Larval ecology of uku (*Aprion virescens*) in the main Hawaiian Islands: a review from historical data

Andrea L. Schmidt, Jonathan L. Whitney, Justin Suca, Kisei R. Tanaka

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration

National Marine Fisheries Service
Pacific Islands Fisheries Science Center

NOAA Technical Memorandum NMFS-PIFSC-145
https://doi.org/10.25923/aevx-hr06

August 2023

Larval ecology of uku (*Aprion virescens*) in the main Hawaiian Islands: a review from historical data

Andrea L. Schmidt[1,2], Jonathan L. Whitney[2] , Justin Suca[1,2], Kisei R. Tanaka[2]

[1] Cooperative Institute for Marine and Atmospheric Research
University of Hawai‘i
1000 Pope Road
Honolulu, Hawai‘i 96822

[2] Pacific Islands Fisheries Science Center (PIFSC)
National Marine Fisheries Service
1845 Wasp Boulevard
Honolulu, Hawai‘i 96818

NOAA Technical Memorandum NMFS-PIFSC-145

August 2023

U.S. Department of Commerce

Gina Raimondo, Secretary

National Oceanic and Atmospheric Administration
Richard W. Spinrad, Ph.D., NOAA Administrator

National Marine Fisheries Service
Janet Coit, Assistant Administrator for Fisheries

About this report

The Pacific Islands Fisheries Science Center of NOAA's National Marine Fisheries Service uses the NOAA Technical Memorandum National Marine Fisheries Service–Pacific Islands Fisheries Science Center (NMFS-PIFSC) series to disseminate scientific and technical information that has been scientifically reviewed and edited. Documents within this series reflect sound professional work and may be referenced in the formal scientific and technical literature.

Recommended citation:

Schmidt AL, Whitney JL, Suca J, Tanaka K. 2023. NOAA Fisheries Larval ecology of Aprion virescens: a review from historical data NOAA Tech. Memo. TM-PIFSC-145, 71 p. https://doi.org/10.25923/aevx-hr06

Copies of this report may be obtained online at: http://spo.nmfs.noaa.gov/tech-memos/

Cover: Larval uku: Andrea Schmidt

Adult uku: https://media.fisheries.noaa.gov/dam-migration-miss/1280_QR6zmh58paQ8.jpg?1592520795

CONTENTS

List of Figures

Executive Summary

Aprion virescens (known in Hawai‘i as uku, broadly, the green jobfish) are a commercially and recreationally important species in the main Hawaiian Islands (MHI). These eteline snappers are top predators on coral reefs throughout the Indo-Pacific and, although they are bottom fish like Hawaii's Deep 7 species, they can be found in much shallower waters than other Deep-7 species. The current Essential Fish Habitat (EFH) designation for post-hatch ("larval") uku extends from 0 to 240 m in depth and from island shorelines to the edge of the Exclusive Economic Zone (EEZ) of the United States. Uku employ a biphasic life cycle which includes a planktonic larval phase after hatch. However, little is known about this species' early life history, which is a critical part of the definition of EFH. We investigated the distribution of its abundance and oceanographic characteristics associated with larvae and pelagic juvenile uku observations. A comprehensive literature review and Indo-Pacific wide specimen inventory was combined with an examination of archived ichthyoplankton samples collected in the proximity of O‘ahu. Our final data set consisted of fewer than 300 records of individual larval uku collected throughout MHI from 1967 to 2012. We characterize size and habitat patterns for 230 larvae from preflexion (3 mm) to pelagic juveniles (30-mm total length) with associated environmental data (surface temperature, surface salinity, date of collection and collection depth). Larval observations from archived samples (2–6.5 mm total length) were restricted to the top 40 m of the water column and the majority of larvae were found 1–27 km from shore. Larvae from the literature (3–30 mm total length) were found 0.5–88 km from shore. We also evaluated sizes of settled benthic juveniles and discovered a knowledge gap; juvenile uku between 30 and 90 mm in length have yet to be recorded anywhere in the Pacific, and thus their habitat use during this critical settlement period is unknown. Our results extend existing information about larval uku habitat and highlight the need for more targeted studies on the early life stages, especially focused on pelagic larval duration (PLD), release depth and locations, of this commercially and culturally important species.

Introduction and Scope

Aprion virescens (Green jobfish) Valenciennes, 1830 is an eteline snapper (Family: Lutjanidae, subfamily: etelinae) found throughout the Indo-Pacific (Allen 1985, Anderson 1987, Kulbicki et al. 2005, Leis and Lee 1994, Talbot 1960,) and is the only member of its genus (Anderson 1987). In ʻōlelo Hawaiʻi the name for this species is uku, and is how *A. virescens* will be referred to for the remainder of this report. Uku are highly mobile, (Meyer et al. 2007, Asher et al. 2017, Filous et al. 2017) and have also been observed to spend time near "home" reefs in the Northwestern Hawaiian Islands (Meyer et al. 2007). Uku have a primarily piscivorous diet (Haight et al. 1993) and have been described as top predators (Meyer et al. 2007, Filous et al. 2017, Asher et al. 2017). Data from fishing studies (Haight et al. 1993) and telemetry tag studies (Filous et al. 2017) suggest uku are diurnal. Recent work involving fishermen interviews suggests that uku are also very active at night (Ayers 2022) and data gaps from a telemetry study on uku were mostly related to the lack of data on nighttime behavior of uku (Meyer et al. 2007). Uku, important socially and economically in the MHI, have value for commercial and recreational fishers as both a main target and consistent secondary target species (Ayers 2022). Nearly all of the uku caught in Hawaiʻi stay in Hawaiʻi, and several communities and regions across the MHI score highly in quotient measured for uku at variable scales (Ayers 2022). Uku is the only shallow bottomfish stock in Hawaiʻi within the Bottomfish Management Unit Species (BMUS) complex (NMFS and WPFMC 2021 section 3.2.4.1). Currently, the stock of uku in the MHI is not overfished nor is it experiencing overfishing and in fact, experienced an increase in population biomass between 2004 and 2018, but the mechanism underlying this is unknown (Nadon et al. 2020). In Hawaiʻi, uku are found in water 0–240 m deep (WPRFMC 2016). They are broadly distributed across depth and habitat types but have been observed most frequently over rubble and sand flats (Asher et al. 2017) on coral reefs (Meyer et al. 2007).

State of Knowledge of Uku Early Life History

Fish in the family, Lutjanidae (henceforth, "lutjanids") have a biphasic lifestyle. They generally engage in broadcast spawning where adults produce pelagic eggs that hatch into larvae (Grimes 1987). The larvae develop in the water column before settling to benthic habitat and then eventually moving into adult habitat (Leis and Lee 1994). The ecology of early life stages remains largely unknown. Generally, lutjanid larvae are rare in plankton samples globally (Newman et al. 2016), and species-level abundances are often too sparse to generate quantitative analyses of larval lutjanid habitat (Leis 1987). This is especially true of uku. Currently, we do not know a series of important life history questions: how frequently batch spawning occurs in a season (Everson et al. 1989), what are the specific cues for spawning, what their eggs look like, the egg duration, size-at-hatch, larval growth rates, age of first exogenous feeding, their pelagic larval duration (PLD), larval size distribution across space, depth distribution of larvae and the oceanographic preferences of larvae. Prior to this contribution, there were no literature records nor analyses of larval uku occurrence or size distributions in relation to their location, depth distributions, or general larval habitat.

Earlier work on uku adults has shown that they spawn from May to October, with a peak in June (Everson et al. 1989). Individuals reach sexual maturity around 4 to 5 years old (43- to 48-cm long; Everson 1989) and spawning occurs chiefly at night (Grimes 1987). Eggs of many lutjanids remain in the water column for 3–4 days before hatching and larvae will remain in the water column from 25 to 47 days (Leis 1987), although to what extent this is true for uku is unknown. The spawning aggregation site at Penguin Banks (the shoals immediately southwest of Molokaʻi) is the only known site in the MHI

(WPRFMC 2021, Ayers 2022). The lack of specificity makes constraining where larvae might be found more difficult. Adult uku in the Northwestern Hawaiian Islands have been found to spend much of their time near the same atoll and rarely venture between atolls (Meyer et al. 2007). These adults are recorded more frequently in the summer and perhaps these "home" atolls are connected with spawning (Meyer et al. 2007).

The habitat areas utilized by uku larvae and juveniles needs to be more specifically defined in order to enhance the current ecosystem based management approach for this federally managed species. Our goal is to define these habitat areas and determine to what extent they are EFH as defined by *"…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity… "Waters" include [consideration of] physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate"* (Magnuson-Stevens Act, 2022). Current EFH designation for uku specifies that *"uku egg habitat comprises…[the] 0–240 m depth range from shore line, out to 50 miles. The Post Hatch Pelagic stage (larvae) EFH comprises of 0–240 m depth range from the shoreline to the EEZ boundary. The post settlement and subadult stage EFH covers the benthic/benthopelagic zone 0–240 m depth range and finally adult EFH is the entire benthopelagic zone from 0 to 240 m depth"* (WPRFMC 2016). We will specify to what extent this is consistent with the data presented here.

Goals and Objectives

The overarching goal of this report is to advance the state of knowledge of ecology and habitat use of larval and pelagic juvenile uku to refine BMUS EFH designations in the Pacific Islands Region. **Our specific objective will be to develop a present-day understanding of larval habitat utilization. Quantifying larval uku occurrence in this way will assist with future habitat models, refine Hawai'i EFH and Habitat Areas of Particular Concern (**HAPCs**), and advise how best to conduct future larval monitoring to fill in gaps on habitat use, particularly in nearshore environments.** To help determine the oceanographic conditions and habitats utilized by uku early life stages we generated a presence-absence data set with associated environmental data from literature, reports, specimen collections, museum records, and unpublished data. We also processed (sorted, identified and measured) larval uku from a backlog of existing partially processed wet-archived ichthyoplankton samples.

Methods

First, we conducted a literature review to obtain all records of larval uku found between 1967 and 2012. We considered museum records (n = 149 museums accessed via n=15 databases), scientific publications, government technical reports, personal notes and Pacific Island Fisheries Science Center (PIFSC) data records. At each of these sources we used the following search terms: "*Aprion virescens,*" "*aprion virescens,*" "*Aprion,*" "uku," "green jobfish," "grey snapper," -lutjanus -griseus -caribbean -florida" or "grey snapper NOT *Lutjanus griseus*." We then sought to match *in situ* environmental data with each record of a given uku larva. After compiling a presence-only and a presence-absence data set we identified and measured larval uku from wet archived ichthyoplankton samples at PIFSC. Finally, these results were analyzed statistically to yield some insight into larval uku habitat preferences.

Literature review

Records of larval and juvenile uku were gathered from a variety of sources including published papers, government reports and museum collections. Any specimen up to 30 mm in length was treated as a larva for this report (also referred to as "post-hatch pelagic", WPRFMC 2016), although these larvae start to become pelagic juveniles with the development of scales (around 7.1-mm total length, Leis and Lee 1994). Benthic-associated juveniles and sub-adults ("post settlement," WPRFMC 2016) were considered those ranging from 150 to 420 mm in length. The gap in records from 30 to 150 mm likely straddles the pelagic-benthic transition. Since the focus of this report is on the early life history of uku this binning of benthic juvenile to the end of sexual immaturity was useful in that it constrained our records search and contextualizes pelagic stage (hatch to settlement period).

Search specifications

We initially focused on optimizing uku related search terms to yield sufficient records for a systematic review. Since we did not find any publications which explicitly describe their larval ecology (larval uku were only mentioned in passing in Boehlert and Mundy 1996 and Gray 1993) and found only one publication which described how to identify larval uku (Leis and Lee 1994). We shifted our focus to obtaining all possible records of larval uku throughout their range. Starting from the University of Hawai‘i at Mānoa's Library website we first searched the library holdings. Then we utilized the following, relevant search terms for databases: "aquaculture", "biology" or "natural resource management". These led us to the Web of Science, The Biodiversity Heritage Library (BHL), The Pacific Data Hub (via the Secretariat of the Pacific Community website) and BioOne Complete. In addition to these recommended databases we also searched the GoogleScholar and the NOAA Scientific Publication Office websites. At each of these databases we searched for "*Aprion virescens*," "*Aprion,*" "uku," "green jobfish," "gray jobfish," "grey jobfish," "grey snapper" -lutjanus -griseus -caribbean – "florida" or "grey snapper" NOT *Lutjanus griseus*. Besides web databases, we also searched museum collections (at VertNet and then specific museums indicated either by geography (a Natural History Museum in the Indo-Pacific region with a larval fish collection or referenced from the BHL citations, Supplement 1.A). Where online searchable collections were unavailable we sent emails. An initial email was sent to the Australian museum which came back with 72 records of uku specimens (POC Amanda Hay). This specimen list was the largest collection of uku larvae after the holdings in the Wet Archive at PIFSC. Many of the data sets of larvae are in reference to the survey where the larvae were collected, not the original source of specimen record. Some records are incomparable to other data sets due to how

deeply different the survey methodologies were, however, since these could still provide information about larval uku on their own they were coded as "case studies" (C, see Table 2).

Larval data set assembly

Two data sets were assembled for the use of analyzing uku habitat preferences for larvae and juveniles. The first set is categorized as presence only data and came from museum records, government technical reports and personal notes, comprising 8 total sources, 6 of which were unique to the MHI. These collections spanned a variety of survey techniques, year and net types. Names of the nets and their associated descriptions in publications are listed: Multiple Opening/Closing Net and Environmental Sensing System (MOCNESS, Weibe et al. 1985), Cobb Trawl (McNeely et al. 1965), large and small bongo nets (Clarke 1991), 0.5 m plankton net (Westree et al. 1972), these final three are grouped together as "small nets". Summarized briefly, these include collections from 14 small net tows (0.5–1 m, 1972–1978), 87 one m^2 MOCNESS tows (1985–1986), 36 Cobb midwater trawls (2011–2012), 1 multi-year diver survey, and 1 survey that amalgamated several handline caught specimens (see Table 2).

Metadata such as collection depth, salinity, and temperature were taken from the source material where available and calculated or derived from corroborating publications and CTD data. Of these, larvae collected in the MHI were considered in the context of the surveys in which they were collected. Those surveys, which included collection information for plankton tows that did not yield uku were compiled in their entirety to create a true presence-absence data set (Table 2).

Information for all larval records were compiled and organized into a spreadsheet where collection site and date could be compared. Size information is also included but is inconsistent across records. For museum records with incomplete metadata we consulted the referenced publications or matched the collection information to publications we found. The missing information in museum records, technical reports and personal notes was filled in, where data were available, by emailing relevant authors (detailed in Appendix 1).

Juvenile data set assembly

In addition to larvae, juvenile uku were of interest because the size at which larval uku settle out from the plankton and become demersal is unknown. For this report we describe any uku between 15 and 30 cm in length a benthic associated juvenile, where individuals live demersally, but have perhaps not recruited to a particular reef and are not yet sexually mature. This definition of juvenile in this report is largely identical to the post-settlement stage (WPFRMC 2016). Data from the National Coral Reef Monitoring Program (NCRMP; 2010–2019) and Baited Remote Underwater Video (BRUVs) data from (2012–2014) were considered. NCRMP data consisted of point count surveys conducted on scuba from April to December (McCoy et al. 2019). Several publications about adult uku were included for more background information on the species. Publications which included information on subadult/juvenile were also considered.

Measuring Larval Sizes

We processed larval uku from a backlog of existing partially processed wet-archived ichthyoplankton samples from O'ahu that were likely to contain larval uku and enhance available record data. Using criterion developed by Leis and Lee 1994 (1984) we identified and measured uku larvae from ichthyoplankton samples collected around the island of O'ahu on cruises TC8504 (September 6–15,

1985) and TC8604 (June 24–July 2, 1986). These cruises were part of a year-long series of quarterly surveys described in Boehlert and Mundy (1996). Every 3 months a series of MOCNESS tows were conducted at 1.8, 9.3, and 27.8 km from shore during the day and the night. Two replicates were collected for each station, but not all replicates were processed. Since the entirety of these samples were archived and stored at PIFSC, we processed the second replicate for TC8604 and measure all previously identified uku from TC8504. These were the only depth integrated samples for which we could generate length data along a gradient from shore. Examination occurred under an EVOCAM2 scope (Vision Engineering Ltd, United Kingdom) and measurements of larval standard length were conducted with the ViPlus software (Vision Engineering Ltd, United Kingdom). The first replicates of the Boehlert and Mundy (1996) data set were used to review lutjanidae identification with a focus on uku and were examined several times. Previously unexamined samples from the second replicate were examined and the uku therein were removed. All identified uku were measured for standard length using the "line" tool in ViPlus. Flexion larvae were measured in segments, measurement points started from the caudal end of the vertebrae to the lateral line at the deepest point of the curve. The next measurement started from the same point and went to the most protruding point on the nose. Bent larvae, or those curled in on themselves which were not easily flattened without damaging the specimen, were laid vertically and measurements were taken in segments along their dorsal side from nose to tail end (Figure 1, D). In all other cases, a straight, single line measurement was taken (Figure 1, A, B).

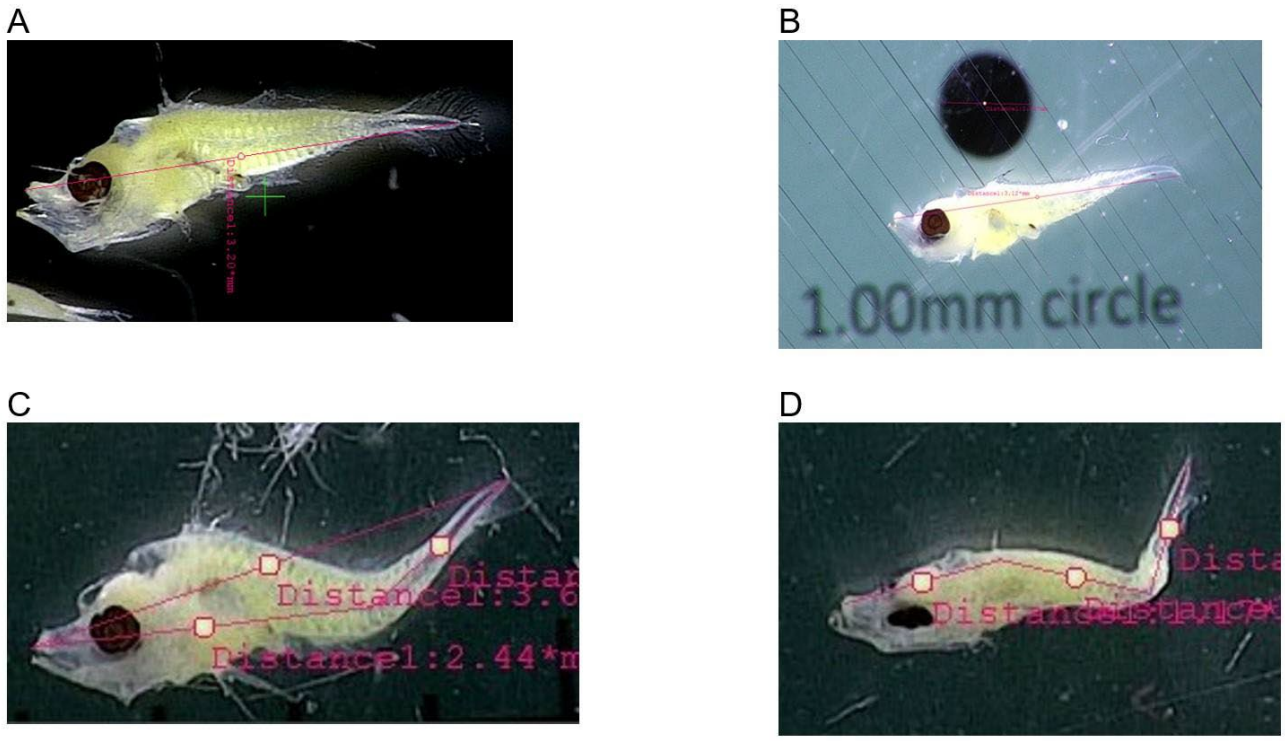

Figure 1. Larval uku were measured with daily calibrated ViPlus software under the EvoCam2. Those which were clearly pre-flexion (A and B) were measured with a straight line while those in flexion or bent required one (C) to two (D) more measurement lines.

