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Aldabra Marine Programme

Phase VI

Report on the 2005 Aldabra Marine Programme Research

**Raymond Buckley, Nigel Downing, Ben Stobart and
Kristian Teleki**

Cover Photo: *Seriatopora hystrix* (Photo Ben Stobart)



Phase VI

Report on the 2005 Aldabra Marine Programme Research

March 2005

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AMP Mission Statement

To undertake a long term research programme of the Aldabra marine environment that supports its management and conservation, and to strengthen Aldabra's regional and global status as an exceptional location of biodiversity and natural history in the Indian Ocean

Executive Summary

The Aldabra Marine Programme (AMP) has been surveying the coral reefs of Aldabra since 1999, and the reefs of Assumption, Astove and St. Pierre since 2002. In April 2005, AMP completed the 5th full survey of the corals and reef fishes at Aldabra and the 3rd full survey at Assumption, Astove and St. Pierre. In addition, exploratory work was done on the nutrient flow from the mangroves to lagoon corals; and genetic samples were collected from three species of reef fish to determine the feasibility of conducting a study of the genetic connectivity between the islands.

While the general health of the reefs appeared good, the soft coral *Rhytisma* is still prolific at certain Aldabra locations. Aggressive interactions between *Rhytisma* and adjacent scleractinian coral colonies are evident. *Rhytisma* has not been as intrusive on Astove or St. Pierre, but is seen at Assumption in low densities. Evidence of coral disease was also detected for the first time at Aldabra, though there was not time to conduct formal surveys of this phenomenon. A bleaching event was detected at Astove, and to a lesser extent at Assumption. Though the bleaching at Astove was widespread amongst species and evident to 20m depth, it was not severe, with only a few colonies having completely expelled their zooxanthellae. It is unlikely to have a significant effect on the corals which will probably all survive. This bleaching event coincides with a period of extended high temperature at Astove recorded by our in-situ temperature data loggers. Furthermore, the temperature hot-spot was also reported by the NOAA coral bleaching website. The alga *Caulerpa* was not found at any of the survey sites, although samples from the Aldabra lagoon were taken for analysis. Unfortunately, Site 1 at Astove was not visited due to high seas, so the status of the alga there could not be ascertained. The fish populations continue to be vibrant, both in terms of diversity and numbers. This is the first time that an April survey has been conducted, and an analysis of the data due to be presented at the 11th International Coral Reef Symposium (July 2008) will show whether there are significant differences between the findings of previous years.

The SIF Board met on Aldabra during the time the April 2005 surveys were being conducted. This gave the AMP team an opportunity to discuss their work with the Board members, and a short presentation was given. Where possible, the Aldabra rangers assisted the team in collecting samples from the lagoon and in removing and re-deploying temperature data loggers. Lucy Black, a volunteer at the Station, also provided some assistance in the mangrove related work. A collapsible drying oven was left at the research station, as well as three larval collecting traps, should the scientific staff wish to make use of this equipment.

Outline of Work Achieved

The 2005 Aldabra Marine Programme Phase VI

Phase VI of the Aldabra Marine Programme took place between the 18th and 24th of April 2005. All but one (Site 8) of the 11 permanent survey sites established at Aldabra (3 of which are in the lagoon), were surveyed. Site 8, located off the south western coast, was inaccessible due to heavy seas from the south east. Other sites surveyed were Assumption (25th April), Astove Site 2 (27th April) and St. Pierre (29th April). Conditions were generally excellent at all survey locations.

Coral Surveys

The coral video transects at 10m and 20m depths were successfully completed at all of the above locations, with the exception of St. Pierre which had already been surveyed in January 2005 as part of the Golden Shadow Expedition (www.livingoceansfoundation.org). A census of coral recruits using 1m x 1m quadrats was also carried out at Aldabra Sites 2, 3, 4 and 6 and at Assumption. Aldabra Sites 1, 6 and 7 and the sites at the other islands have each been used to assess coral recruit growth and survival (by tagging juvenile corals and monitoring their progress) during past surveys. We continued this work during the current visit and extended it to Aldabra Site 2 where 7 new juvenile recruits were located, identified, measured and tagged.

Fish Surveys

We carried out fish surveys at all locations listed above, both along the 10m and 20m survey lines. In addition, to establish more clearly how species diversity varies from one site to another, and to update earlier checklists of fishes found at these locations we completed a species inventory at each survey site and at all islands. Species checklists were generally taken between the depths of 23m and 4m, thus overlapping the survey area.

In-water Temperature Data Collection

Data loggers have been recording reliable water temperature information at selected sites and depths since May 2003. At each logger site they were retrieved, checked for correct functioning, downloaded and redeployed. All temperature data retrieved appears to be sound since there is data agreement between the prime logger (Hobo) and the back-up (Tidbit).

At two sites there was strong evidence that the data loggers had been tampered with. At one site the stake on which the loggers were attached had been removed from the substrate and threaded through the “D-ring” of the logger case, which is not the way the loggers are normally secured. The cable ties holding the instrument in place were missing. At the second site there had been an obvious attempt to cut into a logger case using a knife. Tampering with an AMP data logger also occurred at this location in 2004 when the logger was missing from its protective case. In addition, a temperature data logger, strongly secured to a coral head at Cosmoledo during 2004 (aboard the Indian Ocean Explorer) was found by this same vessel on a later visit and returned to AMP.

Genetic Connectivity

There is currently no genetic data to validate the suspected role that the reef systems at Aldabra contribute propagules to the region. Genetic profiles of the corals and reef fishes are needed from Aldabra and surrounding islands to begin investigating whether Aldabra acts as a “genetic source or a sink”, or both, in relation to other reefs in the region. This information can be used to determine what genetic differences occur between populations of a given species found at the different locations, and thus indicate the degree of bio-connectivity between the locations. To assess the feasibility of carrying out such a genetic connectivity study on a large scale, we targeted four species of fish for genetic sample collections from various sites. Fin-clip samples of *Ctenochaetus truncatus* (a surgeonfish), *Nemanthias carberryii* (a basslet), *Amphiprion akallopis*, and *A. fuscocaudatus* (clownfishes) were collected from Aldabra, Assumption, and Astove. *C. truncatus* was also sampled from St. Pierre. Subject to funding, molecular genetic analyses will be done on these samples at laboratories in the USA (University of Washington) and France (University of Perpignan) to discover to what extent, in these fish species, the reefs share genetic material.

Mangrove – Coral Reef Nutrient Transfers

The importance of the relationship of mangrove-derived nutrients (C, N and S) to reef-building corals is not well studied. Ms. Elise Granek, Ph.D student from Oregon State University, USA, accompanied AMP to conduct the mangrove-coral nutrient transfer sampling in the lagoon as part of her graduate research. To assess the extent to which Aldabra lagoon mangroves are contributing to the nutrients utilized by corals on reefs inside the lagoon, tissue samples were collected for stable isotope analysis. Mangrove leaves, seagrass blades, macroalgae, and

phytoplankton samples were collected to establish baseline data of the primary producers in the system. Coral taxa including *Pocillopora* sp., *Fungia* sp., *Galaxea* sp. and *Porites* sp. were collected to analyze the percent contribution of mangrove-derived nutrients to these species. The coral tissue samples were collected on reefs at three distances from the mangroves to assess how far the mangrove influence is detectable on the reefs.

Location Information

All AMP sites are located in the southern Seychelles Islands Group about 200-300 nautical miles to the north of Madagascar and 300-450 miles east of Africa. Locations are provided in previous AMP reports which are available for download at our www.aldbabra.org website.

Methodology

The procedures used in the 2005 AMP survey to locate and mark permanent survey sites, and the methods used to quantify corals and fishes on the transects, replicated those used in AMP Phases I to V (Teleki *et al.* 1999; Stobart *et al.* 2001; Stobart *et al.* 2002; Downing *et al.* 2003 and Buckley *et al.* 2004 respectively). All previous AMP reports are available online at www.aldbabra.org. At Aldabra surveys were conducted at all AMP Sites except for Site 8 which was inaccessible. Surveys were also conducted at Assumption at Site 1, Astove at Site 2 and at St. Pierre Site 1.

Temperature Data Loggers

AMP Phase VI used the HOBO Water Temp Pro® temperature data logger as the primary recording system, and the StowAway TidbiT® temperature data logger as a back-up, to establish a long-term sea temperature monitoring system at all the AMP sites. Onset Computer Corporation manufactures both instruments. In May 2003 we deployed these temperature loggers in pairs at 10m and 20m depths at Aldabra, Assumption, Astove and St. Pierre. The HOBO Water Temp Pro® measures water temperatures with an accuracy of $\pm 0.2^{\circ}\text{C}$. It can record up to 21,580 temperature measurements at a programmable interval. The StowAway TidbiT® loggers measure water temperatures with an accuracy of $\pm 0.8^{\circ}\text{C}$, and can record up to 32,520 temperature measurements at a programmable interval. To guard against the loss of the temperature data (as was experienced in 2001 with the flooding of the Optic StowAway Temp®

data loggers) the StowAway TidbiT® loggers were deployed in waterproof plastic cases containing desiccant packs.

In 2005 temperature recording intervals were changed from every 30 minutes to hourly. This decision was made to ensure loggers would have enough memory to continue recording between AMP visits. We considered hourly intervals sufficient to calculate daily average temperature. Both models were attached near the base of the 10m and 20m transect line stakes that mark the start of the transect lines.

Ranger Training

The surveys at Aldabra included refresher training for Station Ranger Marvin Aglae in the fish survey techniques provided by AMP in May 2003. This covered standard AMP fish survey protocols, and underwater identification of the butterflyfish (Chaetodontidae) and groupers (Serranidae).



Paracirrhites forsteri. Resting on *Rhytisma*

Results

Coral Transects and Benthic Habitats

At Aldabra, live coral cover (hard and soft coral combined, including *Rhytisma*) at the eight outer reef sites surveyed in 2005 ranged from 14 % to 67% in shallow water and 18% to 55% in deep water. Hard coral growth at all of these sites since the AMP started surveys has been minimal. In shallow water the maximum recovery since 1999 has been only 7.4% at Site 4, while in deep water the maximum recovery was 6.5% at Site 6. Between 2004 and 2005 growth has only been a maximum of 2.4% at Site 4 in shallow water, and 4% at Site 6 in deep water (Fig. 1). Most of the small increase in coral cover detected (hard and soft coral combined) was once again driven by the soft coral *Rhytisma* that continued to increase in cover at most shallow sites surveyed, in particular at Sites 2 (9.8%), 6 (5.7%), and 7 (8.5%) (Fig. 1). Growth at Site 6 appears to have accelerated again following an increase of only 2% between 2003 and 2004. In deep water there has been relatively little change, with maximum increases occurring at Sites 7 (3.3%) and 6 (1.8%). Other soft corals showed little change. Macroalgal cover has remained relatively constant at both depths since May 2003, while encrusting algae has continued to decline at all sites (Fig. 2). The decline in encrusting algae is primarily due to the continuing increase in *Rhytisma*. It is also noteworthy that macroalgae continued to decrease at the 10m transect at Site (5%), primarily due to loss of *Halimeda*. Within the lagoon hard coral cover continues to increase at Site 9, while the benthic cover remains stable at Sites 10 and 11 (Fig. 2).

With the exception of Astove in shallow water, there has been little change in hard coral cover at the other island sites. At Astove coral cover increased by 12.3% and 3.6% in shallow and deep water respectively (Fig. 4). The sharp increase in hard coral cover at St. Pierre noted for previous years appears to have slowed down, particularly in shallow water. Here coral growth has been dominated by *Pocillopora eydouxi*. It increased by as much as 18% between February 2002 and March 2004 but decreased by 3.4% between 2004 and 2005. In deep water hard coral cover continues to increase at a modest pace. It is noteworthy that in shallow water there was evidence of considerable storm damage to corals at St. Pierre during the 2004 survey, with many new colonies being dislodged. This damage has clearly now resulted in a small decline in percent cover. There was a considerable decrease in encrusting algae at Assumption in shallow (10.5%) and deep (10.4%) water and Astove (13.3%) in shallow water (Fig 5). These changes are due to increases in macro algae and sand, rock or rubble at Assumption and hard coral at Astove.

We observed several indicators of poor coral health during the 2005 expedition that were not present in previous years (see Plate 1 below). There was a widespread bleaching event at Astove that was also apparent in a reduced state at Assumption, while there was no evidence of bleaching at Aldabra. At Astove the bleaching was mainly in colonies at 10m and shallower, but we also found evidence of bleached colonies at 20m and deeper. At Aldabra we also recorded many instances of diseased corals and there were clear signs that *Rhytisma* was damaging nearby colonies (see below for examples).

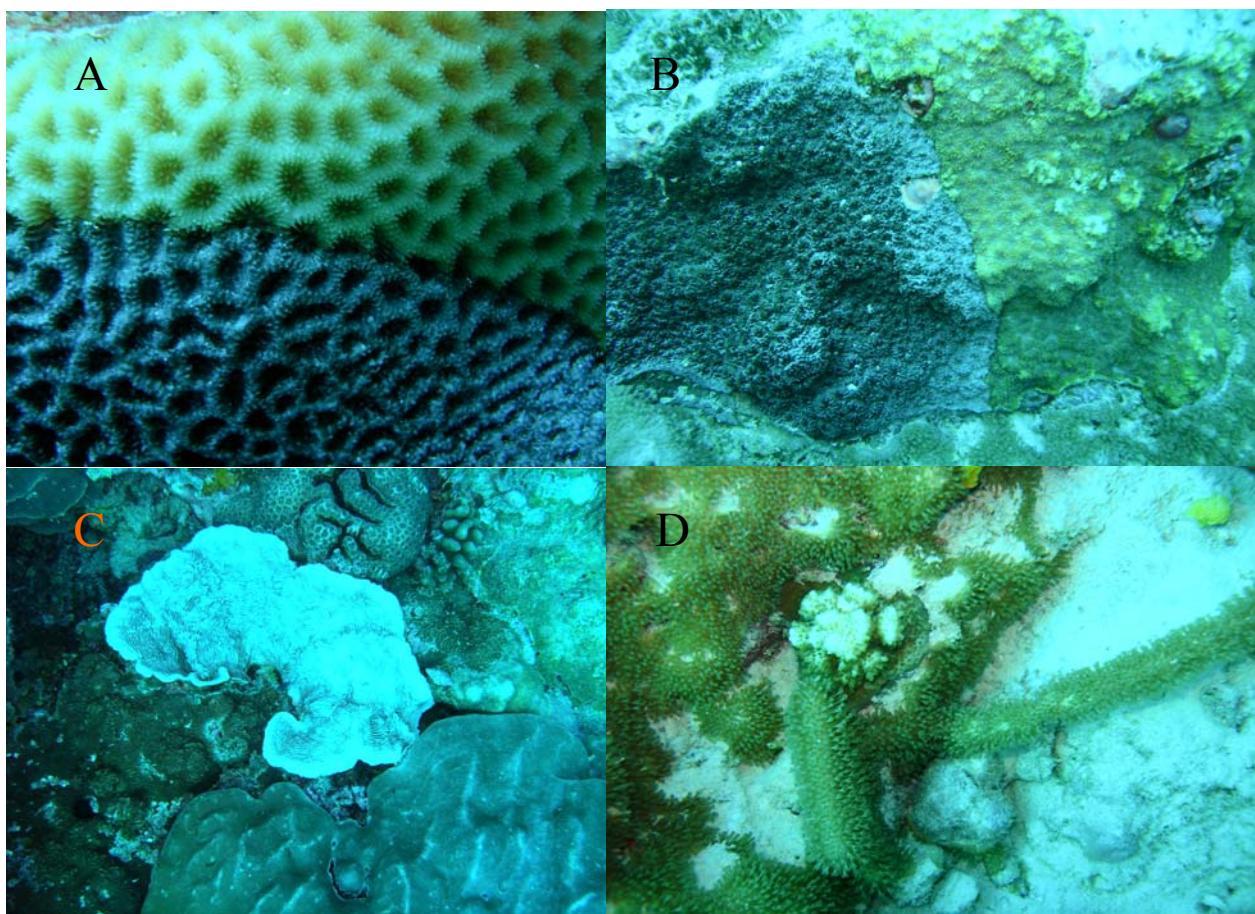


Plate 1. Coral state: A & B – Diseased coral at Aldabra; C – Bleached *Pachyseris* sp. at Astove; D – tagged *Acropora* sp. colony at Aldabra surrounded by *Rhytisma* sp.



