

# Coral Sea sea cucumber catch sampling

## Catch of two foreign fishing vessels, Coral Sea, February 2017

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Parks Australia

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# Acknowledgments

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This study would not have been possible without the support and cooperation of AFMA and officers of the Australian Customs and Quarantine Service. A special thank you to the supervisors and other personnel of MIPEC Slipway in Gladstone for their assistance and patience during the sampling of the sea cucumber barrels during a logistically complex operation.

While conceptually simple, an operation of this kind is logistically and physically demanding, and highlights the need for cooperation from several government organisations and the disposal contractors, during a sometimes difficult and unpredictable disposal operation.  There were delays and logistical considerations (many unforeseen) that delayed sampling and required considerable patience and adaptability. However, the insights and value of this information for assessing the impact of illegal fishing, and potential for facilitating future mitigating activities, makes this kind of study well worth the effort.

# Executive summary

Illegal fishing by foreign fishing vessels (FFV) is a threat to fisheries within Australias EEZ, including the reefs of the Coral Sea territories. Recent activity by Vietnamese based fishing vessels (blue boats) focused on sea cucumber (beche-de-mer) in north east Australia has resulted in several recent apprehensions. Information on the catch of these FFV is critical for assessing and managing their impacts and for optimising future surveillance, enforcement and mitigation activities.

Two FFV were apprehended near Saumarez Reef in Australia's Coral Sea territory on 15 February 2017. The entire catch of one FFV (FFV2) and part of the catch of another (FFV1) was sampled. The catch was all in gutted, salted form, stored in 200 l plastic barrels. It is likely that the catch was intact (not disposed of at sea by the illegal fishers or authorities).

The catch of FFV2 was from 2 separate fishing episodes, separated by a significant time period. The "older" catch was a mix of Prickly redfish (38%), Redfish (24%), Leopardfish (10%), and Brown sandfish (20%). It is possible that it was sourced from the Chesterfield Reefs in the New Caledonian EEZ.

The "recent" catch was mostly made up of White teatfish (86%), with some Black teatfish (10%) and Prickly redfish (2%). It is likely that this catch was sourced from reef passes and deeper lagoon habitats of reefs within Australia Coral Sea territory, fished over about a 1 week period.

The total catch estimate for FFV2 was 8.87 tonnes (or 19.75 tonnes of live sea cucumbers). Of this, the "older" catch was 2.67 tonnes (30%) and the "recent" catch was 6.19 tonnes (70%). The estimated market value of the catch of FFV2 was AUD$250,000, most that return being derived from the higher value species caught in the Australian Coral Sea territory.

The catch of FFV2 alone represents 133% of the White teatfish, and 77% of the Black teafish annual Total Allowable Catch (TAC) for the entire Australian Coral Sea Sea Cucumber Fishery, so it represents a substantial risk to the sustainability of the sea cucumber populations in the Coral Sea territory. In addition, as much as 75% of the White teatfish, and almost 90% Black teatfish in the catch of FFV2 was smaller than the minimum size limit (MSL) for the Australian Coral Sea and GBR sea cucumber fisheries.

Fishing effort is likely to be highly concentrated, and local populations at least significantly depleted, resulting in significant ecological risk given the important role that sea cucumbers play in the ecology of coral reefs.

Sea cucumber fisheries globally have been largely overexploited. They are easy to deplete and can be slow to recover, highlighting the need for careful and responsive management. Australian fisheries are among the few tropical shallow water sea cucumber fisheries globally to have continued viability. Given the restricted and conservative nature of management of the Australian Coral Sea (and GBR) fishery, the size of the illegal catch (especially if extrapolated to a possible several dozen FFV per year) presents a grave risk to sea cucumber populations in the Coral Sea territory, and the ecology of the reefs which they inhabit.

# 1 Introduction

The reefs of the Coral Sea reefs have long been subject to illegal fishing by foreign owned and crewed fishing vessels (FFV), with recent activity predominantly by Vietnamese based fishing vessels (blue boats) focused on sea cucumber (beche-de-mer). This activity has resulted in several recent apprehensions, with 13 FFV being apprehended with illegal sea cucumber product fished from the Coral Sea and Great Barrier Reef in the past year or so. Information on the catch of these FFV is critical for assessing and managing their impacts on Coral Sea fishery stocks, and on the greater environment, and for optimising future surveillance, enforcement and mitigation activities.

The opportunity to fully investigate the catch of a FFV (even though they are often bought into Australian ports for disposal) is surprisingly rare. The logistical, timing and resource difficulties associated with organising personnel with sufficient taxonomic and operational capacity makes it difficult to access and measure the catch before it must be disposed of under stringent quarantine rules.

The apprehension of 2 FFV near Saumarez Reef in Australia's Coral Sea territory on 15 February 2017 provided one such opportunity. Supported and funded by Parks Australia, and facilitated by AFMA, Australian Customs and Quarantine, and by the disposal contractor MIPEC (Gladstone); one Parks Australia staff and an external contractor (T.S.) travelled to Gladstone and sampled the entire catch of one FFV and part of the catch of another. The results of that sampling are presented in this report.

## 1.1 The Coral Sea fishery

The AFMA managed Coral Sea Sea Cucumber Fishery includes most of the reefs of the Coral Sea (Figure 1-1); apart from Saumarez and Marion Reefs, which are part of the Queensland East Coast Sea Cucumber (Beche-de-mer) Fishery (even though those reefs are outside the GBR Marine Park and are part of the Coral Sea Commonwealth Marine Reserve area).

The Coral Sea Sea Cucumber Fishery is one of five sectors in the Coral Sea Fishery and is managed through input and output controls including limited entry, catch limits, spatial closures, move-on provisions, size limits and catch-and-effort triggers that are used to initiate further analysis and assessment. Fishers must hold permits to fish in the fishery and they can only catch species associated with the type of permit they hold. The Sea Cucumber Sector currently has 2 permits. Most of the management arrangement in the Coral Sea Sea Cucumber Fishery are complimentary to the adjacent Queensland East Coast Sea cucumber (beche-de-mer) Fishery.

The catch of sea cucumbers in the Coral Sea Sea Cucumber Fishery peaked at 49 t in 2000–01. Since then, the annual sea cucumber catch has fluctuated between 1.9 t and 9.2 t. Annual catches since 2007–08 have generally been less than 3 t, but increased to 8.2 t in 2013–14. There has been no fishing since 2013-14 (AFMA, unpublished data; AFMA, 2015).

The primary target species in the Sea Cucumber Fishery include:

- Black teatfish (*Holothuria whitmaei*),
- White teatfish (*H. fuscogilva*),
- Surf redfish (*Actinopyga mauritiana*)
- Prickly redfish (*Thelenota ananas*)

At least another dozen species are or could potentially be taken in the fishery.

