Tuvalu Fisheries Department
Coastal Fisheries Division

Creel Survey Report No. 2

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Covering the period April 2015-December 2017

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Summary

This report is the second analysis of a creel survey which is being undertaken by the Tuvalu Fisheries Department (TFD) as part of its on-going mandate to improve fisheries livelihoods and food security in Tuvalu in line with Te Kakeega III and TFD's Corporate plan. As part of that work, the Coastal Fisheries Section has been carrying out resource assessments and monitoring to provide the information needed for management. Creel surveys are suited to that task because they provide information on the fishers, the resources being caught and the effort required in a way that can be used to assess the health of the fishery. The purpose of this creel survey was to (i) identify the contribution of each type of coastal fishery; (ii) profile the methods, grounds and landings being used and the needs of fishers; (iii) measure the catches including numbers, sizes and weights; (iv) asses the health of the resources in terms of numbers, weights and sizes being caught in relation to size at maturity and catch per unit of effort; and (v) identify stressed resources in need of management.

Fisher's catch data were collected between 30th April 2015 and 10th December 2017 on all islands of Tuvalu except Niulakita. A survey team met fishers while they landed their catches and interviewed them to collect data on vessels, methods and gear used costs of fishing, location of fished areas and their perceptions on the fishery and changes over time. At the same time, another member of the team identified, measured and weighed each specimen in the catch. Data on fish lengths were compared with known values of length at maturity (Lm) for 79 species (for which data were available) as an indicator to assess whether the resources were overfished. Fishes were considered overfished if 50% or more of the animals landed were smaller than the size at maturity.

Over the 2.5 years of the survey so far, 1,491 landings were met, with most in Funafuti (503), 192 in Nanumea, 190 in Nanumaga and 188 in Nukufetau, and smaller numbers on all other islands except Niulakita for which no samples have yet been collected. Over the survey 835 fishers were met, some repeatedly, others only once. The average age of fishers was 38 years. Fishers said they went on fishing trips 7-14 times per month, depending on the island. Overall 56% of the catch was for sale, and 44% for home use. The island with the highest percentage of catch for sale was Funafuti at 94%. Twenty-two different types of fishing methods were reported, with trolling for tuna the most common and reported in 47% of all landings. Handline fishing accounted for a further 30% of fishing methods. The most commonly used safety gear recorded in landings were oars, water, bailer, GPS and extra fuel. Overall 60% of the vessels met were of wooden construction, with 30% in aluminium and 9% in fibreglass. The most common boat type was the dinghy with 64% of vessels, almost all of which were powered by 2-stroke engines. Overall 36% of fishers said they were using different fishing grounds since 5 years ago and 69% said that the number in the catch and 61% saying that size of fish had declined. The main reasons given for declining resources included climate change (26% of responses), though the presence of purse seiners within the 12 nm zone, a large number of fishers and boats, and increasing human population and were also cited.

The results of this survey show that coastal fisheries throughout Tuvalu are showing signs of overfishing. A total of 39,263 specimens were measured during the survey, including 268 species of fishes in 106 families and 134 genera, and a total of 42.13 tonnes of catch. Of the 79 species that could be assessed for signs of overfishing, 24 of 62 tests done (39% overall) showed that 50% or more of the individuals landed were undersized (smaller than Lm). This overall score was heavily dependent on island, with many more fishes showing stress on particular islands or in particular years (2015, 2016 or 2017). This means that the fishes are being caught and removed from the population before they can reproduce, and the level of stress is different on each island. The main fishes showing strong signs of overfishing included acanthurids (pone), drummers (nanue), emperors (Noto, Muu) and snappers (e.g. Fakamea,

Savane, Makala and Tagau). All islands showed species that were under stress and which are in need of management.

The second indicator of health of the fisheries, using measures of catch per unit of effort (CPUE) was calculated for the first time in this report (insufficient data in Report 1). The best catches (in numbers of fish or weight) per unit of effort (fishers and hours spent fishing) were in Niutao (12 kg/fisher/hr or for the trip at 14 kg/hr) with Funafuti and Nukufetau having the lowest catches per unit of effort. These results form a baseline for future assessments in response to management.

Few fishers reported using fish aggregating devices (FADs) during their fishing trip (91% said they did not use a FAD), with the greatest use of FADs reported from Nanumaga and Niutao. These data were incompletely collected and will require more sampling effort in future.

Sampling is now well-spread among all the islands (except Niulakita) and with the employment of Outer Island Data Collectors (OIDCs), plus additional samples during Metronome trips, is progressing very well. Initial deficiencies with the number of samples noted in the first creel report are now being addressed and the data are functioning well to identify the status of the multispecies fisheries being landed on the islands. It will be necessary to ensure the samples being collected yearly are sufficient for detecting issues and change in response to management (such as the implementation of the FRFSP). As noted in Creel Report 1, there are still missing collections from women, for shellfish, through walking/gleaning and from canoes. Effort in these areas needs to be increased.

Although size at maturity (Lm) data are now available for 79 species from public sources, is it likely that the sizes we are using to assess the fishing of undersized fish are not completely relevant to Tuvalu. Given our proximity to the equator, it is possible that Lm for many of the species could be different than for other locations in the region. There is a need to gather specific maturity data for Tuvalu to use in our assessments and a request has been made for assistance from SPC for this work.

Mechanisms for improving the poor status of the resources have now been developed and the Funafuti Reef Fisheries Stewardship Plan (FRFSP) is to be implemented in 2018. It is expected that the two main indicators used in the creel surveys will start to improve and overall yield of the fisheries increase. This may take a few years to allow time for undersized fish to grow and start to reproduce, increasing the population to sustainable levels.

There is significant pressure on coastal fishery resources on all islands surveyed. Any mechanisms that seek to divert fishing effort offshore on to tuna and other oceanic species, which for our purposes are virtually unlimited, will be important for future management actions. Diversion offshore will need to be accompanied by greater effort in sea safety, fishing methods suited to pelagic species, a consideration of costs and prices and public awareness.

The following recommendations are made for improving the creel survey data collections and for management of the fisheries:

1. Implementing the FRFSP is now a top priority so that the fisheries can be recovered to more productive levels and food and nutrition security and incomes can be improved;
2. TFD should consider pursue the requests made at the Heads of Fisheries (HOF) Meeting and the SPC-hosted First Regional Technical Meeting on Coastal Fisheries (RTMCF) in 2017 to developing size at maturity data collections specific to Tuvalu to be used for assessing the health of the fisheries. This may include expanding future creel surveys to include measures of gonad ripeness and weight to be correlated with fish length;

3. Future sampling will need to target fishers who do not use boats and who may be fishing more for subsistence uses. There is also a need to gather more data on canoes, women and shellfish;
4. Work on sea safety, particularly on outer islands needs to continue. There are signs that use of safety gear may have declined between 2016 and 2017. This should include more assistance with accessing safety equipment such as grab bags as well as on-going efforts to improve small boat VHF radio facilities;
5. There was a lack of GPS data in this survey to allow for plotting of results in a more visual Geographic Information System (GIS). Future sampling will ensure that GPS measures are taken at all landings;
6. There is a need for data collectors to put more effort on fish identifications and getting details for all parts of the survey sheets. This is an on-going task and there is much confusion in Tuvaluan fish names that need to be by-passed by using scientific naming. For some parts of the creel survey sheet data collections have been poor to date (mostly in the section on fishers' perceptions); and
7. Awareness is needed on the results of this survey to assist with implementation of the FRFSP and the development of similar (though simpler) plans for the outer islands.

Acronyms & Terms

CPUE	Catch per unit of effort
Creel	Irish term for fishermen's basket, to denote surveys focused on fisher's catches
EPIRB	Emergency Position Indicating Radio Beacon
FAD	Fish aggregating device
FCA	Funafuti Conservation Area
FL	Fork length of fish from snout to central tail fork or margin
FRFSP	Funafuti Reef Fisheries Stewardship Plan
GIS	Geographic Information System
GoT	Government of Tuvalu
GPS	Global Positioning System
HOF	Heads of Fisheries Meeting (hosted by SPC, 2017)
Kg	Kilogram
L_m	Length at maturity of a fish, as fork or total length
LMMA	Locally-managed Marine Area
MPA	Marine Protected Area
MRA	Marine Resources Act
N	Number of samples or observations
NAPA	National Adaptation Programme of Action
OIDC	Outer Island Data Collector
R2R	Ridge to Reef Project
RTMCF	Regional Technical Meeting on Coastal Fisheries (hosted by SPC, 2017)
SD	Standard deviation of a sample
SPC	Secretariat of the Pacific Community
TFD	Tuvalu Fisheries Department
TL	Total length (of fish from snout to tip of tail)

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1 Introduction

Under the Falekaupule Act (GoT, 2008) the Kaupules of all of Tuvalu's islands are responsible for managing coastal fisheries. This arrangement relies on technical assistance provided by Tuvalu Fisheries Department (TFD) that can be used by the Kaupules to make good management decisions. As a result of this arrangement this creel survey was undertaken by the TFD as part of its on-going mandate to improve fisheries returns and food security in Tuvalu in line also with Te Kakeega III and other planning documents. In particular, the TFD Corporate Plan (TFD, 2016) calls on the Coastal Fisheries Section to assist the Kaupules to improve management of coastal fisheries in order to maintain livelihoods, food security and dietary health. As part of that work, the Coastal Section is carrying out fishery resource assessment and monitoring to provide the information needed for management.

Creel surveys are particularly suited to providing the foundational data needed for identifying issues with fishery resources, laying the groundwork and providing the monitoring to assess whether management actions are needed, and later on, whether they are working. This survey is the second report of an on-going monitoring programme being run on all islands of Tuvalu for the purpose of:

- Identifying the size, contribution and importance of each type of coastal fishery;
- Profile the fishing approaches being used, fishing gear, landing sites, fishing grounds and the needs of fishers;
- Measure the catches being made, including numbers, sizes and weights;
- Assess the health of the fishery in terms of two 'instantaneous' indicators as follows:
    - Percent of fishes landed which are greater than the length at maturity (Lm);
    - Changes in catch per unit of effort; and
- Identify stressed fisheries, if present, and recommend management that might be needed.

2 Methods

Fisher's catch data were collected on all of Tuvalu's islands (except Niulakita), with the first samples being collected on the 30th April 2015. Initially, data were collected from Funafuti, and several outer islands, but were soon expanded to all islands during regular metronome[1] trips. The survey was carried out by a team of Coastal Fisheries, National Adaptation Programme of Action (NAPAII) and Ridge to Reef (R2R) staff who in Funafuti sampled incoming catches twice per week, usually starting at 5am but encompassing all times of day or night as necessary to match fisher's habits. On outer islands a team of Outer Island Data Collectors (OIDCs) was assembled and trained and deployed to collect data for their island twice a week to match collections in Funafuti. These were supplemented by additional samples taken by the Coastal staff during the metronome trips. Most sampling effort was on fishers using boats, with only a few samples on fishers who did not use boats.

