Catch of Bottomfish Management Unit Species of Guam, 1982–2023

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Toby Matthews and Erin C. Bohaboy

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

EXECUTIVE SUMMARY

Four data sources were integrated to generate catch series for each Guam Bottomfish Management Unit Species (BMUS). The boat-based and shore-based creel surveys provided species-level annual catch estimates, and their sum was compared against lower bounds established by the Commercial Fisheries Biosampling Program and the Commercial Purchase Invoice Program to generate the final catch series. Due to the limited quantity of data available at the species level, the catch series have high uncertainty. This potentially masks temporal trends for some BMUS, though there is still evidence of decreasing catch trends for several shallower BMUS and increasing catch trends for the deepest BMUS. Species identification issues may require some species to be analyzed in complexes, but overall the available data sources provide robust, though uncertain, catch series for the BMUS.

INTRODUCTION

The Bottomfish Management Unit Species (BMUS) of Guam include 13 species of snappers, jacks, and a grouper that are managed in Federal waters by the Western Pacific Regional Fishery Management Council under the Fishery Ecosystem Plan (FEP) for the Mariana Archipelago (FEP; WPRFMC 2009). This report is one of four documents prepared ahead of an external review, to be conducted in July 2024 as part of the Western Pacific Stock Assessment Review (WPSAR), to present data that will be used in benchmark stock assessments of Guam BMUS. Previous stock assessments of the BMUS have been conducted on the entire multi-species complex, most recently in the 2019 benchmark stock assessment (Langseth et al. 2019), which was updated in 2024 (Bohaboy and Matthews, 2024). For the upcoming BMUS benchmark assessment, single-species assessments may be considered. As such, this report describes the data available to estimate catch series for each individual BMUS, and is accompanied by reports on species-specific catch-per-unit-effort, length, and life history data.

METHODS

Data Sources

Boat-based Creel Survey

The Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (DAWR) has conducted its boat-based creel survey (BBS) since 1982. The survey uses a stratified design to estimate total catch from boat fishing across Guam, and is fully documented in Jasper et al. (2016). A succinct description that captures all salient details follows.

The BBS captures two primary data streams: (1) boat logs that record the departure and return of fishing boats, and (2) interviews that collect completed trip information and species-level catch details. Both data streams are captured concurrently on 8 survey days per month, which are randomly assigned on 4 weekdays and 4 weekend days. Each survey takes place at one of three main fishing ports, with the most active port, Agana Boat Basin, surveyed at twice the frequency of Agat Harbor and Merizo Pier. There is also a supplementary trailer count survey to estimate fishing effort outside of the three main ports, which is conducted as part of the shore-based creel survey.

During each survey day there are two shifts: (1) a morning shift from approximately 0500–1200, and (2) an evening shift from approximately 1600–2400. A boat log for the day is maintained across both shifts, and all returning fishers are asked if they will participate in a voluntary interview. During the interview, surveyors collect trip-level information, estimate the total weight and species composition of the catch, and obtain individual fish length and/or weight measurements. If the fisher has limited time to participate, surveyors may need to use broad species groupings (e.g. shallow bottomfish) to describe the catch composition, and only collect length measurements from three or fewer arbitrarily-selected fish of each species.

The BBS is the primary contributor to total catch estimates for Guam bottomfish. Bottomfishing is the second-most observed fishing gear, representing 24% of all fishing trips since 1982. All BMUS have occurred in the BBS, though the total catch estimates are highly variable for some species. Still, the BBS is the only survey that isdesigned to estimate total catch for most of the BMUS.

Shore-based Creel Survey

DAWR has also conducted a shore-based creel survey (SBS) since 1984. Similar to the BBS, the SBS uses a stratified design to estimate total catch from all fishing that originates along Guam's shoreline. The SBS is fully documented in Jasper et al. (2016), and a succinct description follows.

The SBS captures two primary data streams: (1) fishing participation counts logged while driving a coastal route that captures most of central and southern Guam, and (2) interviews that collect completed or partial trip information and species-level catch details. The data streams are collected on separate survey days. Participation counts are collected on 4 survey days per month, which are randomly assigned on 2 weekdays and 2 weekend days and cover the full coastal route. Interviews are also collected on 4 survey days per month with the same division between weekdays and weekend days, but each survey day only covers one of three sections of coast, with the most active section (Merizo to Pago) surveyed at twice the frequency of the other two sections (Gun Beach to Adelup and Adelup to Agat). There is also a supplementary aerial survey to estimate fishing activity outside of the main coastal route, which is conducted on half of the participation count survey days.

During each survey day there are two shifts, regardless of whether participation counts or interviews are collected. The morning shift begins at 0630 and the evening shift begins at 1900. For participation counts, the surveyor drives the full coastal route and logs all shore-based fishing activity. For interviews, the surveyor drives back-and-forth along the designated section of coast, collecting information from fishers in the same manner as in the BBS.

The SBS is a minor contributor to total catch estimates for most BMUS. Only 6 BMUS have been observed in the SBS, as most occur too deep to be accessible by shore-based fishing methods. Of the 6, only *C. ignobilis*, *L. rubrioperculatus*, and *L. kasmira* have been recorded in more than 3 interviews since the start of the SBS. Still, because the BBS and SBS are designed to estimate non-overlapping components of total catch, we include SBS-based catch estimates for these 6 BMUS.

Other Surveys

Several other surveys have collected data on Guam bottomfish in varying levels of detail, though most have been temporary and none except the BBS and SBS has been designed to rigorously estimate total catch. Instead, these surveys typically provide lower bounds on total catch that the combined BBS and SBS total catch estimates can be verified against. Two such surveys are considered here: the Commercial Fisheries Biosampling Program and the Commercial Purchase Invoice Program.

The Commercial Fisheries Biosampling Program, hereafter referred to as the biosampling program, was established in 2009 through cooperation between the Pacific Islands Fisheries Science Center (PIFSC) and local staff on Guam (Sundberg et al., 2015). The goal of the biosampling program is to support the collection of length data, weight data, and life history samples for a wide range of fishery species. Biosampling program staff establish cooperative relations with local fish markets, fishermen, and vendors to gain access to their fish for data collection and to record trip-level information. All available fish are identified to the species level and are typically measured for length and weight, though once a sufficient number of paired length-weight measurements have been obtained, only the length measurement may be taken. For fish with only a measured length, length-weight relationships of the form $W=a*L^b$, derived from the biosampling data, are used to estimate the weight. Since a large quantity of fish is processed by the biosampling program, it provides a suitable lower bound on commercial catch for all BMUS.

The Commercial Purchase Invoice Program, hereafter referred to as the commercial purchase program, was established in 1982 through cooperation between PIFSC and fish dealers on Guam. Fish dealer participation is voluntary, and as many as 11 dealers have participated per year. Dealers log the weight of all fish purchased from fishermen, though fish are not always identified to the species level. Six BMUS have individual species codes available to them, typically those that are easily identified and/or command higher prices. However, because difficulties have been reported distinguishing *P. filamentosus* and *P. sieboldii* (Iwane et al. 2023), only four BMUS are considered to have species-level data: *C. lugubris*, *E. carbunculus*, *E. coruscans*, and *P. zonatus*. While it is unfortunate that the commercial purchase program does not provide lower bounds on commercial catch for all BMUS, it does act as an additional lower bound to compare creel survey estimates for the four BMUS that are reliably identified.

Creel Data Expansion

Survey data from the BBS and SBS are used to produce species-level annual catch estimates through separate expansion algorithms that reflect the unique design of each survey. The expansion methodology is detailed in Ma et al. (2022), and a brief description is provided below. The average fishing effort per survey day is computed from boat logs (for the BBS, measured in trips) and fishing participation runs (for the SBS, measured in gear hours), with adjustment factors for unobserved areas and times of day. This average fishing effort is multiplied by the number of calendar days to estimate annual fishing effort, and then multiplied by the average catch per unit effort from interviews to estimate annual catch. Lastly, annual catch is divided into species-level catch according to the species catch composition of interviews. Catch variances are also calculated according to the specific survey designs. These computations are implemented separately for each expansion domain, represented by a combination of port, gear type, types of day (weekday or weekend/holiday), and charter status for the BBS and region, gear type, type of day, and time of day for the SBS.

