. We also recommend technical improvements to the cameras, focusing on determination of effective camera sampling area (Bohaboy et al. 2020; Dahl and Patterson 2020) and extending the depth range of cameras to those of cooperative fishers using non-obtrusive artificial lighting (Widder et al. 2005; Raymond and Widder 2007; Fitzpatrick et al. 2013; Rooper et al. 2015; Barker and Cowan 2018; Birt et al. 2019).

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Appendices

Appendix 1. Numbers (n) of individual fish (Deep 7 and other species) caught during 2021 BFISH research fishing operations.

Species Code	Common Name	Scientific Name	n
Deep 7			**632**
ETCA	Ehu	*Etelis carbunculus*	303
PRFI	Opakapaka	*Pristipomoides filamentosus*	152
PRSI	Kalekale	*Pristipomoides sieboldii*	64
PRZO	Gindai	*Pristipomoides zonatus*	60
ETCO	Onaga	*Etelis coruscans*	41
HYQU	Hapuʻupuʻu	*Hyporthodus quernus*	10
APRU	Lehi	*Aphareus rutilans*	2
non-Deep 7			**484**
SQMI	Green eye shark	Squalus hawaiiensis	255
SEDU	Kahala	Seriola dumerili	101
POMA	Hogo	Pontinus macrocephalus	19
LUKA	Taʻape	Lutjanus kasmira	12
BOAL	Table boss	Bodianus albotaeniatus	9
APVI	Uku	Aprion virescens	8
POBE	Deep sea Moi	Polymixia berndti	8
CAOR	Yellow spot Papio	Carangoides orthogrammus	6
ERSC	Golden Kale	Erythrocles scintillans	4
SERI	Almaco Jack	Seriola rivoliana	4
OCSP	Tako	Octopus sp.	4
EESP	Eel	Anguilliformes sp.	3
DASY	Sting Ray	Dasyatidae sp.	3
APFU	Wahanui	Aphareus furca	3
SHRK	Shark	Chondrichthid sp.	3
APFU	Waha nui	Aphareus furca	3
CAUN	Hawaiian Sunrise Perch	Caprodon unicolor	3
CAIN	Puffer	Canthigaster inframacula	2
PUFF	Pufferfish	Tetraodontid sp.	2
PORC	Balloon Fish	Tetraodontinae sp.	2
PSDE	Butaguchi	Pseudocaranx cheilio	2
ANSP	Senbei	Antigonia sp.	2
SHAR	Reef Shark	Carcharhinus sp.	2
MABO	?	Malacocephalus boretz	2
TRIG	Triggerfish	Balistid sp.	1
SPHE	Kawelea	Sphyraena helleri	1
GYSP	Moray Eel	Gymnothorax sp.	1
CAAM	Grey Reef Shark	Carcharhinus amblyrhynchos	1
LIZA	Lizard fish	Synodus sp.	1
CASP	Papio	Caranx sp.	1
CAIG	Ulua	Caranx ignobilis	1
NONE	Predator grabbed fish	No fish	1
MUPF	Weke Ula	Mulloidichthys pfluegeri	1
BEDA	Alfonsin	Beryx decadactylus	1
ARLU	Big eye ariomma	Ariomma luridum	1
LIZA	Lizard Fish	Synodus sp.	1
XACA	HumuHumu	Xanthichthys caeruleolineatus	1
EUIL	Monchong	Eumegistus illustris	1
CAAM	Blacktip shark	Carcharhinus amblyrhynchos	1
THAL	Ahi	Thunnus albacares	1
EUAF	Kaua Kaua	Euthynnus affinis	1
MUPF	Weke	Mulloidichthys pfluegeri	1
CAFA	Silky Shark	Carcharhinus falciformis	1
CAME	Omilu	Caranx melampygus	1
EUAF	KawaKawa	Euthynnus affinis	1
PRPR	Mongoose fish?	Promethichthys prometheus	1
	Grand Total		**1122**

Appendix 2. Primary sampling units (PSU) sampled by hook-and-line fishing gear during the 2021 BFISH with location, stratum, and vessel.

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
7/9/2021	Maui Nui	20605	20.9476313	-157.751605	S15	Renee NV	Fishing
7/9/2021	Maui Nui	22703	20.9881758	-157.73684	S23	Renee NV	Fishing
7/9/2021	Maui Nui	22955	20.9926567	-157.731992	S21	Renee NV	Fishing
7/9/2021	Maui Nui	25106	21.0285726	-157.702822	S20	Renee NV	Fishing
7/9/2021	Maui Nui	26584	21.0510821	-157.693004	S24	Renee NV	Fishing
7/9/2021	Maui Nui	30071	21.1135842	-157.600998	S24	Renee NV	Fishing
7/9/2021	Maui Nui	30281	21.1224972	-157.586473	S21	Renee NV	Fishing
7/24/2021	Maui Nui	13582	20.6515034	-156.645682	S12	Naomi K	Fishing
7/24/2021	Maui Nui	13340	20.642344	-156.63623	S21	Naomi K	Fishing
7/24/2021	Maui Nui	12065	20.5977868	-156.680075	S11	Naomi K	Fishing
7/24/2021	Maui Nui	12295	20.6070718	-156.699117	S22	Naomi K	Fishing
7/24/2021	Maui Nui	12059	20.5981704	-156.708841	S22	Naomi K	Fishing
7/24/2021	Maui Nui	12288	20.6075155	-156.73268	S22	Naomi K	Fishing
7/24/2021	Maui Nui	13054	20.6344127	-156.717892	S22	Naomi K	Fishing
7/24/2021	Maui Nui	11937	20.5940975	-156.742469	S22	Naomi K	Fishing
7/24/2021	Maui Nui	11938	20.5940348	-156.737675	S22	Naomi K	Fishing
7/25/2021	Maui Nui	15718	20.7288946	-156.692481	S07	Naomi K	Fishing
7/25/2021	Maui Nui	16099	20.7419831	-156.658684	S10	Naomi K	Fishing
7/25/2021	Maui Nui	16420	20.7556562	-156.668074	S12	Naomi K	Fishing
7/25/2021	Maui Nui	16424	20.7553945	-156.648877	S11	Naomi K	Fishing
7/25/2021	Maui Nui	15859	20.7326923	-156.639629	S10	Naomi K	Fishing
7/26/2021	Kauai	44325	22.1745445	-159.787641	S16	Yukie-Lynn	Fishing
7/26/2021	Kauai	44323	22.1744974	-159.79734	S20	Yukie-Lynn	Fishing
7/26/2021	Kauai	44209	22.1608994	-159.806961	S20	Yukie-Lynn	Fishing
7/26/2021	Kauai	44049	22.1382916	-159.811681	S13	Yukie-Lynn	Fishing
7/26/2021	Kauai	43988	22.1292096	-159.821325	S23	Yukie-Lynn	Fishing
7/26/2021	Kauai	43798	22.0975679	-159.825989	S24	Yukie-Lynn	Fishing
7/26/2021	Kauai	43629	22.0659749	-159.820959	S20	Yukie-Lynn	Fishing
7/26/2021	Kauai	42955	21.989285	-159.801144	S22	Yukie-Lynn	Fishing
7/26/2021	Kauai	42445	21.9488175	-159.762182	S24	Yukie-Lynn	Fishing
7/26/2021	Kauai	42446	21.9488399	-159.75734	S22	Yukie-Lynn	Fishing
7/26/2021	Kauai	42522	21.9534232	-159.742838	S10	Yukie-Lynn	Fishing
7/27/2021	Kauai	41144	21.8596056	-159.456849	S11	Yukie-Lynn	Fishing
7/27/2021	Kauai	41197	21.8639211	-159.524612	S24	Yukie-Lynn	Fishing
7/27/2021	Kauai	41276	21.8684072	-159.534307	S22	Yukie-Lynn	Fishing
7/27/2021	Kauai	41363	21.8728926	-159.544003	S02	Yukie-Lynn	Fishing
7/27/2021	Kauai	41449	21.8773281	-159.568218	S10	Yukie-Lynn	Fishing
7/27/2021	Maui Nui	14930	20.7021286	-156.71688	S10	Naomi K	Fishing
7/27/2021	Kauai	41353	21.8727258	-159.592397	S24	Yukie-Lynn	Fishing
7/27/2021	Maui Nui	15059	20.7067066	-156.72161	S10	Naomi K	Fishing
7/27/2021	Maui Nui	15578	20.7250173	-156.740534	S07	Naomi K	Fishing

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
7/27/2021	Kauai	41617	21.8861517	-159.626332	S21	Yukie-Lynn	Fishing
7/27/2021	Maui Nui	15181	20.7117249	-156.759927	S20	Naomi K	Fishing
7/27/2021	Kauai	41779	21.8951487	-159.636052	S14	Yukie-Lynn	Fishing
7/27/2021	Maui Nui	14791	20.6981813	-156.760126	S17	Naomi K	Fishing
7/27/2021	Kauai	41776	21.895092	-159.650572	S22	Yukie-Lynn	Fishing
7/27/2021	Maui Nui	14917	20.7029445	-156.779251	S20	Naomi K	Fishing
7/27/2021	Kauai	41844	21.8996281	-159.645752	S01	Yukie-Lynn	Fishing
7/27/2021	Maui Nui	15046	20.7075209	-156.783984	S22	Naomi K	Fishing
7/27/2021	Kauai	41843	21.899609	-159.650593	S01	Yukie-Lynn	Fishing
7/27/2021	Maui Nui	15308	20.7164882	-156.779054	S22	Naomi K	Fishing
7/27/2021	Maui Nui	16497	20.7618809	-156.797594	S05	Naomi K	Fishing
7/28/2021	Maui Nui	15864	20.7323613	-156.615638	S10	Naomi K	Fishing
7/28/2021	Maui Nui	16109	20.7413227	-156.610698	S02	Naomi K	Fishing
7/28/2021	Maui Nui	16222	20.7457031	-156.601029	S03	Naomi K	Fishing
7/30/2021	Maui Nui	13801	20.6621274	-156.765453	S22	Naomi K	Fishing
7/30/2021	Maui Nui	13803	20.6620028	-156.75586	S19	Naomi K	Fishing
7/30/2021	Maui Nui	13051	20.6346023	-156.732279	S22	Naomi K	Fishing
7/30/2021	Maui Nui	13052	20.6345392	-156.727483	S20	Naomi K	Fishing
7/30/2021	Maui Nui	13782	20.6632843	-156.856591	S24	Naomi K	Fishing
7/30/2021	Maui Nui	14139	20.6768884	-156.861198	S24	Naomi K	Fishing
7/30/2021	Maui Nui	14396	20.6852548	-156.808299	S22	Naomi K	Fishing
7/31/2021	Maui Nui	15620	20.722252	-156.539013	S01	Naomi K	Fishing
7/31/2021	Maui Nui	14292	20.6794931	-156.712421	S19	Naomi K	Fishing
7/31/2021	Maui Nui	14897	20.7041556	-156.875213	S19	Naomi K	Fishing
7/31/2021	Maui Nui	14898	20.7040963	-156.870415	S22	Naomi K	Fishing
7/31/2021	Maui Nui	15029	20.7085517	-156.865554	S22	Naomi K	Fishing
7/31/2021	Maui Nui	14901	20.7039177	-156.85602	S22	Naomi K	Fishing
7/31/2021	Maui Nui	15038	20.7080108	-156.822369	S20	Naomi K	Fishing
7/31/2021	Maui Nui	14909	20.7034353	-156.817635	S17	Naomi K	Fishing
8/2/2021	Maui Nui	15144	20.7139443	-156.93747	S07	Naomi K	Fishing
8/2/2021	Maui Nui	14746	20.7008547	-156.976041	S24	Naomi K	Fishing
8/2/2021	Maui Nui	14750	20.700628	-156.956847	S20	Naomi K	Fishing
8/2/2021	Maui Nui	14496	20.6912539	-156.928179	S24	Naomi K	Fishing
8/2/2021	Maui Nui	14499	20.6910802	-156.913785	S21	Naomi K	Fishing
8/2/2021	Maui Nui	14631	20.6954202	-156.899329	S21	Naomi K	Fishing
8/2/2021	Maui Nui	14763	20.6998765	-156.894469	S22	Naomi K	Fishing
8/2/2021	Maui Nui	14634	20.695244	-156.884935	S22	Naomi K	Fishing
8/3/2021	Maui Nui	14543	20.6883941	-156.702691	S19	Naomi K	Fishing
8/3/2021	Maui Nui	14053	20.6702728	-156.698166	S22	Naomi K	Fishing
8/3/2021	Maui Nui	14052	20.6703367	-156.702963	S22	Naomi K	Fishing
8/3/2021	Maui Nui	14050	20.6704643	-156.712556	S22	Naomi K	Fishing
8/3/2021	Maui Nui	13934	20.6658862	-156.707827	S22	Naomi K	Fishing
8/3/2021	Maui Nui	13812	20.6614356	-156.712691	S22	Naomi K	Fishing
8/4/2021	Maui Nui	17097	20.7882192	-156.739594	S02	Ao Shibi IV	Fishing