As each fisher approached the shore at the end of a fishing trip, the sampling team established communication with the fishers, seeking permission to sample their catch, which was almost always granted[2]. One of the sampling team then identified the lead fisher and interviewed them on aspects of the fishing trip, vessel used, costs, effort and perceptions using the datasheet

[1] Metronome trips are regular scheduled trips to 3 outer islands done four times per year. Each island being visited once every 9 months or so for a period of 10 days.
[2] Fishers refused the sampling on only 1-2 occasions

shown at Annexe 6.1 on page 25. Other members of the team at the same time identified all the species in the catch, measured and weighed them using a fish board, tape measure and/or a digital scale. Length measurements were of fork length for fishes, carapace length and/or width for crustaceans, and shell length and width for molluscs. Weight was measured in kilograms (kg) to the nearest 10g. Care was taken in handling fisher's catches through use of plastic tubs filled with ice as temporary storage whilst measuring.

The Global Positioning System (GPS) reading for all landings was recorded in decimal degrees for later use in a Geographic Information System (GIS). The location of fishing grounds was recorded on a printed map of each island with points later converted to latitude/longitude using Google Earth.

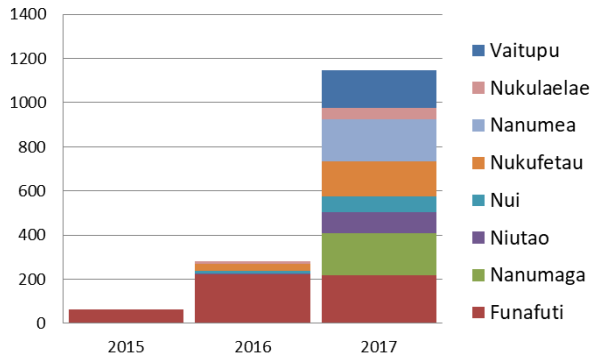
All data collected in the field were entered into a purpose-built database for storage and analysis. At the same time, data were collected from Fishbase (http://www.fishbase.org) on the sizes at maturity for commonly-caught fishes so that an assessment could be made of the percentage of catch which is undersized. The indicator used for an assessment of overfishing of each species for which we could get length at maturity data (L_m) was the percentage of the catch smaller and larger than L_m. For species in which 50% or more of the catch was smaller in length than L_m, the species was considered overfished and in need of management. Additional information on catch per unit of effort was also used to assess changes in the health of the coastal reef fisheries overall.

3 Results

3.1 Samples and Locations

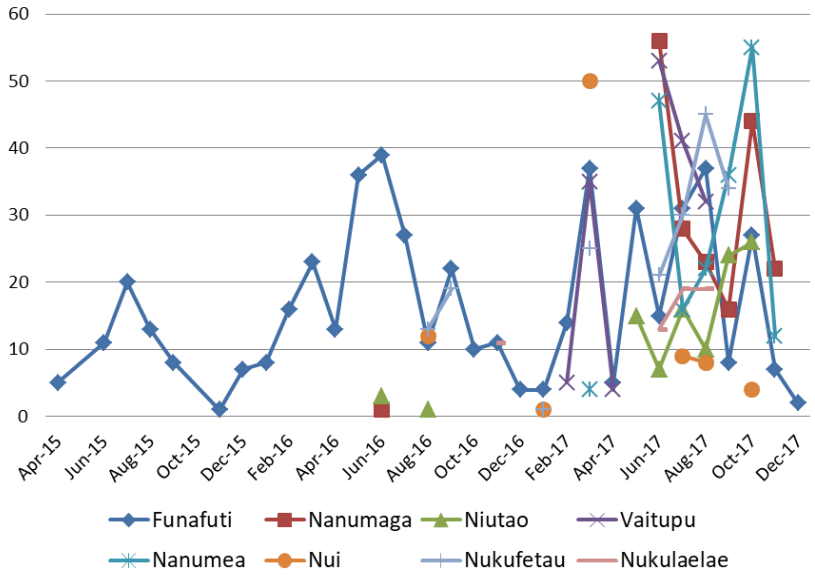
Over the sampling period of 31 months (between 30th April 2015 and 10th December 2017) a total of 1,491 creel samples was completed on 8 islands; this is a significant increase from 275 samples in the first report in October 2016 (Alefaio et al., 2016). The greatest number of samples was collected in Funafuti (503) (Figure 1). Significant numbers of samples were also collected from Nanumea (192), Nanumaga (190), Nukufetau (188) and Vaitupu (170). The smallest number of samples was collected from Nukulaelae (62) and no samples from Niulakita (because no fishing occurred on the sample days). The increase in effort on the outer islands is due to the employment of 8 outer island Data collectors (OIDCs), one on each island except Niulakita.

Figure 1: Total number of landings sampled per island per year



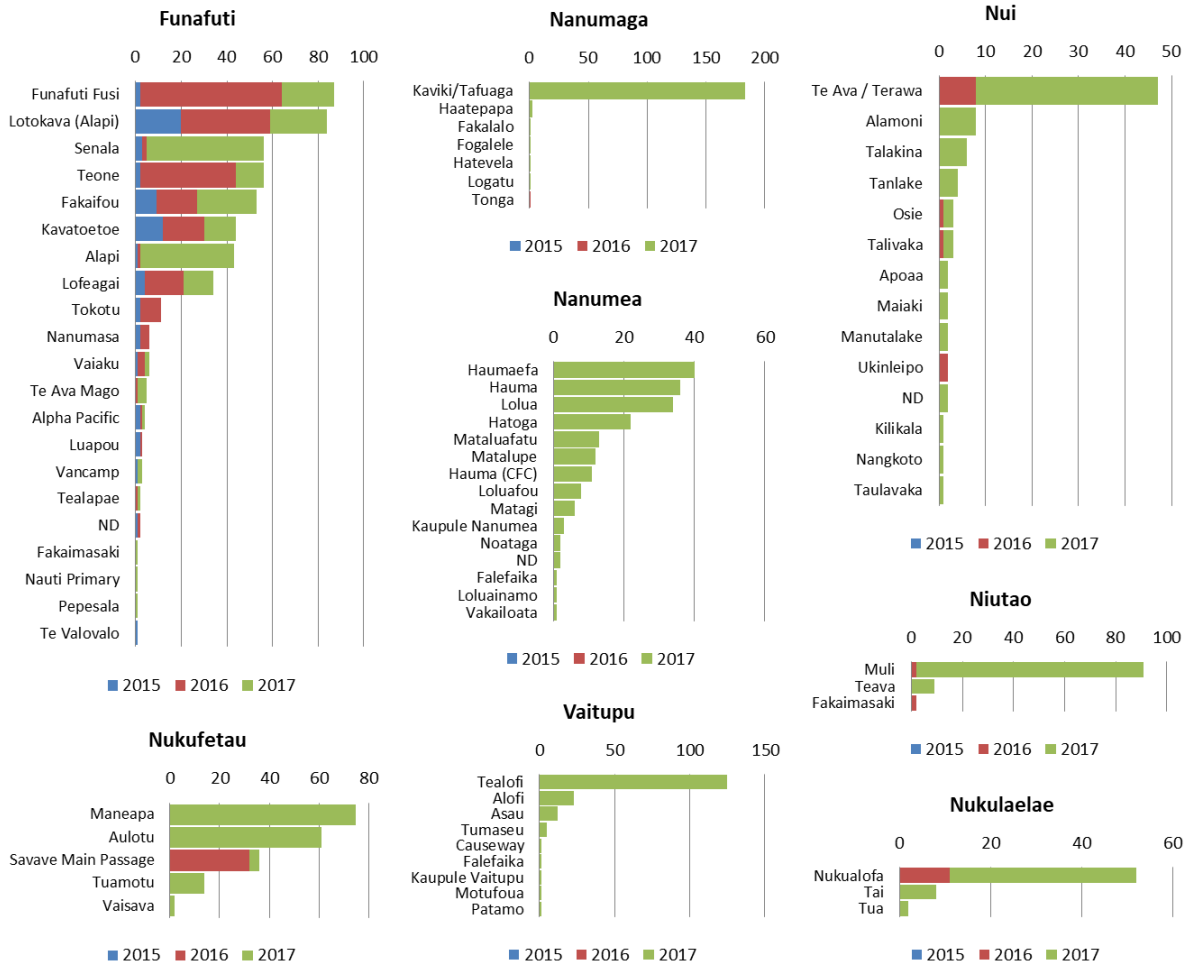
The number of samples collected varied strongly among the months, mostly for outer islands in response to Metro trips and the employment of OIDCs in June 2017. From June 2017 the number of samples overall has vastly improved and our confidence in the results is now very high (Figure 2).

Figure 2: Total Landings met per month (all islands)



There were different numbers of landing sites on each of the islands, with the largest number on Funafuti, at 20 recognised landings (Figure 3), with the next largest number of landing sites at Nanumea (14) and Nui (13). For the samples in Funafuti, most data (34%) were collected from the 2 main sites of Fusi and Lotokava.

Figure 3: Landings per site on all islands



3.2 Details on fishers

Over the creel survey to date, a total of 835 individual fishers were met in landings (a large increase from 286 in Report 1). Overall the number of fishers met, including repeat landings by many of them was 2,845. The maximum frequency that fishers were met was 29 times (2 fishers, one in Funafuti and one in Nanumaga). Overall most fishers were met once (42%) or twice (19%) over the entire survey. Only 8% of fishers were met 8 times or more over the survey.

The largest numbers of fishers were met as expected in Funafuti; this roughly matched the number of landings at each site. On the outer islands, most fishers were met at the main passage area on each, with few fishers found at other sites around the island (Figure 4:). The number of fishers met at each landing did not vary much between years, though longer term data are needed before we could assess this for many of the outer islands where surveys only began in either 2016 or 2017. The emerging patterns are not surprising for the outer islands where most islands have a single channel for access out to fishing grounds. Overall, most fishers were met in landings during this creel survey once or twice, including on outer islands. In Funafuti significant numbers were met as many as 4 times per year (Figure 5). The average age of all fishers met during the survey was 38 years (+/- SD 12) (Figure 6).

The greatest number of fishing trips reported by fishers that they do per month was between 11 and 14 trips per month on Nukulaelae, Nui, Funafuti and Nanumaga. On Vaitupu, Nukufetau, Nanumea and Niutao fishers said that they went on between 7 and 9 fishing trips per month.

The number of fishing trips reported by fishers did not change much over the years of the survey at Funafuti, Nukulaelae and Nui (Figure 7). The number of reported fishing trips appeared to increase between 2016 and 2017 at Nanumaga. In contrast, the number of fishing trips appeared to decline in the same period on Niutao and Nukufetau. As the number of samples from the outer islands is still low, these figures are provisional.