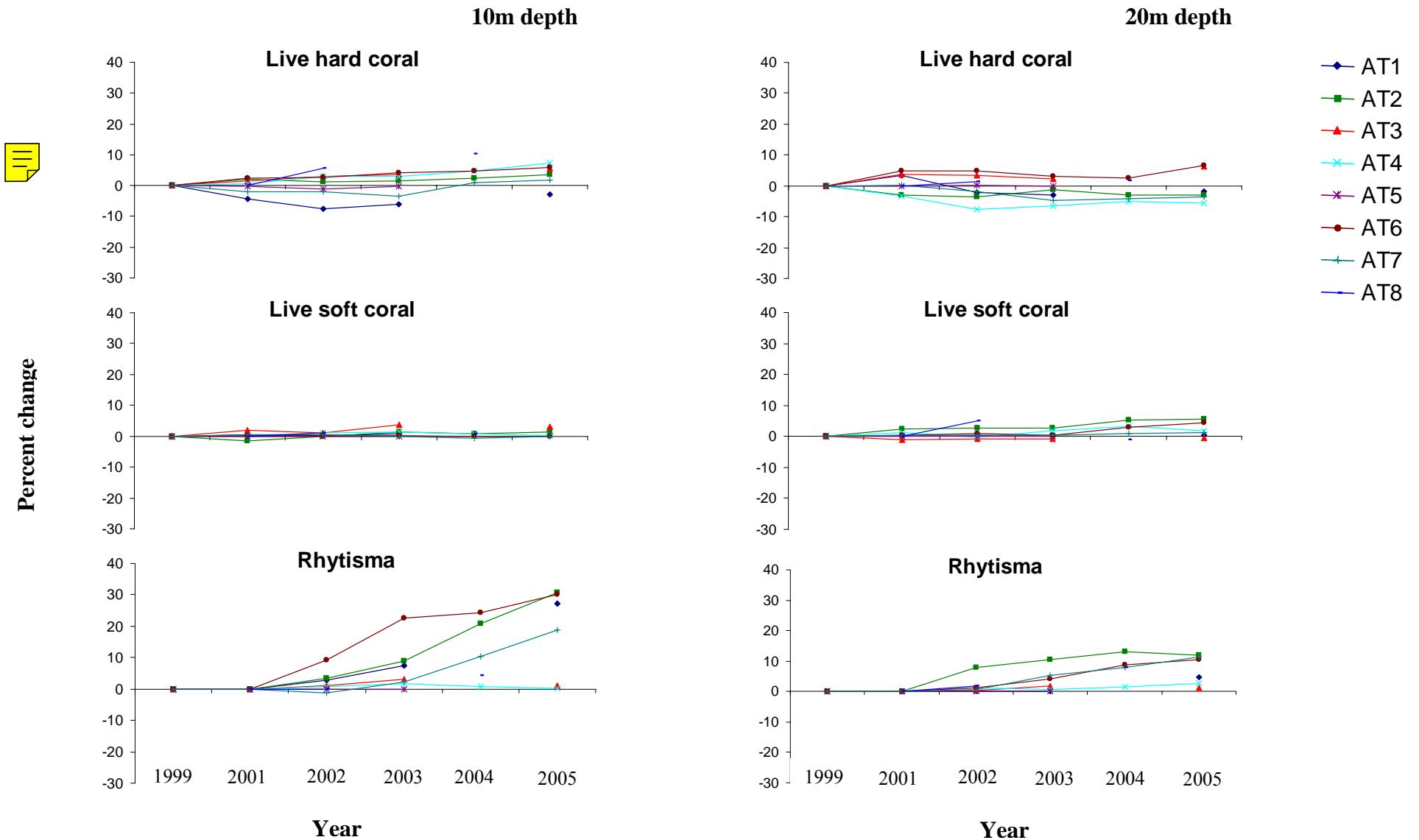


Figure 1. Percent change in cover of hard coral, soft coral and *Rhytisma* at Aldabra between 1999 and 2005, in shallow (10m) and deep (20m) water. Legend shows site number by colour and symbol.

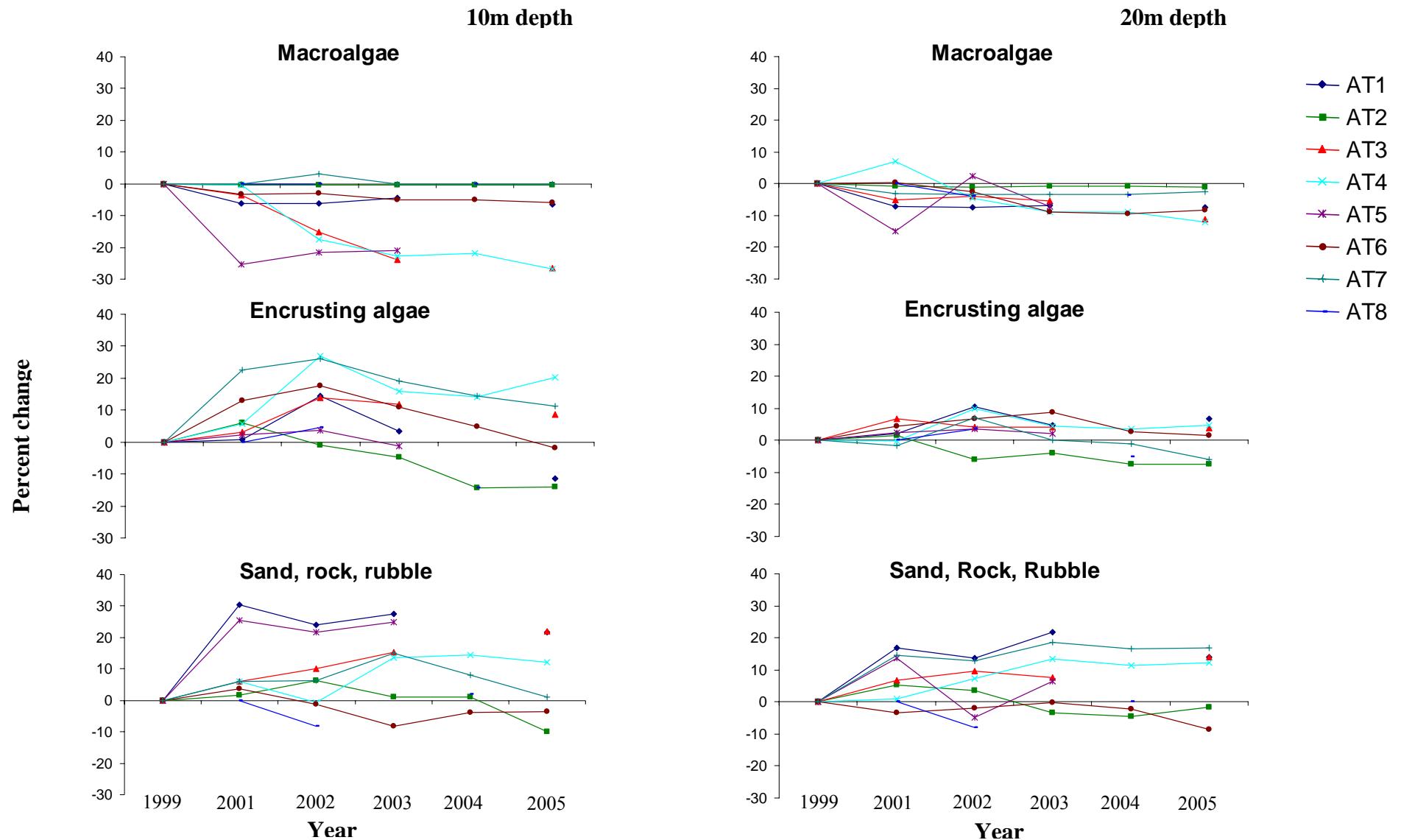


Figure 2. Percent change in cover of macroalgae, encrusting algae and sand/rock/rubble at Aldabra between 1999 and 2005, in shallow (10m) and deep (20m) water. Legend shows site number by colour and symbol.

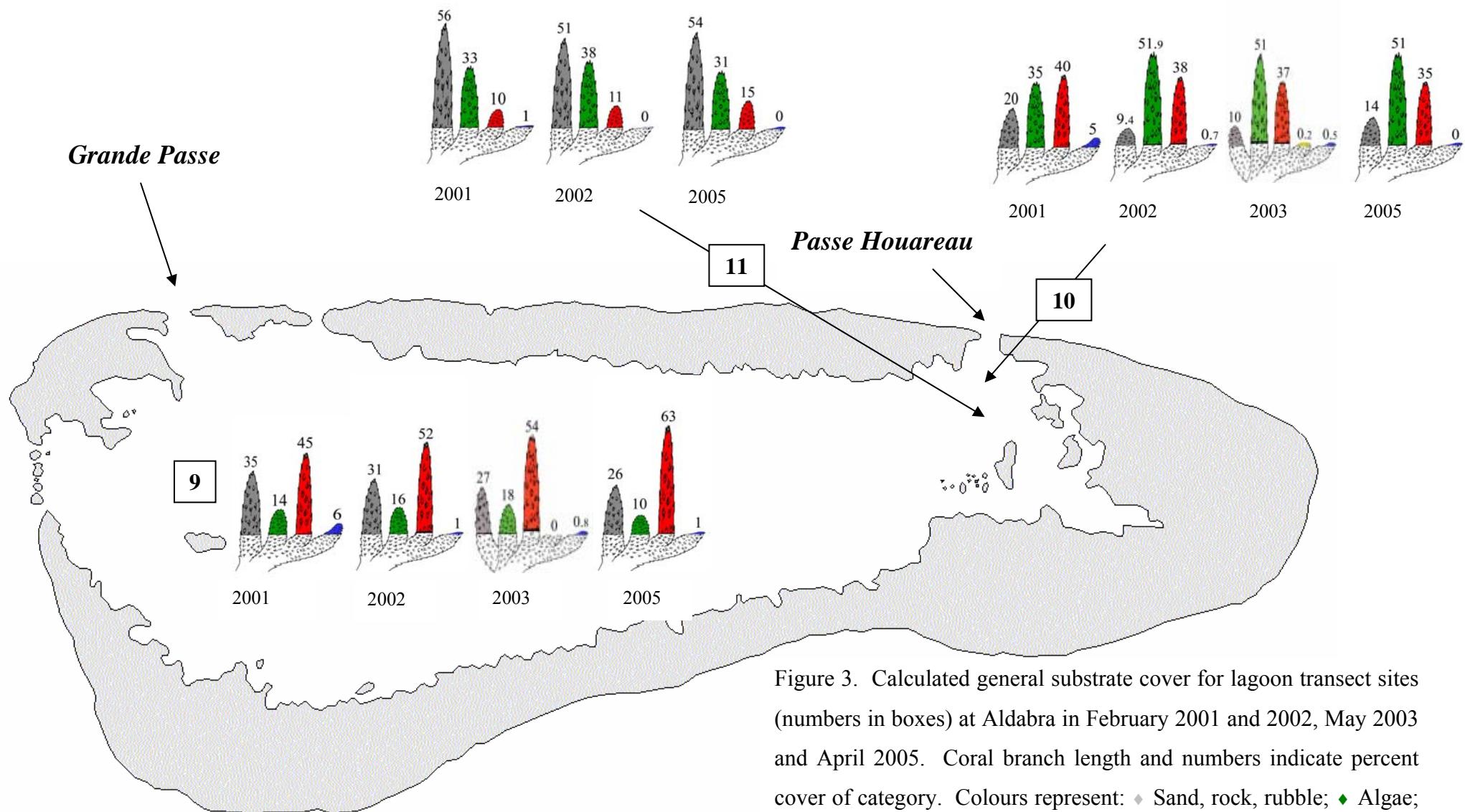


Figure 3. Calculated general substrate cover for lagoon transect sites (numbers in boxes) at Aldabra in February 2001 and 2002, May 2003 and April 2005. Coral branch length and numbers indicate percent cover of category. Colours represent: ◆ Sand, rock, rubble; ♦ Algae; ◆ Hard coral; ♦ Soft coral ; ♦ Dead coral. * Note percentages may not add to 100 due to omitted “others” category.

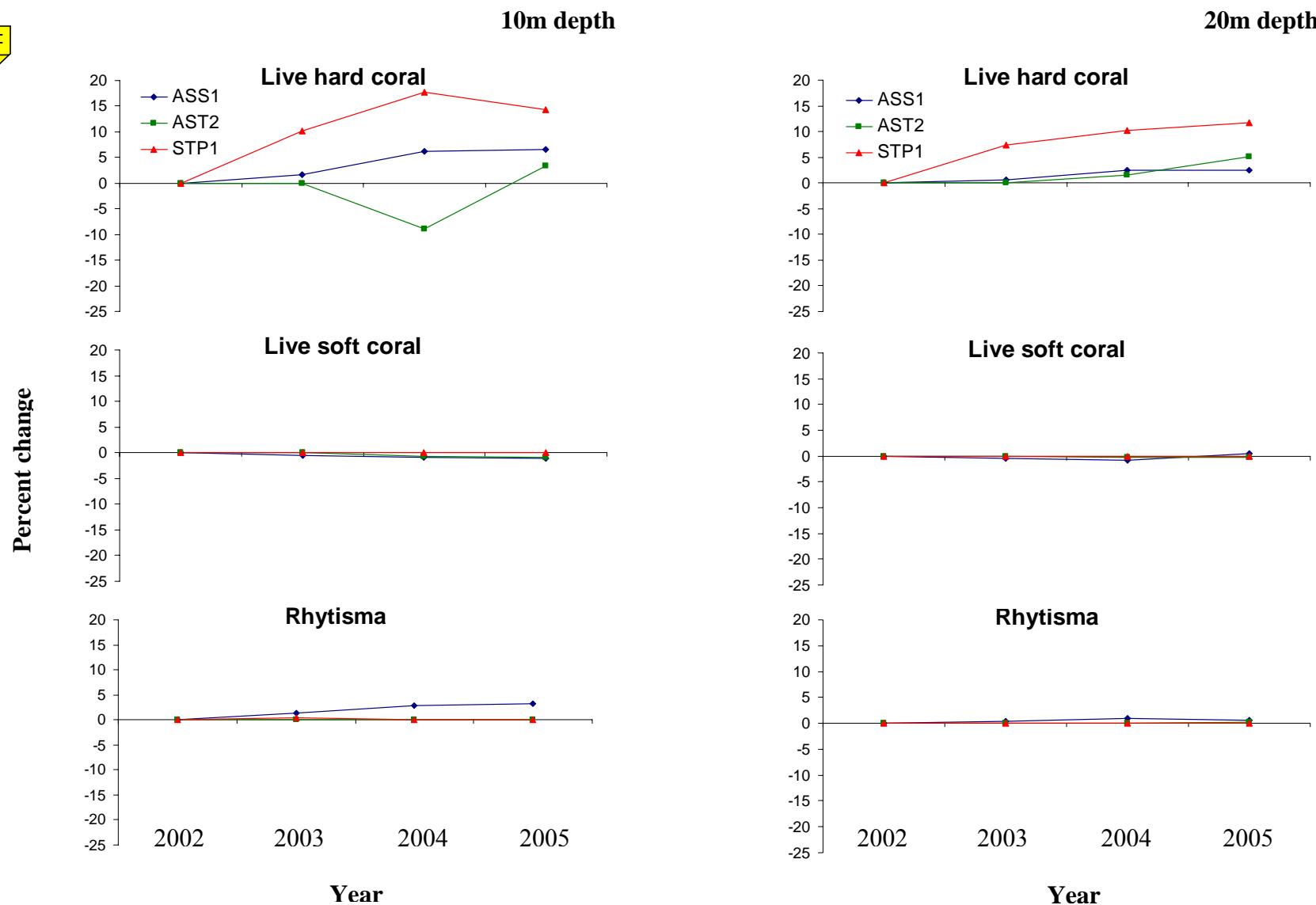


Figure 4. Percent change in cover of hard coral, soft coral and *Rhytisma* at Assomption, Astove (Site 2) and St Pierre between 2002 and 2005, in shallow (10m) and deep (20m) water. Legend shows site by colour and symbol.

