Establishing size limits for coastal reef fish species of Funafuti, Tuvalu

Maturation and spawning seasonality for key species

David J. Welch
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Enquiries:

David Welch

C_2O Fisheries

Mob: +61 414 897 490

Email: d.welch@c2o.net.au

Web: www.c2ofisheries.net.au

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Report series

This report represents Part 1 in a short report series produced through a consultancy to inform the processes for estimating size at maturity and establishing size limits for key coastal reef fish species of Funafuti, Tuvalu. The other reports in the series include: 2. Sampling program, and 3. Training program. These reports are intended as ongoing resources to guide Tuvalu Fisheries Department (TFD) staff in supporting implementation of the Funafuti Reef Fisheries Stewardship plan, and as outputs of the Pacific Islands Regional Oceanscape Program (PROP). A full glossary of terms used in this report series is found in the Part 3 training manual.

Introduction

One of the simplest and most common fisheries management strategies used globally are size limits. Generally, the use of a minimum size limit is used to restrict the catch of fish smaller than the limit size, which is based on the size at which the species reaches maturity. The principle behind this strategy is that by allowing a species to live long enough to reproduce significantly decreases the likelihood of that stock being overfished by maintaining spawning stock biomass (Myers and Mertz, 1998). Therefore, knowledge of the size at which a species reaches maturity is critical for identifying appropriate size limits.

Conducting size at maturity research for coastal tropical finfish fisheries can be highly challenging due to the sheer number of species caught, often 100-200 different species, along with limited local resourcing and capacity. Therefore, it is useful to identify the most important species to focus limited resources available for management. Further, it is also useful to identify the reported spawning seasonality for the key species to inform the timing of sampling for local studies (see sampling program report).

Therefore, this report provides background information used to: i) inform the identification of a prioritised list of key coastal target finfish species in Funafuti, Tuvalu, and ii) document the spawning seasonality of key local finfish species to inform the development of a sampling strategy appropriate for the species and the region.

Key list of species

Given the multi-species nature of coastal fisheries in Tuvalu, and the large number of species taken, it is useful to identify and prioritise the species that are most likely to require management focus. This is very important given a local context of limited staff and resourcing, and to maximise what is gained from management efforts. A simple framework was used to achieve this that removes as much subjectivity as possible, thereby providing a list that provides guidance for the species that should receive management as a priority. It should be emphasised that the list developed using the framework was not meant to be definitive, and the local context for each species was also considered through consultation with local fisheries staff. This best ensures that the use of size limits to manage their harvest will be effective, practical and enforceable.

Methods

Refining the species list

A list of key coastal finfish species for Funafuti was identified using a simple framework that took into account the species most commonly caught in local catches and the species vulnerability. The list was based on local creel survey data for the period 2015-2020. These data were first filtered to remove any species not relevant to the list and to minimise uncertainty in the data used. These filtering steps included: i) data were filtered to include only Funafuti records; ii) records which couldn't identify an individual fish to species level were removed; iii) all oceanic species were removed (tuna species, wahoo, mahi mahi, oceanic white tip shark, sunfish, etc.); and iv) turtle species were removed. It should be noted that species known to occupy deep water habitats (i.e., generally > 40 m depth) were included in the final list of species, which totalled 196 species.

This list was further reduced to 47 species by only including those that made up ~90 % of the catch by number. Two species were subsequently removed based on consultations which concluded them as not occurring in local waters. These were the Yellowspotted trevally (*Carangoides fuscoguttatus*) and Mangrove red snapper (*Lutjanus argentimaculatus*), leaving a total of 45 species.

Ranking species

The framework used to rank species in priority order used three key *criteria* (Table 1). These criteria included catch composition by number and two criteria that represented the relative risk to each species from fishing pressure: i) the proportion of the catch that are likely to be immature, based on estimates of their 50 % maturity (L_{50}), and ii) productivity, which is a proxy for a species resilience to fishing pressure. Relative scores for productivity were based on the estimated age at maturity for each species using best available data (cited in the reference list), and using the Fishbase life history tool where necessary (Froese et al., 2005). The principle is that species that mature younger are capable of replenishing their populations faster when subjected to fishing pressure, while low productivity species can take much longer to recover, placing them at higher risk to fishing.