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
8/4/2021	Maui Nui	16806	20.774676	-156.739796	S05	Ao Shibi IV	Fishing
8/4/2021	Maui Nui	16304	20.7518503	-156.720934	S11	Ao Shibi IV	Fishing
8/5/2021	Maui Nui	15612	20.7227969	-156.577395	S14	Naomi K	Fishing
8/5/2021	Maui Nui	15350	20.7137691	-156.577539	S10	Naomi K	Fishing
8/5/2021	Maui Nui	15220	20.7091876	-156.572813	S14	Naomi K	Fishing
8/5/2021	Maui Nui	13234	20.6362153	-156.521216	S15	Ao Shibi IV	Fishing
8/5/2021	Maui Nui	13367	20.6405218	-156.506758	S14	Ao Shibi IV	Fishing
8/5/2021	Maui Nui	11872	20.5860797	-156.488466	S21	Ao Shibi IV	Fishing
8/5/2021	Maui Nui	11766	20.581566	-156.48854	S22	Ao Shibi IV	Fishing
8/5/2021	Maui Nui	11764	20.5817049	-156.498127	S22	Ao Shibi IV	Fishing
8/6/2021	Maui Nui	10396	20.4997249	-156.777402	S09	Ao Shibi IV	Fishing
8/6/2021	Maui Nui	11564	20.5727467	-156.503067	S21	Ao Shibi IV	Fishing
8/6/2021	Maui Nui	11114	20.5499701	-156.489057	S22	Ao Shibi IV	Fishing
8/6/2021	Maui Nui	11042	20.5455258	-156.493923	S22	Ao Shibi IV	Fishing
8/6/2021	Maui Nui	10979	20.5410814	-156.498788	S22	Ao Shibi IV	Fishing
8/6/2021	Maui Nui	10832	20.5274709	-156.494217	S22	Ao Shibi IV	Fishing
8/9/2021	Maui Nui	26214	21.0289733	-156.519584	S05	Naomi K	Fishing
8/9/2021	Maui Nui	28282	21.0613329	-156.571954	S13	Naomi K	Fishing
8/9/2021	Maui Nui	30374	21.1112584	-156.590388	S23	Naomi K	Fishing
8/9/2021	Maui Nui	30367	21.1117339	-156.624061	S23	Naomi K	Fishing
8/9/2021	Maui Nui	30461	21.1163152	-156.628799	S23	Naomi K	Fishing
8/9/2021	Maui Nui	30808	21.134438	-156.633323	S18	Naomi K	Fishing
8/9/2021	Maui Nui	30363	21.1120027	-156.643302	S17	Naomi K	Fishing
8/9/2021	Maui Nui	30261	21.1076223	-156.652994	S22	Naomi K	Fishing
8/10/2021	Maui Nui	30958	21.1441978	-156.686107	S10	Naomi K	Fishing
8/10/2021	Maui Nui	21779	20.9675059	-157.424439	S22	Renee NV	Fishing
8/10/2021	Maui Nui	21780	20.9674614	-157.419631	S22	Renee NV	Fishing
8/10/2021	Maui Nui	22770	20.9854811	-157.414632	S20	Renee NV	Fishing
8/10/2021	Maui Nui	23279	20.9943784	-157.40011	S20	Renee NV	Fishing
8/10/2021	Maui Nui	23283	20.9941965	-157.380874	S20	Renee NV	Fishing
8/10/2021	Maui Nui	23284	20.9941507	-157.376066	S20	Renee NV	Fishing
8/10/2021	Maui Nui	23032	20.9894965	-157.361688	S22	Renee NV	Fishing
8/10/2021	Maui Nui	23542	20.9985747	-157.366399	S19	Renee NV	Fishing
8/10/2021	Maui Nui	23801	21.0031827	-157.375968	S18	Renee NV	Fishing
8/12/2021	Maui Nui	13819	20.6609869	-156.679117	S20	Naomi K	Fishing
8/12/2021	Maui Nui	13195	20.6388	-156.708233	S22	Naomi K	Fishing
8/12/2021	Maui Nui	13326	20.6432506	-156.70337	S22	Naomi K	Fishing
8/12/2021	Maui Nui	13446	20.6478287	-156.708098	S22	Naomi K	Fishing
8/12/2021	Maui Nui	13569	20.6523431	-156.70803	S22	Naomi K	Fishing
8/12/2021	Maui Nui	13567	20.6524703	-156.717623	S20	Naomi K	Fishing
8/12/2021	Maui Nui	14678	20.6925221	-156.673839	S20	Naomi K	Fishing
8/12/2021	Maui Nui	14816	20.6965794	-156.640189	S20	Naomi K	Fishing
8/13/2021	Maui Nui	15335	20.7147672	-156.649505	S11	Naomi K	Fishing
8/13/2021	Maui Nui	15337	20.7146359	-156.639909	S13	Naomi K	Fishing

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8/16/2021	Maui Nui	18176	20.8614186	-157.699456	S14	Renee NV	Fishing
8/16/2021	Maui Nui	18273	20.865862	-157.689806	S14	Renee NV	Fishing
8/16/2021	Oahu	34014	21.2623817	-157.570687	S19	Alice T	Fishing
8/16/2021	Maui Nui	18471	20.8746345	-157.656088	S16	Renee NV	Fishing
8/16/2021	Oahu	34492	21.2759713	-157.575375	S06	Alice T	Fishing
8/16/2021	Oahu	40145	21.7578106	-157.996151	S22	Ebisui III	Fishing
8/16/2021	Maui Nui	27997	21.0575001	-156.620113	S05	Naomi K	Fishing
8/16/2021	Oahu	34793	21.284922	-157.56565	S06	Alice T	Fishing
8/16/2021	Maui Nui	18778	20.8879166	-157.622325	S10	Renee NV	Fishing
8/16/2021	Maui Nui	29041	21.0758244	-156.639063	S18	Naomi K	Fishing
8/16/2021	Oahu	40267	21.7667851	-157.986417	S22	Ebisui III	Fishing
8/16/2021	Oahu	34798	21.2847151	-157.541557	S23	Alice T	Fishing
8/16/2021	Maui Nui	27704	21.0533215	-156.644228	S05	Naomi K	Fishing
8/16/2021	Oahu	34929	21.2892729	-157.546331	S19	Alice T	Fishing
8/16/2021	Maui Nui	20652	20.9458278	-157.525633	S24	Renee NV	Fishing
8/16/2021	Maui Nui	28264	21.062549	-156.658512	S22	Naomi K	Fishing
8/16/2021	Niihau	40628	21.8011905	-160.264416	S16	Ebisui III	Fishing
8/16/2021	Maui Nui	20463	20.940932	-157.48241	S21	Renee NV	Fishing
8/16/2021	Maui Nui	27401	21.049271	-156.677959	S22	Naomi K	Fishing
8/16/2021	Oahu	35428	21.311937	-157.555748	S22	Alice T	Fishing
8/16/2021	Oahu	40328	21.7712122	-157.971879	S22	Ebisui III	Fishing
8/16/2021	Maui Nui	28256	21.0630753	-156.696985	S19	Naomi K	Fishing
8/16/2021	Oahu	35425	21.3120605	-157.570207	S12	Alice T	Fishing
8/16/2021	Maui Nui	29022	21.0770714	-156.730443	S06	Naomi K	Fishing
8/16/2021	Oahu	40447	21.7800934	-157.947636	S24	Ebisui III	Fishing
8/16/2021	Maui Nui	29273	21.0809352	-156.682277	S19	Naomi K	Fishing
8/16/2021	Oahu	35499	21.3166991	-157.584622	S03	Alice T	Fishing
8/16/2021	Oahu	40323	21.7713608	-157.996056	S22	Ebisui III	Fishing
8/16/2021	Maui Nui	30979	21.1581354	-157.528356	S21	Renee NV	Fishing
8/16/2021	Oahu	35709	21.3348451	-157.59409	S24	Alice T	Fishing
8/16/2021	Oahu	40376	21.775965	-158.010532	S22	Ebisui III	Fishing
8/16/2021	Maui Nui	31302	21.1759891	-157.504102	S19	Renee NV	Fishing
8/16/2021	Oahu	35703	21.3350845	-157.623012	S11	Alice T	Fishing
8/16/2021	Oahu	40536	21.7896298	-158.029784	S24	Ebisui III	Fishing
8/16/2021	Oahu	40250	21.7672684	-158.068619	S24	Ebisui III	Fishing
8/16/2021	Oahu	39342	21.6995968	-158.083555	S08	Ebisui III	Fishing
8/17/2021	Maui Nui	32753	21.2125616	-156.733193	S21	Naomi K	Fishing
8/17/2021	Oahu	35857	21.3532286	-157.632485	S22	Alice T	Fishing
8/17/2021	Maui Nui	32760	21.2121056	-156.699495	S24	Naomi K	Fishing
8/17/2021	Maui Nui	32763	21.2119082	-156.685053	S24	Naomi K	Fishing
8/17/2021	Oahu	35902	21.357745	-157.632443	S21	Alice T	Fishing
8/17/2021	Maui Nui	32306	21.1979678	-156.656384	S19	Naomi K	Fishing
8/17/2021	Oahu	35947	21.3622613	-157.632401	S22	Alice T	Fishing
8/17/2021	Maui Nui	31878	21.184426	-156.656598	S21	Naomi K	Fishing