Figure 4: Total number of fishers met per landing on Funafuti and outer islands

Do something here

Figure 5: Frequency with which individual fishers were met

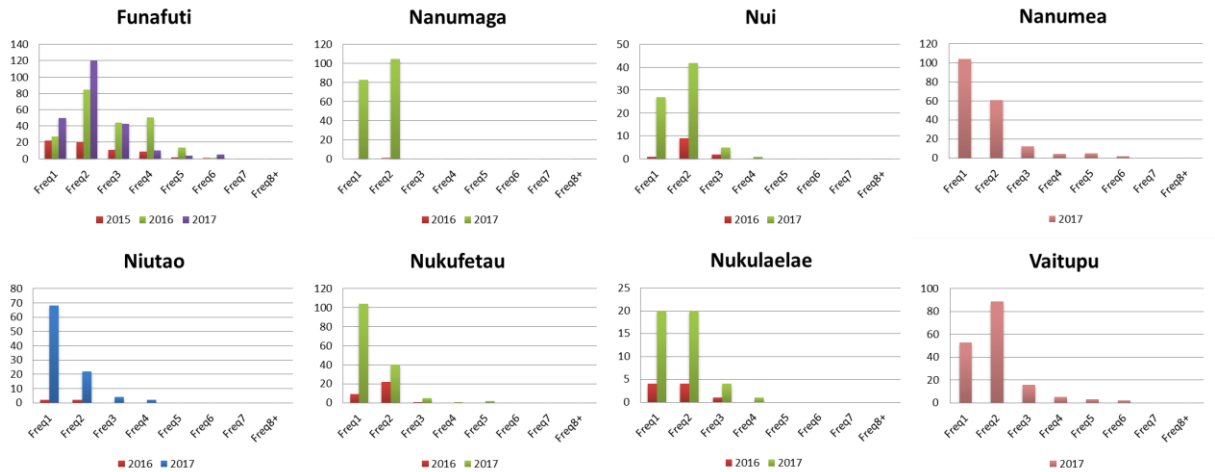


Figure 6: Average age of fishers met (with SD)

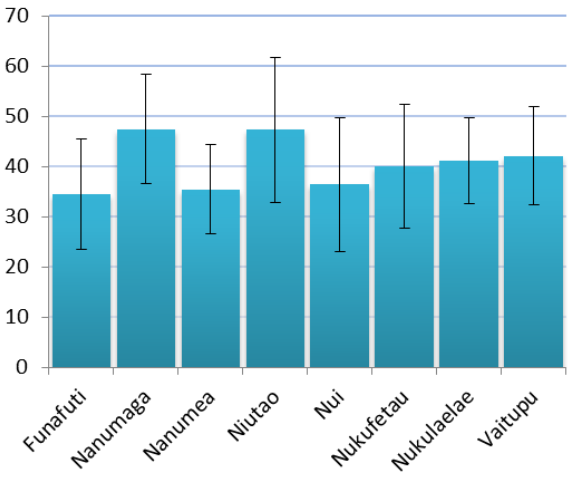
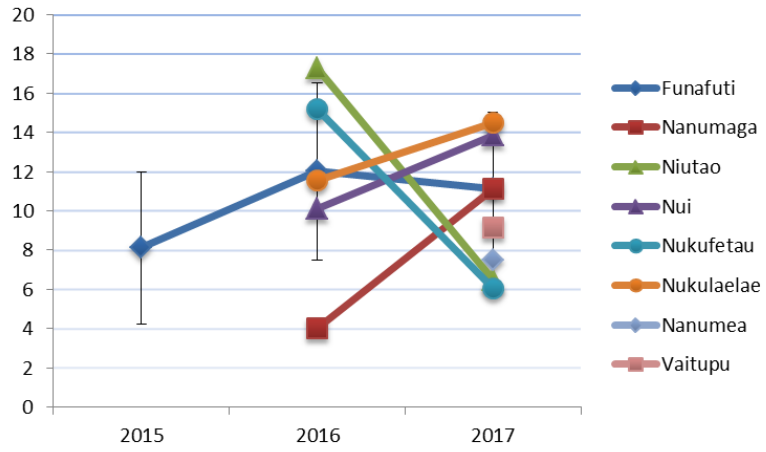


Figure 7: Average number of fishing trips fishers report doing per month

Note: Error bars (Standard errors) are shown only for Funafuti)



Overall 56% of the catch being caught was for sale, and 44% for home use, across all islands and the years of the survey to date. This, however, differed significantly among the islands, with around 94% of the catch for sale in Funafuti (Figure 8). Other islands with high commercial use of the catch were Nanumaga, Niutao, Nukufetau and Vaitupu. The island with the most subsistence use of catch was Nukulaelae, with just 9% being used for sale. This c loosely followed by Nui and Nanumea. In Funafuti there were only small differences among landing sites in terms of what fishers report they did with their catch, except for one site at Pepesala where 100% of the landed catch was for home use. At several sites, Fakaimasaki, Luapou and Te Valovalo 100% of the catch was used for sale.

According to the fishers, the average income from a fishing trip in Funafuti is significantly higher than the outer islands at $190 per trip, a value that has not changed much between 2015 and 2017 ($168 in 2015 and $209 in 2017) (Figure 9). Nukufetau, Nui and Niutao fishers reported an income of around $110-120 per trip, while those in Vaitupu, Nanumaga and Nukulaelae reported and income of between $67 and $70 per trip.

Figure 8: Percentage use of catch as reported by fishers

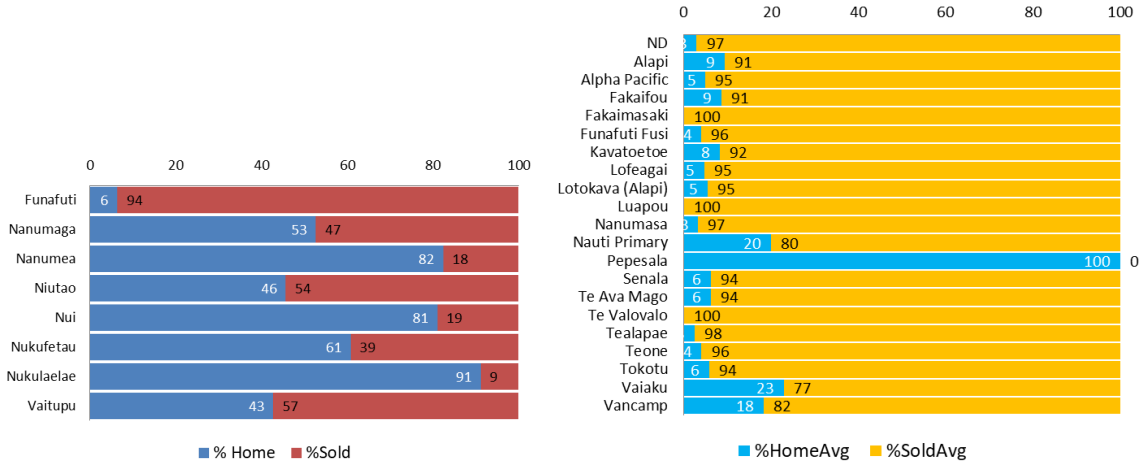
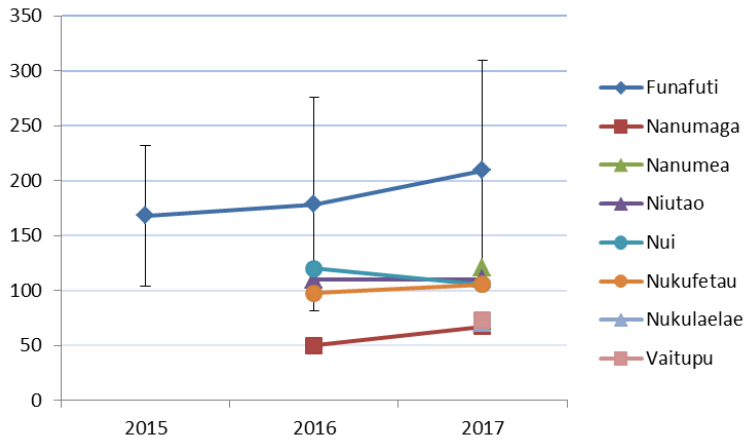


Figure 9: Average income from fishing



Overall, 22 different types of fishing methods were reported in use by fishers (Figure 10). Tuna trolling is the most commonly-reported fishing method as 29% of all methods in use and reported at 47% of landings. The next most common fishing methods commonly in use were Handlining (30% of landings) and scoop netting for flyingfish (22%).

Figure 10: Usual fishing methods reported by fishers

Fishing Method	Total	%Responses	%Landings
Trolling tuna (Taki)	697	29	47
Handline (Matau)	446	19	30
Scoop net flyingfish	332	14	22
Netting gill (Tatili)	210	9	14
Spear hand	155	7	10
Handline Deepsea bottom (Matau poko)	117	5	8
Netting cast	88	4	6
Rod bamboo/stick (Siisi)	83	4	6
Trolling slow (Takitaki)	83	4	6
Handline dropstone deepsea midwater (Luu)	64	3	4
Handline Jigging (Futifuti)	46	2	3
Scoop net reef fish	29	1	2
Rod & reel (Peipei kofe vili)	4	0	0
Gleaning snorkel (Fasua, Kalea, Soopu)	3	0	0
Gleaning walk	3	0	0
Fish trap bottle (Tao Fua)	2	0	0
Gleaning dive	2	0	0
Turtle night dive (Uku fonu)	2	0	0
Turtle wrangling (Eva fonu)	2	0	0
Handline surface (Lafolafo)	1	0	0
Longline	1	0	0
Speargun	1	0	0
Total count = 22	**2371**	**100**	**159**

3.3 Indicator 1: Sizes of fishes landed compared with Lm (the size at maturity)

Over the course of the survey a total of 39,263 fishes and invertebrates were sampled in the creel landings and weighed and measured, including 268 different species of fishes (106 families and 134 genera). This is a large increase since last survey by which 15,201 fishes had been measured. The cumulative catch in landings by weight over the whole survey was 42.13 tonnes. In 2015 a total of 2.4 tonnes of fishes were landed in creel samples, this increased to 8.9 tonnes in 2016 and 29.92 tonnes in 2017.

Size at maturity information was publically available for 79 species of 17 families that turned up in this survey. Of those fish landed in Funafuti (Figure 11a), 41% (14 of 34 assessed for that island) commonly-fished species were found with 50% or more of the fish caught below size at maturity (our defined trigger point) in 2015. By 2016 this figure increased to 43% (20 species out of 46 assessed in 2016), but by 2017 declined to 31% (13 species of 42 assessed). In 2017 these included 2 surgeonfishes (Pokapoka or *Naso*) species, 1 drummer (Nanue, *Kyphosus*) species, 2 emperors (Muu and Noto) and 5 species of snappers (including Fakamea, Savane, Makala and Tagau) (Figure 11a and Figure 12). If management through the FRFSP is successful and the resources are allowed to recover, we expect to see the number of stressed species to decline towards zero.