While the expansion algorithms assume species-level catch is normally distributed, previous investigations of the creel data have indicated the distribution is approximately lognormal (Nadon 2019). The selected distribution is particularly important for rare species, as the high variance attached to their catch estimates can cause an unrealistically high density of the distribution to be near or below zero when the normal distribution is used. We converted the normal distributions from the expansion algorithms to lognormal distributions by matching the mean and coefficient of variation of the two. Formally, given the catch distribution from the expansion $\sim N(\mu, \sigma^2)$ we calculated the corresponding parameters for the lognormal distribution as:

$$sd_{log}^2 = ln(\left(\frac{\sigma}{\mu}\right)^2 + 1)$$

$$mean_{log} = ln(\mu) - \frac{sd_{log}^2}{2}$$

This resulted in a lognormal catch distribution $\sim Lognormal(mean_{log}, sd_{log}^2)$ with the same mean and coefficient of variation as the original distribution.

In both the BBS and SBS interviews, catch is occasionally recorded using common name groups or families, typically when surveyors have insufficient time to log the entire catch. There are eight such groupings that may contain BMUS: ‘shallow bottomfish’, ‘assorted bottomfish’, ‘deep bottomfish’, ‘*Lethrinidae*’, ‘deep snappers’, ‘*Carangidae*’, ‘*Lutjanidae*’, and ‘shallow snappers’. Component species for each of the eight groups were defined generally by family, and more specifically by species depth preference or fishery targeting behavior when appropriate. Catch estimates for these groups were allocated into component species by assuming that species composition of unidentified (group-level) catch was the same as the species composition of identified (species-level) catch within the interviews for each combination of gear type and charter status. For bottomfishing, species composition of identified catch was further restricted to a 5-year sliding window.

While the BBS and SBS almost always adhere to their strict survey schedules, two years with limited data required additional consideration before being processed through the expansion algorithm. First, limited survey days from the BBS were available from May through December 2012. Missing data were particularly prevalent from the summer months, which would typically provide favorable weather conditions for bottomfishing. Because the expansion algorithm does not account for an uneven distribution of survey data throughout the year and to avoid bias resulting from this non-random missing data, an adjustment was made to the original BBS estimates from 2012. Missing survey days were classified by month, type of day (weekday or weekend day), and port, and data from survey days of the same classification in either 2011 or 2013 were used to supplement the existing 2012 data. Separate expansion runs were made using 2011 and 2013 data, and the results of the two were averaged to provide the corrected catch estimates for 2012.

Second, COVID-19 restrictions impacted data collection during 2020. While boat logs were collected consistently throughout the year, interviews were only conducted from the start of the year through mid-March and June through early August. A total of 74 bottomfishing interviews were collected in 2020, which is lower than the average of 109 per year collected from 2014–2023. Though interviews from neighboring years could have been considered for use, this possibility was ruled out because: 1) fishing practices could have differed from other years due to the pandemic; 2) the available interviews cover portions of the year with favorable and unfavorable weather conditions; and 3) the available interviews are sufficient for the expansion algorithm. In the end, 2020 BBS data was processed through the expansion algorithm with no changes, though the unique circumstances surrounding the data still warrant mention.

Data Source Synthesis

Before combining the four data sources, fishing methods were aggregated into five groups, as determined by the finest resolution available across all sources. This was required because each survey allows different fishing method names to be recorded. These groups and the specific fishing methods they include are:

- Bottomfishing: deep bottom, shallow bottom
- Line fishing: troll, hook and line, atulai line, hand line, jig, ika shibi, spin cast
- Net fishing: gill net, cast net, surround net, atulai net, drag net
- Spearfishing: snorkel spear, scuba spear
- Other: all other fishing methods

Boat- and shore-based creel survey species-level catch estimates were summed by year, species, and fishing method group to obtain the creel-based catch estimates. These catch estimates were next compared by year, species, and fishing method group with the lower bounds established by the biosampling and commercial purchase programs. If either program's value exceeded the creel catch estimate, the creel estimate was replaced by the greater of the lower bounds. Because the commercial purchase and biosampling programs do not implement statistical surveys that allow catch variance to be estimated, a coefficient of variation of 50% was assumed to approximate the variance whenever catch values from either of the programs were used to replace creel catch estimates. This normal distribution was then truncated at the program's value since it acts as a lower bound on the catch contribution.

The confidence intervals for the combined catch series were computed as the sum of the confidence interval for each component survey.

RESULTS

The BBS is the primary contributor to BMUS catch series, with over 96% of the catch coming from the BBS for each species, except *C. ignobilis* (Table 1). The SBS and biosampling program make generally minor contributions, and the commercial purchase program makes no contribution. Bottomfishing is the primary fishing method, contributing over 85% of the catch series for each BMUS other than *C. ignobilis*. Line, spear, and net fishing have varied contributions across shallower BMUS, and deeper BMUS (*Etelis* and *Pristipomoides spp.*) are almost entirely caught by bottomfishing.

Species-level catch estimates are quite variable year-to-year and annual estimates have high uncertainty (mean annual BBS CV across BMUS = 49.8%, excluding the very rarely encountered *P. sieboldii*). This potentially masks temporal trends for some BMUS. Some species, especially shallower BMUS, still show evidence of decreasing catch trends and the deepest species, in particular *Etelis spp.*, exhibit increasing catch trends. Given the robust data sources contributing to these catch series, most are still suitable for use in stock assessments for most BMUS, given the high uncertainty resulting from data limitations are properly accounted for.

Aphareus rutilans

The BBS contributes nearly the entire catch series for *A. rutilans* and 98.5% of its catch is from bottomfishing. *A. rutilans* is infrequently encountered in the BBS, appearing in 6.0% of all bottomfishing interviews. This leads to a highly variable catch series with high uncertainty surrounding annual estimates (mean BBS CV = 49.4%, Figure 1). Still, there is some indication that annual catch has decreased over time, as the mean annual catch during the first half of the time series is 99.4% higher than during the second half. There are no known data quality issues for *A. rutilans*.

Outcome: We propose to use the catch series for *A. rutilans*.

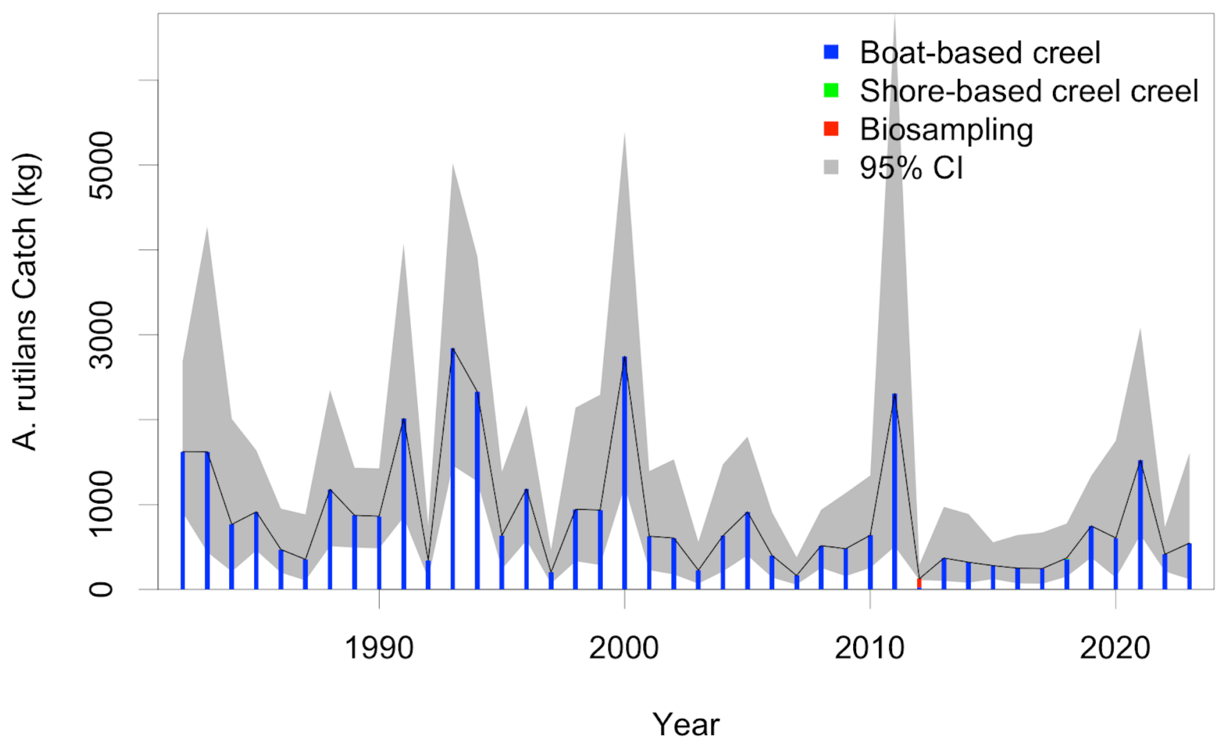

Figure 1. Estimated catch of *A. rutilans* on Guam from 1982 to 2023.

