Tuvalu Fisheries Department
Coastal Fisheries Division

Creel Survey Report No. 1

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Summary

This report is the first 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 and sizes being caught; and (v) identify stressed resources in need of management.

Fisher's catch data were collected between 30th April 2015 and 28th September 2016 in Funafuti (continuously), and Nui, Nukufetau, Nanumaga, Nanumea and Niutao (whilst on survey trips). 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 size at maturity for 28 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 1.5 years of the survey so far, 275 landings were met, with most in Funafuti (227), 12 in Nui, 31 in Nukufetau, and smaller numbers in Nanumaga and Niutao. Over the survey 286 fishers were met, some repeatedly, others only once. The average age of fishers was 35 years, with those on outer islands on average 7 years younger than on Funafuti. On average fishers said they went on trips about 12 times per month. Overall 87% of the catch was for sale, and 13% for home use. The islands with the highest percentage of catch for sale were Funafuti and Niutao at 95%. Thirteen different type of fishing methods were reported, with handline being the most common and in use in 65% of all landings. The most commonly used safety gear recorded in landings were drinking water, oars, bailer and GPS. Overall 79% of the vessels met were of wooden construction, with 13% in fibreglass and 9% aluminium. The most common boat type was the dinghy with 99% of vessels powered by 2-stroke engines and just one canoe powered by paddle. Overall 59% of fishers said they were using different fishing grounds since 5 years ago and 74% said that the number and size of fish had declined. The responses given were highly island-dependent with more fishers from Funafuti saying things had declined than on the other outer islands. The main reasons given for declining resources included a large number of fishers and boats, climate change, increasing human population and the presence of purse seiners within the 12 nm zone. Fishers suggested that small and spawning fishes should be released or not caught and that gillnets should be of larger mesh size. In general different forms of management of the resources themselves or the habitats on which they depend were suggested.

The results of this survey show that coastal fisheries in Tuvalu, and particularly in Funafuti are overfished. A total of 15,201 specimens were landed during the survey, including 180 species of fishes in 30 families and 91 genera, and a total of 9.3 tonnes of catch. Of the 22 species that could be assessed for signs of overfishing, 13 (60% of species) had 50% or more of the catch below the size at maturity. This means that the fishes are being caught and removed from the population before they can reproduce. The main fishes showing strong signs of overfishing included acanthurids (pone), carangids (ulua, kamai), serranids (gatala), lethrinids (noto) and lutjanids (taea). When examined by island, it was found that one species (a grouper, munua) was overfished on Funafuti, but not on Nui . Most species that were found overfished were

stressed on all islands where they were recorded. Fishers targeted reef fishes 69% of the time (in 46% of the landings) making reef fishing the most important across the survey. Pelagic species were targeted only one third of the time (in 20% of landings).

To date most sampling effort has been in Funafuti, close to TFD base, and insufficient samples have been completed on the outer islands. At the same time, missing from the data collections are landings from women, shellfish, through walking/gleaning and from canoes. Effort in these areas needs to be increased. Insufficient data are also available for assessing the health of the fishery for most of the species being caught. Just 28 species had size at maturity information available in public sources (Fishbase) and 17 of those (61%) were found to be under stress and in need of management. As public sources of maturity information are generally lacking there is a need to add maturity information to the survey. This will require weighing and assessing ripeness of gonads of at least a subset of fishes measured. Mechanisms for improving the status of the stressed resources will need to be investigated. These may include consultations with fishers and the Kaupules, setting size limits for some species, improving the function of Marine Protected Areas (MPAs), supporting FADs to deflect effort elsewhere. With 87% of the catch being for income (13% for home use) and 69% of fishers specifically targeting reef fishes over pelagic (31%) there is significant pressure on coastal fishery resources on all islands surveyed. Any mechanisms that seek to divert fishing effort offshore on to tuna, which for our purposes is 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. Mechanisms for management need to be investigated for relieving pressure on overfished resources and deflecting at least some of the effort offshore so that coastal fisheries can recover;
2. TFD should consider mechanisms for developing size at maturity data for assessing the health of the fisheries;
3. Future sampling will need to target outer islands more, as well as 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. Future surveys should be expanded to include measures of gonad ripeness and weight to be correlated with fish length. This is needed to develop Tuvalu's size at maturity measures for future assessments of status of the resource;
5. Increased work on sea safety is needed, particularly on outer islands. 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;
6. 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 measurements are taken at all landings; and
7. Awareness is needed on the results of this survey to begin the dialogue on management.

Acronyms & Terms

Creel	Irish term for fishermen's basket, used to denote surveys focused on fisher's catches
EPIRB	Emergency Position Indicating Radio Beacon
FL	Fork length of fish from snout to central tail fork or margin
GIS	Geographic Information System
GPS	Global Positioning System
L_m	Length at maturity of a fish usually as total length
N	Number of samples or observations
SD	Standard deviation of a sample
TFD	Tuvalu Fisheries Department
TL	Total length (of fish from snout to tip of tail)

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Figures and Tables

1 Introduction

This creel survey was undertaken by the Tuvalu Fisheries Department (TFD) as part of its on-going mandate to improve fisheries returns and food security in Tuvalu in line with Te Kakeega III and other planning documents. The TFD Corporate Plan calls on the Coastal Fisheries Section 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 working. This survey is the first 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 numbers and sizes being caught; and
- Identify stressed fisheries, if present, and recommend management that might be needed.