Table 1. Criteria used to rank Funafuti coastal finfish species in priority order for management focus.

Criterion		Description
	Catch composition	Species were ranked from 1 - 45 in order of the total number of individual fish reported in the overall recorded catches
Relative risk	***% catch < Lm***	Species were ranked from 1 - 45 in order of the proportion (%) of the catch that are likely to be immature fish (below size at 50 % maturity). The species with the highest proportion of juveniles in the catch was ranked #1, and so on.
	Productivity	Species were given a relative score for productivity based on their age at maturity: Low productivity (score 1) - age at maturity >=6 years; Medium productivity (score 2) - age at maturity 2.1-5.9 years, and; High productivity (score 3) - age at maturity <=2 years.

For the "*% catch < L_{50}*" criterion, estimates of size at maturity were identified from searches of the literature, with the best available estimates of length at 50% maturity (L_{50}) used wherever possible. Available data were variable among species and for some the Fishbase life history tool was used to derive length at maturity estimates (Froese et al., 2005). Where possible, maturity estimates were obtained from studies closest to Tuvalu, with a preference for studies at similar latitudes (Table 2). This is important due to evidence that suggests that reef fish species at lower latitudes tend to grow faster, mature at smaller sizes, and attain smaller maximum lengths compared to higher latitudes (Atkinson, 1994; Forster et al., 2012; James, 1970; Ricker, 1981; Williams et al., 2003).

To rank species a score was determined for each species based on applying the following equation:

$$Ranking\ score = Average(CC\ ranking + \%\ catch\ ranking) \times Productivity\ score$$

where '*CC ranking*' refers to the catch composition rank for each species, *'% catch ranking*' refers to the % catch < L_m ranking, and Productivity score refers to a weighting given depending on the species productivity: Low = 1, Medium = 2, and High = 3. This gave a higher priority for low productivity species. The lowest overall ranking score equated to the highest priority.

The final step involved consultation with TFD to determine the final list of species for estimation of size at maturity for the current project, using the ranked list of species to guide decision-making. This ensured that local factors were considered in determining the final list including method of capture, the feasibility of applying a size limit and expert knowledge. The final species ranking list, including the criteria scoring and final decision on ranking, is provided in Appendix 1.

Size at maturity and spawning of key species

Size at maturity estimates and spawning seasonality for the key species are summarised in Table 2. Local relevant studies on the key species are generally scarce for the region, and for many species the estimated sizes at maturity are derived using the Fishbase life history tool, which uses estimates such as L_{inf} and L_{max} as proxies (Froese et al., 2005). Although these estimates were only used to guide the ranking of local species, the review confirmed the lack of reliable maturity data for the region.

Spawning seasonality for the key target species is also poorly documented. Although there appears to be high variability within and among species, the available knowledge suggests that for most fish families spawning seasons tend to be over many months, often year-round, at lower latitudes. This suggests extended spawning seasonality for many coastal reef species of Funafuti (latitude ~8° S). This is consistent with scientific literature with Claydon et al. (2014) stating: "*Among reef fishes in general, spawning seasons have been linked (both separately and in combination) to temperature, winds, currents and rainfall. Where annual variability in these factors is negligible, and for species with physiologies and life histories that permit, spawning is expected to occur year-round. Such locations are more likely to be found at lower latitudes and longer seasons are more characteristic of resident spawners*."

If extended spawning seasonality is found for key reef species of Funafuti, this would provide flexibility in the timing of sampling for maturity studies, recognising that most species tend to show lunar periodicity with spawning peaks on these events (Claydon

et al., 2014). Given that spawning seasonality for local species is currently not documented, it is recommended that field data collections also record data to inform the spawning seasonality for local species. This will require some additional but simple training, as well as maturity and sex determination.