Caranx ignobilis

C. ignobilis is caught by several means, so the surveys and fishing methods contributing to its catch series are varied. The BBS is still the major contributor to its catch series, with 77.4% of the catch. Notable amongst BMUS, 21.3% of the catch comes from the SBS. Though bottomfishing is still the main fishing method and contributes 45.0% of the catch, all method groups contribute, with 34.2% from line fishing, 11.3% from net fishing, and 9.5% from spearfishing. Interestingly, *C. ignobilis* is rarely targeted by bottomfishers, though it is frequently targeted as a trophy species by line and spearfishers (Iwane et al. 2023). It is the second-rarest BMUS in the BBS, appearing in only 1.5% of all bottomfishing interviews. It is also very rare in the SBS, and contributions from the SBS are even more variable than from the BBS. In all, the catch series is extremely variable, there is very high uncertainty surrounding annual estimates (mean BBS CV = 66.7%), and there is no obvious trend in catch over time (Figure 2). There are no known data quality issues for *C. ignobilis*.

Outcome: We propose to use the catch series for *C. ignobilis*.

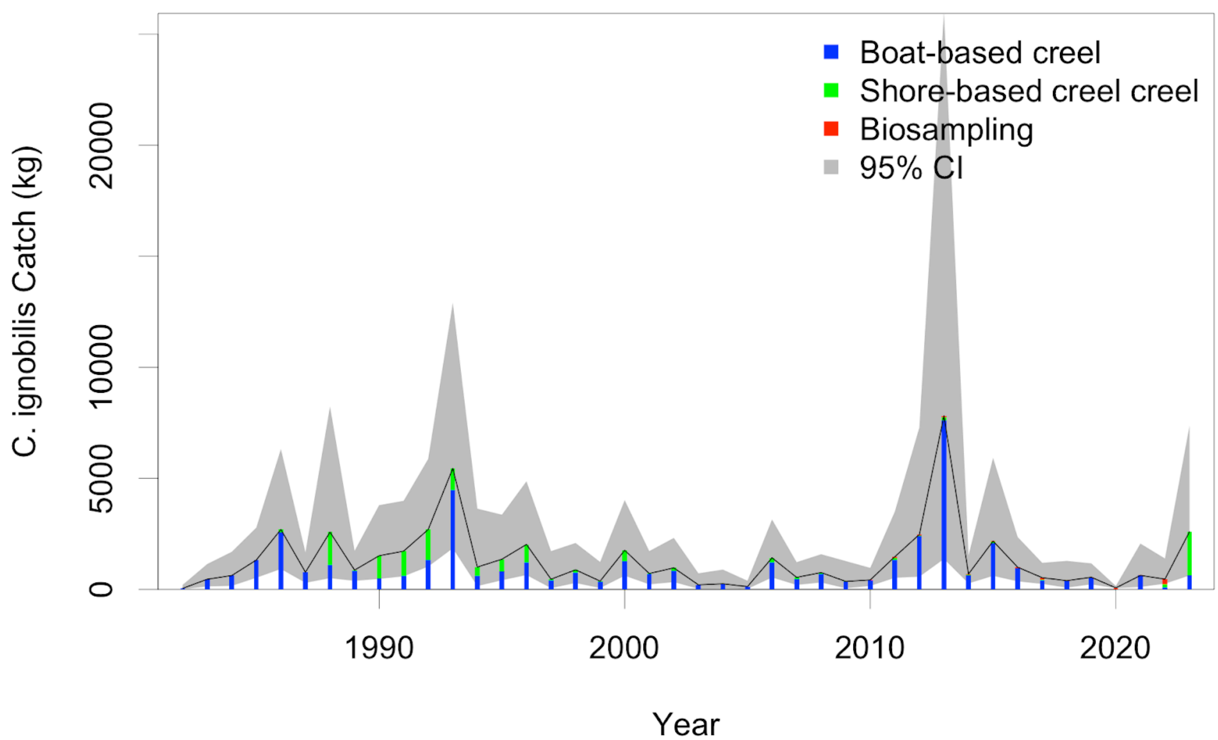

Figure 2. Estimated catch of *C. ignobilis* on Guam from 1982 to 2023.

Caranx lugubris

The BBS contributes nearly the entire catch series for *C. lugubris* and 92.5% of its catch is from bottomfishing, even though it is rarely targeted by bottomfishers (Iwane et al. 2023). *C. lugubris* is infrequently encountered in the BBS, appearing in 3.8% of all bottomfishing interviews. This leads to a highly variable catch series, high uncertainty surrounding annual estimates (mean BBS CV = 55.7%), and no obvious trend in catch over time (Figure 3). There are no known data quality issues for *C. lugubris*.

Outcome: We propose to use the catch series for *C. lugubris*.

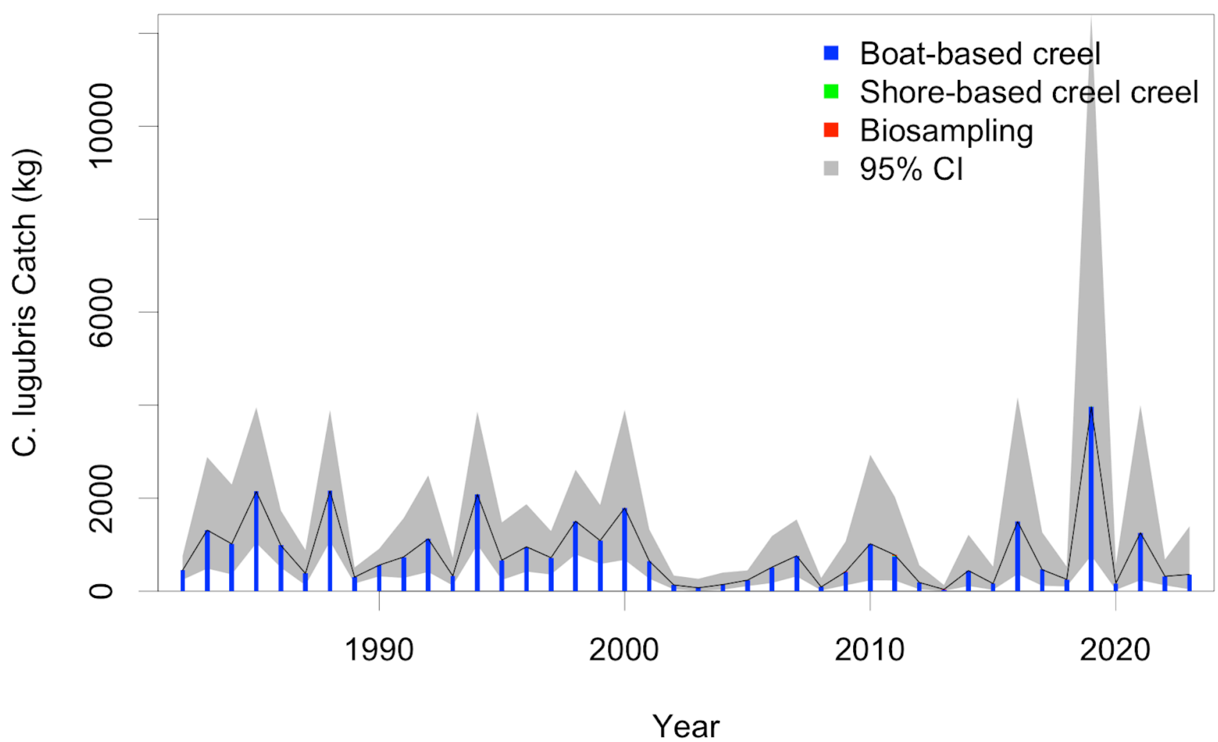

Figure 3. Estimated catch of *C. lugubris* on Guam from 1982 to 2023.