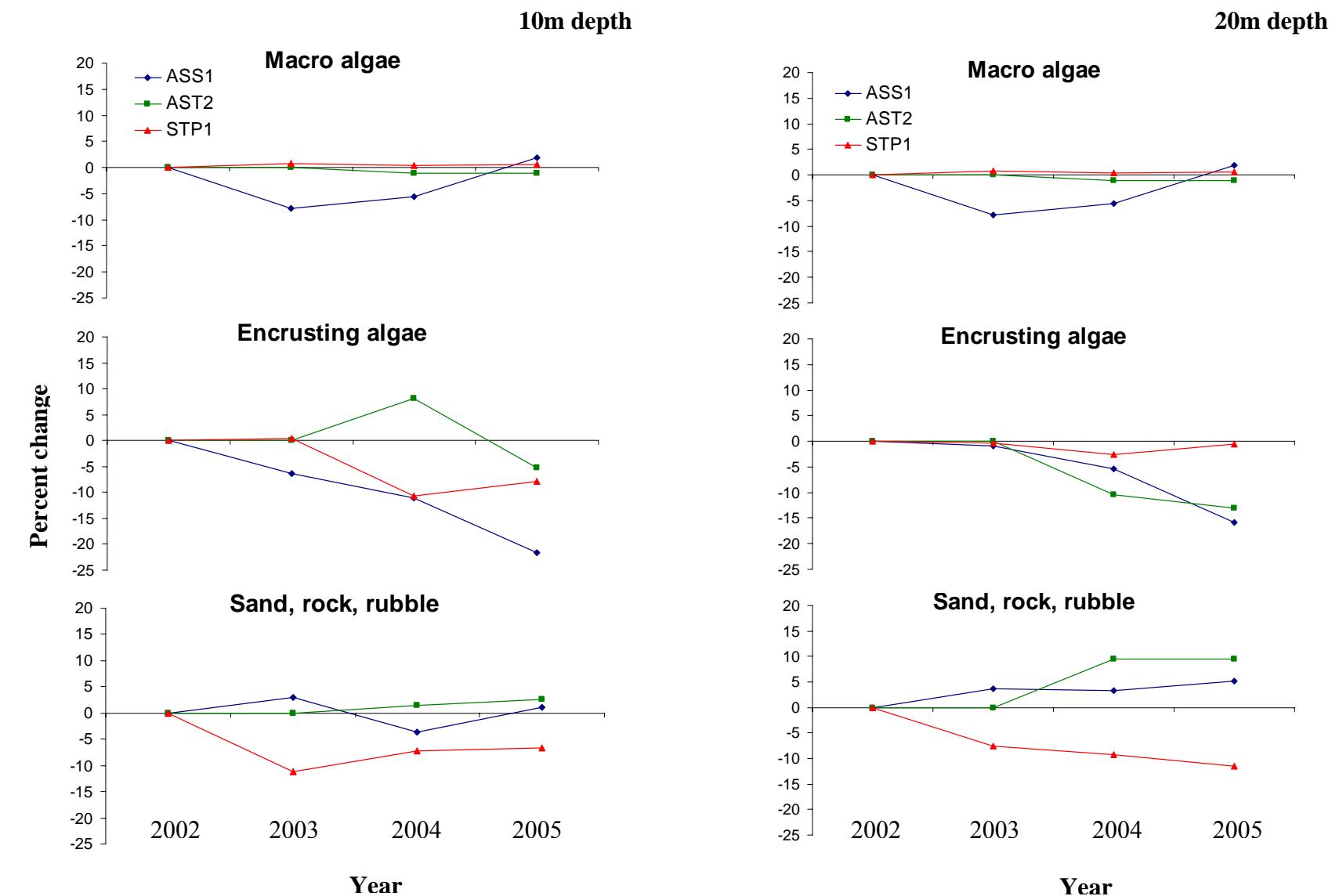


Figure 5. Percent change in cover of macroalgae, encrusting algae and sand/rock/rubble at Assumption, Astove (Site 2) and St Pierre between 2002 and 2005, in shallow (10m) and deep (20m) water. Legend shows site by colour and symbol.

Coral Recruitment and Tagging

Number of Recruits

Due to time restrictions recruit quadrats were only conducted at 10m depth (6m in the case of Site 7). There are sharp declines in comparison with the previous surveys at all locations with the exception of Aldabra Site 7 and St. Pierre (Table 1). Average number of recruits per m² pooled for Aldabra was 5 (s.e. ± 0.42 , n° recruits = 466, 95 1m² quadrats). This was significantly different from the average of 9 recruits per m² recorded in 2003 ($P(T<0t)$ 2 tailed <0.001). Size frequency distributions for key species such as *Pocillopora* and *Acropora* shown in previous reports are not presented here due to the lower number of samples taken in 2005.

Table 1. Average number of coral recruits/m² at 10m depth for Aldabra Atoll, Assumption (ASS), Astove (AST2) and St. Pierre (STP) for 2005. Mean recruit numbers for 2001, 2002 and 2003 are shown for comparison. █ures in vertically adjacent grey cells represent means that differ significantly between selected years ($\alpha = 0.01$). s.e. mean = standard error of the mean, s = standard deviation, max n° = maximum number of recruits per quadrat and n = total number of recruits.

Statistic	Aldabra Site number							Other islands		
	1	2	3	4	5	6	7	ASS	AST2	STP
2001 mean	4.6	5.6	8.7	8.6	5.6	8.7	8.6	n/a	n/a	n/a
2002 mean	5.0	5.6	8.6	10.6	3.8	2.9	7.2	11.5	1.1	12.9
2003 mean	6.4	8.1	12.7	13.5	7.1	4.8	8.1	12.6	11.5	7.8
2005 mean	3.7	5.3	7.4	7.3		1.88	6.6	8.9	5.9	6.3
s.e. mean	0.67	0.83	0.88	1.13		0.41	0.99	1.08	1.11	0.67
s	2.7	3.7	3.5	4.9			3.9	4.3	4.9	3.0
max n°	9	13	14	20		7	14	16	22	12
n	59	107	119	138		43	16	142	117	125
# quadrats	16	20	16	19		24	106	20	20	20

Tagged Corals

Growth trajectories for tagged *Pocillopora* colonies at Aldabra were very similar, with only one colony showing negative growth due to partial mortality (Figure 6a). Mean diameter of *Pocillopora* recruits increased by 3.4 cm between May 2003 and April 2005 (s.e. ± 0.45 , min = 0.5, max = 8.6, n = 17). Few *Acropora* colonies were re-measured, but average growth of 5.6 cm (s.e. ± 4.04 , min = 1.3, max = 17.7, n = 4) registered for this species during the same period suggests a slightly higher growth rate, as is expected for this species. This difference in growth rate is evident in the five year growth plot (Figure 6b). It must be noted that the sample size was very small.

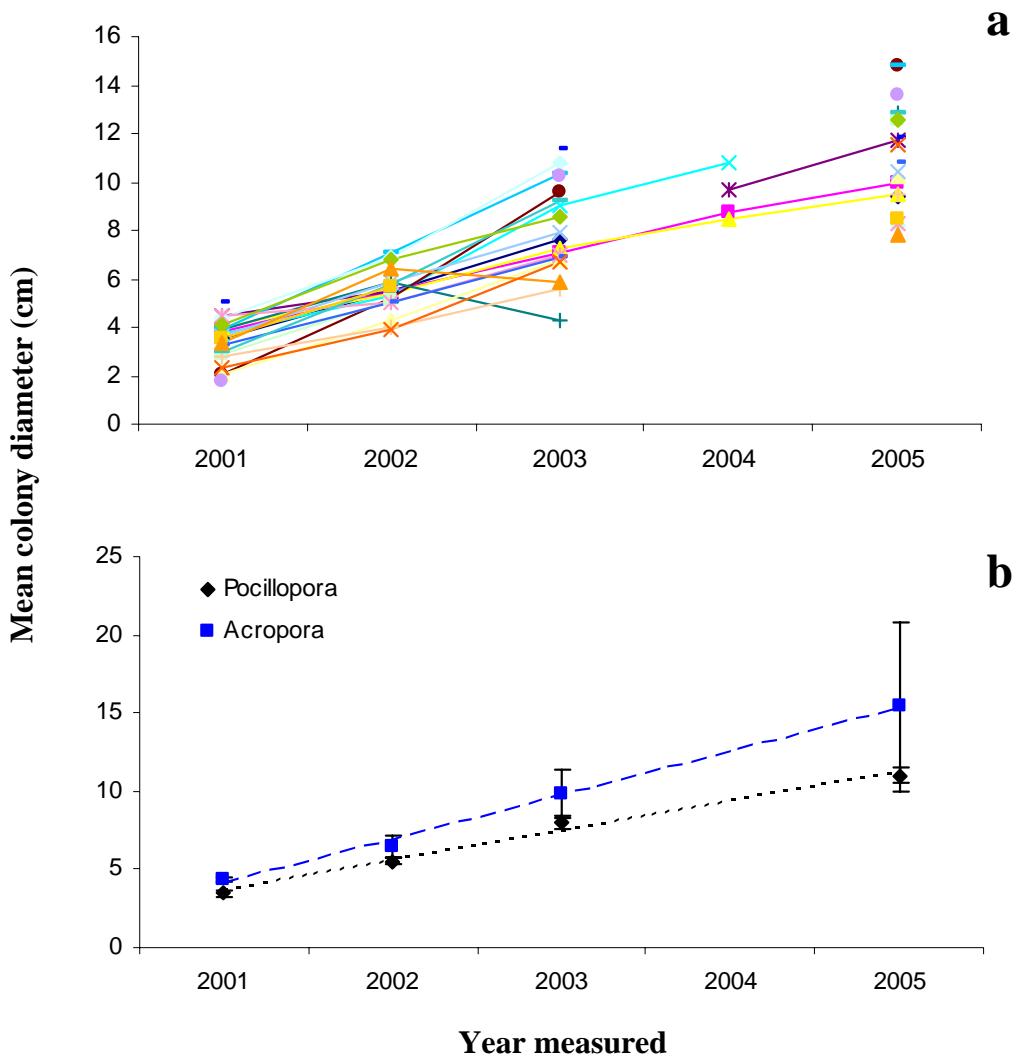


Figure 6. (a) – Growth trajectories of tagged *Pocillopora* individuals at Aldabra between February 2001 and April 2005. (b) - Mean (\pm s.e.) increase of tagged *Pocillopora* and *Acropora* recruit diameter (cm) at Aldabra between February 2001 and April 2005.

Fish Transects

Aldabra Atoll

The species and number of fish counted at Aldabra in 2005, are presented in Appendix 1 by total length (TL) size intervals of <1-10cm, >10-20cm, and >20cm, at 10m and 20m depths. Summary of data from survey years 1999 through to 2005 is given in Table 2. Detailed summary of the number of fish counted at Aldabra during April 2005 by depth is given in Table 3. The number of families and species, and the fish/100m², surveyed in 2005 provide a useful comparison with AMP surveys at Aldabra in previous years (Table 3).

 Table 2. Summary of the AMP fish transect surveys at Aldabra in April 2005, March 2004, May 2003, February 2002, February 2001 and November 1999.

Year	Sites	In/Out Transect Boundary	Total Fish Counted	Total Area Surveyed	Fish/100m ²	Number of Species	Total Nº Families Identified	Total Nº Species Identified
1999	1-7	In	61939	2100m ²	2949	165	29	211
		Out				46	21	
2001	1-8	In	34901	2325m ²	1501	191	32	205
		Out				14	13	
2002	1-8	In	71999	2400m ²	3000	179	30	221
		Out				42	6	
2003	1-7	In	39154	2100m ²	1864	183	30	203
		Out				20	2	
2004	1,2,4,6, 7,8 [1]	In	21610	600 m ²	3602	131	29	131
2005	1-7	In	44208	2100m ²	2105	172	37	208
		Out				33	4	

[1] off transect species counts were not conducted in 2004, and only partial surveys were conducted at each indicated site.

Table 3. Summary of the number of fish counted at Aldabra, by transect depths and fish size groups, during the AMP surveys in April 2005.

Survey Transect Depths		10 m (Site 7 = 5m)				20 m (Site 7 = 15m)				10m + 20m	
Total Area Surveyed		1400 m ²				700 m ²				2100 m ²	
Fish Size Group (Total Length)		<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	Total	
Total Fish Counted		28426	1552	392	30370	9948	3712	178	13838	44208	
Number of Families		24	24	19	29	18	21	16	22	37	
Number of Species		103	98	55	148	75	90	46	140	172	
Fish/100m ²		2030	111	28	2169	1421	530	25	1977	2105	

Assumption, Astove and St. Pierre

The total numbers of fish counted in 2005 at Assumption, Astove and St. Pierre are presented in Appendices 2-4 by total length size intervals of <1-10cm, >10-20cm, and >20cm, and 10m and 20m depths. Summaries are tabulated for each island (Tables 4, 5, 6), and key data compared (Table 7).

Table 4. Summary of the number of fish counted at Assumption, by transect depths and fish size groups, during the AMP surveys in April 2005.

Survey Transect Depths	10 m				20 m				10m + 20m
Total Area Surveyed	200m ²				100m ²				300m ²
Fish Size Group (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	Total
Total fish counted	6397	5616	155	12168	6051	93	41	6183	18353
Number of Families	11	17	11	21	11	10	11	18	23
Number of Species	35	53	21	79	22	24	13	48	92
Fish/100m ²	3200	2808	76	6085	6051	93	41	6185	6118

Table 5. Summary of the number of fish counted at Astove, by transect depths and fish size groups, during the AMP surveys in April 2005.

Survey Transect Depths	10 m				20 m				10m + 20m
Total Area Surveyed	200m ²				100m ²				300m ²
Fish Size Group (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	Total
Total fish counted	5696	696	129	6521	4941	139	16	5096	11617
Number of Families	14	13	14	23	13	12	6	17	28
Number of Species	42	39	29	82	33	28	10	56	94
Fish/100m ²	2848	348	65	3261	4921	139	16	5096	3872

Table 6. Summary of the number of fish counted at St. Pierre, by transect depths and fish size groups, during the AMP surveys in April 2005.

Survey Transect Depths	10 m				20 m				10m + 20m
Total Area Surveyed	200m ²				100m ²				300m ²
Fish Size Group (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	Total
Total fish counted	4813	747	1204	6764	6561	668	67	7296	14060
Number of Families	9	15	18	24	10	11	10	18	35
Number of Species	33	40	44	89	27	36	22	69	108
Fish/100m ²	2407	374	602	3382	6561	668	67	7296	4687

Table 7. Summary of the AMP fish transect surveys at Assumption, Astove and St. Pierre in April 2005, March 2004, May 2003, and February 2002.

	Assumption				Astove				St. Pierre			
	2005	2004	2003	2002	2005	2004	2003	2002	2005	2004	2003	2002
Year	1	1 ^{1]}	1	1	2	2 ^{1]}	2	1	1	1 ^{1]}	1	1
Site	1	1 ^{1]}	1	1	2	2 ^{1]}	2	1	1	1 ^{1]}	1	1
Number of Species in Transects	92	57	88	91	94	69	88	83	108	65	110	107
Total N° of species identified^{2]}	117	[3]	98	100	127	[3]	128	133	141	[3]	128	109
Number of Families in Transects	26	19	25	24	28	19	23	21	35	16	24	25
Families total	25	[3]	26	24	33	[3]	24	29	45	[3]	27	26
Total Fish Counted in Transects	18353	2150 ^{1]}	7291	5336	11617	7807 ^{1]}	5902	6147	14060	8721 ^{1]}	26146	17534
Total Transect Area Surveyed	300m ²	100m ²	300m ²	300m ²	300m ²	100m ²	300m ²	300m ²	300m ²	100m ²	300m ²	300m ²
Fish/100m² in Transects	6118	2150	2430	1779	3872	7807	1967	2049	4687	8721	8715	5845

1] Only partial surveys were conducted at each Site. See text for qualifiers on comparisons with previous years.

