Re-opening of the sea cucumber fishery in Papua New Guinea: A case study from the Tigak Islands in the New Ireland Province

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Abstract

On 1 April 2017, the Papua New Guinea (PNG) nationwide moratorium on sea cucumber fishing and the beche-de-mer trade was lifted seven-and-a-half years after it was introduced. The National Fisheries Authority (NFA) had revised the National Bêche-de-mer Fishery Management Plan (the Plan) prior to the fishery opening and allocated provincial total allowable catch (TAC) quotas based on estimated fishable stocks of sea cucumber in each maritime province. This article presents the results of a study on the sea cucumber fishery (harvest of live animals, processing and selling of beche-de-mer) from three island communities in the Tigak Islands of the New Ireland Province (NIP). Almost 35,000 sea cucumbers that belong to 21 species were recorded from 10 days of catch monitoring. Catch composition and fishing patterns varied between villages and survey times. However, medium- and low-value species replaced high-value species and catch-per-unit-effort (by number and weight) decreased as the fishery progressed. The NIP fishery was closed eight weeks after opening, and the TAC of 43 tonnes (t) was exceeded by at least 36 t. Results from the study highlight the need to increase awareness of fisheries regulations (particularly species size limits to reduce the amount of undersized beche-de-mer that is brought in for sale), to strengthen the reporting requirements for companies and also to implement extension services to improve processing so as to lower the high rejection rates of poorly processed beche-de-mer. In the first year of opening, the NFA revised Plan was not administered properly, causing multiple problems in how the fishery operated in the study area and recommendations are made for improvements in future sea cucumber fishing seasons.

Introduction

On 1 April 2017, the Papua New Guinea (PNG) National Fisheries Authority (NFA) ended the nationwide moratorium on sea cucumber fishing and the beche-de-mer trade, which had been in place since 31 September 2009. During this time, the NFA revised the National Beche-de-mer Fishery Management Plan (hereafter referred to as the Plan), which was formally gazetted on 15 September 2016. NFA had carried out sea cucumber stock assessment surveys between 2010 and 2016, concluding that recovery had occurred for some species, recruitment was limited for others, and most sea cucumber were below the minimum legal size in 2016 (R. Lis, pers. comm.). The surveys were used to estimate fishable (i.e. legal size) stocks of sea cucumbers and allocate total allowable catch (TAC) of beche-de-mer for each of PNG Maritime Provinces and the National Capital District.

Prior to the moratorium, the PNG sea cucumber fishery was extensive, operating in all maritime provinces of the country, supporting up to 200,000 PNG villagers and providing as much as 30% of annual villager income (Polon 2004; Kinch et al. 2008; Barclay et al. 2017). Here, we report on the sea cucumber fishery in the Tigak Islands near Kavieng, New Ireland Province (NIP), where a joint NFA/Australian Centre for International Agricultural Research (ACIAR) project is investigating the potential for mariculture of sandfish (*Holothuria scabra*), which is a high-value sea cucumber. The lifting of the moratorium provided a window of opportunity to monitor the fishery at a time when sea cucumber stocks would presumably be at their most abundant since the beche-de-mer industry began in earnest in the 1980s.

Under the revised Plan, the fishery would run from 1 April to 31 September 2017 or until NIP's TAC of 43 t was reached. This TAC of 43 t was actually reached seven weeks after opening and the fishery was officially closed on 17 May 2017. After a delay in registering that the TAC had been reached and granting of a one-week grace period to allow news

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of the closure to reach remote areas and for sea cucumbers already harvested to be sold, the fishery eventually closed on 26 May 2017. This article presents preliminary data from catch monitoring, describes events associated with the 2017 season and concludes with suggestions on how to avoid some of the problems that were identified during the 2017 season.

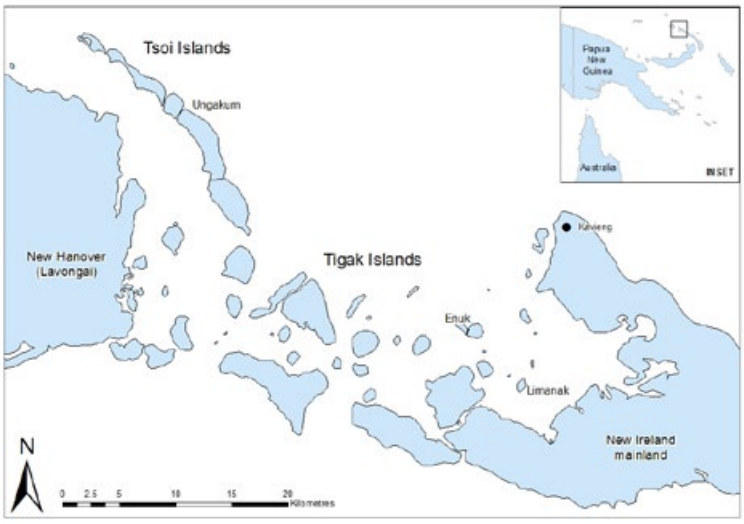

Figure 1. Location map showing the three communities involved in the study.