Etelis carbunculus

The BBS contributes the entire catch series for *E. carbunculus* and 98.4% of its catch is from bottomfishing. *E. carbunculus* is moderately common in the BBS, appearing in 8.5% of all bottomfishing interviews. This leads to a variable catch series with high uncertainty surrounding annual estimates (mean BBS CV = 46.4%, Figure 4). Still, there is some indication that annual catch has increased over time, as the mean annual catch during the second half of the time series is 54.8% higher than during the first half.

There is a species identification issue surrounding *E. carbunculus*, as a visually similar cryptic species with much greater maximum length (*E. boweni*) was recently identified (Andrews et al. 2021). BBS staff are confident in their ability to distinguish the two species since their formal distinction (Iwane et al. 2023), and there is some indication that *E. boweni* is rare in Guam waters. Since the start of 2020 when staff should have known how to separate the two species, there have been 176 *E. carbunculus* and 5 *E. boweni* recorded in BBS interviews. Biosampling program staff are also trained to identify these species and have recorded 713 *E. carbunculus* and 1 *E. boweni* in the same period. This points toward *E. carbunculus* forming the vast majority of catch throughout the time series. Further support comes from research by Dahl et al. (2024), who used otolith morphometrics and spectroscopy together with a set of *E. carbunculus* and *E. boweni* voucher otoliths to identify probable *E. boweni* otoliths collected during the biosampling program. Both methods estimated that only 8% of identified *E. carbunculus* were actually *E. boweni*. While this is greater than the incidence of identified *E. boweni* in the BBS and biosampling programs, it could allow a quantitative estimate of the contribution *E. boweni* makes to *E. carbunculus* catch.

Outcome: The catch timeseries we present here for *E. carbunculus* includes an unknown amount of *E. boweni*. Assumptions regarding the contribution of *E. boweni* to these estimates will be required before the data are used in a single-species stock assessment of *E. carbunculus*.

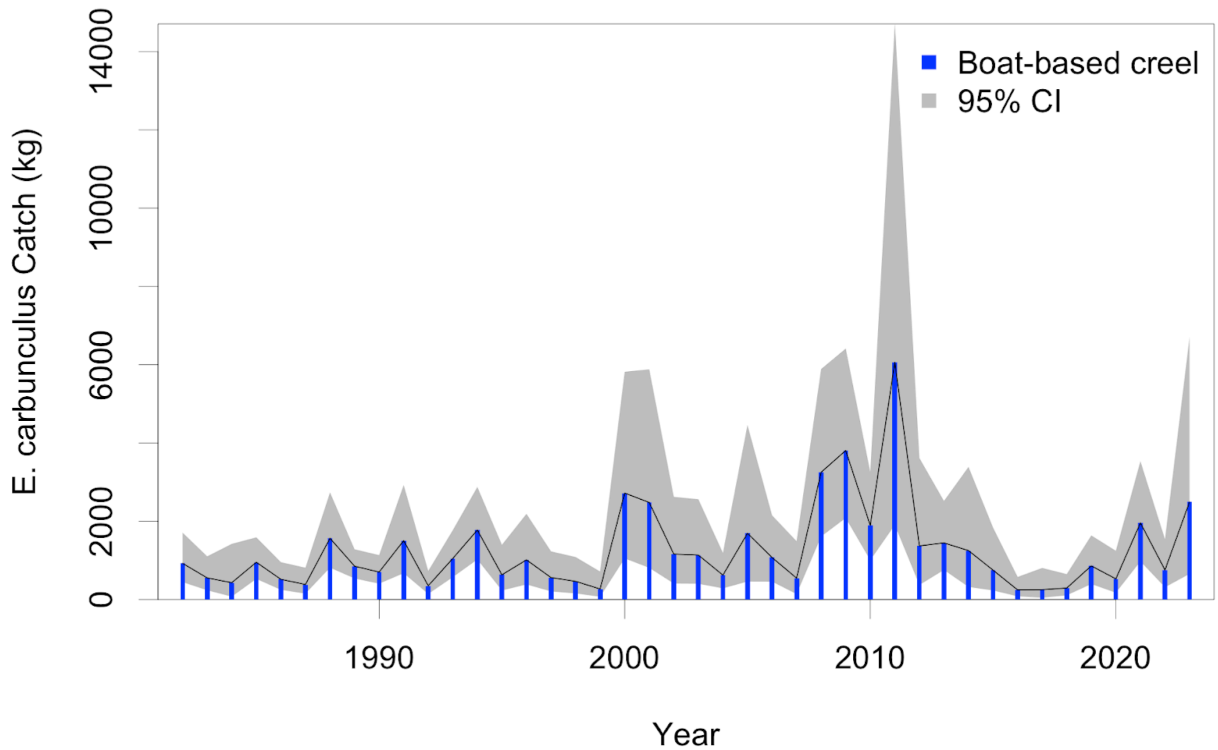

Figure 4. Estimated catch of *E. carbunculus* on Guam from 1982 to 2023.

Etelis coruscans

The BBS contributes the entire catch series for *E. coruscans* and 99.8% of its catch is from bottomfishing. *E. coruscans* is infrequently encountered in the BBS, appearing in 5.0% of all bottomfishing interviews. This leads to a highly variable catch series with high uncertainty surrounding annual estimates (mean BBS CV = 61.4%, Figure 5). Still, there is some indication that annual catch has increased over time, as the mean annual catch during the second half of the time series is 141.9% higher than during the second half and catch is notably high in recent years. There are no known data quality issues for *E. coruscans*.

Outcome: We propose to use the catch series for *E. coruscans*.

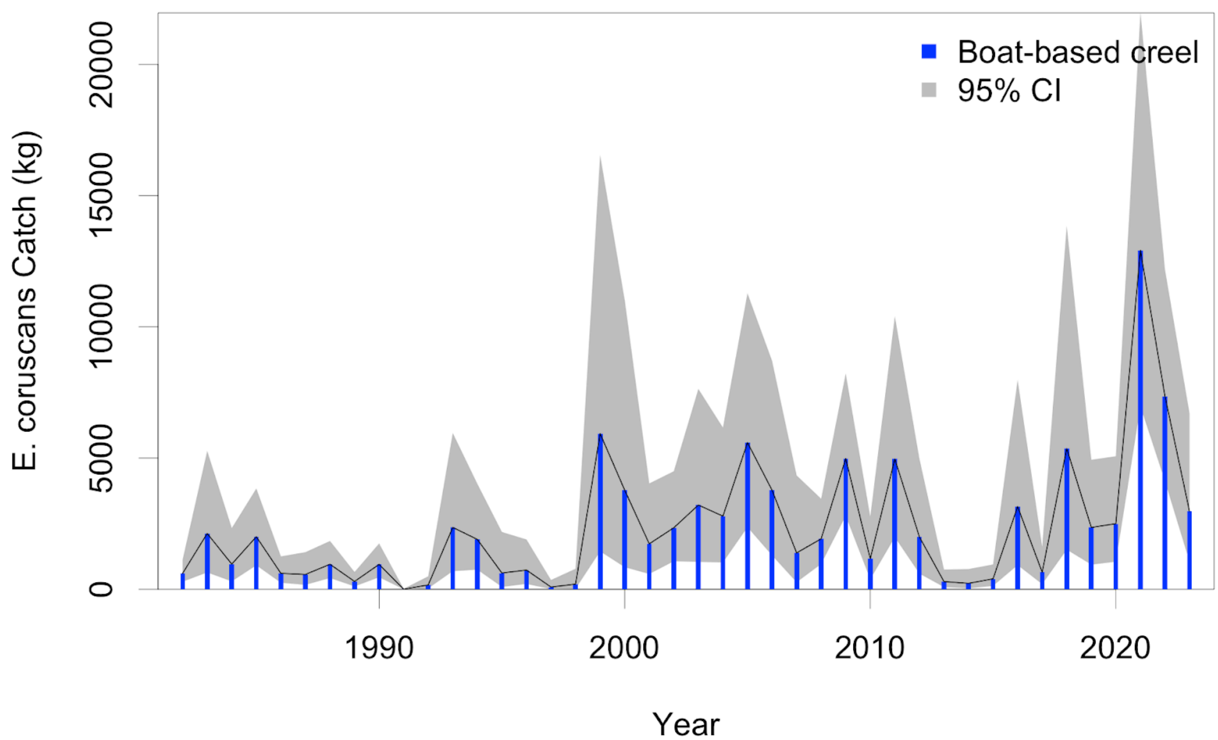

Figure 5. Estimated catch of *E. coruscans* on Guam from 1982 to 2023.

