PACIFIC TUNA TAGGING PROJECT

Phase 2 (Central Pacific)

Cruise CP-12, 9th September to 13th October 2016

SUMMARY REPORT

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INTRODUCTION

The Central Pacific (CP) tagging cruises are part of the Pacific Tuna Tagging Programme (PTTP) that started in August 2006 with the objective of releasing tagged tropical tunas throughout the WCPO and concentrated in the latitudes where the tuna stocks are mostly harvested, approximately 10° N to 10° S. These CP cruises were designed to catch and tag tuna in areas where pole-and-line fishing gear is not efficient due to the absence of suitable bait grounds. Using specific trolling gears developed in Hawaii and initially targeting the NOAA TAO oceanographic buoys anchored east of the International Date Line, and more recently drifting Fishing Aggregating Devices (dFADs), the CP tagging cruises have improved the overall spatial coverage of PTTP tag releases and increased the number of tagged bigeye tuna that are not commonly caught by pole-and-line gear in the western part of the WCPO.

Eleven CP cruises have already been conducted, using Hawaii and Tonga-based fishing vessels; close to 38,000 tuna have been tagged and released, mostly bigeye (90%), on the TAO buoys anchored along the meridians 140°W, 155°W, 170°W and 180°W and between 5°N and 5°S.

This report summarizes activities during the 35 days of a twelfth CP cruise, named hereafter CP-12, on the Hawaii-based FV Gutsy Lady 4. This longline vessel was chartered for the second time but the same captain previously had the charter for Hawaii based CP cruises CP3, CP4 and CP7 on his old vessel, FV Ao Shibi Go.

Following the CP-11 experiment, CP-12 was designed to augment data collection for studies on tuna movements, exploitation rates and FAD association dynamics. In an attempt to cover the gap in bigeye tuna tagging data in the west part of the WCPO (west of the 180 meridian), the study area was selected to cover the 165E and 156E TAO mooring lines and the nearby waters.

This cruise was primarily funded by the European Union, SPC and International Seafood Sustainability Foundation (ISSF). Tri Marine International also supported the cruise by allowing for the participation of a scientist and by providing positions of drifting FADs in the neighbourhood of the cruise. South Pacific Tuna Corporation also agreed to providing positions of nearby FADs but it was not possible to visit these due to logistical constrains.

Crew and scientific personnel onboard Gutsy Lady 4 during CP-12 is listed in **Table 1**.

Table 1: Personnel onboard Pacific Sunrise during CP-11

Name	Title/affiliation	Nationality
Tim Jones	Captain	U.S.
Bruno Leroy	Cruise Leader/ SPC	France
Jeff Muir	Scientist/ ISSF	U.S.
Beth Vanden Heuvel	Scientist/ Tri Marine	U.S.
Fabien Forget	Scientist / ISSF/IRD	Mauritius
Macarthur Malakai	Crew-bosun	U.S.
Kohlen Dakanno	Crew	U.S.

GENERAL DESCRIPTION OF VESSEL

The FV Gutsy Lady 4 (named hereafter GL4) is a 30 meter steel vessel (see **Picture 1**) previously outfitted for prawn trawling in the Gulf of Mexico. Bought by Brian Hara in 2014, it is now equipped with longline gear used for fishing pelagic fish (mainly tuna, with bigeye as the main target) in Hawaii EEZ. 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, one desktop computer for navigation (HighPlot, custom-made by an ex-fisherman) and the OrbMap oceanography information package. GL4 is also equipped with an Iridium satphone linked with Skyfile software for email communication.

Picture 1: FV Gutsy Lady 4 at Uliga dock, Majuro 13th Oct 2016

Prior to CP-12 departure, GL4 was equipped in Ensenada (where the boat had some maintenance done), by one Tri Marine technician, with a Fleet Broad Band 250 satellite communication system coupled with an "oceanbox" data compression server (Thalos). This communication set-up allowed access to oceanographic and weather data (Catsat), as well as to several buoy monitoring systems (Satlink, Marine Instruments and Iris) which provided the dFAD targets to supplement the trip. The systems were used by Beth to monitor the Tri Marine satellite buoys and to direct GL4 to the associated dFADs during the cruise. In addition to this, the scientists benefited from WiFi e-mail access which facilitated work with the onshore collaborators of the project. Beth was also able to continue her usual duties for Tri Marine, mainly by providing oceanography-based fishing recommendations to the Cape Fleet.

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

The operational range of GL4 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 to preserve fish in ice (about 22 ton capacity) and one freezer compartment, mainly used to store frozen bait (about 15 tons).

FISHING GEAR

For this tagging cruise, the vessel was fitted with 6 "danglers". This gear consists of galvanized steel davits which extend at right angles from the hull for 2 meters and deploy two short trolling lines skipping at the surface. This type of gear has been successfully used during the eleven previous CP cruises as well as in Hawaii for other tagging programs and was initially used for commercial fishing at offshore seamounts and FAD tuna aggregations.

Four danglers were placed on the starboard side and 2 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 a 80cm length of 2mm monofilament line was fitted with tube squid-like lures, one 45g lead weight and a 7/0 Mustad galvanized barbless hook.

Three troll lines were also fitted onto hydraulic reels attached from the stern of the vessel. These consisted of a 400 lbs mono to which a 5m by 2mm monofilament line was attached and rigged with a tube squid jig bearing three 45g lead weights and a 7/0 Mustad galvanized barbless hook.

The boat is equipped with a "green stick", a trolling technique developed in Japan. This gear consists of a 13m vertical fiberglass outrigger pole linked to a long mainline ending with a large wooden teaser and longline float, which creates tension at the end on the entire length of the mainline. Six squid lures with increasing leader lengths are attached to the mainline with longline clips, and are adjusted so that they skip on the surface with the leader out of the water. The mainline is retrieved with a hydraulic line puller on the stern of the boat. This method is very effective in various tuna fisheries worldwide, including Japan, East Coast US bluefin, and Hawaii yellowfin, and also features a very short fight time which is attractive for tagging purposes. Due to time constraints, this equipment was only deployed during a few attempts around dFADs, and no fish were captured.

During CP12, rods and reels specially designed for this type of fishing (**Picture 2**) and equipped with heavy metallic jigs associated with 80 lbs. braid line have intensively been used to capture over 95% of the tuna and the different species that were implanted with electronic (archival and sonic) tags. Most of jig fishing action occurred at night (between 2 and 6 am) when tuna are closer to the surface but also in day light after morning trolling sessions

Picture 2: Bringing tuna from 120 meter deep is a hard work…

TAGGING OPERATIONS

Four tagging stations were set up on the deck of the vessel. Three cradles were dedicated to conventional tagging and were of the same design to those previously used for pole-and-line tagging. One cradle was placed at the stern of the vessel while the other two were positioned on the starboard side. The fourth cradle was set up specifically for archival/sonic tagging and supplied with a saltwater hose for irrigating the fish during surgery (see **Picture 3**). This tagging station was also used to deploy the sonic tags in the species targeted by the ISSF project. The archival cradle was placed in a central location on the deck. All cradles were marked with one cm graduations from 30cm to 120cm.

Picture 3: Archival tagging cradle (first plan, with a medium-sized bigeye ready to be tagged) and, at the back, 1 of the 3 conventional cradles.

FISH TAGGING DETAILS

Table 2 summarizes the number of fish tagged per tag type and per species.

Table 2: Numbers of tags deployed by tag type and species (note that 12 bigeye and 5 yellowfin received an archival + a sonic tag). Others include silky sharks, oceanic triggerfish and rainbow runners those numbers are detailed further in the acoustic tagging section.

Tag type	BET	YFT	SKJ	others	Total
Sonic	17	10	29	55	**111**
Archival	93	28	2		**123**
satellite				25	**25**
Conventional Y13	1465	333	78		**1876**
Total fish tagged	**1575**	**371**	**109**	**80**	**2135**

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".

- **<u>Conventional tagging:</u>**

Conventional tagging (CT) consisted of using the 13cm yellow dart tag manufactured by Hallprint Ltd. 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. There were eleven 100 tag blocks available in total. A total of 1876 tropical tunas were tagged and released during the cruise, comprised of 1465 bigeye (78%), 78 skipjack (4 %) and 333 yellowfin tuna (18 %). Their size distributions are shown in **Figure 5.** The spatial distribution of all tuna tag releases is shown in **Figure 1**.

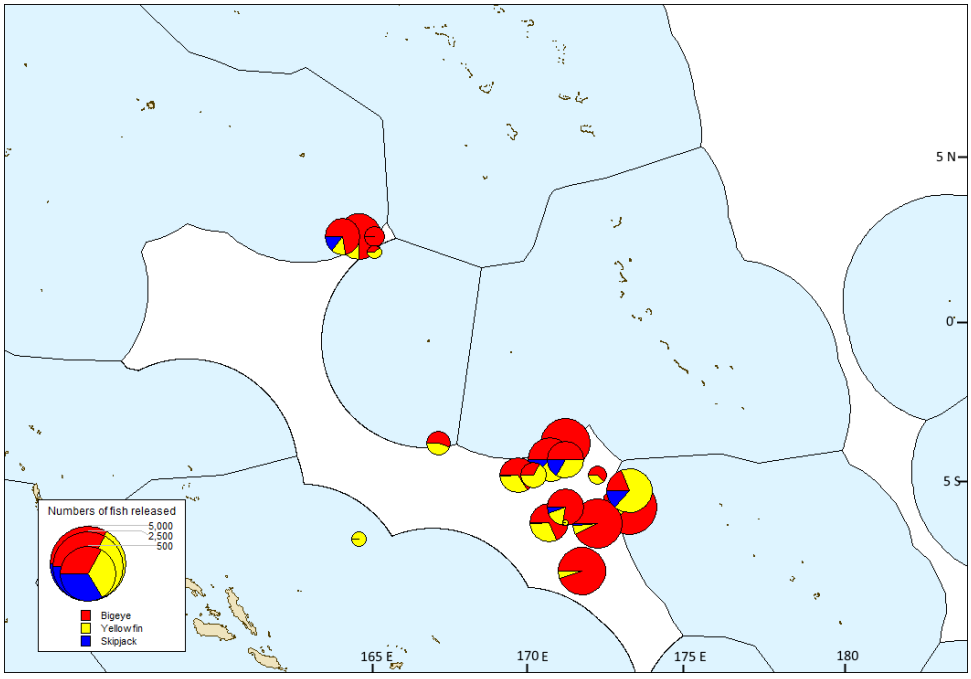


Figure 1: Distribution of tag released in tropical tunas during CP-12

[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.

