PACIFIC TUNA TAGGING PROJECT

Phase 2 (Central Pacific)

Cruise CP-13, 16 July to 23 August 2018

SUMMARY REPORT

Bruno Leroy, Beth Vanden Heuvel, Fabien Forget, Jeff Muir, Francois Roupsard and Marion Boutigny

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^{o} N to 10^{o} 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.

Twelve CP cruises have already been conducted, using Hawaii and Tonga-based fishing vessels; close to 43,000 tuna have been tagged and released, mostly bigeye (90%), on drifting Fads and the TAO buoys anchored along the meridians 165E, 140^{o}W, 155^{o}W, 170^{o}W and 180^{o}W and between 5^{o}N and 5^{o}S.

This report summarizes activities during the 39 days of a thirteenth CP cruise, named hereafter CP-13, on the Hawaii-based FV Gutsy Lady 4. This longline vessel was chartered for the third 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-12 experiment, CP-13 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 180 TAO mooring lines and the nearby waters.

This cruise was primarily funded by the European Union, and the Western and Central Pacific Fisheries Commission (WCPFC). Tri Marine also supported the cruise by providing positions of drifting FADs in the neighbourhood of the cruise. Thanks to IRD/Marbec research unit and ISSF which made Fabien Forget available and covered his salary cost for the cruise and also thanks to the University of Hawaii/HIMB laboratory and ISSF for making Jeff Muir available.

Crew and scientific personnel onboard Gutsy Lady 4 during CP-13 is listed in **Table 1**.

Table 1: Personnel onboard Pacific Sunrise during CP-13

Name	Title/affiliation	Nationality
Tim Jones	Captain	U.S.
Bruno Leroy	Cruise Leader/ SPC	France
Jeff Muir	Scientist/ ISSF/UH-HIMB	U.S.
Francois Roupsard	Scientist/ SPC	France
Fabien Forget	Scientist /IRD	Mauritius
Marion Boutigny	Tagging technician	France
Ramon C. Aguda	Crew-bosom	Philippine
Melvin R. Prudenciano	crew	Philippine
Allan L. Moradillo	Crew	Philippine

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, navigation radar, bird radar and dual frequency sounders (a FurunoCV 295 + 3KW transducer and a Simrad secondary sounder installed especially for CP13 so it could be seen from the working deck, see **Picture 2**), 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 a Fleet-One Inmarsat terminal for email and phone communication.

Picture 1: FV Gutsy Lady 4 at Uliga dock, Majuro 24th Aug 2018

Picture 2: The screen of the Simrad echosounder conveniently allowing observation from the working deck

Prior to CP-13 departure, GL4 was equipped in San Diego (where the boat was based fishing in June), with a cruise dedicated Fleet-One satellite communication system coupled with an "oceanbox" data compression server (Thalos). This communication set-up provided access to the buoy monitoring systems Satlink and Marine Instruments, allowing the TriMarine shared Dfad to be controlled and plotted on the software mapping interfaces. In addition to this, the scientists benefited from WiFi e-mail access, which facilitated work with the onshore collaborators of the project.

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 liters. 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 twelve 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 (**Picture 3**). 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. To increase fish attraction to the lures, a sea-water spray system has been installed for CP13, consisting of length of drilled PVC pipe supplied by 1 strong water pump (**Picture 3**).

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 not deployed during the cruise.

During CP13, rods and reels specially designed for this type of fishing (**Pictures 4&5**) and equipped with heavy metallic jigs associated with 80 lbs. braid line have intensively been used to capture over 75% of

the total tagged tuna and 100% of the fish 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 (0 to 60m on average) but also in day light after morning trolling sessions when tuna could be at 150m…

Picture 3: Waiting for the dangler bite…3 of the 4 starboard side danglers could be seen along with the sea-water spray system in action.

Picture 4: High quality spinning and conventional rods and reels combinations are crucial tools for long hours of jig fishing

Picture 5: Over 1000 fish were captured on rod & reel gear during CP13

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 (**Pictures 6&7**). 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 6: Archival tagging cradle (first plan) and, at the back, 2 of the 3 conventional cradles. A bigeye just implanted with a sonic tag is ready to be released

FISH TAGGING DETAILS

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

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

Table 2: Numbers of tags deployed by tag type and species (see also Table 3).

Tag type	FAL	OCS	BET	SKJ	YFT	TOTAL
Archival			53	-	51	104
Archival and sonic tag			11	-	15	26
Acoustic depth tag			97	14	42	153
Yellow conventional			450	65	335	850
MiniPat satellite tag	**9**	**5**			**1**	**15**
Total fish tagged	**9**	**5**	**611**	**79**	**444**	**1148**

Table 3: Numbers of tags deployed per species and tag type and per FAD (in brackets number of sonic tagged fish that also received an archival tag on the dFADs equipped (highlighted in red) with a satellite acoustic receiver VR4.

FAD Nb	Conventional			Total	Sonic			Total	Archival		Total
	B	S	Y		B	S	Y		B	Y	
TMI CP13 M3i 261365	2	1	9	**12**	4	1	11(4)	**16**		5	**5**
lost fad CP13	105	3	36	**144**	13(1)		10(3)	**23**	1	4	**5**
TAO 02S-180	1		10	**11**					2	3	**5**
TAO Eq-165E	34	6	51	**91**					8	9	**17**
TAO Eq-180	13		5	**18**					13	5	**18**
TAO 2N-180	85		21	**106**					15	1	**16**
TMI CP13 ISL+232208	41	11	37	**89**	11	8	3	**22**	1	9	**10**
TMI CP13 ISL+168308	1		7	**8**							**0**
TMI CP13 ISL+212716	38	1	7	**46**	19(2)		5(1)	**24**	3	1	**4**
TMI CP13 ISL+213098	7	2	14	**23**	13(3)	3	7(1)	**23**	4	2	**6**
TMI CP13 ISL+223750	19	4	21	**44**	18	1	4	**23**			**0**
TMI CP13 ISL+223910		3	2	**5**							**0**
TMI CP13 ISL+224020	42	1	18	**61**	18(5)		5(2)	**23**	15	6	**21**
TMI CP13 ISL+224150			2	**2**						2	**2**
TMI CP13 ISL+224451	1		3	**4**						1	**1**
TMI CP13 ISL+230635	3	5	11	**19**					2	5	**7**
TMI CP13 ISL+230857	1			**1**							**0**
TMI CP13 ISL+231945	29	10	32	**71**						6	**6**
TMI CP13 ISL+232000	16	18	34	**68**	12		10(4)	**22**		4	**4**
TMI CP13 ISL+240370			2	**2**						1	**1**
TMI CP13 M3i 226913			3	**3**							**0**
TMI CP13-ISL+211662				**0**		1	2	**3**		1	**1**
TMI-CP13 M3i+519964	12		10	**22**						1	**1**
Total	**450**	**65**	**335**	**850**	**108(11)**	**14**	**57(6)**	**179**	**64**	**66**	**130**

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) 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 850 tropical tunas were tagged and released with CT only during the cruise, comprised of 450 bigeye (53%), 65 skipjack (8 %) and 335 yellowfin tuna (39 %). Their size distributions are shown in **Figure 3.** The spatial distribution of all tuna tag releases is shown in **Figure 1**.

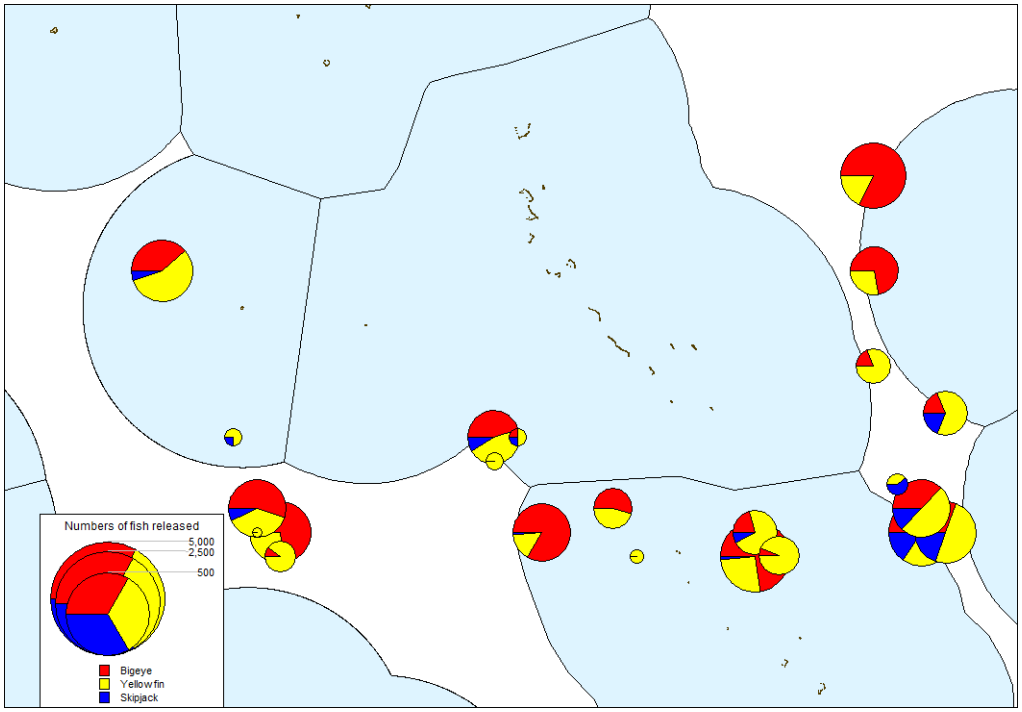


Figure 1: Distribution of tag released in tropical tunas during CP-12

[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:**

Two hundred and nineteen Wildlife Computers MK9 and one Lotek Lat2810 archival tags were available for deployment. Hundred and thirty tags were deployed, 64 on bigeye tuna and 66 on yellowfin. 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 displayed on **Figure 4,** 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 7 and 8**). 11 bigeye and 15 yellowfin tuna also received a sonic tag in addition to the archival.