2] Includes in-transect and off-transect surveys in 2002 and 2003.

3] Off-transect surveys were not conducted in 2004.



Temperature Data Loggers

All temperature data loggers recovered were still recording data. They were downloaded and reset successfully. Temperature data for Aldabra indicates that average seawater temperatures for 6m, 10m and 20m depth were very similar most of the year. This suggests good mixing between these depths and the lack of a thermocline (Figure 7). Over the years temperatures at all depths have reached 24°C lows between July and October, and summer highs of 29°C between December and May. A weak thermocline may be established during the cyclone season when there are periods of good weather, as suggested by the divergence in 10m and 20m depth temperatures between December and April. The cyclone season is characterised by mostly calm seas and a shift from strong southeasterly winds to sporadic and generally weak northwesterly winds. There is the risk of occasional cyclones, though their passage through this area is rare. Comparison of average temperatures at Aldabra with those of single sites at Assumption, Astove and St. Pierre indicates a similar seasonal variation (Figures 8, 9 and 10).

It is noteworthy that summer highs are slightly higher in 2005 for all locations, in many cases exceeding the estimated thermal threshold of 29.2°C at which many coral bleach (Hoegh-Guldberg 1999). However, with the exception of Astove, none of these highs remained above the threshold for an extended period. At Astove the 10m and 20m depth temperature remained above the threshold for approximately two months. We detected widespread mild bleaching at both of these depths. Our data coincides with a degree heating weeks hot-spot during that period, reported by NOAA above Madagascar that bordered on Astove.

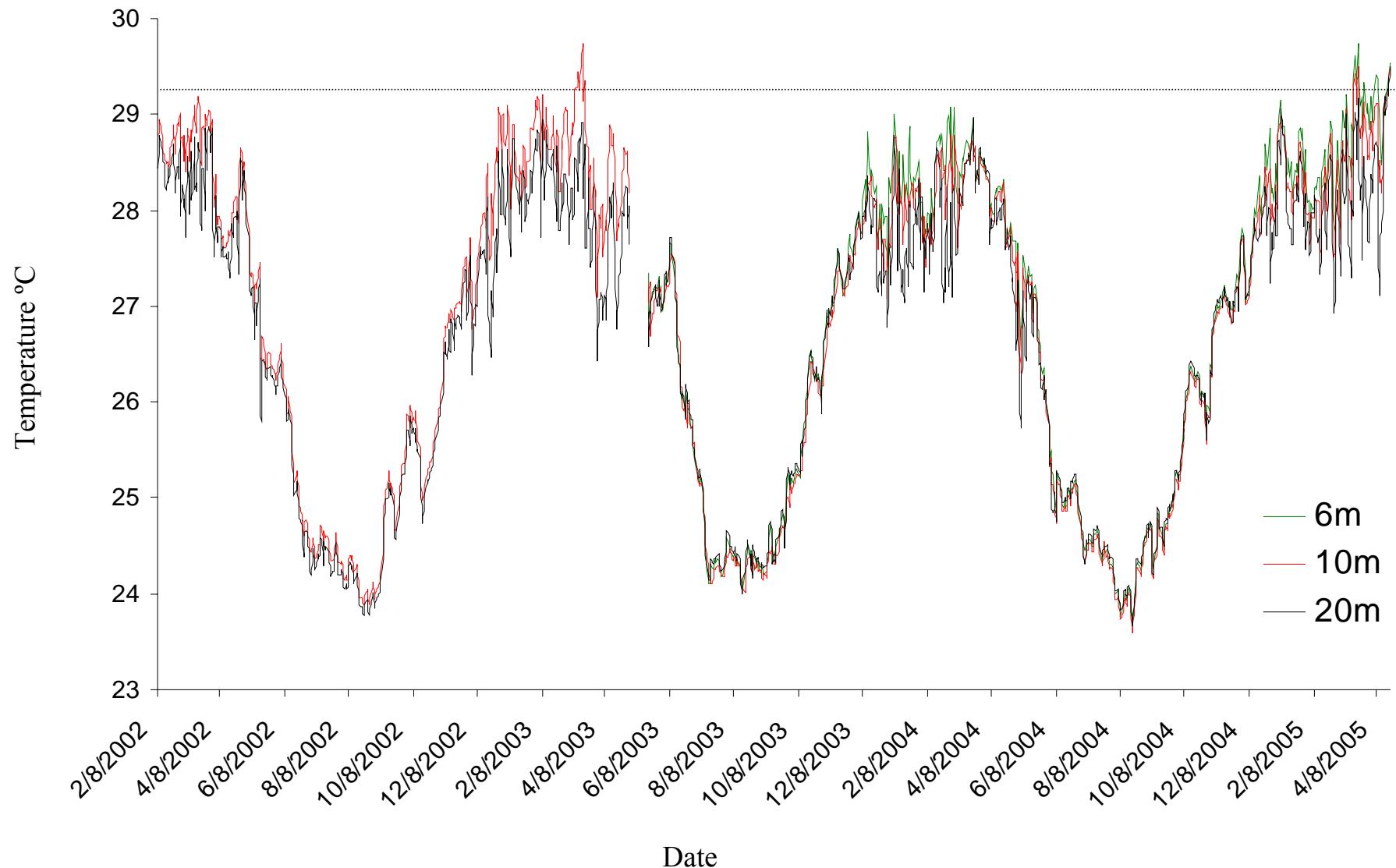


Figure 7. Average daily water temperature for Aldabra Sites 3 and 6 at 6m, 10m and 20m depth (see legend) between February 2002 and April 2005. Dotted line indicates thermal threshold of 29.2°C at which many corals bleach (Hoegh-Guldberg 1999). Note 6m data is only available from June 2003.

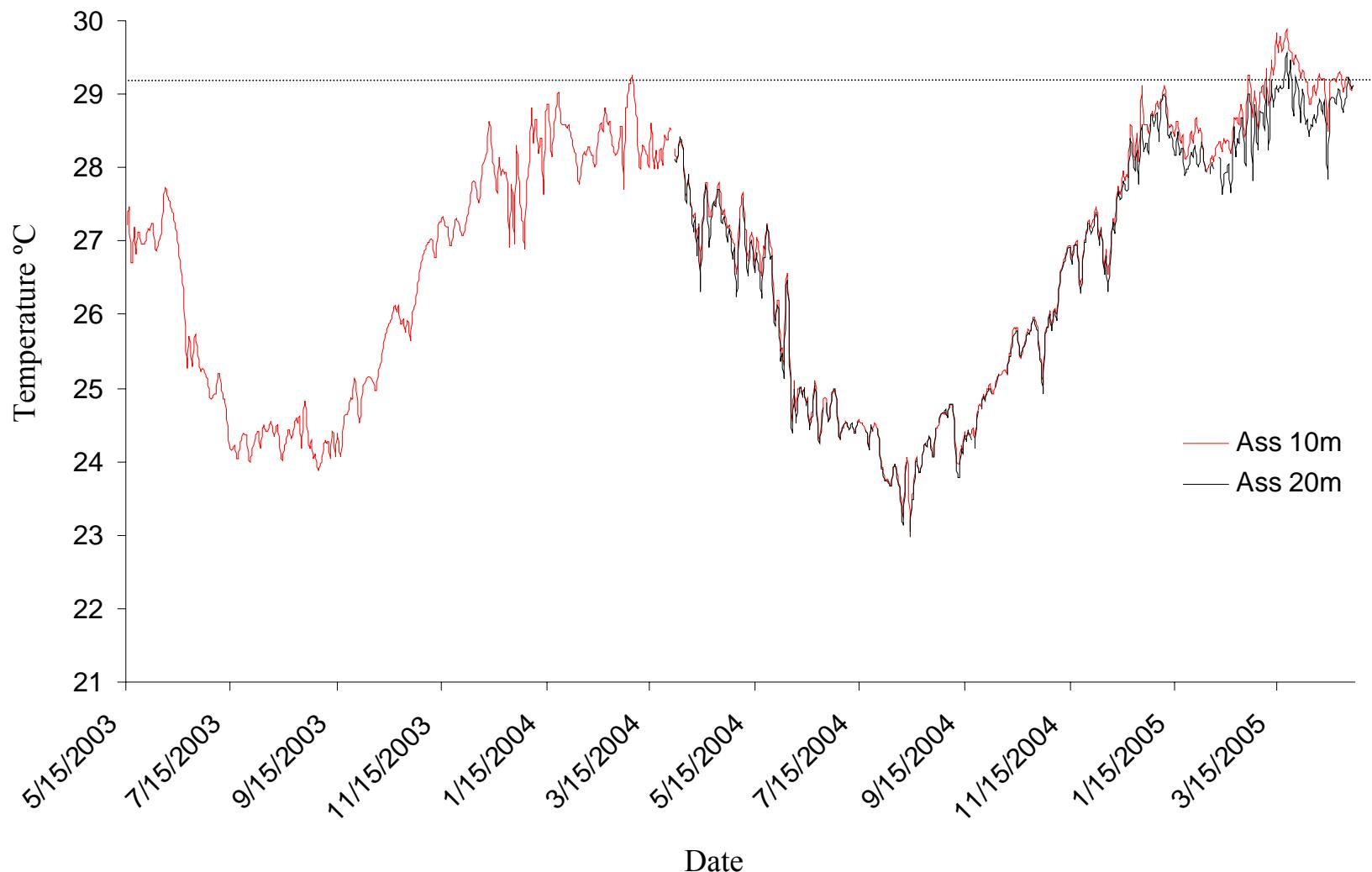


Figure 8. Average daily water temperature for Assumption at 10m and 20m depth (see legend) between May 2003 and April 2005. Dotted line indicates thermal threshold of 29.2°C at which many corals bleach (Hoegh-Guldberg 1999). Note 20m data is not available until after April 2004.

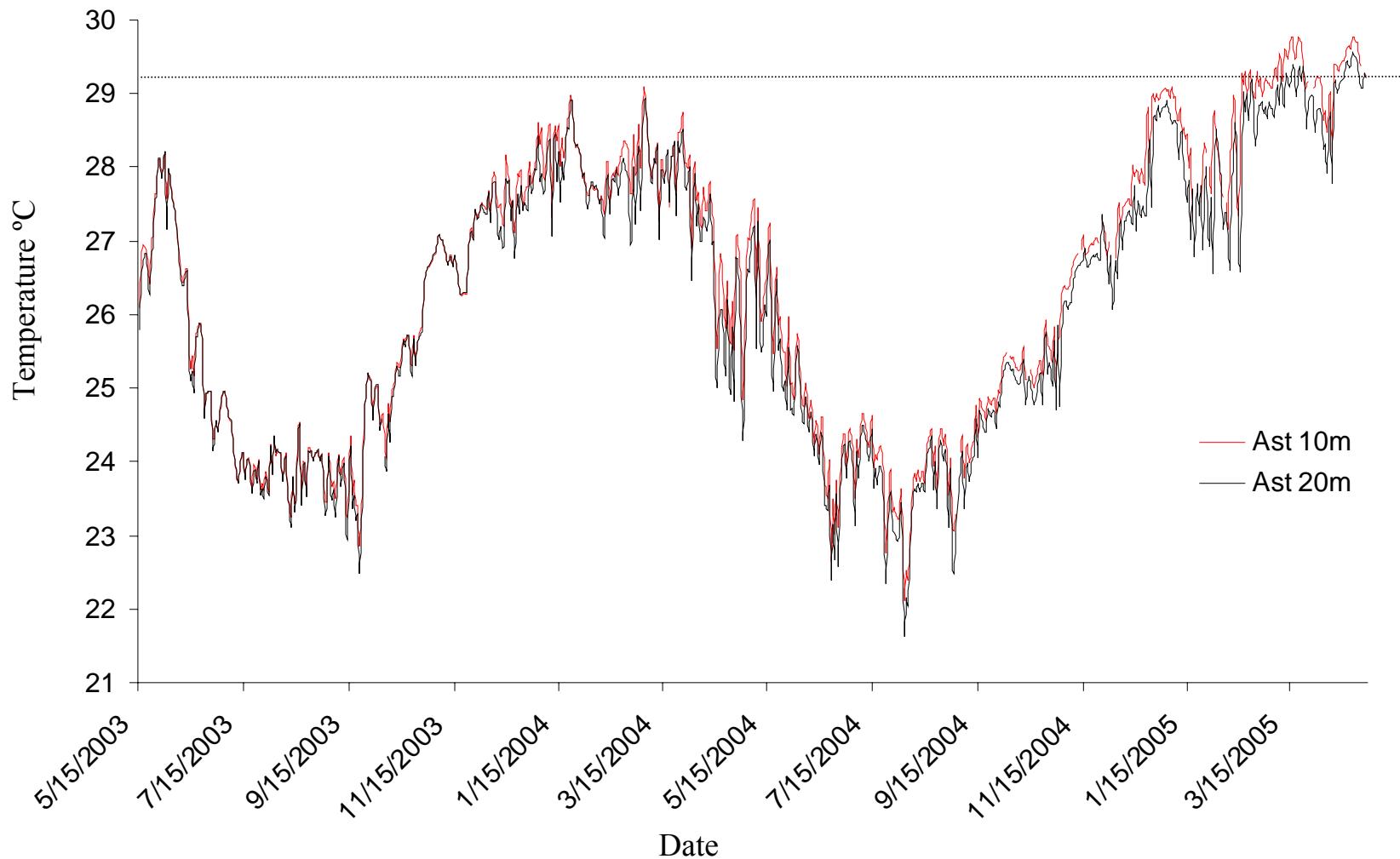


Figure 9. Average daily water temperature for Astove at 10m and 20m depth (see legend) between May 2003 and April 2005. Dotted line indicates thermal threshold of 29.2°C at which many corals bleach (Hoegh-Guldberg 1999).

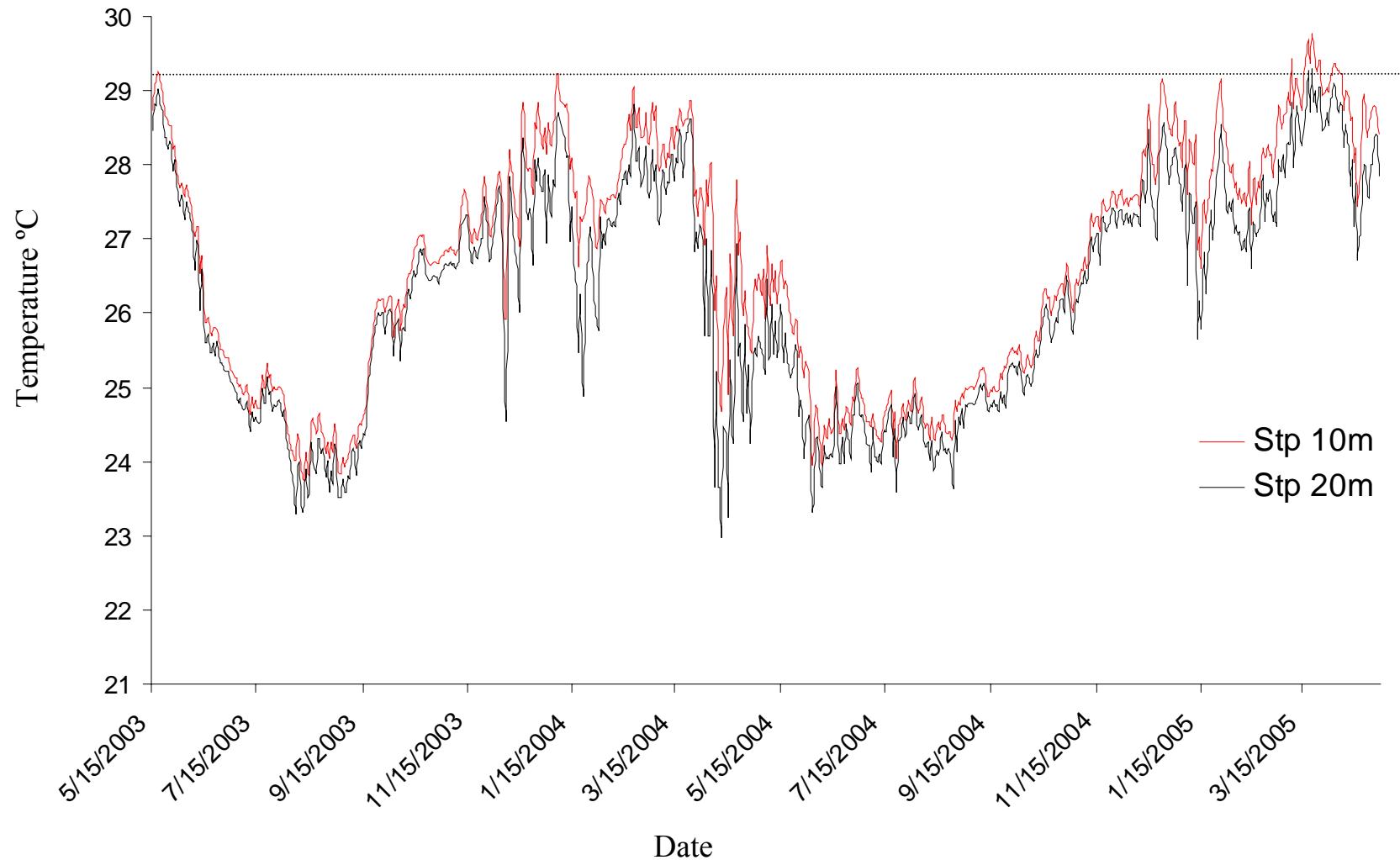


Figure 10. Average daily water temperature for St Pierre at 10m and 20m depth (see legend) between May 2003 and April 2005. Dotted line indicates thermal threshold of 29.2°C at which many corals bleach (Hoegh-Guldberg 1999).

