

**MONITORING OF REEF COMMUNITIES IN THE  
PONTA DO OURO PARTIAL MARINE RESERVE: 2014.**



**By**

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**Centro Terra Viva - Estudos e Advocacia Ambiental**



**Reserva Marinha Parcial da Ponta do Ouro**

O Centro Terra Viva (CTV) e a Reserva Marinha Parcial da Ponta do Ouro (RMPPPO), assinaram em Setembro de 2013 um Memorando de Entendimento (MdE) com vista ao desenvolvimento de actividades relacionadas com investigação e monitoria de espécies e ecossistemas na RMPPPO, promovendo a sua protecção e conservação. A presente publicação resulta de actividades desenvolvidas no âmbito deste MdE.

*Centro Terra Viva (CTV) and the Ponta do Ouro Partial Marine Reserve (POPMR) have established in September 2013 a Memorandum of Understanding (MoU) in order to develop several activities related to research and monitoring of species and ecosystems within the POPMR, promoting their protection and conservation. The present publication is a result of activities undertaken under the MoU.*

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**Cover:** divers conducting benthic surveys at Techobanine 1. Photo: Raquel Fernandes.

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## ABSTRACT

With the proclamation in 2009 of the Ponta do Ouro Partial Marine Reserve (POPMR), a baseline assessment of reef status and subsequent reef monitoring program was established in 2011. This report presents data collected during the February-March 2014 survey. Data were collected on the five reefs selected using standardized methodology. Overall, a reduction in coral cover was observed at all reefs, particularly at Techobanine 2. Live coral cover ranged from 11.3% at Techobanine 2 to 35.5% at Texas. At all reefs surveyed, soft corals (ie. *Lobophytum* and *Sinularia*) were the dominant biota. Conversely, an increase in algal cover (turf and fleshy) occurred in all reefs. Rubble was particularly conspicuous at Techobanine 2 with a cover of 16.5% (SD=23.8). Planktivore fish species dominated the ichthyological communities of the five reefs surveyed. Territorial rockcods as well as pelagic species were present in low numbers, with large fish being scarce. Overall, recreational SCUBA divers were relatively experienced with an average of 160 logged dives and made 16.1 (SD=22.4) contacts with the substrata per 35 min dive. No coral breakage by divers was observed. Two main recommendations are proposed: i) reduction of fishing effort (sport/recreational and illegal); and ii) further research on the causes of coral decline and potential for recovery of the coral communities in Techobanine.

## RESUMO

Com a proclamação em 2009 da Reserva Marinha Parcial da Ponta do Ouro (RMPPPO), uma avaliação de base do estado dos recifes e um programa de monitoria foi subsequentemente estabelecido em 2011. O presente relatório apresenta os dados da monitoria realizada em Fevereiro-Março de 2014. Os dados foram colectados nos cinco recifes previamente selecionados, usando metodologia standardizada. De um modo geral, uma redução na cobertura de coral foi observada em todos recifes, particularmente Techobanine 2. A cobertura de coral vivo variou entre 11.3% em Techobanine 2 e 35.5% no Texas. Em todos recifes, os corais moles (ie. *Lobophytum* and *Sinularia*), constituiram a biota dominante. Reciprocamente, um aumento na cobertura de algas (macroalgas e algas turfosas) ocorreu em todos os recifes. O calhau foi particularmente conspicuo em Techobanine 2 com uma cobertura de 16.5% (DP=23.8). As espécies de peixes plantívoros, dominaram as comunidades ictiológicas dos cinco recifes visitados. As garoupas territoriais assim como as espécies pelágicas estiveram presentes em números muito reduzidos, sendo os peixes de tamanho grande escassos. De um modo geral, os mergulhadores recreativos SCUBA eram relativamente experientes com uma média de 160 mergulhos realizados e tocaram 16.1 (DP=22.4) vezes no substrato por mergulho de 35 minutos. Não foi observada quebra de coral causada por mergulhadores. Duas principais recomendações são propostas: i) redução do esforço de pesca (desportiva/recreativa e ilegal); e ii) investigação adicional sobre as causas do declínio de coral e potencial de recuperação das comunidades coralinas em Techobanine.

## 1. INTRODUCTION

Coral reefs constitute one of the main environmental assets and socio-economic drivers of the Ponta do Ouro Partial Marine Reserve (Pereira, 2004). The great majority of tourists visiting the area are SCUBA divers, followed by deep sea anglers, which come to enjoy the local reefs (Pereira & Schleyer, 2005).

The lack of basic ecological research and monitoring, has traditionally contributed to the poor management of the resources and abusive practices, with deleterious effects on the local marine life. Following the proclamation of the Ponta do Ouro Partial Marine Reserve in August 2009, and approval of its Management Plan, a reef and recreational diving monitoring programme was established in 2011 (Pereira & Videira, 2011).

Essentially, the programme aims at monitoring indicator reef fish and pelagic species, reef benthic communities and underwater behaviour of SCUBA divers. The data generated will be linked to the resource use monitoring already being conducted by the RMPPO staff, which includes recreational and sport fishing landings and effort, as well as SCUBA diving pressure. Ultimately, these will be used to generate management measures, whenever needed. This report presents data collected during the 2014 monitoring.

## 2. MATERIALS AND METHODS

### 2.1. Study Area

The Ponta do Ouro Partial Marine Reserve is located in southern Mozambique at the border with South Africa. A detailed description of the study reefs and general area is presented in Robertson *et al.* (1996), Pereira (2003) and Pereira & Videira (2011).

The five reefs previously chosen for the monitoring program were again surveyed in 2014: three reefs are located near Ponta Malongane (Creche–Cr, Kev’s Ledge–KL and Texas–Tx) and two sites along the reef located off Mount Matonde, near Ponta Techobanine (Techo 1–Te1 and Techo 2–Te2). Table 1 and Figure 1 show the location of the reefs and GPS coordinates.

*Table 1. Location of selected reefs that were surveyed in the POPMR.*

Reef code	Reef Name	GPS Coordinates (WGS84)		Observations
Cr	Creche	S26° 48.371	E32° 53.622	Offshore, subtidal patch reef. Depth: 10-14 m. Very high diving pressure.
KL	Kev’s Ledge	S26° 46.673	E32° 54.268	Offshore, subtidal patch reef. Depth: 18-24 m. High diving pressure.
Te1	Techobanine 1	S26° 37.770	E32° 54.736	Offshore, subtidal patch reef. Depth: 16-20 m. Negligible diving pressure.
Te2	Techobanine 2	S26° 37.806	E32° 54.873	Offshore, subtidal patch reef. Depth: 18-22 m. Negligible diving pressure.
Tx	Texas	S26° 46.275	E32° 54.105	Offshore, subtidal patch reef. Depth: 12-18 m. Low diving pressure.



Figure 1. Schematic map of the study area showing approximate location of the study reefs (adapted from GoogleEarth). CR=Creche; KL=Kev's Ledge; Tx=Texas; Te1= Techobanine 1 and Te2=Techobanine 2.

## 2.2. Sampling Period

The survey was accomplished in two expeditions, one in February which was followed by the second in March 2014, comprising a total of ten diving days. This was largely due to logistical aspects and weather constraints. The complete diving team was composed of fish and coral specialists, dive master, dive buddy, skipper and deckhand (Figure 2).

## 2.3. Reef Benthic Communities

Benthic communities were documented using underwater digital imagery in photo-transects, as described by Pereira & Videira (2011). Geographical coordinates were taken during the dive by means of a GPS device attached to a surface board towed by a SCUBA diver, thus ensuring that the photo-transects were well geo-referenced (Annex 1). Each transect was composed of approximately 40 to 60 photo-quadrats. A total of 25 transects were completed, incorporating 955 photo-quadrats (Table 2).



Figure 2. Part of the dive team. March, 2014.

The data were extracted from the photo-quadrats using the point-intercept technique, where the images in JPEG format were analysed through the software CPCe 3.6. Eight randomly located points were superimposed on each image and the benthic category underneath each point identified to lowest possible taxonomic level. The morphological categories proposed by English *et al.* (1994) were used. A total of 7632 random data points were analysed (Table 2).

Table 2. Sampling effort for reef benthos at the POPMR during the 2014 survey.