Picture 7: Archival tag surgery on a bigeye tuna, closing incision after tag implantation.

Picture 8: A bigeye implanted with an archival tag and ready to be released

- **<u>Acoustic Tagging:</u>**

Acoustic tagging experiments on 8 dFADs were planned for the CP13 crusie. Each of the 8 dFADs was equipped with VR4 Global (Vemco, Amirix, Canada) satellite linked acoustic receivers. For the acoustic tagging, the preferred fishing technique was vertical jigging with fishing rod and reels (**Fig 4**). Pressure sensitive acoustic tags (V13P) were implanted in the 3 major tuna species with a priority for bigeye. The aim of this experiment was to:

1. Collect simultaneous vertical behavior of tuna at dFADs in order to provide information for mitigating bycatch of juvenile bigeye and yellowfin tuna by WCPO purse seine fisheries.
2. Improve the interpretation of the echo sounder buoy data.
3. Collect data on the associative behavior of tuna at dFADs to estimate residency at FADs and determine species-specific vulnerability during the day at dFADs.

Table 4 summarizes the number of acoustic tags implanted per species and per receiver.

Figure 5 shows the length frequencies of the different species implanted with acoustic tags.

Note: Three fish (2Y, 1S) were released with acoustic tag under a FAD that was not equipped with a VR4 after realizing that no suitable bigeye tuna were present in the school.

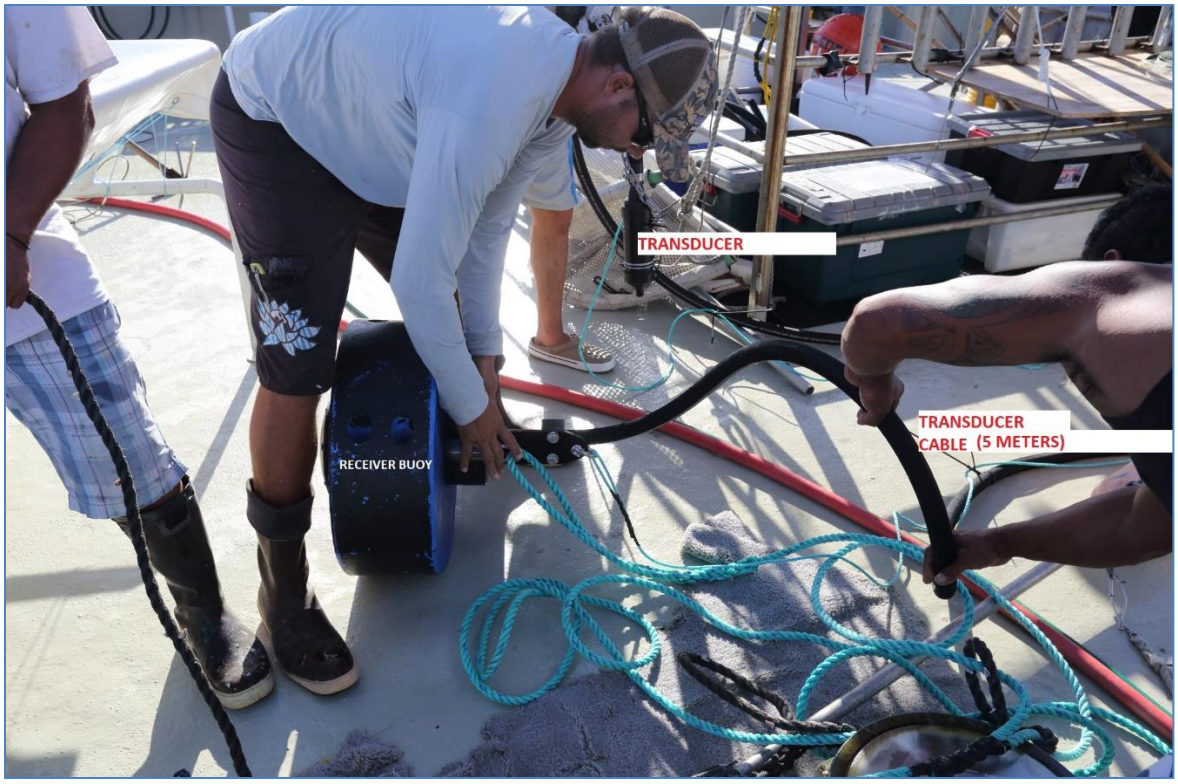
Table 4: Summary of animals implanted with acoustic tags at each receiver station. In brackets the number of fish that also received an archival tag.

FAD	VR4	Schools	Date	BET	SKJ	YFT	TOTAL
TMI CP13 ISL+223750	200146	9	26-Jul	18	1	4	**23**
TMI CP13 ISL+224020	200143	10	27-Jul	18(5)		5(2)	**23**
TMI CP13 ISL+212716	200148	14	30-Jul	19(2)		5(1)	**24**
TMI CP13 ISL+213098	200149	18-20	1-Aug	13(3)	3	7(1)	**23**
lost fad CP13	200150	27 - 32	6-7 Aug	13(1)		10(3)	**23**
Found Fad CP13- M3i 261365	200145	33-37	7-9 Aug	4	1	11(4)	**16**
TMI CP13 ISL+232000	200147	38-40	11-Aug	12		10(4)	**22**
TMI CP13 ISL 232208	200144	41-44	12-13 Aug	11	8	3	**22**
Total				**108(11)**	**13**	**55(16)**	**176**

VR4 Global Description:

The VR4 Global unit allows the user to remotely monitor tagged fish, and eliminates the need to retrieve the receiver at the end of the study. The unit utilizes Iridium satellite communication to relay detection logs, positions, status updates, and error messages to the user. This surface unit is housed in aluminum housing, floated by a doughnut shaped float collar that bolts around the housing. The unit utilizes a hydrophone (Named transducer on the picture 9) attached to a 5 meter communication cable, attached (and protected inside a heavy duty rubber pipe) under the main body of the unit. The VR4G unit is attached to the dFAD prior to releasing fish tagged with sonic transmitters (see **Picture 9**).

An example of tuna implanted sonic tag detection timeline is displayed in **Figure 2**. An example of the registered vertical behavior is displayed in **Figure 3**



Picture 9: Setting-up a VR4 acoustic receiver prior attaching it to a dFAD.

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

Tri Marine provided full access to their dFADs equipped with Satlink or Marine Instrument satellite buoys in the areas that the tagging vessel operated during the cruise. Of the dFADs provided, 27 TMI dFADs were visited and fish were tagged and released on 18 of them (See **Figure 2** for an overview of visited dFAD locations). Seven of them were instrumented with VR4 acoustic receivers and set free. One VR4 was attached to a lost fad (no satellite buoy) found in international waters. Tri Marine will continue providing data regarding the drift trajectories and fishing activity on these 18 dFADs, as needed for further analysis.

An example of associated Satlink buoy echo-sounder histogram figures for a Tri Marine dFAD is displayed in **Appendix IV**. 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.

