PACIFIC TUNA TAGGING PROJECT

Phase 2 (Central Pacific)

Cruise CP-16, 16 August to 29 September 2023

SUMMARY REPORT

Jeff Muir, Fabien Forget, Marion Boutigny, and Chris Stoehr

INTRODUCTION

This report summarizes activities during the 45 days of the sixteenth Central Pacific research cruise (CP-16), on the Honolulu-based F/V Gutsy Lady 4. The cruise was designed for tagging and sampling in a geographic area suited to a Hawaii arrival and departure that maximized working days at sea (vs. steaming) and involved no intermediate port stops for provisioning or crew change. CP-16 was designed to augment data collection for studies on tuna movements, exploitation rates and fish aggregation device (FAD) association dynamics in the WCPO. It was the third major tagging event to incorporate significant numbers of drifting FADs (dFADs) in the geographical area as part of its sampling design. Additionally, it visited only one TAO mooring, which traditionally these cruises were completely dependent on for finding aggregations of fish suitable for tagging and sampling. The geographic area of CP-16 was 13ºN-5ºS, 161ºW-152ºW, in international waters, Palmyra atoll and the Line Islands within the EEZ of Kiribati. (**Figure 1**).

Locations of dFADs were made possible by the cooperation between SPC, Cape Fisheries, Bolton, Trimarine, Oakcity Tuna Fishing Corporation and the U.S. Tuna Group.

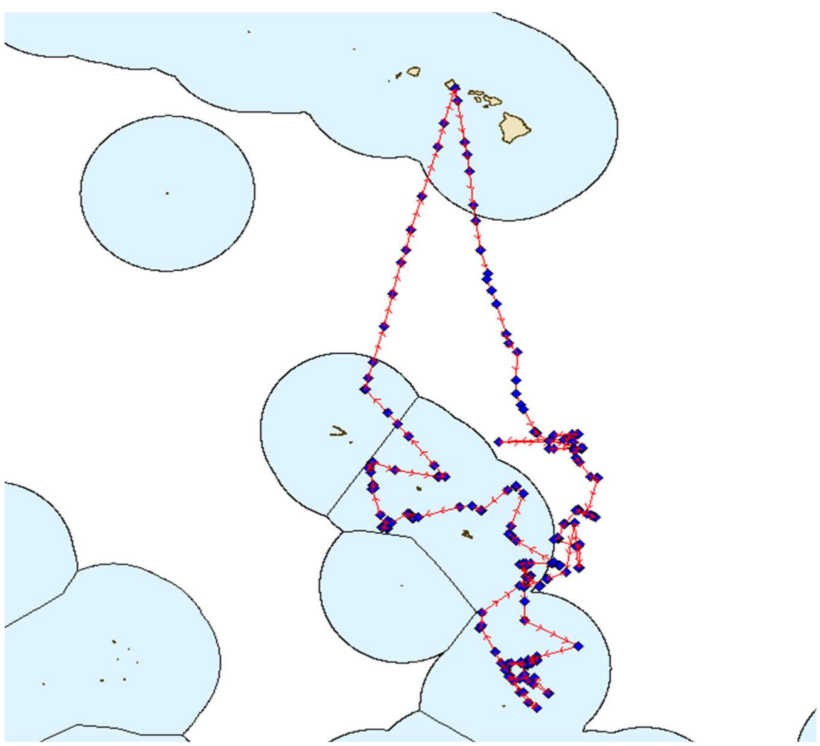


Figure 1: Fourty-five day cruise track (red arrows) of the 5980nm and daily positions (blue squares) of CP-16.

Crew and scientific personnel onboard Gutsy Lady 4 during CP-16 are listed in **Table 1**.

Table 1: Personnel onboard Gutsy Lady 4 during CP-16

Name	Title/affiliation	Nationality
Tim Jones	Captain	U.S.
Ben Stephens	Contractor	U.S.
Jeff Muir	Cruise Leader/SPC	U.S.
Chris Stoehr	Contractor	U.S.
Marion Boutigny	Technician/SPC	France
Fabien Forget	Scientist/IRD	Mauritius
Ade Satiya	Crew	Indonesia
Prio Nurwanto	Crew	Indonesia
Warsito	Crew	Indonesia
Rosikin	Crew	Indonesia
Kusnendri	Crew	Indonesia
Jaenel Abidin	Bosun	Indonesia

GENERAL DESCRIPTION OF VESSEL

The FV Gutsy Lady 4 is a 30 meter steel vessel (**Picture 1**) previously outfitted for shrimp trawling in the Gulf of Mexico. It is now equipped with longline gear and used for fishing pelagic fish (mainly tuna, with bigeye as the main target) in the Central and Eastern Pacific. The vessel is fitted with two 600hp Cummins engines, two 70 KVA Cummins generators, and one water-maker (80 l/h). The vessel is fully equipped with Furuno electronics including 3 VHF and 1 SSB radios, radar and dual frequency sounders (FCV 295 + 3KW transducer), autopilot, AIS, a vessel monitoring system (CLS), 2 water temperature gauges, a longline LP system, two desktop computers for navigation (TimeZero navigation software) and the OrbMap oceanography information package. A new change for CP-16 is the installation and use of a Starlink internet antennae and modem, which made communication during CP-16 virtually identical to that available on land. It's current home port is San Diego, CA, with fishing time split between Hawaii and the west-coast of the USA.

The operational range of the Gutsy Lady 4 is over 10,000 nm and 60 days at 8 knots with a total fuel tank capacity of 110,000 litres. The boat also has a fresh water tank of 30 m^3 capacity and a 2 tons/day capacity ice-maker. The fish hold is divided into two parts, one dedicated as a fresh fish hold, where fish carcasses are dry-packed in flaked ice, typical in the Hawaii longline fishery (about 22 ton capacity), and one freezer compartment, mainly used to store frozen bait (about 15 tons).

The vessel is equipped with a stabilizer arm (**Picture 1).** This apparatus was designed to be deployed immediately after leaving port, and secured upon return, making it a fixed system.

Complete boat specifications are detailed in **Appendix 1**.