Reef	N photo transects	N photo-quadrats	N random data points
Creche	5	177	1416
Kev's Ledge	5	178	1424
Techo 1	5	256	2048
Techo 2	5	208	1656
Texas	5	136	1088
Total	25	955	7632

#### 2.4. Reef Fish Communities

Two visual methods were used to document the fish communities: the point-count (PC; Bohnsack & Bannerot, 1986) and the timed long swims (LS; Choat & Pears, 2003) techniques. The pre-selected list of species surveyed is presented in Annex 2. Again, the methods were described in detail by Pereira & Videira (2011), and will not be repeated here. A total of 113 PCs and 36 LSs were performed (Table 3). A non-exhaustive species list was also compiled (Annex 3). The raw density data of abundant species (*Pseudoanthias squamipinnis* and *Chromis dimidiata*) was allocated to a Log<sub>3</sub> abundance class (1; 2-3; 4-9; 10-27; 28-81; 82-243; 244-729; 730-2187) as suggested by English *et al.* (1994). The mid value of the class was then used as the density estimate for the species.

**Table 3. Sampling effort for selected reef fish species at the POPMR during the 2014 survey.**

Reef	Point counts	Long swims
Creche	26	7
Kev's Ledge	25	6
Techobanine 1	19	8
Techobanine 2	18	7
Texas	25	8
Total	113	36

## 2.5. Underwater Behaviour of Recreational SCUBA Divers in the POPMR

Underwater divers' behaviour surveys were carried out to assess and quantify the damage caused by divers to the benthic communities. The methodology followed Pereira (2003) and Pereira & Videira (2011) in order to ensure consistency and comparability of the results. A total of 20 divers were monitored.

## 3. RESULTS

### 3.1. Reef Benthic Communities

Results of the benthic surveys are summarized in Table 4. Live coral cover ranged from 11.3% at Techobanine 2 to 35.5% at Texas. At all reefs surveyed, soft corals (ie. *Lobophytum* and *Sinularia*; Annex 4) were the dominant biota. Other living benthos (ie. sponges, ascidians, sea urchins, etc.) were present at all reefs, specially at Creche and Kev's Ledge (> 4.5%). Two crown-of-thorns starfish (*Acanthaster planci*) were observed at Techobanine. Rock and algae was the dominant benthic category, with turf macroalgae being conspicuous in both reefs at Techobanine with more than 10% cover. Fleishy macroalgae was also notably conspicuous at Kev's Ledge and Techobanine 2. Techobanine 2 was also the reef with the highest cover of rubble (16.5%).

**Table 4. Percentage cover  $\pm$  SD of the major reef benthic categories at the POPMR during the 2014 survey.**

Category	Creche	Kev's Ledge	Techobanine 1	Techobanine 2	Texas
Branching hard Coral	0.3 $\pm$ 0.4	0.5 $\pm$ 0.5	0.0 $\pm$ 0.0	0.1 $\pm$ 0.2	0.2 $\pm$ 0.2
Encrusting hard Coral	1.1 $\pm$ 1.7	0.8 $\pm$ 0.7	1.0 $\pm$ 1.0	0.6 $\pm$ 0.6	0.8 $\pm$ 1.1
Free living coral	0.0 $\pm$ 0.0	0.3 $\pm$ 0.2	0.0 $\pm$ 0.1	0.2 $\pm$ 0.3	0.0 $\pm$ 0.0
Massive hard coral	3.2 $\pm$ 1.6	3.4 $\pm$ 1.7	3.8 $\pm$ 4.1	3.4 $\pm$ 1.8	2.3 $\pm$ 1.0
Submassive hard coral	0.4 $\pm$ 1.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0
Tabular hard coral	0.3 $\pm$ 0.4	2.6 $\pm$ 5.8	1.4 $\pm$ 1.7	0.1 $\pm$ 0.1	0.0 $\pm$ 0.0
Total hard coral	5.4 $\pm$ 2.3	6.6 $\pm$ 5.9	6.3 $\pm$ 5.1	4.5 $\pm$ 1.6	3.3 $\pm$ 0.9
Soft coral	24.2 $\pm$ 11.4	21.3 $\pm$ 4.7	26.7 $\pm$ 15.3	6.6 $\pm$ 4.6	31.9 $\pm$ 3.9
Unidentified hard coral	0.3 $\pm$ 0.3	0.1 $\pm$ 0.2	0.2 $\pm$ 0.3	0.2 $\pm$ 0.2	0.4 $\pm$ 0.4
Total live coral	29.9 $\pm$ 12.8	22.6 $\pm$ 12.7	33.3 $\pm$ 11.8	11.3 $\pm$ 4.9	35.5 $\pm$ 4.4
Other living benthos	4.7 $\pm$ 1.8	4.6 $\pm$ 1.3	2.5 $\pm$ 1.4	2.4 $\pm$ 2.4	3.2 $\pm$ 1.6
Fleishy macroalgae	2.0 $\pm$ 1.0	13.1 $\pm$ 3.4	2.8 $\pm$ 0.8	7.9 $\pm$ 1.8	6.2 $\pm$ 1.6
Dead coral with algae	0.2 $\pm$ 0.2	0.4 $\pm$ 0.7	0.1 $\pm$ 0.2	0.5 $\pm$ 0.6	0.0 $\pm$ 0.0
Rock and algae	56.1 $\pm$ 9.0	49.6 $\pm$ 5.8	40.8 $\pm$ 16.5	44.8 $\pm$ 25.1	54.3 $\pm$ 5.1
Turf macroalgae	0.1 $\pm$ 0.3	1.5 $\pm$ 1.2	12.3 $\pm$ 3.4	10.0 $\pm$ 10.4	0.2 $\pm$ 0.3
Rubble	2.5 $\pm$ 2.0	1.1 $\pm$ 0.7	1.6 $\pm$ 1.0	16.5 $\pm$ 23.8	0.6 $\pm$ 0.4
Sand	4.4 $\pm$ 1.9	0.4 $\pm$ 0.5	6.3 $\pm$ 4.6	5.5 $\pm$ 4.1	0.0 $\pm$ 0.0

### 3.2. Reef Fish Communities

#### Density

The territorial fish density data is presented in Table 5. As expected, planktivore species (*Pseudoanthias squamipinnis* and *Chromis dimidiata*) were the most abundant species. *P. squamipinnis* was present in high numbers on Kev's Ledge, Creche and Texas while *C. dimidiata* was more abundant in Creche, Tecobanine 2 and Texas.

Predatory rockcods (family Serranidae) were present in low numbers, as it is typical of this family, whereas the largest species monitored – the potato bass (*Epinephelus tukula*) was only observed in two reefs, Kev's Ledge and Techobanine 1.

All corallivore species of the family Chaetodontidae (butterflyfishes) were represented at all reefs.

The parasite removers (*Labroides* spp.) were present at all reefs but in smaller proportions in Techobanine 1 and Techobanine 2, probably due to the overall low fish density at these sites.

Territorial herbivores (*Centropyge* spp.) were present at all reefs, being more abundant in Techobanine 2 and Kev's Ledge and less abundant in Texas. This probably reflects the high cover of fleshy macroalgae and turf macroalgae observed on these reefs as shown in Table 4.

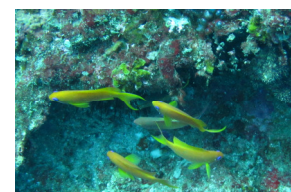


Figure 3. *Pseudoanthias squamipinnis*, Texas. Photo: R. Fernandes.

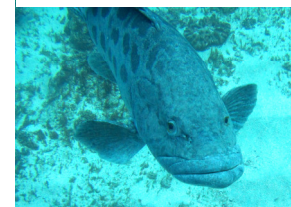


Figure 4. *Epinephelus tukula*, Techob1. Photo: R. Fernandes.



Figure 5. Parasite removers (*Labroides dimidiatus*), Creche. Photo: R. Fernandes.

Table 5. Territorial reef fish density (N fish/154 m<sup>2</sup>) ± SD at the POPMR during the 2014 survey. n = number of point counts.