Statistical analysis

Different statistical analyses were applied to the presence-absence and the presence only data sets. All scripts can be found at https://github.com/a-larval-schmidt/uku_efh.

Environmental Data

All relevant environmental data was compiled for each collection record of a larval uku. Larvae from surveys for which all trawl dates and locations were available were considered (n=232 trawls across n=6 surveys) for the presence-absence data set to ensure true absence data. For multi-month or multi-year cruise series where larval uku were collected, only cruise legs where environmental data were available and uku were collected and identified were utilized. Maximum depth at collection sites in the MHI were taken from the collection record or publication where possible. Depth and distance to shore were calculated from the starting coordinate point for each ichthyoplankton trawl. The SRTM15+ v2 global bathymetry data set (Tozer et al. 2019) was utilized to assess bottom depth for trawl locations and distance to shore. Distance to shore was calculated as the geodesic distance in meters to the nearest point on the shoreline (as defined by the nearest emergent land feature). Trawls were classified by net type as there was variety between cruises. Only trawls conducted with a MOCNESS gave information about depth of capture (within 10 to 20 m) for larvae because of the opening/closing feature on this net type. All other trawls utilized nets which were towed obliquely at specific depths, which meant larval capture could have occurred anywhere in between the maximum net depth and the surface.

Temperature and salinity data were gathered for all tows that yielded uku larvae. Environmental data from ichthyoplankton trawls conducted on NOAA ships were downloaded from InPort or by PIFSC data request (Table 1). Where the coordinates for a larval collection tow and CTD cast did not match up, collection and cast coordinates were matched in the R programming environment ("Prairie Trillium" Release (9f796939, 2022-02-16, code available on github at a-larval-schmidt/uku_efh). If a collection was conducted within the length of that tow from a CTD cast, surface temperature and salinity for the cast were matched with the collection tow. Those collections tows more than their own length away from a CTD cast were coded NA to avoid erroneous assignment of unmatched CTD casts. Surface temperature and salinity were used for all analyses. MOCNESS data from Boehlert and Mundy (1996) provided temperature and salinity at the depth of capture of a given larva. Capture depth was unavailable, however, for larvae collected with a Cobb trawl so surface temperature and salinity were used for these tows to represent the most conservative and consistent depths available across data sets. Sources from the literature review highlighted the importance of moon phase in the timing of adult spawning (Grimes, 1987) hence why it was considered in relation to larval presence-absence. We used lunar illumination as a proxy of moon phase. Lunar illumination was estimated using the "getMoonIllumination" function from the R package suncalc (Thieurmel and Elmarhraoui, 2019) with collection date as input. The individual lunar illumination splines for the models showed virtually no change across larval presence-absences and we chose to optimize ecological relevance with the limited data available. Depth of collection, distance to shore, temperature, salinity, and lunar illumination were collectively used as potential predictors of the occurrence of uku larvae throughout cruise data with sufficient metadata.

Table 1. List of sources for Environmental data from InPort of from PIFSC Data Request (PICDR).

Cruise with uku and associated record	Data set name on InPort	InPort ID or Data Request ID	Type of Environmental Data
Cruises SE-12-06 and SE-11-06 (O'Malley et al. 2021)		PICDR-113137	Water column temperature, salinity
TC-85-04, TC-86-04 (Boehlert and Mundy 1996)	Larval Fish Identification from Cruises at O'ahu, TC-85-04, TC-85-05, TC-86-02, TC-86-04	InPort: 8791 PICDR-113141	Water column temperature, salinity, capture depth
TC-32/ Smithsonian (Record sheet from the Australian Museum)	Midwater trawl station data collected during NOAA *R/V Townsend Cromwell* cruise in 1967 in Hawaiian waters	InPort: 5809	Surface and at depth temperatures, salinity

Presence-absence data set

Analyses of larval uku distribution around the MHI were centered on occurrence rather than abundance given the limited number of positive stations within the data set. Absence data included in this report only consists of surveys that included at least one occurrence of an uku larva. It was outside the scope of this report to include all ichthyoplankton surveys ever conducted in proximity to the MHI as absence data.

First, uku larvae presence-absence were plotted as scatter plots and histograms against potentially meaningful variables (distance from shore, collection depth, maximum depth at collection site, date collected (month, year), size, temperature (at surface and depth of site of collection), SST, salinity) at the scale of the MHI only. All models and comparisons were conducted in R, using the *tidyverse* and *lattice* packages (Wickham et al. 2019, Sarkar 2008)

Generalized Additive Models (GAMs) were fitted using the *mgcv* package (Wood, 2011) to assess the role of these environmental covariates on the distribution of uku larvae. General model form followed the equation [1]:

$$(uku\ presence) = binomial(n_k, p_k)$$

$$logit(uku\ presence_k) = \alpha + sampling\ style + cruise\ year + f_1(ln(distance\ to\ shore)) + f_1(log_{10}(volume\ of\ sampled\ water) + f_1(environmental\ predictor_{1k}) + f_1(environmental\ predictor)\ldots + \mathcal{E}_k$$

Uku presence-absence was treated as a binomially distributed variable within a survey trawl, k, across n number of trawls with p number of trawls where uku were present. Gear type and cruise year were included as parametric fixed effects to account for variability in fishing technique and catchability across gear and individual cruise towing patterns. Temperature, salinity, and log of distance to shore were considered as continuous environmental covariates ("environmental predictors") and related to uku presence through thin-plate regression splines, represented by f_1, with a maximum number of four knots (k=4). The log of volume of seawater filtered was used as an offset to account for inter-trawl differences in volume sampled. Volume of water filtered from the MOCNESS was summed per tow to best match the estimates of volume filtered from oblique Cobb Trawls, and the lack of depth integration in Cobb trawl data. Volume of water from the plankton net was taken from the publication where available. Where not available this was calculated as the area of the net opening, multiplied by the track length that the net was towed. To check for spatial autocorrelation, a bubble plot of the residual values were set on a spectrum of blue to red (-2 to 2) and these colored points were mapped atop the MHI, we looked for strong clustering of colors of points. Model quality was assessed by AICc within R with the package MuMIn (Bartoń 2023).

Analyses involving uku presence only

Generalized linear models were generated using the R *lme4* package (Bates et al. 2015) to assess if an ontogenetic relationship exists with distance to the nearest shoreline. First, larval length was plotted against distance from shore as a scatter plot to assess if this was a relationship worth pursuing. General model form followed the equation [2]:

$$(uku\ length\ (mm)_i = Gamma(link=log))$$

$$log(uku\ length\ (mm)) = \beta_0 + ln(\beta_1) + cruise\ number + tow{:}gear\ type{:}\ cruise + \mathcal{E}_i$$

where i represents an individual larva of a given length, β_1 is natural log transformed distance to shore (in meters), $\mathcal{E}$ is residual error and separately, individual tow was nested in gear type was nested in cruise number to serve as random effects for the model.

Results

Literature review

We found 301 records of uku larvae from across the Indo-Pacific collected from 1967 to 2012. Of these larvae, 255 were caught in the MHI during 6 key surveys (some data from the O'Malley et al. 2021 supplement further detail information from the *Sette* cruises of 2011 and 2012). Of those, 3 had both presence and absence data (Table 2) and had sufficiently comparable methods for statistical analyses (i.e., conducted systematic ichthyoplankton surveys from a large research vessel). Presence-only and case-study designated data sets were not considered for presence-absence modeling in relation to environmental covariates. The level of detail available for the larval records found for this study allowed only for a Level 1 analysis (presence-absence) in regards to better defining Essential Fish Habitat (Figure 2, Magnuson-Stevens Act, 2022). Recent studies on adult uku have addressed Level 2 questions in the 0–30 m span of their known range (Tanaka et al. 2022). All of the studies which considered larval uku, with the exception of the environmental impact assessment at Kahe Point (near 158.1332008°W 21.3532642°N; from map in Westree et al. 1972), were conducted in pelagic habitats five or more kilometers from shore (Figure 3). Although Boehlert and Mundy (1996) published 206 records of uku larvae, when we reexamined these sample vials we were only able to positively locate and identify 136 individuals. We cannot comment on the EFH for uku eggs given the lack of observations of uku eggs in the literature.

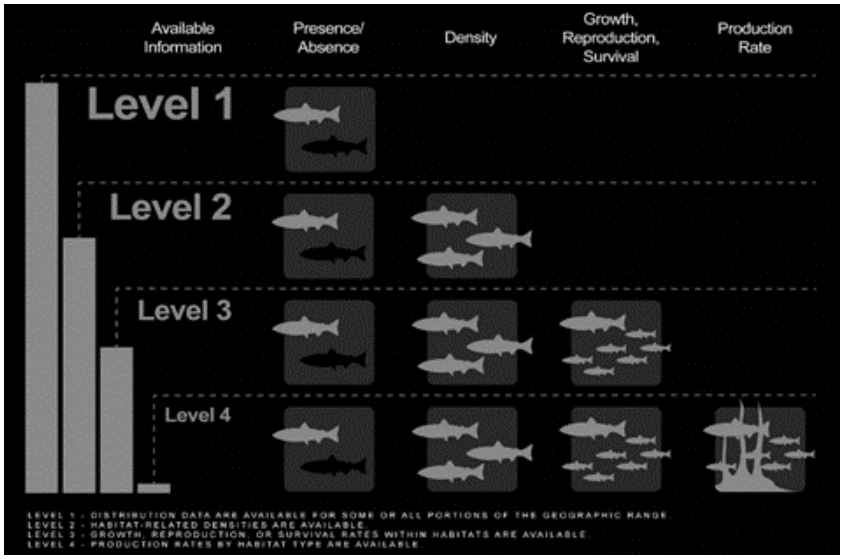

Figure 2. This conceptual diagram of EFH defined by NOAA NMFS shows the prevalence of Level 1 (Presence-absence) surveys relative to studies which address species density or production rate.

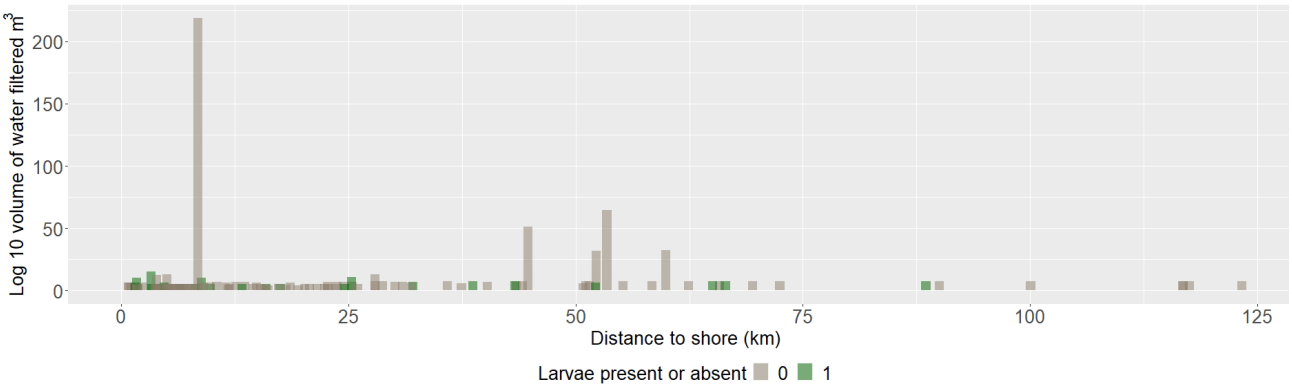

Figure 3. Larval uku presence and absence related to plankton net sampling effort (1967–2012: volume of water filtered) and distance to shore, highlighting how most surveys were conducted offshore in pelagic habitats as opposed to nearshore.

Table 2[1]. Summary of specimen records and metadata from surveys with uku recorded. Data set type: PA = presence-absence data set and subsequent analysis, P = presence only data exist for these larvae, C = case study. For the abbreviations in the environmental data types temp = temperature, sal = salinity, do = dissolved oxygen.

Data set	Data set type	Record type	Date range	uku larvae recorded	Total larvae (all species)	Number of tows (1000 m^3 volume filtered)	Environmental data types	Larval size range (mm)	Habitat sampled
Smithsonian larvae	PA	Museum record	1967	3	unknown	83 tows, 21342 m^3 water	Temp, salinity	5	Pelagic
Collected by T.A. Clarke✦	P	Personal notes, technical memos and museum records	1971, 1977, 1978	4	?	4 tows 28 m^3	none	3–5	Pelagic
Westree et al. 1972	C	Environmental Impact Study	1972	10	4556	24 tows 1154 m^3	Temp	3.2–4.3	Coral reef
Boehlert and Mundy 1996	PA	Technical Memo	1985–1986	206***	155390	87 tows 6828 m^3	Temp, salinity, capture depth*	2–6	Pelagic
Parrish 1989	C	Scientific publication and e-mail	1989	1 juvenile	~20	1 dive	none	155	*Halimeda sp.* stand
R/V Oscar Elton Sette (OES)	PA	Cruise reports	2011–2012	7 larvae	94 lutjanids	81 tows 65855 m^3	Temp, salinity, DO	13–29	Pelagic
O'Malley et al. 2021 supplement	C	Scientific publication	?	3 pelagic juveniles	13**	NA, caught on hand lines	none	94–125	Pelagic

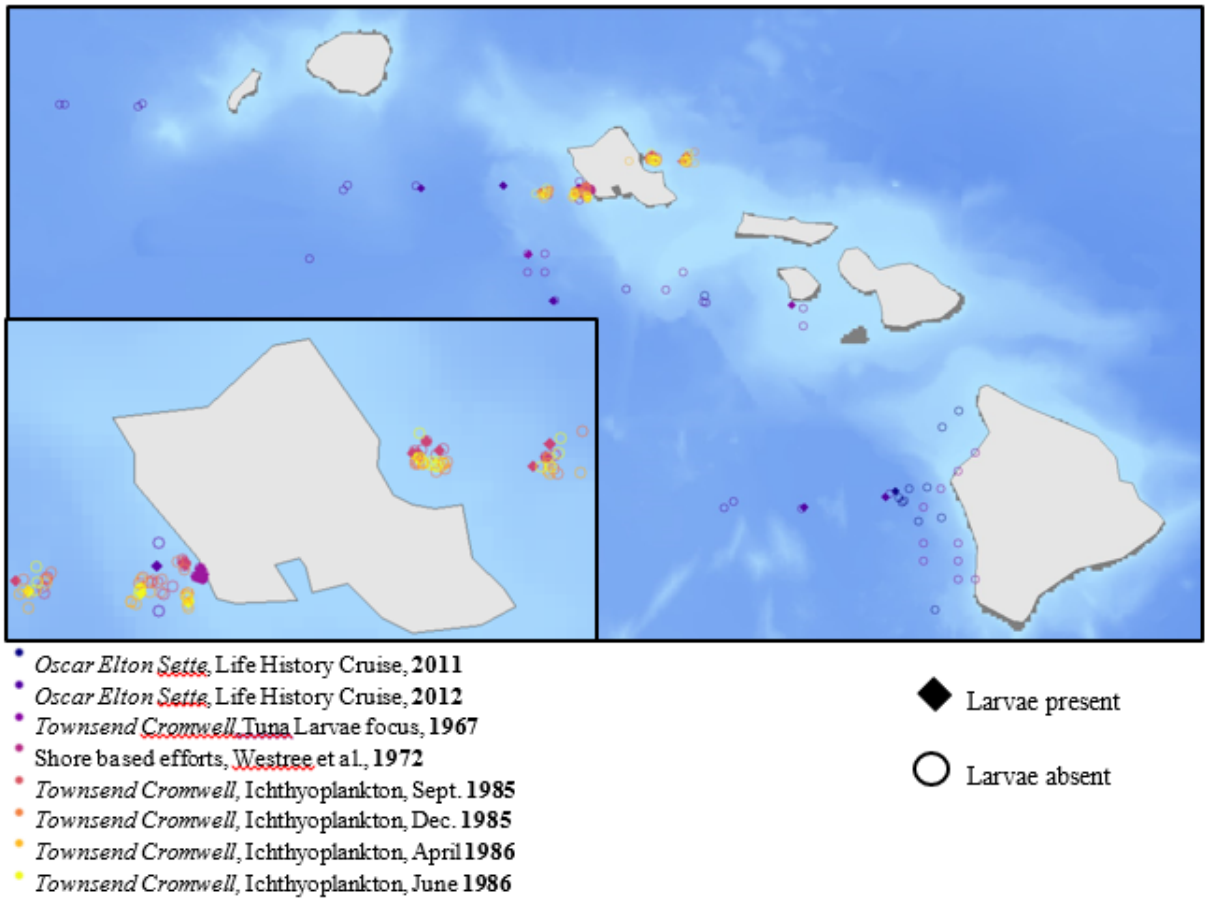

Figure 4. Cruises associated with records of larval uku span nearly five decades and the majority of the main Hawaiian Islands with most sampling clustered around O‘ahu in the mid-1980s (inset panel).

Presence only data set

Presence only data were considered from larvae collected during the following cruises (outlined as P or PA in Table 2): TC-32 (“Smithsonian Larvae”), TC-8504, TC-8604 (“Boehlert and Mundy 1996”), SE11-06 and SE12-06 (“O’Malley et al. 2021 Supplement”), *R/V Kana Keoki* voyages between 1977 and 1987 (“Collected by TA Clarke”). Furthermore, those uku larvae which were kept in the Wet Archive at PIFSC and identified as part of the effort for this report are considered here as well. Our final data set consisted of 255 records of individual larval uku collected throughout MHI from 1967 to 2012.

All known larval uku specimens from the literature have a size range from 3 mm to 29.2 mm in length Figure 5). The 120 re-examined larvae from PIFSC’s archived ichthyoplankton samples ranged from 1.54 mm to 6 mm in length with the majority being close to 3 mm in length (mean: 2.88 mm, SD: +/- 0.64 mm). Preliminary data show a positive relationship (Figure 5, B, C) between size and distance from shore (glmer, 0.00766>|z|), model diagnostic plots Supplement 2. This analysis included some larvae captured within a kilometer from shore (Westree et al 1972). Larvae were captured from June to October, 133/255 larvae (52%) were captured in September.

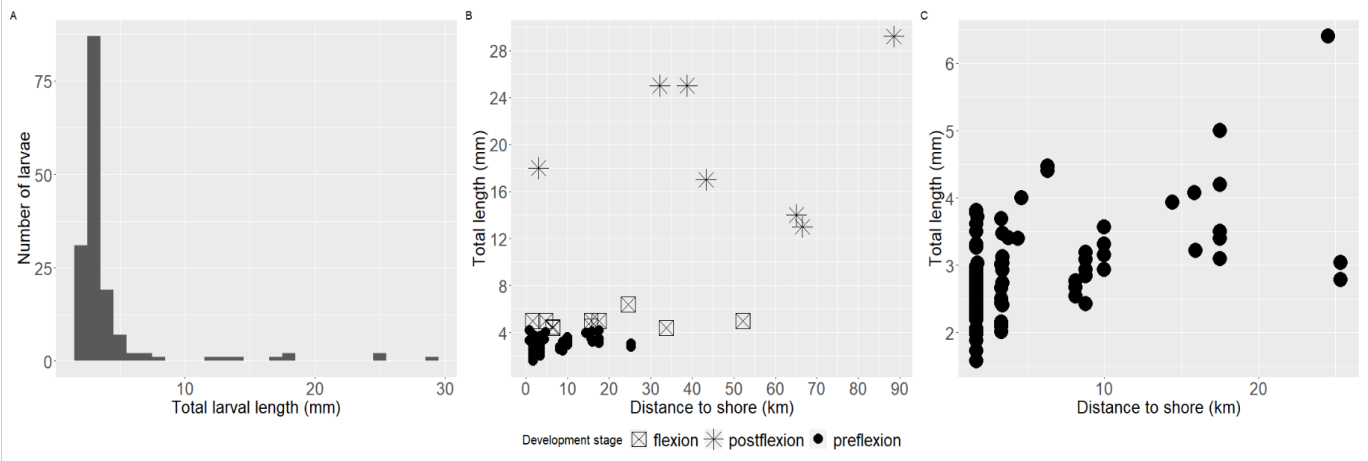

Figure 5. A) Most records of larval length are for larvae smaller than 6 mm in length. Larval length (total length, mm) appears to increase with increasing distance to shore and B) as seen with all known records from the literature and (C) data exclusively from the Boehlert and Mundy (1996) data set.

