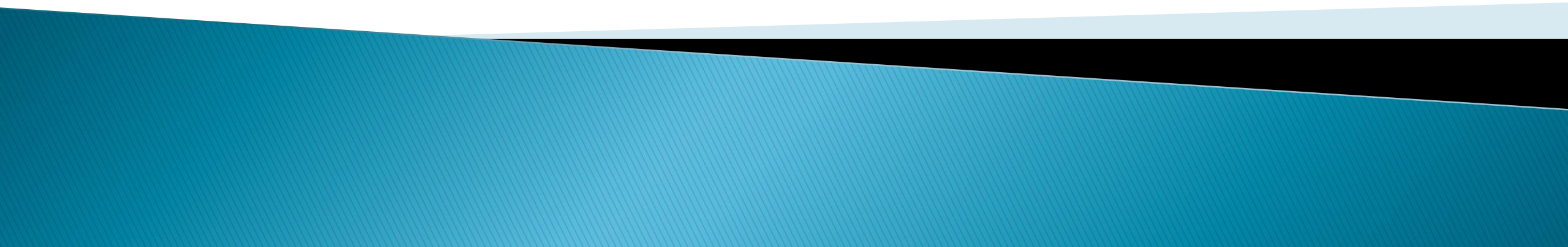


An assessment of the quantity of abandoned, lost, or discarded pelagic longline fishing gear in the Western and Central Pacific Fisheries Convention Area

WCPFC–SC22–2026–EB–WP1 1

Keith Bigelow, Aurélien Panizza, Tiffany Vidal & Raymond Clarke



Marine Pollution

Conservation and Management Measure on Marine Pollution 2017–04

Gilman et al. (2021) assessed relative risks arising from loss of 18 fishing gear classes based on:

- 1) rate of production of ALDFG,
- 2) fishing effort and
- 3) adverse ecological and socioeconomic impacts of ALDFG

The highest risk tuna gears were purse seine with fish aggregating devices (FADs, 3rd in the overall rank), pole-and-line with anchored FADs (5th), and pelagic longline had a relatively low risk (13th)

WCPFC-CA Marine Pollution – GEN-6 form

Richardson et al. (2015) analyzed more than 10,000 pollution incidents by purse seine vessels and more than 200 incidents by longline vessels characterized by “Waste Dumped Overboard as Plastics, Metal, Waste Oil, Chemicals, Old Fishing Gear and General Garbage” within the Exclusive Economic Zones (EEZs) of 25 WCPFC CCMs and the High Seas.

From a total of 1,940 fishery observer trips from 2003 to 2015, there were 84 trips (4%) with reported longline ALDFG incidents with observer coverage.

SPC/FFA REGIONAL OBSERVER POLLUTION REPORT										FORM GEN-6									
REVISED MARCH 2014																			
OBSERVER NAME				VESSEL NAME				OBSERVER ID NUMBER		PAGE OF									
- fill in one form for each pollution incident -																			
INCIDENT DETAILS																			
DD		Ship's DATE and TIME MM		YY		hh		mm		LATITUDE (dd°mm.mmm')		N / S	LONGITUDE (ddd°mm.mmm')		E / W	EEZ / HARBOUR			
WIND DIRECTION				WIND SPEED				SEA CONDITIONS (C, S, M, R)				CURRENT : (knts and direction °)				OBSERVER'S VESSEL ACTIVITY			
NAME OF OFFENDING VESSEL						IRCS		TYPE OF VESSEL		YOUR POSITION FROM OFFENDING VESSEL Compass Bearing Distance (nautical miles)									
WASTE DUMPED OVERBOARD																			
Material		Tick each box that applies:		Describe Type						Describe Quantity									
Plastics		↓																	
Metals																			
Waste oil																			
Chemicals																			
General garbage <i>(within 12 miles of shoreline)</i>		di acri																	
OIL SPILLAGES AND LEAKAGES																			
Source				Tick each box that applies:		Visual Appearance / Colour				Describe Area and Quantity									
Vessel Aground / Collision				↓															
Vessel at Anchor / Berth																			
Vessel Underway																			
Land based source - Describe source																			
Ot he																			
Abandoned or Lost Fishing Gear																			
Source				Activity		Describe Gear				Estimate Quantity									
Lost during fishing																			
Abandoned																			
Dumped																			
Other comments:																			
<i>W</i> <i>Did you take any photos?</i> <i>IJ</i> <i>**</i> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding: 5px;">Y / N</td> </tr> <tr> <td style="padding: 5px;">Y / N</td> </tr> </table>												Y / N	Y / N						
Y / N																			
Y / N																			
MARPOL Regulations - state																			
<i>It is illegal for any vessel to discard any form of plastics into the sea at anytime.</i> <i>It is illegal for any vessel to discard any form of oil into the sea at anytime.</i> <i>It is illegal for any vessel to dump any form of rubbish into the sea within 12 nautical mile of the sea shore.</i>																			