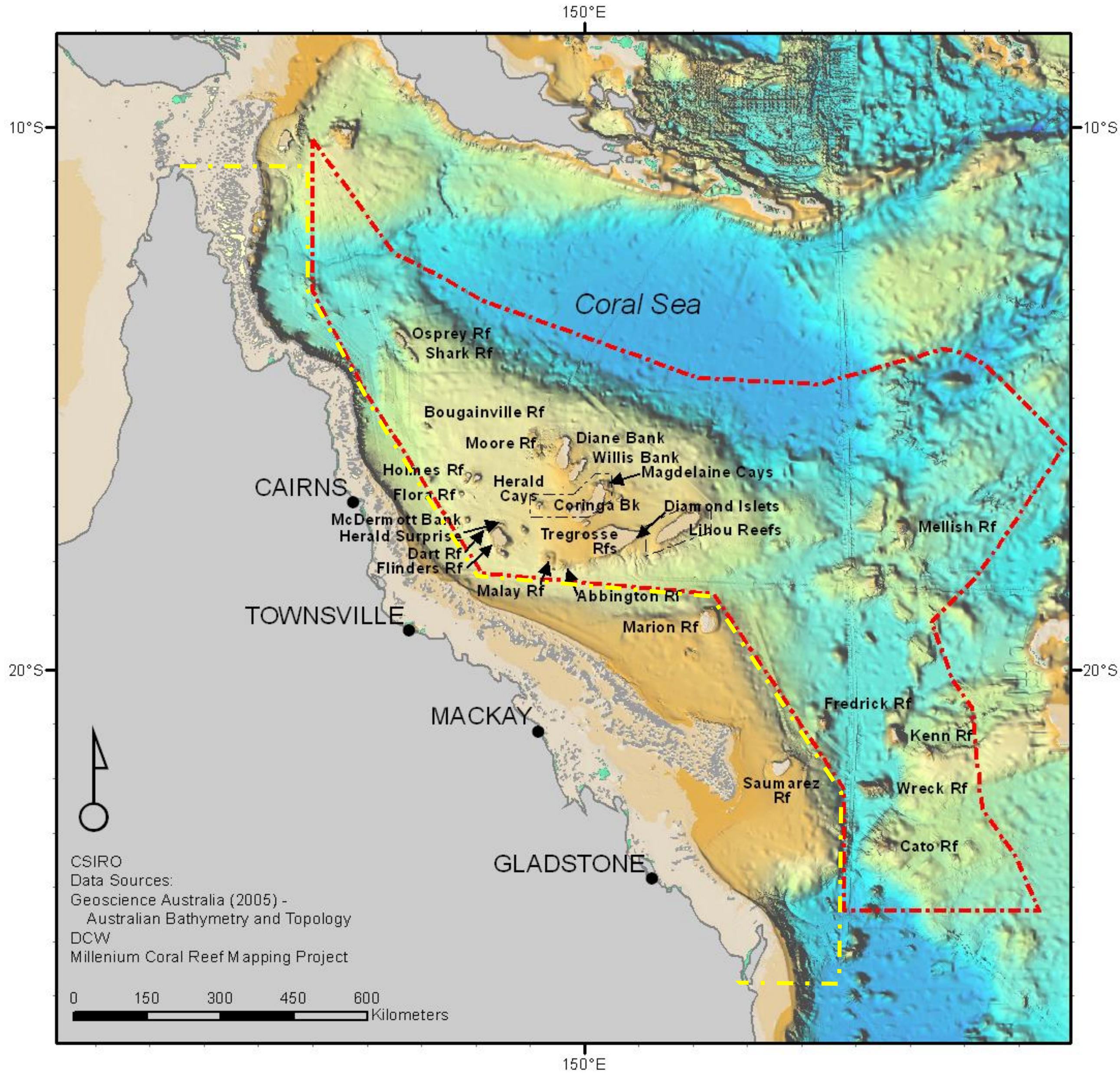



**Figure 1-1. Area of the Coral Sea Fishery (red boundary) and Queensland East Coast Sea Cucumber (Beche-de-mer) Fishery (yellow boundary).**

### 1.1.1 Management

The Coral Sea fishery has a long history of management through management regulation and permit conditions managed by AFMA, and through the granting of a Wildlife Trade Operation permits by the Commonwealth Environment Department based on ecological sustainability considerations. However, in 2008 there was also implemented a formal Harvest Strategy as part of a rollout of Harvest Strategies in Commonwealth fisheries. This was in response to the Commonwealth Fisheries Harvest Strategy Policy 2007 (HSP) (DAFF 2007) which directed that Commonwealth fisheries should be managed to pursue 'the sustainable and profitable utilisation of Australia's Commonwealth fisheries in perpetuity through the implementation of harvest strategies that maintain key commercial stocks at ecologically sustainable levels and within this context, maximise the economic returns to the Australian community'.

The Coral Sea Fishery was regarded as "low data" fishery in that there is a lack of local survey and assessment information available (Dowling et al., 2008). The basis of the HS was therefore predicated on an assumption that existing fishing effort was sustainable, and that any changes in catch and/or catch composition would result in further action. Most of the trigger limits that either control catch or initiate additional analysis and/or assessment are contained in the harvest strategies. HS for the Coral Sea Fisheries were first developed by the CSIRO in consultation with CSF stakeholders at a meeting in March 2007.

In 2002, an assessment examining logbook data and catch rates from 2000 and 2001 for a number of target species in the Coral Sea Sea Cucumber Fishery showed a decline in the number of the higher valued Black teatfish, Prickly redfish and White teatfish (Hunter et al., 2002). Following the assessment results and recommendations, AFMA reduced the annual TACs for black and white teatfish to 1 tonne and 4 tonnes respectively in 2002 (ostensibly as landed weight (gutted, gutted and salted, or gutted and parboiled), but referred to as “whole wet weight” in the fishery regulations (AFMA, 2105). While these catch quotas were considered as extremely conservative given the size of the area and likely species density in the fishery habitats, there is a global predominance of over-exploitation and slow recovery of sea cucumber fisheries illustrating the need for careful management (Purcell et al., 2012).

### 1.1.2 Reducing Uncertainty in Stock Status (RUSS) project

The status of Commonwealth fisheries has been reported in the Fishery Status Reports produced by BRS/ABARES since 1992. These document scientific and economic information for each Commonwealth fishery and they provide government, industry and the community with an independent overview of trends in the biological status of fish stocks for Commonwealth fisheries.

The Reducing Uncertainty in Stock Status (RUSS) project was a research programme to try and reduce the number of Commonwealth fish stocks that classified as uncertain. A series of stock assessments were undertaken including in the Coral Sea Fishery.

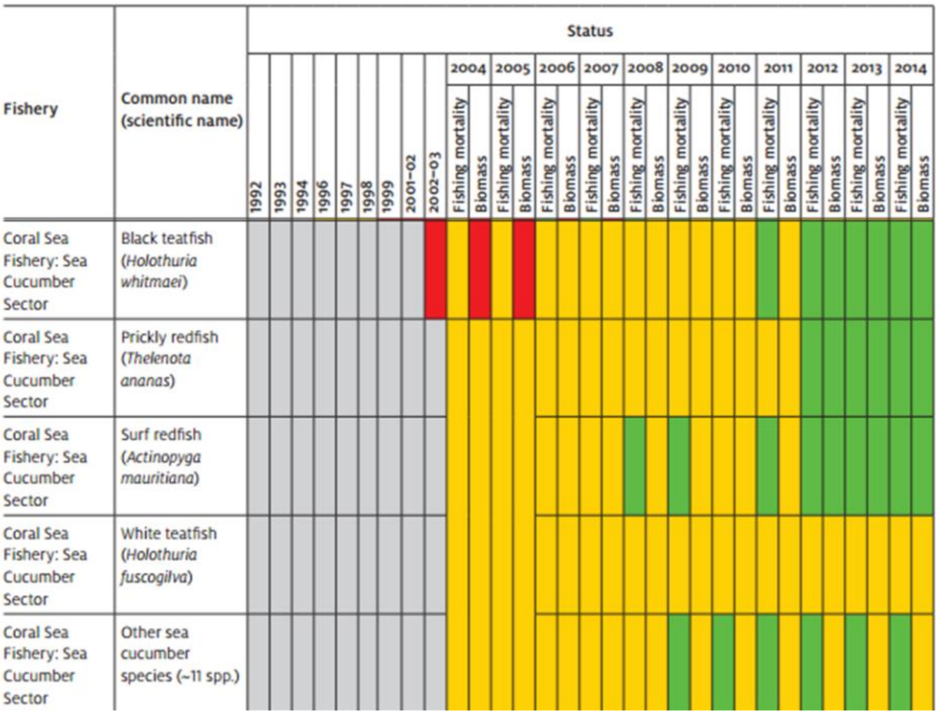
The outputs of the RUSS project have been used to modify the assessments of the status of the Coral Sea Fisheries in the Fishery Status Reports since about 2012, resulting in many previously uncertain stock status and fishing mortality assessments being reclassified as not overfished and not being subject to overfishing (Table 1-1). The RUSS project assessed the 4 primary target species (Black teatfish, White teatfish, Surf redfish and Prickly redfish) (Woodhams et al., 2015).

The assessment estimated a plausible potential biomass for each species in the CSF. It used habitat data from satellite mapping and historical surveys of sea cucumbers in NNR, Qld (GBR) and Torres Strait. MSY was estimated using surplus production models, and fished biomass in 2010 was estimated as a proportion of biomass in 1997. Generally, the data availability was poor across all species, and was particularly poor for White teatfish and Surf redfish. Analyses was done at the reef level but status determination is undertaken at the fishery level.

The principal finding of the RUSS analysis (Woodhams et al., 2015) were:

- Black teatfish and Prickly redfish median biomass was greater than 99% of 1997 biomass.
  - classified as not overfished and not subject to overfishing.
- Surf redfish median biomass was between 70 % and 91 % of 1997 biomass.
  - Surf redfish catch was greater than the median MSY for 3 of 14 years since 1997.
  - Recent catches for surf redfish have been less than the median MSY.
  - classified as unlikely to be overfished and not subject to overfishing.
- White teatfish biomass could not be established.
  - White teatfish catches in recent years well below the historical peak of 19.7 t.
  - White teatfish stock remains uncertain with respect to being overfished and overfishing.
- No stock assessments of the group of other sea cucumber species.
  - Catch has recently been very low.
  - Classified as uncertain with respect to being overfished and not subject to overfishing.

**Table 1-1. Biological stock status of stocks in the Coral Sea Sea Cucumber fishery, assessed in 2014, and their status since 1992. As reported in the 2015 Fishery Status Reports (Patterson et al., 2015) as Fishing mortality status (is it being overfished or not); and Biomass status (is it overfished or not).**




## 1.1.3 Current management

Current management arrangements include an overarching total annual TAC of 150 t whole wet weight – but may also be interpreted as “landed” (either gutted, gutted and salted or gutted and parboiled) weight, with species specific Total Allowable Catches (TAC) for several high and medium targeted species (Table 1-2). These species TACs have never been exceeded in the Coral Sea Fishery.

The management arrangements also include spatial management including move-on provisions where a fishing vessel can only catch a maximum of 5 t from any one reef annually, with no fishing within 15 n.m. once that limit is reached. It also includes a three-year rotational harvesting strategy (RHS) that was implemented in 2005 (included in permit conditions). The RHS Identifies 21 reefs in the Coral Sea Fishery with a set number of days fishing on each reef. Each reef is only open one year in three (Table 1-3). Note that Saumarez and Marion Reefs, as part of the Queensland East Coast Sea Cucumber Fishery, is also part of a similar RHS that is implemented in that fishery. Research on both the Coral Sea (Plaganyi et al., 2011) and GBR fisheries (Skewes et al., 2013; Plagányi et al., 2015) have indicated that risk of overexploitation was reduced under a RHS for sea cucumbers (Figure 1-2). The continued implementation of the RHS is recommended for both the Coral Sea and GBR fisheries.