2 Methods

Fisher's catch data were collected on the Tuvalu islands of Funafuti, Nui, Nukufetau, Nanumaga, Nanumea and Niutao since 30th April 2015. The survey was carried out by a team of Coastal Fisheries staff who 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. In 2015-16 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[1]. 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 shown at Annexe 6.1 on page 17. 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

[1] Fishers refused the sampling on only 1-2 occasions

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.

3 Results

3.1 Samples and Locations

Over the sampling period of 1.5 years (between 30 April 2015 and 28 September 2016) a total of 275 creel samples was completed on 6 islands. Significantly more samples were collected in 2016 to date than were collected in 2015, and most samples were collected in Funafuti (227 samples) (Figure 1). Significant numbers of samples were also collected from Nui (12) and Nukufetau (31). Just one sample was collected from Nanumaga and 4 from Niutao. To date no samples have been collected from the remaining outer islands.

The number of samples collected varied among the months, with peak periods in July 2015, and March, May and June 2016. Samples for outer islands were restricted to field trips conducted in June and August-September 2016 (Figure 2).

Figure 1: Total number of landings per island and year

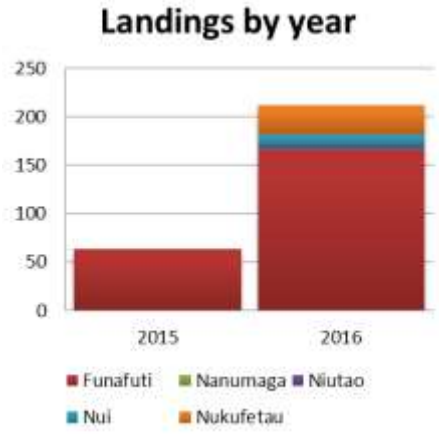
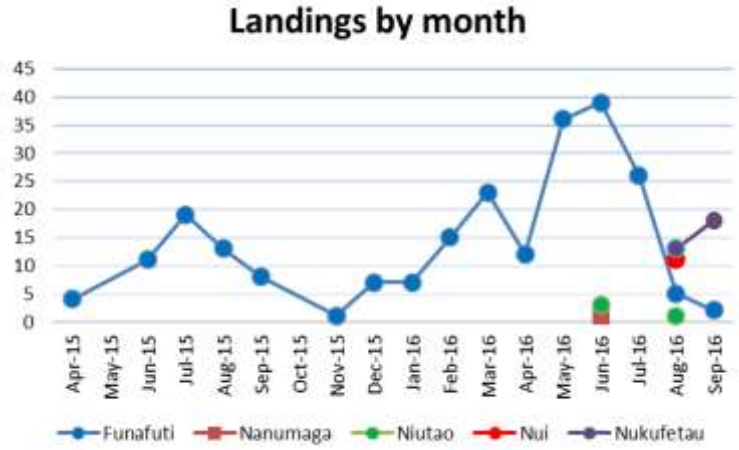
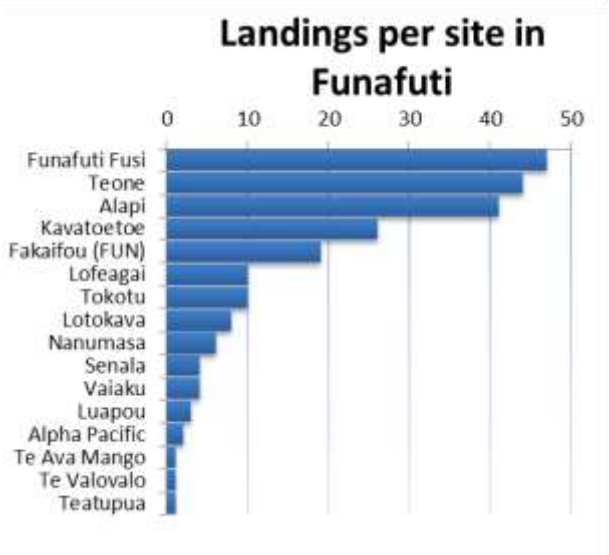


Figure 2: Number of landings met per month and island



For the samples in Funafuti, most data (58%) were collected from the 3 main sites of Fusi. Teone and Alapi (Figure 3). Although the second most used site, Teone accounted for 19% of all samples due to 3 fishing competitions on 20th May, 10th June and 22nd July 2016. The competitions were arranged at the Fisheries Department compound to encourage fishers to use ice and trial the idea of a fish market. The sites Alapi and Fusi are located in the heart of the most populated part of the island.

Figure 3: Landings per site in Funafuti



3.2 Details on fishers

Over the creel survey to date, a total of 286 individual fishers were met. Overall the number of fishers met, including repeat landings by some fishers was 687, with the number from individual islands ranging between 2 in Nanumaga and 599 in Funafuti. In Funafuti as expected the largest numbers of fishers met, 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).

In Funafuti, about a quarter of the fishers were met in landings twice during the survey, while about 20 were only seen once. Twenty-six fishers were found at landings between 3 and 4 times during the survey. No fishers were sampled more than 6 times over the period of 1.5 years of the survey (Figure 5).

The average age of all fishers met during the survey was 35 years (+/- SD 14, N=161). In general, the fishers met in Funafuti were about 7 years younger than on the outer islands (Figure 6).

On average, fishers said that they go on about 12 fishing trips per month (SD=5.7, N=219 fishers met). Fishers from Niutao and Nukufetau tended to report greater numbers of fishing trips per month, with the lowest average from Nanumaga and Nui (Figure 7).