Lethrinus rubrioperculatus

The BBS contributes nearly the entire catch series for *L. rubrioperculatus* and 96.3% of its catch is from bottomfishing. *L. rubrioperculatus* is the most frequently encountered BMUS in the BBS, appearing in 24.8% of all bottomfishing interviews. There is a notable decline in catch over time, despite moderate uncertainty surrounding annual estimates (mean BBS CV = 30.1%, Figure 6). Fishers remark that this decline may be due to people shifting away from targeting the species over time (Iwane et al. 2023). There are no known data quality issues for *L. rubrioperculatus*.

Outcome: We propose to use the catch series for *L. rubrioperculatus*.

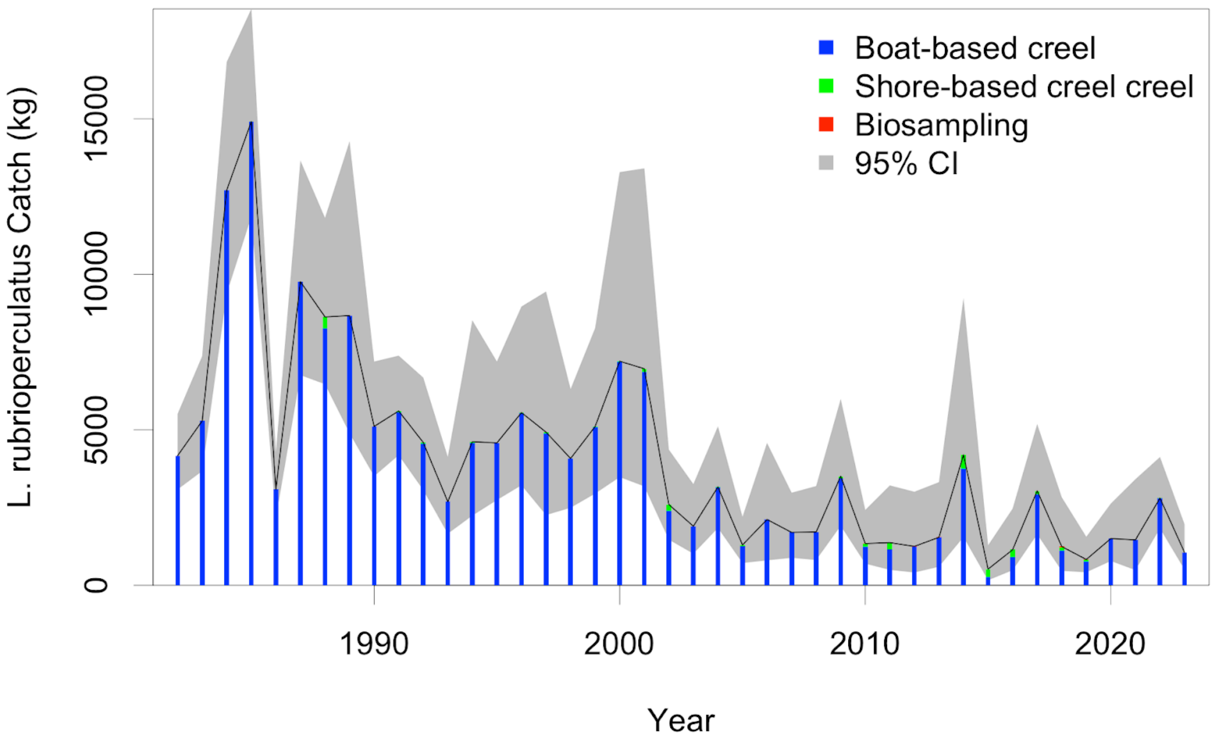

Figure 6. Estimated catch of *L. rubrioperculatus* on Guam from 1982 to 2023.

Lutjanus kasmira

The BBS contributes nearly the entire catch series for *L. kasmira* and 93.2% of its catch is from bottomfishing. Interestingly, bottomfishers do not typically target it, though they remark that it is quick to bite when present (Iwane et al. 2023). *L. kasmira* is the second-most frequently encountered BMUS in the BBS, appearing in 13.2% of all bottomfishing interviews. Despite this, the catch series is highly variable and there is high uncertainty surrounding annual estimates (mean BBS CV = 52.1%, Figure 7). Still, there is some indication that annual catch has decreased over time, as the mean annual catch during the first half of the time series is 52.9% higher than during the second half. There are no known data quality issues for *L. kasmira*.

Outcome: We propose to use the catch series for *L. kasmira*.

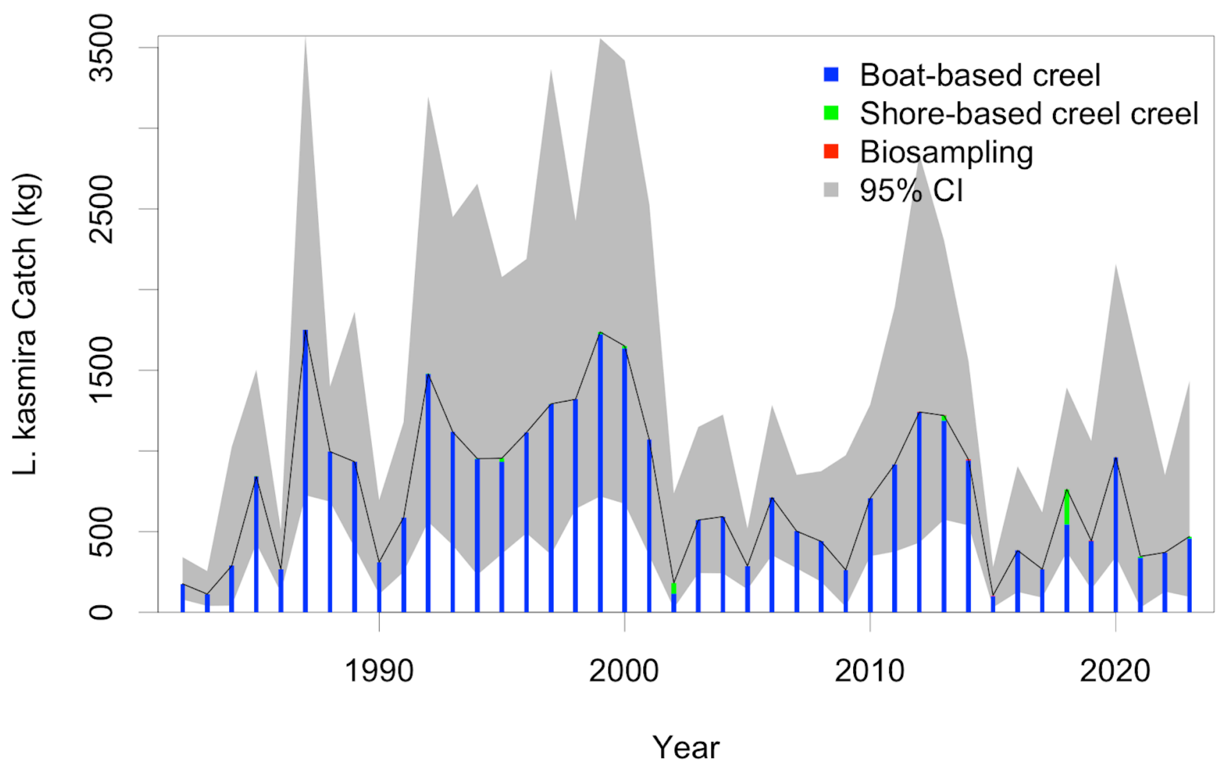

Figure 7. Estimated catch of *L. kasmira* on Guam from 1982 to 2023.

