Status of Sea Cucumber Populations at Ngardmau State

Republic of Palau

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EXECUTIVE SUMMARY

Sea cucumbers are important resources, both ecologically and commercially. Because of their biology and the high commercial demand for them, they can be easily overharvested. In March 2012, the Governor of Ngardmau State requested The Palau International Coral Reef Center (PICRC) to assess sea cucumber populations in Ngardmau State waters after the massive harvesting that occurred in earlier in 2011. The objectives of the survey by PICRC was to assess the current population status of sea cucumbers in Ngardmau State waters and compare those population densities to pre-harvesting levels in 2009. The results of the surveys clearly showed a decline by 88% of mean densities at Ngardmau between 2009 (97.8 $50m^{-2}$) and 2012 (11.8 $50m^{-2}$). The total number of sea cucumbers in the surveyed area outside of Ngermasch MPA has been reduced from 2,445 in 2009 to 295 in 2012, an eight-fold decrease. By contrast, in Ngermasch MPA, the total number of sea cucumbers counted in the survey areas has also been reduced from 3,268 in 2009 to 2,552, with mean densities of *eremrum* also decreasing from 130.7 in 2009 to 102.1 per $50m^2$ in 2012. Our results clearly show that the densities of e*remrum* at Ngardmau have been reduced significantly as a result of the harvesting that occurred in 2011. The ease by which sea cucumbers can be collected led to this massive decline in just six months of harvesting. If the national ban on export of sea cucumber had not been implemented, it is highly likely that population of e*remrum* could have been wiped out in Ngardmau waters, except for those inside Ngermasch MPA. The challenge that resource managers face today is how to ensure long-term economic benefits through the exploitation of such vulnerable fishery resources without cascading negative impacts on the overall marine environment, as well as other fishery resources that Palauans depend upon. Palau currently

lacks a comprehensive management plan for the sea cucumber fishery and thus, allowing continued exploitation for export of these marine resources will only lead to the inevitable collapse that other countries have already experienced.

INTRODUCTION

Sea cucumbers are important for coastal marine environments because of their function and the processes they support. These processes include keeping sands clean by digesting and processing decaying organic materials on the ocean floor and allowing air to reach organisms living in the sand by mixing the sand in the process referred to as bioturbation. Sea cucumbers also process and recycle nutrients, which, if left to accumulate, could lead to harmful algal blooms.

In addition to their ecological value, sea cucumbers are also commercially valuable because of their high demand as a food delicacy and for medicinal use in many Asian countries. Since the 1980's, the sea cucumber fishery has been characterized by boom and bust cycles, with many reported cases of overfishing, as fishermen attempted to supply the increasing demand in Asian countries (Ibarra and Soberon, 2002). A global review of the status of the sea cucumber fisheries shows that they are under intense harvesting pressure in many areas, which necessitates a strong need for effective conservation measures (Toral-Granda et al, 2008).

For many isolated coastal communities in the Pacific, the collection and sales of sea cucumbers can bring in significant economic benefits and provide an important source of cash income. As sea cucumbers are slow moving, conspicuous animals, they are easy to collect and therefore very easy to overharvest. In summary, the drive for cash in many coastal communities,

combined with the biology of sea cucumbers, contribute to overharvesting of sea cucumbers in many places in the world, especially in the Pacific.

Overharvesting of any given biological resource can lead to an imbalance of the ecosystem which depends on the functional role(s) of that particular resource. Thus, overharvesting of sea cucumbers can also lead to major ecological imbalance in coastal marine environment that could have long term consequences for other marine resources. Because they are slow moving organisms and reproduce by broadcast spawning, their successful reproduction depends on having adequate number of individuals in a given area. Overharvesting them reduces their numbers, which then reduces their chances of producing enough offspring for the next generations, thereby affecting their population in the wild. In summary, without sea cucumbers, the process of nutrient recycling can be reduced, which can lead to nutrient build-up that contributes to harmful algal blooms.

