Guam Naval Base Fisheries Data Collection Program 2013-2014

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Western Pacific Regional Fishery Management Council

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Introduction

The Guam Naval base fisheries data collection project is a one year program scheduled to run from June 2013 to May 2014. The purpose of the project is to collect the fisheries data from Guam Naval base to understand the level of small boat and shore-based fishing activities and to estimate annual landing and effort in naval base waters. In addition, the annual estimates of fishing effort in the naval base are compared with the estimates of the rest of the island that were computed from the WPacFIN creel survey data.

This report is organized in three parts: the first section provides a description of the survey and the survey coverage; the second section includes summary statistics of the survey data, and lastly estimates of the catch and effort at an annual level are presented. More detailed information on the survey design and estimation may be found in the appendix at the end of the report.

Survey Summary

Two surveys were employed to collect fishing effort and catch data: Fishing trip count survey and fisher interview survey. In the fishing trip count survey, surveyors record the number of fishing activities at a boat launching area and different shore based fishing sites. In the interview survey, surveyors intercept fishers who have completed a fishing trip and obtain catch information including species composition and weight of the catch.

The geographical coverage of the surveys includes one boat launching area and nine mutually exclusive sections in the shoreline that are accessible for shore-based fishing in the naval base (Table 1). The temporal coverage is 12 months and was stratified by month with approximately 15 days being selected at random each month. On a given survey day, the survey was conducted for the entire geographical coverage. A survey day (24 hours) was divided into 3 shifts (8 hours/shift) and 2 shifts were randomly selected with unequal probability on a given survey day. Between June 2013 and May 2014, the survey was conducted a total of 187 days and 357 shifts (Table 2).

Table 1. Geographical coverage for the surveys: The image shows the bay area where Guam naval base is located and the survey sites: boat launching area (Sumay Cove Marina) and shoreline sites

Site No.	Site Name
1	Sumay Cove
2	Old rusty dock
3	Park/Rec areay
4	San Luis Beach
5	Gab Gab Beach
6	Spanish Steps
7	Tipalao Beach (Old wives)
8	Dadi Beach
9	Polaris Beach

Table 2. Survey shifts and the associated hours on a survey day

Shift	Survey hours
Morning	6am - 2 pm
Evening	2pm - 10pm
Night	10pm - 6am

Table 3. Number of days the survey was conducted each month

Year	Month	No. of survey days
2013	Jun	15
2013	Jul	15
2013	Aug	15
2013	Sep	16
2013	Oct	14
2013	Nov	14
2013	Dec	15
2014	Jan	15
2014	Feb	16
2014	Mar	15
2014	Apr	17
2014	May	20
	Total	*187*

Data summary

Boat based fishing activities

In this report, the boat fishing effort was defined as number of fishing boats (boat count) engaged in or that have completed a fishing activity, and the catch per unit effort (*CPUE)* was defined as total weight of catch (lbs) from a completed fishing trip. During the 187 survey days, a total of 267 boats were observed (Table 4), with trolling as the most common gear type encountered (Table 5). Most of the fishing activities occurred during day time hours (morning and evening) and rarely during the night time (Table 5).

Table 4. Total number of boats observed and recorded during the survey by month and shift. The average boat count suggests higher fishing activities during morning and evening than night time.

Month	Total no. of boats			Total no. of survey shift			Average boat count by shift		
	Morning	Evening	Night	Morning	Evening	Night	Morning	Evening	Night
Jun	11	15	1	10	10	6	1.1	1.5	0.2
Jul	13	11	1	12	12	4	1.1	0.9	0.3
Aug	19	12	2	13	10	6	1.5	1.2	0.3
Sep	11	16	2	14	13	6	0.8	1.2	0.3
Oct	4	3	0	9	11	10	0.4	0.3	0.0
Nov	19	11	1	10	12	7	1.9	0.9	0.1
Dec	16	5	0	13	9	8	1.2	0.6	0.0
Jan	17	11	0	8	11	9	2.1	1.0	0.0
Feb	36	13	0	13	11	5	2.8	1.2	0.0
Mar	2	2	1	9	9	10	0.2	0.2	0.1
Apr	4	3	1	13	10	10	0.3	0.3	0.1
May	1	3	0	12	13	9	0.1	0.2	0.0
Total	*153*	*105*	*9*	*136*	*131*	*90*	-	-	-

