

Estimated Bycatch of Seabirds, Sea Turtles, Bony Fish, Sharks, and Rays in the 2025 Permitted American Samoa Longline Fishery

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Introduction

The supplemental Excel workbook (pir.asll.2025.xlsx) includes annual longline bycatch estimates for the 2025 American Samoa permitted longline fishery. The workbook includes estimates for species with at least one observed bycatch interaction in the 2023–2025 proxy window, along with zero entries for selected species retained in the reporting template. The workbook includes a worksheet labeled “Key” that provides definitions of the column headings and the items being estimated. In this report, bycatch refers to fish not retained and to all observed interactions with seabirds and sea turtles. Marine mammals are excluded and will be reported separately.

In 2025, the fleet completed 32 trips in American Samoa, and the fleet set approximately 4.17 million hooks based on American Samoa Longline Logbook records (PIFSC 2026). Only one 2025 trip was observed, representing approximately 3.1% of trips and 4.9% of hooks. A single trip is insufficient to represent the range of spatial, seasonal, and operational conditions encountered by the fleet over the full year, so 2025 observer data alone could not support a reliable fleet-level estimate.

For 2025, bycatch was estimated using a pooled proxy ratio estimator. Observer data from 2023–2025, representing 8 observed trips, were pooled to calculate species-specific bycatch rates per 1000 hooks. For each species, the pooled rate per 1000 hooks was calculated as total observed bycatch interactions divided by total observed hooks in the proxy window, then multiplied by total 2025 fleet hooks:

$$\hat{\lambda}_s = \frac{\sum_{i=1}^n x_{si}}{\sum_{i=1}^n h_i} \times 1000 \quad \hat{N}_s = \hat{\lambda}_s \times \frac{H_{fleet}}{1000}$$

where x_{si} is observed bycatch of species s on trip i , h_i is hooks set on trip i across $n = 8$ observer trips from the 2023–2025 window, H_{fleet} is total hooks fished by the 2025 fleet (~4.17 million hooks), and $\hat{N}_s$ is estimated fleet-wide bycatch. This approach treats pooled 2023–2025 observed bycatch rates as the most appropriate available proxy for 2025 fleet bycatch rates, given the limited 2025 observer coverage and the supporting analyses described in Appendix A. The 2023–2025 window was selected after evaluating four candidate windows, 2024–2025 through 2021–2025, based on spatial coverage of the 2025 fishing grounds and temporal stationarity of observed bycatch rates. Supporting analyses are provided in the appendices.

Conventional design-based standard errors are not reported because the 2023–2025 observer trips are used as a proxy pool rather than a probability sample from the 2025 fleet; resampling those trips would not address the central uncertainty—whether recent observed rates represent the unobserved 2025 fleet. Differences in seasonal coverage and trip-effort distributions between the proxy observer pool and the 2025 fleet are

potential sources of bias that likely vary in direction and magnitude by species. No bias corrections are applied in this data report; species-specific corrections would require additional analytical decisions beyond the scope of this report. Appendix A documents the window selection analysis and Appendix B provides diagnostic evidence of expected bias direction for select species from two sources—seasonal underrepresentation of April through June and differences in trip-effort distributions. These estimates should therefore be interpreted as proxy-based point estimates rather than fully design-based estimates with conventional sampling-error measures.

McCracken (2019) describes sampling of the American Samoa longline fleet, standard estimators of bycatch, and caveats of the sampling and estimators.

Literature Cited

McCracken, M. L. (2019). *American Samoa Longline Fishery Estimated Anticipated Take Levels for Endangered Species Act Listed Species* (Data Report Series, DR-19-28). Pacific Islands Fisheries Science Center. <https://doi.org/10.25923/b8gs-j441>

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Appendix A: Proxy Window Selection

Observer data from 2023–2025 were pooled as the proxy estimation window. Four candidate windows were evaluated: 2024–2025 ($n = 5$ observer trips), 2023–2025 ($n = 8$), 2022–2025 ($n = 12$), and 2021–2025 ($n = 14$). Window selection balanced spatial coverage of the 2025 fishing grounds against temporal stationarity of bycatch rates.

Spatial coverage. The 2023–2025 window covered 97.8% of 2025 logbook sets at $1^\circ \times 1^\circ$ resolution. Adding 2022 or 2021 observer data produced no improvement in cell coverage; the remaining uncovered cells accounted for a small share of 2025 fishing effort.

