1 FISHERY PERFORMANCE

1.1 FISHERY DESCRIPTIONS

The Samoa Archipelago is a remote chain of 13 islands of varying sizes and an atoll, located 14° south of the equator near the International Date Line. The islands lie between 13° and 14° latitude south and 169° and 173° longitude west, about 480 km (300 mi) from west to east, covering an area of 3,030 sq. km (1,170 sq. miles). With its tropical setting and its latitudinal range lying within the known limits of coral growth, coral reefs fringe the islands and atolls in the archipelago. The archipelago is approximately 4,200 km south of Hawaii in the central South Pacific Ocean and is divided into two political entities: Independent Samoa and American Samoa. The Independent Samoa has two large islands, Upolu and Savaii, and eight islets. American Samoa is comprised of five volcanic islands (Tutuila, Aunu'u, Ofu, Olosega, and Ta'u), one low-island (Swains Island), and a coral atoll (Rose Atoll). The five volcanic islands that are part of the American Samoa territory are very steep with mountainous terrain and high sea cliffs and of various sizes. Tutuila Island, the largest (137 km^2) and most populated island, is the most eroded with the most extensive shelf area and has banks and barrier reefs. Aunu'u is a small island close to Tutuila. Ofu and Olosega (13 km^2 together) are twin volcanic islands separated by a strait which is a shallow and narrow break in the reef flat between the islands. Ta'u is the easternmost island (45 km^2) with a more steeply sloping bathymetry.

The Samoa archipelago was formed by a series of volcanic eruptions from the "Samoan hotspot" (Hart et al. 2000). Based on the classic hotspot model, Savaii Island (the westernmost) in Samoa would be the oldest and Ta'u island (the easternmost) in American Samoa the youngest of the islands in the archipelago. Geological data indicate that Savaii is about four to five million years old, Upolu in Samoa about two to three million years old, Tutuila about 1.5 million years old, Ofu-Olosega about 300,000 years old, and Ta'u about 100,000 years old. Swains and Rose are built on much older volcanoes, they but are not part of the Samoan volcanic chain (Hart et al. 2004). The geological age and formation of Rose Atoll is not well known, and Swains is part of the Tokelau hot-spot chain which is anywhere from 59 to 72 million years old (Neall and Trewick 2008; Konter et al. 2008). There are numerous banks in the archipelago, the origins of which are not well known. The South Bank near Tutuila Island, for instance, is of another geological origin.

American Samoa experiences occasional cyclones due to its geographic location in the Pacific. Cyclones occur on one- to 13-year intervals, with the six strong occurrences happening over the last 40 years (Esau in 1981; Tusi in 1987; Ofa in 1990; Val in 1991; Heta in 2004; Olaf in 2005). The Territory had two tsunamis in the last 100 years due to its proximity to the geologically active Tonga Trench.

It is in this geological and physical setting that the Samoans have established their culture over the last 3,500 years. For three millennia, the Samoans have relied on the ocean for their sustenance. Fish and fishing activities constitute an integral part of the "*fa'a Samoa*", or the Samoan culture. Fish are also used for chiefly position entitlements and other cultural activities during the "*fa'a lalave*", or ceremonies.

1.1.1 BOTTOMFISH FISHERY

Deep, zooxanthellate, scleractinian coral reefs that have been documented in the Pacific often occur around islands in clear tropical oceanic waters (Lang 1974; Fricke and Meischner 1985; Kahng and Maragos 2006). These mesophotic coral ecosystems are found at depths of 30-40 m up to 150 m and have been exploited by bottomfish fishermen mainly targeting snappers, emperors, and groupers. Bottomfish fishing utilizing traditional canoes by the indigenous residents of American Samoa has been a subsistence practice since the Samoans settled on the Tutuila, Manu'a, and Aunu'u islands. It was not until the early 1970s that the bottomfish fishery developed into a commercial scheme utilizing motorized boats. The bottomfish fishery of American Samoa was typically comprised of commercial overnight bottomfish handlining using skipjack as bait on 28 to 30-foot-long aluminum/plywood "alia" (a term used for larger boats in Samoa). Imported bottomfish from the independent state of Samoa help satisfy demand, however the imports weaken the local bottomfish fishery. A government-subsidized program, called the Dory Project, was initiated in 1972 to develop the offshore fisheries into a commercial venture, and resulted in an abrupt increase in the size of the fishing fleet and total landings. In 1982, a fisheries development project aimed at exporting high-priced deep-water snappers to Hawaii initiated another notable increase in bottomfish landings and revenue. Between 1982 and 1988, the bottomfish fishery accounted for as much as half of the total commercial landings (by weight).

American Samoa's bottomfish fishery was a relatively larger size between 1982 and 1985 when it was new and expanding. In 1988, a decline in the bottomfish fishery occurred as many skilled and full-time commercial fishermen converted to trolling. Additionally, profits and revenue in bottomfish fishing suffered from four separate hurricanes, Tusi in 1987, Ofa in February of 1990, Val in December of 1991, and Heta in January of 2004, as well as the 2009 tsunami. The gradual depletion of newly discovered banks and migration of many fishermen into other fishing vendors resulted in the decline of landings through the mid-1980s. Fuel prices have gradually risen in the recent years, causing yet another strain on the bottomfish fisheries. The average price of bottomfish has also declined due to the shift in demand from local to imported bottomfish that complete closely with local prices. In 2004, 60 percent of coolers imported from the independent state of Samoa on the Lady Naomi Ferry were designated for commercial sale, and data from the Commercial Invoice System show that half of these coolers were filled with bottomfish.

Beginning in 1988, the nature of American Samoa's fisheries changed dramatically with a shift in importance from bottomfish fishing to trolling. In recent years, the dominant fishing method has been longlining (by weight). Bottomfish fishing has been in decline for years, but it was dealt a final devastating blow by the impacts of the 2009 tsunami. A fishery failure was declared, and the U.S. Congress allocated $1 million to revive the fishery. This fund has been used to repair boats damaged by the tsunami, maintain the floating docks used by the alia boats, and build a boat ramp. In 2013, the American Samoan Government also implemented a subsidy program that provided financial relief associated the rising fuel prices, and the fuel price has lowered since then.

1.1.2 ECOSYSTEM COMPONENT FISHERY

Traditional coral reef fishing in the lagoons and shallow reef areas has included methods such as gleaning and using bamboo poles with lines and baits or with a multi-pronged spear attached. The deep water and pelagic fisheries have traditionally used wooden canoes, hand-woven sennit lines with shell hooks and stone sinkers, and lures made of wood and shell pieces.

Presumably, the change from traditional to present-day fishing methods started with Western contact in the 18th century. Today the fisheries in American Samoa can be broadly categorized in terms of habitat and target species as either pelagic fisheries, bottomfish fisheries in mesophotic reefs, or nearshore coral reef fisheries. For creel monitoring program purposes, fisheries are either subsistence (i.e., primarily shore-based and mostly for personal consumption) or commercial (i.e., primarily boat-based and mostly sold). Bottomfish fishing is a combination of mesophotic reef fishing (i.e., spearfishing) and/or pelagic fishing (i.e., trolling). The coral reef fishery involves gleaning, spearfishing (snorkel or free dive from shore or using boat), rod-and-reel using nylon lines and metal hooks, bamboo pole, throw nets, and gillnets. SCUBA spearfishing was introduced in 1994, restricted for use by native American Samoans in 1998, and finally banned in 2002 following recommendations by biologists from the DMWR and local scientists.

In 2018, the Council drafted an Amendment 4 to the American Samoa FEP that reclassified a large number of MUS as Ecosystem Component Species (ECS; WPRFMC 2018). The final rule was posted in the Federal Register in early 2019 (84 FR 2767, February 8, 2019). This amendment reduces the number of MUS from 205 species/families to 11 in the American Samoa FEP. All former coral reef ecosystem management unit species (CREMUS) were reclassified as ECS that do not require ACL specifications or accountability measures but are still to be monitored regularly to prioritize conservation and management efforts and to improve efficiency of fishery management in the region. All existing management measures, including reporting and record keeping, prohibitions, and experimental fishing regulations apply to the associated ECS. If an ECS stock becomes a target of a federal fishery in the future, NMFS and the Council may consider including that stock as a MUS to actively manage it. These species are still regularly monitored via other means (see Sections 1.5.3 and 2.2).

1.2 FISHERY DATA COLLECTION SYSTEM

American Samoa has been regularly conducting fishery-dependent monitoring since 1982 for its boat-based fisheries. The boat-based fisheries mostly involve trolling for tuna, skipjacks, and trevally, and bottomfish fishing mostly targets snappers, emperors, and groupers. Boat-based data collection involve two runs: first is the participation run used to determine the number of boats/fishermen out to fish and identify the type of gear being used, and the second is the interview run where the fishermen are interviewed for effort and economic data while also measuring the length and weight of each fish identified to the species level.

1.2.1 BOAT-BASED CREEL SURVEY

The boat-based data collection focuses mostly on the main docks in Fagatogo and Pago Pago. Boat-based data collection is also being conducted in Manu'a. Boat-based data collection in both Ofu-Olosega and Ta'u is opportunistic since there is no set schedule for boats to go out and land their catches.

The survey follows a random stratified design. The stratification is by survey area, weekday/weekend, and time of day. The survey is divided into two phases: 1) participation run;

and 2) catch interview phase. The participation run attempts to estimate the amount of participation by counting the number of boats "not on the dock" or the presence of trailers. The catch interview phase occurs after the participation run, which documents catch composition, CPUE, length-weight information, catch disposition, and some socio-economic information. The data is transcribed weekly into the WPacFIN database. Catch expansion is done on an annual scale through a simple expansion algorithm using expanded effort and CPUE. For more details of the boat-based creel survey see Oram et al. (2011).

1.2.2 SHORE-BASED CREEL SURVEY

The shore-based data collection follows the same general scheme as the boat-based creel survey, and randomly selects eight-hour periods and locations four to five times per week to conduct necessary runs. Survey locations are western Tutuila from Vailoa to Amanave, central Tutuila from Aua to Nuuuli, eastern Tutuila from Lauli'i to Tula, while the Manu'a routes are relatively more complicated.

The following data are generated through these creel collection programs: 1) catch landings; 2) effort; 3) CPUE; 4) catch composition; 5) length (accurate to the nearest centimeter); 6) weight (lbs.). The survey follows a random stratified design. The stratification is by survey area, weekday/weekend, and time of day. The survey is divided into two phases: the participation run and the catch interview phase. The participation run attempts to estimate the amount of participation by counting the number of fishermen along the shoreline. The gear type, number of gears, and number of fishers are recorded. The catch interview phase occurs after the participation run, and documents catch composition, CPUE, length-weight information, catch disposition, and some socioeconomic information. The data is transcribed weekly into the WPacFIN database. Catch expansion is done on an annual basis through an expansion algorithm using expanded effort and CPUE values. For more details of the shore-based creel survey see Oram et al. (2011).

1.2.3 COMMERCIAL RECEIPT BOOK SYSTEM

Entities that sell any seafood products are required by law to report their sales to DMWR (ASCA § 24.0305). This is done through a receipt book system collected on the 16th day of every month. Information required to be reported are: (a) the weight and number of each species of fish or shellfish received; (b) the name of the fisherman providing the fish or shellfish; (c) boat name and registration number, if applicable; (d) the name of the dealer; (e) the date of receipt; (f) the price paid per species; (g) the type of fishing gear used; (h) whether the fish or shellfish are intended for sale in fresh, frozen, or processed form; (i) which fish or shellfish were taken within/outside of territorial waters; and (j) other statistical information the department may require.

1.2.4 BOAT INVENTORY

An annual boat inventory is being conducted to track down fishing boats and determine their ownership. This will provide information on how many boats are potentially available to engage in the fishery.

1.3 META-DATA DASHBOARD STATISTICS

The meta-data dashboard statistics describe the amount of data used or available to calculate the fishery-dependent information. Creel surveys are sampling-based systems that require random-stratified design applied to pre-scheduled surveys. The number of sampling days, participation runs, and catch interviews would determine if there were enough samples to run the expansion algorithm. The trends of these parameters over time may infer survey performance. Monitoring the survey performance is critical for explaining the reliability of the expanded information.

Commercial receipt book information depends on the number of invoices submitted and the number of vendors participating in the program. Variations in these meta-data affect the commercial landing and revenue estimates.

1.3.1 CREEL SURVEY META-DATA STATISTICS

Calculations:

Sample days: Count of the total number of unique dates found in the boat log sampling date data in boat-based creel surveys.

Catch Interviews: In boat-based creel surveys, count of the total number of data records found in the interview header data (number of interview headers). This is divided into two categories, interviews conducted during scheduled survey days (Regular) and opportunistic interviews (Opportunistic), which are collected on non-scheduled days.

Table 1. Summary of American Samoa boat-based creel survey meta-data

Year	# Sample Days	# Catch Interviews	
		Regular	Opportunistic
1986	186	532	1
1987	110	338	0
1988	158	366	0
1989	160	389	0
1990	160	191	0
1991	134	169	0
1992	127	137	0
1993	140	126	0
1994	209	234	0
1995	239	333	0
1996	222	389	3
1997	226	888	1
1998	229	852	1
1999	207	659	0
2000	206	457	0
2001	205	249	2
2002	194	212	0
2003	220	489	0

Year	# Sample Days	# Catch Interviews	
		Regular	**Opportunistic**
2004	239	485	5
2005	238	330	0
2006	238	319	7
2007	251	484	6
2008	225	303	11
2009	165	174	9
2010	188	168	2
2011	240	203	1
2012	269	285	14
2013	262	245	0
2014	236	353	27
2015	233	247	26
2016	224	165	47
2017	222	139	33
2018	215	176	11
2019	218	166	12
2020	230	164	2
2021	206	77	6
2022	170	57	2
2023	189	84	8
10-year avg.	**214**	**163**	**17**
10-year SD	**20**	**83**	**14**
20-year avg.	**223**	**231**	**11**
20-year SD	**27**	**118**	**12**

In summary, there has been a general decline in boat-based surveys for the last ten years with respect to the number of sample days, regular interviews, and opportunistic interviews except for the notable uptick in 2020. It seems that this decline reflects changes in the survey frequency with more recent years having 3 sampling days a week. The decline in creel survey effort in 2022 can be attributed COVID-19 restrictions that lasted approximately four months of that year. The decline of the bottomfish fishery since 2019 likely also contributes to the decline of creel survey interviews. A notable development is the increase of catch interviews in 2023 which may reflect increased fishing activities. This suggests that the boat-based fishery is recovering from the COVID-19 impacts.

1.3.2 COMMERCIAL RECEIPT BOOK STATISTICS

Calculations:

Vendors: Count of the number of unique buyer codes found in the commercial purchase header data from the Commercial Receipt Book, BMUS vendors are only from vendors that landed BMUS species.

Invoices: Count of the number of unique invoice numbers found in the commercial header data from the Commercial Receipt Book, BMUS vendors are only from vendors that landed BMUS species.

Table 2. Summary of American Samoa commercial receipt book meta-data

Year	# Vendors	# Invoices Collected	# BMUS Vendors	# BMUS Invoices Collected
1990	12	349	6	8
1991	15	526	10	35
1992	11	243	6	29
1993	16	523	9	64
1994	14	901	10	60
1995	17	1,724	11	103
1996	13	1,572	7	46
1997	17	1,638	n.d.	n.d.
1998	19	1,633	3	10
1999	18	1,412	5	29
2000	18	1,084	6	54
2001	31	1,054	10	57
2002	24	914	6	39
2003	28	1,041	7	40
2004	25	809	12	50
2005	53	751	13	42
2006	48	827	6	27
2007	50	901	7	59
2008	38	683	10	59
2009	36	569	13	64
2010	28	486	8	21
2011	25	648	3	12
2012	26	698	8	20
2013	32	576	4	10
2014	34	844	8	32
2015	42	1,259	6	45
2016	40	850	5	17
2017	38	748	6	21
2018	42	648	4	16
2019	40	787	6	41
2020	39	297	4	8
2021	29	223	n.d.	n.d.
2022	18	89	n.d.	n.d.
2023	25	334	n.d.	n.d.
10-year avg.	**35**	**608**	**4**	**20**

Year	# Vendors	# Invoices Collected	# BMUS Vendors	# BMUS Invoices Collected
10-year SD	**8**	**344**	**2**	**14**
20-year avg.	**35**	**651**	**6**	**28**
20-year SD	**9**	**262**	**4**	**19**

'n.d.' indicates data are not disclosed due to confidentiality rules.