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8/17/2021	Maui Nui	31883	21.1840905	-156.632533	S23	Naomi K	Fishing
8/17/2021	Oahu	36189	21.3895155	-157.651439	S22	Alice T	Fishing
8/17/2021	Oahu	36708	21.4621592	-157.699022	S10	Alice T	Fishing
8/17/2021	Oahu	36844	21.4755571	-157.679601	S24	Alice T	Fishing
8/17/2021	Oahu	36925	21.4846658	-157.68917	S12	Alice T	Fishing
8/17/2021	Oahu	36953	21.4897344	-157.761515	S11	Alice T	Fishing
8/18/2021	Maui Nui	31535	21.1837277	-157.364373	S20	Renee NV	Fishing
8/18/2021	Maui Nui	31770	21.1928987	-157.378719	S24	Renee NV	Fishing
8/18/2021	Maui Nui	31322	21.1751096	-157.407804	S20	Renee NV	Fishing
8/18/2021	Oahu	39393	21.7041668	-158.093194	S15	Ebisui III	Fishing
8/18/2021	Maui Nui	30680	21.1389364	-157.403377	S01	Renee NV	Fishing
8/18/2021	Oahu	40317	21.7715344	-158.02507	S22	Ebisui III	Fishing
8/18/2021	Maui Nui	31144	21.1665679	-157.460861	S20	Renee NV	Fishing
8/18/2021	Maui Nui	31412	21.1800723	-157.455906	S22	Renee NV	Fishing
8/18/2021	Oahu	40078	21.7534674	-158.025192	S22	Ebisui III	Fishing
8/18/2021	Maui Nui	31515	21.1846323	-157.460674	S22	Renee NV	Fishing
8/18/2021	Oahu	40077	21.7534958	-158.030027	S22	Ebisui III	Fishing
8/18/2021	Oahu	40076	21.753524	-158.034862	S22	Ebisui III	Fishing
8/18/2021	Maui Nui	31634	21.1891044	-157.455812	S24	Renee NV	Fishing
8/18/2021	Oahu	40195	21.7626137	-158.044472	S22	Ebisui III	Fishing
8/18/2021	Oahu	40070	21.7536907	-158.063872	S22	Ebisui III	Fishing
8/18/2021	Oahu	38687	21.641261	-158.156397	S20	Ebisui III	Fishing
8/21/2021	Maui Nui	10744	20.5273606	-156.820143	S24	Naomi K	Fishing
8/21/2021	Maui Nui	10266	20.4865464	-156.806344	S24	Naomi K	Fishing
8/21/2021	Maui Nui	10390	20.5000907	-156.806151	S24	Naomi K	Fishing
8/21/2021	Maui Nui	10444	20.5044841	-156.796504	S19	Naomi K	Fishing
8/21/2021	Maui Nui	10502	20.5088768	-156.786855	S05	Naomi K	Fishing
8/22/2021	Big Island	1122	19.2586714	-155.900907	S04	Ride On	Fishing
8/22/2021	Big Island	1413	19.3217593	-155.894964	S22	Ride On	Fishing
8/22/2021	Big Island	1439	19.3307022	-155.89004	S16	Ride On	Fishing
8/22/2021	Big Island	1953	19.5308432	-155.981436	S07	Ride On	Fishing
8/22/2021	Big Island	2140	19.5808754	-156.004316	S10	Ride On	Fishing
8/22/2021	Big Island	2257	19.6124618	-156.00373	S01	Ride On	Fishing
8/27/2021	Big Island	5510	19.9590069	-155.944728	S22	Ride On	Fishing
8/27/2021	Big Island	5373	19.9500652	-155.949674	S21	Ride On	Fishing
8/27/2021	Big Island	5311	19.9452242	-155.930675	S09	Ride On	Fishing
8/27/2021	Big Island	5102	19.9319354	-155.94525	S06	Ride On	Fishing
8/27/2021	Big Island	5172	19.9366931	-155.959476	S20	Ride On	Fishing
8/27/2021	Big Island	4949	19.9231571	-155.959735	S05	Ride On	Fishing
8/27/2021	Big Island	5237	19.941531	-155.978475	S24	Ride On	Fishing
8/27/2021	Big Island	5159	19.9381434	-156.045362	S24	Ride On	Fishing
8/27/2021	Big Island	4930	19.9246857	-156.050385	S24	Ride On	Fishing
8/27/2021	Big Island	2332	19.6354187	-156.027124	S10	Ride On	Fishing
8/27/2021	Big Island	2347	19.6400098	-156.031804	S22	Ride On	Fishing

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8/28/2021	Big Island	4645	19.9056771	-155.993473	S20	Ride On	Fishing
8/28/2021	Big Island	4576	19.9008413	-155.974477	S08	Ride On	Fishing
8/28/2021	Big Island	4162	19.8736065	-155.965453	S01	Ride On	Fishing
8/28/2021	Big Island	4225	19.8784428	-155.984445	S09	Ride On	Fishing
8/28/2021	Big Island	4292	19.8830357	-155.98913	S06	Ride On	Fishing
8/28/2021	Big Island	4290	19.8831969	-155.998669	S08	Ride On	Fishing
8/28/2021	Big Island	4086	19.8698209	-156.008463	S08	Ride On	Fishing
8/28/2021	Big Island	3797	19.8528022	-156.070799	S05	Ride On	Fishing
8/28/2021	Big Island	3668	19.8439337	-156.080503	S08	Ride On	Fishing
8/28/2021	Big Island	3730	19.8485243	-156.085189	S20	Ride On	Fishing
8/28/2021	Big Island	3788	19.8535027	-156.113723	S24	Ride On	Fishing
8/28/2021	Big Island	2742	19.7628631	-156.091518	S22	Ride On	Fishing
8/29/2021	Oahu	33673	21.2542522	-157.681583	S22	Alice T	Fishing
8/29/2021	Kauai	45376	22.2656871	-159.59889	S06	Yukie-Lynn	Fishing
8/29/2021	Oahu	33255	21.2409996	-157.720244	S01	Alice T	Fishing
8/29/2021	Kauai	44705	22.2157173	-159.671445	S16	Yukie-Lynn	Fishing
8/29/2021	Oahu	33110	21.2368064	-157.76364	S24	Alice T	Fishing
8/29/2021	Kauai	44630	22.2067233	-159.6617	S10	Yukie-Lynn	Fishing
8/29/2021	Oahu	33108	21.2368767	-157.773275	S22	Alice T	Fishing
8/29/2021	Kauai	44627	22.2066635	-159.676253	S09	Yukie-Lynn	Fishing
8/29/2021	Oahu	33100	21.2371526	-157.811815	S21	Alice T	Fishing
8/29/2021	Kauai	44591	22.2021264	-159.681081	S21	Yukie-Lynn	Fishing
8/29/2021	Oahu	34283	21.2736193	-157.859714	S01	Alice T	Fishing
8/29/2021	Kauai	44510	22.1930723	-159.685888	S20	Yukie-Lynn	Fishing
8/29/2021	Oahu	34115	21.269359	-157.898299	S22	Alice T	Fishing
8/29/2021	Kauai	44587	22.2019594	-159.719886	S12	Yukie-Lynn	Fishing
8/29/2021	Kauai	44622	22.2064547	-159.724759	S22	Yukie-Lynn	Fishing
8/29/2021	Oahu	33482	21.2518649	-157.98998	S23	Alice T	Fishing
8/29/2021	Kauai	44582	22.2018504	-159.744138	S23	Yukie-Lynn	Fishing
8/29/2021	Oahu	33780	21.2609277	-157.994737	S24	Alice T	Fishing
8/29/2021	Kauai	44408	22.1836247	-159.777992	S09	Yukie-Lynn	Fishing
8/29/2021	Kauai	44326	22.1745679	-159.782791	S06	Yukie-Lynn	Fishing
8/30/2021	Maui Nui	27904	21.0637216	-157.115499	S10	Renee NV	Fishing
8/30/2021	Maui Nui	27007	21.0502288	-157.12048	S14	Renee NV	Fishing
8/30/2021	Kauai	45407	22.2701679	-159.608615	S22	Yukie-Lynn	Fishing
8/30/2021	Maui Nui	26703	21.0456602	-157.115726	S20	Renee NV	Fishing
8/30/2021	Maui Nui	26091	21.0366295	-157.11584	S19	Renee NV	Fishing
8/30/2021	Kauai	45473	22.2793764	-159.560121	S05	Yukie-Lynn	Fishing
8/30/2021	Kauai	45423	22.2704403	-159.530967	S05	Yukie-Lynn	Fishing
8/30/2021	Maui Nui	25793	21.0320073	-157.106278	S20	Renee NV	Fishing
8/30/2021	Kauai	45480	22.27949	-159.526148	S17	Yukie-Lynn	Fishing
8/30/2021	Maui Nui	25502	21.0275455	-157.111144	S22	Renee NV	Fishing
8/30/2021	Maui Nui	11881	20.5854478	-156.445328	S04	Naomi K	Fishing
8/30/2021	Kauai	45395	22.2660009	-159.506686	S13	Yukie-Lynn	Fishing

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8/30/2021	Maui Nui	11478	20.5674643	-156.450421	S20	Naomi K	Fishing
8/30/2021	Maui Nui	24930	21.0184613	-157.106449	S22	Renee NV	Fishing
8/30/2021	Kauai	45360	22.2615139	-159.496964	S07	Yukie-Lynn	Fishing
8/30/2021	Maui Nui	11477	20.5675348	-156.455214	S22	Naomi K	Fishing
8/30/2021	Maui Nui	25787	21.0323263	-157.135134	S22	Renee NV	Fishing
8/30/2021	Maui Nui	11191	20.5542748	-156.474607	S22	Naomi K	Fishing
8/30/2021	Kauai	45248	22.2525803	-159.462965	S10	Yukie-Lynn	Fishing
8/30/2021	Maui Nui	11376	20.563302	-156.474458	S21	Naomi K	Fishing
8/30/2021	Maui Nui	26697	21.0459778	-157.144586	S22	Renee NV	Fishing
8/30/2021	Kauai	45207	22.2483428	-159.351346	S22	Yukie-Lynn	Fishing
8/30/2021	Maui Nui	11571	20.5722593	-156.469517	S20	Naomi K	Fishing
8/30/2021	Kauai	45271	22.2528598	-159.351357	S22	Yukie-Lynn	Fishing
8/30/2021	Maui Nui	26995	21.0508577	-157.178201	S22	Renee NV	Fishing
8/30/2021	Maui Nui	11771	20.5812163	-156.464575	S15	Naomi K	Fishing
8/30/2021	Kauai	45210	22.2483736	-159.336789	S22	Yukie-Lynn	Fishing
8/30/2021	Maui Nui	26383	21.0418782	-157.18312	S22	Renee NV	Fishing
8/30/2021	Maui Nui	11769	20.5813566	-156.474161	S22	Naomi K	Fishing
8/30/2021	Kauai	45073	22.2393293	-159.34162	S17	Yukie-Lynn	Fishing
8/30/2021	Maui Nui	11875	20.5858702	-156.474087	S22	Naomi K	Fishing
8/31/2021	Oahu	33914	21.2660695	-158.105541	S22	Alice T	Fishing
8/31/2021	Oahu	34072	21.2705866	-158.105514	S04	Alice T	Fishing
8/31/2021	Oahu	34071	21.2706121	-158.110333	S16	Alice T	Fishing
8/31/2021	Maui Nui	13225	20.6368297	-156.564371	S10	Naomi K	Fishing
8/31/2021	Maui Nui	32150	21.193918	-156.690148	S08	Ao Shibi IV	Fishing
8/31/2021	Maui Nui	13727	20.654545	-156.540106	S22	Naomi K	Fishing
8/31/2021	Oahu	35784	21.3521201	-158.148418	S21	Alice T	Fishing
8/31/2021	Maui Nui	14207	20.6725317	-156.535019	S14	Naomi K	Fishing
8/31/2021	Maui Nui	28005	21.0569565	-156.581645	S13	Ao Shibi IV	Fishing
8/31/2021	Maui Nui	14329	20.6770455	-156.534946	S14	Naomi K	Fishing
8/31/2021	Oahu	35992	21.3747785	-158.162755	S10	Alice T	Fishing
8/31/2021	Maui Nui	27719	21.0523055	-156.572101	S05	Ao Shibi IV	Fishing
8/31/2021	Maui Nui	14451	20.6816963	-156.544466	S15	Naomi K	Fishing
8/31/2021	Oahu	36039	21.3793197	-158.167552	S22	Alice T	Fishing
8/31/2021	Maui Nui	14446	20.6820365	-156.568448	S20	Naomi K	Fishing
8/31/2021	Oahu	36224	21.4021153	-158.210836	S21	Alice T	Fishing
8/31/2021	Maui Nui	14441	20.6823733	-156.592431	S11	Naomi K	Fishing
8/31/2021	Oahu	36307	21.4156211	-158.201116	S04	Alice T	Fishing
8/31/2021	Maui Nui	14438	20.6825738	-156.606821	S13	Naomi K	Fishing
8/31/2021	Maui Nui	14565	20.6869543	-156.597157	S11	Naomi K	Fishing
8/31/2021	Oahu	36542	21.4473322	-158.220244	S11	Alice T	Fishing
8/31/2021	Maui Nui	14695	20.6914013	-156.592289	S11	Naomi K	Fishing
9/1/2021	Maui Nui	24921	21.0197574	-157.226677	S22	Renee NV	Fishing
9/1/2021	Kauai	41806	21.8959835	-159.360157	S03	Yukie-Lynn	Fishing
9/1/2021	Maui Nui	24640	21.0152418	-157.226731	S22	Renee NV	Fishing