Palau has implemented some measures to manage the population of some sea cucumbers. In the 1980's six species of sea cucumbers [bakelungal chedelkelek (*Holothuria nobilis),* bakelungal cherou (*Holothuria fuscogilva),* molech (*Holothuria scabra),* badelchelid (*Actinopyga mauritiana),* eremrum (*Actinopyga miliaris),* temetamel (*Thelenota ananas)*] were targeted for export. Recognizing the ease of overharvesting these species, the Palau Government banned their export through the Marine Protection Act of 1994. However, as the demand for sea cucumbers continued to increase and the numbers of originally high-value species continued to

decline (and became harder to find), the less desirable species that are not protected by the Marine Protection Act 1994, are now targeted for harvesting, particularly in the recent nation-wide sea cucumber exploitation. For example, during this recent harvesting of sea cucumbers, certain 'less desirable' species of cheremrum (*Actinopyga* sp.) and mermarch (*Bohadschia* sp.) were targeted for harvest.

In 2009, a Korean investor and a Palauan partner began a sea cucumber hatchery focusing on the spawning and rearing of *Actinopyga miliaris*. The project involved spawning and rearing the larvae up to 3 months and then seeding specific intertidal areas in Aimeliik State. The same company was also involved in the collection of wild *Actinopyga* with no evidence to show if any of the juvenile that were seeded had survived. This practice led to questioning from the Governor of Aimeliik, along with several individuals regarding the certification process that was being imposed by the Bureau of Marine Resources at that time. This led to filing of a court case against the company for the export of non-cultured sea cucumber. The export eventually halted for several months while the case was pending in court.

In June 2011, several investors partnered with local Palauans to buy sea cucumbers from local communities for export to Asia. States that participated in the collection and sale of sea cucumbers included Koror, Airai, Ngardmau, and Ngarchelong states. With no proper monitoring in place and limited understanding of where and how much sea cucumber population was collected, state governments and communities become concerned about the

potential impact of overharvesting of sea cucumbers in their respective areas. This concern eventually led to a prohibition of sea cucumber harvesting in the waters of the states of Ngaraard, Koror, and Ngeachelong. This was followed by an eventual ban on national export, effective on January 1, 2012. Ngardmau State continued to allow harvesting of sea cucumber in their waters up until the national ban took effect on January 1, 2012.

In March, 2012, the Governor of Ngardmau State requested The Palau International Coral Reef Center (PICRC) to assess sea cucumber populations in Ngardmau State waters. The objective of the survey conducted by PICRC was to assess the current population status of sea cucumbers in Ngardmau State waters and compare those population densities to pre-harvesting levels in 2009.

MATERIALS AND METHODS

Two study areas were selected for the surveys: one area in the Ngermasch MPA and the other area in Ngerikerker, a non-MPA site (Fig. 1). These two study areas were selected because sea cucumber data collected in 2009 from these areas were available, thus allowing us to make the needed comparison. The same methods that were used in 2008-2009 were also used in the 2012 surveys.

In each of the two areas, five sites were established for survey. Within each site, five transects (2 x 25 meter) were surveyed. After each 25 m transect was laid, an observer moved along the transect, recording the number and species of sea cucumbers that fall within 1 m on both sides of the transect line. Thus, the area of each transect was 50 m^2. Non-edible sea cucumbers, such as *ewas* were not counted in the surveys. In March 23, 2012, all five sites within the Ngermasch MPA area were surveyed and on March 27, 2012, all the sites at Ngerikerker were surveyed.

Figure 1. Aerial photo of the reefs at Ngardmau where the surveys were conducted. The green dots indicate the sites that were surveyed.

After the surveys were completed, the data were entered into spreadsheets and a statistical program, called Statistica@, was used to analyze and graph the data. The statistics were used to determine two main issues: 1) significant differences in sea cucumber densities in areas that were harvested and in areas that were closed to harvesting; and 2) significant differences between the data collected in 2009 and those collected in this survey to determine if there was a significant reduction in population densities after the massive harvesting which took place for several months in 2011.