Families / Species	Creche (n=26)	Kev's Ledge (n=25)	Techobanine 1 (n=19)	Techobanine 2 (n=18)	Texas (n=25)
Serranidae					
<i>Aethaloperca rogae</i>	0.6 ± 0.8	0.2 ± 0.5	0.1 ± 0.3	0.1 ± 0.3	0.0 ± 0.2
<i>Cephalopholis argus</i>	0.3 ± 0.4	0.0 ± 0.0	0.1 ± 0.4	0.4 ± 0.9	0.1 ± 0.3
<i>Cephalopholis miniata</i>	0.9 ± 1.1	0.1 ± 0.3	0.1 ± 0.3	0.0 ± 0.0	0.2 ± 0.4
<i>Epinephelus tukula</i>	0.0 ± 0.0	0.1 ± 0.3	0.3 ± 0.5	0.0 ± 0.0	0.0 ± 0.0
<i>Pseudoanthias squamipinnis</i>	36.8 ± 35.4	47.9 ± 40.9	6.7 ± 17.4	0.5 ± 1.6	15.2 ± 18.9
<i>Variola louti</i>	0.0 ± 0.0	0.0 ± 0.2	0.1 ± 0.2	0.3 ± 0.7	0.1 ± 0.3
Pomacanthidae					
<i>Centropyge</i> spp.	2.7 ± 1.6	3.4 ± 6.9	2.3 ± 1.6	3.7 ± 2.6	2.1 ± 2.1
Chaetodontidae					
<i>Chaetodon guttatissimus</i>	1.1 ± 1.0	1.0 ± 1.1	0.5 ± 0.9	1.4 ± 1.2	0.8 ± 1.0
<i>Chaetodon kleinii</i>	0.9 ± 0.8	2.0 ± 4.1	1.8 ± 2.0	1.6 ± 1.4	1.6 ± 1.5
<i>Chaetodon meyeri</i>	1.0 ± 1.2	0.3 ± 1.1	1.4 ± 1.9	0.8 ± 1.4	1.3 ± 1.3
<i>Chaetodon trifascialis</i>	0.4 ± 1.0	0.2 ± 0.5	0.6 ± 0.8	1.1 ± 1.4	0.1 ± 0.5
<i>Chaetodon unimaculatus</i>	0.1 ± 0.5	1.0 ± 1.7	0.2 ± 0.4	0.1 ± 0.3	0.3 ± 0.5
Pomacentridae					
<i>Chromis dimidiata</i>	38.7 ± 18.2	10.5 ± 7.5	6.4 ± 8.6	52.6 ± 119.8	27.4 ± 22.9
Labridae					
<i>Labroides</i> spp.	6.7 ± 8.8	6.4 ± 5.4	0.6 ± 1.1	1.1 ± 1.6	3.7 ± 3.3



Results of the pelagic species surveys are presented in Table 6. Fish species were present in very low numbers in Creche, Kev's Ledge, Techobanine 1 and Texas. Not a single pelagic fish was observed at Techobanine 2. Overall, the bluefin kingfish (*Caranx melampygus*), green jobfish (*Aprion virescens*), and bohar snapper (*Lutjanus bohar*) were the commonest pelagic species.

**Table 6.** Pelagic reef fish abundance (N fish/10 min)  $\pm$  SD at the POPMR during the 2014 survey. n = number of long swim transects.

Species	Creche (n=7)	Kev's Ledge (n=6)	Techobanine 1 (n=8)	Techobanine 2 (n=7)	Texas (n=8)
<i>Aphareus furca</i>	0.1 $\pm$ 0.4	0.3 $\pm$ 0.5	1.0 $\pm$ 6.0	0.0 $\pm$ 0.0	0.1 $\pm$ 0.4
<i>Aprion viriscens</i>	0.5 $\pm$ 0.9	0.0 $\pm$ 0.0	1.2 $\pm$ 7.0	0.0 $\pm$ 0.0	1.1 $\pm$ 1.4
<i>Caranx melampygus</i>	0.3 $\pm$ 0.7	2.9 $\pm$ 7.1	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	4.0 $\pm$ 5.8
<i>Lutjanus bohar</i>	2.0 $\pm$ 3.5	0.7 $\pm$ 1.3	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	1.3 $\pm$ 1.2

### Population Structure

The population structures of large territorial species of the family Serranidae and pelagic fish species are presented in Figures 6 and 7 and Annex 5. Despite the low number of individuals per species, the data suggests that all size classes are present, except for some rockcod species such as the potato bass (*E. tukula*), yellow-edged lyretail (*V. louti*) and the red-mouthed grouper (*A. roгаа*). No large-sized individuals were observed for the following pelagic species: *A. furca* and *C. melampygus*.

### Diversity

During the 2014 survey only 79 reef fish species were identified in total (Annex 3). This aspect did not constitute the focus of the survey and, therefore, it should not be taken as a real measure of fish diversity in the POPMR. Previous surveys (Pereira & Videira, 2011) listed 466 species in 90 families, which is still an under-representation of the ichthyological diversity of the area, as many cryptic species have not been recorded.

### 3.3. Underwater Behaviour of Recreational SCUBA Divers

Table 7 presents the results of the surveys on the underwater behaviour of recreational SCUBA divers. On average, divers got in contact 16.1 times (SD = 22.4) with the substrata, per 35 min dive. Most contacts were made with gear (ie. fins, gauges; 50%) and hands (43.5%); these were mostly on other benthos (mostly rock and algae; 47.8%) or sand (45.7%), and resulted mostly on abrasion (52.2%) and sediment resuspension (47.8%). As a result, no coral breakage was observed. The majority of the divers were males (60%). Only 3% of the divers carried cameras. Overall, divers were relatively experienced with an average of 160 logged dives.

## 4. CONCLUDING REMARKS AND RECOMMENDATIONS

From the results of the 2014 monitoring survey, three main points warrant attention:

- i) *Degradation of the coral communities.* A remarkable reduction of coral cover was observed at all reefs, particularly Techobanine 2. This is of particular concern as macroalgae (turf and fleshy) currently cover large areas, and there is a considerable risk of a community phase shift, which would result in an algal dominated community (Done, 1992; Hughes, 1994; Aronson *et al.*, 2004; Hughes *et al.*, 2007).

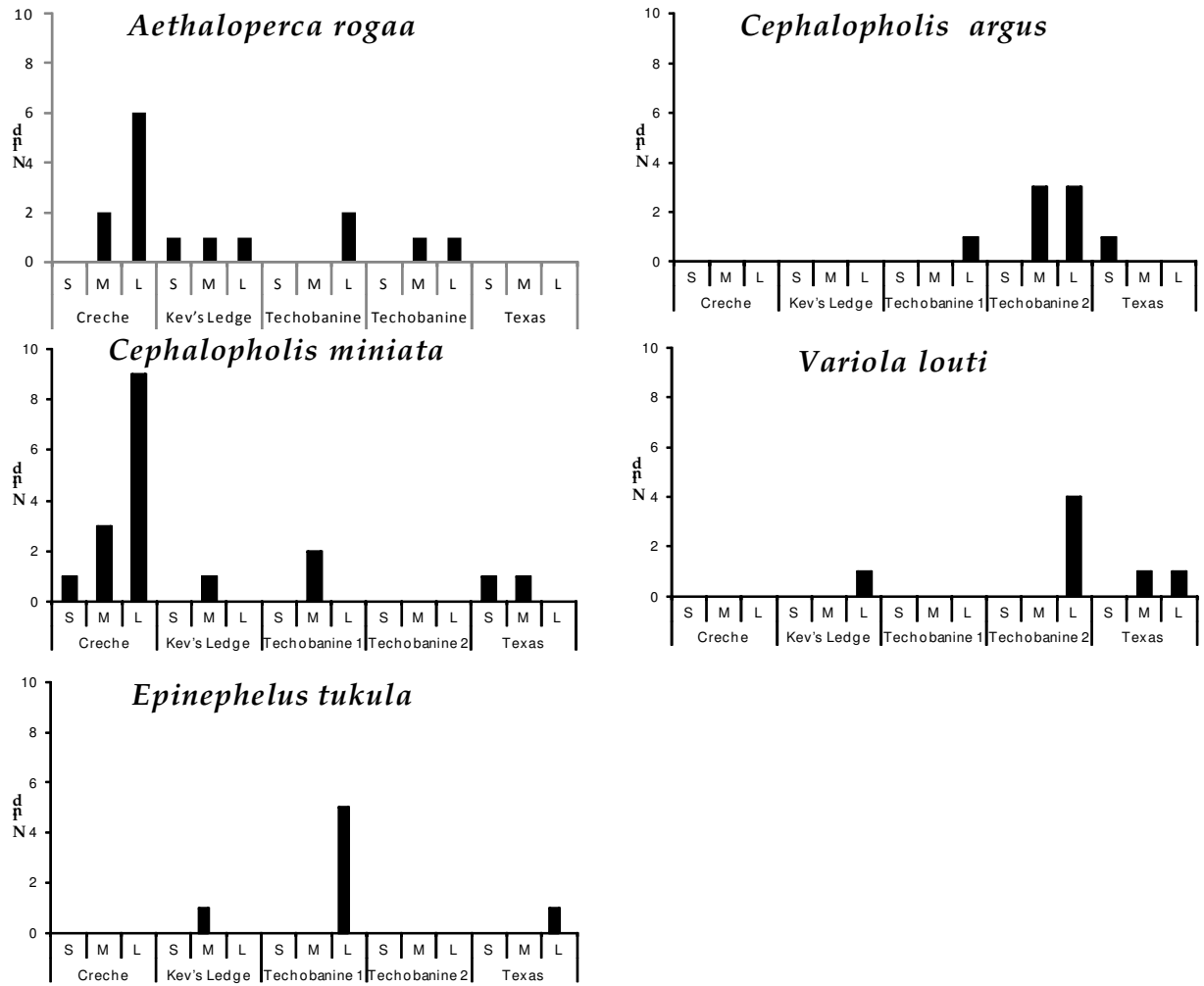


Figure 6. Population structure of large territorial species of serranids in the POPMR in 2014.