Although the numbers of species assessed on the outer islands varied among them and by year, the percentage of fishes considered stressed, where an assessment was possible, tended to be high (Figure 11b). The main difference in comparison with Funafuti is that because sampling only began on the islands in 2016 or 2017 the assessment possible to date has been of far fewer species than for Funafuti and further sampling will be needed to produce a clearer picture of the status of stocks. The results to date do suggest, however, that between 40% and 70% of the assessable species on the outer islands are being landed too small (see also Annexe 6.1 on page 25).

Figure 11: Assessment of Indicator 1 between 2015-2017

(a) Results for Funafuti. The test used was whether 50% or more of the fish measured for that species was below the size at maturity. Green coloured cells are considered OK, while red ones are considered stressed. The numbers shown are the total number of fish for which length was measured for each species.

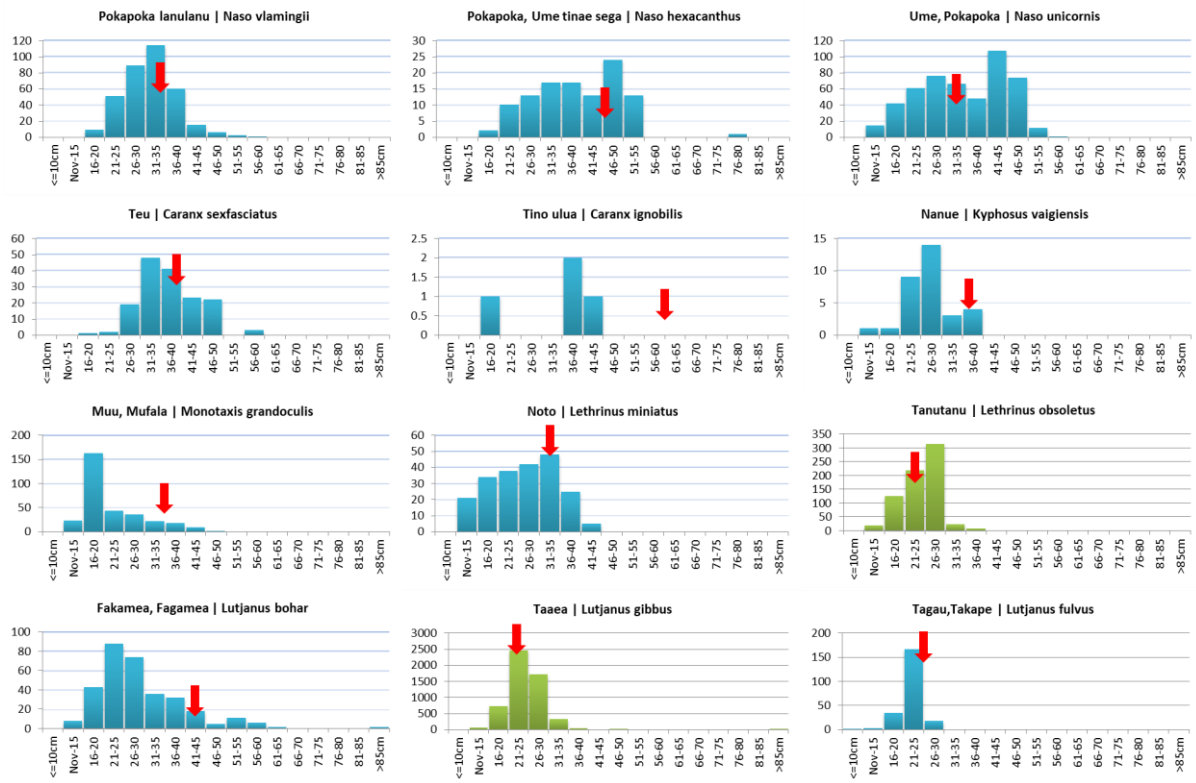
Species	2015	2016	2017	Species	2015	2016	2017
Kapalagi (Acanthurus xanthopterus)	0			Tagau,Takape (Lutjanus fulvus)	100	83	81
Manini (Acanthurus triostegus)	0	0	0	Taiva (Lutjanus monostigma)	53	51	36
Pokapoka lanulanu (Naso vlamingii)	31	63	50	Tonu (Macolor macularis)	78	50	0
Pokapoka (Naso hexacanthus)		66	64	Utu (Aprion virescens)	50	56	34
Ponelolo (Acanthurus lineatus)	5	25	11	Kanase (Crenimugil crenilabis)			0
Ume, Pokapoka (Naso unicornis)	50	43	27	Afulu (Parupeneus multifasciatus)	0		
Aseu (Caranx melampygus)	0	40	40	Kaivete piniki (Parupeneus cyclostomus)		82	33
Kamai (Elagatis bipinnulata)	100	100	67	Kalo (Mulloidichthys vanicolensis)			0
Tafauli (Caranx lugubris)		0	42	Malili, Kaivete (Parupeneus barberinus)		0	0
Teu (Caranx sexfasciatus)	33	78	40	Matapa (Priacanthus hamrur)	0	2	0
Tino ulua (Caranx ignobilis)		100		Salala (Rastrelliger kanagurta)		0	
Lau laufau (Platax teira)		0		Valu (Gymnosarda unicolor)		0	0
Malau (Myripristis berndti)	48	51	42	Gatala (Epinephelus fasciatus)		0	
Malau (Myripristis kuntee)	2	1	0	Gatala (Epinephelus miliaris)	0	0	
Malau (Sargocentron caudimaculatum)		0	0	Gatala (one dot) (Epinephelus polyphekadion)	60	41	26
Malau puku (Myripristis pralinia?)	0	1	1	Gatala lautalo (Anyperodon leucogrammicus)	56	38	24
Talakihi (Neoniphon sammara)	0		0	Gatalaliki (Epinephelus merra)	2	0	0
Nanue (Ff, Nm) (Kyphosus vaigiensis)		87	100	Loi (Cephalopholis argus)	0	17	0
Gole (Cheilinus fasciatus)		0		Mataele (Cephalopholis sexmaculata)			100
Muu, Mufala (Monotaxis grandoculis)	95	96	78	Mataele (Cephalopholis urodeta)	75	52	38
Noto (Lethrinus miniatus)	90	67	88	Munua (Epinephelus fuscoguttatus)	47	40	11
Tanutanu (Lethrinus obsoletus)	10	42	9	Pula (Variola louti)		81	88
Fakamea, Fagamea (Lutjanus bohar)	89	93	83	Tonu (Plectropomus leopardus)		100	
Makala (Macolor niger)	89	87	76	Maiava (Siganus argenteus)	11	35	50
Savane (Lutjanus kasmira)	83	79	84	Maiava (Siganus fuscescens)		0	
Taaea (Lutjanus gibbus)	28	33	26	Maiava fiiti (Siganus punctatus)	36	29	18
Total needing management					14	20	13

(b) Summary for all islands

Island	No. Assessed			No. Stressed			% Stressed		
Year >>	2015	2016	2017	2015	2016	2017	2015	2016	2017
Funafuti	34	46	42	14	20	13	41%	43%	31%
Nanumaga		1	21		0	13		0%	62%
Nanumea			26			13			50%
Niutao		1	15		1	8		100%	53%
Nui		12	19		5	8		42%	42%
Nukufetau		18	15		10	6		56%	40%
Nukulaelae		10	16		7	10		70%	63%
Vaitupu			28			14			50%

Figure 12: Selected size frequency graphs of species in Funafuti.

The blue graphs are those that need management because 50% or more were landed below size at maturity (red arrow). The two green bar graphs show species that are OK for comparison.



3.4 Indicator 2: Catch per Unit of Fishing Effort

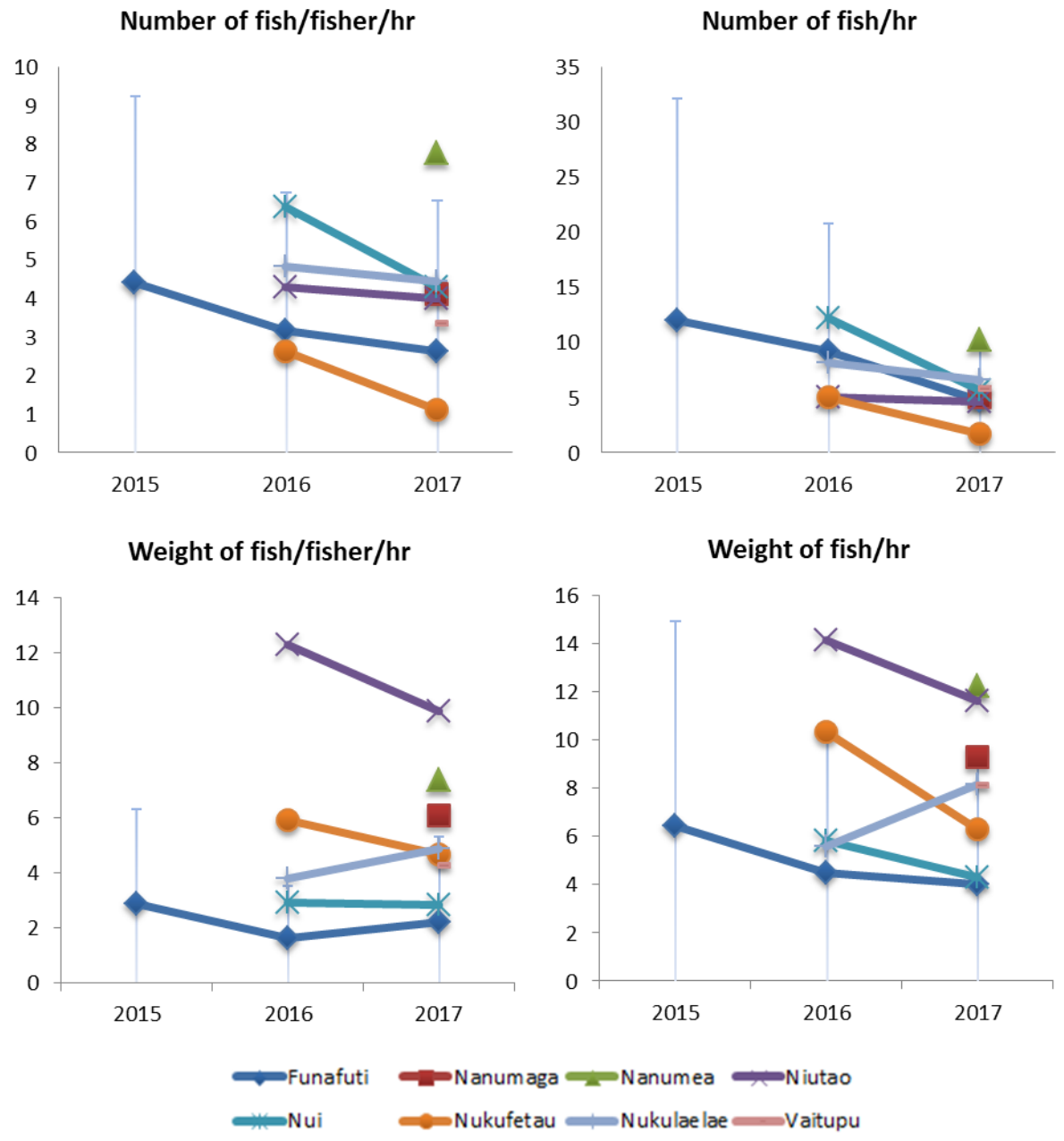
There are several possible measures of catch per unit of effort (CPUE) we could use from these creel data. The catch may be expressed as the total number or weight of each landed sample, and the effort could be expressed as number of fishers, costs of fishing, fuel used or hours spent obtaining the catch, or several combinations of these. The measures used here were number per fisher per hour fished (No/F/Hr), weight per fisher per hour fished (Wt/F/Hr), number per hour fished (No/Hr), and weight per hour fished (Wt/Hr). In using these indicators, we expect that more healthy fisheries may tend to yield more fish per hour than stressed fisheries, and or cost less in effort to obtain. As management measures are put in place and the stocks recover, the values of these indicators are expected to improve.