RESULTS

The populations of sea cucumbers in both 2009 and 2012 were dominated by e*remrum* (*Actinopyga* sp.). In 2009, over 99% of the sea cucumbers encountered in Ngermasch MPA was e*remrum*. Other sea cucumbers that were counted in the surveys include *mermarch, molech* and *ngimes*. However, their composition was less than one percent of the sea cucumber populations in Ngermasch MPA. In Ngerikerker, e*remrum* made up over 96% of the total population of sea cucumbers. Other sea cucumbers that were also encountered in these surveys were *irimd*, *mermarch* (1%), *molech* and *ngimes* (2%).

The sea cucumber species composition in Ngermasch MPA was the same in 2009 and in 2012. Ninety-nine percent of the sea cucumbers in Ngermasch were composed of e*remrum*.

Interestingly enough, none of the other sea cucumber species even made up 1% of the composition. In the non-MPA site, Ngerikerker, where harvesting occurred, 83% of the sea cucumber populations composed of e*remrum*, while m*ermarch* and *ngimes* each composed of 8% (combined total of 16%) of the total sea cucumber populations.

In 2009, the total number of eremrum counted during the surveys at Ngerikerker was 2,445 while Ngermasch had a higher total number of sea cucumbers at 3,268 (Table 1). The mean densities of e*remrum* in Ngerikerker (non-MPA area) was 97.8 in a $50m^2$ area, while densities in Ngermasch MPA were 33% higher at 130.7 in $50m^2$(Fig.2). While the densities were much higher in Ngermasch, the difference in abundance was not statistically significant.

The surveys showed that the total number of sea cucumbers in Ngerikerker has been reduced from 2,445 in 2009 to 295 in 2012, an eight-fold decrease (Table 1). In Ngermasch MPA, the total number of sea cucumbers counted has also been reduced from 3,268 in 2009 to 2,552 (Table 1). In 2012, the mean density of *eremrum* in Ngerikerker was 11.8 per $50m^2$, compared to that of Ngermasch MPA, which was at 102.1 per $50m^2$, over 700% higher in Ngermasch MPA than outside the MPA (Fig. 3). This difference in densities was highly significant.