Observer declarations of ALDFG (GEN-6)

Observers categorized the occurrence of ALDFG for a particular longline set as “lost during fishing” “abandoned” or “dumped” in accordance with following definitions.

‘Lost fishing gear’ should be used when a portion of the primary fishing gear – mainline, branchline or floatline is lost and the vessel makes an attempt to recover the gear but is unable to.

‘Abandoned gear’ should be used where gear is lost and the vessel does not or cannot safely attempt to recover it.

‘Dumped gear’ is when part of the primary fishing gear (for example, the lines) is deliberately dumped as a means of disposal.

The term “dumped” is hereafter referred to as “discarded”.

Pelagic longline – deep set

One gear segment

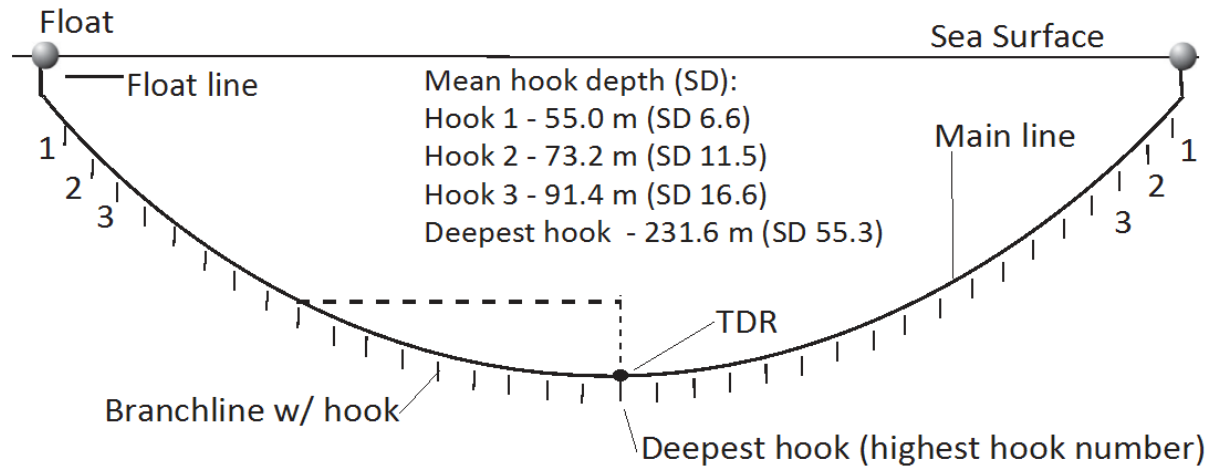
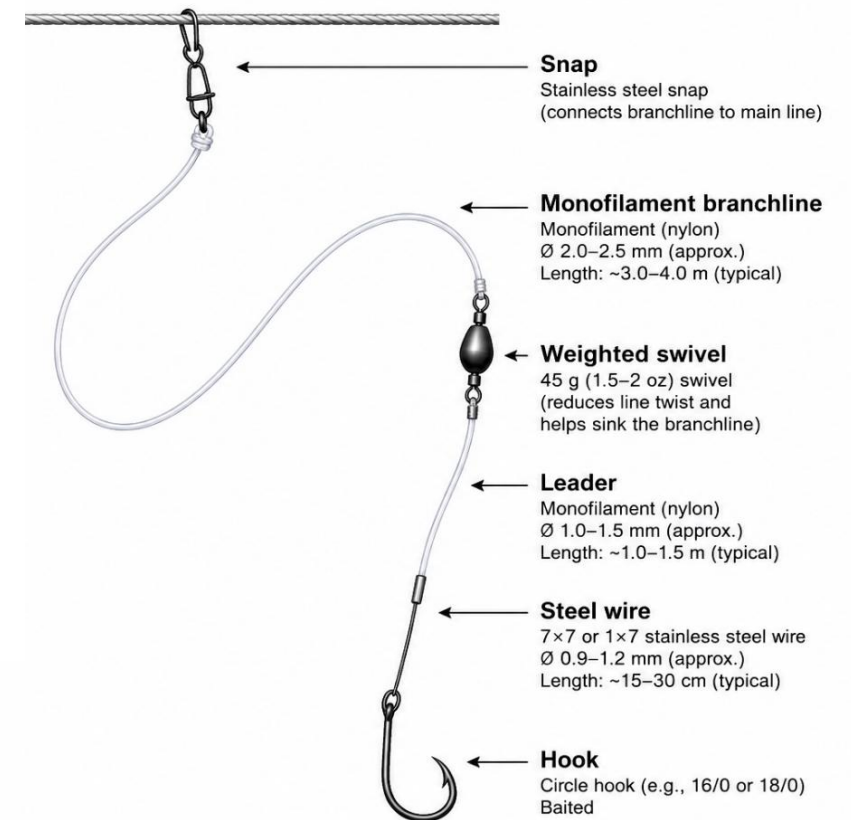


