# Reef fish communities of Praia do Tofo, Mozambique, and the need for best practice management

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The coral reefs around Praia do Tofo, southern Mozambique, are known for their aggregations of marine megafauna but as yet few studies have comprehensively examined their broader biodiversity. This study is the first to assess the ichthyofaunal diversity of this economically important area. Methodology involved SCUBA and snorkel underwater visual censuses conducted between February and May, 2016, and the use of photographic records from 2015 to capture rare species. A total of 324 species, representing 79 families, were recorded from 16 reefs in the region. The area shows comparable species diversity and notably high family diversity in relation to other areas of the Western Indian Ocean. The trophic structure of the reefs, similar to that recorded in the wider region, suggests the reefs are in good health and fairly resilient to disturbance. This study highlights the area's high biological value beyond its megafauna and lends support to greater management of these ecosystems for the benefit of the associated human population.

Title

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Abstract

The coral reefs around Praia do Tofo, southern Mozambique, are known for their aggregations of marine megafauna but as yet few studies have comprehensively examined their broader biodiversity. This study is the first to assess the ichthyofaunal diversity of this economically important area. Methodology involved SCUBA and snorkel underwater visual censuses conducted between February and May, 2016, and the use of photographic records from 2015 to capture rare species. A total of 324 species, representing 79 families, were recorded from 16 reefs in the region. The area shows comparable species diversity and notably high family diversity in relation to other areas of the Western Indian Ocean. The trophic structure of the reefs, similar to that recorded in the wider region, suggests the reefs are in good health and fairly resilient to disturbance. This study highlights the area's high biological value beyond its megafauna and lends support to greater management of these ecosystems for the benefit of the associated human population.

Keywords

Mozambique; ichthyofaunal diversity; Tofo; visual census

## Introduction

The region around Praia do Tofo & Praia da Barra in southern Mozambique has a local economy built around marine tourism, with well-established recreational SCUBA diving and fishing industries wholly or partially reliant on tourism. The primary attraction is the opportunity to see and interact with year-round aggregations of whale sharks and manta rays (Pierce *et al.* 2010; Tibirica *et al.*, 2011); as such a lot of scientific research in the area has focused on these charismatic species (e.g. Pierce *et al.* 2010; Rohner *et al.* 2013; 2014). However, as their populations continue to decline (Rohner *et al.* 2013) it is expected that more value will be placed on the broader marine biodiversity of the region, as has occurred in marine tourism in the Bazaruto Archipelago National Park (BANP; Schleyer & Celliers, 2005). However the species richness of this area has not been previously documented, despite the United Nations & World Heritage Convention (2014) stating that the protected area represented by the BANP be extended south to include this area.

Praia do Tofo & Praia da Barra are bordered by the tropical and sub-tropical latitudes of the Western Indian Ocean (WIO) and so support a number of different reef habitats. The most common are deep offshore patch reefs, characteristic of southern Mozambique, with typically low levels of coral cover (e.g. Pereira, 2000; Motta *et al.*, 2002; Schleyer & Celliers, 2005). Other ecosystem types include mangrove swamps, estuarine reefs and shallow inshore fringing reefs. This range of habitats suggests a potential for high species richness in the area. But despite a relatively large associated human population of over 250,000 people (Instituto Nacional de Estatística, 2007), there is little to no management in place to safeguard these ecosystems' services (Pierce *et al.*, 2010).

Species richness data is vital for ecosystem management and provides the baseline from which: ecosystem stability and function are assessed (Cleland, 2011); key biological components are identified (Pereira, 2000); and the effects of biodiversity loss on ecosystem provision are predicted (Bellwood & Hughes, 2001; Gillibrand, Harries & Mara, 2007; Maggs *et al.*, 2010). This study provides a baseline assessment of reef fish diversity of the seas surrounding Praia do Tofo & Praia da Barra and highlights the area's biological value beyond its charismatic megafauna species.

## Materials & Methods

### *Study Site*

The bays of Praia do Tofo (23° 51.205' S 35° 32.882' E) and Praia da Barra (23° 47.541' S 35° 31.142' E) house a number of shallow fringing reefs. However many of the sites frequented by the local dive industry are in deeper waters to the north and south of these bays. Therefore the recorded diversity is representative of the wider area stretching approximately 40 km south to Paindane Bay (site 16; Fig. 1). A total of 16 reef sites (Table 1) were surveyed between February and May, 2016.

### *Sampling*

The primary method was Underwater Visual Censuses (UVCs) by a single observer to minimize bias (as per English, Wilkinson & Baker, 1997). Deeper sites (> 8 m) were surveyed on SCUBA, as part of a dive charter operated by Peri-Peri Divers, whilst shallow sites were assessed by snorkelling. A total of 1577 minutes of surveying was undertaken. UVCs have a tendency to underestimate cryptic species (Fowler, 1987); therefore, despite relatively extensive surveying, the final list may still prove to be incomplete. All species seen were recorded on an underwater PVC slate during the survey or a photograph was taken for subsequent identification. The list was supplemented by including any species that had been sighted in the year preceding the survey period, and for which there existed photographic evidence (e.g. *Mola mola*). This was done in an attempt to represent those rare species that utilise the area seasonally (Table 2).

*Trophic Structure*

The dietary preference of each species was determined using classifications by Harmelin-Vivien (1979); Hiatt & Strasburg (1960); Hobson (1974); Myers (1999); and FishBase (http://fishbase.org). If information on a species' feeding habit was not available, it was assumed from those of congener species and labelled with a '*'. If this still wasn't possible, they were labelled 'unknown'. Eight trophic categories were used, as in Gillibrand, Harries & Mara (2007); Chabanet & Durville (2005); and Durville, Chabanet & Quod, (2003). These were: herbivore; omnivore; browser of sessile invertebrates; diurnal carnivore; nocturnal carnivore; piscivore; diurnal planktivore; and nocturnal planktivore. These groups, except for herbivores and omnivores, could then be grouped into general carnivores *sensu lato*.

To glean the possible number of species missed during the visual census, the Coral Fish Diversity Index (CFDI) developed by Allen & Werner (2002) was calculated. This examines the diversity of six common and easily observable families that can be used as a representative of reef species richness (SR). These are Pomacanthidae, Labridae, Chaetodontidae, Pomacentridae, Acanthuridae & Scaridae. For areas < 2000 km$^2$, an estimated SR can be generated using the equation: SR = 3.39(CFDI) – 20.595

Results

A total of 324 species, representing 79 families, were recorded; 302 via UVCs and 22 using past photographic records (Table 2). Of the total number of species recorded, 27 were cartilaginous fish and 297 were bony fish. The CFDI-generated estimated SR was 278. 43% of the overall diversity was represented by nine families: Acanthuridae; Pomacentridae; Labridae; Serranidae; Chaetodontidae; Muraenidae; Lutjanidae; Scorpaenidae; and Tetraodontidae. Nearly half the families recorded (48%) were represented by one species only. Five of these families are monospecific: Rachycentridae; Rhincodontidae; Rhinidae; Stegostomatidae; and Zanclidae.

When examining broader trophic categories, the carnivores comprise the majority of the species composition at 80% of the total species (Fig. 2). 17 of the species' feeding habits were assumed from those of congener species whilst 11 were labelled as 'unknown'.

