Annual Report: 2019 Fall Bottomfish Fishery-Independent Survey in Hawai‘i

Benjamin L. Richards, Steven G. Smith, Jerald S. Ault

Pacific Islands Fisheries Science Center
National Marine Fisheries Service
1845 Wasp Boulevard
Honolulu, HI 96818

July 2020

NOAA Administrative Report H-20-09
https://doi.org/10.25923/vnnb-t036

About this report

Pacific Islands Fisheries Science Center Administrative Reports are issued to promptly disseminate scientific and technical information to marine resource managers, scientists, and the general public. Their contents cover a range of topics, including biological and economic research, stock assessment, trends in fisheries, and other subjects. Administrative Reports typically have not been reviewed outside the Center; therefore, they are considered informal publications. The material presented in Administrative Reports may later be published in the formal scientific literature after more rigorous verification, editing, and peer review.

Other publications are free to cite Administrative Reports as they wish provided the informal nature of the contents is indicated, and proper credit is given to the author(s).

Recommended citation

Richards BL, Smith SG, Ault JS. 2020. Annual report: 2019 fall bottomfish fishery-independent survey in Hawai‘i. Pacific Islands Fisheries Science Center. NOAA Administrative Report. H-20-09, 33 p. doi:10.25923/vnnb-t036

Copies of this report are available from

Science Operations Division
Pacific Islands Fisheries Science Center
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
1845 Wasp Boulevard, Building #176
Honolulu, Hawai‘i 96818

Or online at

https://repository.library.noaa.gov/

Cover: Photo courtesy of Pacific Islands Fisheries Science Center and the report author.

Table of Contents

List of Tables

List of Figures

Executive Summary

The Bottomfish Fishery-Independent Survey in Hawai‘i (BFISH) provides robust estimates of size-structured population abundance and biomass for the main Hawaiian Islands Deep 7 bottomfish complex. These survey data complement and enhance the stock assessment process conducted by the Pacific Islands Fisheries Science Center (PIFSC).

The 2019 BFISH survey comprised 517 primary sampling units (PSU) across the eight main Hawaiian Islands. Two survey sampling gears, cooperative research hook-and-line fishing and stereo camera systems, were deployed at depths ranging from 75 to 400 m from September 14 to November 26, 2019.

In the 2019 BFISH survey, ehu was the most abundant species of the Deep 7 complex, followed by ‘ōpakapaka and kalekale. ‘Ōpakapaka had the highest estimated exploited stock biomass, followed by ehu and kalekale. ‘Ōpakapaka and ehu were the two main design species. The estimated stock biomass of ‘ōpakapaka and onaga was approximately 1.563 and 0.537 million kg, respectively. Ehu stock biomass was about 1.067 million kg. Coefficients of variation (CV%) for exploited stock biomass for ehu and ‘ōpakapaka were 17.54 to 23.04, respectively, and were improved over the previous survey year.

To improve overall precision of BFISH surveys, future research will focus on (1) refining PSU metrics of habitat complexity (e.g., bottom hardness, rugosity, etc.); (2) target sample allocations to better reflect species’ depth preferences; and, (3) investments in technological innovations that better define the unit area sampled.

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) (Western Pacific Regional Fishery Management Council 2010) that account for more than 50% of the total insular commercial catch (Western Pacific Regional Fishery Management Council 2010).

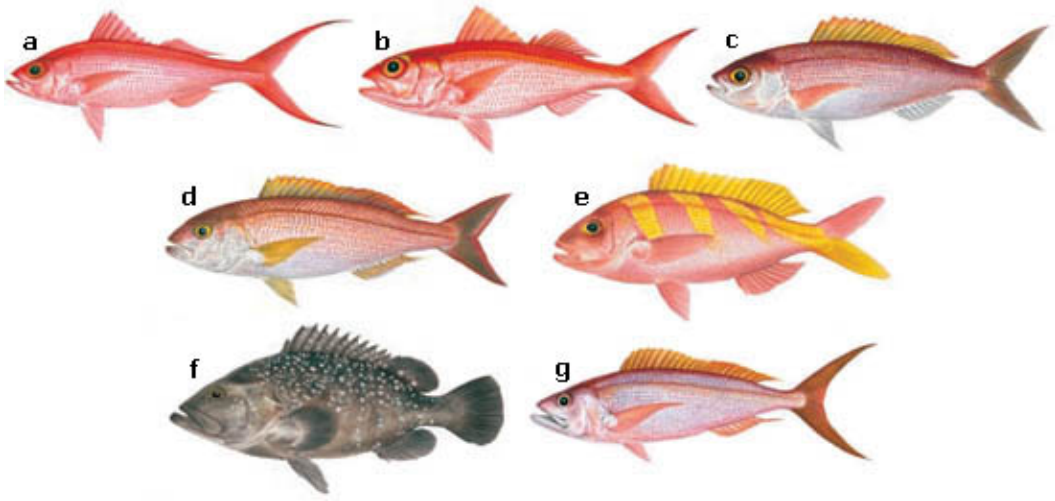


Figure 1. The main Hawaiian Islands “Deep 7” bottomfish complex: (A) Onaga (*Etelis coruscans*), (B) Ehu (*Etelis carbunculus*), (C) Kalekale (*Pristipomoides sieboldii*), (D) ‘Ōpakapaka (*Pristipomoides filamentosus*), (E) Gindai (*Pristipomoides zonatus*), (F) Hapu‘upu‘u (*Hyporthodus quernus*), and (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 are used to 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). 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 can be biased when used as an abundance index as a result of nonrandom spatiotemporal effort distribution of the fishery, imposed length and catch limits, variable gear types, 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. In 2016 PIFSC implemented a multi-gear, Bottomfish Fishery-Independent Survey in Hawai‘i (BFISH)

(Richards et al. 2016). The following are several key advantages of fishery-independent surveys: (1) they employ formal experimental designs; (2) they are less influenced by market forces; and, (3) they obtain similar stock size-structured abundance data as fishery-dependent catch sampling programs, but 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, providing an important independent estimate of stock abundance for use in assessment models.

Development and implementation of this survey has long been a priority for PIFSC (Mace et al. 2001; Ralston et al. 2004). A pilot BFISH survey was developed using a series of gear calibration studies conducted in the Maui-Nui island region from 2001 through 2015 (Richards et al. 2016). The BFISH survey became operational in 2016. Data from the initial full survey, including estimates of absolute size-structured abundance and biomass (Ault et al. 2018), were incorporated into the 2018 benchmark stock assessment for the main Hawaiian Islands Deep 7 bottomfish complex (Langseth et al. 2018). In this report, we present results from the fall 2019 BFISH survey (i.e. SE-19-06 & MP-20-08).

Methods

The BFISH survey employs a stratified-random sampling design (Richards et al. 2016) and is conducted throughout the eight main Hawaiian Islands using two gear types: (1) hook-and-line research fishing parallel to what is used in the commercial fishery; and, (2) remote drop MOUSS stereo-video cameras (Amin et al. 2017). The fall 2019 BFISH, comprising 517 primary sampling units (PSU), was conducted from September 14 through November 26, 2019 (Figure 3, Table 2, Table 3). Research fishing operations were conducted by the Pacific Islands Fisheries Group (PIFG) from September 14 to November 15, 2019, at 303 primary sampling units PSU spanning the island of Hawai‘i to the island of Ni‘ihau (Appendix A). Camera operations were conducted by PIFSC scientists aboard the NOAA Ship *Oscar Elton Sette* and associated small boats from September 12 to November 26, 2019, at 214 PSU across the same spatial domain (0).

The BFISH domain encompassed mapped bottomfish habitats from 75 to 400 m extending 600 km from the island of Hawai‘i to the island of Ni‘ihau. The survey sampling domain was divided into 25,892 500 × 500 m PSU, stratified according to: (1) three depth categories (75 to <200 m, ≥200 to <300 m, ≥300 to 400 m); and, (2) three substrate composition-complexity categories (softbottom-all slopes, hardbottom-low slope, hardbottom-high slope) (Figure 2, Table 1).

Analyses of pilot survey experiments showed that the above stratification scheme effectively spatially partitioned the variance of Deep 7 species density (Richards et al. 2016). Sampling was allocated amongst the nine survey strata following a Neyman scheme (Cochran 1977). Sample units 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* represents the number of PSU 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 2017).

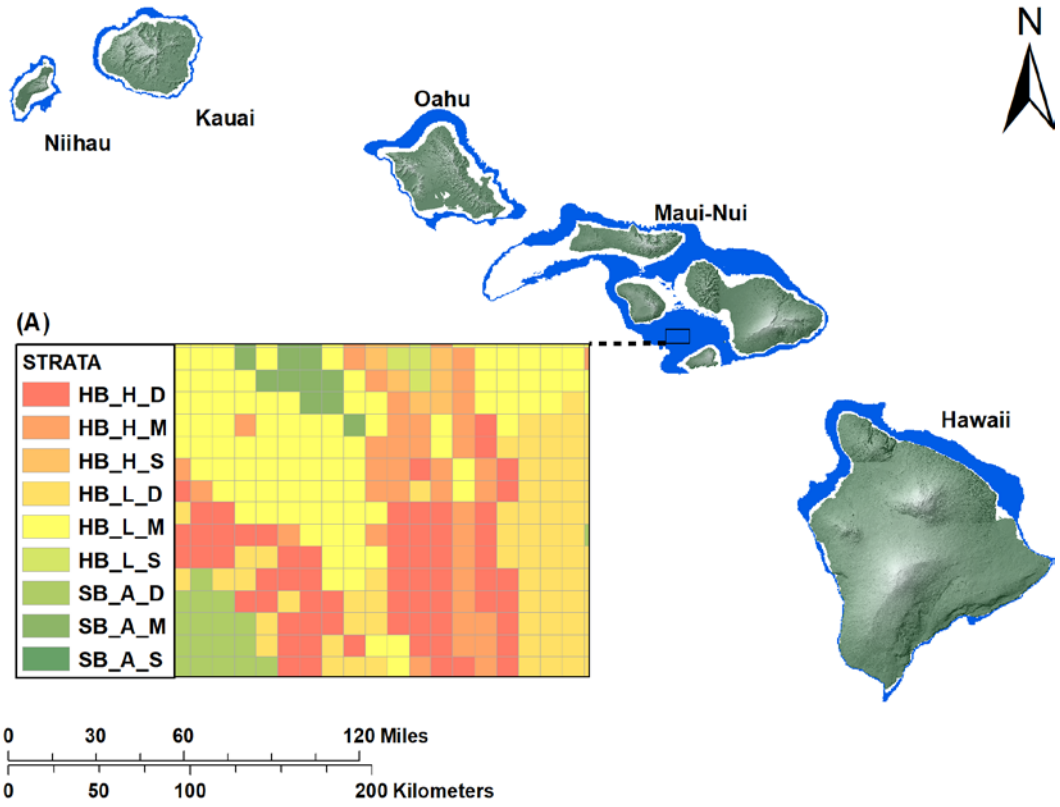


Figure 2. The spatial frame of the Deep 7 bottomfish survey domain (blue shaded region) extending from Niʻihau in the northwest to the island of Hawaiʻi in the southeast. Inset shows a section of the survey frame in the Maui-Nui region (islands of Maui, Molokaʻi, Lanaʻi, Kahoʻolawe) showing the 500 × 500 m mapped grid cells classified by habitat-depth strata. Definitions of substrate-slope-depth strata in panel (A) are given in Table 1.

Table 1. Number (n) of mapped 500 × 500 m primary sampling units (PSU) by substrate-slope-depth strata within the main Hawaiian Islands BFISH sampling domain.

Substrate	Slope	Depth	Strata Code	n
SB (Softbottom)	A (high & low)	Shallow (s, 75 to <200 m)	SB_A_S	1,863
HB (Hardbottom)	L (low slope)	Shallow	HB_L_S	4,562
HB	H (high slope)	Shallow	HB_H_S	4,777
SB	A	Medium (M, ≥200 to <300 m)	SB_A_M	1,449
HB	L	Medium	HB_L_M	2,688
HB	H	Medium	HB_H_M	2,412
SB	A	Deep (D, ≥300 to 400 m)	SB_A_D	1,591
HB	L	Deep	HB_L_D	3,801
HB	H	Deep	HB_H_D	2,749
			TOTAL PSU	**25,892**

At each selected PSU within each stratum, species-specific size-structured abundance was obtained using each of the two principal survey gears. A standard research fishing sample was 30 min of active hook-line fishing within a 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. For stationary cameras, within each PSU, two randomized replicate 15-minute deployments were conducted. In-situ footage was analyzed to generate species-level counts by the MaxN method (Cappo et al. 2006), and measured (FL) to the nearest mm. Replicate counts were averaged for a given sample unit.

Gears were allocated to each PSU based on a combination of gear-specific depth, logistical constraints as well as regulatory restrictions (e.g. camera samples were preferentially allocated to areas where fishing is usually restricted). The MOUSS camera system has a depth limit of 250 m (Amin et al. 2017). A two-stage generalized linear model regression was used to calibrate the relative fishing power of hook-line to camera gears based on comparative gear experiments (Robson 1961; Richards et al. 2016).

Estimation of Deep 7 population metrics followed standard procedures for stratified random sampling (Cochran 1977; Ault et al. 1999; Lohr 2010; Smith et al. 2011; Ault et al. 2018). The number of fish caught/seen per unit sample area (i.e., density) was the principal design metric used to develop the statistical sampling design. Estimation of total population biomass *B* entailed expanding the mean biomass per unit $\bar{U}_B$ to the full survey frame following (Ault et al. 2018),

$$B = \bar{U}_B \frac{A_i}{a_i} G$$

where, A_i is the area of a grid cell sample unit, a_i is the effective sampling area of the camera gear, and G is the number of grid cells in the survey domain. Mean biomass per sample unit was obtained by converting length to weight of each individual fish via an allometric weight-length function, and then summing species the weights for all observed fish by species. Allometric functions were developed for each Deep 7 species using paired weight-length observations collected in the Hawaiian Islands by scientists at PIFSC. All computations were carried out using the R software package (R Development Core Team 2017).

Table 2. Number of sampled primary sampling units (PSUs) by gear type.

Gear	No. of PSUs
Camera	214
Fishing	303
TOTAL	**517**

Table 3. Number of sampled primary sampling units (PSUs) by strata.