Pristipomoides auricilla

The BBS contributes nearly the entire catch series for *P. auricilla* and 99.9% of its catch is from bottomfishing. *P. auricilla* is moderately common in the BBS, appearing in 12.5% of all bottomfishing interviews. This leads to a variable catch series with moderate uncertainty surrounding annual estimates (mean BBS CV = 38.6%, Figure 8). There is some indication that annual catch has decreased over time, as the mean annual catch during the first half of the time series is 59.3% higher than during the second half. There are no known data quality issues for *P. auricilla*.

Outcome: We propose to use the catch series for *P. auricilla*.

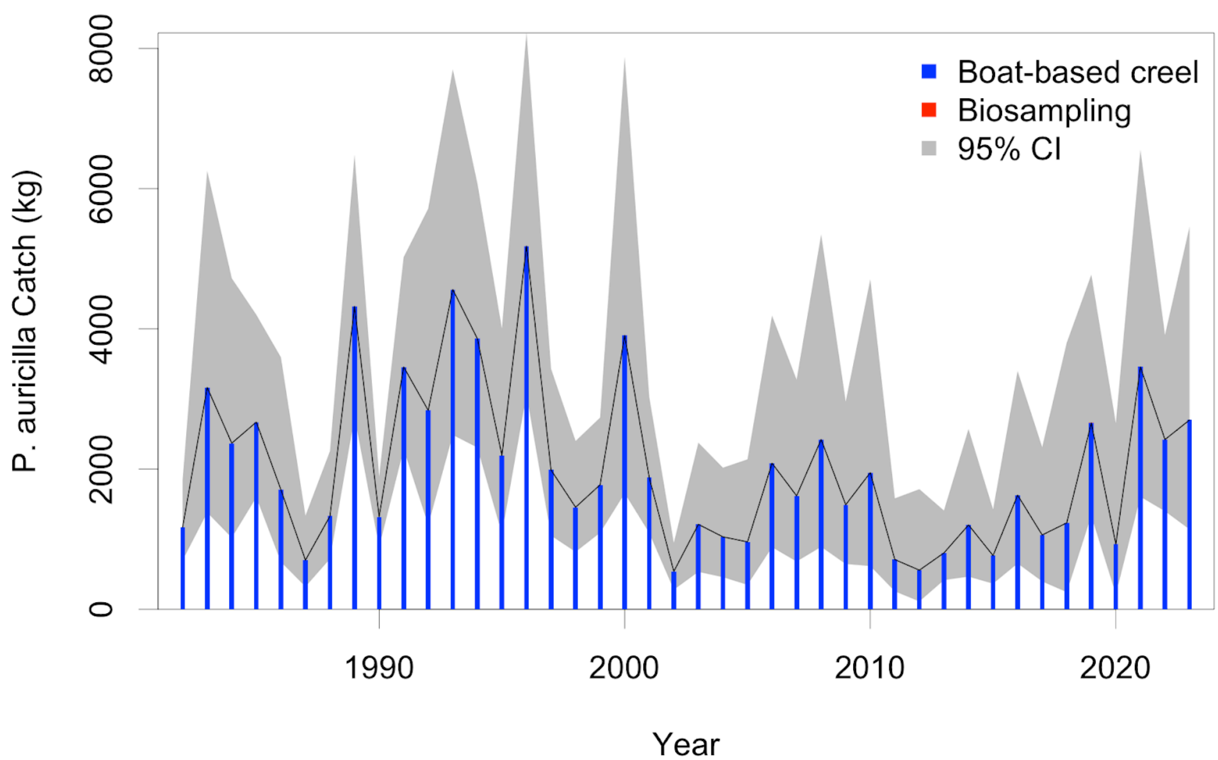

Figure 8. Estimated catch of *P. auricilla* on Guam from 1982 to 2023.

Pristipomoides filamentosus

The BBS contributes nearly the entire catch series for *P. filamentosus* and all of its catch is from bottomfishing. *P. filamentosus* is infrequently encountered in the BBS, appearing in 3.1% of all bottomfishing interviews. This leads to a highly variable catch series with high uncertainty surrounding annual estimates (mean BBS CV = 65.7%, Figure 9). Still, there is some indication that annual catch has decreased over time, as the mean annual catch during the first half of the time series is 130.5% higher than during the second half.

There is a potential species identification issue surrounding *P. filamentosus*, as it can be easily misidentified with *P. sieboldii* at all sizes and has been noted to appear similar to *P. flavipinnis* at large sizes (Iwane et al. 2023). There are several years with no observation of *P. sieboldii*, so it is quite possible that the catch series are conflated.

Outcome: The catch timeseries we present here for *P. filamentosus* may include an unknown amount of *P. flavipinnis* and *P. sieboldii*. Assumptions regarding the contribution of these species will be required before the data are used in a single-species stock assessment of *P. filamentosus*.

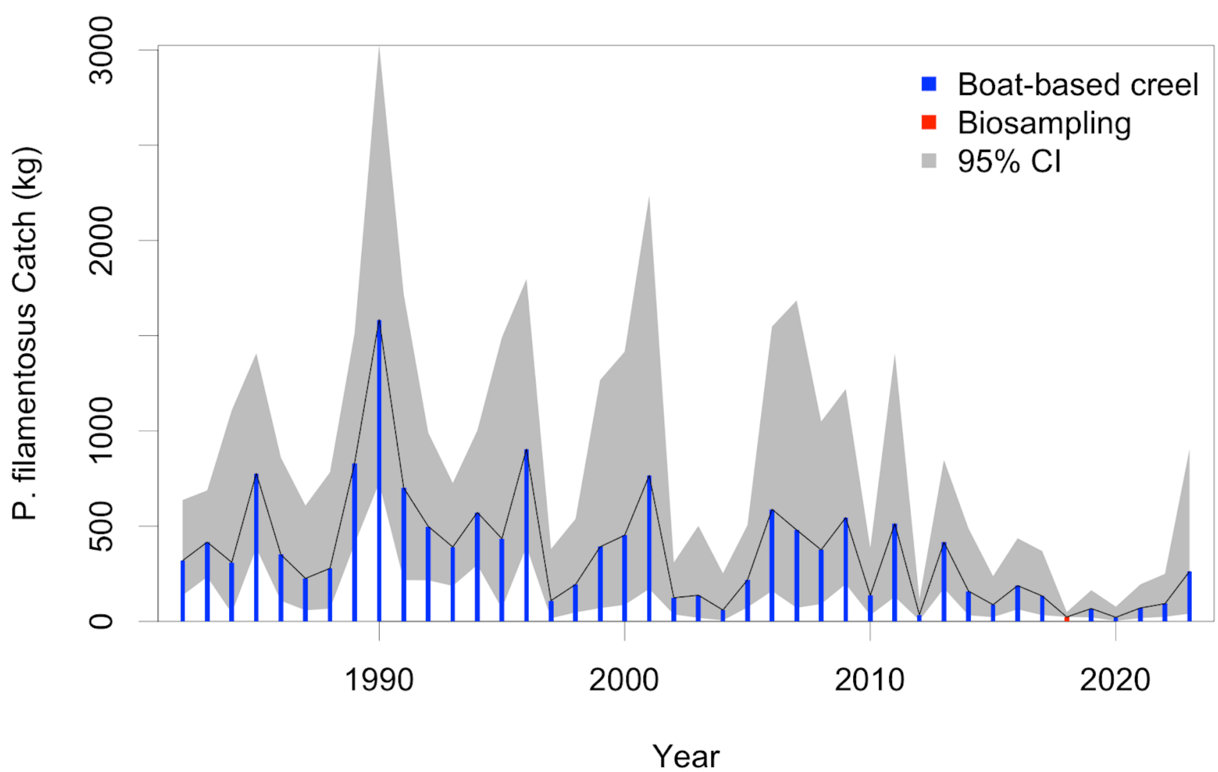

Figure 9. Estimated catch of *P. filamentosus* on Guam from 1982 to 2023.

Pristipomoides flavipinnis

The BBS contributes nearly the entire catch series for *P. flavipinnis* and all of its catch is from bottomfishing. *P. flavipinnis* is infrequently encountered in the BBS, appearing in 5.7% of all bottomfishing interviews. This leads to a highly variable catch series with high uncertainty surrounding annual estimates (mean BBS CV = 52.1%, Figure 10). Still, there is some indication that annual catch has decreased over time, as the mean annual catch during the first half of the time series is 96.6% higher than during the second half. It has been reported that large *P. filamentosus* can appear similar to *P. flavipinnis* (Iwane et al. 2023), but BBS staff do not report this potential confusion. We do not believe there are any major data quality issues with *P. flavipinnis*.