Nutrient Transfer Study

Preliminary results on nutrient transfer between mangroves and reefs:

Aldabra Atoll - Elise Granek PhD

During the 2005 AMP Expedition to Aldabra Atoll, tissue samples were collected from primary producers and hard corals to assess the extent to which mangrove nutrients may be contributing to the nutrient budget of corals inside and outside the lagoon. This pilot study focused on 4 species of reef-building corals and 5 groups of primary producers. The corals sampled included *Pocillopora*, *Pavona*, *Galaxea* and *Fungia*. The primary producer groups were macroalgae, cyanobacteria (mats), seagrass, phytoplankton (via water sampling and filtration) and mangroves (via detrital leaves collected from the substrate).

Samples were collected from three locations: 2 inside and 1 outside the lagoon. Outside the lagoon, Site 6 of the AMP sampling sites was utilized. Samples were collected at ~10m depth. Inside the lagoon, Site 9 (~2m depth) and a patch reef in the lagoon SW of the station (~1.25m depth) were utilized as sampling sites.

At each site, 3-5 samples of each organism were collected (where available). Tissue samples were dried in a drying oven at the Aldabra Research Station and brought back to Oregon State University, USA for isotope analysis. Samples were ground and re-dried and analyzed for carbon, nitrogen and sulphur using a mass spectrometer and elemental analyzer. Results presented here are based on carbon and sulphur results and calculated using the IsoSource Mixing model per Phillips and Gregg (2001; 2003).

The results of this pilot study indicate that some species of corals *may* be incorporating mangrove-fixed carbon into their tissue. However, the extent to which mangrove-derived organic matter (OM) is incorporated varies with species and by proximity to the mangroves. *Fungia* and *Pocillopora* indicate the greatest potential for incorporating mangrove OM with analyses reflecting 0-11% contribution from mangroves found in the lagoon near mangrove habitat. Samples of *Galaxea* collected at the same site reflect only

a 0-5% contribution from mangroves. Moreover, corals sampled at Site 6, outside of the lagoon and several km from the closest mangroves, reflect only a 0-3 % contribution (*Fungia* and *Pavona spp.*). *Fungia* collected at Site 9 (inside the lagoon, several kilometres from any mangroves) reflects a similarly low contribution of mangrove OM at 0-1%. (see Table 8)

To determine how important mangrove OM is to the reefs in and around Aldabra Atoll, further research of an expanded nature is needed. Additional sampling should include a greater number of species sampled, more sites, and multiple seasons. Future research should include additional sessile reef invertebrates such as soft corals (Gorgonians), sponges (Poriferans) and bivalves (Molluscs).

Table 8. Percent contribution of mangrove organic matter. Shaded cells indicate samples were collected in the proximity of mangroves.

<u>Species</u>	<u>Location</u>	<u>Site</u>	<u>Macroalg.</u>	<u>Cyanobac.</u>	<u>Seagr.</u>	<u>Phytpl.</u>	<u>Mangr.</u>
<i>Pocillopora</i>	lagoon	SW	0-85%	0-44%	0-75%	0-43%	0-11%
<i>Pavona</i>	outside	Site 6	0-47%	0-21%	0-18%	50-74%	0-2%
<i>Galaxea</i>	lagoon	SW	0-42%	47-73%	0-35%	0-21%	0-5%
<i>Fungia</i>	lagoon	Site 9	0-95%	0-48%	0-12%	4-48%	0-1%
<i>Fungia</i>	outside	Site 6	59-84%	0-3%	2-27%	10-27%	0-3%
<i>Fungia</i>	lagoon	SW	0-85%	0-44%	0-75%	0-43%	0-11%

Discussion

Coral Community

There has been little change in hard coral cover between May 2003 and April 2005 at all sites surveyed, with the exception of Astove where there has been considerable growth in shallow water. The trend for vibrant growth at St. Pierre recorded over previous years in shallow water was not evident in this period due to considerable storm damage. It is noteworthy that most of the storm damage at this site was made worse by the remains of large plate *Acropora* corals on which new colonies, primarily *Pocillopora eydouxi* colonies were growing. These colonies, which died during the 1998 bleaching event, broke off during the storm and rolled around damaging other colonies in the process.

Once again *Rhytisma* increased in cover at select sites at Aldabra, and shows no sign of slowing down, while its presence remains scarce at other sites. There were other indicators of poor hard coral health evident during this survey, namely diseased colonies at Aldabra and a bleaching event at Astove. Interestingly the bleaching event coincides with higher seawater temperatures recorded by AMP data loggers and with the border of *a degree heating weeks hot-spot reported by NOAA that did not extend to our other survey sites* (http://www.osdpd.noaa.gov/PSB/EPS/SST/climohot_2005.html and see Fig. 11 below).

The reason for poor recovery at most sites remains unclear. It seems that colonies already present are not growing fast, and recruits are not surviving in large enough numbers to rapidly change coral cover. However growth of recruit colonies we have followed appears to be at a reasonable rate. The newly detected levels of coral disease and coral bleaching can only further contribute to this slow recovery.

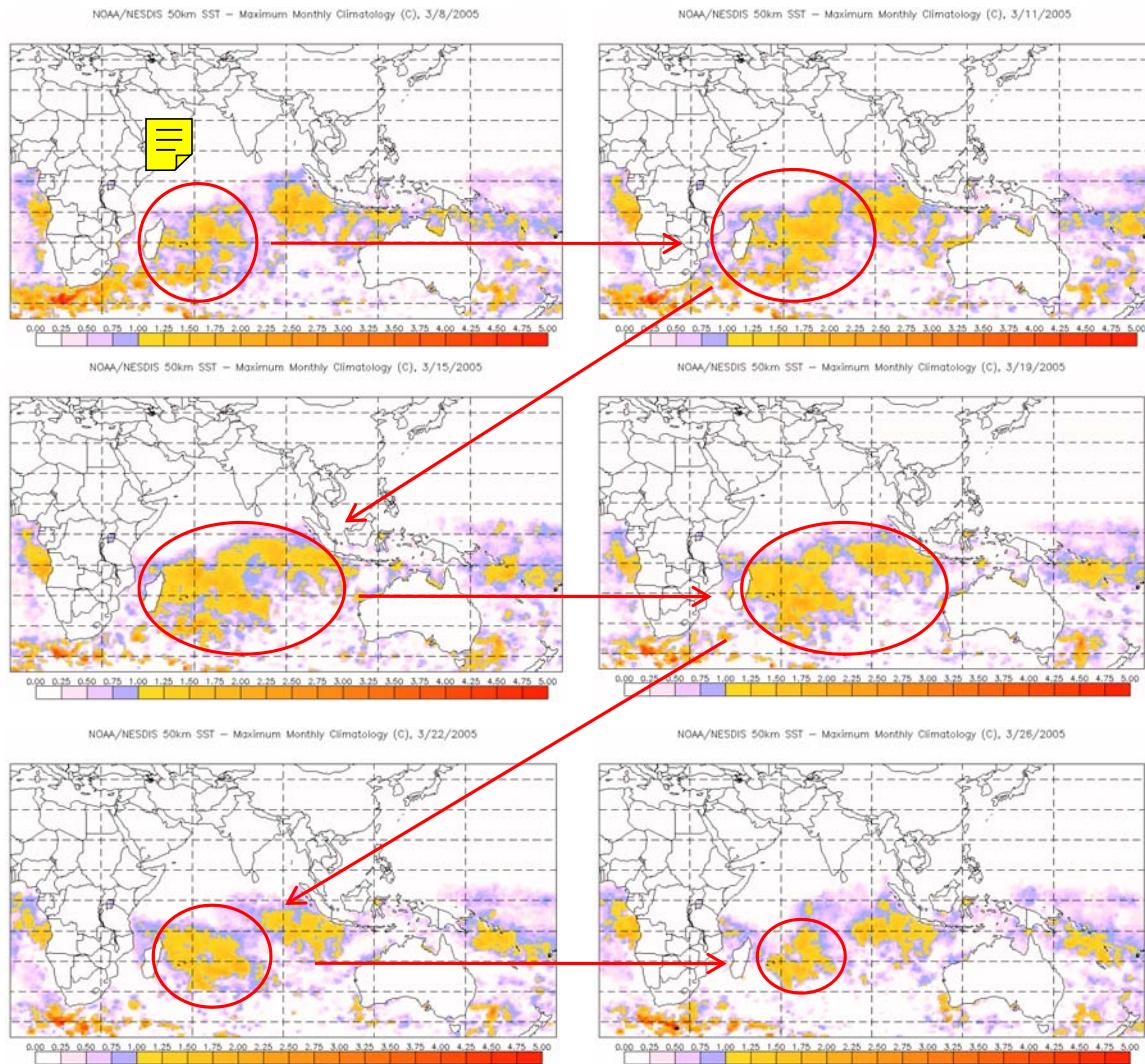


Figure 11. Degree heating week maps for March 2005 showing the Indian Ocean hot-spot East of Madagascar (circled in red). Note the area of influence included the southern Seychelles, and in particular Astove. Maps <http://www.osdpd.noaa.gov/PSB/EPS/SST>.

Fish Communities

Aldabra

Previous surveys of the reef fishes at Aldabra were conducted in November (1999), February (2001, 2002), and May (2003). An analysis of these surveys did not find any significant changes in fish-species diversity over the five year span regardless of the year

or month (Downing et al. 2004). The surveys in 2005 were the first to be conducted in April. The results did not demonstrate any significant deviation from the fish-species diversity found in earlier or later months. The fish populations noted at Aldabra in April 2005 continued to be vibrant, both in terms of diversity and numbers. The number recorded per 100m² (2105), the total number of families (37), and of species (172), all lie within the range of observations recorded since 1999.

Six years on from the first surveys it is possible to make some interesting observations on changes in abundances of certain species. For example *Lutjanus ehrenbergii* has only been twice recorded (2003 and 2005) but both times in high densities. Both these recordings are attributable to very large schools at Site 1 at 20m depth. This lutjanid feeds during the night and typically forms large resting schools at specific locations on the reef that may enhance protection from predators, or that may be associated with freshwater seepage and lower salinities. The reasons for the large schools at Site 1 are undetermined, but could represent a seasonal distribution pattern that starts in April and extends at least into May. This speculation is reinforced by a partial fish survey at Site 1 in March 2004 that did not record any *L. ehrenbergii*, matching the surveys in November and February. Another example is the number of *Parupeneus macronema* which was exceptionally high in the 2005 surveys. This resulted from a record high number of juveniles at Site 5. It indicates a strong cohort recruited to this site which has low profile coral rubble habitat that is optimal for juveniles.

Also interesting from an ecological perspective is the extremely low number of *Labroides dimidiatus* in April 2005 in comparison to counts during previous years' surveys. The abundance of this cleaner wrasse was 78% lower than in May 2003 and significant decreases were found at all Sites 1-7. During the intervening year, partial surveys in March 2004 found *L. dimidiatus* at numbers that compared favourably with previous years. This indicates that the severe reduction of this species occurred over one year. It is not known what ecological consequences will result from the low numbers of this important reef fish.

In contrast to the dramatic reduction in the number of cleaner wrasse, two ecologically important species of surgeon fish, *Acanthurus thompsoni* and *Ctenochaetus striatus*, showed atypically high densities in 2005 compared with previous years. These fish are major representatives of two different feeding guilds. *A. thompsoni* feeds on plankton well away from the reef. *C. striatus* feeds on algae on the reef substrate. The increases of these two species that rely on separate food resources indicates that the reef ecosystem at Aldabra remains productive.

The overall conclusion is that the reef fish populations at Aldabra, seven years post-bleaching, do not show any particular decline, or increase, and remain diverse and vibrant. There are notable fluctuations, which at present are best interpreted as “normal” on a tropical coral reef system, especially without the benefit of a good seasonal benchmark.

Assumption, Astove and St. Pierre

2005 was the only the third year of complete surveys at each of these locations. Furthermore, Astove Site 1 was first surveyed in 2002, but could not be resurveyed in 2003 and 2005 because of the sea state at the site. Instead a new site (Site 2) was set up in 2003 and revisited in 2005. Therefore, meaningful comparisons are difficult. However, it is notable that fish densities in 2005 at Astove (3,872 per 100m²) and Assumption (6,118 per 100m²) were the highest we have recorded to date. The high counts at Assumption were driven by large numbers of planktivores, specifically two species of fusiliers (Caesionidae), *Pterocaesio tile* and *Caesio xanthonota*, three species of basslets (Serranidae), *Pseudanthias evansi*, *Nemanthias carberryi* and *P. squamipinnis*, and two species of damselfishes (Pomacentridae), *Chromis dimidiata* and *Lepidozygus tapeinosoma*. At Astove, the high counts were driven by the same species of basslets and damselfishes, but there were no fusiliers.

By contrast, at St. Pierre fish density (4,687 per 100m²) in 2005 was the lowest recorded to date, even though the species count at St. Pierre was highest ever recorded for this island. This applied both for those species recorded in the survey transects (108), as well as the total species count (141). The in-survey species count was also higher than at either

Assumption (92) or Astove (94). The most numerous fishes in the St. Pierre surveys were some of the same planktivores that dominated at Assumption and Astove, specifically *N. carberryi*, *L. tapeinosoma*, *C. dimidiata* and *P. tile*.

On the basis of 3 years of observations, it is therefore difficult to see any particular pattern emerging, either looking at one island over time, or comparing islands. However, as more years of data accumulate so it should be possible to bring sophisticated analytical techniques to bear and to understand more fully the nature of the fluctuations in reef fish populations at these islands.

Ranger Fish Surveys

One of the primary goals of AMP is to increase scientific information about the marine environment at Aldabra Atoll by providing training for Aldabra Station rangers to conduct marine surveys on the outer reef and in the lagoon. AMP surveys are conducted only during one month each year. These surveys cannot capture vital information on the natural annual cycles in the marine environment at the atoll. Also the AMP surveys cannot monitor all of the important biological and oceanographic processes in the marine system that need to be considered for conservation of Aldabra's resources. The rangers stationed on Aldabra are in a unique position to conduct this monitoring research, having had training in the proper scientific survey techniques.

AMP has informed the Rangers of the need to follow the fish survey protocols designed to provide information on the environmental factors (season, time-of-day, tide stage, etc) that cause natural variation in fish counts. This information will increase the value of the fish surveys at Aldabra. In 2005 AMP had discussions with the rangers in the survey techniques and fish identification. Ranger training provided by AMP will also include assisting the rangers in analysing the information from their surveys, and preparing manuscripts on the survey for the rangers to publish in scientific journals as contributions from Aldabra Station.

