

On the external slope, the 2003 results from the reference site show that coral cover is at 44 %. Compared to previous results (2001 and 1999), there is a progressive increase in coral cover on the external slope (from 35 % in 1999, 38 % in 2001 and 44 % in 2003) to the detriment of abiotic substrates.

Since there are little anthropogenic activities on the external slope (handline fishing mainly), and no real problem of sedimentation (strong hydrodynamic activity), the reef develops progressively in the absence of major destructive events.

For the reef flat, the 2003 data analysis shows (and confirms) a rapid degradation of the environment. At present, the coral vitality is very low (14,7 %) which was close to the results of 2001. The analysis of the other components show the importance of abiotic substrates (sand and silt mainly) and of « others » component (soft corals, Coralliomorphs), which shows the strong imbalance of this station, and seem to reinforce the hypothesis of a progressive deterioration of the Foulpointe reef.

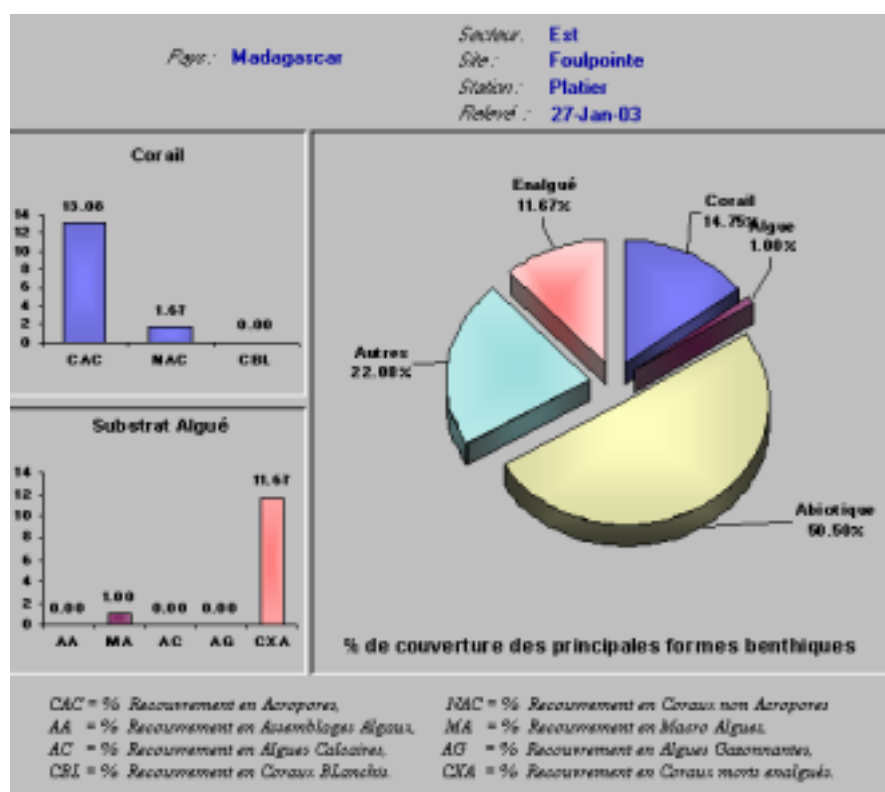


Figure 18 :: 2003 benthic cover for the reef flat station of Foulpointe

The trend analysis 1999-2003 for the reference site confirms that the greatest decrease in coral cover is on the reef flat. The difference is highly significant between 1999 and the other years 2001 and 2003.

In fact, if in 1999 coral cover was around 40%, only three years later, that is in 2001, it has dropped to 13 %.

This situation is very critical. It is in direct relationship with increasing sedimentation on the reef flat, and near-total degradation can be expected in a few years time.

Evolution de Recouvrement des Formes Benthiques

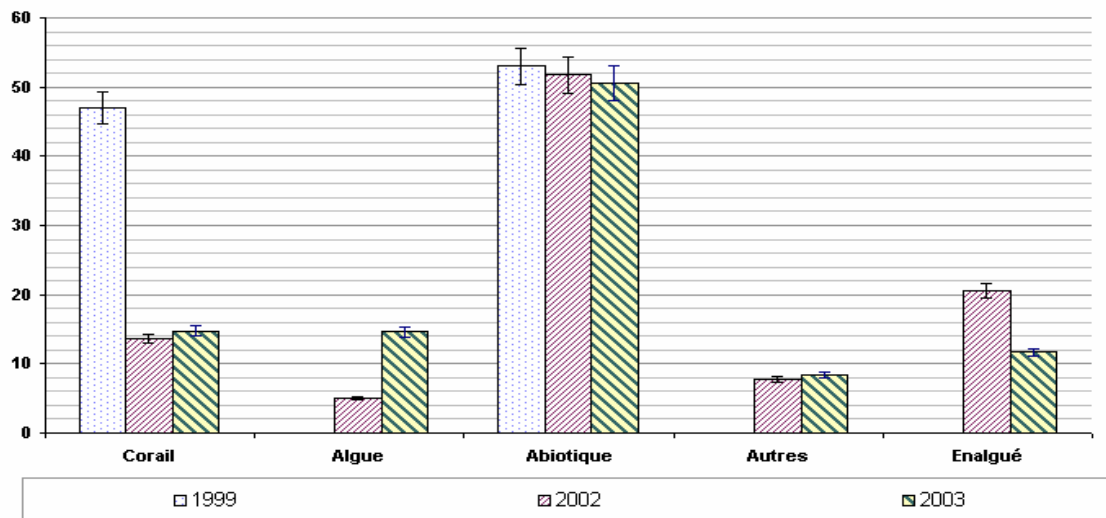


Figure 19/ :: Evolution of benthic cover 1999 /2003 for the reef flat station of Foulpointe

During the survey of December 2001, it was noted that there nearly no live coral on the reef flat. The branching *Acropora* found in 1999 were buried a few centimeters under the substrate. In 2003, observations show that this phenomenon seem to have increased. A proliferation of the sea urchin *Echinometra mathaei* contributes towards bio-erosion of the reef flat in a non-negligible way.

In the same way, there is a slight decrease of algae and an increase of the « others » substrate which is mainly represented by seagrass beds. The development of these seagrass beds is probably enhanced by the sedimentation.

The percentage of abiotics remains stable since 1999 and shows the intensity of the silting up of the reef flat. Moreover, algae that were not present in 1999 seem to grow well since 2003, which confirm the degradation process.

4.3.3. Recapitulation

At the organization level, new members have been trained in reef monitoring which helped conduct simultaneous surveys at the North (Nosy Be) and Southwest (Toliara) sectors. Independently from the results, this shows a more advanced structuring of the Malagasy network. This increase in trained personnel will continue with planned training for other participants before the end of 2003.

At the technical level, the new version of COREMO II has helped the network increase the level of analysis and interpretation of the data. (benthos, fish), and to study in a more specific manner the trends at the different stations (time-series analysis).

The main results show the trends observed at the Nosy Be, Toliara and Foulpointe sites.

- *At Tanikely*, the Marine Protected Area reference site of Nosy Be, coral populations seem stable, and are getting better on the external slopes. On the reef flats however, the cover has slightly decreased due to the more or less uncontrolled access to the site. The same has been observed for the degraded site at Dzamandjar.

- *At Toliara*, the data analysis for the reference site of the « Great reef » show that the situation is stagnant, with important environmental disturbances that were already shown during the previous surveys.
- *At Foulpointe*, the advanced state of deterioration of the reference site (reef flat) is confirmed and is even more pronounced during the period 2001/2003, mainly due to the silting up of the reef that is close to the coast. This sedimentation problem is more or less important at the other sectors, and should be specifically monitored. It is probably linked to the intense deforestation period that took place (or is still taking place?) in Madagascar.

As such, and following the different alarms raised previously by the Malagasy network, a pilot study has started at Foulpointe (reef mapping, study of sedimentation rates, vitality of populations, ...) to determine the causes of the chronic sedimentation of the reef. From the results of this study, it will be imperative to launch the necessary actions in order to protect the Foulpointe reef.

4.4. Mauritius / Rodrigues

4.4.1. Location of the current survey sectors and sites

Among the numerous existing sites that are monitored in Mauritius (monitoring programme of AFRC and MPA), 6 official sites are at present incorporated in the WIO regional network (including 4 new sites in 2003). Their description is given below.

On Rodrigues, 7 sites are regularly monitored (once or twice / year) by the Shoals Rodrigues team. New sites to be monitored by new participants in the Mauritius/Rodrigues network (RUG, others,...) are planned for year 2004.

Mauritius:

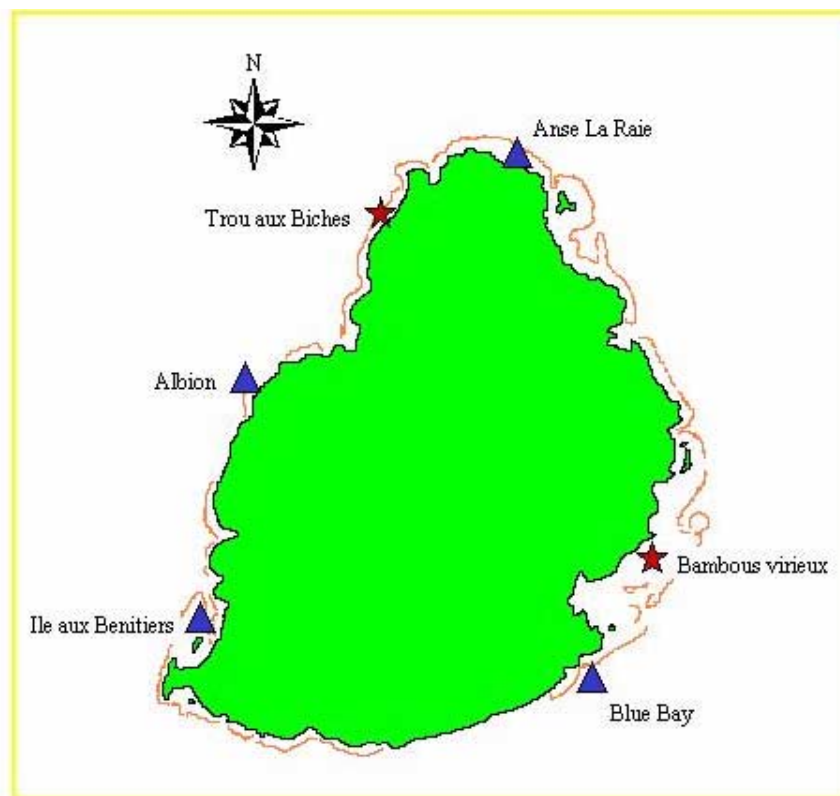


Figure 20 :: Monitoring sites in 2003 - Maurice

SITE	JUSTIFICATION
Trou aux Biches	Hotel development, tourist activities and public beach
Bambous Virieux	Runoff of agricultural effluents; sand extraction site and associated shore-based activities.
Albion	Situated opposite Albion Fisheries Research Centre
Anse la Raie	Potential site for further development (tourism and industry)
Ile aux Bénitiers	No coastal development, control site
Blue Bay	Proclaimed Marine park; hotel development

The new Albion site:

The lagoon at Albion is about 500 m wide and the reef runs inshore both at the northern and southern end enclosing a lagoon area of about 1.7 km². While the lagoon is shallow in most areas (<2 m), it is deeper in the southern end (about -5 m). At this latter end, the lagoon receives input from River Belle Eau; also the main pass is situated at this end. The back-reef station is located some 200 m from the shore and here the dominant coral types are the Acropora branching. The

fore-reef station is located at about 150 m off the reef. Dominant coral species are the encrusting and submassive types.

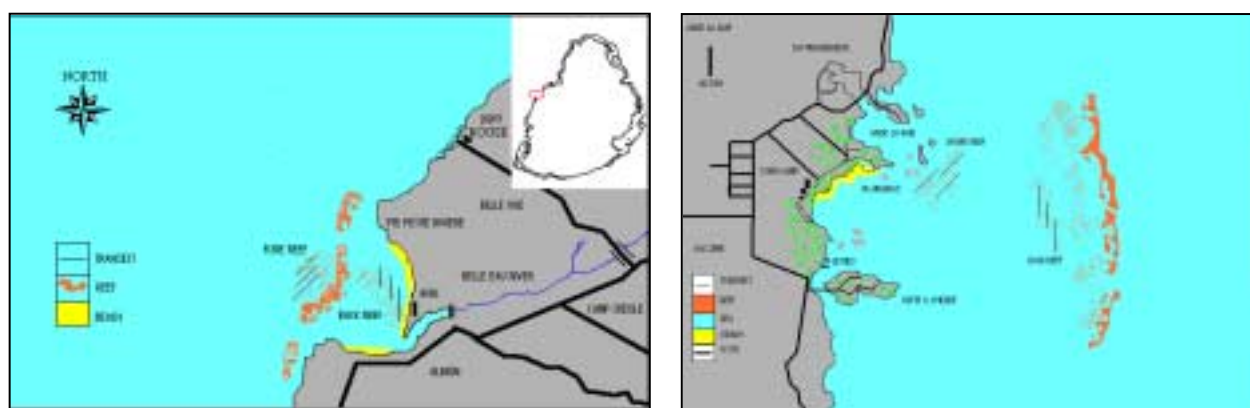


Figure 21 : Geographical location of the Albion sites (left) and ANSE LA RAIE (right)

Anse la Raie

The lagoon at Anse la Raie is about 2 km wide and contains a number of channels of up to 8 m deep. Dense macroalgae namely *Sargassum* spp. and *Turbinaria ornata* are dominant species. The back reef station is located just inside the fringing reef. The bottom topography at the backreef is uneven with depths ranging from 1m to 3 m. The dominant coral species are the *Montipora tuberculosa* and *Acropora grandis*. The shore-reef station is located at about 900 m from the shoreline and the depth range is 2-3 m. The dominant species of coral were the branching *Acropora* and the foliose and submassive types.

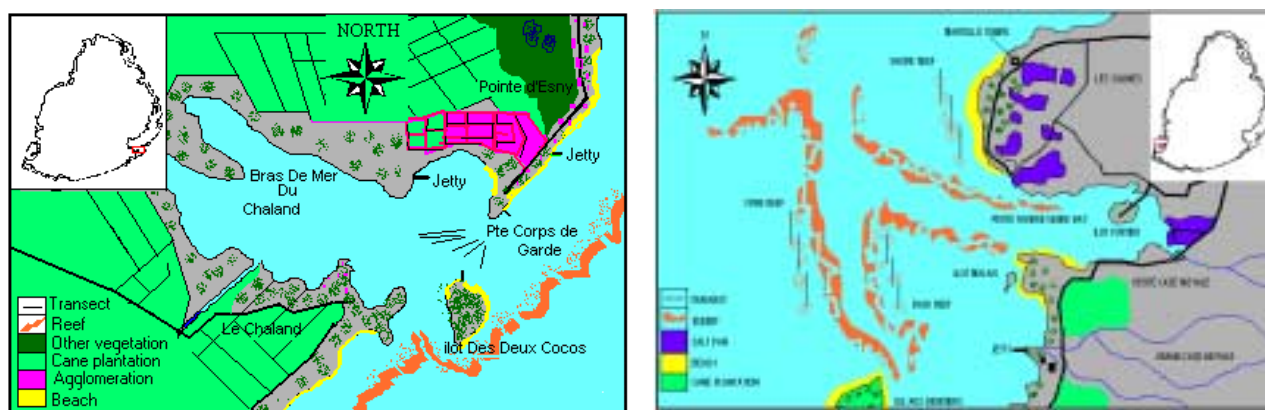


Figure 22 :: Location of the BLUE BAY site (left) and ILE AUX BÉNITIERS (right)

Blue Bay

Blue Bay is found in the South East of Mauritius. The site is located in strict a conservation zone in the lagoon of the Blue Bay Marine Park. The stations represent the most pristine areas of the coral garden in the marine park. The most dominant corals are *Acropora tabular* followed by *Acropora* branching and foliose corals.