The largest trophic group, the diurnal carnivores representing 26% of the species composition, was composed largely of labrids whilst the most common nocturnal carnivore families were the lutjanids, the muraenids and the serranids. Chaetodontids made up the majority of the browsers of sessile invertebrates, whilst acanthurids and scarids represented most of the herbivores. There were no other notably common families dominating other trophic groups.

## Discussion

This study represents the first visual assessment of ichthyofaunal diversity for this economically important area of the southern Mozambique. Through the use of UVCs and retrospective data collection, 324 species of fish were recorded. The number of species recorded via UVC only is greater than that predicted from Allen & Werner's (2002) Coral Fish Diversity Index. Therefore this list can be seen as near complete, though future surveys may reveal new additions. The diversity of these reefs is similar to others in the Western Indian Ocean (WIO) that have used visual censuses as their primary data collection method (Maggs *et al.*, 2010; Chabanet & Durville, 2005; Gillibrand, Harries & Mara, 2007; Durville, Chabanet & Quod, 2003). When authors have chosen to comprehensively include species present in historical records (e.g. McKenna & Allen, 2005) or publicly available collections (e.g. Fricke *et al.*, 2009), species richness increases dramatically (Table 3).

A notably high diversity of fish families was found when compared to other areas in the WIO (Table 3). For example, 249 species in 40 families were recorded by Maggs *et al.* (2010) in the BANP. Given the higher relative coral cover in the BANP compared to Tofo (Motta *et al.*, 2002) a greater species richness would be expected (e.g. Komyakova, Munday & Jones, 2013). Temporal sampling effort can account for this mismatch with surveying time in this study (1577 mins; 16 sites) being over double that of Maggs *et al.* (2010; 720 mins; 8 sites), mirroring the differences in family diversity. Additionally, 38 families in this study were represented by only one species whilst the BANP study had the equivalent of 17 families. Similarly, a short sampling time of approximately 330 minutes by Chabanet *et al.* (2002) yielded the second lowest value for

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the number of recorded families in Table 3. In contrast, the studies of Chabanet & Durville (2005), Durville, Chabanet & Quod, (2003), and Gillibrand, Harries & Mara (2007) used more extensive sampling and observed a higher number of families relative to the number of recorded species. Gotelli & Colwell (2011) showed that as biodiversity sampling time increases, the number of species recorded per unit time decreases. Therefore the value of more time-intensive surveying lies in the detection of less speciose families. Additionally, the present study surveyed a greater depth range with a maximum depth of 32 metres (Table 1) compared to the 20 metres reported in other studies (Maggs *et al.* 2010; Chabanet & Durville, 2005). Distinct changes in the fish community assemblage along depth gradients have been previously demonstrated (Friedlander & Parrish, 1998; Jankowski, Graham & Jones, 2015) and attributed to decreased niche breadth in deeper waters, driving ecological specialisation (Bridge *et al.* 2016). This would also help explain the high number of families represented by one species observed in the present study. Equally, some species are restricted to shallower depths, in areas of high wave action (e.g. *Acanthurus lineatus*; Choat *et al.* 2012) or different prey types (Bridge *et al.* 2016). By surveying a greater depth, a wider variety of physical conditions are accounted for as well as the species that are specialised to them. The result of differential sampling effort is evident in comparing the BANP value with that of this study. Despite the total species richness here being greater than that of Maggs *et al.* (2010), the CFDI value their study is higher (359 vs. 278). Given its protected status and large seagrass meadows boosting diversity on nearby reefs (Dorenbosch *et al.* 2005; Pereira *et al.* 2014), you would expect higher diversity in the BANP.

On small oceanic islands with low levels of anthropogenic pressure (e.g. Juan da Nova; Chabanet & Durville, 2005), a higher species richness would be expected. However in the current study direct evidence of a fishing-driven decline in reef fish diversity is sparse. Fishing pressure can reduce the diversity of target families (Jennings, Grandcourt & Polunin, 1995; Micheli *et al.*, 2014) but is not necessarily detrimental to total species richness (Jennings & Polunin, 1997; Watson *et al.*, 1996; Francisco-Ramos & Arias-González, 2013). Yet it has been demonstrated that protected marine reserves (e.g. Glorieuses Islands) can enhance fish diversity (Cote, Mosqueira & Reynolds, 2001; Friedlander *et al.*, 2003); this could be used as a proxy for the detrimental effects of fishing. In these comparisons however, a more important factor determining fish diversity appears to be the islands' isolation. This would result in lower levels of immigration, higher probabilities of local extinction and overall lower species richness (MacArthur & Wilson, 1967; Sandin, Vermeij & Hurlbert, 2008; Stier *et al.*, 2014).

An alternative explanation for the differences in both species and family diversity could be the high amounts of primary productivity supported by consistent coastal upwelling at this point of the continental shelf (Rohner *et al.* 2014). Near-shore productivity has been positively linked to species richness in a study by Sandin, Vermeij & Hurlbert (2008) on Caribbean coral reefs. High plankton abundance reduces resource limitation for planktivorous species, potentially decreasing competitive exclusion (Abrams, 1995) and/or increasing population size that can reduce local extinction risk and lead to increased species richness on small spatial scales (Evans, Warren & Gatson, 2005). The proportion of planktivore species in the current study was not notably higher than those in others (e.g. Chabanet & Durville, 2005; Maggs *et al.*, 2010). However abundance was not recorded and this is the aspect most likely to change as a result of high primary productivity.

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Carnivores, *sensu lato*, represented the majority of the present fish community, as in other studies in the WIO (Floros *et al.*, 2012; Chabanet & Durville, 2005; Gillibrand, Harries & Mara, 2007). Further comparisons show that the relative proportions of carnivores, omnivores and herbivores are very similar to WIO areas (Table 4); this supports the assertion of Kulbicki (1988) that the trophic structure of reef fish communities is constant throughout a region. In this study, the proportion of carnivores was marginally higher than those with which it was compared (Table 4), likely to due to higher richness in the Dasyatidae (6 sp.) and Muraenidae (14 sp.) families. This suggests that these reefs are in good health according to Harmelin-Vivien's (1979) observation that carnivore levels are usually between 60-80% on healthy reefs. It may also indicate resilience of these reefs to disturbance. Higher species richness of predator populations can reduce the likelihood of top-down trophic cascades through the suppression of herbivore feeding activity; however this is only when they show specialised dietary preferences (Finke & Denno, 2005). This is also supported by Biswas & Mallik (2011) who showed a correlation between overall species richness and functional diversity. When there is a higher number of generalist predators, interspecific competition leads to diminished suppression of herbivore populations and so a decrease in primary productivity (Finke & Denno, 2005). As such a small reduction in predator populations through targeted fishing of, for example, serranids could lead to a reduction in the % cover of turf algae. This is the dominant substrate type on these reefs (Motta *et al.* 2002); coupled with the fish assemblage's trophic structure, this would suggest that algal-dominance is the ecosystems' healthy state (as in Friedlander *et al.* 2004). Therefore, a reduction in algal cover is likely to cause a fundamental change in fish community assemblage. This may be driven by alterations to bottom-up trophic energy transfer, as turf algae are important primary producers (Haas *et al.*, 2011; Jantzen *et al.*, 2013). Therefore as an extension of Harmelin-Vivien's (1979) assertion, high species richness in carnivore/predator populations can be used as an indicator for reef health when the trophic composition of the predators is considered (Finke & Denno, 2005)

Differences in regional comparisons are likely due to the varied sampling effort employed across the studies. A consequence of greater temporal and spatial sampling effort seems to be that it has more value in detecting new families compared new species. Nonetheless, the diversity of the area is higher than we may expect given its level of unregulated anthropogenic exploitation. This may be due to high levels of upwelling causing low local extinction rates. When simultaneously examining trophic structure and species richness, the conclusion may be drawn that these reefs are currently healthy. Their resilience will depend on the functional diversity of the species assemblage; this is a superior measure of the stability of ecosystem function (Cleland, 2011). So while the species richness alone may indicate reef resilience, formal testing of this is needed to understand the susceptibility of these reefs to trophic cascades.