- **Archival tagging:**

Seventy eight Wildlife Computers MK9, 23 Lotek LTD2310 and 22 Lotek Lat2810 archival tags were available for deployment. All available tags were deployed; 93 on bigeye tuna, 35 on yellowfin and 2 on skipjack. All tags were configured to sample all likely depths, sea and internal fish temperatures and light intensity every 30 seconds. Archival tagged tuna were externally marked with an orange 13 cm conventional tag. Suitable sized tuna (generally > 55 cm for MK9 and > 45 cm for LAT2810, see the length frequencies (**Figure 6**) for further details) were placed belly up on the V-shaped central tagging cradle, the eye covered with a synthetic chamois and irrigated via the mouth by a seawater hose. All archival tags were implanted into the peritoneal cavity and secured with one or two sutures (**Picture 4**). 12 bigeye and 5 yellowfin tuna also received a sonic tag in addition to the archival.

Table 3 displays the number of fish tagged with archival per species and FAD (TAOs are considered as anchored FADs)

Picture 4: Release of a yellowfin implanted with an archival tag

Table 3: Numbers of archival tags deployed per species and per FAD (in brackets number of fish that also received a sonic tag on the dFADs equipped with a satellite acoustic receiver VR4 (see Figure 4, page 13).

Species	Exp.1	Exp.2	Exp.3	Exp.4	TAO 0/165	Trolling	dFad 122300	dFad 152310	dFad 128902	dFad 131914	Total
YFT	0	6 (3)	5 (1)	4 (1)		3	5	3	1	1	**28**
SKJ	0	0	0	2							**2**
BET	8 (3)	11(2)	25 (4)	35 (3)	1		9	4			**93**
Total	**8**	**17**	**30**	**41**	**1**	**3**	**14**	**7**	**1**	**1**	**123**

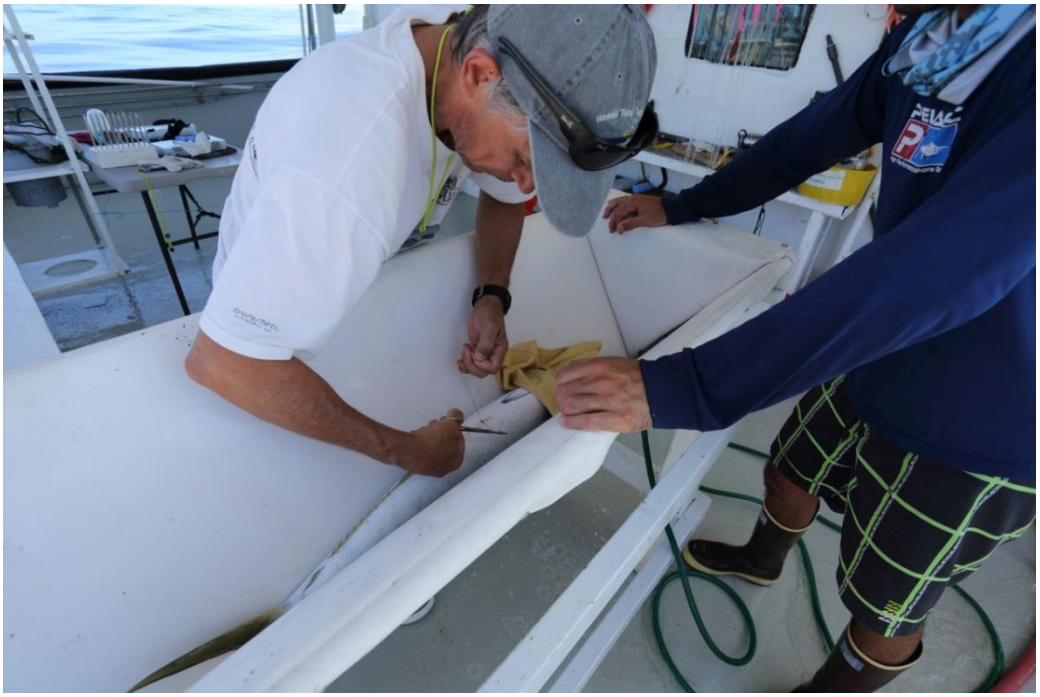
- **Acoustic Tagging:**

ISSF's component of the CP-12 cruise consisted of conducting acoustic tagging experiments on 4 dFADs. Each of the 4 dFADs was equipped with VR4 Global (Vemco, Amirix, Canada) satellite linked acoustic receivers. Both tuna and non-tuna species were captured using a combination of fishing techniques which include trolling, handling and jigging. Pressure sensitive acoustic tags were implanted in tuna (SKJ, YFT, BET) and non-tuna species (silky shark: FAL, oceanic trigger fish: CNT and rainbow runners: RRU (see **picture 4**). The aim of this experiment was to:

1. Collect simultaneous vertical behavior of tuna and non-tuna species at dFADs in order to improve the interpretation of the echo sounder buoy data.
2. Collect data on the associative behavior of tuna and non-tuna species at dFADs to estimate residency at FADs and determine species specific vulnerability during the day at dFADs.

Table 4 (page 10) summarizes the number of acoustic tags implanted per species and per receiver.

Figure 2 (page 11) shows the length frequencies of the different species implanted with acoustic tags.

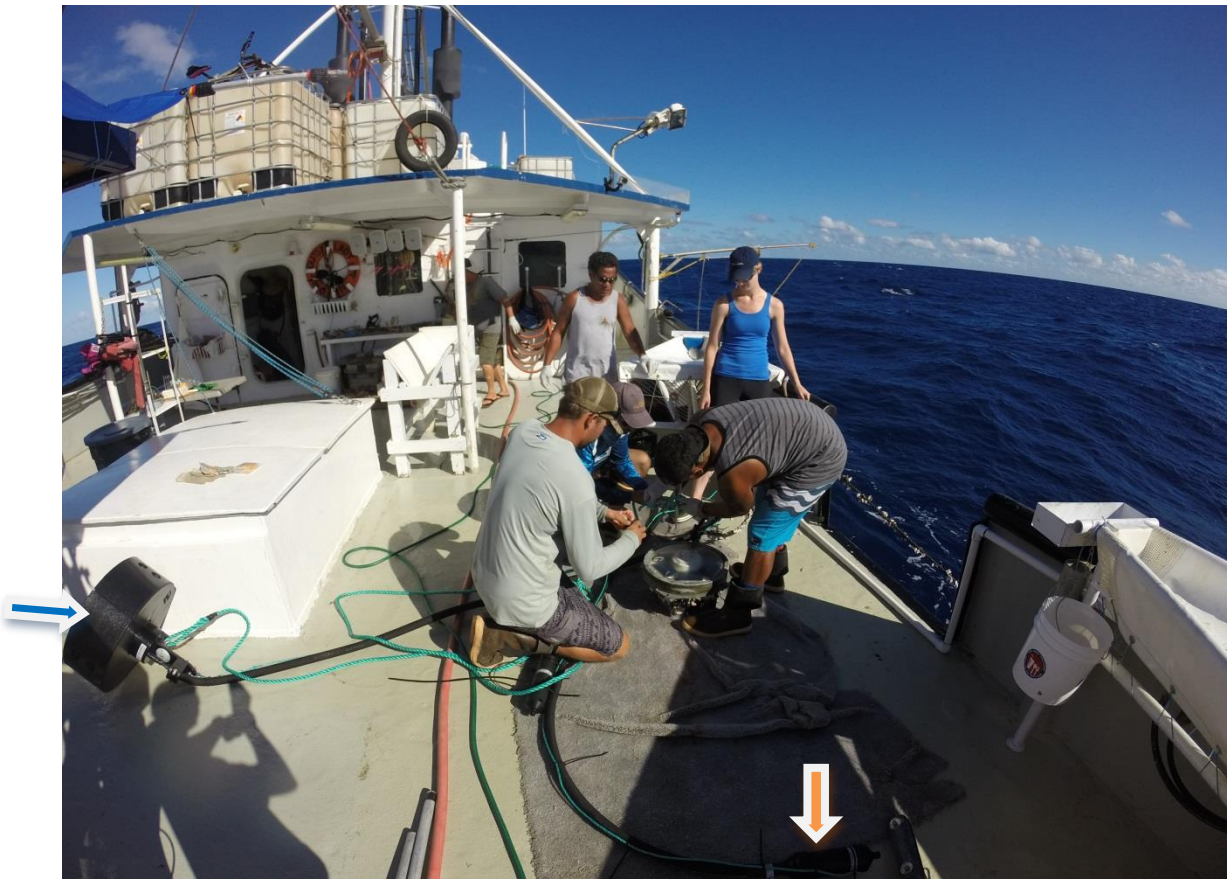


Picture 4: Rainbow runner implanted with an acoustic tag.

VR4 Global Description:

The VR4 Global unit allows the user to remotely monitor tagged fish, and eliminates the need to retrieve the receiver after the study has finished. The unit utilizes Iridium satellite communication to relay detection logs, status updates, and error messages to the user. This part of the unit is housed in aluminum housing, floated by a doughnut shaped float collar which bolts around the housing. The unit utilizes a hydrophone attached to a 5 meter communication cable, suspended (and protected inside a

heavy duty rubber pipe) under the main body of the unit. The VR4 unit is attached to the dFAD prior to releasing fish tagged with sonic transmitters (see **Picture 5**)



Picture 5: Attaching a VR4 receiver to a dFAD. Blue arrow shows the unit and orange arrow the hydrophone

<u>Access to dFADs and satellite buoy data information used during the cruise:</u>

Tri Marine provided full access to their dFADs all equipped with Satlink and Marine Instrument satellite buoys owned by them in the areas that the tagging vessel operated during the cruise. A total of 15 different dFADs (all Tri Marine) were visited and fished (See **Figure 4** for an overview of dFAD locations) and four of them were instrumented with VR4 acoustic receivers and set free.