Ile aux Benitiers

This region is close to a fishing village, located in the South west coast. The lagoon is about 2 km wide. This site is the control site for monitoring purposes due to no coastal development activities in the region. Three stations were established, the fore reef, back reef and the shore reef stations. The back reef and shore reef stations were opposite each other, just inside and outside the reef, north of Ile aux Benitiers. The shore reef station is further north in front the sandy

beach at l'Harmonie. The shore reef station was dominated by two species, *Acropora grandis* and *Pavona cactus*. The table coral *Acropora hyacinthus* dominated at the back reef station, where as there was a high coral diversity at the fore reef.

Rodrigues :

Between January and March 2002, the surveys using the COI method were carried-out at 6 sites around Rodrigues by the Shoals Rodrigues team with the assistance of the Fish Protection Service and the Coast Guards.

Name	Reef Flat (RF)	Reef Slope (RS)	Depth RF	Depth RS
Riviere Banane	19° 40.224' S 63° 28.224' E	19° 40.154' S; 63° 28.484' E	1m	9m
Passe Armand	19° 40.302' S; 63° 25.051' E	19° 40.084' S; 63° 24.677' E	1m	6m
Ile aux Fous		19° 39.125' S; 63° 23.262' E		9m
Grand Bassin	19° 39.408' S; 63° 25.447' E	19° 39.381' S; 63° 21.366' E	1m	9m
Passe Demie		19° 42.288' S; 63° 17.657' E		9m
Trou Blanc	19° 45.401' S; 63° 28.443' E		1m	

Tableau 3 : Location and depth of the sites surveyed around Rodrigues

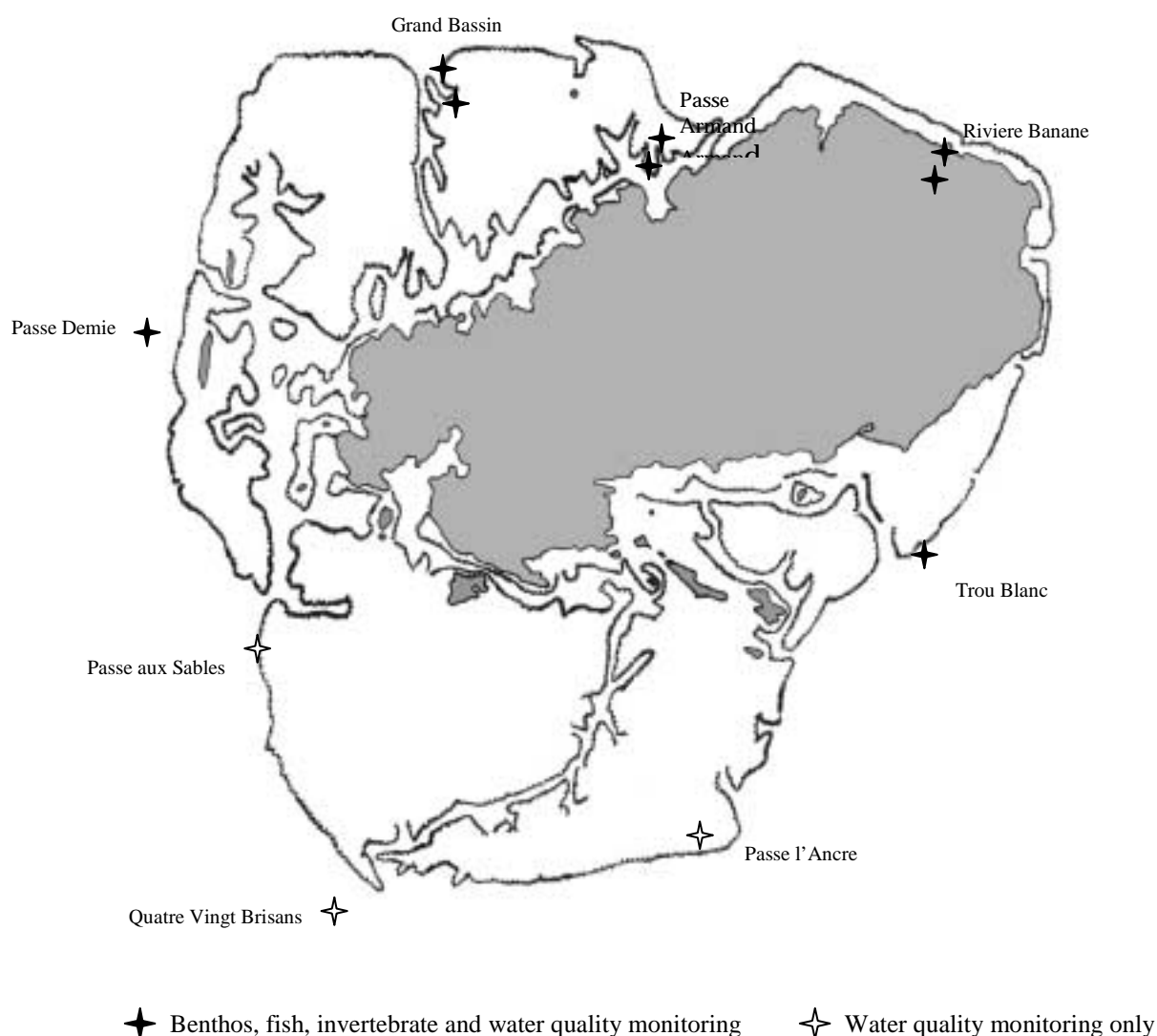


Figure 23 :: Location of surveyed sites at RODRIGUES in 2002

4.4.2. Results

a) New site 2003 at Mauritius (Blue Bay and Ile aux Bénitiers)

BLUE BAY (South East Region):

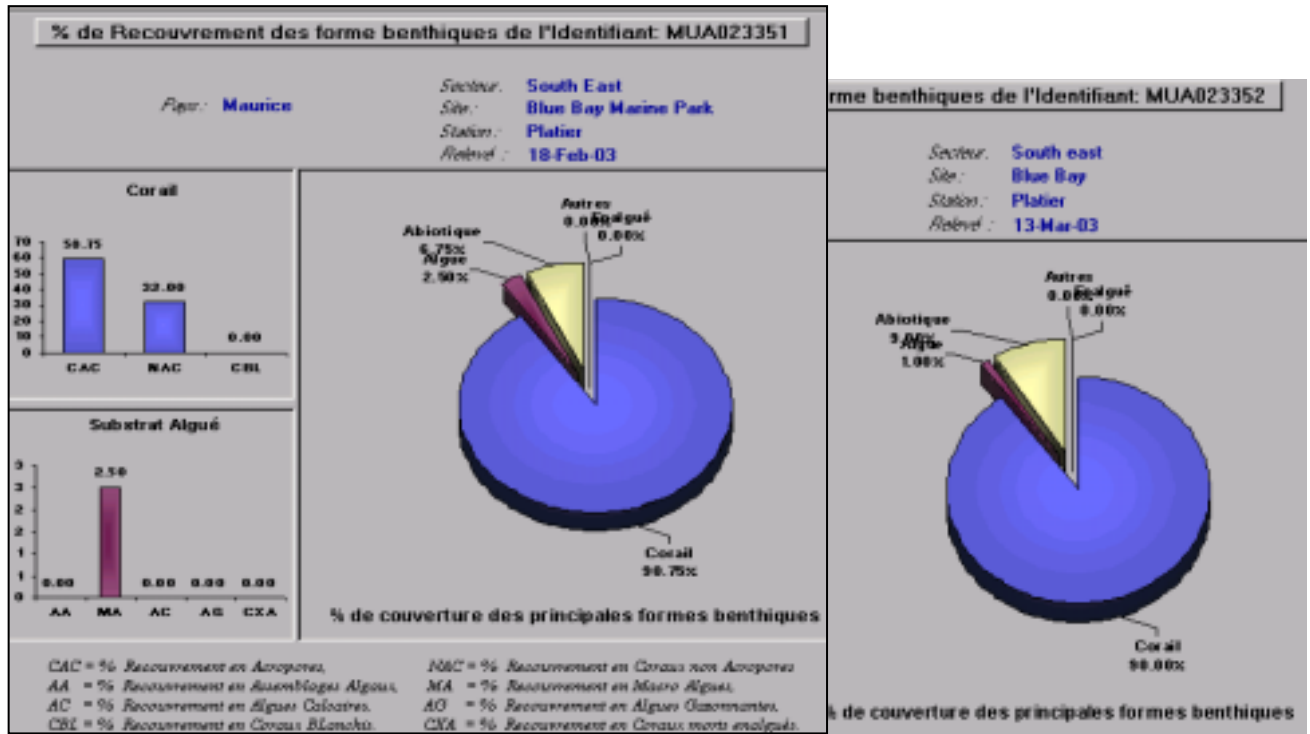


Figure 24 : Percentage cover of main benthic forms at Blue Bay (Station 1 and 2)

The station 1 had a coral cover of 91% out of which 59 % was *Acropora* sp. (mainly tabular corals), and 32% was non-*Acropora*. Algal cover was 3 % and abiotics amounted to about 7 %. In the station 2 (back reef, Blue Bay), the total coral cover was 90%, which mainly comprised of *Acropora* sp. (71%) and non-*Acropora* (19%). Only 1 % of algal cover was observed and abiotics amounted to about 9 % of the total substrate cover.

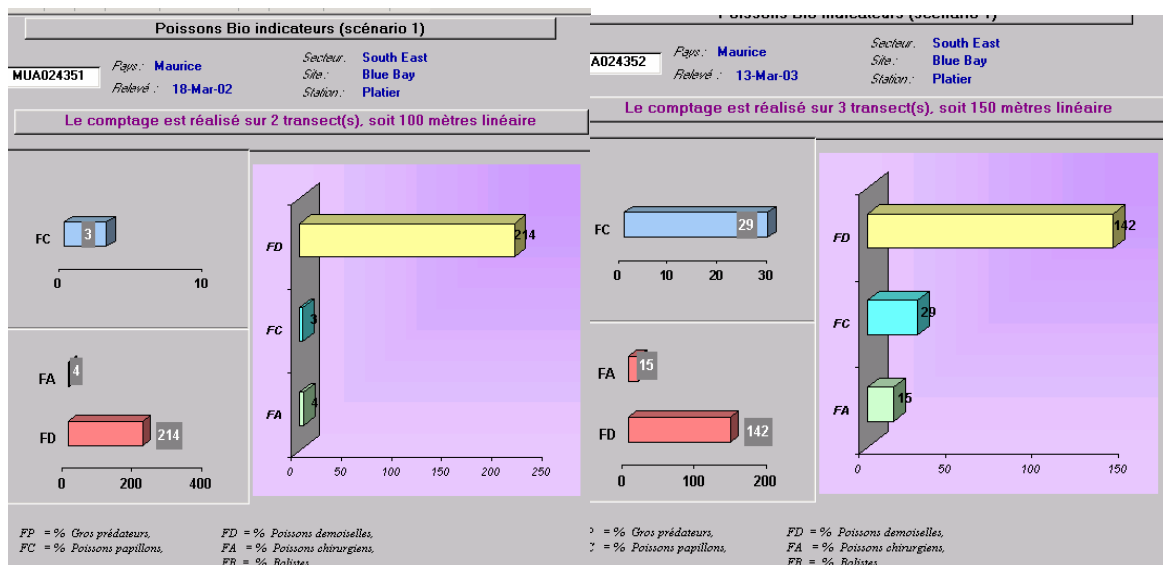


Figure 25 :: Percentage of fish populations at Blue Bay (Station 1 & 2)

At both the stations 1 & 2, there was dominance of damselfish (*Stegastes* sp. & *Dascyllus aruanus*) followed by butterfly fish (*Chaetodon* sp.) and surgeonfish.

ILE AUX BÉNITIERS (South West Region)

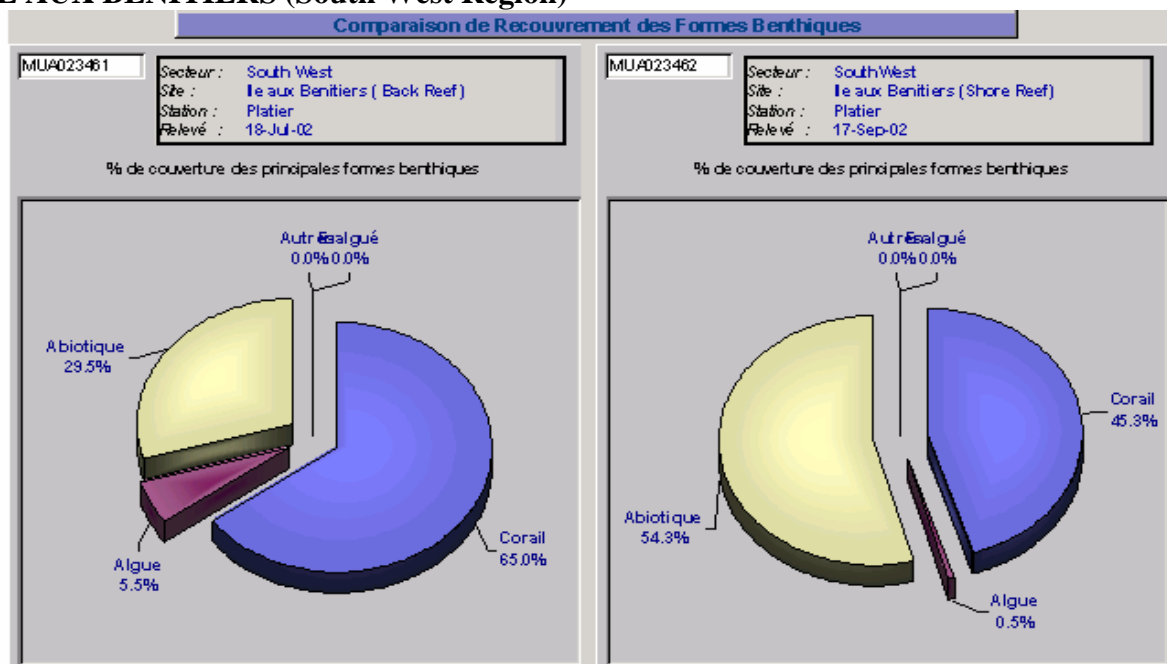


Figure 26 :: Percentage cover of main benthic forms at Ile aux Benitiers (back reef & shore reef)

On the back reef, the station had a total coral cover of 65%, which was dominated by *Acropora* sp.. The percentage of abiotic component was 29 % and algae were represented by 6 % of the substrate cover.

On the shore reef, the dominant coral species here was coral foliose (33 %) and *Acropora* branching (12 %) and the abiotic component had a percentage of 54 %. Very sparse algal cover (0.5%) was observed.

About the fish survey, Damselfish studies on the back reef were dominant at this station and comprised of *Stegastes* sp., *Chromis viridis*, *Dascyllus aruanus*. Other species observed were surgeonfish (FA), butterfly fish (*Chaetodon* sp.) and *Labroides* sp.