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## Figure 1(on next page)

Survey Site Map

Map of the study area and its location along the coast of Mozambique (inset). Sampled reefs are indicated by (•); their broad characteristics are described in Table 1.

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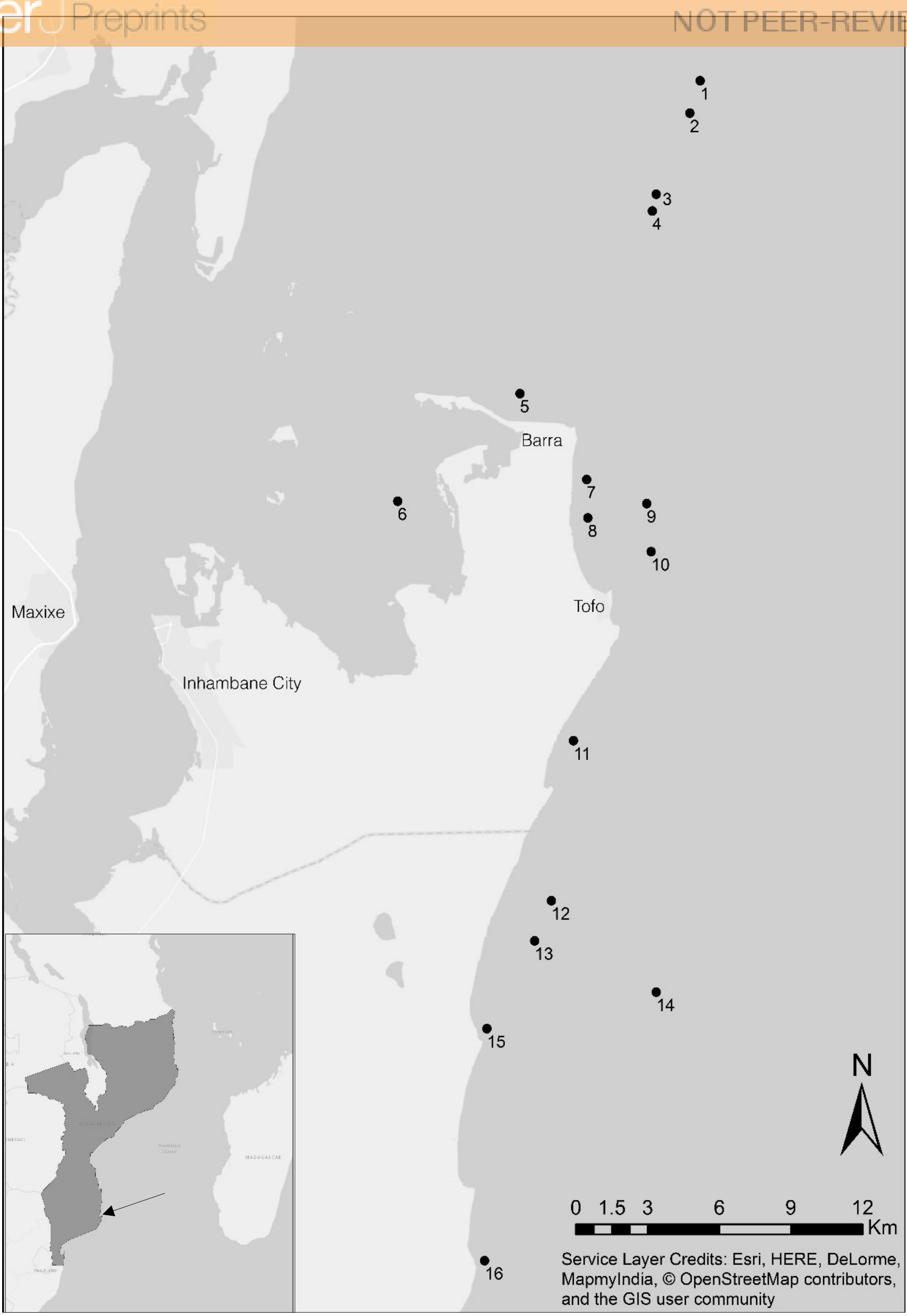
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## Table 1(on next page)

Survey Site Descriptions and Sampling Effort

Names and descriptions of sampled reefs, as well as the amount of time spent surveying each location.

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| Site Name (Number) | Site Description | Sampling Method | Sampling Effort (mins) |
|---|---|---|---|
| Amazon (1) | Offshore, horseshoe reef with an abundance of azooxanthellate soft corals; 23 – 28 metres. | SCUBA | 87 |
| Hospital (2) | Offshore, southward sloping reef with occasional short pinnacles; 24 – 26 metres. | SCUBA | 80 |
| The Office (3) | Topographically complex offshore reef with an abundance of overhangs and valleys with many encrusting soft corals; 22 – 26 metres. | SCUBA | 139 |
| Reggie's (4) | Tall, offshore reef rising between 4 – 8 metres from the seafloor; reef crests are dominated by large colonies of *Tubastrea micranthus*; 22 – 30 metres. | SCUBA | 124 |
| Buddies (5) | Shallow, inshore reef subject to persistent swell and fishing pressure; 8 – 10 metres. | SCUBA | 57 |
| The Wall (6) | Shallow estuarine reef with daily exposure to strong tidal currents; a combination of seagrass, rocky reef and sand patch microhabitats; 0-4 metres. | Snorkel | 70 |
| Mike's Cupboard (7) | Submerged sand dune reef, with many potholes and gullies surrounded by sandy reef flats; 12 – 16 metres. | SCUBA | 66 |
| Salon (8) | Shallow inshore reef composed of multiple large pinnacles surrounded by sandy bottom; subject to high turbidity from wave action; 10-14 metres. | SCUBA | 53 |
| Sherwood Forest (9) | Offshore reef just outside of Tofo bay, made of one large and one smaller pinnacle both supporting large populations of *Tubastrea micranthus*; 22 – 26 metres | SCUBA | 40 |
| Giants Castle (10) | Straight north-south reef with an extensive reef flat and deep reef wall; known within the local dive industry as having the best sighting rate for marine megafauna; 27 – 32 metres. | SCUBA | 162 |
| Marble Arch (11) | Inshore reef exposed to minor wave action; large reef flat with a few large potholes and one large rock arch; 14 – 18 metres. | SCUBA | 51 |
| Rob's Bottom (12) | Very patchy eastward sloping reef that is often subject to high current with high algal cover; 23 – 27 metres. | SCUBA | 83 |
| Manta Reef (13) | A large offshore reef, with a large central reef flat; peripheries are characterised by short, steep reef slopes with a number of tall pinnacles; 18 – 24 metres | SCUBA | 290 |
| Outback (14) | Similar reef shape as Giant's Castle, yet with more small inlets that house a number of deep overhangs and archways; 25 – 30 metres. | SCUBA | 40 |
| Coconut Bay (15) | Shallow inshore rocky reef with small patches of encrusting soft coral and larger swathes of seagrass; | Snorkel | 53 |

| | | | |
|---|---|---|---|
| | 4 – 8 metres. | | |
| Paindane Coral Gardens (16) | Small, shallow reef protected from offshore waves by a barrier rock extending from shore; the most abundant coral community in this area, dominated by *Sinularia* spp. soft coral and corymbose acroporids; 1 – 6 metres. | Snorkel | 182 |