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

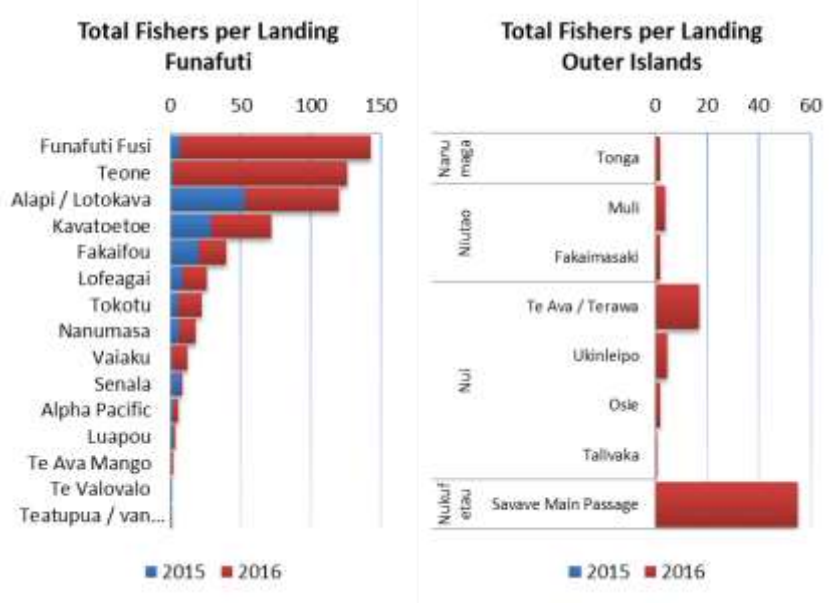


Figure 5: Frequency with which individual fishers were met in Funafuti

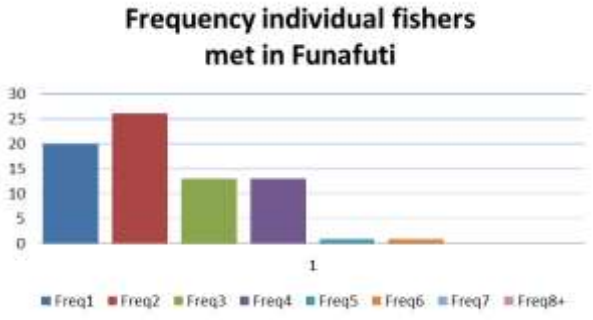


Figure 6: Average age of fishers met (with SD)

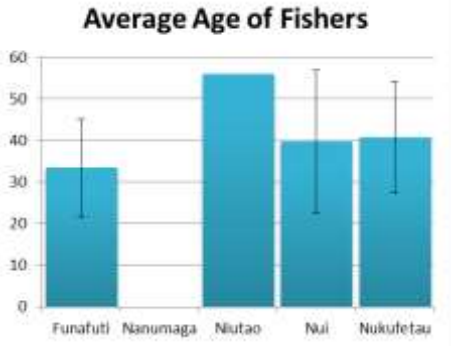
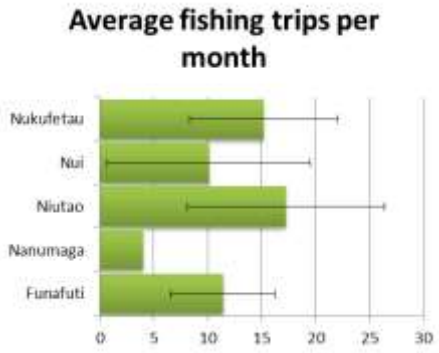


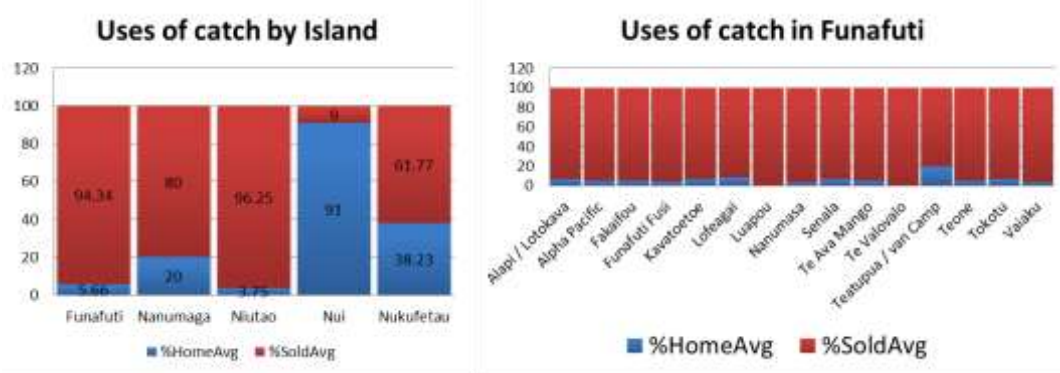
Figure 7: Average number of fishing trips fishers report doing per month



Overall 87% of the catch being caught was for sale, and just 13% for home use, across all islands. This differed significantly among the islands, with around 95% of the catch for sale in Funafuti and Niutao (Figure 8). The island with the most subsistence use of catch was Nui, with just 9% being used for sale.

In Funafuti there were only small differences among landing sites in terms of what fishers report they did with their catch. At two sites 100% of the catch was used for sale, while at one site as much as 20% was for home use.