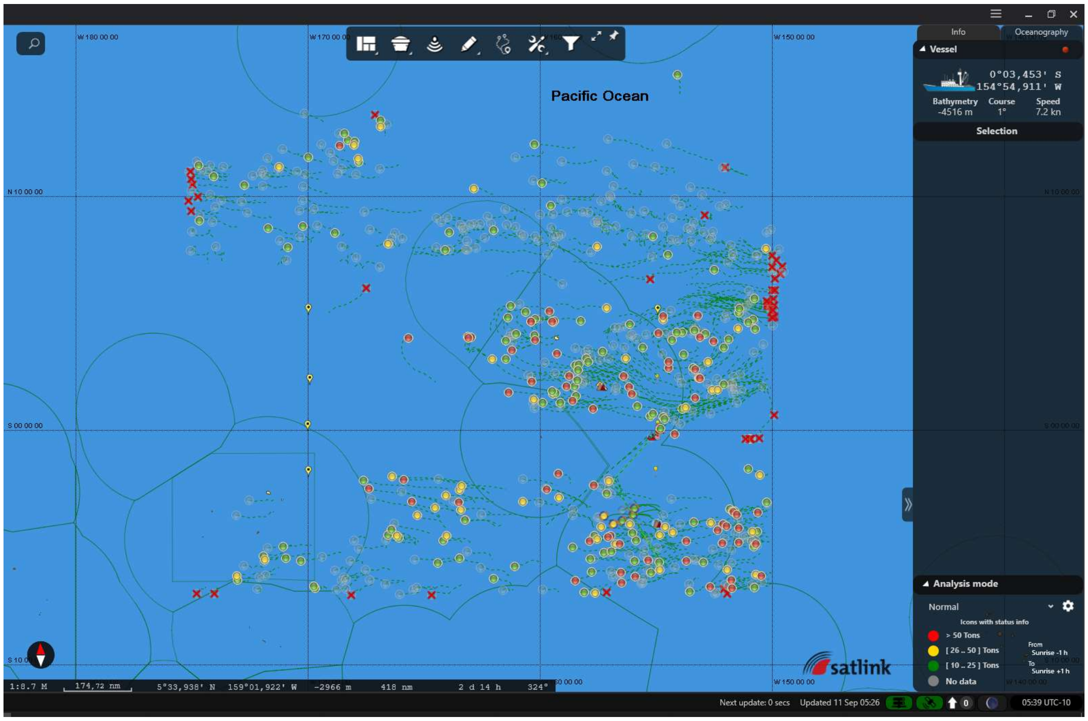
Picture 1: FV Gutsy Lady 4 at Kewalo Basin, Honolulu, Hawaii (left) stabilizer arm (right).

Prior to CP-16 departure, the GL4 was also outfitted with a Fleet One FB-250+ satellite communication system coupled with an “Oceanbox” data compression server (Thalos). The system was installed as a backup communication system as a precaution, since the Starlink system is still relatively new and reliability is somewhat undescribed in remote areas such as the equatorial Central Pacific. During the course of the cruise, the backup system was never used as Starlink performed well with only a few minor, momentary outages.

Access to dFADs and satellite buoy data information used during the cruise

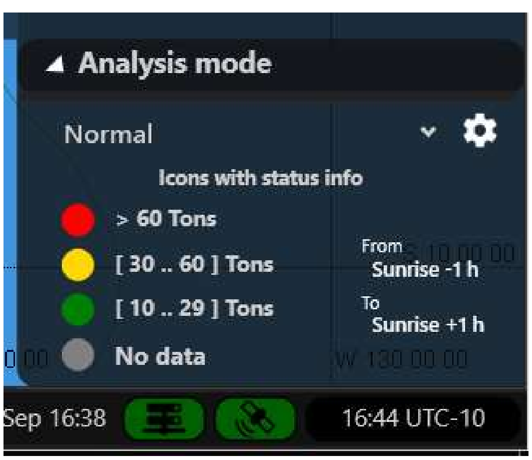
Cape Fisheries (formerly Trimarine), Bolton and TriMarine Group, Oakcity Tuna Fishing Corporation, and the US Pacific Tuna Group (USPTG) provided full access to dFADs owned by them, all of which are equipped with Satlink SLX satellite buoys, in the areas that the tagging vessel operated during the cruise. All of the companies agreed to share their buoys for the core of the tagging cruise, with this agreement made directly between SPC and Satlink which served as an umbrella for all participating companies. A geographic fence was installed, upon which their dFADs would appear and disappear when crossed (dFADs crossing into the WCPO over the 150W meridian were turned on, for example). (**Picture 2**). A handful of dFADs were also shared equipped with Marine Instruments buoys, but only one was visited. The Marine Instruments software proved to be more difficult to use and was not as reliable as the Satlink ELB3010 software. A total of 76 different dFADs were visited and fished, and a maximum of 1300 buoys shared over the course of the agreement. (See **Figure 3** for an overview of dFAD locations during release events).

Satlink ELB3010 Manager software was used for buoy management and querying.

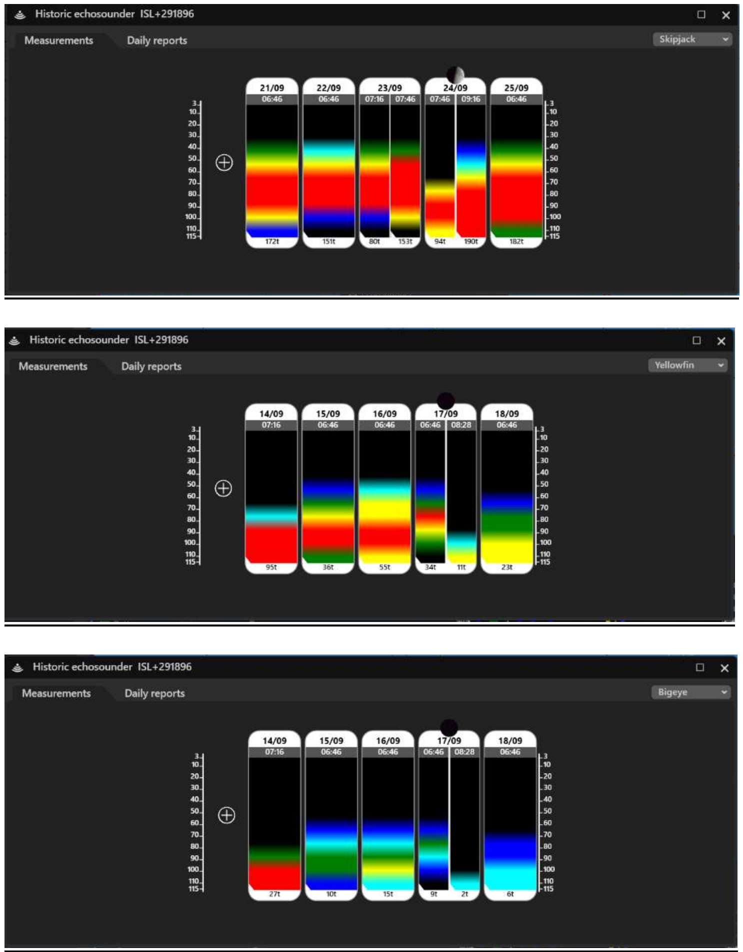


Picture 2: Screen display of Satlink ELB3010 Manager dFADs in CP-16 study area.