There are also species specific size limits for all species caught in the fishery (Table 1-2). They are intended to allow individuals to breed once before being fished.

**Table 1-2. Management arrangements for the Sea Cucumber Sector in the CSF (AFMA 2015).**

| Common name | Species | Minimum size limit | Total Allowable Catch |
|---|---|---|---|
| Black teatfish | *Holothuria whitmaei* | 25 cm | 1 tonne |
| White teatfish | *Holothuria fuscogilva* | 32 cm | 4 tonnes |
| Prickly redfish | *Thelenota ananas* | 30 cm | 20 tonnes |
| Surf red fish | *Actinopyga mauritiana* | 15 cm | 10 tonnes |
| Greenfish and lollyfish | *Stichopus chloronotus* and *Holothuria atra* | 15 cm | 10 tonnes |
| Other species | | 15 cm | 10 tonnes |
| All species of the Order Aspidochirotida | | 15 cm | 150 tonnes (including the take of the above species) |

**Table 1-3. Sea cucumber sector rotational zone plan (AFMA, 2015)**

| 2016-2017 | | 2017-2018 | | 2018-2019 | |
|---|---|---|---|---|---|
| Days permitted | Zone | Days permitted | Zone | Days permitted | Zone |
| 15 | Holmes Reef | 15 | Wreck Reefs | 15 | Flinders Reefs |
| 15 | Diamond Islets | 5 | Tregrosse Reefs | 15 | Willis Islets |
| 10 | Kenn Reefs | 5 | Moore Reefs | 30 | Osprey Reef |
| 5 | Frederick Reefs | 5 | Mellish Reefs | 5 | Diane Bank |
| 2 | Bougainville | 5 | Cato Island Reef | 2 | Malay Reef |
| 2 | Flora Reef | 5 | McDermott Bank | 2 | Abington Reef |
| | | 2 | Dart Reef | | |
| | | 2 | Heralds Surprise | | |
| | | 2 | Shark Reef | | |

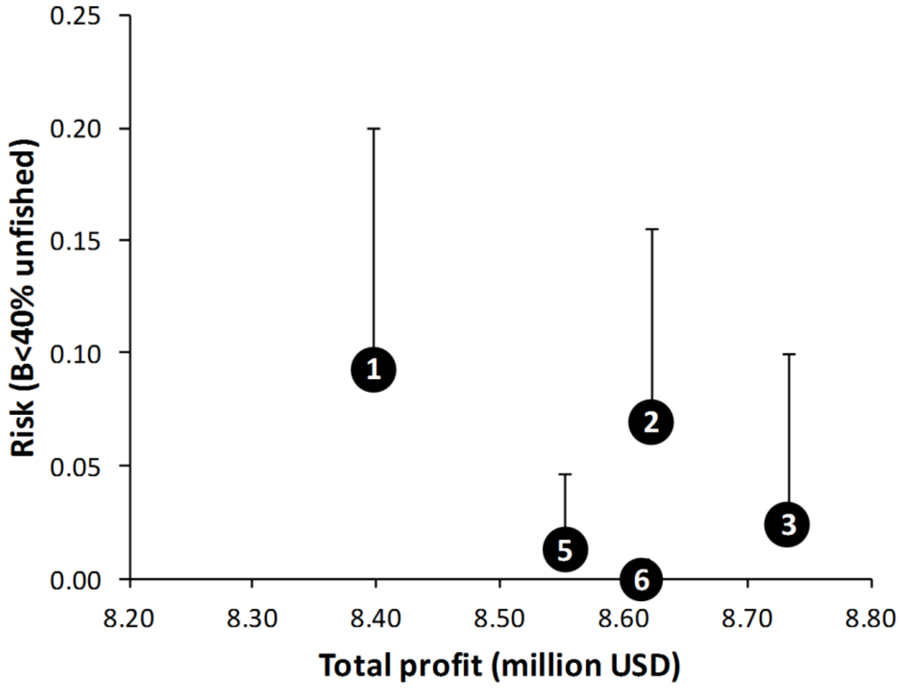



**Figure 1-2. Trade-off curve between median risk performance (defined as probability of biomass being reduced below 40% of the comparable no fishing scenario; +1 SD encompasses variation across nine species) and total revenue (million dollars) for RZSs with the different cycle times (year) as indicated on the symbols. (Plaganyi et al., 2015)**

# 2 Methods

Two foreign fishing vessels (FFV) fishing illegally in the Australian EEZ were apprehended in the vicinity of Samuarez Reef on 15 February 2017. They were eventually transported to Gladstone and were slipped in Gladstone Harbour on the 27th and 28th February, 2017.

During this operation, the catch of both vessels was available for measurement, and of one vessel, the entire catch (FFV2). The catch was all in gutted, salted form, stored in 200 l plastic barrels. It is likely that the catch was intact (not disposed of at sea by the illegal fishers or authorities) as at least one of the bins was of relatively freshly caught product that was still in its first stage of salting (i.e. containing large relative quantities of liqueur).

## 2.1 Sampling procedure

The partial catch of the first vessel (FFV1), and the entire catch of the second (FFV2), was sampled during the sampling operation, using the following protocol.

1. Each barrel (approximate size 200 l) that we could access from the two FFV (3 of 28 barrels from FFV1 and all 38 barrels of FFV2) were visibly assessed for its contents. At least 12 individuals were removed from each barrel and identified to species level (where possible), and the remaining contents visually assessed for species mix.

For one representative barrel (designated as a white teatfish barrel of FFV2 – see Results Section), all individual sea cucumbers were removed, identified and counted.

2. For several representative barrels (as many as time and logistics could allow), at least 12 Individual sea cucumbers were removed and identified to species level (where possible), and measured in total length (to the nearest 5 mm), and (a smaller sample) also recorded for total weight (in grams).

## 2.2 Data analysis

Average length and weight, and the size frequency of each of the species in each of the catch groups (by vessel and catch age (see Results Section) was analysed. The estimated catch was calculated by the product of the average size of the measured catch for each species, by the species mix per barrel by the estimated weight of sea cucumbers in a barrel.

As the product is in a semi-processed form (salted), it is useful convert the catch estimates to live weight for comparison to survey data, and to dry weight to estimate the quantity and value of the final product. There are available conversion ratios for converting salted weight to live weight and dry (processed) weight for most sea cucumber species (Skewes et al., 2004; Purcell et al., 2009), and for those without conversion factors for salted weight, we used an average conversion ratio of 0.867 for gutted to salted (average of 6 species (Skewes et al., 2004)), then used gutted weight conversion factors (Table 2-1, Table 2-2).

As fishery minimum size limits (MSL) are usually applied to live caught animals, it would also be useful to convert measured (salted) length data to live length, to assess the amount of the catch that would be considered “undersized”. Unfortunately, there is little available information available to convert salted length to live length equivalent for the species in the FFV catch, however, there is one reported conversion ratio of live length to salted length for Black teatfish that indicates no shrinkage in length with salting (Purcell et al., 2009). We therefore included the MSL on size frequency graphs as indicators only of the proportion of undersize animals in the catch of the FFV.

**Table 2-1. Conversion ratios (C.R.) for live to salted weight for commercial holothurians (from Skewes et al., 2004; Purcell et al., 2009).**

| Species | C.R. |
|---|---|
| Prickly redfish | 0.506 |
| Mixed species | 0.433 |
| Black teatfish | 0.529 |
| White teatfish | 0.434 |

**Table 2-2. Conversion ratios (C.R.) for salted to dry weight for commercial holothurians (from Skewes et al., 2004, Purcell et al., 2009).**

| Species | C.R. |
|---|---|
| Prickly redfish | 0.141 |
| Mixed species | 0.217 |
| Black teatfish | 0.219 |
| White teatfish | 0.286 |

# 3 Results

## 3.1 Catch and catch composition

FFV1 had 28 barrels on board of which only 3 were sampled (all located on deck). FFV2 had 38 barrels of sea cucumber on board with all 38 being sampled (Table 3-1).

While all 3 barrels inspected from FFV1 appeared to have been recently caught, the catch of FFV2 appeared to be from 2 separate fishing episodes that was separated by a significant time period, as indicated by the amount of evaporation and salt encrusting in the "older" barrels, and the greater level of packaging and attempts to seal the "older" barrels.

The species mix of the two catch episodes on FFV2 was also markedly different (Table 3-1, Figure 3-1). The "older" barrels had a mixed catch of Prickly redfish (*Thelenota ananas*) (38% by weight), Redfish (*Actinopyga echinites*/*A. mauritiana*) (24%), Leopardfish (*Bohadschia argus*) (10%), and Brown sandfish (*B. vitiensis*) (20%) with some individuals appearing to be Brown sandfish/Leopardfish hybrids (*B. argus* X *B. vitiensis* hybrid). The "recent" catch was mostly made up of White teatfish (86% by weight), with some Black teatfish (*H. whitmaei*) (10%) and Prickly redfish (2%).

The barrels on FFV1 were all recently caught and was also made up mostly of White teatfish (61% by weight), but with higher proportions of Black teatfish (27%) and Prickly redfish (10%) (Table 3-1, Figure 3-1).