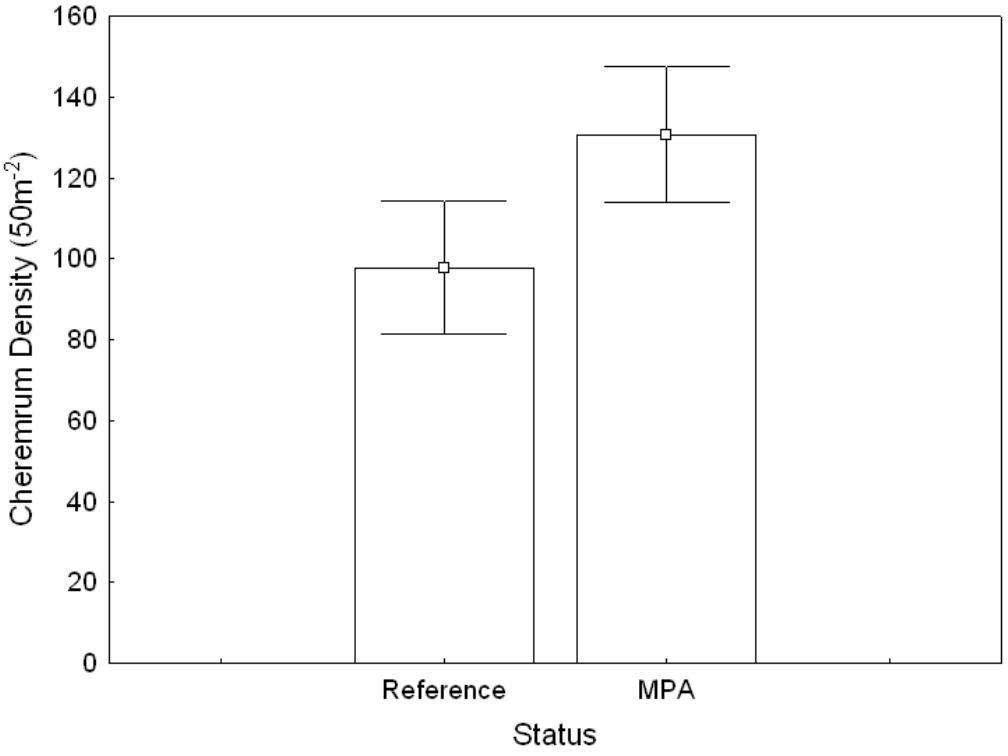

Figure 2. *Cheremrum* density inside and outside Ngermasch MPA in 2009.

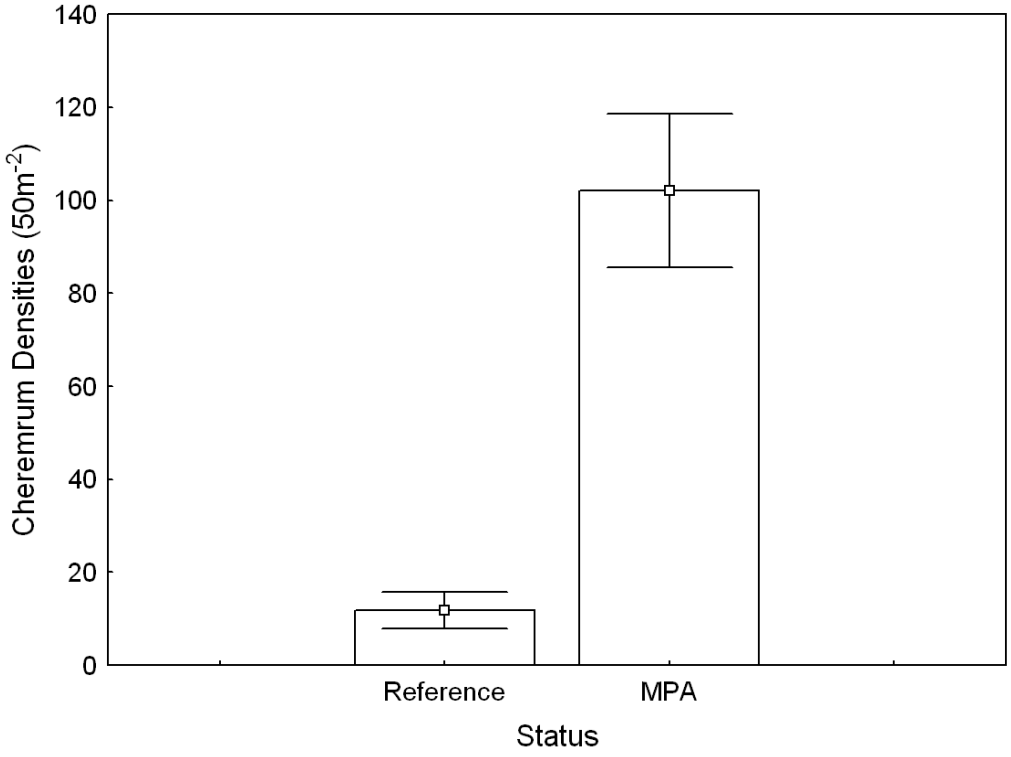

Figure 3. *Cheremrum* density inside and outside Ngermasch MPA in 2012.