Strata Description	Strata Code	No. of PSU	% of Total
Hardbottom, High Slope, Deep	HB_H_D	37	7%
Hardbottom, High Slope, Medium	HB_H_M	117	23%
Hardbottom, High Slope, Shallow	HB_H_S	166	32%
Hardbottom, Low Slope, Deep	HB_L_D	42	8%
Hardbottom, Low Slope, Medium	HB_L_M	63	12%
Hardbottom, Low Slope, Shallow	HB_L_S	30	32%
Softbottom, All Slopes, Deep	SB_A_D	20	4%
Softbottom, All Slopes, Medium	SB_A_M	19	4%
Softbottom, All Slopes, Shallow	SB_A_S	23	4%
	TOTAL	**517**	

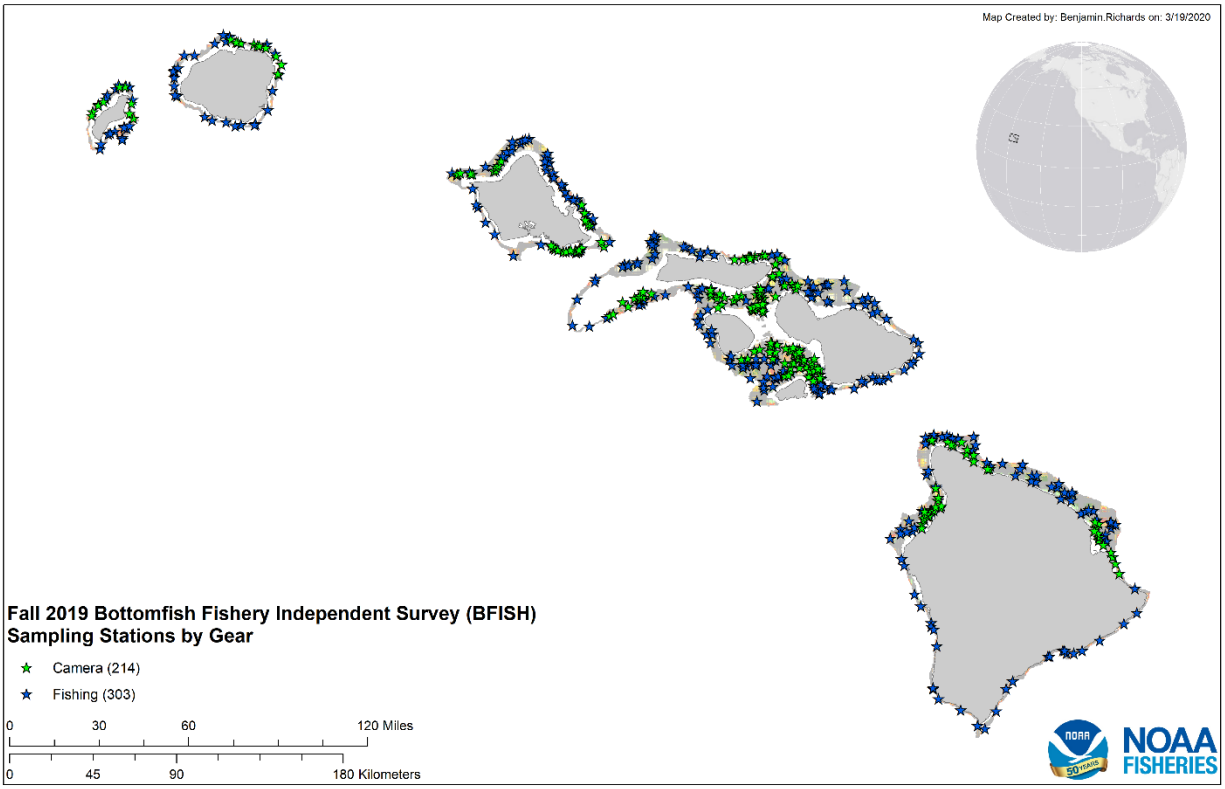


Figure 3. Map showing BFISH sampling locations by gear type. Research fishing operations (blue stars) that extended from the big island of Hawai‘i in the southeast to Ni‘ihau in the northwest. Camera operations (green stars) extended from the northern half of the big island of Hawai‘i to Ni‘ihau.

Results

A total of 589 fishes were caught during research fishing operations (Pacific Islands Fisheries Science Center 2020a), including 330 Deep 7 individuals (Table 4), of which 325 were measured (Table 5). Ehu made up the majority of the Deep 7 catch (n = 214), followed by ʻōpakapaka (39), and gindai (31).

All Deep 7 individuals were retained for subsequent study of age, growth, and sexual maturity by the Life History Program (LHP) of PIFSC Fisheries Research and Monitoring Division (FRMD). PIFSC LHP scientists also collected 42 ʻōpakapaka and 82 non-Deep 7 individuals for age and growth studies, in addition to those captured during research fishing operations.

A total of 469 Deep 7 individuals were observed by the MOUSS camera system (Table 5) (Pacific Islands Fisheries Science Center 2020b). ʻŌpakapaka was the most abundant (n = 331), followed by kalekale (n = 91) and ehu (n = 35). Accurate length measurements were obtainable for 370 of the 469 fishes captured (79%).

Table 4. Number (n) of individual fish (Deep 7 and other species) caught during BFISH_2019_F research fishing operations. List represents all species caught over all survey years.

	Species Code	*Common Name*	*Scientific Name*	**n**	**Total**
Deep 7	ETCA	**Ehu**	*Etelis carbunculus*	214	330
	PRFI	**Opakapaka**	*Pristipomoides filamentosus*	39	
	PRZO	**Gindai**	*Pristipomoides zonatus*	31	
	PRSI	**Kalekale**	*Pristipomoides sieboldii*	30	
	ETCO	**Onaga**	*Etelis coruscans*	13	
	HYQU	**Hapuʻupuʻu**	*Hyporthodus quernus*	3	
	APRU	**Lehi**	*Aphareus rutilans*	0	
non-Deep 7	SQSP	Green Eye Shark	*Squalus* sp.	151	259
	SEDU	Kahala	*Seriola dumerili*	42	
	LUKA	Taʻape	*Lutjanus kasmira*	13	
	POMA	Hogo	*Pontinus macrocephalus*	8	
	POBE	Deep Sea Moi	*Polymixia berndti*	7	
	APVI	Uku	*Aprion virescens*	6	
	PSAU	Yellowtail Kale	*Pristipomoides auricilla*	5	
	CAAM	Grey Reef Shark	*Carcharhinus amblyrhynchos*	4	
	BEDA	Alfonsin	*Beryx decadactylus*	3	
	BOAL	Table Boss	*Bodianus albotaeniatus*	2	
	CAOR	Yellowspot Papio	*Carangoides orthogrammus*	2	
	EUAF	Kawakawa	*Euthynnus affinis*	2	
	PORC	Balloonfish	*Tetraodontinae* sp.	2	
	PUFF	Pufferfish	*Tetraodontid* sp.	2	

	Species Code	*Common Name*	*Scientific Name*	**n**	**Total**
	SARD	Kitsune	*Sarda* sp.	2	
	ANSP	Antigonia	*Antigonia* sp.	1	
	CALU	Gunkan Ulua	*Caranx lugubris*	1	
	EESP	Puhi	*Anguilliformes sp.*	1	
	ERSC	Golden kale	*Erythrocles scintillans*	1	
	ERSC	Golden Rover	*Erythrocles scintillans*	1	
	OCSP	Tako	*Octopus* sp.	1	
	PSDE	Butaguchi	*Pseudocaranx cheilio*	1	
	TRIG	Triggerfish	*Balistidae*	1	
	AKUU	Aku	*Katsuwonus pelamis*	0	
	ALSP	Thresher Shark	*Alopias sp.*	0	
	APFU	Wahanui	*Aphareus furca*	0	
	ARBR	Shortfin Ariomma	*Ariomma brevimanus*	0	
	CAEQ	Whitefin trevally	*Carangoides equula*	0	
	CAME	Omilu	*Caranx melampygus*	0	
	COJA	Deep Sea Aweoweo	*Cookeolus japonicus*	0	
	EUIL	Monchong	*Eumegistus illustris*	0	
	FISH	Unknown	*Teleost sp.*	0	
	INPA	Nabeta	*Iniistius pavo*	0	
	MUPF	Weke ula	*Mulloidichthys pfluegeri*	0	
	MYSP	Soldierfish	*Myripristis sp.*	0	
	NAHE	Opelu Kala	*Naso hexacanthus*	0	
	SEDU	Amberjack	*Seriola dumerili*	0	
	SERI	Almaco Jack	*Seriola rivoliana*	0	
	SPHE	Kawelea	*Sphyraena helleri*	0	
	THAL	Yellowfin Tuna	*Thunnus albacares*	0	
	TRMY	Lizardfish	*Trachinocephalus myhops*	0	
	XACA	Bluelined triggerfish	*Xanthichthys caeruleolineatus*	0	

Table 5. Number (n) and size (cm FL) of Deep 7 species caught during research fishing operations or observed (MaxN) by MOUSS camera during BFISH_2019_F.

	RESEARCH FISHING					MOUSS CAMERA					
		Fork Length (cm)						Fork Length (cm)			
Species	**n**	**Min**	**Mean**	**Max**	**SD**	**MaxN**	**measured**	**Min**	**Mean**	**Max**	**SD**
Ehu	205	18.0	34.8	60.0	7.4	35	14	29.5	39.5	53.3	6.2
Gindai	29	23.0	31.7	47.0	6.8	3	3	23.7	34.6	43.8	10.2
Hapu'upu'u	3	48.0	55.3	59.0	6.4	2	2	55.3	76.7	98.0	30.3
Kalekale	35	22.0	32.9	41.0	5.2	91	82	15.6	31.0	111.6	11.1
Lehi	0	-	-	-	-	6	6	35.8	64.7	76.0	15.1
Onaga	13	30.0	54.3	91.0	18.8	1	1	57.2	57.2	57.2	-
Opakapaka	40	22.0	41.5	64.0	11.7	331	262	5.4	37.4	79.4	19.7
TOTAL Deep 7	**325**					**469**	**370**				

Ehu had the largest absolute abundance estimate, followed by ‘ōpakapaka and kalekale (Table 6). ‘Ōpakapaka had the greatest exploited stock biomass, followed by ehu and kalekale. The estimated population biomass of ‘ōpakapaka and onaga was approximately 1.563 and 0.5372 million kg, respectively. Ehu stock biomass was about 1.067 million kg. Coefficients of variation (CV%) for exploited stock biomass were 17.5 and 23.0 for ehu and ‘ōpakapaka, the two main design species.

Trends in exploited stock biomass varied among the species, but generally, there were few significant differences among years (Figure 6). Survey precision has ranged from 15 to 30 % CV for ‘ōpakapaka and ehu (Figure 7). The effective survey sample size by year by species has remained similar over the years.

Patterns in abundance-at-size remain stable across years (Figure 4), with slightly more spread in 2019 onaga size range. Hardbottom, High Slope, Medium and Shallow strata (HB_H_M, HB_H_S) show the highest diversity and relative biomass of Deep 7 species, with the notable exception of 2016, when ‘ōpakapaka were encountered in soft bottom shallow areas (SB_A_S).

Table 6. BFISH_2019_F descriptive statistics , catch per unit effort (CPUE), and estimated exploited stock abundance and biomass by species (fishing and camera gears combined).

Species	CPUE	SE	Abundance	SE	Biomass (kg)	SE	CV (%)
Ehu	0.3572	0.0627	966,135	169,479.0	1,066,592.4	198,989.3	17.5
Gindai	0.0196	0.0058	53,042	15,689.2	68,132.5	22,198.0	29.6
Hapu'upu'u	0.0043	0.0024	11,677	6,496.0	55,931.5	29,401.4	55.6
Kalekale	0.2124	0.0761	574,529	205,721.3	571,324.7	188,082.0	35.8
Lehi	0.0030	0.0019	8,224	5,007.9	32,466.4	20,927.3	60.9
Onaga	0.0467	0.0211	126,227	57,024.2	537,376.6	261,432.9	45.2
Opakapaka	0.2557	0.0589	691,620	159,332.6	1,563,363.1	369,850.7	23.0
TOTAL					**3,895,187.3**	**530,946**	

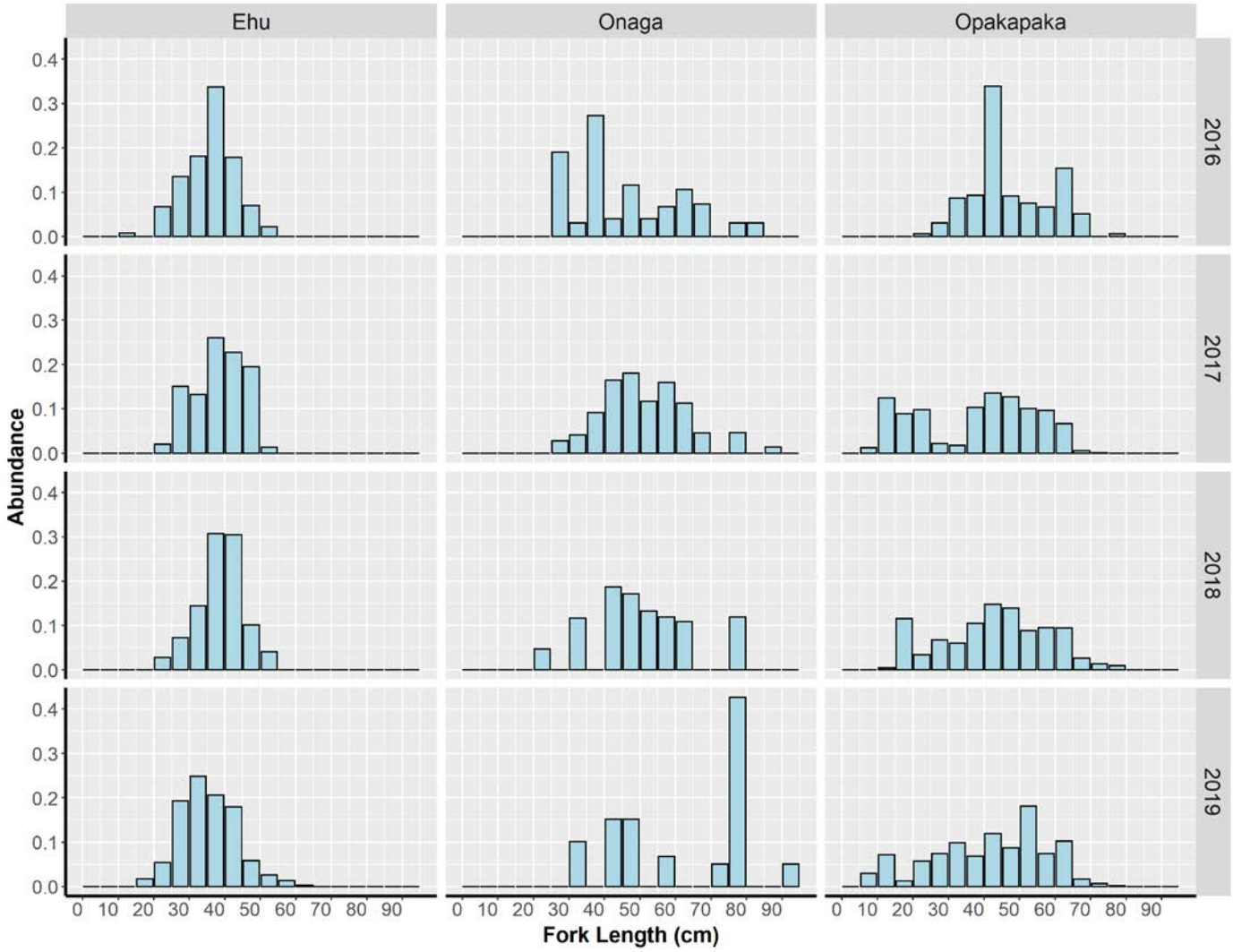
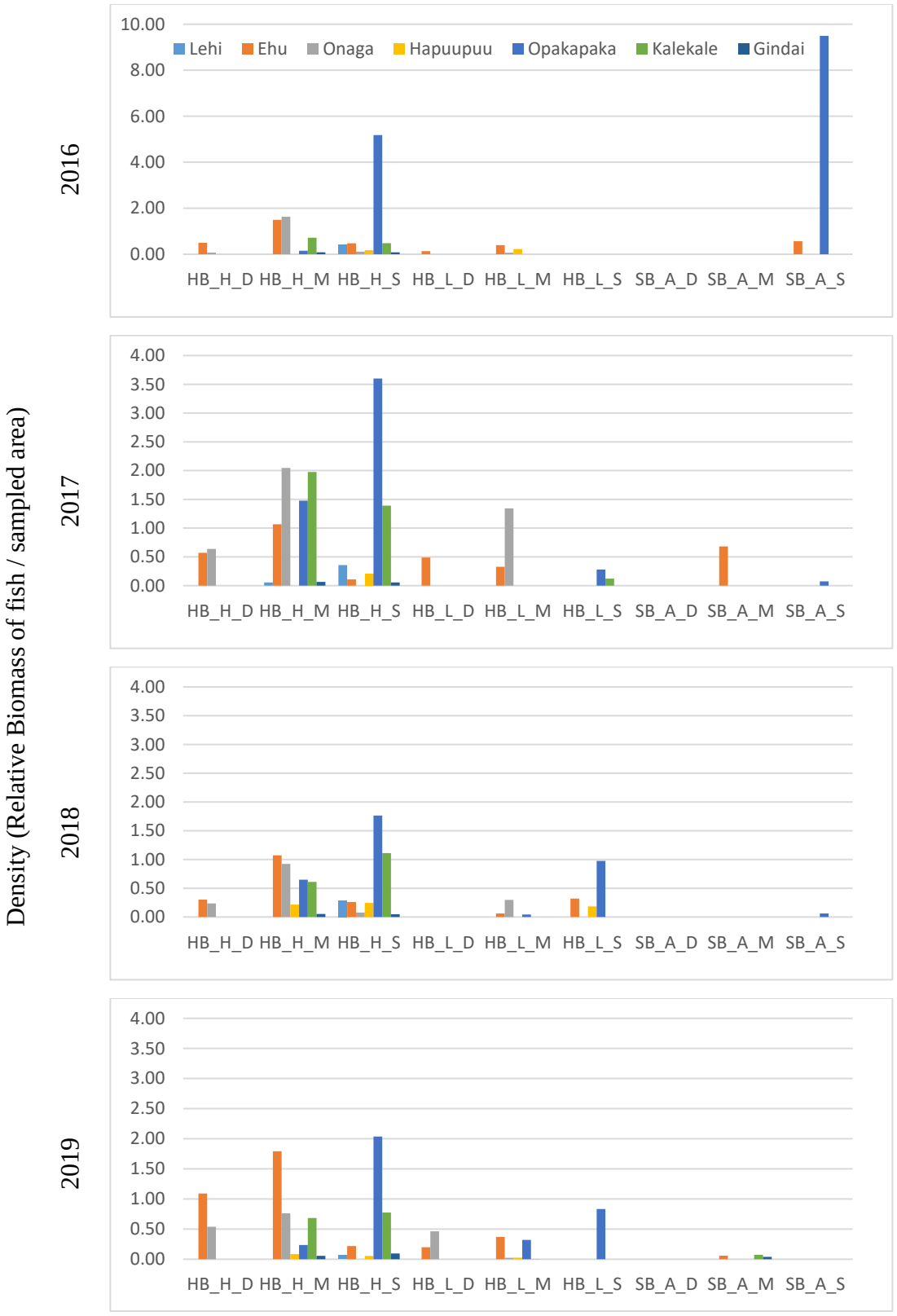
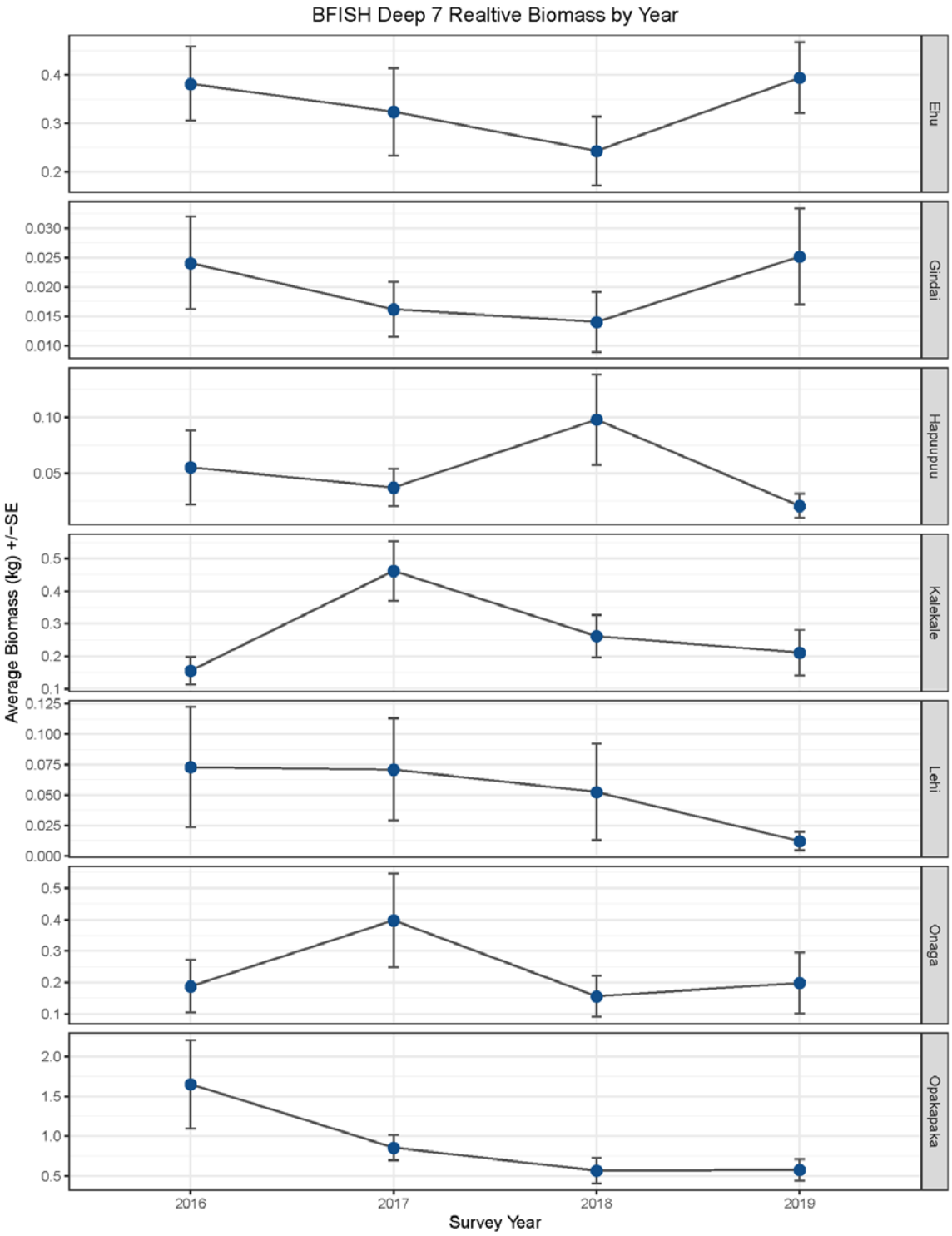