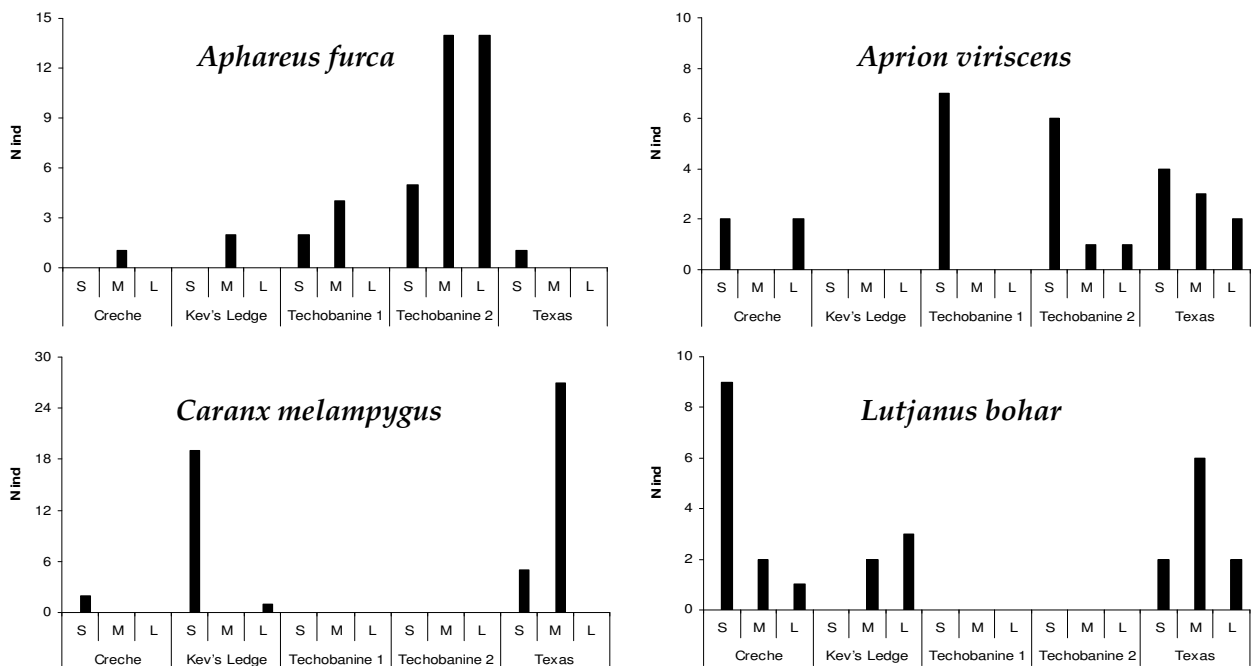


Figure 7. Population structure of pelagic fish species in the POPMR in 2014.

**Table 7. Summary results of the underwater behavior of recreational SCUBA divers in 2014 at the POPMR.**

Parameter	2014
N Males	12
N Females	8
Average N dives ( $\pm$ SD)	160.1 $\pm$ 342.5
Average contacts/35 min dive ( $\pm$ SD)	16.1 $\pm$ 22.4
N divers with cameras	3 (15%)
N contacts: divers with cameras	22.2 $\pm$ 31.4
N contacts: divers without cameras	15.2 $\pm$ 19.8
Contact by hand (%)	43.5
Contact by knee (%)	6.5
Contact by gear (%)	50.0
Contact by other (%)	0
Contacts on hard coral (%)	4.3
Contacts on soft coral (%)	2.2
Contacts on other benthos (%)	47.8
Contacts on sand (%)	45.7
Contacts with breakage (%)	0.0
Contacts with abrasion (%)	52.2
Contacts with sediment resuspension (%)	47.8

Phase-shift reversal can take a long time (>10 years; Done, 1992), although a rapid recovery (<10 years) as been reported in Jamaica (Idjadi *et al.*, 2006) However, several conditions need to be present including long-lived, massive corals that provided structural complexity and refugia, and herbivores (urchins, fish) that reduce algal biomass and thus help coral recovery (McManus *et al.*, 2000; Hughes *et al.*, 2007). Sea urchins were not particularly abundant in the Techobanine reefs, neither were large herbivorous fish (parrotfishes, surgeonfishes) although these were not the focus of the survey. It is thus recommended, that a more detailed study should be conducted and look into the key factors causing such decline in coral cover and recovery potential of the reef;

- ii) *Overfishing*. Very few individuals pelagic species were observed in the most popular reefs, which are subjected to recreational fishing. Even reefs located in fully protected areas (ie. Techobanine) had a very poor pelagic community. As previously mentioned (Pereira & Videira, 2011), the sport and recreational fishing effort is already taking a toll in the pelagic fish communities of the POPMR, which corroborates observations of a declining CPUE in this fishery (Pereira *et al.*, 2014). During the 2014 survey, a spearfishing party of about 8 men were spotted illegally spearfishing in Techobanine. About 90 kg of fish were already on board and included three potato basses (*E. tukula*), 18 parrotfish (*Scarus ghobban* and *S. rubroviolaceus*) among other species (surgeonfishes, rubberlips and other rockcods). This is particularly important given the need for a healthy fish community, particularly herbivores, in the recovery of the coral community as mentioned above in i). We therefore recommend, the reduction of the sport and recreational fishing effort and promotion of catch and release within the

POPMR. An improvement in the patrolling and enforcement particularly of the more remote reefs, should also be implemented;

- iii) *Crown-of-thorns-starfish (COTS; Acanthaster planci)*. This corallivorous echinoid is a very aggressive coral predator and in large numbers can be highly detrimental to coral reefs (Glynn, 1974; Lourey *et al.*, 2000). COTS have previously been reported in the area (Schleyer, 1998), but not reported in 2011 (Pereira & Videira, 2011). Although, only two individuals were observed in Techobanine, this is a case for concern as it may hinder the recovery of the coral communities. Further monitoring should pay particular attention to this species.

## 5. ACKNOWLEDGMENTS

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**ANNEX 1. GPS co-ordinates (WGS 84) of the photo-transects. Transects run either North or South depending on the prevailing current at the time of sampling.**

Reef (reef code)	Transect #	Start	End
Creche (Cr)	Tr1	S26 48.762 ; E32 53.634	S26 48.769 ; E32 53.644
	Tr2	S26 48.772 ; E32 53.642	S26 48.786 ; E32 53.636
	Tr3	S26 48.790 ; E32 53.635	S26 48.801 ; E32 53.636
	Tr4	S26 48.804 ; E32 53.635	S26 48.787 ; E32 53.630
	Tr5	S26 48.783 ; E32 53.634	S26 48.781 ; E32 53.637
Kev's Ledge (KL)	Tr1	S26 46.743 ; E32 54.259	S26 46.732 ; E32 54.253
	Tr2	S26 46.729 ; E32 54.253	S26 46.721 ; E32 54.253
	Tr3	S26 46.721 ; E32 54.253	S26 46.709 ; E32 54.247
	Tr4	S26 46.707 ; E32 54.247	S26 46.715 ; E32 54.251
	Tr5	S26 46.717 ; E32 54.252	S26 46.717 ; E32 54.252
Techobanine 1 (Te1)	Tr1	S26 37.777 ; E32 54.700	S26 37.764 ; E32 54.689
	Tr2	S26 37.759 ; E32 54.688	S26 37.737 ; E32 54.676
	Tr3	S26 37.722 ; E32 54.682	S26 37.739 ; E32 54.699
	Tr4	S26 37.746 ; E32 54.701	S26 37.729 ; E32 54.721
	Tr5	S26 37.729 ; E32 54.721	S26 37.699 ; E32 54.727
Techobanine 2 (Te2)	Tr1	S26 37.821 ; E32 54.839	S26 37.808 ; E32 54.833
	Tr2	S26 37.802 ; E32 54.835	S26 37.777 ; E32 54.839
	Tr3	S26 37.764 ; E32 54.850	S26 37.743 ; E32 54.862
	Tr4	S26 37.730 ; E32 54.871	S26 37.714 ; E32 54.898
	Tr5	S26 37.709 ; E32 54.899	S26 37.691 ; E32 54.904
Texas (Tx)	Tr1	S26 46.331 ; E32 54.025	S26 46.328 ; E32 54.021
	Tr2	S26 46.333 ; E32 54.022	S26 46.344 ; E32 54.027
	Tr3	S26 46.346 ; E32 54.031	S26 46.350 ; E32 54.043
	Tr4	S26 46.321 ; E32 54.030	S26 46.291 ; E32 54.040
	Tr5	26 46.289 ; E32 54.042	S26 46.277 ; E32 54.045

ANNEX 2. List of species recorded during the fish surveys. The trophic function of each species is as follows: TP=territorial piscivore; Co=corallivore; He= territorial herbivore; PR=parasite remover; Pl=Planktivore; MP=mobile predator.