Study design

Data collection was carried out in three villages that are the collaborators in the NFA/ACIAR mariculture research. These are Limanak, Ungakum and Enuk (Figure 1). Limanak and Enuk are located within Balgai Bay in close proximity to the provincial capital of Kavieng (less than 15 minutes boat ride), while Ungakum is one of the eastern islands, bordering the Tsoi group and is at least one hour from town.

Sea cucumber catch and effort were monitored for six days in the opening week of the fishery, then for 48-hour periods in Week 3 and then again in Week 6. Enumerators were accompanied by local assistants from each village. Information on effort for each sea cucumber fishing trip was collected in personal interviews as near as possible to the landing time, ideally as the fisher returned to shore with a fresh catch, although in some cases, beche-de-mer processing had already commenced. Number and weight of each species was recorded and the catch photographed on a plastic sheet marked with a 10 cm grid to facilitate length estimation (Figure 2). Very large catches were sub-sampled.

All sea cucumbers were included in abundance estimates, but only fresh whole and freshly eviscerated individuals were measured for length. The weight of individual species within each catch was recorded but should be regarded as an approximation only due to inaccuracy of the field scales, errors introduced through subsampling, and varying condition of sea cucumber. Some catches were not measured, weighed or photographed because sea cucumbers were either in bad condition or were already undergoing processing.

Figure 2. A sea cucumber catch laid out on the 10 x 10 cm grid plastic sheets (left) and an enumerator photographing a catch (right).

Interviews about various aspects of the fishery and beche-de-mer industry with fishers were carried out during the fishing season and three months after closure. Additional information and observations on the fishing, processing and selling process have also been used to inform this study.

Fisheries effort

When the fishery opened on 1 April 2017, collecting and processing sea cucumber into beche-de-mer became the main activity of most people in the study villages (Figure 3). In the course of the monitoring programme, 152 landings were recorded at Enuk, 231 at Limanak and 245 at Ungakum, with much fewer trips recorded in the final surveys in Week 6. Very few fishing trips were missed during the survey periods.

Gender break up of effort showed that males accounted for 421 landings, 126 landings were by females and four by mixed gender groups. Diving was the most common harvest method (over 86% of all records), predominantly, but not exclusively, conducted by males with different trends being exhibited at the individual village level. For example, at Enuk, which had an extensive area of shallow marine habitats accessible from shore, more than one-third of the landings were made by females and gleaning was very common (47% of all landings). Females made a much smaller contribution to landings at the other villages where gleaning was uncommon due to habitat differences. The average age of fishers (for both genders) was between 30–37 years of age across all villages and survey times, with a range of 9–67 years of age for males and 10–66 for females. Paddling canoe were the most popular means of transport in the fishery, accounting for over 94% of all fishing trips. Canoes doubled as a holding container for fresh sea cucumber (Figure 4). Walking was most common at Enuk and absent at Limanak.

In Enuk and Limanak, most fishing trips were recorded in zones closest to the village. At Ungakum, almost 99% of landings were recorded from zones where sandfish occurred, despite being further from the village centre. However, changes in fishing zone use through time were observed in Enuk, whereby fishing effort switched to a more distant zone in Week 6, and in Ungakum, where effort shifted to a more distant and deeper zone.

Figure 3. Processing a sandfish catch at Limanak Island.

Figure 4. A canoe being used as a sea cucumber catch container. (Photo: P. Kanawi)

Sea cucumber landings

A total of 34,611 sea cucumbers belonging to at least 21 species were recorded in the surveys. Enuk fishers collected 10,070 sea cucumbers from 20 species; Limanak 19,874 sea cucumbers from 16 species; and Ungakum 4667 sea cucumbers from 14 species (Table 1).

Table 1. Abundance and percentage contribution to total for common sea cucumber species.