Figure 8: Percentage use of catch as reported by fishers



Overall, 13 different types of fishing methods were reported in use by fishers (Table 1). Use of handline is the most commonly-reported fishing method as 35% of all methods in use and reported at 65% of landings. Tuna trolling, scooping flyingfish and hand spearing were the next most common methods, together accounting for 50% of all methods reported and reported in between 24-37% of landings.

Table 1: Usual fishing methods reported by fishers

Fishing Method	Number	%Responses	%Landings
Handline (Matau)	178	35	65
Trolling tuna (Taki)	101	20	37
Scoop net flyingfish	89	17	32
Spear hand	67	13	24
Gill net (Tatili)	28	5	10
Deepsea line midwater	26	5	9
Handline bottom fishing	8	2	3
Handline Jigging	6	1	2
Deepsea line bottom	6	1	2
Rod fishing (siisi)	2	0.4	1
Cast netting	2	0.4	1
Longline	1	0.2	0.4
Bivalve Flesh only (Nao soopu)	1	0.2	0.4
Total	**515**	**100**	**187**

3.3 Species, Sizes and Weights

Over the course of the survey a total of 15,201 fishery products were sampled in the creel landings and weighed and measured, including 180 different species of fishes (30 families and 90 genera). In 2015 a total of 2.4 tonnes were landed in creel samples, and in 2016 to date the amount is 6.9 tonnes (total 9.3 tonnes).

Size at maturity was available for 22 species of 6 families that turned up in this survey. Of those, 60% (13) commonly-fished species were found with 50% or more of the fish caught below size at maturity (our defined trigger point) overall. These included 1 acanthurid (pone), 3 carangids (ulua, kamai), 3 serranids (gatala), both Lethrinids (noto), and all 4 Lutjanids (taea) (Table 2). When taking the island into account, the percentage overfished was greater, with 65% of the species observed across the 4 islands examined showing stress. Further, some species were found overfished everywhere, while others overfished on some islands and not on others. For example, rainbow runner or kamai were stressed on all 4 islands, and at least one grouper (Munua) stressed on Funafuti, but not on Nui. For the most part, species stressed on one island were usually also stressed on all others where they were recorded (see also Annexe 6.1).

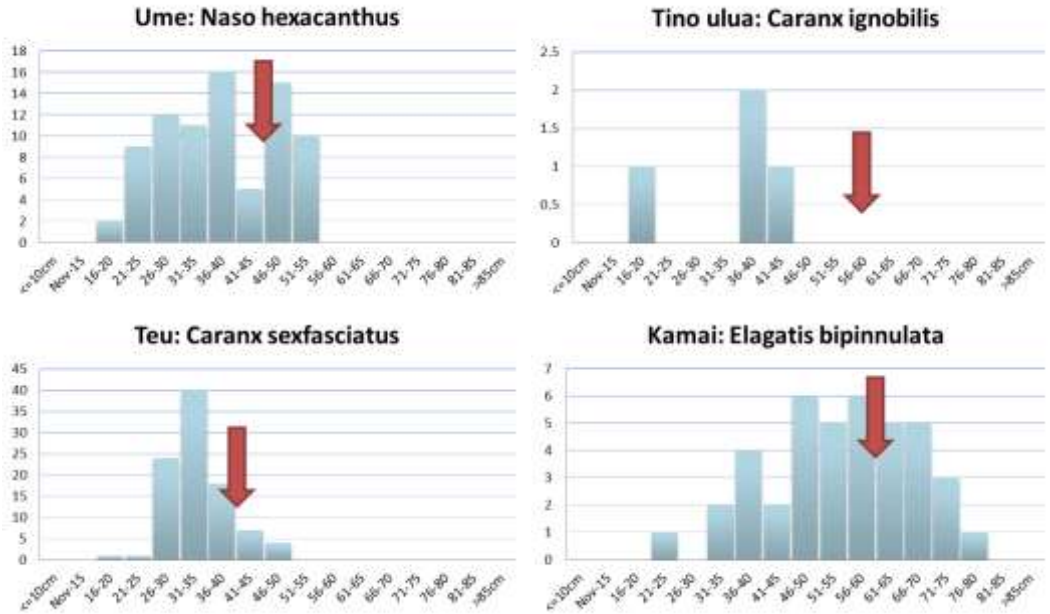
Table 2: Species identified at each island during the creel survey as requiring management