The total catch estimate for FFV2, the only vessel where all the catch was inspected, was 8.87 tonnes. Of this, the "older" catch was 2.67 tonnes (30%) and the more recent catch was 6.19 tonnes (70%) (Table 3-1).

**Table 3-1. Catch estimates of two FFV sampled in Gladstone in February, 2017. Catch component incudes barrel count. Catch is in kgs salted weight.**

| VESSEL | CATCH COMPONENT | WHITE TEATFISH | BLACK TEATFISH | PRICKLY REDFISH | LEOPARD FISH | BROWN SANDFISH | REDFISH | STONE FISH | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| FFV1 | Partial (3/28) | 461.5 | 194.3 | 72.9 | 0.0 | 0.0 | 0.0 | 0.0 | 728.7 |
| FFV2 | Total (38) | 5,367.8 | 765.1 | 1,133.1 | 308.6 | 546.1 | 696.2 | 48.6 | 8,865.3 |
| FFV2 | Recent (27/38) | 5,319.2 | 607.2 | 121.4 | 48.6 | 0.0 | 48.6 | 48.6 | 6,193.6 |
| FFV2 | Older (11/38) | 48.6 | 157.9 | 1,011.6 | 260.0 | 546.1 | 647.6 | 0.0 | 2,671.7 |

Using established conversion factors, the total catch of FFV2 was estimated to represent 19.75 tonnes of live sea cucumbers (Table 3-2). Of this, the "older" catch was 5.77 tonnes (29%) and the more recent catch was 13.98 tonnes (71%) (Table 3-2).

**Table 3-2. Catch estimates of two FFV sampled in Gladstone in February, 2017, in kgs live weight.**

| VESSEL | CATCH COMPONENT | WHITE TEATFISH | BLACK TEATFISH | PRICKLY REDFISH | LEOPARD FISH | BROWN SANDFISH | REDFISH | STONE FISH | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| FFV1 | Partial | 1,063.3 | 367.3 | 144.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1,574.6 |
| FFV2 | Total | 12,368.2 | 1,446.3 | 2,239.2 | 712.7 | 1,261.2 | 1,607.8 | 112.2 | 19,747.5 |
| FFV2 | Recent | 12,256.2 | 1,147.9 | 240.0 | 112.2 | 0.0 | 112.2 | 112.2 | 13,980.7 |
| FFV2 | Older | 111.9 | 298.4 | 1,999.2 | 600.5 | 1,261.2 | 1,495.6 | 0.0 | 5,766.8 |

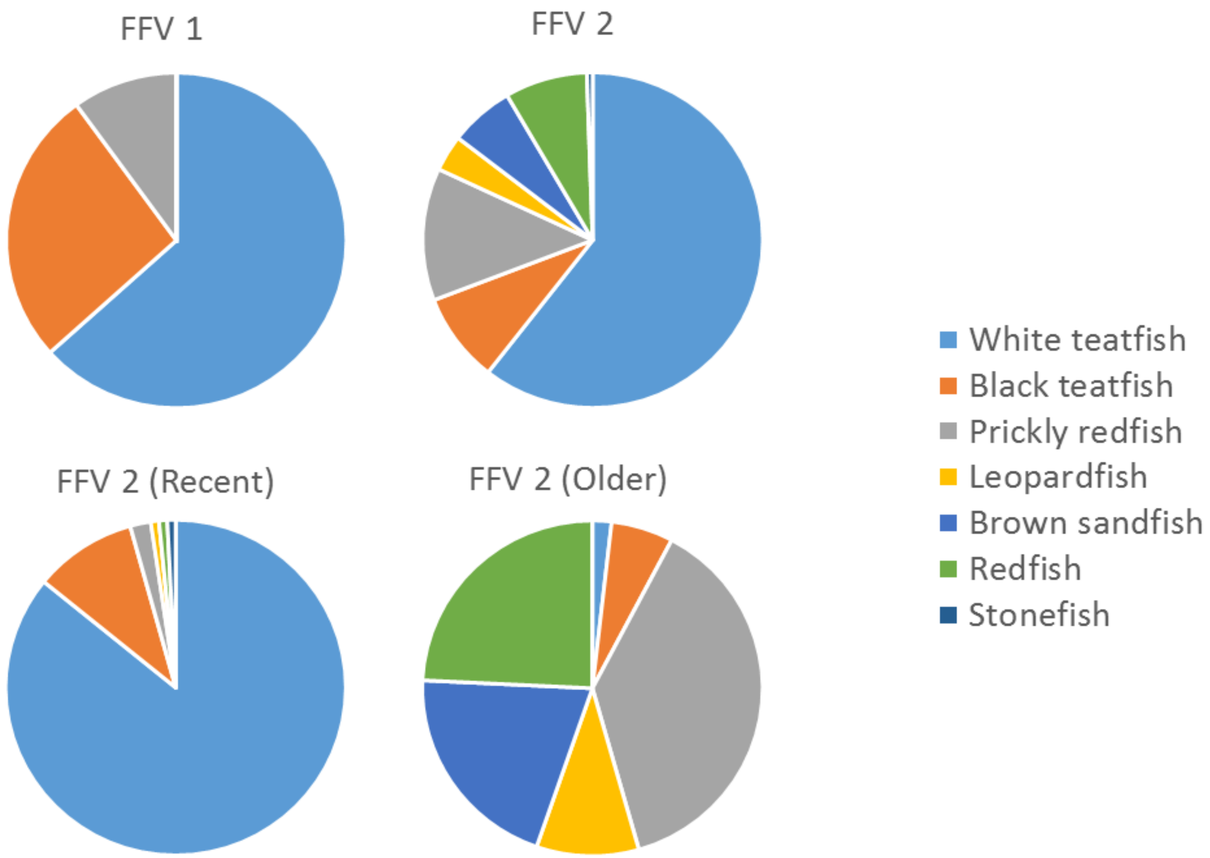



**Figure 3-1. Catch composition by salted weight of sea cucumbers on two FFV apprehended in the Coral Sea in February, 2017**

## 3.2 Species size frequency

### 3.2.1 White teatfish

The average size of White teatfish in the catch was larger on FFV2 that on FFV1 (Table 3-3). This could represent a difference in the habitats fished by the 2 vessels, with FFV1 most likely fishing in shallower water closer to the shallow reef edge – as also evidenced by the larger proportion of Black teatfish in the catch of FFV1.

Both FFV average size was smaller than the Australian Coral Sea Sea Cucumber Fishery minimum size limit (MSL) for White teatfish of 32 cm. Overall, about 78% of the White teatfish in the catch was smaller than the minimum size limit (MSL) (Figure 3-4).

The length to weight relationship for salted white teatfish was also calculated for use in converting length measurements to weight in future operations (Figure 3-2).

**Table 3-3. Size of White teatfish in the catch of 2 FFV vessels apprehended in the Coral Sea in February, 2017. *weight data derived from the length weight relationship of measured individuals.**

| SIZE | ALL | FFV1 (RECENT) | FFV2 (RECENT) |
|---|---|---|---|
| Ave Length (mm) | 289.8 | 273.8 | 302.3 |
| SD | 39.6 | 33.1 | 39.0 |
| n | 193 | 81 | 111 |
| Min | 200 | 205 | 215 |
| Max | 405 | 350 | 405 |
| Ave Weight (g) | | 1,353.1 | *1,490.1 |
| SD | | 272.1 | 192.2 |
| n | | 81 | 111 |
| Min | | 723 | 1,060 |
| Max | | 2,075 | 1,996 |

