CHECKLIST OF THE CORAL REEF FISHES OF BAA ATOLL, MALDIVES

BY

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INTRODUCTION

The Maldives are an archipelago of nearly 1,200 coral islets forming a double chain of 26 atolls, which is situated in the Laccadive Sea, central Indian Ocean, southwest of India. Being a country with more territorial sea than land, the economy is essentially dependent on marine resources including fisheries, with fish providing more than 96% of animal proteins in the Maldives (Kent, 1997). Studies related to marine fish have been conducted primarily to address the concerns generated by the increase in economic development as the country has undergone rapid expansion and diversification since the late 1970.

Fisheries yields in the Maldives are largely composed of top-level predators such as tuna (MRS, 1996; Anderson et al., 1998; Adam and Kirkwood, 2001; Adam, 2006). However smaller species including baitfish such as silver sprat (Dussumieriidae), anchovies (Engraulidae) and fusiliers (Caesionidae), or reef fish such as sweepers (Pempheridae), cardinalfish (Apogonidae), damselfish (Pomacentridae) and triggerfish (Balistidae) are also targeted (Anderson and Hafiz, 1984; Adam and Jauharee, 2009). Shark fishing is one of the major secondary fishing activities in the Maldives (Anderson and Ahmed, 1993), which was developed as a response to a request from Asian markets (Martin and Hakeem, 2006), similar to live grouper fishery (Sattar and Adam, 2005). The marine aquarium trade is also experiencing rapid increase and more than 120 reef fish species are being exported, including species that are rare and vulnerable to overexploitation (Adam, 1995; Saleem and Adam, 2004). Due to the rise of tourism in the Maldives, the food demand for luxury fish such as groupers has dramatically increased (Adam, 2006; Newton et al., 2007). As a result, a decline in grouper populations is now observed. There is currently no enforced restriction on either baitfish or live grouper fishery (McClanahan, 2011). However, shark fishing is forbidden since 2008 (Anderson and Hafiz, 1984; Anderson and Ahmed, 1993).

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Despite an economy that is essentially depending on marine resources including fisheries, the reef fish stocks in the Maldives are among the least exploited in the Indian Ocean (Newton et al., 2007), as the artisanal fisheries have traditionally focused on pelagic species. The cultural preference to eat tuna is largely responsible for this condition (Risk and Sluka, 2000). Thus, Maldives reef fish communities are considered relatively undisturbed by fishing activities (Sluka and Miller, 2001; McClanaham, in press). A checklist of epipelagic and shore fishes of the Maldives Islands was compiled by Randall and Anderson (1993) who reported 899 species.

The project "Biodiversity, resources and conservation of the coral reefs of the Republic of Maldives" aims at studying the biodiversity of Maldives coral reefs. This checklist includes the shore fish species recorded from the upper 20 m at Baa Atoll.

SITES AND METHODS

The Baa Atoll is located in the northern third of the Maldives archipelago (5° 23' N - 4° 49'N) on the western side of the double chain of atolls making up the central Maldives (Fig. 1). The atoll, approximately 40 km long and wide, has a discontinuous rim characterised by numerous deep passages, which allow oceanic currents and waves to penetrate the lagoon. The study sites were chosen according to the representation of habitats within and outside the MPAs (Andrefouët et al., this issue). The twenty-one sampled stations for fish survey included shallow and deep strata including reef flat and reef slope (lagoon and outer reef), reef ridge (lagoon), pass slope (outer reef) and seagrass flat (Fig. 1).

The fish diversity (total number of species) was estimated using underwater visual census methods. At each station, species list was built from the combination of a 40 minutes random path and a 50 x 10 m belt transect. For some stations, small cryptic species were collected using an anaesthetic (eugenol) over 1m^2 of reef. Anderson's book (2005) has been used occasionally for fish identification. All surveys were conducted in June 2009.

In order to minimize the effect of the sampling effort and to enable a comparison between the diversities of different areas, some authors recommend the use of a theoretic species richness (SRth) (Werner & Allen, 1998; Allen & Werner, 2002). The calculation of SRth is based on the number of species (or CFDI = Coral Fish Diversity Index) of the six most common families easily observed underwater, i.e the Chaetodontidae, Pomacanthidae, Pomacentridae, Labridae, Acanthuridae and Scaridae. SRth is a function of the island size and for islands < 2,000 km^2 (e.g. the Maldives), SRth is calculated as follows (Allen & Werner, 2002):

$$SRth = 3.39\ CFDI - 20.595$$

We used this approach to compare reef fish diversity of Baa and the Maldives with that reported by other studies in other islands of Indian Ocean regions.