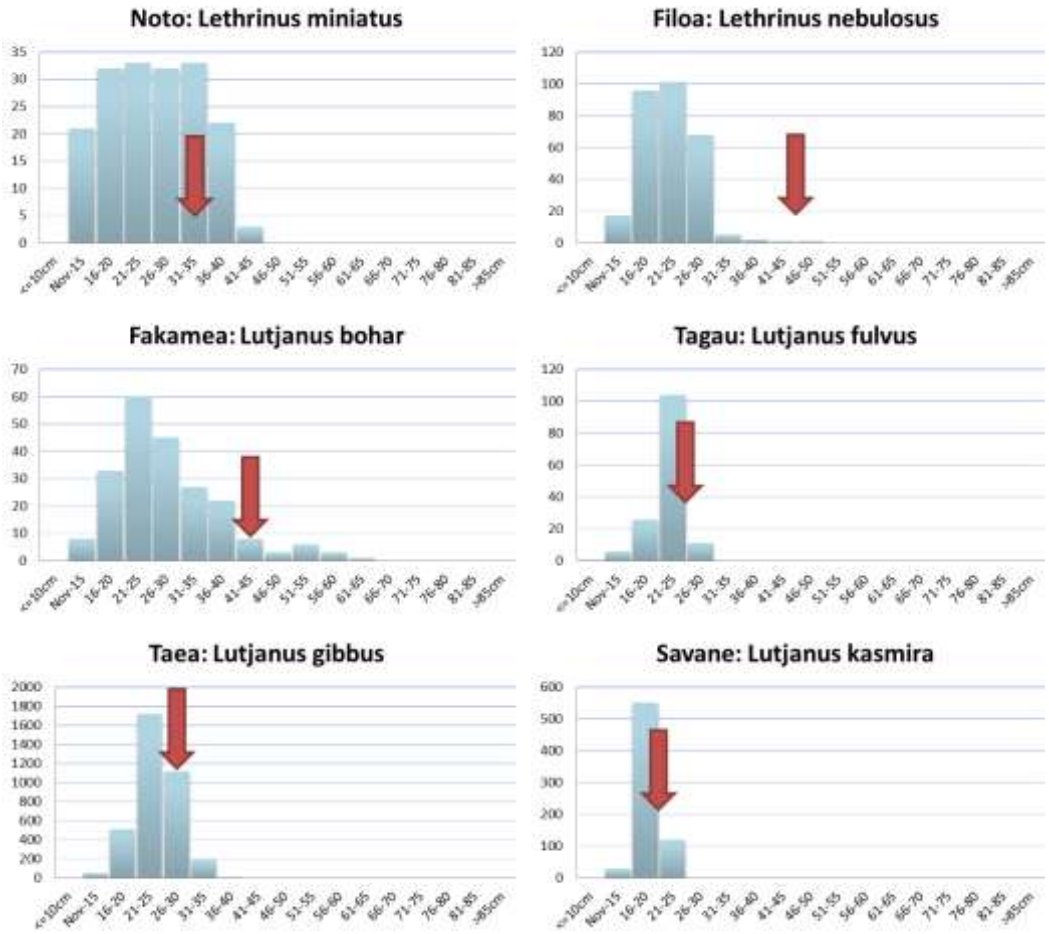
The test used was whether 50% or more of the fish measured for that species was below the size at maturity. Green ticked species are considered OK, while Red crossed species are considered stressed. The numbers shown are the total number of fish for which length was measured for each species.

Family	FishName	Funafuti	Nui	Nukufetau	Niutao	No.	Overall
Acanthuridae	Acanthurus lineatus (Ponelolo)	✓				1026	OK
	Acanthurus triostegus (Manini)	✓	✓			102	OK
	Naso hexacanthus (Ume tinae sega)	×				80	Manage
Carangidae	Caranx ignobilis (Lupo, Aseu)	×				4	Manage
	Caranx lugubris (Tafauli, Tino tafauli)			✓		6	OK
	Caranx melampygus (Asea, Aseu, Ulua)	✓		✓		20	OK
	Caranx sexfasciatus (Ulua, Aseu, Teu, Kata)	×		×		95	Manage
	Elagatis bipinnulata (Kami, Kamai)	×	×	×	×	40	Manage
Lethrinidae	Lethrinus miniatus (Noto)	×				176	Manage
	Lethrinus nebulosus (Tanutanu)	×	×	×		291	Manage
Lutjanidae	Lutjanus bohar (Fakamea, Fagamea)	×	×	×		216	Manage
	Lutjanus fulvus (Tagau,Takape)	×	×	×		148	Manage
	Lutjanus gibbus (Taaea)	×	×	×		3604	Manage
	Lutjanus kasmira (Savane)	×		×		702	Manage
Serranidae	Cephalopholis argus (Loi)	✓		✓		10	OK
	Epinephelus fuscoguttatus (Munua)	×	✓			29	Manage
	Epinephelus merra (Gataliki)	✓	✓			80	OK
	Plectropomus leopardus (Tonu)	×				1	Manage
	Variola louti (Pula)	×				16	Manage
Siganidae	Siganus argenteus (Maiava)	✓				66	OK
	Siganus fuscescens (Maiava)	✓				7	OK
	Siganus punctatus (Maiava fiti)	✓				18	OK

Almost all of the fishes landed for *Caranx ignobilis* (tino ulua), the Lethrinids (noto and filoa) and *Lutjanus bohar* (fakamea) were undersized (Figure 9).

Figure 9: Selected size frequency graphs of species identified as needing management because 50% or more were landed below size at maturity (red arrow).





3.4 Fishing Effort & Perceptions of Fishers

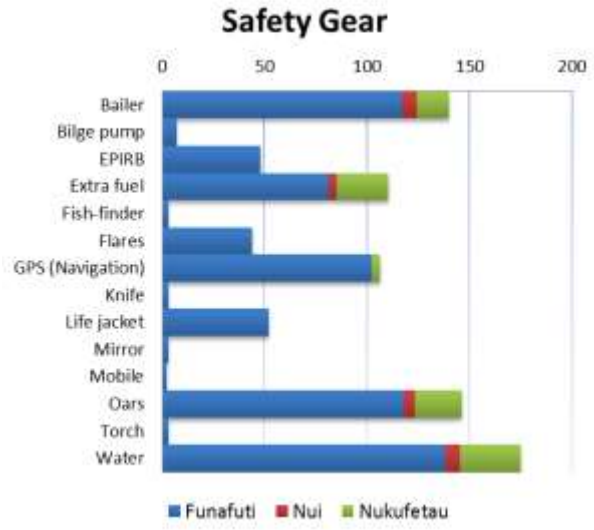
Fishers targeted reef fishes 69% of the time (in 46% of the landings) making reef fishing the most important across the survey. In contrast pelagic species were targeted only one third of the time (20% of landings) (Table 3).