Outcome: We propose to use the catch series for *P. flavipinnis*.

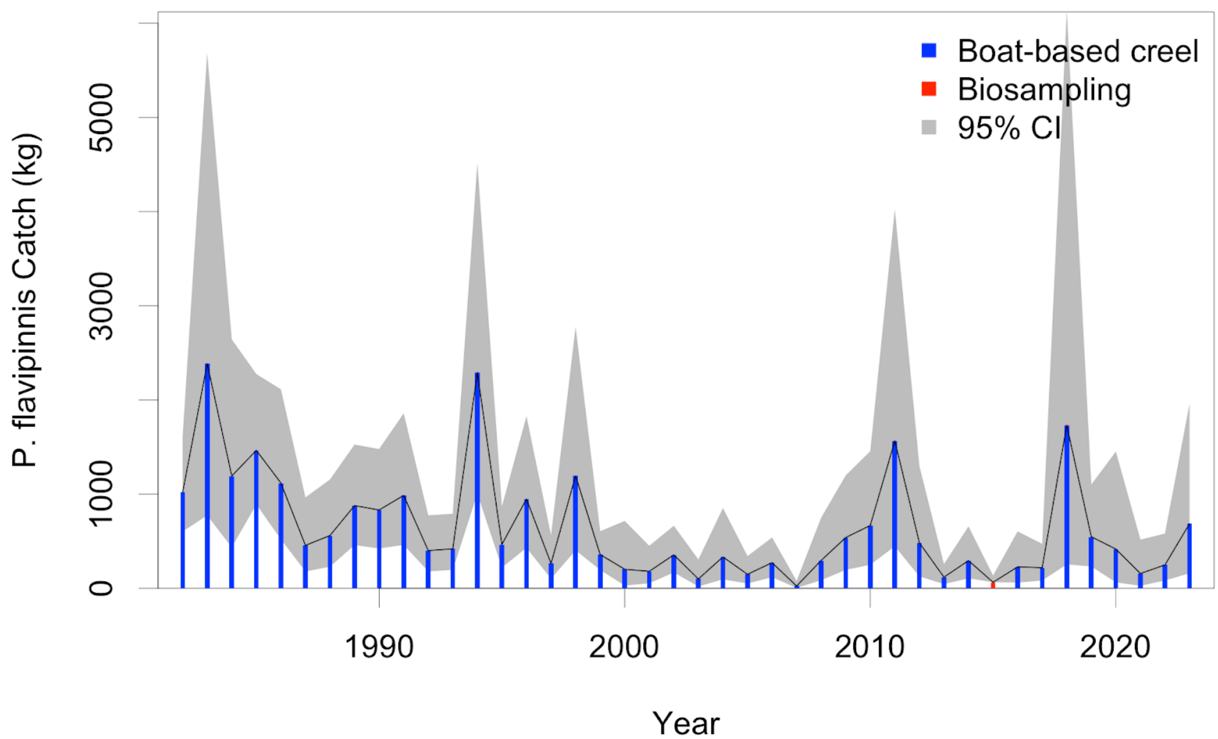

Figure 10. Estimated catch of *P. flavipinnis* on Guam from 1982 to 2023.

Pristipomoides sieboldii

The BBS contributes 96.5% of the catch series for *P. sieboldii*, though notably it is the BMUS with the greatest contribution from the biosampling program at 3.5%. 99.9% of its catch is from bottomfishing. It is the rarest BMUS in the BBS, appearing in only 0.8% of all bottomfishing interviews. This leads to a highly variable catch series with extremely high uncertainty surrounding annual estimates (mean BBS CV = 314.9%, Figure 11). The estimated catch from the BBS is zero for several years, leading to greater use of lower bounds on catch established by the biosampling program. The biosampling lower bound on catch is used in several years, indicating the BBS may not be an effective means to estimate *P. sieboldii* catch. There is a potential species identification issue surrounding *P. sieboldii*, as it can be easily misidentified with *P. filamentosus* at all sizes and has also been reported to look similar to *P. flavipinnis* at large sizes (Iwane et al. 2023).

Outcome: The catch timeseries we present here for *P. sieboldii* may include an unknown amount of *P. filamentosus* and *P. flavipinnis*. In addition to these species identification challenges, the likely rarity of this species in Guam contributes to the high uncertainty in catch estimates, as such, we acknowledge assumptions may be necessary before these data are used in a single-species stock assessment.

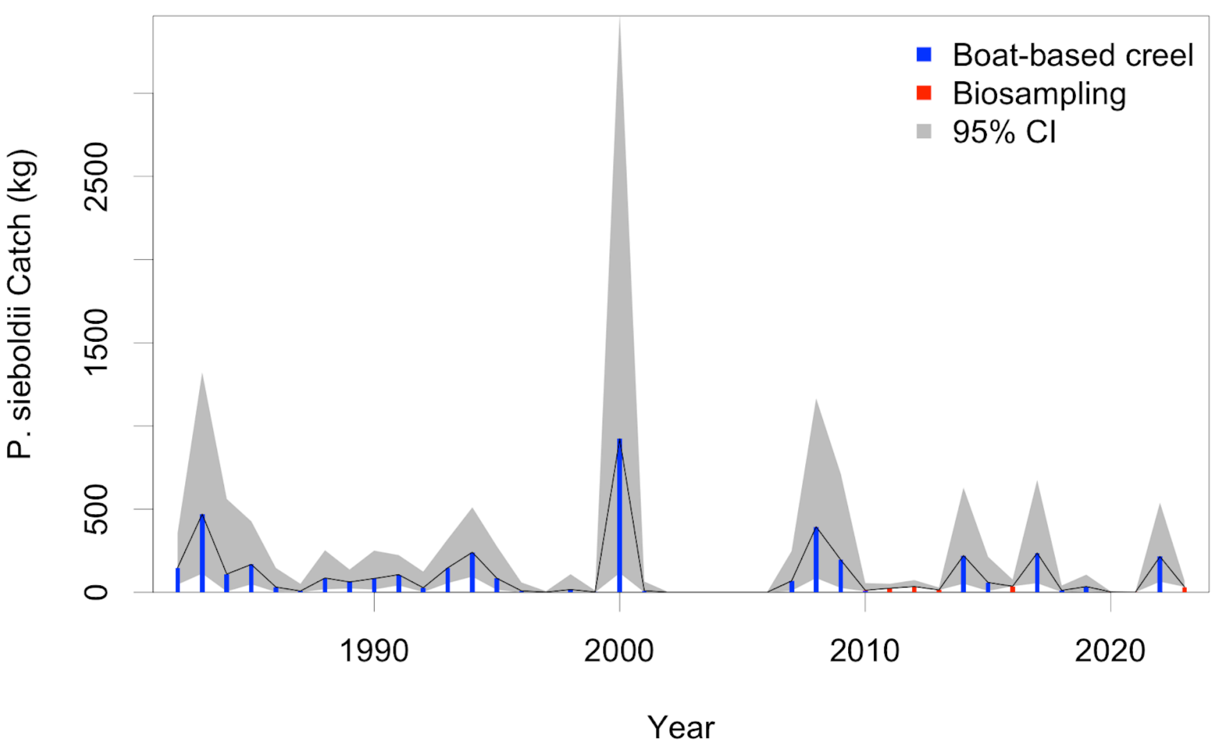

Figure 11. Estimated catch of *P. sieboldii* on Guam from 1982 to 2023.

Pristipomoides zonatus

The BBS contributes nearly the entire catch series for *P. zonatus* and 99.9% of its catch is from bottomfishing. *P. zonatus* is moderately common in the BBS, appearing in 11.3% of all bottomfishing interviews. This leads to a variable catch series with moderate uncertainty surrounding annual estimates (mean BBS CV = 38.2%, Figure 12). There are no known data quality issues for *P. zonatus*.

Outcome: We propose to use the catch series for *P. zonatus*.