The indicators of CPUE shown in Figure 13 below show that the catch per unit of effort varies over time (where data were available given that some islands have only been included since

2016 or 2017) and by island. The best catches were generally found in Niutao (12 kg/fisher/hr or 14 kg/hr in 2016), followed by Nukulaelae (8 fish/fisher/hr), and Nui (12 fish/fisher/hr in 2016). Funafuti and Nukufetau tended to have lower catches per fisher per hour in terms of numbers caught; but for Nukufetau the catch was higher than Funafuti in terms of weight caught (kg/fisher/hr or kg/hr). Most islands showed a trend of declining number or weight caught (per fisher/hr or per hour) but because the variance in the samples was so high, it was hard to determine whether this was a real decline. Continued sampling will be needed to uncover real trends over time. In particular, if the management provisions in FRFSP are implemented successfully, we could expect that the catch/fisher/hr or catch/hr would increase as the populations recover.

Figure 13: CPUE by island and year for 4 forms of catch and effort

Note that standard errors (SD) are shown only for Funafuti. The CPUE measures were (a) number of fish landed per fisher/hour; (b) number of fish landed per boat/hour; (c) weight (kg) of fish landed per fisher per hour; and (d) weight (kg) of fish landed per boat per hour.



3.5 FADs

The majority of fishers interviewed at landings (91%) did not fish on a fish aggregating device (FAD) on the day they were sampled. The greatest user of FADs was recorded from Nanumaga and Niutao (Figure 14), with no fisher reporting use of FADs from Nukulaelae, Nui or Funafuti. These results are likely to be incomplete since only a total of 513 responses were collected over the entire creel survey, with just 25 from Funafuti. The main species targeted were rainbow runner (kamai), followed by yellowfin, skipjack and unspecified tunas. However, these results are derived from only 30 responses collected for this question.

The main reasons people gave for fishing on FADs included for checking whether there was a school of fish there, because they are known to have many fish around them or because the fish would be large. A couple of fishers said that the FADs were the only place to get fish. However, as only 14 valid responses were collected for this question, future monitoring will need to focus on better collecting these data. The main problems with FADs included the presence of many sharks around them, that they can be lost or that they are moving. One fisher suggested that the location of the FAD should be changed (Figure 15).

Figure 14: Did you use a FAD for fishing today?

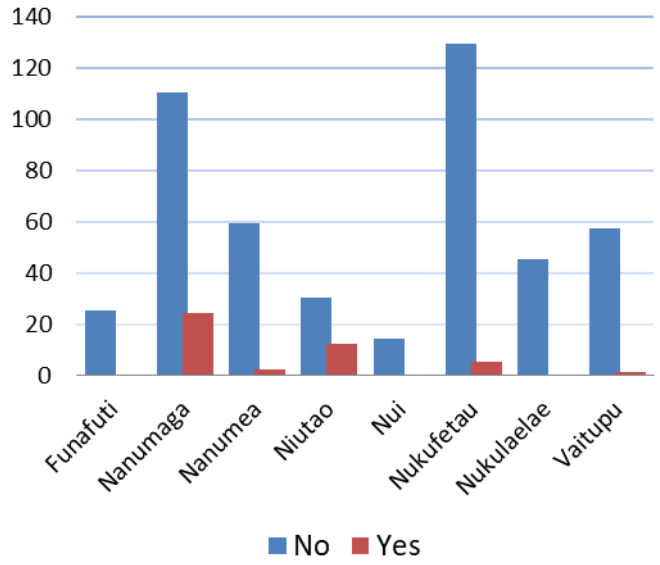


Figure 15: Problems with FADs

Problems with FADs	No.	% Responses	% Landings
Many sharks around FADs	2	25	0.13
FADs can get lost / are lost now	2	25	0.13
No fish on FAD for a long time	1	12.5	0.07
Location should be changed	1	12.5	0.07
FAD moving	1	12.5	0.07
Don't know	1	12.5	0.07
Total	**8**	**100**	**0.54**

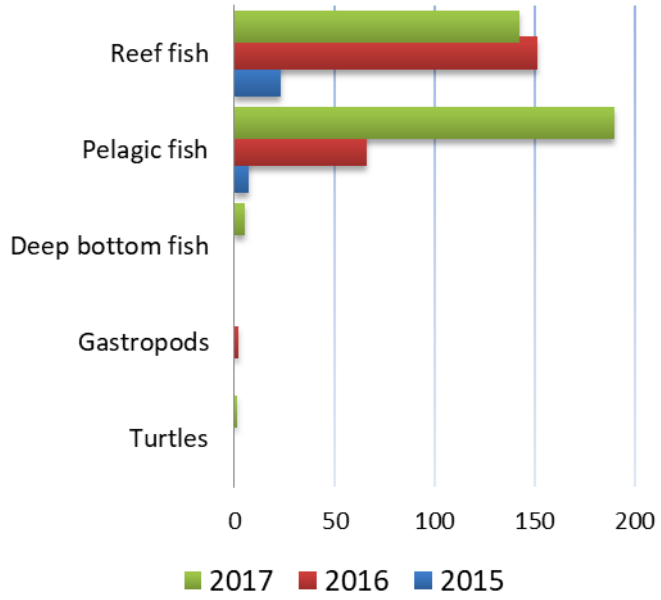
3.6 Perceptions of Fishers

Data on target species groups for fishing trips were collected in 39% of the landings met during the creel survey. Based on these results, it was found that reef fishes were targeted by fishers in 21% of landings, compared with 18% of landing for pelagic species (Figure 16). Other groups

such as deep bottom fish, molluscs and turtles together accounted for only 0.5% of landings overall. These results differ from those reported in the first Creel Survey Report where reef fishes were targeted in 46% of landings; while pelagic species in about the same number (20%) of the landings. The data also showed large differences among years, with pelagic species being more important than reef fishes in 2017, and the reverse trend in 2016.

Figure 16: Types of seafoods targeted by fishers by year

The graph shows total numbers and the table shows % of landings targeting each species group



Fishing Product	2015	2016	2017	Total%
Reef fish%	1.5	10.1	9.5	21.2
Pelagic fish%	0.5	4.4	12.7	17.6
Deep bottom fish%	0	0	0.34	0.34
Gastropods%	0	0.1	0	0.13
Turtles%	0	0	0.07	0.07

The most commonly used safety gear recorded in landings were oars, water, bailer and GPS, as reported in the first Creel Report (Figure 17). The safety items in use were roughly similar on all of the islands. Interestingly, a larger number of safety items were recorded on boats in 2016 than in 2017, which resembled the reporting in 2015. It is possible that the items supplied through grab bags are falling into disrepair, being lost or just not being taken out on trips as they were in 2016. This trend will need to be investigated further through focus group meetings with fishers.

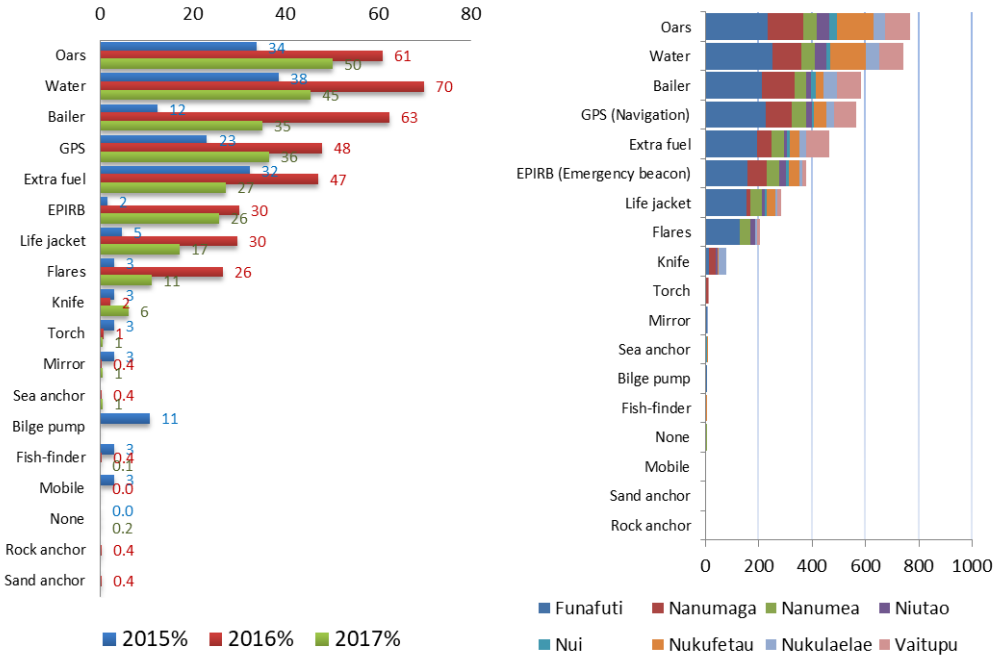
Figure 17: Frequency of safety gear used in landings

(a) Overall use of safety gear showing frequency reported, and percentage of landings that included the gear. This sums to more than 100% because more than one type of gear could be in each boat. (b) Shows the breakdown by year as the % of landings for that year with each type of safety gear on board.