Table 3: Types of seafoods being targeted by fishers

Fishing Product	Number	%Responses	%Samples
Reef fish	127	69	46
Pelagic	57	31	20
Gastropods	1	1	0.4
Total	**185**	**100**	**66**

The most commonly used safety gear recorded in landings were water, oars, bailer and GPS (Figure 10). These items plus extra fuel were the main ones reported by fishers in outer islands samples. In Funafuti there was a much larger range of equipment considered by the fishers to be safety gear, including EPIRB Emergency Position Indicating Radio Beacon, GPS Global Positioning System, flares and lifejackets. These items have not yet turned up in outer islands samples.

Figure 10: Frequency of safety gear used in landings



Boat details were collected for 137 of the 279 landings (49%) (Table 4). Overall 79% of the vessels met were of wooden construction, with 13% in fibreglass and 9% of aluminium. The most common boat type was the dinghy (81%) (open small boat without cabin), followed by banana boats (17%) and only small numbers of canoes. Just one boat, a canoe, was powered by paddle, 99% were powered by 2-stroke engines.

Table 4: Details of boats in use, listed separately for construction materials, boat type and power.

Construction	Number	%
Aluminium	12	9
Fibreglass	17	13
Wood	107	79
Total	**136**	**100**

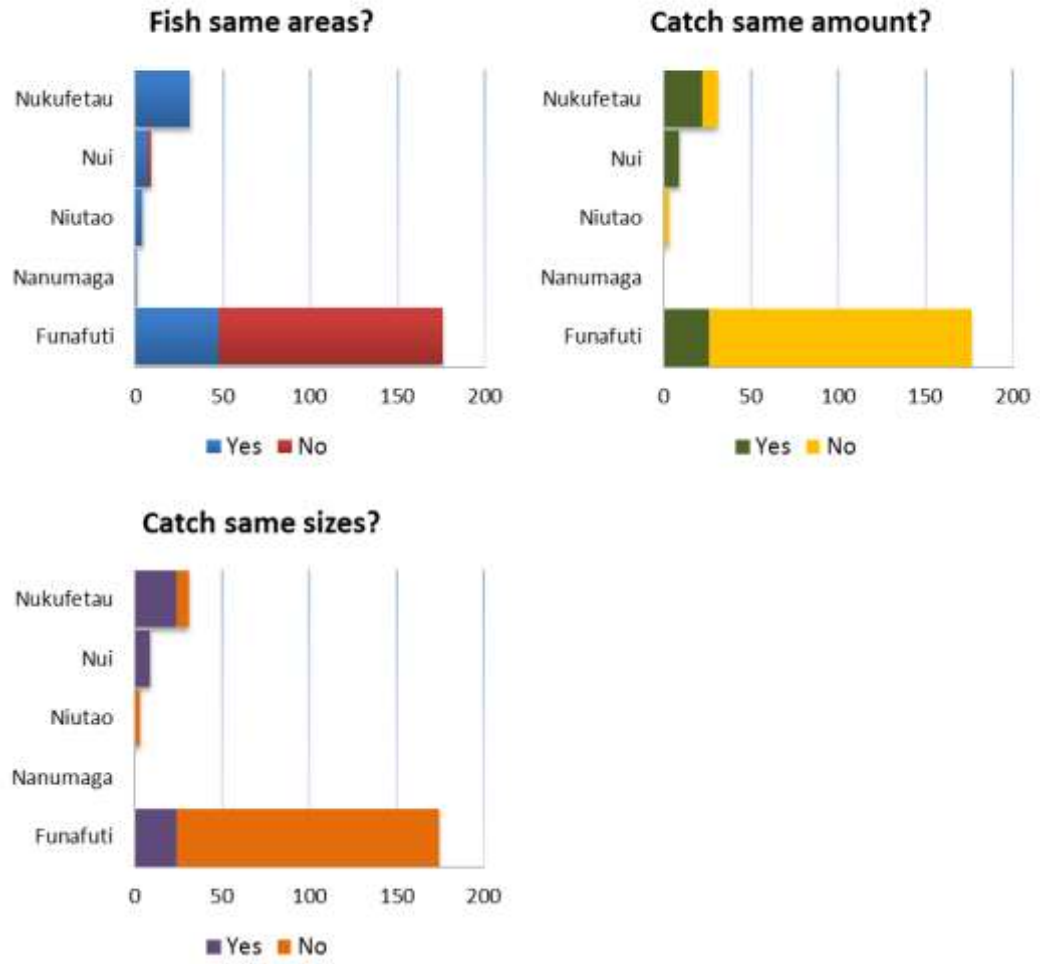
Type	Number	%
Banana boat	24	17
Canoe	3	2
Dinghy	113	81
Total	**140**	**100**

Power	Number	%
2 stroke outboard	135	99
4 stroke outboard	1	1
Paddle	1	1
Total	**137**	**100**

When fishers were asked their perceptions of changes in their fishery compared with catches they were getting 5 years ago, 41% overall said that they used the same fishing grounds as in the past, with 59% saying that they had changed grounds. This response was highly dependent on the island, with most people saying that they had to change their fishing grounds being from Funafuti (Figure 11). Similar patterns were seen for whether fishers caught the same amount of fish, and whether the sizes of the fishes had changed. For catch amount and fish sizes, 74% of fishers overall said that both measures had declined, with the strongest signals of decline in the catches coming from Funafuti.