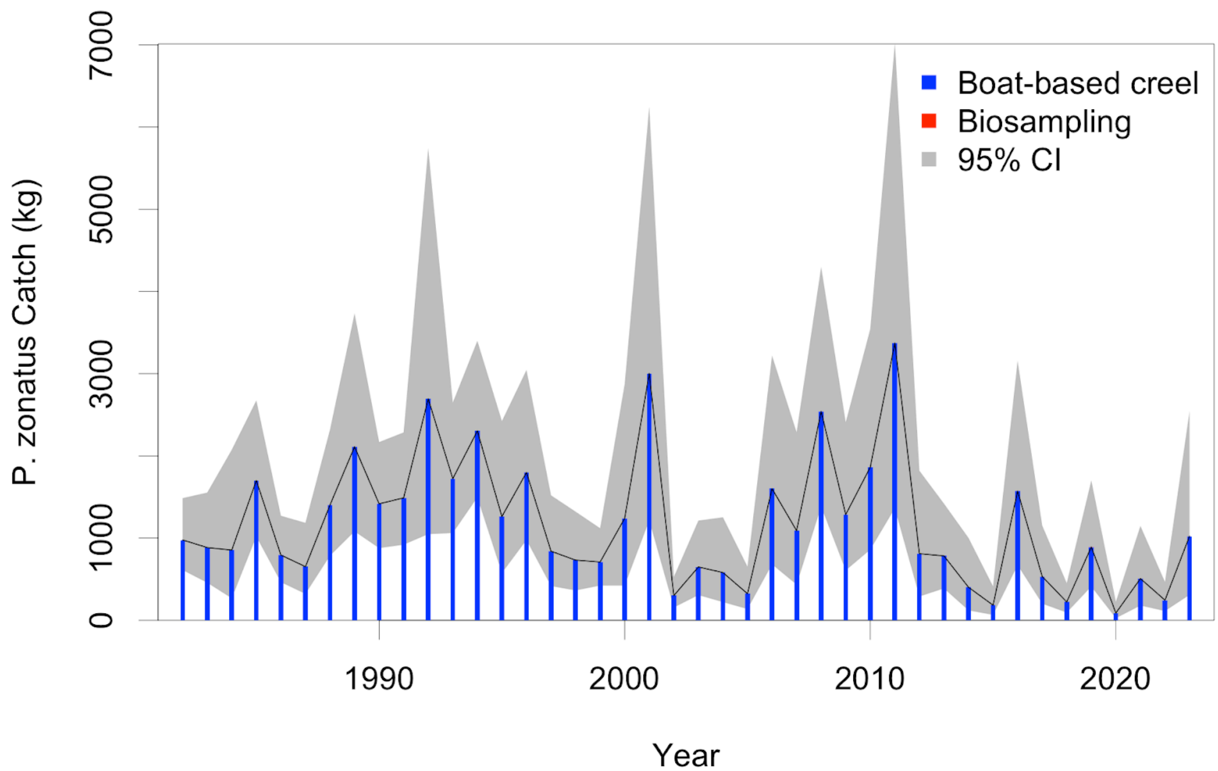

Figure 12. Estimated catch of *P. zonatus* on Guam from 1982 to 2023.

Variola louti

The BBS contributes nearly the entire catch series for *V. louti* and 85.6% of its catch is from bottomfishing, with spearfishing contributing an additional 12.6%. *V. louti* is moderately common in the BBS, appearing in 9.7% of all bottomfishing interviews. This leads to a variable catch series with moderate uncertainty surrounding annual estimates (mean BBS CV = 41.1%, Figure 13). Notably, catch is quite low in recent years and bottomfishers report that it is not commonly caught (Iwane et al. 2023). There are no known data quality issues for *V. louti*.

Outcome: We propose to use the catch series for *V. louti*.

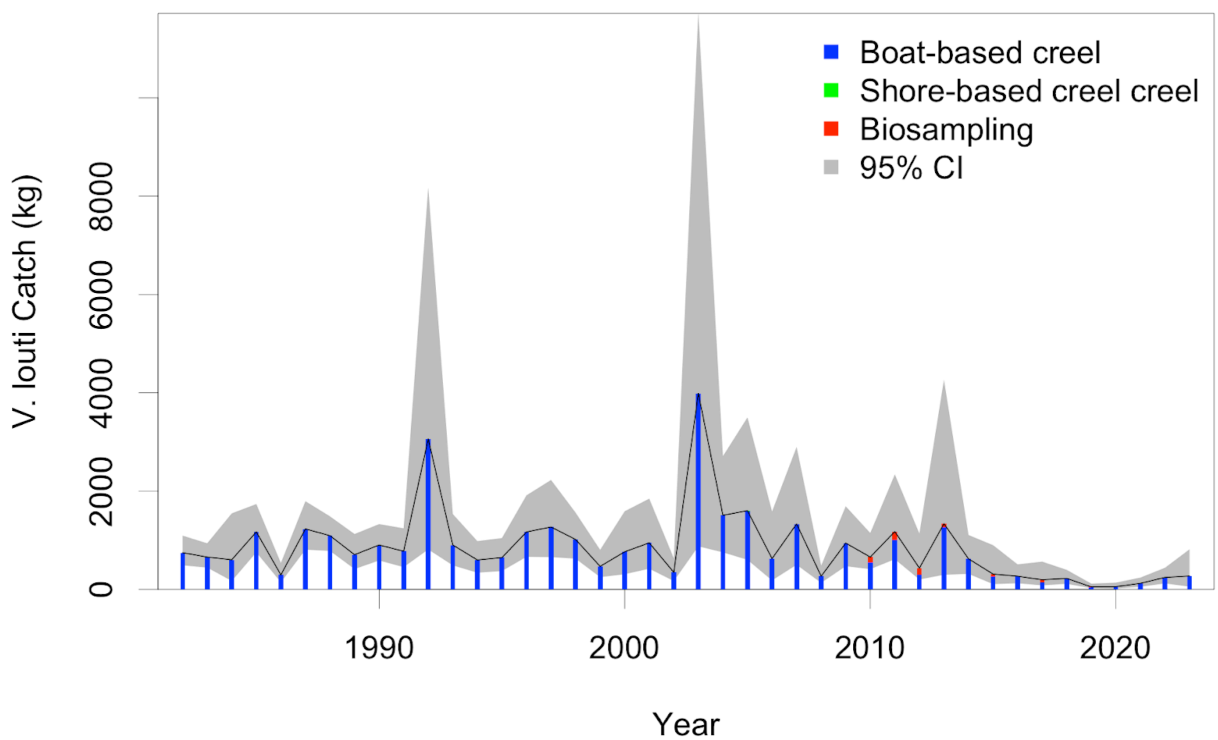

Figure 13. Estimated catch of *V. louti* on Guam from 1982 to 2023.

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Table 1. Catch series contributions by survey and fishing method for each BMUS. Percentages less than 1% are not included. The percent of interviews containing each BMUS and mean annual catch coefficient of variation are also provided. BBS = boat-based creel survey, SBS = shore-based creel survey.

	Catch from BBS	Catch from Other Surveys	Catch from Bottomfishing	Catch from Other Methods	BBS Interview Occurrence	BBS Mean Annual CV
A.rutilans	99.6%		98.5%	1.1% line	6.0%	49.4%
C. ignobilis	77.4%	21.3% SBS, 1.3% biosampling	45.0%	34.2% line, 11.3% net, 9.5% spear	1.5%	66.7%
C. lugubris	99.8%		92.5%	5.2% line, 2.3% spear	3.8%	55.7%
E. carbunculus	100.0%		98.4%	1.6% line	8.5%	46.4%
E. coruscans	100.0%		99.8%		5.0%	61.4%
L. rubrioperculatus	98.4%	1.5% SBS	96.3%	1.9% line, 1.5% spear	24.8%	30.1%
L. kasmira	98.7%	1.3% SBS	93.2%	3.1% line, 1.9% spear, 1.8% net	13.2%	52.1%
P. auricilla	100.0%		99.9%		12.5%	38.6%
P. filamentosus	99.8%		100.0%		3.1%	65.7%
P. flavipinnis	99.8%		100.0%		5.7%	52.1%
P. sieboldii	96.5%	3.5% biosampling	99.9%		0.8%	314.9%
P. zonatus	100.0%		99.9%		11.3%	38.2%
V. louti	98.3%	1.7% biosampling	85.6%	12.6% spear, 1.8% line	9.7%	41.1%