Temporal stationarity. Annual observed catch per unit effort (CPUE) patterns were not stationary from 2021 onward for several key species (Figure A1). Oceanic whitetip and silky shark CPUE increased through 2024; blue shark and shortfin mako CPUE declined over the same period. Including 2021 or 2022 data would therefore shift estimates in opposite directions by species, without improving spatial coverage. Data before 2021 were not considered because the fleet contracted substantially after 2020, making pre-2021 conditions less comparable to the current fishery (Table A1).

Annual pooled CPUE by species (2021–2025)

Point size = observed trips that year.

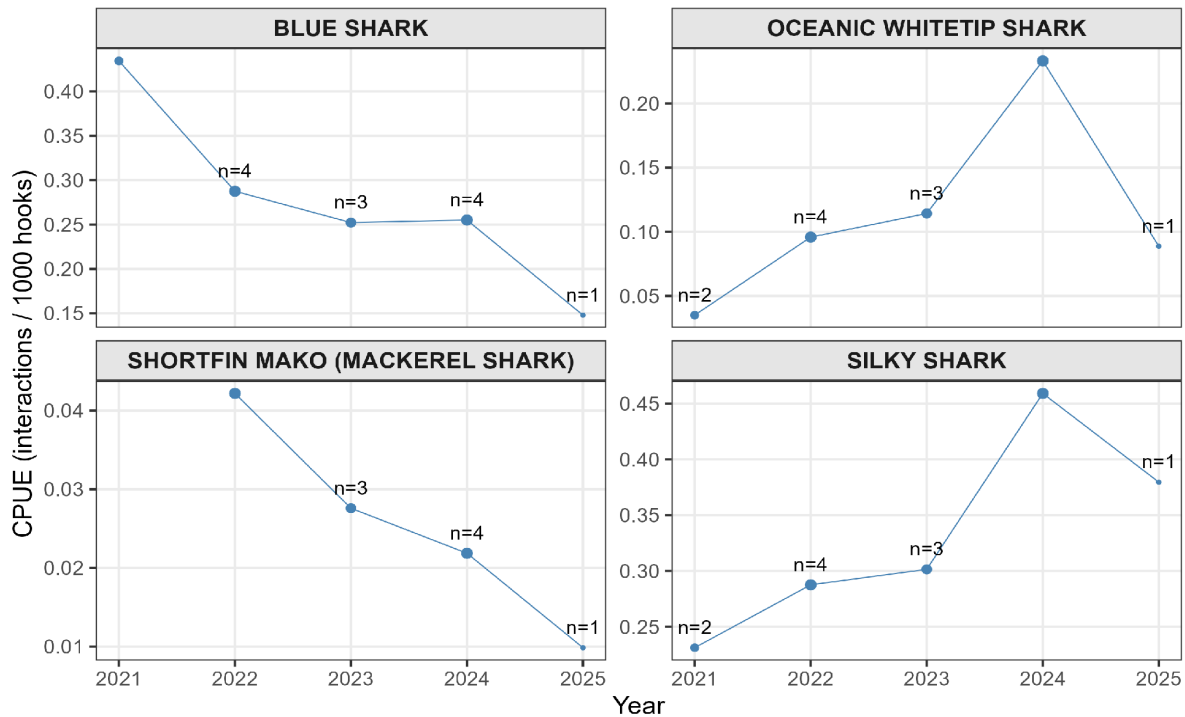


Figure A1. Annual observed CPUE (interactions per 1,000 hooks) for four shark species, 2021–2025. Directional trends support limiting the proxy pool to 2023–2025: OWT and silky shark CPUE increased through 2024 while blue shark and shortfin mako CPUE declined.

Observer coverage by year. Table A1 shows fleet trips, observer trips, and observer hook coverage for 2012–2025. At 4.9% observer hook coverage, 2025 had the lowest coverage of any year outside the COVID-19-affected period (2020: 2.3%; 2021: 3.3%).

Table A1. American Samoa longline observer coverage by year, 2012–2025. Logbook trips are trips with logbook data. Observer hook coverage is observer hooks as a percentage of fleet hooks.