Common name	Species name	Number	% of total
Sandfish	*Holothuria scabra*	12,677	36.6
Pink curryfish (yellowfish)	*Stichopus naso*	5309	15.3
Blackfish spp.	*Actinopyga miliaris, A. palauensis*	3995	11.5
Curryfish spp.	*Stichopus hermanni, S. vastus, S. ocellatus*	3351	9.7
Chalkfish	*Bohadschia marmorata*	2941	8.5
Brown sandfish	*B. vitiensis*	2604	7.5
Golden sandfish	*H. lessoni*	1141	3.3
15 species		2658	7.7

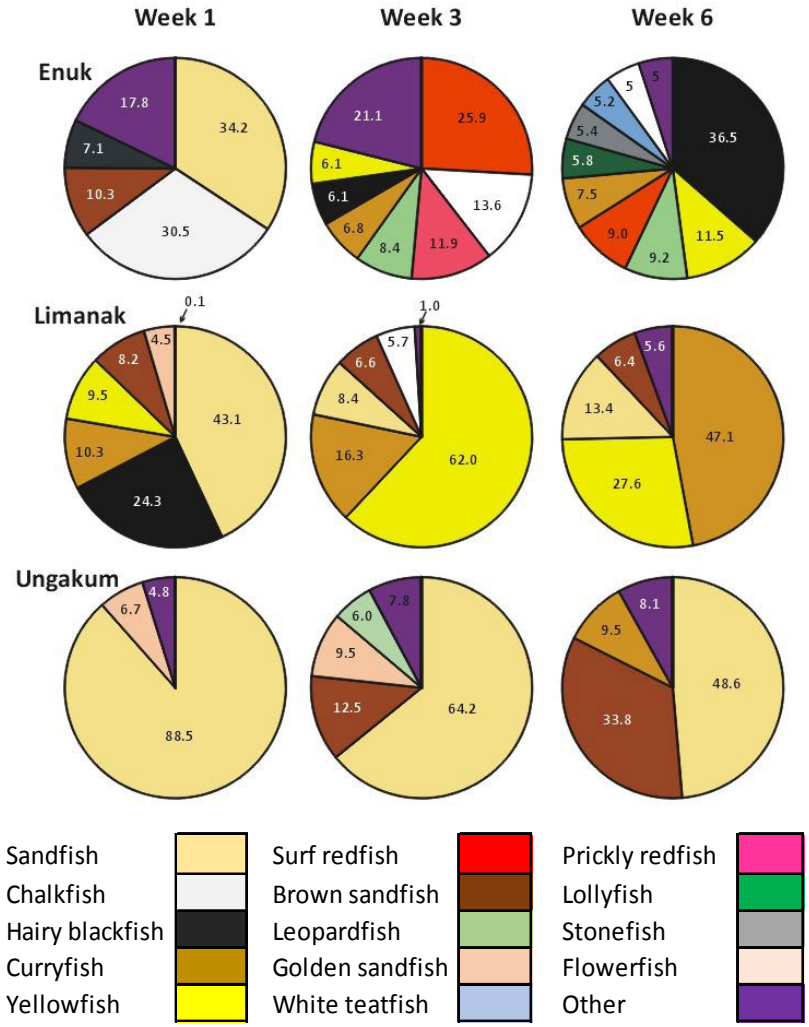

Figure 5. Changes in sea cucumber species composition in surveyed villages over the three surveys (Enuk top row, Limanak middle row, Ungakum bottom row). Species contributing more than 5% in abundance to the landing are shown as a slice of the pie chart.

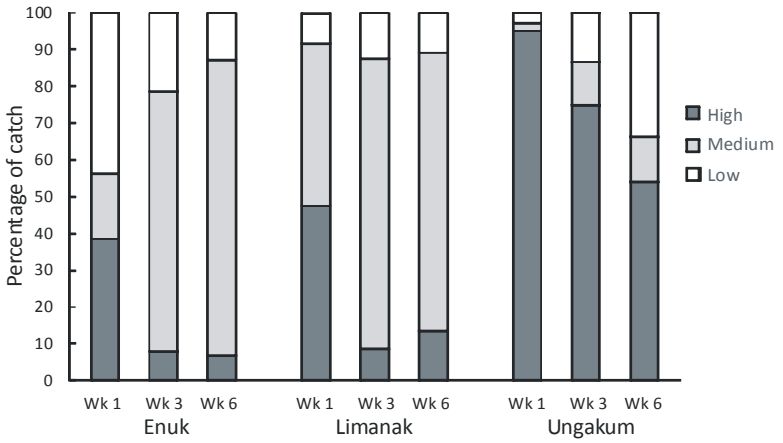

Figure 6. Percentage of catch by number of high-, medium- and low-value species for each village in each survey week (Wk).

