



Core Zone

SH. FARUKOLHU



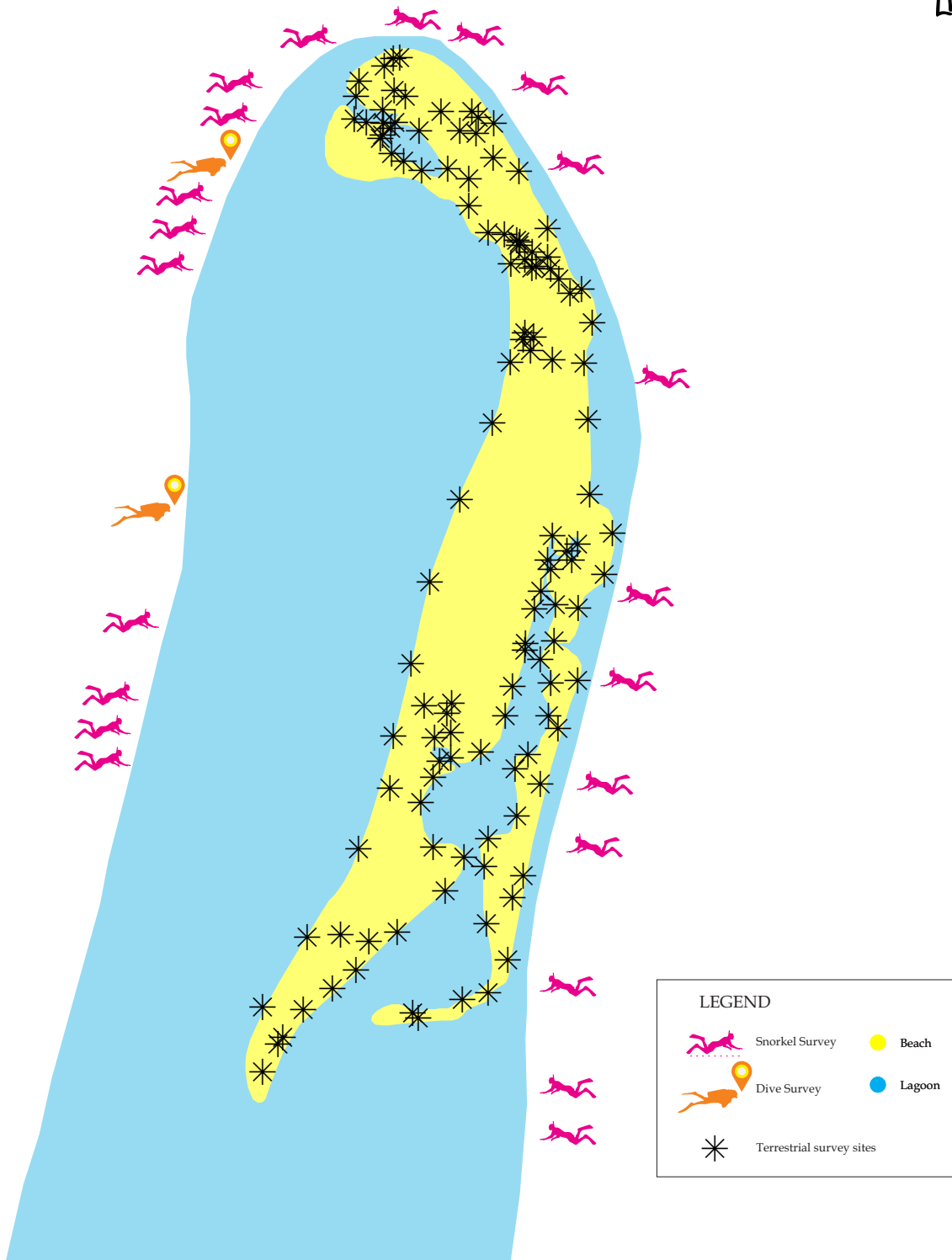
Introduction

Farukolhu is a long, narrow uninhabited island on the eastern edge of the Shavyani atoll. The southern half of the island is split in two lengthways by a long mangrove bay. The northern end has several brackish water ponds, many of which are connected by narrow channels. The island's vegetation was made up primarily of coastal scrub vegetation typical of the region. *Scaevola taccada* and *Talipariti tiliaceum* dominated on the sheltered inner atoll facing shore and *Pemphis scidula* on the exposed outer atoll edge. The vegetation around the ponds was primarily made up of these species. Ponds may have been formed by seawater flowing through channels which have now closed or filled by rainwater or water transported through the porous underlying rocks. Only two of these ponds had mangrove trees present, and in both cases the trees appeared to be dying. There was also an area of coconut grove in the centre of the island that is regularly harvested. The mangrove bay was dominated by *Ceriops tagal* though much of the outer bay was *P. scidula*. *Rhizophora mucronata* was also present. Many juvenile sharks and rays were observed throughout the bay, as well juvenile reef fish and birds. Juvenile sicklefin lemon sharks (*Negaprion acutidens*), a vulnerable (IUCN Redlist) species, were observed in high numbers. A fringing reef is present around the outside of the island. The outer atoll facing reef had many small branching and table corals. The inner reef slope was generally rubble with small rocky patches of coral growth.

Table 1. Latitude and longitude of the quantitative survey sites

Site	Latitude	Longitude
1	6.2007	73.29252
2	6.1913	73.29028

Sh. Farukolhu



Coral Reef Benthos



Figure 1. A sting ray hovering on top of the benthic habitat of Farukolhu