Figure 4. Length frequencies for ʻōpakapaka, onaga, and ehu during fall 2016–2019 BFISH surveys.



151 **Figure 5. Density of Deep 7 species by habitat strata by year. (Note different *y*-axis scale**
152 **for 2016).**



153

154 **Figure 6. Deep 7 relative biomass (kg) by species. Data from fall Bottomfish Fishery-**
155 **Independent Surveys in Hawai‘i. Year-to-year differences are of low magnitude and**
156 **marginal, if any, significance. High 2016 ‘ōpakapaka biomass is a result of two instances**
157 **where the species was captured in low slope, soft bottom habitats. An unusual**
158 **occurrence, which is magnified by the domain-wide expansion.**

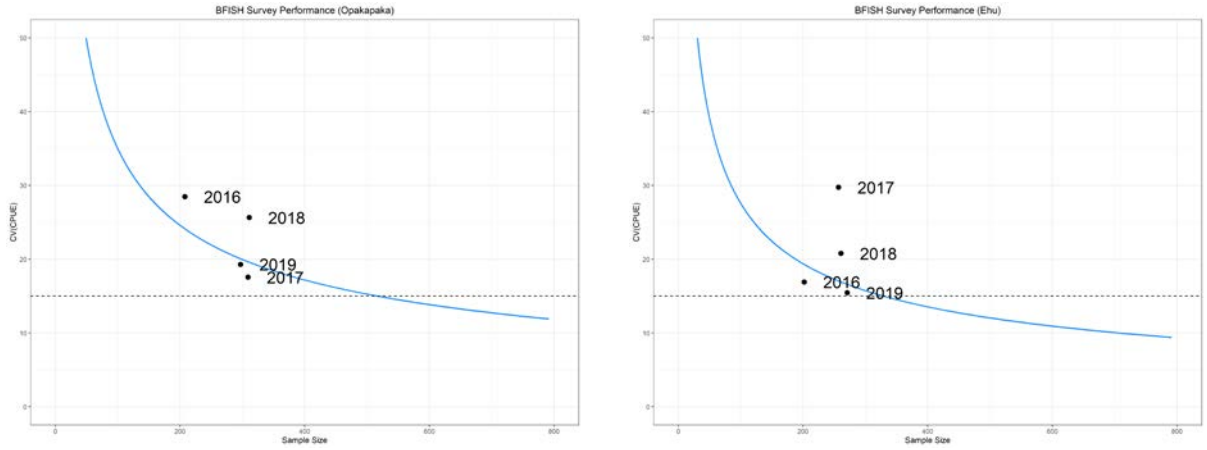


Figure 7. Survey performance (CV of population biomass) dependent on effective sample size by survey year as compared to Neyman (optimal) allocation (blue line): ʻōpakapaka (left panel) and ehu (right panel).

Discussion

The Pacific Islands Fisheries Science Center began development of the collaborative multi-gear Bottomfish Fishery-Independent Survey in Hawaiʻi (BFISH) in 2011 involving PIFSC scientists and commercial cooperative research fishers (Richards et al. 2016). BFISH became operational in 2016 with the goal of providing reliable fishery-independent estimates of size-structured abundance and biomass for use in Deep 7 bottomfish stock assessments (Langseth et al., 2018; Ault et al., 2018).

The results of the fall 2019 BFISH indicated an exploited Deep 7 complex biomass of 3,895,187 kg (8.59 million lb). This suggests that the 2019 annual catch limit of 492,000 lb represented approximately 6% of the exploited stock biomass. While there have been some fluctuations in Deep 7 complex biomass over the 2016–2019 survey years, differences in estimated biomass of the principal fishery species (ʻōpakapaka and onaga) have been relatively low and insignificant (Figure 6). The markedly higher ʻōpakapaka biomass in 2016 was inflated by two instances in which ʻōpakapaka were caught by research fishers in softbottom low relief habitats (Figure 5). Because of the prevalence of this habitat type within the survey domain, these few instances had a substantial effect on our domain-level estimates.

The BFISH survey sampling design is focused on ʻōpakapaka and ehu with a goal of achieving a 15% CV. Since 2016, survey performance has ranged from 16% to 30% CV for both species (Figure 7).

CVs above the Neyman curve generally indicate suboptimal sample allocations. The large and variable CVs seen in 2016–2018 BFISH likely arise from uncertainty in benthic habitat maps that define domain structure and that guide survey stratification and allocation. The 2019 BFISH achieved much improved CVs, likely due to our increased understanding of species' depth-habitat relationships, primarily as it relates to distribution of these within a given strata.

To improve overall precision of BFISH surveys, future research will focus on (1) refining PSU metrics of habitat complexity (e.g., bottom hardness, rugosity, etc.); (2) target sample allocations to better reflect species' depth preferences; and (3) investments in technological innovations that better define the unit area sampled. Our recent research findings suggest that the arc-chord ratio metric (Du Preez 2015) may be a significantly more informative proxy for habitat complexity than those employed to date, and will be the basis of improved future survey designs.

Acknowledgements

This work greatly benefited from the support and strategic insights of Michael Seki, Sam Pooley, Gerard Dinardo, Annie Yau, Felipe Carvalho, and T. Todd Jones of PIFSC, Clay Tam of the Pacific Island Fisheries Group, and Forest O'Neil and Elizabeth Tarquin from Lynker Technologies, Inc. Others contributing to these efforts include Ruhul Amin, James Barlow, Christopher Demarke, Rory Driskell, Alexa Gonzalez, Louise Guiseffi, Hoku Johnson, Kyle Koyanagi, Dianna Miller, William Misa, Justin Ossolinski, Russell Reardon, Audrey Rollo, Jessica Schem, Noriko Shoji, Jeremy Taylor, and Chad Yoshinaga of the PIFSC Science Operations Division; Kelli-Ann Bliss, David McVay, Kristin Raja, and Laura Rock from the NOAA Office of Marine and Aviation Operations; Jacob Asher from the PIFSC Ecosystem Sciences Division; Emily Contreras, Ryan Nichols, and Joseph O'Malley from PIFSC Fisheries Research and Monitoring Division; John Bravender, Leigh Anne Eaton, and Genki Kino from the National Weather Service; and Catherine Geweke and Alton Smith of the Division of Aquatic Resources at the Hawai‘i Department of Land and Natural Resources. The authors also wish to thank the officers and crew of the NOAA Ship *Oscar Elton Sette* and the PIFG Cooperative Research captains Mike Abe, Nathan Abe, Kevin Awa, Kevin DeSilva, Eddie Ebisui, Jon Moribe, Roy Morioka, Layne Nakagawa, and Miles Togioka and observers Nathan Abe, Dennis Colon, Eddie Ebisui, Robert Moffitt, Kent Onaka, Brealand Tam, Bryce Whittaker, and Reno Young for their assistance with field survey efforts.

The use of trade, firm, or corporation names in this publication is for the convenience of the reader and does not constitute an official endorsement or approval of any product or service to the exclusion of others that may be suitable.

Literature Cited

Amin R, Richards BL, Misa WFXE, Taylor JC, Miller DR, Rollo A, Demarke C, Singh H, Young GC, Childress J, et al. 2017. The Modular Optical Underwater Survey System. Sensors. 17:1–14. doi:10.3390/s17102309.

Ault JS, Diaz GA, Smith SG, Luo J, Serafy JE. 1999. An efficient sampling survey design to estimate pink shrimp population abundance in Biscayne Bay, Florida. North American Journal of Fisheries Management. 19:696–712. doi:https://doi.org/10.1577/1548-8675(1999)019<0696:AESSDT>2.0.CO;2.

Ault JS, Smith SG, Browder JA, Nuttle W, Franklin EC, Luo J, DiNardo GT, Bohnsack JA. 2014. Indicators for assessing the ecological dynamics and sustainability of southern Florida's coral reef and coastal fisheries. Ecological Indicators. 44:164–172.

Ault JS, Smith SG, Richards BL, Yau AJ, Langseth BJ, O'Malley JM, Boggs CH, Seki MP, DiNardo GT. 2018. Towards fishery-independent biomass estimation for Hawaiian Islands deepwater snappers. Fisheries Research. 208:321–328. doi:10.1016/j.fishres.2018.08.012.

Brodziak J, Yau A, O'Malley J, Andrews A, Humphreys R, DeMartini E, Pan M, Parke M, Fletcher E. 2014. Stock assessment update for the main Hawaiian Islands Deep7 bottomfish complex through 2013 with projected annual catch limits through 2016. PIFSC Administrative Report. NMFS-PIFSC-42. doi:http://dx.doi.org/10.7289/V5T151M8.

Cappo M, Harvey ES, Shortis MR. 2006. Counting and measuring fish with baited video techniques -- an overview. In: Cutting-Edge Technologies in Fish and Fisheries Science. (Australian Society for Fish Biology). p. 101–114.

Cochran WG. 1977. Sampling Techniques. NY, NY: John Wiley and Sons.

Du Preez C. 2015. A new arc–chord ratio (ACR) rugosity index for quantifying three-dimensional landscape structural complexity. Landscape Ecol. 30(1):181–192. doi:10.1007/s10980-014-0118-8.

ESRI Inc. 2017. ArcGIS Desktop. ESRI Inc. http://www.esri.com.

Haight WR, Kobayashi DR, Kawamoto KE. 1993. Biology and management of deepwater snappers of the Hawaiian Archipelago. Marine Fisheries Review. 55:20–27.

Hilborn R, Walters CJ. 1992. Quantitative fisheries stock assessment: choice, dynamics and uncertainty. Boston/Dordrecht/London: Kluwer Academic Publishers (books.google.com).

Langseth B, Syslo J, Yau A, Kapur M, Brodziak, Jon K. T. (Jon Kenton Tarsus). 2018. Stock assessment for the main Hawaiian Islands deep 7 bottomfish complex in 2018, with catch projections through 2022. Honolulu, HI Report No.: NMFS-PIFSC-69. [accessed 2019

Mar 8]. ftp://ftp.library.noaa.gov/noaa_documents.lib/NMFS/PIFSC/TM_NMFS_PIFSC/NOAA_Tech_Memo_PIFSC_69.pdf.

Law AM, Kelton WD. 2000. Building valid, credible, and appropriately detailed simulation models. Simulation Modeling and Analysis 3rd ed Singapore: McGraw-Hill.:264–291.

Lohr SL. 2010. Sampling: design and analysis. Boston: Brooks/Cole.

Mace PM, Bartoo NW, Hollowed AB, Kleiber P, Methot RD, Murawski SA, Powers JE, Scott GP. 2001. Marine fisheries stock assessment improvement plan. Report of the National Marine Fisheries Service National Task Force for Improving Fish Stock Assessments.