Acknowledgements

We would like to thank the following organisations and individuals for their invaluable support and advice:

The staff at SIF headquarters and at Aldabra have once again given us their unwavering support. We are very grateful to them, especially to the SIF Chairman M. Lostau Lalanne, Mr. Lindsay Chong Seng and Mr. Ronnie Renaud from head office, and Joe, the Station Manager. Ranger Mervin assisted us in the lagoon in a thoroughly professional and helpful way. We welcomed back the Research Officer Rainer von Brandis who immediately set to re-arranging the monthly fish survey protocols.

We greatly appreciate Ms. Elise Granek's expertise in nutrient transfer processes and assistance with many of the coral surveys. Dr. Bernhard Wessling was the fifth member of the AMP team. We thank him for his hard work and his very generous, and cheerful, support. We are very grateful to the owner Mr. Pichler, manager (Andreas Pirker) and crew (Gervais Adeline, Pierre Barbé and Isabelle Adrien) of the Lady Anja, and Angel Fish Charters for providing us with a fine vessel and the back-up to match it.

Selby Remie from the Ministry of the Environment very kindly processed all the paperwork needed for us to export the biological samples we collected, and at a very unsociable hour. He is warmly thanked for his assistance. We also thank Mr. Rolf Payette for his support and for backing our application to the Seychelles Bureau of Standards to carry out the research programme.

The continued financial support TUI AG and BorgWarner was crucial to this research trip. We are particularly grateful to Dr. Wolf Michael Iwand (TUI) and Skip Cline (BW).

We also thank the following organisations and individuals for their generous support: PADI Project Aware, Mares, Sea Independence, Angel Fish Charters, Mr. Shahram Pahlavi, Maya Moltzer, and ProfitAbility Business Simulations Ltd.

Underwater observations are difficult to record at the best of times. This has proved to be much easier with the use of ICI Imagedata's 'permanent paper' (2EP169). We would like to thank ICI Imagedata, and particularly Godfrey Moore, who kindly arranged for this to be donated to AMP.

We thank Onset Computer Corporation for their cooperation and support in resolving the problems associated with establishing the critical long-term water temperature monitoring system at AMP research locations.

Jeanne Mortimer continues to be a wealth of support and assistance both scientifically and with the logistics of conducting marine research on Aldabra.

Tom Spencer, *Shoals of Capricorn* Science Plan Co-ordinator, provided us with valuable early advice on both the logistics and the science plan of the research programme.

Clare Bradshaw, Mark Spalding, Tom Spencer and Kristian Teleki made important contributions as members of the original Southern Seychelles Atoll Research Programme (SSARP) who first visited Aldabra in 1998 at the peak of the coral bleaching event.

The Cambridge Coastal Research Unit (CCRU), Department of Geography, has continued to provide logistic support and is thanked for allowing their personnel to participate in this research.

Fabrice Meziani, Eureka Design Ltd kindly helped with some of the artwork in this report. We also thank Camerapix Nairobi, the late Mr. Doi Malingri and NASA (Images courtesy of Earth Sciences and Image Analysis Laboratory, NASA Johnson Space Center) for use of their photographs.

The enthusiasm, encouragement and support from Professor David Stoddart is deeply appreciated.

The mangrove nutrient project was made possible with funding from a Budweiser Conservation Scholarship and a US National Science Foundation Graduate Research Fellowship. In kind support was provided by the Aldabra Marine Programme (room and board on AMP research cruise), lab space from the Aldabra Atoll Field Station, sample analysis support from the Western Ecology Division of the US Environmental Protection Agency, and field assistance from Lucy Jack.

Finally we especially thank Glenny Savy (Executive Chairman of the Islands Development Company IDC) for permission to work at Astove which has proved invaluable, and Terence Coopoosamy (Manager of the Centre for Science and Technology) who as ever has helped us with the permits and requirements to work in the Seychelles.

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Appendices

Appendix 1. Number of fish counted at Aldabra, by transect depths and fish size groups, during the AMP surveys in April 2005.

Survey Transect Depths	10m (Site 7 = 5m)			20m (Site 7 = 15m)				10m +20m		
Total Area Surveyed	1400m ²				700m ²				2100m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
MYLIOBATIDAE										
<i>Aetobatis narinari</i>										X
MURAENIDAE										
<i>Gymnothorax breedeni</i>			2	2					2	
CHANIDAE										
<i>Chanos chanos</i>										X
SYNODONTIDAE										
<i>Synodus jaculum</i>	1	3		4	2			2	6	
<i>Synodus variegatus</i>	2			2	2			2	4	
<i>Synodus indicus</i>										X
HOLOCENTRIDAE										
<i>Myripristis berndti</i>	13	12	13	38		120	27	147	185	
<i>Myripristis murdjan</i>	3			3		5		5	8	
<i>Sargocentron caudimaculatum</i>		15	7	22		21	1	22	44	
<i>Sargocentron diadema</i>			3	3		19		19	22	
<i>Sargocentron spiniferum</i>							1	1	1	
SERRANIDAE										
<i>Aethaloperca rogaa</i>		1	1	2						2
<i>Cephalopholis argus</i>			10	10			3	3	13	
<i>Cephalopholis leopardus</i>			1	1		1		1	2	
<i>Cephalopholis miniata</i>	2	12	20	34	1		19	20	54	
<i>Cephalopholis nigripectoralis</i>	14	68	15	97		18	1	19	116	
<i>Epinephelus fasciatus</i>	15	6	1	22	3	2	3	8	30	
<i>Epinephelus fuscoguttatus</i>										X
<i>Epinephelus polyphekadion</i>										X
<i>Epinephelus spilotoceps</i>		3	6	9					9	
<i>Epinephelus tukula</i>							1	1	1	
<i>Gracila albomarginata</i>	1	2	15	18			2	2	20	
<i>Plectropomus laevis</i>			2	2			3	3	5	
<i>Variola louti</i>			4	4			2	2	6	
<i>Nemania carberryi</i>	2160			2160					2160	
<i>Pseudanthias cooperi</i>	41	3		44	6	28		34	78	
<i>Pseudanthias evansi</i>	17			17	140	31		171	188	
<i>Pseudanthias squamipinnis</i>	442	1		443	490	1		491	934	
APOGONIDAE										
<i>Apogon angustatus</i>	3			3	2	2		4	7	
<i>Apogon apogonoides</i>	2119	117		2236	553	13		566	2802	
<i>Apogon fraenatus</i>	11			11		1		1	12	
<i>Apogon nigrofasciatus</i>		1		1	1	1		2	3	
<i>Cheilodipterus macrodon</i>	14			14		2		2	16	

Survey Transect Depths	10m (Site 7 = 5m)				20m (Site 7 = 15m)				10m +20m		
Total Area Surveyed	1400m ²				700m ²				2100m ²		Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect	
HAEMULIDAE											
<i>Plectorhinchus obscurus</i>											X
<i>Plectorhinchus orientalis</i>											X
<i>Plectorhinchus plagiodesmus</i>											X
LUTJANIDAE											
<i>Aphareus furca</i>		5	18	23		1	2	3	26		
<i>Aprion virescens</i>			1	1					1		
<i>Lutjanus bengalensis</i>					58	190		248	248		
<i>Lutjanus bohar</i>	3	7	6	16	2	5	3	10	26		
<i>Lutjanus gibbus</i>											X
<i>Lutjanus kasmira</i>											X
<i>Lutjanus erenberghi</i>						2500		2500	2500		
<i>Malcolor niger</i>											X
CAESIONIDAE											
<i>Caesio teres</i>											X
<i>Pterocaesio tile</i>		10		10		35		35	45		
MULLIDAE											
<i>Parupeneus barberinus</i>							3	3	3		
<i>Parupeneus bifasciatus</i>	6	9	7	22		3	4	7	29		
<i>Parupeneus cyclostomus</i>	4	1	9	14		1	3	4	18		
<i>Parupeneus macronema</i>	407	47	7	461	183	32	2	217	678		
<i>Parupeneus pleurostigma</i>	25	3		28	80	1		81	109		
<i>Mulloidichthys vanicolensis</i>						1		1	1		
<i>Mulloidichthys flavolineatus</i>	3	3		6	25	63		88	94		
CHAETODONTIDAE											
<i>Chaetodon auriga</i>		6		6		13		13	19		
<i>Chaetodon bennetti</i>						6		6	6		
<i>Chaetodon falcula</i>		2	4	6		6		6	12		
<i>Chaetodon guttatissimus</i>	41	12		53	19	12		31	84		
<i>Chaetodon kleinii</i>	6			6	12	15		27	33		
<i>Chaetodon lineolatus</i>						2	4	6	6		
<i>Chaetodon lunula</i>		11		11		1		1	12		
<i>Chaetodon melannotus</i>		4		4					4		
<i>Chaetodon meyeri</i>	19	13		32	2			2	34		
<i>Chaetodon trifasciatus</i>	1	11		12		4		4	16		
<i>Chaetodon xanthocephalus</i>											X
<i>Chaetodon zanzibariensis</i>		4		4		7		7	11		
<i>Forcipiger flavissimus</i>	1	13		14	1	13		14	28		
<i>Hemitaurichthys zoster</i>		3		3		27		27	30		
<i>Heniochus diphreutes</i>						2		2	2		
<i>Heniochus monoceros</i>											X
<i>Chaetodon interruptus</i>											X
<i>Chaetodon mertensii</i>	2	4		6					6		
LETHRINIDAE											
<i>Gnathodentex aureolineatus</i>	4	176		180		20		20	200		
<i>Lethrinus nebulosus</i>		4		4					4		
<i>Monotaxis grandoculis</i>	15	12	6	33	18	13	9	40	73		
<i>Lethrinus xanthochilus</i>											X

Survey Transect Depths	10m (Site 7 = 5m)				20m (Site 7 = 15m)						10m +20m	
Total Area Surveyed	1400m ²				700m ²					2100m ²	Off	
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	TRANSECT		
<i>Lethrinus obsoletus</i>			2	2				1	1	3		
<i>Lethrinus microdon</i>			1	1						1		
EPHIPPIDAE												
<i>Platax orbicularis</i>			2	2						2		
MALACANTHIDAE												
<i>Malacanthus brevirostris</i>	2	10	1	13		4	1	5	18			
<i>Malacanthus latovittatus</i>	3	2		5						5		
PINGUIPEDIDAE												
<i>Parapercis signata</i>	7	12		19	4			4	23			
POMACANTHIDAE												
<i>Apolemichthys trimaculatus</i>	1	7	1	9	5	3		8	17			
<i>Centropyge acanthops</i>	74			74	5			5	79			
<i>Centropyge multispinis</i>	203	6		209	65	2		67	276			
<i>Pomacanthus imperator</i>			6	6				5	5	11		
<i>Pygoplites diacanthus</i>		2		2		1	3	4	6			
<i>Centropyge bispinosa</i>	3			3	1			1	4			
<i>Centropyge debelius</i>				1				1	1			
POMACENTRIDAE												
<i>Amphiprion fuscocaudatus</i>		1		1						1		
<i>Chromis dimidiata</i>	1965			1965	1011			1011	2976			
<i>Chromis lepidolepis</i>	40			40					40			
<i>Chromis nigrura</i>	1997			1997	80			80	2077			
<i>Chromis ternatensis</i>	55	1		56	55	2		57	113			
<i>Chromis weberi</i>	179	14		193	14	10		24	217			
<i>Dascyllus carneus</i>	68			68	74			74	142			
<i>Dascyllus trimaculatus</i>	2			2	81	2		83	85			
<i>Lepidozygus tapeinosoma</i>	15876	3		15879	6250			6250	22129			
<i>Plectroglyphidodon dickii</i>	4			4					4			
<i>Plectroglyphidodon johnstonianus</i>	50	5		55	1			1	56			
<i>Plectroglyphidodon lacrymatus</i>	65	12		77	9			9	86			
<i>Pomacentrus caeruleus</i>	77			77	14			14	91			
<i>Pomacentrus sulfureus</i>	1			1	1			1	2			
<i>Chromis xutha</i>					175			175	175			
<i>Chromis opercularis</i>	273			273	3			3	276			
<i>Chromis viridis</i>										X		
<i>Amphiprion akallopisos</i>										X		
<i>Chrysiptera unimaculata</i>										X		
LABRIDAE												
<i>Anampsese lineatus</i>						2		2	2			
<i>Anampsese meleagrides</i>	1	5		6		3		3	9			
<i>Bodianus axillaris</i>	4	7	1	12	2	1		3	15			
<i>Bodianus diana</i>	2	16	4	22	2	22		24	46			
<i>Cheilinus undulatus</i>			2	2					2			
<i>Cirrhilabrus exquisitus</i>	726	40		766	19			19	785			
<i>Coris aygula</i>										X		
<i>Coris formosa</i>	2			2		1		1	3			
<i>Epibulus insidiator</i>			1	1					1			
<i>Gomphosus caeruleus</i>	23	36	1	60	2	8	1	11	71			

Survey Transect Depths	10m (Site 7 = 5m)				20m (Site 7 = 15m)						10m +20m	
Total Area Surveyed	1400m²				700m²					2100m²	Off	
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	TRANSECT		
<i>Halichoeres cosmetus</i>	66	41		107	17	15		32	139			
<i>Halichoeres hortulanus</i>	3	14	5	22		10	1	11	33			
<i>Hemigymnus fasciatus</i>		5	4	9		3		3	12			
<i>Hemigymnus melapterus</i>							1	1	1			
<i>Hologymnosus doliatus</i>		2	8	10					10			
<i>Labroides bicolor</i>	52	7		59	38	1		39	98			
<i>Labroides dimidiatus</i>	47	5		52	32	1		33	85			
<i>Labropsis xanthonota</i>	1	2		3	2	1		3	6			
<i>Macropharyngodon bipartitus</i>	11			11	3			3	14			
<i>Pseudocheilinus evanidus</i>	71			71	66	1		67	138			
<i>Pseudocheilinus hexataenia</i>	249	7		256	76			76	332			
<i>Pseudocheilinus octotaenia</i>	31	17		48	3	2		5	53			
<i>Pseudodax moluccanus</i>	2	7	6	15		6		6	21			
<i>Thalassoma amblycephalum</i>	27	4		31	1	1		2	33			
<i>Thalassoma hardwicke</i>										X		
<i>Thalassoma hebraicum</i>	18	63	8	89		15	3	18	107			
<i>Thalassoma janseni</i>	3	27		30	1	5		6	36			
<i>Thalassoma lunare</i>					3	12	5	20	20			
<i>Cheilinus fasciatus</i>		3	2	5		1		1	6			
<i>Anampsese caeruleopunctatus</i>										X		
<i>Coris caudimacula</i>	5	22		27	2	7	1	10	37			
<i>Stethojulis albovittata</i>	16	20		36	3			3	39			
<i>Cheilinus trilobatus</i>										X		
CIRRHITIDAE												
<i>Cirrhitichthys oxycephalus</i>	26			26	12			12	38			
<i>Paracirrhites arcatus</i>	34	4		38	15	2		17	55			
<i>Paracirrhites forsteri</i>	21	7		28	6	2		8	36			
SCARIDAE												
<i>Scarus sordidus</i>	21	81	21	123	2	12	10	24	147			
<i>Scarus rubroviolaceus</i>	1	1		2		1		1	3			
<i>Scarus strongylocephalus</i>			3	3		2	2	4	7			
<i>Scarus tricolor</i>	1	2		3					3			
<i>Cetoscarus bicolor</i>		5		5					5			
<i>Hipposcarus harid</i>										X		
<i>Scarus caudofasciatus</i>								1	1	1		
CARANGIDAE												
<i>Caranx melampygus</i>			28	28				8	8	36		
<i>Caranx sexfasciatus</i>										X		
SPHYRAENIDAE												
<i>Sphyraena barracuda</i>								1	1	1		
BLENNIIDAE												
<i>Ecsenius midas</i>	11	1		12	4			4	16			
<i>Plagiotremus rhinorhynchos</i>	17	3		20	10			10	30			
<i>Plagiotremus tapeinosoma</i>	38			38	21	2		23	61			
<i>Ecsenius minutus</i>	3			3					3			
<i>Cirripectes castaneus</i>	8			8					8			
<i>Cirripectes auritus</i>	3			3					3			
GOBIIDAE												