Table 5. Total number of boats observed and recorded during the survey by fishing method

Fishing method	Morning	Evening	Night
Trolling	103	46	3
Trolling, jigging	1	-	-
Trolling, bottomfishing	3	1	-
Trolling, bottomfishing, jigging	-	1	-
Trolling, spear/snorkel	1	4	-
Trolling, spear/scuba	-	1	-
Bottomfishing	6	14	2
Bottomfishing, spear/snorkel	1	-	-
Bottomfishing, jigging	-	1	-
Jigging	3	1	-
Atulai	3	2	-
Mix spearfishing	1	-	-
Spear/snorkel	4	5	-
Spear/scuba	1	2	-
Rod & reel	-	-	1
Non fishing activities/unknown	26	27	3

Table 6. Total number of voluntary interviews from boat fishing trips by shift

Month	Morning	Evening	Night	Total
Jun	4	4	2	10
Jul	4	6	1	11
Aug	8	4	-	12
Sep	2	8	1	11
Oct	2	3	-	5
Nov	21	13	1	35
Dec	7	2	-	9
Jan	10	8	1	19
Feb	19	6	-	25
Mar	1	1	-	2
Apr	2	2	-	4
May	-	1	-	1
Total	*80*	*58*	*6*	*144*

Table 7. Total number of voluntary boat-based interviews by fishing method and month

Month	Trolling	Bottom	Spear /snorkel	Spear /scuba	Rod &reel	Atulai	Trolling, Spear snorkel	Trolling, Bottom
Jun	6	2	-	-	1	-	-	1
Jul	9	-	2	-	-	-	-	-
Aug	8	3	1	-	-	-	-	-
Sep	7	3	-	-	-	1	-	-
Oct	2	3	-	-	-	-	-	-
Nov	28	1	2	2	1	1	-	-
Dec	9	-	-	-	-	-	-	-
Jan	17	-	1	1	-	-	-	-
Feb	22	-	2	-	-	-	1	-
Mar	2	-	-	-	-	-	-	-
Apr	4	-	-	-	-	-	-	-
May	1	-	-	-	-	-	-	-
Total	115	12	8	3	2	2	1	1