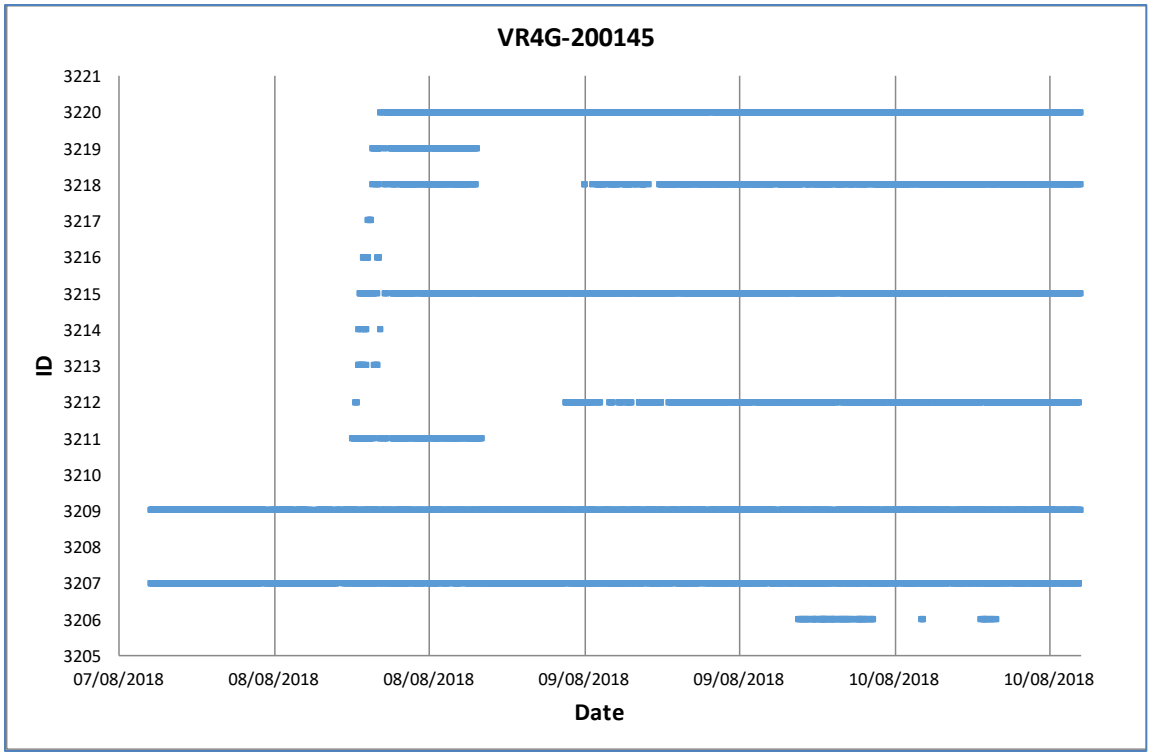


Figure 2: An example of detection timeline of tagged bigeye and yellowfin tuna at a dFAD over a 3-day period

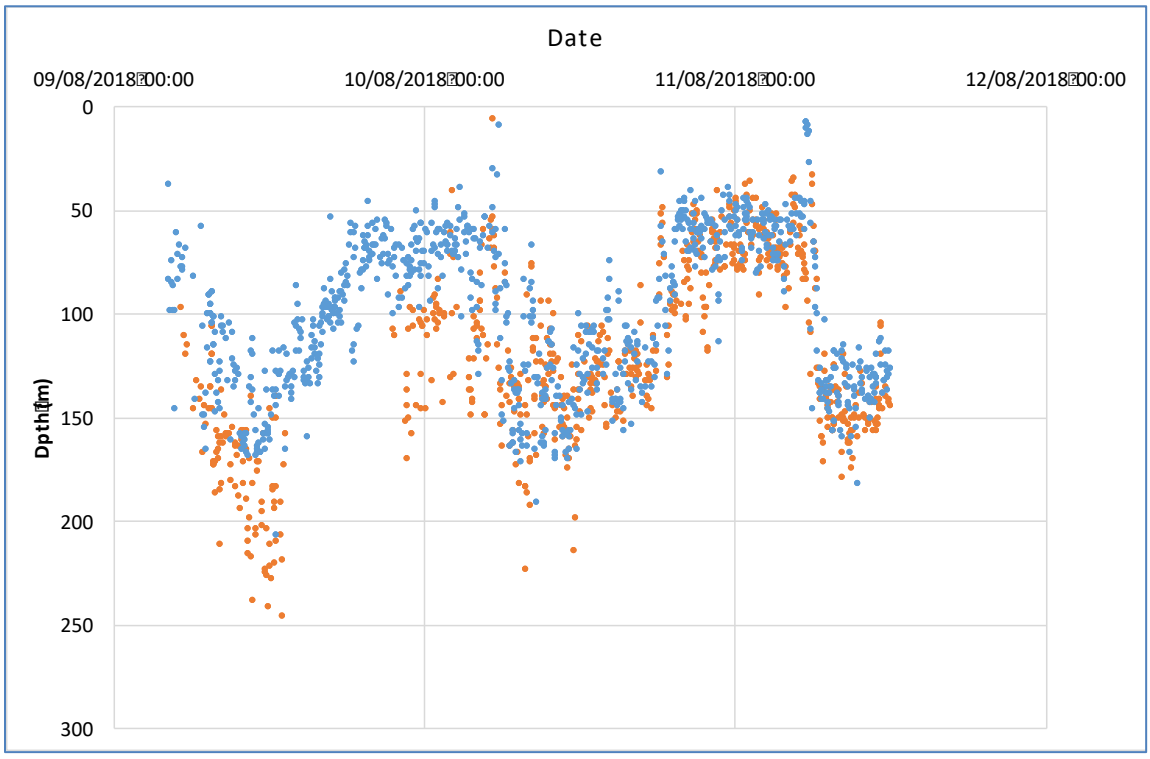


Figure 3: An example of vertical behavior of tagged bigeye ID 3218 (47 cm FL, orange circles) and yellowfin tuna ID 3215 (56 cm FL, blue circles) at a dFAD over a 3-day period.

GENERAL DESCRIPTION OF CRUISE TRACK AND FISHING ACTIVITY

The track of Cruise CP-13 is shown below in **Figure 4**. The 5N, 2N and Equator (The 2S was gone adrift) TAOs on the 165E line were visited along with the 2S, Equator and 2N on the 180 meridian. In addition to the TAOs, 28 drifting FADs were visited and their initial position is displayed on **Figure 4**. Most of fishing occurred in International and Tuvalu waters. Few fish were also tagged and released in Nauru and Kiribati eez.

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 39 days of charter during CP-13, 11 days were spent steaming and/or checking buoys with no fish, and part or all of 28 days were spent fishing and tagging.

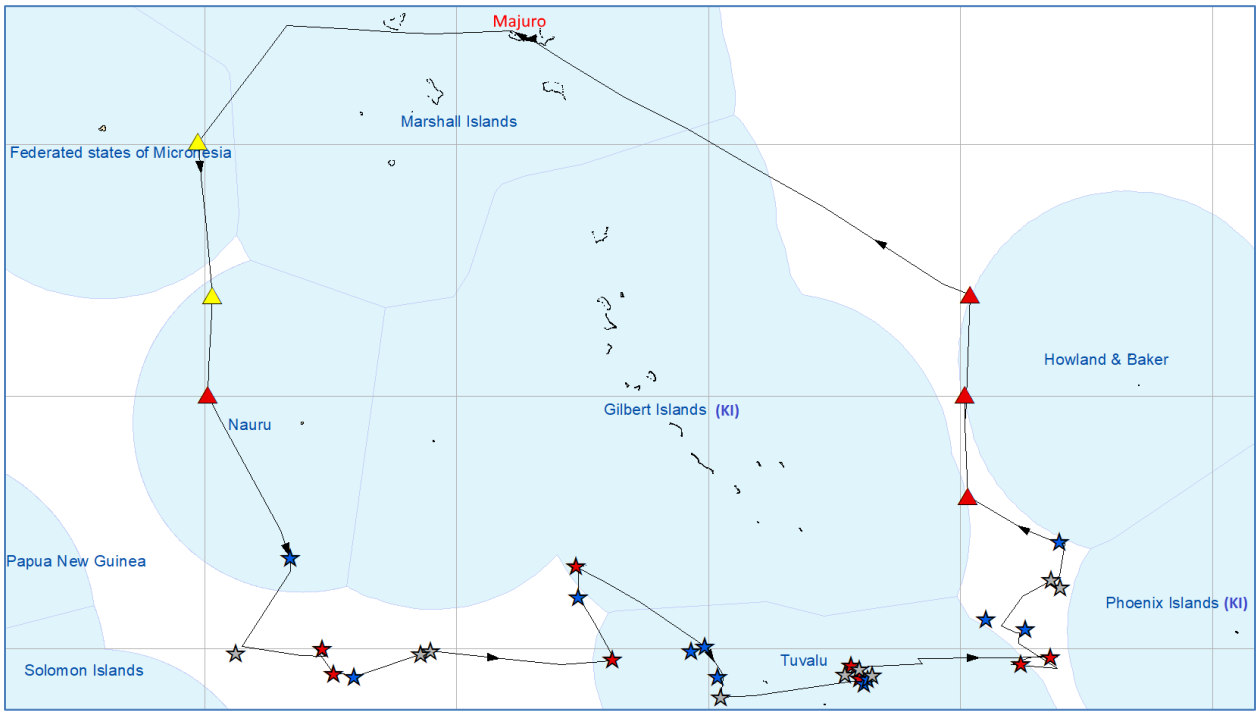


Figure 4: Cruise track during CP-13 and positions of TAOs and visited drifting FADs. Red stars are dFADs equipped with VR4. Blue stars are dFAD were some fish were tagged with archival and/or CT. Grey stars are visited dFADs with no tagging. Yellow triangles are the visited TAOs along the 165E line (The TAO where fish were tagged are in red color).