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9/1/2021	Kauai	42030	21.9140734	-159.35052	S14	Yukie-Lynn	Fishing
9/1/2021	Maui Nui	24632	21.0156385	-157.265204	S20	Renee NV	Fishing
9/1/2021	Kauai	42229	21.9321922	-159.326357	S12	Yukie-Lynn	Fishing
9/1/2021	Maui Nui	19412	20.892234	-156.147156	S10	Naomi K	Fishing
9/1/2021	Maui Nui	24353	21.0113178	-157.284493	S20	Renee NV	Fishing
9/1/2021	Kauai	42551	21.9548157	-159.307039	S22	Yukie-Lynn	Fishing
9/1/2021	Maui Nui	19414	20.8920733	-156.137553	S07	Naomi K	Fishing
9/1/2021	Maui Nui	24622	21.0161222	-157.313298	S20	Renee NV	Fishing
9/1/2021	Maui Nui	17761	20.8131528	-156.009438	S24	Ao Shibi IV	Fishing
9/1/2021	Kauai	43378	22.0315901	-159.316894	S11	Yukie-Lynn	Fishing
9/1/2021	Maui Nui	24080	21.0069949	-157.303781	S22	Renee NV	Fishing
9/1/2021	Maui Nui	16873	20.7625115	-155.952856	S24	Ao Shibi IV	Fishing
9/1/2021	Kauai	43795	22.0949094	-159.273411	S02	Yukie-Lynn	Fishing
9/1/2021	Maui Nui	17829	20.8179986	-156.028544	S11	Naomi K	Fishing
9/1/2021	Maui Nui	23555	20.9979632	-157.303883	S22	Renee NV	Fishing
9/1/2021	Maui Nui	17902	20.8225104	-156.028455	S10	Naomi K	Fishing
9/1/2021	Maui Nui	16259	20.7354423	-155.953398	S16	Ao Shibi IV	Fishing
9/1/2021	Maui Nui	23038	20.9892165	-157.332837	S22	Renee NV	Fishing
9/1/2021	Kauai	44014	22.1310627	-159.263783	S22	Yukie-Lynn	Fishing
9/1/2021	Maui Nui	18163	20.836378	-156.047387	S20	Naomi K	Fishing
9/1/2021	Maui Nui	15256	20.6994346	-155.958915	S24	Ao Shibi IV	Fishing
9/1/2021	Maui Nui	19068	20.877726	-156.0898	S24	Naomi K	Fishing
9/1/2021	Maui Nui	24335	21.0121687	-157.371061	S08	Renee NV	Fishing
9/1/2021	Kauai	44616	22.2032959	-159.288173	S22	Yukie-Lynn	Fishing
9/1/2021	Maui Nui	25748	21.0348405	-157.380436	S11	Renee NV	Fishing
9/1/2021	Maui Nui	13277	20.6286645	-156.041827	S16	Ao Shibi IV	Fishing
9/1/2021	Kauai	44698	22.2123037	-159.302745	S03	Yukie-Lynn	Fishing
9/1/2021	Maui Nui	13148	20.6242346	-156.046706	S22	Ao Shibi IV	Fishing
9/1/2021	Kauai	44935	22.2303348	-159.322191	S07	Yukie-Lynn	Fishing
9/1/2021	Maui Nui	13142	20.6247242	-156.075463	S10	Ao Shibi IV	Fishing
9/1/2021	Maui Nui	13136	20.625209	-156.10422	S01	Ao Shibi IV	Fishing
9/2/2021	Maui Nui	12021	20.5867168	-156.234372	S10	Ao Shibi IV	Fishing
9/2/2021	Maui Nui	12020	20.5867934	-156.239164	S07	Ao Shibi IV	Fishing
9/2/2021	Maui Nui	12019	20.5868698	-156.243956	S07	Ao Shibi IV	Fishing
9/2/2021	Maui Nui	11716	20.573255	-156.239408	S24	Ao Shibi IV	Fishing
9/2/2021	Maui Nui	11505	20.5655097	-156.32103	S07	Ao Shibi IV	Fishing
9/2/2021	Maui Nui	11201	20.5535692	-156.426686	S22	Ao Shibi IV	Fishing
9/2/2021	Maui Nui	11196	20.5539236	-156.450646	S22	Ao Shibi IV	Fishing
9/2/2021	Maui Nui	11046	20.5452475	-156.474755	S22	Ao Shibi IV	Fishing
9/2/2021	Maui Nui	10882	20.5317065	-156.474977	S22	Ao Shibi IV	Fishing
9/3/2021	Big Island	5809	19.975468	-155.85371	S03	Ao Shibi IV	Fishing
9/4/2021	Big Island	6251	20.0070485	-155.853082	S10	Ao Shibi IV	Fishing
9/4/2021	Big Island	7021	20.0757334	-155.909033	S24	Ao Shibi IV	Fishing
9/5/2021	Big Island	9711	20.2914392	-155.85694	S10	Ao Shibi IV	Fishing

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9/5/2021	Big Island	9766	20.2962932	-155.875976	S14	Ao Shibi IV	Fishing
9/5/2021	Big Island	9107	20.2431683	-155.934423	S15	Ride On	Fishing
9/5/2021	Big Island	8920	20.2210256	-155.958765	S24	Ride On	Fishing
9/5/2021	Big Island	8890	20.216098	-155.934954	S14	Ride On	Fishing
9/5/2021	Big Island	8779	20.2027293	-155.944778	S22	Ride On	Fishing
9/5/2021	Big Island	8494	20.180004	-155.935661	S21	Ride On	Fishing
9/5/2021	Big Island	6924	20.0663746	-155.890111	S21	Ride On	Fishing
9/5/2021	Big Island	6876	20.0616102	-155.875876	S11	Ride On	Fishing
9/5/2021	Big Island	6635	20.0387986	-155.862001	S12	Ride On	Fishing
9/5/2021	Big Island	6636	20.0387138	-155.857227	S11	Ride On	Fishing
9/5/2021	Big Island	6527	20.0302815	-155.890822	S22	Ride On	Fishing
9/5/2021	Big Island	6478	20.0256018	-155.881364	S20	Ride On	Fishing
9/6/2021	Big Island	5733	19.9714624	-155.882431	S04	Ride On	Fishing
9/6/2021	Niihau	40058	21.7519793	-160.201132	S05	Yukie-Lynn	Fishing
9/6/2021	Big Island	5866	19.9809039	-155.906114	S22	Ride On	Fishing
9/6/2021	Niihau	39862	21.7383596	-160.210688	S12	Yukie-Lynn	Fishing
9/6/2021	Maui Nui	23417	20.9820454	-156.400188	S08	Naomi K	Fishing
9/6/2021	Big Island	5990	19.9900938	-155.915483	S24	Ride On	Fishing
9/6/2021	Niihau	39921	21.742625	-160.244565	S12	Yukie-Lynn	Fishing
9/6/2021	Maui Nui	24500	20.9995061	-156.361428	S05	Naomi K	Fishing
9/6/2021	Big Island	7150	20.0738887	-155.340759	S20	Ao Shibi IV	Fishing
9/6/2021	Big Island	6056	19.9943556	-155.901077	S22	Ride On	Fishing
9/6/2021	Niihau	40108	21.7561011	-160.254351	S24	Yukie-Lynn	Fishing
9/6/2021	Maui Nui	27458	21.0453029	-156.4039	S17	Naomi K	Fishing
9/6/2021	Maui Nui	26542	21.0319832	-156.418556	S17	Naomi K	Fishing
9/6/2021	Big Island	6245	20.0075554	-155.88172	S22	Ride On	Fishing
9/6/2021	Niihau	40661	21.8057068	-160.264455	S21	Yukie-Lynn	Fishing
9/6/2021	Big Island	6714	20.030696	-155.217662	S20	Ao Shibi IV	Fishing
9/6/2021	Maui Nui	25057	21.0093442	-156.414138	S06	Naomi K	Fishing
9/6/2021	Big Island	6304	20.012235	-155.891177	S20	Ride On	Fishing
9/6/2021	Niihau	40769	21.8192185	-160.269411	S07	Yukie-Lynn	Fishing
9/6/2021	Maui Nui	24483	21.0007536	-156.443131	S06	Naomi K	Fishing
9/6/2021	Big Island	6816	20.0395084	-155.207905	S23	Ao Shibi IV	Fishing
9/6/2021	Big Island	6362	20.0167466	-155.891088	S20	Ride On	Fishing
9/6/2021	Niihau	40871	21.83273	-160.274368	S22	Yukie-Lynn	Fishing
9/6/2021	Maui Nui	27737	21.051046	-156.485554	S17	Naomi K	Fishing
9/6/2021	Big Island	6769	20.034795	-155.198473	S23	Ao Shibi IV	Fishing
9/6/2021	Niihau	41313	21.8689716	-160.260173	S01	Yukie-Lynn	Fishing
9/6/2021	Big Island	6207	19.9895065	-155.190019	S13	Ao Shibi IV	Fishing
9/6/2021	Niihau	41814	21.8961061	-160.255572	S01	Yukie-Lynn	Fishing
9/6/2021	Big Island	6394	20.0027227	-155.175386	S20	Ao Shibi IV	Fishing
9/6/2021	Niihau	41986	21.9096917	-160.250851	S07	Yukie-Lynn	Fishing
9/6/2021	Big Island	6276	19.9933965	-155.161297	S20	Ao Shibi IV	Fishing
9/6/2021	Niihau	42036	21.9142079	-160.25089	S17	Yukie-Lynn	Fishing