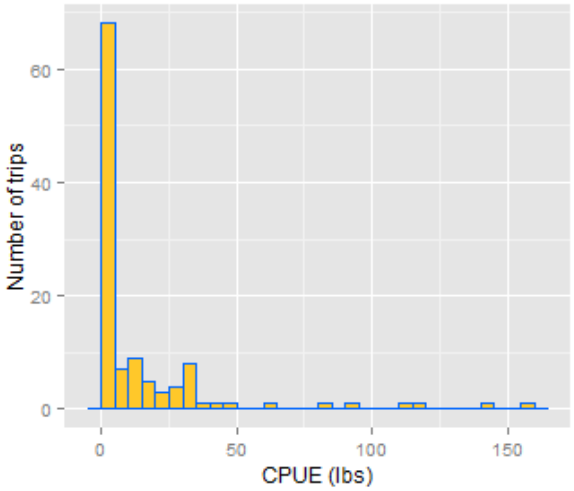

Figure 1. Distribution of total catch (lbs): Trolling trips

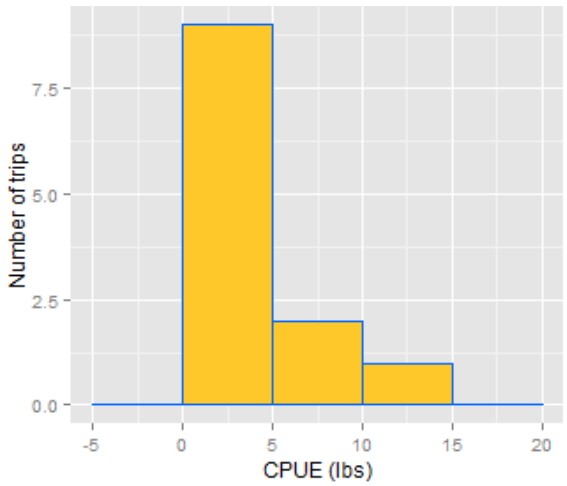

Figure 2. Distribution of total catch (lbs): Bottomfishing trips

Table 8. CPUE (Total catch per trip) statistics by fishing method

Method	*n*	Mean (lbs)	SD (lbs)	Min (lbs)	Q2 (lbs)	Median (lbs)	Q4 (lbs)	Max (lbs)
Trolling	115	14.0	28.2	0.0	0.0	0.0	17.0	157.1
Bottomfishing	12	2.8	4.5	0.0	0.0	0.4	3.9	13.8
Atulai	2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Spear/snorkel	8	5.3	6.5	0.0	0.0	2.5	9.8	17.6
Spear/scuba	3	19.8	34.3	0.0	0.0	0.0	29.7	59.3
Rod n reel	2	6.5	9.1	0.0	0.0	6.5	12.9	12.9

Table 9. Trip catch mean (mean CPUE) and standard deviation (SD) by fishing method and month

Month	Trolling		Bottom		Spear/snorkel		Spear/scuba		Rod & reel	
	CPUE (lb)	SD (lb)	CPUE (lb)	SD (lb)	CPUE (lb)	SD (lb)	CPUE (lb)	SD (lb)	CPUE (lb)	SD (lb)
Jun	4.3	4.4	1.3	0.7	-	-	-	-	12.9	-
Jul	0.0	0.0	-	-	8.8	12.4	-	-	-	-
Aug	7.6	14.2	0.0	0.0	0.0	-	-	-	-	-
Sep	55.1	59.9	6.4	6.9	-	-	-	-	-	-
Oct	3.6	5.1	3.0	5.2	-	-	-	-	-	-
Nov	6.4	11.6	2.3	-	7.1	4.8	29.7	42.0	0.0	-
Dec	9.2	16.3	-	-	-	-	-	-	-	-
Jan	22.1	39.2	-	-	0.0	-	0.0	-	-	-
Feb	17.7	24.7	-	-	5.2	5.6	-	-	-	-
Mar	0.0	0.0	-	-	-	-	-	-	-	-
Apr	21.0	41.9	-	-	-	-	-	-	-	-

Table 10. A complete list of species that were identified and recorded from the boat based fishing trips

Species name	
ablennes sp.	*makaira mazara*
acanthocybium solandri	*marlin*
Barracuda	*monotaxis grandoculus*
Bonita	*mullus surmuletus*
katsuwonus pelamis	*naso lituratus*
caranx melampygus	*naso unicornis*
cephalopholis urodeta	*parupeneus barkerinus*
cetoscarus bicolor	*parupeneus insularis*
cheilinus trilobatus	*plectorivehus picus*
coryphaena hippenus	*plectropomus laevis*
dog tooth	*sarda chileasis*
elagatis binnulatus	*sargocentron spiniferum*
elegata binnulata	*scarus festivus*
ephinephalus polyphekadion	*scarus psittacus*
epinephelus fasciatus	*scarus schlegeli*
etelis carbunculus	*scomberoides lysan*
Giadao	*seriola dumerili*
gymnosarda unicolor	*silver milkfish*
hipposcarus longiceps	*sphyraena barracuda*
katsuwanus pelaivus	*sphyrena genie*
l. gibbus	*tataja*
lethrinus obsoletus	*thunnus albacarcs*
lethrinus olivaceus x 3	*thunnus albacores*
lethrinus rubrioperculatus	*triggerfish*
lethrinus sp	*tunnus albacares*
lethrinus xanthothilus	*variola albimarginata*
lutjanus fuluus	*Wahoo*
lutjanus gibbus	*wrasse red, black, white]*
lutjanus kasmira	*yellow fin tuna*
Mafute	*yellow tail*

Shore-based fishing activities

In the summary of the shore-based survey data, the unit of fishing effort was defined by gear and the catch per unit effort is defined by total weight of catch (lb) per gear. During the 187 survey days, a total of 998 gears were observed (Table 11), and the most frequently observed fishing method was hook and line (Table 12), with the most active level of shore based fishing occurring during evening hours (Table 11). A total of 50 complete interviews were conducted, and these were primarily from hook and line fishers. During the interviews, about 40 different species were identified and recorded from the catch.