Table 2. Selected Pacific reproductive studies for the highest priority species in Tuvalu showing, where possible, estimates of size at maturity and spawning seasonality. Sampling location and latitude is given for comparison with Tuvalu (Funafuti is latitude ~8° S). Species shaded light grey are those identified as the highest priority for inclusion in the initial sampling program for local size at maturity estimation.

Species	Location	Latitude	Spawning season	L50 ♀ (cm)	L50 ♂ (cm)	Reference
ACANTHURIDAE - Surgeonfishes						
Acanthurus lineatus	Solomon Islands	8° S		16.2 FL		Prince et al., 2020
	Morobe, PNG	7° S	Sept-Feb; year-round	18 FL	~17 FL	Longenecker et al., 2013
	American Samoa	14° S	Year-round			Craig, 1998
	Palau	7° N	Feb-Apr			Robertson, 1983
Acanthurus triostegus	Palau	7° N	May-Aug			Randall, 1961a
	Hawaii	21° N	Dec-Jul	13.2 TL*		Randall, 1961b; Schemmel and Friedlander, 2017
	Moorea, French Polynesia	17° S		9.5 SL*		Frédérich et al., 2012
	American Samoa	14° S	Year-round			Craig, 1998
Ctenochaetus binotatus				14.1 TL		Froese et al., 2005
Naso caesius				29.3 TL		Froese et al., 2005
Naso brevirostris	Great Barrier Reef, Australia			25 SL*		Choat and Robertson, 2002
Naso lituratus	Guam	13° N	~ year-round	14.5 FL	17.8 FL	Taylor et al., 2014
	Pohnpei, FSM	6° N	~ year-round			Taylor et al., 2014
	Solomon Islands	8° S		17.1 FL		Prince et al., 2020
Naso unicornis	Hawaii	21° N	May-Jun	35.5 FL		DeMartini et al., 2014
	Palau	7° N	~ year-round			Johannes, 1981
	Guam	13° N	May-Oct	29.2 FL	27.1 FL	Taylor et al., 2014
	Pohnpei, FSM	6° N	~ year-round	31.2 FL	26.9 FL	Taylor et al., 2014
Naso vlamingii	Morobe, PNG	7° S		33 FL*		Longenecker et al., 2013
CAESIONIDAE - Fusiliers						
Caesio caerulaurea	Solomon Islands	8° S		16.6 FL		Prince et al., 2020
	Philippines	9° N	Year-round			Abesamis et al., 2015
CARANGIDAE – Jacks/Trevallies						

Caranx sexfasciatus				42.0 FL		Froese et al., 2005
	Eastern Pacific		Jul-Sept			Jayakumar et al., 2017
Decapterus macarellus	Hawaii	21° N	Apr-Aug	24.5 SL	24.5 SL	Honebrink, 2000
Selar crumenophthalmus	Hawaii	21° N	Apr-Nov	19-20 SL	19-20 SL	Honebrink, 2000
EXOCOETIDAE – Flying fishes[#]						
Exocoetus volitans				16.3 FL		Froese et al., 2005
FISTULARIIDAE - Cornetfishes						
Fistularia petimba				98.9 FL		Froese et al., 2005
HOLOCENTRIDAE – Soldierfishes, Squirrelfishes						
Myripristis berndti	Hawaii	21° N		17.5 TL		See Weible et al., 2021
Myripristis kuntee	Morobe, PNG	7° S		12 FL		Longenecker et al., 2013
Myripristis pralinia?	Morobe, PNG	7° S		12 FL		Longenecker et al., 2013
Sargocentron spiniferum				29.7 TL		Froese et al., 2005
Sargocentron tiere				20.1 FL		Froese et al., 2005
LETHRINIDAE - Emperors						
Lethrinus amboinensis	Indonesia	6° S		27* TL		Wibisono et al., 2019
Lethrinus erythracanthus	Solomon Islands	8° S		28.7 FL		Prince et al., 2020
Lethrinus miniatus				36.1 FL		Froese et al., 2005
	Palau	7° N	Most months			Johannes, 1981
	Great Barrier Reef, Australia	~20° S	Jul-Oct			Williams, 2002
Lethrinus obsoletus	Solomon Islands	8° S		22.4 FL		Prince et al., 2020
	Fiji	17° S	Year-round			Ferral, 2003
Lethrinus olivaceous	Solomon Islands	8° S		40.4 FL		Prince et al., 2020
	Great Barrier Reef, Australia	15-20° S	Sept-Oct			Currey et al., 2013
Lethrinus variegatus				12.9 FL		Froese et al., 2005
Lethrinus xanthochilus	Solomon Islands	8° S		35.8 FL		Prince et al., 2020
Monotaxis grandoculis	Solomon Islands	8° S		20.1 FL		Prince et al., 2020
	Palau	7° N	Most months			Johannes, 1981
LUTJANIDAE – Snappers						
Aphareus furca				39.1 TL		Froese et al., 2005
Aprion virescens	Hawaii	21° N	May-Oct	42.5-47.5 FL		Everson et al., 1989
				44.9 FL		Froese et al., 2005