## Table 2 (on next page)

Reef Fish Species List

Reef fish species inventory for the Tofo/Barra area of Mozambique, sighted through surveys (S) and photographic records (P).

1

| FAMILIES - Species - Authors | Sighting Record | Trophic Category |
|---|---|---|
| ACANTHURIDAE | | |
| *Acanthurus dussumieri* Cuvier & Valenciennes, 1835 | S | H |
| *Acanthurus leucosternon* Bennett, 1833 | S | H |
| *Acanthurus lineatus* Linnaeus, 1758 | S | H |
| *Acanthurus nigrofuscus* Forsskål, 1775 | S | H |
| *Acanthurus tennentii* Günther, 1861 | S | H |
| *Acanthurus triostegus* Linnaeus, 1758 | S | H |
| *Acanthurus xanthopterus* Valenciennes, 1835 | S | H |
| *Naso brachycentron* Valenciennes, 1835 | S | H |
| *Naso brevirostris* Cuvier, 1829 | S | H |
| *Paracanthurus hepatus* Linné, 1766 | S | DPL |
| *Zebrasoma desjardinii* Bennett, 1836 | S | H |
| AMBASSIDAE | | |
| *Ambassis natalensis* Gilchrist & Thompson, 1908 | S | DC |
| ANTENNARIIDAE | | |
| *Antennarius coccineus* Lesson, 1831 | S | Pi |
| *Antennarius commerson* Lacepède, 1798 | S | Pi |
| *Antennarius nummifer* Cuvier, 1817 | P | Pi |
| APOGONIDAE | | |
| *Cheilodipterus quinquelineatus* Cuvier, 1828 | S | NC |
| *Ostorhinchus angustatus* Smith & Radcliffe, 1911 | S | BSI |
| *Ostorhinchus fleurieu* Lacepède, 1802 | S | BSI* |
| *Pristiapogon kallopterus* Bleeker, 1856 | S | NC |
| ATHERINIDAE | | |
| *Atherinomorus lacunosus* Forster, 1801 | S | NPL |
| AULOSTOMIDAE | | |
| *Aulostomus chinensis* Linnaeus, 1766 | S | Pi |
| BALISTIDAE | | |
| *Balistapus undulatus* Park, 1797 | S | DC |
| *Balistoides conspicillum* Bloch & Schneider, 1801 | S | DC |
| *Balistoides viridescens* Bloch & Schneider, 1801 | S | DC |
| *Odonus niger* Rüppell, 1836 | S | DC |
| *Pseudobalistes fuscus* Bloch & Schneider, 1801 | S | DC |
| *Rhinecanthus aculeatus* Linnaeus, 1758 | S | DC |
| *Rhinecanthus rectangulus* Bloch & Schneider, 1801 | S | O |
| *Sufflamen bursa* Bloch & Schneider, 1801 | S | DC |
| *Xanthichthys lineopunctatus* Hollard, 1854 | S | DC* |
| BLENNIIDAE | | |
| *Aspidontus dussumieri* Valenciennes, 1836 | S | H |
| *Aspidontus taeniatus* Quoy & Gaimard, 1834 | S | DC |
| *Aspidontus tractus* Fowler, 1903 | S | DC |

| FAMILIES - Species - Authors | Sighting Record | Trophic Category |
|---|---|---|
| *Cirripectes stigmaticus* Strasburg & Schultz, 1953 | S | H |
| *Ecsenius midas* Starck, 1969 | S | H |
| *Istiblennius edentulous* Forster & Schneider, 1801 | S | H |
| *Plagiotremus rhinorhynchos* Bleeker, 1852 | S | NPL |
| *Plagiotremus tapeinosoma* Bleeker, 1857 | S | O |
| BOTHIDAE | | |
| *Bothus mancus* Broussonet, 1782 | P | DC |
| *Bothus pantherinus* Rüppell, 1830 | S | NC |
| CAESIONIDAE | | |
| *Caesio varilineata* Carpenter, 1987 | S | DPL |
| *Caesio xanthalytos* Holleman, Connell & Carpenter, 2013 | S | DPL* |
| *Caesio xanthonata* Bleeker, 1853 | S | DPL |
| *Pterocaesio marri* Schultz, Herald, Lachner, Welander & Woods, 1953 | S | DPL |
| *Pterocaesio tile* Cuvier & Valenciennes, 1830 | S | DPL |
| CALLIONMYIDAE | | |
| *Neosynchiropus stellatus* Smith, 1963 | S | DC |
| CARANGIDAE | | |
| *Alectis ciliaris* Bloch, 1787 | P | DC |
| *Alectis indica* Rüppell, 1830 | P | DC |
| *Caranx bucculentus* Alleyne & Macleay, 1877 | P | DC |
| *Caranx ignobilis* Forsskål, 1775 | S | DC |
| *Caranx melampygus* Cuvier, 1833 | S | DC |
| *Caranx sexfasciatus* Quoy & Gaimard, 1825 | S | Pi |
| *Gnathanodon speciosus* Forsskål, 1775 | S | DC |
| CARCHARHINIDAE | | |
| *Carcharhinus amblyrhynchos* Bleeker, 1856 | S | Pi |
| *Carcharhinus leucas* Müller & Henle, 1839 | P | DC |
| *Carcharhinus limbatus* Müller & Henle, 1839 | S | Pi |
| *Carcharhinus melanopterus* Quoy & Gaimard, 1824 | S | Pi |
| *Carcharhinus obscurus* Lesueur, 1818 | P | DC |
| *Triaenodon obesus* Rüppell, 1837 | S | DC |
| CENTRISCIDAE | | |
| *Aeoliscus strigatus* Günther, 1861 | P | DC |
| CHAETODONTIDAE | | |
| *Chaetodon auriga* Forsskål, 1775 | S | BSI |
| *Chaetodon blackburnii* Desjardins, 1836 | S | BSI |
| *Chaetodon dolosus* Ahl, 1923 | S | BSI |
| *Chaetodon guttatissimus* Bennett, 1833 | S | BSI |
| *Chaetodon interruptus* Ahl, 1923 | S | BSI |
| *Chaetodon kleinii* Bloch, 1790 | S | BSI |
| *Chaetodon lineolatus* Cuvier, 1831 | S | BSI |
| *Chaetodon lunula* Lacepède, 1802 | S | BSI |