Survey Transect Depths	10m (Site 7 = 5m)				20m (Site 7 = 15m)						10m +20m	
Total Area Surveyed	1400m²				700m²					2100m²	Off	
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	TRANSECT		
<i>Eviota sebreei</i>					3				3	3		
<i>Gnatholepis anjerensis</i>	62			62	20				20	82		
<i>Gunnellichthys curiosus</i>	9			9	9				9	18		
<i>Valenciennea helsdingeni</i>						2			2	2		
<i>Valenciennea strigata</i>	8	6		14	1	5			6	20		
ACANTHURIDAE												
<i>Acanthurus leucocheilus</i>											X	
<i>Acanthurus leucosternon</i>	15	60	8	83	5	5			10	93		
<i>Acanthurus thompsoni</i>	81	15		96	12	178			190	286		
<i>Acanthurus xanthopterus</i>											X	
<i>Ctenochaetus binotatus</i>	2	4		6		4			4	10		
<i>Ctenochaetus striatus</i>	113	70		183	6	35			41	224		
<i>Ctenochaetus truncatus</i>	173	178	1	352	8	40	1	49	401			
<i>Naso brevirostris</i>		7	22	29				6	6	35		
<i>Naso elegans</i>		1	7	8				3	3	11		
<i>Naso unicornis</i>			2	2						2		
<i>Zebrasoma scopas</i>	19	21		40		15			15	55		
<i>Acanthurus nigricauda</i>		3	6	9		1	4	5	5	14		
<i>Acanthurus tennenti</i>								1	1	1		
<i>Naso vlamingii</i>						2	16	18	18			
<i>Zebrasoma desjardinii</i>	1	1	1	3						3		
ZANCLIDAE												
<i>Zanclus cornutus</i>		13	4	17		17			17	34		
BALISTIDAE												
<i>Balistapus undulatus</i>	2	3		5		1			1	6		
<i>Balistoides viridescens</i>								1	1	1		
<i>Melichthys indicus</i>		2	57	59		1	3	4	63			
<i>Melichthys niger</i>			2	2						2		
<i>Odonus niger</i>	2	11	7	20	72			1	73	93		
<i>Sufflamen bursa</i>		1	1	2						2		
<i>Sufflamen chrysopteru</i> s	14	3	1	18	12	3	1	16	34			
OSTRACIIDAE												
<i>Ostracion meleagris</i>	1			1						1		
<i>Ostracion cubicus</i>											X	
TETRAODONTIDAE												
<i>Arothron meleagris</i>		1		1			2	2	2	3		
<i>Arothron nigropunctatus</i>		1		1		1		1	1	2		
<i>Canthigaster valentini</i>	3			3						3		
SCORPAENIDAE												
<i>Pterois miles</i>							2	2	2			
SIGANIDAE												
<i>Siganus stellatus</i>			9	9						9		
CARCHARHINIDAE												
<i>Carcharhinus amblyrhynchos</i>											X	
<i>Triaenodon obesus</i>											X	
MOBULIDAE												
<i>Manta birostris</i>											X	

Survey Transect Depths	10m (Site 7 = 5m)					20m (Site 7 = 15m)					10m +20m	
Total Area Surveyed	1400m ²					700m ²					2100m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect		
MICRODESMIDAE												
<i>Nemateleotris magnifica</i>	34	7		41	8			8	49			
<i>Ptereleotris heteroptera</i>						1		1	1			
<i>Ptereleotris evides.</i>	1			1					1			
MONACANTHIDAE												
<i>Amanses scopas</i>	1	10		11					11			
<i>Cantherhines pardalis</i>											X	
<i>Paralutereres prionurus</i>					1			1	1			
<i>Pervagor janthinosoma</i>	1			1					1			
AULOSTOMIDAE												
<i>Aulostomus chinensis</i>											X	
Total Fish Counted	28426	1552	392	30370	9948	3712	178	13838	44208			
Number of Species Counted	103	98	55	148	75	90	46	140	172			
No Species Off Transect												34
Total Species												208
Fish/100m²	2030	111	28	2169	1421	530	25	1977	2105			

Appendix 2. Number of fish counted at Assumption, by transect depths and fish size groups, during the AMP surveys in April 200¹

Survey Transect Depths	10m				20m				10m + 20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
HOLOCENTRIDAE										
<i>Myripristis berndti</i>		46	16	62		12	23	35	97	
<i>Sargocentron caudimaculatum</i>										X
SERRANIDAE										
<i>Cephalopholis argus</i>								1	1	1
<i>Cephalopholis leoparda</i>										X
<i>Cephalopholis miniata</i>			1	1				3	3	4
<i>Cephalopholis nigripinnis</i>		7		7		2		2	9	
<i>Dermatolepis striolatus</i>										X
<i>Epinephelus tukula</i>										X
<i>Variola louti</i>			3	3					3	
<i>Nemanthias carberryi</i>	1520			1520					1520	
<i>Pseudanthias evansi</i>					3800			3800	3800	
<i>Pseudanthias squamipinnis</i>	252			252	620			620	872	
HAEMULIDAE										
<i>Plectrohinchus obscurus</i>										X
<i>Plectrohinchus orientalis</i>								3	3	3
LUTJANIDAE										
<i>Aphareus furca</i>		1	1	2	1			1	2	4
<i>Lutjanus bohar</i>		5	4	9						9
<i>Lutjanus gibbus</i>										X
<i>Lutjanus monostigma</i>			1	1					1	
CAESIONIDAE										
<i>Caesio xanthonota</i>		3000		3000					3000	
<i>Pterocaesio chrysozona</i>		250		250					250	
<i>Caesio lunaris</i>			90	90					90	
<i>Pterocaesio tile</i>	400	2100		2500	1000			1000	3500	
MULLIDAE										
<i>Parupeneus barberinus</i>										X
<i>Parupeneus bifasciatus</i>		5	1	6					6	
<i>Parupeneus macronema</i>	1	10		11				1	1	12
<i>Parupeneus pleurostigma</i>		2		2					2	
<i>Mulloidichthys vanicolensis</i>		3		3		3		3	6	
<i>Mulloidichthys flavolineatus</i>		1		1					1	
CHAETODONTIDAE										
<i>Chaetodon auriga</i>	1	4		5		1		1	6	
<i>Chaetodon bennetti</i>		1		1					1	
<i>Chaetodon falcula</i>		1		1					1	
<i>Chaetodon guttatissimus</i>	9	1		10	2	2		4	14	
<i>Chaetodon kleinii</i>		1		1					1	
<i>Chaetodon lunula</i>		8		8		2		2	10	
<i>Chaetodon melannotus</i>		3		3					3	
<i>Chaetodon meyeri</i>	2	1		3		1		1	4	
<i>Chaetodon trifasciatus</i>		5		5					5	

Survey Transect Depths	10m				20m				10m + 20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
<i>Chaetodon xanthocephalus</i>		1		1					1	
<i>Chaetodon zanzibariensis</i>										X
<i>Forcipiger flavissimus</i>		1		1		1	1	2	3	
<i>Hemitaurichthys zoster</i>						8		8	8	
<i>Chaetodon interruptus</i>		4		4					4	
LETHRINIDAE										
<i>Gnathodentex aureolineatus</i>										X
<i>Monotaxis grandoculis</i>	1	5		6					6	
PINGUIPEDIDAE										
<i>Parapercis punctulata</i>										X
POMACANTHIDAE										
<i>Centropyge multispinis</i>	41			41	7	1		8	49	
<i>Pomacanthus imperator</i>							1	1	1	
<i>Pygoplites diacanthus</i>	1		6	7		1		1	8	
<i>Centropyge bispinosa</i>	3			3					3	
POMACENTRIDAE										
<i>Amphiprion fuscocaudatus</i>										X
<i>Chromis dimidiata</i>	1730			1730	530	1		531	2261	
<i>Chromis lepidolepis</i>	1			1	20			20	21	
<i>Chromis nigrura</i>	81			81					81	
<i>Chromis ternatensis</i>										X
<i>Dascyllus trimaculatus</i>	5	3		8					8	
<i>Lepidozygus tapeinosoma</i>	2200			2200					2200	
<i>Plectroglyphidodon johnstonianus</i>	2			2	1			1	3	
<i>Plectroglyphidodon lacrymatus</i>	32			32					32	
<i>Pomacentrus caeruleus</i>										X
<i>Pomacentrus sulfureus</i>										X
<i>Chromis xutha</i>					27			27	27	
LABRIDAE										
<i>Anampsese meleagrides</i>										X
<i>Bodianus axillaris</i>		1		1					1	
<i>Bodianus diana</i>		4		4		5		5	9	
<i>Cirrhilabrus exquisitus</i>	23			23	1			1	24	
<i>Gomphosus caeruleus</i>		1		1	1			1	2	
<i>Halichoeres cosmetus</i>	4	5		9	1	3		4	13	
<i>Halichoeres hortulanus</i>		8		8		1		1	9	
<i>Hemigymnus fasciatus</i>										X
<i>Hologymnosus doliatus</i>		2		2					2	
<i>Labroides bicolor</i>	7	3		10	4			4	14	
<i>Labroides dimidiatus</i>	4			4	1			1	5	
<i>Labropsis xanthonota</i>						1		1	1	
<i>Macropharyngodon bipartitus</i>	2	1		3					3	
<i>Pseudocheilinus evanidus</i>	8			8	12			12	20	
<i>Pseudocheilinus hexataenia</i>	34			34	3			3	37	
<i>Pseudocheilinus octotaenia</i>	1	8		9					9	
<i>Pseudodax moluccanus</i>		1		1					1	
<i>Thalassoma herbraicum</i>		7	1	8					8	
<i>Thalassoma janseni</i>		1		1		2		2	3	

Survey Transect Depths	10m				20m				10m + 20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
<i>Thalassoma lunare</i>						1		1	1	
<i>Stethojulis albovittata</i>	2			2					2	
CIRRHITIDAE										
<i>Paracirrhites forsteri</i>	1	1		2	2			2	4	
SCARIDAE										
<i>Scarus sordidus</i>		4	10	14					14	
<i>Scarus rubroviolaceus</i>										X
<i>Scarus strongylocephalus</i>			2	2					2	
<i>Scarus tricolor</i>		5	1	6					6	
<i>Scarus caudofasciatus</i>		1	1	2					2	
<i>Cetoscarus bicolor</i>										X
CARANGIDAE										
<i>Caranx melampygus</i>			4	4					4	
BLENNIIDAE										
<i>Ecsenius midas</i>						1		1	1	
<i>Plagiotremus rhinorhynchos</i>	2			2	2	1		3	5	
<i>Plagiotremus tapeinosoma</i>										X
<i>Cirripectes castaneus</i>										X
GOBIIDAE										
<i>Gunnellichthys curiosus</i>	1	2		3					3	
<i>Valenciennea strigata</i>										X
ACANTHURIDAE										
<i>Acanthurus leucocheilus</i>			2	2				3	3	5
<i>Acanthurus leucosternon</i>	2	6	1	9						9
<i>Acanthurus thompsoni</i>	1	34		35		27		27	62	
<i>Ctenochaetus striatus</i>	1	1		2		5		5	7	
<i>Ctenochaetus truncatus</i>	18	34	1	53	5	4		9	62	
<i>Naso brevirostris</i>										X
<i>Naso unicornis</i>										X
<i>Zebrasoma scopas</i>	4	6		10		5		5	15	
<i>Acanthurus nigricauda</i>		1	7	8					8	
<i>Zebrasoma desjardinii</i>					1		1	2	2	
ZANCLIDAE										
<i>Zanclus cornutus</i>		5		5					5	
BALISTIDAE										
<i>Balistapus undulatus</i>			1	1					1	
<i>Balistoides viridescens</i>										X
<i>Melichthys indicus</i>			1	1			1	1	2	
SCOMBRIDAE										
<i>Gymnosarda unicolor</i>										X
SCORPAENIDAE										
<i>Pterois miles</i>		1		1			1	1	2	
SIGANIDAE										
<i>Siganus argenteus</i>		2		2					2	
PRIACANTHIDAE										
<i>Priacanthus hamrur</i>							1	1	1	

Survey Transect Depths	10m				20m				10m + 20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
MICRODESMIDAE										
<i>Nemateleotris magnifica</i>					10	2		12	12	
MONACANTHIDAE										
<i>Amanses scopas</i>		2		2					2	
Total Fish Counted	6397	5616	155	12168	6051	93	41	6183	18353	
Number of Species Counted	35	53	21	79	22	24	13	48	92	
Number of Off Transect Species										25
Total Species										117
Fish/100m²	3200	2808	76	6085	6051	93	41	6185	6118	

Appendix 3. Number of fish counted at Astove, by transect depths and fish size groups, during the AMP surveys in April 2005.

Survey Transect Depths	10m				20m				10m + 20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
MURAENIDAE										
<i>Gymnothorax breedeni</i>			1	1					1	
SYNODONTIDAE										
<i>Synodus jaculum</i>			2	2					2	
HOLOCENTRIDAE										
<i>Myripristis berndti</i>		63	56	119		56	3	59	178	
<i>Myripristis murdjan</i>						15		15	15	
<i>Neoniphon sammara</i>		4	9	13					13	
<i>Sargocentron spiniferum</i>										X
SERRANIDAE										
<i>Cephalopholis argus</i>			2	2					2	
<i>Cephalopholis leopardus</i>			2	2					2	
<i>Cephalopholis miniata</i>			4	4		2	1	3	7	
<i>Cephalopholis nigripinnis</i>		1		1		2		2	3	
<i>Epinephelus fasciatus</i>										X
<i>Epinephelus fuscoguttatus</i>	1	2		3					3	
<i>Epinephelus tukula</i>										X
<i>Gracila albomarginata</i>								3	3	3
<i>Plectropomus laevis</i>			3	3						3
<i>Variola louti</i>			1	1			2	2	3	
<i>Nemanthias carberryi</i>	645			645					645	
<i>Pseudanthias evansi</i>	13			13	510			510	523	
<i>Pseudanthias squamipinnis</i>	193			193	138			138	331	
APOGONIDAE										
<i>Apogon apogonoides</i>										X
<i>Cheilodipterus macrodon</i>	6			6		1		1	7	
<i>Apogon kallopterus</i>										X
HAEMULIDAE										
<i>Plectorrhinchus obscurus</i>										X
LUTJANIDAE										
<i>Aphareus furca</i>			3	3			1	1	4	
<i>Lutjanus bohar</i>			5	5	1	1		2	7	
<i>Lutjanus fulvus</i>			1	1						1
<i>Lutjanus gibbus</i>			1	1						1
<i>Lutjanus monostigma</i>			1	1						1
<i>Malcolor niger</i>										X
CAESIONIDAE										
<i>Pterocaesio tile</i>										X
MULLIDAE										
<i>Parupeneus bifasciatus</i>						1		1	1	
<i>Parupeneus macronema</i>	2	2		4	2	4	1	7	11	
<i>Mulloidichthys vanicolensis</i>		443	20	463		3		3	466	
<i>Mulloidichthys flavolineatus</i>		2		2	1			1	3	