Two sites were surveyed using quantitative transect methods (Table 1). The substrate of the reefs surveyed was predominantly rock, rubble and sand. This characterised the inner and northern fringing reef. However, environmental conditions prevented detailed surveys of the outer reef which rapid surveys indicated had higher coral cover than those reported here. The mean coral cover of 14% was below the average observed during the ecological surveys. Algal cover was very low. The highest coral cover was found on the northern channel reef (16.7%). Structural complexity was low at survey sites with a mean of 1.2 for the reefs.

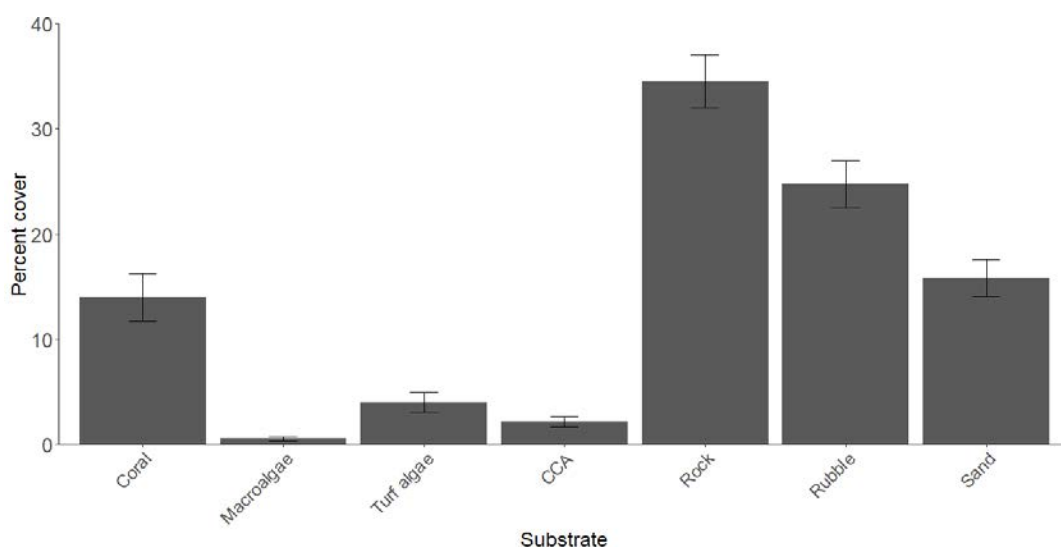


Figure 2. Mean percentage cover of substrate categories across all surveys on Farukolhu

Site	Complexity	Hard Coral	Macro algae	Turf algae	Rock	Rubble	Sand	CCA	Soft coral	Sponge
1	1.3	16.7	1.7	5.7	33.5	24.3	13.5	2.5	0.0	1.8
2	1.0	9.9	2.9	3.7	34.1	23.7	16.7	4.0	2.4	1.8

Table 2. Location, mean complexity and mean substrate cover of the quantitative surveys.

Fish Community

Values for the fish community matched the national averages for fish diversity. A diverse fish community indicates a healthy reef and a resilience against future degradation (Bellwood et al. 2004). Groupers and butterflyfish are indicators of unfished and healthy reef areas. 51 reef associated fish families were observed across the country, 31 of which were found on Farukolhu. Densities of the key herbivores, surgeonfish and parrotfish were not as high as observed elsewhere and their density was low. Herbivores are a functionally important group on coral reefs. They play a key role in keeping algae levels low enough for corals to thrive (Mumby et al. 2006). These results suggest the reefs here could be of algal overgrowth due to low herbivore numbers. It is important that preservation of these herbivores is part of any future management plan.