Maunder MN, Punt AE. 2004. Standardizing catch and effort data: a review of recent approaches. Fisheries Research. 70:141–159.

Pacific Islands Fisheries Science Center. 2020a. Bottomfish fishery-independent survey in Hawaii (BFISH) - cooperative research fishing surveys. https://inport.nmfs.noaa.gov/inport/item/20969.

Pacific Islands Fisheries Science Center. 2020b. Bottomfish fishery-independent survey in Hawaii (BFISH) - camera surveys. https://inport.nmfs.noaa.gov/inport/item/20970.

Quinn TJ, Deriso RB. 1999. Quantitative fish dynamics. New York: Oxford University Press. [accessed 2018 Sep 28]. http://public.eblib.com/choice/publicfullrecord.aspx?p=430433.

R Development Core Team. 2017. R: a language and environment for statistical computing. https://cran.r-project.org.

Ralston S, Cox S, Labelle M, Mees C. 2004. Bottomfish stock assessment workshop - Final Report.

Richards BL, Smith, Steven G., Ault JS, DiNardo GT, Kobayashi DR, Domokos R, Anderson J, Taylor JC, Misa W, Giuseffi L, et al. 2016. Design and implementation of a bottomfish fishery-independent survey in the main Hawaiian Islands. Honolulu, HI NMFS-PIFSC Report No.: 53. https://doi.org/10.7289/V5/TM-PIFSC-67.

Robson D. 1961. Estimation of the relative fishing power of individual ships.

Smith SG, Ault JS, Bohnsack JA, Harper DE, Luo J, McClellan DB. 2011. Multispecies survey design for assessing reef-fish stocks, spatially explicit management performance, and ecosystem condition. Fisheries Research. 109:25–41. doi:10.1016/j.fishres.2011.01.012.

Western Pacific Regional Fishery Management Council. 2010. Bottomfish fisheries in the Hawaii Archipelago.

Appendix A: Primary sampling units (PSU) sampled by hook-and-line fishing gear during BFISH_2019_F with location, stratum, and vessel.

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
09/14/19	Oahu	36252	21.3984312	-157.6368882	HB_H_D	Amy C	Fishing
09/14/19	Oahu	36364	21.4167678	-157.6704828	HB_H_M	Amy C	Fishing
09/14/19	Oahu	34796	21.2847983	-157.5511942	HB_H_M	Amy C	Fishing
09/14/19	Oahu	35987	21.366856	-157.6420026	HB_L_M	Amy C	Fishing
09/14/19	Oahu	36708	21.4621592	-157.6990218	HB_H_S	Amy C	Fishing
09/14/19	Oahu	36707	21.4621966	-157.7038466	HB_H_S	Amy C	Fishing
09/15/19	Oahu	39340	21.6996499	-158.093222	HB_H_S	Ebisui III	Fishing
09/15/19	Oahu	39680	21.7266979	-158.0833838	HB_L_M	Ebisui III	Fishing
09/15/19	Oahu	39745	21.7310792	-158.0591837	HB_H_S	Ebisui III	Fishing
09/15/19	Oahu	40072	21.7536357	-158.0542017	HB_L_M	Ebisui III	Fishing
09/15/19	Oahu	40262	21.7669315	-158.010594	HB_L_M	Ebisui III	Fishing
09/15/19	Oahu	40367	21.7762197	-158.0540536	HB_L_D	Ebisui III	Fishing
09/15/19	Oahu	40436	21.7804235	-158.0008294	HB_L_D	Ebisui III	Fishing
09/15/19	Oahu	39185	21.6862296	-158.1174709	HB_L_M	Ebisui III	Fishing
09/15/19	Oahu	39390	21.7042455	-158.1076939	HB_L_M	Ebisui III	Fishing
09/15/19	Oahu	40549	21.7892488	-157.966914	SB_A_D	Ebisui III	Fishing
09/15/19	Oahu	40493	21.7848519	-157.9862902	HB_L_D	Ebisui III	Fishing
09/16/19	Oahu	37325	21.5469069	-158.2631692	HB_H_M	Ebisui III	Fishing
09/16/19	Oahu	36603	21.4564334	-158.2346718	HB_H_M	Ebisui III	Fishing
09/16/19	Oahu	36714	21.4700288	-158.2442527	HB_H_D	Ebisui III	Fishing
09/16/19	Oahu	38326	21.6241355	-158.3690627	HB_L_D	Ebisui III	Fishing
09/16/19	Oahu	38426	21.628279	-158.277251	HB_L_D	Ebisui III	Fishing
09/16/19	Oahu	38830	21.6550038	-158.1949729	HB_L_D	Ebisui III	Fishing
09/21/19	Maui Nui	23157	20.9777517	-156.4146825	HB_L_S	Naomi K	Fishing
09/21/19	Maui Nui	23412	20.9824106	-156.4242159	HB_H_S	Naomi K	Fishing
09/21/19	Maui Nui	24754	21.0061241	-156.5007313	HB_H_S	Naomi K	Fishing
09/21/19	Maui Nui	24470	21.0016811	-156.5056129	HB_L_S	Naomi K	Fishing
09/21/19	Maui Nui	25922	21.0237515	-156.4715877	HB_L_M	Naomi K	Fishing
09/22/19	Big Island	2008	19.5492098	-156.0001396	HB_H_M	Ride On	Fishing
09/22/19	Big Island	2502	19.6899608	-156.0499463	HB_H_M	Ride On	Fishing
09/22/19	Big Island	2581	19.7217831	-156.0636623	HB_H_S	Ride On	Fishing
09/22/19	Maui Nui	12296	20.6070079	-156.6943224	HB_H_D	Naomi K	Fishing
09/22/19	Maui Nui	12532	20.6161644	-156.7037763	HB_H_M	Naomi K	Fishing
09/22/19	Maui Nui	12649	20.6211845	-156.7420699	HB_H_D	Naomi K	Fishing
09/22/19	Maui Nui	10392	20.4999693	-156.7965682	HB_L_M	Naomi K	Fishing
09/22/19	Maui Nui	11933	20.5943468	-156.7616469	HB_H_D	Naomi K	Fishing
09/22/19	Maui Nui	11083	20.5536536	-156.7574462	HB_H_M	Naomi K	Fishing
09/22/19	Maui Nui	11335	20.5672594	-156.762042	HB_H_M	Naomi K	Fishing
09/22/19	Maui Nui	11441	20.5711474	-156.7140395	HB_H_S	Naomi K	Fishing
09/22/19	Maui Nui	12537	20.615844	-156.6798018	HB_L_D	Naomi K	Fishing
09/22/19	Maui Nui	12661	20.6204227	-156.6845284	HB_L_D	Naomi K	Fishing
09/22/19	Maui Nui	13067	20.6335772	-156.6555511	HB_L_M	Naomi K	Fishing
09/22/19	Maui Nui	13457	20.6471199	-156.6553435	HB_L_M	Naomi K	Fishing
09/22/19	Maui Nui	32040	21.2014614	-157.3304655	HB_L_M	Amy C	Fishing
09/22/19	Maui Nui	32811	21.2238967	-157.3157632	SB_A_M	Amy C	Fishing
09/22/19	Maui Nui	34804	21.2828405	-157.3391859	HB_L_D	Amy C	Fishing
09/22/19	Maui Nui	34941	21.2871168	-157.3150441	HB_L_M	Amy C	Fishing
09/22/19	Maui Nui	35358	21.3051313	-157.3100194	HB_L_D	Amy C	Fishing
09/22/19	Maui Nui	35512	21.3142593	-157.3195542	HB_L_D	Amy C	Fishing
09/22/19	Maui Nui	34026	21.2600706	-157.3201699	HB_L_M	Amy C	Fishing
09/22/19	Maui Nui	34346	21.2691979	-157.3297026	HB_L_D	Amy C	Fishing
09/24/19	Maui Nui	12388	20.6132619	-156.8285151	HB_H_D	Naomi K	Fishing
09/24/19	Maui Nui	14022	20.6721944	-156.84687	HB_L_D	Naomi K	Fishing
09/24/19	Maui Nui	14640	20.694888	-156.8561473	HB_L_M	Naomi K	Fishing
09/24/19	Maui Nui	14126	20.6776511	-156.9235656	HB_L_D	Naomi K	Fishing
09/24/19	Maui Nui	13780	20.6634033	-156.8661851	SB_A_D	Naomi K	Fishing

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
09/24/19	Maui Nui	14138	20.6769479	-156.8659958	HB_L_D	Naomi K	Fishing
09/24/19	Maui Nui	14884	20.7049142	-156.9375922	HB_L_M	Naomi K	Fishing
09/24/19	Maui Nui	15407	20.7229167	-156.9325486	SB_A_S	Naomi K	Fishing
09/24/19	Maui Nui	15408	20.722859	-156.9277496	HB_H_S	Naomi K	Fishing
09/25/19	Maui Nui	23613	20.992799	-156.8471136	HB_H_M	Naomi K	Fishing
09/25/19	Maui Nui	24620	21.0162173	-157.3229166	HB_H_M	Renee Nv	Fishing
09/25/19	Maui Nui	25197	21.02467	-157.2650998	HB_H_M	Renee Nv	Fishing
09/25/19	Maui Nui	23799	21.0032742	-157.3855861	HB_H_M	Renee Nv	Fishing
09/25/19	Maui Nui	22529	20.9806941	-157.3858289	HB_H_M	Renee Nv	Fishing
09/25/19	Maui Nui	29279	21.0805385	-156.6534201	HB_H_M	Naomi K	Fishing
09/25/19	Maui Nui	30044	21.0986609	-156.6579465	HB_L_M	Naomi K	Fishing
09/25/19	Maui Nui	22275	20.9763141	-157.4003023	HB_L_M	Renee Nv	Fishing
09/25/19	Maui Nui	23536	20.9988491	-157.3952528	HB_L_M	Renee Nv	Fishing
09/25/19	Maui Nui	23540	20.9986667	-157.3760167	HB_L_M	Renee Nv	Fishing
09/25/19	Maui Nui	27087	21.0455359	-156.7357313	HB_L_M	Naomi K	Fishing
09/25/19	Maui Nui	27391	21.0499217	-156.7260454	HB_L_M	Naomi K	Fishing
09/25/19	Maui Nui	29899	21.093813	-156.6339677	HB_L_D	Naomi K	Fishing
09/26/19	Maui Nui	32758	21.2122366	-156.7091226	HB_H_D	Naomi K	Fishing
09/26/19	Maui Nui	31308	21.175731	-157.4752121	HB_H_M	Renee Nv	Fishing
09/26/19	Maui Nui	31063	21.1622691	-157.48498	HB_L_S	Renee Nv	Fishing
09/26/19	Maui Nui	31222	21.1709961	-157.4511846	SB_A_M	Renee Nv	Fishing
09/26/19	Maui Nui	31526	21.1841415	-157.4077076	HB_L_D	Renee Nv	Fishing
09/26/19	Maui Nui	31145	21.166524	-157.4560462	SB_A_M	Renee Nv	Fishing
09/26/19	Maui Nui	31322	21.1751096	-157.4078043	SB_A_D	Renee Nv	Fishing
09/26/19	Maui Nui	31881	21.1842251	-156.642159	HB_L_M	Naomi K	Fishing
09/26/19	Maui Nui	32922	21.2163561	-156.6801686	SB_A_D	Naomi K	Fishing
09/29/19	Big Island	4004	19.8662611	-156.0657807	HB_H_M	Ride On	Fishing
09/29/19	Big Island	3878	19.8562041	-156.003948	HB_L_S	Ride On	Fishing
09/29/19	Big Island	3357	19.8219912	-156.1190621	HB_L_D	Ride On	Fishing
09/29/19	Big Island	3671	19.8436987	-156.0661958	HB_L_S	Ride On	Fishing
09/29/19	Big Island	3805	19.8521708	-156.0326463	HB_H_S	Ride On	Fishing
09/29/19	Big Island	4156	19.8740921	-155.9940697	HB_L_S	Ride On	Fishing
09/29/19	Big Island	4639	19.9061589	-156.0220961	HB_L_D	Ride On	Fishing
09/29/19	Big Island	5438	19.9546591	-155.9543587	HB_H_D	Ride On	Fishing
10/01/19	Maui Nui	14168	20.6751058	-156.722082	HB_H_M	Naomi K	Fishing
10/01/19	Maui Nui	14272	20.6807401	-156.8083636	HB_H_M	Naomi K	Fishing
10/01/19	Maui Nui	14274	20.6806178	-156.7987689	HB_L_D	Naomi K	Fishing
10/01/19	Maui Nui	14399	20.6850711	-156.7939064	HB_H_M	Naomi K	Fishing
10/01/19	Maui Nui	14152	20.6761032	-156.7988341	HB_L_D	Naomi K	Fishing
10/01/19	Maui Nui	15052	20.7071478	-156.7551954	HB_H_M	Naomi K	Fishing
10/01/19	Maui Nui	14804	20.6973587	-156.6977573	HB_L_M	Naomi K	Fishing
10/01/19	Maui Nui	14932	20.7020011	-156.7072844	HB_L_M	Naomi K	Fishing
10/01/19	Maui Nui	15043	20.7077056	-156.7983779	SB_A_M	Naomi K	Fishing
10/04/19	Maui Nui	20391	20.9200247	-156.1898661	SB_A_S	Naomi K	Fishing
10/04/19	Maui Nui	22425	20.9622709	-156.2899946	SB_A_S	Naomi K	Fishing
10/04/19	Maui Nui	19418	20.8917504	-156.118347	HB_H_S	Naomi K	Fishing
10/04/19	Maui Nui	20796	20.9286522	-156.1656835	SB_A_M	Naomi K	Fishing
10/04/19	Maui Nui	22949	20.9695022	-156.1793305	SB_A_D	Naomi K	Fishing
10/04/19	Maui Nui	22438	20.961266	-156.2275396	HB_L_S	Naomi K	Fishing
10/04/19	Maui Nui	23977	20.9885754	-156.2414548	SB_A_M	Naomi K	Fishing
10/04/19	Maui Nui	24531	20.9971306	-156.2124575	SB_A_D	Naomi K	Fishing
10/04/19	Maui Nui	26562	21.0304955	-156.3224181	HB_L_M	Naomi K	Fishing
10/04/19	Maui Nui	29577	21.0803639	-156.3359543	SB_A_D	Naomi K	Fishing
10/05/19	Maui Nui	11203	20.5534265	-156.4171017	HB_H_M	Naomi K	Fishing
10/05/19	Maui Nui	11205	20.5532833	-156.4075178	HB_H_M	Naomi K	Fishing
10/05/19	Maui Nui	10882	20.5317065	-156.4749775	HB_H_D	Naomi K	Fishing
10/05/19	Maui Nui	11479	20.5673936	-156.4456286	HB_H_M	Naomi K	Fishing
10/05/19	Maui Nui	11564	20.5727467	-156.5030667	HB_H_M	Naomi K	Fishing
10/05/19	Maui Nui	10933	20.5361502	-156.4701117	HB_H_D	Naomi K	Fishing
10/05/19	Maui Nui	11188	20.5544838	-156.4889834	HB_L_M	Naomi K	Fishing
10/05/19	Maui Nui	11276	20.5591363	-156.4984945	HB_L_M	Naomi K	Fishing
10/05/19	Maui Nui	11669	20.5767027	-156.4646496	HB_L_M	Naomi K	Fishing