<u>Comment:</u> CP12 is the third cruise in a row to not encounter a suitable size tuna aggregation on the targeted TAO moorings. Between CP10, CP11 and CP12, this is a total of 27 visited moorings for about 1280 fish tagged…

The associated Satlink buoy echo-sounder histogram figures for the Tri Marine dFADs are displayed in **Appendix IV**, pages 25-27. Indications of the approximate amount of fish under a buoy have been used to direct the boat to the best available dFAD in range of the tagging vessel.

Detail of acoustic tagging work:

Experiment 1 (associated with Trimarine dFAD DSL+124592)

Tagging and deployment of the VR4 unit commenced on 12nd September in the FSM EEZ; we left the FAD the 13th Sep. 25 animals were implanted with V13 coded pressure sensing acoustic tags (tuna and sharks) or with V9 coded pressure sensing acoustic tags (rainbow runners and triggerfish) (**Table 4**).

Experiment 2 (associated with Trimarine dFAD DSL+119526)

Tagging and deployment of the VR4 unit commenced on 19th September in the International Waters (IW) and we left the FAD the 20th Sep. A second visit was made on the 2nd Oct. A total of 34 animals were implanted with acoustic tags (**Table 4**).

Experiment 3 (associated with Trimarine dFAD DSL+128436)

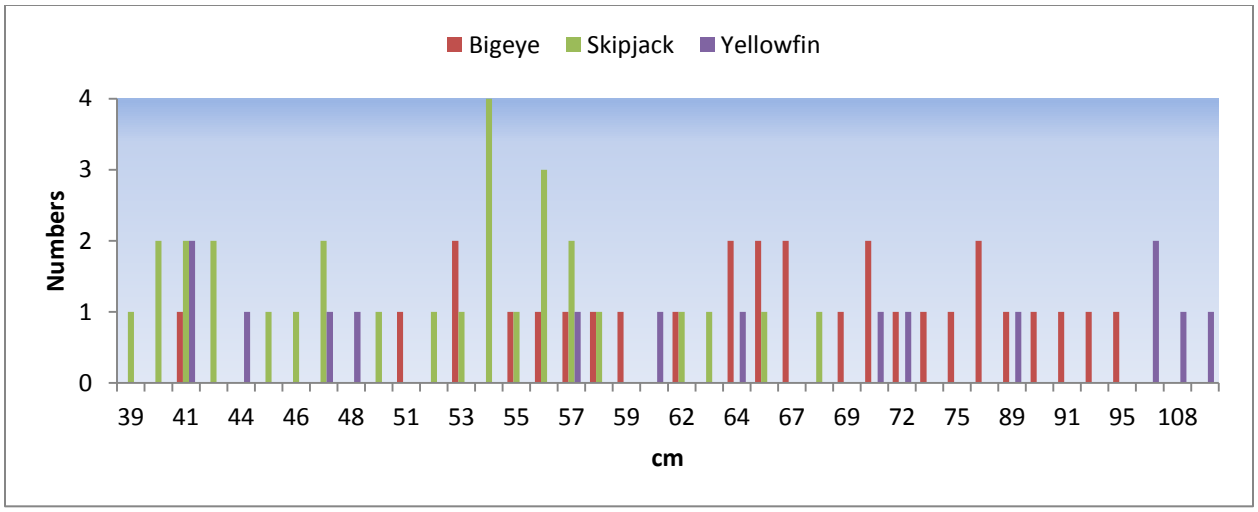
Tagging and deployment of the VR4 unit commenced on 22th September in Tuvalu waters; we left the FAD on the 25th Sep. A second visit was made on the 1st Oct in the IW. A total of 33 animals were implanted with acoustic tags (**Table 4**).

Experiment 4 (associated with Trimarine dFAD DSL+100831)

Tagging and deployment of the VR4 unit commenced on 27th September in the IW; we left the FAD on the 28th Sep. A second visit was made on the 5th and 6th Oct in the IW. A total of 36 animals were implanted with acoustic tags (**Table 4**).

Table 4: Summary of animals implanted with acoustic tags at each receiver station. In brackets the number of fish that also received an archival tag.

Species	Exp.1	Exp.2	Exp.3	Exp.4	Total
YFT	4	5 (3)	3(1)	3(1)	**15**
SKJ	7		6	16	**29**
BET	5(3)	10 (2)	7 (4)	7 (3)	**29**
FAL	3	6	10	7	**26**
RRU	3	8	2		**13**
CNT	3	5	5	3	**16**
Total	**25**	**34**	**33**	**36**	**128**



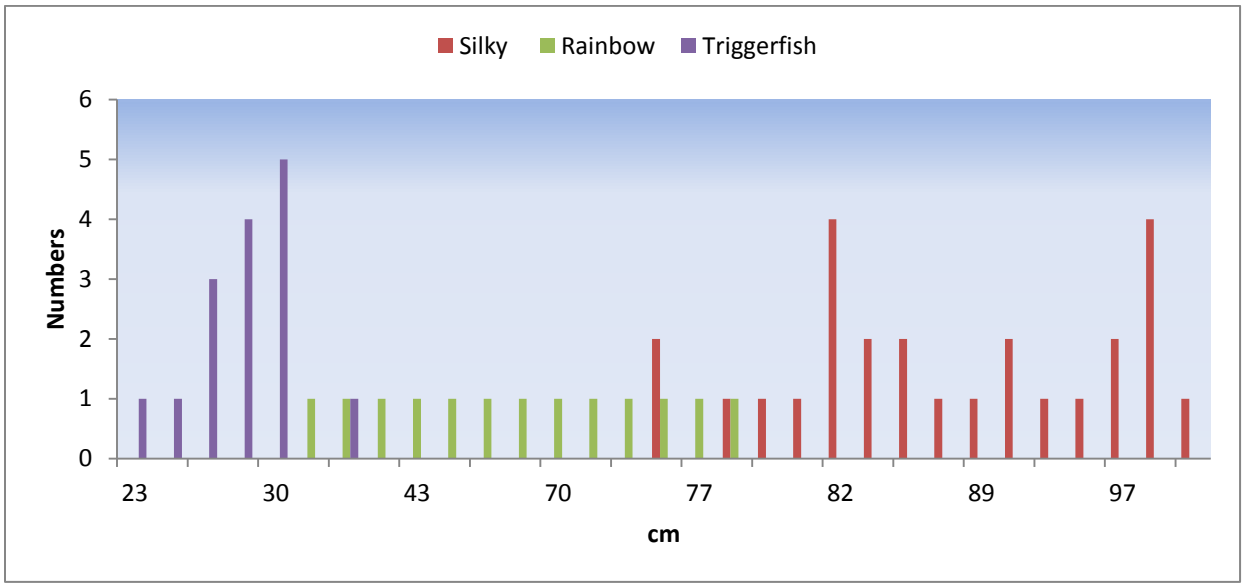


Figure 2: length frequencies of fish tagged with sonic tags (top panel are the tunas and bottom panel other species)

GENERAL DESCRIPTION OF CRUISE TRACK AND FISHING ACTIVITY

The track of Cruise CP-12 is shown below in **Figure 3**. The 5N, 2N, equator, 2S and 5S TAOs on the 165E line were visited along with 15 dFADs in FSM, Solomon, Tuvalu, and International waters. Those dFAD positions were tagging occurred are shown in **Figure 4**

A summary of general movements during the cruise and daily tag releases by area/buoy is given in **Appendix II**. Daily log extracts providing detailed written descriptions of daily activities are provided in **Appendix III**.

Of the 35 days of charter during CP-12, 12 days were spent steaming and/or checking buoys with no fish, and part or all of 23 days were spent fishing and tagging.

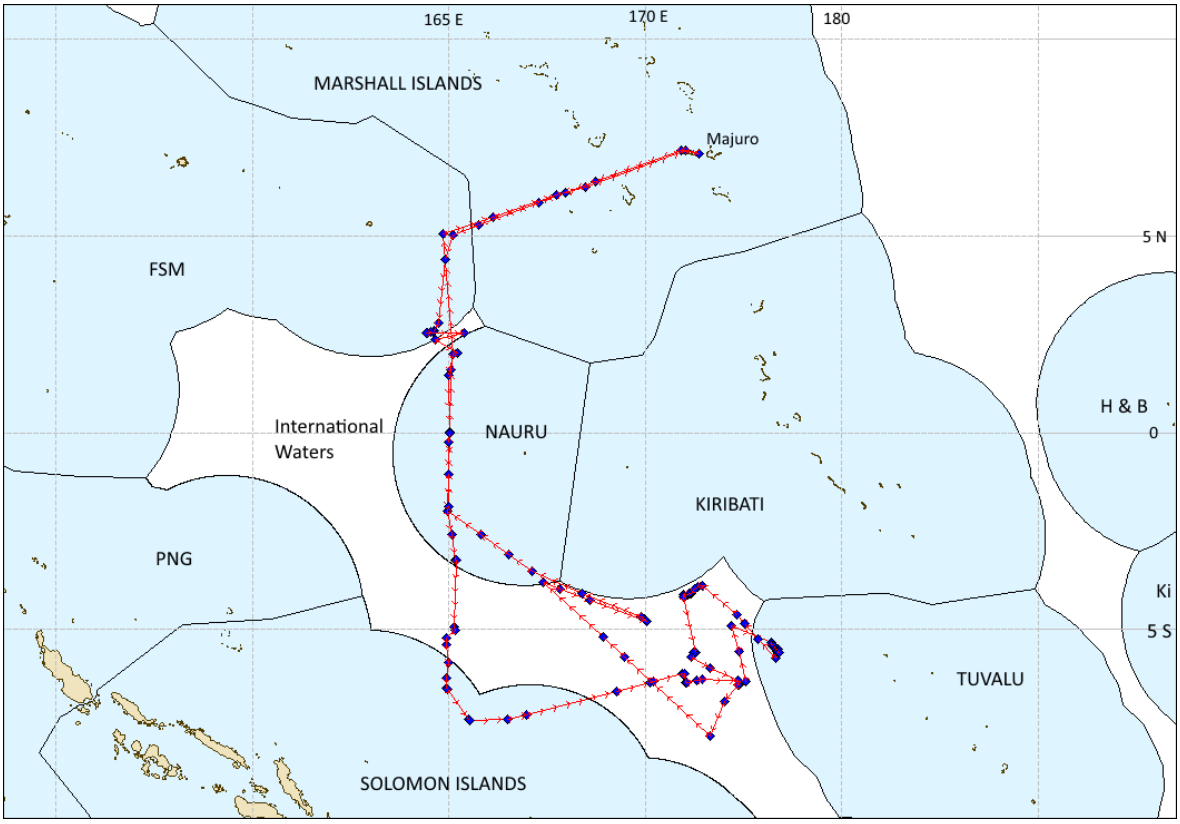


Figure 3: Cruise track during CP-12.