Year	Logbook trips	Observer trips	Observer hooks (%)
2012	224	22	15.5
2013	104	20	16.7
2014	189	20	18.7
2015	198	18	18.5
2016	214	15	18.0
2017	132	12	17.0
2018	139	9	13.2

Year	Logbook trips	Observer trips	Observer hooks (%)
2019	196	11	18.9
2020	91	1	2.3
2021	37	2	3.3
2022	42	4	6.6
2023	34	3	13.2
2024	42	4	9.9
2025	32	1	4.9

Window sensitivity. Table A2 shows estimated fleet-wide bycatch under each candidate window for species with at least 250 observed interactions in the 2023–2025 pool—a threshold that retains species with sufficient data to assess stability and includes the two key shark species (silky and blue)—plus dolphinfish as the clearest example of window sensitivity. For most species, estimates are broadly stable across windows. Blue shark estimates increase as the window extends back, consistent with the declining CPUE trend in Figure A1—earlier years had higher blue shark CPUE, so including them may upwardly bias the estimate. Dolphinfish shows a different pattern, not trend-driven but driven by two outlier 2022 observer trips, producing a 13× higher estimate under the 2022–2025 window (147.7) than under the recommended 2023–2025 window (11.1).

Table A2. Estimated fleet-wide bycatch under four candidate proxy windows for species with $n \geq 250$ observed interactions in the 2023–2025 pool, plus dolphinfish. The $n \geq 250$ threshold retains species with sufficient data to assess stability and includes key shark species. Estimates are bycatch interactions scaled to total 2025 fleet hooks. n = observed interactions in the 2023–2025 window.

Species	n (23–25)	Est 24–25	Est 23–25	Est 22–25	Est 21–25
Stingray, Pelagic	2,306	7,826.9	8,565.7	8,216.1	7,873.6
Lancetfish, Longnose	1,070	3,547.2	3,974.5	3,469.1	3,529.8
Escolar, Longfin	880	2,462.0	3,268.8	3,445.0	3,499.7
Escolar	764	2,794.4	2,837.9	3,059.2	3,251.1
Tuna, Yellowfin	482	2,136.5	1,790.4	2,130.9	1,964.3
Shark, Silky	419	1,804.1	1,556.4	1,488.9	1,439.8
Tuna, Albacore	332	976.7	1,233.2	1,440.7	1,360.5
Shark, Blue	263	915.6	976.9	1,018.7	1,092.8
Barracuda, Great	252	1,356.5	936.1	904.2	819.6
Dolphinfish	3	13.6	11.1	147.7	136.6

Appendix B: Seasonal Coverage and Expected Bias Direction

April through June (Q2) was consistently underrepresented in the observer record relative to the 2025 fleet's seasonal fishing pattern. This is a persistent feature of the observer program, not an artifact of the chosen window; extending the proxy pool back to 2021 or 2022 does not meaningfully close the Q2 gap (Figure B1).