Figure 1. Illustration of one section (typically 23–36 hooks between floats) of a longline set, repeated in many sections (up to <100 times). The catenary is drawn to scale with the exception of branchline lengths, which were doubled for the purpose of illustration. Hook numbering scheme, time-depth recorder (TDR) location, and average settled hook depths (1 SD) are shown. The intersecting dashed lines illustrate the relationship of the intermediate horizontal position along the catenary with a depth 0.73 times that of the deepest position along the catenary.

Branchline, snood or gangion



American Samoa – Watson & Bigelow 2014

Longline gear loss

Richardson et al. (2022) interviewed 451 fishers from seven countries about annual fishing effort and ALDFG incidents across multiple fisheries.

60 longline fishermen were surveyed, including 15 fishermen each from New Zealand, Indonesia, U.S. and Peru.

Global estimates were based on how much fishing gear they lose annually and multiplied reported losses by global fishing effort data.

For pelagic longline fisheries, surveys indicated that annual global ALDFG incidents involved:

- 1) 3.33% ($\pm 0.59\%$) of all mainlines,
- 2) 3.58% ($\pm 0.78\%$) of all branchlines, and
- 3) 2.86% ($\pm 0.55\%$) of all hooks

Project objectives

- 1) update the Richardson et al. (2015) study with observer data from 2005 to 2024 to better characterize longline ALDFG;
- 2) quantify eight ALDFG metrics from observer data, including mainline length and weight, branchline length and weight, combined line length and weight, and number of buoys and radio beacons;
- 3) discuss potential drivers for longline ALDFG;
- 4) provide quantitative estimates of ALDFG for the WCPFC–CA longline fisheries which has not previously been conducted; and
- 5) gather information from WCPFC CCMs on management and disposal of end-of-life longline gear when vessels arrive in port.