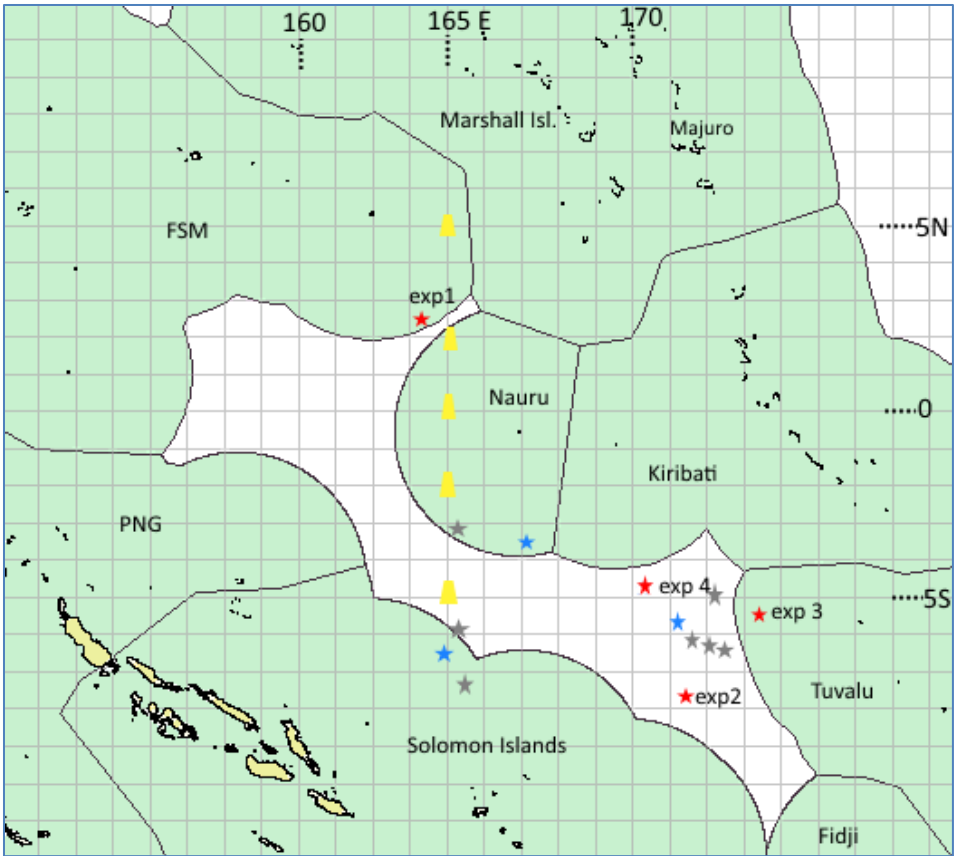
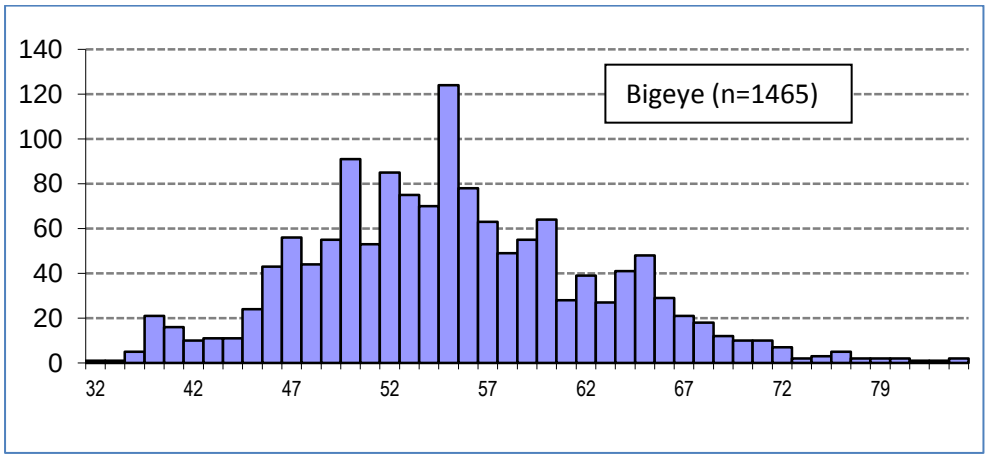


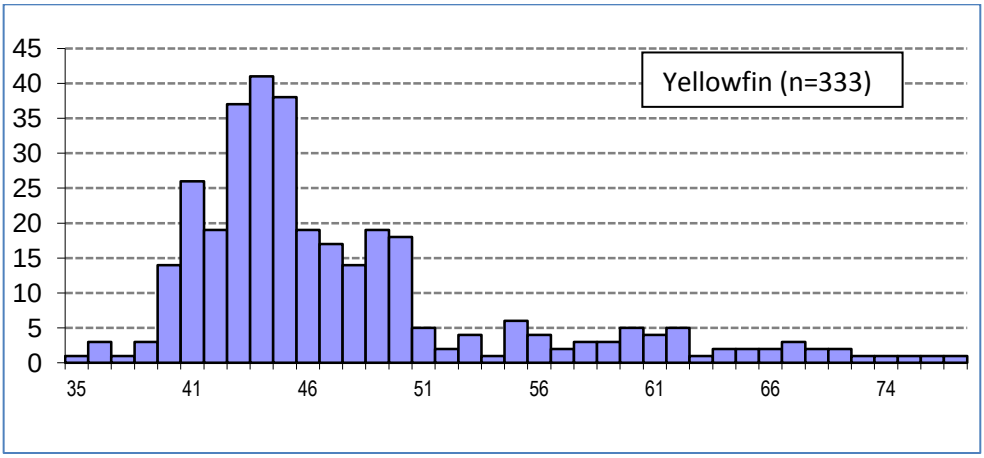
Figure 4: Positions of visited drifting FADs. Red stars are dFADs equipped with VR4. Blue stars are dFAD were some fish were tagged with archival. Grey stars are dFADs with no tagging or few conventional tags. Yellow trapezoids are the visited TAOs along the 165E line.

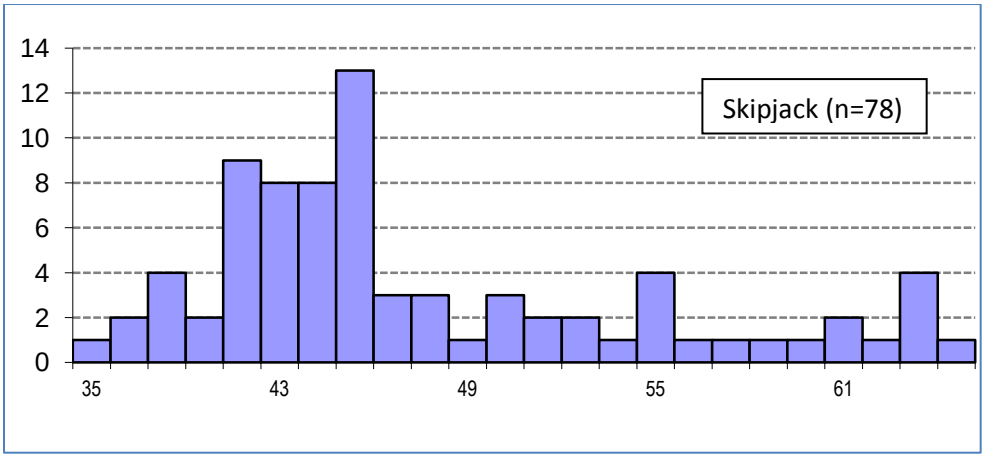
SIZE DISTRIBUTION OF TAGGED FISH

The size distribution of tuna conventionally tagged during the cruise is shown in **Figure 5** below.

Figure 5: Size distribution (cm) of fish conventionally tagged during CP-12



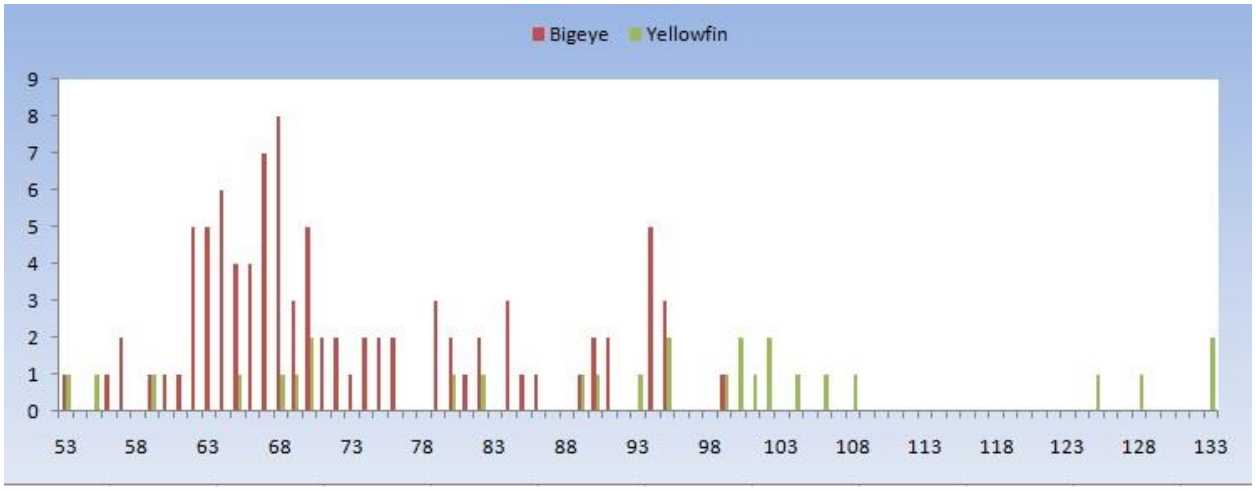




ARCHIVAL TAGS

123 fish were released with archival tags. The size range for the 93 bigeye was 53 to 99 cm and 53 to 133 cm for the 28 yellowfin. The length frequencies for both species are displayed in **Figure 6**.