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
10/06/19	Oahu	37248	21.530525	-157.7804794	HB_H_D	Amy C	Fishing
10/06/19	Oahu	37004	21.4939232	-157.7180442	HB_H_M	Amy C	Fishing
10/06/19	Oahu	37076	21.5033196	-157.7662268	HB_H_S	Amy C	Fishing
10/06/19	Oahu	37452	21.5577294	-157.7947372	HB_H_M	Amy C	Fishing
10/06/19	Oahu	37531	21.5667973	-157.7994909	HB_H_M	Amy C	Fishing
10/06/19	Oahu	37991	21.5986872	-157.8378661	HB_H_M	Amy C	Fishing
10/06/19	Oahu	36958	21.4895538	-157.7373865	HB_H_S	Amy C	Fishing
10/07/19	Maui Nui	18470	20.8746721	-157.6608939	HB_H_S	Renee Nv	Fishing
10/07/19	Maui Nui	18547	20.8798443	-157.7473601	HB_H_S	Renee Nv	Fishing
10/07/19	Maui Nui	19465	20.9145812	-157.569203	HB_H_M	Renee Nv	Fishing
10/07/19	Maui Nui	23729	21.0061349	-157.7222575	HB_H_M	Renee Nv	Fishing
10/07/19	Maui Nui	29782	21.1047482	-157.6251476	HB_H_M	Renee Nv	Fishing
10/07/19	Maui Nui	29119	21.0912378	-157.6300848	HB_H_M	Renee Nv	Fishing
10/07/19	Maui Nui	28023	21.0557016	-156.4950946	SB_A_D	Naomi K	Fishing
10/07/19	Maui Nui	28310	21.0593538	-156.437321	SB_A_D	Naomi K	Fishing
10/07/19	Maui Nui	28579	21.0637216	-156.4276273	HB_L_D	Naomi K	Fishing
10/07/19	Maui Nui	28581	21.0635755	-156.418011	HB_L_D	Naomi K	Fishing
10/07/19	Maui Nui	29538	21.0832061	-156.5234953	SB_A_D	Naomi K	Fishing
10/07/19	Kauai	42228	21.9321825	-159.3311982	HB_H_S	Ao Shibi Too	Fishing
10/07/19	Kauai	43341	22.0270913	-159.3071942	HB_H_D	Ao Shibi Too	Fishing
10/08/19	Maui Nui	24096	21.0047541	-157.0921947	HB_H_D	Ebisui III	Fishing
10/08/19	Maui Nui	19917	20.9233706	-157.083614	HB_H_S	Ebisui III	Fishing
10/08/19	Maui Nui	21092	20.9500259	-157.0448161	SB_A_S	Ebisui III	Fishing
10/08/19	Maui Nui	25504	21.0274383	-157.1015259	HB_L_M	Ebisui III	Fishing
10/08/19	Maui Nui	26709	21.0453377	-157.0868677	HB_L_M	Ebisui III	Fishing
10/08/19	Maui Nui	27319	21.054205	-157.0723222	HB_L_S	Ebisui III	Fishing
10/08/19	Maui Nui	26215	21.0289031	-156.514777	HB_L_S	Naomi K	Fishing
10/08/19	Maui Nui	27898	21.0640395	-157.1443617	HB_H_S	Ebisui III	Fishing
10/08/19	Maui Nui	26213	21.0290434	-156.5243918	HB_L_S	Naomi K	Fishing
10/08/19	Kauai	44548	22.197464	-159.7150122	HB_H_M	Ao Shibi Too	Fishing
10/08/19	Kauai	45279	22.2566173	-159.6085566	HB_H_M	Ao Shibi Too	Fishing
10/08/19	Kauai	44657	22.2078043	-159.2930329	HB_H_M	Ao Shibi Too	Fishing
10/08/19	Kauai	45274	22.2528907	-159.3367998	HB_H_M	Ao Shibi Too	Fishing
10/08/19	Kauai	45386	22.2658588	-159.5503617	HB_L_S	Ao Shibi Too	Fishing
10/08/19	Kauai	45524	22.2885081	-159.5310355	SB_A_D	Ao Shibi Too	Fishing
10/08/19	Kauai	45551	22.2974272	-159.5650473	SB_A_D	Ao Shibi Too	Fishing
10/09/19	Maui Nui	17698	20.8281691	-157.0511972	HB_H_D	Ebisui III	Fishing
10/09/19	Maui Nui	17704	20.8278389	-157.0223812	HB_L_M	Ebisui III	Fishing
10/09/19	Maui Nui	18104	20.8504704	-157.0268895	SB_A_S	Ebisui III	Fishing
10/09/19	Maui Nui	16975	20.7873123	-157.0325139	SB_A_D	Ebisui III	Fishing
10/09/19	Maui Nui	19114	20.8964396	-157.0983733	HB_L_M	Ebisui III	Fishing
10/09/19	Maui Nui	18577	20.8737556	-157.089049	HB_L_M	Ebisui III	Fishing
10/09/19	Kauai	43934	22.1202004	-159.816425	HB_H_S	Ao Shibi Too	Fishing
10/09/19	Kauai	43961	22.1246929	-159.8212987	HB_L_D	Ao Shibi Too	Fishing
10/09/19	Kauai	44021	22.1338228	-159.8019589	HB_L_S	Ao Shibi Too	Fishing
10/09/19	Kauai	43747	22.0885588	-159.8210896	HB_H_M	Ao Shibi Too	Fishing
10/09/19	Kauai	43932	22.1201517	-159.8261201	HB_L_D	Ao Shibi Too	Fishing
10/09/19	Kauai	44537	22.197221	-159.7683657	HB_H_D	Ao Shibi Too	Fishing
10/09/19	Kauai	43517	22.0479078	-159.8208548	SB_A_S	Ao Shibi Too	Fishing
10/09/19	Kauai	41841	21.8995705	-159.6602731	HB_H_M	Ao Shibi Too	Fishing
10/09/19	Kauai	43039	21.998295	-159.8060382	HB_H_S	Ao Shibi Too	Fishing
10/09/19	Kauai	43089	22.0027639	-159.8157509	HB_L_M	Ao Shibi Too	Fishing
10/10/19	Kauai	41531	21.881653	-159.6214726	HB_H_D	Ao Shibi Too	Fishing
10/10/19	Kauai	41362	21.8728766	-159.5488421	HB_H_S	Ao Shibi Too	Fishing
10/10/19	Kauai	41141	21.8595647	-159.4713657	HB_H_S	Ao Shibi Too	Fishing
10/10/19	Kauai	41224	21.8642852	-159.3939526	HB_H_S	Ao Shibi Too	Fishing
10/10/19	Kauai	41072	21.854962	-159.5003843	HB_H_D	Ao Shibi Too	Fishing
10/10/19	Kauai	41156	21.8597563	-159.3987793	HB_H_M	Ao Shibi Too	Fishing
10/16/19	Niʻihau	39863	21.7383949	-160.2058534	HB_H_M	Ao Shibi Too	Fishing
10/16/19	Niʻihau	40580	21.7933984	-160.0902419	HB_H_M	Ao Shibi Too	Fishing
10/16/19	Niʻihau	40709	21.8109696	-160.1629287	SB_A_S	Ao Shibi Too	Fishing
10/16/19	Niʻihau	41008	21.8476608	-160.0809767	HB_H_M	Ao Shibi Too	Fishing

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
10/16/19	Niʻihau	40477	21.7843652	-160.0901736	HB_H_D	Ao Shibi Too	Fishing
10/16/19	Niʻihau	40937	21.8387221	-160.0663957	HB_L_D	Ao Shibi Too	Fishing
10/16/19	Niʻihau	40180	21.7610121	-160.2012071	HB_H_S	Ao Shibi Too	Fishing
10/16/19	Niʻihau	40821	21.8247541	-160.1291786	SB_A_M	Ao Shibi Too	Fishing
10/16/19	Niʻihau	40968	21.8431442	-160.0809427	HB_L_M	Ao Shibi Too	Fishing
10/16/19	Niʻihau	41065	21.8523651	-160.0519818	HB_L_D	Ao Shibi Too	Fishing
10/16/19	Niʻihau	40747	21.8155539	-160.1532916	SB_A_M	Ao Shibi Too	Fishing
10/17/19	Niʻihau	42869	21.9789215	-160.0383837	HB_H_M	Ao Shibi Too	Fishing
10/17/19	Niʻihau	42557	21.9551087	-160.2173564	HB_H_M	Ao Shibi Too	Fishing
10/17/19	Niʻihau	43058	22.0006239	-160.1693121	HB_H_D	Ao Shibi Too	Fishing
10/17/19	Niʻihau	43475	22.0420601	-160.0533782	HB_H_D	Ao Shibi Too	Fishing
10/17/19	Niʻihau	43383	22.0325437	-160.1259746	SB_A_D	Ao Shibi Too	Fishing
10/17/19	Niʻihau	42894	21.9824893	-160.1788488	SB_A_D	Ao Shibi Too	Fishing
10/17/19	Niʻihau	43509	22.0464508	-160.0727906	HB_H_M	Ao Shibi Too	Fishing
10/17/19	Niʻihau	43538	22.0507086	-160.1115832	HB_H_M	Ao Shibi Too	Fishing
10/20/19	Big Island	369	18.9811613	-155.7732387	HB_H_M	Ride On	Fishing
10/20/19	Big Island	524	19.0372575	-155.8860569	HB_H_M	Ride On	Fishing
10/20/19	Big Island	631	19.0873702	-155.9136058	HB_H_M	Ride On	Fishing
10/20/19	Big Island	641	19.0918824	-155.9135221	HB_H_M	Ride On	Fishing
10/20/19	Oahu	32465	21.220609	-158.0528217	HB_H_D	Renee Nv	Fishing
10/20/19	Oahu	35525	21.3250172	-158.1485745	HB_H_M	Renee Nv	Fishing
10/20/19	Oahu	33386	21.2453688	-157.7009341	HB_H_D	Renee Nv	Fishing
10/20/19	Oahu	34273	21.2739386	-157.9079028	HB_H_M	Renee Nv	Fishing
10/20/19	Oahu	36079	21.3839779	-158.1964644	HB_H_M	Renee Nv	Fishing
10/27/19	Big Island	1628	19.4078924	-155.9171152	HB_H_S	Ride On	Fishing
10/27/19	Big Island	1835	19.489994	-155.9679161	HB_H_M	Ride On	Fishing
10/27/19	Big Island	1352	19.2946062	-155.890723	HB_H_S	Ride On	Fishing
10/27/19	Big Island	1590	19.3898441	-155.9174554	HB_H_M	Ride On	Fishing
10/27/19	Big Island	1558	19.3760655	-155.903447	HB_H_S	Ride On	Fishing
11/01/19	Maui Nui	32708	21.2160242	-157.0076218	HB_H_M	Renee Nv	Fishing
11/01/19	Maui Nui	32372	21.2078857	-157.0847807	HB_L_S	Renee Nv	Fishing
11/01/19	Maui Nui	33024	21.2258917	-157.0797321	HB_H_S	Renee Nv	Fishing
11/01/19	Maui Nui	33326	21.2344789	-157.0410889	HB_H_D	Renee Nv	Fishing
11/01/19	Maui Nui	33443	21.2399252	-157.1229012	HB_H_S	Renee Nv	Fishing
11/01/19	Maui Nui	33901	21.2538431	-157.1564459	HB_H_S	Renee Nv	Fishing
11/01/19	Maui Nui	34058	21.2584636	-157.1660234	SB_A_S	Renee Nv	Fishing
11/03/19	Big Island	7657	20.1171013	-155.468711	SB_A_S	Ride On	Fishing
11/03/19	Big Island	9505	20.2699475	-155.670866	HB_H_D	Ride On	Fishing
11/03/19	Big Island	9908	20.3032277	-155.7610334	HB_H_D	Ride On	Fishing
11/03/19	Big Island	9959	20.3085308	-155.8039746	HB_L_D	Ride On	Fishing
11/03/19	Big Island	10011	20.3137373	-155.8421381	HB_L_M	Ride On	Fishing
11/03/19	Big Island	10045	20.3107242	-155.6795604	HB_L_D	Ride On	Fishing
11/03/19	Big Island	10075	20.3178149	-155.8181355	HB_H_D	Ride On	Fishing
11/03/19	Big Island	8554	20.170445	-155.4292865	HB_L_D	Ride On	Fishing
11/03/19	Big Island	9177	20.2431559	-155.685781	HB_H_D	Ride On	Fishing
11/03/19	Big Island	9902	20.3037569	-155.7897224	HB_H_D	Ride On	Fishing
11/03/19	Big Island	8378	20.1647414	-155.596649	HB_H_M	Ride On	Fishing
11/03/19	Big Island	8198	20.1481879	-155.4441251	HB_L_D	Ride On	Fishing
11/03/19	Big Island	8605	20.1770583	-155.534259	SB_A_D	Ride On	Fishing
11/03/19	Big Island	8661	20.1831516	-155.6153651	HB_H_D	Ride On	Fishing
11/03/19	Oahu	38069	21.603271	-157.8474893	HB_H_M	Amy C	Fishing
11/03/19	Oahu	38401	21.6213037	-157.8425159	HB_H_D	Amy C	Fishing
11/03/19	Oahu	38642	21.6350855	-157.8762233	HB_H_M	Amy C	Fishing
11/03/19	Oahu	38868	21.6531846	-157.8809148	HB_H_S	Amy C	Fishing
11/03/19	Oahu	39071	21.6711195	-157.8614475	HB_L_D	Amy C	Fishing
11/03/19	Oahu	39271	21.6892189	-157.8661382	SB_A_D	Amy C	Fishing
11/03/19	Oahu	39430	21.7028671	-157.8805312	SB_A_M	Amy C	Fishing
11/03/19	Oahu	39610	21.7163512	-157.8707594	HB_L_D	Amy C	Fishing
11/03/19	Oahu	39165	21.6803167	-157.885538	SB_A_S	Amy C	Fishing
11/04/19	Big Island	6976	20.0707177	-155.8804718	HB_H_S	Ride On	Fishing
11/04/19	Big Island	9933	20.3107599	-155.9283094	HB_H_D	Ride On	Fishing
11/04/19	Big Island	7701	20.130208	-155.9270766	HB_H_M	Ride On	Fishing