*Calculated using Length and the Length to Weight relationship

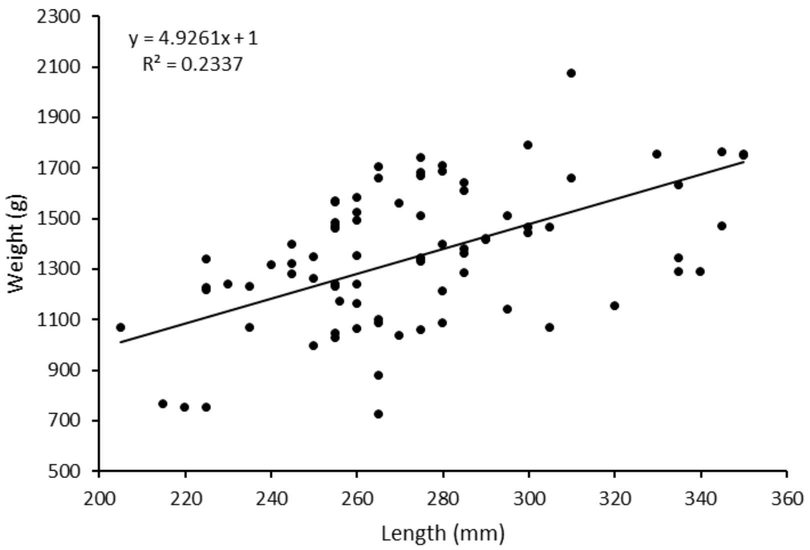



**Figure 3-2. Length and weight of gutted salted White teatfish in the catch of FFV 1.**

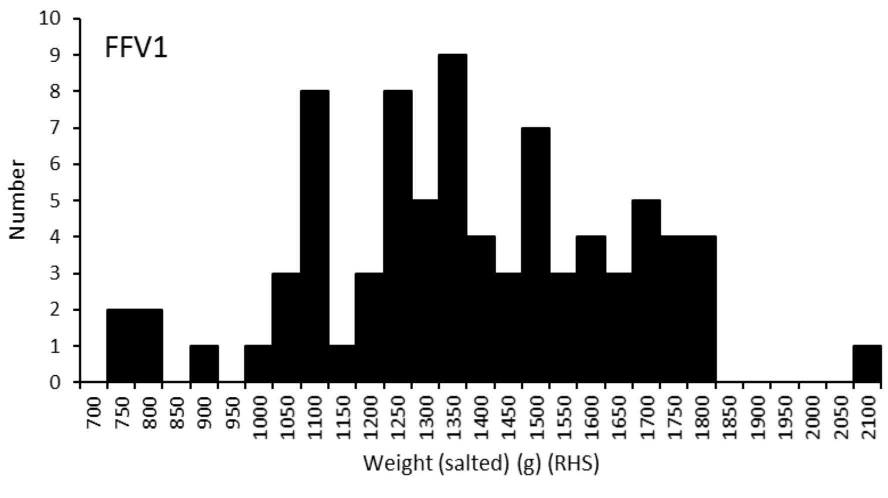



**Figure 3-3. Size frequency, in weight (salted) (g) for White teatfish sampled on FFV1 apprehended in the Coral Sea in February, 2017.**

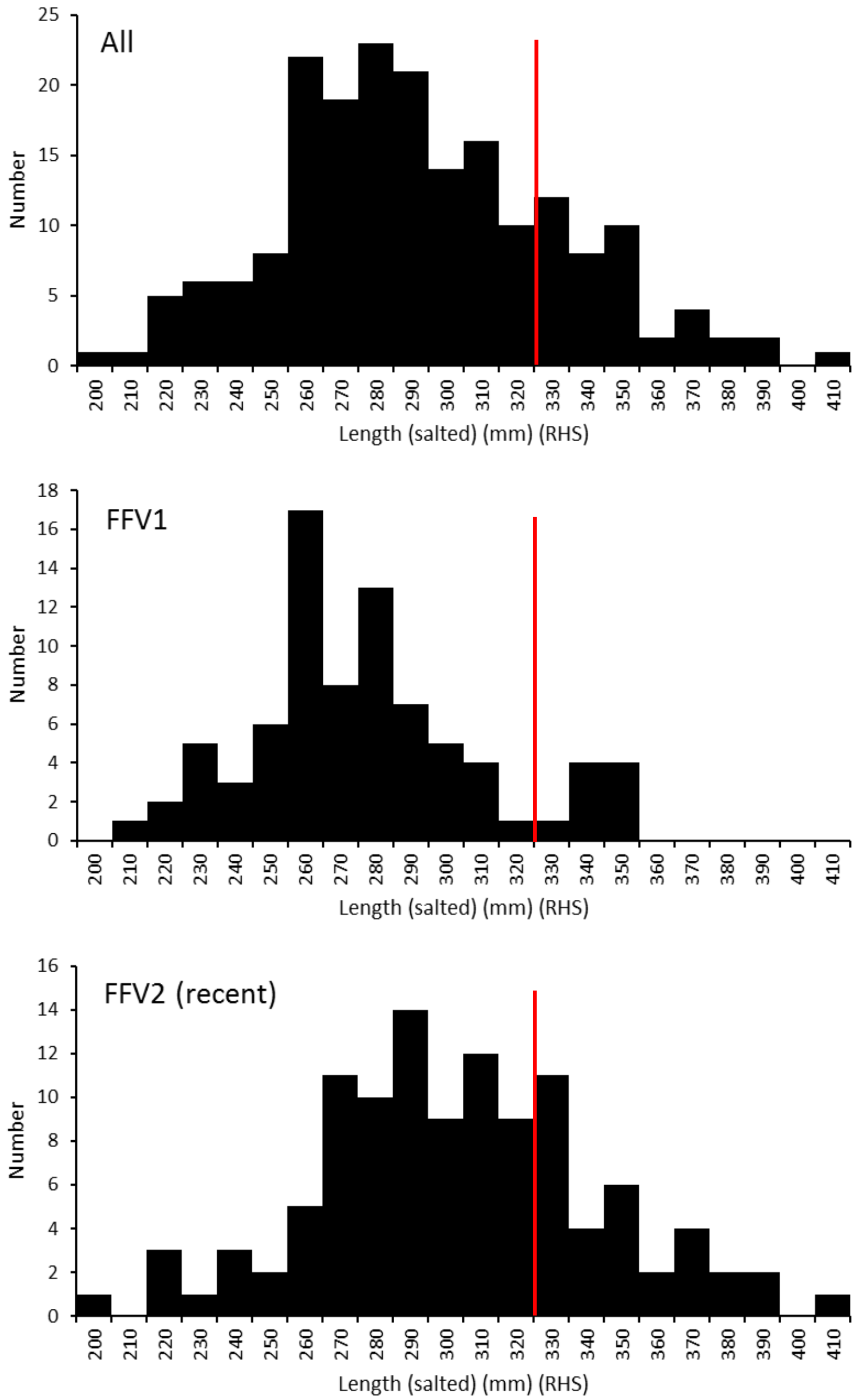



**Figure 3-4. Size frequency, Total length (salted) (mm) for White teatfish sampled on two FFV apprehended in the Coral Sea in February, 2017. The red line is the Australian Coral Sea Fishery Minimum Size Limit (MSL).**

## 3.2.2 Black teatfish

The average size of Black teatfish in the catch was larger on FFV1 that for FFV2 (Table 3-4Table 3-3), and again reflects the targeting of Black teatfish by FFV1 to a greater extent than FFV2 – as evidenced by the larger proportion of Black teatfish in the catch of FFV1.

On both FFV, the average size of Black teatfish was smaller than the Australian Coral Sea Fishery minimum size limit (MSL) of 25 cm. About 80% of the Black teatfish in the catch of FFV1, and over 90% of the catch of FFV2 was smaller than the minimum size limit (MSL) (Figure 3-7).

**Table 3-4. Size of Black teatfish in the catch of 2 FFV apprehended in the Coral Sea in February, 2017.**

| Size | All | FFV1 (RECENT) | FFV2 (RECENT) |
|---|---|---|---|
| Ave Length (mm) | 227.0 | 243.0 | 222.3 |
| SD | 31.6 | 9.7 | 32.6 |
| n | 43 | 5 | 35 |
| Min | 165 | 230 | 165 |
| Max | 330 | 255 | 330 |
| Ave Weight (g) | 1,191.9 | 1,191.2 | 1,192.1 |
| SD | 192.7 | 162.7 | 199.9 |
| n | 34 | 5 | 29 |
| Min | 762 | 1014 | 762 |
| Max | 1,600 | 1342 | 1,600 |

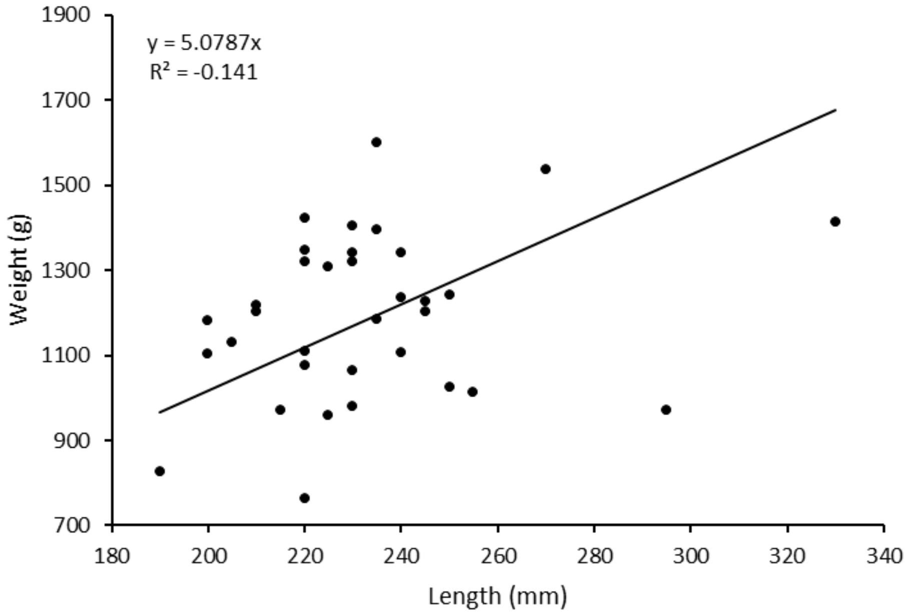



**Figure 3-5. Length and weight of gutted salted Black teatfish in the catch of FFV 1.**

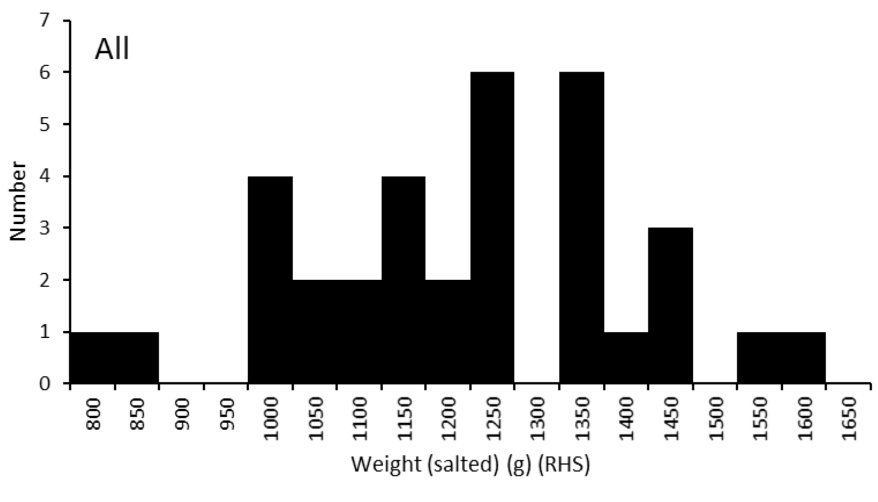



**Figure 3-6. Size frequency, Total weight (salted) (g) for Black teatfish sampled on FFV1 apprehended in the Coral Sea in February, 2017.**