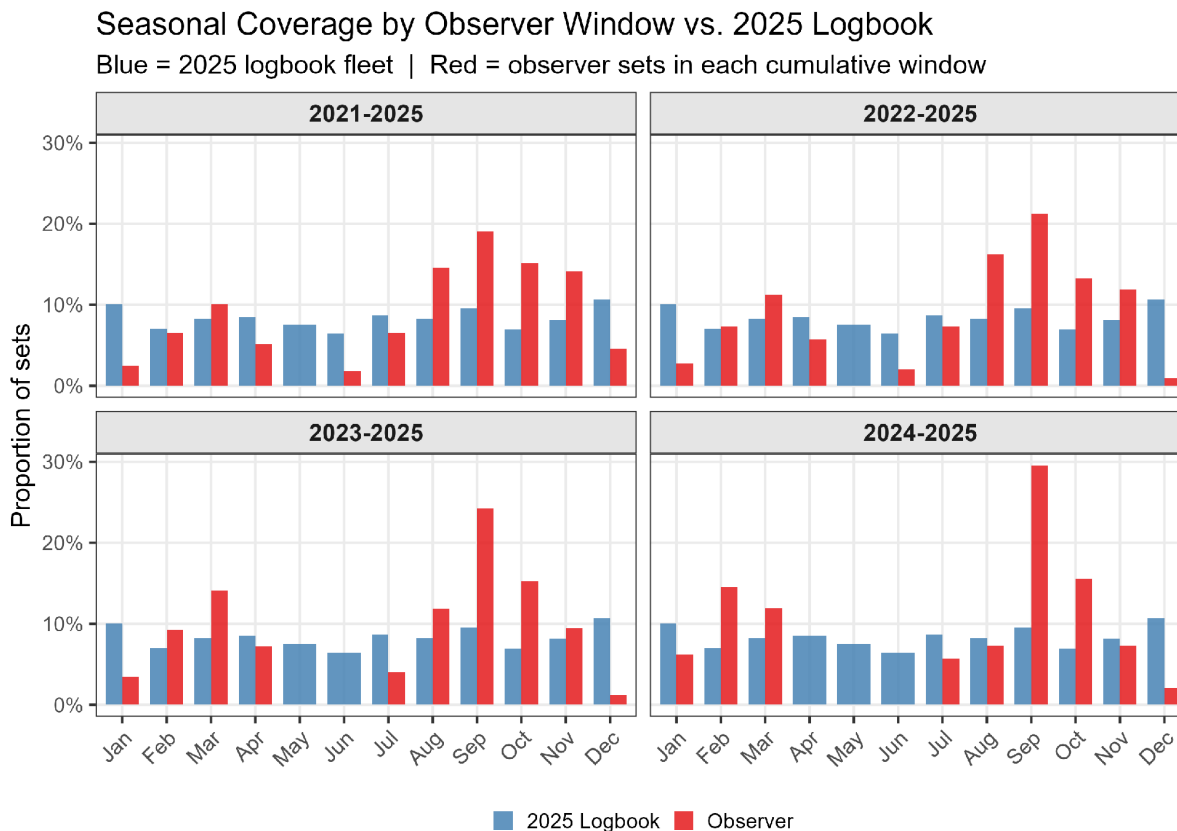


Figure B1. Monthly proportions of longline sets for the 2025 logbook fleet (blue) and observer sets in each cumulative proxy window (red), for all four candidate windows. April through June is underrepresented across all windows, confirming that Q2 underrepresentation is a structural feature of the observer program rather than an artifact of the chosen window.

Table B1 shows observer and fleet hooks by quarter for the 2023–2025 comparison. Q2 observer hook coverage was 2.9% of 2023–2025 fleet hooks, compared with 11.3%, 12.8%, and 9.6% in Q1, Q3, and Q4.

Table B1. Observer and fleet hooks (thousands) by quarter, 2025 fleet and 2023–25 window. Q2 = April–June. % Observed = 2023–25 observer hooks as a percentage of 2023–25 fleet hooks.

Period	Q1	Q2	Q3	Q4
2025 Fleet (hooks, 000s)	1,031	949	1,099	1,088
2023–25 Fleet (hooks, 000s)	2,801	2,942	3,438	2,954
2023–25 Observed (hooks, 000s)	317	85	438	282
2023–25 % Observed	11.3%	2.9%	12.8%	9.6%

To assess whether Q2 underrepresentation is likely to bias individual species estimates, a trip-level Wilcoxon rank-sum test compared observed bycatch CPUE in Q2-dominant trips against non-Q2-dominant trips using the full 2012–2025 observer record (2012 is the first full year following the September 2011 gear modification ruling (Western Pacific Pelagic Fisheries; American Samoa Longline Gear Modifications To Reduce Turtle Interactions, 2011). Each trip was assigned to the quarter in which most of its hooks were set to avoid within-trip pseudoreplication. Table B2 shows species for which the test detected a significant Q2 difference ($p < 0.05$). “Underestimate” indicates Q2 CPUE is significantly higher than non-Q2 CPUE, so the proxy pool’s Q2 underrepresentation likely pulls the estimate downward; “Overestimate” indicates the reverse. These tests are intended as diagnostic evidence of expected bias direction, not as formal bias corrections to the 2025 estimates.

Table B2. Species with a significant Q2 vs. non-Q2 CPUE difference (trip-level Wilcoxon rank-sum test, $p < 0.05$), 2012–2025 observer record. Each trip assigned to its majority-hooks quarter. Significance: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, $p < 0.1$.

Species	p (trip-level)	Expected bias
Shark, Blue	0.0067 **	Underestimate (Q2 elevated)
Shark, Shortfin Mako	0.0085 **	Overestimate (Q2 lower)
Shearwater, Unidentified	0.0408 *	Underestimate (Q2 elevated)
Albatross, Black-footed	0.0408 *	Underestimate (Q2 elevated)

Trip size and CPUE-effort relationships. The body text notes that observer trips in the proxy pool deployed more hooks per trip than typical 2025 fleet trips, which could produce downward-biased estimates for species whose CPUE decreases with trip effort. Blue shark shows the strongest negative relationship between hooks per trip and CPUE over the full 2012–2025 record ($\rho = -0.19$) and the 2020–2025 period alone ($\rho = -0.70$) and is the species most likely to have downward-biased estimates from this source. Silky shark shows a moderate negative relationship over 2020–2025 ($\rho = -0.29$), though sample sizes are small (15 observer trips). These correlations are

intended as diagnostic evidence of expected bias direction, not as formal bias corrections to the 2025 estimates.