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Butterflyfishes (Chaetodontidae) from Abu Hashish fringing reefs, Port Sudan, Red Sea

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Abstract

Using Reef Check Programme butterflyfishes of Abu Hashish fringing reefs were recorded during 2003 and 2013. The results showed that the numbers of species declined from nine to seven. Chi square test revealed that the number of butterflyfishes significantly decreased ($p<0.00001$). This reduction was attributed to continuous construction and anthropogenic actives

Keywords: Butterflyfishes, Abu Hashish, Port Sudan

1. Introduction

Abu Hashish fringing reef extends for about 6 km from the entrance of Port Sudan Harbour northwards to Falamingo Bay. It has a special scientific value as a teaching, training and research site as well as economic significance. Studies included the work of Eltayeb (1999) on abundance of *Trochus* spp.; Elghasain, (2001) on some holothurians species; Ali (2001) on the biodiversity of echinoderms and Awad (2001) on environmental hazards to its corals. According to Ali *et al.* (2000) Abu Hashish fringing reefs are facing many environmental problems due to continuous construction work. Mohamed (2013) added to these threats, establishment of large touristic restaurants discharging their organic and detergent wastes into the sea, desalination plant, and collection of ornamental fishes for trade.

According to Randall (1992) 14 butterflyfishes are known from the Red Sea of which seven are endemic (range no farther than the Gulf of Aden). Vine and Vine (1980) in their study of the ecology of Sudanese coral reefs reported 12 species of butterflyfishes (*Chaetodon auriga*, *C. austriacus*, *C. Chrysurus*, *C. fasciatus*, *C. lineolatus*, *C. melannotus*, *C. mesoleusus*, *C. semilarvatus*, *Megaprotodon trifascialis*, *Gonochaetodon larvatus*, *Heniochus intermedius*, *H. diphreutes*).

Many studies have been conducted on Butterflyfishes such as their social system (Hourigan, 1989; Roberts and Ormond, 1992), prey selection (Tricas, 1989), brain organization (Bouchot *et al.*, 1989), feeding habits (Sano, 1989), feeding rate and coral consumption (Gregson *et al.*, 2008), distribution (Zekeria *et al.*, 2005), growth (Zekeria *et al.*, 2006) and molecular phylogenetics (Fessler and Westneat, 2007). Butterflyfishes have been considered as a bioindicator for the healthiness of coral reefs (Crobsy and Reese, 1996; Reese and Crobsy, 1999 and Temraz and Abou Zaid, 2005).

In the interest of monitoring the situation in the area, Elamin (2003) correlated the diversity of butterflyfishes with healthiness of the corals. This work compares finding from the same transects after a decade.

2. Material and Methods

This area has a length of about 2.5 km and maximum width of about 800 m from shoreline to reef face. It is mostly less than 2 m deep although occasionally depths more than 20 m are encountered in reef lagoons (Ali *et al.*, 2000). During 2003 and 2013 studies butterflyfishes were visually censuses *in situ* following Sale and Sharp (1983). Three transects were made and fishes were recorded at 5 and 10 m at each depth following the Reef Check Programme (2002) standard format for data collection. The transects surveyed during 2003 were resurveyed during 2013 (Table 1 and Fig. 1). Butterflyfishes were photographed using Nikon III and Sony (digital camera, 12 mega pixel).

Statistical analysis:

Diversity Index, Richness Index, and Evenness Index of butterflyfishes were calculated following Ali (2001).

a- Diversity Index or Shannon-Wiener Index (H')

$$H' = -\Sigma (p_r) * (\ln p_r)$$

Where:

pr = is the proportion of the total number of individuals in the population that are in species "r". and ln = the natural log of the number.

b- Richness Index or Margalef's index (D)

$$D = (S-1) \div \text{Ln}(N)$$

Where:

S = Total number of species in the community

N = Total number of individuals in the community

c- Evenness Index (J).

$$J = H' \div \text{Ln}(S)$$

Where:

H' = Shannon-Wiener Index

S = Total number of species in the community

Table 1. The geographical location and orientation of each transect.