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9/6/2021	Big Island	6284	19.992565	-155.123146	S24	Ao Shibi IV	Fishing
9/6/2021	Niihau	42488	21.9505924	-160.217318	S07	Yukie-Lynn	Fishing
9/6/2021	Big Island	5626	19.9459081	-155.052744	S24	Ao Shibi IV	Fishing
9/7/2021	Big Island	6084	19.9799753	-155.166393	S20	Ao Shibi IV	Fishing
9/7/2021	Maui Nui	32271	21.2002219	-156.824861	S06	Naomi K	Fishing
9/7/2021	Niihau	40528	21.7887854	-160.104716	S21	Yukie-Lynn	Fishing
9/7/2021	Maui Nui	32120	21.1958312	-156.834555	S08	Naomi K	Fishing
9/7/2021	Niihau	40529	21.7888177	-160.09988	S16	Yukie-Lynn	Fishing
9/7/2021	Maui Nui	31693	21.1831378	-156.902142	S01	Naomi K	Fishing
9/7/2021	Big Island	5043	19.9113173	-155.120364	S02	Ao Shibi IV	Fishing
9/7/2021	Niihau	40622	21.797883	-160.095112	S01	Yukie-Lynn	Fishing
9/7/2021	Maui Nui	32249	21.2015529	-156.930772	S20	Naomi K	Fishing
9/7/2021	Niihau	40683	21.8068517	-160.104854	S01	Yukie-Lynn	Fishing
9/7/2021	Maui Nui	32718	21.2154489	-156.959472	S10	Naomi K	Fishing
9/7/2021	Big Island	4385	19.8697002	-155.073705	S07	Ao Shibi IV	Fishing
9/7/2021	Niihau	40685	21.8069161	-160.095181	S01	Yukie-Lynn	Fishing
9/7/2021	Big Island	4176	19.8560718	-155.069274	S02	Ao Shibi IV	Fishing
9/7/2021	Niihau	40690	21.8070747	-160.070998	S24	Yukie-Lynn	Fishing
9/7/2021	Big Island	4249	19.8601576	-155.050106	S20	Ao Shibi IV	Fishing
9/7/2021	Niihau	40857	21.8293365	-160.119539	S17	Yukie-Lynn	Fishing
9/7/2021	Big Island	3632	19.8199048	-155.0654	S11	Ao Shibi IV	Fishing
9/7/2021	Niihau	40894	21.8339184	-160.1099	S14	Yukie-Lynn	Fishing
9/7/2021	Niihau	40929	21.8384674	-160.105097	S01	Yukie-Lynn	Fishing
9/7/2021	Big Island	3506	19.8109943	-155.070385	S10	Ao Shibi IV	Fishing
9/7/2021	Niihau	41060	21.852209	-160.076173	S07	Yukie-Lynn	Fishing
9/7/2021	Niihau	41191	21.8613674	-160.056886	S02	Yukie-Lynn	Fishing
9/7/2021	Big Island	3450	19.8060658	-155.051445	S12	Ao Shibi IV	Fishing
9/7/2021	Niihau	41696	21.8887407	-160.013531	S24	Yukie-Lynn	Fishing
9/7/2021	Big Island	3458	19.8052184	-155.013344	S21	Ao Shibi IV	Fishing
9/8/2021	Big Island	4554	19.8759373	-154.949604	S24	Ao Shibi IV	Fishing
9/8/2021	Big Island	4925	19.8986896	-154.95856	S24	Ao Shibi IV	Fishing
9/8/2021	Big Island	4769	19.8899999	-154.973083	S24	Ao Shibi IV	Fishing
9/8/2021	Big Island	4920	19.89923	-154.982385	S24	Ao Shibi IV	Fishing
9/8/2021	Big Island	4765	19.8904307	-154.992143	S24	Ao Shibi IV	Fishing
9/8/2021	Big Island	4262	19.8587722	-154.988173	S24	Ao Shibi IV	Fishing
9/8/2021	Big Island	3780	19.8265757	-154.96039	S24	Ao Shibi IV	Fishing
9/8/2021	Big Island	3020	19.7691587	-155.014243	S10	Ao Shibi IV	Fishing
9/8/2021	Big Island	2888	19.7554237	-155.005058	S03	Ao Shibi IV	Fishing
9/8/2021	Big Island	2890	19.7552106	-154.995536	S11	Ao Shibi IV	Fishing
9/8/2021	Big Island	2932	19.759718	-154.995423	S07	Ao Shibi IV	Fishing
9/8/2021	Big Island	2892	19.754997	-154.986015	S07	Ao Shibi IV	Fishing
9/8/2021	Big Island	3082	19.772382	-154.956995	S24	Ao Shibi IV	Fishing
9/8/2021	Big Island	2775	19.7412611	-154.976832	S07	Ao Shibi IV	Fishing
9/9/2021	Big Island	2702	19.7322466	-154.977058	S10	Ao Shibi IV	Fishing

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9/9/2021	Niihau	42351	21.9414879	-160.226923	S05	Yukie-Lynn	Fishing
9/9/2021	Big Island	2511	19.6687166	-154.959605	S12	Ao Shibi IV	Fishing
9/9/2021	Niihau	42743	21.9688001	-160.198104	S07	Yukie-Lynn	Fishing
9/9/2021	Niihau	42849	21.9779729	-160.178811	S20	Yukie-Lynn	Fishing
9/9/2021	Big Island	2295	19.6002499	-154.923251	S20	Ao Shibi IV	Fishing
9/9/2021	Niihau	42973	21.9916257	-160.164395	S20	Yukie-Lynn	Fishing
9/9/2021	Big Island	2198	19.5726679	-154.900158	S16	Ao Shibi IV	Fishing
9/9/2021	Maui Nui	21002	20.9334034	-156.180007	S14	Naomi K	Fishing
9/9/2021	Niihau	43168	22.0100609	-160.111266	S02	Yukie-Lynn	Fishing
9/9/2021	Big Island	2182	19.5679444	-154.890763	S12	Ao Shibi IV	Fishing
9/9/2021	Maui Nui	20587	20.9246951	-156.199388	S07	Naomi K	Fishing
9/9/2021	Niihau	43266	22.0191265	-160.106493	S10	Yukie-Lynn	Fishing
9/9/2021	Maui Nui	22195	20.9560446	-156.184388	S20	Naomi K	Fishing
9/9/2021	Niihau	43265	22.0190937	-160.111336	S10	Yukie-Lynn	Fishing
9/9/2021	Big Island	2073	19.5391545	-154.81539	S12	Ao Shibi IV	Fishing
9/9/2021	Maui Nui	21936	20.9522409	-156.227706	S10	Naomi K	Fishing
9/9/2021	Niihau	43543	22.0508713	-160.087359	S14	Yukie-Lynn	Fishing
9/9/2021	Maui Nui	22434	20.9615776	-156.246756	S07	Naomi K	Fishing
9/9/2021	Big Island	2019	19.5253039	-154.80148	S12	Ao Shibi IV	Fishing
9/9/2021	Maui Nui	22930	20.9709895	-156.270613	S07	Naomi K	Fishing
9/9/2021	Niihau	43507	22.046387	-160.08248	S07	Yukie-Lynn	Fishing
9/9/2021	Maui Nui	23436	20.9806268	-156.308889	S10	Naomi K	Fishing
9/9/2021	Niihau	43227	22.0148986	-160.062865	S01	Yukie-Lynn	Fishing
9/9/2021	Big Island	1730	19.4276899	-154.870542	S12	Ao Shibi IV	Fishing
9/9/2021	Maui Nui	28335	21.0574967	-156.317126	S23	Naomi K	Fishing
9/9/2021	Big Island	1719	19.4232912	-154.875406	S12	Ao Shibi IV	Fishing
9/9/2021	Niihau	43231	22.0150231	-160.04349	S16	Yukie-Lynn	Fishing
9/9/2021	Big Island	1699	19.4144933	-154.885134	S12	Ao Shibi IV	Fishing
9/9/2021	Niihau	42053	21.9155973	-160.052446	S07	Yukie-Lynn	Fishing
9/9/2021	Big Island	1677	19.4058021	-154.899611	S12	Ao Shibi IV	Fishing
9/9/2021	Big Island	1655	19.3971094	-154.914087	S12	Ao Shibi IV	Fishing
9/10/2021	Big Island	1633	19.3884152	-154.928561	S12	Ao Shibi IV	Fishing
9/10/2021	Big Island	1597	19.3708111	-154.948006	S12	Ao Shibi IV	Fishing
9/10/2021	Maui Nui	25297	21.0181286	-156.712102	S17	Naomi K	Fishing
9/10/2021	Big Island	1474	19.3226971	-155.015705	S24	Ao Shibi IV	Fishing
9/10/2021	Maui Nui	22088	20.9658927	-156.861921	S05	Naomi K	Fishing
9/10/2021	Maui Nui	21595	20.9569236	-156.866856	S11	Naomi K	Fishing
9/10/2021	Maui Nui	21356	20.9524689	-156.871726	S02	Naomi K	Fishing
9/10/2021	Maui Nui	22080	20.9663709	-156.900374	S10	Naomi K	Fishing
9/10/2021	Maui Nui	22327	20.9710039	-156.909925	S16	Naomi K	Fishing
9/10/2021	Big Island	1232	19.2597124	-155.235707	S10	Ao Shibi IV	Fishing
9/10/2021	Maui Nui	24410	21.0070632	-156.904614	S05	Naomi K	Fishing
9/10/2021	Big Island	1223	19.2605881	-155.278437	S02	Ao Shibi IV	Fishing
9/10/2021	Maui Nui	26151	21.0331857	-156.827296	S10	Naomi K	Fishing

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
9/10/2021	Big Island	1073	19.2389071	-155.321673	S02	Ao Shibi IV	Fishing
9/10/2021	Maui Nui	27076	21.0462328	-156.788628	S10	Naomi K	Fishing
9/10/2021	Big Island	966	19.2035908	-155.36045	S11	Ao Shibi IV	Fishing
9/10/2021	Maui Nui	27080	21.0459813	-156.769393	S13	Naomi K	Fishing
9/10/2021	Big Island	699	19.1118299	-155.514354	S12	Ao Shibi IV	Fishing
9/10/2021	Big Island	508	19.0225106	-155.563666	S12	Ao Shibi IV	Fishing
9/10/2021	Big Island	445	19.004732	-155.578264	S24	Ao Shibi IV	Fishing
9/11/2021	Big Island	299	18.9555501	-155.602983	S10	Ao Shibi IV	Fishing
9/11/2021	Big Island	210	18.9288311	-155.622491	S02	Ao Shibi IV	Fishing
9/11/2021	Big Island	134	18.9064484	-155.632424	S16	Ao Shibi IV	Fishing
9/11/2021	Big Island	117	18.9021948	-155.646734	S10	Ao Shibi IV	Fishing
9/11/2021	Big Island	130	18.9067915	-155.651383	S01	Ao Shibi IV	Fishing
9/11/2021	Big Island	47	18.8756389	-155.675707	S07	Ao Shibi IV	Fishing
9/11/2021	Big Island	54	18.8803195	-155.685096	S01	Ao Shibi IV	Fishing
9/11/2021	Big Island	30	18.8667856	-155.685362	S07	Ao Shibi IV	Fishing
10/16/2021	Maui Nui	20672	20.9413236	-157.073771	S20	Alice T	Fishing
10/16/2021	Maui Nui	19350	20.9053093	-157.083844	S07	Alice T	Fishing
10/16/2021	Maui Nui	19117	20.8962786	-157.083958	S07	Alice T	Fishing
10/16/2021	Maui Nui	19119	20.8961706	-157.074348	S02	Alice T	Fishing
10/16/2021	Maui Nui	18683	20.8781633	-157.079383	S07	Alice T	Fishing
10/16/2021	Maui Nui	18285	20.860048	-157.074809	S20	Alice T	Fishing
10/16/2021	Big Island	8818	20.206991	-155.930352	S07	Ao Shibi IV	Fishing
10/16/2021	Maui Nui	18191	20.8553699	-157.060455	S10	Alice T	Fishing
10/16/2021	Big Island	9518	20.2787571	-155.905025	S12	Ao Shibi IV	Fishing
10/16/2021	Maui Nui	17701	20.8280046	-157.036789	S20	Alice T	Fishing
10/16/2021	Maui Nui	17702	20.8279495	-157.031986	S20	Alice T	Fishing
10/16/2021	Big Island	9583	20.2830144	-155.890591	S10	Ao Shibi IV	Fishing
10/16/2021	Maui Nui	17927	20.8413845	-157.022204	S07	Alice T	Fishing
10/16/2021	Big Island	9700	20.2923763	-155.909538	S18	Ao Shibi IV	Fishing
10/16/2021	Maui Nui	17706	20.8277278	-157.012776	S11	Alice T	Fishing
10/16/2021	Big Island	9819	20.3013149	-155.904577	S18	Ao Shibi IV	Fishing
10/16/2021	Maui Nui	16877	20.782797	-157.032572	S24	Alice T	Fishing
10/16/2021	Big Island	10000	20.3146799	-155.894743	S19	Ao Shibi IV	Fishing
10/16/2021	Maui Nui	16782	20.778005	-157.008626	S14	Alice T	Fishing
10/16/2021	Big Island	9824	20.30089	-155.880667	S16	Ao Shibi IV	Fishing
10/17/2021	Big Island	7225	20.0762904	-155.24044	S24	Ao Shibi IV	Fishing
10/17/2021	Big Island	6902	20.0498461	-155.269712	S20	Ao Shibi IV	Fishing
10/17/2021	Big Island	7110	20.0680824	-155.278828	S17	Ao Shibi IV	Fishing
10/17/2021	Big Island	7382	20.0909277	-155.292613	S20	Ao Shibi IV	Fishing
10/17/2021	Big Island	7101	20.0689828	-155.321776	S20	Ao Shibi IV	Fishing
10/17/2021	Big Island	7099	20.0691815	-155.33132	S20	Ao Shibi IV	Fishing
10/17/2021	Big Island	7837	20.1233887	-155.334831	S24	Ao Shibi IV	Fishing
10/17/2021	Big Island	7678	20.1150629	-155.368457	S20	Ao Shibi IV	Fishing
10/17/2021	Big Island	7308	20.088106	-155.373855	S20	Ao Shibi IV	Fishing