In summary, there has been a decline in the number of engaged vendors, invoices collected, and invoices collected and vendors selling BMUS in the last 8 years until 2023. The decline has been especially notable over the last three years, which coincides with when the stocks were declared overfished and experiencing overfishing according to the most recent stock assessment (Langseth et al. 2019). Further, COVID-19 restrictions also negatively affected commerce for BMUS and fish since 2020. There were fewer than three vendors that sold BMUS in 2021 and 2022, and thus, the data are not disclosed due to confidentiality rules. The number of vendors engaged and invoices collected increased in 2023 which may reflect increased fishing activities. However, the number of vendors selling BMUS has not recovered.

1.4 FISHERY SUMMARY DASHBOARD STATISTICS

The Fishery Summary Dashboard Statics section consolidates all fishery-dependent information comparing the most recent year with short-term (recent 10 years) and long-term (recent 20 years) average (shown bolded in [brackets]). Trend analysis of the past 10 years will dictate the trends (increasing, decreasing, or no trend). The right-most symbol indicates whether the mean of the short-term and long-term years were above, below, or within one standard deviation of the mean of the full time series.

Legend Key:

- ↗ - *increasing trend in the time series*
- ↘ - *decreasing trend in the time series*
- ⇔ - *no trend in the time series*
- ⊕ - *above 1 standard deviation*
- ⊖ - *below 1 standard deviation*
- ⊙ - *within 1 standard deviation*

e.g., 10,000 [**1,000**] – *point estimate of fishery statistic* [% ***difference from short/long term average***]

Table 3. Annual indicators for the American Samoa BMUS fishery describing performance and comparing 2023 estimates with short- (10-year) and long-term (20-year) averages

Fishery	Fishery statistics	Short-term (10 years)	Long-term (20 years)
Bottomfish	**Total estimated catch (lb)**		

Fishery	Fishery statistics	Short-term (10 years)	Long-term (20 years)
All gears (BMUS only)	All BMUS from creel survey data	**4,689[▼58%]**	**4,689[▼63%]**
	All BMUS from commercial purchase data	**n.d.**	**n.d.**
	Catch-per-unit-effort (from boat-based creel surveys)		
Bottomfish fishing (BMUS only)	Bottomfish lb/trip	**21[▼40%]**	**21[▼59%]**
	Bottomfish lb/gr-hr	**0.67[▼33%]**	**0.67[▼51%]**
	Fishing effort (from boat-based creel surveys)		
Bottomfish fishing (BMUS only)	Tallied bottomfish trips	**23[▼58%]**	**23[▼62%]**
	Tallied bottomfish gear hours	**664[▼75%]**	**664[▼75%]**
	Fishing participation (from boat-based creel surveys)		
Bottomfish fishing (BMUS only)	Tallied number of bottomfish vessels	**6[▼33%]**	**6[▼45%]**
	Estimated average number of fishermen per bottomfish trip	**3[no change]**	**3[no change]**
	Bycatch (from boat-based creel surveys)		
Bottomfish fishing (BMUS only)	# fish caught	**308[▼72%]**	**308[▼86%]**
	# fish discarded/released	**0[no change]**	**0[no change]**
	% bycatch	**0[no change]**	**0[no change]**

‘n.d.’ indicates data were not disclosed due to confidentiality rules.

Table 4. Annual indicators for American Samoa ECS fisheries describing performance and comparing 2023 estimates with short- (10-year) and long-term (20-year) averages

Fishery	Fishery statistics	Short-term (10 years)	Long-term (20 years)
ECS	**Total estimated boat-based catch (lb)**		
Prioritized ECS	*Sargocentron tiere* from creel survey data	**28[▲8%]**	**28[▲75%]**
	Sargocentron tiere from commercial purchase data	**0[no change]**	**0[no change]**
	Crenimugil crenilabis from creel survey data	**47[▼19%]**	**47[▲68%]**
	Crenimugil crenilabis from commercial purchase data	**22[▲633%]**	**22[▲2100%]**

	Panulirus penicillatus from creel survey data	**776[▲104%]**	**776[▼33%]**
	Panulirus penicillatus from commercial purchase data	**37[▼95%]**	**37[▼97%]**
	Clams from creel survey data	**0[no change]**	**0[no change]**
	Clams from commercial purchase data	**0[no change]**	**0[no change]**
	Octopus cyanea from creel survey data	**0[no change]**	**0[no change]**
	Octopus cyanea from commercial purchase data	**0[no change]**	**0[no change]**
	Epinephelus malanostigma from creel survey data	**112[▲3%]**	**112[▲115%]**
	Epinephelus malanostigma from commercial purchase data	**0[no change]**	**0[no change]**

'n.d.' indicates data are not disclosed due to confidentiality rules.

1.5 CATCH STATISTICS

The following section summarizes the catch statistics for bottomfish, a one-year snapshot of the top ten landed species, and the top six prioritized species (and species groups) in American Samoa as determined by DMWR. The six species are the bluelined squirrelfish (*Sargocentron tiere*), fringelip mullet (*Crenimugil crenilabis*), green spiny lobster (*Panulirus penicillatus*), clams, day octopus (*Octopus cyanea*), and one-blotch grouper (*Epinephelus melanostigma*). Estimates of catch are summarized from the creel survey and commercial receipt book data collection programs. Catch statistics provide estimates of annual harvest from the different fisheries. Estimates of fishery removals can provide proxies for the level of fishing mortality and a reference level relative to established quotas. This section also provides detailed levels of catch for fishing methods and the top species complexes harvested in bottomfish fisheries in addition to the top ten landed species and top six prioritized species.

1.5.1 CATCH BY DATA STREAM

This section describes the estimated total catch from the boat-based creel survey programs as well as the commercial landings from the commercial receipt book system. The difference between the creel total and the commercial landings is assumed to be the non-commercial component. However, there are cases where the commercial landing may be higher than the estimated creel total of the commercial receipt book program. In this case, the commercial receipt books can capture fishery data better than the creel surveys.

Calculations: Estimated landings are based on a pre-determined list of species (Appendix A) identified as BMUS regardless of the gear used, for all data collection (boat-based creel surveys and the commercial purchase reports).

Table 5. Summary of American Samoa BMUS total catch (lb) from expanded boat-based and shore-based creel surveys and the commercial purchase system for all gear types

Year	Boat-Based Creel Survey Estimates	Shore-Based Creel Survey Estimates	Total Creel Survey Estimates	Commercial Landings
1986	11,036	-	11,036	-
1987	935	-	935	-
1988	23,704	-	23,704	-
1989	26,143	-	26,143	-
1990	9,765	1,777	11,542	1,304
1991	11,199	327	11,526	2,116
1992	8,361	855	9,216	1,895
1993	9,368	342	9,710	3,464
1994	21,616	509	22,125	2,375
1995	22,228	255	22,483	4,855
1996	20,831	1,023	21,854	1,082
1997	27,380	-	27,380	n.d.
1998	7,661	-	7,661	492
1999	9,925	-	9,925	1,701
2000	13,114	-	13,114	3,693
2001	29,847	-	29,847	3,447
2002	24,888	-	24,888	1,448
2003	12,872	-	12,872	2,511
2004	10,760	-	10,760	3,233
2005	9,580	-	9,580	2,490
2006	3,029	277	3,306	2,203
2007	10,499	183	10,682	4,001
2008	23,170	238	23,408	3,171
2009	48,229	201	48,430	3,035
2010	9,335	4	9,339	1,084
2011	15,981	3	15,984	711
2012	2,125	7	2,132	1,161
2013	6,272	1	6,273	882
2014	16,319	-	16,319	3,140
2015	22,787	8	22,795	2,047
2016	19,502	6	19,508	566
2017	15,131	190	15,321	1,131
2018	11,519	311	11,830	838
2019	10,848	574	11,422	1,749
2020	7,408	312	7,720	336

Year	Boat-Based Creel Survey Estimates	Shore-Based Creel Survey Estimates	Total Creel Survey Estimates	Commercial Landings
2021	1,361	439	1,800	n.d.
2022	1,022	474	1,496	n.d.
2023	3,768	921	4,689	n.d.
10-year avg.	**10,967**	**359**	**11,290**	**1,092**
10-year SD	**7,173**	**271**	**6,957**	**908**
20-year avg.	**12,432**	**244**	**12,640**	**1,645**
20-year SD	**10,493**	**245**	**10,431**	**1,155**

'-' indicates no data are available. 'n.d.' indicates data are not disclosed due to confidentiality rules.

In summary, bottomfish and BMUS landings have steadily declined in the last 10-20 years, with a steeper decline in 2021 and 2022 possibly associated with COVID-19 restrictions. Total estimated BMUS catch decreased more notably in 2021 and 2022 with reductions of nearly 80% relative to 2020. Commercial data were non-disclosed due to data confidentiality rules. The BMUS landings seemed to have increased in 2023 but the uptick has not significantly changed the declining trend.

1.5.2 EXPANDED CATCH ESTIMATES BY FISHING METHOD

Catch information is provided for boat-based fishing methods that contribute most of the annual catch for American Samoa.

Calculations: The creel survey catch time series are the sum of the estimated weight for selected gear in all strata for all species and all BMUS species.

Table 6. Total catch time series estimates (lb) for all species and BMUS only using American Samoa expanded boat-based creel survey data for bottomfish fishing gears

Year	Bottomfish Fishing		Bottom-Troll Mixed		Spearfishing	
	All	BMUS	All	BMUS	All	BMUS
1986	61,092	8,599	60,052	2,419	32,186	0
1987	8,650	334	38,299	601	31,014	0
1988	27,392	15,714	35,774	7,495	53,718	42
1989	20,248	11,862	41,279	13,624	43,281	617
1990	8,467	4,843	12,194	4,855	3,221	0
1991	14,522	7,305	14,562	3,894	-	-
1992	15,552	8,361	-	-	-	-
1993	18,273	7,852	4,876	1,471	-	-
1994	46,341	20,010	7,936	1,492	26,279	0
1995	20,895	11,282	37,376	10,850	-	-
1996	37,774	16,941	12,829	3,890	-	-
1997	38,373	22,029	10,411	4,957	59,724	394
1998	10,717	7,248	723	338	48,762	75

Year	Bottomfish Fishing		Bottom-Troll Mixed		Spearfishing	
	All	BMUS	All	BMUS	All	BMUS
1999	14,506	9,577	823	219	53,643	129
2000	25,207	12,063	1,950	1,013	27,067	38
2001	53,698	28,891	2,459	956	9,104	0
2002	50,701	24,120	1,774	768	7,516	0
2003	28,437	12,286	1,510	586	4,444	0
2004	29,539	9,335	3,260	1,422	371	0
2005	20,643	8,126	3,944	1,454	30	0
2006	11,834	2,515	1,169	494	2,799	20
2007	33,957	9,934	1,009	483	15,969	81
2008	54,102	22,648	1,566	497	7,797	25
2009	114,910	47,503	3,104	726	22,267	0
2010	21,792	9,286	-	-	51,528	49
2011	33,735	14,612	6,933	1,358	28,389	12
2012	14,854	2,100	406	18	10,192	1
2013	27,577	5,724	1,994	482	32,125	62
2014	37,946	15,420	4,444	879	17,453	5
2015	47,789	21,030	8,265	1,666	16,150	72
2016	32,785	14,795	16,285	4,456	6,677	252
2017	34,348	12,810	7,070	2,136	11,370	185
2018	20,902	10,878	2,998	511	6,625	99
2019	21,856	10,451	1,965	348	6,952	48
2020	15,959	5,678	6,987	1,379	11,500	190
2021	998	435	5,487	880	8,359	46
2022	1,509	807	84	66	9,324	120
2023	5,286	1,967	8,949	1,696	10,727	105
10-year avg.	**21,938**	**9,427**	**6,253**	**1,402**	**10,514**	**112**
10-year SD	**15,382**	**6,624**	**4,290**	**1,194**	**3,609**	**73**
20-year avg.	**29,116**	**11,303**	**4,296**	**1,048**	**13,830**	**69**
20-year SD	**24,022**	**10,337**	**3,866**	**985**	**11,888**	**70**

'-' indicates no data are available.

In summary, BMUS landings have closely tracked landings for all bottomfish and account for 40% of the total bottomfish landings. In addition, Bottomfishing has declined in the last 10 to 20 years with steep decline in 2020 and 2021 due to the impact of COVID-19. However, the mixed bottomfish-trolling displays a different trend, with landings from bottomfish-trolling increased in 2020 and a not so steep decline in 2021. There was a slight increase in bottomfishing, including BMUS fishing in 2022. There was a notable catch decline in mixed bottomfishing-trolling in 2022 as part of a continuous decline since 2020. However, the years from 2020 to 2022 are characterized by low fishing effort especially for mixed bottomfishing-trolling. There was a recommendation in the previous Plan Team meeting for PIFSC to analyze the influence of low fishing effort on expanded catch estimates.

1.5.3 TOP AND PRIORITIZED SPECIES IN BOAT-BASED FISHERY CATCH

Catch time series can act as indicators of fishery performance. Variations in the catch can be attributed to various factors, and there is no single explanatory variable for the observed trends. A one-year reflection of the top ten harvested species (by weight) is included to monitor which ECS are being caught the most annually. Additionally, DMWR selected six species/groups that were reclassified as ECS that are still of priority for regular monitoring, and complete catch time series of these species are included in the report as well.

Calculations: Catch tallied from the boat-based expanded species composition data combining gear types for all species excluding BMUS and pelagic MUS species.

Table 7a. Top ten landed ECS in American Samoa from boat-based creel survey data in 2023

Common Name	Scientific Name	Catch (lb)
Humpback snapper	*Lutjanus gibbus*	2,556
Redlip parrotfish	*Scarus rubroviolaceus*	1,363
Blue-banded surgeonfish	*Acanthurus lineatus*	1,068
Bluespine unicornfish	*Naso unicornis*	1,067
Redtail parrotfish	*Chlorurus japanensis*	967
Steephead parrotfish	*Chlorurus microrhinos*	833
Spiny lobster	*Panulirus pencillatus*	776
Twinspot/red snapper	*Lutjanus bohar*	654
Orangespot emperor	*Lethrinus erythracanthus*	521
Dark-capped parrotfish	*Scarus oviceps*	509

Calculations: Catch tallied from commercial receipt data combining gear types for all species excluding BMUS and pelagic MUS species.

Table 7b. Top ten landed ECS in American Samoa from commercial landings data in 2023

Common Name	Scientific Name	Catch (lb)
Blue-banded surgeonfish	*Acanthurus lineatus*	6,278
Unicornfishes	*Naso* spp.	2,608
Parrotfishes	*Scarus* spp.	2,563
Groupers	*Epinephelus* spp.	782
Squirrelfishes	*Sargocentron* spp.	644
Striped bristletooth	*Ctenochaetus striatus*	567
Emperors	Multi-genera, multi-species	463
Inshore groupers	Multi-genera, multi-species	285
Bigeye scad	*Selar crumenophthalmus*	276
Mullet	*Mugil cephalus*	245

In summary, species groupings and catch are usually different for ECS between the creel survey and commercial invoice data. The differences reflect fish species consumer preferences and fishermen's preferences for which species to keep or sell. *Acanthurus lineatus* was the top ECS from commercial invoices and a top species in the creel. On the other hand, *Lutjanus gibbus* was the most dominant species in the creel surveys but recorded in the invoices. It is also notable that various species are aggregated into larger taxonomic groupings in the commercial invoices, such as surgeonfish as *Naso* spp., parrotfish as *Scarus* spp., squirrelfish as *Sargocentron* spp., groupers "*Epinephelus* spp.", emperors and inshore groupers. Inshore groupers actually include *Epinephelus* groupers. These general groupings covered the species level catch in the creel surveys. Lobsters had high catches in the creel survey data but were notably absent in the commercial invoices. Lobsters are usually in-demand although relatively more expensive. Based on figures below, there was relatively few lobsters sold in 2023.