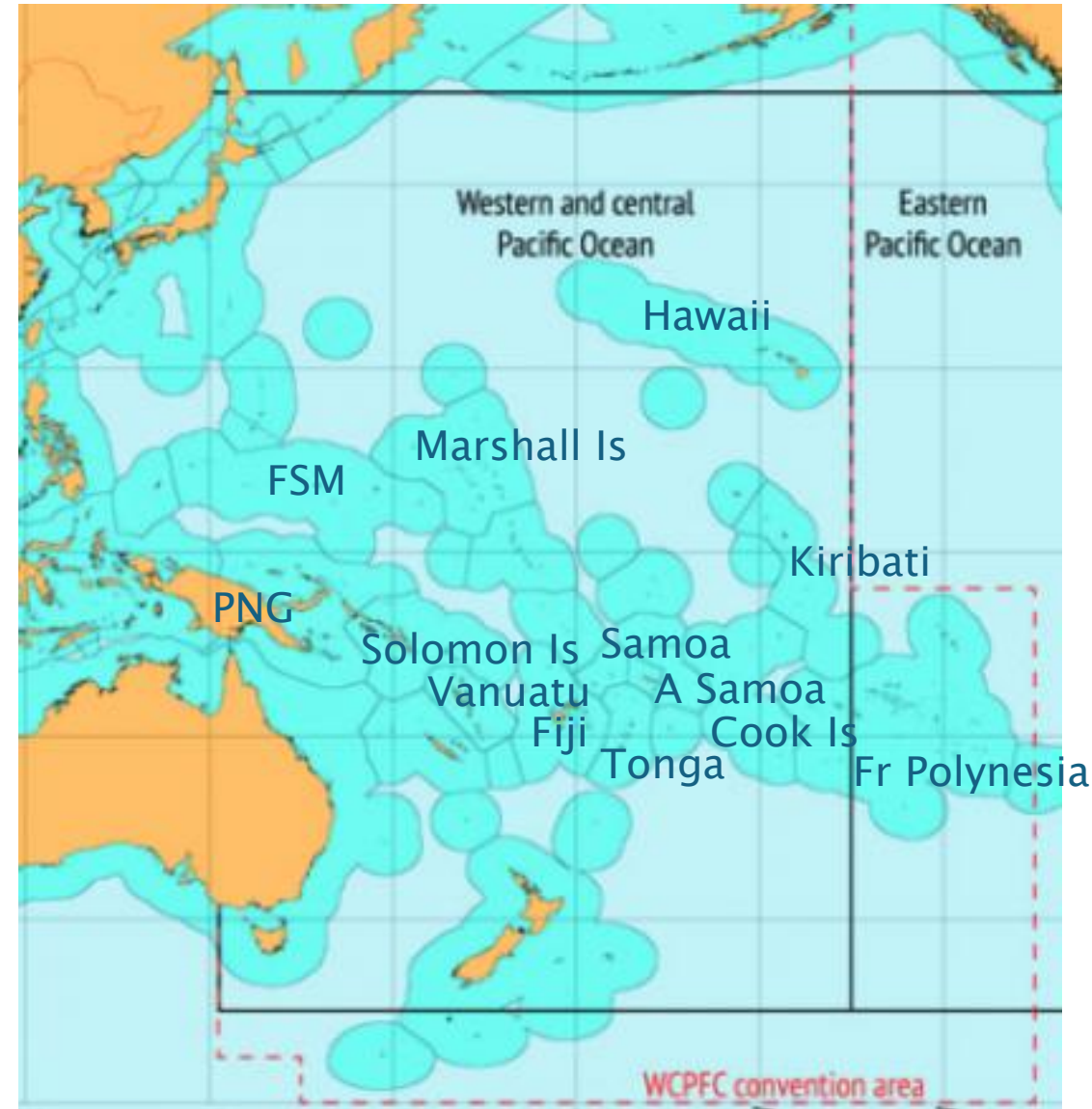
Data – GEN–6 (11 CCMs) and Pacific Islands Region Observer Program (2 CCMs).

Time – 2005 – 2024

- ALDFG incidents were reported on 4.8% of the trips analyzed (477 of 9,864 trips)
- Incidents occurred on 8.7% of trips covered by GEN–6 data (347 of 3,985 trips) and
- 2.2% of trips covered by PIROP data (130 of 5,879 trips)

GEN–6 – 706 separate incidents

PIROP – 138 separate incidents



WCPFC-CA Marine Pollution

Observed vessel flag	Number of trips	Number of GEN6 pollution incidents	Number of GEN6 ALDFG incidents	Number of trips with GEN6 ALDFG incidents	Percentage of trips with ALDFG
Cook Islands	94	80	18	10	10.6%
Fiji	2,037	871	343	177	8.7%
FSM	129	228	80	29	22.5%
Kiribati	51	15	3	3	5.9%
Marshall Islands	256	300	50	32	12.5%
French Polynesia	826	152	83	36	4.4%
Papua New Guinea	96	219	35	16	16.7%
Solomon Islands	70	295	58	18	25.7%
Tonga	192	71	8	3	1.6%
Vanuatu	177	211	26	21	11.9%
Samoa	57	26	2	2	3.5%
Total	3,985	2,468	706	347	8.7%
	Number of trips		Number of ALDFG incidents	Number of trips with ALDFG incidents	Percentage of trips with ALDFG
Hawaii	5,622		110	105	1.9%
American Samoa	257		28	25	9.7%
Total	5,879		138	130	2.2%