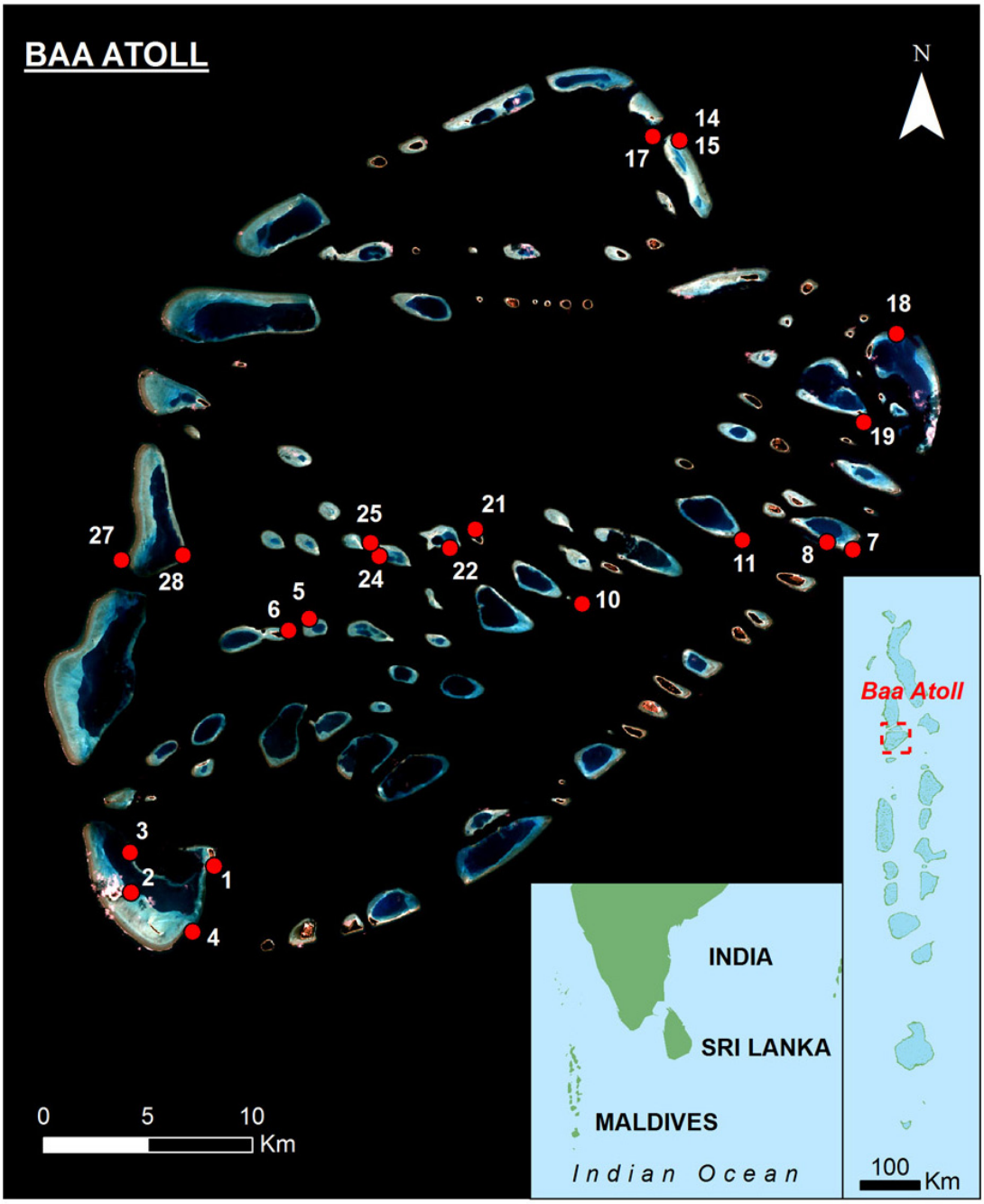

Figure 1. Location of the study area (Baa Atoll) in the Maldives and location of the sampling stations. According to reef geomorphology, the following biotopes were differentiated: lagoon reef flat (3, 8, 28), lagoon reef ridge (11), lagoon reef slope (1, 5, 6, 10, 19, 21, 22, 24, 25), outer reef flat (15), outer reef pass slope (4, 17), outer reef slope (7, 14, 18, 27) and seagrass flat (2).

RESULTS AND DISCUSSION

A total of 349 bony fish species (Osteichthyes) belonging to 46 families were recorded (Table 1, Plates 1- 3). Only one chondrichthyes (*Manta alfredi*) was observed during our sampling. Despite the extensive amount of time spent underwater, no shark was observed during our survey. Of the 350 species recorded, 30 species of small cryptic fish species were collected with clove oil. More than half of the recorded species (51.6%) belonged to six families: Labridae (47 sp, 13.4% of the total species), Pomacentridae (33 sp, 9.4%), Chaetodontidae (29 sp, 8.2%), Gobiidae (28 sp, 8%), Acanthuridae (24 sp, 6.9%) and Serranidae (20 sp, 5.7%). Only four stations provided a lower diversity than 100 species; they are located on shallow areas as seagrass flat (station 2) and reef flats (stations 3, 8 and 15). On the other hand, six stations situated on reef slopes (stations 10, 17, 19, 25 and 27) and outer reef ridge (station 11) yielded more than 130 species (Table 1). Some species were found only on specific biotopes: *Cheilio inermis, Calotomus carolinus, Leptoscarus vaigiensis, Pardachirus sp, Arothron hispidus and A. immaculatus* on seagrass flat, and *Lethrinus harak*, *Rhinecanthus aculeatus* and *R. rectangulus* on reef flat stations (stations 8 and 15). Five species are endemic to Maldives (1.4% of the total shore fish species recorded during the fieldtrip): the black-finned clownfish *Amphiprion nigripes* (Pomacentridae), the black-flag sandperch *Parapercis signata* (Pinguipedidae), the Maldivian triple-fin *Helcogramma larvata and Helcogramma maldivensis* (Tripterygiidae) and the comb-tooth blenny *Ecsenius minutus* (Blenniidae).

Comparison of the 350 fish species recorded at Baa Atoll during the present study with the species richness values recorded from other islands in the Indian Ocean revealed that Baa had one of the highest theoretic fish species richness recorded in the Indian Ocean region (Table 2). The Maldives belong to one of the eleven marine biodiversity hotspot regions identified on Earth, hotspot that encompasses the Maldives, Chagos islands and much of the Lakshadweep and Lakkadives archipelagoes as well as Sri Lanka. On the Southern hemisphere, Reunion island has also a high species richness compared to others islands of the Mascareignes archipelago (Rodrigues) and Mozambique Channel (Juan de Nova, Glorieuses, Geyser, Mayotte). This could be due to the higher sampling effort at the Reunion island since reef fish research is permanently conducted there since the 90's (eg. Letourneur, 1992; Chabanet, 1994) while in other areas inventories are conducted over a few weeks only.