Table 11. Total number of fishing gears by month and shift

Month	Morning	Evening	Night
Jun	21	66	-
Jul	33	110	-
Aug	24	139	2
Sep	5	77	-
Oct	-	55	-
Nov	26	65	1
Dec	23	20	-
Jan	19	67	-
Feb	36	48	5
Mar	5	40	1
Apr	17	23	10
May	14	46	-
Total	*223*	*756*	*19*

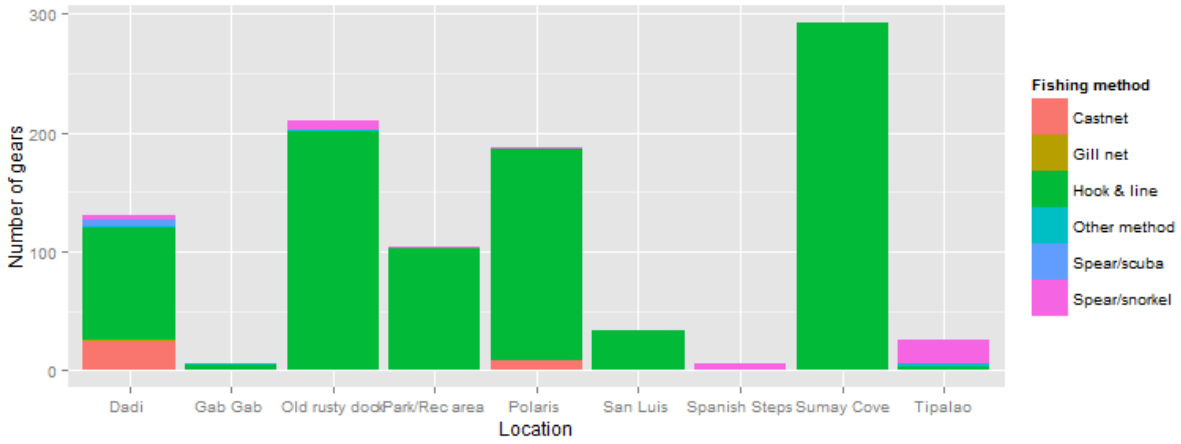

Figure 3. Number of gears that were engaged in shore-based fishing activities by survey site

Table 12. Number of gears engaged in shore based fishing activities by fishing method survey site

Method	Dadi	Gab Gab	Old rusty dock	Park/Rec Area	Polaris	San Luis	Spanish Steps	Sumay Cove	Tipalao
Castnet	24	-	-	-	8	-	-	-	-
Gill net	1	-	-	-	-	-	-	-	-
Hook & line	95	4	201	103	178	34	-	293	3
Spear/scuba	6	-	-	-	-	-	-	-	-
Spear/snorkel	4	-	8	1	2	-	6	-	21
Other method	1	2	1	-	-	-	-	-	2

Table 13. Number of interviews with complete fishing trips

Month	No. of Interview
Jun	11
Jul	8
Aug	15
Sep	1
Oct	3
Nov	5
Dec	5
Jan	2
Feb	0
Mar	0
Apr	0
May	0

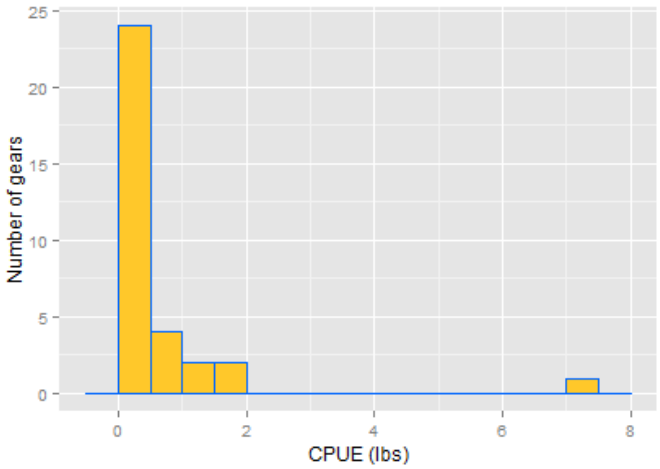

Figure 4. Distribution of CPUEs of hook & line fishing activities

Table 14. CPUE (Total catch per gear) statistics by fishing method

Method	***n***	**Mean** (lbs)	**SD** (lbs)	**Min** (lbs)	**Q2** (lbs)	**Median** (lbs)	**Q4** (lbs)	**Max** (lbs)
Hook & line	33	1.3	1.8	0.0	0.0	0.7	1.1	7.1
Cast net	2	4.9	4.0	2.2	2.2	4.9	7.7	7.7
Snorkel spear	1	15.0	-	15.0	15.0	15.0	15.0	15.0
Bottom	1	0.4	-	0.4	0.4	0.4	0.4	0.4
Bottom/casting	1	0.4	-	0.4	0.4	0.4	0.4	0.4
casting	1	1.1	-	1.1	1.1	1.1	1.1	1.1
Unknown	14	1.5	2.6	0.0	0.0	0.7	1.5	9.9