Challenges for quantifying ALDFG

Observers record ALDFG incidents in the “Comments” field. These data are not easily extracted

Unstandardized methodology in recording ALDFG as length, weight and number of longline segments abandoned or lost

Conversions were developed to convert length to weight and weight to length

Mainline – 25 kgs = 1 nm

Branchline – 4.5 kgs = 1 nm

Observers estimated the volume of mainline and branchline discarded using multiple container types



GEN-6 and PIROP data

	GEN-6	PIROP
Trips	347	130
Incidents	706	138
Abandoned incidents	55	13
Lost incidents	64	125
Discarded incidents	587	0
Incidents in EEZs	645 (91%)	72 (52%)
Incidents in the High seas	61 (9%)	66 (48%)

ALDFG – GEN–6 and PIROP

GEN-6 mean per incident (n=706)						PIROP mean per incident (n=138)		
		Mean					Mean	
	All	Abandoned	Lost during fishing	Discarded		All	Abandoned	Lost during fishing
Mainline length (meters)	560.5	335.2	2,714.9	346.8		3,891.6	5,620.9	3,726.9
Mainline weight (grams)	7,538.2	4,519.7	36,648.6	4,656.0		52,533.2	75,876.6	50,309.9
Branchline length (meters)	448.5	380.0	1,788.6	308.8		1,363.6	1,915.0	1,311.1
Number of branchlines	29.9	25.3	119.2	20.6		90.9	127.7	87.4
Branchline weight (grams)	1,965.5	1,654.7	7,669.2	1,372.8		5,847.1	8,211.3	5,621.9
Mainline plus branchline length (meters)	1,009.0	715.2	4,503.5	655.5		5,255.3	7,535.9	5,038.1
Mainline plus branchline weight (grams)	9,503.7	6,172.7	44,317.7	6,020.0		58,380.2	84,087.8	55,931.9
Number of buoys	0.508	0.618	4.422	0.072		4.239	5.583	4.111
Number of radio beacons	0.028	0.018	0.188	0.012		0.254	0.167	0.262

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Drivers for abandoned longline gear

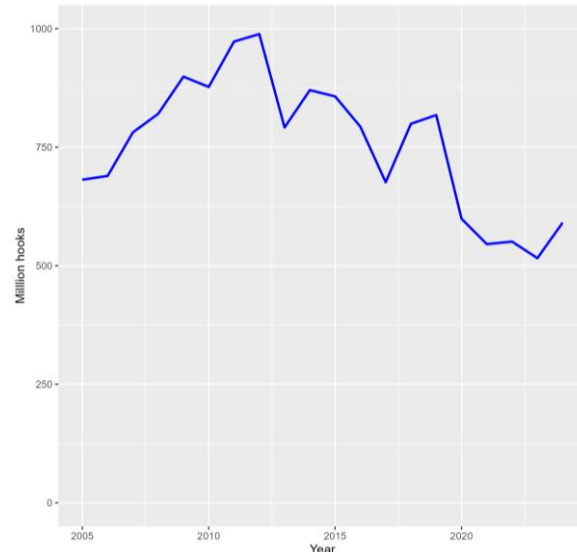
Abandoned fishing gear								
Category								
1	Gear abandoned to start next longline set							1
2	Mainline gear separated							3
3	Interaction with a seamount							3
4	Interaction with a drifting object, usually a dFAD							9
5	Unknown reason							38
6	Operator error							1
7	Something very heavy on gear							3
8	Large gear tangle							10
Total								68