| **FAMILIES - Species - Authors** | **Sighting Record** | **Trophic Category** |
|---|---|---|
| *Chaetodon madagaskariensis* Ahl, 1923 | S | BSI |
| *Chaetodon melannotus* Bloch & Schneider, 1801 | S | BSI |
| *Chaetodon meyeri* Bloch & Schneider, 1801 | S | BSI |
| *Chaetodon trifascialis* Quoy & Gaimard, 1825 | S | BSI |
| *Chaetodon xanthurus* Bleeker, 1857 | S | BSI |
| *Forcipiger flavissimus* Jordan & McGregor, 1898 | S | BSI |
| *Hemitaurichthys zoster* Bennett, 1831 | S | DPL |
| *Heniochus acuminatus* Linnaeus, 1758 | S | BSI |
| *Heniochus diphreutes* Jordan, 1903 | S | DPL |
| *Heniochus monoceros* Cuvier, 1831 | S | BSI |
| CIRRHITIDAE | | |
| *Cirrhitichthys oxycephalus* Bleeker, 1855 | S | DC |
| *Cyprinocirrhites polyactis* Bleeker, 1874 | S | DPL |
| *Oxycirrhites typus* Bleeker, 1857 | P | DPL |
| *Paracirrhites arcatus* Cuvier, 1829 | S | DC |
| *Paracirrhites forsteri* Schneider, 1801 | S | DC |
| CLINIDAE | | |
| *Clinus venustris* Gilchrist & Thompson, 1908 | S | U |
| *Pavoclinus laurentii* Gilchrist & Thompson, 1908 | S | U |
| CLUPEIDAE | | |
| *Gilchristella aestuaria* Gilchrist, 1913 | S | DPL |
| CONGRIDAE | | |
| *Heteroconger hassi* Klausewitz & Eibl-Eibesfeldt, 1959 | S | NC |
| DACTYLOPTERIDAE | | |
| *Dactyloptena orientalis* Cuvier, 1829 | S | NC |
| DASYATIDAE | | |
| *Dasyatis microps* Annandale, 1908 | S | NC* |
| *Himantura jenkinsii* Annandale, 1909 | S | NC |
| *Himantura uarnak* Gmelin, 1789 | S | NC |
| *Neotrygon kuhlii* Müller & Henle, 1841 | S | NC |
| *Taeniura lymma* Forsskål, 1775 | P | NC |
| *Taeniura meyeni* Müller & Henle, 1841 | S | NC |
| DIODONTIDAE | | |
| *Diodon holocanthus* Linnaeus, 1758 | S | NC |
| *Diodon hystrix* Linnaeus, 1758 | S | NC |
| *Diodon liturosus* Shaw, 1804 | S | NC |
| ECHENEIDAE | | |
| *Echeneis naucrates* Linnaeus, 1758 | S | NC |
| ENGRAULIDAE | | |
| *Thryssa vitrirostris* Gilchrist & Thompson, 1908 | S | DPL |
| EPHIPPIDAE | | |

| FAMILIES - Species - Authors | Sighting Record | Trophic Category |
|---|---|---|
| *Platax teira* Forsskål, 1775 | S | O |
| FISTULARIIDAE | | |
| *Fistularia commersonii* Rüppell, 1838 | S | Pi |
| GERREIDAE | | |
| *Gerres longirostris* Lacepède, 1801 | S | DC |
| GINGLYMOSTOMATIDAE | | |
| *Nebrius ferrugineus* Lesson, 1831 | P | NC |
| GOBIIDAE | | |
| *Amblyeleotris steinitzi* Klausewitz, 1974 | S | DC |
| *Amblyeleotris wheeleri* Polunin & Lubbock, 1977 | S | DC* |
| *Caffrogobius saldanha* Barnard, 1927 | S | U |
| *Valenciennea strigata* Broussonet, 1782 | S | DC |
| HAEMULIDAE | | |
| *Diagramma pictum* Thunberg, 1792 | S | DC |
| *Plectorhinchus flavomaculatus* Cuvier, 1830 | S | NC |
| *Plectorhinchus gaterinus* Forsskål, 1775 | S | NC |
| *Plectorhinchus playfairi* Pellegrin, 1914 | S | DC |
| *Plectorhinchus vittatus* Linnaeus, 1758 | S | NC |
| HEMIRAMPHIDAE | | |
| *Hyporhamphus affinis* Günther, 1866 | S | O |
| HOLOCENTRIDAE | | |
| *Myripristis adusta* Bleeker, 1853 | S | NPL |
| *Myripristis berndti* Jordan & Evermann, 1903 | S | NC |
| *Myripristis botche* Cuvier, 1829 | S | NC |
| *Myripristis murdjan* Forsskål, 1775 | S | NPL |
| *Neoniphon samara* Forsskål, 1775 | S | NC |
| *Pagellus natalensis* Steindachner, 1903 | S | O |
| *Sargocentron caudimaculatum* Rüppell, 1838 | S | NC |
| *Sargocentron diadema* Lacepède, 1802 | S | NC |
| *Sargocentron spiniferum* Forsskål, 1775 | S | NC |
| ISTIOPHORIDAE | | |
| *Istiompax indica* Cuvier, 1832 | S | Pi |
| *Istiophorus platypterus* Shaw, 1792 | P | Pi |
| *Makaira nigricans* Lacepède, 1802 | P | Pi |
| KYPHOSIDAE | | |
| *Kyphosus vaigiensis* Quoy & Gaimard, 1825 | S | H |
| LABRIDAE | | |
| *Anampses meleagrides* Valenciennes, 1840 | S | DC |
| *Bodianus anthioides* Bennett, 1832 | S | DC |
| *Bodianus axillaris* Bennett, 1832 | S | DC |
| *Bodianus diana* Lacepède, 1801 | S | DC |