Transect		**Longitude**	**Latitude**	**Orientation**
No. 1	Start point	37º 14' 49.1"	19º 37' 30.3"	S-N
	End point	37º 14' 48.0"	19º 37' 32.1"	
No. 2	Start point	37º 14' 48.7"	19º 37' 11.2"	N-S
	End point	37º 14' 48.2"	19º 37' 09.4"	
No. 3	Start point	37º 14' 41.2"	19º 36' 42.6"	S-N
	End point	37º 14' 42.3"	19º 36' 44.2"	

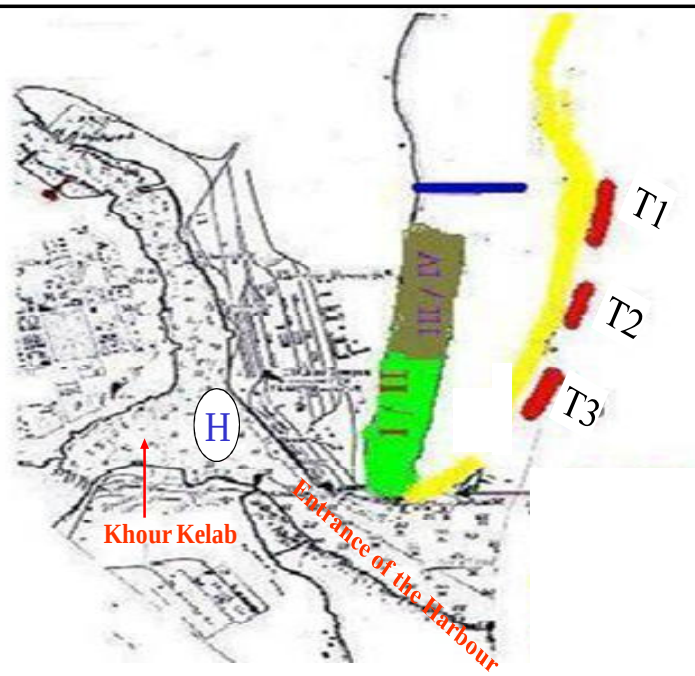

Fig. 1. The study area showing transects studied.

3. Results and Discussion

The study showed the presence of nine species of butterflyfishes (Chaetodontidae) in the study area during 2003 (Table 2, Plates 1 to 8). The survey during 2013 showed the disappearance of *C. melannotus* and *C. trifascialis*. *C. auriga*, *C. fasciatus*, *C. semilarvatus* and *H. intermedius* were encountered at both depths at each of the three transects. While in 2013 study *C. austriacus* and *H. intermedius* were found in the same depth in all transects. *H. intermedius* outnumbered the other species in the two studies.

Table 2**.** The total number of butterflyfishes species recorded in each transect and at each depth during 2003 and 2013.

Species	**Transect 1**				**Transect 2**				**Transect 3**				**Total of specimens**	
	5 m		**10 m**		**5 m**		**10 m**		**5 m**		**10 m**			
	03	**13**	**03**	**13**	**03**	**13**	**03**	**13**	**03**	**13**	**03**	**13**	**03**	**13**
Chaetodon melannotus	0	0	0	0	1	0	0	0	0	0	0	0	**1**	**0**
Chaetodon trifascialis	2	0	1	0	0	0	0	0	0	0	0	0	**3**	**0**
Chaetodon auriga	1	0	4	1	4	1	3	2	1	1	1	0	**14**	**5**
Chaetodon austriacus	9	1	4	2	4	4	9	2	2	2	0	4	**28**	**15**
Chaetodon fasciatus	6	1	2	0	1	1	2	1	4	2	6	0	**21**	**5**
Chaetodon larvatus	6	2	6	1	3	6	1	1	2	0	0	1	**18**	**11**
Chaetodon semilarvatus	6	3	4	2	1	0	2	0	2	5	2	5	**17**	**15**
Gonochaetodon larvatus	0	0	2	2	2	0	0	2	2	2	0	0	**6**	**6**
Heniochus intermedius	13	6	9	9	11	6	11	3	8	12	14	10	**66**	**46**
Number of species	**7**	**5**	**8**	**6**	**8**	**5**	**6**	**6**	**7**	**6**	**4**	**4**		
Number of specimens	**43**	**13**	**32**	**17**	**27**	**18**	**28**	**11**	**21**	**24**	**23**	**20**	**174**	**103**