Drivers for lost longline gear

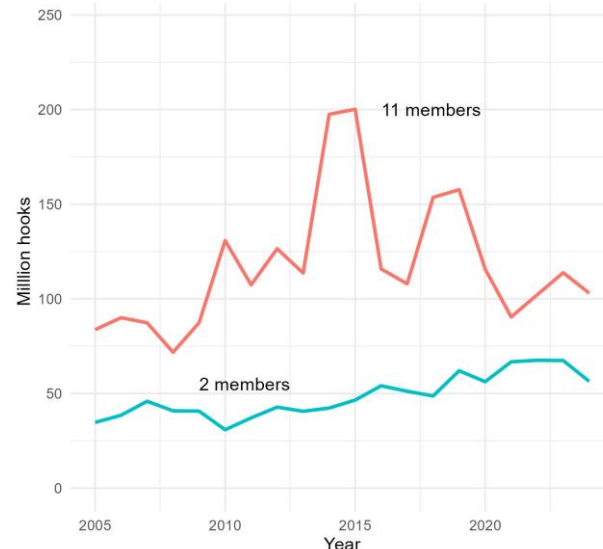
Lost fishing gear							
Category							
1	Line parted and could not find and retrieve gear						57
2	Unknown reason						88
3	Could not find the end radio buoy to retrieve backwards						12
4	Operator error (e.g. poor snap placement, branchline dropped into the ocean)						7
5	Something very heavy on gear						2
6	Gear cut or stolen by another vessel						10
7	Gear caught on propeller						9
8	Lost due to rough seas or strong current						4
Total							189

Raising ALDFG to WCPFC-CA

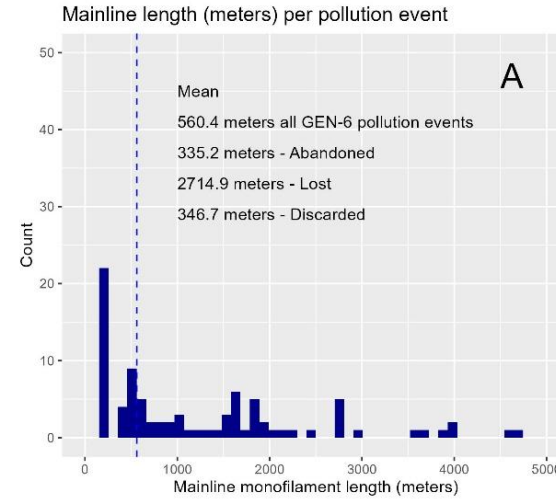
WCPFC-CA
longline effort



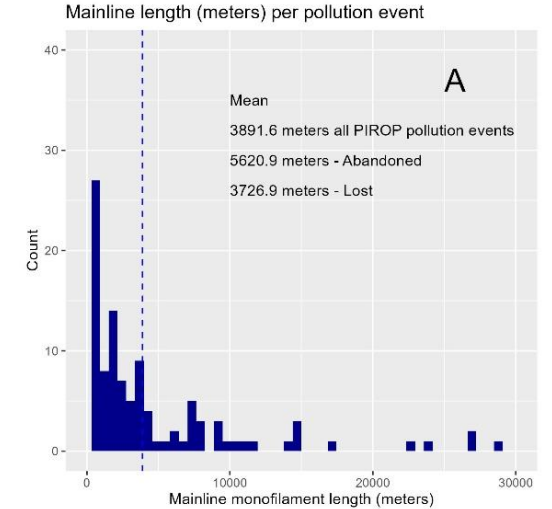
WCPFC-CA
Longline effort
By 11 and 2
CCMs



GEN-6 706 ALDFG incidents



PIRO 138 ALDFG incidents



Sample each distribution 5,000 times

Sum all values and divide by an assumed longline set effort of 3,000 hooks

Scale to 2015 WCPFC-CA longline effort of 857 million hooks

11 CCMs with GEN-6 data had 81.1% of effort and were raised to the 857 million hooks

2 U,S, CCMs with PIROP data had 18.9% of effort and were raised to the 857 million hooks

A procedure was applied to mainline weight, branchline length and weight, number of buoys and radio beacons

Analyses proceeded with the four assumptions for longline sets within a trip that had no observer documented ALDFG

Four scenarios in raising ALDFG

Assumptions – longline set is the sampling unit, 3,000 hooks and 15 sets in a trip

GEN-6 percentage of trips with ALDFG – 8.7%

PIROP percentage of trips with ALDFG – 2.2%

Scenario 1 (not plausible) – Highest ALDFG. All 15 sets in a trip are assumed to have 100% ALDFG.

Scenario 2 (not plausible) – Lowest ALDFG. One of 15 sets in a trip are assumed to have ALDFG and 14 sets have zero ALDFG.