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
10/17/2021	Big Island	7364	20.0927133	-155.378524	S20	Ao Shibi IV	Fishing
10/17/2021	Big Island	7303	20.0885952	-155.397719	S10	Ao Shibi IV	Fishing
10/17/2021	Big Island	7412	20.0981	-155.42138	S10	Ao Shibi IV	Fishing
10/17/2021	Big Island	7590	20.1125917	-155.468812	S10	Ao Shibi IV	Fishing
10/18/2021	Big Island	8192	20.1487647	-155.472776	S21	Ao Shibi IV	Fishing
10/18/2021	Big Island	8328	20.1583565	-155.501227	S20	Ao Shibi IV	Fishing
10/18/2021	Big Island	8466	20.167566	-155.510578	S24	Ao Shibi IV	Fishing
10/18/2021	Big Island	7955	20.1364687	-155.535156	S14	Ao Shibi IV	Fishing
10/18/2021	Big Island	8307	20.1603235	-155.601523	S20	Ao Shibi IV	Fishing
10/18/2021	Big Island	8586	20.178825	-155.625016	S20	Ao Shibi IV	Fishing
10/18/2021	Big Island	8580	20.1793732	-155.653679	S10	Ao Shibi IV	Fishing
10/18/2021	Big Island	8761	20.1933583	-155.677277	S10	Ao Shibi IV	Fishing
10/18/2021	Big Island	8978	20.2206929	-155.691038	S14	Ao Shibi IV	Fishing
10/18/2021	Big Island	9090	20.2344051	-155.700309	S14	Ao Shibi IV	Fishing
10/18/2021	Big Island	9126	20.2392746	-155.719331	S10	Ao Shibi IV	Fishing
10/18/2021	Big Island	9269	20.2522675	-155.690369	S20	Ao Shibi IV	Fishing
10/19/2021	Big Island	9861	20.2976447	-155.703754	S24	Ao Shibi IV	Fishing
10/19/2021	Big Island	9797	20.2935829	-155.727754	S21	Ao Shibi IV	Fishing
10/19/2021	Oahu	38820	21.6485697	-157.866456	S20	Ebisui III	Fishing
10/19/2021	Big Island	10032	20.311894	-155.741719	S24	Ao Shibi IV	Fishing
10/19/2021	Oahu	38643	21.6350528	-157.871393	S21	Ebisui III	Fishing
10/19/2021	Big Island	9496	20.2707603	-155.713887	S20	Ao Shibi IV	Fishing
10/19/2021	Oahu	38644	21.6350199	-157.866562	S20	Ebisui III	Fishing
10/19/2021	Big Island	9555	20.2755397	-155.728133	S16	Ao Shibi IV	Fishing
10/19/2021	Oahu	38483	21.6258873	-157.852141	S24	Ebisui III	Fishing
10/19/2021	Big Island	9617	20.2800505	-155.728038	S22	Ao Shibi IV	Fishing
10/19/2021	Oahu	37573	21.571279	-157.794625	S24	Ebisui III	Fishing
10/19/2021	Big Island	9614	20.2803181	-155.74238	S16	Ao Shibi IV	Fishing
10/19/2021	Oahu	37226	21.5258304	-157.756382	S20	Ebisui III	Fishing
10/19/2021	Big Island	9428	20.2666965	-155.737882	S13	Ao Shibi IV	Fishing
10/19/2021	Oahu	37196	21.5214212	-157.770901	S20	Ebisui III	Fishing
10/19/2021	Big Island	9364	20.2622746	-155.742757	S07	Ao Shibi IV	Fishing
10/19/2021	Oahu	37342	21.5441798	-157.794849	S10	Ebisui III	Fishing
10/19/2021	Big Island	9426	20.2668744	-155.747443	S09	Ao Shibi IV	Fishing
10/19/2021	Oahu	37413	21.5532824	-157.80443	S02	Ebisui III	Fishing
10/19/2021	Big Island	9484	20.2718277	-155.771251	S10	Ao Shibi IV	Fishing
10/19/2021	Oahu	37681	21.5805192	-157.823524	S10	Ebisui III	Fishing
10/19/2021	Big Island	9669	20.2853607	-155.770971	S17	Ao Shibi IV	Fishing
10/19/2021	Big Island	9901	20.3038446	-155.794504	S21	Ao Shibi IV	Fishing
10/20/2021	Maui Nui	21803	20.9634055	-157.030219	S14	Renee NV	Fishing
10/20/2021	Maui Nui	21804	20.9633499	-157.025412	S07	Renee NV	Fishing
10/20/2021	Maui Nui	22808	20.98113	-157.001137	S01	Renee NV	Fishing
10/20/2021	Big Island	10022	20.312779	-155.789536	S21	Ao Shibi IV	Fishing
10/20/2021	Oahu	39066	21.6712835	-157.885607	S10	Ebisui III	Fishing

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
10/20/2021	Maui Nui	23326	20.9898762	-156.976979	S05	Renee NV	Fishing
10/20/2021	Big Island	9658	20.2863234	-155.823562	S07	Ao Shibi IV	Fishing
10/20/2021	Maui Nui	23575	20.9950115	-157.029805	S21	Renee NV	Fishing
10/20/2021	Oahu	39021	21.6666029	-157.861483	S20	Ebisui III	Fishing
10/20/2021	Big Island	9773	20.2956922	-155.842504	S16	Ao Shibi IV	Fishing
10/20/2021	Maui Nui	24113	21.003818	-157.010453	S05	Renee NV	Fishing
10/20/2021	Oahu	39220	21.6847023	-157.866174	S20	Ebisui III	Fishing
10/20/2021	Big Island	9712	20.2913532	-155.852159	S07	Ao Shibi IV	Fishing
10/20/2021	Maui Nui	25236	21.021822	-157.005405	S07	Renee NV	Fishing
10/20/2021	Big Island	9589	20.2825023	-155.861904	S02	Ao Shibi IV	Fishing
10/20/2021	Oahu	39816	21.735485	-158.039817	S07	Ebisui III	Fishing
10/20/2021	Maui Nui	26115	21.0353107	-157.000415	S05	Renee NV	Fishing
10/20/2021	Big Island	9885	20.3052306	-155.871013	S22	Ao Shibi IV	Fishing
10/20/2021	Maui Nui	25232	21.0220466	-157.02464	S16	Renee NV	Fishing
10/20/2021	Oahu	40012	21.7490634	-158.044561	S21	Ebisui III	Fishing
10/20/2021	Maui Nui	26109	21.0356477	-157.029271	S01	Renee NV	Fishing
10/20/2021	Big Island	10008	20.313996	-155.856485	S19	Ao Shibi IV	Fishing
10/20/2021	Oahu	39878	21.7401403	-158.06396	S22	Ebisui III	Fishing
10/20/2021	Maui Nui	24942	21.017809	-157.048743	S20	Renee NV	Fishing
10/20/2021	Big Island	10067	20.3185073	-155.856393	S22	Ao Shibi IV	Fishing
10/20/2021	Oahu	39740	21.7312148	-158.083355	S22	Ebisui III	Fishing
10/20/2021	Big Island	10164	20.3274439	-155.851428	S24	Ao Shibi IV	Fishing
10/20/2021	Maui Nui	27322	21.0540407	-157.057892	S10	Renee NV	Fishing
10/20/2021	Oahu	39738	21.731268	-158.093024	S22	Ebisui III	Fishing
10/20/2021	Maui Nui	27320	21.0541504	-157.067512	S10	Renee NV	Fishing
10/20/2021	Maui Nui	27016	21.0497443	-157.07719	S15	Renee NV	Fishing
10/20/2021	Oahu	39676	21.7268038	-158.102721	S22	Ebisui III	Fishing
10/20/2021	Oahu	39444	21.7087883	-158.1125	S22	Ebisui III	Fishing
10/20/2021	Oahu	39443	21.7088141	-158.117333	S22	Ebisui III	Fishing
10/20/2021	Oahu	39392	21.7041932	-158.098027	S17	Ebisui III	Fishing
10/21/2021	Oahu	38348	21.6236982	-158.262781	S22	Ebisui III	Fishing
10/21/2021	Big Island	122	18.9074719	-155.689303	S22	Ride On	Fishing
10/21/2021	Oahu	38185	21.614664	-158.262826	S07	Ebisui III	Fishing
10/21/2021	Big Island	201	18.9300284	-155.688858	S22	Ride On	Fishing
10/21/2021	Oahu	38182	21.6147276	-158.277318	S05	Ebisui III	Fishing
10/21/2021	Big Island	247	18.9438159	-155.702814	S16	Ride On	Fishing
10/21/2021	Oahu	38342	21.6238242	-158.291766	S14	Ebisui III	Fishing
10/21/2021	Big Island	306	18.9622821	-155.726168	S16	Ride On	Fishing
10/21/2021	Oahu	38506	21.6328585	-158.291722	S22	Ebisui III	Fishing
10/21/2021	Big Island	339	18.971723	-155.749702	S12	Ride On	Fishing
10/21/2021	Oahu	38500	21.6329795	-158.32071	S19	Ebisui III	Fishing
10/21/2021	Big Island	589	19.0690824	-155.899704	S12	Ride On	Fishing
10/21/2021	Oahu	38413	21.6285402	-158.340056	S22	Ebisui III	Fishing
10/21/2021	Big Island	611	19.0782662	-155.909027	S16	Ride On	Fishing