Table 15. A complete list of species that were identified and recorded from shore based fishing trips

Species name	
Gadas	*monotaxis grandoculus*
Atulon	*moolgarda seheli*
Barracuda	*mulloidycthus flavolineatus*
caranx ignbilis	*myrichthys colubrinus*
caranx melampygus	*octopus*
caranx sexfasciatus	*onespot emperor*
cheilinus trilobatus	*parupeneus insularis*
epinephelus merra	*platax orbicularis*
hipposcorus longiceps	*redgill emperor*
kyphosus vagiensis	*sargocentren spineferum*
lethrinus divaceus	*sargocentron*
lethrinus horak	*scarus psittacus*
lethrinus obsoletus	*scarus schlegeli*
lethrinus olivaceious	*scomberoides lysan*
lethrinus xanthochilus	*selar crumenophthalmus*
lutjanus gibbus	*sepioteuthis lessoniana*
lutjanus fulvus	*siganus spinus*
lutjanus monostigma	*sphryaena sp*
mafute lethrinus obsoletus	*sphyraena barracuda*
modigarda seheli	*strongylura incisa*

Catch and effort expansion

Boat based fishery data

Under the stratified simple random sampling design, the unbiased estimates of the annual boat based fishing effort (number of boats) and the *cpue* were computed (Tables 16 and 17). The survey data suggest that the major fishing activities on the base are trolling and bottomfishing, thus the estimates of those two fishing methods were reported. For this report, *cpue* was computed as average boat trip catch, and total catch as a product of the annual estimate of the total number of boat trip and the catch rate (*cpue)* with the assumption that the effort and catch rate are independent (Table 18).

Table 16. Total boat count estimate and statistical properties, by fishing method

Fishing Method	$\boldsymbol{Boat\ count_g}$	$\boldsymbol{SE_g}$	Confidence Interval ($\boldsymbol{\alpha = 0.05}$)	
			Lower	Upper
Trolling	430.9	11.94	407.5	454.3
Bottomfishing	43	6.01	31	55

Table 17. CPUE estimate and statistical properties, by fishing method

Fishing Method	$\boldsymbol{CPUE_g}$ (lbs/trip)	$\boldsymbol{SE_g}$	Confidence Interval ($\boldsymbol{\alpha = 0.05}$)	
			Lower	Upper
Trolling	14	7.54	6.45	21.54
Bottomfishing	4.5	1.30	1.95	7.05

Table 18. Total catch estimate and statistical properties, by fishing method

Fishing Method	$\boldsymbol{catch_g}$ (lbs)	$\boldsymbol{SE_g}$	Confidence Interval ($\boldsymbol{\alpha = 0.05}$)	
			Lower	Upper
Trolling	8488.2	824.3	6872.6	10103.8
Bottomfishing	193.5	62.6	70.8	316.2

Shore based fishery data

Under the stratified simple random sampling design, the unbiased estimates of the annual shore-based fishing effort (number of gears) and the *cpue* were computed (Tables 19 and 20). The survey data suggest that the major shore fishing activity on the base is hook and line. For this report, *cpue* was computed as average fishing trip catch, and total catch as a product of the annual estimate of the total number of gears and the catch rate with assumption that the effort and catch rate are independent (Table 21).