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
11/04/19	Big Island	9942	20.3099982	-155.8852686	HB_L_M	Ride On	Fishing
11/04/19	Big Island	10001	20.3145949	-155.8899606	HB_L_D	Ride On	Fishing
11/04/19	Big Island	10119	20.3235327	-155.8849975	HB_L_D	Ride On	Fishing
11/04/19	Big Island	8005	20.1480879	-155.9171685	HB_H_S	Ride On	Fishing
11/04/19	Big Island	9513	20.2791782	-155.9289324	HB_L_M	Ride On	Fishing
11/08/19	Big Island	7254	20.0834003	-155.364413	SB_A_M	Ao Shibi IV	Fishing
11/08/19	Big Island	7305	20.0883999	-155.3881735	SB_A_S	Ao Shibi IV	Fishing
11/08/19	Big Island	7675	20.1153575	-155.3827783	SB_A_D	Ao Shibi IV	Fishing
11/08/19	Big Island	7680	20.1148657	-155.3589097	HB_L_D	Ao Shibi IV	Fishing
11/09/19	Big Island	6619	20.0207556	-155.174949	HB_L_D	Ao Shibi IV	Fishing
11/09/19	Big Island	6321	19.9995436	-155.2374956	SB_A_S	Ao Shibi IV	Fishing
11/09/19	Big Island	6559	20.0167616	-155.1989068	SB_A_D	Ao Shibi IV	Fishing
11/09/19	Big Island	6714	20.030696	-155.2176624	HB_H_M	Ao Shibi IV	Fishing
11/09/19	Big Island	6957	20.0540518	-155.2552909	SB_A_M	Ao Shibi IV	Fishing
11/09/19	Big Island	7002	20.0591654	-155.2838127	SB_A_M	Ao Shibi IV	Fishing
11/09/19	Big Island	7170	20.0718834	-155.2453188	SB_A_D	Ao Shibi IV	Fishing
11/09/19	Big Island	6208	19.9894038	-155.1852503	SB_A_M	Ao Shibi IV	Fishing
11/09/19	Big Island	6722	20.0298752	-155.1795006	HB_H_D	Ao Shibi IV	Fishing
11/10/19	Big Island	4126	19.8496502	-154.9836363	HB_H_D	Ao Shibi IV	Fishing
11/10/19	Big Island	4406	19.8674639	-154.9736536	HB_H_D	Ao Shibi IV	Fishing
11/10/19	Big Island	4409	19.8671399	-154.9593616	HB_L_D	Ao Shibi IV	Fishing
11/10/19	Big Island	5263	19.9251533	-155.1343338	SB_A_S	Ao Shibi IV	Fishing
11/10/19	Big Island	4546	19.8768013	-154.9877187	HB_L_D	Ao Shibi IV	Fishing
11/10/19	Big Island	4620	19.881201	-154.9828405	HB_L_D	Ao Shibi IV	Fishing
11/10/19	Big Island	4752	19.8918167	-155.054088	HB_L_M	Ao Shibi IV	Fishing
11/10/19	Big Island	5402	19.9336485	-155.1102797	SB_A_M	Ao Shibi IV	Fishing
11/10/19	Big Island	5479	19.9373161	-155.0720346	HB_L_D	Ao Shibi IV	Fishing
11/10/19	Big Island	5545	19.9423501	-155.0957576	SB_A_M	Ao Shibi IV	Fishing
11/11/19	Big Island	1750	19.4364868	-154.8608119	HB_H_S	Ao Shibi IV	Fishing
11/11/19	Big Island	1625	19.3839081	-154.928673	HB_H_M	Ao Shibi IV	Fishing
11/11/19	Big Island	2132	19.5538803	-154.8673348	HB_H_S	Ao Shibi IV	Fishing
11/11/19	Big Island	3643	19.8187407	-155.0130069	HB_L_D	Ao Shibi IV	Fishing
11/11/19	Big Island	3232	19.7870821	-155.0090321	HB_H_M	Ao Shibi IV	Fishing
11/11/19	Big Island	3455	19.8055371	-155.0276318	HB_H_M	Ao Shibi IV	Fishing
11/12/19	Big Island	1422	19.3054926	-155.0541256	HB_H_D	Ao Shibi IV	Fishing
11/12/19	Big Island	1050	19.2343977	-155.3217738	HB_H_M	Ao Shibi IV	Fishing
11/12/19	Big Island	1052	19.2342065	-155.3122789	HB_H_D	Ao Shibi IV	Fishing
11/12/19	Big Island	1251	19.257831	-155.1455054	HB_H_D	Ao Shibi IV	Fishing
11/12/19	Big Island	1230	19.2599079	-155.2452021	HB_H_S	Ao Shibi IV	Fishing
11/12/19	Big Island	1134	19.2459898	-155.226521	HB_H_M	Ao Shibi IV	Fishing
11/12/19	Big Island	1232	19.2597124	-155.2357066	HB_H_S	Ao Shibi IV	Fishing
11/12/19	Big Island	1142	19.2452017	-155.1885438	HB_H_M	Ao Shibi IV	Fishing
11/13/19	Big Island	81	18.888747	-155.6517427	HB_H_M	Ao Shibi IV	Fishing
11/13/19	Big Island	710	19.1161601	-155.5047692	HB_H_M	Ao Shibi IV	Fishing
11/13/19	Big Island	108	18.9029606	-155.6893915	HB_H_M	Ao Shibi IV	Fishing
11/13/19	Big Island	366	18.9734192	-155.5931338	HB_H_S	Ao Shibi IV	Fishing
11/13/19	Big Island	637	19.0807046	-155.5387362	HB_H_S	Ao Shibi IV	Fishing
11/14/19	Maui Nui	12617	20.6073204	-156.1141465	HB_H_S	Ao Shibi 4	Fishing
11/14/19	Maui Nui	15777	20.7173961	-155.9537596	HB_H_S	Ao Shibi 4	Fishing
11/14/19	Maui Nui	17066	20.7716197	-155.9574715	HB_H_M	Ao Shibi 4	Fishing
11/14/19	Maui Nui	14736	20.6818098	-155.9832458	HB_H_S	Ao Shibi 4	Fishing
11/14/19	Maui Nui	12262	20.5942612	-156.143154	HB_H_M	Ao Shibi 4	Fishing
11/14/19	Maui Nui	14359	20.6685258	-155.9978948	HB_H_S	Ao Shibi 4	Fishing
11/14/19	Maui Nui	13642	20.6420357	-156.0319784	HB_H_S	Ao Shibi 4	Fishing
11/14/19	Maui Nui	17407	20.7900898	-155.9810973	HB_H_S	Ao Shibi 4	Fishing
11/15/19	Maui Nui	11319	20.5560362	-156.2924381	HB_H_S	Ao Shibi 4	Fishing
11/15/19	Maui Nui	11919	20.5822806	-156.2392451	HB_H_M	Ao Shibi 4	Fishing
11/15/19	Maui Nui	12122	20.5915352	-156.2534601	SB_A_S	Ao Shibi 4	Fishing
11/15/19	Maui Nui	12600	20.6086623	-156.1956211	SB_A_S	Ao Shibi 4	Fishing
11/15/19	Maui Nui	12255	20.5948124	-156.1766995	HB_H_M	Ao Shibi 4	Fishing
11/15/19	Maui Nui	12258	20.594577	-156.1623227	HB_H_S	Ao Shibi 4	Fishing

Appendix B: BFISH_2019_F camera deployment locations (two per PSU) by stratum, and vessel.

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
9/12/2019	Maui Nui	14897	20.705132	-156.873603	HB_H_M	Rubber Duck	Camera
9/12/2019	Maui Nui	14897	20.704788	-156.876786	HB_H_M	Rubber Duck	Camera
9/12/2019	Maui Nui	15034	20.708024	-156.842206	HB_L_M	Steel Toe	Camera
9/12/2019	Maui Nui	15034	20.708927	-156.841184	HB_L_M	Steel Toe	Camera
9/12/2019	Maui Nui	15969	20.738824	-156.725535	HB_H_S	Rubber Duck	Camera
9/12/2019	Maui Nui	15969	20.737213	-156.727357	HB_H_S	Rubber Duck	Camera
9/12/2019	Maui Nui	15975	20.737469	-156.696313	HB_H_S	Steel Toe	Camera
9/12/2019	Maui Nui	15975	20.739224	-156.695954	HB_H_S	Steel Toe	Camera
9/12/2019	Maui Nui	16068	20.742283	-156.807232	HB_H_S	Oscar Sette	Camera
9/12/2019	Maui Nui	16068	20.743678	-156.807899	HB_H_S	Oscar Sette	Camera
9/12/2019	Maui Nui	16292	20.750671	-156.776428	HB_H_S	Oscar Sette	Camera
9/12/2019	Maui Nui	16292	20.75219	-156.777458	HB_H_S	Oscar Sette	Camera
9/12/2019	Maui Nui	16613	20.765035	-156.716747	HB_H_S	Rubber Duck	Camera
9/12/2019	Maui Nui	16613	20.763541	-156.7177572	HB_H_S	Rubber Duck	Camera
9/12/2019	Maui Nui	16710	20.77082	-156.727588	HB_H_S	Rubber Duck	Camera
9/12/2019	Maui Nui	16710	20.771542	-156.724668	HB_H_S	Rubber Duck	Camera
9/12/2019	Maui Nui	16817	20.775665	-156.689057	HB_H_S	Rubber Duck	Camera
9/12/2019	Maui Nui	16817	20.774925	-156.687077	HB_H_S	Rubber Duck	Camera
9/12/2019	Maui Nui	17006	20.783687	-156.720097	HB_H_S	Steel Toe	Camera
9/12/2019	Maui Nui	17006	20.784261	-156.719006	HB_H_S	Steel Toe	Camera
9/12/2019	Maui Nui	17007	20.78308	-156.71594	HB_H_S	Steel Toe	Camera
9/12/2019	Maui Nui	17007	20.784302	-156.715445	HB_H_S	Steel Toe	Camera
9/13/2019	Maui Nui	13831	20.659241	-156.621062	HB_H_M	Rubber Duck	Camera
9/13/2019	Maui Nui	13831	20.661191	-156.619998	HB_H_M	Rubber Duck	Camera
9/13/2019	Maui Nui	14429	20.684736	-156.648644	HB_H_S	Oscar Sette	Camera
9/13/2019	Maui Nui	14429	20.683579	-156.652144	HB_H_S	Oscar Sette	Camera
9/13/2019	Maui Nui	14437	20.681631	-156.611872	HB_H_M	Rubber Duck	Camera
9/13/2019	Maui Nui	14437	20.684842	-156.61245	HB_H_M	Rubber Duck	Camera
9/13/2019	Maui Nui	14439	20.682359	-156.604175	HB_H_M	Steel Toe	Camera
9/13/2019	Maui Nui	14439	20.682843	-156.600802	HB_H_M	Steel Toe	Camera
9/13/2019	Maui Nui	15061	20.707975	-156.711279	HB_H_M	Oscar Sette	Camera
9/13/2019	Maui Nui	15061	20.70753	-156.712896	HB_H_M	Oscar Sette	Camera
9/13/2019	Maui Nui	15089	20.706233	-156.579228	HB_H_M	Steel Toe	Camera
9/13/2019	Maui Nui	15089	20.705954	-156.577038	HB_H_M	Steel Toe	Camera
9/13/2019	Maui Nui	15480	20.719378	-156.58217	HB_H_S	Steel Toe	Camera
9/13/2019	Maui Nui	15480	20.717691	-156.581497	HB_H_S	Steel Toe	Camera
9/13/2019	Maui Nui	15610	20.72462	-156.588253	HB_H_S	Rubber Duck	Camera
9/13/2019	Maui Nui	15610	20.723426	-156.58658	HB_H_S	Rubber Duck	Camera
9/13/2019	Maui Nui	15737	20.728927	-156.600049	HB_H_S	Rubber Duck	Camera
9/13/2019	Maui Nui	15737	20.728008	-156.600646	HB_H_S	Rubber Duck	Camera
9/13/2019	Maui Nui	16001	20.737302	-156.571381	HB_L_S	Steel Toe	Camera
9/13/2019	Maui Nui	16001	20.735137	-156.573424	HB_L_S	Steel Toe	Camera
9/13/2019	Maui Nui	16107	20.743593	-156.621161	HB_H_S	Rubber Duck	Camera
9/13/2019	Maui Nui	16217	20.745224	-156.624573	HB_H_S	Rubber Duck	Camera
9/13/2019	Maui Nui	16225	20.745792	-156.587436	HB_H_S	Rubber Duck	Camera
9/13/2019	Maui Nui	16225	20.744249	-156.587327	HB_H_S	Rubber Duck	Camera
9/13/2019	Maui Nui	16228	20.744229	-156.572564	HB_H_S	Rubber Duck	Camera
9/13/2019	Maui Nui	16228	20.747174	-156.571841	HB_H_S	Rubber Duck	Camera
9/13/2019	Maui Nui	16335	20.749759	-156.570744	HB_H_S	Steel Toe	Camera
9/13/2019	Maui Nui	16335	20.749246	-156.572474	HB_H_S	Steel Toe	Camera
9/13/2019	Maui Nui	16425	20.756481	-156.645239	HB_H_S	Oscar Sette	Camera
9/13/2019	Maui Nui	16425	20.753871	-156.64551	HB_H_S	Oscar Sette	Camera
9/13/2019	Maui Nui	16537	20.760793	-156.603867	HB_H_S	Steel Toe	Camera
9/13/2019	Maui Nui	16537	20.758518	-156.606627	HB_H_S	Steel Toe	Camera
9/14/2019	Maui Nui	20540	20.934019	-156.757335	HB_H_S	Steel Toe	Camera
9/14/2019	Maui Nui	20540	20.932403	-156.756771	HB_H_S	Steel Toe	Camera
9/14/2019	Maui Nui	20929	20.943816	-156.81012	HB_H_S	Steel Toe	Camera

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
9/14/2019	Maui Nui	20929	20.943306	-156.808916	HB_H_S	Steel Toe	Camera
9/14/2019	Maui Nui	20939	20.943484	-156.762509	HB_H_M	Rubber Duck	Camera
9/14/2019	Maui Nui	20939	20.94312	-156.760275	HB_H_M	Rubber Duck	Camera
9/14/2019	Maui Nui	21140	20.945749	-156.815105	HB_H_S	Rubber Duck	Camera
9/14/2019	Maui Nui	21140	20.947711	-156.814961	HB_H_S	Rubber Duck	Camera
9/14/2019	Maui Nui	21143	20.94822	-156.79907	HB_L_M	Rubber Duck	Camera
9/14/2019	Maui Nui	21143	20.9477	-156.801441	HB_L_M	Rubber Duck	Camera
9/14/2019	Maui Nui	21851	20.961116	-156.799767	HB_L_M	Steel Toe	Camera
9/14/2019	Maui Nui	21851	20.95908	-156.800015	HB_L_M	Steel Toe	Camera
9/14/2019	Maui Nui	22359	20.970165	-156.754464	HB_L_M	Steel Toe	Camera
9/14/2019	Maui Nui	22359	20.969235	-156.754899	HB_L_M	Steel Toe	Camera
9/14/2019	Maui Nui	22607	20.975257	-156.759564	HB_L_M	Rubber Duck	Camera
9/14/2019	Maui Nui	22607	20.974544	-156.761306	HB_L_M	Rubber Duck	Camera
9/14/2019	Maui Nui	24732	21.009039	-156.69201	HB_L_S	Oscar Sette	Camera
9/14/2019	Maui Nui	24732	21.006812	-156.693278	HB_L_S	Oscar Sette	Camera
9/14/2019	Maui Nui	27118	21.042853	-156.58633	HB_L_S	Steel Toe	Camera
9/14/2019	Maui Nui	27118	21.044347	-156.585581	HB_L_S	Steel Toe	Camera
9/14/2019	Maui Nui	28003	21.05572	-156.589722	HB_L_S	Rubber Duck	Camera
9/14/2019	Maui Nui	28003	21.055792	-156.592522	HB_L_S	Rubber Duck	Camera
9/14/2019	Maui Nui	28266	21.060168	-156.650941	HB_H_M	Oscar Sette	Camera
9/14/2019	Maui Nui	28266	21.06247	-156.650401	HB_H_M	Oscar Sette	Camera
9/14/2019	Maui Nui	28267	21.060841	-156.644615	HB_H_S	Oscar Sette	Camera
9/14/2019	Maui Nui	28267	21.06284	-156.6442231	HB_H_S	Oscar Sette	Camera
9/14/2019	Maui Nui	28281	21.059976	-156.576366	HB_L_M	Steel Toe	Camera
9/14/2019	Maui Nui	28281	21.06277	-156.576481	HB_L_M	Steel Toe	Camera
9/14/2019	Maui Nui	28798	21.069819	-156.604648	SB_A_M	Rubber Duck	Camera
9/14/2019	Maui Nui	28798	21.069054	-156.606788	SB_A_M	Rubber Duck	Camera
9/15/2019	Maui Nui	12668	20.619927	-156.648841	HB_H_M	Oscar Sette	Camera
9/15/2019	Maui Nui	12668	20.620073	-156.652019	HB_H_M	Oscar Sette	Camera
9/15/2019	Maui Nui	12801	20.625203	-156.631361	HB_H_M	Rubber Duck	Camera
9/15/2019	Maui Nui	12801	20.62236	-156.63049	HB_H_M	Rubber Duck	Camera
9/15/2019	Maui Nui	13214	20.637662	-156.615897	HB_H_M	Rubber Duck	Camera
9/15/2019	Maui Nui	13214	20.637647	-156.618232	HB_H_M	Rubber Duck	Camera
9/15/2019	Maui Nui	13841	20.660069	-156.575231	HB_H_S	Rubber Duck	Camera
9/15/2019	Maui Nui	13841	20.658143	-156.575525	HB_H_S	Rubber Duck	Camera
9/15/2019	Maui Nui	14583	20.687075	-156.510546	HB_H_S	Steel Toe	Camera
9/15/2019	Maui Nui	14583	20.685583	-156.511488	HB_H_S	Steel Toe	Camera
9/15/2019	Maui Nui	14702	20.690001	-156.557339	HB_H_M	Steel Toe	Camera
9/15/2019	Maui Nui	14965	20.701159	-156.547451	HB_H_S	Oscar Sette	Camera
9/15/2019	Maui Nui	14965	20.699542	-156.55118	HB_H_S	Oscar Sette	Camera
9/15/2019	Maui Nui	15106	20.702078	-156.494801	HB_H_S	Rubber Duck	Camera
9/15/2019	Maui Nui	15106	20.703333	-156.4959	HB_H_S	Rubber Duck	Camera
9/16/2019	Kauai	43849	22.105172	-159.273677	HB_H_S	Rubber Duck	Camera
9/16/2019	Kauai	43849	22.103671	-159.273755	HB_H_S	Rubber Duck	Camera
9/16/2019	Kauai	43875	22.110402	-159.277193	HB_H_S	Steel Toe	Camera
9/16/2019	Kauai	43875	22.108552	-159.277016	HB_H_S	Steel Toe	Camera
9/16/2019	Kauai	44171	22.15352	-159.260209	HB_H_M	Steel Toe	Camera
9/16/2019	Kauai	44171	22.151991	-159.259396	HB_H_M	Steel Toe	Camera
9/16/2019	Kauai	44532	22.192219	-159.287775	HB_H_S	Steel Toe	Camera
9/16/2019	Kauai	44532	22.193515	-159.286661	HB_H_S	Steel Toe	Camera
9/16/2019	Kauai	45002	22.234415	-159.341401	HB_H_S	Rubber Duck	Camera
9/16/2019	Kauai	45002	22.235977	-159.343233	HB_H_S	Rubber Duck	Camera
9/16/2019	Kauai	45134	22.244701	-159.385118	SB_A_S	Oscar Sette	Camera
9/16/2019	Kauai	45134	22.242315	-159.385924	SB_A_S	Oscar Sette	Camera
9/16/2019	Kauai	45136	22.243728	-159.376097	HB_H_S	Oscar Sette	Camera
9/16/2019	Kauai	45136	22.243176	-159.375707	HB_H_S	Oscar Sette	Camera
9/16/2019	Kauai	45260	22.251341	-159.404922	HB_H_M	Steel Toe	Camera
9/16/2019	Kauai	45260	22.251767	-159.405765	HB_H_M	Steel Toe	Camera
9/16/2019	Kauai	45307	22.255853	-159.472564	HB_H_S	Rubber Duck	Camera
9/16/2019	Kauai	45307	22.256664	-159.474053	HB_H_S	Rubber Duck	Camera
9/16/2019	Kauai	45360	22.260217	-159.498312	HB_H_S	Oscar Sette	Camera
9/16/2019	Kauai	45360	22.263008	-159.497247	HB_H_S	Oscar Sette	Camera