Calculations: Catch tallied from boat-based expanded species composition data for species identified as priority ECS (Appendix A).

Table 8a. Catch (lb) from boat-based creel survey expansion data for prioritized species in American Samoan ECS fisheries

Year	***Sargocentron tiere***	***Crenimugil crenilabis***	***Panulirus penicillatus***	**Clams (multi-species)**	***Octopus cyanea***	***Epinephelus melanostigma***
1986	0	0	1,762	0	0	0
1987	0	0	2,437	0	0	0
1988	0	0	6,043	0	0	0
1989	0	0	4,460	0	0	0
1990	0	0	416	0	0	0
1991	0	0	0	0	0	0
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	0	0	976	0	0	0
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	3,172	0	0	0
1998	0	0	2,459	0	0	0
1999	0	0	1,707	0	0	0
2000	0	0	1,197	0	0	0
2001	0	0	1,450	0	0	0
2002	0	0	622	0	0	0
2003	0	0	772	0	0	0
2004	0	0	0	0	0	0
2005	0	0	65	0	0	0
2006	0	0	245	0	0	0
2007	0	2	1,417	0	0	0
2008	0	0	1,079	0	0	0
2009	0	0	3,639	0	0	0
2010	0	0	8,583	0	0	0

Year	*Sargocentron tiere*	*Crenimugil crenilabis*	*Panulirus penicillatus*	Clams (multi-species)	*Octopus cyanea*	*Epinephelus melanostigma*
2011	0	0	2,552	0	0	0
2012	0	0	389	0	0	0
2013	67	5	1,800	0	0	14
2014	9	0	143	0	0	58
2015	1	0	5	0	0	42
2016	13	64	221	0	0	64
2017	45	42	941	0	0	218
2018	24	179	147	0	0	179
2019	18	127	0	0	0	119
2020	14	14	295	0	0	153
2021	61	82	727	0	0	52
2022	46	23	551	0	0	90
2023	28	47	776	0	0	112
10-yr avg.	**26**	**58**	**381**	**0**	**0**	**109**
10-yr SD	**19**	**58**	**341**	**0**	**0**	**59**
20-yr avg.	**16**	**28**	**1,159**	**0**	**0**	**52**
20-yr SD	**22**	**49**	**1,935**	**0**	**0**	**68**

Calculations: Catch tallied from commercial purchase data for species identified as priority ECS (Appendix A).

Table 8b. **Catch (lb) from commercial purchase data for prioritized species in American Samoan ECS fisheries**

Year	*Sargocentron tiere*	*Crenimugil crenilabis*	*Panulirus penicillatus*	Clams (multi-species)	*Octopus cyanea*	*Epinephelus melanostigma*
1990	0	0	1,307	0	0	0
1991	0	0	1,389	0	0	0
1992	0	0	482	0	0	0
1993	0	0	1,487	0	0	0
1994	0	0	2,488	0	0	0
1995	0	0	3,927	0	0	0
1996	0	0	3,104	0	0	0
1997	0	0	4,262	0	0	0
1998	0	0	3,088	0	0	0
1999	0	0	2,255	0	0	0
2000	0	0	808	0	0	0
2001	0	0	1,105	0	0	0
2002	0	0	762	0	0	0

Year	***Sargocentron tiere***	***Crenimugil crenilabis***	***Panulirus penicillatus***	**Clams (multi-species)**	***Octopus cyanea***	***Epinephelus melanostigma***
2003	0	0	779	0	0	0
2004	0	0	506	0	0	0
2005	0	0	3,238	0	0	0
2006	0	0	5,380	0	0	0
2007	0	0	1,649	0	0	0
2008	0	0	1,417	0	0	0
2009	0	0	680	0	0	0
2010	0	0	1,464	0	0	0
2011	0	0	974	0	0	0
2012	0	0	621	0	0	0
2013	0	0	899	0	0	0
2014	0	0	1,292	0	0	0
2015	0	0	989	0	0	0
2016	0	0	1,102	0	0	0
2017	0	0	767	0	0	0
2018	0	3	743	0	0	0
2019	0	0	1,256	0	0	0
2020	0	0	228	0	0	0
2021	0	0	379	0	0	0
2022	0	0	58	0	0	0
2023	0	22	37	0	0	0
10-yr avg.	**0**	**3**	**685**	**0**	**0**	**0**
10-yr SD	**0**	**7**	**481**	**0**	**0**	**0**
20-yr avg.	**0**	**1**	**1,184**	**0**	**0**	**0**
20-yr SD	**0**	**5**	**1,212**	**0**	**0**	**0**

In summary, only the spiny lobster has substantial data throughout the years since it is caught by boat-based spearfishing. The rest of the priority ECS are primarily harvested by various nearshore fisheries.

1.6 CATCH-PER-UNIT-EFFORT (CPUE) STATISTICS

This section summarizes the estimates for CPUE in the boat-based fisheries both for all species and for BMUS only. The boat-based fisheries include bottomfish fishing (handline gear), spearfishing (snorkel), and bottom-trolling mixed that comprise a majority of the total bottomfish catch. Trolling is primarily a pelagic fishing method but also catches coral reef fishes including jacks and gray jobfish. CPUE is reported as both pounds per gear hour and pounds per trip in the boat-based methods.

Calculations**:** CPUE is calculated from interview data by gear type using ∑catch /∑ (number of gears used*number of hours fished) or ∑catch /∑trips for boat-based data. If the value is blank (i.e., zero), then there was no interview collected for that method. Landings from interviews without fishing hours or number of gears are excluded from the calculations.

All - lb/trip: All catch and trips are tallied from landings by gear level, including non-BMUS species.

All - lb/gr-hr.: All catch and trips are tallied from trips with data on the number of gears used and numbers of hours fished, including non-BMUS species.

BMUS - lb/trip: Only BMUS catch and trips that landed BMUS species are tallied from landings by gear level.

BMUS - lb/gr-hr.: Only BMUS catch and trips that landed BMUS are tallied from trips with data on the number of gears used and numbers of hours fished.

In summary, CPUE in lb/trip has declined for bottomfish overall as well as BMUS since 2014 with an uptick in 2022. The uptick can be an artifact of low fishing effort. The general decline is also reflected when comparing 10- and 20-year averages. There were variabilities in CPUE for mixed-bottomfishing trolling and spearfishing and their respective BMUS over time, and there has been no robust analysis of potential variables that could account for this interannual variabilities.

Table 9. Non-expanded CPUE (lb/trip and lb/gear hour) for bottomfish fishing gears in the American Samoa boat-based fishery for all species and BMUS only

Year	Bottomfish Fishing				Bottom-Troll Mixed				Spearfishing			
	All		BMUS		All		BMUS		All		BMUS	
	lb/trip	lb/gr-hr	lb/trip	lb/gr-hr	lb/trip	lb/gr-hr	lb/trip	lb/gr-hr	lb/trip	lb/gr-hr	lb/trip	lb/gr-hr
1986	136	3.16	189	3.42	217	5.08	130	2.10	257	5.08	-	-
1987	138	4.83	13	0.58	210	5.12	61	1.20	191	5.24	-	-
1988	175	6.65	107	4.08	285	6.10	96	2.40	215	5.44	13	0.33
1989	159	6.87	103	4.21	326	4.56	107	1.50	332	7.02	66	0.94
1990	127	4.12	83	2.60	248	4.32	95	1.66	170	5.27	-	-
1991	121	2.99	69	1.58	219	5.69	81	1.99	358	6.28	-	-
1992	139	4.00	80	2.29	-	-	-	-	-	-	-	-
1993	124	2.75	62	1.39	255	4.90	100	1.93	70	-	-	-
1994	125	2.62	53	1.10	193	3.37	30	0.53	247	2.40	-	-
1995	121	3.11	67	1.50	160	3.42	49	1.00	-	-	-	-
1996	143	5.58	61	2.27	283	6.69	72	1.67	-	-	-	-
1997	139	5.07	79	2.87	151	6.42	63	2.65	294	10.47	10	0.61
1998	175	4.83	116	3.20	35	1.46	-	-	393	10.90	-	-
1999	151	5.12	103	3.44	103	8.58	-	-	186	7.16	-	-
2000	122	4.11	61	2.08	36	3.00	5	0.42	-	-	-	-
2001	140	5.58	76	2.94	-	-	-	-	164	6.24	-	-
2002	81	2.62	40	1.27	-	-	-	-	177	3.75	-	-
2003	105	5.26	50	2.53	157	6.57	61	2.01	179	5.00	-	-
2004	77	1.54	32	1.06	151	6.24	73	2.88	154	6.91	-	-
2005	97	4.72	53	2.82	138	7.64	53	2.93	30	3.00	-	-
2006	81	3.47	32	1.03	97	4.30	41	1.82	86	2.11	4	-
2007	147	4.20	50	1.41	87	3.68	49	2.09	104	2.99	4	0.10
2008	191	4.43	82	1.83	107	2.93	32	0.87	106	3.43	2	0.06

Year	Bottomfish Fishing				Bottom-Troll Mixed				Spearfishing			
	All		BMUS		All		BMUS		All		BMUS	
	lb/trip	lb/gr-hr	lb/trip	lb/gr-hr	lb/trip	lb/gr-hr	lb/trip	lb/gr-hr	lb/trip	lb/gr-hr	lb/trip	lb/gr-hr
2009	320	5.71	135	2.39	278	4.17	65	0.97	330	9.21	-	-
2010	190	3.73	94	1.61	507	7.68	308	4.67	246	6.21	17	0.52
2011	194	4.65	89	2.03	292	8.22	68	1.79	326	8.49	10	0.19
2012	54	4.66	61	2.65	227	2.87	55	2.19	123	11.93	-	-
2013	81	1.91	34	0.52	162	3.94	49	1.13	247	7.43	5	0.13
2014	118	3.50	56	1.54	153	5.25	31	1.07	124	2.88	1	0.01
2015	109	2.98	51	1.36	140	0.63	31	0.14	147	3.49	14	0.28
2016	87	0.59	41	0.28	166	3.24	46	1.03	49	1.32	9	0.26
2017	91	1.13	36	0.44	145	0.31	58	0.19	45	0.13	3	-
2018	65	1.73	35	0.94	75	3.52	19	0.84	32	0.92	2	0.06
2019	66	2.39	33	1.11	138	4.22	27	0.84	31	0.83	1	0.07
2020	58	2.82	26	1.15	114	5.06	25	1.07	59	1.46	4	0.07
2021	49	2.55	21	1.11	154	4.22	25	0.68	55	1.03	2	0.03
2022	41	1.83	30	1.38	56	1.90	31	1.07	53	1.35	3	0.07
2023	56	1.85	21	0.67	119	4.46	23	0.84	73	1.80	6	0.16
10-year avg.	**74**	**2.14**	**35**	**1.00**	**126**	**3.28**	**32**	**0.77**	**67**	**1.52**	**5**	**0.10**
10-year SD	**25**	**0.84**	**11**	**0.40**	**34**	**1.68**	**11**	**0.33**	**37**	**0.94**	**4**	**0.09**
20-year avg.	**109**	**3.02**	**51**	**1.37**	**165**	**4.22**	**55**	**1.45**	**121**	**3.85**	**5**	**0.13**
20-year SD	**67**	**1.38**	**28**	**0.68**	**98**	**2.06**	**60**	**1.05**	**92**	**3.25**	**5**	**0.13**

"-" indicates no data are available.

1.7 EFFORT STATISTICS

This section summarizes the effort trends in the American Samoa bottomfish fishery. Fishing effort trends provide insights on the level of fishing pressure through time. Effort information is provided for the top boat-based fishing methods that comprise most of the annual catch.

Calculations: Effort estimates (in both trips and gear hours) are calculated from boat-based interview data. Trips are tallied according to the interview data in boat-based creel surveys. Gear hours are generated by summing the data on number of gears used*number of hours fished collected from interviews by gear type. For the boat-based estimates, data collection started in 1982, but is reported here from 1986.

All - Trips: All trips tallied by gear type.

All - Gear-hr: Gear hours tallied by gear type.

BMUS - Trips: Trips that landed BMUS tallied by gear type.

BMUS - Gear-hr: Gear hours tallied by gear type for trips landed BMUS with data on both number of gears used and numbers of hours fished.

In summary, the number of bottomfish fishing vessels, trips, and gear-hours have continued their decreasing trends relative to 10- and 20-year averages.

Table 10. Non-expanded effort (trips and gear hours) for bottomfish fishing gears in the American Samoa boat-based fishery for all species and BMUS only

Year	Bottomfish Fishing				Bottom-Troll Mixed				Spearfishing			
	All		BMUS		All		BMUS		All		BMUS	
	Trips	Gr-hr	Trips	Gr-hr	Trips	Gr-hr	Trips	Gr-hr	Trips	Gr-hr	Trips	Gr-hr
1986	135	5,341	13	346	80	3,385	5	260	39	1,976	0	0
1987	19	544	4	90	57	2,337	3	152	51	1,860	0	0
1988	41	1,082	37	974	34	1,589	22	879	73	2,887	1	40
1989	30	694	28	681	34	2,435	34	2,435	40	1,893	3	210
1990	19	587	16	512	15	863	15	863	8	258	0	0
1991	32	1,300	29	1,256	19	730	14	571	2	114	0	0
1992	26	902	24	841	0	0	0	0	0	0	0	0
1993	38	1,719	33	1,475	3	156	3	156	1	0	0	0
1994	40	1,917	37	1,784	9	514	8	451	4	411	0	0
1995	23	896	19	842	25	1,165	22	1,090	0	0	0	0
1996	37	949	34	916	10	423	8	343	0	0	0	0
1997	46	1,261	45	1,241	14	330	14	330	31	871	5	83
1998	17	614	17	614	2	48	0	0	2	72	0	0
1999	15	442	14	418	1	12	0	0	4	104	0	0
2000	10	297	9	265	1	12	1	12	0	0	0	0
2001	37	886	35	878	0	0	0	0	9	237	0	0
2002	44	1,343	44	1,343	0	0	0	0	7	330	0	0
2003	83	1,103	82	1,103	10	99	10	99	7	110	0	0
2004	103	4,882	92	2,631	20	484	19	484	3	67	0	0
2005	56	743	53	687	29	455	28	455	1	10	0	0
2006	88	1,779	56	1,451	12	272	12	272	7	88	1	0
2007	127	4,147	121	4,085	13	306	11	258	71	2,282	10	366
2008	105	4,349	102	4,311	10	366	10	366	35	1,051	6	241

Year	Bottomfish Fishing				Bottom-Troll Mixed				Spearfishing			
	All		BMUS		All		BMUS		All		BMUS	
	Trips	Gr-hr	Trips	Gr-hr	Trips	Gr-hr	Trips	Gr-hr	Trips	Gr-hr	Trips	Gr-hr
2009	109	6,046	107	6,032	8	534	8	534	27	961	0	0
2010	42	2,132	36	2,086	1	66	1	66	94	3,533	2	64
2011	55	2,173	52	2,135	18	608	16	569	58	2,158	1	54
2012	99	1,088	14	269	5	277	2	42	55	513	1	0
2013	75	3,160	36	2,276	11	399	8	252	68	2,171	6	202
2014	125	4,081	107	3,818	22	642	22	642	64	2,761	2	160
2015	122	4,045	116	3,997	27	5,542	25	5,498	26	1,093	4	190
2016	63	8,127	62	8,119	46	1,785	46	1,785	35	1,230	7	228
2017	73	5,650	72	5,650	18	7,420	13	3,780	35	10,195	9	7,117
2018	58	2,083	57	2,083	16	280	11	249	46	1,577	10	392
2019	58	1,469	57	1,469	7	229	7	229	41	1,446	6	115
2020	43	881	39	871	17	357	16	339	48	1,933	14	675
2021	8	152	8	152	4	146	4	146	30	1,611	5	262
2022	9	203	7	151	3	88	3	88	30	1,143	6	287
2023	23	664	23	664	11	293	10	278	47	1,755	10	398
10-year avg.	**58**	**2,736**	**55**	**2,697**	**17**	**1,678**	**16**	**1,303**	**40**	**2,474**	**7**	**982**
10-year SD	**39**	**2,529**	**35**	**2,517**	**12**	**2,481**	**12**	**1,774**	**11**	**2,614**	**3**	**2,051**
20-year avg.	**72**	**2,893**	**61**	**2,647**	**15**	**1,027**	**14**	**817**	**41**	**1,879**	**5**	**538**
20-year SD	**36**	**2,146**	**35**	**2,137**	**10**	**1,874**	**10**	**1,351**	**23**	**2,101**	**4**	**1,519**

1.8 PARTICIPANTS

This section summarizes the estimated participation in each fishery. The information presented here can be used in the impact analysis of potential amendments in the FEPs associated with the bottomfish fisheries. The trend in participation over time can also be used as an indicator of fishing pressure.