SIZE DISTRIBUTION OF TAGGED FISH

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

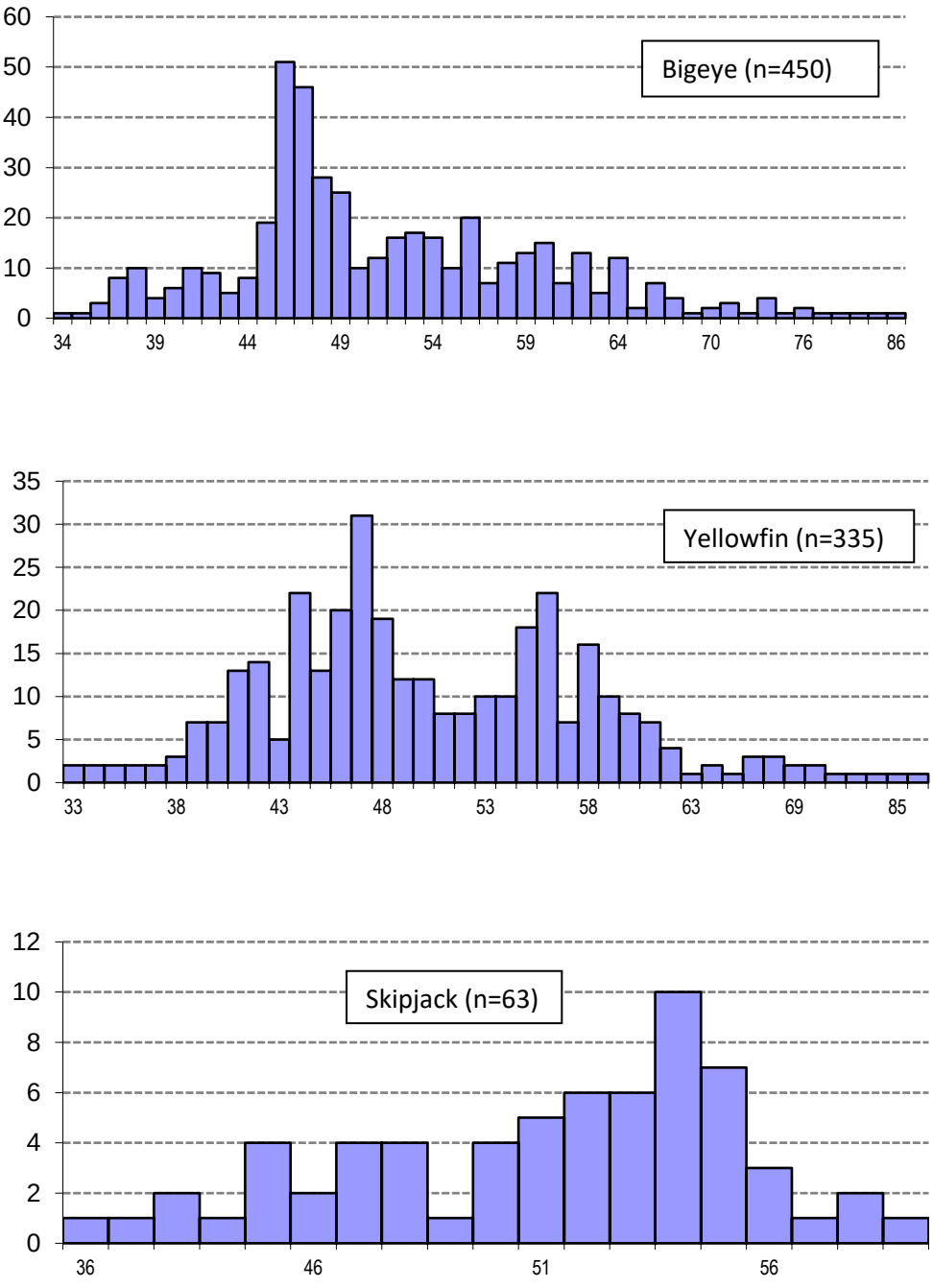


Figure 5: Size distribution (cm) of fish conventionally tagged during CP-13

ARCHIVAL TAGS

The size range for the 64 bigeye was 57 to 89 cm and 54 to 115 cm for the 66 yellowfin. The length frequencies for both species are displayed in **Figure 6**.

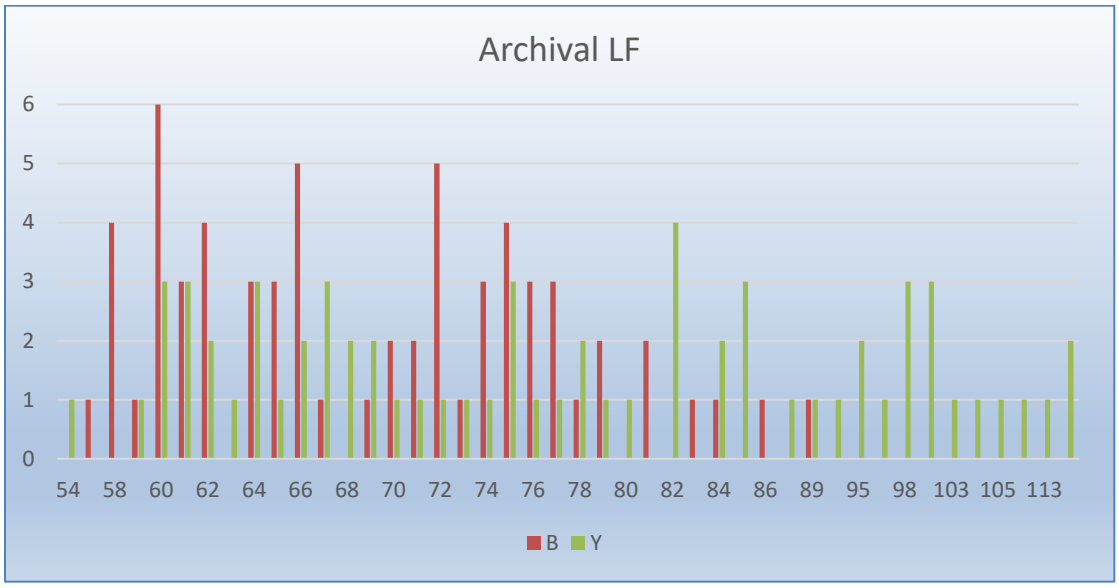


Figure 6: Length frequency of fish tagged with archival tags

ACOUSTIC TAGS

The size range for the 108 bigeye was 40 to 89 cm, 37 to 98 cm for the 57 yellowfin and 48 to 60 for the 14 skipjack. The length frequencies for both species are displayed in **Figure 7**.