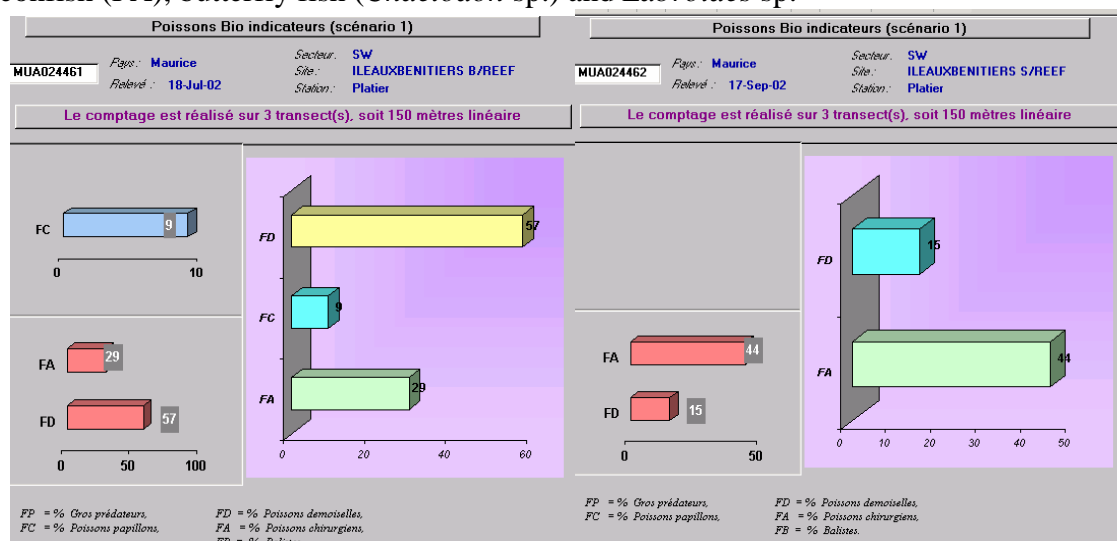


Figure 27 A: Abundance of fish populations at Ile aux Benitiers (back reef & shore reef)

On the shore reef, *Scarus* sp. was dominant at his station followed by *Labroides*, *Acanthurus* (FA) and damselfish (*Dascyllus aruanus*).

On the reef slope of Ile aux Benitiers (fore reef), the coral cover was 31 % and this was dominated by encrusting, massive and sub massive corals. Abiotics cover was 62 % of the substrate, which was composed of rock. There was no presence of algae and soft corals amounted to 7% of the substrate cover.

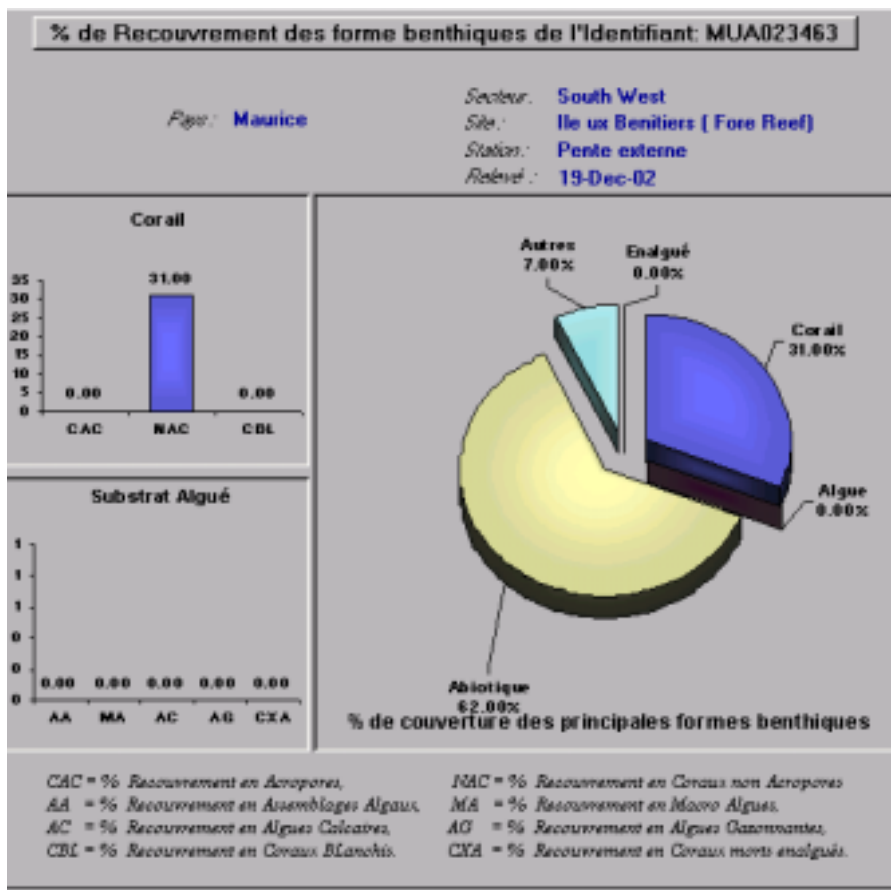


Figure 28 Percentage of cover of main benthic forms at Ile aux Benitiers (fore reef)

b) Results of Rodrigues (October 2002)

Reef Slope stations:

The percentage cover of hard coral at reef slope stations ranged from 40 % at Riviere Banane to 71 % at Passe Demie. Soft coral covered only 3 % of the substrate at Riviere Banane and Passe Armand, increasing to 12-13 % at Grande Bassin and Passe Demie. No gorgonians, sponges, zoanthids or other lifeforms were recorded at any site. The limestone rock platform with a sparse algal covering was an important substrate particularly at Riviere Banane and Passe Armand (52% and 41% respectively), while other abiotic features including sand, rubble and blocks occupied only a small percentage of the substrate. The distribution of the major substrates and benthic species for the reef slope sites are shown in Figure .

Acropora species, particularly the branching forms, dominated at all sites and accounted for over 50 % of live hard coral at Grande Bassin and Passe Demie. The total cover of all non-*Acropora* corals did not exceed 20 % at any site, and amounted to only 6% of the substrate at Riviere Banane. Seven coral forms (three *Acropora* and four non-*Acropora*) were recorded at Passe Armand and Grande Bassin, and five (two *Acropora* and three non-*Acropora*) were found at the remaining sites. Massive and submassive corals were the most abundant forms after branching *Acropora*.

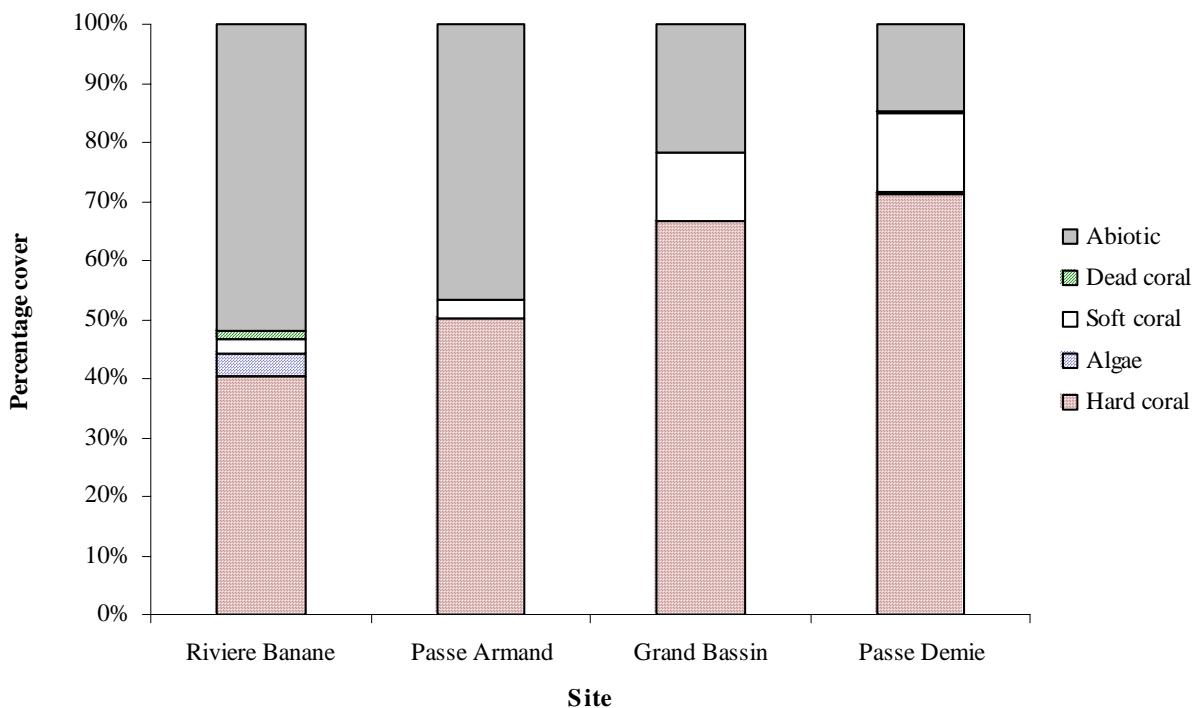


Figure 29 :: The percentage cover of principal life forms and abiotic features – REEF SLOPE station

Reef Flat stations:

The coverage of live hard coral at Passe Armand (53 %) was similar to the values recorded from the reef slope stations, but was much lower for the remaining reef flat stations and ranged from 15 % at Riviere Banane to 19 % at Grande Bassin. Soft coral was only recorded at Trou Blanc, and other lifeforms were again absent from each site. Limestone rock was again an important substrate, with greater percentage cover than for the reef slope stations. The distribution of these substrate categories is illustrated in Figure 30.

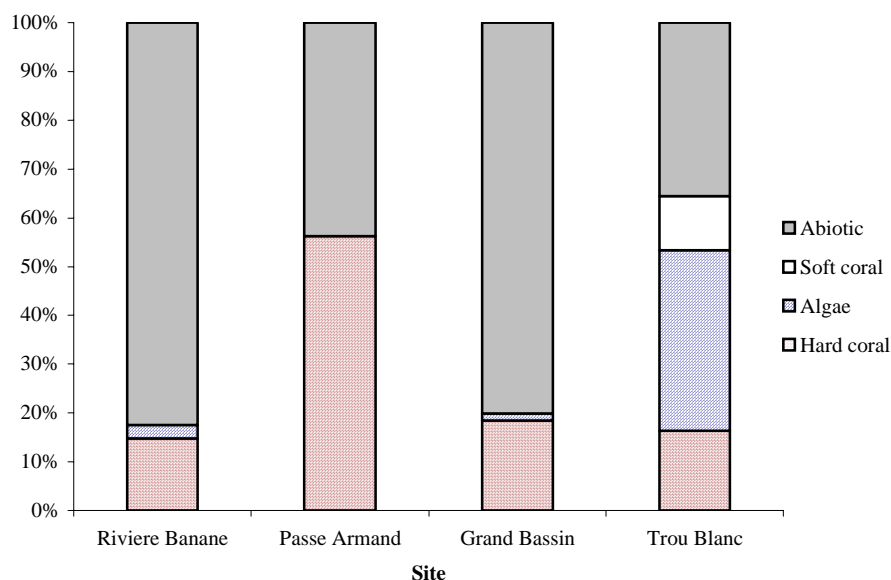
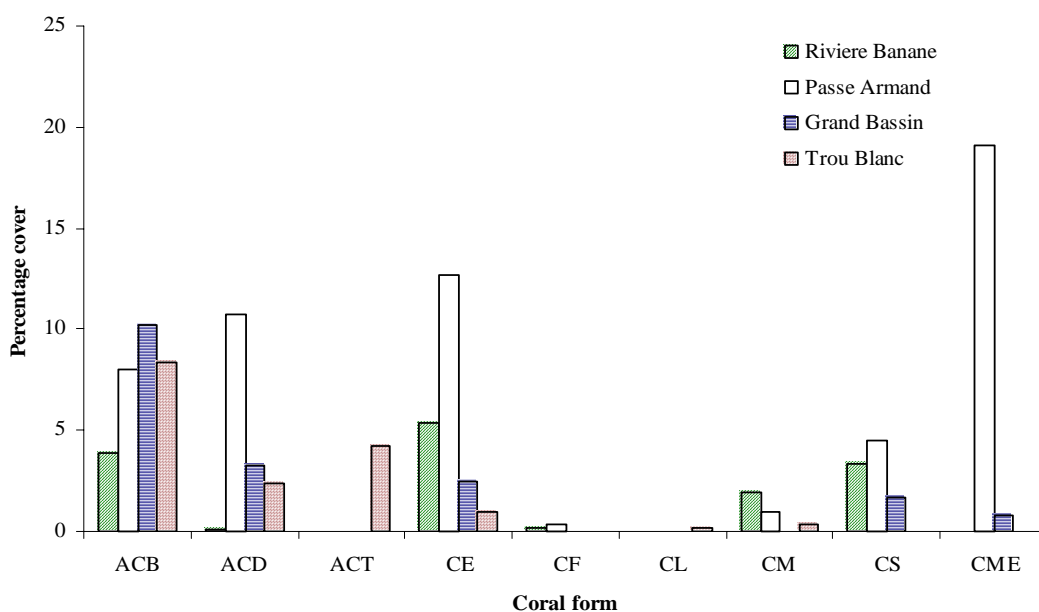


Figure 30 :: The percentage cover of principal life forms – REEF FLAT stations

Acropora was again more abundant than non-*Acropora* coral except at Passe Armand, but the different coral forms were more evenly represented than on the reef slopes (Figure 31).



ACB - *Acropora* branching, **ACD** - *Acropora* digitate, **ACT** - *Acropora* tabular, **CB** - Coral branching, **CD** -Coral digitate, **CE** -Coral encrusting, **CF** -Coral foliose, **CL** – Free living coral, **CM** -Coral massive, **CS** -Coral submassive, **CME** -Coral *Millepora*

Figure 31 :: The percentage cover of different coral forms corals – REEF FLAT stations

Millepora was particularly prevalent at Passe Armand (19 % cover), while branching coral was dominant at Grande Bassin and Trou Blanc. Digitate *Acropora* and encrusting coral were also common. Grand Bassin was the least diverse site in terms of coral forms, with two *Acropora* and three non-*Acropora* corals noted, and two *Acropora* and five non-*Acropora* corals were found at Passe Armand. Foliose and free living (mushroom) corals were recorded on the reef flats but had not been observed at reef slope stations.

Fish distribution:

Pomacentridae were once again the most abundant group, with *Pomacentrus indicus*, *Plectroglyphidodon dickii* and *Stegastes nigricans* particularly well represented. Large numbers of other *Stegastes* species and *Dascyllus aruanus* were recorded at Trou Blanc, and *Chrysiptera glauca* was very common on the reef flat at Riviere Banane.

Surgeonfish were the only other group with reasonable representation on the reef flat, although it was the small species that were most prevalent.

There was a good diversity of Chaetodontidae, with between five and seven species recorded at each reef slope station. Both numbers and diversity decreased on the reef flat stations, with no members of this group recorded from Grand Bassin, and only a single individual from Trou Blanc. No species of Balistidae were noted at any of the sites.