Each buoy utilized echosounder data collected at different times of the day (depending on the model of buoy) to estimate the tonnage of fish, and further categorized by species. A four color system (**Picture 3**) was used to differentiate tonnage estimates to make planning easier. Tonnage estimates (**Picture 4** as an example) seemed to be inaccurate, usually overestimating total tonnage probably because of the presence of bigeye (with larger swim bladders). However, there was no way to empirically confirm this with the resources available on the Gutsy Lady 4. It was useful to use the tonnage estimates more as a total biomass indication, rather than rely on it to make planning decisions based on how many tons of bigeye or yellowfin were predicted. This seemed to work well for the purposes of a hook and line tagging trip.



Picture 3: Color-coded tonnage estimates on ELB3010 software.



Picture 4: Tonnage estimates for SKJ, YFT and BET at a dFAD instrumented with an echosounder buoy

FISHING GEAR

For this tagging cruise, the vessel was fitted with 8 “danglers” (**Picture 5)**. This gear consists of stainless steel or aluminum davits which extend at right angles from the hull for 2 meters and deploy two short trolling lines which skip at the surface. This technique has been successfully used during the fourteen previous CP cruises as well as in Hawaii for other tagging programs. Initially developed for commercial fishing at offshore seamount and FAD tuna aggregations in Hawaii, it is still used in Hawaii by a handful of commercial fishermen.

Five danglers were placed on the starboard side and 3 on the port side. The troll lines hanging from the danglers consisted of a 2m length of 6mm rope spliced with loops at both ends, to which an 80cm length of 2mm monofilament line was fitted with a variety of trolling lures and a 7/0 Mustad galvanized barbless hook.

Picture 5. Dangler gear in action aboard the Gutsy Lady 4.

Six troll lines were also deployed on the stern of the vessel- three on hydraulic reels and three handlines. The lines consisted of 400 lbs monofilament line, to which a 5m length of 2mm monofilament line was attached and rigged with a trolling lure and a 7/0 Mustad galvanized barbless hook.

Sprayers were installed around the starboard and port gunwhales, where saltwater was directed at the lures in the water to mimic a school of fish, and also obscure the leaders and hooks on the lures.

Jigging (**Picture 6)** landed a large proportion of the fish tagged during CP-16. When conditions allowed, 5 rods and 4 handlines were jigging simultaneously, and this resulted in multiple hook ups for most of the duration of the jigging sessions. Timing of jigging sessions was also critical; 02:30 seemed to be a good start time as it allowed enough time before daylight to have a decent amount of effort, but at the same time not so early that it prematurely wore the crew down. Jigging after daylight was also useful during CP-16, resulting in many short but productive sessions to top off the morning's dangling school.

Picture 6. Jigging operations, day and night aboard the Gutsy Lady 4.

TAGGING OPERATIONS

For daytime tagging, three tagging stations were set up on the deck of the vessel. Two cradles were dedicated to conventional tagging (example of conventionally tagged fish in **Picture 7**), and one for $SrCL_2$ marking; all were of the same design to those previously used for pole-and-line tagging and CP cruises. One conventional cradle was placed at the stern of the vessel while the second one was positioned on the starboard side at midships. The $SrCL_2$ cradle was place forward on the starboard side near the vessel's aft house bulkhead. During nighttime jigging operations, one midships cradle was positioned on the port side of the vessel to free up space on the starboard gunwhale for fishing and also isolate the tagging cradle from the chaos that sometimes overflows during fishing. This port cradle was used for $SrCL_2$ marking, and then a conventional cradle was positioned forward for conventional tagging.

A dedicated cradle was set up specifically for acoustic tagging and supplied with a saltwater hose for irrigating the gills of fish during surgery. This cradle was placed in a central location on the deck. All cradles were marked with one cm graduations from 30cm to 120cm. Fish larger than 120cm were left on deck, tagged in place, and measured with calipers before release.

Picture 7: A nice specimen of bigeye tuna tagged with a conventional dart tag immediately before release.

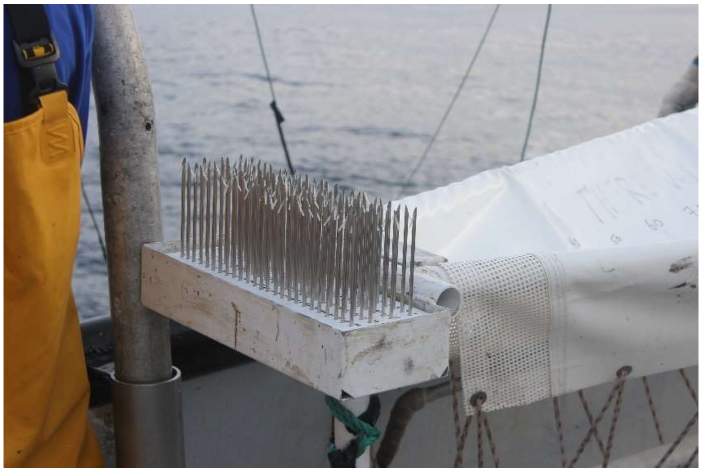
Data recording

Each tagger was equipped with a digital voice recorder enclosed in a waterproof sleeve. The first and last tag in each new block was read out before commencing tagging, and tag numbers were intermittently recorded and checked. After each fish was tagged, its length was recorded from the graduations on the cradles. Data were later transcribed onto hard copy release log sheets at the end of each tagging session. Data were subsequently entered into the Microsoft SQL Server data base “TagDager”.

Conventional tagging

Conventional tagging (CT) uses the 13cm yellow dart tag manufactured by Hallprint Ltd (**Picture 7**). After checking if fish did not present any severe injuries[1], the tag was inserted between the pterygiophores of the second dorsal fin using a sharp stainless steel applicator tube. Used applicators were collected and immersed in a bucket containing a solution of fresh water and bleach, rinsed in fresh water and dried for re-use. Prior to each tagging operation, tags were placed inside the applicators and mounted in numbered tagging blocks each holding 100 loaded applicators (**Picture 8**). There were eleven 100-tag blocks in total.

[1] Typical injuries, incurred by large hooks and the shock/trauma of hookset, included mouth/lower jaw damage, eye damage (from inside the mouth cavity) and bleeding from various locations, and ranging from superficial to heavy. Bites from cookie cutter sharks and wounds from sharks and billfish were also noted.



Picture 8: Conventional tagging cradle with 100 tag block ready for tagging.

FISH TAGGING RESULTS

A total of 11,296 tropical tunas were tagged and released during the cruise, comprised of 5,996 bigeye (53%), 4,485 yellowfin tuna (40%) and 815 skipjack (7%). Their size distributions are shown in **Figure 2.** The spatial distribution of all tuna tag releases is shown in **Figure 3**.