Figure 6: Length frequency of bigeye (brown) and yellowfin (green) tagged with archival tags



BIOLOGICAL SAMPLING

Table 4 summarizes the nature and number of collected biological samples.

Table 4: Summary of biological samples collected during CP-12 (S: stomach; M: muscle;, G: gonad, DS: dorsal spine, B: blood L: liver).

Species	Number	S	M	G	DS	B	L
BET	30	30	30	29	30		30
YFT	13	13	13	13	13	1	13
SKJ	2	2	2	2	2		2
DOL	5	5	5	4			5
RRU	6	6	6	6			6
BUM	4	4	4	4	4		4
WAH	5	5	5	5			5
Total	**65**	**65**	**65**	**63**	**49**	**1**	**65**

CONCLUSION

The CP12 cruise was quite challenging at the start. It was the first attempt to release large quantities of electronic tags in tuna and associated species around drifting FADs in this part of the west-central Pacific. During previous PTTP pole and line tagging cruises it has been difficult to catch the targeted amount of suitable size bigeye for deploying archival tags on this species. Once again, no tuna schools were observed on the 5 visited TAO moorings during the cruise, highlighting the high risk of failure for a cruise only relying on these "anchored FADs"…

Having full access to purse seine industry drifting FADs proved to be a key component of the success of such experiment. Adequate jigging rod and reel combinations manned by skilled fishermen could provide enough amounts of suitable fish of all species for archival/sonic tag deployment. However, tagging a large quantity of fish (>500 in one school) with conventional tags seems not to be easily achievable with dangler fishing gear in this area. The depth of the thermocline (much deeper than between the 170 and 140 West longitudes where previous CP cruises were implemented) is probably the main explanation for the bigeye and yellowfin tuna not wanting to stay at the surface after sunrise and remain vulnerable to the dangler gear

FV Gutsy Lady 4 proved again during this cruise to be the perfect platform for this type of experiment. Its long range, stability, ample space on the working deck and comfortable accommodations make this a combination hard to surpass 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 multi-purpose tuna tagging project a success…

APPENDIX I: F.V. GUTSY LADY4 specifications

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	**Gutsy Lady 4 LLC** **350 Ward Avenue, Ste 106-315** **Honolulu, HI 96814, USA** **Tel: +1 808 217 4539**

APPENDIX II: Summary of cruise activities, with number of fish released per day (dates are displayed on Marshall Is time, GMT+12). EEZ abbreviations: IW: International Waters, FSM: Federated States of Micronesia, MI: Marshall Islands, NR: Nauru SI: Solomon Islands, Tv: Tuvalu,

Date	General area	Principal activity	Conventional tags			Archival (red) or sonic (green) tags			Sonic tags	Satellite tags	Total tagged
2016			BET	SKJ	YFT	BET	SKJ	YFT	Other	FAL	
9-Sep	Majuro	Leave port 8 :40am									**0**
10-Sep	MI	Steaming- gear prep									**0**
11-Sep	MI	Steaming- gear prep									**0**
12-Sep	FSM	Fish dFAD	160	16	17	7	7	3	9		**219**
13-Sep	FSM-NR	dFAD & TAO 2N/165E	53	8	9	3		1			**74**
14-Sep	NR	Check TAO 00/165E									**0**
15-Sep	NR	Check TAO 2S & 1dFAD									**0**
16-Sep	IW & SI	Fish TAO 5S & dFADs								**7**	**7**
17-Sep	SI	Fish dFADs			4			1			**5**
18-Sep	SI	Check Fad-Steam									**0**
19-Sep	IW	Steam-fish Fad	31	0	8	13		6	5	1	**64**
20-Sep	IW	Fish fad-steam-fad	3	1	9	3		2	9	1	**28**
21-Sep	IW	Fish Fad steam	5		3						**8**
22-Sep	TV	Fish dFAD	6	12	84		1	2	17	5	**127**
23-Sep	TV	Fish dFAD	37	7	19	20	5	5			**93**
24-Sep	TV	Fish dFAD	371	4	18	7					**400**
25-Sep	TV & IW	Fish Fad steam	12	3	11			1			**27**
26-Sep	IW	Fish dFAD	226	3	18	14		2			**263**
27-Sep	IW	Fish dFAD	22	5	16	7	5	2			**57**
28-Sep	IW	Fish dFAD	49	2	43	10	13	1	10	3	**131**
29-Sep	IW	Fish dFAD	24	3	3	4		4		1	**39**
30-Sep	IW	Fish dFAD	19	1	3	5		1			**29**
1-Oct	IW	Fish dFAD	205	4	13	1				4	**227**
2-Oct	IW	Fish dFAD	188		8	3		3	5	1	**208**
3-Oct	IW	Steaming									**0**
4-Oct	NR	Fish Fad steam			1			2		2	**5**
5-Oct	IW	Fish dFAD	4		11	2		1			**18**
6-Oct	IW	Fish Fad steam	31	1	18	6					**56**
7-Oct	NR	Fish Fad steam	5		3	4		1			**13**
8-Oct	NR	Check TAO 2S and Eq									**0**
9-Oct	NR	Fish TAO Eq-steam	14	8	14	1					**37**
10-Oct	NR	Check TAO 2N-steam									**0**
11-Oct	FSM	Check TAO 5N Steam									**0**
12-Oct	MI	Steam									**0**
13-Oct	MI	Arrival in Majuro									**0**
Total			**1465**	**78**	**333**	**110**	**31**	**38**	**55**	**25**	**2135**

APPENDIX III: Daily activities summary from Daily Log entries

Date	Activity	Notes
9/09/2016	leave Majuro-start of CP12	After immigration clearance at 08:30, left Ken floating dock (also called PII dock) at 08:43 and started steaming towards the TAO 5N/165E (1 d and 22h ETA). Perfect calm sea to set-up cradles and sort the pile (impressive) of gears...Set up archival tags (75 MK9) most of the afternoon, between 2 Wahoo and one good size blue marlin (sampled) on the trolling lines..
10/09/2016	steaming toward TAO 5N/165E	Carry on rigging gears including sonic listening stations, sport fishing outfits, filling tagging blocks... Very hot day with no wind and rare clouds...One small blue marlin (186 cm LF) trolled and sampled at about 12:00. Crossed a raining area between 3 to 6 pm.
11/09/2016	steaming and fish TAO 5S/165E	Weather still perfectly calm. Warning messages of Marshall eez exit and FMS entry sent to the people in charge. ETA for the 5N/165E is 1pm. Arrived on time in calm conditions on the spot but alas, no sign of TAO. Did a survey that only spotted a longline float and a piece of Styrofoam. Started steaming again at 15:40 toward a TMI dFAD about 70 nm in our South, on the direction of the TAO 2N/165E. Arrived at dFAD DSL-93374 at 22:10 but the raft has been cut-off from the buoy...Started steaming to the next one at 22:15, about 78 nm away in our south-south-est;ETA 7:30
12/09/2016	fish dFAD DSL124592	Arrived at dFAD DSL-124592 at 07:56. A few bobbies on top of the raft and...good school detection on the echo-sounder at 80 meters...started danglers at 08:05 and after the few small yellowfin on the stern troll lines, nice bigeye came and jump on the lures...end at 08:48 with over 150 fish tagged, mostly bigeye. From 9h30 to 12:00 we jigged to deploy sonic tags (10 tags in 3 sharks, 4 B (2 double tagged with AT), 1Y and 1 RRU and 1 TRI) Had a long fishing session in the afternoon between 3:50 and 19h for some more sonics (total 23 for the day) and a few CT (15) and one AT in a B. We put the sea anchor. Sampling for biological sampling and entering data make us finishing at 22h. Time for a rest till 3h30 tomorrow...
13/09/2016	fish dFAD DSL124592	Drifted with the sea-anchor- Awake at 3 am but no fish under the boat; decide to wait till 6am for going to the FAD for dangler fishing. Visited at 4am (a bit too closed at 0.3 nm..!) by a PNG flag PS boat, Pacific Journey. Wind pick-up to 15 knt at 5am. Fish came to the danglers briefly a couple of time but stayed mostly in the deep over 50 meters deep. Stopped after 70 min and switch to jigging to try increase archival releases. 5 bigeye were archival tagged included one doubled with sonic. After checking the VR4 listening station, we started steaming toward the TAO 2N/165E about 50 nm away. Left FSM waters a about 12:30 and entered Nauru at 15h. Found TAO at 18:45 about 7 nm from the last listed position. Strong west-east current about 2 knt . Very small school of small bigeye, 5 tagged. Decided to move on and started steaming to the equator TAO at 19h
14/09/2016	Fish TAO 00/165E	Rock n'roll nigth with side-way seas. Arrived at the TAO at 10am but nothing at echo-sounder. Caught 2 mahi and on rainbow on troll lines. Start steaming again at 10:20 to the 2S TAO. ETA tomorrow 1am
15/09/2016	fish TAO 2S and steam to	Arrived at the position 2S/165E at 0:50 but can't see the thing. Strong current (2 knts) and waves do not help...finally found it with radar and search light at