Ten larvae were collected less than 1200 m from shore and over near-shore reef habitat. This survey was part of an Environmental Baseline Report to determine if ichthyoplankton were affected by the placement of the Kahe Point electrical power plant (Westree et al. 1972). This data set is valuable because it is one of the only ichthyoplankton surveys conducted in the nearshore. Notably, larval uku were recorded within 988 m from shore at the surface above coral reef habitat. Depths at the site in question ranged from 3 m to 9 m. Deepest cast depths ranged from 7 m to 9 m. Unfortunately the authors of this report stressed that these results were only preliminary, and no clear follow up survey has been published. These few records confirm early life stages of uku utilize nearshore habitats.

Presence-Absence data set

Depth and Daily Vertical Migration

Data from Boehlert and Mundy (1996) were used in the presence-absence data set, however, this was the only data set that had information on larval capture depth (within a 20-m range) due to the use of the depth-stratified MOCNESS sampling. Across the entire set of larval uku records, oblique tows were conducted down to 255 m deep; however, the collection depth of the larvae themselves remains unknown in any trawl not conducted with a MOCNESS. Because most studies used oblique tows, it was not possible to consider capture depth across the entire presence-absence data set. Therefore, we present results from the Boehlert and Mundy (1996) data set alone. In the Boehlert and Mundy (1996) study, uku collection depths ranged from 40 m to the surface, with most uku larvae caught between 0 and 20 m. The majority of MOCNESS tows (17 of 24) with uku present were sampled in either 0–10 m or 0–20 m depth strata. In summary, this data set including what was published in Boehlert and Mundy (1996) and newly examined material from those cruises provided a total of 206 larval uku ranging from 1.54 mm to 6.4 mm in length were collected exclusively in a limited range of the water column from 0 m to 40 m.

The MOCNESS trawls conducted during the Boehlert and Mundy study (1996, cruises TC8504 and TC8604) were paired day and night. These were the only ichthyoplankton surveys we found that allow for abundance to be compared across day and night tows. Furthermore, this study included identifications of the other ichthyoplankton caught in a given tow. Information from density kernel plots indicate that larval uku were caught more frequently during day-time hours than at night (Figure 6). Other lutjanids that were identified to at least genus do not exhibit this same diel pattern. Larval uku are also distinct from other lutjanids caught during these survey efforts (1985–1986) in that they exhibit notably higher densities during summer months and have clear depth preferences with a shallower depth distribution relative to confamiliars (Figure 6).

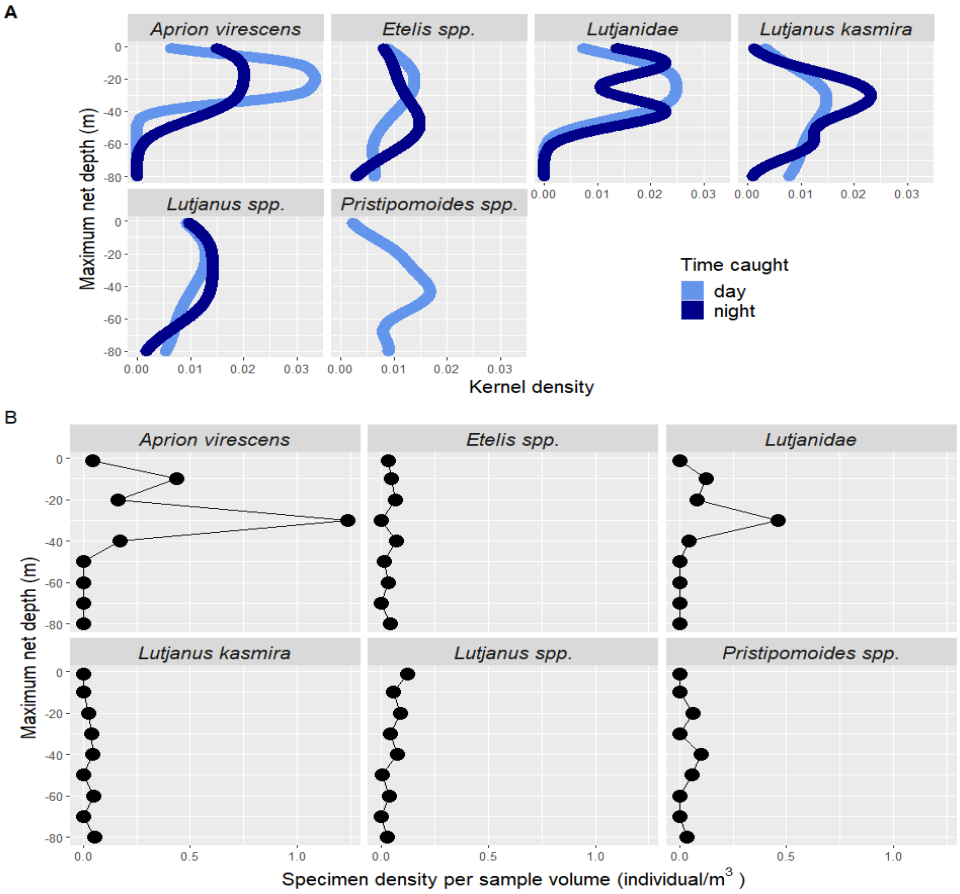

Figure 6. Depth distribution of larval Snapper (Lutanidae) collected with depth-stratified MOCNESS tows on O‘ahu 1985–1986. A) Day-night occurrence varies amongst members of the family lutjanidae with uku demonstrating the strongest diel pattern. The lutjanidae facet includes all larvae that were only identified to family level and is an amalgamation of mixed proportions of all the other species listed here B) Depth distributions of larval lutjanids (pooling day and night tows) highlighting peak abundances vary among species with uku having the highest density (individuals/m^3 filtered sea water) across all months.

Environmental Drivers

From 1967 to 2012 uku larvae were collected only between June and October within 1 km to 88 km from shore, while collection efforts broadly ranged from April to December and out to 123.3 km from

shore (Figure 4). Larval uku were caught in waters with surface temperatures between 25.57 ℃ and 27.70 ℃ (Figure 8) with a mean surface temperature of 26.41℃ (Figure 7). Temperature at collection depth (± 5 m) was only available from MOCNESS tows where the mean temperature at collection depth for uku was 26.3℃ (SD: ± 0.39). Mean sea surface temperatures (SST) over this 4-month span in 1986 were warmer than the same span in 1985, 2011 and 2012 (Figure 9). Notably, the windward sides of the MHI were all cooler than the leeward sides in each of the 4 years considered with SST data (Figure 9). Surface salinities ranged from 34.12 PSU to 35.27 PSU with a mean salinity of 35 PSU (Figure 10, B). We found little statistical support for an occurrence pattern driven by salinity or by lunar illumination for larval uku in the MHI with the data that are currently available. During tests of collinearity (Supplement 2) temperature and salinity were found to be collinear and thus were tested in separate multivariate analyses (Table 3), those models with salinity had higher AIC values (and lower deviance explained) than those with temperature. Surface temperature and distance to shore, best explained the variation in larval uku occurrence and yielded the best fit model, determined by AICc (Table 3). Model four, with the next closest AICc value (ΔAIC from best model= 3.07271, Table 3) yielded poorer fit smooth terms, with weak support for lunar illumination and the tensor product of longitude and latitude (Supplement S2).

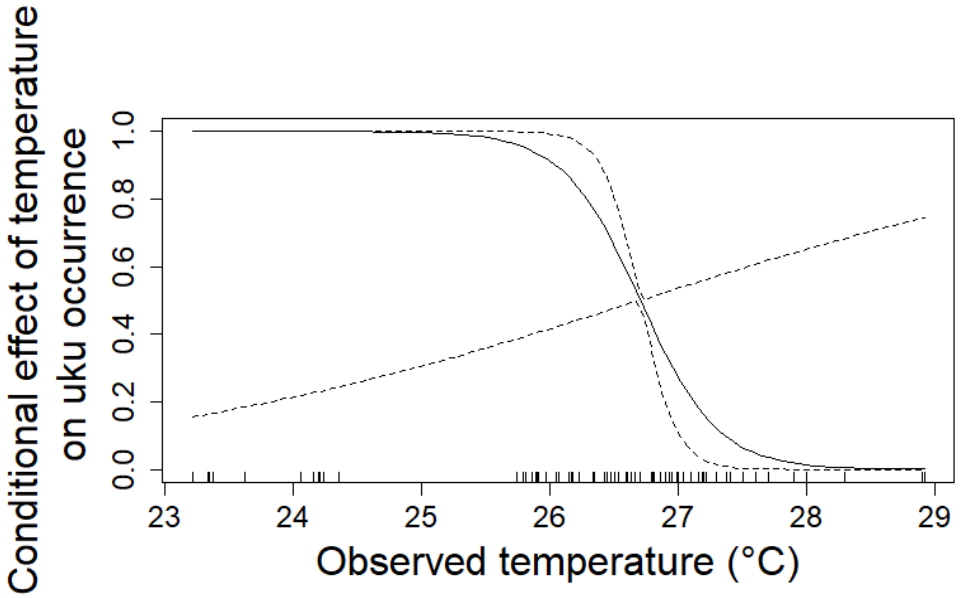

Figure 7. Patterns of larval uku occurrence with maximum surface temperature from in situ measurements. A multivariate GAM revealed that surface temperature is a significant explanatory variable for uku presence-absence.

Table 3. Environmental predictors included in the presence-absence generalized additive model. A description of the function and associated number of knots for the predictor is written when included in the model. Temp = temperature (C°), Month = month that sample was collected, Dist2Shore = distance to nearest shoreline. Log(Dist2Shore) was present as a smoother (k=4) in all models. Degrees of freedom (df) rounded to two decimal places. AICc value is given in full.

Model	Maximum temp.	Month	Lunar illumination	salinity	Dist2Shore	lat, long	df	AICc
1				Smoother, k=4	log(), Smoother, k=4		8.97	105.06398
2	Smoother, k=4				log(), Smoother, k=4		9.76	100.93888
3		Smoother k=4			log(), Smoother, k=4		9.31	118.60778
4	Smoother, k=4	Smoother k=4	Smoother k=4		log(), Smoother, k=4	Tensor product	18.22	91.95680
5	Smoother, k=4	Smoother k=4	Smoother k=4	Smoother, k=4	log(), Smoother, k=4	Tensor product	18.34	95.97178
6				Smoother, k=4	log(), Smoother, k=4	Tensor product	17.39	93.55912
7	**Smoother, k=4**				log(), Smoother, k=4	**Tensor product**	**16.34**	**88.88409**

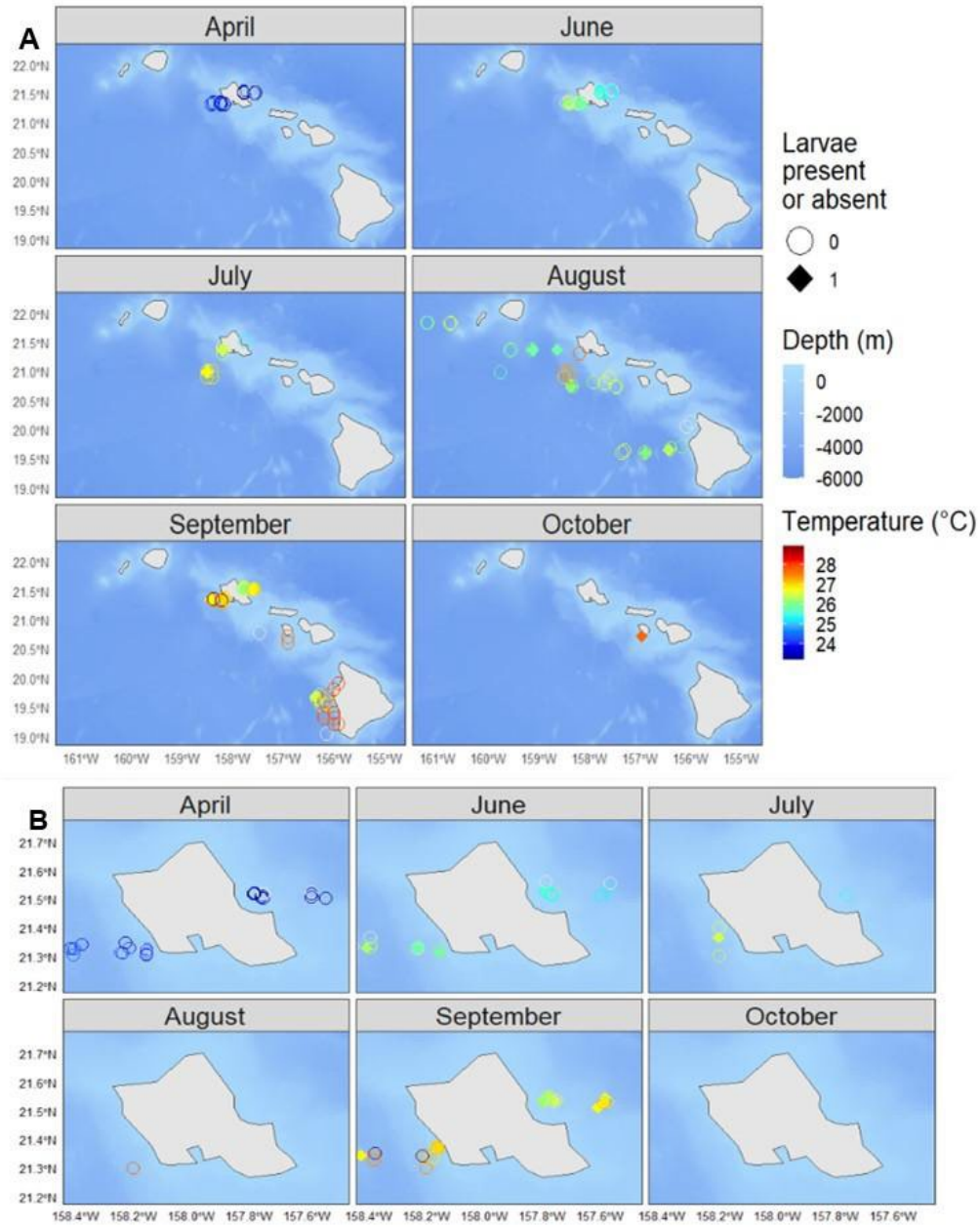

Figure 8. Surface temperature data collected in conjunction with surveys where larval uku were recorded in 1967, 1985, 1986, 2011, and 2012 (see Presence-absence (PA) data sets in Table 1) across the MHI (A) and zoomed in on O‘ahu (B). Panels highlight variability in effort around island regions and throughout seasons, larval uku presence-absence, and temperature by month from April to October).

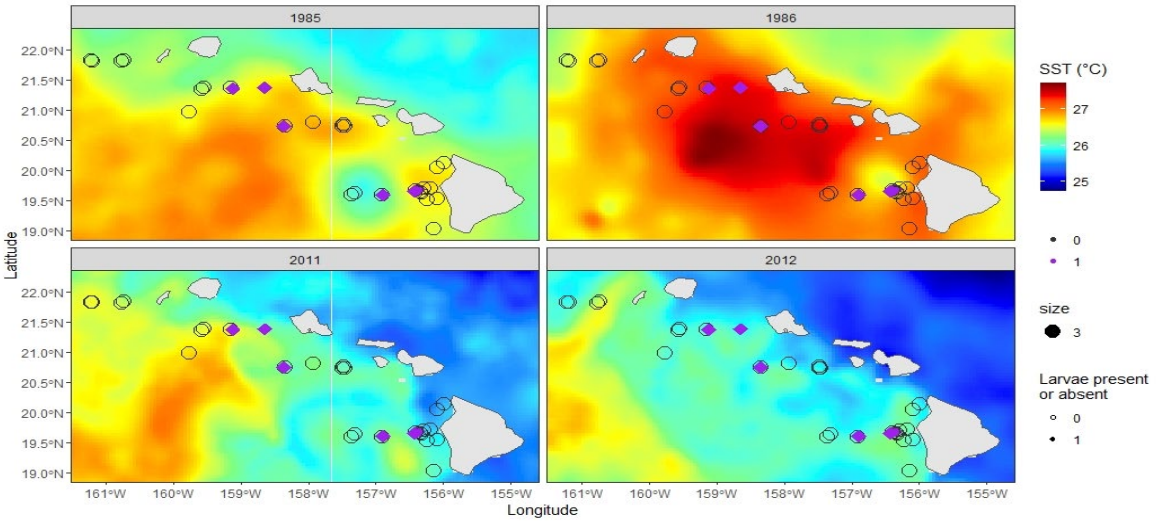

Figure 9. Environmental conditions varied across cruises where larval uku were collected. Mean sea surface temperatures from June to October during four cruises where larval uku were collected shows clear temperature differences between leeward and windward sides of the islands.

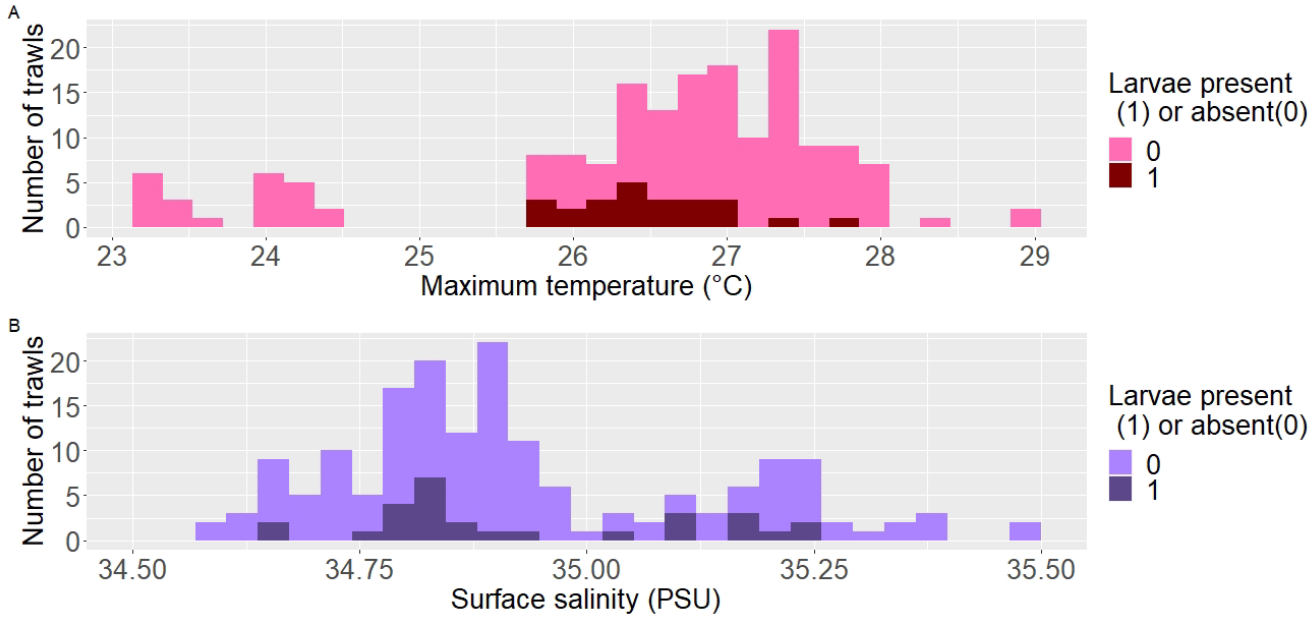

Figure 10. A) Distribution of surface temperatures at ichthyoplankton trawl locations where larvae of any species but uku were present span 23°C–29°C (pink), but those where uku larvae were present (maroon) are found in a compressed temperature range (25.5°C–27.7°C). B) The distribution of surface salinity at sites of larval uku capture broadly reflects the distribution of salinities across all trawl locations regardless of uku occurrence. This further supports the idea that salinity alone cannot be used on its own to predict uku presence.