(a) Type Safety Gear	Frequency	% Landings
Oars	768	52
Water	741	50
Bailer	584	39
GPS (Navigation)	566	38
Extra fuel	463	31
EPIRB (Emergency beacon)	379	25

(a) Type Safety Gear	Frequency	% Landings
Life jacket	282	19
Flares	203	14
Knife	78	5
Torch	11	0.7
Mirror	9	0.6
Sea anchor	8	0.5
Bilge pump	7	0.5
Fish-finder	4	0.3
Mobile	2	0.1
None	2	0.1
Rock anchor	1	0.07
Sand anchor	1	0.07
Total	**4,109**	**276**

(b) Percent of landings by year

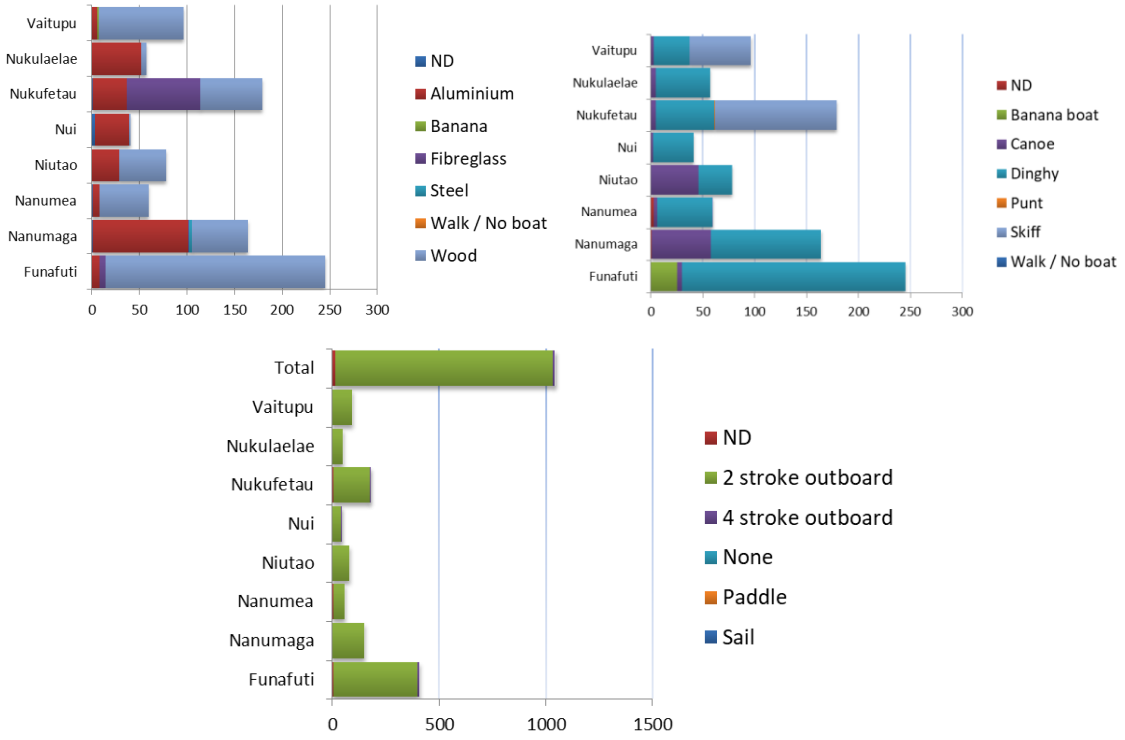


Boat details were collected for around 920 of the 1491 landings (62%). Overall 60% of the vessels met were of wooden construction, with 30% in aluminium and 9% in fibreglass. The construction materials most commonly used varied significantly by island, with wooden boats being most common in Funafuti, and aluminium boats being most common in Nanumaga (Figure 18). Fibreglass boats were almost exclusively found on Nukufetau.

The most common boat type was the dinghy (64% of responses, 39% of all landings) (open small boat without cabin), followed by banana boats (25%) and about 14% of landings using canoes. By far the most common type of power used was 2-stroke outboard, which accounted for 97% of all the boats responding to this question (n=1048).

Figure 18: Details of boats in use by island

(a) Materials from which boats are constructed; (b) Type of boat; (c) How boat is powered.



When asked their perceptions of changes in their fishery compared with catches they were getting 5 years ago, fishers in 42% of landings said that they used the same fishing grounds as in the past, with 36% saying that they had changed grounds (22% did not respond). This response was highly dependent on the island, with most people saying that they changed their fishing grounds being from Funafuti, Nanumea and Vaitupu (Figure 19) (i.e. not fishing in the same areas now as they did 5 years ago). The islands in which most people were still fishing in the same areas were Nanumaga and Nukufetau. Some of the reasons given for why fishing grounds were changed included:

- *"I usually go out fishing in the same areas but only after the Cyclone PAM, most of patch reef are all cover by sand*"; and
- "*Getting old and can't go far.*"

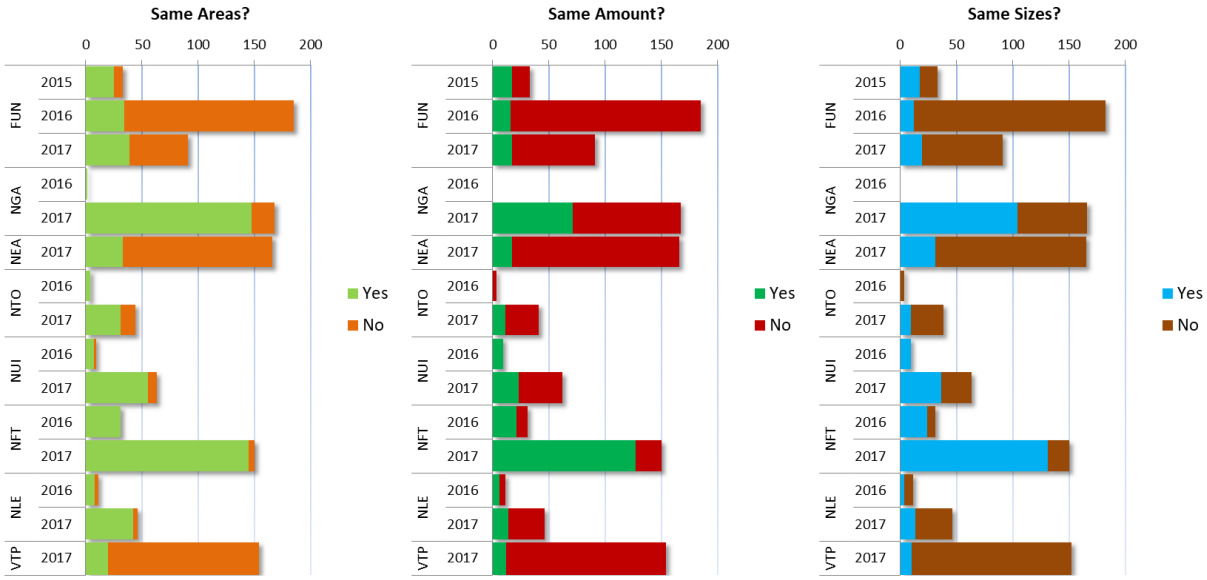
Some reasons for <u>not</u> changing grounds included:

- *"There are no other places for fishing, the island is too small"*.

Similar patterns were seen for whether fishers caught the same amount of fish as they did 5 years ago, and whether the sizes of the fishes had changed. Overall 53% of fishers said that the amount of catch had changed, and 48% said that the sizes of fishes had changed. For catch amount 69% of fishers who responded (in 13% of landings) said that there were fewer fish being caught now compared with 5 years ago. Around 10% of fishers who responded said that they were catching about the same amount of fish as 5 years ago, and another 10% said the catch just fluctuates (2% of landings). Four percent of fishers said that their catches were increasing (1% of landings). In terms of sizes of fishes being caught 61% of fishers who responded to this question (10% of landings) said that sizes were getting smaller, with 21% of responders saying the sizes were staying the same. Ten percent of responders (2% of landings) said that sizes were variable, with no directional change. Just 3% of responders (0.5% of landings) said that fish sizes were increasing. Some of the text responses given were:

- "There is an apparent difference in fish quantity and time spent on fishing to get a good catch. In the past, I can catch a half full bucket (biscuit) in 3 hours from where the *Manaui* is anchored" and
- "It takes many hours (5-6hrs) of fishing to get a good catch to sell. As in the past it only takes about 3-4 hours on average to catch as many fish I wanted".

Figure 19: Perceptions of fishers on changes in their fishery since 5 years ago



When asked what had changed to result in the changes in fishing they had reported, 26% of fishers who responded to this question gave climate change as the reason (7% of landings) (Figure 20). A large number of fishers also blamed the presence of foreign fishing vessels (24% responses, 6% of landings), nothing (12%), or too much fishing pressure (12%). Some of the answers given included:

- "A lots of difference after the Cyclone Pam. The lagoon is getting shallower"
- "Corals are dying hence it is harder to catch these reef fish"
- "I think the purse seine fishery has damaged our tuna fishery resources"
- "So many fishers and FCA is not working" and
- "Depend on the chief's ruling, sometimes good sometimes bad."

A surprising number of fishers (58% of responses in 20% of landings) said that they had no concern over the resources (Figure 21), despite the number saying they had to change fishing grounds, and that said catches and sizes were declining in the questions above (Figure 19, Figure 20). The main concerns that were quoted were that people were concerned that resources were declining and that foreign vessels were fishing in Tuvalu's waters, taking the fish. Some of the answers given included:

- "Well, the number of fish (tuna) is really low this year…I bet is fishing foreign vessel (purseiner) is the cause, because sometime we see them just within 12 nm"
- "Commercial fishing vessels chase away pelagic fish offshore or away far from the Island, thus hardly to fish nearshore. Modern fishing gears"
- "Encourage people not to catch under-size fish, and people needs to take seriously the important of their LMMA or MPA"
- "Gillnet fishing to used much larger size 3-4 inch, decreasing under-size catches"
- "FADs to be maintain in the Island. And Conservation Area to be managed well"
- "Too many laws can cause confusions and often hard to enforce" and
- "Not enough fish for the island."

Figure 20: If catches are different since 5 years ago, what has changed?

What changed?	Number	% Responses	% Landings
Climate change	104	26	7
Foreign vessels / within 12nm zone	93	24	6
Nothing	48	12	3
Pressure: Too many fishing boats / fishers	48	12	3
Human population increased	18	5	1
Overfishing	17	4	1
Don't know / Not sure	12	3	0.8
Natural disaster / Cyclone Pam effects	9	2	0.6
Lagoon getting shallower	6	2	0.4
Rules have changed	4	1	0.3
Fish breeding less / slow	4	1	0.3
Corals dying / damaged	3	0.8	0.2
Many hours to get a good catch	3	0.8	0.2
Catching undersized fish	3	0.8	0.2
Weather patterns changed	3	0.8	0.2
Some species are now rare	2	0.5	0.1
Algal overgrowth	2	0.5	0.1
Techniques changed / had to change	2	0.5	0.13
Water currents changed	2	0.5	0.13
Fish can't breed / undersized	2	0.5	0.13
Purse seiners / foreign vessels	2	0.5	0.13
Catch varies over time	1	0.3	0.07
Depends on the Chief's ruling (sometimes good, sometimes bad)	1	0.3	0.07
Effort has changed (time)	1	0.3	0.07
Knowledge of fishers	1	0.3	0.07
MPA not working	1	0.3	0.07
Pollution	1	0.3	0.07
Tides changed	1	0.3	0.07
Just started fishing	1	0.3	0.07
Total	**395**	**100**	**29**

Figure 21: Top 20 main concerns about the resources

Text Answer Group: Main concerns	Number	% Responses	% Landings
No / resources still healthy	303	58	20
Resources declining	29	6	2
Yes	27	5	2
Foreign vessels fishing in territorial / 12nm zone	26	5	2
Manage resources wisely / protect them / plans	16	3	1
Business / livelihood depends on fish resources	11	2	0.7
LMMA Manage well / Monitor / Prioritize	8	2	0.5
Undersized / juveniles being caught	8	2	0.5
Gillnet size should be bigger / protect small fish	7	1	0.5
Ban destructive fishing	4	0.8	0.3
FADs to be maintained well	4	0.8	0.3
LMMA/MPA taken seriously / discourage poaching	4	0.8	0.3
Release / don't catch small fish	4	0.8	0.3
Don't know	3	0.6	0.2

Text Answer Group: Main concerns	Number	% Responses	% Landings
Not happy with rules on the island	3	0.6	0.2
Open LMMA because hard to catch pelagic	3	0.6	0.2
Overfishing / too many fishers	3	0.6	0.2
Enforcement	3	0.6	0.2
Resources becoming extinct	3	0.6	0.2
Resources still healthy	3	0.6	0.2
Total	**526**	**100**	**35**

4 Discussion

Sampling is now well-spread among all the islands (except Niulakita) and with the employment of Outer Island Data Collectors (OIDCs) is progressing very well. Initial deficiencies with the number of samples noted in the first creel report are now being addressed and the data are functioning well to identify the status of the multispecies fisheries being landed on the islands. It will be necessary to combine information collected by OIDCs and during Metronome trips to ensure the samples being collected yearly are sufficient for detecting issues and change in response to management (such as the implementation of the FRFSP). As noted in Creel Report 1, there are still missing collections from women, for shellfish, through walking/gleaning and from canoes. Effort in these areas needs to be increased.