Table 3. Location, total number of fish families and mean number of fish families per transect observed across all sites and at individual survey sites

Site	Total number of families	Mean number of families
Farukolhu	31	14.9
1	25	15.2
2	28	14.7

Table 4. Location, total number of species, mean number of species and mean density per transect observed for grouper and butterflyfish across all sites and at individual survey sites

Site	Total number of grouper species	Mean number of grouper species	Mean grouper density /100m ²	Total number of butterflyfish species	Mean number of butterflyfish species	Mean butterflyfish density /100m ²
Farukolhu	5	3.2	3.1	11	3.4	4.0
1	4	2.7	2.9	8	3.0	4.2
2	4	3.0	3.2	10	2.5	3.9

Table 5. Location, total number of species, mean number of species and mean density per transect observed for parrotfish and surgeonfish across all sites and at individual survey sites

Site	Total number of parrotfish species	Mean number of parrotfish species	Mean parrotfish density /100m ²	Total number of surgeonfish species	Mean number of surgeonfish species	Mean surgeonfish density /100m ²
Farukolhu	3	2.0	4.9	8	4.4	9.6
1	3	2.5	6.0	7	5.0	8.2
2	2	2.3	2.8	7	5.8	11.0

Number of Endangered Animals



Figure 3. An Endangered hawksbill turtle laying on the benthos in Farukolhu

These species are under threat and identifying and protecting habitat where they are found is key to their survival. Complex reef flats and slopes are foraging grounds for reef sharks and provide shelter spaces for large groupers. Endangered hawksbill turtles are relatively common in the Maldives; however, their populations are at risk from a decline in available nesting sites and the declining health of coral reefs.

Table 6. Location and number of IUCN Redlisted (endangered, vulnerable and least concern) species observed during rapid surveys.

Latitude	Longitude	<i>Cheilinus undulatus</i>	<i>Chelonia mydas</i>	<i>Epinephelus fuscoguttatus</i>	<i>Eretmochelys imbricata</i>	<i>Plectropomus areolatus</i>	<i>Plectropomus laevis</i>	<i>Tridacna sp.</i>
6.17356	73.29979					3		3
6.18492	73.30095					1		
6.18539	73.30095	1						
6.19030	73.29019						1	
6.20160	73.29305					1		
6.20493	73.29789		1	5	1		6	

Vegetation



Figure 4. Shoreline vegetation of Farukolhu



Figure 5. Island vegetation



Figure 6. Mangrove vegetation



Figure 7. Bruguier sp.

The coastal fringe facing the inner atoll was dominated by *S. taccada*, *T. tiliaceum* and *Guettarda speciosa*. Here the vegetation line is far from the high-water line, behind a sandy beach. *P. scidula* dominated on outer edge where there was a rocky shore and the high-water line reached the vegetation edge. The pond fringe areas were also dominated by these species, though there were also patches of *Pandanus tectorius*. The ponds in the north which were connected to the sea by channels at high tide had stands of *R. mucronata*. The mangrove bay was dominated by *C. tegal*, with stands of *R. mucronata*. The width of mangrove growth was very narrow, usually only a single tree deep. Though seedling density was not recorded, there was evidence of significant juvenile growth, an indicator of a healthy community.

Table 7. Percent cover of plant species in the three vegetation zones surveyed.

Scientific name	Common name	Dhivehi name	Zone			
			Coastal fringe	Pond fringe	Mangrove bay fringe	Inland forest
<i>Cocos nucifera</i>	Coconut palm	Dhivehi ruh		5.3		6.0
<i>Guetarda speciosa</i>	Beach gardenia	Uni	8.1		7.7	0.0
<i>Pandanus tectorius</i>	Screw pine	Boa Kashikeyo	13.1	10.5	13.2	
<i>Pemphis scidula</i>	Iron wood	Kuredhi	52.2	36.8		18.1
<i>Scaevola taccada</i>	Sea lettuce	Magoo	23.7	13.2	42.3	14.9
<i>Talipariti tiliaceum</i>	Sea hibiscus	Dhigga	2.8	21.1	2.5	30.2
<i>Thespesia populnea</i>	Thespesia	Hirun'dhu		2.6		
<i>Ochrosia oppositifolia</i>	Cork wood tree	Dhun'buri				30.9
<i>Brugeira cylindrica</i>	Small-leafed orange mangrove	Kandoo		2.6		
<i>Ceriops tegal</i>	Yellow mangrove	Karamana		2.6	34.3	

Birds



Figure 8. A flock of black Naoed Tern



Figure 9. A Grey Heron flying on top of the mangrove trees

A high number of birds were observed across the island. The bird species observed differed between survey zones. Birds were most abundant in the mangrove bay habitat. This might be due to the abundance of potential prey, including gastropods and small fish. Surveys were limited to daylight hours, so no roosting was observed, and we were unable to determine the location of any nesting sites.