Juveniles

We found 91 records of uku 112 mm–425 mm long between 1989 and 2019 in the MHI. For this report we considered individuals in this size range as benthic juveniles. The small end of this range was informed by the first record we found of benthic associated juvenile uku which were estimated between 112 mm and 191 mm in length (Parrish 1989 and *F. Parrish pers. comm.*[2]). We assume records of uku between 9.4 cm and 15.5 cm were benthic associated juveniles. Although they were caught on hand lines, we cannot say with certainty where the uku were swimming when caught. The larger end of this range was informed by the minimum size of sexually mature uku at 425 mm (Everson et al. 1989). We found records of 13 uku of lengths ranging from 94 to 304 mm in length caught with handlines and used to inform the t_0 parameter of the adult growth curve but no spatial or depth information is associated with these records (supplement, O'Malley et al. 2021). The 112 mm–425 mm size range we have chosen still leaves a large gap between the largest larva presented here, at 29.2 mm (O'Malley et al. 2021) and the smallest confirmed benthic associated juvenile estimated between 112 mm and 191 mm long (Parrish 1989). This individual was found at a sandy bottom area with sparse *Halimeda sp.* cover near the entrance to Kāneʻohe Bay, and its gut contents included fish eye lens and muscle and a single mysid shrimp 15 mm total length (*F. Parrish, pers. comm*[1].). At Molokini Shoals near Maui satellite passive acoustic telemetry data from a single 400-mm subadult uku showed that it had different behaviors and movement patterns than adults (Filous et al. 2017). Nine juveniles were detected with BRUVs between 2012 and 2014 (InPort data set 50417). Two of these occurred around 13 m, one at 25 m, 35 m and 44 m respectively and then a final two at 73 m deep. Uku observations on BRUVS spanned 4 different habitat types: "aggregate reef," "rock/boulder," "rubble flat," and "sand flat" (Figure 11). Lacking associated temperature data, we cannot comment on thermal preferences in deep water. From 2010 to 2019, 71 observations were made of juvenile uku (15 cm–30 cm) in the NCRMP data set (Figure 12, A,B) all of which were observed on forereef areas with rocky, aggregate reef or pavement substrate 7 m–25 m deep (McCoy et al. 2019). Juvenile uku were observed between April and October and occurred in a tight temperature band of 25.5–26.6 C^0 (Figure 12, C).

[1] In an e-mail with F. Parrish about the juvenile uku he described in his 1989 publication "Identification of Habitat of Juvenile Snappers in Hawaii" he added further details noting: "that note in Fish Bull was mostly about the habitat of Paka [*Pristipomoides sp.*] so other than a mention of uku we didn't encounter them enough to focus on them….It was not measured as paka was the focus but it was within the size range of the paka, which ranged from 11.2 cm to 19.9 cm. Like the other fish its gut was inspected and it contained -Fish eye lens and muscle, -a mysid 15-mm TL ... I remember catching uku inside the paka grounds in ~140' of water, flat bottom with thin halimeda stands." From this we used a mean size of 15.5 cm to describe this one juvenile uku for analyses but retained the stated size range in the main text of this report.

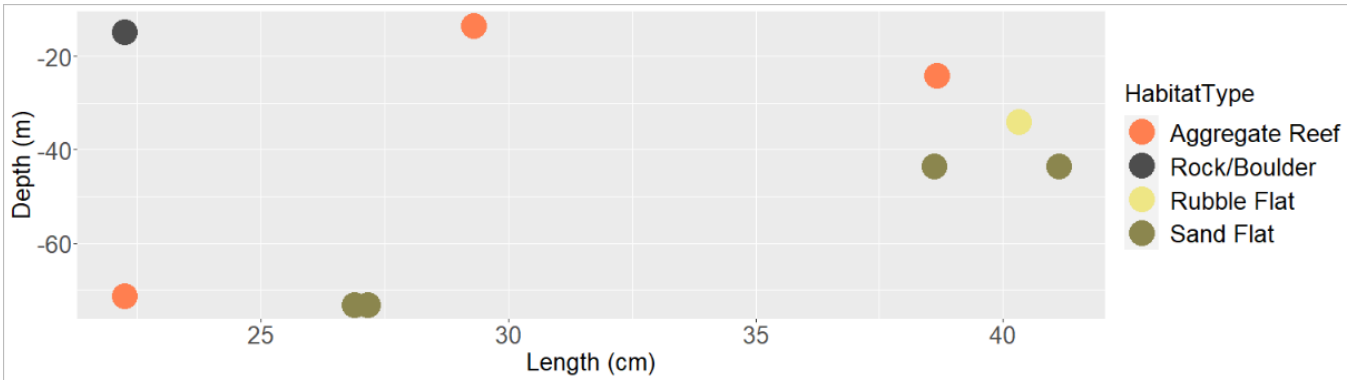

Figure 11**. Depth distribution of juvenile uku across habitats observed with Baited Roving Underwater Video in the MHI.**

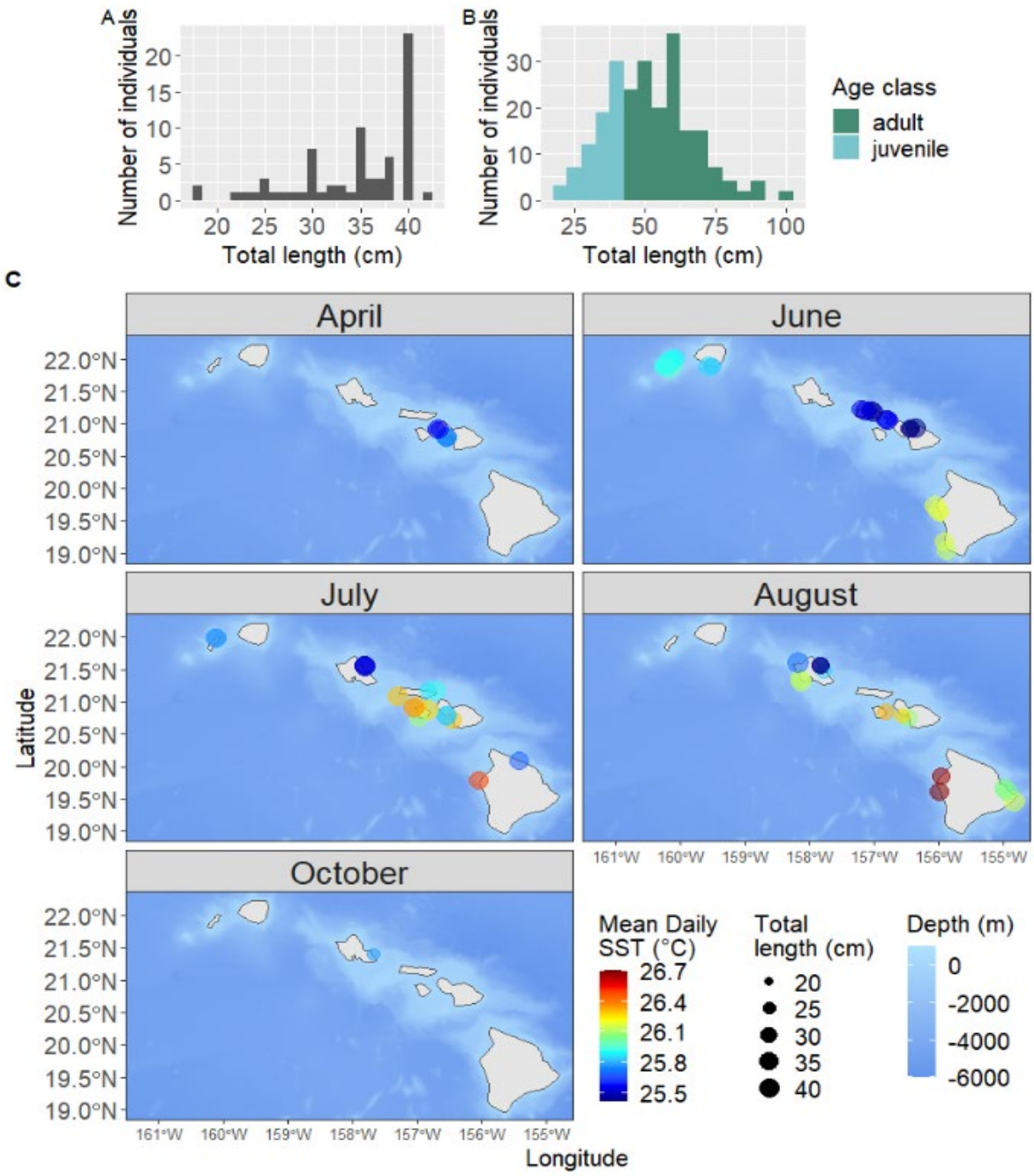

Figure 12. Size distribution and patterns of occurrence of juvenile uku in the MHI. Size frequency histograms of juvenile uku (A) from hand-line caught (Parish 1989; O'Malley et al. 2021) and BRUV (InPort data set 50417) specimens; B) NCRMP stationary point count surveys on coral reefs from 2010 to 2019 (McCoy et al. 2019). Uku are not commonly encountered at sizes between 15 cm (Parish 1989) and 22 cm (McCoy et al. 2019). (C) Occurrence of juvenile uku across MHI by sampling month and mean sea surface temperature. Juveniles, like larvae, appear to have a tight band of temperature preferences. Note the much tighter temperature band on the figure key as compared to Figure 8.

Discussion

Review of Objectives

After researching literature, reports, specimen collections, museum records, and unpublished data, we compiled fewer than 300 records of individual larval uku collected throughout the MHI from 1967 to 2012. From our review of the literature we now know how far larval uku can be found from shore in their first month of life (Figure 3). Furthermore, we enhanced these findings and provided new data from the literature by processing backlogged ichthyoplankton samples from O‘ahu (1985–1986) and revealed that larvae around O‘ahu between 2 mm and 6.5 mm in length are likely restricted to the top 40 m of the water column and can be found 0.5 km–88 km from shore. Larval uku have been found in nearshore habitat (as close as 500 m off shore) in water 3-m deep directly above coral reef habitat (Westree et al. 1972). We suggested two environmental drivers of habitat utilization that could be applied to the present day (Figure 8, A; Figure 9), temperature and distance to shore. Finally, we evaluated sizes of pelagic larvae and settled benthic juveniles and discovered an important knowledge gap. Juvenile uku between 30 and 90 mm in length have yet to be recorded anywhere in the Pacific, and thus their habitat use during this critical developmental period, which includes the pelagic-benthic transition, remains unknown.

We have quantified larval uku occurrence to the best of our ability with the currently available data. In doing so we have advanced the state of knowledge of ecology and habitat use of larval and pelagic juvenile uku. We hope these data will eventually assist with informing potential future habitat models and refining Hawai`i EFH and HAPCs. However, our understanding of uku early life history is data-limited and we lack spatially-randomized and effort-standardized *in-situ* observations across data sets. Given this knowledge gap, it is difficult to assess critical aspects of the life history of this species, which are quintessential to refining EFH.

Larval habitat utilization

Temperature was the only environmental predictor that was present in both models that had considerable support as determined by AICc, although this support is still weak as the parameter estimates were highly uncertain. Furthermore, the temperature data used for all statistical models were selected from the surface only, which likely represents an overestimate for larval thermal preferences when considered in context of the depth most uku larvae were caught (0–40 m). Given that temperature at capture depth was lacking for all but 1 data set, and the surveys considered here span more than 5 decades, it is difficult to assign a minimal temperature to larval uku occurrence. Uku larvae were rarely captured at temperatures below 25.5 °C, however, which may serve as an initial tentative proxy for the minimal temperature of larval uku occurrence (Figure 8). Evidence from publications on larval fish physiology and ecology generally support temperature as an explanatory variable for distribution, so we feel comfortable positing the same here (McMahon et al. 2023, Boehlert et al. 1992, O’Connor et al. 2007, Sponaugle et al. 2005). The temperature and depth data have various levels of resolution depending on the origin of sampling, so we used surface measurements from various instruments to maximize comparability among collections. We chose not to use satellite data for the statistical analyses because the first collections in our data predate the surface temperature satellite records. Our data limitations constrained what we were able to infer from our output.

We utilized satellite data to illustrate temperature differences between some of the survey years (Figure 9). We chose two sets of surveys which were conducted in back-to-back years with both presence and absence data across a wide range of sampling sites. Interestingly, the warmest year of the 4 we examined was the oldest, 1985. Although there was a clear temperature difference between windward and leeward sides of the islands, only the Boehlert and Mundy (1996) study conducted surveys in both regions. All other studies were conducted only on the leeward sides of each island; thus, we cannot determine if larvae occur more commonly on the windward or leeward side. Larval presence in relation to their distance from shore is an uncertain relationship as well, considering how patchy sampling occurred between 0 km and 88 km from shore over the 50-year period considered in this report. We saw that inter-annual thermal variability between collection years was not significant in our statistical analyses, meaning that surface temperature could explain this variability.

Currently the cue for spawning in uku specifically remains unknown (Everson et al. 1989), although, many snapper species utilize lunar phase (either full or new moons) as a cue to begin spawning (Grimes 1987). Although adult uku have also been observed to be most active during the day (hook and line fishing, Haight et al. 1993, spearfishing, Ayers 2022), fishermen in the MHI also note that catch is associated with moon phase and nighttime fishing (Ayers 2022). Larvae of the size classes observed in this study range in age from a few days to a week old (Appendix 2). Larvae near a week old would be expected to appear about a quarter of a moon phase after the cue for adult spawning. However, we found weak statistical evidence to support an occurrence pattern driven by lunar illumination with the data available. This would be consistent with records of two Atlantic eteline snappers, *Etelis oculatus* and *Pristipomoides sp.,* which have been observed to have no lunar spawning pattern (D'Allesandro et al. 2013). The collection regimes associated with the records of larval uku that we found, however, were not conducted over the course of an entire lunar cycle and thus were insufficient to accurately assess lunar phase as a predictor of presence-absence. Future sampling efforts should include explicit assessment of both lunar illumination and day-night preferences.

There was a clear pattern of uku occurrences only in the summer. Temperature had only a slightly better fit than month in our statistical analyses. Uku occurrence in response to thermal cues could vary annually but, so far, uku have only been collected in the summer, and thus temperature and month effects are difficult to disentangle. The timing of larval uku presence in the water column from collection data is consistent with the spawning period for adult uku, which lasts May through October (Everson et al. 1989). The peak of adult spawning is in June and most larvae mentioned in this report were collected in September, although effort across summer months and data sets was variable. Over a monthly collection period which spanned August 1977 to October 1978, monthly sampling efforts only yielded uku in August of either year (Clarke 1991). Other lutjanids use lunar and seasonal cues for spawning (Grimes 1987). This coupling of adult spawning with certain seasons and lunar periods has been posited to serve a role in setting up larvae for success by releasing them into an ocean environment of ideal tides and low predators (Grimes 1987). Perhaps this knowledge of larval occurrence with temperature and certain tidal regimes during the summer spawning season could be used to elucidate spawning locations in the future.

Enhancing available record data

The size range of all larvae discussed in this report (2 mm–30 mm total length) spans the preflexion to postflexion stages, with the majority of the reexmained larvae falling into the preflexion category (Leis and Lee 1994). Uku larvae transition from preflexion to flexion between 4 mm and 4.5 mm, and reach

post-flexion after about 6 mm (Leis and Lee 1994). Flexion larvae start appearing in our samples 5 km from shore (Figure 5, A) and post-flexion larvae from the literature start appearing more than 25 km from shore (Figure 5, B). Few larvae have been sampled in nearshore waters, although those that have, have been small (less than 5 mm in length). Larval lutjanids sampled around the reef on Lizard Island in Australia were preflexion size while those farther out in the Great Barrier Reef lagoon were more often post-flexion size larvae (Leis 1987). Although these were not uku, this pattern of being found farther offshore at larger sizes is consistent with the pattern exhibited by the few larvae we can consider at this time.

Before embarking on this effort, the largest pelagic uku larva ever recorded was only 17.8 mm (Leis and Lee 1994). Recent work by O'Malley et al. (2021), however, revealed a specimen 29.2-mm long that was caught in a Cobb trawl. This individual was described as "pelagic stage", which we took to mean that although it has not yet settled it more closely resembles an adult morphologically (Kingsford 1998). The next largest known specimen is 94-mm long, yet this was caught on a handline (O'Malley et al. 2021), and certainly too developed to be considered a larva. The lack of larger specimens from ichthyoplankton trawls has been suggested as evidence that uku become bottom associated after this size (i.e., 17.8 mm; Leis 1994). It should be noted that ichthyoplankton studies conducted in the Florida Keys with MOCNESS caught no lutjanid larvae larger than 10 mm suggesting that net avoidance is common at and above this size (D'Allesandro et al. 2010). This could further support benthic settlement around this size range as the individuals would be strong enough swimmers to reach the benthos, or that 1 m^2 MOCNESS is an inappropriate net at these sizes. Sampling in waters far offshore has also been patchy for larval uku, but the rarity of specimens in their pelagic juvenile life stage is common across many fish species (Leis 1996, E. Malca 2022).

Juveniles

Few records of juvenile uku exist throughout the literature and in the examined data sets (NCRMP and BRUVS). Most observations of benthic juvenile uku occurred in reefs, so non-reef usage is not well characterized. The majority of individuals observed in the NCRMP surveys were seen in June 2015, which suggests the possibility of a previous large recruitment event. A multispecies episodic recruitment event occurred in Hawai‘i in the summer of 2014, which could have included uku, but there are no available data sets to test this hypothesis. Anomalously warm oceanographic conditions were associated with abnormally high settlement of pelagic juveniles to reefs around Hawai`i for a range of reef-associated taxa. Identifications within ichthyoplankton surveys from this time period need to be conducted to further support this assertion.

Research Priorities for Future Policy Decisions

Given the current state of understanding of the distribution of uku eggs and larvae, application of Magnuson Stevens Act (MSA) policy and establishment of the location of EFH and HAPCs would be benefitted by information about the occurrence of these life stages in water less than 100-ft (30.5-m) deep. The majority of information about larval uku comes from greater than 0.6 miles (1 km) offshore. To move toward the goal of refining EFH for this species, understanding uku larval distribution near shore is paramount. Policy recommendations are on hold until more information can be obtained. Thusly, steps to validate the methods and results of sampling larvae in waters greater than 100-ft (30.5-m) deep are warranted. These methods can then be applied in shallower nearshore waters that are relevant for the types of actions that consult with HCD on effects to EFH.

In order to advise how best to conduct future larval monitoring to fill existing gaps about post-hatch life history for uku in nearshore environments we recommend generally for researchers to sample between 10 m and 30 m of depth during the summer months, in order to coincide with adult spawning. Additional surveys placed at set distances from shore (up to the EEZ boundary) could also capture information about uku spatial dispersal with ontogeny. Sampling should be paired day-night to account for diel movement and be conducted over an entire lunar cycle for several months. Specimens should either be immediately frozen or fixed in ethanol to allow for otolith microstructure analysis to elucidate larval ages and growth rates and population genetic studies (which are currently impossible as most existing specimens were fixed in formalin). The span of the current range to the EEZ boundary remains appropriate for now as, although the furthest larvae have been captured is only 88 km from shore, this effort did not include research cruises that conducted ichthyoplankton tows near the edge of the EEZ and thus we cannot comment on their occurrence in this area. Furthermore, we used data from opportunistic surveys, not efforts specifically targeting uku. Going forward, uku specific studies should be prioritized in order to properly define uku depth of occurrence. Without conducting sampling deeper than 200 m, we cannot determine if uku larvae venture deeper as they age.

Recommended, specific near term research steps are:

1. Establish a consistent, repeatable method for sampling uku larvae that works in water depths greater than 100 ft (30.5 m). The method should be able to provide information on the environmental conditions and depth that larvae are captured.

2. Compare different sampling approaches for collecting uku larvae in low density situations. Look for a method that would increase the probability of detection or aggregating uku larvae for sampling. Try to also identify sampling methods that decrease the chances of false negatives.

3. Use the method(s) established in Steps 1 and 2 to sample areas offshore where uku larvae occur at a range of densities. Develop an understanding of the capture rate for uku larvae and its relationship to larval density.

4. Apply the sampling method in areas less than 100-ft (30.5-m) deep to determine the presence of uku larvae in shallow waters. Embayments, harbors, estuaries, and channels should be sampled as well as coastal waters.

5. Attempt to determine if capture rates of larvae in shallow water can be used to infer density.

6. Obtain an understanding of uku life history and important behaviors in order to have more factors for parameterizing the distribution models.