	dFAD DSL129700	2:45. Small detection. Have to wait for the morning to assess if there is some fish or not. Start fishing at 0610 for one hour but only caught 3 mahi and a small YF. No tag. Nothing at echosounder. We started to steam toward dFAD DSL129700 (drifting west at 0.8knt) about 73 nm away in our South. Arrived at the Fad at 1750, no fish. Started steaming toward TAO5S at 1805; another drifting FAD is closed to this TAO.
16/09/2016	fish TAO5S-165E and dfad	Heavy rain at 5am. Arrived at TAO at 07am, nothing there not even a mahi on the troll lines. Tried to jig for 30 minutes. Start to head to a dFAD (129606) about 15 nm away in our SSW. Alas, the raft has been cut-off from the buoy as we discovered at 10am.. Checked a log nearby but only associated with triggerfish and at least one shark (FAL). Started to steam to another dFAD (93178) at 1048. Arrived at 15:25, the Fad had drifted inside Solomon waters. No tuna associated , we started to steam to another dFAD (DSL-131914), that is marking since some days) at 1545. Arrived at the buoy at 20:15 , attached to it a flag and a beacon. No tuna detection, catch and tag with mini pat 5 silky sharks . School of small RRU. Caught one bigeye on a jigg. Dropped the sea anchor and wait for the morning to assess presence of tuna.
17/09/2016	fish dfads in Solomon eez	Drifted 4 nm away from the Fad from 23h to 5h30; night not comfortable with sea anchor a bit on the side (can't be fixed at the bow because of the steel anchor fixed there..) Sea conditions not really helpful...20knots and 2 m waves... Tried to troll/dangling for one hour, caught RRU, a wahoo, couple of 45 cm YF and one 99 cm YF we tagged with a MK9. Tried jigging after but weather conditions were too difficult. Started steaming toward dFAD128701 (~60nm in our south east) at 09am. Arrived at 1830h; tried to troll around but not takers and no echo-detection. Tried to catch sharks for deploying MiniPat but the 4 we caught were all too small. Stopped at 19H30. Started steaming again toward dFAD93314 about 60 nm in our west
18/09/2016	Fish dFad in Solomon waters	Arrived at the FAD position at 06:35 but only find the gps buoys at 0750, raft has been cut-off...Waste of time... Decided to go for the buoy that is really marking good, 270nm away in the ENE in IW...ETA tomorrow late afternoon. 1 small BUM (180cm) caught in the afternoon (samples)
19/09/2016	Steam to dFAD dsl-119526	Slow rolling passage overnight, quit Solomon waters at about 1am; some rain clouds coming from the north in the morning. Favourable current made us doing 8.4 knt. Caught a nice ~45 kg yf on a troll line- Deployed a MK9 but fish looked too tired at release-more likely it won't survive. Arrived at dFAD DSL119526 at 18:40. Detection not clear, small patched scattered from 40 to 60. Dangler no success ; started jigging at 19h till 24h and carry on till 1:40 the next day. 15Archival and 12 Sonic plus 39 CT were deployed during this quite productive Jigging session... Stopped and drift hoping for good trolling in the morning
20/09/2016	fish dFads in IW	Finished the jigging session at 01:40am. Total archival 15, including 4 Y and 11 B. Sonic total was 12, including 5 FAL, 4 B (1 double tag with 1 Lat 2810), 3 Y (double tagged with MK9); 39 CT including 31 B and 8 Y. Almost no drift during the night; 0.1 to 0.2 knt , we stayed closed to the FAD without the sea-anchor. Tried troll/dangler/jigging from 06:20 to 09:12. Caught fish including bigeye on stern troll lines but no fish came to the danglers. Managed to deploy 12 sonics tag (4 RRU, 4TRI and 3 BET) and 9 CT (2B, 7Y). Decided to

		check dFAD DSL-129544 about 12 nm in our south. Good detection at about 200 meters. Not sure if it's tuna; probably not. Only caught a wahoo on a troll line; saw mahi, sharks and triggerfish. Started steaming again to another dfAD about 26 nm in the east, DSL128902, at 12 am. Caught a nice 128 cm YF on a troll line at 14H02 and deployed a Mk9 on it. Arrived at the FAD at 15h. Not much on the eco-sounder caught a couple of small YF with spreader bar and plastic; tag one with a Lat 2810.Tag a shark with a minipat. Start steaming to the next one(DSL 128369, marking 49t this morning) Set the course to be there in the morning
21/09/2016	Fish dFAD in IW	Arrived at the FAD DSL128369 position at 4 am. Drift till dawn. Found the raft at 6am but no detection at echo-sounder..Start trolling around at 0615, only caught a couple of wahoo and a small yf. Then saw a pod of dolphin around the raft; might explain the absence of fish..Decided to run for DSL152317 marking this morning about 90 nm in our north. Arrived at the Fad at 17:50. No sign of a decent school at the echo sounder screen, only scatered points. The raft had no tail. School of big size RRU, some triggerfish and many small FAL around. Caught 3 wahoo , some RRU and a few small YF (...tagged). Stopped at 19h and tried to jigg without success. Hit the road at 20H20 toward a Fad inside Tuvalu waters, about 56 nm away.
22/09/2016	Fishing dFAD in Tuvalu eez	Arrived at 0600 at the fad DSL128436. It's a Spanish type raft... Large detection between 60 to 150 m; started to troll after flag and beacon attached at 0612. The big school (more likely bigeye), stayed down deep between 80 to150m. Only caught small YF and few SJ (41 Y, 6S and 1B tagged) , some RRU and Mahi. Stopped at 07:20, attached a VR4 to the raft and started to jigg to deploy sonic tags. 5 TRI, 2 RRU, 7 FAL (2 doubled with miniPat). Could not get any bigeye, only a couple of small YF half-eaten by the sharks...Stopped at 10:20 and drift. Start trolling first then dangler to catch sj and yf for sonics and if possible the elusive bigeye. But the big school is gone during the afternoon. Only caught a couple of sj (one sonic) and small YF (2 sonics and 43 CT)+5 B. Stop at 18:18 to have dinner , hoping the school will come back during the night. Had a brief handline session at 20:20 to deploy sonic and miniPat on 3 FAL
23/09/2016	fish dFad in Tuvalu eez	Awake at 3 am, our drift brought us just 1 nm from the Fad; Started jigging at 0350 and end at 05:30. ..The jigging session proved that what we saw at echo-sounder screen was what we thought: large fish, mainly bigeye between 60 to 90+ cm associated with YFT of various sizes up to 110+cm. These fish are very reluctant to come to the surface and they didn't come to the danglers early in the morning. A second jigging session in the morning provided many nice fish to the operation table, thanks to Jeff and Fabien who brought them from 100+ meters ... Again the school of big fish vanished in the afternoon. Large breezers of skipjack and small YF/Bet provided a few conventional tags (96Y,43B an 15S) We planned to have a last jigging game early in the morning and do a last dangler attempt tomorrow morning 5Y (55 to 100 cm) and 17 Bet (56 to 94 cm) were archival tagged Sonic total for this FAD : 10 FAL , 5 TRI, 2RRU, 6 YFT, 6 Skj, 7Bet

24/09/2016	fish dFAD in Tuvalu waters	Arrived at the FAD at 0335 and started to jigg till 0530; 7 B with AT and 33 CT. Danglers started at 0535 and fish came to danglers approximately 15 min later. They came in bursts for about one hour and went down to the deep. Managed to tag 356 fish, mostly bigeyes (96%). Stopped at 0715 and drop the sea anchor. Tried a dangler/trolling session later in the day on the way to the FAD and around it but only a couple a sj and small yf. Again the big school seen in the morning is absent in the evening. Stopped at dusk and steamed for 5 nm before dropping the chute so our drift will end-up close to the FAD in the morning.
25/09/2016	Fish dFad in Tuvalu	The perfect drif brought us very close to the dFad at 3am. The raft is drifting 0.5 knt to the 200 course. Weather change with wind turning NNE and increasing to 15 knts. Tried to jigg at 4:40 but the 2-3 tuna caught were all bitten by sharks. Started danglers/trolling at 5H35 till 6h40 but once again they came closed but didn't want to play and went quickly back to their favourite 80 to 150 m. After changing the VR4 that seemed to had problem, we started steaming toward a good looking dFAD (90+ tons marking this morning) located in the NE of the high Sea , about 140 nm away.ETA 3 am tomorrow. Caught a 130 cm yf on a troll line and deploy a LTD2310 at 16:28
26/09/2016	fish dFAD in IW	After a good passage overnight, we arrived at the dFAD DSL100831 at 2:20; good detection at the screen.. After we attached our flag and beacon we did a good jigging session that allowed the deployment of 14 archivals in B (62 to 95 cm) and 2 in Y. Dangler at 0535 for about 2 hours not very productive with close to 200 fish tagged. Bigeye do not stay long time on the bite and come by short bursts. They completely stopped at about 8am. Came back to the raft and dropped the sea anchor. Part of the school stayed with us; tried dangling in the evening but just caught a few. Steamed back to the dFAD and dropped the chute at 20h.
27/09/2016	fish dfad in IW	Drift till 3h30. Steam back to the fad with a bit of fish under the boat. Start jigging at 0430 till 545 for 6 ats deployed in Bet. The danglers didn't work; fish came to the chum but not taking the lures. Stopped at 0715 after just a few (16) trolled small fish. Decided to do the sonic experiment and deployed the VR4; start to jigg at 8h30 till 10h50 for just a couple of SK tagged. Dropped the sea anchor and drift. Slowly steam back to the Fad at 17h; Troll from 174 till 1850 for deploying sonic in 3 S, 1 B and 2 Y. Then put the sea anchor and drift.
28/09/2016	fish dfad in IW	Retrieved sea anchor at 1:30 and steamed back to the raft. Started to jigg at 0220 till 0545 for a very productive session of sonics and archivals. Then tried dangler/trolling but once again only scratch the surface; also the big school of small Yf and skipjack didn't help to attract the good size bigeye that stayed around the 100-150 m strata. Started to steam to DSL122300 at mid day
29/09/2016	Fish dFAD in IW	Arrived closed to the raft DSL 122300 at 22h30 last night and drift. Go to the fad at 3h and started to jigg for archivals (4 B and 4 Y tagged) One small OCS (1m) tagged with miniPat. Stopped at 0555 and started trolling/danglers, but no joy, the school of larger fish stayed between 120 and 150 m deep; less than 10 to the danglers and few at the troll lines in the middle of a large splashing school of sj mixed with few yf. 30 fish tagged; Tried again to jig at the Fad without success. Dropped the sea anchor at 09h. Went back to the