In comparing the e*remrum* mean densities at Ngardmau between 2009 and 2012, we see a reduction in mean densities by 88%. In 2009, mean density was 97.8 but in 2012, it has been reduced to 11.8 per $50m^2$ (Fig.4). In Ngermasch MPA, densities of *eremrum* also decreased from a mean density of 130.7 in 2009 to 102.1 per $50m^2$in 2012 (Fig.5).

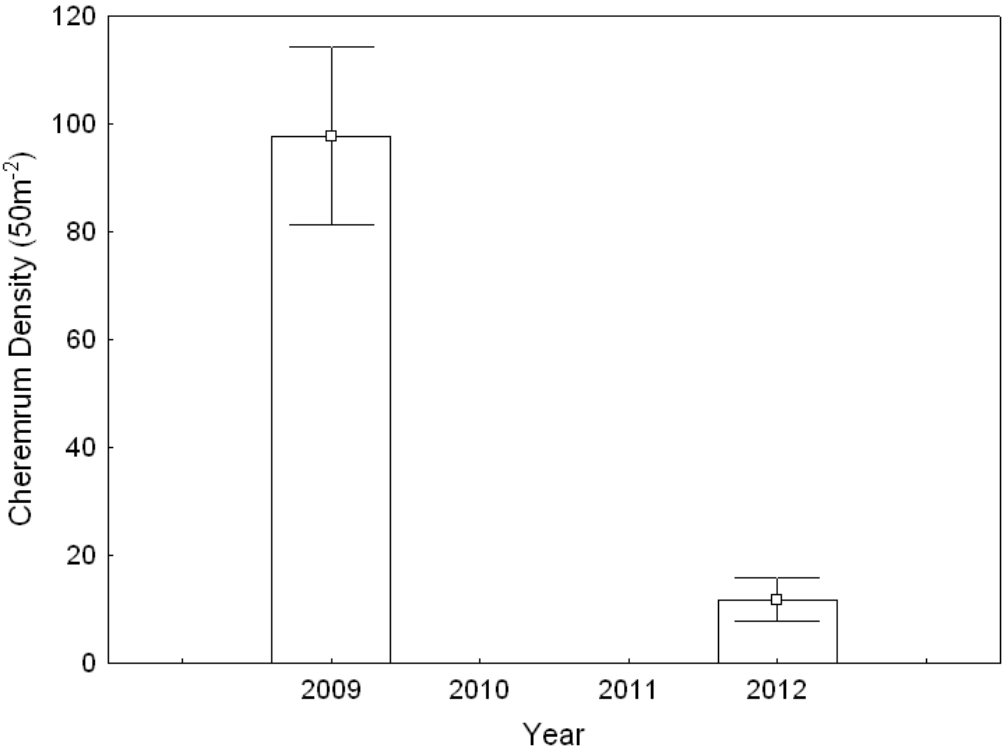

Figure 4. *Eremrum* densities at Ngardmau in 2009 and 2012.