Lutjanus bohar	Morobe, PNG	7° S	Aug-Apr	43 FL	<30 FL	Longenecker et al., 2013
	Palau	7° N	Apr-Jul; year-round			Johannes, 1981
	Solomon Islands	8° S		26.7 FL		Prince et al., 2020
Lutjanus fulvus	Morobe, PNG	7° S	Year-round	19 FL	14 FL	Longenecker et al., 2013
	Solomon Islands	8° S		18.2 FL		Prince et al., 2020
Lutjanus gibbus	Morobe, PNG	7° S	Jan-Apr	18-23 FL	~14 FL	Longenecker et al., 2013
	Solomon Islands	8° S		20.9 FL		Prince et al., 2020
	Palau	7° N	Apr-May			Johannes, 1981
Lutjanus kasmira	Morobe, PNG	7° S	Year-round	12 FL	14 FL	Longenecker et al., 2013
	Solomon Islands	8° S		17.4 FL		Prince et al., 2020
Lutjanus monostigma	Morobe, PNG	7° S	Feb & Nov	~32 FL	~32 FL	Longenecker et al., 2013
	Solomon Islands	8° S		23.4 FL		Prince et al., 2020
MUGILIDAE - Mullets						
Crenimugil crenilabis	Fiji	16° S		32.2 FL		Prince et al., 2019
	Marshall Islands	7° N	June			Helfrich and Allen, 1975
Liza vaigiensis				35.6 FL		Froese et al., 2005
PRIACANTHIDAE - Bulleyes						
Priacanthus hamrur	Morobe, PNG	7° S	Apr-Jul	20 FL	18 FL	Longenecker et al., 2013
				23.1 TL		Froese et al., 2005
SCARIDAE - Parrotfishes						
Chlorurus microrhinos	Fiji	16° S		37.5 FL		Prince et al., 2019
Hipposcarus longiceps	Solomon Islands	8° S		25.0 FL		Prince et al., 2020
	Guam	13° N	Year-round	32.9 FL	40.1 FL	Taylor and Cruz, 2017
SERRANIDAE - Groupers						
Epinephelus macrospilos				29.5 FL		Froese et al., 2005
Epinephelus maculatus	Solomon Islands	8° S		39.7 FL		Prince et al., 2020
Epinephelus merra	Morobe, PNG	7° S		11 FL		Longenecker et al., 2013
Epinephelus polyphekadion	Solomon Islands	8° S	Oct-Jun	32.9 FL		Prince et al., 2020; Flynn et al., 2006
	Palau	7° N	Jun-Aug			Flynn et al., 2006
	Marshall Islands	7° N	Dec-Jan			
	Pohnpei, FSM	6° N	Feb-Apr			
	French Polynesia	17° S	March			

	Cook Islands	21° S	Apr-Jun			
	New Caledonia	22° S	Oct-Feb			
SIGANIDAE - Rabbitfishes						
Siganus argenteus	Solomon Islands	8° S		19.3 FL		Prince et al., 2020
	New Caledonia	22° S	Sept-Mar			Flynn et al., 2006
	Palau	7° N	Mar-May			Johannes, 1981
SPHYRAENIDAE - Barracudas						
Sphyraena forsteri	Solomon Islands	8° S		38.6 FL		Prince et al., 2020

*Sex not specified; #No published data for the Pacific was located.