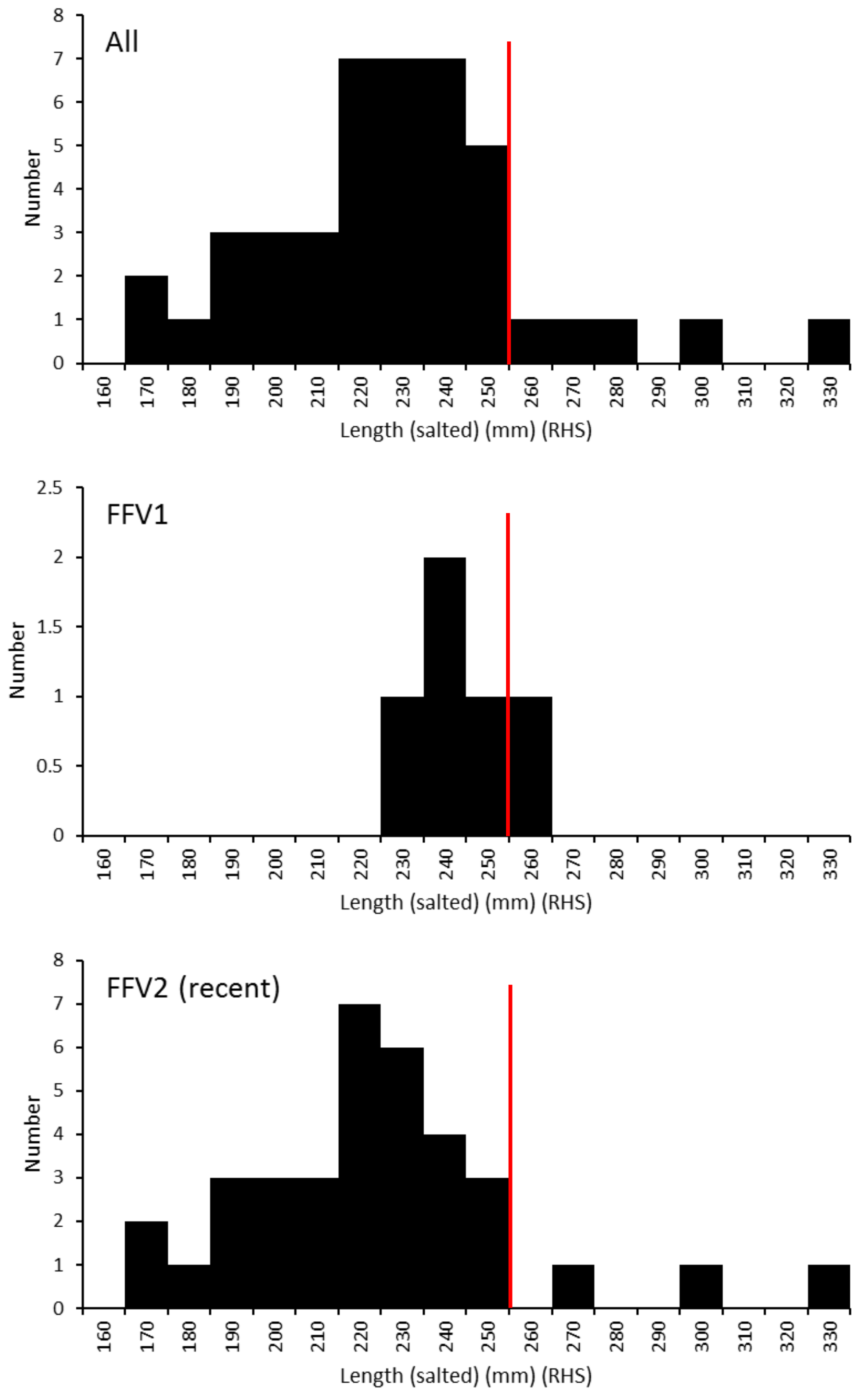



**Figure 3-7. Size frequency, Total length (salted) (mm) for Black teatfish sampled on 2 FFV vessels apprehended in the Coral Sea in February, 2017. The red line is the Australian Coral Sea Fishery Minimum Size Limit (MSL).**

### 3.2.3 Prickly redfish

The average size of Prickly redfish in the catch for both FFV in the recent catch was similar, though FFV2 had slightly larger average size and again supports the theory that FFV2 was fishing deeper more open grounds where larger Prickly redfish are found (Table 3-5). The Prickly redfish in the older catch on FFV2 was markedly smaller than the more recent catches. This supports the contention that the older catch from FFV2 is from reefs outside the Australian Coral Sea fishery area.

On both FFV, the average size of Prickly redfish was larger than the Australian Coral Sea Fishery minimum size limit (MSL) of 30 cm. Nearly all the individual Prickly redfish on both FFV was larger than the MSL (Figure 3-8).

**Table 3-5. Size of Prickly redfish in the catch of 2 FFV apprehended in the Coral Sea in February, 2017.**

| Size | All | FFV1 (RECENT) | FFV2 (RECENT) | FFV2 (OLDER) |
|---|---|---|---|---|
| Ave Length (mm) | 373.8 | 383.8 | 391.9 | 327.5 |
| SD | 59.1 | 64.1 | 60.6 | 29.9 |
| n | 16 | 4 | 8 | 4 |
| Min | 290 | 290 | 300 | 290 |
| Max | 460 | 435 | 460 | 360 |
| Ave Weight (g) | 1,793.9 | 1,511.3 | 2,076.5 | |
| SD | 599.8 | 530.6 | 587.3 | |
| n | 8 | 4 | 4 | |
| Min | 745 | 745 | 1350 | |
| Max | 2620 | 1950 | 2620 | |

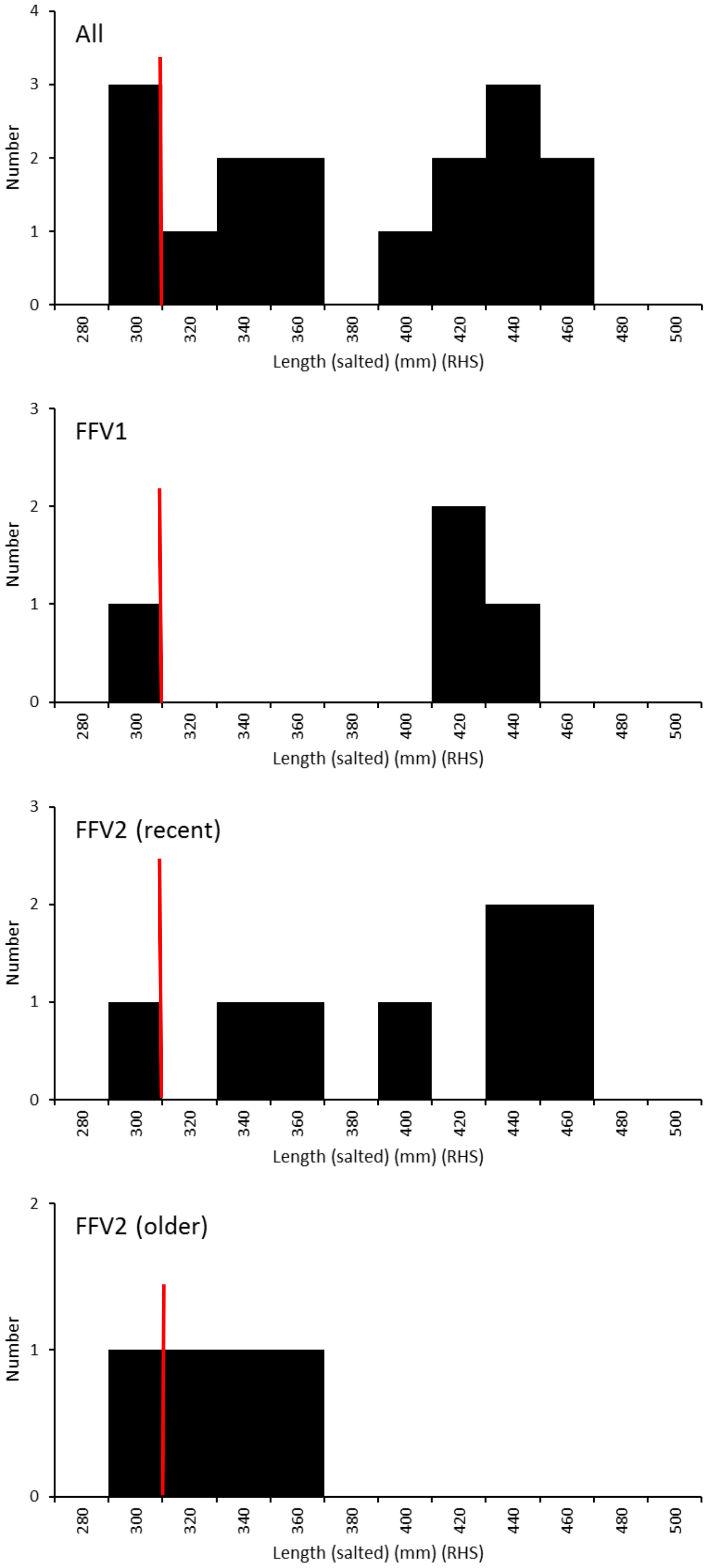



**Figure 3-8. Size frequency, Total length (salted) (mm) for Prickly redfish sampled on 2 FFV apprehended in the Coral Sea in February, 2017. The red line is the Australian Coral Sea Fishery Minimum Size Limit (MSL).**