| **FAMILIES - Species - Authors** | **Sighting Record** | **Trophic Category** |
|---|---|---|
| *Bodianus trilineatus* Fowler, 1934 | S | DC* |
| *Cheilinus trilobatus* Lacepède, 1801 | S | DC |
| *Cheilinus undulates* Rüppell, 1835 | S | DC |
| *Cheilio inermis* Forsskål, 1775 | S | DC |
| *Coris caudimacula* Quoy & Gaimard, 1834 | S | DC |
| *Coris formosa* Bennett, 1830 | S | DC |
| *Gomphosus caeruleus* Lacepède, 1801 | S | DC |
| *Gomphosus varius* Lacepède, 1801 | S | DC |
| *Halichoeres cosmetus* Randall & Smith, 1982 | S | DC |
| *Halichoeres iridis* Randall & Smith, 1982 | S | DC |
| *Halichoeres nebulosus* Valenciennes, 1839 | S | DC |
| *Halichoeres scapularis* Bennett, 1832 | S | DC |
| *Halichoeres zeylonicus* Bennett, 1833 | S | DC |
| *Labroides bicolor* Fowler & Bean, 1928 | S | DC |
| *Labroides dimidiatus* Valenciennes, 1839 | S | DC |
| *Macropharyngodon bipartitus* Smith, 1957 | S | DC |
| *Macropharyngodon cyanoguttatus* Randall, 1978 | S | DC* |
| *Novaculichthys taeniourus* Lacepède, 1801 | S | DC |
| *Thalassoma amblycephalum* Bleeker, 1856 | S | DC |
| *Thalassoma hebraicum* Lacepède, 1801 | S | DC |
| *Thalassoma lunare* Linnaeus, 1758 | S | DC |
| LUTJANIDAE | | |
| *Aprion virescens* Valenciennes, 1830 | S | Pi |
| *Lutjanus ehrenbergii* Peters, 1869 | S | NC |
| *Lutjanus fulviflamma* Forsskål, 1775 | S | NC |
| *Lutjanus gibbus* Forsskål, 1775 | S | NC |
| *Lutjanus kasmira* Forsskål, 1775 | S | NC |
| *Lutjanus lutjanus* Bloch, 1790 | S | NC |
| *Lutjanus monostigma* Cuvier, 1828 | S | NC |
| *Lutjanus notatus* Cuvier, 1828 | S | NC |
| *Lutjanus rivulatus* Cuvier, 1828 | S | NC |
| *Lutjanus sebae* Cuvier, 1816 | S | NC |
| *Macolor niger* Forsskål, 1775 | S | NC |
| *Paracaesio sordida* Abe & Shinohara, 1962 | S | DPL |
| MALACANTHIDAE | | |
| *Malacanthus brevirostris* Guichenot, 1848 | S | DC |
| MICRODESMIDAE | | |
| *Nemateleotris magnifica* Fowler, 1938 | S | NPL |
| *Ptereleotris evides* Jordan & Hubbs, 1925 | S | NPL |
| *Ptereleotris heteroptera* Bleeker, 1855 | S | DP |
| MOLIDAE | | |
| *Mola mola* Linnaeus, 1758 | P | DC |
| MONACANTHIDAE | | |
| *Cantherhines fronticinctus* Günther, 1867 | S | BSI |
| *Acreichthys tomentosus* Linnaeus, 1758 | S | DC |

| FAMILIES - Species - Authors | Sighting Record | Trophic Category |
|---|---|---|
| *Aluterus scriptus* Osbeck, 1765 | S | O |
| *Stephanolepis auratus* Castelnau, 1861 | S | U |
| MONOCENTRIDAE | | |
| *Cleidopus gloriamaris* De Vis, 1882 | P | U |
| MONODACTYLIDAE | | |
| *Monodactylus argenteus* Linnaeus, 1758 | S | DPL |
| MULLIDAE | | |
| *Mulloidichthys ayliffe* Uiblein, 2011 | S | NC |
| *Mulloidichthys flavolineatus* Lacepède, 1801 | S | NC |
| *Mulloidichthys vanicolensis* Valenciennes, 1831 | S | NC |
| *Parupeneus barberinus* Lacepède, 1801 | S | DC |
| *Parupeneus indicus* Shaw, 1803 | S | DC |
| *Parupeneus macronemus* Lacepède, 1801 | S | DC |
| MURAENIDAE | | |
| *Echidna nebulosa* Ahl, 1789 | S | NC |
| *Enchelycore pardalis* Temminck & Schlegel, 1846 | S | Pi |
| *Gymnomuraena zebra* Shaw, 1797 | S | NC |
| *Gymnothorax breedeni* McCosker & Randall, 1977 | S | NC |
| *Gymnothorax eurostus* Abbott, 1860 | S | NC |
| *Gymnothorax favagineus* Bloch & Schneider, 1801 | S | NC |
| *Gymnothorax flavimarginatus* Rüppell, 1830 | S | Pi |
| *Gymnothorax griseus* Lacepède, 1803 | S | NC* |
| *Gymnothorax javanicus* Bleeker, 1859 | S | NC |
| *Gymnothorax meleagris* Shaw, 1795 | S | DC |
| *Gymnothorax miliaris* Kaup, 1856 | S | DC |
| *Gymnothorax nudivomer* Günther, 1867 | S | NC* |
| *Gymnothorax undulates* Lacepède, 1803 | S | NC |
| *Rhinomuraena quaesita* Garman, 1888 | P | Pi |
| MYLIOBATIDAE | | |
| *Aetobatus narinari* Euphrasen, 1790 | P | DC |
| *Manta alfredi* Krefft, 1868 | S | DPL |
| *Manta birostris* Walbaum, 1792 | S | DPL |
| *Mobula japonica* Müller & Henle, 1841 | S | DPL |
| ODONTASIPSIDAE | | |
| *Carcharias taurus* Rafinesque, 1810 | S | DC |
| OPHICHTHIDAE | | |
| *Myrichthys colubrinus* Boddaert, 1781 | S | NC |
| *Myrichthys maculosus* Cuvier, 1816 | S | NC |
| *Pisodonophis cancrivorus* Richardson, 1848 | P | NC |
| OPLEGNATHIDAE | | |
| *Oplegnathus robinsoni* Regan, 1916 | S | O |
| OSTRACIIDAE | | |

| **FAMILIES - Species - Authors** | **Sighting Record** | **Trophic Category** |
|---|---|---|
| *Lactoria fornasini* Bianconi, 1846 | S | BSI* |
| *Lactoria cornuta* Linnaeus, 1758 | S | BSI |
| *Ostracion cubicus* Linnaeus, 1758 | S | BSI |
| *Ostracion meleagris* Shaw, 1796 | S | BSI |
| PEGASIDAE | | |
| *Eurypegasus draconis* Linnaeus, 1766 | S | BSI |
| PEMPHERIDAE | | |
| *Parapriacanthus ransonneti* Steindachner, 1870 | S | NPL |
| *Pempheris schwenkii* Bleeker, 1855 | S | NPL |
| PINGUIPEDIDAE | | |
| *Parapercis schauinslandii* Steindachner, 1900 | S | DC |
| PLATYCEPHALIDAE | | |
| *Papilloculiceps longiceps* Cuvier, 1829 | S | DC |
| PLOTOSIDAE | | |
| *Plotosus lineatus* Thunberg, 1787 | S | NC |
| POMACANTHIDAE | | |
| *Apolemichthys trimaculatus* Cuvier, 1831 | S | O |
| *Centropyge acanthops* Norman, 1922 | S | O |
| *Centropyge bispinosa* Günther, 1860 | S | O |
| *Centropyge multispinis* Playfair, 1867 | S | O |
| *Pomacanthus chrysurus* Cuvier, 1831 | S | O |
| *Pomacanthus imperator* Bloch, 1787 | S | O |
| *Pomacanthus rhomboides* Gilchrist & Thompson, 1908 | S | O* |
| *Pomacanthus semicirculatus* Cuvier, 1831 | S | BSI |
| *Pygoplites diacanthus* Boddaert, 1772 | S | BSI |
| POMACENTRIDAE | | |
| *Abudefduf natalensis* Hensley & Randall, 1983 | S | O |
| *Abudefduf sexfasciatus* Lacepède, 1801 | S | O |
| *Abudefduf vaigiensis* Quoy & Gaimard, 1825 | S | O |
| *Amphiprion allardi* Klausewitz, 1970 | S | O |
| *Amphiprion perideraion* Bleeker, 1855 | S | O* |
| *Chromis fieldi* Randall & DiBattista, 2013 | S | DPL |
| *Chromis nigrura* Smith, 1960 | S | DPL |
| *Chromis viridis* Cuvier, 1830 | S | O |
| *Chromis weberi* Fowler & Bean, 1928 | S | DPL |
| *Chrysiptera unimaculata* Cuvier, 1830 | S | O |
| *Dascyllus aruanus* Linnaeus, 1758 | S | DPL |
| *Dascyllus carneus* Fischer, 1885 | S | O |
| *Dascyllus trimaculatus* Rüppell, 1829 | S | DPL |
| *Neopomacentrus cyanomos* Bleeker, 1856 | S | U |
| *Plectroglyphidodon dickii* Liénard, 1839 | S | O |
| *Pomacentrus caeruleus* Quoy & Gaimard, 1825 | S | O |
| *Pomacentrus pavo* Bloch, 1787 | S | O |