POINT COUNTS		LONG SWIMS	
<b>Serranidae</b>		<b>Lutjanidae</b>	
<i>Aethaloperca rogae</i>	TP	<i>Aprion viriscens</i>	MP
<i>Epinephelus tukula</i>	TP	<i>Lujanus bohar</i>	MP
<i>Cephalopholis argus</i>	TP		
<i>Cephalopholis miniata</i>	TP	<b>Carangidae</b>	
<i>Pseudanthias squamipinnis</i>	Pl	<i>Caranx ignobilis</i>	MP
<i>Variola louti</i>	TP	<i>Caranx melampygus</i>	MP
<b>Chaetodontidae</b>		<b>Scombridae</b>	
<i>Chaetodon guttatissimus</i>	Co	<i>Scomberomorus commersonii</i>	MP
<i>Chaetodon kleinii</i>	Co		
<i>Chaetodon unimaculatus</i>	Co	<b>Sphyraenidae</b>	
<i>Chaetodon meyeri</i>	Co	<i>Sphyraena spp.</i>	MP
<i>Chaetodon trifascialis</i>	Co		
<b>Labridae</b>		<b>Sharks, rays</b>	
<i>Labroides spp.</i>	PR		MP
<b>Pomacanthidae</b>			
<i>Centropyge spp.</i>	He		
<b>Pomacentridae</b>			
<i>Chromis dimidiatus</i>	Pl		

**ANNEX 3. Cumulative checklist of reef and litoral fish species identified at the POPMR during the 2011 survey. Species list was compiled from Pereira *et al.* (2004) and Floros (2010). # = species observed in 2011; (X) = species observed in 2014.**

<i>Acanthuridae</i>		<i>Caracanthus madagascariensis</i>
<i>Acanthurus auranticavus</i> #	<i>Aulostomidae</i>	<i>Caracanthus unipinna</i>
<i>Acanthurus blochii</i>	<i>Aulostomos chinensis</i> #	
<i>Acanthurus dussumieri</i> #X	<i>Balistidae</i>	<i>Carangidae</i>
<i>Acanthurus leucosternon</i> #X	<i>Aluterus scriptus</i> #	<i>Alectis ciliaris</i>
<i>Acanthurus lineatus</i>	<i>Balistapus undulatus</i> #X	<i>Alectis indicus</i>
<i>Acanthurus mata</i> #	<i>Balistoides conspicillum</i> #X	<i>Alepes djedaba</i> #
<i>Acanthurus nigrofuscus</i>	<i>Balistoides viridescens</i> #	<i>Carangoides caeruleopinnatus</i>
<i>Acanthurus tennentii</i> #X	<i>Melichthys indicus</i> #X	<i>Carangoides ferdau</i> #
<i>Acanthurus thompsoni</i> #	<i>Melichthys niger</i>	<i>Carangoides fulvooguttatus</i>
<i>Acanthurus triostegus</i>	<i>Odonus niger</i> #X	<i>Caranx heberi</i> #
<i>Acanthurus xanthopterus</i>	<i>Pseudobalistes fuscus</i> #	<i>Caranx ignobilis</i>
<i>Ctenochaetus binotatus</i> #	<i>Sufflamen bursa</i> #	<i>Caranx melampygus</i> #X
<i>Ctenochaetus striatus</i> #	<i>Sufflamen chrysopterus</i> #	<i>Caranx papuensis</i>
<i>Ctenochaetus strigosus</i> #	<i>Sufflamen fraenatus</i> #X	<i>Caranx sem</i>
<i>Ctenochaetus truncatus</i>		<i>Caranx sexfasciatus</i>
<i>Naso brachycentron</i> #	<i>Blenniidae</i>	<i>Decapterus macarellus</i>
<i>Naso brevirostris</i>	<i>Alloblennius parvus</i>	<i>Gnathanodon speciosus</i>
<i>Naso fageni</i> #	<i>Aspidontus dussumieri</i>	<i>Pseudocaranx dentex</i> #
<i>Naso hexacanthus</i> #	<i>Aspidontus taeniatus tractus</i>	<i>Scomberoides lysan</i>
<i>Naso lituratus</i> #	<i>Cirripectes castaneus</i>	<i>Seriolina nigrofasciata</i> #
<i>Naso unicornis</i> #	<i>Ecsenius midas</i> #	<i>Trachinotus botla</i>
<i>Paracanthurus hepatus</i>	<i>Ecsenius nalolo</i> #	<i>Carcharhinidae</i>
<i>Zebrassoma gemmatum</i> #X	<i>Exallias brevis</i>	<i>Carcharhinus amblyrhynchos</i>
<i>Zebrassoma scopas</i> #	<i>Hirculops cornifer</i>	<i>Carcharhinus leucas</i>
	<i>Istiblennius andamensis</i>	<i>Galeocerdo cuvier</i>
<i>Antennariidae</i>	<i>Istiblennius dussumieri</i>	<i>Triaenodon obesus</i> #
<i>Antennarius coccineus</i>	<i>Istiblennius edentulus</i>	
<i>Antennarius nummifer</i>	<i>Pereulixia kosiensis</i>	<i>Chaetodontidae</i>
	<i>Plagiotremus rhinorhynchos</i> #X	<i>Chaetodon auriga</i> #X
<i>Antherinidae</i>	<i>Plagiotremus tapeinosoma</i>	<i>Chaetodon blackburnii</i> #X
<i>Antennarius coccineus</i>	<i>Scartella emarginata</i>	<i>Chaetodon dolosus</i>
<i>Antennarius nummifer</i>		<i>Chaetodon guttatissimus</i> #X
	<i>Bythitidae</i>	<i>Chaetodon interruptus /unimaculatus</i> #X
<i>Apogonidae</i>	<i>Bothidae</i>	<i>Chaetodon kleinii</i> #X
<i>Apogon aereus</i> #X	<i>Bothus mancus</i>	<i>Chaetodon lunula</i> #X
<i>Apogon angustatus</i>	<i>Dinematichthys sp.</i>	<i>Chaetodon mertensii /</i>
<i>Apogon apogonides</i>	<i>Engyproponon sp.</i>	<i>madagaskariensis</i> #X
<i>Apogon coccineus</i>		<i>Chaetodon meyeri</i> #X
<i>Apogon fraenatus</i>	<i>Caesionidae</i>	<i>Chaetodon trifascialis</i> #
<i>Apogon kallopterus</i>	<i>Caesio caeruleaureus</i> #	<i>Chaetodon trifasciatus</i> #
<i>Apogon nitidus</i>	<i>Caesio lunaris</i> #	<i>Chaetodon vagabundus</i> #
<i>Apogon semiornatus</i>	<i>Caesio teres</i>	<i>Forcipiger flavissimus</i> #X
<i>Apogon taeniophorus</i> #	<i>Caesio xanthonota</i> #	<i>Hemitaurichthys zoster</i> #X
<i>Apogonichthys ocellatus</i>	<i>Pterocaesio tile</i> #	<i>Heniochus acuminatus</i> #
<i>Cheilodipterus artus</i> #		<i>Heniochus diphreutes</i> #
<i>Cheilodipterus lineatus</i>	<i>Callionymidae</i>	<i>Heniochus monoceros</i> #
<i>Gymnapogon africanus</i>	<i>Callionymus marleyi</i>	
<i>Neamia octospina</i>	<i>Synchiropus postulus</i>	<i>Cirrhitidae</i>
<i>Siphamia mossambica</i>	<i>Synchiropus stellatus</i>	<i>Amblycirrhitus bimacula</i>
		<i>Cirrhitichthys oxycephalus</i> #X
<i>Atherinidae</i>	<i>Caracanthidae</i>	<i>Paracirrhites arcatus</i> #X
<i>Atherinomorus lacunosus</i>		