Future directions

Besides studies to address basic life history information for post-hatch pelagic uku, population genetics, dispersal modeling and larval condition could all be assessed. Additional collections of larval uku with size and collection information, coupled with oceanographic models, could be used to back trace drifting larvae to adult spawning aggregations. Other scientists at PIFSC are currently considering dispersal models for uku larvae. The current EFH designations for eggs and larvae were based on the assumption that fish eggs would not be spawned deeper than the deepest depth range of the adults and were based on a 2008 HYbrid Coordinate Ocean Model in which particles were "released" at 50-m and 100-m depth. With the information assembled in this report, circulation models can be more precise as they are informed by species specific biology. For example, conducting model runs in which particles are released at 20 m, where the majority of uku larvae were captured in this study. Connectivity analyses are important for management (Cook et al. 2009), especially with a species like uku that is highly motile as an adult and is widely dispersed as a larva.

Larval condition can be assessed from specimens currently in the lab. The mortality/growth ratio of larval stocks acts as a snapshot of both effects of prey and predators (Suthers 1998) that could be applied to recruitment estimates (Suthers 1998, Houde 2008). Ferron and Legget (1994) state that body condition should be utilized for predicting survival probabilities.

In other species like bigeye tuna (*Thunnus obesus*), median phytoplankton size integrated over a year has been suggested as an informative predictor of recruitment because it is indicative of food quality available during the larval stage (Woodwoth-Jeffcoats and Wren 2019). There is much more data for the *T. obesus* fishery, but including phytoplankton data with future uku survey efforts could be worthwhile. *Chl-a* data were not considered in this report as remote sensing data are available starting in 2011. Other studies that considered feeding in Etelinae larvae found zooplankton to be a large part of their diet when they were 3 mm–6 mm in length. Therefore, the phytoplankton linkage would be manifested through its relationship to the zooplankton prey of uku larvae (Llopiz and Cowen 2009).

Finally, there is an urgent need to understand the influence of climate change on larval uku. The most recent NOAA Fisheries Climate Strategy Document (Link et al. 2015) only mentions early life history once, in regards to oyster larvae and ocean acidification. This is an excellent example, but taxonomically and regionally limited considering that the larval stage is a bottleneck for many marine populations. In fish, mortality during the larval phase is high (Houde 1987) and that acts as a major selection pressure during the larval stage (Marshall and Morgan 2011). These factors make larval ecology crucially important for species persistence and evolution. Some traits like size-at-hatch significantly impacted survival of lutjanid larvae in the Caribbean (D'Allesandro et al. 2013). Size-at-hatch can be affected by temperature (Vasbinder and Ainsworth 2020). Thus, changes in the thermal environment of lutjanid larvae could have an impact on larval survival, though this is unexplored for uku larvae. Many other environmental stressors have and will result from climate change that we could not comment on here for lack of data, including effects of increasing partial pressures of CO_2 and hypoxia (Melzner et al. 2013). Furthermore, larval transport and habitat, can be constrained to certain density layers (Bohlert and Mundy 1994) or fine-scale eddies (Garcia et al. 2022, Holliday et al. 2011), both of which are by definition, dependent on ocean temperatures. Ocean circulation models can help elucidate these patterns.

Some reefs around O‘ahu remain resilient despite persistent stressors (Bahr et al. 2015), which offers hope for adult uku as a reef-associated species. To what extent this can be said for larval uku requires further study. Additional surveys may remedy this dearth of data, including establishing a time-series of ichthyoplankton data (similar to the California Cooperative Oceanic Fisheries Investigations surveys) or conducting physiology experiments to test species persistence under climate change. Environmental DNA sampling could also serve to enhance *in-situ* trawling if complete genetic reference libraries for the fish of the MHI were to be developed. Long-term time series can allow a view of population persistence through time and inter-annual changes in the environment. Physiology experiments conducted with multiple drivers (temperature, pCO_2, O_2 concentration, food availability etc.) will provide insights into the ocean conditions that larval uku tolerate and better inform population persistence under changing ocean conditions.

Acknowledgements

Mahalo nui loa to Bruce Mundy for help with uku identification and sharing the data files from various NOAA Ship *Townsend Cromwell* cruises. To Brent Miyamoto and Christopher Tokita for help with locating archived environmental data. To Joey Lecky for assistance with spatial data. To Amanda Hay for sharing all of the larval uku records at the Australian Museum and for answering our many questions. To Jeff Leis for conducting the ichthyoplankton study referenced in Westree et al. 1972, for creating the original resources of etline larval identification and for also being willing to answer my questions about the Australian Museum records. To Don Kobayashi for finding and sharing T.A. Clarke's old notes. To T.A. Clarke for collecting some of the larvae used in this project and for keeping meticulous records that I could interpret decades later. To Jenni Samson, Malia Chow, Gerry Davis, Michael Parke, Erik Franklin, Anne Chung and Lilian Raz for your support of this project and offering support and advice during EFH meetings. To Joe O'Malley and his team for sharing the age/length data for his uku larvae. To Frank Parrish for sharing more details from his 1989 publication. To Bob Humphreys for answering methods questions. To Gento Shinohara at the Tokyo Museum, Erling Holm at the Royal Ontario Museum, Simon Thorrold at Woods Hole, Diane Piatassy at the Smithsonian and Michael Hammer at the Museum and Art Gallery Northern Territory all for kindly responding to our emails about specimens. To Tony Miskiewicz for collecting some of the larvae used here and for his time and conversations at the 45th Larval Fish Conference. To our thorough anonymous reviewer for making this manuscript better. To the PIFSC editorial staff for also making this manuscript better. And finally, to all scientists and crew on cruises by NOAA Ship *Townsend Cromwell* 32, 8504, 8505, 8602, 8604; and NOAA Ship *Oscar Elton Sette* 11-06 and 12-06; and all other ichthyoplankton collection efforts mentioned here.

Literature and Software Cited

Publications

Allen GR. 1985. FAO Species Catalogue. Vol. 6. Snappers of the world. An annotated and illustrated catalogue of lutjanid species known to date. 207 p. FAO, Rome.

Anderson WD. 1987. Systematics of the fishes of the family lutjanidae (Perciformes: Percidei), the snappers. *In Tr*opical snappers and groupers: biology and fisheries management. (J.J. Polovina , S. Ralston , eds.), p. 12. : Westview Press. Boulder, CO.

Asher J, Williams ID, Harvey E. 2017. An assessment of mobile predator populations along shallow and mesophotic depth gradients in the Hawaiian Archipelago. Sci. Rep. 7:3905. https://doi.org/10.1038/s41598-017-03568-1

Ayers AL. 2022. Ecosystem and Socio Economic Profile of uku (*Aprion virescens*) in the main Hawaiian Islands. Pacific Islands Fisheries Science Center, PIFSC Administrative Report, H-22-01, 62 p. https://doi.org/10.25923/9f2m-4e10

Bahr KD, Jokiel PL, Toonen RJ. 2015. The unnatural history of Kāne‘ohe Bay: coral reef resilience in the face of centuries of anthropogenic impacts. PeerJ. 3.

Bell J, Ganachaud A, Gehrke P, et al. 2013. Mixed responses of tropical Pacific fisheries and aquaculture to climate change. Nat. Clim. Change. 3, 591–599 p. https://doi-org.eres.library.manoa.hawaii.edu/10.1038/nclimate1838

Boehlert GW, Watson W, Sun LC. 1992. Horizontal and vertical distributions of larval fishes around an isolated oceanic island in the tropical Pacific. Deep-Sea Res. 39:¾: 439–466.

https://swfsc-publications.fisheries.noaa.gov/publications/CR/1992/9217.PDF

Boehlert GW, Mundy BC. 1994. Vertical and onshore-offshore distributional patterns of tuna larvae in relation to physical habitat features. Mar. Ecol. Prog. Ser. 107,1–13 p.

Boehlert GW, Mundy BC. 1996. Ichtyoplankton distributions near O‘ahu, Hawai’i, 1985-1986: data report. NOAA Tech. Memo. NMFS-SWFS-235,156 p.

Clarke TA. 1991. Larvae of nearshore fishes in oceanic waters near O‘ahu, Hawaii. NOAA Tech. Rep. NMFS-101, 23 p. https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf

D’Alessandro EK, Sponaugle S, Cowen RK. 2013. Selective mortality during the larval and juvenile stages of snappers (lutjanidae) and great barracuda Sphyraena barracuda. Mar. Ecol. Prog. Ser. 474:227-242. https://doi.org/10.3354/meps10114

Everson AR, Williams HA, Ito BM. 1989. Maturation and Reproduction in Two Hawaiian Eteline Snappers, uku, *Aprion Virescens*, and Onaga, *Etelis Coruscans*. Fish. Bull., 87:877-888. https://swfsc-publications.fisheries.noaa.gov/publications/CR/1990/9012.PDF

Franklin EC. 2021. Model-based essential fish habitat definitions for the uku *Aprion virescens* in the Main Hawaiian Islands. Report to WPRFMC. 33 pp.

Filous AF, Alan WB, Stamoulis K, Scherrer S, Wong A, Stone K. Sparks R. 2017. Movement Patterns of Reef Predators in a Small Isolated Marine Protected Area with Implications for Resource Management. Mar. Biol. 164:1:1–16. https://doi.org/10.1007/s00227-016-3043-3

Garcia V, Schilling HT, Cruz DO, Hawes SM et al. 2022. Entrainment and development of larval fish assemblages in two contrasting cold core eddies of the East Australian Current system. Mar Ecol Prog Ser 685:1-18. https://doi.org/10.3354/meps13982

Gray, C.A. Horizontal and vertical trends in the distributions of larval fishes in coastal waters off central New South Wales, Australia. *Marine Biology* **116**, 649–666 (1993). https://doi.org/10.1007/BF00355483

Grimes CB. 1987. Reproductive biology of the Lutjanidae: A review. *In* Tropical Snappers and Groupers: Biology and Fisheries Management (J.J. Polovina and S. Ralston, eds.), p. 239-294. Westview Press, Boulder, CO.

Haight WR, Parrish JD, Hayes TA. 1993. Feeding Ecology of Deepwater L

Lutjanid Snappers at Penguin Bank, Hawaii. Trans. Am. Fish. Soc. 122: 328-347.https://doi.org/10.1577/1548-8659(1993)122%3C0328:FEODLS%3E2.3.CO;2

Holliday D, Beckley LE, Olivar P. 2011. Incorporation of larval fishes into a developing anti-cyclonic eddy of the Leeuwin Current off south-western Australia. Jour. Plank. Reas. 33:11: 1696–1708 p.

Houde E. 1987. Fish early life Dynamics and Recruitment Variability. American Fisheries Society Symposium. 2:17–29 p.

InPort Data set BRUVS Field Desc, ID 50417. Accessed 11/01/2021. https://www.fisheries.noaa.gov/inport/item/50417

Jason S, Link RG, Busch S (Editors). 2015. NOAA Fisheries Climate Science Strategy. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-F/SPO-155, 70p.

Kingsford MJ. 1988. The early life history of fish in coastal waters of northern New Zealand: A review. New Zeal. Jour. of Mar. Fresh. Res., 22(3): 463-479, DOI: 10.1080/00288330.1988.9516316

Kulbicki M, Bozec Y-M, Labrosse P, Letourneur Y, Mou-Tham G, Wantiez L. 2005. Diet composition of carnivorous fishes from coral reef lagoons of New Caledonia. Aquat. Living Resour. 18: 231. DOI: 10.1051/alr:2005029

Leis JM. 1987. Review of the early life history of tropical groupers (Serranidae) and snappers (Lutjanidae). *In* Tropical Snappers and Groupers: Biology and Fisheries Management (J.J. Polovina and S. Ralston, eds.), p. 189-238. Westview Press, Boulder, CO.

Leis JM, Lee K. 1994. Larval development in the lutjanid subfamily etelinae (Pisces): the genera *Aphareus, Aprion, Etelis* and *Pristipomoides.* Bull. Mar. Sci. 55(1): 46-125.

Link JS, Griffis R, Busch S (Editors). 2015. NOAA Fisheries Climate Science Strategy. U.S. Dept. of Commerce, NOAA Technical Memorandum NMFS-F/SPO-155, 70p

Llopiz JK, Cowen RK. 2009. Variability in the trophic role of coral reef fish larvae in the oceanic plankton. Mar. Ecol. Prog. Ser. 381:259-2. https://doi.org/10.3354/meps07957

Magnuson-Stevens Act Provisions; Essential Fish Habitat (EFH), 16 U.S.C. § 600.10 (2022). https://www.federalregister.gov/d/02-885/p-459

Malca E, Quintanilla JM, Swalethorp R, Shiroza A, Shropshire T, Zapfe G, Shulzitski K, Landry MR, Lamkin JT, Gerard T, Laiz-Carrión R. A synthesis of larval bluefin tuna growth dynamics from otolith microstructure in the Gulf of Mexico [Conference presentation]. 45th Larval Fish Conference, San Diego, CA United States.

Marshall, DJ, and Morgan SG 2011. Ecological and Evolutionary Consequences of Linked Life-History Stages in the Sea. Curr. Bio. 21:18. R718-R725 p. https://doi.org/10.1016/j.cub.2011.08.022

McCook LJ, Almany GR, Berumen ML. et al. 2009. Management under uncertainty: guide-lines for incorporating connectivity into the protection of coral reefs. Coral Reefs. 28, 353–366. https://doi.org/10.1007/s00338-008-0463-7

McCoy K, Asher J, Ayotte P, Gray A, Kindinger K, Williams I. 2019. Pacific Reef Assessment and Monitoring Program Data Report Ecological monitoring 2019—Reef fishes and benthic habitats of the main Hawaiian Islands. PIFSC Data Report. https://doi.org/10.25923/he4m-6n68

McMahon SJ, Munday PL, Donelson JM. 2023. Energy use, growth and survival of coral reef snapper larvae reared at elevated temperatures. Coral Reefs 42, 31–42. https://doi.org/10.1007/s00338-022-02306-y

McNeely RL, Johnson LJ, Gill CD. 1965. Construction and operation of the "Cobb" pelagic trawl (1964). Comm. Fish. Rev. 27:10: 10-17.

Melzner F, Thomsen J, Koeve W et al. 2013. Future ocean acidification will be amplified by hypoxia in coastal habitats. Mar. Biol. 160, 1875–1888 p. https://doi.org/10.1007/s00227-012-1954-1

Meyer CG, Papastamatiou YP, Holland KN. 2007. Seasonal, Diel, and Tidal Movements of Green Jobfish (Aprion Virescens, lutjanidae) at Remote Hawaiian Atolls: Implications for Marine Protected Area Design. Mar. Biol. 151:6:2133–43. https://doi.org/10.1007/s00227-007-0647-7

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

Newman, SJ, Williams AJ, Wakefield CB et al. 2016. Review of the life history characteristics, ecology and fisheries for deep-water tropical demersal fish in the Indo-Pacific region. Rev. Fish. Biol. Fish. 26, 537–562p. https://doi-org.eres.library.manoa.hawaii.edu/10.1007/s11160-016-9442-1

NMFS and WPFMC. 2021. Annual catch limits and accountability measures for the Main Hawaiian Islands Deep 7 Bottomfish fishery for fishing years 2021–22 through 2023–24.Environ. Assess. (RIN 0648-BK72) p.49 https://repository.library.noaa.gov/view/noaa/34367/noaa_34367_DS1.pdf

O'Connor MI, Bruno JF, Gaines SD, Halpern BS, Lester SE, Kinlan BP, Weiss JM. 2007. Temperature control of larval dispersal and the implications for marine ecology, evolution, and conservation. Proc. Nat. Aca. Sci. 104:4:1266–1271, https://doi.org/10.1073/pnas.0603422104

O'Malley J, Wakefield CB, Kinney MJ, Newman SJ. 2021. Markedly similar growth and longevity of Green Jobfish *Aprion virescens* over an expansive geographic range between the Hawaiian Archipelago and the Eastern Indian Ocean. Mar. Coast. Fish. 13:3:253–62, https://doi.org/10.1002/mcf2.10155.

Parrish FA. 1989. Identification of Habitat ofJuvenile Snappers in Hawaii. Fish. Bull. 87:1001-1005. https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/fish-bull/parrish%20%281%29.pdf

Sponaugle S, Lee T, Kourafalou V, Pinkard D. 2005. Florida Current frontal eddies and the settlement of coral reef fishes. Assoc. Sci. Limn. Ocean. 50:4: 1033–1048. https://doi.org/10.4319/lo.2005.50.4.1033

Talbot F. 1960. Notes on the biology of the lutjanidae (Pisces) of the East African Coast, with special reference to *L. bohar* (Forsskal). Ann. So. Afri. Mus. 45:549-74.https://www.biodiversitylibrary.org/page/40866703

Tanaka KR, Schmidt AL, Kindinger TL, Whitney JL, Samson JC. 2022. Spatiotemporal assessment of *Aprion virescens* density in shallow main Hawaiian Islands waters, 2010-2019. NOAA Tech. Memo. NMFS-PIFSC-132, 33 p. https://doi.org/10.25923/f24q-k056.

Tozer B, Sandwell DT, Smith WHF, Olson C, Beale JR, and Wessel P. 2019. Global bathymetry and topography at 15 arc seconds: SRTM15+. Earth Space Sci. 6:10:1847–1864. https://doi.org/10.1029/2019EA000658.

Vasbinder K, Ainsworth C. 2020. Early life history growth in fish reflects consumption-mortality tradeoffs. Fish. Res. 227. https://doi.org/10.1016/j.fishres.2020.105538

Weibe PH, Morton AW, Bradley AMM, Backus RH, Craddock JE, Barber V, Cowles TJ, Flierl GR. 1985. New developments in the MOCNESS, an apparatus for sampling zooplankton and micronekton. Mar. Bio. 87:313-323.

Westree B, Leis J, Watson W, VanSant J, McCain J. 1972. Part 5: Marine Biology, Section II Zooplankton: General Zooplankton Collections and Analyses. *In* Marine Environmental Baseline Report for Hawaiian Electric Company, Incorporated: Kahe Point Facility. (Agardy FJ, Staackmann M, Castle R, Westree B, eds.) p.6-58, URS Research Company, San Mateo, California, USA

Wood SN. 2017. Generalized Additive Models: An Introduction With R. Chapman and Hall.

Woodworth-Jefcoats, PA, Wren, JLK. Toward an environmental predictor of tuna recruitment. *Fish Oceanogr*. 2020; 29: 436– 441. https://doi.org/10.1111/fog.12487

WPRFMC. 2016. 4.3.2 *Aprion virescens* (gray snapper, uku) *In* Amendment 4 to the Fishery Ecosystem Plan for the Hawai‘i Archipelago. Western Pacific Regional Fisheries Management Council. Honolulu, Hawai’i. p. 49–52 http://www.wpcouncil.org/wp-content/uploads/2013/03/2016-01-28-FINAL-Hawaii-FEP-Amd-4-Bottomfish-EFH-RIN-0648-XD907-All-Pages-with-Appendices.pdf

WPRFMC. Sabater M, DeMello J. 2021. Managing the Main Hawaiian Island *Aprion virescens* (gray jobfish, uku) fishery. Western Pacific Regional Fisheries Management Council. Honolulu, Hawai’i [accessed 2022 August]. https://www.wpcouncil.org/wp-content/uploads/2021/02/6.C1-2021-04-19-Issue-paper-on-managing-the-MHI-uku-fishery.pdf

Software

SRTM15V2.0 Data set from:
https://www.arcgis.com/home/item.html?id=ad7c957273a741ce82d83c76bc20ca73
(see Tozer et al. 2019 in reference section for associated publication)

lme4:: Bates D, Maechler M, Bolker B, Walker S. 2015. Fitting Linear Mixed-Effects Models Using lme4. Journal of Statistical Software, 67(1), 1–48. doi:10.18637/jss.v067.i01.

suncalc:: Thieurmel B, Elmarhraoui A. 2019. suncalc: Compute Sun Position, Sunlight Phases, Moon Position and Lunar Phase. R package version 0.5.0. https://CRAN.R-project.org/package=suncalc

lattice:: Sarkar D. 2008. Lattice: Multivariate Data Visualization with R. Springer, New York. ISBN 978-0-387-75968-5

tidyverse:: Wickham et al. 2019. Welcome to the tidyverse. Journal of Open Source Software, 4(43), 1686, https://doi.org/10.21105/joss.01686

mgcv:: Wood SN. 2011. Fast stable restricted maximum likelihood and marginal likelihood estimation of semiparametric generalized linear models. Journal of the Royal Statistical Society (B) 73(1):3–36

MuMIn:: Bartoń K. 2023. MuMIn: Multi-Model Inference. R package version 1.47.5. https://CRAN.R-project.org/package=MuMIn

ViPlus: Vision Engineering Ltd The Freeman Building Galileo Drive Send, Woking Surrey GU23 7ER UK https://www.visioneng.us/products/microscope-software/viplus/#overview

Appendices

Appendix A. Records Search and Collection

The following contains the definitions and sources of metadata and environmental data which were used in the analysis of larval uku habitat preferences in this report.