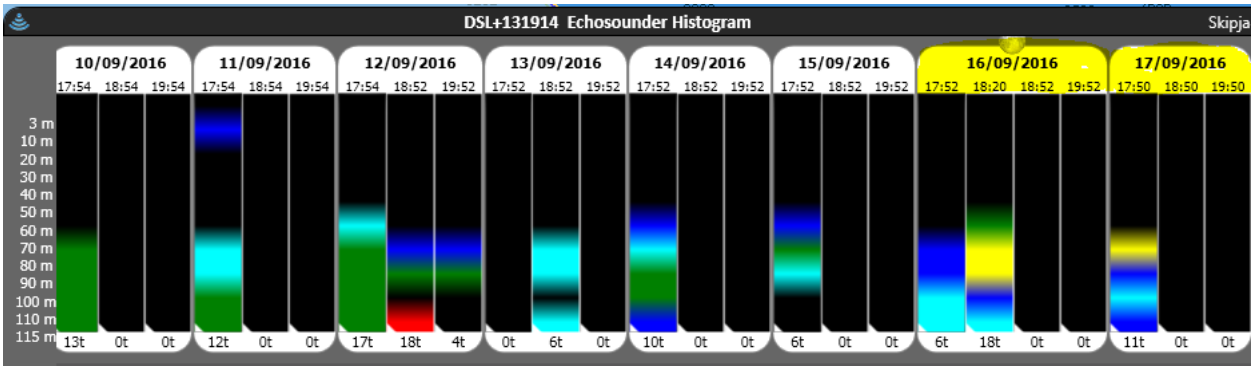
		fad at 17h but no sign of deep school; will wait till 3h to have a last jigging .
30/09/2016	Fish dFAD in IW	Started to jig in difficult conditions (wind, rain and 25-30 sharks around...) at 03am. Many fish lost, eaten, broken rod...for 6 archivals deployed in 1Y and 5 B. Tried to troll/dangler from 6 to 6:50 but no taker on dangler, only 2 tags on the stern troll lines. Started steaming at 7:30 to the "Tuvalu" dFAD 128436 about 70 nm in our SE. Arrived at the Fad at 1850 and removed the non-working VR4, replaced by a VR2, run 4 nm before dropping the sea anchor.
1/10/2016	Fish dFAD in IW	After a quiet drift, retrieved the parachute at 0240 and steam to the raft. Started at 3h15 with jigg and handlines. Tagged 4 FAL with miniPat (total to date 19 FAL and 1 OCS tagged with sat tags). The large quantity of sharks (>30) prevent us to get good condition fish with the jigging gears. This session end-up at 0545 with no archival deployed. Started danglers/troll lines at 0550 and managed to get the bigeye to the danglers for about 30 minutes, allowing the release of 200+ tagged fish (94 % B). . End at 0750 and decide to steam to FAD DSL-119526, where we deployed a VR4, 7 days ago. Arrived closed to the Fad at 20h30 and dropped the sea anchor.
2/10/2016	Fish dFADs in IW	Retrieved the sea anchor at 0230 about 5 nm from the last fad position. Arrived at the fad at 0310 and jigg till 0545 for deploying sonics in 2 YF, 1FAL (double tagged with MiniPat), 2 Bet and one Y with Mk9; then fish came to the danglers for about 30 minutes for 171... CT releases and 1 Mk9. We then came back to the raft and released 4 RRU with sonics. Decided that our work was done there and started steaming to DSL152310, 300+nm in our NNW and marking over 100 tons in the morning.
3/10/2016	steaming in IW	A peaceful day steaming in calm weather, allowing to catch-up on sleep and to start writing trip report...The dFAD is only marking 12 t this morning... Might arrive too late?
4/10/2016	fish dFad in IW	Arrived at DSL-153310 at 0330am inside Nauru EEZ by about 3 nm. Started to jigg and hand-line at 0350, end at 0605 for 2 YF archivals and 2 FAL minipats. No bigeye caught although there is detection around 80-90 m. Tried a short dangler session with no bite, followed by a try of the green stick troll. No taker, detection red solid all the screen width at the same depth...tried again jigging with spreader bar, plastic and medal: no bite. Maybe not tuna..? Started steaming to DSL 100831 we fished already one week ago, marking 9t this morning.
5/10/2016	Fish dFAD in IW	Arrived at DSL-100831 at 06am.Started danglers/trolling ; only got small fish on the stern troll lines (9 CTs) with a couple of bigger YF (one archival). Then tried to jig but with limited success, big fish staying around 100 m deep. Stopped at 0920 for 2bigeyes tagged with archival (one doubled with sonic V9ap) and 6 CTs. Steam 20 min up wind and dropped the sea anchor. Taking advantage of the good weather, we decided to do the sonic tag range test. Not so easy to implement; we used the main long line attached to the sea anchor and a portable GPS to clip on every 100 meters a float and a 5 m branch line wit a lead and, attached just above it, the V13 tags . The boat stayed on to maintain the tension and keep the intervals. This experiment took about 3 hours. Then drop the sea anchor again to wait for the morning jigging session...
6/10/2016	Fish dFAD in	Retrieved the sea anchor at 0330. Arrived at the fad at 04 and jigged for 6

	IW	archivals in BET till 6am. Then tried a dangler session but fish stayed shy and just came briefly to the lures (31 CTs); tried again to jigg but no taker apart a few SKJ to tired to be tagged. Start to steam toward DSL152310, about 170 nm away in our NE.
7/10/2016	Fish dFAD in Nauru eez	After a very calm passage over night and entered in Nauru eez, arrived at the raft at 0330. Not much detection, scattered points. Jigging till 6am revealed good size fish presence. 5 archival deployed in 4 B and 1 Y. Dangler/troll no results, probably no real school here. Start steaming towards the TAO 2S/165E before 8am. ETA tomorrow 4am
8/10/2016	fish tao 2S/165E steam	Steam at 4 knts part of the night to arrive around 4 am at the buoy. No detection on echosounder, tried to jigg for 30 minute in 1.2 knt current; started steaming to equator buoy at 05:15 in fair weather. Arrived at 20h30 after slowing down to repair the central air cond vent support. Little detection on the echosounder and 3 booby birds made us stay for a morning check....Steam toward the wind 2 hours and dropped the sea anchor.
9/10/2016	fish tao equator/165E and steam	Retrieved the chute at 0445 and steam back to the TAO. Start jigging at 0510 till 6am to release the last archival tag in a 70cm bigeye. Small school there but unfortunately was perturbed by a false killer whale that came grabbing the fish on the jig... The dangler session only caught few rats on the stern lines. Started steaming to the TAO 2 N at 0730. Arrived at 2210; school of mahi, few detection. 2 knts of current , so need to run up for about 1h30 before dropping the sea anchor...
10/10/2016	fish TAO 2N/165E	Retrieve sea anchor at 04h30 and steam to the buoys 2nm away. No real detection at echo-sounder, tried to jigg but the 2 knt current were not helping... No bite. Troll around from 6 to 7h. Caught 3 mahi. No sign of tuna. Running out of option, the TMI FADs closest position would not fit with our scheduled arrival time in Majuro. Started to steam toward the TAO 5N position in case we'd missed it last time.
11/10/2016	checking TAO 5N/165E position and steam	Finally found the TAO 5N but no sign of school, not even a mahi. Set the course to Majuro at 07:30
12/10/2016	Steaming towards Majuro	Steaming all day. Time spent in gear cleaning, storing and inventorying.
13/10/2016	Arrival in Majuro-end of CP12	Arrived at the pass entrance at 07am and alongside the main dock at 09 am

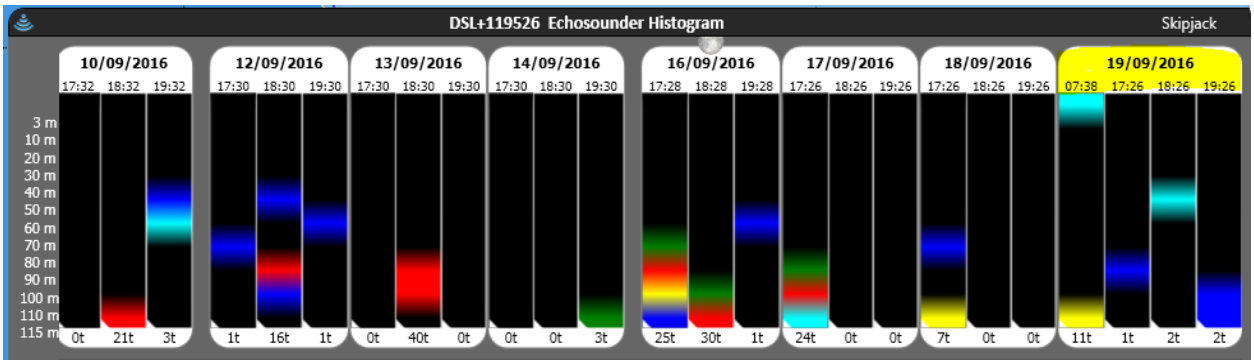
APPENDIX IV: Satlink buoys echo sounder histograms for the visited Tri Marine dFADs

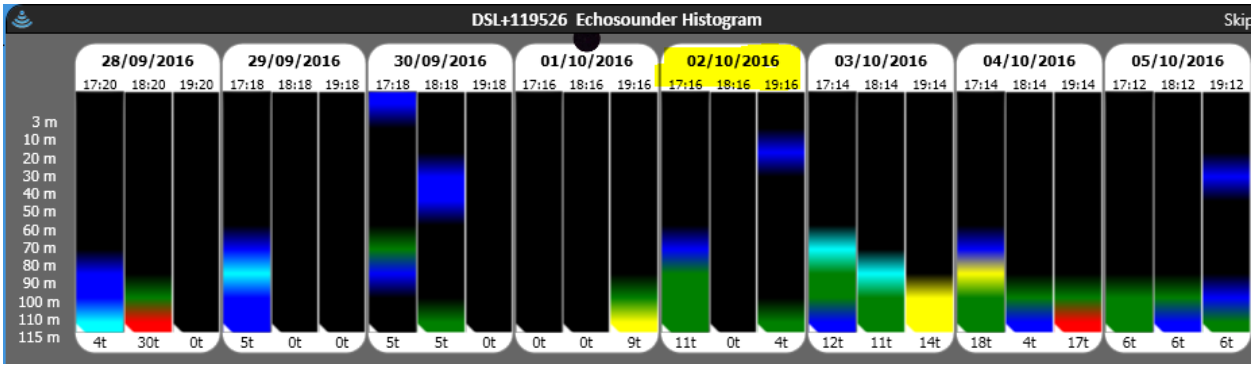
- **DSL+124592**
  - 12th and 13th Sep, equipped with a VR4 (Exp. 1), 2°34'N, 164°34'E
  - No echo-sounder image available