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
10/21/2021	Oahu	38086	21.6105282	-158.35463	S20	Ebisui III	Fishing
10/21/2021	Big Island	650	19.0963946	-155.913438	S12	Ride On	Fishing
10/21/2021	Oahu	38006	21.606011	-158.35465	S12	Ebisui III	Fishing
10/21/2021	Big Island	667	19.1054986	-155.918018	S12	Ride On	Fishing
10/21/2021	Big Island	843	19.1643166	-155.926425	S22	Ride On	Fishing
10/21/2021	Oahu	37769	21.592478	-158.35954	S12	Ebisui III	Fishing
10/21/2021	Big Island	2377	19.6491133	-156.036401	S24	Ride On	Fishing
10/28/2021	Oahu	39508	21.7131205	-158.078636	S11	Ebisui III	Fishing
10/28/2021	Oahu	39448	21.7086837	-158.093165	S17	Ebisui III	Fishing
10/28/2021	Oahu	38890	21.6592296	-158.136964	S20	Ebisui III	Fishing
10/28/2021	Oahu	38936	21.6637965	-158.146601	S22	Ebisui III	Fishing
10/28/2021	Oahu	39077	21.6774457	-158.165852	S24	Ebisui III	Fishing
10/28/2021	Oahu	38882	21.659426	-158.17562	S24	Ebisui III	Fishing
10/28/2021	Oahu	38445	21.6278546	-158.185461	S22	Ebisui III	Fishing
10/28/2021	Oahu	38362	21.6233846	-158.195148	S22	Ebisui III	Fishing
10/28/2021	Oahu	38442	21.627925	-158.199954	S22	Ebisui III	Fishing
10/28/2021	Oahu	38271	21.6190723	-158.23865	S16	Ebisui III	Fishing
10/29/2021	Oahu	38192	21.6145107	-158.229012	S07	Ebisui III	Fishing
10/29/2021	Oahu	38519	21.632579	-158.228916	S24	Ebisui III	Fishing
10/29/2021	Oahu	37921	21.6015857	-158.378821	S22	Ebisui III	Fishing
10/29/2021	Oahu	37689	21.588034	-158.378879	S22	Ebisui III	Fishing
10/29/2021	Oahu	37626	21.5834249	-158.35475	S09	Ebisui III	Fishing
10/29/2021	Oahu	37538	21.5743905	-158.35479	S22	Ebisui III	Fishing
10/29/2021	Oahu	37352	21.5516504	-158.316261	S15	Ebisui III	Fishing
10/29/2021	Oahu	37233	21.533269	-158.243926	S02	Ebisui III	Fishing
10/30/2021	Maui Nui	33864	21.2556983	-157.334673	S20	Alice T	Fishing
10/30/2021	Maui Nui	34812	21.2824559	-157.300642	S13	Alice T	Fishing
10/30/2021	Maui Nui	35176	21.2961483	-157.314941	S22	Alice T	Fishing
10/30/2021	Maui Nui	35175	21.2961964	-157.31976	S22	Alice T	Fishing
10/30/2021	Maui Nui	35063	21.2917288	-157.324629	S19	Alice T	Fishing
10/30/2021	Maui Nui	35060	21.291872	-157.339084	S24	Alice T	Fishing
10/30/2021	Maui Nui	35361	21.3049855	-157.295563	S22	Alice T	Fishing
10/30/2021	Maui Nui	35360	21.3050342	-157.300382	S22	Alice T	Fishing
10/30/2021	Maui Nui	34378	21.2675989	-157.175546	S20	Alice T	Fishing
10/30/2021	Maui Nui	33740	21.2493804	-157.161319	S05	Alice T	Fishing
10/30/2021	Maui Nui	33024	21.2258917	-157.079732	S07	Alice T	Fishing
10/30/2021	Maui Nui	32867	21.2209338	-157.041268	S10	Alice T	Fishing

Appendix 3. Primary sampling units (PSU) sampled by camera gear during the 2021 BFISH with location, stratum, and vessel.

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
7/10/2021	Oahu	34011	21.262504	-157.585141	S13	Ao Shibi IV	Camera
7/10/2021	Oahu	34011	21.262504	-157.585141	S13	Ao Shibi IV	Camera
7/10/2021	Oahu	36070	21.376082	-157.666028	S02	Ao Shibi IV	Camera
7/10/2021	Oahu	36070	21.376082	-157.666028	S02	Ao Shibi IV	Camera
7/10/2021	Oahu	36962	21.489407	-157.718084	S13	Ao Shibi IV	Camera
7/10/2021	Oahu	36962	21.489407	-157.718084	S13	Ao Shibi IV	Camera
7/10/2021	Oahu	37074	21.503391	-157.775879	S02	Ao Shibi IV	Camera
7/10/2021	Oahu	38641	21.635118	-157.881054	S11	Ao Shibi IV	Camera
7/10/2021	Oahu	38641	21.635118	-157.881054	S11	Ao Shibi IV	Camera
7/10/2021	Oahu	39318	21.693899	-157.890266	S10	Ao Shibi IV	Camera
7/10/2021	Oahu	39164	21.680349	-157.89037	S07	Ao Shibi IV	Camera
7/10/2021	Oahu	39164	21.680349	-157.89037	S07	Ao Shibi IV	Camera
7/10/2021	Oahu	39546	21.711998	-157.894961	S10	Ao Shibi IV	Camera
7/10/2021	Oahu	39546	21.711998	-157.894961	S10	Ao Shibi IV	Camera
7/11/2021	Oahu	39746	21.731052	-158.05435	S09	Ao Shibi IV	Camera
7/11/2021	Oahu	39746	21.731052	-158.05435	S09	Ao Shibi IV	Camera
7/11/2021	Oahu	39043	21.672601	-158.103056	S05	Ao Shibi IV	Camera
7/11/2021	Oahu	39043	21.672601	-158.103056	S05	Ao Shibi IV	Camera
7/11/2021	Oahu	38991	21.668162	-158.117581	S14	Ao Shibi IV	Camera
7/11/2021	Oahu	38991	21.668162	-158.117581	S14	Ao Shibi IV	Camera
7/11/2021	Oahu	38171	21.61495	-158.330456	S08	Ao Shibi IV	Camera
7/11/2021	Oahu	38171	21.61495	-158.330456	S08	Ao Shibi IV	Camera
7/11/2021	Oahu	37387	21.556187	-158.321068	S03	Ao Shibi IV	Camera
7/11/2021	Oahu	37387	21.556187	-158.321068	S03	Ao Shibi IV	Camera
8/4/2021	Maui Nui	16705	20.770288	-156.749463	S01	Ao Shibi IV	Camera
8/4/2021	Maui Nui	16705	20.770288	-156.749463	S01	Ao Shibi IV	Camera
8/4/2021	Maui Nui	16179	20.74846	-156.807389	S05	Ao Shibi IV	Camera
8/4/2021	Maui Nui	16179	20.74846	-156.807389	S05	Ao Shibi IV	Camera
8/4/2021	Maui Nui	15824	20.734916	-156.807584	S10	Ao Shibi IV	Camera
8/4/2021	Maui Nui	15824	20.734916	-156.807584	S10	Ao Shibi IV	Camera
8/4/2021	Maui Nui	15025	20.708789	-156.884747	S11	Ao Shibi IV	Camera
8/4/2021	Maui Nui	15025	20.708789	-156.884747	S11	Ao Shibi IV	Camera
8/4/2021	Maui Nui	14668	20.693163	-156.721812	S10	Ao Shibi IV	Camera
8/4/2021	Maui Nui	14668	20.693163	-156.721812	S10	Ao Shibi IV	Camera
8/4/2021	Maui Nui	15712	20.729278	-156.721272	S10	Ao Shibi IV	Camera
8/4/2021	Maui Nui	15712	20.729278	-156.721272	S10	Ao Shibi IV	Camera
8/4/2021	Maui Nui	15722	20.728636	-156.673288	S10	Ao Shibi IV	Camera
8/4/2021	Maui Nui	15722	20.728636	-156.673288	S10	Ao Shibi IV	Camera
8/4/2021	Maui Nui	16916	20.778551	-156.691727	S04	Ao Shibi IV	Camera

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
8/4/2021	Maui Nui	16916	20.778551	-156.691727	S04	Ao Shibi IV	Camera
8/4/2021	Maui Nui	17008	20.783323	-156.710859	S05	Ao Shibi IV	Camera
8/4/2021	Maui Nui	17008	20.783323	-156.710859	S05	Ao Shibi IV	Camera
8/5/2021	Maui Nui	15995	20.736675	-156.601172	S10	Ao Shibi IV	Camera
8/5/2021	Maui Nui	15995	20.736675	-156.601172	S10	Ao Shibi IV	Camera
8/5/2021	Maui Nui	15604	20.723333	-156.615779	S14	Ao Shibi IV	Camera
8/5/2021	Maui Nui	15604	20.723333	-156.615779	S14	Ao Shibi IV	Camera
8/5/2021	Maui Nui	15084	20.705077	-156.601669	S10	Ao Shibi IV	Camera
8/5/2021	Maui Nui	15084	20.705077	-156.601669	S10	Ao Shibi IV	Camera
8/5/2021	Maui Nui	14442	20.682306	-156.587634	S15	Ao Shibi IV	Camera
8/5/2021	Maui Nui	14442	20.682306	-156.587634	S15	Ao Shibi IV	Camera
8/5/2021	Maui Nui	14197	20.673211	-156.582981	S10	Ao Shibi IV	Camera
8/5/2021	Maui Nui	14197	20.673211	-156.582981	S10	Ao Shibi IV	Camera
8/5/2021	Maui Nui	13740	20.653645	-156.477765	S07	Ao Shibi IV	Camera
8/5/2021	Maui Nui	13740	20.653645	-156.477765	S07	Ao Shibi IV	Camera
8/5/2021	Maui Nui	12454	20.608995	-156.512067	S07	Ao Shibi IV	Camera
8/5/2021	Maui Nui	12454	20.608995	-156.512067	S07	Ao Shibi IV	Camera
8/6/2021	Maui Nui	10398	20.499602	-156.767819	S09	Ao Shibi IV	Camera
8/6/2021	Maui Nui	10398	20.499602	-156.767819	S09	Ao Shibi IV	Camera
8/6/2021	Maui Nui	10318	20.490076	-156.72962	S08	Ao Shibi IV	Camera
8/6/2021	Maui Nui	10318	20.490076	-156.72962	S08	Ao Shibi IV	Camera
8/6/2021	Maui Nui	12069	20.597528	-156.660898	S14	Ao Shibi IV	Camera
8/6/2021	Maui Nui	12069	20.597528	-156.660898	S14	Ao Shibi IV	Camera
8/6/2021	Maui Nui	12929	20.628998	-156.650825	S11	Ao Shibi IV	Camera
8/6/2021	Maui Nui	12929	20.628998	-156.650825	S11	Ao Shibi IV	Camera
8/6/2021	Maui Nui	13583	20.651438	-156.640887	S16	Ao Shibi IV	Camera
8/6/2021	Maui Nui	13583	20.651438	-156.640887	S16	Ao Shibi IV	Camera
8/7/2021	Maui Nui	24978	21.015735	-156.875638	S05	Ao Shibi IV	Camera
8/7/2021	Maui Nui	24978	21.015735	-156.875638	S05	Ao Shibi IV	Camera
8/7/2021	Maui Nui	24412	21.006944	-156.894998	S05	Ao Shibi IV	Camera
8/7/2021	Maui Nui	24412	21.006944	-156.894998	S05	Ao Shibi IV	Camera
8/7/2021	Maui Nui	23843	20.999247	-157.005705	S09	Ao Shibi IV	Camera
8/7/2021	Maui Nui	23843	20.999247	-157.005705	S09	Ao Shibi IV	Camera
8/7/2021	Maui Nui	21093	20.949971	-157.040009	S10	Ao Shibi IV	Camera
8/7/2021	Maui Nui	21093	20.949971	-157.040009	S10	Ao Shibi IV	Camera
8/7/2021	Maui Nui	27608	21.059313	-157.125176	S10	Ao Shibi IV	Camera
8/7/2021	Maui Nui	27608	21.059313	-157.125176	S10	Ao Shibi IV	Camera
8/7/2021	Maui Nui	25485	21.029087	-157.255428	S10	Ao Shibi IV	Camera
8/7/2021	Maui Nui	25485	21.029087	-157.255428	S10	Ao Shibi IV	Camera
8/7/2021	Maui Nui	25470	21.029812	-157.327575	S10	Ao Shibi IV	Camera
8/7/2021	Maui Nui	25470	21.029812	-157.327575	S10	Ao Shibi IV	Camera
8/7/2021	Maui Nui	24337	21.012076	-157.361442	S16	Ao Shibi IV	Camera