These results indicate that the coral reefs of Baa Atoll have a high fish diversity, suggesting a relatively healthy system, keeping in mind its proximity to Asia and the "coral triangle" where diversity is maximum in the Indo-Pacific. However, some of the largest apex predators (Carangidae, Sphyraenidae, Lutjanidae) were rare. Notably, not a single shark (Carcharhinidae) was observed during the 10 days fish survey. Angling and shark fishing are likely the cause of such dramatic depopulation. In turn, parrotfishes (Scaridae) and surgeonfishes (Acanthuridae) were abundant and displayed sizes near their maximum lengths, while their behaviour was nearly unaffected by the presence of divers, which is typical for areas (usually MPAs) where spear and net fishing is prohibited.

Table 1. Inventory of the reef fishes of the Baa atoll, Maldives (from depths of 0-20 m) according to stations where they were sampled (UVC: underwater visual census, CO: clove oil, Ph: photo). The total number of species recorded by UVC is specify for each station at the end of the table. See Fig. 1 for the localisation of stations.

Families - Species - Authors / stations		1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	24	25	27	28
Myliobatidae																						
Manta alfredi (Krefft, 1868)	UVC									1	1											
Muraenidae																						
Gymnothorax berndti Snyder, 1904	UVC								1													
Gymnothorax breedeni McCosker & Randall, 1977	UVC							1														
Gymnothorax flavimarginatus (Rüppell, 1830)	UVC									1												
Gymnothorax javanicus (Bleeker, 1859)	UVC							1		1	1		1	1	1							
Gymnothorax undulatus (Lacepède, 1803)	UVC		1							1	1											
Synodontidae																						
Saurida gracilis (Quoy & Gaimard, 1824)	UVC	1		1	1	1		1						1		1	1					
Synodus binotatus Schultz in Schultz et al., 1953	CO							1														
Synodus variegatus (Lacepède, 1803)	UVC														1		1	1				
Atherinidae																						
Hypoatherina barnesi Schultz, 1953	UVC			1					1				1									1
Holocentridae																						
Myripristis adusta Bleeker, 1853	UVC							1			1	1		1							1	1
Myripristis berndti Jordan & Evermann, 1903	UVC	1		1	1	1	1	1			1			1	1	1	1	1	1	1	1	1
Myripristis kuntee Valenciennes in Cuvier & Valenciennes, 1831	UVC				1			1													1	
Myripristis pralinia Cuvier, 1829	UVC									1				1								
Myripristis violacea Bleeker, 1851	UVC			1	1	1	1	1			1							1	1	1	1	1
Myripristis vittata Valenciennes in Cuvier & Valenciennes, 1831	UVC							1									1					
Neoniphon sammara (Forsskål in Niebuhr, 1775)	UVC			1													1					1
Sargocentron caudimaculatum (Rüppell, 1838)	UVC	1		1	1	1	1	1		1	1	1		1	1	1	1	1	1	1	1	1
Sargocentron diadema (Lacepède, 1802)	UVC				1			1	1				1								1	
Sargocentron spiniferum (Forsskål in Niebuhr, 1775)	UVC				1	1	1	1			1	1		1			1	1	1	1	1	
Sargocentron tiere (Cuvier in Cuvier & Valenciennes, 1829)	UVC							1														
Sargocentron violaceum (Bleeker, 1853)	UVC					1								1				1				
Aulostomidae																						
Aulostomus chinensis (Linnaeus, 1766)	UVC					1		1											1			1
Syngnathidae																						
Corythoichthys schultzi Herald in Schultz *et al*., 1953	UVC			1												1						1
Fistulariidae																						
Fistularia commersonii Rüppell, 1838	UVC									1												
Scorpaenidae																						
Pterois antennata (Bloch, 1787)	UVC	1					1												1			

Table 1 Con'td

Families - Species - Authors / stations		1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	24	25	27	28
Pterois miles (Bennett, 1828)	UVC				1					1				1								
Scorpaenodes parvipinnis (Garrett, 1863)	CO	1																				
Scorpaenodes varipinnis Smith, 1957	CO							1														
Scorpaenopsis diabolus (Cuvier, 1829)	UVC								1	1												
Scorpaenopsis oxycephala (Bleeker, 1849)	UVC									1		1										
Sebastapistes cyanostigma (Bleeker, 1856)	UVC												1									
Platycephalidae																						
Thysanophrys chiltonae Schultz in Schultz et al., 1966	CO														1							
Serranidae																						
Aethaloperca rogaa (Forsskål in Niebuhr, 1775)	UVC	1					1	1		1	1	1		1	1	1	1		1	1	1	
Anyperodon leucogrammicus (Cuvier in Cuvier & Valenciennes, 1828	UVC					1		1		1				1			1	1	1			1
Cephalopholis argus Bloch & Schneider, 1801	UVC	1		1	1	1	1	1		1		1		1	1	1	1	1	1	1	1	1
Cephalopholis leopardus (Lacepède, 1801)	UVC	1			1	1	1	1		1	1	1		1	1		1	1	1	1	1	1
Cephalopholis miniata (Forsskål in Niebuhr, 1775)	UVC					1	1			1	1	1		1	1	1					1	
Cephalopholis sexmaculata (Rüppell, 1830)	UVC	1					1			1	1	1		1		1					1	
Cephalopholis urodeta (Bloch & Schneider, 1801)	UVC	1								1	1				1	1				1	1	
Epinephelus merra Bloch, 1793	UVC				1				1										1	1		1
Epinephelus oceanicus (Lacepède, 1802)	UVC	1																			1	
Epinephelus polyphekadion (Bleeker, 1849)	UVC										1			1					1			
Epinephelus spilotoceps Schultz in Schultz *et al*., 1953	UVC	1			1		1	1						1	1	1	1				1	
Epinephelus tauvina (Forsskål in Niebuhr, 1775)	UVC											1										
Gracila albomarginata (Fowler & Bean, 1930)	UVC					1	1															
Grammistes sexlineatus (Thunberg, 1792)	UVC													1								
Plectropomus laevis (Lacepède, 1801)	UVC	1				1	1			1				1		1	1					1
Pseudanthias evansi (Smith, 1954)	UVC	1					1	1				1		1	1		1		1			
Pseudanthias ignitus (Randall & Lubbock, 1981)	UVC							1						1							1	
Pseudanthias squamipinnis (Peters, 1855)	UVC	1			1		1	1		1	1	1		1	1	1	1				1	
Pseudogramma polyacantha (Bleeker, 1856)	CO							1														
Variola louti (Forsskål, 1775)	UVC	1			1	1	1		1					1	1	1	1	1	1	1	1	1
Pseudochromidae																						
Chlidichthys inornatus Lubbock, 1976	CO							1				1										1
Plesiopidae																						
Calloplesiops altivelis (Steindachner, 1903)	UVC	1																	1			
Priacanthidae																						
Priacanthus hamrur (Forsskål in Niebuhr, 1775)	UVC					1																
Apogonidae																						