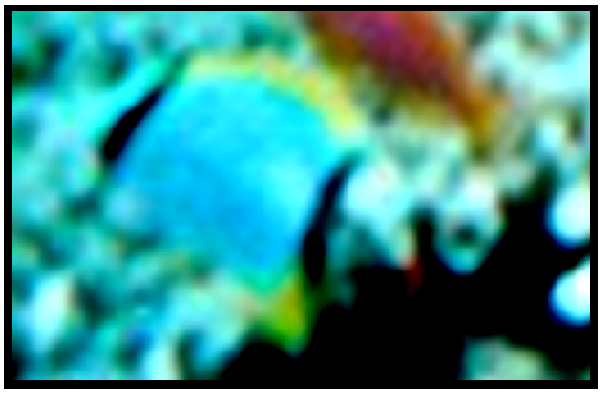

Plate 1. *Chaetodon trifascialis*

Plate 2. *Chaetodon Auriga*

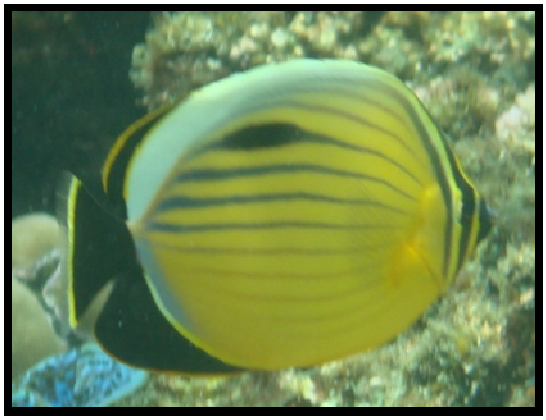

Plate 3. *Chaetodon austriacus*

Plate 4. *Chaetodon fasciatus*

Plate 5. *Chaetodon larvatus*

Plate 6. *Chaetodon semilarvatus*

Plate 7. *Gonochaetodon larvatus*

Plate 8. *Heniochus intermedius*

In 2003 the least encountered species were *C. melannotus* followed by *C. trifascialis*, for 2013 the least encountered species were *C. auriga* and *C. fasciatus*. With respect to depth and transects, more individual are found in transect 1 at both depths for the study in 2003. However in the study in 2013 more individual are found in transect 3 at both depths. The number of species is almost similar in all transects but is relatively low at 10 m depth in transect 3 for the two studies (Table 2). All species of butterflyfishes in Abu Hashish area declined in number except *Gonochaetodon larvatus*. Chi square test revealed that the number of butterflyfishes significantly ($p<0.00001$) declined from 174 specimen in 2003 to 103 specimen in 2013. This declined is probably due to construction work (Ali *et al.*, 2000) and pollution and aquarium fish trade (Mohamed, 2013). The 2003 and 2013 study showed that relatively more fishes are found at 5 m depth as compared to 10 m depth. This is probably due to denser corals at 5 m depth than at 10 m depth. This is in accordance with Barratt and Modloy (1990) who demonstrated that the numbers of individuals tend to be lower at 10 m stations than comparable 0 m, transects. Transects are acceptable method of survey inflicting minimal destruction to the corals thus enforcing the conservatory concept. However, discrepancy in layout (depth, length, location… etc) and checking (diurnal or nocturnal) may affect results from the same area.