Table 2 summarizes the number of fish tagged per tag type and per species. **Figure 2** details the length frequency distribution of all released tropical tunas during CP1-16, with spatial distribution described in **Figure 3**.

Table 2: Numbers of tags deployed by tag type and species.

Tag type	BET	YFT	SKJ	OCS	Total
Conventional Y13	4608	4153	783	-	**9544**
Conventional W13 (SrCl marked)	1388	261	7	-	**1656**
Vemco V13P	-	70	-	-	**61**
Vemco V13	-	1	25	-	**26**
Satellite (miniPAT)*	-	1	-	23	**24**
*not included in grand total					
Total tuna tagged	5996	4485	815		**11,296**
Total fish tagged	**5996**	**4485**	**815**	**23**	**11,306**

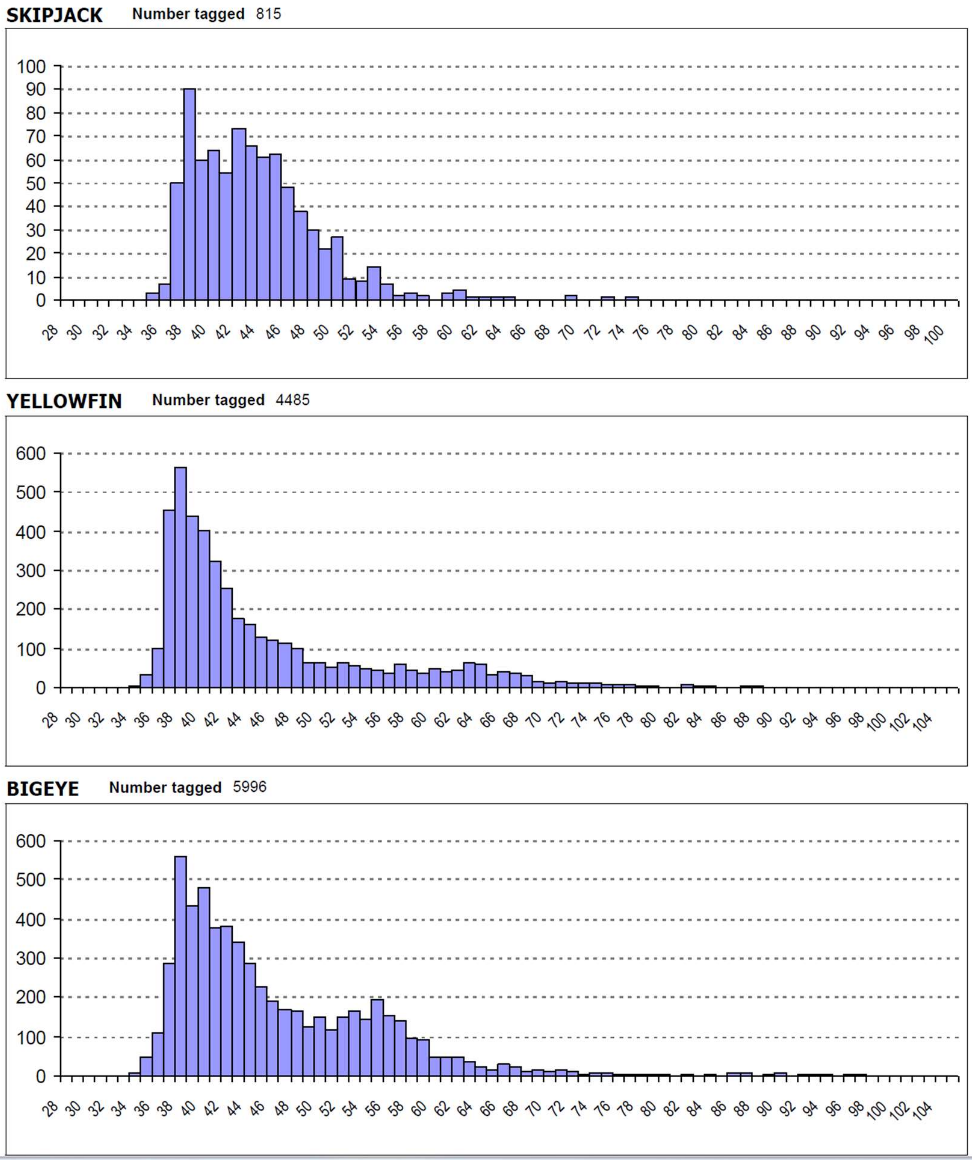


Figure 2: Length frequencies of releases by species, all tag types.