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
8/7/2021	Maui Nui	21777	20.967595	-157.434055	S03	Ao Shibi IV	Camera
8/7/2021	Maui Nui	21777	20.967595	-157.434055	S03	Ao Shibi IV	Camera
8/7/2021	Maui Nui	22266	20.976715	-157.443578	S10	Ao Shibi IV	Camera
8/7/2021	Maui Nui	22266	20.976715	-157.443578	S10	Ao Shibi IV	Camera
8/8/2021	Maui Nui	28872	21.08676	-157.634939	S10	Ao Shibi IV	Camera
8/8/2021	Maui Nui	28872	21.08676	-157.634939	S10	Ao Shibi IV	Camera
8/8/2021	Maui Nui	30902	21.153535	-157.518772	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	30902	21.153535	-157.518772	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	30985	21.157882	-157.499469	S13	Ao Shibi IV	Camera
8/8/2021	Maui Nui	30985	21.157882	-157.499469	S13	Ao Shibi IV	Camera
8/8/2021	Maui Nui	30745	21.144333	-157.499606	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	30745	21.144333	-157.499606	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	31084	21.161333	-157.383878	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	31084	21.161333	-157.383878	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	31664	21.187674	-157.306543	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	31664	21.187674	-157.306543	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	33181	21.230516	-157.089305	S14	Ao Shibi IV	Camera
8/8/2021	Maui Nui	33181	21.230516	-157.089305	S14	Ao Shibi IV	Camera
8/8/2021	Maui Nui	33443	21.239925	-157.122901	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	33443	21.239925	-157.122901	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	33437	21.240244	-157.151798	S05	Ao Shibi IV	Camera
8/8/2021	Maui Nui	33437	21.240244	-157.151798	S05	Ao Shibi IV	Camera
8/31/2021	Maui Nui	32270	21.200284	-156.829675	S05	Ao Shibi IV	Camera
8/31/2021	Maui Nui	32270	21.200284	-156.829675	S05	Ao Shibi IV	Camera
8/31/2021	Maui Nui	32293	21.198825	-156.718959	S07	Ao Shibi IV	Camera
8/31/2021	Maui Nui	32293	21.198825	-156.718959	S07	Ao Shibi IV	Camera
8/31/2021	Maui Nui	26207	21.029461	-156.553236	S05	Ao Shibi IV	Camera
8/31/2021	Maui Nui	26207	21.029461	-156.553236	S05	Ao Shibi IV	Camera
8/31/2021	Maui Nui	23949	20.990703	-156.376004	S05	Ao Shibi IV	Camera
8/31/2021	Maui Nui	23949	20.990703	-156.376004	S05	Ao Shibi IV	Camera
8/31/2021	Maui Nui	21458	20.942745	-156.199052	S10	Ao Shibi IV	Camera
8/31/2021	Maui Nui	21458	20.942745	-156.199052	S10	Ao Shibi IV	Camera
8/31/2021	Maui Nui	21000	20.933562	-156.189614	S07	Ao Shibi IV	Camera
8/31/2021	Maui Nui	21000	20.933562	-156.189614	S07	Ao Shibi IV	Camera
9/1/2021	Maui Nui	19685	20.901499	-156.161391	S10	Ao Shibi IV	Camera
9/1/2021	Maui Nui	19685	20.901499	-156.161391	S10	Ao Shibi IV	Camera
9/1/2021	Maui Nui	17830	20.817915	-156.023745	S10	Ao Shibi IV	Camera
9/1/2021	Maui Nui	17830	20.817915	-156.023745	S10	Ao Shibi IV	Camera
9/1/2021	Maui Nui	17686	20.808725	-156.014326	S03	Ao Shibi IV	Camera
9/1/2021	Maui Nui	17686	20.808725	-156.014326	S03	Ao Shibi IV	Camera
9/3/2021	Big Island	1806	19.480569	-155.944296	S11	Ao Shibi IV	Camera
9/3/2021	Big Island	1806	19.480569	-155.944296	S11	Ao Shibi IV	Camera

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
9/3/2021	Big Island	1789	19.476057	-155.94438	S10	Ao Shibi IV	Camera
9/3/2021	Big Island	1789	19.476057	-155.94438	S10	Ao Shibi IV	Camera
9/3/2021	Big Island	2123	19.576284	-155.999638	S02	Ao Shibi IV	Camera
9/3/2021	Big Island	2123	19.576284	-155.999638	S02	Ao Shibi IV	Camera
9/3/2021	Big Island	2122	19.576363	-156.004399	S10	Ao Shibi IV	Camera
9/3/2021	Big Island	2122	19.576363	-156.004399	S10	Ao Shibi IV	Camera
9/3/2021	Big Island	4503	19.896491	-155.984103	S12	Ao Shibi IV	Camera
9/3/2021	Big Island	4503	19.896491	-155.984103	S12	Ao Shibi IV	Camera
9/3/2021	Big Island	4793	19.91454	-155.983761	S15	Ao Shibi IV	Camera
9/3/2021	Big Island	4793	19.91454	-155.983761	S15	Ao Shibi IV	Camera
9/3/2021	Big Island	4876	19.9184	-155.94551	S12	Ao Shibi IV	Camera
9/3/2021	Big Island	4876	19.9184	-155.94551	S12	Ao Shibi IV	Camera
9/3/2021	Big Island	5247	19.940712	-155.930762	S12	Ao Shibi IV	Camera
9/3/2021	Big Island	5247	19.940712	-155.930762	S12	Ao Shibi IV	Camera
9/3/2021	Big Island	5107	19.931523	-155.921395	S04	Ao Shibi IV	Camera
9/3/2021	Big Island	5107	19.931523	-155.921395	S04	Ao Shibi IV	Camera
9/3/2021	Big Island	5033	19.926929	-155.916712	S04	Ao Shibi IV	Camera
9/3/2021	Big Island	5033	19.926929	-155.916712	S04	Ao Shibi IV	Camera
9/4/2021	Big Island	3483	19.830318	-156.075982	S05	Ao Shibi IV	Camera
9/4/2021	Big Island	3483	19.830318	-156.075982	S05	Ao Shibi IV	Camera
9/4/2021	Big Island	3802	19.852408	-156.046953	S12	Ao Shibi IV	Camera
9/4/2021	Big Island	3802	19.852408	-156.046953	S12	Ao Shibi IV	Camera
9/4/2021	Big Island	3865	19.857236	-156.065947	S08	Ao Shibi IV	Camera
9/4/2021	Big Island	3865	19.857236	-156.065947	S08	Ao Shibi IV	Camera
9/4/2021	Big Island	4006	19.866104	-156.056242	S11	Ao Shibi IV	Camera
9/4/2021	Big Island	4006	19.866104	-156.056242	S11	Ao Shibi IV	Camera
9/4/2021	Big Island	4078	19.870458	-156.046619	S05	Ao Shibi IV	Camera
9/4/2021	Big Island	4078	19.870458	-156.046619	S05	Ao Shibi IV	Camera
9/4/2021	Big Island	6003	19.989003	-155.853441	S05	Ao Shibi IV	Camera
9/4/2021	Big Island	6003	19.989003	-155.853441	S05	Ao Shibi IV	Camera
9/4/2021	Big Island	8747	20.197884	-155.92575	S07	Ao Shibi IV	Camera
9/4/2021	Big Island	8747	20.197884	-155.92575	S07	Ao Shibi IV	Camera
9/4/2021	Big Island	7454	20.111827	-155.908324	S10	Ao Shibi IV	Camera
9/4/2021	Big Island	7454	20.111827	-155.908324	S10	Ao Shibi IV	Camera
9/4/2021	Big Island	7455	20.111743	-155.903548	S05	Ao Shibi IV	Camera
9/4/2021	Big Island	7455	20.111743	-155.903548	S05	Ao Shibi IV	Camera
9/5/2021	Big Island	9646	20.287356	-155.880938	S10	Ao Shibi IV	Camera
9/5/2021	Big Island	9646	20.287356	-155.880938	S10	Ao Shibi IV	Camera
9/5/2021	Big Island	9645	20.287441	-155.88572	S10	Ao Shibi IV	Camera
9/5/2021	Big Island	9645	20.287441	-155.88572	S10	Ao Shibi IV	Camera
9/5/2021	Big Island	9707	20.291782	-155.876066	S10	Ao Shibi IV	Camera
9/5/2021	Big Island	9707	20.291782	-155.876066	S10	Ao Shibi IV	Camera

SAMPLE_DATE	Island	PSU	Latitude	Longitude	Strata	VESSEL	Gear
9/5/2021	Big Island	9459	20.273991	-155.890772	S02	Ao Shibi IV	Camera
9/5/2021	Big Island	9459	20.273991	-155.890772	S02	Ao Shibi IV	Camera
9/5/2021	Big Island	9519	20.278672	-155.900244	S11	Ao Shibi IV	Camera
9/5/2021	Big Island	9519	20.278672	-155.900244	S11	Ao Shibi IV	Camera
9/5/2021	Big Island	9286	20.260795	-155.910164	S12	Ao Shibi IV	Camera
9/5/2021	Big Island	9286	20.260795	-155.910164	S12	Ao Shibi IV	Camera
9/5/2021	Big Island	9238	20.256368	-155.915034	S10	Ao Shibi IV	Camera
9/5/2021	Big Island	9238	20.256368	-155.915034	S10	Ao Shibi IV	Camera
9/5/2021	Big Island	9422	20.267229	-155.766564	S10	Ao Shibi IV	Camera
9/5/2021	Big Island	9422	20.267229	-155.766564	S10	Ao Shibi IV	Camera
9/5/2021	Big Island	9489	20.271385	-155.747349	S16	Ao Shibi IV	Camera
9/5/2021	Big Island	9489	20.271385	-155.747349	S16	Ao Shibi IV	Camera
9/5/2021	Big Island	8510	20.174589	-155.639444	S14	Ao Shibi IV	Camera
9/5/2021	Big Island	8510	20.174589	-155.639444	S14	Ao Shibi IV	Camera
9/5/2021	Big Island	8091	20.146608	-155.592265	S10	Ao Shibi IV	Camera
9/5/2021	Big Island	8091	20.146608	-155.592265	S10	Ao Shibi IV	Camera
9/6/2021	Big Island	7801	20.126883	-155.506706	S10	Ao Shibi IV	Camera
9/6/2021	Big Island	7801	20.126883	-155.506706	S10	Ao Shibi IV	Camera
9/6/2021	Big Island	7041	20.065167	-155.355285	S07	Ao Shibi IV	Camera
9/6/2021	Big Island	7041	20.065167	-155.355285	S07	Ao Shibi IV	Camera
9/7/2021	Big Island	5603	19.948315	-155.162389	S02	Ao Shibi IV	Camera
9/7/2021	Big Island	5603	19.948315	-155.162389	S02	Ao Shibi IV	Camera
9/7/2021	Big Island	5604	19.948212	-155.157622	S07	Ao Shibi IV	Camera
9/7/2021	Big Island	5604	19.948212	-155.157622	S07	Ao Shibi IV	Camera
9/7/2021	Big Island	5121	19.915721	-155.115488	S10	Ao Shibi IV	Camera
9/7/2021	Big Island	5121	19.915721	-155.115488	S10	Ao Shibi IV	Camera
9/7/2021	Big Island	4314	19.865087	-155.069052	S10	Ao Shibi IV	Camera
9/7/2021	Big Island	4314	19.865087	-155.069052	S10	Ao Shibi IV	Camera
9/7/2021	Big Island	3453	19.805749	-155.037157	S16	Ao Shibi IV	Camera
9/7/2021	Big Island	3453	19.805749	-155.037157	S16	Ao Shibi IV	Camera
9/7/2021	Big Island	3389	19.801769	-155.061081	S11	Ao Shibi IV	Camera
9/7/2021	Big Island	3389	19.801769	-155.061081	S11	Ao Shibi IV	Camera