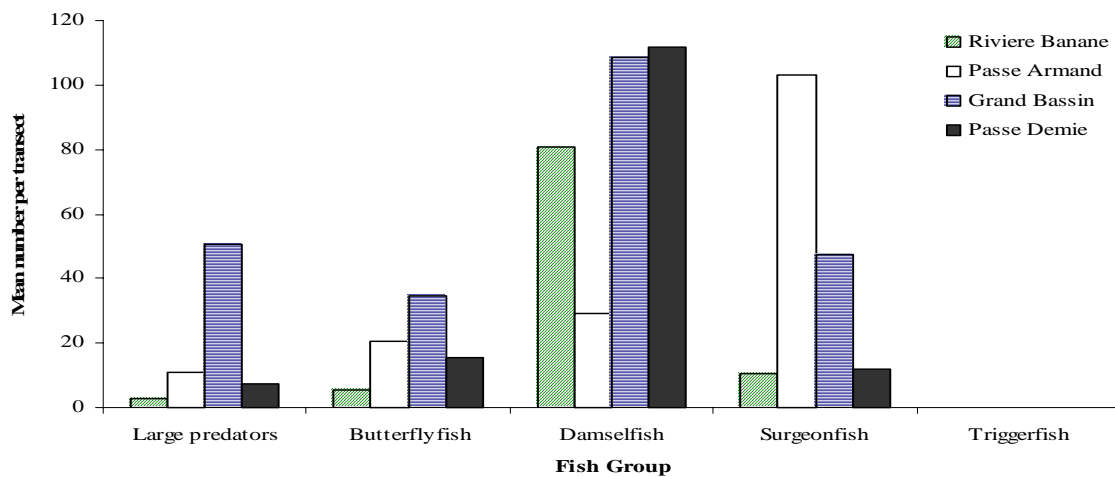


Figure 32 :: Mean number of fish from different groups per 250m² belt transect – REEF SLOPE

In general, few carnivorous fish were observed. Shoals of *Gnathodentex aurolineatus* were observed on the reef flat at Riviere Banane and the reef slope at Grande Bassin, increasing the number of predators recorded at these sites. Fish numbers were generally higher on the reef slopes, except at Riviere Banane where the greater fish abundance was found on the reef flat (Figures 32, 33).

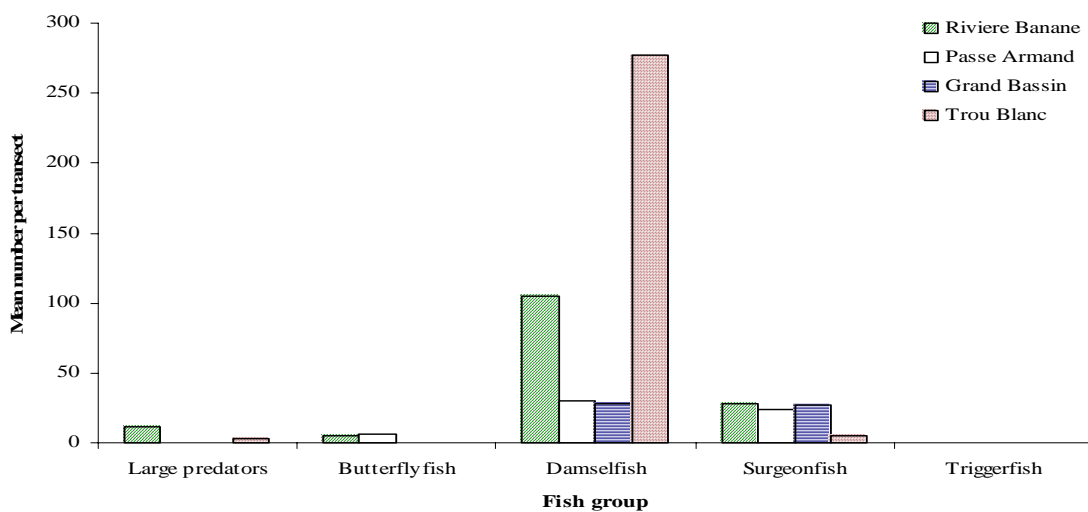


Figure 33 :: Mean number of fish from different groups per 250m² belt transect – REEF FLAT

Water quality:

In addition, a hydrological survey based on a few physico-chemical parameters (T°, salinity, nitrates, phosphates, suspended solids) was carried-out by Shoals for the main reef survey stations. Detailed results are given in the annual national Mauritius / Rodrigues report.

The seasonal trend in water temperature was very clear, with temperature decreasing between March and mid-August before beginning to increase (Figure 34). The highest temperatures were found on the reef flat, reaching a maximum of 29.4°C when the average for all sites was taken, but exceeding 30°C at individual sites. Mean minimum temperatures were again found on the reef flat, dropping to 22.4°C. Mean salinity was 35.1PSU for all stations. The widest range of salinity was found on the reef flat, reaching a maximum of 37.3 PSU.

The mean nitrate concentration ranged from 0.9 mg.l⁻¹ at Riviere Banane, Quatre Vingt Brisans and Trou Blanc to 1.2 mg.l⁻¹ at Passe aux Sables. Maximum concentrations were between 1.4mg.l⁻¹ (Trou Blanc) and 3.5mg.l⁻¹ (Passe l’Ancre).

Phosphate concentrations were between 0.3 and 0.7 mg.l⁻¹ on average, with maximum values reaching 1.6 mg.l⁻¹ at Riviere Banane and 3.6 mg.l⁻¹ at Passe l’Ancre. The mean and range of nitrate and phosphate concentrations are given in Figures 41 and 42 respectively. Nitrite was also measured, but concentrations were rarely within the limit of detection of the instruments used. Water turbidity was low, only exceeding 5mg.l⁻¹ on one occasion (out of 124 samples).

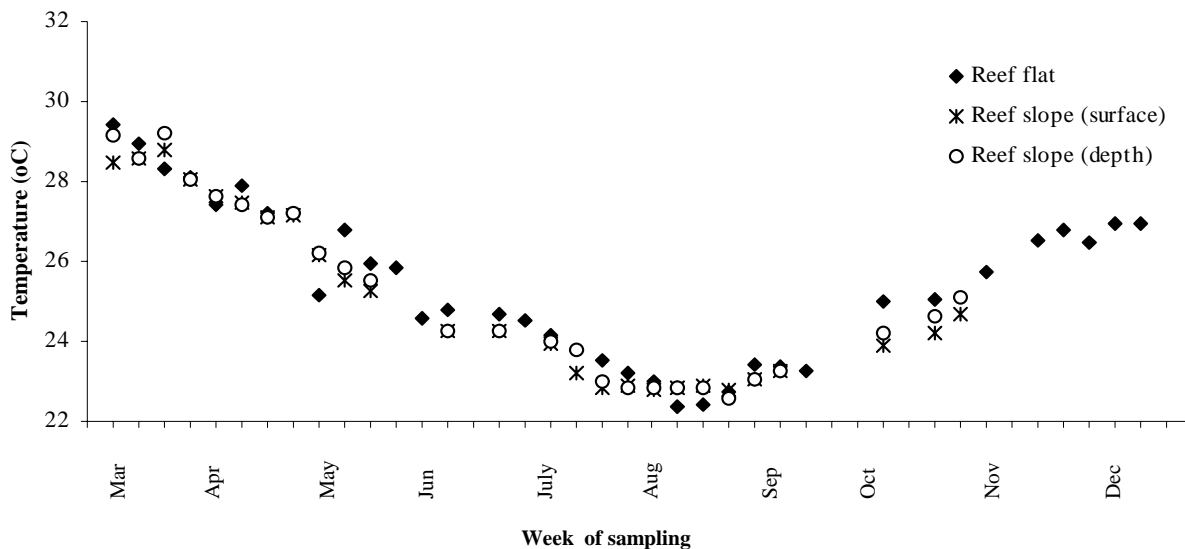


Figure 34 : Mean temperature (in °C) on the REEF FLAT, at the surface above the reef slope, and at depth on the RREF SLOPE during 2002.

c) Time-series analysis at two sites in Mauritius (“Trou aux Biches” / “Bambous Virieux”)

In agreement with the strategy that was decided in 2003 for the production of the reef national report, a trend analysis is done for two reef sites (**Trou aux Biches and Bambous Virieux**) that have been monitored for more than 4 years.

At Trou aux Biches, the reef flat station (back reef flat) is surveyed annually. The percentage of coral cover was 45 % in 1998 and a slight decrease was recorded in 1999 (43 %) and 2000 (44 %). In 2002 there was an increase of 4 % of coral cover and this has remained stable in 2003 (48 %).

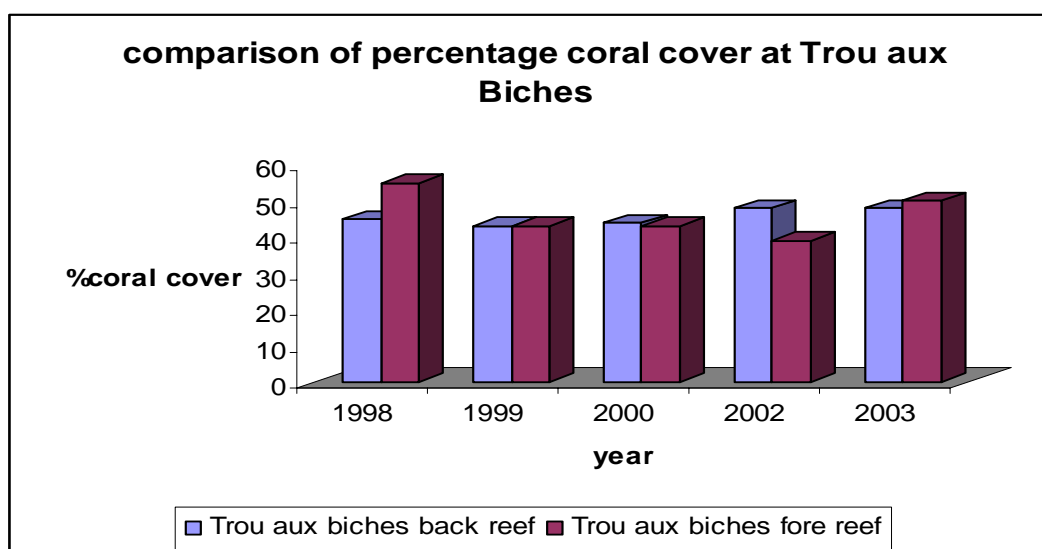


Figure 35 Evolution of the coral cover 1998/2003 at Trou aux Biches

For the reef slope station, the coral cover was 55 % in 1998 and a decrease of 12 % was noted in 1999 and 2000. There was a further decrease from 43 % to 39 % in 2002. In 2003 there has been an increase of 11 % of coral cover and this can be attributed to the increase in encrusting corals.

On the whole, no significant change in the live coral cover has been noted between 2002 and 2003 for the reef flat and the reef slope shows an increase. The decrease or increase in the algal percentage seems to correspond to seasonal fluctuations.

At Bambous Virieux, the two reference stations of the internal fringing reef (back reef flat and shore reef) have been monitored since 1998. Trends with respect to percentage of coral cover for the region of Bambous Virieux.

At the reference station located close to the (back reef), two growth phases can be observed. Following a phase of progressive decrease of coral cover between 1998 and 2002 (see previous annual reports, Figure) probably linked to the impacts of intensive agriculture in the neighborhood, there is a clear increase since 2002 to reach around 56% in 2003.

There is more stability at the reference station located near the internal reef flat (shore reef).

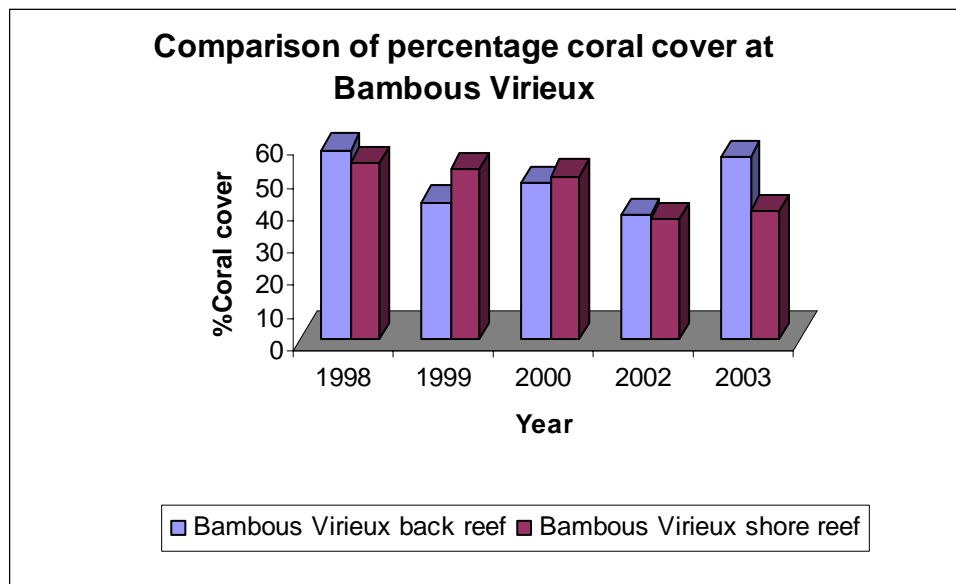


Figure 36 : Evolution 1998 – 2003 of coral cover – Bambous Virieux

These results are in agreement with observations done in March 2003 on the reef flat of Bambous Virieux (see reef mapping project, MOI /COI, 2003) that show relatively satisfactory vitality of the coral formations.

4.4.3. Recapitulation

On Mauritius, the salient points that were highlighted in the monitoring of coral reefs 2003 at the six sites are :

- The state of coral reefs at Trou aux Biches and Bambous Virieux did not show very any significant change. Situation on Bambous Virieux is actually better since 2002.
- The coral reefs at Albion, Anse la Raie and Ile aux Benitiers had an average coral cover of 50%,
- The Blue Bay Marine Park clearly shows the pristine state of the coral reefs and the protection of the site through restricted activities and enforcement of the MPAs regulations help in maintaining the excellent health of the ecosystems.
- The coral cover does not show much change at the sites. However, there is continuous development taking place along the coastline and an increase in activities in the lagoon that may impact on the coral communities. The threat of coral bleaching due to high SST is apparent and studies are underway to monitor this situation.

On Rodrigues, the surveys revealed that, in terms of percentage cover of hard coral, the reef slopes in Rodrigues appear to be in very good condition. The overall coverage of Scleractinian coral is good, although diversity amongst species and forms is not high. Algae is not abundant, which may be due to the high percentage cover of corals, and hence competition for space. Coral cover is notably lower on reef flat areas, which is perhaps a result of the higher wave energy in the surf zone, shallower water increasing exposure to elevated water temperatures and raised UV levels, or trampling by net and octopus fishers.

Compared to the reef slope, the reef flat is generally more diverse in terms of coral forms and species, however, which could result from its being a more disturbed environment and so offering a higher percentage of exposed substrate for settlement, unlike the reef slope where well-established colonies dominate.

The reef flat sites showed poor diversity and numbers of reef fish, which may reflect the reduced habitat complexity compared to the reef slopes. These sites are regularly impacted by octopus fishers and seine net fishers, with direct effects on fish numbers and the indirect effect of trampling destroying habitats and food sources. The reef slope stations generally showed marginally higher numbers in all categories, which perhaps reflects the greater habitat complexity and lower disturbance.

Large gastropods and *Tridacna* clams occur in a similar abundance on the reef flat and reef slope. The absence of any large gastropods from Trou Blanc during both sets of surveys may indicate that they have been over exploited locally.

The close similarities between the two sets of surveys (January 2002 and October 2002) indicated that no major changes had occurred during the six-month intervening period.

4.5. Seychelles

4.5.1. Localisation des secteurs et sites de monitoring actuels

A summary of the different characteristics of the survey sectors and sites of the Seychelles is given below.