The reasons given for why fishers had *not* changed their fishing grounds included easy access, the ability to use their canoe, or because the fish or invertebrates at their favourite sites were still abundant. Those that had to move fishing grounds said they did so mainly because the fish had declined in number and/or size, that they were always searching for new grounds and that fish were hard to catch nearshore.

Figure 11: 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, a large number of fishers (38% or responses received) said "nothing", with most of these fishers in Nukufetau and Nui. The most common reasons given for change were too many boats and/or fishers and "overfishing" (Table 5). Others said that climate change, increasing human population and the presence of purse seiners were to blame. Some of the comments given included:

- *"It takes many hours (5-6hrs) of fishing to get a good catch to sell. As in the past it only take about 3-4 hours on average to catch as many fish I wanted"; and*
- *"Fishing vessels fishing inside 12nm".*

The main concerns people had with fishing centred on proper management of the marine protected areas (LMMAs), protecting small fishes and the impacts of foreign fishing vessels within the 12nm zone (Table 6). There was a clear understanding of the economic impacts of the declining fish resources and an understanding that catching small fishes and those about to spawn was a problem. Some of the answers given included:

- "Yes, I would spent more money to buy fish from fishermen with boats as I don't catch more fish today";
- "My business depends on fish resources";
- "Well, the number of fish (Tuna) is really low this year…I bet is fishing foreign vessel(Purse seiner) is the cause, because sometime we see them just within 12 Nm";
- "Release small fish as well as those fish are almost spawn";
- "Gillnet fishing to use much larger size 3-4 inch, decreasing under-size catches";
- "Maintain the conservation area and encourage people not to practice poaching".

Table 5: If catches are different, what has changed?

What changed?	Number	%Responses	%Landings
Nothing	29	38	10
Too many fishing boats / fishers	9	12	3
Overfishing	8	10	3
Climate change	4	5	1
Don't know / Not sure	4	5	1
Human population increased	3	4	1
Weather patterns changed	3	4	1
Purse seiners / foreign vessels	2	3	1
Many hours to get a good catch	2	3	1
Algal overgrowth	2	3	1
Foreign vessels within 12nm zone	2	3	1
Catch varies over time	1	1	0.4
Catching undersized fish	1	1	0.4
Cyclone Pam effects	1	1	0.4
Fish migrate	1	1	0.4
Lagoon getting shallower	1	1	0.4
Pollution	1	1	0.4
Tides changed	1	1	0.4
Water currents changed	1	1	0.4
Just started fishing	1	1	0.4
Total	**77**	**100**	**28**

Table 6: What are the main concerns about the resources?

Concerns	Number	%Responses	%Landings
LMMA Manage well / Monitor / Prioritize / poaching	11	15	4
Release / don't catch small fish	7	10	3
Foreign vessels fishing in territorial / 12nm zone	6	8	2
Business / livelihood depends on fish resources	5	7	2
Ban destructive fishing	4	6	1
FADs to be maintained well	4	6	1
Ban gillnets	3	4	1
Don't know	3	4	1
Gillnet size should be bigger / protect small fish	3	4	1
Manage resources wisely	3	4	1
Spearfishing controlled	3	4	1
Enforcement	2	3	1
Fish move around / offshore	2	3	1
Modern fishing gear	2	3	1
Overfishing	2	3	1
Resources declining	2	3	1
Coral bleaching	1	1	0.4
Fishing is the same everyday	1	1	0.4
Hard to get a good catch	1	1	0.4
Have to buy fish instead of catching them	1	1	0.4
Have to catch more small fishes to get enough	1	1	0.4
Prevent anchor damage to corals	1	1	0.4
Release spawning fish	1	1	0.4
Resources still healthy	1	1	0.4
Review laws	1	1	0.4
Sustainable fishing / only what is needed for the day	1	1	0.4
Total	**72**	**100**	**26**

4 Discussion

To date most sampling effort has been in Funafuti, close to TFD base, and insufficient samples have been completed on the outer islands. With increasing access to the outer islands through use of Tala Moana and the outer islands data collectors, it is expected that the samples for outer islands will be significantly increased over the next year. At the same time, missing from the data collections are landings from women, shellfish, through walking/gleaning and from canoes. Effort in these areas needs to be increased.

Insufficient data are available for assessing the health of the fishery for most of the species being caught. Just 28 species had size at maturity in Fishbase, and 17 of those (61%) were found to be under stress and are in need of management. As public sources of maturity information are generally lacking there is a need to add maturity information to the survey. This will require weighing and assessing ripeness of gonads of at least a subset of fishes measured.

Mechanisms for improving the status of these resources will need to be investigated. These may include consultations with fishers and the Kaupules, setting size limits for some species, improving the function of Marine Protected Areas (MPAs), supporting FADs to deflect effort elsewhere.