Table 19. Total gear count estimates and statistical properties

Fishing Method	$Gear\ count_g$	SE_g	Confidence Interval ($\alpha = 0.05$)	
			Lower	Upper
Hook & line	1813	98.39	1621	2006

Table 20. CPUE estimates and statistical properties

Fishing Method	$CPUE_g$ (lbs/gear)	SE_g	Confidence Interval ($\alpha = 0.05$)	
			Lower	Upper
Hook & line	1.32	0.31	0.73	1.92

Table 21. Total catch estimates and statistical properties

Fishing Method	$catch_g$ (lbs)	SE_g	Confidence Interval ($\alpha = 0.05$)	
			Lower	Upper
Hook & line	2398.2	575.4	1270.5	3525.8

Fishing effort comparison

To compare fishing effort occurring in the naval base waters to that of the rest of the island, the WPacFIN boat log survey data were used for boat-based fishery, and the WPacFIN participation count survey data for shore-based fishery. The estimates of total trips suggest that fishing effort at the naval base represents approximately 4 percent of the island-level trolling fishing effort and approximately 2 percent of the bottomfishing effort (Table 24).

It must be noted that the shore-based daily fishing effort data were collected differently thus the comparison should be made only qualitatively. The estimates of the shore based fishing effort were computed under the assumption that the effort data collected represents a census of daily fishing effort. The issue with this comparison is that the effort data were collected more frequently for the naval base project on a survey day than WPacFIN data collection program, thus the naval base survey shows higher daily effort, most likely due to the frequency of the survey.

Table 22. Total boat count estimates and statistical properties, by fishing method (WPacFIN)

Fishing Method	$Boat\ count_g$	SE_g	Confidence Interval ($\alpha = 0.05$)	
			Lower	Upper
Trolling	7492	163.71	7190	7793
Bottomfishing	2445	141.2	2168	2722

Table 23. Total gear count estimates of hook and line trips and statistical properties

	Gear count estimate (# of gears)	SE	Confidence Interval ($\alpha = 0.05$)	
			Lower	Upper
Hook & line	12145	399.18	11362	12927

Table 24. Fishing effort from the naval base and other areas in Guam and the ratio

	Boat count estimate (# of boats)		SE (# of boats)		Ratio
	Naval base	WPacFIN	Naval base	WPacFIN	
Trolling	301	7492	11.1	163.71	~5%
Bottomfishing	43	2445	4.9	141.2	~2%

Table 25. Fishing effort from the naval base and other areas in Guam and the ratio

	Gear count estimate (# of gears)		SE (# of gears)		Ratio
	Naval base	WPacFIN	Naval base	WPacFIN	
Hook & line	1813	12145	32.41	399.18	~15%

Conclusion

The purpose of the project was to understand the level of fishing effort in the Guam naval base in comparison to that of the other areas on Guam. This research has shown that the majority of the fishing activities in the naval base are trolling and hook & line, which are congruent with the major fishing activities of the other areas according to WPacFIN data. The annual fishing effort estimates suggest that the level of fishing effort in the naval base occupies less than 5% of the island-wide effort for boat and shore based fisheries.

Data Issues

The survey data needed to be heavily cleaned and some omitted due to incomplete and/or inconsistent data entries. For future efforts, to ensure data quality and improve the estimates, a comprehensive training program of the data collection/entry is strongly recommended.

APPENDIX A. Fisheries Data Estimation Equations

A1. Total effort estimation

$Let\ y_k be\ the\ number\ of\ participation\ count\ (part.count)\ on\ the\ k^{th}\ survey\ day.$

N_h: number of days in stratum h
$\bar{y}_{s_h}$: mean part count in stratum h
f_h: sampling weight of stratum h ($\frac{n_h}{N_h}$)
$S^2{}_{ys_h}$: $Sample\ variance\ of\ stratum\ h$

$$\widehat{Total\ part\ counts} = \sum_{h\in\{months\}} N_h \bar{y}_{s_h}$$

$$\hat{V}(\widehat{Total\ part\ counts}) = \sum_{h=1}^{H} N^2{}_h \frac{1-f_h}{n_h} S^2{}_{ysh}$$

$$S^2{}_{ysh} = \frac{1}{n_h - 1}\sum_{s_h} (y_k - \bar{y}_{s_h})^2$$

$$SE = \sqrt{\frac{\hat{V}}{n}}$$

A2. Total participation count estimation grouped by fishing method

Let $p_g = n_g/n$ and $q_g = 1 - p_g$,

$$\widehat{Total\ part\ count}_g = \sum_{h\in\{months\}} N_{hg} \bar{y}_{s_{hg}}$$

$$\hat{V}\left(\widehat{Total\ part\ count}\right)_g = \sum_{h=1}^{H} N^2{}_h\,(1-f_h)\frac{p_g q_g}{n_h - 1}$$

$$SE_g = \sqrt{\frac{\hat{V}_g}{n_g}}$$

APPENDIX B. Survey and Sampling design documentation

Project: 12-month fishery data collection on Naval Base Guam

Objective: To collect fisheries data including the number of fishing trips and landing information from fishing activities on Naval Base Guam between June 2013 and May 2014.