| **FAMILIES - Species - Authors** | **Sighting Record** | **Trophic Category** |
|---|---|---|
| *Stegastes fasciolatus* Ogilby, 1889 | S | H |
| *Stegastes pelicieri* Allen & Emery, 1985 | S | H |
| PRIACANTHIDAE | | |
| *Priacanthus hamrur* Forsskål, 1775 | S | NC |
| PSEUDOCHROMIDAE | | |
| *Pseudochromis dutoiti* Smith, 1955 | S | DC |
| RACHYCENTRIDAE | | |
| *Rachycentron canadum* Linnaeus, 1766 | S | DC |
| RHINCODONTIDAE | | |
| *Rhincodon typus* Smith, 1828 | S | DPL |
| RHINIDAE | | |
| *Rhina ancylostoma* Bloch & Schneider, 1801 | P | NC |
| RHINOBATIDAE | | |
| *Rhinobatus annulatus* Müller & Henle, 1841 | P | NC |
| *Rhinobatus leucospilus* Norman, 1926 | S | NC |
| *Rhynchobatus djiddensis* Forsskål, 1775 | S | NC |
| SCARIDAE | | |
| *Chlorurus cyanescens* Valenciennes, 1840 | S | H |
| *Chlorurus sordidus* Forsskål, 1775 | S | H |
| *Scarus ghobban* Forsskål, 1775 | S | H |
| *Scarus rubroviolaceus* Bleeker, 1847 | S | H |
| *Scarus scaber* Valenciennes, 1840 | S | H |
| *Scarus tricolor* Bleeker, 1847 | S | H |
| SCOMBRIDAE | | |
| *Euthynnus affinis* Cantor, 1849 | S | DC |
| *Gymnosarda unicolor* Rüppell, 1836 | S | Pi |
| *Katsuwonus pelamis* Linnaeus, 1758 | S | DC |
| *Scomberomorus commerson* Lacepède, 1801 | S | Pi |
| *Scomberomorus plurilineatus* Fourmanoir, 1966 | P | Pi |
| *Thunnus albacares* Bonnaterre, 1788 | S | DC |
| SCORPAENIDAE | | |
| *Dendrochirus brachypterus* Cuvier, 1829 | S | NC |
| *Dendrochirus zebra* Cuvier, 1829 | S | NC |
| *Parascorpaena mossambica* Peters, 1855 | S | U |
| *Pterois antennata* Bloch, 1787 | S | DC |
| *Pterois miles* Bennett, 1828 | S | Pi |
| *Rhinopias eschmeyeri* Condé, 1977 | P | Pi* |
| *Rhinopias frondosa* Günther, 1892 | P | Pi |
| *Scorpaenopsis diabolus* Cuvier, 1829 | S | Pi |
| *Scorpaenopsis oxycephala* Bleeker, 1849 | S | Pi |
| *Scorpaenopsis venosa* Cuvier, 1829 | S | DC |
| *Taenianotus triacanthus* Lacepède, 1802 | S | DC |

| FAMILIES - Species - Authors | Sighting Record | Trophic Category |
|---|---|---|
| SERRANIDAE | | |
| *Cephalopholis argus* Schneider, 1801 | S | Pi |
| *Cephalopholis miniata* Forsskål, 1775 | S | NC |
| *Cephalopholis sonnerati* Valenciennces, 1828 | S | NC |
| *Epinephelus chlorostigma* Valenciennes, 1828 | S | NC |
| *Epinephelus fasciatus* Forsskål, 1775 | S | NC |
| *Epinephelus flavocaeruleus* Lacepède, 1802 | P | Pi |
| *Epinephelus lanceolatus* Bloch, 1790 | P | NC |
| *Epinephelus macrospilos* Bleeker, 1855 | S | DC |
| *Epinephelus malabaricus* Bloch & Schneider, 1801 | S | NC |
| *Epinephelus merra* Bloch, 1793 | S | Pi |
| *Epinephelus rivulatus* Valenciennes, 1830 | S | Pi |
| *Epinephelus tauvina* Forsskål, 1775 | S | Pi |
| *Epinephelus tukula* Morgans, 1959 | S | NC |
| *Grammistes sexlineatus* Thunberg, 1792 | S | NC |
| *Nemanthias carberryi* Smith, 1954 | S | DPL |
| *Plectropomus punctatus* Quoy & Gaimard, 1824 | S | Pi |
| *Pogonoperca punctate* Valenciennes, 1830 | S | NC* |
| *Pseudanthias evansi* Smith, 1954 | S | DPL |
| *Pseudanthias squamipinnus* Peters, 1855 | S | DPL |
| SIGANIDAE | | |
| *Siganus luridus* Rüppell, 1829 | S | H |
| SOLEIDAE | | |
| *Solea turbynei* Gilchrist, 1904 | S | U |
| SPARIDAE | | |
| *Chrysoblephus puniceus* Gilchrist & Thompson, 1908 | S | DC |
| *Diplodus hottentotus* Smith, 1844 | S | DC |
| SPHRYNIDAE | | |
| *Sphyrna lewini* Griffith & Smith, 1834 | S | DC |
| SPHYRAENIDAE | | |
| *Sphyraena putnamae* Jordan & Seale, 1905 | S | NC |
| STEGOSTOMATIDAE | | |
| *Stegostoma fasciatum* Hermann, 1783 | S | NC |
| SYNANCEIIDAE | | |
| *Synanceia verrucosa* Bloch & Schneider, 1801 | S | Pi |
| SYNGNATHIDAE | | |
| *Corythoichthys intestinalis* Ramsay, 1881 | P | DC |
| *Doryrhamphus dactyliophorus* Bleeker, 1853 | S | DPL |
| *Hippocampus borboniensis* Duméril, 1870 | S | DPL* |
| *Hippocampus camelopardalis* Bianconi, 1854 | P | DPL* |
| *Hippocampus histrix* Kaup, 1856 | S | DPL |
| *Hippocampus kuda* Bleeker, 1852 | S | DPL |