N.B. Longenecker et al (2013) used estimates of L_{50} from published literature where possible, otherwise used L_{inf} to derive maturity estimates.

N.B. Froese et al (2005) refers to the use of the Fishbase life history tool (https://www.fishbase.in/manual/key%20facts.htm) to derive estimates of L_{mat} using proxies (generally L_{inf} or L_{max}).

Priority species

Following consultations with TFD staff, and guided by the fully prioritised species list (see Appendix 1), the final prioritised list of species to guide sampling for size at maturity analyses comprised of 28 species (Table 3).

There were also three species in the final list that were assessed as possible mis-identifications:

1. *Epinephelus longispinis* – Fishbase report that they do not occur east of the Banda Sea (Indonesia) and a recent CITES publication reported that "….*records from Fiji are likely misidentifications of* Epinephelus maculatus." (Nair, 2018). These records were therefore assumed to be *E. maculatus*, but photo verification is recommended to confirm this.
2. *Lethrinus elongatus* (Longface emperor, Longnose emperor) - Fishbase states that *L. elongatus* is a misapplied name for *L. olivaceus*. These records were therefore assumed to be *L. olivaceus*, but photo verification is recommended to confirm this.
3. *Lethrinus miniatus* (Trumpet emperor) - are not reported from latitudes anywhere as high as Tuvalu (A. Williams, B. Moore, pers. comm.). Photo verification is recommended before final consideration of this species.

The Scarlet soldierfish, *Myripristis pralinia*, was also recorded in the Tuvalu creel survey database with a question mark. Future collections of this and all other target species should follow relevant fish identification guides to ascertain accurate species identification (e.g. Moore and Colas, 2016; https://coastfish.spc.int/component/content/article/465-identification-guide-to-the-common-coastal-food-fishes-of-the-pacific-islands-region; also available as an app).

Table 3. Final ranked species list for collection of samples for local size at maturity studies.

Common name	Species name	Tuvalu Name	Rank
Camouflage grouper	*Epinephelus polyphekadion*	Gatala pulepule	**1**
Fringelip mullet	*Crenimugil crenilabis*	Fuakanase	**2**
Ambon emperor	*Lethrinus amboinensis*	Noto	**3**
Highfin grouper	*Epinephelus maculatus*	Gatala moeo	**4**
Humpback red snapper	*Lutjanus gibbus*	Taea	**5**
Orange-striped emperor	*Lethrinus obsoletus*	Tanutanu	**6**
Common bluestripe snapper	*Lutjanus kasmira*	Savane	**7**
Bluespine unicornfish	*Naso unicornis*	Ume, Tupotupo	**8**
Sabre squirrelfish	*Sargocentron spiniferum*	Tamalau	**9**
Yellowlip emperor	*Lethrinus xanthocheilus*	Gutula	**10**
Lined surgeonfish	*Acanthurus lineatus*	Pone lolo, Pone matagi	**11**
Squaretail mullet	*Liza vaigiensis*	Kafakafa, Baibue	**12**
Convict surgeonfish	*Acanthurus triostegus*	Manini, Koinava	**13**
Orangespine unicornfish	*Naso lituratus*	Manini lakau, Umalei	**14**
Bigscale soldierfish	*Myripristis berndti*	Malau puku, Te mon	**15**
Blue lined squirrelfish	*Sargocentron tiere*	Malau loa, Malau gutu loa	**16**
Longface emperor	*Lethrinus olivaceous*	Filoa, Rou, Kapatiko	**17**
Blacktail snapper	*Lutjanus fulvus*	Tagau, Takape	**18**
Streamlined spinefoot	*Siganus argenteus*	Maiava	**19**
Honeycomb grouper	*Epinephelus merra*	Gatala liki	**20**
Humpnose big-eye bream	*Monotaxis grandoculis*	Muu fatu	**21**
Bignose unicornfish	*Naso vlamingii*	Taitifi, Tativi	**22**
Spotted unicornfish	*Naso brevirostris*	Pokapoka, Ume pokapoka	**23**
Gray unicornfish	*Naso caesius*	Pokapoka, Ume	**24**
Pacific longnose parrotfish	*Hipposcarus longiceps*	Ulafi	**25**
Scarlet soldierfish	*Myripristis pralinia?*	Malau puku	**26**
Snubnose grouper	*Epinephelus macrospilos*	Gatala	**27**
Shoulderbar soldierfish	*Myripristis kuntee*	Malau, Malau po	**28**