Purpose: The collected data will be used to estimate annual total catch and fishing effort of the small boat fisheries and shore-based fisheries active on Naval Base Guam. In addition, the data can be used to understand the relative magnitude of fishing effort and catch to the rest of the island, and could be applied to compute an adjustment factor to the WPacFIN annual estimates of total catch and effort at the island level.

Parameters of Interest:

1. The annual total number of fishing trips within Naval Base Guam (*T*)
2. The annual total catch (in weight) from the fishing trips at species level (*C*)
3. Catch per unit effort (or trip) at species level (*CPUE*)

Surveys: Three types of surveys will be implemented to collect appropriate data to estimate the fisheries parameters of interest: *boat-based fishery survey, shore-based fishery survey*, and *fishing trip count survey*. The *boat-based fishery survey* targets fishing trips involving a boat, and the surveys will be conducted at the boat launching areas within Naval Base Guam. The *shore-based fishery survey* targets fishing trips made along the coastline which do not involve a boat. This survey will be conducted as a surveyor roves along the coastline. The *fishing trip count survey* targets all fisheries to obtain the distribution of fishing activities around Naval Base Guam at any given time.

Collaborators
Naval Base Guam (Gretchen Grimm)
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Survey Descriptions

Boat-based fishery survey

Two survey instruments are included in the boat-based fishery survey: (1) boat count survey and (2) voluntary interview, and they will be conducted simultaneously at Summary Cove Marina on Naval Base Guam.

Survey Name	**Boat count survey**
Objective	To capture the total number of fishing trips that launch from and/or return to Naval Base Guam
Purpose	To understand the level of boat-based fishing activities on Naval Base Guam
Target Population	All fishing boat launching areas on Naval Base Guam (Sumay Cove Marina)
Sampling Unit	A fishing day
Data collected	- All fishing boats returning to the harbor - All fishing boats leaving the harbor - All boat trailers parked at the harbor
Parameter of interest	Annual total number of fishing trips that launch from and/or return to Naval Base Guam
Sampling Frame (geographical)	Sumay Cove Marina (boat launching area on Naval base) 
Sampling Frame (temporal)	Available fishing days (24 hours/day) between June 2013 and May 2014; excluding certain holidays and any days that boat-based fishing activities are not allowed by the authorities of Naval Base Guam

Survey Name	**Boat count survey (con't)**
Sampling Design	(Stratified simple random sampling) Let the total number of available fishing days be N_t and the total number of survey days be n_t. The temporal sampling frame is stratified by wave (2 month) and day type (week days and weekends) (h). A survey day is divided into three segments: morning, evening and night. In each stratum (h), n_{th} days will be selected at random and two segments will be randomly selected with unequal probability for the boat count survey.
Survey Design	On a survey day, a surveyor will be stationed at the Sumay Cove Marina and will record all boat trips (returning, leaving, parked trailers)

Survey Name	**Boat trip voluntary interview**
Objective	To obtain fishing trip and catch-related information from the boat-fishing trips that return to Naval Base Guam
Purpose	To understand the total catch, catch rate and the species composition landed on Naval Base Guam
Target Population	All fishing trips completed on Naval Base Guam between June 2013 and May 2014. This included trips that may have begun elsewhere on the island but terminated on Naval Base Guam.
Sampling Unit	Fishing trip on a fishing day
Parameter of interest	Total weight of catch at species level, total hours of fishing trips, measurement (length) of fish caught
Sampling Frame (geographical)	Sumay Cove Marina 
Sampling Frame (temporal)	Available fishing days (24 hours/day) between June 2013 and May 2014; excluding certain government holidays and any days that boat-based fishing activities are not allowed by the authorities of Naval Base Guam
Sampling Design	(Stratified simple random sampling) Let the total number of available fishing days be N_t and the total number of survey days be n_t. The temporal sampling frame is stratified by wave (2 month) and day type (week days and weekends)(h). A survey day is divided into three segments: morning, evening and night. In each stratum (h), n_{th} days will be selected at random and two segments will be randomly selected with unequal probability for the voluntary interviews
Survey Design	On a survey day, a surveyor will be stationed at the Sumay Cove Marina and will intercept fishermen returning from fishing trips in an effort to complete voluntary interviews.