Enuk consistently had a higher number of species in landings and Ungakum fewer species. Sandfish was the most common species collected in every village (n = 2722, 6142, and 3813 or 27%, 31% and 82% of the total catch for Enuk, Limanak and Ungakum, respectively). The composition and diversity of the catch varied with survey week (Figure 5).

Overall, 41% of total sea cucumber catch was of high-value species, 42% was of low-value species, and 17% was of low-value species (Purcell et al. 2008, 2014). By village: Enuk returned 31%, 31% and 38% (high-, medium- and low-value species, respectively); Limanak 34%, 56% and 10%; and Ungakum 89%, 5% and 6%. However, these proportions shifted as the fishery progressed (Figure 6), generally medium- and low-value species replaced high-value ones.

The weight of the sea cucumber landings are underestimated due to reasons explained above but nonetheless provide valuable information on species' contributions to the fishery. Some 28.6 t of sea cucumber (corrected weight) were recorded from all surveys. Six species each had combined landing weight greater than 1 t (Table 2).

Table 2. Landed weight and percentage contribution to total weight for common sea cucumber species.

Common name	Weight (tonne)	% of total
Sandfish	11.6	40.7
Curryfish spp.	6.3	21.9
Pink curryfish	2.8	9.7
Brown sandfish	2.1	7.4
Golden sandfish	1.7	6.3
Blackfish spp.	1.8	6.0
Chalkfish	0.5	1.9
15 species	1.7	6.1

There were no obvious trends of decreasing individual size for most species although estimated mean length and weight did decrease for some species in some villages. For example, sandfish declined in length at Limanak, although remained above legal minimum length in all surveys. The largest single species landing by number was

a catch of 600 pink curryfish (known locally as yellowfish), and by weight was 300 kg of sandfish. Each village had different catch-per-unit-effort (CPUE) values but the general trend was for both the number and weight of sea cucumber collected per hour to decrease as the fishery progressed (Figure 7).

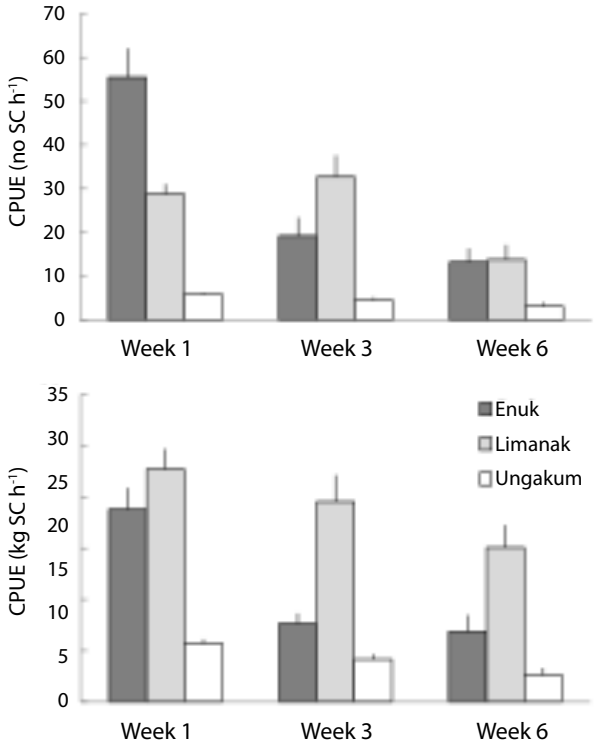

Figure 7. CPUE by number (± SE) (top) and weight (± SE) of sea cucumber collected per fisher hour in each survey week in each village (bottom).

Beche-de-mer buying and selling

Many fishers had their beche-de-mer rejected by buyers – Enuk had the worst quality issues with 87% of respondents having some or all of their beche-de-mer rejected by buyers at their first selling attempt, compared to 40% and 61% for Limanak and Ungakum, respectively. Commonly cited reasons for rejection was that beche-de-mer that was offered for sale was not fully dried (i.e. still had high moisture content), was undersized or was damaged (i.e. broken, misshapen, twisted, etc.). Rejected wet beche-de-mer was mostly re-dried and re-sold, but undersized or broken beche-de-mer were usually discarded. Some of the rejected beche-de-mer was retained by buyers (as stipulated in the Plan) but the majority was dumped in the Kavieng streets or at the Kavieng town rubbish depot (until this was stopped by local government authorities), or back in the village (dumped, buried or thrown in the sea).