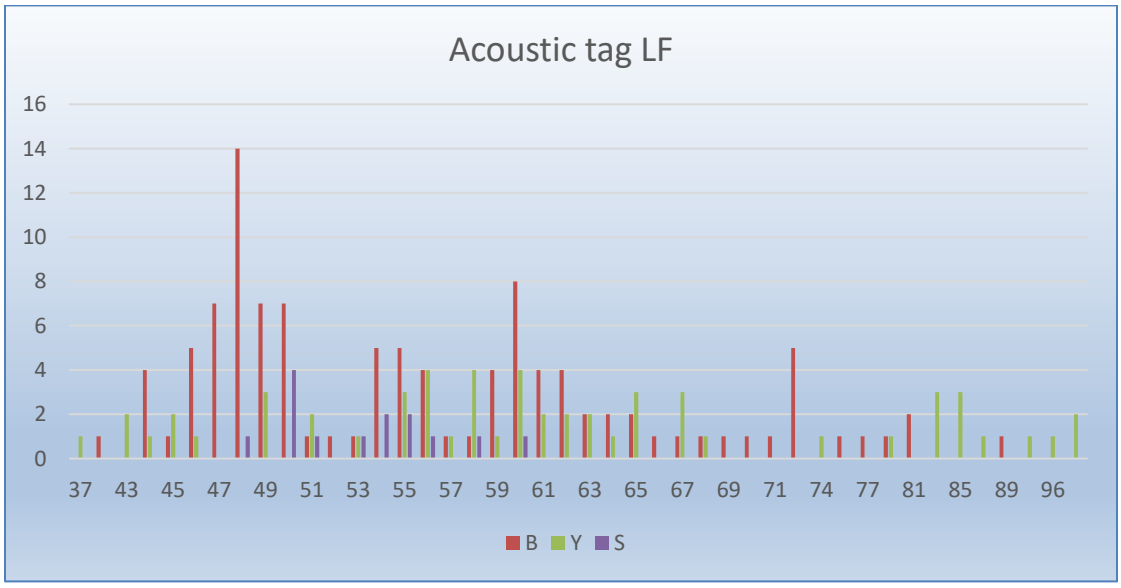
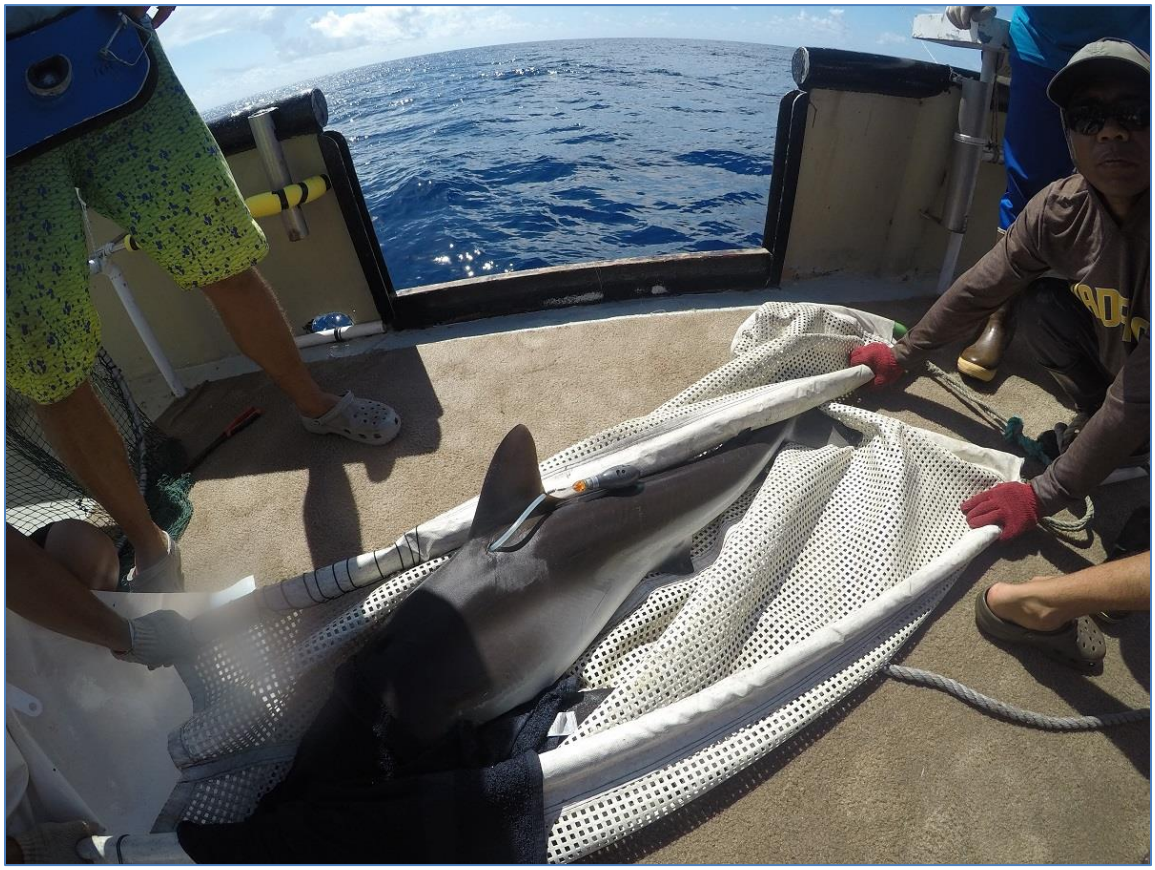


Figure 7: length frequencies of fish tagged with sonic tags

MINIPAT SATELITTE TAGS DEPLOYED ON SHARKS AND TUNA:

These tags have been opportunely deployed during the cruise by Fabien F. and were not part of the original research cruise plan. They have been attached to 9 silky sharks (**Picture 10**) of 110 to 202 cm TL, 5 oceanic white tip sharks of 116 to 160cm TL and one yellowfin tuna of 118 cm FL.



Picture 10: a silky shark tagged with a MiniPat and ready to be realeased.

BIOLOGICAL SAMPLING

Biological sampling was conducted during jigging sessions and after trolling (danglers). Two persons were in charge of the biological sampling, Marion Boutigny and Francois Roupsard sessions (**Picture 11**). Having one person dedicated to biological sampling and another one assisting and able to jump on other opportunistic tasks (CT tagging, recording footage) proved to be a very efficient option. It allowed us to sample 223 fish (1185 samples) which is a clear improvement compared to previous CP trips (see **Figure 8**).

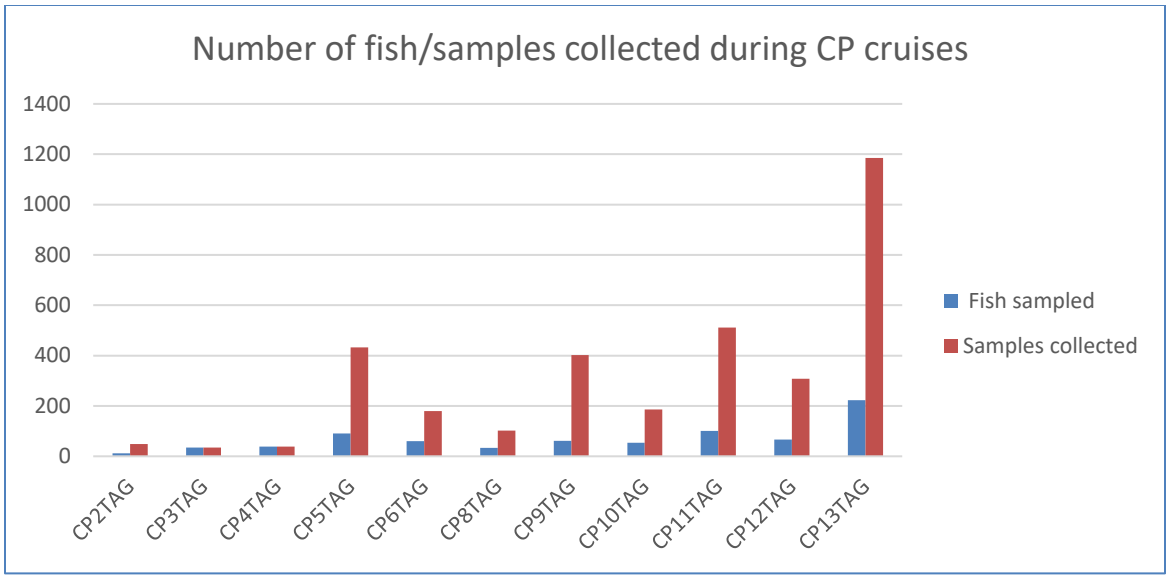


Figure 8: Number of fish and biological samples collected during CP cruises

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

Table 4: Summary of biological samples collected during CP-13

Species	nb of fish sampled	Muscle	Liver	Stomach	Gonad	Otolith	Spine	Blood
BET	79	79	61	61	59	61	61	35
BUM	8	8	8	8	5	0	0	0
DOL	14	14	14	14	0	0	0	0
RRU	16	16	16	16	1	1	1	0
SKJ	22	22	22	22	22	21	22	0
SSP	1	1	1	1	0	0	0	0
WAH	5	5	5	5	0	4	0	0
YFT	78	78	78	77	77	78	77	27
Total	**223**	**223**	**205**	**204**	**164**	**165**	**161**	**63**

In addition of SPC routine sampling, we also collected samples for two scientific partners:

- IRD (Anne Lorrain) : YFT and BET blood sampling (n=63) for methyl-mercury studies
- CSIRO (Pete Grewe) : BET muscle sampling (n=50) for genetics analyses

Samples for Pete Grewe were brought back to Hawaii with Jeff Muir who will transfer of the samples in RNA later and assure their shipment to CSIRO Hobart.