Survey Transect Depths	10m				20m				10m + 20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
PEMPHERIDAE										
<i>Pempheris vanicolensis</i>		10		10			2		2	12
CHAETODONTIDAE										
<i>Chaetodon auriga</i>							1		1	1
<i>Chaetodon bennetti</i>										X
<i>Chaetodon falcula</i>										X
<i>Chaetodon guttatissimus</i>	9	8		17			4		4	21
<i>Chaetodon kleinii</i>	1			1	3	2		5		6
<i>Chaetodon lunula</i>										X
<i>Chaetodon meyeri</i>	11	4		15	3	1		4		19
<i>Chaetodon trifasciatus</i>	3	3		6	1			1		7
<i>Chaetodon zanzibariensis</i>	1			1						1
<i>Forcipiger flavissimus</i>		4		4			1		1	5
<i>Hemitaurichthys zoster</i>					3			3		3
<i>Heniochus monoceros</i>										X
<i>Chaetodon interruptus</i>	1			1						1
LETHRINIDAE										
<i>Gnathodentex aureolineatus</i>										X
<i>Monotaxis grandoculis</i>	3	1		4	1			1		5
EPHIPPIDAE										
<i>Platax orbicularis</i>										X
POMACANTHIDAE										
<i>Apolemichthys trimaculatus</i>			1	1	3			3		4
<i>Centropyge acanthops</i>					2	1		3		3
<i>Centropyge multispinis</i>	14			14	7			7		21
<i>Pomacanthus imperator</i>										X
<i>Pygoplites diacanthus</i>		1	1	2			1	1	2	4
<i>Centropyge bispinosa</i>		1		1	1	2		3		4
<i>Centropyge debelius</i>					1			1		1
POMACENTRIDAE										
<i>Amphiprion akallopisos</i>										X
<i>Chromis dimidiata</i>	1210			1210	613			613		1823
<i>Chromis leptolepis</i>										X
<i>Chromis nigrura</i>	112			112						112
<i>Chromis ternatensis</i>	14	1		15						15
<i>Chromis weberi</i>		2		2			2		2	4
<i>Lepidozygus tapeinosoma</i>	3300			3300	3600			3600		6900
<i>Plectroglyphidodon dickii</i>	3			3						3
<i>Plectroglyphidodon johnstonianus</i>	4			4						4
<i>Plectroglyphidodon lacrymatus</i>	1			1						1
<i>Chromis viridis</i>	16			16						16
<i>Abudefduf sparoides</i>		11		11						11
<i>Abudefduf sexfasciatus</i>		16		16						16
<i>Abudefduf vaigiensis</i>		1		1						1
LABRIDAE										
<i>Anampsese meleagrides</i>		1		1			1		1	2

Survey Transect Depths	10m				20m				10m + 20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
<i>Bodianus axillaris</i>							2		2	2
<i>Bodianus bilunulatus</i>										X
<i>Bodianus diana</i>		3	1	4			5	1	6	10
<i>Cheilinus undulatus</i>										X
<i>Epibulus insidiator</i>		1		1						1
<i>Gomphosus caeruleus</i>	1	5		6	1				1	7
<i>Halichoeres cosmetus</i>	1			1	1				1	2
<i>Halichoeres hortulanus</i>		5	1	6						6
<i>Hemigymnus fasciatus</i>										X
<i>Labroides bicolor</i>	11	1		12	6				6	18
<i>Labroides dimidiatus</i>	6	2		8	2				2	10
<i>Labropsis xanthonota</i>		5		5	1	1			2	7
<i>Pseudocheilinus evanidus</i>	3			3	8				8	11
<i>Pseudocheilinus hexataenia</i>	43	2		45	10				10	55
<i>Pseudocheilinus octotaenia</i>	1	1		2						2
<i>Pseudodax moluccanus</i>		1	3	4				1	1	5
<i>Thalassoma hebraicum</i>										X
<i>Thalassoma janseni</i>		1		1						1
<i>Thalassoma lunare</i>	1	2		3		2			2	5
<i>Bodianus anthiooides</i>							2	2		2
CIRRHITIDAE										
<i>Cirrhitichthys oxycephalus</i>					1				1	1
<i>Paracirrhites arcatus</i>	8			8						8
<i>Paracirrhites forsteri</i>	2			2	1				1	3
SCARIDAE										
<i>Scarus sordidus</i>			1	1						1
<i>Scarus tricolor</i>			1	1						1
CARANGIDAE										
<i>Caranx melampygus</i>			1	1						1
SPHYRAENIDAE										
<i>Sphyraena barracuda</i>										X
BLENNIIDAE										
<i>Ecsenius midas</i>										X
<i>Plagiotremus rhinorhynchos</i>	2			2	1				1	3
<i>Plagiotremus tapeinosoma</i>	1			1						1
<i>Cirripectes castaneus</i>										X
GOBIIDAE										
<i>Gunnellichthys curiosus</i>	2			2		2			2	4
ACANTHURIDAE										
<i>Acanthurus leucocheilus</i>										X
<i>Acanthurus leucosternon</i>	2	4		6		1		1		7
<i>Acanthurus thompsoni</i>	6	48	1	55	2	10		12		67
<i>Ctenochaetus binotatus</i>					1				1	1
<i>Ctenochaetus striatus</i>										X
<i>Ctenochaetus truncatus</i>	18	28		46	4	10		14		60
<i>Naso brevirostris</i>										X

Survey Transect Depths	10m				20m				10m + 20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
<i>Naso lituratus</i>			2	2					2	
<i>Zebrasoma scopas</i>	20	5		25	1	3		4	29	
<i>Acanthurus lineatus</i>			2	2					2	
<i>Acanthurus dussumieri</i>										X
ZANCLIDAE										
<i>Zanclus cornutus</i>		1	1	2					2	
BALISTIDAE										
<i>Balistapus undulatus</i>	1		1	2					2	
<i>Balistoides conspicillum</i>										X
<i>Balistoides viridescens</i>										X
<i>Melichthys indicus</i>										X
<i>Sufflamen bursa</i>		1		1					1	
OSTRACIDIACE										
<i>Ostracion meleagris</i>	2	1		3	1			1	4	
TETRAODONTIDAE										
<i>Canthigaster valentini</i>										X
<i>Cantherinus dumerilii</i>			1	1					1	
MICRODESMIDAE										
<i>Nemateleotris magnifica</i>					10			10	10	
DIODONTIDAE										
<i>Diodon liturosus</i>										X
Total Fish Counted	5696	696	129	6521	4941	139	16	5096	11617	
Number of Species Counted	42	39	29	82	33	28	10	56	94	
Number of Off Transect Species										33
Total Species										127
Fish/100m²	2848	348	65	3261	4941	139	16	5096	3872	

Appendix 4. Number of fish counted at St Pierre, by transect depths and fish size groups, during the AMP surveys in April 2005.

Survey Transect Depths	10m				20m				10m+20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
MURAENIDAE										
<i>Gymnothorax breedeni</i>										X
CHANIDAE										
<i>Chanos chanos</i>										X
SYNODONTIDAE										
<i>Synodus jaculum</i>			1	1					1	
HOLOCENTRIDAE										
<i>Myripristis berndti</i>			7	7		60	9	69	76	
<i>Sargocentron caudimaculatum</i>			1	1		1	2	3	4	
<i>Sargocentron spiniferum</i>							11	11	11	
SERRANIDAE										
<i>Aethaloperca rogaa</i>							1	1	1	
<i>Cephalopholis leopardus</i>						4		4	4	
<i>Cephalopholis miniata</i>			16	16		1	12	13	29	
<i>Cephalopholis nigripinnis</i>		9	4	13		1		1	14	
<i>Epinephelus fasciatus</i>							2	2	2	
<i>Epinephelus tukula</i>										X
<i>Gracilia albomarginata</i>							4	4	4	
<i>Plectropomus laevis</i>										X
<i>Variola louti</i>			3	3			1	1	4	
<i>Nemanihas carberryi</i>	2090			2090	3100			3100	5190	
<i>Pseudanthias cooperi</i>										X
<i>Pseudanthias evansi</i>					50			50	50	
<i>Pseudanthias squamipinnis</i>	351			351	314			314	665	
HAEMULIDAE										
<i>Plectorhinchus orientalis</i>			1	1					1	
LUTJANIDAE										
<i>Aphareus furca</i>		2	2	4			3	3	7	
<i>Apriom virescens</i>			1	1					1	
<i>Lutjanus bengalensis</i>										X
<i>Lutjanus bohar</i>		1	3	4		1		1	5	
<i>Lutjanus gibbus</i>										X
<i>Lutjanus kasmira</i>			2	2		1	3	4	6	
<i>Lutjanus monostigma</i>		1	31	32			3	3	35	
CAESIONIDAE										
<i>Caesio teres</i>			500	500					500	
<i>Pterocaesio lativittata</i>			500	500					500	
<i>Pterocaesio tile</i>		540		540		460		460	1000	
MULLIDAE										
<i>Parupeneus barberinus</i>			1	1					1	
<i>Parupeneus bifasciatus</i>		6		6		2	1	3	9	
<i>Parupeneus macronema</i>		8	3	11		1		1	12	
<i>Mulloidichthys vanicolensis</i>										X
<i>Mulloidichthys flavolineatus</i>										X
CHAETODONTIDAE										
<i>Chaetodon auriga</i>		3		3					3	
<i>Chaetodon falcula</i>										X
<i>Chaetodon guttatissimus</i>	2	10		12	2	3		5	17	
<i>Chaetodon kleinii</i>						3		3	3	
<i>Chaetodon lineolatus</i>										

Survey Transect Depths	10m				20m				10m+20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
<i>Chaetodon lunula</i>						1		1	1	
<i>Chaetodon meyeri</i>		1		1		3		3	4	
<i>Chaetodon trifasciatus</i>		1		1		5		5	6	
<i>Chaetodon xanthocephalus</i>										X
<i>Chaetodon zanzibariensis</i>		1		1					1	
<i>Forcipiger flavissimus</i>		4		4		2		2	6	
<i>Hemitaurichthys zoster</i>		2		2		2		2	4	
<i>Chaetodon interruptus</i>						1		1	1	
<i>Heniochus singularis</i>						1		1	1	
LETHRINIDAE										
<i>Gnathodentex aureolineatus</i>						5		5	5	
<i>Lethrinus nebulosus</i>			1	1					1	
<i>Monotaxis grandoculis</i>		1	2	3					3	
<i>Lethrinus xanthochilus</i>										X
<i>Lethrinus obsoletus</i>			3	3					3	
MALACANTHIDAE										
<i>Malacanthus latovittatus</i>										X
PINGUIPEDIDAE										
<i>Parapercis signata</i>		3		3					3	
POMACANTHIDAE										
<i>Apolemichthys trimaculatus</i>		1		1		1		1	2	
<i>Centropyge acanthops</i>	3			3	2			2	5	
<i>Centropyge multispinis</i>	22	9		31	14			14	45	
<i>Pomacanthus imperator</i>			2	2				1	1	3
POMACENTRIDAE										
<i>Chromis dimidiata</i>	450			450	830			830	1280	
<i>Chromis nigrura</i>	445			445					445	
<i>Dascyllus carneus</i>	5			5					5	
<i>Dascyllus trimaculatus</i>	3	2		5					5	
<i>Lepidozygus tapeinosoma</i>	1315			1315	2200			2200	3515	
<i>Plectroglyphidodon dickii</i>	8			8					8	
<i>Plectroglyphidodon johnstonianus</i>	25	1		26	3			3	29	
<i>Plectroglyphidodon lacrymatus</i>	9	3		12					12	
<i>Pomacentrus caeruleus</i>	1			1					1	
<i>Chromis xutha</i>					2			2	2	
LABRIDAE										
<i>Anampsese meleagrides</i>		1		1					1	
<i>Bodianus bilunulatus</i>	1			1				1	1	2
<i>Bodianus diana</i>		2	1	3		4	1	5	8	
<i>Cheilinus undulatus</i>			2	2					2	
<i>Cirrhitabrus exquisitus</i>	4			4					4	
<i>Coris aygula</i>										X
<i>Coris frerei</i>			1	1					1	
<i>Epibulus insidiator</i>			1	1					1	
<i>Gomphosus caeruleus</i>	2	2		4	1	7		8	12	
<i>Halichoeres cosmetus</i>	5	5		10		1		1	11	
<i>Halichoeres hortulanus</i>		2	1	3		2		2	5	
<i>Hemigymnus fasciatus</i>		1	2	3		2	1	3	6	
<i>Labrodes bicolor</i>	7			7	9			9	16	
<i>Labrodes dimidiatus</i>	4			4	3			3	7	
<i>Labropsis xanthonota</i>					1	2		3	3	
<i>Macropharyngodon bipartitus</i>	2			2					2	
<i>Pseudocheilinus evanidus</i>					2			2	2	
<i>Pseudocheilinus hexataenia</i>	34			34	8			8	42	
<i>Pseudocheilinus octotaenia</i>	2	4		6	1	1		2	8	
<i>Pseudodax moluccanus</i>		3	2	5	1	2	1	4	9	

Survey Transect Depths	10m				20m				10m+20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
<i>Thalassoma amblycephalum</i>										X
<i>Thalassoma hebraicum</i>		12	1	13				1	1	14
<i>Thalassoma lunare</i>	2			2					2	
<i>Coris caudimacula</i>										X
<i>Novaculichthys taeniourus</i>										X
<i>Stethojulis albovittata</i>		2		2					2	
<i>Halichoeres scapularis</i>										X
CIRRHITIDAE										
<i>Cirrhitichthys oxycephalus</i>	1				1	1			1	2
<i>Paracirrhites arcatus</i>						1	1		2	2
<i>Paracirrhites forsteri</i>		5		5	2	6		8	13	
SCARIDAE										
<i>Scarus sordidus</i>			1	1					1	
<i>Scarus rubroviolaceus</i>		1	4	5					5	
<i>Scarus tricolor</i>			4	4					4	
<i>Hipposcarus harid</i>										X
CARANGIDAE										
<i>Caranx melampygus</i>			18	18				4	4	22
<i>Scomberoides lysan</i>										X
SPHYRAENIDAE										
<i>Sphyraena barracuda</i>										X
BLENNIIDAE										
<i>Ecsenius midas</i>	3				3	5			5	8
<i>Plagiotremus rhinorhynchos</i>						2			2	2
<i>Plagiotremus tapeinosoma</i>	2				2	2			2	4
<i>Cirripectes castaneus</i>	2				2				2	
<i>Cirripectes auritus</i>	2				2				2	
GOBIIDAE										
<i>Gnatholepis anjerensis.</i>	4				4				4	
<i>Valenciennea strigata</i>										X
ACANTHURIDAE										
<i>Acanthurus leucosternon</i>		25	7	32		4		4	36	
<i>Acanthurus thompsoni</i>	1	10	31	42		47		47	89	
<i>Acanthurus xanthopterus</i>										X
<i>Ctenochaetus striatus</i>		4		4		1		1	5	
<i>Ctenochaetus truncatus</i>	3	47	3	53		19		19	72	
<i>Naso brevirostris</i>			4	4					4	
<i>Naso elegans</i>			4	4					4	
<i>Zebrasoma scopas</i>	3	9		12	2	10		12	24	
<i>Acanthurus nigricauda</i>							3	3	3	
<i>Acanthurus dussumieri</i>										X
ZANCLIDAE										
<i>Zanclus cornutus</i>		1	3	4				1	1	5
BALISTIDAE										
<i>Balistapus undulatus</i>			2	2					2	
<i>Melichthys indicus</i>			3	3			1	1	4	
<i>Melichthys niger</i>										X
<i>Odonus niger</i>										X
<i>Sufflamen bursa</i>		2	2	4					4	
TETRAODONTIDAE										
<i>Cantherhines dumerili</i>										X
SCOMBRIDAE										
<i>Gymnosarda unicolor</i>										X

Survey Transect Depths	10m				20m				10m+20m	
Total Area Surveyed	200m ²				100m ²				300m ²	Off
Fish Size Groups (Total Length)	<1-10cm	>10-20cm	>20cm	Total	<1-10cm	>10-20cm	>20cm	Total	TOTAL	Transect
SCORPAENIDAE										
<i>Pterois miles</i>										X
SIGANIDAE										
<i>Siganus stellatus</i>			1	1					1	
CARCHARHINIDAE										
<i>Carcharhinus amblyrhynchos</i>										X
<i>Triaenodon obesus</i>										X
GINGLYMOSOMATIDAE										
<i>Nebrius ferrugineus</i>										X
KYPHOSIDAE										
<i>Kyphosus cinerascens</i>			21	21					21	
MICRODESMIDAE										
<i>Nemateleotris magnifica</i>					2			2	2	
MONACANTHIDAE										
<i>Amanses scopas</i>										X
DIODONTIDAE										
<i>Diodon liturosus</i>			1	1	1			1	2	
Total Fish Counted	4813	747	1204	6764	6561	668	67	7296	14060	
Number of Species Counted	33	40	44	89	27	36	22	69	108	
Number of Off Transect Species										33
Total Species										141
Fish/100m²	2407	374	602	3382	6561	668	67	7296	4687	