Calculations: For boat-based data, the estimated number of unique vessels is calculated by tallying the number of vessels recorded in the interview data via vessel registration or name.

All: Total unique vessels by gear type.

BMUS: Unique vessels from trips that landed BMUS by gear type.

Table 11a. Non-expanded number of unique vessels for bottomfish fishing gears in the American Samoa boat-based fishery for all species and BMUS only

Year	Bottomfish Fishing		Bottom-Troll Mixed		Spearfishing	
	All	BMUS	All	BMUS	All	BMUS
1986	20	5	20	3	7	0
1987	11	3	14	3	8	0
1988	12	12	11	9	9	1
1989	14	13	13	13	4	1
1990	5	4	6	6	2	0
1991	13	12	9	7	1	0
1992	9	9	0	0	0	0
1993	10	9	3	3	1	0
1994	8	7	6	6	2	0
1995	10	8	12	12	0	0
1996	15	14	8	6	0	0
1997	13	12	8	8	4	3
1998	9	9	1	0	2	0
1999	9	8	1	0	1	0
2000	8	7	1	1	0	0
2001	12	11	0	0	5	0
2002	13	13	0	0	3	0
2003	14	14	4	4	4	0
2004	21	21	7	6	3	0
2005	13	12	5	5	1	0
2006	20	14	1	1	2	1
2007	21	19	6	4	3	3
2008	18	16	8	8	3	2
2009	14	14	4	4	3	0
2010	11	8	1	1	5	1
2011	8	7	5	5	2	1

Year	Bottomfish Fishing		Bottom-Troll Mixed		Spearfishing	
	All	BMUS	All	BMUS	All	BMUS
2012	11	6	4	2	2	1
2013	13	10	5	3	3	2
2014	16	13	9	9	4	1
2015	14	14	10	9	4	2
2016	15	15	10	10	3	2
2017	11	11	8	7	6	3
2018	9	9	6	5	3	3
2019	6	6	3	3	5	2
2020	7	6	6	6	3	3
2021	3	3	2	2	4	2
2022	5	4	2	2	5	3
2023	6	6	6	6	7	6
10-year avg.	**9**	**9**	**6**	**6**	**4**	**3**
10-year SD	**4**	**4**	**3**	**3**	**1**	**1**
20-year avg.	**12**	**11**	**5**	**5**	**4**	**2**
20-year SD	**5**	**5**	**3**	**3**	**1**	**1**

In summary, the number of operating vessels has been affected by natural disasters and access to the government-provided fuel subsidy over the recent years in the midst of a declining trend. The number of bottomfishing and mixed bottomfishing-trolling vessels has been declining since 2015-2016 with a slight increase for the former and a significant increase for the latter in 2023.

Calculations: For boat-based data, the estimated number of fishermen per trip is calculated by filtering interviews that recorded the number of fishers, and then ∑fishers/∑trips. A blank cell indicates insufficient data to generate an estimate of average fishers.

All: Average fishers from all trips by gear type.

BMUS: Average fishers from trips that landed BMUS by gear type.

Table 11b. Non-expanded average number of fishers per trip for bottomfish fishing gears in the American Samoa boat-based fishery for all species and BMUS only

Year	Bottomfish Fishing		Bottom-Troll Mixed		Spear	
	All	BMUS	All	BMUS	All	BMUS
1986	3	2	2	2	5	0
1987	3	2	2	2	5	0
1988	2	2	3	3	4	4
1989	3	3	4	4	5	6
1990	2	2	3	3	4	0
1991	3	3	3	3	5	0

Year	Bottomfish Fishing		Bottom-Troll Mixed		Spear	
	All	BMUS	All	BMUS	All	BMUS
1992	2	2	0	0	0	0
1993	2	2	3	3	5	0
1994	2	2	3	3	4	0
1995	3	2	2	3	0	0
1996	3	3	3	2	0	0
1997	3	3	3	3	5	3
1998	3	3	3	0	6	0
1999	2	2	3	0	4	0
2000	3	3	3	3	0	0
2001	3	3	0	0	3	0
2002	3	3	0	0	5	0
2003	3	3	3	3	4	0
2004	3	3	3	3	6	0
2005	3	3	3	3	5	0
2006	3	4	3	3	4	6
2007	3	3	3	3	5	5
2008	3	3	3	3	4	5
2009	4	4	4	4	6	0
2010	3	4	3	3	6	5
2011	3	3	3	3	7	9
2012	2	3	5	3	5	0
2013	3	3	4	4	6	6
2014	3	3	3	3	6	7
2015	3	3	3	3	5	5
2016	3	3	3	3	5	4
2017	6	6	7	4	7	14
2018	3	3	3	2	5	5
2019	3	3	3	3	5	4
2020	2	2	2	2	5	5
2021	3	3	3	3	7	6
2022	3	3	3	3	5	5
2023	3	3	3	3	5	5
10-year avg.	**3**	**3**	**3**	**3**	**6**	**6**
10-year SD	**1**	**1**	**1**	**1**	**1**	**3**
20-year avg.	**3**	**3**	**3**	**3**	**5**	**5**
20-year SD	**1**	**1**	**1**	**0**	**1**	**3**

1.9 BYCATCH ESTIMATES

This section focuses on Magnuson-Stevens Fishery Conservation and Management Act (MSA) § 303(a)(11), which requires that all fishery management plans (FMPs) establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the fishery. Additionally, it is required to include conservation and management measures that, to the extent practicable, minimize bycatch and bycatch mortality. The MSA § 303(a)(11) standardized reporting methodology is commonly referred to as a ''Standardized Bycatch Reporting Methodology'' (SBRM) and was added to the MSA by the Sustainable Fisheries Act of 1996 (SFA). The Council implemented omnibus amendments to FMPs in 2003 to address MSA bycatch provisions and established SBRMs at that time.

Calculations: The number caught is the sum of the total number of individuals found in the raw data including bycatch. The number discarded or released is number of individuals marked as bycatch. Percent bycatch is the sum of all released divided by the number caught.

In summary, there is generally zero bycatch in bottomfishing, whether BMUS or non-BMUS.

Table 12. Non-expanded catch and bycatch in the American Samoa boat-based fisheries

Year	BMUS			Non-BMUS			BMUS + Non-BMUS		
	# Caught	# Discard or Release	% Bycatch	# Caught	# Discard or Release	% Bycatch	# Caught	# Discard or Release	% Bycatch
1992	1,803	0	0	637	0	0	2,440	0	0
1993	1,534	0	0	860	0	0	2,394	0	0
1994	5,447	0	0	2,210	0	0	7,657	0	0
1995	2,397	0	0	1,008	0	0	3,405	0	0
1996	3,940	0	0	2,059	0	0	5,999	0	0
1997	2,910	0	0	2,283	0	0	5,193	0	0
1998	998	0	0	846	0	0	1,844	0	0
1999	3,213	0	0	2,417	0	0	5,630	0	0
2000	3,386	0	0	3,052	0	0	6,438	0	0
2001	3,499	0	0	2,703	0	0	6,202	0	0
2002	3,362	0	0	3,597	0	0	6,959	0	0
2003	3,778	0	0	4,019	1	0.025	7,797	1	0.013
2004	2,970	0	0	3,764	0	0	6,734	0	0
2005	1,807	0	0	1,877	0	0	3,684	0	0
2006	1,573	0	0	4,260	0	0	5,833	0	0
2007	2,752	0	0	4,184	0	0	6,936	0	0
2008	4,616	0	0	3,972	0	0	8,588	0	0
2009	11,080	0	0	8,441	0	0	19,521	0	0
2010	2,902	0	0	2,119	0	0	5,021	0	0
2011	4,229	0	0	3,130	0	0	7,359	0	0
2012	775	0	0	4,362	0	0	5,137	0	0

Year	BMUS			Non-BMUS			BMUS + Non-BMUS		
	# Caught	# Discard or Release	% Bycatch	# Caught	# Discard or Release	% Bycatch	# Caught	# Discard or Release	% Bycatch
2013	1,031	0	0	3,494	0	0	4,525	0	0
2014	3,123	0	0	3,504	0	0	6,627	0	0
2015	3,602	0	0	3,666	0	0	7,268	0	0
2016	888	0	0	1,234	0	0	2,122	0	0
2017	926	0	0	1,425	0	0	2,351	0	0
2018	630	0	0	742	0	0	1,372	0	0
2019	771	0	0	823	0	0	1,594	0	0
2020	404	0	0	632	0	0	1,036	0	0
2021	124	0	0	108	0	0	232	0	0
2022	89	0	0	88	0	0	177	0	0
2023	308	0	0	451	0	0	759	0	0
10-yr avg.	**1,087**	**0**	**0**	**1,267**	**0**	**0**	**2,354**	**0**	**0**
10-yr SD	**1,176**	**0**	**0**	**1,227**	**0**	**0**	**2,398**	**0**	**0**
20-yr avg.	**2,230**	**0**	**0**	**2,614**	**0**	**0**	**4,844**	**0**	**0**
20-yr SD	**2,453**	**0**	**0**	**2,005**	**0**	**0**	**4,277**	**0**	**0**

2.2

2.2 CORAL REEF FISH ECOSYSTEM PARAMETERS

2.2.1 REGIONAL REEF FISH BIOMASS AND HABITAT CONDITION

Description: 'Reef fish biomass' is mean biomass of reef fishes per unit area derived from visual survey data between 2010 and 2023. 'Hard Coral Cover' is mean cover derived from benthic imagery (photoquadrats) collected by divers across the survey domain, including most sites where reef fish surveys occurred. In previous reports, this parameter stemmed from diver visual rapid assessments of coral cover. Note that no surveys were conducted in 2020 or 2021 in any region due to COVID-19.

Rationale: Reef fish biomass has been widely used as an indicator of relative ecosystem status and has repeatedly been shown to be sensitive to changes in fishing pressure, habitat quality, and oceanographic regime. Hard coral cover is an indicator of relative status of the organisms that build coral reef habitat and has been shown to be sensitive to changes in oceanographic regime, and a range of direct and indirect anthropogenic impacts. Most fundamentally, cover of hard corals has been increasingly impacted by temperature stress as a result of global heating.

Data Category: Fishery-independent

Timeframe: Triennial

Jurisdiction: American Samoa, Commonwealth of the Northern Mariana Islands (CNMI), Guam, Main Hawaiian Islands (MHI), Northwestern Hawaiian Islands (NWHI), and Pacific Remote Island Area (PRIA)

Spatial Scale: Regional

Data Source: Data used to generate cover and biomass estimates come from surveys conducted by the National Marine Fisheries Service (NMFS) Pacific Island Fisheries Science Center (PIFSC) Ecosystem Sciences Division (ESD) and their partners as part of the Coral Reef Conservation Program's (CRCP) National Coral Reef Monitoring Program (NCRMP). Fish survey methods are described in detail in Ayotte et al. (2015). In brief, they involve teams of divers conducting stationary point count cylinder (SPC) surveys within a target domain of < 30 meter hard-bottom habitat at each island, stratified by depth zone and, for larger islands, by section of coastline. For consistency among islands, only data from forereef habitats are used. At each SPC, divers record the number, size, and species of all fishes within or passing through paired 15 meter-diameter cylinders over the course of a standard count procedure. Cover estimates are derived from photoquadrats collected by divers within the same survey domain, including at all the fish survey sites. Post-hoc annotation methods are described in detail in Lamirand et al. (2022).

Fish sizes and abundance are converted to biomass using standard length-to-weight conversion parameters, taken largely from FishBase and converted to biomass per unit area by dividing by the area sampled per survey. Site-level data were pooled into island-scale values by first calculating mean and variance within strata, and then calculating weighted island-scale mean and variance using the formulas given in Smith et al. (2011) with strata weighted by their respective sizes.

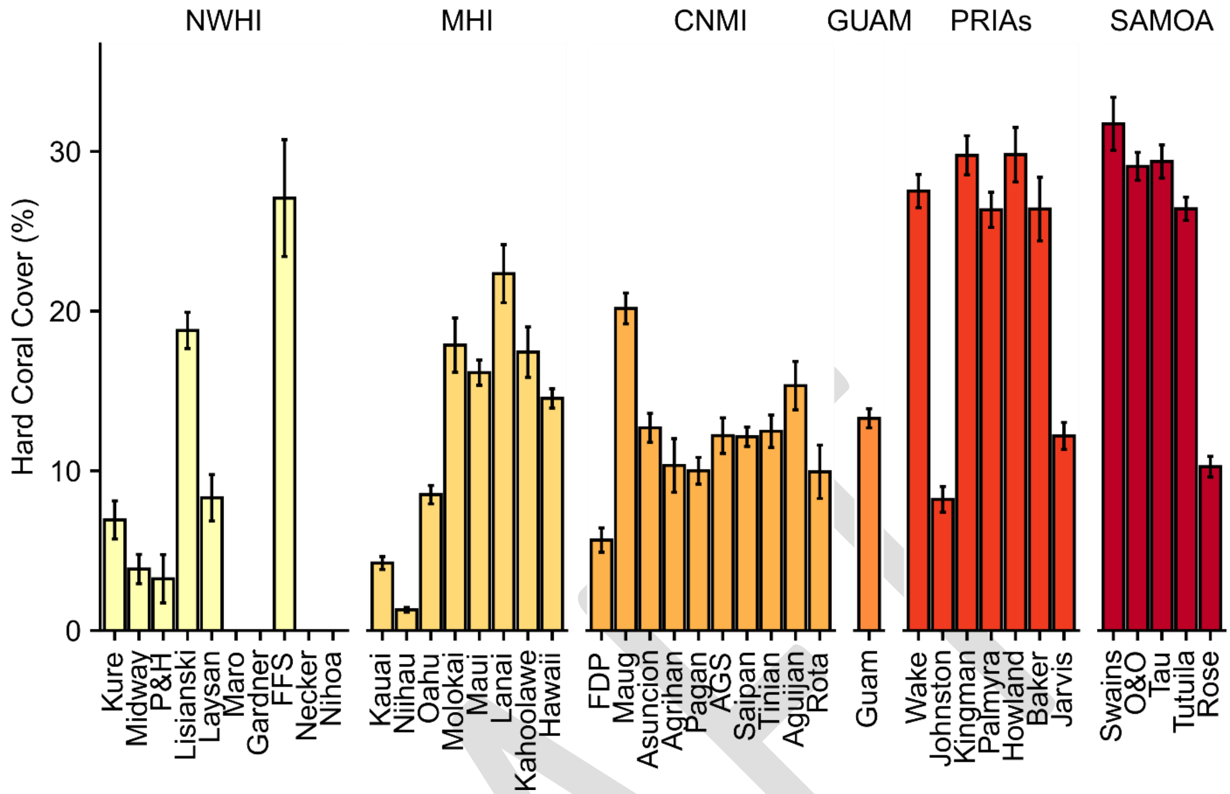

Figure 1. Mean coral cover (%± standard error of the mean, or SEM) per U.S. Pacific Island averaged from 2010-2023 by latitude