### 3.2.4 Value of catch in market value

The estimated catch in processed (dried) form was 2.2 tonnes for FFV2, with an estimated market (retail) value of about AUD$250,000 using recent price estimates from Hong Kong and Guangzhou, China (Purcell, 2014; Barclay et al., 2016), the majority of that return coming derived from the higher value species caught in the Australian Coral Sea territory. Note that the value of most kinds of tropical beche-de-mer has declined by 30 to 50 percent in the past year or so; due to a variety of factors such as the economic downturn in China and changes in food fashions (Barclay et al., 2016).

**Table 3-6. Catch estimates of sea cucumbers on two FFV sampled in Gladstone in February, 2017, in kgs processed (dry) weight.**

| VESSEL | CATCH COMPONENT | WHITE TEATFISH | BLACK TEATFISH | PRICKLY REDFISH | LEOPARD FISH | BROWN SANDFISH | REDFISH | STONE FISH | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| FFV1 | Partial | 132.0 | 42.6 | 10.3 | 0.0 | 0.0 | 0.0 | 0.0 | 184.8 |
| FFV2 | Total | 1,535.2 | 167.6 | 159.8 | 67.0 | 118.5 | 151.1 | 10.5 | 2,209.6 |
| FFV2 | Recent | 1,521.3 | 133.0 | 17.1 | 10.5 | 0.0 | 10.5 | 10.5 | 1,703.0 |
| FFV2 | Older | 13.9 | 34.6 | 142.6 | 56.4 | 118.5 | 140.5 | 0.0 | 506.6 |

**Table 3-7. Approximate market (retail) value of sea cucumbers (beche-de-mer) in the catch of two FFV sampled in Gladstone in February, 2017 in AUD$. Prices are for Hong Kong and Guangzhou using recent market studies (Purcell, 2014; Barclay et al., 2016).**

| VESSEL | CATCH COMP. | WHITE TEATFISH | BLACK TEATFISH | PRICKLY REDFISH | LEOPARD FISH | BROWN SANDFISH | REDFISH | STONE FISH | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| FFV1 | Partial | $18,606 | $5,999 | $429 | $0 | $0 | $0 | $0 | $25,034 |
| FFV2 | Total | $216,415 | $23,620 | $6,673 | $2,143 | $3,792 | $4,834 | $337 | $257,815 |
| FFV2 | Recent | $214,457 | $18,746 | $715 | $337 | $0 | $337 | $337 | $234,930 |
| FFV2 | Older | $1,959 | $4,874 | $5,958 | $1,806 | $3,792 | $4,497 | $0 | $22,885 |

# 4 Discussion

The two FFV apprehended at Samaurez Reef in February 2017 had substantial quantities of sea cucumber on board, with one vessel having nearly 9 tonnes of salted sea cucumber, and the other slightly less. The catch from one of the vessels (FFV2) at least, was from two different fishing episodes, separated by a significant time period – the species mix, the size of common species, and barrel packaging was significantly different. The more recent catch was likely to have been sourced entirely within Australia's Coral Sea territory. It was comprised of mostly high value species, predominantly White teatfish, with some lesser quantities of Black teatfish and Prickly redfish. This is consistent with fishing in deeper lagoon and reef pass habitats of reefs of the Coral Sea, as indicated by ship logs and plotter information found on board the two vessels.

The source of the older catch is difficult to determine; however, the species mix – including a predominance of lower value Bohadschia species, Prickly redfish and Redfish – was very similar to sea cucumber populations observed during surveys of the Chesterfield Reefs within the New Caledonian EEZ (Kinch, 2011); while unlikely to be sourced from reefs within the Australian or PNG EEZs (Skewes et al., 2013, Skewes et al., 2002).

Given the likely catch rates (Australian commercial fishers catch about 30kg/diver/hr in the Coral Sea Fishery – Hunter et al., 2002), and assuming 8 possible divers down at any one time (up to 8 individual hookah lines were observed on FFV2), a 6 hour diving day, and allowing for time to process catch, reposition the vessel etc; the catch on FFV2 would probably represent about a week's fishing effort on reefs within the Coral Sea territory.

It is difficult to say how much more product these FFV would have captured before heading back to their home ports, however, there appeared to be ample supplies of fuel on board one of the vessels at least. In any case, assuming the "recent" catch was caught in the area of the Australian Coral Sea fishery, the catch of one vessel alone (FFV2) represents 133% of the White teatfish, and 77% of the Black teafish annual Total Allowable Catch (TAC) for the entire Australian Coral Sea Fishery. While these TACs are considered as likely to be quite conservative, there is considerable uncertainty about the White teatfish population in the Coral Sea in particular (Woodhams et al., 2015), so this represents a substantial risk to the sustainability of the sea cucumber populations in the Coral Sea territory. In addition, as much as 75% of the White teatfish catch, and almost 90% Black teatfish in the catch was smaller than the minimum size limit (MSL) for the Australian Coral Sea and GBR fisheries.

The provision for large numbers of simultaneous divers indicates the likelihood of intensive fishing effort in suitable habitat on reefs fished by the FFV, and other FFV have been apprehended in areas closed to fishing by Australian fishers. This fishing effort is likely to result in a marked decrease in the density of sea cucumbers in the habitats where fishing effort has been concentrated, such as reef passes and deeper lagoon areas. It is likely that the fishing effort would be targeted to the reef passes due to the shallower depths compared to the deep lagoon, and the presence of currents that would make a drift operation (fishing operations appear to be solely conducted from the main vessel) feasible. This mode of operation is supported by available data from logbooks and plotter information found on board the FFV.

The depletion of sea cucumbers also represents an ecological risk. Sea cucumbers play a variety of roles in the ecology of reefs (for a recent comprehensive review of the ecological roles of sea cucumbers, see Purcell et al., 2016). This includes bioturbation of sediments by feeding and burying, and by grazing sedimentary algae and bacteria. They, in turn, are predated upon by a wide range of echinoderms (19 species), crustaceans (17) and fishes (30). They also have a range of escape and defence mechanisms (evisceration, disintegration, extruding cuverian tubules) that also provide food for predators and scavengers while not resulting in the loss if the individual sea cucumber. They ingest calcium carbonate sediments while feeding and excrete ammonia, which is a nutrient and also increases the alkalinity of seawater in their vicinity. In these ways, sea cucumbers play an important role in recycling nutrients in oligotrophic reef systems, and may play some role in buffering the impact of ocean acidification due to anthropogenic related increases in $CO_2$ in the oceans.

Beside their own value for biodiversity of reef systems, sea cucumbers are also associated to many symbiotic relationships, many of them obligate (meaning the symbiont would not survive without the host sea cucumber). Symbionts from nine different phyla and from all symbiosis categories (parasitism, mutualism and commensalism) have been found to associate with tropical sea cucumbers (Purcell et al., 2016).

Sea cucumber fisheries globally have been overexploited by unregulated (and even sometimes regulated) fishing effort (Purcell et al., 2012). They are easy to deplete (especially the higher value species) and can be slow to recover (Uthicke et al., 2004; Skewes et al., 2010); highlighting the need for careful and responsive management. Australian fisheries are among the few tropical shallow water sea cucumber fisheries globally to have continued viability. Given the restricted and conservative nature of management of the Australian Coral Sea (and GBR) fishery, including conservative TACs, minimum size limits that will allow an individual to breed before it is harvested, extensive close areas, and a rotational harvest strategy that limits fining to once every three years, the size of the illegal catch (especially if extrapolated to a possible several dozen FFV per year) presents a grave risk to sea cucumber populations in the Coral Sea territory, and the ecology of the reefs which they inhabit.