Picture 11: Biological sampling during CP13 greatly beneficiated from the sturdy table we built for the purpose

CONCLUSION

The CP13 cruise has been a very challenging cruise to organize and implement. The amount of electronic tags to be deployed on fish associated with drifting FADs was increased by 30% compared to the already ambitious cruise organized in the same area in 2016. Coordination between all the actors involved to operate the research in a quite narrow time frame (dFAD closure period) was crucial. Having full access to a large quantity of purse seine industry drifting FADs was again a key component of the success of such experiment. Adequate jigging rod and reel combinations manned by skilled fishermen provided sufficient amounts of suitable fish for archival/sonic tag deployment. However, the capture and tagging of a large number of tuna with conventional tags could not be achievable this time using dangler fishing gear. The relatively smaller amount of bigeye tuna found during this cruise at the dFAD associated schools combined with deep thermocline (± 150m) is likely to explain why bigeye and yellowfin tuna were reluctant to move to the surface, and thus were not accessible to the dangler gear.

FV Gutsy Lady 4 proved once again to be the perfect platform such experiment during this kind of cruise. 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. A special mention to the boat owner who always make sure that his vessel and its food supply suits our needs! The skills and dedication of the captain and his crews are of course one of the main components that made this CP13 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 and tag type (dates are displayed on Marshall Is time, GMT+12). EEZ abbreviations: IW: International Waters, FSM: Federated States of Micronesia, MI: Marshall Islands, NR: Nauru, TV: Tuvalu, KI: Kiribati

Date	General area	Principal activity	Conventional tags			Archival (red), sonic (green) or both (purple) tags			Satellite tags	Total tagged
2018			BET	SKJ	YFT	BET	SKJ	YFT	FAL	
16-Jul	Majuro	Leave port 15:40								0
17-Jul	MI	Steaming- gear prep								0
18- Jul	MI	Steaming- gear prep								0
19- Jul	FSM	Check TAO 5N/165E								0
20- Jul	FSM-NR	Check TAO 2N&00								0
21- Jul	NR	Fish TAO 00/165E	15	2	24	5		6		52
22-Jul	NR	TAO 00/165E & steam	19	4	27	3		3		56
23-Jul	NR	Fish dFAD					1	2		3
24-Jul	NR &IW	Fish dFAD						1	2	3
25-Jul	IW	Fish dFAD			2					2
26-Jul	IW	Fish dFAD	19	4	21	18	1	4	1	68
27-Jul	IW	Fish dFAD	42	1	18	5-10-13		2-4-3	1 YFT	99
28-Jul	IW	Fish dFAD- Steam	1		7				1	9
29-Jul	IW & TV	Steam								0
30-Jul	TV & IW	Fish dFAD- Steam	38	1	6	2-1-17		1-4	2	72
31-Jul	IW & KI	Fish dFAD- Steam		1	4	1		2		8
1-Aug	KI	Fish dFAD	7	1	12	3-10	3	1-1-6		44
2-Aug	KI & TV	Steam-Fish dFAD	1							1
3-Aug	TV	Fish dFAD	12		9			1		22
4-Aug	TV	Fish dFAD			3				1	4
5-Aug	TV	Fish dFAD	1		14			2	1	18
6-Aug	TV	Fish dFAD	62	2	13	1-5		2-1-5	1	92
7-Aug	TV	Fish dFAD	44	1	17	7		1-1-2	1	74
8-Aug	TV	Fish dFAD	1	1	4	2	1	1-2	1	75
9-Aug	TV	Fish dFAD			2	2		3-5	1	13
10-Aug	TV & IW	Check dFAD-Steam								0
11-Aug	IW	Fish dFAD-Steam	16	18	34	12		4-6		90
12-Aug	TV	Fish dFAD	10	4	24			9	1	48
13-Aug	TV & IW	Fish dFAD-Steam	31	7	13	1-11	8	3	1	75
14-Aug	IW	Fish dFAD	29	10	32			5		76
15-Aug	IW	Fish dFAD-Steam		3	2			1		6
16-Aug	IW	Check dFAD-Steam								0
17-Aug	IW	Fish dFAD-Steam	3	5	11	2		5		26
18-Aug	IW	Fish TAO 2S/180	1		10	2		3		16
19-Aug	IW	Fish TAO eq/180	13		5	13		5		36
20-Aug	IW	Fish TAO 2N/180	85		21	15		1		122
21-Aug	TV & MI	Steaming								0
22-Aug	MI	Steaming								0
23-Aug	MI	Steaming								0
Total			**450**	**65**	**335**	**11-53-97**	**14**	**15-51-42**	**15**	**1148**

APPENDIX III: Daily activities summary from Daily Log entries

logdate	Activity_Desc	Notes
16/07/2018	Departure from Majuro, start of CP13	Boat arrived at Uliga dock at 08h30. Clearance well organised by agent Romeo R. 6,000 gallon of fuel loaded before 13h. Installed the computer network and linked to Oceanbox, all working fine, email tests sent and well received, dFAD buoys software connected without problem. Small last shopping for a bit of fresh food and the usual small missing items. Short lunch at RR hotel and, after clearance-out. Casted the ropes at 15:40 under light rain. Smooth start, seems nothing missing, started to set-up tagging cradles and loading tags.
17/07/2018	steaming toward dFAD MI 261365	Good passage overnight in following seas, doing about 7.5 knt. Spent all day rigging rod and reels, archival tags, sonic tags, between marlin bites (4 sampled)…Luckily 100% cloud cover helped to work on the deck…Arrival to MI buoy should be 4am tomorrow morning.
18/07/2018	checking MI 261365 and steam toward TAO 5N-165E	Arrived at the buoy at 0425 after a bit of searching around as the buoy wasn't flashing at the beginning… Alas, the fad wasn't there, only the buoy…Took it onboard and started steaming to TAO5N at 0435. Setting gears and archival tags kept the team busy the whole day.
19/07/2018	Fish Tao 5N/165 and steam to 2N	Nothing at the TAO 5N apart a nice Micronesian sunrise on peaceful waters..Baby blue marlin on the trolling line at 0710, shake it to let it go. Crossed some bird piles, terns and shearwaters, few splashers but nothing jumped on the lures; most likely small skj. All day spent rigging lures.
20/07/2018	Check TAO 2S/165E , steam to TAO equator	Started to check the TAO 2N at 06:30 but it was dead, nothing apart a Caranx s. Tried to jig without success. Hit the road again at 0650. Arrived at the TAO 00 at 22h. Some detection at echosounder closed to the buoy. Jigging till 22h 40 for one silky and one small bet. Decided to try again in the morning
21/07/2018	fishing TAO equator/165	Awake 3:30. Started jigging at 0400 and get bites right away. Some good size Y and B at the start then slowly drift away with some smaller size fish. 5 AT before 5am. Finished at 0615 with 6 Y and 5 B tagged with archivals and 41 with CT. Started dangling at 06:20 but got only small Y on the stern troll lines along with few RRU and C Sexfaciatus. Decided to stay on this TAO to fish in the afternoon and get some more AT deployment tomorrow morning. The afternoon dangler session did not succeed, fish seemed to be largely spread-out all around the buoy. Only one small Y for the sampling. Steamed for one hour against current for the drift.
22/07/2018	Fish TAO equator and steam toward dFAD	Started jigging at the buoy at 03am until 06:20. Many small yellowfin and bigeyes with a few S. Only 3B and 3Y with archivals. Good session of biological sampling at the same time. Danglers attempt for 40 min for nothing. Started to steam at 0730 toward Fad +ISL211662, 200 NM , course 152
23/07/2018	fish dfad	After a good passage overnite, arrived at the Fad at 0950; multiple