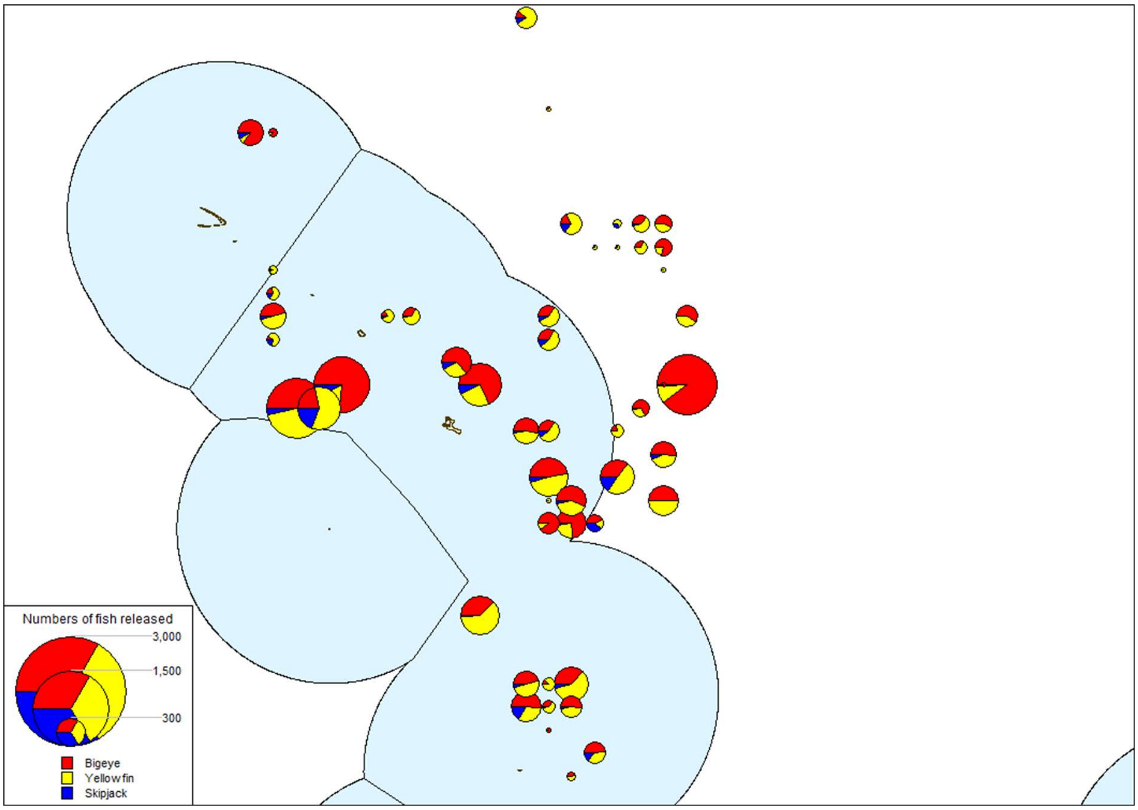
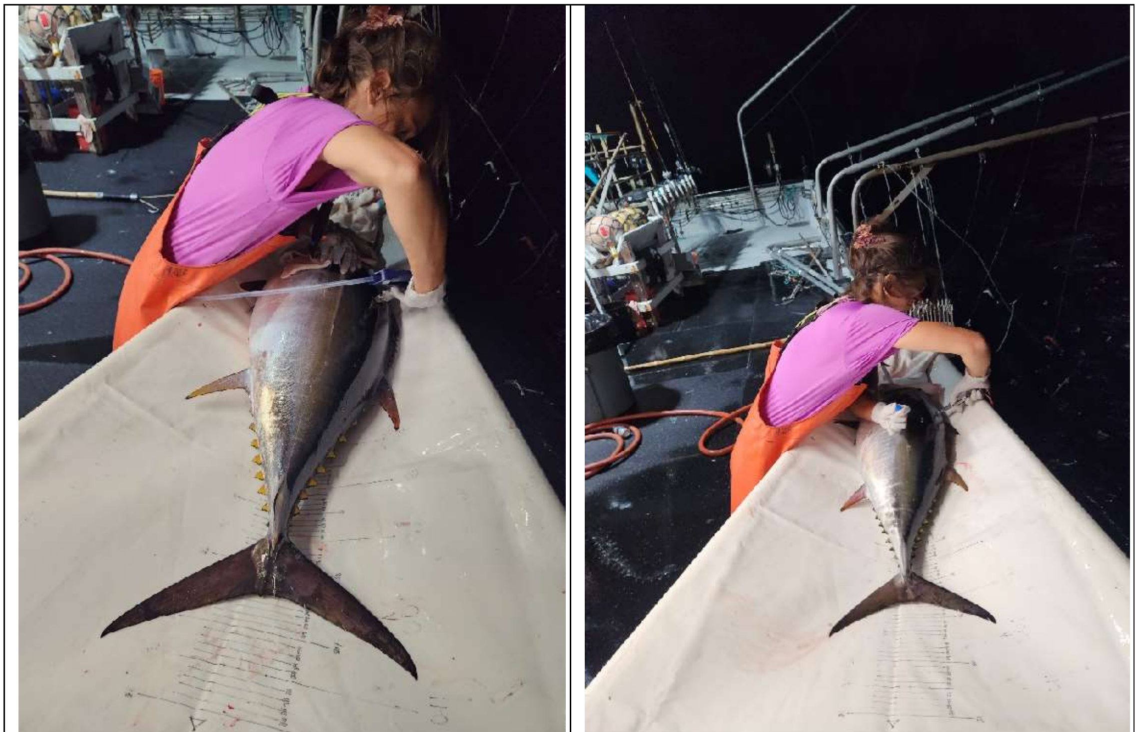


Figure 3: Spatial distribution of all releases during CP-16.

Strontium Chloride Marking

To address the need for updated otolith-based age validation, one of the main objectives for CP-16 was to release bigeye and yellowfin tuna injected with $SrCl_2$ with the hope of obtaining recaptures with at least 365 days at liberty. Additionally, a biopsy sample was desired from as many as possible of these $SrCl_2$ marked fish to calibrate epigenetic age models from recaptured fish. This work requires a dedicated technician and cradle during tagging operations, and it does slow down normal conventional tagging.

A veterinarian grade injection tool with a 16ga hypodermic needle attached to a 500ml bottle of $SrCl_2$ solution was affixed to the port midships cradle at night, and the starboard midships cradle during the day. Suitable (>42cm and <100cm) bigeye and yellowfin in good condition were routed to this cradle, and after condition of the fish was evaluated, a biopsy (**picture 9**) was sampled from this region and then placed in a 5ml vial containing RNAlater preservative. The live biopsy was taken with the "widget", (a stainless tool with a single use plastic tip) developed by CSIRO, Australia. The widget increases the chance of getting a good quality sample for genetic studies and no genetic cross contamination with previous fish sampled. The single use tip with a genetic sample was placed in a 2ml tube filled with RNAlater preservative. The fish was then injected (**picture 9**) with the proper dose of $SrCl_2$ solution, with the hypodermic needle insertion just posterior of the biopsy site, or in some cases, the fish was flipped and the injection occurred on the opposite side. The fish was then marked with a W13 conventional tag, measured to the nearest centimeter and released.



Picture 9. Bigeye injected with $SrCl_2$ solution (left) and then a live biopsy taken (right) on the port-midships cradle.

Results of this effort are in table 3.

Table 3. Results of $SrCl_2$ and live biopsy tagging protocol.

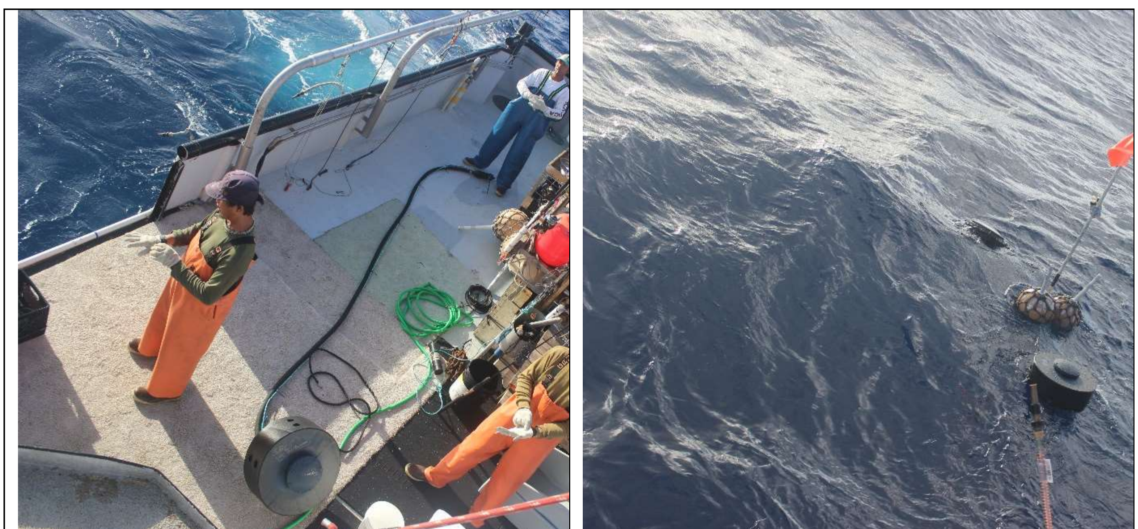
Type	BET	YFT	SKJ	Total
Conventional W13 (SrCl marked)	1388	261	7	**1656**
Live biopsy taken	821	129	1	**951**
Live biopsy % of total	**59.1**	**49.4**	**14.3**	**57.4**