Sector	Site Name	Depth	Description and comments	Years Surveyed	Located in MPA
Mahé – Baie Ternay	TERNAY - Middle Reef	3 –12	The reef slope from 2m to the base at 16m.	1997, 1998, 1999, 2000, 2001, 2002, 2003	Yes
	Bay TERNAY South of Bay Reef	16	The granitic boulders	2002, 2003	Yes
Mahé – Port Launay	Port Launay	1-5	The site is one with very good coral cover	2003	Yes
Thérèse	Therese Island	1-4	This is a site with a very flat reef.	2003	No
Mahé – Ste Anne	Anse Cimetièrre	1-7	The reef is sheltered from high wave action	2002, 2003	Yes
	Cerf Island	1-8	Its reef slope is very narrow. The reef flat and slope site is at 2 m and 6m respectively.	2002, 2003	Yes
	Moyenne	1-6	The site has a good 3-D structural complexity. The site is relatively sheltered from strong wave action	2002, 2003	Yes
	Cachée Island	1-12	The site is located opposite the industrial zone on the East Coast of Mahe.	2003	Yes
Ile Curieuse	Coral Garden	10-14	This site is located on a path reef.	2002, 2003	Yes
	Anse Papaie	1-8	This site is located on a fringing reef.	2002, 2003	Yes
Mahé – Airport	Airport	2 -9	The reef is in the close proximity of the Seychelles airport	2003	No
Mahé – NE Point	North East Point	2-12	The site is on an extensive fringing Reef.	2002	No
Ile Alphonse	Oasis 1	1-7	This site is located within the lagoon of the Alphonse Atoll.	2002	No
	Anse Papaie	1-8	This site is located on a fringing reef	2002, 2003	Yes

Tableau 4: Sectors, sites specifications in SEYCHELLES - 2003

In this report, only the results of the Ste Anne, Mahé / North West, and Curieuse Island sectors are given.

Northwest Sector

There are 4 sites in this sector with 2 new sites at Port Launay and Therese (Fig 37). The sites in the Bay Ternay Marine National Park have been thoroughly described in Bijoux (2002). The new monitoring site at Port Launay is on the right hand side of the bay opposite the viewpoint on the Cap Ternay road. The site at Therese is situated on the Northeastern tip of Therese Island

with the reef slope having a low inclination and characterized by layers of fine sediments on rubble.

Curieuse Sector

There were no increase in the number of sites monitored within this sector (Fig. 37) between 2002 and 2003. Similar to the other sites established in 2002 site descriptions for Anse Papaie and Coral Garden are available in Bijoux (2002).

Ste Anne Sector

There are 5 monitoring sites in this sector (Fig. 37). The sites at Ste Anne (Anse Cimetière), Moyenne and Cerf have been monitored since early 2002 whilst the one at Cachée and at the Airport were first monitored in early 2003. Once again there are thorough descriptions of the old sites in Bijoux (2002). The site at the airport is the only one not found within the Ste Anne MNP.

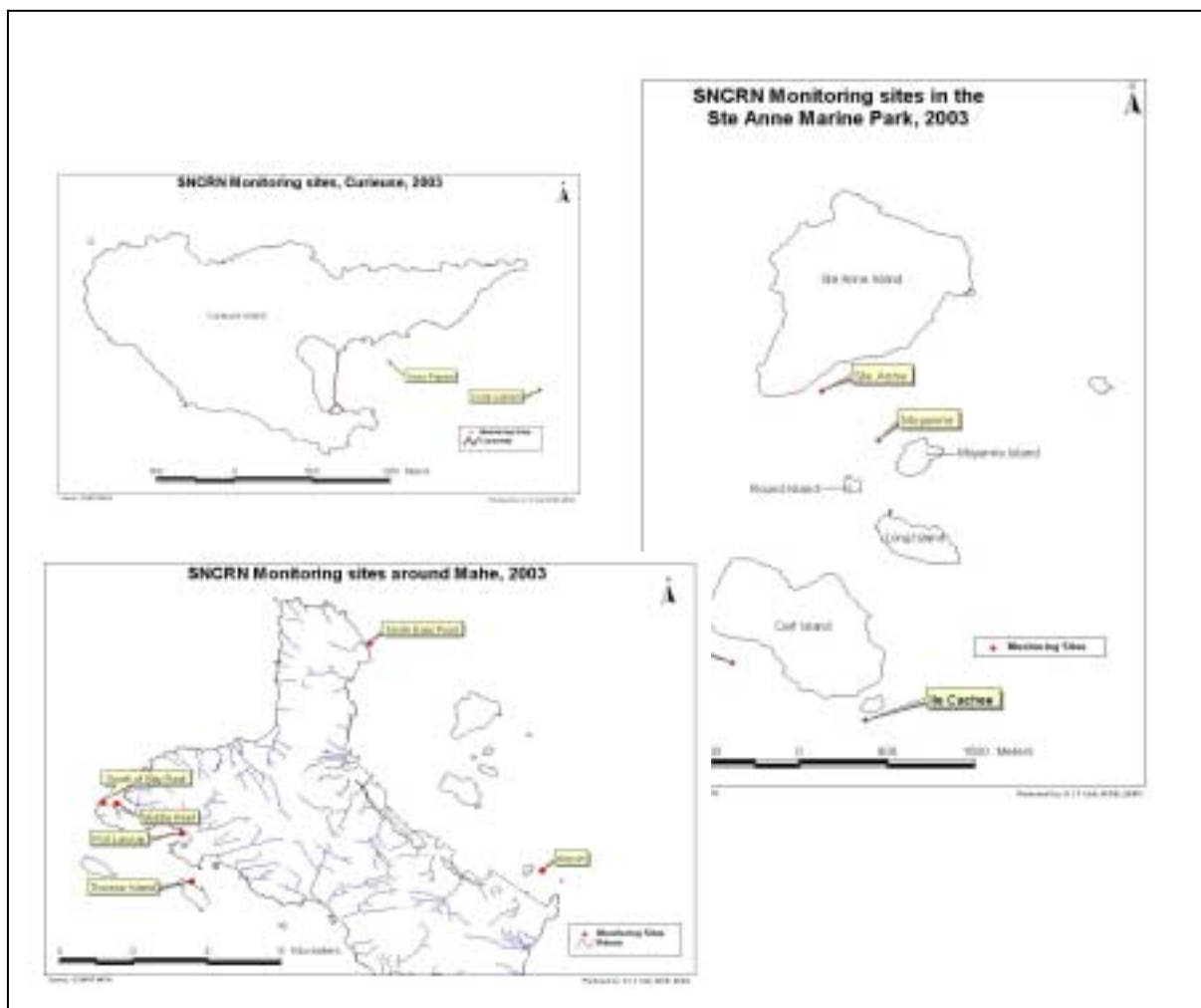


Figure 37 Location of the survey sectors and sites at Mahe Ste Anne and at Curieuse

4.5.2. Results Seychelles

a) New site 2003 at Mahé “Port Launay” and “Airport”

Airport (reclamation site)

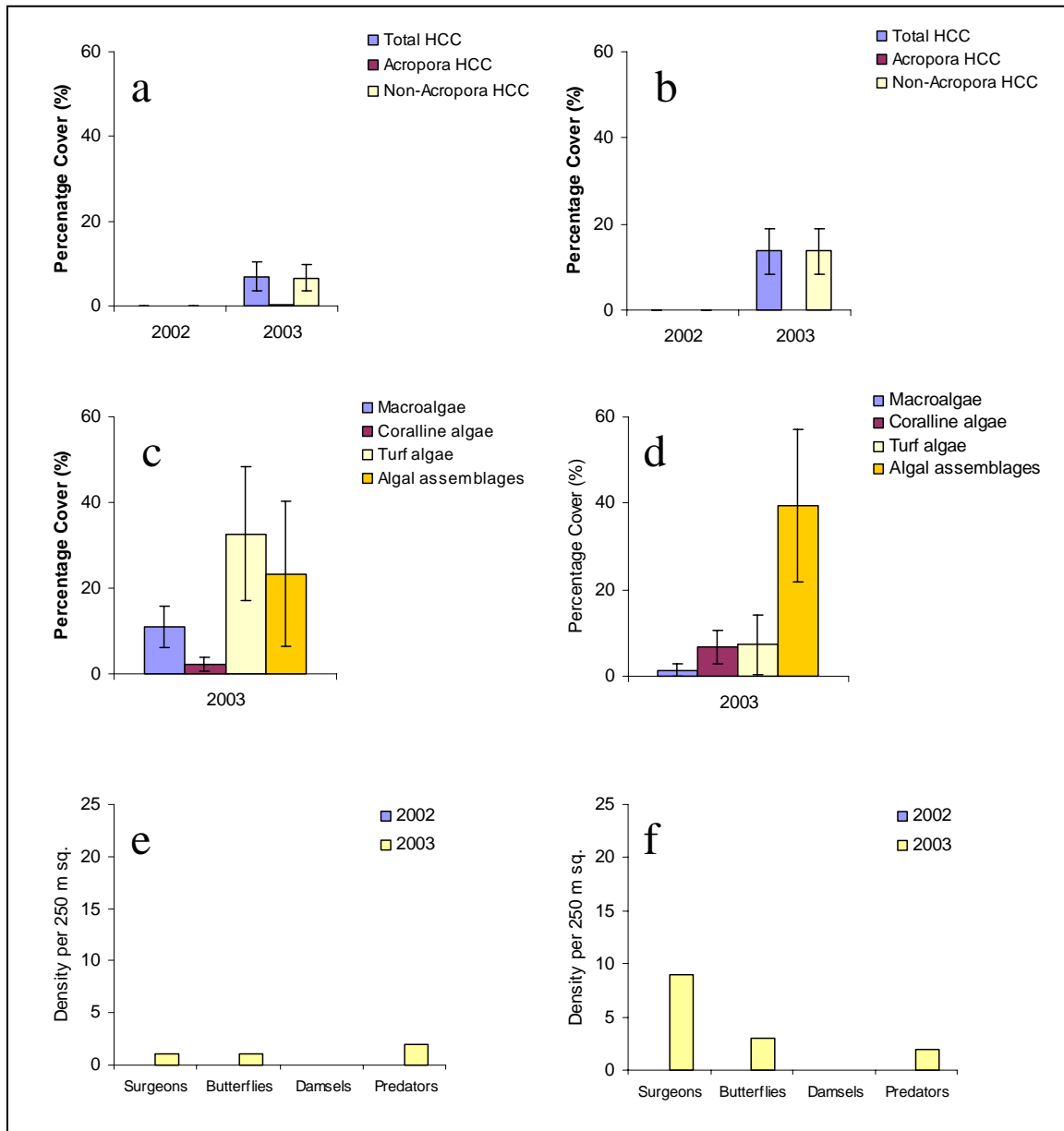


Figure 38 Percentage Coral Cover on the reef flat (a) and slope (b) at Airport. Percentage algal cover on the reef flat (c) and slope (d) at Airport. Fish bio-indicator density per 250m² on the reef flat (e) and slope (f) at Airport.

Live coral cover on the reef slope (7.0%) was less than on the reef flat (13.7%) for this site (Fig. 38 a, b). Acropora coral species occupied only 0.3% of the live coral cover with non-Acropora corals making up for the difference (6.7%). Much of the coral skeletons are still standing but are however overgrown by algal assemblages and turf algae suggesting that the death of corals on this reef is probably due to an event in the near past, most probably the coral bleaching event of 1998. Algal assemblages is the most widespread algal group on this station (39.5%) with lesser amount of turf (7.2%), coralline (6.7%) and macro-algae (1.4%) (Fig. 38d). Algal assemblages

are often the result of nutrient input into the system, suggesting that there may be a possible source of anthropogenic nutrient discharge onto that reef coming from nearby infrastructures. The fish count recorded all but one of the bio-indicator fish groups (Fig. 38f). It is interesting to note that there were no sediment layer on the algal assemblages and turf algae on this station and that this correlated to higher abundances of Surgeonfish (figure 38) than was recorded on sites with higher sediment loads recorded per 250 m².

Port Launay (MPA site):

Good coral cover was recorded the first time this site was monitored in 2003 (21.1%). Coral cover comprised mostly of non-Acropora corals (17.8%) with smaller percentages of Acropora (3.4%). Algae covered 27.3% of this site, of which turf algae covered 22.3% with algal assemblages and coralline algae covering 4.1% and 0.9% of the site respectively. Once again no macro-algae were recorded. The fish population appears to be very with a total of 9 Surgeonfish, 13 Butterflyfish, 7 Damselfish and 1 Predatory species being recorded. The relatively good coral cover is accompanied with similarly good diversity (*Pers. Obs.*), thus making this site a very attractive one. This site is frequently visited by snorkellers and should be the focus of conservation of Port Launay Marine National Park management as it contains many coral specimens (and hence, probably genetic traits) that were resistant to the bleaching event of 1998. These coral colonies may have genetic and physiological adaptations that acclimatize them to coral bleaching. Future coral bleaching event, which we are sure to encounter again within the near future will either prove or disprove this hypothesis. If this is proven true then this site may prove to be one of the most important sites in this sector, as it will serve as a source of acclimatized seeds for other depleted coral reefs in the region.

b) *Comparative analysis of the North West sector (Bay Ternay / Port Launay)*

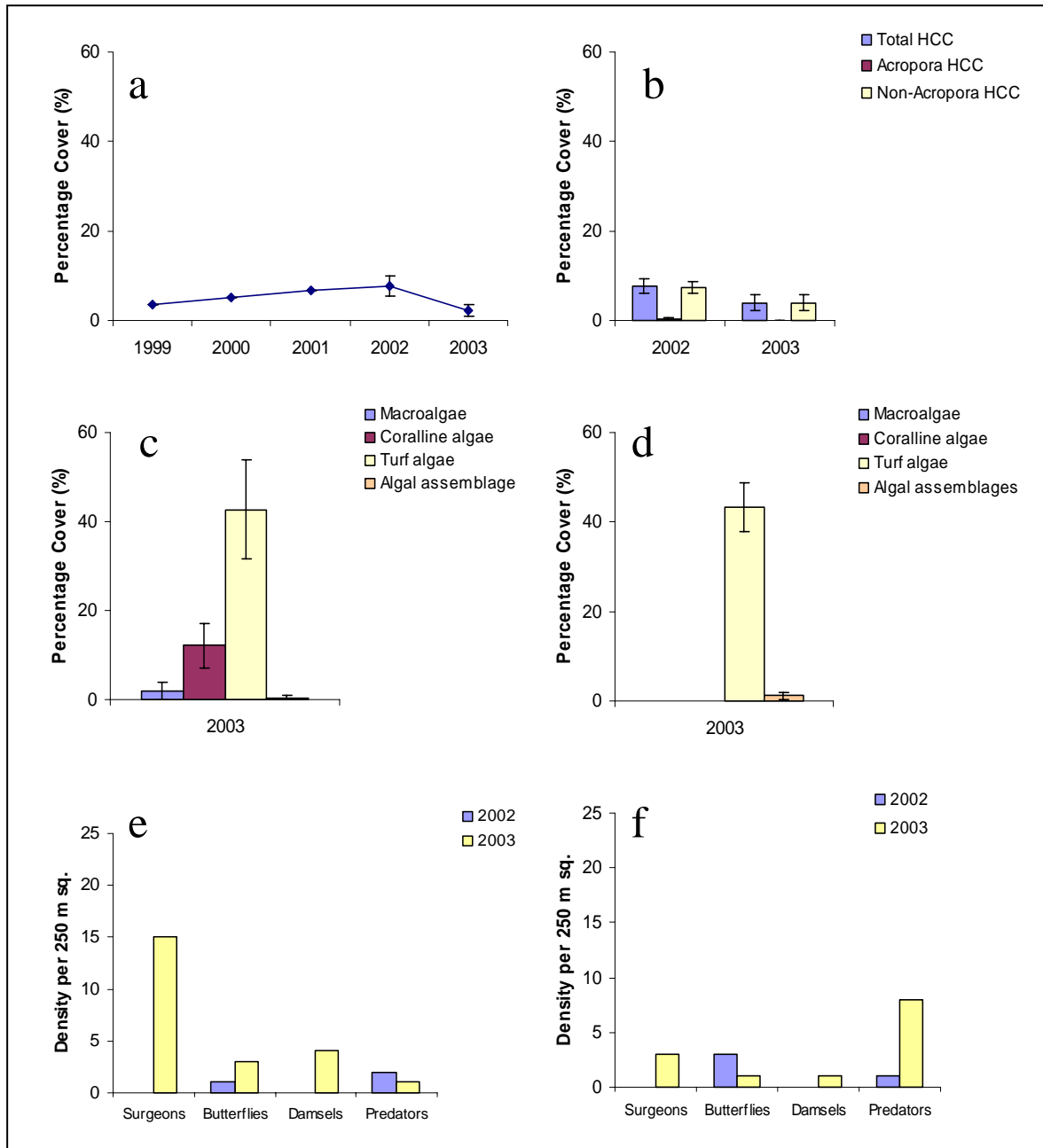


Figure 39 . Percentage Coral Cover on the reef slope at BAY TERNAY Middle Reef (a) and South of Bay Reef (b). Percentage algal cover on the reef slope at Middle Reef (c) and South of Bay Reef (d). Fish bio-indicator density per 250m² on the reef slope at Middle Reef (e) and South of Bay Reef (f)

Bay Ternay - Middle Reef and South of Bay – Reef Slope

On Middle reef, the slow increase in coral cover that this station was experiencing since the beginning of monitoring in 1999 appears to have ended in 2003. Live coral cover decreased from 6.7 % to 2.3% between 2002 and 2003 (Fig. 39a). Small percentages make it easier to have large discrepancies between data even if they were gathered under similar conditions by the same person. Thus, this decrease of 4.4% coral cover observed at this station may not be significant.