Scenario 3 – Intermediate ALDFG. One of 15 sets in a trip are assumed to have ALDFG and 14 sets have 50% ALDFG.

Scenario 4 – Intermediate ALDFG. One of 15 sets in a trip are assumed to have ALDFG and 14 sets have 25% ALDFG.

WCPFC–CA estimates of ALDFG

	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	All 15 sets in a trip have 100% ALDFG	1 of 15 sets in a trip has 100% ALDFG	1 of 15 sets in a trip has 100% ALDFG	1 of 15 sets in a trip has 100% ALDFG
ALDFG loss (mean 2005–2024)			14 sets with 50% ALDFG	14 sets with 25% ALDFG
Mainline length (kms)	396,231	26,160	183,225	91,534
Mainline weight (mt)	5,319	351	2,449	1,220
Branchline length (kms)	184,258	12,399	87,184	43,821
Branchline weight (mt)	809	54	377	188
Mainline plus branchline length (kms)	580,489	38,559	270,409	135,355
Mainline plus branchline weight (mt)	6,128	404	2,825	1,408
Number of buoys	42,306	2,807	19,685	9,852
Number of radio beacons	2,504	168	1,200	595
Number of branchlines	12,283,881	826,602	5,812,282	2,921,416
Number of hooks	8,814,659	592,583	4,148,590	2,080,704
Branchline %	1.64	0.11	0.78	0.39
Hook %	1.19	0.08	0.56	0.28
Confidence intervals calculated after SC22				

WCPFC–CA ALDFG comparison of studies

WCPFC reference year 2015				
Longline effort	857	million hooks		
Mainline length	30,640,606	kms		
Branchline length	12,855,000	kms		
Loss (Richardson et al. 2022)		Loss – this study		
		1 of 15 sets in a trip has 100% ALDFG,		
		14 sets with 25% ALDFG		
Mainline loss (%)	3.30	0.30		
Mainline loss (kms)	1,011,140	91,534		
Branchline loss (%)	3.58	0.39		
Branchline loss (million)	28.97	2.92		
Branchline loss (length)	434,499	43,821		
Hook loss (%)	2.86	0.39		
Hook loss (million)	24.51	2.08		

Disposal of gear when vessels arrive in port

Interviews at WCPFC22

American Samoa
Australia
Cook Islands
French Polynesia
South Korea
Tonga
Solomon Islands

Deposed of
on land

Interviews at SC22 margins?

China
Chinese–Taipei
Indonesia
Japan
Kiribati
New Caledonia
New Zealand

Directed Port Surveys

FSM & RMI – end-of-life purse seine gear is managed through an established and largely effective private-sector system.

U.S. Hawaii – longline gear incinerated for electrical power, other fishing gear (mostly trawls) collected and fishers paid \$1 USD per pound. 90 mt collected since November 2022.

Reducing abandoned and lost gear



The secondary cause of gear loss in 'lost during fishing' incidents is when the vessel cannot locate the radio buoy at the end and the gear cannot be retrieved.

Radio beacons are not commonly used in contemporary pelagic longline fisheries as direction finders are difficult to procure.



There are modern GPS/AIS longline buoys that may reduce gear loss and are preferred to radio buoys. These buoys are battery or solar powered and can transmit consistent and accurate GPS positions to the vessel.



Recommendations

- 1) Increase longline observer coverage.
- 2) Explore opportunities to capture ALDFG indicators via electronic monitoring. Longline fleets could expand the scope of EM indicators to examine ALDFG incidents, including quantities and drivers.
- 3) Extend ALDFG reporting to the entire WCPFC ROP.
- 4) Extend ALDFG reporting to additional WCPFC fleets.
- 5) Update the GEN-6 and PIROP forms. Both the GEN-6 and PIROP forms could be updated to facilitate analysis.
- 6) Require observer training on ALDFG reporting. Observer training could be adapted to include a specific module on reporting ALDFG incidents.
- 7) Request authorization for the release of observer journals that may contain ancillary data to inform ALDFG estimations.
- 8) Identify opportunities for improving gear management at the end of its useful life to prevent discard or incidental loss. CCMs could consider identifying circumstances and their respective port facilities and possible end-of-life gear management options.