A.1. Tables with Results of Records Search

Records of larval and juvenile uku were retrieved from a variety of sources including published papers, government reports and museum collections. To make these data accessible but also acknowledging that they were built from existing data sets created by scientists and taxonomists not on this Technical Memorandum, the list of all sources of uku larvae globally and the curated presence-absence data set for the main Hawaiian Islands are below. The presence only data set used in this Technical Memorandum was the Global Data set filtered by region to the main Hawaiian Islands only. Please see Supplementary material section 1 for more details about museum specific searches. Tables of all uku results globally (note that only those in the region "main Hawaiian Islands" (MHI) were used for this analysis) and presence-absence data set created from uku results in the MHI is included at very end of appendices.

A.2. Information for larvae in Westree et al. 1972 came from notes in the Australian Museum Collection

Collection information for specimens I.25000-028 to -036 collected in July 1972 was found in "Marine environment impact assessment report for Hawaiian Electric Company, Incorporated Kahe Point Facility, O'ahu, Hawaii," which is published by URs research company in 1973 and available via the University of Hawai'i Library System. After using uku-related search terms to no avail we tried "Electric Company" and "Kahe," thanks to information provided by Jeff Leis via email. The notes in the excel sheet provided by the Australian Museum Collection contained fractions such as "6/3" and "2/4" but the denominator was never larger than 4 and the numerator was never larger than 6. Collection information for zooplankton tows conducted on July 5, 1972, listed 6 sites with 4 tows at each location. It was surmised that the fractions in the Australian Museum excel referred to the site/tow number from which each larvae was collected. The report itself did not list *Aprion* explicitly as a collected species but it did list several unidentified species in various samples. Identifying lutjanidae and etelines to species level is difficult for non-experts so it is unsurprising that these were unidentified at time of collection. The Environmental Baseline Report used to determine if ichthyoplankton were affected by the placement of the electrical power plant proceeded as follows: 48 day-night paired and replicated tows were conducted over a 24-hr period across 6 different locations. Uku larvae were caught at 5 out of 6 stations, most often at night. Uku caught at stations 2 and 4 were sampled in the warm effluent water of the power station, suggesting that they might have a high tolerance to heat.

Table A-1. Collection information for uku larvae caught during the course of the Environmental Impact Assessment.

Station Number	Day or night	uku caught? (yes and number of uku)	Larval length (mm) if available	Benthic composition	Cast depth	Location temperature (°C)

1	day			Mostly dead massive coral and sand cover	surface	26
1	night	Yes, 1		Mostly dead massive coral and sand cover	surface	26
2	day			Massive reef	surface	27.9
2	night	Yes, 2		Massive reef	surface	27.9
3	day	Yes, 1		Massive reef	surface	25.9
3	night	Yes, 1		Massive reef	surface	25.9
4	day			Thin sand, no coral	surface	27
4	night			Thin sand, no coral	surface	27
5	day			Sandy bottom	surface	25.8
5	night	Yes, 4	4.2, 3.3	Sand bottom	surface	25.8
6	day			Reef	7.6–9.1m	26
6	night	Yes, 2		Reef	7.6– 9.1m	26

A.3. Larvae from O'Malley et al. 2021 supplement

The larvae that were aged with otolith chronology as part of O'Malley et al. 2021 had specimen identifications that matched with records of larvae collected during cruises SE1106 and SE1206 of the *R\V Oscar Elton Sette.* The datasheets we had access to from the PIFSC archives were organized so that for a given station the first page is the station and Cobb trawl information and the page after has measurements of the specimens caught on a particular trawl. We matched the station number associated with the larval specimen ID with the "Plankton, Eggs, and Larvae #1" datasheet which was provided to us by the PIFSC Data Center. The Cobb trawls were towed at three different depths for an hour each (Table A2). Due to the fact that Cobb trawls do not have closing doors, larvae could have entered the net at any depth regardless of tow time. With this information we chose to be conservative and utilized only the maximum cast depth when considering potential capture depth of larvae. We also examined the "Plankton, Eggs, and Larvae #1" datasheets associated with Issacs-Kid Trawls on these same cruises and found no records of larval uku. Environmental data came from CTD casts taken around the same time as

these Cobb trawls. Trawl and CTD cast coordinates were obtained from both the cruise reports and CTD logs from the PIFSC data center. CTD and Cobb trawls were matched based on spatial proximity using a function in R. Pease see https://github.com/a-larval-schmidt/uku_efh for that code. Of particular interest to us was station 29 where Specimen SE120629ETEL-02 was identified as *Aprion* and was found to be 29.2mm in length. What might also be of interest are the pages for station 32, where Bob Humphreys described what they caught as "pelagic stage etelines", which he did not do for specimens captured at station 29. Specimens SE120632ETEL-20 and SE120632ETEL-05 from this station were identified as *Aprion* and specimen 05 was 25mm in length according to the supplement from O'Malley et al. 2021.

Table A-2. Amalgamation of data from "Plankton, Eggs, and Larvae #1 datasheets recorded during cruises SE1106 and SE1206 of the R\V Oscar Elton Sette for both Cobb trawls and Issacs-Kid trawls.

Cruise	Station number	Sample record id	Larva length (mm)	Cast depth maximum (m)	Time at depth (minutes)	Intermediate fishing depth (m)	Time at depth (minutes)	Cast depth minimum (m)	Time at depth (minutes)	Notes from raw data sheet
SE 11-06	84	OES1106084Etel.01	25	23	125	NA	NA	0	3	
SE 12-06	1	SE1206001ETEL-01	17	255	63	136	75	16	60	
SE 12-06	4	SE1206004ETEL-02	14.1	189	60	112	60	40	60	
SE 12-06	29	SE120629ETEL-02	29.2	161	60	108	60	27	60	"Trawling into a following current"
SE 12-06	32	SE120632ETEL-05	25	160	60	108	60	31	60	"The shore fish catch was not dominated by anyone family but apogonids appeared to be in the majority.'
SE 12-06	32	SE120632ETEL-20	18	160	60	108	60	31	60	

A.4. Larvae from Smithsonian records

Three of the larvae listed as models for illustrations in Lies and Lee (1994) had specimen identification numbers that matched those in the collections of the Smithsonian. The associated specimen collection information included coordinates, collection year and station numbers. These data were used to track down information for *R\V Townsend Cromwell* cruise 32 via InPort record 5809 (available at: https://www.fisheries.noaa.gov/inport/item/5809). Environmental data were available for deepest cast

depth and the surface. Being uncertain about what depth larvae were collected, we elected to use the surface values only (SURFACE_TEMP), minimum temperature is the average of TEMP_1, TEMP_2 and SURFACE_TEMP.

A.5. Environmental data which were unavailable

For records collected on the *R\V Teritu,* we queried NCEI and found records for the appropriate year and time period but these were in C100 Ocean_Station_Data format. NCEI is reformatting these but data were not available at time of publication. Further queries via NCEI yielded no environmental data associated with *Kagoshima Maru*, *R\V Kana Keoki* and *Kakuhu-maru* for the appropriate years.

A.6. Environmental data and reprocessing of samples from Boelhert and Mundy (1996)

We started this project with data from Boelhert and Mundy (1996), provided via GUID: gov.noaa.nmfs.inport:8791). This paper by Boelhert and Mundy utilized data from four quarterly cruises spanning 1985 and 1986. Trawling with a $1m^2$ MOCNESS was conducted at six stations, three on either side of O‘ahu. Nearshore stations were 1–2 nautical miles (nm) from shore, offshore stations were 5 or 15 nm from shore. The $1m^2$ MOCNESS is equipped with 8 nets each opening and closing at specified depths. Nearshore sampling was conducted between 100 m depth and the surface in 8 depth strata (neuston, 0–10, 10–20, 20–30, 30–40, 40–50, 50–60, and 60–80 m depths). Offshore sampling was conducted between 200 m and the surface with 20 m depth bins per net and 9 depth strata (neuston, 0–20, 20–40, 40–60, 60–80, 80–100, 100–120, 120–160, and 160–200 m depths). There were four trawls per station, two replicates during daylight hours and two during nighttime. The MOCNESS took *in situ* temperature, salinity, velocity, volume and net angle measurements while flying. B. Mundy shared his records of the raw output from the MOCNESS with us for cruises TC 8604 and TC 8602. These output files were stored in .MOC format, which consisted of a single column of output data. We went through and created an R script to parse this out into a more user friendly table format (see .MOC function in Supplement 3.c). For TC8504 and TC8505 we petitioned the PIFSC datacenter to share scans of the printed MOCNESS output. We used the OCR function to transform the PDFs into Excel files. Due to poor print quality on many of the scans the OCR was not successful and data had to be input/ fixed by hand. Due to the fact that TC8505 had no associated uku larvae and the environmental data were in shambles we elected to only transcribe TC8504 data. Scans from TC 8504 listed the salinity values ~41 for all MOCNESS flights which is highly unlikely for the region and inconsistent with salinity values obtained from CTD casts on the same cruise. ALS took summarized salinity values from the upper 100m of the water column from the CTD and subtracted them from the average salinity value of all the TC8504 MOCNESS flights. This value was 6.323265288 and it was then subtracted from every salinity value in the TC 8504 MOCNESS readouts.

Replicate 1 sampled of all tows from TC cruises 8504, 8505, 8602, 8604 were all processed. Replicate 2 was only processed from TC 8504. We used replicate 1 of TC8504 to train our search image for larval uku identification. We relied on Leis and Lee (1994) to identify larval eteline snappers and help from B. Mundy. ALS and JW utilized Leis and Lee (1994) to help create our own quick reference character chart (Table A1. F) and processed replicate 1 samples that had confirmed uku larvae, seeking to find the same number of individuals in a sample as was published in the 1996 publication. After re-processing all of replicate 1, we reached out to B. Mundy to confirm and refine our identifications. Due to this lab effort occurring during COVID-19 (i.e. restricted lab access), B. Mundy assisted with identifying uku virtually. We contacted B. Mundy via GoogleMeet video chat and shared our screen which was connected to a camera microscope. After B. Mundy confirmed and corrected our identifications we went

back and measured all of the positively identified uku larvae. We then re-sorted replicate 2 from TC8504 and measured uku larvae therein. Finally, we selected all MOCNESS samples taken from 40 m to 0 m at all stations and day times for TC 8604 and reexamined them to identify and measure uku larvae therein. Most larvae were 2–4 mm in length (Figure A1.F).

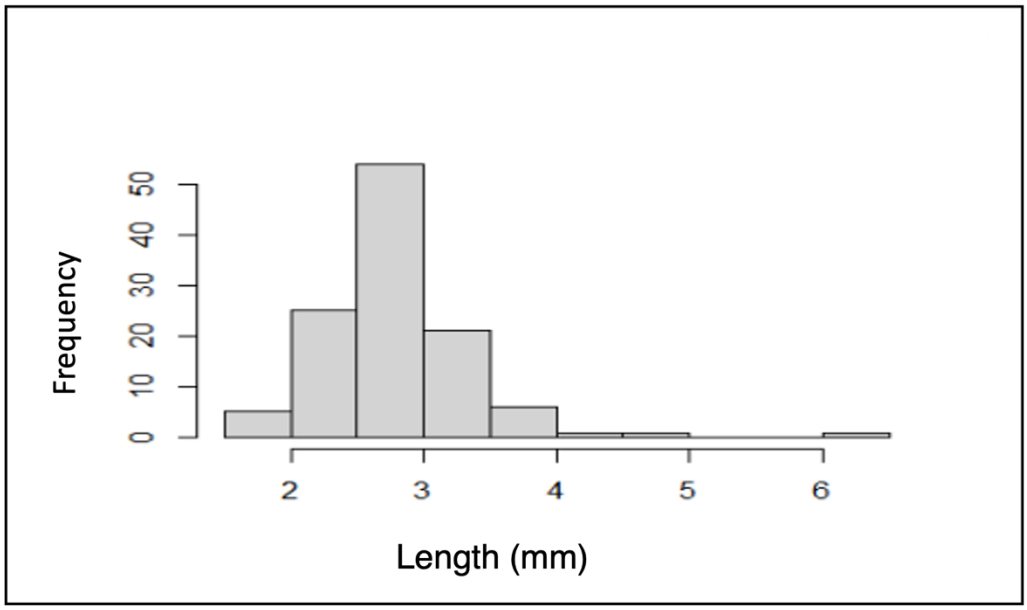

Figure A-1. Distribution of larval lengths only from re-examination of old ichthyoplankton samples.

A.7. Notes from Thomas A. Clarke

Eleven larvae listed in the collection spreadsheet of holdings at the Australian Museum were collected by Thomas A. Clarke. Unfortunately Dr. Clarke is no longer living so we used his personal notes and publications to match collection information with the larvae listed in the museum record. We used the collection dates from the museum record to match with publications from Clarke. Where publications did not list matching information we consulted his personal notes, which were provided by Don Kobayashi via T.A. Clarke's wife, Nancy. In investigating publications and notes we found 7 observations of larvae which were previously unrecorded. Larvae collected between August 1977 and October 1978 are associated with Clarke's 1991 Technical Report. Sizes for these larvae and details about trawl volumes and timing which were not available in publications were gleaned from his personal notes. We were unable to locate the associated environmental data for these cruises. Scans of Clarke's notes used to inform this report are in section 1 of the attached supplement.

Appendix B. Larval Age

B.1. Methods

Approximate larval age in days post hatch (DPH) can be calculated by subtracting size at hatch from total length and dividing this value by the larval growth rate. No growth rate values exist for larval uku. Lacking both size at hatch and growth rate data for uku, we found the size at hatch for *Pristipomoides filamentosus* (2–2.1 mm; WPRFMC 2016). This same publication also listed a series of ages and lengths for *P. filamentosus* raised in captivity. We found records of nine larvae with ages and associated lengths during our literature search (O'Malley et al. 2016). We used the information from these nine uku larvae along with the *P. filamentosus* size at hatch to create a growth rate (equation A5.1) and an approximate age (Equation A5.2) for uku. Confirmed age is the larval age determined either by rearing from hatch or from otolith analysis

Equations:

[A4.1] $growth\ rate = (length - size\ at\ hatch)/confirmed\_age\_days$

[A4.2] $calculated\ age = (length - size\ at\ hatch) \div\ growth\ rate$

Due to the exponential shape of the growth curve in the early days of life it was determined to be inappropriate to apply the VonBertanaffly Growth Function for adult uku to larval data (J. O'Malley *pers. comm.*). We examined linear relationships instead.

B.2. Results and Discussion

Current available models for *uku* growth focus on settled juvenile and adult stages, and although the early life history was examined, larval ages were only used to generate a t_0 value for the adult model (O'Malley et al. 2021). Although we used a rough linear regression to model age, more appropriate functions like an exponential or Laird-Gompertz model, tested in R would have been better methodologically (Vasbinder and Ainsworth 2020). Based on this rough linear regression, larvae 3–6mm in length (like those from PIFSC's archived ichthyoplankton samples) were barely in their first week of life (Appendix 2). Several other species and associated growth curves were also compared to the length/ages from the O'Malley et al.2021 supplement). Back-calculating larval location from age data and dispersal modeling could allow for approximating adult spawning locations. The samples and records of planktonic uku encapsulate hatching to ~30 days old (as estimated from larvae 2–30 mm in length using O'Malley et al. 2021). There is a gap from 3 cm to 9 cm (animals aged 30–90days, see gaps in A5.A and A5.B) where no specimens or records exist in any data set range wide. To be sure, even in the 2–30 mm size class there are very few larvae longer than 6 mm in length, we would like to put forward the idea of net avoidance as a possible mechanism for their scarcity in our samples and records. Another 60 day gap exists in between this and the next time stamp of around 150 days old (150 mm juvenile, Parrish 1989 and 180 mm juvenile from REA surveys). The pelagic-benthic transition remains completely unknown because no records of larvae between 30 and 90 mm long exist across the Pacific basin.

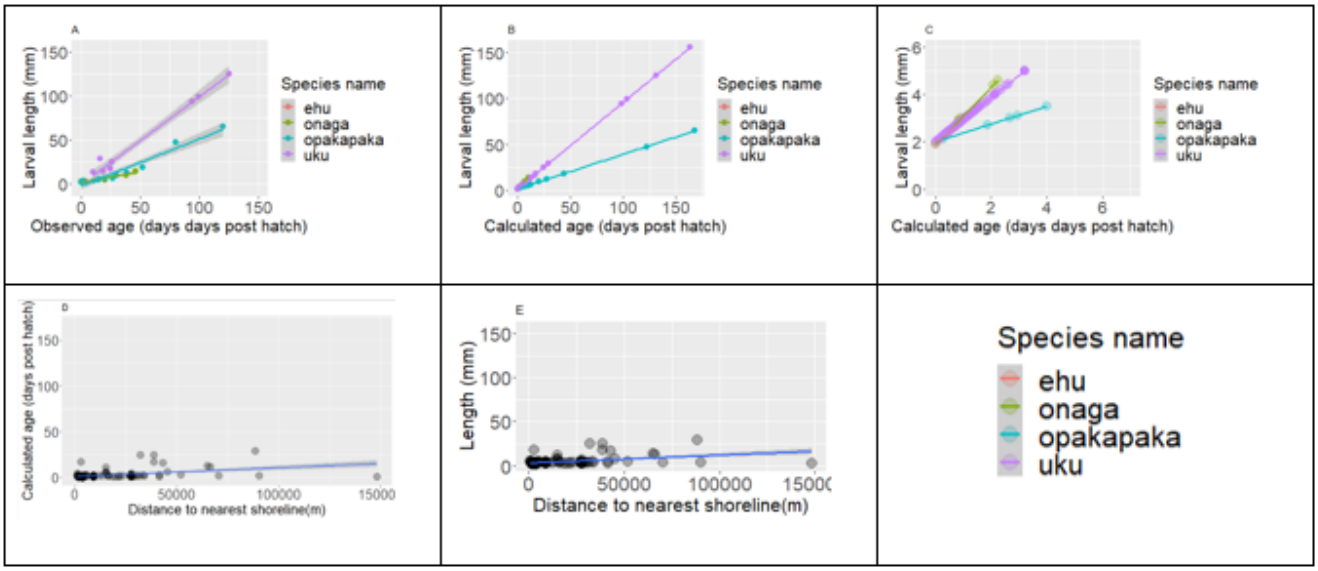

Figure B-1. Lengths and ages for uku in purple are compared to growth rates for other Eteline snappers.

Etelis oculatus, Pristipomoides sp. and *Rhomboplites aurorubens* have been observed to have deeper distributions with development (D'Allesandro et al. 2010). We did not find that pattern with uku.

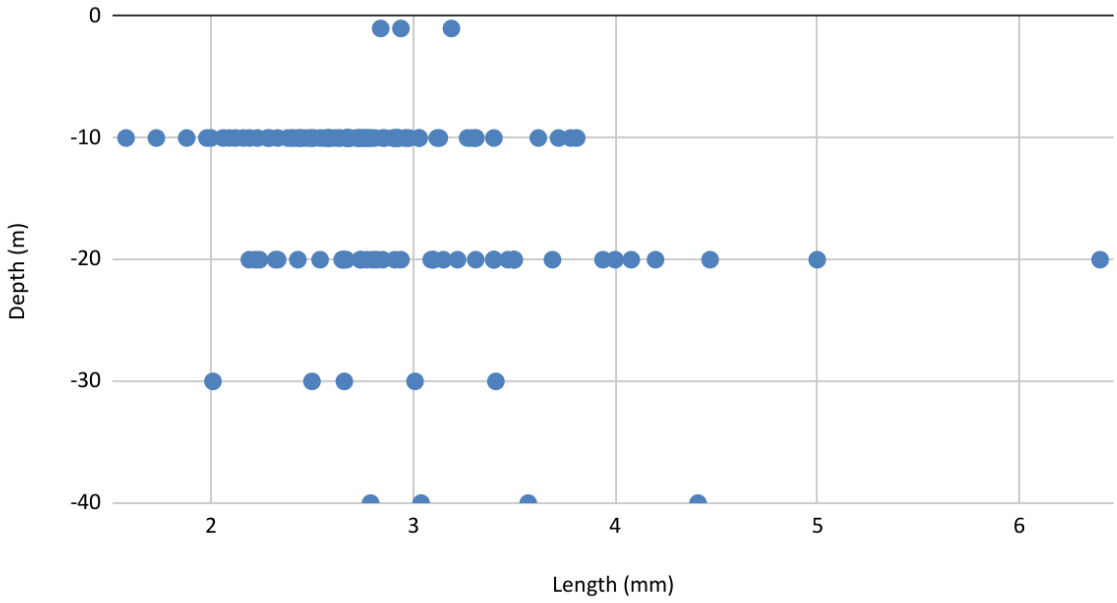

Figure B-2. Lengths (total length, mm) and collection depths for uku do not show a discernable pattern of increasing depth with ontogeny.