Although size at maturity (Lm) data are now available for 79 species from public sources, is it likely that the sizes we are using to assess the fishing of undersized fish are not completely relevant to Tuvalu. Given our proximity to the equator, it is possible that Lm for many of the species could be different than for other locations in the region. As noted in the first creel report, there is still a need to gather specific maturity data for Tuvalu to use in our assessments. This will require weighing and assessing ripeness of gonads of at least a subset of fishes measured. A request has been made for assistance from SPC for this work.

Mechanisms for improving the poor status of the resources have now been developed and the Funafuti Reef Fisheries Stewardship Plan (FRFSP) is to be implemented in 2018. The FRFSP was developed in response to the first creel report and extensive consultations with communities, fishers and the Kaupules during 2017. Once the provisions have been put in place, it is expected that the two main indicators used in the creel surveys will start to improve and overall yield of the fisheries increase. This may take a few years to allow time for undersized fish to grow and start to reproduce, increasing the population to sustainable levels.

There is significant pressure on coastal fishery resources on all islands surveyed. Any mechanisms that seek to divert fishing effort offshore on to tuna and other oceanic species, which for our purposes are virtually unlimited, will be important for future management actions. Diversion offshore will need to be accompanied by greater effort in sea safety, fishing methods suited to pelagic species, a consideration of costs and prices and public awareness.

5 Recommendations

The following recommendations are made for improving the creel survey data collections and for management of the fisheries:

1. Implementing the FRFSP is now a top priority so that the fisheries can be recovered to more productive levels and food and nutrition security and incomes can be improved;
2. TFD should consider pursue the requests made at the Heads of Fisheries (HOF) Meeting and the SPC-hosted First Regional Technical Meeting on Coastal Fisheries (RTMCF) in 2017 to developing size at maturity data collections specific to Tuvalu to be used for assessing the

health of the fisheries. This may include expanding future creel surveys to include measures of gonad ripeness and weight to be correlated with fish length;

3. Future sampling will need to target fishers who do not use boats and who may be fishing more for subsistence uses. There is also a need to gather more data on canoes, women and shellfish;
4. Work on sea safety, particularly on outer islands needs to continue. There are signs that use of safety gear may have declined between 2016 and 2017. This should include more assistance with accessing safety equipment such as grab bags as well as on-going efforts to improve small boat VHF radio facilities;
5. There was a lack of GPS data in this survey to allow for plotting of results in a more visual Geographic Information System (GIS). Future sampling will ensure that GPS measures are taken at all landings;
6. There is a need for data collectors to put more effort on fish identifications and getting details for all parts of the survey sheets. This is an on-going task and there is much confusion in Tuvaluan fish names that need to be by-passed by using scientific naming. For some parts of the creel survey sheet data collections have been poor to date (mostly in the section on fishers' perceptions); and
7. Awareness is needed on the results of this survey to assist with implementation of the FRFSP and the development of similar (though simpler) plans for the outer islands.

6 Annexes

6.1 Sizes at maturity and indications of undersized fishes for all outer islands

Island	Family	Lm	Species	2015	2016	2017
Nanumaga	ACANTHURIDAE	25	Kapalagi, Maa (Acanthurus xanthopterus)			0
	ACANTHURIDAE	8.8	Manini, Koinava (Acanthurus triostegus)			0
	ACANTHURIDAE	33	Pokapoka lanulanu (Naso vlamingii)			50
	ACANTHURIDAE	18	Ponelolo, (Acanthurus lineatus)			100
	Carangidae	35	Aseu (Caranx melampygus)			0
	Carangidae	65	Kami, Kamai (Elagatis bipinnulata)			93
	Carangidae	35	Tafauli, Tino tafauli (Caranx lugubris)			87
	Carangidae	39	Teu (Caranx sexfasciatus)			50
	Carangidae	60	Tino ulua, Lupo, Aseu (Caranx ignobilis)			100
	CARCHARHINIDAE	11	Mago (Carcharinus amblyrhynchos)			0
	KYPHOSIDAE	36	Nanue (Ff, Nm) (Kyphosus vaigiensis)			97
	Lethrinidae	36	Muu, Mufala (Monotaxis grandoculis)			100
	Lutjanidae	25	Tagau,Takape (Lutjanus fulvus)			100
	Lutjanidae	32	Taiva (Lutjanus monostigma)			100
	Lutjanidae	40	Utu (Aprion virescens)			0
	Mugilidae	20	Kanase (Crenimugil crenilabis)		0	
	MULLIDAE	15	Afulu (Parupeneus multifasciatus)			0
	MULLIDAE	12	Malili, Kaivete (Parupeneus barberinus)			0
	Scombridae	70	Valu (Gymnosarda unicolor)			100
	SERRANIDAE	33	Gatala lautalo, (Anyperodon leucogrammicus)			100
	Serranidae	11	Gatalaliki (Epinephelus merra)			0
	Serranidae	18	Mataele (Cephalopholis urodeta)			100
Nanumea	ACANTHURIDAE	8.8	Manini, Koinava (Acanthurus triostegus)			2
	ACANTHURIDAE	18	Ponelolo, (Acanthurus lineatus)			33
	Carangidae	35	Aseu (Caranx melampygus)			81
	Carangidae	65	Kami, Kamai (Elagatis bipinnulata)			33
	Carangidae	39	Teu (Caranx sexfasciatus)			99
	CARANGIIDAE	25	Aseu uluuli (Carangoides plagiotaenia)			77
	CARCHARHINIDAE	80	Mago (Carcharinus melanopterus)			0
	KYPHOSIDAE	36	Nanue (Ff, Nm) (Kyphosus vaigiensis)			96
	KYPHOSIDAE	25	Nanue (Kyphosus cinerascens)			4
	Lethrinidae	36	Muu, Mufala (Monotaxis grandoculis)			92
	Lethrinidae	23	Tanutanu (Lethrinus obsoletus)			0
	Lutjanidae	21	Savane (Lutjanus kasmira)			88
	Lutjanidae	23	Taaea (Lutjanus gibbus)			60
	Lutjanidae	57	Tagau (Lutjanus argentimaculatus)			100
	Lutjanidae	25	Tagau,Takape (Lutjanus fulvus)			91
	Lutjanidae	32	Taiva (Lutjanus monostigma)			95
	Lutjanidae	40	Utu (Aprion virescens)			0
	Mugilidae	20	Kanase (Crenimugil crenilabis)			2
	MULLIDAE	17	Kalo (Mulloidichthys vanicolensis)			0
	MULLIDAE	12	Malili, Kaivete (Parupeneus barberinus)			0
	Scaridae	20	Taona (Scarus psittacus)			20
	Scombridae	65	Paala (Scomberomorus commersoni)			100
	Scombridae	70	Valu (Gymnosarda unicolor)			100
	Serranidae	11	Gatalaliki (Epinephelus merra)			0
	Serranidae	22	Loi (Cephalopholis argus)			67
	SERRANIDAE	41	Munua (Epinephelus fuscoguttatus)			0
Niutao	ACANTHURIDAE	8.8	Manini, Koinava (Acanthurus triostegus)			10
	ACANTHURIDAE	18	Ponelolo, Alogo, Pone hamoa (Acanthurus lineatus)			83
	Carangidae	65	Kami, Kamai (Elagatis bipinnulata)		100	75
	Carangidae	39	Teu (Caranx sexfasciatus)			100
	Carangidae	60	Tino ulua, Lupo, Aseu (Caranx ignobilis)			100
	CARCHARHINIDAE	97	Mago (Triaenodon obesus)			0
	HOLOCENTRIDAE	18	Malau (Myripristis berndti)			100
	HOLOCENTRIDAE	12	Malau puku (Myripristis pralinia?)			0
	KYPHOSIDAE	36	Nanue (Ff, Nm) (Kyphosus vaigiensis)			60