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Appendix 1.

The final species ranking list, including the criteria scoring and final decision on ranking (see methods for a description of each criterion). The final ranking ('Priority list') was determined by Tuvalu Fisheries staff.

Family	Common name	Species name	Tuvalu Name	Catch rank	% < Lm rank	Productivity score	Overall score	Overall rank	Priority List
Serranidae	Camouflage grouper	*Epinephelus polyphekadion*	Gatala pulepule	15	22	1	18.50	2	1
Mugilidae	Fringelip mullet	*Crenimugil crenilabis*	Fuakanase	21	2	2	23.00	4	2
Lethrinidae	Ambon emperor	*Lethrinus amboinensis*	Noto	10	13	2	23.00	5	3
Serranidae	Highfin grouper	*Epinephelus maculatus*	Gatala moeo	19	9	2	28.00	6	4
Lutjanidae	Humpback red snapper	*Lutjanus gibbus*	Taea	1	27	2	28.00	7	5
Lethrinidae	Orange-striped emperor	*Lethrinus obsoletus*	Tanutanu	7	24	2	31.00	8	6
Lutjanidae	Common bluestripe snapper	*Lutjanus kasmira*	Savane	3	28	2	31.00	9	7
Acanthuridae	Bluespine unicornfish	*Naso unicornis*	Ume,Tupotupo	14	19	2	33.00	12	8
Holocentridae	Sabre squirrelfish	*Sargocentron spiniferum*	Tamalau	12	11	3	34.50	13	9
Lethrinidae	Yellowlip emperor	*Lethrinus xanthocheilus*	Gutula	33	5	2	38.00	16	10
Acanthuridae	Lined surgeonfish	*Acanthurus lineatus*	Pone lolo,Pone matagi	5	34	2	39.00	17	11
Mugilidae	Squaretail mullet	*Liza vaigiensis*	Kafakafa,Baibue	40	1	2	41.00	20	12

Acanthuridae	Convict surgeonfish	*Acanthurus triostegus*	Manini,Koinava	8	21	3	43.50	22	13
Acanthuridae	Orangespine unicornfish	*Naso lituratus*	Manini lakau,Umalei	6	37	2	43.00	21	14
Holocentridae	Bigscale soldierfish	*Myripristis berndti*	Malau puku,Te mon	9	23	3	48.00	25	15
Holocentridae	Blue lined squirrelfish	*Sargocentron tiere*	Malau loa,Malau gutu loa	27	6	3	49.50	26	16
Lethrinidae	Longface emperor	*Lethrinus olivaceous*	Filoa,Rou,Kapatiko	35	15	2	50.00	27	17
Lutjanidae	Blacktail snapper	*Lutjanus fulvus*	Tagau,Takape	20	35	2	55.00	29	18
Siganidae	Streamlined spinefoot	*Siganus argenteus*	Maiava	29	25	3	81.00	37	19
Serranidae	Honeycomb grouper	*Epinephelus merra*	Gatala liki	39	42	3	121.50	44	20
Lethrinidae	Humpnose big-eye bream	*Monotaxis grandoculis*	Muu fatu	13	18	2	31.00	10	21
Acanthuridae	Bignose unicornfish	*Naso vlamingii*	Taitifi,Tativi	18	14	2	32.00	11	22
Acanthuridae	Spotted unicornfish	*Naso brevirostris*	Pokapoka,Ume pokapoka	16	29	2	45.00	24	23
Acanthuridae	Gray unicornfish	*Naso caesius*	Pokapoka,Ume	45	26	2	71.00	34	24
Scaridae	Pacific longnose parrotfish	*Hipposcarus longiceps*	Ulafi	42	32	2	74.00	35	25
Holocentridae	Scarlet soldierfish	*Myripristis pralinia?*	Malau puku	11	40	3	76.50	36	26
Serranidae	Snubnose grouper	*Epinephelus macrospilos*	Gatala	37	20	3	85.50	38	27
Holocentridae	Shoulderbar soldierfish	*Myripristis kuntee*	Malau,Malau po	25	39	3	96.00	41	28