Appendix C: Table of Records

Global Uku Data Set

Column heading	Further explanation
sample_record_identifier	Unique identifier for an individual or lot of *Aprion virescens.* If specimen was from a musem collection the same identifier is used. If specimen is in fact merely a record from the literature a unique identifier was created combining the date of either the survey or the publication, author initals and a unique sequential number to differentiate the specimen from others caught in the same tow.
doi	Digital Object Identifier is listed for records that show whether uku were present or absent in a given tow
Life stage	Type of record/document that contained information about individual uku specimens. Larv= larva, juv=juvenile
Region	Region either listed in publication or assigned by ALS
collection_date	Date of trawl
length_mm	fork length (FL) OR total length (TL) of an individual specimen listed in millimeters
length_type	description of whether length is fork length (FL) OR total length (TL)

sample_record_identifier	doi	life_stage	region	collection_date	length_mm	length_type
770802_1	https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf, sizes from T.A. Clarke's personal notes provided by Don Kobayashi	larv	Main Hawaiian Islands	08/10/1977	4	TL
770802_2	https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf, sizes from T.A. Clarke's personal notes provided by Don Kobayashi	larv	Main Hawaiian Islands	08/10/1977	4.5	TL
770802_3	https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf, sizes from T.A. Clarke's personal notes provided by Don Kobayashi	larv	Main Hawaiian Islands	08/10/1977		TL
770803_1	https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf, sizes from T.A. Clarke's personal notes provided by Don Kobayashi	larv	Main Hawaiian Islands	08/10/1977	4.5	TL
770808_1	https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf, sizes from T.A. Clarke's personal notes provided by Don Kobayashi	larv	Main Hawaiian Islands	08/11/1997	5	TL
780804_1	https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf, sizes from T.A. Clarke's personal notes provided by Don Kobayashi	larv	Main Hawaiian Islands	08/03/1978	3.5	TL
780804_2	https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf, sizes from T.A. Clarke's personal notes provided by Don Kobayashi	larv	Main Hawaiian Islands	08/03/1978	4	TL
AMS I.31530	email request to Tokyo Natural History Museum for all records on Aprion virescens	larv	East China Sea	10/05/1982		NA
AMS I.31824	email request to Tokyo Natural History Museum for all records on Aprion virescens	larv	East China Sea	07/03/1984		NA
AMS I.31978	email request to Tokyo Natural History Museum for all records on Aprion virescens	larv	East China Sea	07/03/1984		NA
AMS I.32036	email request to Tokyo Natural History Museum for all records on Aprion virescens	larv	East China Sea	07/03/1984		NA
I.23566-017	email request to Australian Museum for all records on Aprion virescens	larv	Main Hawaiian Islands	07/05/1972	4.4	TL
I.23570-056	email request to Australian Museum for all records on Aprion virescens	larv	Main Hawaiian Islands	09/09/1975	4	SL
I.23599-008	email request to Australian Museum for all records on Aprion virescens	larv	Main Hawaiian Islands	June 1976	6.1	TL

sample_record_identifier	doi	life_stage	region	collection_date	length_mm	length_type
I.23599-009	email request to Australian Museum for all records on Aprion virescens	larv	Main Hawaiian Islands	06/04/1976		NA
I.23603-011	email request to Australian Museum for all records on Aprion virescens	larv	Main Hawaiian Islands	10/04/1972	18	SL
I.23728-003	email request to Australian Museum for all records on Aprion virescens	larv	Queensland, Australia	02/27/1983		NA
I.23818-003	email request to Australian Museum for all records on Aprion virescens	larv	Main Hawaiian Islands	07/05/1974	5	TL
I.23818-005	email request to Australian Museum for all records on Aprion virescens	larv	Main Hawaiian Islands	15-16 July, year unknown	3.3	TL
I.23818-006	email request to Australian Museum for all records on Aprion virescens	larv	Main Hawaiian Islands	15-16 July, year unknown	3.3	TL
I.24883-002	email request to Australian Museum for all records on Aprion virescens	larv	Queensland, Australia	03/11/1984	3	SL
I.24998-003	https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1973/712/clarke.pdf	larv	Main Hawaiian Islands	09/03/1971		NA
I.24998-004	https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1973/712/clarke.pdf	larv	Main Hawaiian Islands	09/03/1971	7	SL
I.24998-005	https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1973/712/clarke.pdf	larv	Main Hawaiian Islands	09/02/1971	12.3	TL
I.24998-006	https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1973/712/clarke.pdf	larv	Main Hawaiian Islands	09/07/1971	8	SL
I.24998-012	https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1973/712/clarke.pdf	larv	Main Hawaiian Islands	09/03/1971	7	SL
I.24998.015	https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1973/712/clarke.pdf	larv	Main Hawaiian Islands	NA		NA
I.25000-028	email request to Australian Museum for all records on Aprion virescens AND https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	larv	Main Hawaiian Islands	05/07/1972		NA
I.25000-029	email request to Australian Museum for all records on Aprion virescens AND https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	larv	Main Hawaiian Islands	05/07/1972		NA
I.25000-030	email request to Australian Museum for all records on Aprion virescens AND https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	larv	Main Hawaiian Islands	05/07/1972		NA

sample_record_identifier	doi	life_stage	region	collection_date	length_mm	length_type
I.25000-031	email request to Australian Museum for all records on Aprion virescens AND https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	larv	Main Hawaiian Islands	05/07/1972		NA
I.25000-032	email request to Australian Museum for all records on Aprion virescens AND https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	larv	Main Hawaiian Islands	05/07/1972		NA
I.25000-033	email request to Australian Museum for all records on Aprion virescens AND https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	larv	Main Hawaiian Islands	05/07/1972		NA
I.25000-034	email request to Australian Museum for all records on Aprion virescens AND https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	larv	Main Hawaiian Islands	05/07/1972	4.2	TL
I.25000-035	email request to Australian Museum for all records on Aprion virescens AND https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	larv	Main Hawaiian Islands	05/07/1972		NA
I.25000-036	email request to Australian Museum for all records on Aprion virescens AND https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	larv	Main Hawaiian Islands	05/07/1972		NA
I.25000-037	email request to Australian Museum for all records on Aprion virescens AND https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	larv	Main Hawaiian Islands	05/07/1972	3.3	TL
I.25362-005	https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf	larv	Main Hawaiian Islands	08/10/1977	4.5	TL
I.25362-006	https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf	larv	Main Hawaiian Islands	08/10/1977	5	TL
I.25650-001	https://spo.nmfs.noaa.gov/sites/default/files/legacy-pdfs/tr101.pdf	larv	Main Hawaiian Islands	10/03/1971		NA
I.25650-004	https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1973/712/clarke.pdf	larv	Main Hawaiian Islands	10/03/1971		NA
I.25650.019	https://spo.nmfs.noaa.gov/sites/default/files/pdf-content/1973/712/clarke.pdf	larv	Main Hawaiian Islands	10/1971 - 10/1971		NA
I.26058-012	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	01/20/1983	4	SL
I.26062-002	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	01/20/1983	4	SL

sample_record_identifier	doi	life_stage	region	collection_date	length_mm	length_type
I.26110-011	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/23/1983		NA
I.26111-014	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/22/1983	5	SL
I.26111-015	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/22/1983	3	SL
I.26112-002	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/23/1983	4	SL
I.26112-006	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/23/1983		NA
I.26119-003	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/23/1983	3	SL
I.26120-012	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/24/1983	4	SL
I.26121-010	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/24/1983	4	SL
I.26122-008	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/24/1983	4	SL
I.26124-005	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/24/1983	4	SL
I.26129-001	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/24/1983		NA
I.26129-007	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/24/1983	3	SL
I.26129-008	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/24/1983	4	SL

sample_record_identifier	doi	life_stage	region	collection_date	length_mm	length_type
I.26129.031	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/24/1983		NA
I.26130-001	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/25/1983	4	SL
I.26131-001	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/25/1983		NA
I.26135-001	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/25/1983		NA
I.26135-002	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/25/1983		NA
I.26135-009	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/25/1983		NA
I.26135.024	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/25/1983		NA
I.26140-003	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/26/1983	5	SL
I.26140-008	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/26/1983	5	SL
I.26141-009	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/26/1983	4	SL
I.26142-005	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	03/26/1983	4	SL
I.26153-007	email request to Australian Museum for all records on Aprion virescens	larv	Queensland, Australia	03/27/1983	4	SL
I.26154-003	email request to Australian Museum for all records on Aprion virescens	larv	Queensland, Australia	03/27/1983	4	SL

sample_record_identifier	doi	life_stage	region	collection_date	length_mm	length_type
I.26156-004	email request to Australian Museum for all records on Aprion virescens	larv	Queensland, Australia	03/27/1983	4	SL
I.30541-001	email request to Australian Museum for all records on Aprion virescens	larv	Queensland, Australia	11/27/1987	3	SL
I.30556-002	email request to Australian Museum for all records on Aprion virescens	larv	Queensland, Australia	11/29/1991	4	SL
I.30557-002	email request to Australian Museum for all records on Aprion virescens	larv	Queensland, Australia	11/29/1991	3	SL
I.30609-007	email request to Australian Museum for all records on Aprion virescens	larv	Queensland, Australia	11/15/1988	3	SL
I.31383-001	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	04/26/1990		NA
I.31390-001	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	04/19/1990		NA
I.32089-001	email request to Australian Museum for all records on Aprion virescens	larv	East China Sea	12/09/1986	8	SL
I.33153-001	email request to Australian Museum for all records on Aprion virescens	larv	Western Indian Ocean	03/05/1974	4	SL
I.33161-003	email request to Australian Museum for all records on Aprion virescens	larv	Western Indian Ocean	07/05/1974		NA
I.33233-003	email request to Australian Museum for all records on Aprion virescens	larv	Western Indian Ocean	17/12/1974	4	SL
I.36590-003	email request to Australian Museum for all records on Aprion virescens	larv	New South Wales, Australia	13/05/1989		NA
OES1106084Etel.01	https://doi.org/10.1002/mcf2.10155	larv	Main Hawaiian Islands	09/05/2011	25	FL
Parrish89_5	https://www.biodiversitylibrary.org/page/3235135	juv	Main Hawaiian Islands	October 1988	155.5	TL
RoyM12-1	https://doi.org/10.1002/mcf2.10155	juv	Main Hawaiian Islands	NA	94	FL
RoyM12-2	https://doi.org/10.1002/mcf2.10155	juv	Main Hawaiian Islands	NA	99	FL

sample_record_identifier	doi	life_stage	region	collection_date	length_mm	length_type
RoyM12-3	https://doi.org/10.1002/mcf2.10155	juv	Main Hawaiian Islands	NA	125	FL
SE1206001ETEL-01	https://doi.org/10.1002/mcf2.10155	larv	Main Hawaiian Islands	08/12/2012	17	FL
SE1206004ETEL-02	https://doi.org/10.1002/mcf2.10155	larv	Main Hawaiian Islands	08/13/2012	14	FL
SE120629ETEL-02	https://doi.org/10.1002/mcf2.10155	larv	Main Hawaiian Islands	08/20/2012	29.2	FL
SE120632ETEL-05	https://doi.org/10.1002/mcf2.10155	larv	Main Hawaiian Islands	08/21/2012	25	FL
SE120632ETEL-20	https://doi.org/10.1002/mcf2.10155	larv	Main Hawaiian Islands	08/21/2012	18	FL
SE120640LUTJ-01	https://doi.org/10.1002/mcf2.10155	larv	Main Hawaiian Islands	08/24/2012	13	FL
TC8504_003_9	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/06/1985		NA
TC8504_005_9	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/07/1985		NA
TC8504_008_8	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/07/1985	4	SL
TC8504_010_7	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/07/1985		NA
TC8504_011_9	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/08/1985	3.1	SL
TC8504_011_9_b	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/08/1985	3.1	SL
TC8504_011_9_c	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/08/1985	3.5	SL
TC8504_011_9_d	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/08/1985	3.4	SL
TC8504_011_9_e	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/08/1985	3.4	SL
TC8504_011_9_f	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/08/1985	3.4	SL
TC8504_011_9_g	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/08/1985	3.5	SL

sample_record_identifier	doi	life_stage	region	collection_date	length_mm	length_type
TC8504_011_9_h	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/08/1985	4.2	SL
TC8504_011_9_i	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/08/1985	5	SL
TC8504_014_9	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/08/1985		NA
TC8504_015_9	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/09/1985		NA
TC8504_031_7	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/11/1985		NA
TC8504_032_7	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/11/1985		NA
TC8504_032_8	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/11/1985		NA
TC8504_037_0	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/12/1985		NA
TC8504_037_8	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/12/1985		NA
TC8504_044_8	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	09/14/1985		NA
TC8604_002_0	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	06/24/1986		NA
TC8604_002_9	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	06/24/1986		NA
TC8604_004_9	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	06/25/1986		NA
TC8604_006_7	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	06/25/1986		NA
TC8604_006_8	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	06/25/1986		NA
TC8604_006_9	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	06/25/1986		NA
TC8604_008_8	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	06/25/1986		NA
TC8604_012_9	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	06/26/1986	6.4	SL

sample_record_identifier	doi	life_stage	region	collection_date	length_mm	length_type
TC8604_032_8	https://www.fisheries.noaa.gov/inport/item/8791	larv	Main Hawaiian Islands	06/29/1986	3.4	SL
USNM 322279	https://collections.nmnh.si.edu/search/fishes/#:~:text=http%3A//n2t.net/ark%3A/65665/35bc3ec3b,%C2%A0	larv	Main Hawaiian Islands	10/09/1967	5	TL
USNM 322280	http://n2t.net/ark:/65665/3bf247b13-c332-4d46-aac7-fe15637002a9	larv	Main Hawaiian Islands	07/13/1967	5	TL
USNM 322281	http://n2t.net/ark:/65665/348654a2f-3a3d-4a98-9246-7de2248d2df7	larv	Main Hawaiian Islands	07/23/1967	5	TL
1E39F4FE-5105-4581-AF06-C43D957BAED0	http://portal.vertnet.org/o/lacm/fish?id=1e39f4fe-5105-4581-af06-c43d957baed0	larv	Indonesia	05/18/1975		

Presence-absence Data set

Column heading	Further explanation
sample_record_identifier	Unique identifier for an individual or lot of *Aprion virescens.* If specimen was from a musem collection the same identifier is used. If specimen is in fact merely a record from the literature a unique identifier was created combining the date of either the survey or the publication, author initals and a unique sequential number to differentiate the specimen from others caught in the same tow.
fish_doi	Digital Object Identifier is listed for records that show whether uku were present or absent in a given tow
environmental_data_doi	Digital Object Identifier is listed for records that give temperature and/or salinity data for a cruise where uku were collected
uku_present1_absent0	Denotes if uku were present (1) or absent (0) in a given tow
collection_date	Date of trawl
sampling_method	Net type used for ichthyoplankton trawl
sampling_method_mesh_size_um	Mesh size for net in micrometers
day_night	Whether tow occurred during the day time or night time

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
I.25000-028	email request to Australian Museum for all records on Aprion virescens	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	1	05/07/1972	1 meter net	505	night
I.25000-029	email request to Australian Museum for all records on Aprion virescens	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	1	05/07/1972	1 meter net	505	night
I.25000-030	email request to Australian Museum for all records on Aprion virescens	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	1	05/07/1972	1 meter net	505	night
I.25000-031	email request to Australian Museum for all records on Aprion virescens	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	1	05/07/1972	1 meter net	505	night
I.25000-032	email request to Australian Museum for all records on Aprion virescens	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	1	05/07/1972	1 meter net	505	night
I.25000-033	email request to Australian Museum for all records on Aprion virescens	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	1	05/07/1972	1 meter net	505	night
I.25000-034	email request to Australian Museum for all records on Aprion virescens	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	1	05/07/1972	1 meter net	505	night
I.25000-035	email request to Australian Museum for all records on Aprion virescens	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	1	05/07/1972	1 meter net	505	night
I.25000-036	email request to Australian Museum for all records on Aprion virescens	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	1	05/07/1972	1 meter net	505	day
I.25000-037	email request to Australian Museum for all records on Aprion virescens	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	1	05/07/1972	1 meter net	505	night
OES1106084Etel.01	https://doi.org/10.1002/mcf2.10155	PICDR-113137	1	09/05/2011	COBB TRAWL	1000	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
Oscar Elton Sette_11_06station100	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	09/07/2011	COBB TRAWL	1000	night
Oscar Elton Sette_11_06station107	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	09/08/2011	COBB TRAWL	1000	night
Oscar Elton Sette_11_06station116	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	09/09/2011	COBB TRAWL	1000	night
Oscar Elton Sette_11_06station133	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	09/10/2011	COBB TRAWL	1000	night
Oscar Elton Sette_11_06station20	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/30/2011	COBB TRAWL	1000	night
Oscar Elton Sette_11_06station31	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/31/2011	COBB TRAWL	1000	night
Oscar Elton Sette_11_06station44	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	09/01/2011	COBB TRAWL	1000	night
Oscar Elton Sette_11_06station54	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	09/02/2011	COBB TRAWL	1000	night
Oscar Elton Sette_11_06station66	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	09/03/2011	COBB TRAWL	1000	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
Oscar Elton Sette_11_06station76	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	09/04/2011	COBB TRAWL	1000	night
Oscar Elton Sette_11_06station9	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinates from: https://repository.library.noaa.gov/view/noaa/9074 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/29/2011	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station12	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/15/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station13	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/16/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station16	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/16/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station17	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/17/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station20	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/17/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station21	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/18/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station23	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/18/2012	COBB TRAWL	1000	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
Oscar Elton Sette_12_06station25	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/19/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station26	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/20/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station30	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/21/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station34	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/22/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station36	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/22/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station37	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/23/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station39	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/23/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station42	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/24/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station43	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/25/2012	COBB TRAWL	1000	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
Oscar Elton Sette_12_06station5	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/14/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station8	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/14/2012	COBB TRAWL	1000	night
Oscar Elton Sette_12_06station9	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	0	08/15/2012	COBB TRAWL	1000	night
SE1206001ETEL-01	https://doi.org/10.1002/mcf2.10155	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	1	08/12/2012	COBB TRAWL	1000	night
SE1206004ETEL-02	https://doi.org/10.1002/mcf2.10155	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	1	08/13/2012	COBB TRAWL	1000	night
SE120629ETEL-02	https://doi.org/10.1002/mcf2.10155	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	1	08/20/2012	COBB TRAWL	1000	night
SE120632ETEL-05	https://doi.org/10.1002/mcf2.10155	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	1	08/21/2012	COBB TRAWL	1000	night
SE120640LUTJ-01	https://doi.org/10.1002/mcf2.10155	coordinating from: https://repository.library.noaa.gov/view/noaa/9050 Environmental Data from Internal PIFSC Data request: PICDR-113152	1	08/24/2012	COBB TRAWL	1000	night
TC8504_003_9	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/06/1985	MOCNESS	333	night
TC8504_005_9	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/07/1985	MOCNESS	333	day