For the 2003 study, transect 1 had more individuals as compared with other transects. Transect 1 lies well with the artisanal fishery site and its predatory fishes are liable to be thinned out. Barratt and Modloy (1990) stated that the removal of large predators by the fishery is probably the main reason why more individuals were observed in a region than elsewhere. Another reason stems from the fact that more space between corals are found in transect 2 thus affecting distribution as well as fish count. For the study 2013 transect 3 had more individuals as compared with other transects this may be due to fact that transect 3 near the entrance of Green port and relatively far from activities of ornamental fishes companies which collects their fishes nearby the two transects.

Elsheikh (1999) surveyed 3 families and found 5 species and 43 specimens of buttterflyfishes (*C. austriacus*; *C.*

fasciatus; *C. semilarvatus*; *G.larvatus* and *H. intermedius*). Ali *et al.* (2000) surveyed 13 families and found 2 species of butterflyfishes: *C. semilarvatus* (16 specimens) and *H. intermedius* (12 specimens). In 2003 and 2013 study 9 and 7 species of buttterflyfishes were found (Table 2). The differences in number of species were due to difference in survey design. Elsheikh (1999) and Ali *et al.* (2000) using a 50 m long transect without resting intervals executed a multi-family survey. The 2003 and 2013 study adopted the standard Reef Check Programme (2002) which put more emphasizes on 5 m resting intervals and a 100 m transect line. Brock (1982) adopted the 100 m line and stated that such technique allow fish in large areas of reef to be counted quickly and is particularly useful for counting diurnal and non-cryptic species. He was skeptical about the problem associated with it such as difficulty in estimating abundance of large (particularly multi-species) schools of fish as well as small, cryptic or nocturnal species.

Fish counts provide a reasonably accurate measure of relative abundance (Barratt and Modloy, 1990). Standardized visual censuses of fish within belt or strip transects is acceptable for quantitative measures (Branden *et al*., 1986) and can be used for temporal or spatial comparison (Sale and Sharp, 1983; Sanderson and Solonsky, 1986). Some species like *C. semilarvatus*, *C. fasciatus* and *H. intermedius* were reported to be nocturnal (Bemert and Ormond, 1982) and are associated with reef slope. If the survey was also executed during night more specimens of at least the above mentioned species might be encountered.

For the pooled three transects it is apparent from table 3, that the butterflyfishes are more diverse and showed the highest richness for the study in 2003 as compared with the study in 2013. While showed equality in evenness for two studies.

Table 3. Some ecological indices (Diversity, Richness, and Evenness) of butterflyfishes in each transect.

Index	Transect 1		Transect 2		Transect 3		Pooled transects	
	03	**13**	**03**	**13**	**03**	**13**	**03**	**13**
Species Diversity	1.87	1.51	1.67	1.64	1.46	1.41	1.80	1.62
Richness	1.62	1.76	1.75	1.48	1.59	1.59	1.55	1.29
Evenness	0.90	0.78	0.80	0.91	0.75	0.72	0.82	0.83

The two studies quantified the number of species and individuals in each depth and each transect using standard ecological indices. For the study in 2003 the highest diversity and evenness indices of butterflyfishes in transect 1 as compared with the other two transects, while for the study in 2013 the highest diversity and evenness indices of butterflyfishes in transect 2 as compared with the other two transects, is probably due to its richness in the number of individuals for study in 2003 (75 specimens) and due to lower number of species (6 species) for the study in 2013 (Table 3).

4. Conclusion

The study attributed the disappearance of *C. melannotus* and *C. trifascialis* and the declining in numbers of individuals from 174 in 2003 to 103 in 2013 to due to pollution, dredging work and collection of members this family (Chaetodontidae) for trade in ornamental fish. Butterflyfishes in Abu Hashish fringing reefs showed more diversity in species and richness index for the study in 2003 than in the study in 2013and with no difference in evenness index for the two studies.

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