Shore-based fishery survey

Similar to the boat-based survey, the shore-based survey will utilize two survey instruments: (1) shore-based fishing trip count and (2) voluntary interviews. The surveyor will first conduct the fishing trip count survey as he/she visits each pre-determined fishing site. Once the surveyor is completes the trip count survey, he/she will revisit each site to conduct the voluntary interview.

Survey Name	**Shoreline fishing trip count**
Objective	To obtain the total number of fishing trips during the survey period
Purpose	To understand the level of shore-based fishing activities on Naval Base Guam by estimating annual total number of fishing trips
Target Population	All coastline that is accessible for fishing on Naval Base Guam
Sampling Unit	Fishing day
Parameter of interest	Annual total number of shore-based fishing trips made on Naval Base Guam during the survey period of June 2013 to May 2014
Sampling Frame (geographical)	All accessible coastline on Naval Base Guam 
Sampling Frame (temporal)	Available fishing days between June 2013 and May 2014; excluding certain holidays and any days that shore-based fishing activities are not allowed by the authorities of Naval Base Guam

Site No.	Site Name
1	Sumay Cove
2	Old rusty dock?
3	Park/Rec area?
4	San Luis Beach
5	Gab Gab Beach
6	Spanish Steps
7	Tipalao Beach (Old wives)
8	Dadi Beach
9	Polaris Beach

Survey Name	**Shoreline fishing trip count (con't)**
Sampling Design	(Stratified simple random sampling) Let the total number of available fishing days be N_t and the total number of survey days be n_t. The temporal sampling frame is stratified by fishing wave (2 month) and day type (week days and weekends) (h). In each stratum (h), n_{th} days will be selected at random and two segments will be randomly selected with unequal probability for the shore-based fishing trip count survey.
Survey Design	There will be a fixed number of pre-determined fishing observation points along the coastline on Naval Base Guam. On a survey day, a surveyor will drive to a pre-determined observation point and record the total number of shore-based fishing trips observed during the sampling period. Upon completion, the surveyor will proceed to the next one until all points of the survey section are covered. During a shift, this survey will be conducted 4 times within a 2 hour interval.

Survey Name	**Shoreline voluntary interview**
Objective	To obtain fishing trip and catch related information of shore-based fishing trips on Naval Base Guam
Purpose	To understand total catch, catch rate, and species composition of catch and to estimate annual total catch and effort on Naval Base Guam
Target Population	All shore-based fishing trips made along the coastline on Naval Base Guam
Sampling Unit	Shore-based fishing trip (a fishing trip can consist of one or more fishermen)
Parameter of interest	Total weight of catch at species level, total hours of fishing trips, measurement (length) of fish caught
Sampling Frame (geographical)	All accessible coastline on Naval Base Guam 
Sampling Frame (temporal)	Available fishing days between June 2013 and May 2014; excluding government holidays and any days that shore-based fishing activities are not allowed by the authorities of Naval Base Guam

Site No.	Site Name
1	Sumay Cove
2	Old rusty dock?
3	Park/Rec area?
4	San Luis Beach
5	Gab Gab Beach
6	Spanish Steps
7	Tipalao Beach (Old wives)
8	Dadi Beach
9	Polaris Beach

Survey Name	**Shoreline voluntary interview (con't)**
Sampling Design	(Stratified simple random sampling) Let the total number of available fishing days be N_t and the total number of survey days be n_t. The temporal sampling frame is stratified by wave (2 month) and day type (week days and weekends) (h). In each stratum (h), n_{th} days will be selected at random and two segments will be randomly selected with unequal probability for the voluntary interviews.
Survey Design	On a survey day, a surveyor will drive along the coastline visiting each site indicated on the map in the geographical sampling frame. When the surveyor encounters a fishing trip in progress or recently completed, the surveyor will intercept the fishing trip in an effort to complete a voluntary interview. Upon completion of the interview, the surveyor will continue roving to the next site. During a shift, the survey will be conducted 4 times within a 2 hour interval.