| FAMILIES - Species - Authors | Sighting Record | Trophic Category |
|---|---|---|
| *Solenostomus cyanopterus* Bleeker, 1854 | S | DC |
| *Trachyrhamphus bicoarctatus* Bleeker, 1857 | S | U |
| SYNODONTIDAE | | |
| *Synodus dermatogenys* Fowler, 1912 | S | Pi |
| *Synodus jaculum* Russell & Cressey, 1979 | S | Pi |
| TETRAODONTIDAE | | |
| *Arothron hispidus* Linnaeus, 1758 | S | NC |
| *Arothron meleagris* Anonymous, 1798 | S | NC |
| *Arothron nigropunctatus* Bloch & Schneider, 1801 | S | NC |
| *Arothron stellatus* Anonymous, 1798 | S | NC |
| *Canthigaster amboinensis* Bleeker, 1864 | S | H |
| *Canthigaster bennetti* Bleeker, 1854 | S | O |
| *Canthigaster janthinoptera* Bleeker, 1855 | S | O |
| *Canthigaster smithae* Allen & Randall, 1977 | S | O* |
| *Canthigaster solandri* Richardson, 1845 | S | O |
| *Canthigaster valentine* Bleeker, 1853 | S | O |
| TETRAROGIDAE | | |
| *Ablabys binotatus* Peters, 1855 | S | U |
| *Ablabys macracanthus* Bleeker, 1852 | S | U |
| TORPEDINIDAE | | |
| *Torpedo marmorata* Risso, 1810 | S | Pi |
| *Torpedo spp.* | S | Pi |
| ZANCLIDAE | | |
| *Zanclus cornutus* Linnaeus, 1758 | S | DC |

Trophic Categories: Herbivore (H); Omnivore (O); Browser of Sessile Invertebrates (BSI); Diurnal Carnivore (DC); Nocturnal Carnivore (NC); Piscivore (Pi); Diurnal Planktivore (DPL); Nocturnal Planktivore (NPL); Unknown (U)

## Figure 2 (on next page)

Trophic Structure of Tofo Reef Fish Communities

The trophic structure of the recorded reef fish community.

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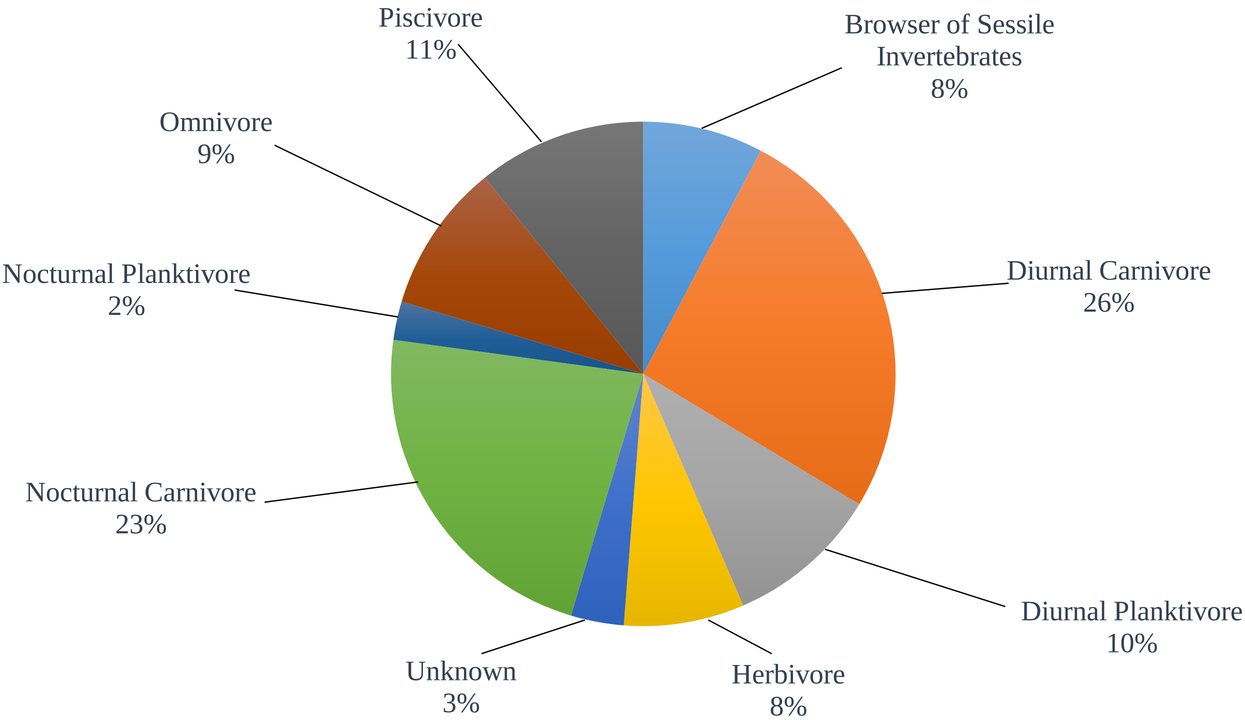


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## Table 3(on next page)

Species and Family Diversity in the Western Indian Ocean.

Comparison of species and family diversity in other areas of the Western Indian Ocean (WIO).

| Location | Reference | No. of Species | No. of Families | Species to Family Ratio (2 d. p.) |
|---|---|---|---|---|
| BANP | Maggs et al. (2010) | 249 | 40 | 6.23:1 |
| Tofo/Barra | This study | 324 | 79 | 4.16:1 |
| Juan de Nova | Chabanet & Durville, (2005) | 299 | 55 | 5.44:1 |
| Andavadoaka | Gillibrand et al. (2007) | 334 | 58 | 5.76:1 |
| Mayotte | Wickel et al. (2014) | 759 | 118 | 6.43:1 |
| Glorieuses Islands | Durville et al. (2003) | 332 | 57 | 5.82:1 |
| Geyser & Zelee Banks | Chabanet et al. (2002) | 294 | 43 | 6.84:1 |
| Maputaland & Ponta Malongane | Floros et al. (2012) | 284 | 50 | 5.68:1 |
| Bassas da India | Van der Elst & Everett (2015) | 311 | 50 | 6.22:1 |
| Northwestern Madagascar | McKenna & Allen (2005) | 788 | 91 | 8.66:1 |
| Mafia Island | Garpe & Ohman, (2003) | 394 | 56 | 7.04:1 |
| Watamu Marine Park | Cowburn et al., (2013) | 354 | 56 | 6.32:1 |
| La Réunion | Fricke et al., (2009) | 965 | 160 | 6.03:1 |

## Table 4(on next page)

Trophic Structure across the Western Indian Ocean

Trophic structure of reef fish communities (expressed as % of total species recorded) in other areas of the Western Indian Ocean (WIO).

1

| **Location** | **Reference** | **Carnivores (% of total)** | **Herbivores (% of total)** | **Omnivores (% of total)** |
|---|---|---|---|---|
| BANP | Maggs et al., 2010 | 76 | 12 | 12 |
| Tofo/Barra | This study | 80 | 8 | 9 |
| Juan de Nova | Chabanet & Durville, 2005 | 73 | 16 | 11 |
| Andavadoaka | Gillibrand et al., 2007 | 76 | 13 | 11 |
| Mayotte | Wickel et al., 2014 | 78 | 8 | 13 |
| Glorieuses Islands | Durville et al., 2003 | 73 | 15 | 12 |
| Geyser & Zelee Banks | Chabanet et al., 2002 | 72 | 16 | 12 |
| Maputaland & Ponta Malongane | Floros et al., 2012 | 78 | 11 | 11 |