Acoustic tagging

Ninety-six Vemco V13 and V13P acoustic transmitters were available for deployment. All tags were deployed; 71 in yellowfin and 25 in SKJ. Acoustic tagged tuna were externally marked with a yellow 13 cm conventional tag (versus orange; acoustic tags do not need to be returned to obtain data). Suitable sized tuna (>37cm for YFT and SKJ) were placed belly up on the V-shaped central tagging cradle, the eye covered with a synthetic chamois and the gills irrigated via the mouth by a seawater hose. All acoustic tags were implanted into the peritoneal cavity and the incision was closed with one or two sutures (**Picture 10**) prior to release.

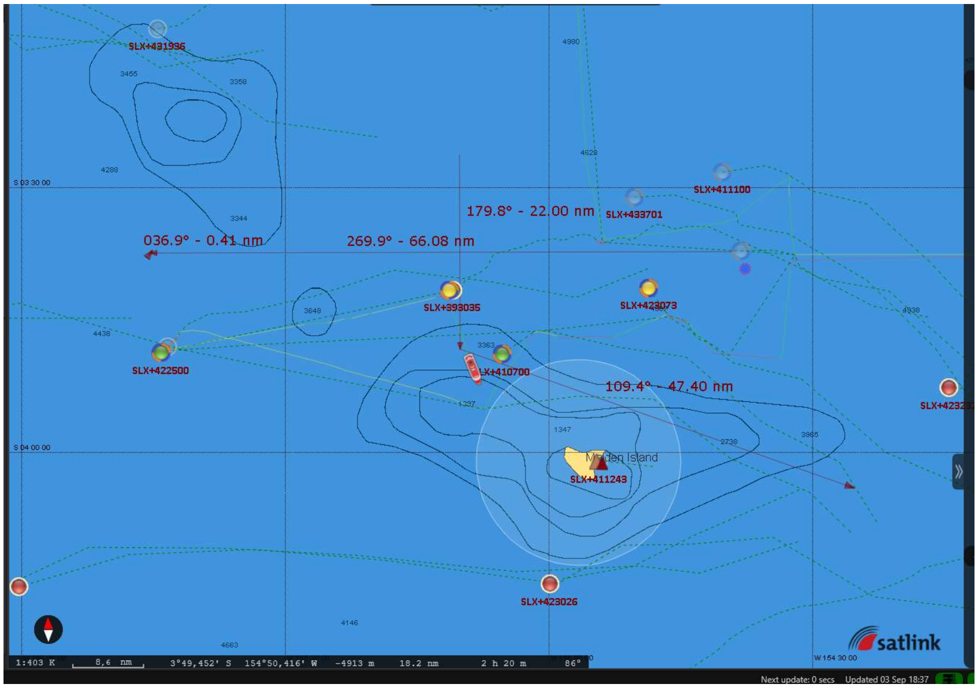
Picture 10. Yellowfin being implanted with an acoustic tag and incision closed with 2 sutures.

Vemco VR4-Global acoustic receivers were attached **(picture 11)** to 7 dFADs in an array north of Malden Island where stations were (initially) separated by a maximum of 25nm (**picture 12**). There were many different groups of dFADs that could have been instrumented, but this cluster was chosen due to it's consistency of drift speeds and direction in addition to consistent echosounder detections on several of the dFADs within the array.



Picture 12. VR4-Global acoustic receiver on deck (left) and deployed (right).

The VR4-Global acoustic receivers are programmed to collect and collate detections from acoustic transmitters (implanted in fish) with a detection range of about 500m. At user-defined intervals, the unit then sends logs of detections at each station via iridium satellite communication. The unit will also report error messages, such as the unit's hydrophone having an issue. These features make the unit completely autonomous, and in an application in the remote pelagic environment (with no real chance of retrieval) there is no other option for this type of study.



Picture 11. Array of 7 VR4-Global instrumented dFADs around Malden Island, Kiribati.

Most tagged individuals departed from the the array within a week while some individuals displayed prolonged association up to 3 weeks to the same dFAD. This emphasizes how dynamic fish aggregations are around dFADs and within an array of dFADs.

Shark Tagging

Twenty five miniPATs (Wildlife Computers) were available for deployment during CP-16. The target species was oceanic whitetip sharks. Upon sighting a suitable sized candidate, a handline was deployed with a barbless circle hook. The shark was hooked, and then brought to the landing net, and once inside the net, brought onboard the vessel's deck onto a wetted carpet. The animal's eyes were covered with a wet towel, and the hook removed. Fork length, total length and sex were recorded, and a finclip from the caudal fin was taken. Then, a small incision was made in the dorsal musculature, and a miniPAT was deployed with a titanium dart and monofilament leader into the dorsal fin structure. The animal was then quickly released. One yellowfin tuna was also marked using this method. Metadata of this effort is in table 4.

Table 4. Metadata of miniPAT tagging efforts during CP-16.