	+ISL211662	detection levels/layers from 150m to 40m; attached the boat buoy for easier retrieval. Started jigging at 1010 but hard to get fish in good condition at the surface with many silky sharks around. Tagged with sonic 2 yf and 1 S. Deployed the VR4G-200146 and stop the jig session at 12h. Drifted till 16:30.Tried to dangler fishing but nothing except one small mahi on the stern troll line. Smaller detection than this morning on the echosounder.
24/07/2018	Fish dfad Isl+211662 and steam to and fish Mi3260800, then toward ISL+223750	Arrived at the Fad at 2:50 but found with disapointment that detection was almost null…Jig for 1,5 h for only one large YF (115cm) tagged with AT. Decided to pick-up the VR4 and run to the next Fad, 120 nm away in our SSW. Arrived at M3i260800 at 1915.Almost no detection, got 3 small Y on troll line. Jigg but nothing except sharks. Probably around 20 silky (one tagged with minipat) Decided to leave and head to ISL+223750, about 100 nm in the east
25/07/2018	Fish +ISL223750	Arrived at the Fad at 09:06. Decent detection at 150m, up the drift. Started danglers at 0914 but stopped quickly, as obviously no fish was showing up (one too small yf under 35cm). Then did 3/4 of an hour of jigging; only got a couple of silky, one large skj and 2 small yf (ct). Stopped at 10:14 under heavy rain and steam up the wind for the drift. Came back to the buoy at 16:30 and tried to troll around, only caught a small y and a silky shark. Decided to try jigg at midnight so if nothing there we would have time to steam to the next good looking Fad 50 nm in our SSE
26/07/2018	fish dFAD ISL+223750 and steam to ISL+224020	Started jigging at midnight in difficult condition, with about 15 knt of SE wind and many sharks eating our fish. Waited for a while to take decision for deploying sonic. Then deployed 23 sonics , mostly in 45-50 cm B, few Y and 1 S. Stopped at 0430 and wait daylight for dangling. Started at 6:30 and stopped at 07:15 but no success the school was close to surface at the start but didn't come to the lures apart a few small fish at the stern troll lines; quickly the bulk of the school went done to 160m. Started steaming to dFAD ISL+224020 at 8am. Arrived at 16:20 good detection at 160m. Not worth tempting danglers, decided to steam a bit in the wind and drop sea-anchor to wait for 02am
27/07/2018	Fish ISL+ 224020 and steam to ISL +168308	Had a particularly useful jigging session between 2am and 6:20, with only a few shark, and a school mostly composed of perfect size bigeye for electronic tagging. Deployed 23 sonic tags in 18 B and 5 Y and 21 archivals in 6Y and 15 B. 5 B and 2 Y received both tags. The dangler session again didn't attract the fish although it looked promising at start with fish closed to the surface. Another jigging attempt between 845 and 940 but only 2 small Y were caught on spreader bar as bigeye returned to their 150 m deep daily habitat. Started steaming to fad ISL+168308 at 10am . Arrived at 1405. Small detection but more likely bigeye at 150m. Put the boat flag and radio on the raft and deployed the sea anchor to wait for jigging time
28/07/2018	Fish dFAD	Finished our drift at 1h30 at 1.4 nm from the fad. Not bad planning

	ISL+168308 and steam	Captain… Decent detection at the Fad but alas revealed to be mostly small yf surrounded by a horde of hungry silky sharks. Impossible to work (except for biological sampling…). Deployed one Minipat in the largest silky (1.60m). Threw the towel at 0445 after less than 10 CT deployed in 7 small Y and 1 B. Started steaming to one MI Fad (M3i261231) about 110 nm away in our NE. Found it at 17:30, was an absolute desert. Steamed to a nearby satlink +ISL224159, but same thing. Decided to do the big move for the Tuvalu waters and +SL212716, about 220 nm away
29/07/2018	steam to ISL+212716	SE swell made our passage a bit rock'n roll along night and day. Nothing to report except a short-bill caught one troll line when passing through a large school of sj actively feeding. Found the fad at 20h under the rain. Not much detection but not the time for that. Put our beacon on it and run before dropping the chute and wait for 2am.
30/07/2018	Fish ISL+212716-deploy VR4 200148 and steam to ISL+224150	After a peaceful drift in calm waters we awake at 01:30 only 0.5 nm from the Fad. Started the jigging session at 0150. Was difficult at start with large silky taking all our fish and pushing fish to stay in the deep. Tagged 2 of those (around 190 LT). Then drifted away with part of the school and began to catch and tag mostly bigeye around 60 cm. Deployed 24 sonics with 4 doubled with an archival plus one bigeye with AT only . Deployed VR4 200148 at about 05:30. Started the dangler trolling at 06:10 and this time we were successful, fish came to bite the lures. Unfortunately only small fish, mostly too small 35-38 cm FL were caught. Stopped at 0655 and started to steam to ISL+224150 about 70 nm in our NNW, located in the NE corner of IW pocket. Arrived there a 16h; nothing on the echosounder. Drift to wait the 2am fishing time.
31/07/2018	Fish isl+224150 and ISL+213098	Started jig fishing at 2am until 0410. No real success this time only got 2 YF AT, no bigeye, plenty sharks. A school of mahi gave us enough fish for the coming week or so and provided good entertainment for some. Decided to steam to ISL+213098, inside Ki waters that is showing good detection at about 35 nm away. Arrived at 08:30, birds around, good detection. After putting our flag on we had a short jigging session (100 to 150 m deep…) and caught a couple of small Y and S and one decent B (64cm , AT). Stopped at 0930 and drift. We had the visit of a small group of false killer whales, 1 large male, 3 of 4 smaller adults and a young. Amazing moment when they accepted to be fed with pieces of tuna alongside. Footage taken with Gopro on a pole…Checked the Fad at 16h but most fish gone or at 160 m depth.
1/08/2018	fish ISL+213098-VR4 200149	Weird jigging session being on what looked like a quite nice aggregation and getting only a few bites. No obvious reason. Large predators? Tried to catch sharks and got one large silky (over 2 m) that managed to get away. Just got 5 sonics deployed and one archival. The dangler session did not success again. Stopped at 0630, deployed the VR4 200149 and had breakfast. Started jigging again

		at 0750, stopped at 0930 for 3S, 4 Y and 1 B with sonics, all painfully brought back from 160m. Drifted to sleep until 2130 and then had a good jigging session until 2320 that deployed 1 Y and 9 B sonics (including 3 doubled with AT). Started steaming toward Fad ISL+224211, about 200 nm away in Tuvalu waters.
2/08/2018	Steaming to FAD ISL+230857	Calm passage overnight. Decided at 10am to change our course to catch ISL+230857 that is drifting full west. We would missed this good-looking one if not catching it now. The other Fads in the cluster are drifting south. Arrived at the fad at 2210, tried to jig but got only 2 small fish with no real sign of school. Started to steam to a MI Fad, M3i+519964 about 19nm in the east.
3/08/2018	Fish M3i+519964 and M3i226913	Hard work for no reward, too many sharks, large fish too difficult to bring quickly, another unsuccessful dangler session except few fish on the stern troll lines. One archival in a 20kg YF, this is all. Very disappointing. Start steaming to the next Fad at 0645. Arrived at mid-day many birds around the fad. Small detection at 150 m at the buoy. Drifted till 21h, then go check the Fad but nothing there. Steam again into the wind for 4 nm and drift again…
4/08/2018	Fish M3i 226913 and steam to ISL+ 218732. Steam to ISL+ 224451	Came back to the Fad at 2am and tried to jig for 1,5h before stopping. Only a few YF and sharks around. Started to steam to ISL+ 218732, 30 nm in our SSE; Arrived there at 07:30, absolute desert. Started to steam to ISL+224451, about 204 nm away in our ENE.
5/08/2018	Fish ISL+240370, ISL+224451, and a lost fad	Arrived at the Fad 240370 at 0450; no detection, go to the nearby (5nm) ISL+224451, only small detection, jig and tag 3 Y 1B with CT and 1 Y with AT. One small (<3m) whale shark associated. Back to the previous fad to check. Very few detection at echosounder, caught 3 Y with Jig (1 AT). Started steaming at 0840 to Fad ISL+240353, not marking but on our way. Found a half-sinking lost fad (no sat-buoy) with good detection on it. Attached our flag and jigg /tag 9 small YF. Also, tag a silky with Minipat. A small whale shark (2.5m at most) seemed to be associated with the fad. Decided to stay. Back at the fad at 0930 but no fish. Back to the drift to wait till 2:30
6/08/2018	Fishing lost Fad	Started jigging at 0245 till 6 and tagged 13 sonic (6B, 7 Y) including 2Y & 1B double tagged and 1 Y archival. Then we had the first real dangler session of the trip for about 25 minutes and tagged 51 B 2S and 4 Y. Jigg again for less than 30 min but can't get any interesting fish (1 small y with sonic). Stopped at and deployed our VR4 200150 (and the MI buoy261365 we found at the beginning of the trip) after having reinforced the raft with floats and ropes. Then saw a dfad (Satlink 218308 -CC) just 200m from us…We thought it was a TMI but learned later it was not. Good detection under it. Attached our float and beacon to it and drift. At 20h tagged an OCS with minipat.
7/08/2018	Fish lost Fad/M3i261365-VR4200150 and Fad	Started the jigging session at 0210 and managed to sonic tag 3 Y and 7 B including 1 Y double tagged. One OCS tagged with minipat (111 LF). Stopped at 0455 and wait for dangler time. Started at 0542 for one hour. The fish (bigeye) came briefly to the lures (less than 10