<i>Paracirrhites forsteri</i> #X	<i>Eviota prasina</i>	<i>Labridae</i>
<i>Clinidae</i>	<i>Fusigobius duospillus</i>	<i>Anampses caeruleopunctatus</i> #
<i>Pavoclinus graminis</i>	<i>Fusigobius longispinus</i>	<i>Anampses lineatus</i> #
<i>Pavoclinus laurentii</i>	<i>Gnatholepis</i> sp.	<i>Anampses meleagrides</i> #
	<i>Gobiodon rivulatus</i>	<i>Anampses twistii</i> #
<i>Congridae</i>	<i>Heteroleotris tentaculata</i>	<i>Bodianus anthioides</i>
<i>Conger cinereus cinereus</i>	<i>Heteroleotris zonata</i>	<i>Bodianus axillaris</i> #
	<i>Istigobius decoratus</i>	<i>Bodianus bilunulatus</i> #X
<i>Congrogadidae</i>	<i>Nemateleotris magnifica</i> #X	<i>Bodianus diana</i> #
<i>Halimuraena shakai</i>	<i>Pleurosicya mossambica</i>	<i>Bodianus perditio</i> #
	<i>Priolepis cincta</i>	<i>Bodianus trilineatus</i> #
<i>Coracinidae</i>	<i>Ptereleotris eteroptera</i>	<i>Calotomus carolinus</i> #
<i>Coracinus multifasciatus</i>	<i>Ptereleotris evides</i> #X	<i>Cheilinus bimaculatus</i>
	<i>Trimma macrophthalmia</i>	<i>Cheilinus trilobatus</i> #
<i>Creediidae</i>	<i>Valenciennea strigata</i> #	<i>Cheilio inermis</i>
<i>Apodocreeidia vanderhorsti</i>	<i>Grammistidae</i>	<i>Chlorurus atrilunula</i> #
<i>Limnichthys nitidus</i>	<i>Grammistes sexlineatus</i> X	<i>Chlorurus cyanescens</i> #
		<i>Cirrhilabrus exquisitus</i> #
<i>Cynoglossidae</i>	<i>Haemulidae</i>	<i>Coris aygula</i> #
<i>Cynoglossus</i> sp.	<i>Diagramma pictum</i> #	<i>Coris caudimacula</i> #X
<i>Parapaglusia bilineata</i>	<i>Plectorhinchus chubbi</i> #	<i>Coris cuvieri</i> #
	<i>Plectorhinchus flavomaculatus</i> #X	<i>Coris formosa</i>
<i>Dasyatidae</i>	<i>Plectorhinchus gaterinus</i>	<i>Coris gaimard africana</i> #
<i>Himantura gerrardi</i> #	<i>Plectorhinchus orientalis</i> #	<i>Gomphosus caeruleus</i> #X
<i>Neotrygon kuhlii</i> #	<i>Plectorhinchus plagiodesmus</i> #	<i>Halichoeres cosmetus</i> #
<i>Taeniura lymma</i> #X	<i>Plectorhinchus playfairi</i> #	<i>Halichoeres hortulanus</i> #
<i>Taeniura melanospilos</i> #	<i>Plectorhinchus schotaf</i>	<i>Halichoeres iridis</i> #
<i>Urogymnus asperrimus</i>	<i>Pomadasys commersonii</i>	<i>Halichoeres nebulosus</i>
	<i>Pomadasys furcatum</i>	<i>Hemigymnus fasciatus</i> #
<i>Dinopercidae</i>		<i>Hologymnosus annulatus</i> #
<i>Dinoperca petersi</i>	<i>Hemiramphidae</i>	<i>Hologymnosus doliatus</i> #
	<i>Hyporhamphus affinis</i>	<i>Iniistius pavo</i> #
<i>Diodontidae</i>		<i>Labroides bicolor</i> #X
<i>Diodon hystrix</i>	<i>Holocentridae</i>	<i>Labroides dimidiatus</i> #X
<i>Diodon liturosus</i> #	<i>Myripristis berndti</i> #	<i>Labropsis xanthonota</i>
	<i>Myripristis botche</i> #	<i>Macropharyngodon bipartitus bipartitus</i>
<i>Echeneidae</i>	<i>Myripristis kuntee</i>	#
<i>Echeneis naucrates</i>	<i>Myripristis murdjan</i> #X	<i>Macropharyngodon cyanoguttatus</i>
	<i>Neoniphon argenteus</i> #	<i>Macropharyngodon vivienae</i>
<i>Ephipidae</i>	<i>Neoniphon sammara</i> #	<i>Novaculichthys taeniourus</i>
<i>Platax teira</i>	<i>Sargocentrom ittodai</i>	<i>Oxycheilinus diagramma</i> #
<i>Tripteron orbis</i>	<i>Sargocentron caudimaculatum</i> #	<i>Pseudocheilinus evanidus</i>
	<i>Sargocentron diadema</i> #X	<i>Pseudocheilinus hexataenia</i> #
<i>Exocoetidae</i>		<i>Pseudojuloides cerasinus</i>
<i>Exocoetidae</i> sp.	<i>Istiophoridae</i>	<i>Scarus frenatus</i> #
<i>Fistularia commersonii</i> #	<i>Istiophorus platypterus</i>	<i>Scarus ghobban</i> #X
<i>Fistularia petimba</i>	<i>Makaira indica</i>	<i>Scarus rubroviolaceus</i> #X
<i>Fistulariidae</i>		<i>Scarus tricolor</i> #
	<i>Khuliidae</i>	<i>Scarus viridifucatus</i> #
<i>Gerreidae</i>	<i>Khulia mugil</i>	<i>Stethojulis albovittata</i>
<i>Gerres acinaces</i>		<i>Stethojulis interrupta</i> #
<i>Gobiesocidae</i>	<i>Kraemeriidae</i>	<i>Stethojulis strigiventer</i>
<i>Lepadichthys coccinotaenia</i>	<i>Kraemia samoensis</i>	<i>Thalassoma amblycephalum</i> #X
		<i>Thalassoma genivittatum</i> #
<i>Gobiidae</i>	<i>Kyphosidae</i>	<i>Thalassoma hebraicum</i> #X
<i>Callogobius sclateri</i>	<i>Kyphosus bigibbus</i>	<i>Thalassoma lunare</i> #X