Island	Family	Lm	Species	2015	2016	2017
	Lutjanidae	40	Utu (Aprion virescens)			0
	MULLIDAE	17	Kalo (Mulloidichthys vanicolensis)			100
	MULLIDAE	12	Malili, Kaivete (Parupeneus barberinus)			0
	Scombridae	70	Valu (Gymnosarda unicolor)			0
	SERRANIDAE	33	Gatala lautalo, (Anyperodon leucogrammicus)			100
	Serranidae	11	Gatalaliki (Epinephelus merra)			0
Nui	ACANTHURIDAE	8.8	Manini, Koinava (Acanthurus triostegus)		1	3
	Carangidae	35	Aseu (Caranx melampygus)			89
	Carangidae	65	Kami, Kamai (Elagatis bipinnulata)		36	0
	Carangidae	39	Teu (Caranx sexfasciatus)			100
	Carangidae	60	Tino ulua, Lupo, Aseu (Caranx ignobilis)			100
	CARANGIIDAE	25	Aseu uluuli (Carangoides plagiotaenia)			0
	HOLOCENTRIDAE	12	Malau (Myripristis kuntee)		0	
	HOLOCENTRIDAE	12	Malau puku (Myripristis pralinia?)			0
	Holocentridae	8	Talakihi (Neoniphon sammara)			0
	KYPHOSIDAE	36	Nanue (Ff, Nm) (Kyphosus vaigiensis)		0	100
	LABRIDAE	12	Gole (Cheilinus fasciatus)			0
	Lethrinidae	36	Muu, Mufala (Monotaxis grandoculis)		100	100
	Lethrinidae	23	Tanutanu (Lethrinus obsoletus)		13	50
	Lutjanidae	43	Fakamea, Fagamea (Lutjanus bohar)		100	
	Lutjanidae	23	Taaea (Lutjanus gibbus)		54	
	Lutjanidae	25	Tagau,Takape (Lutjanus fulvus)		95	86
	Lutjanidae	32	Taiva (Lutjanus monostigma)		57	100
	Mugilidae	20	Kanase (Crenimugil crenilabis)			43
	MULLIDAE	12	Malili, Kaivete (Parupeneus barberinus)			0
	Serranidae	24	Gatala (Epinephelus miliaris)			0
	Serranidae	11	Gatalaliki (Epinephelus merra)		0	0
	SERRANIDAE	41	Munua (Epinephelus fuscoguttatus)		0	0
Nukufetau	ACANTHURIDAE	8.8	Manini, Koinava (Acanthurus triostegus)			0
	Carangidae	35	Aseu (Caranx melampygus)		0	22
	Carangidae	65	Kami, Kamai (Elagatis bipinnulata)		80	0
	Carangidae	35	Tafauli, Tino tafauli (Caranx lugubris)		17	0
	Carangidae	39	Teu (Caranx sexfasciatus)		94	56
	HOLOCENTRIDAE	18	Malau (Myripristis berndti)		36	
	HOLOCENTRIDAE	12	Malau puku (Myripristis pralinia?)			0
	Lethrinidae	36	Muu, Mufala (Monotaxis grandoculis)		100	50
	Lethrinidae	23	Tanutanu (Lethrinus obsoletus)		50	0
	Lutjanidae	43	Fakamea, Fagamea (Lutjanus bohar)		100	
	Lutjanidae	21	Savane (Lutjanus kasmira)		67	100
	Lutjanidae	23	Taaea (Lutjanus gibbus)		44	0
	Lutjanidae	25	Tagau,Takape (Lutjanus fulvus)		100	
	Lutjanidae	32	Taiva (Lutjanus monostigma)		100	
	Lutjanidae	40	Utu (Aprion virescens)		0	
	Mugilidae	20	Kanase (Crenimugil crenilabis)		0	0
	Mugilidae	35	Kanase (Mugil cephalus)			86
	Scombridae	70	Valu (Gymnosarda unicolor)		100	
	Serranidae	34	Gatala (one dot) (Epinephelus polyphekadion)		55	50
	SERRANIDAE	33	Gatala lautalo, (Anyperodon leucogrammicus)		0	
	Serranidae	22	Loi (Cephalopholis argus)		0	
	SERRANIDAE	41	Munua (Epinephelus fuscoguttatus)			71
	Siganidae	20	Maiava (Siganus argenteus)			0
Nukulaelae	ACANTHURIDAE	33	Pokapoka lanulanu (Naso vlamingii)			50
	ACANTHURIDAE	33	Ume, Pokapoka (Naso unicornis)			11
	Carangidae	35	Aseu (Caranx melampygus)		100	88
	Carangidae	65	Kami, Kamai (Elagatis bipinnulata)		80	67
	Carangidae	39	Teu (Caranx sexfasciatus)			38
	KYPHOSIDAE	36	Nanue (Ff, Nm) (Kyphosus vaigiensis)			70
	Lethrinidae	36	Muu, Mufala (Monotaxis grandoculis)		100	90
	Lethrinidae	23	Tanutanu (Lethrinus obsoletus)		6	50
	Lutjanidae	43	Fakamea, Fagamea (Lutjanus bohar)		100	

Island	Family	Lm	Species	2015	2016	2017
	Lutjanidae	21	Savane (Lutjanus kasmira)			100
	Lutjanidae	23	Taaea (Lutjanus gibbus)		81	64
	Lutjanidae	25	Tagau,Takape (Lutjanus fulvus)		100	100
	Lutjanidae	32	Taiva (Lutjanus monostigma)		100	50
	Serranidae	11	Gatalaliki (Epinephelus merra)		0	0
	Serranidae	22	Loi (Cephalopholis argus)		0	29
	SERRANIDAE	41	Munua (Epinephelus fuscoguttatus)			20
	Serranidae	41	Tonu (Plectropomus leopardus)			0
Vaitupu	ACANTHURIDAE	8.8	Manini, Koinava (Acanthurus triostegus)			0
	ACANTHURIDAE	33	Pokapoka lanulanu (Naso vlamingii)			100
	ACANTHURIDAE	18	Ponelolo, (Acanthurus lineatus)			24
	Carangidae	35	Aseu (Caranx melampygus)			40
	Carangidae	65	Kami, Kamai (Elagatis bipinnulata)			67
	Carangidae	39	Teu (Caranx sexfasciatus)			60
	Carangidae	60	Tino ulua, Lupo, Aseu (Caranx ignobilis)			67
	HOLOCENTRIDAE	18	Malau (Myripristis berndti)			50
	HOLOCENTRIDAE	12	Malau puku (Myripristis pralinia?)			0
	KYPHOSIDAE	36	Nanue (Ff, Nm) (Kyphosus vaigiensis)			83
	Lethrinidae	36	Muu, Mufala (Monotaxis grandoculis)			100
	Lethrinidae	33	Noto (Lethrinus miniatus)			100
	Lethrinidae	23	Tanutanu (Lethrinus obsoletus)			44
	Lutjanidae	23	Taaea (Lutjanus gibbus)			100
	Lutjanidae	25	Tagau,Takape (Lutjanus fulvus)			99
	Lutjanidae	32	Taiva (Lutjanus monostigma)			96
	Mugilidae	20	Kanase (Crenimugil crenilabis)			37
	MULLIDAE	15	Afulu (Parupeneus multifasciatus)			0
	MULLIDAE	17	Kalo (Mulloidichthys vanicolensis)			0
	MULLIDAE	12	Malili, Kaivete (Parupeneus barberinus)			0
	SERRANIDAE	14	Gatala (Epinephelus fasciatus)			0
	Serranidae	34	Gatala (one dot) (Epinephelus polyphekadion)			0
	SERRANIDAE	33	Gatala lautalo, (Anyperodon leucogrammicus)			100
	Serranidae	11	Gatalaliki (Epinephelus merra)			27
	Serranidae	22	Loi (Cephalopholis argus)			0
	Serranidae	18	Mataele (Cephalopholis urodeta)			60
	Serranidae	41	Tonu (Plectropomus leopardus)			0
	Serranidae	40	Tonu gatala (Plectropomus areolatus)			89

6.2 Creel Datasheet

Tuvalu Fisheries Creel Survey Data Sheets

Use ONE sheet for each landing met (replicate). This can be a boat or catch basket brought in by gleaners etc. Note that this is presented by slice, to show all the data so you can choose which parts of the information you want to collect.

Date:	Serial / ID Number:		
Island:	Village/Site:		
Surveyor 1:	Surveyor 2:		
Latitude (DD):	Longitude (DD):		
C1 Basic Information on Fishers			
Lead Fisher's Name:			
Date of birth:	Gender:	☐ Male	☐ Female
Address as Village / Town / City:			
Is the fisher with others?		☐ Yes	☐ No
➔ Data on other fishers in the landing today:			

#	Fisher's Name:	DOB (d/m/y)	Gender	
1			☐ Male	☐ Female
2			☐ Male	☐ Female
3			☐ Male	☐ Female
4			☐ Male	☐ Female
5			☐ Male	☐ Female

➔ Back to Lead fisher:		
How often do you go fishing per month?		/ month
How many months a year do you fish *(i.e. exclude closed months)*		months fished
What fishing methods do you usually use *(over the last year)?*	Method 1:	
Method 2:	Method 3:	
Method 4:	Method 5:	

Where else do you land your fish? What other locations?
(List by priority and use map)

Most often	#	Location	# trips/month
↓	1		
	2		
	3		
	4		
Least often	5		

Why do you go fishing?	☐ Subsistence | ☐ Income | ☐ Both | ☐ Other _____
Please provide details:	

About how much of today's catch will be eaten at home / sold?	Home: %	Sold: %
What would you expect as income from today's catch overall?	$	

What is your eye-estimate of the total weight of the day's catch? *(Estimated by you, not the fisher)*	kg

C2 Species composition / counts

What is the total count by species of all fishes / invertebrates / other landed?

Species name / Group	Number	Species name / Group	Number

C3 Species sizes and C4 Species weights

Species Name	All sizes in the catch in cm and all weights in kg *(Continue along rows for a species. Each row fits 5 fish. Repeat species in a new line if you need more space)*									
	cm	kg	cm	kg	cm	kg	cm	kg	cm	kg

C5 Effort data for CPUE

How many hours spent fishing today?	hrs
Fishing method / gears used for each species group (separate pelagic fish, reef fish, crabs, lobsters etc) and how much they cost the fisher to buy	

#	Species / Group	Methods / gears used	Cost buy
1			$
2			$
3			$
4			$
5			$

Did you have any gear losses during this fishing trip? What and how much to replace or repair?

#	Gear	What loss / damage?	Cost r/r
1			$
2			$
3			$
4			$
5			$

Please list any other costs of this fishing trip. Include fuel, wages, ice, food, drink, any other items		
#	Item description	Price
1		$
2		$
3		$
4		$
5		$

What is the distance to the furthest site you fished in today? *(ask person to show you on map and draw, we will extract coordinates later)*	km

#	Site name	Latitude (DD)	Longitude (DD)
1			
2			
3			
4			
5			

What kind of boat used today?
Construction: □ Wood | □ Fibreglass | □ Plastic | □ Aluminium | □ Concrete
Type of boat: □ Alia | □ Canoe | □ Dinghy | □ Punt | □ Skiff | □ Other | □ None
If "other", what kind of boat?

How is the boat powered?	□ Paddle | □ Sail | □ Inboard | Outboard: □ 2 stroke | □ 4 stroke

Length:	m	Engine:	hp

What safety gear do you have on board today? *(tick all that apply)*	□ Oars | □ Life jackets | □ Water | □ EPIRB | □ GPS | □ Flares | □ Bailer / Bilge | □ Extra fuel | □ Others (specify):

FADs

Did you fish on a FAD today?	□ Yes	□ No
What species were you targeting?		
Why do you use a FAD (this trip and others?)		
Are there any problems with the FADs?	□ Yes	□ No
Please explain:		

C7 Perceptions of fishers

How long have you been fishing?	years
How long have you been doing **this type** of fishing?	years

What **other types** of fishing have you done in the **past**?		
Do you do **other** types of fishing now?	□ Yes	□ No
Describe:		
Are you fishing in the same **areas** as 5 years ago?	□ Yes	□ No
Please explain:		

Are you catching the same **quantities** as 5 years ago?	□ Yes	□ No
Please explain:		
Are you catching the same **sizes** as 5 years ago?	□ Yes	□ No
Please explain:		
If catches are **different**, what has changed?		
Are you aware of any existing Fisheries Laws?	□ Yes	□ No
Please explain:		
Do you have any **concerns** about the resources?		
Thank you		

7 References

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