- **DSL+131914**
  - 16th and 17th Sep, 6°31'S, 164°58'E

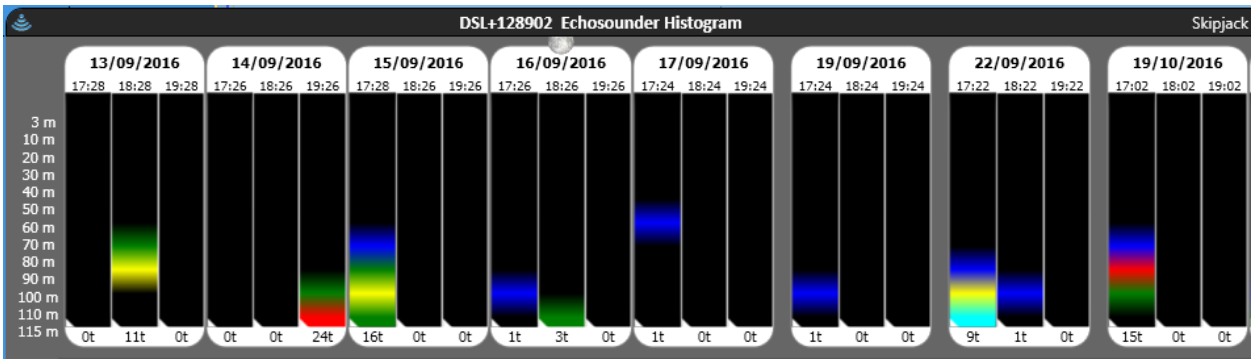


- **DSL+119526**
  - 19th Sep, equipped with a VR4 (Exp. 2), 6°08'S, 170°59'E
  - 2nd Oct, 7°40'S, 171°43'E



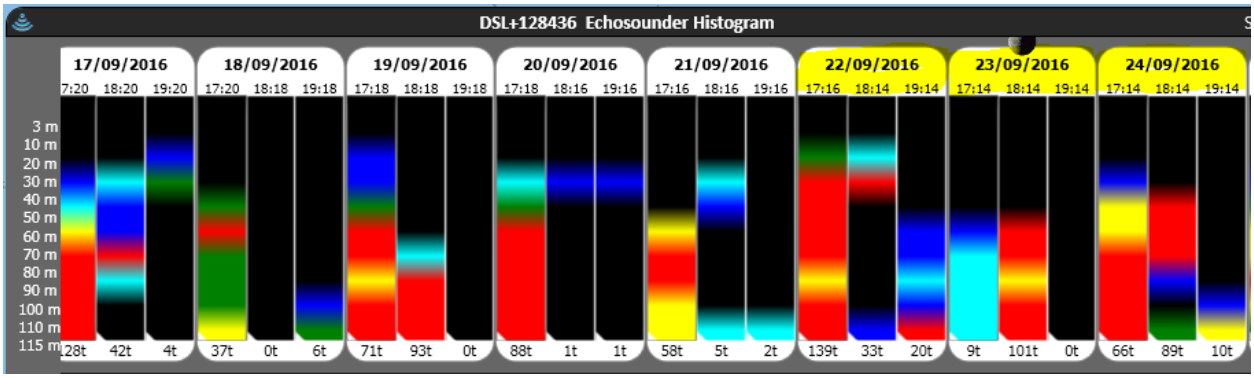


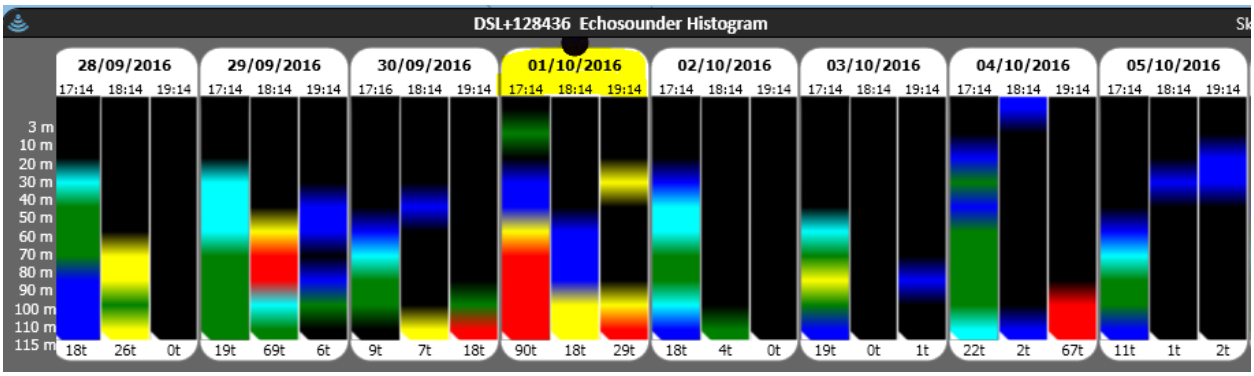
- **DSL+128902**
  - 20th Sep, 6°16'S, 171°26'E



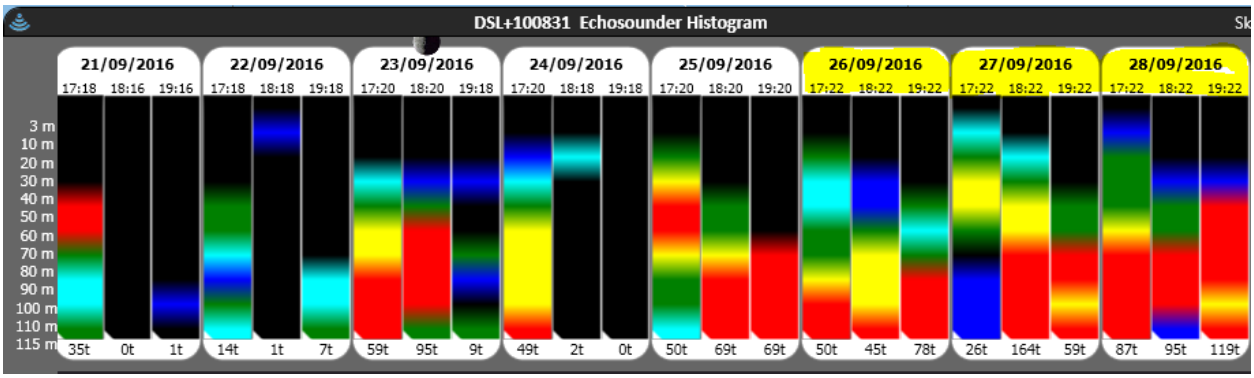
- **DSL+152317**
  - 21st Sep, 4°54'S, 172°11'E
  - No echo-sounder image available

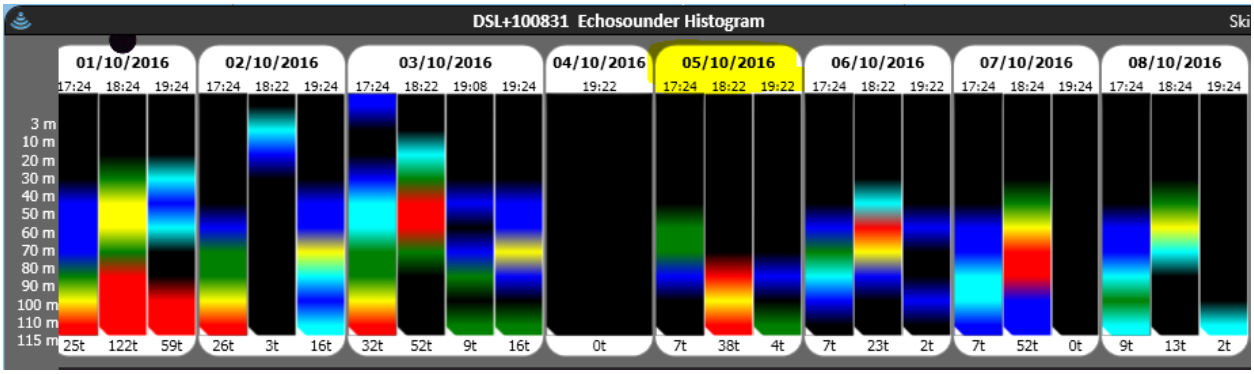
- **DSL+128436**
  - 22nd to 24th Sep, equipped with a VR4 (Exp. 3), 5°30'S, 173°21'E
  - 1st Oct, 6°26'S, 172°21'E



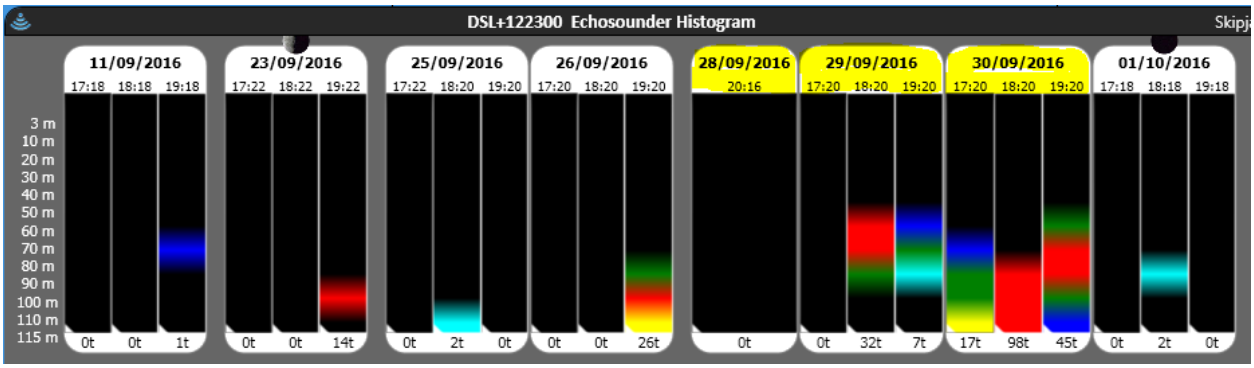


- **DSL+100831**
  - 26th to 28th sep, equipped with a VR4 (Exp. 4), 4°05'S, 171°10'E
  - 5th Oct, 4°43'S, 169°58'E





- **DSL+122300**
  - 28th to 30th Sep, 5°35'S, 171°16'E



- **DSL+152310**
  - 10/2, 3°47.733'S, 167°2.367'E
  - 10/7, 3°27.350'S, 166°54.983'E
  - No echo-sounder image available