Most fishers were unhappy with the buyers and the buying process. Long queues at buyers' premises (Figure 8) were a problem for both buyers and fishers where a full day wait was normal for at least the first week of buying. This was exacerbated by delayed issuance of licences three weeks after the fishery opened. Fishers who were not satisfied with prices usually did not shop around because they had already invested considerable time in waiting. Some buyers worked long hours to help people make their sale and get back home, some even providing food and a place to sleep. Fishers' major complaints concerned undersized product

Figure 8. Beche-de-mer sellers lined up outside a buyer's premises the day after buying commenced.

(saying that 'it's already dead, why waste it?') and no sales of wet product as had been the case in the past. Fishers also reported that graders at buying premises lacked expertise; that grading (and therefore pricing) was inconsistent and unfair; and that beche-de-mer parcels were not weighed accurately. Nonetheless, when asked what they might do differently if the fishery reopens again in 2018, 15% of all interviewed fishers said they would process higher-quality beche-de-mer and 20% said they would harvest larger sea cucumbers.

Additional challenges for exporters included a lack of clear policy over who would be awarded a licence and a delay of three weeks after the fishery had opened before these licences were issued. In total, seven licences were eventually issued in the NIP instead of the two as recommended by the National Management and Advisory Committee (NMAC).

Discussion

Harvest of sea cucumbers in PNG had been banned for seven-and-a-half years prior to the opening of the 2017 fishing season. It's not possible to ascertain if the TAC allocated to the NIP had been set at an appropriate level but monitoring the TAC was certainly complicated by the three-week delay in issuing licences after the fishery opening and NFA's inability to track of purchases in real-time, even though the new Plan stated that companies were to provide purchasing records on a weekly basis.

Potential indicators of overfishing

As observed across the Pacific Islands Region, sea cucumber moratoria often precede another cycle of rapid depletion instead of the envisaged revitalised fishery on re-opening (Friedman et al. 2011; Carleton et al. 2013; Pakoa et al. 2013) with recovery being either slow or absent (Anderson et al. 2011). Signals of overfishing in tropical, multi-species sea cucumber fisheries include the replacement of high-value species with medium- and then low-value species; declining size of sea cucumber individuals within a species; declining catch-per-unit-effort; and fishers accessing more distant and deeper fishing grounds, to name a few (Friedman et al. 2008; Carleton et al. 2013).

In our survey, species composition changes showed that high-value species, notably sandfish, were preferentially targeted in the early stages of the fishery and over-exploited very quickly. The early, high catches of this species were reminiscent of the late-1980s boom when sandfish supported a mono-specific fishery in the Tigak Islands for almost two years before declining (Lokani 1996; Hair et al. 2016). Medium- and low-value species replaced high-value species in all villages during the season. For the most part, CPUEs declined as the fishery progressed, although absolute CPUE values and rate of decline varied between villages.

Other possible indicators of overfishing were less conclusive. Heavy fishing occurred close to the major village centres in the early weeks of the fishery, and fishers later accessed more distant and/or deeper fishing grounds. However, the brevity of the fishing season and limited data collection does not allow for firm conclusions, also the choice of fishing site was influenced by other factors such as weather. Overall, we did not detect decreasing length or weight for most species. Given that this study was a one-off and the limitations of individual measurements, these aspects are best left for comparison with future surveys.

Future sea cucumber fishing seasons

Data collected and observations made during the 2017 season suggest that various actions are required to improve management outcomes and benefits for all stakeholders in the future. First and foremost, awareness of the rules and regulations should be provided to everyone well in advance of the opening of the season, and regularly updated throughout the season. NFA and Provincial Fisheries Officers, non-governmental organisations that are focused on natural resource management, beche-de-mer dealers and other interested stakeholders can provide awareness and training at the grassroots level. Ward Councillors and Ward Development Committees should also take a proactive role in ensuring their village constituents are informed and empowered with the appropriate distribution of information at village level.