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
9/16/2019	Kauai	45362	22.259756	-159.486326	SB_A_M	Rubber Duck	Camera
9/16/2019	Kauai	45362	22.259724	-159.488872	SB_A_M	Rubber Duck	Camera
9/16/2019	Kauai	45453	22.273257	-159.524988	HB_H_M	Rubber Duck	Camera
9/16/2019	Kauai	45453	22.273746	-159.528132	HB_H_M	Rubber Duck	Camera
9/17/2019	Niʻihau	41692	21.888192	-160.032406	HB_H_S	Steel Toe	Camera
9/17/2019	Niʻihau	41692	21.89029	-160.031239	HB_H_S	Steel Toe	Camera
9/17/2019	Niʻihau	41877	21.900559	-160.25048	HB_H_S	Rubber Duck	Camera
9/17/2019	Niʻihau	41877	21.898537	-160.252403	HB_H_S	Rubber Duck	Camera
9/17/2019	Niʻihau	42003	21.912252	-160.05129	SB_A_S	Steel Toe	Camera
9/17/2019	Niʻihau	42003	21.910548	-160.05141	SB_A_S	Steel Toe	Camera
9/17/2019	Niʻihau	42085	21.919967	-160.244106	HB_H_S	Rubber Duck	Camera
9/17/2019	Niʻihau	42085	21.917942	-160.244081	HB_H_S	Rubber Duck	Camera
9/17/2019	Niʻihau	42488	21.952247	-160.216587	HB_H_S	Rubber Duck	Camera
9/17/2019	Niʻihau	42488	21.95147	-160.215009	HB_H_S	Rubber Duck	Camera
9/17/2019	Niʻihau	42651	21.961282	-160.044003	HB_H_M	Steel Toe	Camera
9/17/2019	Niʻihau	42651	21.959738	-160.044229	HB_H_M	Steel Toe	Camera
9/17/2019	Niʻihau	42745	21.969612	-160.18783	HB_L_S	Rubber Duck	Camera
9/17/2019	Niʻihau	42745	21.970028	-160.188081	HB_L_S	Rubber Duck	Camera
9/17/2019	Niʻihau	43464	22.043466	-160.108222	HB_H_S	Oscar Sette	Camera
9/17/2019	Niʻihau	43464	22.041827	-160.108395	HB_H_S	Oscar Sette	Camera
9/17/2019	Niʻihau	43470	22.040461	-160.078141	HB_H_S	Oscar Sette	Camera
9/17/2019	Niʻihau	43470	22.041987	-160.076765	HB_H_S	Oscar Sette	Camera
9/18/2019	Maui Nui	24333	21.013672	-157.382124	HB_H_S	Oscar Sette	Camera
9/18/2019	Maui Nui	24333	21.010836	-157.379752	HB_H_S	Oscar Sette	Camera
9/18/2019	Maui Nui	24886	21.02206	-157.396622	HB_H_S	Oscar Sette	Camera
9/18/2019	Maui Nui	24886	21.019718	-157.394374	HB_H_S	Oscar Sette	Camera
9/18/2019	Maui Nui	25468	21.030318	-157.338464	HB_L_S	Oscar Sette	Camera
9/18/2019	Maui Nui	25468	21.028815	-157.337181	HB_L_S	Oscar Sette	Camera
9/18/2019	Maui Nui	26043	21.04019	-157.381892	HB_H_S	Oscar Sette	Camera
9/18/2019	Maui Nui	26043	21.038506	-157.381454	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	4097	19.869309	-155.953709	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	4097	19.866999	-155.954588	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	4439	19.892219	-155.953809	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	4439	19.893171	-155.954524	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	4728	19.907843	-155.940223	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	4728	19.909681	-155.939655	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	4876	19.917001	-155.943584	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	4876	19.92014	-155.944758	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5031	19.928018	-155.92448	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5031	19.925249	-155.925982	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5033	19.925954	-155.914598	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	5033	19.927993	-155.914794	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	5178	19.937295	-155.930185	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5178	19.935117	-155.930774	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5250	19.941254	-155.916238	HB_H_S	Steel Toe	Camera
9/19/2019	Big Island	5250	19.938709	-155.917458	HB_H_S	Steel Toe	Camera
9/19/2019	Big Island	5375	19.951349	-155.939317	HB_H_S	Steel Toe	Camera
9/19/2019	Big Island	5375	19.950085	-155.939168	HB_H_S	Steel Toe	Camera
9/19/2019	Big Island	5382	19.950334	-155.906268	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5382	19.948017	-155.905787	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5447	19.955396	-155.910216	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5447	19.952301	-155.911877	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5451	19.953233	-155.890162	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	5451	19.951777	-155.891344	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	5518	19.959307	-155.907062	HB_H_S	Steel Toe	Camera
9/19/2019	Big Island	5669	19.967763	-155.85912	HB_H_S	Steel Toe	Camera
9/19/2019	Big Island	5669	19.96586	-155.860316	HB_H_S	Steel Toe	Camera
9/19/2019	Big Island	5733	19.972287	-155.883241	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5733	19.969659	-155.881616	HB_H_S	Oscar Sette	Camera
9/19/2019	Big Island	5809	19.974694	-155.852593	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	5809	19.973366	-155.85168	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	6186	20.004167	-155.871362	HB_H_M	Steel Toe	Camera

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
9/19/2019	Big Island	6186	20.003034	-155.871881	HB_H_M	Steel Toe	Camera
9/19/2019	Big Island	6367	20.015186	-155.86871	HB_H_S	Steel Toe	Camera
9/19/2019	Big Island	6367	20.017037	-155.866257	HB_H_S	Steel Toe	Camera
9/19/2019	Big Island	6875	20.061295	-155.8792	HB_H_S	Rubber Duck	Camera
9/19/2019	Big Island	6875	20.059806	-155.87974	HB_H_S	Rubber Duck	Camera
9/20/2019	Maui Nui	12095	20.593605	-156.503085	HB_H_S	Steel Toe	Camera
9/20/2019	Maui Nui	12095	20.595918	-156.503726	HB_H_S	Steel Toe	Camera
9/20/2019	Maui Nui	12344	20.605201	-156.462519	HB_H_S	Steel Toe	Camera
9/20/2019	Maui Nui	12344	20.603545	-156.462837	HB_H_S	Steel Toe	Camera
9/20/2019	Maui Nui	12463	20.610352	-156.468731	HB_H_S	Rubber Duck	Camera
9/20/2019	Maui Nui	12463	20.610325	-156.470067	HB_H_S	Rubber Duck	Camera
9/20/2019	Maui Nui	12569	20.614763	-156.525149	HB_H_S	Oscar Sette	Camera
9/20/2019	Maui Nui	12569	20.613815	-156.526693	HB_H_S	Oscar Sette	Camera
9/20/2019	Maui Nui	12825	20.62395	-156.517271	HB_H_M	Oscar Sette	Camera
9/20/2019	Maui Nui	12825	20.622856	-156.51776	HB_H_M	Oscar Sette	Camera
9/20/2019	Maui Nui	12967	20.624632	-156.468863	HB_H_S	Rubber Duck	Camera
9/20/2019	Maui Nui	12967	20.62786	-156.470471	HB_H_S	Rubber Duck	Camera
9/20/2019	Maui Nui	13485	20.645085	-156.520868	HB_L_M	Oscar Sette	Camera
9/20/2019	Maui Nui	13485	20.643733	-156.522253	HB_L_M	Oscar Sette	Camera
9/20/2019	Maui Nui	13490	20.645952	-156.496843	SB_A_S	Steel Toe	Camera
9/20/2019	Maui Nui	13619	20.647068	-156.467331	HB_H_S	Rubber Duck	Camera
9/20/2019	Maui Nui	13619	20.648739	-156.467756	HB_H_S	Rubber Duck	Camera
9/20/2019	Maui Nui	13740	20.653655	-156.479246	HB_H_S	Rubber Duck	Camera
9/20/2019	Maui Nui	13740	20.654661	-156.476979	HB_H_S	Rubber Duck	Camera
9/20/2019	Maui Nui	13969	20.662357	-156.541447	HB_H_M	Oscar Sette	Camera
9/20/2019	Maui Nui	13969	20.663768	-156.539351	HB_H_M	Oscar Sette	Camera
9/20/2019	Maui Nui	14094	20.667491	-156.500695	HB_H_S	Rubber Duck	Camera
9/20/2019	Maui Nui	14094	20.668019	-156.502046	HB_H_S	Rubber Duck	Camera
9/21/2019	Maui Nui	31283	21.16325	-156.692067	HB_H_S	Rubber Duck	Camera
9/21/2019	Maui Nui	31384	21.164845	-156.691732	HB_L_S	Rubber Duck	Camera
9/21/2019	Maui Nui	31962	21.191725	-156.903349	HB_H_S	Steel Toe	Camera
9/21/2019	Maui Nui	31962	21.190382	-156.900883	HB_H_S	Steel Toe	Camera
9/21/2019	Maui Nui	31971	21.19154	-156.859115	HB_H_S	Rubber Duck	Camera
9/21/2019	Maui Nui	31971	21.192892	-156.860382	HB_H_S	Rubber Duck	Camera
9/21/2019	Maui Nui	32123	21.196341	-156.820265	HB_H_S	Oscar Sette	Camera
9/21/2019	Maui Nui	32123	21.194797	-156.819228	HB_H_S	Oscar Sette	Camera
9/21/2019	Maui Nui	32155	21.192154	-156.668149	HB_H_M	Steel Toe	Camera
9/21/2019	Maui Nui	32155	21.193396	-156.666951	HB_H_M	Steel Toe	Camera
9/21/2019	Maui Nui	32273	21.198703	-156.815867	HB_H_M	Steel Toe	Camera
9/21/2019	Maui Nui	32273	21.201603	-156.816127	HB_H_M	Steel Toe	Camera
9/21/2019	Maui Nui	32421	21.203131	-156.830341	HB_H_S	Oscar Sette	Camera
9/21/2019	Maui Nui	32421	21.20529	-156.830583	HB_H_S	Oscar Sette	Camera
9/21/2019	Maui Nui	32423	21.203901	-156.822171	HB_H_S	Rubber Duck	Camera
9/21/2019	Maui Nui	32423	21.202993	-156.821695	HB_H_S	Rubber Duck	Camera
9/21/2019	Maui Nui	32428	21.203326	-156.797956	HB_H_M	Oscar Sette	Camera
9/21/2019	Maui Nui	32428	21.204785	-156.79495	HB_H_M	Oscar Sette	Camera
9/21/2019	Maui Nui	32592	21.20603	-156.744816	HB_L_S	Rubber Duck	Camera
9/21/2019	Maui Nui	32592	21.20789	-156.745305	HB_L_S	Rubber Duck	Camera
9/21/2019	Maui Nui	32748	21.212539	-156.75791	HB_H_M	Steel Toe	Camera
9/21/2019	Maui Nui	32748	21.212444	-156.75892	HB_H_M	Steel Toe	Camera
9/22/2019	Maui Nui	21605	20.956192	-156.819425	HB_H_M	Rubber Duck	Camera
9/22/2019	Maui Nui	21605	20.954966	-156.820057	HB_H_M	Rubber Duck	Camera
9/22/2019	Maui Nui	22353	20.970414	-156.786557	HB_L_M	Steel Toe	Camera
9/22/2019	Maui Nui	22353	20.968236	-156.784028	HB_L_M	Steel Toe	Camera
9/22/2019	Maui Nui	24166	21.001604	-156.756909	HB_L_M	Steel Toe	Camera
9/22/2019	Maui Nui	24166	21.000052	-156.755806	HB_L_M	Steel Toe	Camera
9/22/2019	Maui Nui	24717	21.010498	-156.76411	HB_L_M	Rubber Duck	Camera
9/22/2019	Maui Nui	24717	21.010622	-156.76388	HB_L_M	Rubber Duck	Camera
9/22/2019	Maui Nui	24979	21.015341	-156.871173	HB_L_S	Rubber Duck	Camera
9/22/2019	Maui Nui	24979	21.015406	-156.872607	HB_L_S	Rubber Duck	Camera
9/22/2019	Maui Nui	24998	21.014491	-156.78017	HB_L_M	Rubber Duck	Camera
9/22/2019	Maui Nui	24998	21.012892	-156.780623	HB_L_M	Rubber Duck	Camera