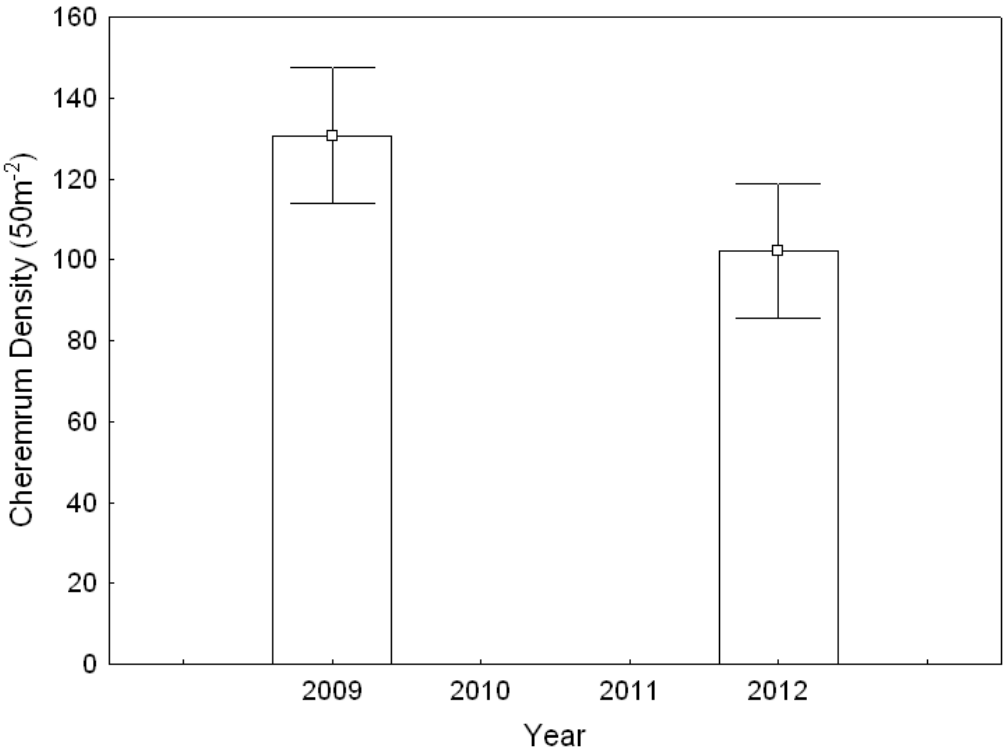

Figure 5. *Eremrum* densities in Ngermasch MPA in 2009 and 2012.

Table 1. Total number of *eremrum* counted in the 2009 and 2012 surveys at Ngardmau.

	2009	**2012**
Ngermasch	3,268	2,552
Ngerikerker	2,445	295

DISCUSSION

The study results clearly show that the densities of e*remrum* at Ngardmau have been reduced significantly as a result of the harvesting that occurred in 2011. The ease by which sea cucumbers can be collected led to this massive decline in about six months of harvesting. If harvesting had continued, it is highly likely that population of e*remrum* could have been wiped out in Ngardmau waters, except for those inside Ngermasch MPA.

The Ngermasch MPA appeared to have been effective in protecting the e*remrum* populations inside the MPA. Even though there was a decrease in *eremrum* populations between 2009 and 2012, the decrease was not statistically significant and pales in comparison to the decrease that took place outside of the MPA. Unfortunately, Ngermasch is only about 21% of fringing reefs around Ngardmau, which means 79% of the fringing reefs experienced the dramatic decline in sea cucumber populations.

Other studies (Uthicke et al, 2004; Friedman et al, 2004) have shown that even after four to seven years of closure, depleted sea cucumber populations will not recover. It will be interesting to see if the depleted populations of sea cucumber in Ngardmau will recover if the ban on harvesting continues. The high densities of sea cucumbers in Ngermasch MPA might be able to provide the seeds necessary to restore the depleted populations at Ngardmau, but only time and regular monitoring will provide the answer.

It is evident from the recent boom in the sea cucumber fishery in Palau that there are economic benefits for individuals, not only skilled fishermen. The dilemma that resource managers face today is how to ensure long-term economic benefits through the exploitation of such vulnerable fishery resources without cascading negative impacts on the overall marine environment, as well as other fishery resources that Palauans depend upon. There are examples worldwide of collapse of such fisheries, simply because of lack of management and control of harvest (see review by Buckner, 2004). Palau currently lacks a comprehensive management plan for the sea cucumber fishery; therefore, allowing continued exploitation for export of these marine resources will only lead to the inevitable collapse that other countries have already experienced. A 2009 study in Palau, commissioned by the Secretariat of the Pacific Community (SPC) showed that the use of sea cucumber within Palau was driven by subsistence (70%) rather than by commercial use (Pakoa et al, 2009). Therefore, having a management plan that guides the exploitation of this fishery will allow for subsistence use and export without compromising the ecological role of these species and the dependence of Palauans on this particular fishery.

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