Table 1 Con'td

Families - Species - Authors / stations		1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	24	25	27	28
Apogon cf. *chrysotaenia* Bleeker, 1851	UVC															1						
Apogon doryssa (Jordan & Seale, 1906)	CO							1														
Apogon fleurieu (Lacepède, 1802)	CO							1														
Apogon cookii Macleay, 1881	UVC				1					1				1		1				1		
Cheilodipterus artus Smith, 1961	UVC						1	1						1			1		1			
Cheilodipterus isostigmus (Schultz, 1940)	UVC					1								1					1			
Cheilodipterus lineatus (Lacepède, 1801)	UVC					1											1					
Cheilodipterus quinquelineatus Cuvier in Cuvier & Valenciennes, 182	UVC													1								
Ostorhinchus angustatus (Smith & Radcliffe in Radcliffe, 1911)	UVC						1				1											
Osrorhinchus nigrofasciatus (Lachner, 1953)	UVC/CO						1	1	1			1		1	1	1	1	1	1			
Ostorhinchus novemfasciatus (Cuvier in Cuvier & Valenciennes, 1828	CO								1													
Pristiapogon fraenatus (Valenciennes, 1832)	UVC	1																				
Pristiapogon kallopterus (Bleeker, 1856)	UVC														1	1						
Pristiapogon taeniopterus (Bennett, 1836)	UVC													1								
Apogon sp.									1													
Malacanthidae																						
Malacanthus latovittatus (Lacepède, 1801)	UVC														1	1					1	
Carangidae																						
Carangoides ferdau (Forsskål in Niebuhr, 1775)	UVC								1													
Caranx ignobilis (Forsskål in Niebuhr, 1775)	UVC									1	1											
Caranx melampygus Cuvier in Cuvier & Valenciennes, 1833	UVC									1	1	1									1	1
Lutjanidae																						
Aphareus furca (Lacepède, 1801)	UVC	1		1			1	1		1	1	1		1				1	1	1	1	1
Aprion virescens Valenciennes in Cuvier & Valenciennes, 1830	UVC					1	1				1	1						1			1	
Lutjnanus biguttatus (Valenciennes in Cuvier & Valenciennes, 1830)	UVC																1	1	1			
Lutjanus bohar (Forsskål in Niebuhr, 1775)	UVC	1		1	1	1	1	1		1	1	1		1	1	1	1	1	1	1	1	1
Lutjanus gibbus (Forsskål in Niebuhr, 1775)	UVC		1		1	1			1			1		1		1	1	1	1			1
L*utjanus kasmira* (Forsskål in Niebuhr, 1775)	UVC					1	1			1				1			1		1		1	1
Lutjanus monostigma (Cuvier in Cuvier & Valenciennes, 1828)	UVC									1	1			1		1						1
Macolor macularis Fowler, 1931	UVC				1	1		1		1		1		1		1					1	
Macolor niger (Forsskål in Niebuhr, 1775)	UVC			1	1	1				1	1			1			1	1	1	1		
Caesionidae																						
Caesio lunaris Cuvier in Cuvier & Valenciennes, 1830	UVC											1										1
Caesio xanthonota Bleeker, 1853	UVC	1								1												
Pterocaesio chrysozona (Cuvier in Cuvier & Valenciennes, 1830)	UVC											1										
Pterocaesio marri Schultz in Schultz *et al* ., 1953	UVC																	1				

Table 1 Con'td

Families - Species - Authors / stations		1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	24	25	27	28
Pterocaesio pisang (Bleeker, 1853)	UVC					1					1			1	1	1				1		
Pterocaesio tile (Cuvier in Cuvier & Valenciennes, 1830)	UVC	1				1	1	1		1	1	1		1		1			1	1		
Pterocaesio trilineata Carpenter, 1987	UVC	1					1												1	1		
Haemulidae																						
Plectorhinchus chaetodonoides Lacepède, 1801	UVC													1								
Plectorhinchus obscurus (Günther, 1872)	UVC														1							
Plectorhinchus vittatus (Linnaeus, 1758)	UVC			1		1	1	1		1	1		1	1			1		1	1	1	1
Lethrinidae																						
Gnathodentex aureolineatus (Lacepède, 1802)	UVC			1				1										1		1	1	
Lethrinus harak (Forsskål in Niebuhr, 1775)	UVC								1													
Lethrinus olivaceus Valenciennes in Cuvier & Valenciennes, 1830	UVC																				1	
Lethrinus xanthochilus Klunzinger, 1870	UVC															1					1	1
Lethrinus sp.	UVC		1																			
Monotaxis grandoculis (Forsskål in Niebuhr, 1775)	UVC	1		1		1	1	1		1	1				1	1	1	1	1	1	1	1
Nemipteridae																						
Scolopsis aurata (Park, 1797)	UVC						1															
Scolopsis bilineata (Bloch, 1793)	UVC	1		1	1	1	1	1		1	1			1	1	1		1	1	1	1	1
Mullidae																						
Mulloidichthys flavolineatus (Lacepède, 1801)	UVC			1		1											1					
Parupeneus barberinus (Lacepède, 1801)	UVC	1		1	1	1	1		1	1		1	1		1	1			1	1		1
Parupeneus cyclostomus (Lacepède, 1801)	UVC	1		1	1	1			1	1				1	1	1		1	1		1	1
Parupeneus macronemus (Lacepède, 1801)	UVC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Parupeneus pleurostigma (Bennett, 1831)	UVC	1								1	1									1		
Parupeneus trifasciatus (Lacepède, 1801)	UVC	1		1	1		1	1	1				1		1						1	1
Pempheridae																						
Parapriacanthus ransonneti Steindachner, 1870	UVC	1																			1	
Kyphosidae																						
Kyphosus vaigiensis (Quoy & Gaimard, 1825)	UVC																					1
Chaetodontidae																						
Chaetodon auriga Forsskål in Niebuhr, 1775	UVC	1		1				1				1	1			1	1	1	1	1	1	1
Chaetodon bennetti Cuvier, 1831	UVC																		1			
Chaetodon citrinellus Cuvier, 1831	UVC	1		1	1				1				1								1	1
Chaetodon collare Bloch, 1787	UVC	1		1	1			1			1	1		1	1	1	1	1			1	1
Chaetodon decussatus Cuvier, 1829	UVC				1																	
Chaetodon falcula Bloch, 1795	UVC	1		1		1	1			1	1	1		1	1		1	1	1	1	1	1
Chaetodon guttatissimus Bennett, 1833	UVC	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