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
9/22/2019	Maui Nui	25280	21.020532	-156.79357	HB_L_M	Rubber Duck	Camera
9/22/2019	Maui Nui	25280	21.019805	-156.795471	HB_L_M	Rubber Duck	Camera
9/22/2019	Maui Nui	25572	21.021383	-156.776133	HB_L_M	Oscar Sette	Camera
9/22/2019	Maui Nui	25572	21.02308	-156.773593	HB_L_M	Oscar Sette	Camera
9/22/2019	Maui Nui	25573	21.024462	-156.769844	HB_L_M	Steel Toe	Camera
9/22/2019	Maui Nui	25573	21.022896	-156.77082	HB_L_M	Steel Toe	Camera
9/22/2019	Maui Nui	26161	21.033795	-156.77878	HB_L_M	Steel Toe	Camera
9/22/2019	Maui Nui	26161	21.031386	-156.780279	HB_L_M	Steel Toe	Camera
9/22/2019	Maui Nui	27080	21.047471	-156.767211	HB_H_M	Steel Toe	Camera
9/22/2019	Maui Nui	27080	21.044564	-156.769044	HB_H_M	Steel Toe	Camera
9/22/2019	Maui Nui	27379	21.050231	-156.784987	HB_H_S	Rubber Duck	Camera
9/22/2019	Maui Nui	27379	21.04952	-156.784422	HB_H_S	Rubber Duck	Camera
9/22/2019	Maui Nui	30145	21.105523	-156.712005	HB_H_S	Oscar Sette	Camera
9/22/2019	Maui Nui	30145	21.102734	-156.712278	HB_H_S	Oscar Sette	Camera
9/22/2019	Maui Nui	30250	21.109647	-156.704606	HB_H_S	Oscar Sette	Camera
9/22/2019	Maui Nui	30250	21.108345	-156.707335	HB_H_S	Oscar Sette	Camera
9/22/2019	Maui Nui	30542	21.120445	-156.673103	HB_H_M	Oscar Sette	Camera
9/22/2019	Maui Nui	30542	21.123106	-156.670987	HB_H_M	Oscar Sette	Camera
9/23/2019	Maui Nui	21569	20.957168	-156.993377	HB_H_S	Oscar Sette	Camera
9/23/2019	Maui Nui	21569	20.959898	-156.99187	HB_H_S	Oscar Sette	Camera
9/23/2019	Maui Nui	22314	20.971174	-156.974104	SB_A_S	Oscar Sette	Camera
9/23/2019	Maui Nui	22314	20.971077	-156.971227	SB_A_S	Oscar Sette	Camera
9/23/2019	Maui Nui	23341	20.987296	-156.905235	HB_H_S	Oscar Sette	Camera
9/23/2019	Maui Nui	23341	20.990451	-156.905458	HB_H_S	Oscar Sette	Camera
9/23/2019	Maui Nui	23600	20.991895	-156.910409	HB_H_S	Oscar Sette	Camera
9/23/2019	Maui Nui	23600	20.99511	-156.909441	HB_H_S	Oscar Sette	Camera
9/24/2019	Big Island	2387	19.629589	-154.945754	HB_H_S	Rubber Duck	Camera
9/24/2019	Big Island	2387	19.629011	-154.94709	HB_H_S	Rubber Duck	Camera
9/24/2019	Big Island	2535	19.678757	-154.964993	HB_H_S	Steel Toe	Camera
9/24/2019	Big Island	2535	19.679628	-154.962623	HB_H_S	Steel Toe	Camera
9/24/2019	Big Island	2606	19.708527	-154.977076	HB_H_S	Rubber Duck	Camera
9/24/2019	Big Island	2606	19.70917	-154.977806	HB_H_S	Rubber Duck	Camera
9/24/2019	Big Island	2700	19.733191	-154.987065	HB_H_S	Steel Toe	Camera
9/24/2019	Big Island	2700	19.733657	-154.984857	HB_H_S	Steel Toe	Camera
9/24/2019	Big Island	3018	19.769666	-155.022231	HB_H_S	Oscar Sette	Camera
9/24/2019	Big Island	3018	19.769574	-155.025627	HB_H_S	Oscar Sette	Camera
9/24/2019	Big Island	3278	19.792287	-155.04851	HB_H_S	Oscar Sette	Camera
9/24/2019	Big Island	3278	19.794181	-155.046002	HB_H_S	Oscar Sette	Camera
9/24/2019	Big Island	3451	19.80457	-155.048316	HB_H_S	Oscar Sette	Camera
9/24/2019	Big Island	3451	19.806824	-155.048231	HB_H_S	Oscar Sette	Camera
9/24/2019	Big Island	3512	19.811371	-155.043063	HB_H_M	Rubber Duck	Camera
9/24/2019	Big Island	3512	19.810468	-155.04068	HB_H_M	Rubber Duck	Camera
9/24/2019	Big Island	3698	19.825435	-155.049676	HB_H_M	Steel Toe	Camera
9/24/2019	Big Island	3698	19.822322	-155.049198	HB_H_M	Steel Toe	Camera
9/24/2019	Big Island	3899	19.838003	-155.06951	SB_A_S	Rubber Duck	Camera
9/24/2019	Big Island	3899	19.839908	-155.070007	SB_A_S	Rubber Duck	Camera
9/24/2019	Big Island	4110	19.850072	-155.059065	HB_H_S	Steel Toe	Camera
9/24/2019	Big Island	4110	19.852656	-155.058518	HB_H_S	Steel Toe	Camera
9/24/2019	Big Island	4464	19.873787	-155.04694	HB_L_M	Rubber Duck	Camera
9/24/2019	Big Island	4464	19.875601	-155.045743	HB_L_M	Rubber Duck	Camera
9/24/2019	Big Island	4603	19.883329	-155.065478	HB_L_M	Steel Toe	Camera
9/24/2019	Big Island	4603	19.882015	-155.064956	HB_L_M	Steel Toe	Camera
9/25/2019	Big Island	8163	20.152556	-155.609759	HB_H_S	Steel Toe	Camera
9/25/2019	Big Island	8163	20.152299	-155.612145	HB_H_S	Steel Toe	Camera
9/25/2019	Big Island	8165	20.152364	-155.600617	SB_A_M	Steel Toe	Camera
9/25/2019	Big Island	8165	20.152935	-155.601821	SB_A_M	Steel Toe	Camera
9/25/2019	Big Island	8712	20.187683	-155.682337	SB_A_S	Rubber Duck	Camera
9/25/2019	Big Island	8712	20.188532	-155.682169	SB_A_S	Rubber Duck	Camera
9/25/2019	Big Island	8980	20.221834	-155.682563	HB_H_M	Steel Toe	Camera
9/25/2019	Big Island	8980	20.219562	-155.682829	HB_H_M	Steel Toe	Camera
9/25/2019	Big Island	9008	20.224364	-155.720141	HB_H_S	Rubber Duck	Camera
9/25/2019	Big Island	9008	20.226607	-155.720587	HB_H_S	Rubber Duck	Camera

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
9/25/2019	Big Island	9217	20.246989	-155.716021	SB_A_S	Oscar Sette	Camera
9/25/2019	Big Island	9217	20.249645	-155.713144	SB_A_S	Oscar Sette	Camera
9/25/2019	Big Island	9418	20.269503	-155.786639	SB_A_S	Steel Toe	Camera
9/25/2019	Big Island	9418	20.2693	-155.784602	SB_A_S	Steel Toe	Camera
9/25/2019	Big Island	9479	20.27137	-155.794993	HB_L_S	Rubber Duck	Camera
9/25/2019	Big Island	9479	20.273216	-155.796426	HB_L_S	Rubber Duck	Camera
9/25/2019	Big Island	9660	20.285802	-155.815696	HB_L_S	Oscar Sette	Camera
9/25/2019	Big Island	9660	20.28693	-155.813056	HB_L_S	Oscar Sette	Camera
9/25/2019	Big Island	9675	20.283425	-155.743584	HB_L_M	Oscar Sette	Camera
9/25/2019	Big Island	9675	20.285594	-155.741172	HB_L_M	Oscar Sette	Camera
9/25/2019	Big Island	9702	20.294188	-155.899744	HB_L_M	Rubber Duck	Camera
9/25/2019	Big Island	9702	20.293176	-155.900904	HB_L_M	Rubber Duck	Camera
9/25/2019	Big Island	9762	20.294697	-155.894428	HB_L_M	Rubber Duck	Camera
9/25/2019	Big Island	9762	20.29546	-155.896149	HB_L_M	Rubber Duck	Camera
9/26/2019	Maui Nui	19743	20.925102	-157.553594	HB_H_S	Rubber Duck	Camera
9/26/2019	Maui Nui	19743	20.923684	-157.554494	HB_H_S	Rubber Duck	Camera
9/26/2019	Maui Nui	20067	20.930901	-157.536655	HB_H_S	Steel Toe	Camera
9/26/2019	Maui Nui	21772	20.968432	-157.459501	HB_H_S	Oscar Sette	Camera
9/26/2019	Maui Nui	21772	20.966408	-157.459716	HB_H_S	Oscar Sette	Camera
9/26/2019	Maui Nui	23006	20.990915	-157.488517	HB_L_S	Oscar Sette	Camera
9/26/2019	Maui Nui	23006	20.989972	-157.486406	HB_L_S	Oscar Sette	Camera
9/26/2019	Maui Nui	23796	21.003801	-157.401227	HB_H_M	Steel Toe	Camera
9/26/2019	Maui Nui	23796	21.001917	-157.399356	HB_H_M	Steel Toe	Camera
9/26/2019	Maui Nui	23797	21.004449	-157.395063	HB_H_M	Rubber Duck	Camera
9/26/2019	Maui Nui	23797	21.005263	-157.39401	HB_H_M	Rubber Duck	Camera
9/26/2019	Maui Nui	24055	21.009281	-157.424683	HB_L_S	Rubber Duck	Camera
9/26/2019	Maui Nui	24055	21.008436	-157.421962	HB_L_S	Rubber Duck	Camera
9/26/2019	Maui Nui	24328	21.010596	-157.404189	HB_H_S	Steel Toe	Camera
9/26/2019	Maui Nui	24328	21.010938	-157.405849	HB_H_S	Steel Toe	Camera
9/26/2019	Maui Nui	26721	21.042797	-157.030214	HB_L_S	Oscar Sette	Camera
9/26/2019	Maui Nui	26721	21.045846	-157.030158	HB_L_S	Oscar Sette	Camera
9/26/2019	Maui Nui	27027	21.047638	-157.025241	HB_H_S	Oscar Sette	Camera
9/26/2019	Maui Nui	27027	21.050431	-157.023716	HB_H_S	Oscar Sette	Camera
9/27/2019	Maui Nui	24116	21.003111	-156.996323	HB_H_S	Steel Toe	Camera
9/27/2019	Maui Nui	24116	21.004615	-156.997281	HB_H_S	Steel Toe	Camera
9/27/2019	Maui Nui	24399	21.006772	-156.958137	HB_H_S	Steel Toe	Camera
9/27/2019	Maui Nui	24399	21.008464	-156.957848	HB_H_S	Steel Toe	Camera
9/27/2019	Maui Nui	24690	21.011179	-156.893561	HB_H_S	Rubber Duck	Camera
9/27/2019	Maui Nui	24690	21.012135	-156.89418	HB_H_S	Rubber Duck	Camera
9/27/2019	Maui Nui	24947	21.017786	-157.025901	HB_H_M	Steel Toe	Camera
9/27/2019	Maui Nui	24947	21.01657	-157.023699	HB_H_M	Steel Toe	Camera
9/27/2019	Maui Nui	25519	21.02552	-157.028292	HB_H_M	Rubber Duck	Camera
9/27/2019	Maui Nui	25519	21.026644	-157.030191	HB_H_M	Rubber Duck	Camera
9/27/2019	Maui Nui	25529	21.026549	-156.980697	HB_L_S	Rubber Duck	Camera
9/27/2019	Maui Nui	25529	21.02764	-156.981093	HB_L_S	Rubber Duck	Camera
9/28/2019	Oahu	38168	21.615921	-158.346195	HB_H_M	Steel Toe	Camera
9/28/2019	Oahu	38168	21.616459	-158.344578	HB_H_M	Steel Toe	Camera
9/28/2019	Oahu	38250	21.618681	-158.34168	HB_H_M	Rubber Duck	Camera
9/28/2019	Oahu	38250	21.617854	-158.340872	HB_H_M	Rubber Duck	Camera
9/28/2019	Oahu	38264	21.62071	-158.272335	HB_H_M	Steel Toe	Camera
9/28/2019	Oahu	38264	21.620797	-158.273469	HB_H_M	Steel Toe	Camera
9/28/2019	Oahu	38266	21.617671	-158.261516	HB_H_M	Rubber Duck	Camera
9/28/2019	Oahu	38266	21.617927	-158.261412	HB_H_M	Rubber Duck	Camera
9/28/2019	Oahu	38335	21.625233	-158.326324	HB_H_M	Steel Toe	Camera
9/28/2019	Oahu	38335	21.625261	-158.324369	HB_H_M	Steel Toe	Camera
9/28/2019	Oahu	38535	21.63213	-158.150041	HB_L_M	Rubber Duck	Camera
9/28/2019	Oahu	38535	21.631224	-158.150847	HB_L_M	Rubber Duck	Camera
9/28/2019	Oahu	38617	21.637922	-158.140417	HB_L_S	Steel Toe	Camera
9/28/2019	Oahu	38617	21.635298	-158.142599	HB_L_S	Steel Toe	Camera
9/28/2019	Oahu	38793	21.650759	-158.136002	HB_L_M	Rubber Duck	Camera
9/28/2019	Oahu	38793	21.650115	-158.13617	HB_L_M	Rubber Duck	Camera
9/28/2019	Oahu	38892	21.657447	-158.128126	HB_L_M	Oscar Sette	Camera

SAMPLE_DATE	Island	PSU	lat_deg	lon_deg	STRATUM	VESSEL	GEAR
9/28/2019	Oahu	38892	21.660164	-158.128065	HB_L_M	Oscar Sette	Camera
9/28/2019	Oahu	39137	21.680874	-158.114283	SB_A_M	Oscar Sette	Camera
9/28/2019	Oahu	39137	21.681014	-158.112901	SB_A_M	Oscar Sette	Camera
11/21/2019	Oahu	33104	21.238027	-157.793118	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33104	21.238665	-157.793835	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33107	21.236835	-157.778074	HB_H_M	Ao Shibi IV	Camera
11/21/2019	Oahu	33107	21.238069	-157.778056	HB_H_M	Ao Shibi IV	Camera
11/21/2019	Oahu	33246	21.241978	-157.763195	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33246	21.242742	-157.763262	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33361	21.24551	-157.819503	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33361	21.245771	-157.819846	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33375	21.245632	-157.754484	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33375	21.247405	-157.755877	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33489	21.251236	-157.833989	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33489	21.251804	-157.834009	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33639	21.254211	-157.843947	HB_H_M	Ao Shibi IV	Camera
11/21/2019	Oahu	33639	21.255634	-157.844377	HB_H_M	Ao Shibi IV	Camera
11/21/2019	Oahu	33798	21.258593	-157.844746	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	33798	21.259578	-157.844488	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	34124	21.267355	-157.853281	HB_H_S	Ao Shibi IV	Camera
11/21/2019	Oahu	34124	21.268639	-157.853173	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	33384	21.245955	-157.710246	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	33384	21.245127	-157.710291	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	33668	21.254129	-157.705575	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	33668	21.255218	-157.70387	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	33670	21.255625	-157.697409	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	33670	21.256651	-157.696566	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	35943	21.362865	-157.653185	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	35943	21.363615	-157.651923	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	36026	21.372369	-157.66297	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	36026	21.371658	-157.66206	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	36149	21.387014	-157.671599	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	36184	21.388816	-157.676434	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	36184	21.390311	-157.67702	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	36432	21.425219	-157.680354	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	36432	21.4265	-157.679945	HB_H_S	Ao Shibi IV	Camera
11/25/2019	Oahu	36752	21.464814	-157.692665	HB_H_M	Ao Shibi IV	Camera
11/25/2019	Oahu	36752	21.46608	-157.696106	HB_H_M	Ao Shibi IV	Camera
11/26/2019	Oahu	32960	21.233199	-157.725163	HB_H_M	Ao Shibi IV	Camera
11/26/2019	Oahu	32960	21.232016	-157.723835	HB_H_M	Ao Shibi IV	Camera
11/26/2019	Oahu	33118	21.237269	-157.725429	HB_H_S	Ao Shibi IV	Camera
11/26/2019	Oahu	33118	21.237054	-157.725945	HB_H_S	Ao Shibi IV	Camera
11/26/2019	Oahu	33120	21.2361	-157.71582	HB_H_S	Ao Shibi IV	Camera
11/26/2019	Oahu	33120	21.236449	-157.716686	HB_H_S	Ao Shibi IV	Camera
11/26/2019	Oahu	33257	21.240746	-157.7102	HB_H_S	Ao Shibi IV	Camera
11/26/2019	Oahu	33257	21.24081	-157.710434	HB_H_S	Ao Shibi IV	Camera
11/26/2019	Oahu	33380	21.246454	-157.729848	HB_H_S	Ao Shibi IV	Camera
11/26/2019	Oahu	33380	21.245506	-157.731502	HB_H_S	Ao Shibi IV	Camera
11/26/2019	Oahu	34012	21.263939	-157.580831	HB_L_M	Ao Shibi IV	Camera
11/26/2019	Oahu	34012	21.262983	-157.580937	HB_L_M	Ao Shibi IV	Camera
11/26/2019	Oahu	34787	21.286224	-157.593973	HB_L_S	Ao Shibi IV	Camera
11/26/2019	Oahu	34787	21.285674	-157.595107	HB_L_S	Ao Shibi IV	Camera