The rate of coral recruitment appears to be very low at this site, similar to many other reef sites around Mahe. With increasing occurrence of warm water events resulting in coral bleaching event it is doubtful whether this station would ever regain its pre-bleaching coral cover of 54.6 % when 29.1% of the site was covered by *Acropora* corals. Mean algal cover on this station was 57.3% with the most common algal form being turf algae (42.7%) followed by coralline algae (12.2%), macro-algae (1.9%) and algal assemblages (0.5%) (Fig. 39c). The percentage cover of coralline algae at this site is encouraging as they create suitable surfaces for the settlement of coral larvae (Ref). Collecting data on fish bio-indicator species with Scenario 2 was used in 2003 as it has been employed at other sites in the Ste Anne sector. This allows us to collect species-specific data on a larger number of reef fish species. Hence, comparison cannot be made on the abundance of Surgeons and Damselfish between 2002 and 2003. In 2003, Surgeonfish was the most common fish group on which data were collected with 15 individuals per 250 m².

On South of Bay, similar to the previously discussed neighboring Middle Reef, a decrease in 3.8% in coral cover was observed on this reef between 2002 and 2003 (Fig. 39). Percentage live coral stood at 3.9% in 2003. Once again the low percentage cover makes it difficult to determine if the observed decrease in coral cover is real or the result of statistical errors. No *Acropora* corals were recorded on this station in 2003.

A large percentage of turf algae cover is transient for this station. Large areas of turf algae growing over sandy substrate were recorded at this station. This was the result of calmer weather conditions of the Northwest monsoon in January to February, the period when data for the first part of 2003 were collected.

Once again, quantitative fish bio-indicator data were collected using the scenario 2 in 2003. The most significant difference between the 2002 and 2003 fish data set for this station is the South den increase in the number of recorded large predators. The large predators recorded in 2003 were mostly juvenile (c. 15 – 20 cm) *Epinephelus fasciatus* that live in small crevices in the more or less 2 dimensional landscape of this site. Even though there were large areas covered by turf algae the abundance of grazing species e.g. surgeonfish was low at this site. The number of recorded butterfly fish showed a reduction between 2002 and 2003.

Northwest Sector discussion

The number of monitored reefs within this sector has doubled between 2002 and 2003. An interesting new addition is the site at Therese, which will allow us to follow reef trends in both protected and non-protected areas. Total coral cover is below 10% on 3 of the 4 sites within this sector with decreasing coral cover being observed on both of the Bay Ternay Marine National Park sites. The Port Launay site is displaying the greatest coral cover in this sector with a number of old colonies that have survived the 1998 bleaching events. It will be interesting to see if this coral cover will increase in 6 months time when the site will be monitored again. The Port Launay reef may be an important one for this region, especially the semi-enclosed Port Launay bay, providing seeds for the colonization of other nearby degraded reefs. The Port Launay site clearly illustrates the fact that an increase in live coral cover and 3-dimensional complexity of a site will increase the fish population of that particular site. One other important thing that must be noted for this sector is the concept of representation. From on site observation it is clearly visible that the sites of Bay Ternay are not representative of the area from the fact that they are either too deep on the reef slope or too shallow on the reef crest. In between these 2 extremes there are comparatively large differences in coral cover on more or less heterogeneous reefs. Monitoring stations half way down the reef slope will be more representative of the reefs in this region. It is therefore recommended that 2 new sites be placed in the Bay Ternay area at more representative locations but at the same time continue to monitor the existing reefs.

c) Comparative analysis “Mahé - Ste Anne” sector

The comparative analysis takes into account all the 5 sites that have been monitored since 1998 in this MPA sector. However, only a few examples of spatial evolution are given in this report (Anse Cimetière, Ile Moyenne) followed by a more global discussion for the sector.

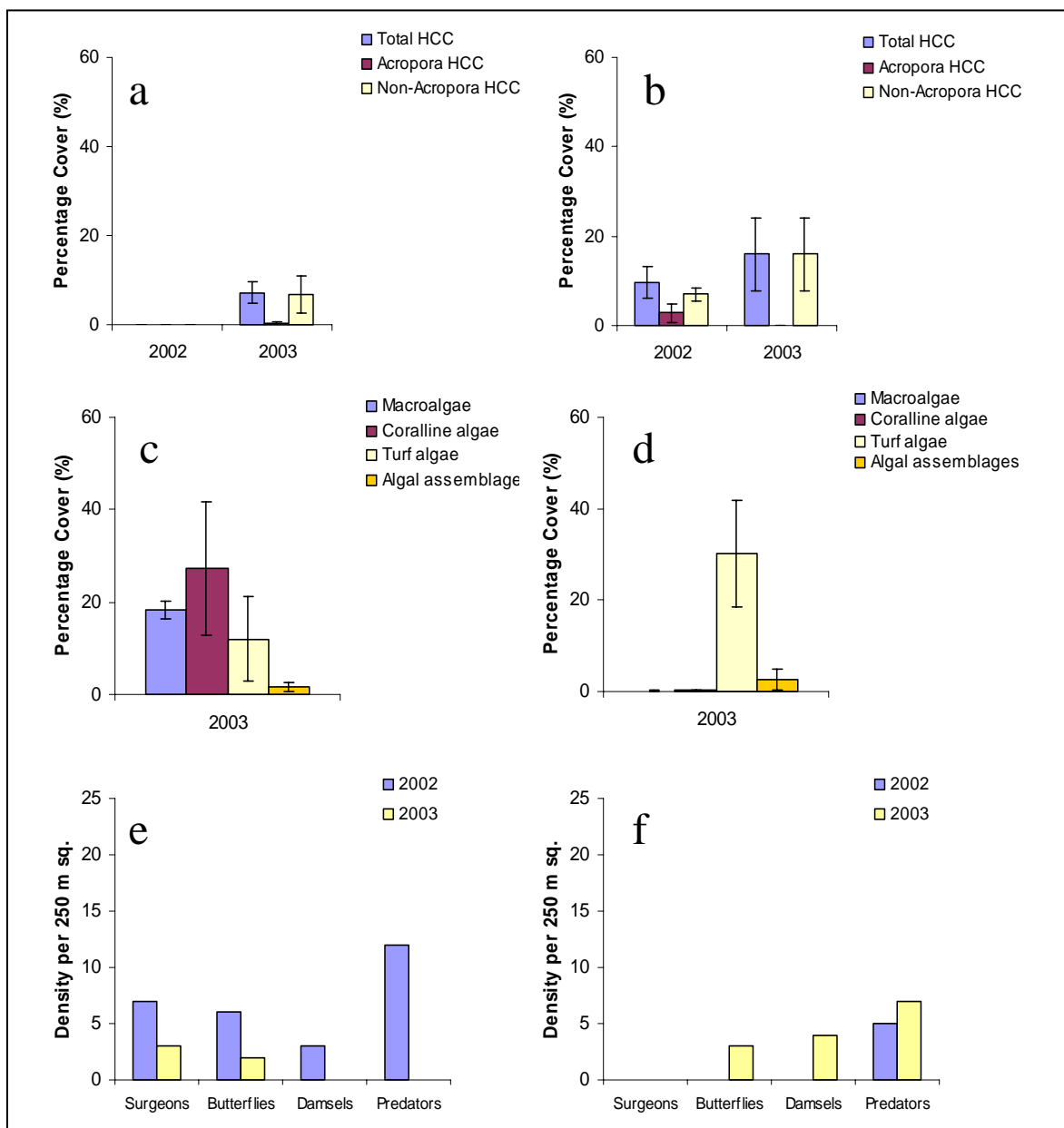


Figure 40 : Percentage Coral Cover on the reef flat (a) and slope (b) at STE ANNE / “Anse Cimetière”. Percentage algal cover on the reef flat (c) and slope (d) at Anse Cimetière. Fish dicator Fish density per 250m² on the reef flat (e) and slope

STE ANNE « Anse Cimetière »

On the reef flat, the monitoring was performed only on the reef slope station of this site in 2002 as a result of extreme weather conditions that create strong surge on the reef flat in 2002. Thus, the reef flat station was first monitored in 2003. In 2003, live coral cover stood at 7.2% (Fig. 40a) and was made up mostly by non-Acropora coral species (6.8%) with smaller percentages of Acropora corals (0.4%). Percentage algal cover, as to be expected, was high on this station (69.1%) (Fig. 40c) and comprised mostly of coralline algae (27.3%). The coralline algae are

growing over these *Acropora* coral skeletons, thus consolidating them and preventing their breakdown. In theory, the coralline algae should form a suitable base for encouraging the settlement of coral larvae. However, not much recruitment was observed on these consolidated *Acropora* skeletons. This may be the result of low availability of coral larvae for settlement. The growth of coralline algae on this station is favored by high water dynamic inherent to it, thus cleaning the reef's carbonate base and leaving suitable conditions for their growth.

The fish population on the reef moves from the reef slope to reef flat and vice versa. As a result of the narrow nature of this reef it may be a better idea to consider the fish population on the reef slope and flat as one.

On the reef slope, major improvements in coral cover have been observed on the reef slope of Anse Cimetière in 2003 compared to 2002. Coral cover on this station stood at 9.7% in 2002 and 16.0% in 2003 (Fig. 40). The result is very encouraging for this station, but what must be noted is the reduction in *Acropora* coral cover from 2002 to 2003. Scleractinian corals appear to be prospering at this station, mostly in the proximity of the jetty. Algae covered 33.1% of the reef slope (Fig. 40d) in 2003 with the most common group being the turf algae (30.2%). Abiotic substrate, made up mostly of coral rubble, covered 48.8% of the station. Rubble moves around when the reef is impacted by strong waves during the southeast trade winds.

Increase in fish abundance is clearly visible for this station in 2003. In both 2002 and 2003, no surgeonfish were recorded on this station even though it has high turf algal cover. This phenomenon is the same on most reefs having a layer of fine sediments on the turf algae. It appears that this layer of sediments is in some way limiting Surgeonfish population on the reef.

STE ANNE «Ile Moyenne »

This is another reef slope station where increase in coral cover has been observed between 2002 (10.5%) and 2003 (16.7%). The observed increase in coral has been accompanied by an increase in *Acropora* coral cover from 1.4% in 2002 to 9.4% in 2003 at the expense of a decrease in non-*Acropora* coral cover. This increase in *Acropora* coral cover may be a perceived one due to over-sampling or under-sampling of *Acropora* corals in 2003 and 2002 respectively.

In 1999, after the catastrophic coral-bleaching event of the preceding year a project was initiated to transport live corals from an undamaged reef in the vicinity of the Victoria harbor to this site. *Acropora* corals were favored and planted haphazardly on this site and it is for this reason that they are found in much higher percentage cover on this site compared to the other sites in the Ste Anne Sector. With respect to the selected fish bio-indicator population the most apparent change was in relation to the Damselfish, whose population decreased between 2002 and 2003. The same trend was observed in predatory species, which recorded a 50% reduction from 2002 to 2003.

Discussion on the Ste ANNE sector

Ste Anne sector live coral cover is still at highly reduced percentages 5 years after the mass bleaching event of 1998 that reduced it from 90% on some sites to less than 5% on many. Interestingly, most sites are now showing slow increase in coral cover, which is an encouraging trend. Two new sites have been monitored for the first time (2003) in this sector. The continuing increase in the number of monitored sites will increase the amount of reef-specific data that we have for this sector and allow us to have an expanding picture of this sector's overall coral reef status. The reefs of this sector are among those with highest socio-economic value in the country as a result of their location within the Ste Anne Marine National Park. This national park is one of the greatest visitor attractions as a result of its diverse marine habitats and close proximity to the port of Victoria. However, it is this close proximity to the Mahe East

Coast that is the source of the greatest anthropogenic threat to the reefs. The Mahe East Coast is the most developed area in the Seychelles and as a result impacts the environment in many ways. The fish population is relatively small on most reefs and controlled by many different factors. There are a number of small changes that has been observed. We feel that we need at least another year's monitoring result before any conclusion is made with regards to the fish population due to natural variability in the system.

d) Comparative analysis of the Curieuse sector

On the reef flat of Anse Papaie, there has been little change in coral cover between 2002 (2.5%) and 2003 (1.5%). Coral cover on this reef flat remains in a severely degraded state. Macro-algae are thus the dominant biological lifeforms (58.5%) (Fig. 41).