Count	Date	Latitude		Longitude		Species	Sex	FL (cm)
1	22/08/2023	05 35.203	N	153 04.610	W	OCS	U	152
2	28/08/2023	02 19.244	N	153 24.930	W	OCS	F	119
3	30/08/2023	00 25.202	N	152 51.26	W	OCS	F	121
4	30/08/2023	00 25.202	N	152 51.26	W	OCS	F	119
5	30/08/2023	00 25.202	N	152 51.26	W	OCS	F	127
6	29/08/2023	01 20.086	N	152 53.050	W	OCS	F	135
7	3/9/2023	03 47.015	N	155 42.170	W	OCS	F	114
8	3/9/2023	03 47.015	N	155 42.170	W	OCS	F	91
9	3/9/2023	03 47.015	N	155 42.170	W	OCS	M	124
10	4/9/2022	04 14.253	N	155 02.848	W	YFT	NA	122
11	9/11/2023	00 03.022	N	154 48.465	W	OCS	M	119
12	13/09/2023	00 34.633	N	155 09.417	W	OCS	M	98
13	13/09/2023	00 34.633	N	155 09.417	W	OCS	M	118
14	13/09/2023	00 37.517	N	155 05.076	W	OCS	F	144
15	13/09/2023	00 22.255	S	154 23.925	W	OCS	F	156
16	14/09/2023	00 37.455	N	153 54.570	W	OCS	M	139
17	14/09/2023	00 37.455	N	153 54.570	W	OCS	F	132
18	14/09/2023	00 38.839	N	153 50.882	W	OCS	M	105
19	14/09/2023	00 38.839	N	153 50.882	W	OCS	U	124
20	14/09/2023	00 30.056	N	153 37.509	W	OCS	F	129
21	15/09/2023	01 34.397	N	155 22.936	W	OCS	M	113
22	16/09/2023	03 338.474	N	155 06.798	W	OCS	F	122
23	17/09/2023	00 30.056	N	153 37.509	W	OCS	F	121
24	17/09/2023	00 30.056	N	153 37.509	W	OCS	M	106

BIOSAMPLING

Biosampling goals onboard CP16 were very flexible, with a maximum goal of all fish that come onboard and a minimum of 'whatever is manageable.' Although biosampling can be conducted on all species, tuna were the priority and due to the demands of other objectives of the trip, very little non-tuna species were sampled as a result.

In total, 306 fish were sampled, of which 246 were tunas (105 bigeye). The total also includes 37 finclips from sharks (**Table 5**). Of these, 132 were biopsied and the sample was stored in RNAlater.

Table 5: distribution of biosamples by species and length

Species	Length (cm)					Total
	<35	35-54	55-74	75-94	95+	
BET	16	63	20	0	6	**105**
BUM	0	0	0	0	5	**5**
DOL	0	0	4	4	4	**12**
FAL	0	0	0	12	1	**13**
OCS	0	0	0	1	23	**24**
RRU	0	0	1	0	0	**1**
KAW	0	1	0	0	0	**1**
SKJ	3	34	4	0	0	**41**

WAH	0	0	0	3	1	**4**
YFT	16	51	27	1	5	**100**
Total	35	149	58	19	45	**306**

Blood samples were taken from 55 tuna along with anal and dorsal muscle for mercury acid content analysis (**table 6**).

Table 6: Blood samples taken by species and size.

Species	X<80cm	X>80cm	Total
BET	30	3	33
YFT	15	6	21
SKJ	1	0	1

OTHER PROJECTS

A tablet was sent to obtain images of yellowfin, skipjack and bigeye tuna with the purpose of training an artificial intelligence algorithm. This effort produced 380 pictures on 185 fish.

CONCLUSIONS

Industry collaboration in the form of dFAD access again played a critical role in the success of CP-16. Having access to a large amount of dFADs allowed almost all of the cruise days to begin on a known aggregation which already tipped the chances of success in the trip's favor. Most days, multiple stops on different dFADs were made making it even more productive. Including still more fleets in these buoy-sharing programs would further increase the chance of the success of future cruises.

The staffing of CP-16 was a unique blend of highly adept fishermen from Hawaii, San Diego, and Mauritius, and skilled scientific staff. Furthermore, the crew on the vessel were already trained in Hawaiian-style tuna handline fishing, which made a notable difference in the catch rate and resulting numbers of tagged fish. Having an exceptional team once again proved it's worth.

Another benefit of having a larger, skilled team is the ability to accomplish multiple objectives effectively and in parallel. The $SrCl_2$ marking represents nearly 20% of all fished tagged during CP16, yet it was essentially invisible to the operation and did not affect other objectives being completed. However, as the sampling and other extraneous tasks get added to the objectives of the trip, manning of the cruises will have to be done with consideration of having more technicians that are capable and willing to do the work. For example, even though over 300 fish were biosampled during CP-16, many dead fish (unsuitable for tagging) were discarded after tagging events simply because there was not enough time to process everything for every event.

CP-16 provided some surprises in the form of small fish, less bigeye than expected, and a significant proportion of skipjack.

- Small fish. Many dFADs were abandoned even with fish biting danglers because most were too small to handle 13cm tags (<37cm). These small fish were observed in the entire extent of the geographical boundaries of the trip, which is remarkable considering we traveled over 1000nm in latitude and 540nm in longitude, and across temperature, current, and thermocline breaks, but it didn't seem to make a difference. Perhaps an indication of good recruitment in the region for bigeye and yellowfin.
- Less bigeye. It's hard to discern why the overall catch of bigeye was so much less than previous CP cruises (CP-15 had 87% bigeye in the same region) but proves that dFAD fishing is dynamic and these circumstances are not necessarily bad (biggest release in CP history of yellowfin and skipjack).
- More skipjack. Again, dFAD fishing is dynamic and compared to CP-15 (skipjack 1%, 98 tagged) fishing with the same gear, in the same areas with roughly the same amount of effort, CP-16 produced 815 skipjack (7% overall). However, even though CP-16 tagged this amount of skipjack while targeting bigeye and yellowfin, it would be very difficult to target skipjack and expect to tag the same amount on a CP style cruise.

Jigging once again proved itself to be an essential and reliable method of capturing nearly 50% of all tagged fish during CP-16 (**Table 7**). Further, the fish captured using this method were in as-good or better shape than those caught dangling and trolling, likely due to the smaller hook size, lighter line used to capture, and the fact that most fish caught jigging are landed using a net rather than hauled aboard by the hook in the mouth. For any future planning of CP style cruises, jigging should be focused on, especially if archival, sonic, or $SrCl_2$ marking is involved. Obviously jigging is much more physically taxing then dangling and trolling, but with the right personnel onboard this is not an issue (because they are completely addicted to fishing!).

Table 7. Numbers of fish tagged by fishing method.

Species	Fishing Method	Releases	% of total
BET	Jigging	2499	22.1
SKJ	Jigging	330	2.9
YFT	Jigging	2020	17.9
BET	Dangle/troll	3497	31.0
SKJ	Dangle/troll	485	4.3
YFT	Dangle/troll	2465	21.8
	Total	11296	

Once again, there seemed to be no discernible pattern to when, where and why dangling would work during CP-16. The 3 largest dangling sessions were completely different; 902 fish were tagged immediately after a jigging session starting at 02:25 during the first, and the second and third occurred on undisturbed dFADs at daylight (523 and 588 tags). There was decent success several times during the middle of the day dangling, but these schools usually were short-lived and less tags deployed. There was also a decent spatial signal just west of Kiritimati from 0^o-4^oN during CP-16 where there has been success dangling in previous cruises on dFADs (CP-14 and CP-15).