Table 8. Abundance of bird species observed in the three zones surveyed

		Zone		
		Inland	Pond	Mangrove bay
<i>Corvus splendens</i>	Kaalhu	14		
<i>Eudynamys scolopaceus</i>	Koel	12		
<i>Ardea cinerea</i>	Maakanaa		2	5
<i>Ardeola grayii phillipsi</i>	Huvadhu Raabondhi		2	
<i>Casmerodius albus</i>	Lagana		1	2
<i>Charadrius mongolus</i>	Kuda Bondana		2	
<i>Nycticorax nycticorax</i>	Raabondhi			3
<i>Arenaria interpres</i>	Rathafai			2
<i>Numenius phaeopus</i>	Bulhithun'bi			1
<i>Tringa hypoleucos</i>	Findhana			4

Mangrove Fish Community

The mangrove bay had an abundant and diverse fish community sheltering or hunting amongst the mangrove roots. A high number of juvenile sharks and rays were found at indicating this habitat is an important nursery ground. Notably, juvenile sicklefin lemon sharks (*Negaprion acutidens*), a rare and vulnerable (IUCN Redlist) species, were observed in high numbers. There were also juveniles of commercially important fish species such as blue-fin jacks, and snapper and groupers. The importance of these Mangrove Bays as nursery habitats is undervalued across the country and a proper evaluation of the goods and services provided by the different mangrove, sea grass and wetland habitats needs to be conducted.

Table 8. Abundance of fish species observed in the mangrove bay

Species/Family	Common Name	Abundance
<i>Caranx melampygus</i>	Blue-fin jack	2
<i>Carcharhinus melanopterus</i>	Blacktip reef shark	23
<i>Chaetodon auriga</i>	Threadfin butterflyfish	6
<i>Chaetodon lunula</i>	Raccoon butterflyfish	6
<i>Chanos</i>	Milkfish	30
<i>Gerres oyena</i>	Black-tip pursemouth	66
<i>Himantura granulata</i>	Mangrove whipray	69
<i>Lethrinidae</i>	Emperor	3
<i>Lutjanus monostigma</i>	One-spot snapper	7
<i>Mullidae</i>	Goatfish	13
<i>Negaprion acutidens</i>	Sicklefin lemon shark	9
<i>Ostraciidae</i>	Pufferfish	1
<i>Pastinachus sephen</i>	Cowtail stingray	63
<i>Urogymnus asperrimus</i>	Porcupine ray	2

Methods

Transect surveys were used to quantitatively assess fish and benthic communities at a high taxonomic level. Transect sites were selected using a stratified, haphazard process. Transect surveys were conducted using SCUBA at a depth of 5 – 10 m. Six transects were conducted at each site and a gap of at least 5 m was left between each transect to ensure independence of samples. The cover of different substrate categories was collected using a point intercept approach along the 30 m transect tape. Starting at 0.5 m the substrate type directly under the transect tape every 50 cm along the transect was identified as one of the categories: live coral, dead coral, sponge, algae, rock, rubble, sand and CCA. Coral reef structural complexity was visually assessed during roaming surveys, for the duration of the timed swim, and for the length of the transects. Structural complexity was estimated on a scale from 0 (completely flat) to 5 (highly complex) (following Wilson et al. 2007). Fish communities were surveyed on six 4 x 30 m transects using the same transects as the benthos surveys. The presence of all fish families was recorded on each transect. All butterflyfish (Chaetodontidae), groupers (Serranidae), parrotfish (Scaridae), surgeonfish (Acanthuridae), sharks and rays were counted and identified to species and their total length estimated to the nearest 5 cm.