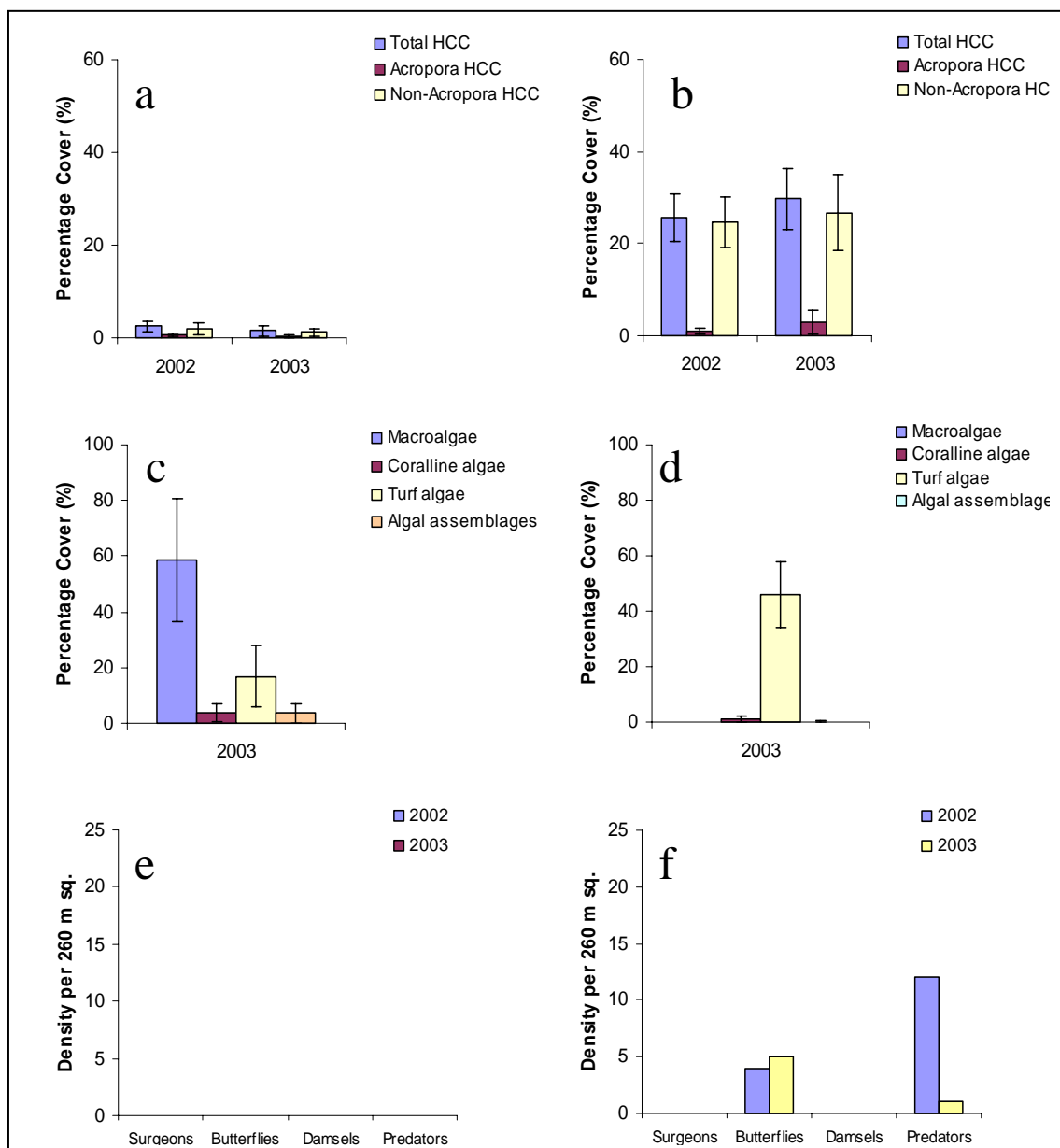


Figure 41 Percentage Coral Cover on the reef flat (a) and slope (b) at CURIEUSE “Anse Papaie”. Percentage algal cover on the reef flat (c) and slope (d) at Anse Cimetière. Fish dicator Fish density per 250m² on the reef flat (e) and slope.

On the reef flat of Anse Papaie, there has been little change in coral cover between 2002 (2.5%) and 2003 (1.5%). Coral cover on this reef flat remains in a severely degraded state (Fig. 41). Macro-algae are thus the dominant biological lifeforms (58.5%) (Fig. 41).

On the reef slope, there is a small increase in live coral cover between 2002 (25.7%) and 2003 (29.7%) (Fig. 41). With the increase in total coral cover there appears to be a small reduction in *Acropora* coral cover. Algae covers 47.3% of this slope with the most dominant form being the turf algae 46.0% with much smaller percentages of other algal groups (Fig. 41).

About **Fish population**, there is a small decrease in the number of butterflyfish from 2002 to 2003 and large increase in the number of predatory species from 1 to 12 individuals per 260 m² (Fig. 41). This increase in predatory species may be the result of reduced fishing pressure due to fish poaching. It will be interesting to see if this number will continue to increase over the years.

Discussion on the CURIEUSE sector

Live coral cover on both reefs within this sector (Anse Papaie, Oasis 1) is above 20%. However, much of this cover is composed of non-*Acropora* corals. The reef sites in this sector are important as they could be used for comparisons purposes for looking at recovery rate on reefs with different percentage of coral cover. There is also scope that will enable us to look at recruitment of fish to reefs with different degrees of degradation. Much of the work that has been done in relation to coral reef regeneration has focused on corals and benthic grazers (see Engelhardt, 2001 a, b) and very little has been done in relation to coral reef fish recruitment, which may be a limiting factor in coral reef regeneration.

4.5.3. General Recapitulation

The majority of the sites monitored under this programme are showing small insignificant changes in coral cover which may be attributed to the way in which the transect line was placed (certain degree of inherent variations naturally). As more data are collected over the years it will be possible for us to sort out the real changes in the community.

The Seychelles experienced another bleaching event in April and May 2003 with surface water temperature reaching 33°C on many reefs. Large scale bleaching was observed in *Pocillopora* species where more than 90% of colonies were bleached or fluorescing in late April. At around this time, large scale bleaching became more apparent in *Acropora* corals (report in prep.). Coral cover reported for many of the above mentioned sites might now, 3 months after the start of the bleaching episode, be lower than was reported in various parts of this document.

These renewed bleaching events are putting increasing pressure against the recovery of many reefs. It is also allowing us to detect areas of high resilience and colonies that are becoming acclimatized to coral bleaching. It is these areas of high resilience and acclimatized colonies that will determine the future of Seychelles reefs. Their early identification and protection should be of highest importance.

It is clearly apparent from our data that the density of fish is correlated to some extent to coral cover. As coral cover has been more or less stable on many of the monitored sites we have not noticed large changes in the fish community. Once again we need to have longer series data to determine any trends that the fish community may be following.

Recommendations from the 2002 report have been taken into account. The number of monitoring sites has increased from 2002 to 2003. The number of monitoring sites should

continue to increase provided that there are adequate numbers of trained and dedicated personnel to collect data. There should be better integration of the different member organization into the network; this should resolve the above mentioned (training workshops should be organized in 2003). Continuing organization of these training workshops every 6 months prior to the start of the monitoring session should be encouraged as it will put all the data collectors at the same level and reduce variation between data sets.

4.6. Reunion Island

4.6.1. Location of the current survey sectors and sites - reminders

Four sectors (7 sites) are officially surveyed at present at Reunion Island:

SECTOR 1 = Saint-Gilles / La Saline

- A disturbed site: Planch'Alizé (2 GCRMN stations)
- A healthy site: Toboggan (2 GCRMN stations)

SECTOR 2 = Saint-Leu

- One site close to a pass at La « Corne Nord » (2 GCRMN stations)
- One reference site at « La Varangue » (2 GCRMN stations)

SECTOR 3 = Etang Salé

- Only one site (2 GCRMN stations)

SECTOR 4 = Saint-Pierre

- A disturbed site: Alizé Plage (2 GCRMN stations)
- A healthy site: Ravine Blanche (2 GCRMN stations)

Following the recommendations of the methods manual, each site has 2 stations (1 reef flat, 1 outer slope). **In 2003, a total of 14 stations** located along West and South coast of Réunion Island were surveyed.

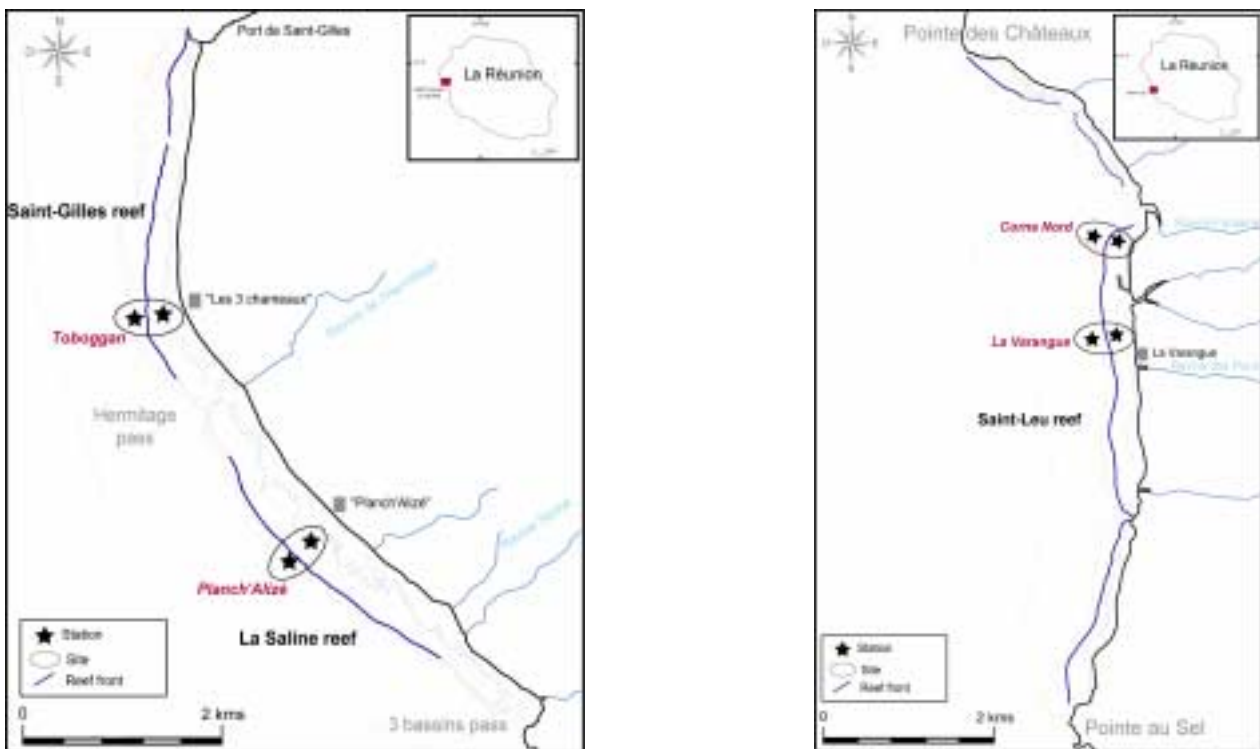


Figure 42 Location of the reef survey sites at La Réunion (St Gilles and St Leu sectors).

In this 2003 regional report, a trend analysis is given only for the two sectors that have been surveyed for more than 4 consecutive years (St Gilles and St Leu).

4.6.2. Evolution at the “St Gilles / La Saline” sector

The recapitulation of the results obtained between 1998 and 2003 show the main trends for 6 years at Saint-Gilles and 5 years at Saint-Leu. This time frame offers sufficient hindsight to show the global evolution of the coral reefs (reliable trends) at reference sites identified for their specificity or for their representativeness of the sectors surveyed.

a) External slope sites



The benthic communities surveyed since 1998 at St Gilles, show an evolution characterized by different successive phases:

Following a more or less regular coral growth phase till 2000, for the sites that have good coral cover (site de 3 Chameaux), a progressive decrease in coral cover is observed on the external slope stations. Even if it is reasonable, and show a certain stability of the coral communities for Reunion (average of 35 % in 2003), this trend is significant (ec). It is observed at several sites of St Gilles la Saline, (Petit Moteur, Planch'alizés), thus it is not an artifact or a sampling error.

The progressive decrease of live corals, observed in 2002, continues in 2003 for the benefit of algal populations (opportunistic algal turf) and coralline algae. This underlines well the importance of bio-construction of algal origin at Reunion Island.

It is possible that this present trend is due to natural factors that are at present unfavorable (succession of cyclones or heavy rains, small bleaching events that are more or less localized and chronic).

This observation, in the context of coral entities in Reunion that are subjected to chronic sources of degradation, is not an alarming factor. It needs however to be monitored in the long-term (natural cycle ?, real problem of chronic deterioration ? underground infiltration?,...).

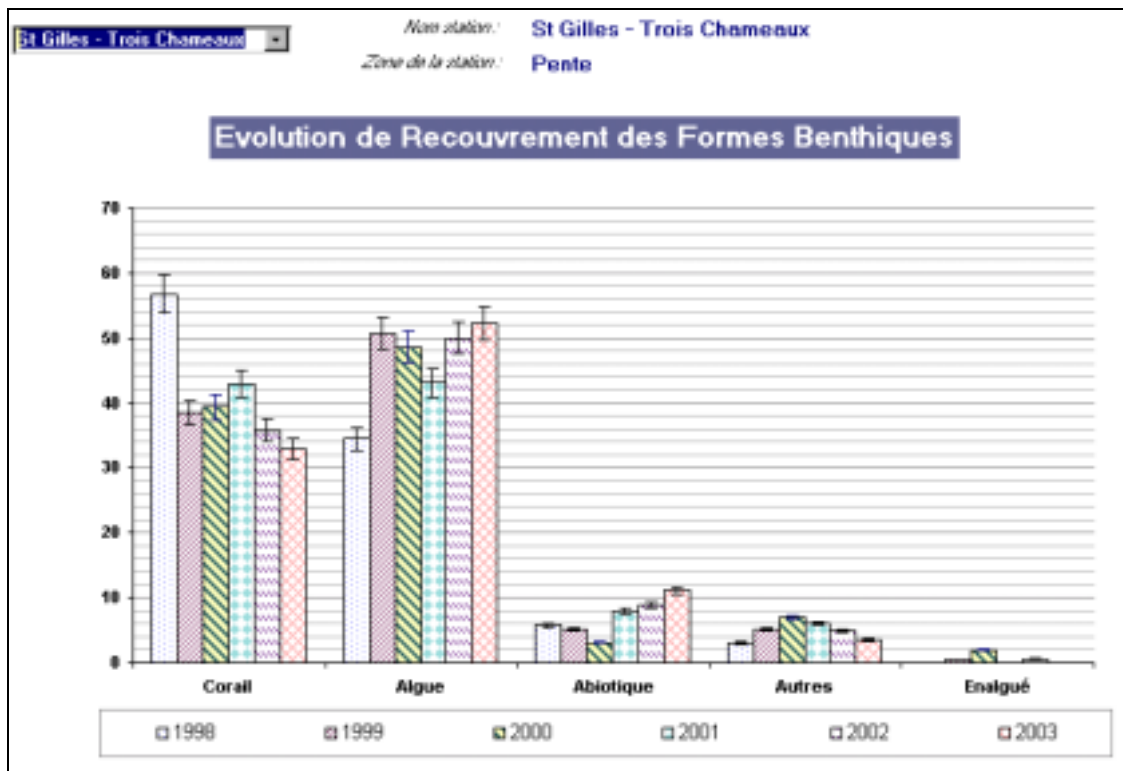


Figure 43 Evolution 1998/2003 of benthic populations on the external slopes of the Saint-Gilles/La Saline sector « Trois-Chameaux » station.

This first assessment is the result of a slight imbalance between factors contributing to the deterioration of the environment (anthropogenic or natural origin), and bio-construction linked to reef organisms (corals, coralline algae).