F/V Gutsy Lady 4 proved again during this cruise to be the perfect platform for this type of experiment. The combination of its long range, stability, ample space on the working deck and comfortable accommodations are hard to compete in this class of commercial fishing vessel. The skills of the captain and his crews are of course one of the main components that made this tuna tagging project a success.

Lessons Learned and Recommendations

1. Starlink internet was a huge improvement across the board for communication, and future cruises should not leave port without this system installed.
2. Permits for Palymra and Jarvis U.S. remote area EEZs, although not utilized much during CP-16, should be sought for future tagging experiments in this region.
3. Smaller tags (11cm), applicators and tagging blocks should be procured for future CP cruises to be ready for smaller fish.
4. Having large numbers of dFADs available to a tagging trip is advantageous and a key element to success
5. Having a large team with many skilled fishermen and sampling technicians allows the vessel to capitalize on opportunities mentioned in (4).

Appendix 1. Gutsy Lady 4 characteristics

Name of Vessel	GUTSY LADY 4
Owner of Vessel	Gutsy Lady 4 LLC
Port of Registration	Honolulu, Hawaii
Vessel Type	Fishing vessel
Flag	USA (US)
Hull Type/year built	Steel / 2001
WCPFC registration	1120347
IMO	8970469
MMSI	367571490
Length (LOA)	26.15m /
Beam	7.92m
Draft	4.5m

Tons Gross	170
Engines Make and Model	2x Cummins KTA 19 (600hp)
Call Sign	WDG 7854
Address of company owner	**Game Over LLC** **350 Ward Avenue, Ste 106-315** **Honolulu, HI 96814, USA** **Tel: +1 808 217 4539**

Appendix 2. Specifics about daily activity, location and deployed tags.

			Conventional Tags				Percentage			Acoustic Tags		
Date	Area	Activity	BET	SKJ	YFT	Total	%BET	%SKJ	%YFT	SKJ	YFT	Total
16-Aug-2023	Honolulu Harbor/US-HI	In port/Steaming	-	-	-	-	-	-	-	-	-	-
17-Aug-2023	US-HI	Steaming	-	-	-	-	-	-	-	-	-	-
18-Aug-2023	Int'l waters	Steaming	-	-	-	-	-	-	-	-	-	-
19-Aug-2023	Int'l waters	Fishing/Tagging	38	4	11	53	71.7	7.5	20.8	-	-	-
20-Aug-2023	Int'l waters	Fishing/Tagging	19	18	139	176	10.8	10.2	79	-	-	-
21-Aug-2023	Int'l waters	Fishing/Tagging	7	-	14	21	33.3	-	66.7	-	-	-
22-Aug-2023	Int'l waters	Fishing/Tagging	29	24	116	169	17.2	14.2	68.6	-	-	-
23-Aug-2023	Int'l waters	Fishing/Tagging	108	2	61	171	63.2	1.2	35.7	-	-	-
24-Aug-2023	Int'l waters	Fishing/Tagging	65	14	87	166	39.2	8.4	52.4	-	-	-
25-Aug-2023	Int'l waters	Fishing/Tagging	37	3	61	101	36.6	3	60.4	-	-	-
26-Aug-2023	Int'l waters	Fishing/Tagging	112	-	75	187	59.9	-	40.1	-	-	-
27-Aug-2023	Int'l waters	Fishing/Tagging	918	15	96	1029	89.2	1.5	9.3	-	-	-
28-Aug-2023	Int'l waters	Fishing/Tagging	83	5	77	165	50.3	3	46.7	-	-	-
29-Aug-2023	Int'l waters	Fishing/Tagging	103	15	80	198	52	7.6	40.4	-	-	-
30-Aug-2023	Kiribati/Line EEZ	Fishing/Tagging	164	4	161	329	49.8	1.2	48.9	-	-	-
31-Aug-2023	Kiribati/Line EEZ	Fishing/Tagging	156	-	26	182	85.7	-	14.3	-	-	-
01-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	62	3	147	212	29.2	1.4	69.3	2	18	20
02-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	80	17	85	182	44	9.3	46.7	14	25	39
03-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	121	12	159	292	41.4	4.1	54.5	10	27	37
04-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	107	10	107	224	47.8	4.5	47.8	-	-	-
05-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	88	27	69	184	47.8	14.7	37.5	-	-	-
06-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	121	25	59	205	59	12.2	28.8	-	-	-
07-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	10	-	12	22	45.5	-	54.5	-	-	-
08-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	71	35	42	148	48	23.6	28.4	-	-	-
09-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	183	10	289	482	38	2.1	60	-	-	-
10-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	155	4	64	223	69.5	1.8	28.7	-	-	-
11-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	214	15	116	345	62	4.3	33.6	-	-	-
12-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	58	50	24	132	43.9	37.9	18.2	-	-	-
13-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	202	23	201	426	47.4	5.4	47.2	-	-	-
14-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	129	58	167	354	36.4	16.4	47.2	-	-	-
15-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	189	26	190	405	46.7	6.4	46.9	-	-	-
16-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	105	31	164	300	35	10.3	54.7	-	-	-
17-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	611	74	234	919	66.5	8.1	25.5	-	-	-
18-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	655	67	135	857	76.4	7.8	15.8	-	-	-
19-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	233	142	690	1065	21.9	13.3	64.8	-	-	-
20-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	372	11	173	556	66.9	2	31.1	-	-	-
21-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	106	25	149	280	37.9	8.9	53.2	-	-	-
22-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	14	12	60	86	16.3	14	69.8	-	-	-
23-Sep-2023	Kiribati/Line EEZ	Fishing/Tagging	47	8	115	170	27.6	4.7	67.6	-	-	-
24-Sep-2023	Palmyra	Steaming	-	-	-	-	-	-	-	-	-	-
25-Sep-2023	Palmyra	Fishing/Tagging	224	22	20	266	84.2	8.3	7.5	-	-	-
26-Sep-2023	Int'l waters	Steaming	-	-	-	-	-	-	-	-	-	-
27-Sep-2023	Int'l waters	Steaming	-	-	-	-	-	-	-	-	-	-
28-Sep-2023	US Hawaii	Steaming	-	-	-	-	-	-	-	-	-	-
29-Sep-2023	US-HI/Honolulu Harbor	Steaming/arrive port		-	-	-	-	-	-	-	-	-
45 days			**Conventional Tags**									
			BET	**SKJ**	**YFT**							
Total			**5996**	**815**	**4485**	**Grand Total**	**11296**					
		Percent Total	**53%**	**7%**	**43%**							