Island vegetation areas were classified into five vegetation zones based on location: coastal fringe, pond fringe, mangrove bay fringe, mangrove forest and inland forest. Survey points were identified within each zone using a stratified sampling approach and the GPS coordinates were extracted from Google Earth® version 7.3.1 and entered into a handheld GPS (Garmin etrex 20x) for navigation to the point. At a survey point a 2.5 m radius circle was estimated and the dominant and secondary flora within the area were identified

to species and their respective percent covers were estimated. The height of the dominant species was estimated to the nearest metre. Bird surveys were conducted concurrent with terrestrial habitat surveys. All birds observed were counted and identified to species. Mangrove fish surveys were conducted first during high tide when the bay was sufficiently deep, surveys were conducted from a boat, and then during low tide surveys were conducted on foot. All fish were counted and identified to family and where possible to species.

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Annex

Fish families observed at Farukolhu

Table A1. All fish families recorded

Common Family	Family
Surgeonfish	Acanthuridae
Cardinalfish	Apogonidae
Trumpetfish	Aulostomidae
Triggerfish	Balistidae
Blenny	Blenniidae
Fusilier	Caesionidae
Jack	Carangidae
Requiem Shark	Carcharhinidae
Butterflyfish	Chaetodontidae
Hawkfish	Cirrhitidae
Garden eel	Congridae
Stingray	Dasyatidae
Batfish	Ephippidae
Goby	Gobiidae
Sweetlips	Haemulidae
Squirrelfish	Holocentridae
Rudderfish	Kyphosidae
Wrasse	Labridae
Emperor	Lethrinidae
Snapper	Lutjanidae
Tilefish	Malacanthidae
Dart Goby	Microdesmidae
Goatfish	Mullidae
Moray Eel	Muraenidae
Eagle ray	Myliobatidae
Spinecheek	Nemipteridae
Boxfish	Ostraciidae
Grubfish	Pinguipedidae
Angelfish	Pomacanthidae
Damselfish	Pomacentridae
Parrotfish	Scaridae
Tuna	Scombridae
Scorpionfish	Scorpaenidae
Grouper	Serranidae
Rabbitfish	Siganidae
Barracuda	Sphyraenidae
Pufferfish	Tetraodontidae
Triplefin	Tripterygiidae
Moorish idol	Zanclidae

Grouper, butterflyfish, parrotfish and surgeonfish species observed at Farukolhu

Table A2. All grouper species recorded across detailed underwater visual census

Common name	Scientific name
Red-flushed grouper	<i>Aethaloperca rogaa</i>
Peacock rock cod	<i>Cephalopholis argus</i>
Leopard rock cod	<i>Cephalopholis leopardus</i>
Blackfin rock cod	<i>Cephalopholis nigripinnis</i>
Honeycomb grouper	<i>Epinephelus merra</i>
Marble grouper	<i>Epinephelus fuscoguttatus</i>
Squartetail coral grouper	<i>Plectropomus areolatus</i>
Black-saddle coral grouper	<i>Plectropomus laevis</i>

Table A3. All butterflyfish species recorded across detailed underwater visual census

Common name	Scientific name
Threadfin butterflyfish	<i>Chaetodon auriga</i>
Head-band butterflyfish	<i>Chaetodon collare</i>
Double-saddle butterflyfish	<i>Chaetodon falcula</i>
Spotted butterflyfish	<i>Chaetodon guttatissimus</i>
Brown butterflyfish	<i>Chaetodon kleinii</i>
Madagascar butterflyfish	<i>Chaetodon madagaskariensis</i>
Meyers butterflyfish	<i>Chaetodon meyeri</i>
Triangular butterflyfish	<i>Chaetodon triangulum</i>
Pinstriped butterflyfish	<i>Chaetodon trifasciatus</i>
Yellow-head butterflyfish	<i>Chaetodon xanthocephalus</i>
Long-nose butterflyfish	<i>Forcipiger flavissimus</i>

Table A4. All parrotfish species recorded across detailed underwater visual census

Common name	Scientific name
Shabby parrotfish	<i>Chlorurus sordidus</i>
Five-saddle parrotfish	<i>Scarus scaber</i>
Three-colour parrotfish	<i>Scarus tricolor</i>

Table A5. All surgeonfish species recorded across detailed underwater visual census

Common name	Scientific name
Ring-tail surgeonfish	<i>Acanthurus auranticavus</i>
Powder-blue surgeonfish	<i>Acanthurus leucosternon</i>
Eye-line surgeonfish	<i>Acanthurus nigricauda</i>
Dusky surgeonfish	<i>Acanthurus nigrofusus</i>
Two-spot bristletooth	<i>Ctenochaetus binotatus</i>
Fine-lined bristletooth	<i>Ctenochaetus striatus</i>
Gold-ring bristletooth	<i>Ctenochaetus truncatus</i>
Brown Tang	<i>Zebrasoma scopas</i>