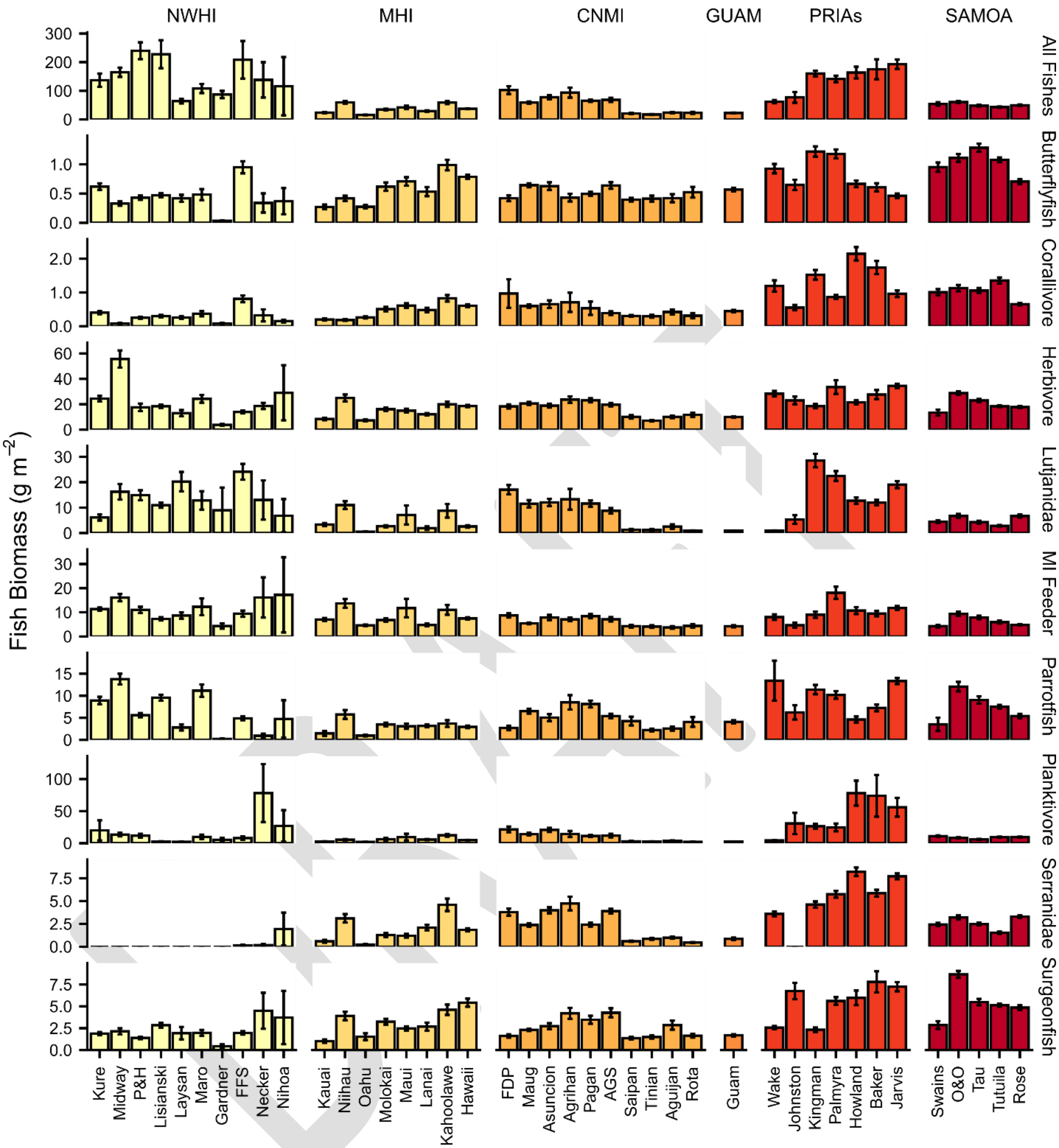

Figure 2. Mean fish biomass (g/m^2 ± SEM) per U.S. Pacific Island of functional, taxonomic, and trophic groups from 2010-2023 by latitude

Note: The group 'Serranidae' excludes planktivorous members of that family (i.e., anthias), which can be hyper-abundant in some regions. Similarly, the bumphead parrotfish, *Bolbometopon muricatum,* has been excluded from the corallivore group. The group 'MI Feeder' consists of fishes that primarily feed on mobile invertebrates; 'Butterflyfish' are non-planktivorous butterflyfish species; and 'Surgeonfish' are mid-large targeted surgeonfish species.

2.2.2 ARCHIPELAGIC REEF FISH BIOMASS AND HABITAT CONDITION

Description: 'Reef fish biomass' is mean biomass of reef fishes per unit area derived from visual survey data between 2010 and 2023. 'Hard Coral Cover' is mean cover derived from benthic imagery (photoquadrats) collected by divers across the survey domain, including most sites where reef fish surveys occurred. In previous reports, this parameter stemmed from diver visual rapid assessments of coral cover. Note that no surveys were conducted in 2020 or 2021 in any region due to COVID-19.

Rationale: Reef fish biomass has been widely used as an indicator of relative ecosystem status and has repeatedly been shown to be sensitive to changes in fishing pressure, habitat quality, and oceanographic regime. Hard coral cover is an indicator of relative status of the organisms that build coral reef habitat and has been shown to be sensitive to changes in oceanographic regime, and a range of direct and indirect anthropogenic impacts. Most fundamentally, cover of hard corals has been increasingly impacted by temperature stress as a result of global heating.

Data Category: Fishery-independent

Timeframe: Triennial

Jurisdiction: American Samoa

Spatial Scale: Island

Data Source: Data are sourced from surveys conducted by NMFS PIFSC ESD and partners as part of the Pacific NCRMP. Survey methods and sampling design, and methods to generate biomass and cover parameters are described in Section 2.2.1.

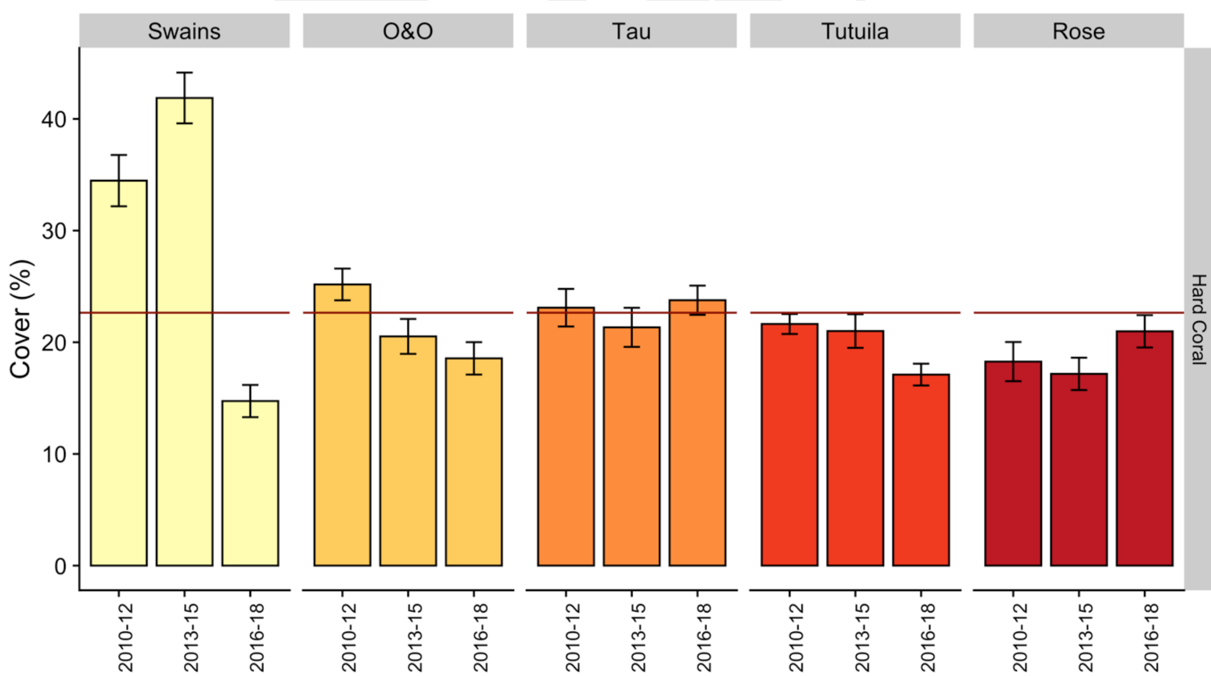

Figure 3. Mean coral cover (%± SEM) per island from 2010-2023 by latitude

Note: The red horizontal line is the region-wide mean estimate for the entire time period.

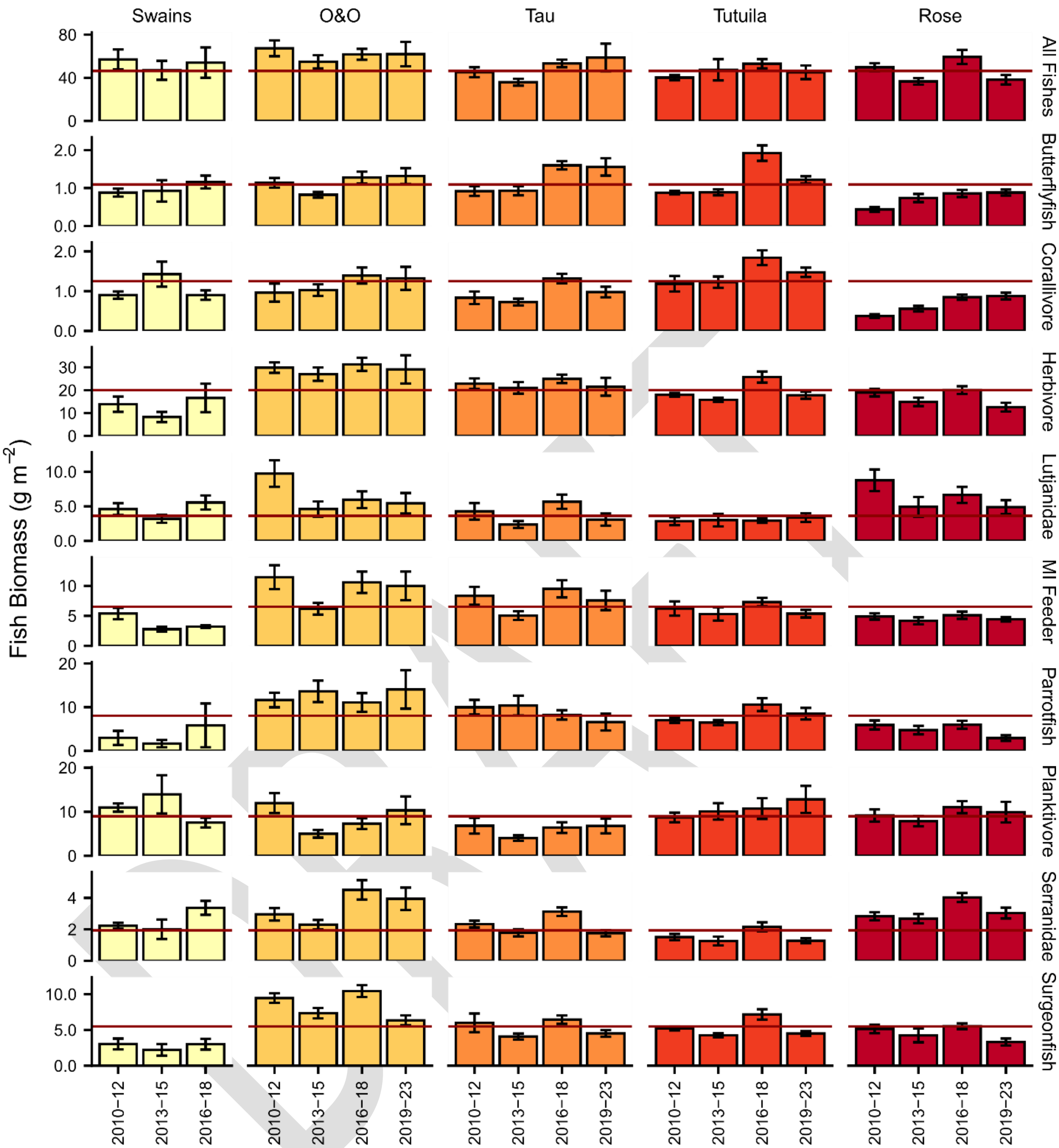

Figure 4. Mean fish biomass (g/m^2 ± standard error) of American Samoa functional, taxonomic, and trophic groups from 2010-2023 by island

Note: The group 'Serranidae' excludes planktivorous members of that family (i.e., anthias), which can be hyper-abundant in some regions. Similarly, the bumphead parrotfish, *Bolbometopon muricatum,* has been excluded from the corallivore group. The group 'MI Feeder' consists of fishes that primarily feed on mobile invertebrates; 'Butterflyfish' are non-planktivorous butterflyfish species; and 'Surgeonfish' are mid-large targeted surgeonfish species. Red horizontal lines are the region-wide mean estimates for the entire time period.

1.10 ADMINISTRATIVE AND REGULATORY ACTIONS

This summary describes management actions NMFS implemented for insular fisheries in American Samoa during calendar year 2023.

On December 26, 2023, NMFS published the final rule to extend the region-wide moratorium on the harvest of gold corals in the U.S. Pacific Islands through June 30, 2028 (88 FR 88835). NMFS intends this rule to prevent overfishing and to stimulate research on gold corals.

1.10 NON-COMMERCIAL FISHERY CATCH STATISTICS

In the Pacific Islands, small boat fisheries are known to comprise a mix of commercial and non-commercial fishing. While over anywhere from 78% to 100% of fish catches in American Samoa are typically intended for sale, non-commercial catch supports fishing communities in many important ways, from contributing to food security to social cohesion and upholding cultural traditions (Chan and Pan 2019; Leong et al. 2020). These benefits, including those from informal and non-market economies, are especially important for community resilience during times of stress, such as during COVID-19 (Smith et al. 2022). While limited data are collected on non-commercial fishing, calculating non-commercial catch estimates is an important first step in demonstrating the potential scope of these additional under-documented benefits from fishing.

1.10.1 Catch Estimates

The general approach agreed upon by the Archipelagic Plan Team for the estimation of non-commercial BMUS catches in the territories is to subtract the dealer-reported (i.e. commercial) catches from the total estimated catches from creel surveys. Three sources of catch data are needed from each territory: the boat-based creel survey data, the shore-based creel survey data, and the dealer-reported catches. This report is preliminary, as continual improvement of the process and integration into the central WPacFIN data warehouse are underway. The estimates of total BMUS catch and effort may differ from those in other sections of this annual SAFE report.

The boat- and shore-based creel surveys consist of fisher interviews and effort surveys conducted by the American Samoa DMWR. During an interview, species-specific catch and fishing effort information are recorded to obtain catch rate estimates. Effort data are collected through a participation survey and a boating-log survey for shore- and boat-based fishing, respectively, to estimate the total annual fishing effort. The data are uploaded into the WPacFIN data warehouse and quality control and processing scripts (via SQL and R) are used to generate the expanded catch by year. These scripts are stored and maintained in the WPacFIN Github repository (see top box in Figure 1). Further details regarding these data collection programs and the expansion algorithms designed to estimate total catch and effort can be found in Langseth et al. (2019) and Ma et al. (2022).