Table 1 Con'td

Families - Species - Authors / stations		1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	24	25	27	28
Amblyglyphidodon batunai Allen, 1995	UVC																		1			
Amphiprion clarkii (Bennett, 1830)	UVC					1	1	1		1	1	1		1	1	1		1		1	1	
Amphiprion nigripes Regan, 1908	UVC						1			1						1				1		
Chromis agilis Smith, 1960	UVC																1	1				
Chromis atripectoralis Welander & Schultz, 1951	UVC			1		1	1			1		1		1		1	1	1	1	1		1
Chromis dimidiata (Klunzinger, 1871)	UVC	1			1	1	1	1		1	1	1		1	1	1	1	1	1	1	1	1
Chromis flavipectoralis Randall, 1988	UVC	1				1	1											1	1			
Chromis lepidolepis Bleeker, 1877	UVC													1								
Chromis nigrura Smith, 1960	UVC												1									
Chromis opercularis (Günther, 1867)	UVC	1			1	1				1		1				1	1				1	1
Chromis ternatensis (Bleeker, 1856)	UVC	1				1	1	1		1		1		1	1	1	1	1	1	1		1
Chromis viridis Cuvier in Cuvier & Valenciennes, 1830	UVC	1		1	1	1	1							1	1	1		1	1			1
Chromis weberi Fowler & Bean, 1928	UVC				1			1		1	1	1			1	1					1	
Chromis xutha Randall, 1988	UVC	1				1	1	1				1	1	1	1				1	1		
Chrysiptera brownriggii (Bennett, 1828)	UVC												1									
Chrysiptera glauca (Cuvier in Cuvier & Valenciennes, 1830)	UVC								1													
Chrysiptera unimaculata (Cuvier in Cuvier & Valenciennes, 1830)	UVC								1				1									
Dascyllus aruanus (Linnaeus, 1758)	UVC	1		1		1	1	1						1		1	1	1	1	1		1
Dascyllus carneus Fischer, 1885	UVC	1			1	1	1	1		1	1	1		1	1	1	1	1	1	1	1	1
Dascyllus trimaculatus (Rüppell, 1829)	UVC	1	1							1	1	1		1	1	1	1	1		1	1	
Lepidozygus tapeinosoma (Bleeker, 1856)	UVC										1					1					1	
Plectroglyphidodon dickii (Liénard, 1839)	UVC										1											1
Plectroglyphidodon lacrymatus (Quoy & Gaimard, 1825)	UVC	1		1	1	1	1	1		1	1	1		1	1	1	1	1	1	1	1	1
Pomacentrus caeruleus Quoy & Gaimard, 1825	UVC	1				1	1			1	1	1				1	1	1	1	1	1	
Pomacentrus chrysurus Cuvier in Cuvier & Valenciennes, 1830	UVC		1	1	1			1	1	1	1	1	1	1	1	1	1	1		1	1	1
Pomacentrus indicus Allen, 1991	UVC	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		1
Pomacentrus nagasakiensis Tanaka, 1917	UVC									1					1	1	1	1				
Pomacentrus pavo (Bloch, 1787)	UVC	1		1		1				1				1		1		1	1	1		1
Pomacentrus philippinus Evermann & Seale, 1907	UVC	1			1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1
Stegastes fasciolatus (Ogilby, 1889)	UVC								1													
Stegastes nigricans (Lacepède, 1802)	UVC			1																		1
Labridae																						
Anampses caeruleopunctatus Rüppell, 1829	UVC																	1				
Anampses meleagrides Valenciennes in Cuvier & Valenciennes, 1840	UVC	1			1	1				1	1				1	1				1	1	
Bodianus axillaris (Bennett, 1832)	UVC	1		1	1	1	1	1		1	1				1	1	1				1	1
Bodianus bilunulatus (Lacepède, 1801)	UVC																			1		