Carangidae	Mackerel scad	*Decapterus macarellus*	Atule fakalaulau	4	7	3	16.50	1	Omitted
Lutjanidae	Two-spot red snapper	*Lutjanus bohar*	Fagamea	22	17	1	19.50	3	Omitted
Carangidae	Bigeye trevally	*Caranx sexfasciatus*	Teu,Kata	23	12	2	35.00	14	Omitted
Lethrinidae	Trumpet emperor	*Lethrinus miniatus*	Gutula,Filoa	32	4	2	36.00	15	Omitted
Scaridae	Steephead parrotfish	*Chlorurus microrhinos*	Laea	31	8	2	39.00	18	Omitted
Lethrinidae	Orange-spotted emperor	*Lethrinus erythracanthus*	Saputu,Haputu	24	16	2	40.00	19	Omitted
Fistulariidae	Red cornetfish	*Fistularia petimba*	Taotao,Taotaoama	43	1	2	44.00	23	Omitted
Lutjanidae	Green jobfish	*Aprion virescens*	Utu	41	10	2	51.00	28	Omitted
Lutjanidae	One-spot snapper	*Lutjanus monostigma*	Taiva	28	30	2	58.00	30	Omitted
Lutjanidae	Small toothed jobfish	*Aphareus furca*	Palusega,Kotua,Taelepe	36	3	3	58.50	31	Omitted
Exocoetidae	Tropical two-wing flyingfish	*Exocoetus volitans*	Isave,Sasave,Hahave	2	43	3	67.50	32	Omitted
Sphyraenidae	Bigeye barracuda	*Sphyraena forsteri*	Taotao,Pauea,Tapatu	38	31	2	69.00	33	Omitted
Caesionidae	Blue and gold fusilier	*Caesio caerulaurea*	Ulia,Ulihega	17	41	3	87.00	39	Omitted
Carangidae	Bigeye scad	*Selar crumenophthalmus*	Atule,Salala	26	36	3	93.00	40	Omitted
Priacanthidae	Moontail bullseye	*Priacanthus hamrur*	Matapa,Matapula	34	33	3	100.50	42	Omitted
Lethrinidae	Slender emperor	*Lethrinus variegatus*	Noto	30	44	3	111.00	43	Omitted
Acanthuridae	Twospot surgeonfish	*Ctenochaetus binotatus*	Pone uli	44	38	3	123.00	45	Omitted

N.B. The ranked list is to guide species for local studies of life history. Therefore, those omitted from the current study may be candidates for future local studies. For example:

- The Mackerel scad (*Decapterus macarellus*) was ranked as the #1 species using the initial framework. Small coastal pelagic species such as these are generally highly productive and tend to be taken in large quantities at a time, often in nets. For such species, size limits are often not practical. It is ranked very high due to the very large quantities taken but also because a very high proportion of the catch are likely to be juvenile fish. Rather than size limits, a review of net mesh sizes is recommended for such species.
- Some species didn't rank in the top half of the list using the criteria alone due to their relatively low contribution to catches overall, however have a very large proportion of catches that are likely to be immature. This heightens their risk to fishing and should be considered for early intervention also. These include: Red cornetfish, *Fistularia petimba*, and Small toothed jobfish, *Aphareus furca*.

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