<i>Thalassoma lutescens</i> #	<i>Parupneus rubescens</i> #	<i>Pempheridae</i>
<i>Thalassoma purpuraceum</i>	<i>Parupneus bifasciatus</i> #X	<i>Parapriacanthus ransonneti</i>
<i>Thalassoma trilobatum</i>	<i>Parupneus cinnabarinus</i> #	<i>Pempheris adusta</i> #X
<i>Lethrinidae</i>	<i>Parupneus cyclostomus</i> #	<i>Pinguipedidae</i>
<i>Gnathodentex aureolineatus</i> #	<i>Parupneus indicus</i> #X	<i>Parapercis hexophthalma</i>
<i>Gymnocranius griseus</i>	<i>Parupneus macronema</i> #	<i>Parapercis punctulata</i> #
<i>Lethrinus crocineus</i> #	<i>Muraenidae</i>	<i>Parapercis robinsoni</i>
<i>Lethrinus harak</i>	<i>Echidna nebulosa</i>	<i>Parapercis xanthozona</i> #
<i>Lethrinus lentjan</i> #	<i>Gymnomuraena zebra</i>	<i>Platycephalidae</i>
<i>Lethrinus nebulosus</i> #	<i>Gymnothorax breedeni</i> #X	<i>Onigocia oligolepis</i>
<i>Lethrinus variegatus</i>	<i>Gymnothorax buroensis</i>	<i>Thysanophrys chiltonae</i>
<i>Monotaxis grandoculis</i> #X	<i>Gymnothorax eurostrus</i>	<i>Thysanophrys otaitensis</i>
<i>Lutjanidae</i>	<i>Gymnothorax favagineus</i> #X	<i>Pleuronectidae</i>
<i>Aphareus furca</i> #X	<i>Gymnothorax flavimarginatus</i>	<i>Samariscus triocellatus</i>
<i>Aphareus rutilans</i>	<i>Gymnothorax fuscomaculatus</i>	<i>Plotosidae</i>
<i>Aprion virescens</i> #X	<i>Gymnothorax javanicus</i> #	<i>Plotosus lineatus</i>
<i>Lutjanus argentimaculatus</i> #	<i>Gymnothorax margaritophorus</i>	<i>Polynemidae</i>
<i>Lutjanus bohar</i> #X	<i>Gymnothorax melatremus</i>	<i>Polydactylus plebeius</i>
<i>Lutjanus fulviflamma</i> #	<i>Gymnothorax meleagris</i> #	<i>Pomacanthidae</i>
<i>Lutjanus gibbus</i> #X	<i>Gymnothorax nudivomer</i> #	<i>Apolemichthys kingi</i> #
<i>Lutjanus kasmira</i> #X	<i>Gymnothorax undulatus</i>	<i>Apolemichthys trimaculatus</i> X
<i>Lutjanus lutjans</i> #	<i>Gymnothorax zonipectis</i>	<i>Centropyge acanthops</i> X
<i>Lutjanus monostigma</i>	<i>Siderea grisea</i> X	<i>Centropyge bispinosus</i>
<i>Lutjanus rivulatus</i> #X	<i>Siderea picta</i>	<i>Centropyge multispinis</i> X
<i>Lutjanus russellii</i>	<i>Myliobatidae</i>	<i>Genicanthus caudovittatus</i> #
<i>Macolor niger</i> #	<i>Aetobatus narinari</i>	<i>Pomacanthus imperator</i> X
<i>Malacanthidae</i>	<i>Nemipteridae</i>	<i>Pomacanthus rhomboides</i> X
<i>Malacanthus brevirostris</i> #	<i>Scolopsis vosmeri</i>	<i>Pomacanthus semicirculatus</i>
<i>Malacanthus latovittatus</i> #	<i>Notocheiridae</i>	<i>Pygoplites diacanthus</i> #
<i>Mobulidae</i>	<i>Eugomphodus taurus</i>	<i>Pomacentridae</i>
<i>Manta birostris</i>	<i>Iso natalensis</i>	<i>Abudefduf natalensis</i> #X
<i>Monacanthidae</i>	<i>Odontaspidae</i>	<i>Abudefduf notatus</i>
<i>Cantherines dumerilii</i> #	<i>Ophichthidae</i>	<i>Abudefduf sexfasciatus</i>
<i>Cantherines fronticintus</i> #	<i>Myrichthys maculosus</i> #	<i>Abudefduf sordidus</i>
<i>Cantherines pardalis</i> #	<i>Ophidiidae</i>	<i>Abudefduf sparoides</i> #
<i>Paraluteres prionurus</i>	<i>Brotula multibarbata</i>	<i>Abudefduf vaigiensis</i> #
<i>Perogor janthinosa</i> #	<i>Opistognathidae</i>	<i>Amphiprion akallopisos</i> #
<i>Stephanolepis auratus</i>	<i>Opistognathus margaretae</i>	<i>Amphiprion allardi</i> #X
<i>Monodactylidae</i>	<i>Oplegnathidae</i>	<i>Chromis dasygenys</i>
<i>Monodactylus argenteus</i>	<i>Oplegnathus peaolopesi</i>	<i>Chromis dimidiata</i> #X
<i>Mugilidae</i>	<i>Oplegnathus robinsoni</i> #X	<i>Chromis lepidolepis</i> #
<i>Liza macrolepis</i>	<i>Orectolobidae</i>	<i>Chromis nigrura</i> #
<i>Mugil cephalus</i>	<i>Stegostoma fasciatum</i>	<i>Chromis opercularis</i> #
<i>Valamugil buchanani</i>	<i>Ostraciidae</i>	<i>Chromis weberi</i> #X
<i>Mullidae</i>	<i>Ostracion cubicus</i> #	<i>Chrysiptera unimaculata</i>
<i>Mulloidides vanicolensis</i> #	<i>Ostracion meleagris</i> #	<i>Dascyllus carneus</i> #
<i>Mulloidichtys flavolineatus</i> #X		<i>Dascyllus trimaculatus</i> #X
<i>Parupneus barberinus</i> #		<i>Neopomacentrus cyanomos</i>
<i>Parupneus pleurostigma</i> #		<i>Plectroglyphidodon dickii</i> #
		<i>Plectroglyphidodon jhonstonianus</i> #

<i>Plectroglyphidodon lacrymatus</i> #	<i>Serranidae</i>	<i>Synodontidae</i>
<i>Plectroglyphidodon leucozonus</i>	<i>Aethaloperca rogae</i> # X	<i>Saurida gracilis</i>
<i>Pomacentrus caeruleus</i> # X	<i>Anthias evansi</i> #	<i>Synodus binotatus</i>
<i>Pomacentrus pavo</i> #	<i>Cephalopholis argus</i> # X	<i>Synodus dermatogenys</i> #
<i>Pomacentrus trichourus</i> #	<i>Cephalopholis miniata</i> # X	<i>Synodus jaculum</i>
	<i>Cephalopholis nigripinnis</i> #	<i>Synodus variegatus</i>
<i>Pomatomidae</i>	<i>Cephalopholis sonnerati</i> #	
<i>Pomatomus saltatrix</i>	<i>Epinephelus andersoni</i> #	<i>Teraponidae</i>
	<i>Epinephelus caeruleopunctatus</i>	<i>Terapon jarbua</i>
<i>Priacanthidae</i>	<i>Epinephelus fasciatus</i> # X	
<i>Priacanthus cruentatus</i>	<i>Epinephelus flavocaeruleus</i> # X	<i>Tetraodontidae</i>
<i>Priacanthus hamrur</i> #	<i>Epinephelus lanceolatus</i> #	<i>Amblyrhynchotes honckenii</i>
<i>Rhincodon typus</i>	<i>Epinephelus macrospilos</i> # X	<i>Arothron hispidus</i> #
	<i>Epinephelus malabaricus</i>	<i>Arothron meleagris</i> #
<i>Pseudochromidae</i>	<i>Epinephelus marginatus</i>	<i>Arothron nigropunctatus</i> # X
<i>Chlidichthys johnvoelckeri</i>	<i>Epinephelus posteli</i> #	<i>Arothron stellatus</i> #
<i>Pseudochromis dutoiti</i> #	<i>Epinephelus rivulatus</i>	<i>Canthigaster ambionensis</i>
<i>Pseudochromis melas</i>	<i>Epinephelus tauvina</i> #	<i>Canthigaster bennetti</i>
<i>Pseudochromis natalensis</i>	<i>Epinephelus tukula</i> # X	<i>Canthigaster cyanospilota</i>
	<i>Nemanthias carberryi</i> #	<i>Canthigaster janthinoptera</i>
<i>Pseudogrammidae</i>	<i>Plectranthias longimanus</i>	<i>Canthigaster smithae</i>
<i>Pseudogramma polyacanthum</i>	<i>Plectropomus punctatus</i> #	<i>Canthigaster valentini</i> # X
	<i>Pseudoanthias squamipinnis</i> # X	
<i>Rhincodontidae</i>	<i>Variola albimarginata</i>	<i>Torpedinidae</i>
	<i>Variola louti</i> X	<i>Torpedo sinuspersici</i>
<i>Rhinobatidae</i>		
<i>Rhynchobatus djiddensis</i> #	<i>Siganidae</i>	<i>Trichonotidae</i>
	<i>Siganus luridus</i>	<i>Trichonotus marleyi</i>
<i>Sciaenidae</i>	<i>Siganus stellatus</i>	<i>Enneapterygius abeli</i>
<i>Argyrosomus japonicus</i>	<i>Siganus sutor</i> #	<i>Enneapterygius elegans</i>
<i>Umbrina canariensis</i>		<i>Enneapterygius pusillus</i>
<i>Umbrina ronchus</i> #	<i>Soleidae</i>	<i>Enneapterygius ventermaculus</i>
-	<i>Parachirus xenicus</i>	<i>Helcogramma fuscopinna</i>
<i>Sarda orientalis</i>	<i>Pardachirus morrowi</i>	<i>Helcogramma obtusirostre</i>
<i>Scomberomorus commerson</i> #	<i>Sparidae</i>	<i>Zanclidae</i>
<i>Thunnus albacares</i>	<i>Acanthopagrus bifasciatus</i>	<i>Zanclus canescens</i> #
	<i>Chrysoblephus anglicus</i> #	
<i>Scorpaenidae</i>	<i>Chrysoblephus puniceus</i> #	
<i>Parascorpaena mcadamsi</i>	<i>Diplodus cervinus hottentotus</i>	
<i>Parascorpaena mossambica</i>	<i>Diplodus sargus capensis</i>	
<i>Pterois miles</i> #	<i>Lithognathus mormyrus</i> #	
<i>Pterois mombasae</i>	<i>Pachymetopon aeneum</i> #	
<i>Scorpaenodes kelloggi</i>	<i>Pachymetopon grande</i> #	
<i>Scorpaenodes parvipinnis</i>	<i>Rhabdosargus holubi</i>	
<i>Scorpaenodes varipinnis</i>	<i>Rhabdosargus sarba</i>	
<i>Scorpaenopsis brevifrons</i>	<i>Rhabdosargus thorpei</i>	
<i>Scorpaenopsis oxycephala</i>		
<i>Scorpaenopsis venosa</i> #	<i>Sphyraenidae</i>	
<i>Sebastapistes cyanostigma</i>	<i>Sphyraena jello</i>	
<i>Sebastapistes mauritiana</i>		
<i>Sebastapistes strongia</i>	<i>Sphyrnidae</i>	
<i>Taenianotus triacanthus</i> #	<i>Sphyrna sp.</i>	
<i>Scorpididae</i>	<i>Syngnathidae</i>	
<i>Neoscorpis lithophilus</i>	<i>Doryrhamphus excisus excisus</i>	