Table 1 Con'td

Families - Species - Authors / stations		1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	24	25	27	28
Bodianus diana (Lacepède, 1801)	UVC				1			1		1	1	1		1	1	1					1	
Cheilinus chlorourus (Bloch, 1791)	UVC	1	1		1		1		1				1						1			1
Cheilinus fasciatus (Bloch, 1791)	UVC					1	1			1						1		1	1	1		1
Cheilinus oxycephalus Bleeker, 1853	UVC																	1				1
Cheilinus trilobatus Lacepède, 1801	UVC		1	1					1				1							1		1
Cheilinus undulatus Rüppell, 1835	UVC			1				1							1							
Cheilio inermis (Forsskål in Niebuhr, 1775)	UVC		1																			
Coris cuvieri (Bennett, 1831)	UVC	1			1					1	1			1		1					1	
Coris frerei (Günther in Playfair & Günther, 1867)	UVC								1						1						1	
Coris batuensis (Bleeker, 1856)	UVC	1				1	1								1	1			1	1		1
Cymolutes praetextatus (Quoy & Gaimard, 1834)	UVC								1													
Cirrhilabrus exquisitus Smith, 1957	UVC	1			1	1	1	1		1	1	1	1	1	1	1	1	1	1	1	1	1
Epibulus insidiator (Pallas, 1770)	UVC	1		1		1	1	1						1					1			1
Gomphosus caeruleus Lacepède, 1801	UVC	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Halichoeres cosmetus Randall & Smith, 1982	UVC				1	1		1	1	1	1	1		1	1	1		1			1	
Halichoeres hortulanus (Lacepède, 1801)	UVC	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Halichoeres lamarii Cuvier & Valenciennes, 1839	UVC		1	1		1							1			1		1	1	1		1
Halichoeres leucoxanthus Randall & Smith, 1982	UVC	1		1						1		1				1					1	
Halichoeres nebulosus (Valenciennes in Cuvier & Valenciennes, 1839	UVC		1						1				1									
Halichoeres scapularis (Bennett, 1832)	UVC		1	1					1					1		1		1			1	1
Halichoeres trispilus Randall & Smith, 1982	UVC													1				1	1	1		
Halichoeres vrolikii (Bleeker, 1855)	UVC	1		1		1	1			1	1			1			1	1	1	1		1
Hemigymnus fasciatus (Bloch, 1792)	UVC	1		1		1	1	1		1	1	1		1	1	1	1	1	1	1		1
Hemigymnus melapterus (Bloch, 1791)	UVC	1		1				1			1				1		1	1		1		1
Hologymnosus annulatus (Lacepède, 1801)	UVC	1				1				1											1	
Labroides bicolor Fowler & Bean, 1928	UVC	1		1	1	1	1	1		1		1		1	1		1	1	1	1	1	1
Labroides dimidiatus (Valenciennes in Cuvier & Valenciennes, 1839)	UVC	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Labrichthys unilineatus (Guichenot, 1847)	UVC	1		1		1	1	1		1	1			1	1		1			1		1
Macropharyngodon bipartitus Smith, 1957	UVC	1			1	1		1		1	1	1	1		1	1				1	1	
Novaculichthys taeniourus (Lacepède, 1801)	UVC	1							1													
Oxycheilinus bimaculatus (Valenciennes in Cuvier & Valenciennes, 18	UVC																	1				
Oxycheilinus digrammus (Lacepède, 1801)	UVC	1				1	1	1		1	1			1	1		1	1	1	1		1
Pseudocheilinus evanidus Jenkins, 1901	UVC				1																	
Pseudocheilinus hexataenia (Bleeker, 1857)	UVC	1		1		1	1	1		1	1	1		1	1	1	1	1	1	1	1	1
Pseudodax moluccanus (Valenciennes in Cuvier & Valenciennes, 184(	UVC					1		1			1	1				1					1	1
Stethojulis albovittata (Bonnaterre, 1788)	UVC	1	1	1	1			1	1			1	1	1	1		1	1		1	1	1

Table 1 Con'td

Families - Species - Authors / stations		1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	24	25	27	28
Ecsenius midas Starck, 1969	UVC																				1	
Ecsenius minutus Klausewitz, 1963	UVC	1			1	1	1	1	1		1	1	1	1			1	1	1	1	1	
Meiacanthus smithi Klausewitz, 1962	UVC			1				1										1				
Plagiotremus phenax Smith-Vaniz, 1976	UVC					1								1								
Plagiotremus rhinorhynchos (Bleeker, 1852)	UVC				1		1			1	1	1	1	1	1	1		1			1	
Salarias fasciatus (Bloch, 1786)	UVC												1									
Gobiidae																						
Amblyeleotris steinitzi (Klausewiz, 1974)	UVC															1						
Amblyeleotris sp.	UVC										1					1						
Amblygobius hectori (Smith, 1957)	UVC					1	1										1	1				
Amblygobius semicinctus (Bennett, 1833)	UVC/CO		1																			1
Bryaninops erythrops (Jordan & Seale, 1906)	CO	1																				
Bryaninops natans Larson, 1985	UVC						1	1		1	1			1					1	1	1	
Bryaninops tigris Larson, 1985	PH											1										
Ctenogobiops crocineus Smith, 1959	CO																1					
Eviota albolineata Jewett & Lachner, 1983	CO							1														
Eviota guttata Lachner & Karnella, 1978	UVC/CO			1			1	1			1	1		1				1	1	1		1
Eviota nebulosa Smith, 1958	CO							1														
Eviota nigriventris Giltay, 1933	CO																1					
Eviota sebreei Jordan & Seale, 1906	CO											1					1					
Eviota zebrina Lachner & Karnella, 1978	UVC/CC	1												1				1		1		
Fusigobius duospilus Hoese & Reader, 1985	UVC											1								1		
Fusigobius neophytus (Günther, 1877)	UVC/CC	1	1		1	1							1		1		1			1	1	1
Gnatholepis anjerensis (Bleeker, 1851)	UVC															1						
Gnatholepis cauerensis (Bleeker, 1853)	UVC/CO		1												1		1			1	1	1
Gobiodon rivulatus (Rüppell, 1830)	CO																			1		
Gobiodon unicolor (Castelnau, 1873)	CO																			1		
I*stigobius decoratus* (Herre, 1927)	UVC															1					1	
Paragobiodon xanthosomus (Bleeker, 1852)	CO																1			1		1
Pleurosicya mossambica Smith, 1959	CO														1							
Trimma flammeum (Smith, 1959)	CO	1						1				1					1					1
Trimma haima Winterbottom, 1984	CO	1																				
Trimma taylori Lobel, 1979	CO	1				1																
T*rimma tevegae* Cohen & Davis, 1969	UVC						1			1	1			1			1	1	1		1	