With 87% of the catch being for income (13% for home use) and 69% of fishers specifically targeting reef fishes over pelagic (31%) 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. Mechanisms for management need to be investigated for relieving pressure on overfished resources and deflecting at least some of the effort offshore so that coastal fisheries can recover;
2. TFD should consider mechanisms for developing size at maturity data collection for assessing the health of the fisheries;
3. Future sampling will need to target outer islands more and 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. Future surveys should be expanded to include measures of gonad ripeness and weight to be correlated with fish length. This is needed to develop Tuvalu's size at maturity measures for future assessments of status of the resource;
5. Increase work on sea safety, particularly on outer islands. 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;
6. 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; and
7. Awareness is needed on the results of this survey to begin the dialogue on management.

6 Annexes

6.1 Sizes at maturity and details of undersized fishes

Family	FishName	Maturity TL	Avg Size FL	SD	N	Small%	OK%	Trigger
	Acanthurus lineatus (Ponelolo)	**18**	**19**	**3**	**1026**	**19**	**81**	**OK**
	Funafuti		19	3	1026	19	81	✓
	Acanthurus triostegus (Manini)	**8.8**	**14**	**2**	**102**	**1**	**99**	**OK**
Acanthuridae	Funafuti		17	3	13	0	100	✓
	Nui		14	2	89	1	99	✓
	Naso hexacanthus (Ume tinae sega)	**45**	**38**	**10**	**80**	**68**	**33**	**Manage**
	Funafuti		38	10	80	68	33	×
	Caranx ignobilis (Lupo, Aseu	**60**	**35**	**10**	**4**	**100**	**0**	**Manage**
	Funafuti		35	10	4	100	0	×
	Caranx lugubris (Tafauli, Tino tafauli)	**38**	**40**	**8**	**6**	**50**	**50**	**OK**
	Nukufetau		40	8	6	50	50	✓
	Caranx melampygus (Aseu, Ulua)	**35**	**41**	**8**	**20**	**20**	**80**	**OK**
	Funafuti		37	5	12	33	67	✓
	Nukufetau		48	7	8	0	100	✓
Carangidae	**Caranx sexfasciatus (Ulua, Aseu)**	**42**	**34**	**5**	**95**	**89**	**11**	**Manage**
	Funafuti		35	7	41	78	22	×
	Nukufetau		33	4	54	98	2	×
	Elagatis bipinnulata (Kami, Kamai)	**64.6**	**54**	**12**	**40**	**78**	**23**	**Manage**
	Funafuti		46	10	17	100	0	×
	Niutao		45	7	2	100	0	×
	Nui		66	6	11	36	64	✓
	Nukufetau		56	11	10	80	20	×
	Lethrinus miniatus (Noto)	**33**	**26**	**8**	**176**	**80**	**20**	**Manage**
	Funafuti		26	8	176	80	20	×
Lethrinidae	**Lethrinus nebulosus (Tanutanu)**	**45.3**	**22**	**5**	**291**	**100**	**0**	**Manage**
	Funafuti		22	4	274	100	0	×
	Nui		28	8	15	93	7	×
	Nukufetau		25	4	2	100	0	×
	Lutjanus bohar (Fakamea, Fagamea)	**42.9**	**28**	**10**	**216**	**93**	**7**	**Manage**
	Funafuti		28	10	213	92	8	×
	Nui		35	2	2	100	0	×
	Nukufetau		28		1	100	0	×
	Lutjanus fulvus (Tagau,Takape)	**25**	**22**	**3**	**148**	**84**	**16**	**Manage**
	Funafuti		22	3	121	82	18	×
	Nui		19	3	21	95	5	×
Lutjanidae	Nukufetau		23	1	6	100	0	×
	Lutjanus gibbus (Taaea)	**28**	**24**	**5**	**3604**	**82**	**18**	**Manage**
	Funafuti		24	5	3455	82	18	×
	Nui		24	7	13	62	38	×
	Nukufetau		23	3	136	88	13	×
	Lutjanus kasmira (Savane)	**21**	**19**	**2**	**702**	**83**	**17**	**Manage**
	Funafuti		19	2	681	83	17	×
	Nukufetau		20	2	21	67	33	×
	Cephalopholis argus (Loi)	**22**	**28**	**6**	**10**	**10**	**90**	**OK**
	Funafuti		28	6	9	11	89	✓
	Nukufetau		32		1	0	100	✓
	Epinephelus fuscoguttatus (Munua)	**50**	**48**	**16**	**29**	**59**	**41**	**Manage**
	Funafuti		48	17	28	61	39	×
	Nui		53		1	0	100	✓
Serranidae	**Epinephelus merra (Gataliki)**	**11**	**19**	**4**	**80**	**1**	**99**	**OK**
	Funafuti		19	4	79	1	99	✓
	Nui		16		1	0	100	✓
	Plectropomus leopardus (Tonu)	**40.5**	**40**		**1**	**100**	**0**	**Manage**
	Funafuti		40		1	100	0	×
	Variola louti (Pula)	**41**	**32**	**7**	**16**	**81**	**19**	**Manage**
	Funafuti		32	7	16	81	19	×
	Siganus argenteus (Maiava)	**20**	**22**	**6**	**66**	**41**	**59**	**OK**
	Funafuti		22	6	66	41	59	✓
Siganidae	**Siganus fuscescens (Maiava)**	**5.6**	**24**	**4**	**7**	**0**	**100**	**OK**
	Funafuti		24	4	7	0	100	✓
	Siganus punctatus (Maiava fiti)	**24**	**26**	**6**	**18**	**33**	**67**	**OK**
	Funafuti		26	6	18	33	67	✓

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		