**ANNEX 4. Percentage cover  $\pm$  SD of coral genera identified within the POPMR during the 2014 survey. % tran = percentage of the genera within the transect; % coral = percentage of the genera within corals only. SD = standard deviation.**

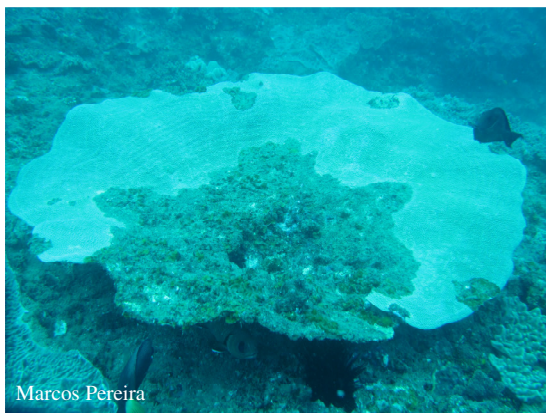
Genera	Creche				Kev's Ledge				Techobanine 1				Techo banine 2				Texas			
	% tran	SD	% coral	SD	% tran	SD	% coral	SD	% tran	SD	% coral	SD	% tran	SD	% coral	SD	% tran	SD	% coral	SD
<i>Acanthastrea</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Acropora</i>	0.7	0.2	2.9	2.1	0.3	0.3	1.2	1.2	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.5	0.1	0.2	0.3	0.6
<i>Alveopora</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.9	11.1	11.0	0.1	0.2	0.3	0.7
<i>Astreopora</i>	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.8	0.6	0.6	2.5	2.6	0.2	0.5	1.8	4.1	0.5	0.8	1.2	2.1
<i>Cespitularia</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Cladiela</i>	0.3	0.8	0.9	1.9	0.4	0.5	1.4	1.9	0.6	0.8	1.6	1.8	0.2	0.3	1.4	2.1	0.0	0.0	0.0	0.0
<i>Diploastrea</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Echinopora</i>	0.1	0.2	0.2	0.4	0.2	0.3	0.7	1.0	0.1	0.3	0.5	1.1	0.1	0.2	1.1	1.6	0.0	0.0	0.0	0.0
<i>Favia</i>	0.5	0.7	2.8	4.4	0.8	0.5	2.8	1.6	0.6	0.4	2.0	1.8	0.3	0.4	3.7	4.2	0.8	0.4	2.2	1.2
<i>Favites</i>	0.7	0.6	3.0	2.7	1.5	0.9	5.1	2.8	0.3	0.4	1.5	2.5	0.4	0.3	2.6	2.9	0.7	0.7	1.8	1.9
<i>Fungiid</i>	0.0	0.0	0.0	0.0	0.3	0.2	1.2	0.8	0.0	0.1	0.1	0.3	0.2	0.3	1.4	2.1	0.0	0.0	0.0	0.0
<i>Galaxea</i>	0.2	0.5	2.0	4.5	0.4	0.5	1.5	1.9	0.0	0.0	0.0	0.0	0.2	0.2	0.9	1.3	0.1	0.2	0.3	0.7
<i>Goniastrea</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Goniopora</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Gorgonian</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Hydnophora</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lobophyllia</i>	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.4	0.4	0.8	2.2	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Lobophytum</i>	17.6	7.2	58.6	15.3	9.1	2.7	31.1	10.1	18.0	11.2	49.9	18.1	2.0	1.8	15.0	8.2	25.7	5.0	72.8	13.4
<i>Merulina</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
<i>Montipora</i>	0.7	1.7	1.8	4.0	0.3	0.6	0.9	2.0	0.4	0.4	1.7	2.4	0.1	0.2	0.9	1.3	0.2	0.5	0.6	1.3
<i>Mycedium</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Nephthiid</i>	0.1	0.2	0.2	0.4	0.1	0.2	0.3	0.7	0.0	0.0	0.0	0.0	0.3	0.6	1.4	3.2	0.0	0.0	0.0	0.0
<i>Oxypora</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pachyseris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pachyseris</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pavona</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Platygyra</i>	1.0	0.9	3.2	2.1	0.5	0.8	1.6	2.7	0.9	0.7	3.1	2.1	0.7	0.9	5.4	6.9	0.1	0.2	0.3	0.6
<i>Plesiastrea</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Pocillopora</i>	0.1	0.1	0.2	0.4	0.2	0.2	0.6	0.8	0.0	0.0	0.0	0.0	0.1	0.2	0.7	1.5	0.1	0.2	0.2	0.4
<i>Porites</i>	0.9	1.3	2.3	3.1	0.1	0.2	0.5	0.7	1.4	2.5	4.9	8.2	0.6	0.6	10.1	10.5	0.7	1.0	1.8	2.8
<i>Rhytisma</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0
<i>Sarcophyton</i>	0.1	0.2	0.4	0.5	0.4	0.3	1.5	1.3	1.6	0.7	5.8	4.6	1.0	0.9	7.6	7.3	1.0	1.0	2.7	2.7

**ANNEX 4. Cont.**

<i>Genera</i>	<b>Creche</b>				<b>Kev's Ledge</b>				<b>Techobanine 1</b>				<b>Techobanine 2</b>				<b>Texas</b>			
	% tran	SD	% coral	SD	% tran	SD	% coral	SD	% tran	SD	% coral	SD	% tran	SD	% coral	SD	% tran	SD	% coral	SD
<i>Seriatopora</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Simularia</i>	5.8	4.7	16.9	10.8	11.2	3.8	37.9	11.6	5.9	4.2	16.3	6.8	3.1	2.2	23.1	15.8	5.2	5.4	14.4	14.3
<i>Stylophora</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Tubipora</i>	0.1	0.3	0.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Turbinaria</i>	0.0	0.0	0.0	0.0	2.7	5.7	8.8	18.9	1.4	1.7	4.8	5.9	0.1	0.1	0.5	1.1	0.0	0.0	0.0	0.0
<i>Xeniid</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.3	1.9	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

**ANNEX 5. Population structure of large territorial and pelagic fish species at the POPMR in 2014. The total number of individuals per size class is presented for each reef surveyed. Size classes are presented as: S=0-30 cm; M=31-50 cm and L=+51 cm.**

Species	Creche			Kev's Ledge			Techobanine 1			Techobanine 2			Texas		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
<b>Territorial Species</b>															
<i>Aethaloperca rogae</i>	0	2	6	1	1	1	0	0	2	0	1	1	0	0	0
<i>Cephalopholis argus</i>	0	0	0	0	0	0	0	0	1	0	3	3	1	0	0
<i>Cephalopholis miniata</i>	1	3	9	0	1	0	0	2	0	0	0	0	1	1	0
<i>Epinephelus tukula</i>	0	0	0	0	1	0	0	0	5	0	0	0	0	0	1
<i>Variola louti</i>	0	0	0	0	0	1	0	0	0	0	0	4	0	1	1
<b>Pelagic Species</b>															
<i>Aphareus furca</i>	0	1	0	0	2	0	2	4	0	5	14	14	1	0	0
<i>Aprion viriscens</i>	2	0	2	0	0	0	7	0	0	6	1	1	4	3	2
<i>Caranx melampygus</i>	2	0	0	19	0	1	0	0	0	0	0	0	5	27	0
<i>Dasyatis kuhlii</i>	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
<i>Lutjanus bohar</i>	9	2	1	0	2	3	0	0	0	0	0	0	2	6	2
<i>Taeniura lymma</i>	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0



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