Table 1 Con'td

Families - Species - Authors / stations		1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	24	25	27	28
Valenciennea strigata (Broussonet, 1782)	UVC								1												1	
Microdesmidae																						
Nemateleotris magnifica Fowler, 1938	UVC				1			1			1				1						1	
Ptereleotris evides (Jordan & Hubbs, 1925)	UVC	1			1		1	1			1	1		1	1	1		1		1	1	1
Ephipiidae																						
Platax orbicularis (Forsskål in Niebuhr, 1775)	UVC										1											
Siganidae																						
Siganus argenteus (Quoy & Gaimard, 1825)	UVC		1																	1		1
Siganus corallinus (Valenciennes in Cuvier & Valenciennes, 1835)	UVC																		1			1
Siganus puelloides Woodland & Randall, 1979	UVC					1		1												1		
Siganus stellatus (Forsskål in Niebuhr, 1775)	UVC	1						1				1		1		1	1		1	1	1	
Zanclidae																						
Zanclus cornutus (Linnaeus, 1758)	UVC	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Acanthuridae																						
Acanthurus auranticavus Randall, 1956	UVC			1	1			1	1													
Acanthurus bariene Lesson, 1831	UVC										1					1						
Acanthurus leucocheilus Herre, 1927	UVC	1		1	1		1	1							1						1	
Acanthurus leucosternon Bennett, 1833	UVC	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Acanthurus lineatus (Linnaeus, 1758)	UVC			1					1				1									1
Acanthurus mata Russell in Cuvier, 1829	UVC					1	1							1				1	1	1	1	
Acanthurus nigricauda Duncker & Mohr, 1929	UVC	1		1	1		1	1	1	1	1	1	1		1	1	1			1	1	
Acanthurus nigrofuscus (Forsskål in Niebuhr, 1775)	UVC				1				1		1		1							1	1	1
Acanthurus tennentii Günther, 1861	UVC				1				1				1	1								1
Acanthurus thompsoni (Fowler, 1923)	UVC	1				1	1			1	1	1		1	1	1	1	1	1	1	1	1
Acanthurus triostegus (Linnaeus, 1758)	UVC								1				1							1		
Acanthurus tristis Randall, 1993	UVC									1					1							
Ctenochaetus binotatus Randall, 1955	UVC	1		1	1	1	1			1	1	1			1						1	1
Ctenochaetus striatus (Quoy & Gaimard, 1825)	UVC	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ctenochaetus strigosus (Bennett, 1828)	UVC	1			1	1	1	1			1	1		1	1	1	1	1	1	1	1	
Naso brachycentron (Valenciennes in Cuvier & Valenciennes, 1835)	UVC																	1	1			
Naso brevirostris (Cuvier, 1829)	UVC	1		1	1		1	1		1	1	1				1		1	1	1	1	1
Naso elegans (Rüppell, 1829)	UVC	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Naso hexacanthus (Bleeker, 1855)	UVC	1		1	1	1	1	1		1	1	1		1		1	1		1	1	1	
Naso thynnoides (Valenciennes in Cuvier & Valenciennes, 1835)	UVC	1						1				1									1	
Naso unicornis (Forsskål in Niebuhr, 1775)	UVC								1					1				1		1		
Naso vlamingi (Valenciennes, 1835)	UVC	1				1	1			1	1			1	1	1	1	1	1	1	1	
Zebrasoma scopas (Cuvier, 1829)	UVC	1		1	1	1	1	1		1	1	1		1	1	1	1	1	1	1	1	1

Table 1 Con'td

Families - Species - Authors / stations		1	2	3	4	5	6	7	8	10	11	14	15	17	18	19	21	22	24	25	27	28
Zebrasoma velifer (Bloch, 1795)	UVC			1	1						1	1		1	1	1	1	1	1	1	1	1
Scombridae																						
Gymnosarda unicolor (Rüppell, 1836)	UVC				1		1			1				1	1			1	1			
Soleidae																						
Aseraggodes xenicus (Matsubara & Ochiai, 1963)	CO								1													
Pardachirus sp.	UVC		1																			
Balistidae																						
Balistapus undulatus (Park, 1797)	UVC	1		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Balistoides conspicillum (Bloch & Schneider, 1801)	UVC	1			1		1	1		1	1	1		1	1	1	1	1		1	1	1
Balistoides viridescens (Lacepède, 1801)	UVC	1			1	1		1		1	1	1			1	1			1	1		
Melichthys indicus Randall & Klausewitz, 1973	UVC	1			1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Odonus niger (Rüppell, 1836)	UVC	1			1			1		1	1	1		1	1	1				1	1	
Pseudobalistes flavimarginatus (Rüppell, 1829)	UVC		1			1						1		1	1	1				1	1	
Rhinecanthus aculeatus (Linnaeus, 1758)	UVC								1													
Rhinecanthus rectangulus (Lacepède in Bloch & Schneider, 1801)	UVC								1				1									
Sufflamen bursa (Lacepède in Bloch & Schneider, 1801)	UVC	1			1	1	1	1		1	1	1	1	1	1		1			1	1	
Sufflamen chrysopterum (Bloch & Schneider, 1801)	UVC		1	1	1	1	1		1	1			1		1	1				1	1	1
Aluteres scriptus (Osbeck, 1765)	UVC									1		1								1		
Amanses scopas (Cuvier, 1829)	UVC	1			1	1	1	1													1	
Cantherhines dumerilii (Hollard, 1854)	UVC																				1	
Cantherhines pardalis (Rüppell, 1837)	UVC	1	1	1	1				1	1	1		1			1		1	1	1	1	1
Pervagor aspricaudus (Hollard, 1854)	UVC													1						1		
Pervagor janthinosoma (Bleeker, 1854)	UVC				1		1															
Ostraciidae																						
Ostracion cubicus Linnaeus, 1758	UVC													1							1	
Ostracion meleagris Shaw in Shaw & Nodder, 1796	UVC					1	1	1		1	1								1			
Tetraodontidae																						
Arothron hispidus (Linnaeus, 1758)	UVC		1																			
Arothron immaculatus (Bloch & Schneider, 1801)	UVC		1																			
Arothron meleagris (Anonymus, 1798)	UVC					1																
Arothron nigropunctatus (Bloch & Schneider, 1801)	UVC										1				1		1	1	1			
Canthigaster amboinensis (Bleeker, 1865)	UVC									1										1		
Canthigaster bennetti (Bleeker, 1854)	UVC			1					1							1						
Canthigaster janthinoptera (Bleeker, 1855)	UVC																					1
Canthigaster valentini (Bleeker, 1853)	UVC	1		1	1	1	1	1		1	1			1	1	1	1	1		1		1
Diodontidae																						
Diodon liturosus Shaw, 1804	UVC							1			1						1			1		
Total number of species	UVC	124	31	94	108	119	117	123	67	133	131	114	59	134	116	130	108	116	120	130	139	126