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
TC8504_008_8	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/07/1985	MOCNESS	333	day
TC8504_010_7	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/07/1985	MOCNESS	333	night
TC8504_011_9	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/08/1985	MOCNESS	333	day
TC8504_014_9	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/08/1985	MOCNESS	333	night
TC8504_015_9	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/09/1985	MOCNESS	333	night
TC8504_031_7	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/11/1985	MOCNESS	333	day
TC8504_032_7	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/11/1985	MOCNESS	333	night
TC8504_032_8	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/11/1985	MOCNESS	333	night
TC8504_037_0	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/12/1985	MOCNESS	333	night
TC8504_037_8	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/12/1985	MOCNESS	333	night
TC8504_044_8	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	09/14/1985	MOCNESS	333	night
TC8604_002_0	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	06/24/1986	MOCNESS	333	night
TC8604_002_9	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	06/24/1986	MOCNESS	333	night
TC8604_004_9	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	06/25/1986	MOCNESS	333	day
TC8604_006_7	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	06/25/1986	MOCNESS	333	day
TC8604_006_8	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	06/25/1986	MOCNESS	333	day
TC8604_006_9	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	06/25/1986	MOCNESS	333	day
TC8604_008_8	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	06/25/1986	MOCNESS	333	night
TC8604_012_9	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	06/26/1986	MOCNESS	333	day

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
TC8604_032_8	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	1	06/29/1986	MOCNESS	333	day
Townsend Cromwell_32_1_1159	https://www.fisheries.noaa.gov/inport/item/5809	https://www.fisheries.noaa.gov/inport/item/5809	0	07/12/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_10_1154	https://www.fisheries.noaa.gov/inport/item/5810	https://www.fisheries.noaa.gov/inport/item/5810	0	07/15/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_11_1950	https://www.fisheries.noaa.gov/inport/item/5811	https://www.fisheries.noaa.gov/inport/item/5811	0	07/15/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_12_403	https://www.fisheries.noaa.gov/inport/item/5812	https://www.fisheries.noaa.gov/inport/item/5812	0	07/16/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_13_1154	https://www.fisheries.noaa.gov/inport/item/5813	https://www.fisheries.noaa.gov/inport/item/5813	0	07/16/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_14_1953	https://www.fisheries.noaa.gov/inport/item/5814	https://www.fisheries.noaa.gov/inport/item/5814	0	07/16/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_15_352	https://www.fisheries.noaa.gov/inport/item/5815	https://www.fisheries.noaa.gov/inport/item/5815	0	07/17/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_16_1155	https://www.fisheries.noaa.gov/inport/item/5816	https://www.fisheries.noaa.gov/inport/item/5816	0	07/19/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_17_1946	https://www.fisheries.noaa.gov/inport/item/5817	https://www.fisheries.noaa.gov/inport/item/5817	0	07/19/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_18_354	https://www.fisheries.noaa.gov/inport/item/5818	https://www.fisheries.noaa.gov/inport/item/5818	0	07/20/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_19_1944	https://www.fisheries.noaa.gov/inport/item/5819	https://www.fisheries.noaa.gov/inport/item/5819	0	07/20/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_2_1953	https://www.fisheries.noaa.gov/inport/item/5820	https://www.fisheries.noaa.gov/inport/item/5820	0	07/12/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_20_354	https://www.fisheries.noaa.gov/inport/item/5821	https://www.fisheries.noaa.gov/inport/item/5821	0	07/21/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
Townsend Cromwell_32_21_1142	https://www.fisheries.noaa.gov/inport/item/5822	https://www.fisheries.noaa.gov/inport/item/5822	0	07/21/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_22_1952	https://www.fisheries.noaa.gov/inport/item/5823	https://www.fisheries.noaa.gov/inport/item/5823	0	07/21/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_23_403	https://www.fisheries.noaa.gov/inport/item/5824	https://www.fisheries.noaa.gov/inport/item/5824	0	07/22/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_24_1151	https://www.fisheries.noaa.gov/inport/item/5825	https://www.fisheries.noaa.gov/inport/item/5825	0	07/22/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_25_1942	https://www.fisheries.noaa.gov/inport/item/5826	https://www.fisheries.noaa.gov/inport/item/5826	0	07/22/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_27_1205	https://www.fisheries.noaa.gov/inport/item/5827	https://www.fisheries.noaa.gov/inport/item/5827	0	07/25/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_28_1952	https://www.fisheries.noaa.gov/inport/item/5828	https://www.fisheries.noaa.gov/inport/item/5828	0	07/25/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_29_343	https://www.fisheries.noaa.gov/inport/item/5829	https://www.fisheries.noaa.gov/inport/item/5829	0	07/26/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_30_1944	https://www.fisheries.noaa.gov/inport/item/5830	https://www.fisheries.noaa.gov/inport/item/5830	0	08/12/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_31_354	https://www.fisheries.noaa.gov/inport/item/5831	https://www.fisheries.noaa.gov/inport/item/5831	0	08/13/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_32_1148	https://www.fisheries.noaa.gov/inport/item/5832	https://www.fisheries.noaa.gov/inport/item/5832	0	08/13/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_33_1950	https://www.fisheries.noaa.gov/inport/item/5833	https://www.fisheries.noaa.gov/inport/item/5833	0	08/13/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_34_342	https://www.fisheries.noaa.gov/inport/item/5834	https://www.fisheries.noaa.gov/inport/item/5834	0	08/14/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_35_1151	https://www.fisheries.noaa.gov/inport/item/5835	https://www.fisheries.noaa.gov/inport/item/5835	0	08/14/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
Townsend Cromwell_32_36_1943	https://www.fisheries.noaa.gov/inport/item/5836	https://www.fisheries.noaa.gov/inport/item/5836	0	08/14/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_37_354	https://www.fisheries.noaa.gov/inport/item/5837	https://www.fisheries.noaa.gov/inport/item/5837	0	08/15/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_38_1144	https://www.fisheries.noaa.gov/inport/item/5838	https://www.fisheries.noaa.gov/inport/item/5838	0	08/15/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_39_1953	https://www.fisheries.noaa.gov/inport/item/5839	https://www.fisheries.noaa.gov/inport/item/5839	0	08/15/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_4_1146	https://www.fisheries.noaa.gov/inport/item/5840	https://www.fisheries.noaa.gov/inport/item/5840	0	07/13/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_40_342	https://www.fisheries.noaa.gov/inport/item/5841	https://www.fisheries.noaa.gov/inport/item/5841	0	08/16/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_41_1151	https://www.fisheries.noaa.gov/inport/item/5842	https://www.fisheries.noaa.gov/inport/item/5842	0	08/16/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_43_1946	https://www.fisheries.noaa.gov/inport/item/5843	https://www.fisheries.noaa.gov/inport/item/5843	0	08/17/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_44_353	https://www.fisheries.noaa.gov/inport/item/5844	https://www.fisheries.noaa.gov/inport/item/5844	0	08/18/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_45_1143	https://www.fisheries.noaa.gov/inport/item/5845	https://www.fisheries.noaa.gov/inport/item/5845	0	08/18/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_46_1951	https://www.fisheries.noaa.gov/inport/item/5846	https://www.fisheries.noaa.gov/inport/item/5846	0	08/18/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_47_341	https://www.fisheries.noaa.gov/inport/item/5847	https://www.fisheries.noaa.gov/inport/item/5847	0	08/19/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_48_1155	https://www.fisheries.noaa.gov/inport/item/5848	https://www.fisheries.noaa.gov/inport/item/5848	0	08/19/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_5_1946	https://www.fisheries.noaa.gov/inport/item/5849	https://www.fisheries.noaa.gov/inport/item/5849	0	07/13/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
Townsend Cromwell_32_50_345	https://www.fisheries.noaa.gov/inport/item/5850	https://www.fisheries.noaa.gov/inport/item/5850	0	08/21/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_51_1153	https://www.fisheries.noaa.gov/inport/item/5851	https://www.fisheries.noaa.gov/inport/item/5851	0	08/21/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_52_1942	https://www.fisheries.noaa.gov/inport/item/5852	https://www.fisheries.noaa.gov/inport/item/5852	0	08/21/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_53_349	https://www.fisheries.noaa.gov/inport/item/5853	https://www.fisheries.noaa.gov/inport/item/5853	0	08/22/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_54_1142	https://www.fisheries.noaa.gov/inport/item/5854	https://www.fisheries.noaa.gov/inport/item/5854	0	08/22/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_55_1951	https://www.fisheries.noaa.gov/inport/item/5855	https://www.fisheries.noaa.gov/inport/item/5855	0	08/22/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_56_1952	https://www.fisheries.noaa.gov/inport/item/5856	https://www.fisheries.noaa.gov/inport/item/5856	0	08/23/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_57_344	https://www.fisheries.noaa.gov/inport/item/5857	https://www.fisheries.noaa.gov/inport/item/5857	0	08/24/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_58_1221	https://www.fisheries.noaa.gov/inport/item/5858	https://www.fisheries.noaa.gov/inport/item/5858	0	08/24/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_59_1941	https://www.fisheries.noaa.gov/inport/item/5859	https://www.fisheries.noaa.gov/inport/item/5859	0	08/24/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_6_354	https://www.fisheries.noaa.gov/inport/item/5860	https://www.fisheries.noaa.gov/inport/item/5860	0	07/14/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_60_943	https://www.fisheries.noaa.gov/inport/item/5861	https://www.fisheries.noaa.gov/inport/item/5861	0	08/25/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_61_1226	https://www.fisheries.noaa.gov/inport/item/5862	https://www.fisheries.noaa.gov/inport/item/5862	0	08/25/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_62_28	https://www.fisheries.noaa.gov/inport/item/5863	https://www.fisheries.noaa.gov/inport/item/5863	0	09/09/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
Townsend Cromwell_32_63_430	https://www.fisheries.noaa.gov/inport/item/5864	https://www.fisheries.noaa.gov/inport/item/5864	0	09/09/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_65_426	https://www.fisheries.noaa.gov/inport/item/5865	https://www.fisheries.noaa.gov/inport/item/5865	0	09/10/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_66_345	https://www.fisheries.noaa.gov/inport/item/5866	https://www.fisheries.noaa.gov/inport/item/5866	0	09/15/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_67_1152	https://www.fisheries.noaa.gov/inport/item/5867	https://www.fisheries.noaa.gov/inport/item/5867	0	09/15/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_68_1953	https://www.fisheries.noaa.gov/inport/item/5868	https://www.fisheries.noaa.gov/inport/item/5868	0	09/15/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_69_402	https://www.fisheries.noaa.gov/inport/item/5869	https://www.fisheries.noaa.gov/inport/item/5869	0	09/16/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_7_1154	https://www.fisheries.noaa.gov/inport/item/5870	https://www.fisheries.noaa.gov/inport/item/5870	0	07/14/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_70_1946	https://www.fisheries.noaa.gov/inport/item/5871	https://www.fisheries.noaa.gov/inport/item/5871	0	09/16/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_71_352	https://www.fisheries.noaa.gov/inport/item/5872	https://www.fisheries.noaa.gov/inport/item/5872	0	09/16/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_72_1145	https://www.fisheries.noaa.gov/inport/item/5873	https://www.fisheries.noaa.gov/inport/item/5873	0	09/17/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_73_1945	https://www.fisheries.noaa.gov/inport/item/5874	https://www.fisheries.noaa.gov/inport/item/5874	0	09/17/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_74_1945	https://www.fisheries.noaa.gov/inport/item/5875	https://www.fisheries.noaa.gov/inport/item/5875	0	09/18/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_75_346	https://www.fisheries.noaa.gov/inport/item/5876	https://www.fisheries.noaa.gov/inport/item/5876	0	09/19/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_76_1147	https://www.fisheries.noaa.gov/inport/item/5877	https://www.fisheries.noaa.gov/inport/item/5877	0	09/19/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
Townsend Cromwell_32_77_1949	https://www.fisheries.noaa.gov/inport/item/5878	https://www.fisheries.noaa.gov/inport/item/5878	0	09/19/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_78_1942	https://www.fisheries.noaa.gov/inport/item/5879	https://www.fisheries.noaa.gov/inport/item/5879	0	09/22/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_79_350	https://www.fisheries.noaa.gov/inport/item/5880	https://www.fisheries.noaa.gov/inport/item/5880	0	09/23/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_8_1954	https://www.fisheries.noaa.gov/inport/item/5881	https://www.fisheries.noaa.gov/inport/item/5881	0	07/14/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_80_1147	https://www.fisheries.noaa.gov/inport/item/5882	https://www.fisheries.noaa.gov/inport/item/5882	0	09/23/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_81_1941	https://www.fisheries.noaa.gov/inport/item/5883	https://www.fisheries.noaa.gov/inport/item/5883	0	09/23/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_82_343	https://www.fisheries.noaa.gov/inport/item/5884	https://www.fisheries.noaa.gov/inport/item/5884	0	09/24/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_83_1155	https://www.fisheries.noaa.gov/inport/item/5885	https://www.fisheries.noaa.gov/inport/item/5885	0	09/24/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	day
Townsend Cromwell_32_84_1942	https://www.fisheries.noaa.gov/inport/item/5886	https://www.fisheries.noaa.gov/inport/item/5886	0	09/24/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_85_344	https://www.fisheries.noaa.gov/inport/item/5887	https://www.fisheries.noaa.gov/inport/item/5887	0	09/25/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
Townsend Cromwell_32_9_354	https://www.fisheries.noaa.gov/inport/item/5888	https://www.fisheries.noaa.gov/inport/item/5888	0	07/15/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station1_tow 1	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station1_tow 2	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605683	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station1_tow 3	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605684	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/06/1972	1 meter net	505	night
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station2_tow 1	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605685	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station2_tow 2	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605686	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station3_tow 2	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605687	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station3_tow 3	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605688	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	night
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station4_tow 1	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605689	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station4_tow 2	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605690	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station4_tow 3	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605691	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	night
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station4_tow 4	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605692	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station5_tow 1	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605693	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station5_tow 2	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605694	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station6_tow 1	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605695	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station6_tow 2	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605696	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/05/1972	1 meter net	505	day
URS_Zooplankton_1972_Leis and Watson in U.R.S. Research Co., 1972station6_tow 4	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605697	https://uhawaii-manoa.primo.exlibrisgroup.com/permalink/01UHAWAII_MANOA/k22ptt/alma995100864605682	0	07/06/1972	1 meter net	505	night
USNM 322279	https://collections.nmnh.si.edu/search/fishes/#:~:text=http%3A//n2t.net/ark%3A/65665/35bc3ec3b,%C2%A0	https://www.fisheries.noaa.gov/inport/item/5809	1	10/09/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
USNM 322280	http://n2t.net/ark:/65665/3bf247b13-c332-4d46-aac7-fe15637002a9	https://www.fisheries.noaa.gov/inport/item/5809	1	07/13/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
USNM 322281	http://n2t.net/ark:/65665/348654a2f-3a3d-4a98-9246-7de2248d2df7	https://www.fisheries.noaa.gov/inport/item/5809	1	07/23/1967	ANCHOVY #2; COBB PELAGIC TRAWL	6400	night
TC8504_002	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/06/1985	MOCNESS	333	day
TC8504_004	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/07/1985	MOCNESS	333	night
TC8504_005	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/07/1985	MOCNESS	333	day
TC8504_007	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/07/1985	MOCNESS	333	day

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
TC8504_009	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/07/1985	MOCNESS	333	night
TC8504_012	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/08/1985	MOCNESS	333	day
TC8504_013	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/08/1985	MOCNESS	333	day
TC8504_025	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/10/1985	MOCNESS	333	day
TC8504_026	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/10/1985	MOCNESS	333	night
TC8504_027	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/11/1985	MOCNESS	333	night
TC8504_028	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/11/1985	MOCNESS	333	day
TC8504_029	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/11/1985	MOCNESS	333	day
TC8504_030	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/11/1985	MOCNESS	333	day
TC8504_033	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/11/1985	MOCNESS	333	night
TC8504_035	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/12/1985	MOCNESS	333	day
TC8504_036	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/12/1985	MOCNESS	333	day
TC8504_038	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	09/12/1985	MOCNESS	333	night
TC8505_001	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/12/1985	MOCNESS	333	day
TC8505_002	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/12/1985	MOCNESS	333	night
TC8505_003	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/13/1985	MOCNESS	333	night
TC8505_004	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/13/1985	MOCNESS	333	day
TC8505_005	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/13/1985	MOCNESS	333	day
TC8505_006	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/13/1985	MOCNESS	333	day

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
TC8505_007	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/13/1985	MOCNESS	333	night
TC8505_008	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/13/1985	MOCNESS	333	night
TC8505_010	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/14/1985	MOCNESS	333	day
TC8505_011	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/14/1985	MOCNESS	333	day
TC8505_014	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/14/1985	MOCNESS	333	night
TC8505_015	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/14/1985	MOCNESS	333	night
TC8505_021	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/16/1985	MOCNESS	333	day
TC8505_022	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/16/1985	MOCNESS	333	day
TC8505_023	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/16/1985	MOCNESS	333	day
TC8505_024	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/16/1985	MOCNESS	333	night
TC8505_025	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/16/1985	MOCNESS	333	night
TC8505_026	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/17/1985	MOCNESS	333	night
TC8505_027	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/17/1985	MOCNESS	333	night
TC8505_028	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/17/1985	MOCNESS	333	day
TC8505_029	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/17/1985	MOCNESS	333	day
TC8505_030	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/17/1985	MOCNESS	333	day
TC8505_031	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/17/1985	MOCNESS	333	night
TC8505_032	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/17/1985	MOCNESS	333	night
TC8505_033	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	12/18/1985	MOCNESS	333	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
TC8602_001	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/08/1986	MOCNESS	333	day
TC8602_002	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/08/1986	MOCNESS	333	night
TC8602_003	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/08/1986	MOCNESS	333	night
TC8602_005	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/09/1986	MOCNESS	333	day
TC8602_006	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/09/1986	MOCNESS	333	day
TC8602_007	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/09/1986	MOCNESS	333	day
TC8602_008	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/09/1986	MOCNESS	333	day
TC8602_009	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/09/1986	MOCNESS	333	night
TC8602_010	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/09/1986	MOCNESS	333	night
TC8602_011	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/10/1986	MOCNESS	333	day
TC8602_012	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/10/1986	MOCNESS	333	day
TC8602_018	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/11/1986	MOCNESS	333	day
TC8602_019	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/11/1986	MOCNESS	333	day
TC8602_020	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/11/1986	MOCNESS	333	night
TC8602_021	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/11/1986	MOCNESS	333	night
TC8602_031	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/14/1986	MOCNESS	333	day
TC8602_032	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/14/1986	MOCNESS	333	day
TC8602_034	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/14/1986	MOCNESS	333	day
TC8602_035	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/15/1986	MOCNESS	333	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
TC8602_037	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/15/1986	MOCNESS	333	day
TC8602_038	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/15/1986	MOCNESS	333	day
TC8602_039	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/15/1986	MOCNESS	333	day
TC8602_042	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/15/1986	MOCNESS	333	night
TC8602_043	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/16/1986	MOCNESS	333	night
TC8602_045	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/16/1986	MOCNESS	333	day
TC8602_046	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/16/1986	MOCNESS	333	day
TC8602_047	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/16/1986	MOCNESS	333	night
TC8602_048	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/16/1986	MOCNESS	333	night
TC8602_049	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	04/17/1986	MOCNESS	333	night
TC8604_001	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/24/1986	MOCNESS	333	day
TC8604_005	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/25/1986	MOCNESS	333	day
TC8604_009	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/25/1986	MOCNESS	333	night
TC8604_010	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/26/1986	MOCNESS	333	day
TC8604_013	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/26/1986	MOCNESS	333	day
TC8604_014	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/26/1986	MOCNESS	333	day
TC8604_016	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/26/1986	MOCNESS	333	night
TC8604_017	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/26/1986	MOCNESS	333	night
TC8604_029	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/29/1986	MOCNESS	333	night

sample_record_identifier	fish_doi	environmental_data_doi	uku_present1_absent0	collection_date	sampling_method	sampling_method_mesh_size_um	day_night
TC8604_030	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/29/1986	MOCNESS	333	day
TC8604_031	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/29/1986	MOCNESS	333	day
TC8604_033	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/29/1986	MOCNESS	333	day
TC8604_035	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/29/1986	MOCNESS	333	night
TC8604_036	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/30/1986	MOCNESS	333	night
TC8604_037	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/30/1986	MOCNESS	333	night
TC8604_039	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/30/1986	MOCNESS	333	day
TC8604_040	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/30/1986	MOCNESS	333	day
TC8604_045	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	06/30/1986	MOCNESS	333	night
TC8604_047	https://www.fisheries.noaa.gov/inport/item/8791	https://www.fisheries.noaa.gov/inport/item/8791	0	07/01/1986	MOCNESS	333	night