# Appendix A Sample procedure for apprehended IUU catch

1. Inventory of catch as accurately as possible. Take photos (Broad catch inventory sheets, camera, ID sheets)
2. Measure a portion of each catch/drum grouping - 30 individuals of each species/species group at least. Take photos. (size frequency sheets, rulers, scales, buckets, camera, ID sheets).
3. Take samples of uncertain IDs. Take photos (Sample bags, labels, scissors, camera)
4. Weigh as much as possible of the rest – at least weight the product from several barrels. (data sheets, bathroom scales, large bags, buckets)
5. Inventory of fishing gear. (Hookah lines etc)

## A.1 Gear list

- Data sheets: Inventory catch sheets; Individual catch sheets; barrel weight sheets
- Clipboards
- Pencils, marker, waterproof labels
- ID sheets
- Rulers (2) (30 cm)
- Small scales (2kg)
- Large scales (100 kg)
- Sample bags (for samples for uncertain IDs)
- Scissors/scalpel for taking samples
- Sample bag labels
- Large bags for weighing (sugar bags are good for this)
- Camera
- 9 lt buckets (2) (with water for washing off salt)
- Rubber gloves
- Overalls
- Towels

# Appendix B Catch data from two FFV vessels apprehended in the Coral Sea on February 15, 2017

| Boat No. | Barrel No. | Species present | Notes |
|---|---|---|---|
| 1 | 1 | White teatfish, Black teatfish | |
| 1 | 2 | White teatfish | |
| 1 | 3 | Prickly redfish, Black teatfish, White teatfish | |
| 2 | 4 | White teatfish | |
| 2 | 5 | White teatfish | |
| 2 | 6 | White teatfish | |
| 2 | 7 | White teatfish | |
| 2 | 8 | White teatfish | |
| 2 | 9 | White teatfish | |
| 2 | 10 | White teatfish | |
| 2 | 11 | White teatfish | |
| 2 | 12 | White teatfish | 163 pieces of WTF in total |
| 2 | 13 | Black teatfish | 2/3 full |
| 2 | 14 | White teatfish | |
| 2 | 15 | White teatfish | Freshly caught - not decanted of initial fluid |
| 2 | 16 | Leopardfish, Black teatfish, Prickly redfish, Stonefish, Actinopyga sp. (Redfish) | |
| 2 | 17 | Prickly redfish, Black teatfish, White teatfish | |
| 2 | 18 | White teatfish | 1/2 full |
| 2 | 20 | Black teatfish | |
| 2 | 21 | White teatfish | |
| 2 | 22 | White teatfish | |
| 2 | 23 | White teatfish | |
| 2 | 24 | White teatfish | |
| 2 | 25 | White teatfish | |
| 2 | 26 | White teatfish | |
| 2 | 27 | White teatfish | |
| 2 | 28 | White teatfish | |
| 2 | 29 | White teatfish | |
| 2 | 30 | White teatfish | |
| 2 | 31 | Prickly redfish | Older (dried salt on top) |
| 2 | 32 | Prickly redfish, Actinopyga spp. (Redfish?), Leopardfish hybrid, Black teatfish, Leopardfish, Brown sandfish | Older (dried salt on top) |
| 2 | 33 | Prickly redfish, Actinopyga spp. (Redfish?), Leopardfish hybrid, Black teatfish, White teatfish, Leopardfish, Brown sandfish | Older (dried salt on top) |
| 2 | 34 | Leopardfish, Leopardfish hybrid, Black teatfish, Brown sandfish | Older (dried salt on top); All large animals. |

| | | | |
|---|---|---|---|
| 2 | 35 | Prickly redfish (6), Actinopyga spp. (Redfish?) (3), Brown sandfish (4) | Older (dried salt on top) |
| 2 | 36 | Prickly redfish (6), Actinopyga spp. (Redfish?) (3), Brown sandfish (4) | Older (dried salt on top) |
| 2 | 37 | Prickly redfish (6), Actinopyga spp. (Redfish?) (6), Brown sandfish (1) | Older (dried salt on top) |
| 2 | 38 | Prickly redfish (5), Actinopyga spp. (Redfish?) (6), Leopardfish (2) | Older (dried salt on top); Very large Leopardfish |
| 2 | 39 | Prickly redfish (5), Brown sandfish (8) | Older (dried salt on top) |
| 2 | 40 | Prickly redfish (2), Actinopyga spp. (Redfish?) (8), Brown sandfish (8) | Older (dried salt on top) |
| 2 | 41 | Prickly redfish (6), Actinopyga spp. (Redfish?) (4), Leopardfish (2) | Older (dried salt on top) |

# References


ABARES 2015, Reducing uncertainty in fisheries stock status, ABARES research report, Canberra, August. CC BY 3.0

AFMA (2015) Coral Sea Fishery Management Arrangements Booklet 2016, Australian Fisheries Management Authority. Canberra, Australia.

Barclay, K., Kinch, J., Fabinyi, M., EDO NSW, Waddell, S., Smith, G., Sharma, S., Kichawen, P., Foale, S. and Hamilton, R.H. (2016) Interactive Governance Analysis of the Bêche-de-Mer 'Fish Chain' from Papua New Guinea to Asian Markets. Report commissioned by the David and Lucile Packard Foundation, University of Technology Sydney, Sydney, October.

DAFF (2007) Commonwealth Fisheries Harvest Strategy Policy and Guidelines, Australian Government Department of Agriculture Fisheries and Forestry, Canberra.

Dowling, N.A., D.C. Smith, I. Knuckey, A.D.M. Smith, P. Domaschenz, H.M. Patterson, and W. Whitelaw. (2008). Developing harvest strategies for low-value and data-poor fisheries: Case studies from three Australian fisheries. Fisheries Research 94(3): 380-390.

Hunter, C., Skewes, T., Burridge, C. Dennis, D. (2002) Research for management of the Coral Sea Collector Fishery (beche-de-mer). CSIRO Division of Marine Research Final Report. 21 pp.

Kinch, J. (2011) Marine Invertebrate Species of Commercial Value. In: Clua, E.; Gardes, L.; McKenna, S. and Vieux, C. (eds.). Contribution to the Biological Inventory and Resources Assessment of the Chesterfield Reefs. Pp: 90-107. Apia: Secretariat of the Pacific Regional Environment Program.

Patterson, H, Georgeson, L, Stobutzki, I & Curtotti, R (ed) (2015) Fishery status reports 2015, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 3.0.

Plagányi, É., Skewes, T., Dowling, N., Haddon, M., Woodham, J., Larcombe, J. and M. Chambers (2011) Evaluating management strategies for data-poor sea cucumber species in the Coral Sea Fishery. CSIRO, Marine and Atmospheric Research, Hobart. 73 p.

Plagányi, É.E., T. Skewes, N. Murphy, R. Pascual, M. Fischer (2015) Crop rotations in the sea: Increasing returns and reducing risk of collapse in sea cucumber fisheries. Proceedings of the National Academy of Sciences 05/2015; DOI:10.1073/pnas.1406689112.

Purcell S.W., Gossuin H. and Agudo N.S. (2009) Changes in weight and length of sea cucumbers during conversion to processed bechede- mer: Filling gaps for some exploited tropical species. SPC Beche-de-mer Information Bulletin 29:3–6.

Purcell, S. (2014) Value, Market Preferences and Trade of Beche-De-Mer from Pacific Island Sea Cucumbers. PLoS ONE, 9, e95075.

Purcell, S.W., Conand, C., Uthicke, S., Byrne, M. (2016) Ecological roles of exploited sea cucumbers: a review. Oceanography and Marine Biology: An Annual Review

Purcell SW, Mercier A, Conand C, Hamel J-F, Toral- Granda V, Lovatelli A, Uthicke S. 2013 Sea cucumber fisheries: global review of stock status, management measures and drivers of overfishing. Fish Fish. 14, 34–59. (doi:10.1111/j.1467-2979.2011.00443.x)

Skewes T., L. Smith, D. Dennis, N. Rawlinson, A. Donovan, N. Ellis (2004) Conversion ratios for commercial beche-de-mer species in Torres Strait. AFMA Project Number: R02/1195. Australian Fisheries Management Authority Torres Strait Research Program Final Report. Canberra. ISBN 1 876996 74 9. DOI: 10.13140/RG.2.1.3352.0167

Skewes, T., Kinch, J., Polon, P., Dennis, D., Seeto, P., Taranto, T., Lokani, P., Wassenberg, T., Koutsoukos, A, Sarke, J. (2002) Research for sustainable use of beche-de-mer resources in Milne Bay Province, Papua New Guinea. CSIRO Division of Marine Research Final Report, Cleveland Australia. DOI: 10.13140/RG.2.1.3823.0560

Skewes, T.D., Murphy, N.E., McLeod, I., Dovers, E., Burridge, C., Rochester, W. (2010) Torres Strait Hand Collectables, 2009 survey: Beche-de-mer. CSIRO, Cleveland. 68pp. ISBN 9781921605321

Skewes, T., Plagányi, É., Murphy, N., Pascual, R., Fischer, M. (2013) Evaluating rotational harvest strategies for sea cucumber fisheries. FRDC Final Report. Canbarra. 192 pp.

Uthicke, S., Welch, D., Benzie, J.A.H. (2004) Slow growth and Lack of recovery in overfished Holothurians on the Great Barrier Reef: Evidence from DNA fingerprints and repeated large-scale surveys, Conservation Biology, vol. 18, no. 5, p. 1395-1404.

Woodhams, J, Chambers, M & Penrose, L (2015) Assessing Coral Sea Fishery sea cucumber stocks using spatial methods, In: J Larcombe, R Noriega & I Stobutzki (eds), Reducing Uncertainty in Fisheries Stock Status, unpublished report, ABARES, Canberra.

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