For each territory, the standard estimates of total annual catch and effort are obtained by first multiplying the catch rate by the total annual effort. The species composition from the creel interviews is then applied to obtain total species-specific catches for each territory. For the dealer-reported catch, the local resource management agencies collect data from first-level purchasers of local fresh fish by species or species groups (e.g. genus, family, and non-taxonomic groups such as “grouper”, “deep snapper”, or “bottomfish”).

The commercial receipt and creel data are checked for errors and inconsistencies before estimating the species-level catches. The PIFSC Stock Assessment and WPacFIN programs continue to work with staff in the jurisdictions to capture and fix the errors in the raw data, when possible. However, some of these errors are identified during the latest stock assessments and are fixed using temporary R scripts that are not yet integrated into the WPacFIN system (Figure 1), resulting in the different estimates of catch presented here. This process will be further reviewed and incorporated into the WPacFIN system in the next improvement phase.

The key difference resulting from this new method is improved estimates of total catch by species from the species groups (e.g. “grouper”, “deep snapper”, “bottomfish”) reported by the dealers using the proportions calculated from the creel surveys.

This methodology for splitting catches by species for the new approach to estimating catch consists of:

1. Calculate the average catch by species in 10-year periods from the creel data, then calculate the proportions of species in each taxonomic group (e.g. deep snapper, grouper). The period averaging controls for temporal changes in species composition (see Section 1.1.2 in Nadon et al. (2023) for further details)
2. Apply the species proportions to the total catch by year in each taxonomic group to split this catch into its individual species.
3. Sum all species-level catches into the BMUS group to obtain a final, corrected catch
4. Subtract the dealer-reported catch from the total catch to obtain the non-commercial catch.

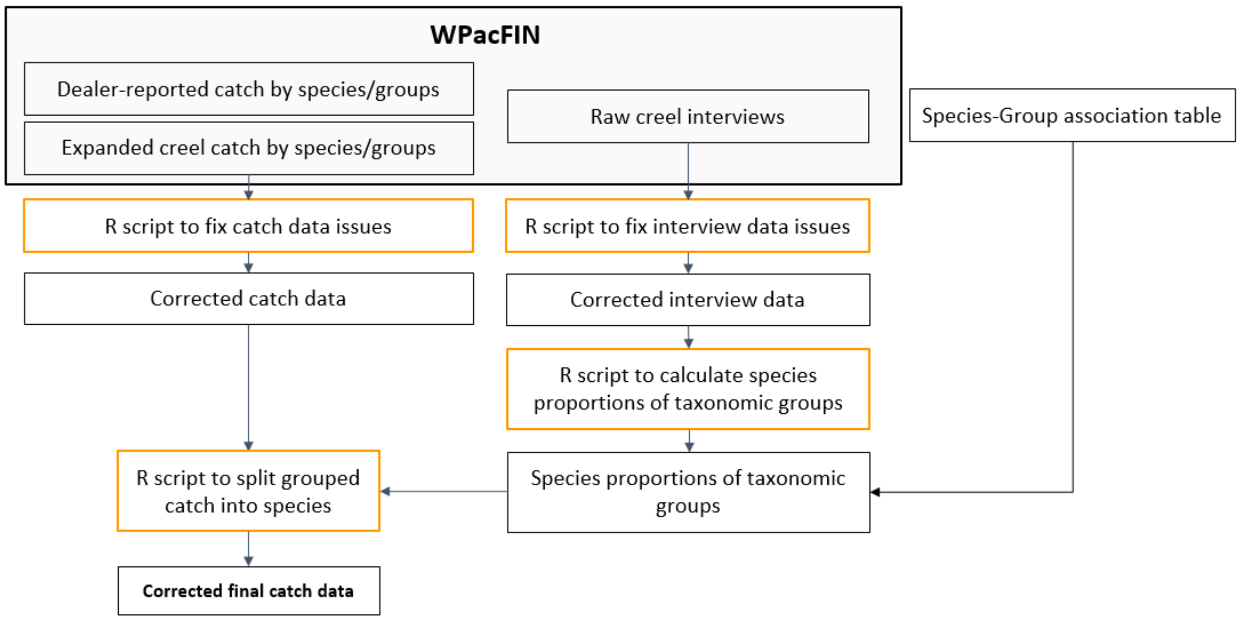

Figure 1. Data sources (gray boxes) and scripts (orange boxes) used to generate commercial and total catch estimates in the territories, from which non-commercial catch can be calculated.

Table 1. Summary of American Samoa BMUS non-commercial catch estimates (lb) derived from commercial purchase system data and creel survey program data for all gear types

Year	Total Corrected Creel Survey Catch Estimates	Total Corrected Commercial Landings	Total Estimated Non-Commercial Catch	Proportion of Non-Commercial Catch
1990	11,128	1,615	9,513	0.85
1991	17,834	4,163	13,671	0.77
1992	11,455	4,333	7,123	0.62
1993	11,386	6,572	4,814	0.42
1994	26,150	7,997	18,153	0.69
1995	25,166	23,589	1,577	0.06
1996	25,204	20,914	4,290	0.17
1997	30,470	13,891	16,579	0.54
1998	8,508	15,709	-	0.00
1999	11,002	10,765	237	0.02
2000	16,078	19,435	-	0.00
2001	33,310	21,279	12,031	0.36
2002	29,123	21,848	7,275	0.25
2003	11,614	17,840	-	0.00
2004	14,729	13,328	1,401	0.10
2005	12,678	11,575	1,104	0.09
2006	5,247	16,814	-	0.00
2007	20,126	15,866	4,260	0.21
2008	32,387	13,820	18,566	0.57
2009	62,148	12,131	50,017	0.80
2010	12,102	4,415	7,687	0.64
2011	24,722	2,888	21,834	0.88
2012	7,588	3,474	4,115	0.54
2013	21,578	5,575	16,003	0.74
2014	23,354	6,256	17,098	0.73
2015	30,712	5,601	25,111	0.82
2016	23,168	5,401	17,766	0.77
2017	17,635	5,492	12,143	0.69
2018	13,853	2,218	11,635	0.84
2019	12,943	3,881	9,062	0.70
2020	8,889	589	8,299	0.93
2021	2,338	705	1,634	0.70
2022	3,443	475	2,968	0.86
10-year avg.	**15,791**	**3,620**	**12,172**	**0.78**
10-year SD	**8,741**	**2,258**	**6,770**	**0.08**

Year	Total Corrected Creel Survey Catch Estimates	Total Corrected Commercial Landings	Total Estimated Non-Commercial Catch	Proportion of Non-Commercial Catch
20-year avg.	**18,063**	**7,417**	**11,535**	**0.58**
20-year SD	**13,046**	**5,586**	**11,617**	**0.31**

1.10.2 Caveats for Non-Commercial Catch Estimates

There are several important concerns and caveats that must be taken into account when estimating non-commercial catch values and using those data for monitoring and management purposes. With respect to available data, catch estimates are based on the best available existing data collected via creel surveys. As noted by Chan and Pan (2019), the actual populations of fishing participants in American Samoa are difficult to gauge. Without accurate knowledge of the population, the representativeness of the sample cannot be meaningfully calculated. While quantitative evaluations of the survey methods have shown that they are conceptually sound (Pawluk et al. 2023), fishers and members of the fishing community have voiced concerns about the representativeness of expanded data derived from creel interviews. In addition, the estimates of total catch and fish sales come from different reporting systems. The quality of commercial landings data collected through commercial sales receipt books are also variable across years and geographic areas (Chan and Pan 2019). Further, additional commercial activity via channels such as roadside markets or direct-to-consumer sales may not be captured through the commercial purchase system methodology. However, those channels are also more reflective of the broader informal and non-market economies supported by non-commercial fishing.

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1.10 FEDERAL LOGBOOK DATA

1.10.1 NUMBER OF FEDERAL PERMIT HOLDERS

In American Samoa, the following federal permits are required for fishing in the exclusive economic zone (EEZ) under the American Samoa FEP. Regulations governing fisheries under this FEP are in the Code of Federal Regulations (CFR), Title 50, Part 665.

1.10.1.1 SPECIAL CORAL REEF ECOSYSTEM PERMIT

Regulations require the special coral reef ecosystem fishing permit for anyone fishing for coral reef ECS in a low-use marine protected area (MPA), fishing for species on the list of Potentially Harvested Coral Reef Taxa, or using fishing gear not specifically allowed in the regulations. NMFS will make an exception to this permit requirement for any person issued a permit to fish under any FEP who incidentally catches American Samoa coral reef ECS while fishing for BMUS, crustacean MUS or ECS, western Pacific pelagic MUS, precious coral, or seamount groundfish. Regulations require a transshipment permit for any receiving vessel used to land or transship potentially harvested coral reef taxa, or any coral reef ECS caught in a low-use MPA.

1.10.1.2 WESTERN PACIFIC PRECIOUS CORAL

Regulations require this permit for anyone harvesting or landing black, bamboo, pink, red, or gold corals in the EEZ in the Western Pacific Region.

1.10.1.3 WESTERN PACIFIC CRUSTACEAN PERMIT

Regulations require a permit for the owner of a U.S. fishing vessel used to fish for lobster (now ECS) or deepwater shrimp in the EEZ around American Samoa, Guam, Hawaii, and the Pacific Remote Islands Area (PRIA), and in the EEZ seaward of three nautical miles of the shoreline of the Northern Mariana Islands.

There is no record of special coral reef or precious coral fishery permits issued for the EEZ around American Samoa since 2007. NMFS has issued few crustacean fishery permits as shown in Table 13. Table 13 provides the number of permits issued to American Samoa FEP fisheries between 2014 and 2023. Data are from the Pacific Islands Regional Office (PIRO) Sustainable Fisheries Division (SFD) permits program.

Table 13. Number of federal permit holders in American Samoa crustacean fisheries

Crustacean Fishery[1]	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Lobster	1	0	0	0	0	0	0	0	0	0
Shrimp	1	0	0	0	0	0	0	0	0	0

[1] Source: PIRO SFD unpublished data.

1.10.2 SUMMARY OF CATCH AND EFFORT FOR FEP FISHERIES

The American Samoa FEP requires fishermen to obtain a federal permit to fish for certain species in federal waters and to report all catch and discards. While NMFS annually issues permits for various FEP fisheries, there is currently limited data available on the level of catch or effort made by federal non-longline permit holders. Determining the level of fishing activity through the required federal logbook reporting for each fishery helps establish the level of non-longline fishing occurring in federal waters to assess whether there is a continued need for active conservation and management measures (e.g., annual catch limits) for these fisheries. For each FEP fishery, the number of federal permits issued since the federal permit and logbook reporting requirement became effective as well as available catch and effort data are presented.

Federal permits are not required to fish for bottomfish in American Samoa, and NMFS has never issued a federal permit for precious coral or coral reef fishing in federal waters around American Samoa. Therefore, catch and effort data is not presented for these fisheries.

1.10.2.1 SPINY AND SLIPPER LOBSTER

Table 14. Summary of available federal logbook data for lobster fisheries in American Samoa

Year	No. of Federal Lobster Permits Issued[1]	No. of Federal Lobster Permits Reporting Catch	No. of Trips in AS EEZ	Total Reported Logbook Catch (lb)		Total Reported Logbook Release/Discard (#)	
				Spiny lobster ECS[2]	*Slipper lobster ECS*[2]	*Spiny lobster ECS*[2]	*Slipper lobster ECS*[2]
2004	0	-					
2005	0	-					
2006	2	0					
2007	2	0					
2008	7	0					
2009	0	-					
2010	0	-					
2011	0	-					
2012	0	-					
2013	0	-					
2014	1	0					
2015	0	-					
2016	0	-					
2017	0	-					
2018	0	-					
2019	0	-					
2020	0	-					
2021	0	-					
2022	0	-					
2023	0	-					

[1] Source: PIRO SFD unpublished data.
[2] On February 8, 2019, NMFS published a final rule (84 FR 2767) to reclassify all crustacean MUS in American Samoa as ECS.

1.10.2.2 DEEPWATER SHRIMP

Table 15. Summary of available federal logbook data for deepwater shrimp fisheries in American Samoa

Year	No. of Federal Shrimp Permits Issued[1]	No. of Federal Shrimp Permits Reporting Catch	No. of Trips in American Samoa EEZ	Total Reported Logbook Shrimp ECS[2] Catch (lb)	Total Reported Logbook Shrimp ECS[2] Release/Discard (lb)
2009	0	-			
2010	0	-			
2011	0	-			
2012	0	-			
2013	0	-			
2014	1	0			
2015	0	-			
2016	0	-			
2017	0	-			
2018	0	-			
2019	0	-			
2020	0	-			
2021	0	-			
2022	0	-			
2023	0	-			

[1] Source: PIRO SFD unpublished data.
[2] On February 8, 2019, NMFS published a final rule (84 FR 2767) to reclassify all crustacean MUS in American Samoa as ECS.
Note: Federal permit and reporting requirements for deepwater shrimp fisheries became effective on June 29, 2009 (74 FR 25650, May 29, 2009).

2.5 PROTECTED SPECIES

This section of the report summarizes information on protected species interactions in fisheries managed under the American Samoa FEP. Protected species covered in this report include sea turtles, seabirds, marine mammals, sharks, and corals. Most of these species are protected under the Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), and/or Migratory Bird Treaty Act (MBTA). A list of protected species found in or near American Samoa waters and a list of critical habitat designations in the Pacific Ocean are included in Appendix B.

2.5.1 Indicators for Monitoring Protected Species Interactions in the American Samoa FEP Fisheries

This report monitors the status of protected species interactions in the American Samoa FEP fisheries using proxy indicators such as fishing effort and changes in gear types as these fisheries do not have observer coverage. Creel surveys and logbook programs are not expected to provide reliable data about protected species interactions. Discussion of protected species interactions is focused on fishing operations in federal waters and associated transit through territorial waters.

2.5.1.1 FEP Conservation Measures

Bottomfish, precious coral, coral reef and crustacean fisheries managed under this FEP have not had reported interactions with protected species, and no specific regulations are in place to mitigate protected species interactions. Destructive gear such as bottom trawls, bottom gillnets, explosives and poisons are prohibited under this FEP, and these prohibitions benefit protected species by preventing potential interactions with non-selective fishing gear.

2.5.1.2 ESA Consultations

ESA consultations were conducted by NMFS and the U.S. Fish and Wildlife Service (USFWS; for species under their jurisdiction including seabirds) to ensure ongoing fisheries operations managed under the American Samoa FEP are not jeopardizing the continued existence of any ESA-listed species or adversely modifying critical habitat. The results of these consultations conducted under section 7 of the ESA are briefly described below and summarized in Table 31.

NMFS concluded in an informal consultation dated April 9, 2015 that all fisheries managed under the American Samoa FEP are not likely to adversely affect the Indo-West Pacific distinct population segment (DPS) of scalloped hammerhead shark or ESA-listed reef-building corals.