NFA's revised Plan was a good step in bringing better management to the sea cucumber fishery and the beche-de-mer trade (Hair et al. 2016; Barclay 2017), but as was witnessed in the 2017 season, many of its own regulations were not implemented properly or were contravened. With respect to exporters, the impact of licensing delays reverberated through all aspects of the fishery with negative consequences. It is of paramount importance that exporters and their buyers be licensed well ahead of the next season, so they can have their premises in readiness and their graders prepared. The licensing of seven exporters over the two originally recommended by the NMAC may have increased competition, which may have also benefited fishers but it did not contribute to the proper reporting as required in the Plan. Real-time recording and reporting of beche-de-mer purchases was necessary to facilitate proper monitoring of the TAC. The late closure of the sea cucumber fishery and the beche-de-mer trade in the NIP was compounded by the granting of a one-week 'grace'

buying period, which essentially became a fishery extension. In future, it is also recommended that all exporters and their buyers must retain and record all rejected beche-de-mer in the same way as normal sales are recorded and reported for several important reasons: (1) when added to the purchased product, it provides an estimate of the total harvest from the source area; (2) to prevent indiscriminate dumping and the associated environmental and health hazards; and (3) to assist in identifying priority communities for awareness and extension services. The presence of buyers in remote areas benefited many fishers; however, these buyers must remain in communication with the exporter so that their purchases can be included in the records submitted to NFA, which is then added to the running TAC calculations.

More local management at the community level should be encouraged. Before the next season, communities should be supported in forming community management bodies and provided with information on natural resource management and training on beche-de-mer processing. Understanding the relationship between sound management practices and optimum profit from beche-de-mer would also be beneficial. There are a range of resources available that could be distributed quickly and easily (e.g. Friedman et al. 2004; Purcell 2014).

Fishers had many complaints about the buying process. Conversely, exporters and their buyers complained about the quantity of undersized and badly processed beche-de-mer that was offered for sale. Many new fishers entered the fishery in 2017 due to abundant stocks in nearby shallow waters, requiring minimal skill to harvest. High beche-de-mer prices were an added incentive for inexperienced fishers to try their hand, despite knowing little about the fishery regulations or how to process sea cucumber into good beche-de-mer. There is probably truth in both the exporters and their buyers' and sellers' versions of events. Exporters and their buyers quite rightly rejected undersized beche-de-mer. However, this practice was common in the past (NFA 2000) as was the practice of buying wet beche-de-mer at a lower price. Not surprisingly, fishers assumed it would be business as usual (i.e. pre-moratorium). The problem was exacerbated by the delay in licensing because any opportunity to learn by trial and error (i.e. rejection of a small catch) was lost. Increased awareness of what constitutes high quality beche-de-mer and training in how to produce it are therefore needed. All fishers (new and experienced) should be made aware of the fishery rules, in particular, the size limits. A combination of improved knowledge and processing skills for fishers, training of graders, sufficient time for buyers to prepare for the buying season and a code of conduct (e.g. calibration of weighing scales and a transparent buying process) might address some of these problems.

Future catch data should be collected using similar methods to monitor changes in sea cucumber species composition, size and CPUE in further seasons for Enuk, Limanak and Ungakum (and possibly expanded to include other villages elsewhere). The survey methods are now established and training materials are prepared. Feedback was given to community members who appeared to be supportive of future monitoring as it also assists them in understanding and managing their marine resources. The value of this critical baseline data will increase once subsequent seasons' data are available for comparison. Lessons learnt during the 2017 surveys can be used to better train enumerators for monitoring of the future seasons.

Conclusions

Continued monitoring will provide feedback on the health of the Tigak Islands sea cucumber fishery. In 2017, the fishery was not closed when the TAC was reached as the most recent progressive NFA export figures show that the TAC in NIP was overshot by at least 36 t (and this does not take into account the additional tonnage of rejected beche-de-mer). Barclay et al. (2017) noted that the success of the revised Plan would rest in part on the ability to close the fishery on time, or render this management measure ineffective. Production in subsequent seasons will be affected to an unknown extent by the harvest of undersized sea cucumber in the 2017 season.

The current study collected baseline data on the sea cucumber fishery in three Tigak island communities after an extended moratorium. Through surveys and observations, we were able to describe the progress of the fishery for various stakeholders, and suggest some ways that stakeholders can benefit more from the fishery while not compromising future productivity of this very valuable resource. A unified approach and initiation of the joint management bodies (government, community and industry) is advocated.

Acknowledgements

This study was supported by the National Fisheries Authority in Papua New Guinea and the Australian Centre for International Agricultural Research (ACIAR) under the auspices of ACIAR project FIS/2010/054 'Mariculture Development in New Ireland, Papua New Guinea'. Thanks to Esther Sione, July Kuri, Nelson Sapung and Nicholas Daniels for additional project support. We acknowledge the generosity of Limanak, Ungakum and Enuk community members and Kavieng beche-de-mer exporters for sharing information and data.

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