	218308/VR42001 45	min) and we only managed to tag 15 B and 8 Y. We then went visit the nearby Fad and jig there for one hour (7 to 8am). Good detection, couple of bigeye caught and CT, one Y tagged with AT. Picked up the VR2 that we had attached yesterday and observed in the log that sonic tagged fish were present at some stage, some even arrived this morning after been tagged on the other Fad. Deployed at 08:15 the VR4 200145. Came back to the previous fad to collect our boat beacon and leave this raft with our VR4 only at 8h30. Then spent 4 h to check 3 TMI Fad in the area (ISL+ 230620, 239763, 240353).Nothing under those 3. Started to drift at 13h50
8/08/2018	fish found fad/ M3i261365	Arrived at the Fad at 0210 and started a jigging session that ended at 0558. Tagged only 5 fish (2B, 3Y one Y double tagged) although good mark at the sounders Some big Y around, one estimated around 50+kg lost at the boat. Tagged an OCS with minipat coupled with a sonic. The dangler run did not provide any fish except a couple on stern troll lines. We then put the TMI Mi31262365 in place of the unknown Satlink buoy. Tried again to jig with plastic bag and got only one taggable fish: a skj…Tried to troll around for more but got only few 35 cm yf. Started to steam for checking ISL+240370 that is showing more fish than during our last visit on the 5th. Alas nothing again to be seen around it at about 10:30. Back toward Found Fad and drift. Jigging attempt between 21 and 22h; no bite. Back to drift
9/08/2018	fish lost fad - M3i261365 and steam	Started jigging at 2am and finished at 5:30. Fish not biting the jigs again, we used palu-ahi and anchovy on hooks to catch the yellowfin (8 sonics including 3 double tagged with AT) and 2 bigeye. Also tagged a good size (2m) silky with miniPat. Not worth to dangler regarding the few bigeye present. After waiting for daylight and picked up the boat buoys we left the fad at 0558 and started steaming to a good marking Fad located in the IW 260 nm in our west
10/08/2018	steaming to ISL+232000, visit ISL+232208	Calm passage overnite; left Tuvalu waters at about 8am. On our way we visited at 09:30 ISL+232208; large skj schools all around but very few detection at the fad. Not really the best time of the day but anyway next fad looks better. Arrived at ISL+232000 at 14h and got 2 YF around 55 cm and one mahi. Good detection on the echosounder. Tried to jigg and palu ahi but got sharked immediately. Pull-up and steam 5 nm to drift and wait
11/08/2018	Fish ISL+232000 and steam to ISL+232208	Set a short length (about 1.5nm, 200 hooks) of long line at about 0.3 nm from the Fad between 01 and 01.45 am. Then started a jigging session at 02 and finished at 05:30 for 19 sonics (11 B & 8 Y) including 4 doubled-tagged Y with Mk9. Then another non-productive dangler (24 fish tagged with CT) that end-up around 06 10; Started to haul the longline at 06:29 and finished at 0722 for 3 silky sharks (2 dead) and one 88 cm B (too damaged to be tagged). Then a last 30 min jigging provided 2Y and 1 b that completed the needed number of sonic tags. Then we checked the morning report

		log of the VR4 and observed there was no detection in the csv file although it was reporting 280+ detections. We pulled up the VR4 from the water to have a complete test but all seemed to be fine. We finally rebooted the unit and attached a VR2 as backup. Also sent an email to Vemco asking to check any backlog and test the unit remotely. We started to steam to ISL+232208 at 10:30. Drift 5 nm from the buoy from 15h.
12/08/2018	fish ISL+232208	Arrived at the Fad at about 2am and jig the school from 0215 to 0550. We caught mostly YF with some of good size for archival (9 tagged) and only few smaller (45-50 cm) bigeye. This low bigeye % did not incite us to start deploy sonic tags. At dawn, some bigger yf (up to 115 cm FL) show-up. We tried to dangler during about half an hour but only got skj and few YF on the stern troll lines. We stopped at 6:30 and started the drift under sea anchor. Some good size SKJ (55 cm) stayed with us for a short moment and were biting well the jigs. This might be the opportunity to have a VR4 with skipjack and we decided to stay one more night
13/08/2018	Fish ISL+232208 - VR4 200144. Then steam to ISL+231945 (58nm)	Bigeye bites as soon as we started to jig on the Fad, after we deployed the VR4 200144. Completely different from yesterday, almost no Yf and certainly all the big size are gone… We tagged 11 B, 2 Y and 3 S with sonic and 1 B with At before 5h30. Mantra on CP13 cruise is definitively: "Turn the handle!". Then had a dangler/trolling session to add 4 S to this total of 22 fish tagged with sonic. The fish, once again, did not come to the danglers. Started at 8am to steam to ISL+231945 (58 nm away in our NNE) that was showing good detection from this morning.
14/08/2018	Fishing ISL+231945	Arrived to ISL+231945 at about 2am and started to fish with rods and reels. A good school associated with Skj, YF and fewer B. Also many large silky shark (2+m) we had to fish to scare them away before we could get tuna in good condition for tagging. Brought around 4 of those and same number of smaller one. Managed to tag 5 Y with archivals, only seen two bigeye of good size (many others but too small) but alas too damaged to be tagged. We finished at 6h16 with the school under the boat and tried to dangler but no success. Back to the drift to wait and fish one more night. Tried briefly at sunset but only got one small Y and no sign of the school on the sounder.
15/08/2018	fish ISL+231945 and ISL+223910, then steam to ISL+231931	No school to be seen at 2am, only on large Y caught and AT. Stopped at 3am, then checked again at 4am but nothing the fish are gone... Steamed to ISL+223910 about 30 nm away in our NNW. Arrived at 0745, few detection on the echosounders, caught some S and small Y; large silky present. Nothing really appealing so hit the road again at 0915 towards ISL+231931, about 90 nm in our NNE
16/08/2018	fish 231931, check 230945 and 230635	Arrived at 231931 at 1:50, no detection and no appearance of a school presence (no shark, rru or even triggerfish). After jig tries, we started to steam to one of the buoy recently sent by Beth, 15 nm away in our SSE (ISL+230345, no history of echosounder

		measurement). Arrived at 0415, no school, the Fad raft had no tail. Few RRU and triggerfish. Started steaming toward ISL+230635, about 56 nm in our North that is the only fad showing some good detection around. One 120+kg BUM caught on one troll line. Arrived at the fad at 11:20, actively feeding schools around, few deep detection, tried to jig but no success. Drive 30 min in the wind, dropped the chute and drift
17/08/2018	Fish ISL+230635 and steam to TAO 2s-180	15 knt wind made the drift more uncomfortable than usual. Arrived at the Fad at 02am under the rain. No detection on sounders. Then manage to scratch a few fish, good size S, small and large Y a very few bigeye. Archivals deployed in 2 bigeye and 4 Y. Started steaming toward the TAO 2S at 0650. About 130 nm to go. One 50 kg marlin on the troll at 11am.
18/08/2018	Fish TAO 2S/180 and steam to 00/180	Arrived at 0345 at the buoy and jig till day light for 2 B and 4Y archival tagged. Small school aggregated to the mooring, mostly small Yf. Large silky around that of course took their share…After a short dangler attempt and another jigging try, we left the buoy at 07am and headed full north to the equator buoy. Arrived at 10:30, briefly checked around and not much detection to be seen. Drifted to wait till 3am.
19/08/2018	Fish TAO 00/180 and steam to the 2N	Intense jigging effort, non-stop between 3 and 8:40 am. 1,5 knt current and 15 knt wind in the same direction made the drift way too quick but we had a good run at the beginning with fish staying in the shallows around 20 m…Good size Y and bigeye 70-80 cm… Become harder when the fish went done especially the last 2 hours with bigeye staying between 100 and 150 m… each drift passing near the buoy allowed the catch of one or 2 fish. Hard day at the office for Jeff and Fabien! Useful result with a total of 18 archival deployed in 5 Y and 13 B. No dangler possible, chumming inefficient in those conditions. Started steaming North at 8:50.
20/08/2018	Fish TAO 2N/180	Arrived at TAO at 3am, good detection, a decent school at last! Good jigging session of about 2, 5 h. Many fish damaged unfortunately and, for some reason, lots of them have they swim-bladder too inflated to support surgery.11 archival "only" were deployed in B and Y. Started danglers at 7am and had a small burst of fish for 56 B and 7 Y tagged. Stopped at 0605 and steamed back to the buoy (3.5 nm) at 4 knt with fish following. Started to jig again at 7 but fish reluctant to bite, only 5 B tagged with archival after 1,5h. Throw the towel at 8h30 and started the long journey back to Majuro, 600 nm away.
21/08/2018	Steaming to Majuro	All day spent on rinsing, inventorying and storing the gears
22/08/2018	Steaming to majuro	Spent the day writing report. We trolled some (6) 80 cm YF when we passed over Keats banks at 16h. Tried to jig on the summit we found (about 150 m) but only caught a C.albimarginatus…
23/08/2018	Arrival in Majuro-End of CP13	Our speed decreased overnight, fighting against the current, down to 7.3 knt. Arrived at Uliga at 15:20 but no space to park…Called

		Romeo who directed us to the working dock located toward airport on the other side of the bridge. Roped at 1550 at Kremer dock. Romeo arrived 16h25, then wait for quarantine-immigration…

APPENDIX IV: Example of associated Satlink buoy echo-sounder histogram