Table 31. Summary of ESA consultations for American Samoa FEP Fisheries

Fishery	Consultation date	Consultation type[a]	Outcome[b]	Species
All fisheries	4/9/2015	LOC	NLAA	Reef-building corals, scalloped hammerhead shark (Indo-West Pacific DPS)
Bottomfish	3/3/2002	BiOp	NLAA	Blue whale, fin whale, green sea turtle, hawksbill sea turtle, humpback whale, leatherback sea turtle, loggerhead sea turtle, olive ridley sea turtle, sei whale, sperm whale
	8/26/2022	BiOp	NLAA	Oceanic whitetip shark, giant manta ray, chambered nautilus
Coral reef ecosystem	3/7/2002	LOC	NLAA	Blue whale, fin whale, green sea turtle, hawksbill sea turtle, humpback whale, leatherback sea turtle, loggerhead sea turtle, olive ridley sea turtle, sei whale, sperm whale
	5/22/2002	LOC (USFWS)	NLAA	Green, hawksbill, leatherback, loggerhead, and olive ridley turtles, Newell's shearwater, short-tailed albatross, Laysan duck, Laysan finch, Nihoa finch, Nihoa millerbird, Micronesian megapode, 6 terrestrial plants.
	9/18/2018	No effect memo	No effect	Oceanic whitetip shark, giant manta ray
Crustaceans	9/28/2007	LOC	NLAA	Blue whale, fin whale, green sea turtle, hawksbill sea turtle, humpback whale, leatherback sea turtle, loggerhead sea turtle, olive ridley sea turtle, sei whale, sperm whale
	9/18/2018	No effect memo	No effect	Oceanic whitetip shark, giant manta ray
Precious corals	10/4/1978	BiOp	Does not constitute threat	Leatherback sea turtle, sperm whale
	12/20/2000	LOC	NLAA	Green sea turtle, hawksbill sea turtle, humpback whale
	9/18/2018	No effect memo	No effect	Oceanic whitetip shark, giant manta ray

[a] BiOp = Biological Opinion; LOC = Letter of Concurrence

[b] LAA = likely to adversely affect; NLAA = not likely to adversely affect.

Bottomfish Fishery

In a biological opinion issued on March 3, 2002, NMFS concluded that the ongoing operation of the Western Pacific Region's bottomfish and seamount groundfish fisheries is not likely to jeopardize the continued existence of five sea turtle species (loggerhead, leatherback, olive ridley, green and hawksbill turtles) and five marine mammal species (humpback, blue, fin, sei and sperm whales).

On August 26, 2022, NMFS completed a BiOp initiated in response to the 2018 ESA listings of the oceanic whitetip shark, giant manta ray, and chambered nautilus for the American Samoa bottomfish fishery. This BiOp did not re-evaluate species previously consulted on because NMFS determined that reinitiation has not been triggered for those species in a Biological Evaluation dated June 5, 2019. NMFS determined that American Samoa bottomfish fishery is not likely to adversely affect giant manta rays, the chambered nautilus, or the oceanic whitetip shark.

Crustacean Fishery

In an informal consultation completed on September 28, 2007, NMFS concluded that American Samoa crustacean fisheries are not likely to adversely affect five sea turtle species (loggerhead, leatherback, olive ridley, green and hawksbill turtles) and five marine mammal species (humpback, blue, fin, sei and sperm whales).

On September 18, 2018, NMFS concluded the American Samoa crustacean fisheries will have no effect on the oceanic whitetip shark and giant manta ray.

Coral Reef Ecosystem Fishery

In an informal consultation completed on March 7, 2002, NMFS concluded that the American Samoa coral reef ecosystem fisheries are not likely to adversely affect five sea turtle species (loggerhead, leatherback, olive ridley, green and hawksbill turtles) and five marine mammal species (humpback, blue, fin, sei and sperm whales).

On May 22, 2002, the USFWS concurred with the determination of NMFS that the activities conducted under the Coral Reef Ecosystems FMP are not likely to adversely affect listed species under USFWS's exclusive jurisdiction (i.e., seabirds) and listed species shared with NMFS (i.e., sea turtles).

On September 18, 2018, NMFS concluded the American Samoa coral reef ecosystem fisheries will have no effect on the oceanic whitetip shark and giant manta ray.

Precious Coral Fishery

In a biological opinion issued on October 4, 1978, NMFS concluded that the ongoing operation of the Western Pacific Region's precious coral fisheries was not likely to jeopardize the continued existence of any threatened or endangered species under NMFS's jurisdiction or destroy or adversely modify critical habitat. In an informal consultation completed on December 20, 2000, NMFS concluded that American Samoa precious coral fisheries are not likely to adversely affect humpback whales, green turtles, or hawksbill turtles.

On September 18, 2018, NMFS concluded the American Samoa precious coral fisheries will have no effect on the oceanic whitetip shark and giant manta ray.

2.5.1.3 Non-ESA Marine Mammals

The MMPA requires NMFS to annually publish a List of Fisheries (LOF) that classifies commercial fisheries in one of three categories based on the level of mortality and serious injury of marine mammals associated with that fishery. According to the 2024 LOF (89 FR 12257, February 16, 2024) the American Samoa bottomfish fishery is classified as a Category III fishery (i.e., a remote likelihood of or no known incidental mortality and serious injury of marine mammals).

2.5.2 Status of Protected Species Interactions in the American Samoa FEP Fisheries

Bottomfish and Coral Reef Fisheries

As described in Section 2.6.1.2, NMFS determined that bottomfish and coral reef fisheries operating under the American Samoa FEP are not expected to interact with any ESA-listed species in federal waters around American Samoa.

The 2022 biological opinion determined that the American Samoa bottomfish fishery is not likely to adversely affect the oceanic whitetip shark, giant manta rays, or chamber nautilus, and there are currently no known reported interactions. Based on fishing effort and other characteristics described in Chapter 1 of this report, no notable changes have been observed in the fishery. There is no other information to indicate that impacts to protected species from this fishery have changed in recent years.

Based on current ESA consultations, coral reef fisheries are not expected to interact with any ESA-listed species in federal waters around American Samoa.

NMFS has concluded that the American Samoa bottomfish and coral reef commercial fisheries will not affect marine mammals in any manner not considered or authorized under the MMPA.

There are also no observer data available for the American Samoa bottomfish or coral reef fisheries.

Crustacean and Precious Coral Fisheries

There are currently no crustacean or precious coral fisheries operating in federal waters around American Samoa. However, based on current ESA consultations, crustacean fisheries are not expected to interact with any ESA-listed species in federal waters around American Samoa. NMFS has also concluded that the American Samoa crustacean and precious coral commercial fisheries will not affect marine mammals in any manner not considered or authorized under the MMPA.

2.5.3 Identification of Emerging Issues

Table 32 summarizes current candidate ESA species, recent listing status, and post-listing activity (critical habitat designation and recovery plan development). Impacts from FEP-managed fisheries on any new listings and critical habitat designations will be considered in future versions of this report.

Table 32. Status of candidate ESA species, recent ESA listing processes, and post-listing activities

Species		Listing Process			Post-Listing Activity	
Common Name	**Scientific Name**	**90-Day Finding**	**12-Month Finding / Proposed Rule**	**Final Rule**	**Critical Habitat**	**Recovery Plan**
Oceanic whitetip shark	*Carcharhinus longimanus*	Positive (81 FR 1376, 1/12/2016)	Positive, threatened (81 FR 96304, 12/29/2016)	Listed as threatened (83 FR 4153, 1/30/2018)	Designation not prudent; no areas within U.S. jurisdiction that meet definition of critical habitat (85 FR 12898, 3/5/2020)	Draft Recovery Plan published January 25, 2023 (88 FR 4817)
Chambered nautilus	*Nautilus pompilius*	Positive (81 FR 58895, 8/26/2016)	Positive, threatened (82 FR 48948, 10/23/2017)	Listed as threatened (83 FR 48876, 9/28/2018)	Designation not prudent; no areas within U.S. jurisdiction that meet definition of critical habitat (85 FR 5197, 01/29/2020)	TBA
Giant manta ray	*Manta birostris*	Positive (81 FR 8874, 2/23/2016)	Positive, threatened (82 FR 3694, 1/12/2017)	Listed as threatened (83 FR 2916, 1/22/2018)	Designation not prudent; no areas within U.S. jurisdiction that meet definition of critical habitat (84 FR 66652, 12/5/2019)	Recovery outline published 12/4/19 to serve as interim guidance until full recovery plan is developed; recovery planning workshop planned for 2021.
Corals	N/A	Positive for 82 species (75 FR 6616, 2/10/2010)	Positive for 66 species (77 FR 73219, 12/7/2012)	20 species listed as threatened (79 FR 53851, 9/10/2014)	Critical habitat proposed (85 FR 76262, 11/27/2020, withdrawn), Critical habitat proposed (88 FR 83644, November 30, 2023)	In development, interim recovery outline in place; recovery workshops convened in May 2021.

Species		Listing Process			Post-Listing Activity	
Common Name	**Scientific Name**	**90-Day Finding**	**12-Month Finding / Proposed Rule**	**Final Rule**	**Critical Habitat**	**Recovery Plan**
Giant clams	*Hippopus, H. porcellanus, Tridacna costata, T. derasa, T. gigas, T. Squamosa,* and *T. tevoroa*	Positive (82 FR 28946, 06/26/2017)	TBA (status review ongoing)	TBA	N/A	N/A
Green sea turtle	*Chelonia mydas*	Positive (77 FR 45571, 8/1/2012)	Identification of 11 DPSs, endangered and threatened (80 FR 15271, 3/23/2015)	11 DPSs listed as endangered and threatened (81 FR 20057, 4/6/2016)	Critical habitat proposed (88 FR 46572, 07/19/2023	TBA
Shortfin Mako Shark	*Isurus oxyrinchus*	Positive (86 FR 19863. 4/15/2021)	Not warranted (87 FR 68236, 11/14/2022)	N/A	N/A	N/A

[a] NMFS and USFWS have been tasked with higher priorities regarding sea turtle listings under the ESA, and do not anticipate proposing green turtle critical habitat designations in the immediate future.

2.5.4 Identification of Research, Data, and Assessment Needs

The following research, data, and assessment needs for insular fisheries were identified by the Council's Plan Team:

- Improve species identification of commercial and non-commercial fisheries data (e.g., outreach, use FAO species codes) to improve understanding of potential protected species impacts.
- Define and evaluate innovative approaches to derive robust estimates of protected species interactions in insular fisheries.
- Conduct genetic and telemetry research to improve understanding of population structure and movement patterns for listed elasmobranchs.
- Estimates of post release survival for incidental protected species.

2.3

2.3 LIFE HISTORY INFORMATION AND LENGTH-DERIVED VARIABLES

The annual SAFE report will serve as the repository of available life history information for the Western Pacific region. Life history data, particularly age, growth, reproduction, and mortality information inform stock assessments on fish productivity and population dynamics. Some assessments, particularly for data poor stocks, utilize information from other areas that introduces biases and increases uncertainties in the population estimates. An archipelago-specific life history parameter ensures accuracy in the input parameters used in the assessment.

The NMFS PIFSC Biosampling Program allows for the collection of life history samples like otoliths and gonads from priority species in the bottomfish and coral reef fisheries. A significant number of samples are also collected during research cruises. These life history samples, once processed and examined, will contribute to the body of scientific information for the two data poor fisheries in the region (coral reef fish and bottomfish). The life history information available from the region will be monitored by the Fishery Ecosystem Plan Team and will be tracked through this section of the report.

This section will be divided into two fisheries: 1) prioritized coral reef ecosystem component species (ECS), and 2) bottomfish management unit species (BMUS). The prioritized coral reef species list was developed by the American Samoa Department of Marine and Wildlife Resources (DMWR) in 2019. The BMUS are the species that are listed in the federal ecosystem plan and are managed on a federal level. Within each fishery, the available life history information will be described under the age, growth, and reproductive maturity section. The section labelled “Fish Length Derived Parameters” summarizes available information derived from sampling the fish catch or the market. Length-weight conversion coefficients provide area-specific values to convert length from fishery-dependent and fishery-independent data collection to weight or biomass.

2.3.1 AMERICAN SAMOA CORAL REEF ECOSYSTEM – LIFE HISTORY

2.3.1.1 AGE, GROWTH, AND REPRODUCTIVE MATURITY

Description: Age determination is based on counts of yearly growth marks (annuli) and/or daily growth increments (DGIs) internally visible within transversely cut, thin sections of sagittal otoliths. Validated age determination is based on several methods including an environmental signal (bomb radiocarbon ^{14}C) produced during previous atmospheric thermonuclear testing in the Pacific and incorporated into the core regions of sagittal otolith and other aragonite-based calcified structures such as hermatypic corals. This technique relies on developing a regionally based aged coral core reference series for which the rise, peak, and decline of ^{14}C values is available over the known age series of the coral core. Estimates of fish age are determined by projecting the ^{14}C otolith core values back in time from its capture date to where it intersects with the known age ^{14}C coral reference series. Fish growth is estimated by fitting the length-at-age data to a growth function, typically the von Bertalanffy growth function (VBGF). This function typically uses three coefficients (L_∞, k, and t_0), which together characterize the shape of the length-at-age growth relationship.

Length-at-reproductive maturity is based on the histological analyses of small tissue samples of gonad material that are typically collected along with otoliths when a fish is processed for life history studies. The gonad tissue sample is preserved, cut into five-micron sections, stained, and sealed onto a glass slide for subsequent examination. Based on standard cell structure features and developmental stages within ovaries and testes, the gender, developmental stage, and maturity status (immature or mature) is determined via microscopic evaluation. The percent of mature samples for a given length interval are assembled for each sex, and these data are fitted to a three- or four-parameter logistic function to determine the best fit for the data based on statistical analyses. The mid-point of the fitted function provides an estimate of the length at which 50% of fish have achieved reproductive maturity (L_{50}). For species that undergo sex reversal (primarily female to male in the tropical Pacific region), such as groupers and deeper-water emperors among the bottomfishes, and for parrotfish, shallow-water emperors, and wrasses among the coral reef fishes, standard histological criteria are used to determine gender and reproductive developmental stages that indicate the transitioning or completed transition from one sex to another. These data are similarly analyzed using a three- or four-parameter logistic function to determine the best fit of the data based on statistical analyses. The mid-point of this fitted function provides an estimate of the length at which 50% of fish of a particular species have or are undergoing sex reversal ($L\Delta_{50}$).

Age at 50% maturity (A_{50}) and age at 50% sex reversal ($A\Delta_{50}$) can be derived by referencing the VBGF for that species and using the corresponding L_{50} and $L\Delta_{50}$ values to obtain the corresponding age value from this growth function. In studies where both age and growth and reproductive maturity are concurrently determined, estimates of A_{50} and $A\Delta_{50}$ are derived directly by fitting the percent of mature samples for each age (i.e., one-year) interval to a three- or four-parameter logistic function using statistical analyses. The mid-point of this fitted logistic function provides a direct estimate of the age at which 50% of fish of a species have achieved reproductive maturity (A_{50}) and sex reversal ($A\Delta_{50}$).

Data Category: Biological

Timeframe: N/A

Jurisdiction: American Samoa

Spatial Scale: Archipelagic

Data Source: Sources of data are directly derived from research cruises sampling and market samples collected by the American Samoa contracted bio-sampling team which samples the catch of fishermen and local fish vendors. Laboratory analyses and data generated from these analyses reside with the PIFSC Life History Program (LHP). Refer to the “Reference” column in Table 21 for specific details on data sources by species.

Parameter Definitions:

T_{max} **(maximum age)** – The maximum observed age revealed from an otolith-based age determination study. T_{max} values can be derived from ages determined by annuli counts of sagittal otolith sections and/or bomb radiocarbon (^{14}C) analysis of otolith core material. Units are years.

L_∞ **(asymptotic length)** – One of three coefficients of the VBGF that measures the mean maximum length at which the growth curve plateaus and no longer increases in length with increasing age. This coefficient reflects the estimated mean maximum length and not the observed maximum length. Units are centimeters.

***k* (growth coefficient)** – One of three coefficients of the VBGF that measures the shape and steepness by which the initial portion of the growth function approaches its mean maximum length (L_∞).

t_0 (hypothetical age at length zero) – One of three coefficients of the VBGF whose measure is highly influenced by the other two VBGF coefficients (*k* and L_∞) and typically assumes a negative value when specimens representing early growth phases) are not available for age determination. This parameter can be fixed at 0. Units are years.

***M* (natural mortality)** – This is a measure of the mortality rate for a fish stock and is considered to be directly related to stock productivity (i.e., high *M* indicates high productivity and low *M* indicates low stock productivity). *M* can be derived through use of various equations that link *M* to T_{max} and the VBGF coefficients (*k* and L_∞) or by calculating the value of the slope from a regression fit to a declining catch curve (regression of the natural logarithm of abundance versus age class) derived from fishing an unfished or lightly fished population.