Table 2. Species richness (SR) of fish communities on Indian Ocean coral reefs. SR_{obs}: observed SR; SR_{th}: theoretic SR calculated from CFDI (Coral Fish Diversity Index) according to Allen & Werner formula (2002). GC: geographic coordinates. *: underwater visual census (UVC) (0-20 m), **: fishing methods, ***: UVC, rotenone, fishing, museum and literature records.

Sites	GC	References	RS obs	RS th
Maldives	7°N-1°S, 72°-74°E	Randall and Anderson, 1993	899	671
Baa (Maldives)*co	5°N and 73°E	This study	333	505
Juan de Nova*	17°S, 42°E	Chabanet and Durville, 2005	299	423
Glorieuses*	11°S, 47°E	Durville et al., 2003	347	468
Geyser*	12°S, 46E	Chabanet et al., 2002	294	433
Mayotte*	13°S, 45°E	Letourneur, 1996; Chabanet, 2002	239	423
Reunion***	21°S, 55°E	Fricke et al., 2009	549	596
Rodrigues***	20°S, 62°E	Heemstra et al., 2004	410	493

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Plate 1: fish species photographed in situ (photos: Hani Amir, Serge Andréfouët)

Ecsenius minutus

Helcogramma maldivensis and *Ecsenius minutus*

Amphiprion clarkii (juvenile)

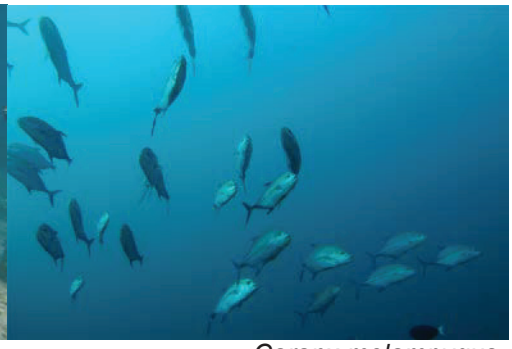
Chaetodon collare

Odonus niger

. *Sargocentron spiniferum*

Plate 2: fish species photographed in situ (photos: Hani Amir, Serge Andréfouët)

Mixed school of parrotfish including *Scarus rubroviolaceus, S. prasiognathus, S. frenatus* and *Chlorurus strongylocephalus*



Caranx melampygus

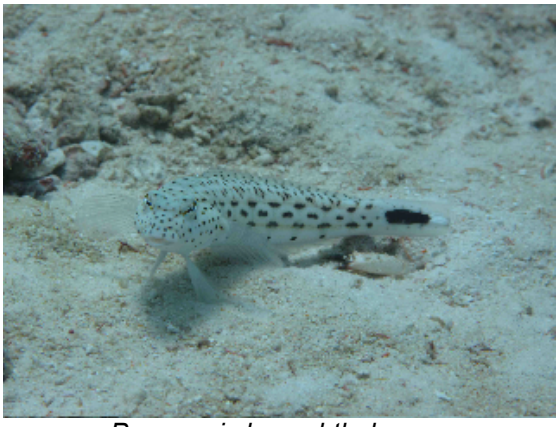
Bryaninops tigris

Ecsenius lineatus

Helcogramma maldivensis (endemic)

Paracirrhites forsteri

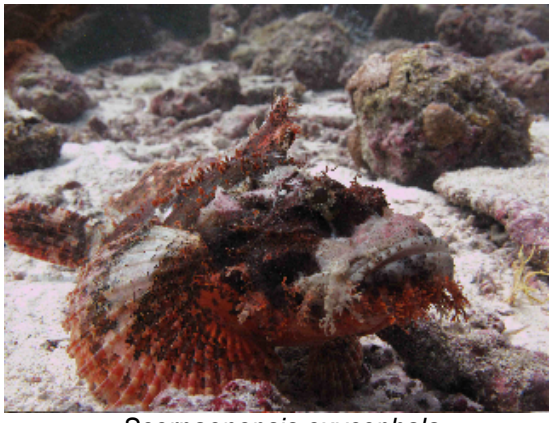
Plate 3: fish species photographed in situ (photos: Hani Amir, Serge Andréfouët)



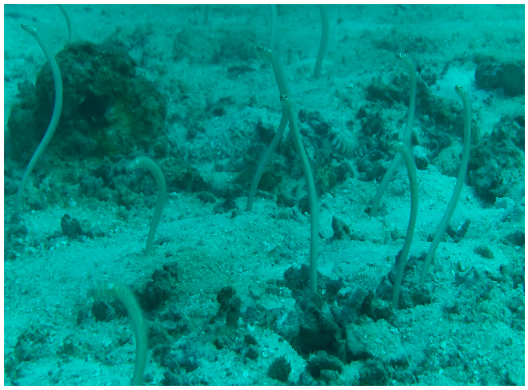
Parapercis hexophthalma

Parapercis signata (endemic)

Pseudanthias squamipinnis



Scorpaenopsis oxycephala



Gorgasia maculata

Manta alfredi (bottom), Platax orbicularis (top)