A_{50} (age at 50% maturity) – Age at which 50% of the sampled stock under study has attained reproductive maturity. This parameter is best determined based on studies that concurrently determine both age (otolith-based age data) and reproductive maturity status (logistic function fitted to percent mature by age class with maturity determined via microscopic analyses of gonad histology preparations). A more approximate means of estimating A_{50} is to use an existing L_{50} estimate to find the corresponding age (A_{50}) from an existing VBGF curve. Units are years.

$A\Delta_{50}$ (age of sex switching) – Age at which 50% of the immature and adult females of the sampled stock under study is undergoing or has attained sex reversal. This parameter is best determined based on studies that concurrently determines both age (otolith-based age data) and reproductive sex reversal status (logistic function fitted to percent sex reversal by age class with sex reversal determined via microscopic analyses of gonad histology preparations). A more approximate means of estimating $A\Delta_{50}$ is to use an existing $L\Delta_{50}$ estimate to find the corresponding age ($A\Delta_{50}$) from the VBGF curve. Units are years.

L_{50} (length at which 50% of a fish population are capable of spawning) – Length at which 50% of the females of a sampled stock under study has attained reproductive maturity; this is the length associated with A_{50} estimates. This parameter is derived using a logistic function to fit the percent mature data by length class with maturity status best determined via microscopic analyses of gonad histology preparations. L_{50} information is typically more available than A_{50} since L_{50} estimates do not require knowledge of age and growth. Units are centimeters.

$L\Delta_{50}$ (length of sex switching) – Length at which 50% of the immature and adult females of the sampled stock under study is undergoing or has attained sex reversal; this is the length associated with $A\Delta_{50}$ estimates. This parameter is derived using a logistic function to fit the percent sex reversal data by length class with sex reversal status best determined via microscopic analyses of gonad histology preparations. $L\Delta_{50}$ information is typically more available than $A\Delta_{50}$ since $L\Delta_{50}$ estimates do not require knowledge of age and growth. Units are centimeters.

<u>Rationale</u>: These nine life history parameters provide basic biological information at the species level to evaluate the productivity of a stock - an indication of the capacity of a stock to recover once it has been depleted. These parameters are also used as direct inputs into stock assessments. Currently, the assessment of coral reef fish resources in American Samoa is data limited. Knowledge of these life history parameters support current efforts to characterize the resilience of these resources and provide important biological inputs for future stock assessment efforts and enhance our understanding of the species' likely role and status as a component of the overall ecosystem. Furthermore, knowledge of life histories across species at the taxonomic level of families or among different species that are ecologically or functionally similar can provide important information on the diversity of life histories and the extent to which species can be grouped (based on similar life histories) for future multi-species assessments.

Table 21. Available age, growth, and reproductive maturity information for prioritized coral reef ecosystem component species in American Samoa

Species	Age, growth, reproductive maturity parameters									Reference
	T_{max}	L_∞	k	t_0	M	A_{50}	$A\Delta_{50}$	L_{50}	$L\Delta_{50}$	
Crenimugil crenilabis										
Epinephelus melanostigma										
Octopus cyanea										
Panulirus penicillatus										
Sargocentron tiere										
Tridacna maxima										

Parameter estimates are for females unless otherwise noted (f=females, m=males). Parameters T_{max}, t_0, A_{50}, and $A\Delta_{50}$ are in years; L_∞, L_{50}, and $L\Delta_{50}$ are in mm fork length (FL); k is in units of year^{-1}; X means the parameter estimate is too preliminary and Y means the published age and growth parameter estimates are based on DGI numerical integration technique and likely to be inaccurate. Superscript letters indicate status of parameter estimate (see footnotes below table). Published or in press publications ([d]) are shown in the "Reference" column.

2.3.1.2 FISH LENGTH DERIVED PARAMETERS

Description: The NMFS Commercial Fishery Biosampling Program started in 2010 and ended in 2015. This program had two components: first was the Field/Market Sampling Program and the second was the Lab Sampling Program. The goals of the Field/Market Sampling Program were to allow:

- Broad scale observations of commercial landings (by fisher/trip, gear, and area fished);
- Length and weight frequencies of whole commercial landings per fisher-trip (with an effort to also sample landings not sold commercially);
- Accurate species identification; and
- Development of accurate local length-weight curves.

In American Samoa, the Biosampling Program focused on the commercial coral reef spear fishery with occasional sampling of the bottomfish fishery occurring locally and less frequently at the outer islands. Sampling is conducted in partnership with the fish vendors. The Market

Sampling information includes (but not limited to): 1) fish length; 2) fish weight; 3) species identification; and 4) basic effort information.

Data Category: Biological

Timeframe: N/A

Jurisdiction: American Samoa

Spatial Scale: Archipelagic

Data Source: NMFS Biosampling Program

Parameter Definitions:

n* – *sample size is the total number of samples accumulated for each species recorded in the Biosampling Program database from the commercial spear fishery.

L_{max} – *maximum fish length* is the largest individual per species recorded in the Biosampling Program database from the commercial spear fishery. This value is derived from measuring the length of individual samples for species occurring in the spear fishery. Units are centimeters.

$N_{L\text{-}W}$ – *sample size for L-W regression* is the number of samples used to generate the *a* and *b* coefficients.

a and b* – *length-weight coefficients are the coefficients derived from the regression line fitted to all length and weight measured by species in the commercial spear fishery. These values are used to convert length information to weight. Values are influenced by the life history characteristics of the species, geographic location, population status, and nature of the fisheries from which the species are harvested.

Rationale: Length-derived information is an important component of fisheries monitoring and data poor stock assessment approaches. Maximum length (L_{max}) is used to derive missing species- and location-specific life history information (Nadon et al. 2015; Nadon and Ault 2016; Nadon 2019). The length-weight coefficients (*a* and *b* values) are used to convert length to weight for fishery-dependent and fishery-independent data collection where length is typically recorded but weight is the factor being used for management. This section of the report presents the best available information for the length-derived variables for the American Samoa coral reef ecosystem component fisheries.

Table 22. Available length-derived information for prioritized coral reef ecosystem component species in American Samoa

Species	Length-derived parameters					Reference
	n	L_{max}	$N_{L\text{-}W}$	***a***	***b***	
Crenimugil crenilabis	380	48.2	380	0.0388	2.73	Matthews et al. (2019)
Epinephelus melanostigma	2,662	54.9	2,662	0.0109	3.10	Matthews et al. (2019)
Octopus cyanea						
Panulirus penicillatus	3,384	15.8	3,384	2.6004	2.41	Matthews et al. (2019)
Sargocentron tiere	3,002	25.0	3,002	0.069	2.62	Matthews et al. (2019)
Tridacna maxima						

2.3.2 AMERICAN SAMOA – MANAGEMENT UNIT SPECIES LIFE HISTORY

2.3.2.1 AGE, GROWTH, AND REPRODUCTIVE MATURITY

Description: Age determination is based on counts of yearly growth marks (annuli) and/or DGIs internally visible within transversely cut, thin sections of sagittal otoliths. Validated age determination is based on several methods including an environmental signal (bomb radiocarbon ^{14}C) produced during previous atmospheric thermonuclear testing in the Pacific and incorporated into the core regions of sagittal otolith and other aragonite-based calcified structures such as hermatypic corals. This technique relies on developing a regionally based aged coral core reference series for which the rise, peak, and decline of ^{14}C values is available over the known age series of the coral core. Estimates of fish age are determined by projecting the ^{14}C otolith core values back in time from its capture date to where it intersects with the known age ^{14}C coral reference series. Fish growth is estimated by fitting the length-at-age data to a growth curve, typically a VBGF. This function typically uses three coefficients (L_∞, k, and t_0), which together characterize the shape of the length-at-age growth relationship.

Length-at-reproductive maturity is based on the histological analyses of small tissue samples of gonad material that are typically collected along with otoliths when a fish is processed for life history studies. The gonad tissue sample is preserved, cut into five-micron sections, stained, and sealed onto a glass slide for subsequent examination. Based on standard cell structure features and developmental stages within ovaries and testes, the gender, developmental stage, and maturity status (immature or mature) is determined via microscopic evaluation. The percent of mature samples for a given length interval are assembled for each sex, and these data are fitted to a three- or four-parameter logistic function to determine the best fit for the data based on statistical analyses. The mid-point of the fitted function provides an estimate of the length at which 50% of fish have achieved reproductive maturity (L_{50}). For species that undergo sex reversal (primarily female to male in the tropical Pacific region), such as groupers and deeper-water emperors among the bottomfishes, and for parrotfish, shallow-water emperors, and wrasses among the coral reef fishes, standard histological criteria are used to determine gender and reproductive developmental stages that indicate the transitioning or completed transition from one sex to another. These data are similarly analyzed using a three- or four-parameter logistic function to determine the best fit of the data based on statistical analyses. The mid-point of this fitted function provides an estimate of the length at which 50% of fish of a particular species have or are undergoing sex reversal ($L\Delta_{50}$).

Age at 50% maturity (A_{50}) and age at 50% sex reversal ($A\Delta_{50}$) can be derived by referencing the von Bertalanffy growth function for that species and using the corresponding L_{50} and $L\Delta_{50}$ values to obtain the corresponding age value from this growth function. In studies where both age and growth and reproductive maturity are concurrently determined, estimates of A_{50} and $A\Delta_{50}$ are derived directly by fitting the percent of mature samples for each age (i.e., one-year) interval to a three- or four-parameter logistic function using statistical analyses. The mid-point of this fitted logistic function provides a direct estimate of the age at which 50% of fish of a species have achieved reproductive maturity (A_{50}) and sex reversal ($A\Delta_{50}$).

Category: Biological

Timeframe: N/A

Jurisdiction: American Samoa

Spatial Scale: Archipelagic

Data Source: Sources of data are directly derived from field samples collected at sea on NOAA research vessels and from the American Samoa contracted bio-sampling team which samples the catch of fishermen and local fish vendors. Laboratory analyses and data generated from these analyses reside with the PIFSC LHP. Refer to the “Reference” column in Table 23 for specific details on data sources by species.

Parameter definitions: Identical to Section 2.4.1.1.

Rationale: These nine life history parameters provide basic biological information at the species level to evaluate the productivity of a stock - an indication of the capacity of a stock to recover once it has been depleted. Currently, the assessment of coral reef fish resources in American Samoa is data limited. Knowledge of these life history parameters support current efforts to characterize the resilience of these resources and provide important biological inputs for future stock assessment efforts and enhance our understanding of the species likely role and status as a component of the overall ecosystem. Furthermore, knowledge of life histories across species at the taxonomic level of families or among different species that are ecologically or functionally similar can provide important information on the diversity of life histories and the extent to which species can be grouped (based on similar life histories) for multi-species assessments.

Parameter estimates are for females unless otherwise noted (f=females, m=males). Parameters T_{max}, t_0, A_{50}, and $A\Delta_{50}$ are in years; L_∞, L_{50}, and $L\Delta_{50}$ are in mm FL; k is in units of year^{-1}; X means the parameter estimate is too preliminary and Y means the published age and growth parameter estimates are based on DGI numerical integration technique and likely to be inaccurate; NA=not applicable. Superscript letters indicate status of parameter estimate (see footnotes below table). Published or in press publications ([d]) are shown in the “Reference” column.

Table 23. Available age, growth, and reproductive maturity information for BMUS targeted for otoliths and gonads sampling in American Samoa

Species	Age, growth, and reproductive maturity parameters									Reference
	T_{max}	L_{∞}	k	t_0	M	A_{50}	$A\Delta_{50}$	L_{50}	$L\Delta_{50}$	
Aphareus rutilans							NA		NA	
Aprion virescens							NA		NA	
Caranx lugubris							NA		NA	
Etelis carbunculus[1]							NA		NA	
Etelis coruscans							NA		NA	
Lethrinus rubrioperculatus	f=10[d] m=10[d]	f=27.3[d] m=29.1[d]	f=0.74[d] m=0.71[d]	f=-0.16[d] m=-0.15[d]				f=21.2[d,e]		Pardee et al. (2020)
Lutjanus kasmira							NA		NA	
Pristipomoides filamentosus							NA		NA	
Pristipomoides flavipinnis	28[d]	41.15[d]	0.47[d]		0.22[d]		NA		NA	O'Malley et al. (2019)
Pristipomoides zonatus							NA		NA	
Variola louti										

[1] *E. carbunculus* is now known to be comprised of two distinct, non-interbreeding lineages (Andrews et al. 2016). Both species occur in the Samoa Archipelago and were likely both captured by fishermen in the 1980s but reported as one species.
[a] signifies estimate pending further evaluation in an initiated and ongoing study.
[b] signifies a preliminary estimate taken from ongoing analyses.
[c] signifies an estimate documented in an unpublished report or draft manuscript.
[d] signifies an estimate documented in a finalized report or published journal article (including in press).
[e] L_{50} was derived from the published literature based on the relationship between L_{∞} and L_{50}

2.3.2.2 FISH LENGTH DERIVED PARAMETERS

Description: The NMFS Commercial Fishery Biosampling Program started in 2010 and ended in 2015. This program had two components: first was the Field/Market Sampling Program and the second was the Lab Sampling Program, details of which are described in a separate section of this report. The goals of the Field/Market Sampling Program were:

- Broad scale looks at commercial landings (by fisher/trip, gear, and area fished);
- Length and weight frequencies of whole commercial landings per fisher-trip (with an effort to also sample landings not sold commercially);
- Accurate species identification; and
- Develop accurate local length-weight curves.

In American Samoa, the Bio-Sampling focused on the commercial coral reef spear fishery with occasional sampling of the bottomfish fishery occurring locally and less frequently at the northern islands. Sampling was conducted in partnership with the fish vendors. The Market Sampling information includes (but not limited to): 1) fish length; 2) fish weight; 3) species identification; and 4) basic effort information.

Category: Biological

Timeframe: N/A

Jurisdiction: American Samoa

Spatial Scale: Archipelagic

Data Source: NMFS Bio-Sampling Program

Parameter Definition: Identical to Section 2.4.1.2

Rationale: Length-derived information is an important component of fisheries monitoring and data poor stock assessment approaches. Maximum length (L_{max}) is used to derive missing species- and location-specific life history information (Nadon et al. 2015; Nadon and Ault 2016; Nadon 2019). The length-weight coefficients (*a* and *b* values) are used to convert length to weight for fishery-dependent and fishery-independent data collection where length is typically recorded but weight is the factor being used for management. This section of the report presents the best available information for the length-derived variables for the American Samoa BMUS fishery.

Table 24. Available length-derived information for BMUS in American Samoa

Species	Length derived parameters					Reference
	n	L_{max}	N_{L-W}	***a***	***b***	
Aphareus rutilans	173	85.0	173	0.0395	2.73	Matthews et al. (2019)
Aprion virescens	952	73.4	952	0.0157	2.99	Matthews et al. (2019)
Caranx lugubris	164	86.0	164	0.0404	2.80	Matthews et al. (2019)
Etelis carbunculus[1]						
Etelis coruscans	106	89.5	106	0.0322	2.81	Matthews et al. (2019)
Lethrinus rubrioperculatus	2,349	57.0	2,349	0.0287	2.86	Matthews et al. (2019)
Lutjanus kasmira	461	35.0	461	0.0176	3.01	Matthews et al. (2019)

Species	**Length derived parameters**					**Reference**
	n	***L_{max}***	***N_{L-W}***	***a***	***b***	
Pristipomoides flavipinnis	262	56.5	262	0.0249	2.90	Matthews et al. (2019)
Pristipomoides zonatus						
Pristipomoides filamentosus						
Variola louti		50.5	365	0.0135	3.08	Matthews et al. (2019)

[1] *E. carbunculus* is now known to be comprised of two distinct, non-interbreeding lineages (Andrews et al. 2016). Both species occur in the Samoa Archipelago and were likely both captured by fishermen in the 1980s but reported as one species.