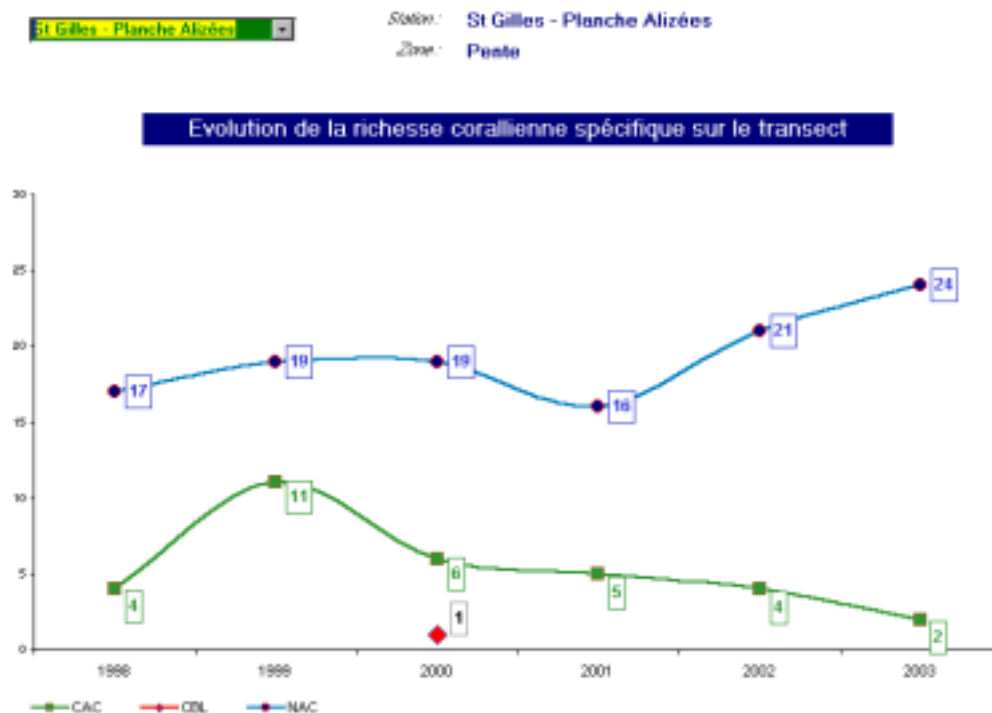


Figure 44 : Evolution of specific coral diversity on the external slope at Planché Alizées.

A thorough analysis of the structure of the communities, notably of the coral diversity on the transect (NAC, CAC) (figure), shows a more or less regular decrease of Acropora (*Acropora robusta*, *A cytherea*, *A hyacinthus*,) to the benefit of non Acropora (NAC).

These entities, made up mainly of Pocilloporidae (*Pocillopora verrucosa*, *P menadrina*), Faviidae (*Favia speciosa*, *Favites pentagona*, *Platygyra daedalea*, *Astreopora myriophthalma*, *Echinopora sp*) and Poritidae, are rather opportunistic communities and quite resistant disturbance of the environment. They seem to have been in good expansion during the past 3 years. This observation could be revealing an evolution of the structure of the populations on the slope at St Gilles, in response to an environmental situation that is not very favorable for coral growth.

Moreover. It is interesting to note the predominance of algal forms (52 %) represented mainly by turf algae (AA) that colonize the surface of the substrate.

The evolution of algal cover at the Trois Chameaux station (figure 45) show a predominance of turf algae which have increased considerably during the 2002 / 2003 period to the detriment of Corallinacea (AC) that are more characteristic of bio-construction of algal origin which are more favorable for the development of the reefs.

This observation and inversion in trend (AA/AC), which seems to have taken place since 2000 should be correlated with the progressive decrease in coral cover (HC) observed previously. This is proof of the competition between algal and coral forms for the colonization of the environment, which is for the time being favorable to algae growth.

Even if it is not alarming, the global decrease in coral cover to the benefit of more opportunistic algae, is observed both at the 3 Chameaux and Planch' Alizé stations. It should be closely monitored during the next surveys.

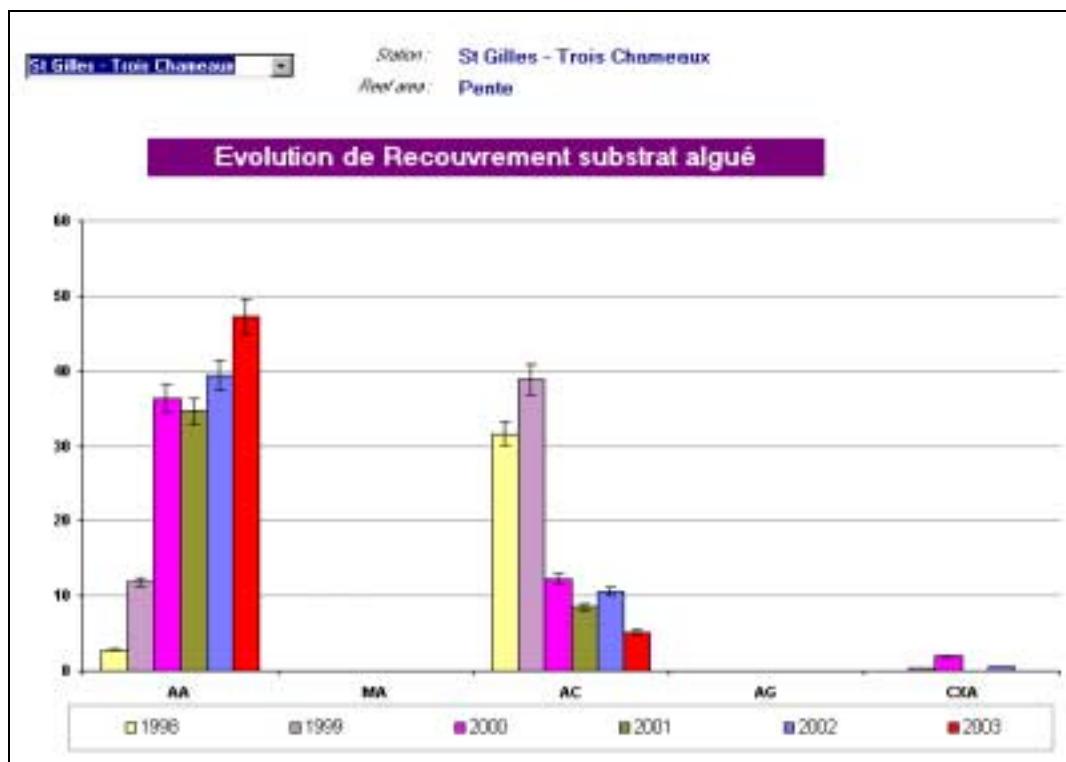


Figure 45 Evolution of the algal cover for the external slope station at Trois Chameaux

The analysis of the **fish populations** show a relative stability on the external slopes during the past 5 years, even if the population of nocturnal carnivores seem to show important fluctuations since 2002 which could probably reflect the instability of the resource in high trophic-level species.

As such, absolute piscivorous fish (predator fish) are always absent in the survey as shown in figure 46. Their low representativeness on the whole of the sector is probably linked partly to reef fishing.

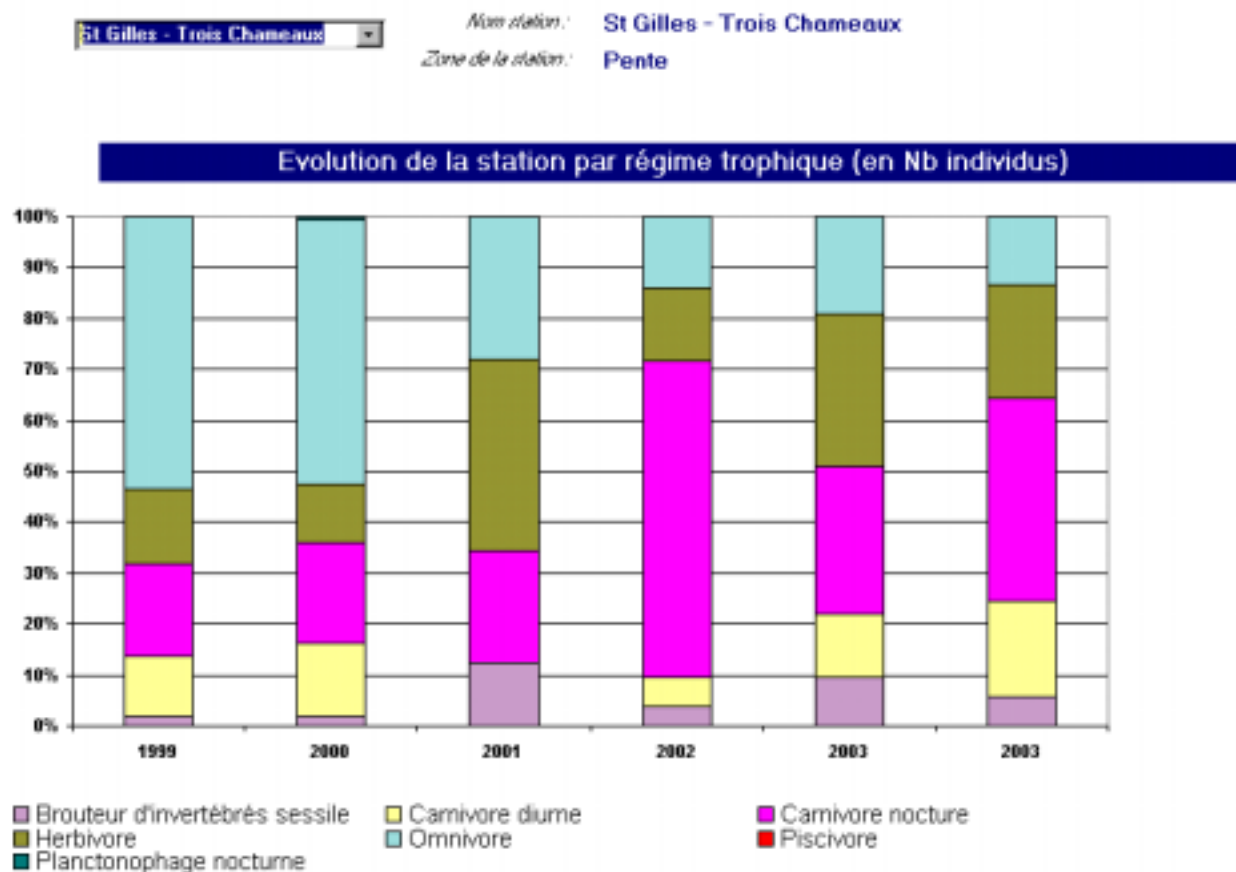


Figure 46 Evolution 1998/2003 of fish populations on the external slopes at 3 Chameaux.

The herbivorous populations are also well represented, notably the Acanthuridae, which could be correlated to the high algal cover observed on the reef slope stations.

However, there is a clear decrease in the abundance of omnivorous fish represented by the Pomacentridae (fig 46).

A specific analysis on the abundance of the main fish Families was conducted between the 28 January 2003 and the 03 March 2003 (Figure 46).

During this period, the regulation of the Prefect banning fishing (notably underwater fishing) for this sector was cancelled; this caused intensive fishing of high trophic level species (Serranidae) as is shown in figure 47.

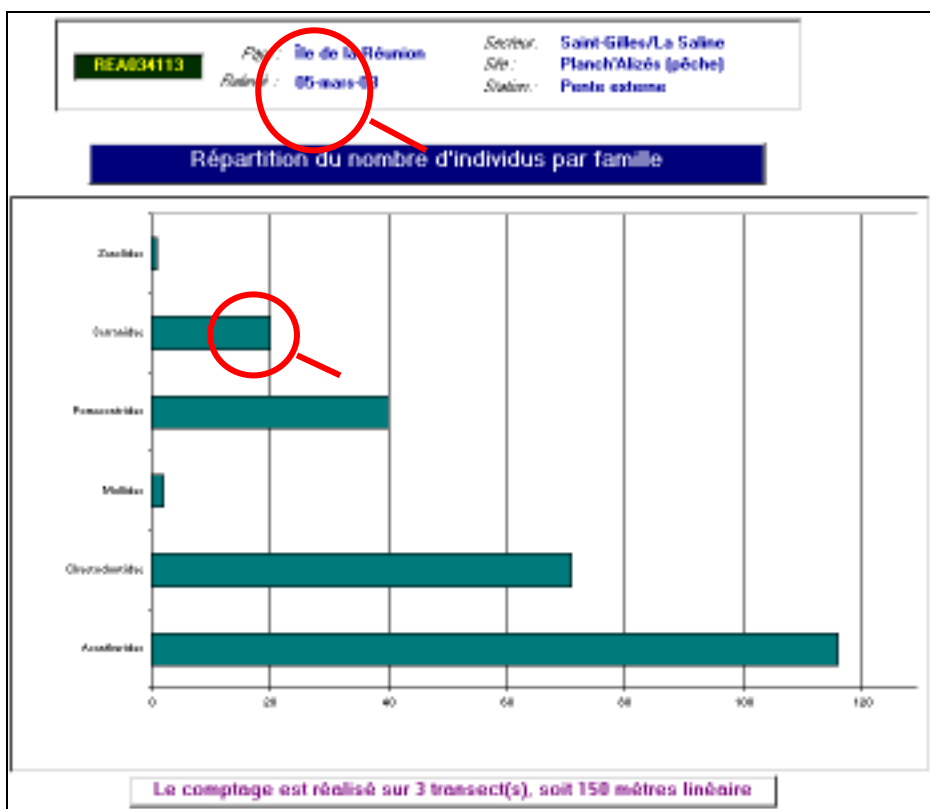
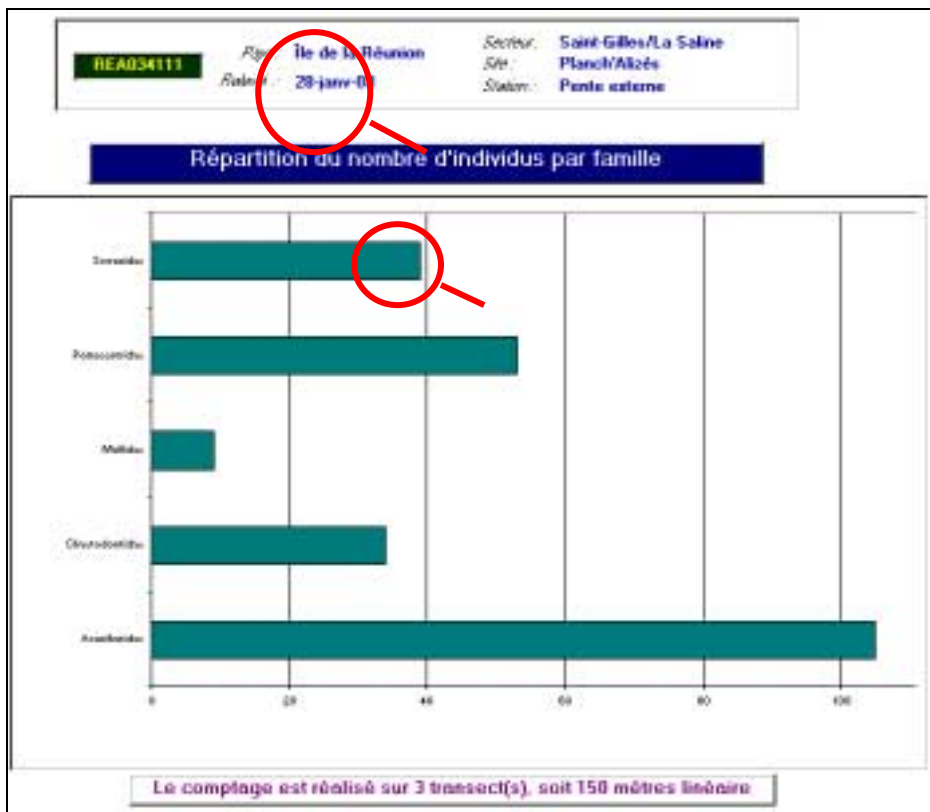


Figure 47 : Abundance evolution of fishes before and after MPA fishing on Planch Alizé reef slope station.

The low representativeness of high trophic level (groupers, snappers, emperors, ...) is an important result of this trend analysis, which is also confirmed by visual observations from numerous persons. It has been worsened by the intensive fishing event that took place between January and March 2003 at St Gilles / La Saline.

b) Reef flat sites

The **2003 results** show a progressive but regular increase in coral cover (42 %) represented mainly by *Acropora* (38%), at the Trois-Chameaux station. This increase is correlated to a slight decrease in algal populations, which confirms the good state of this reference site and its stability in time.

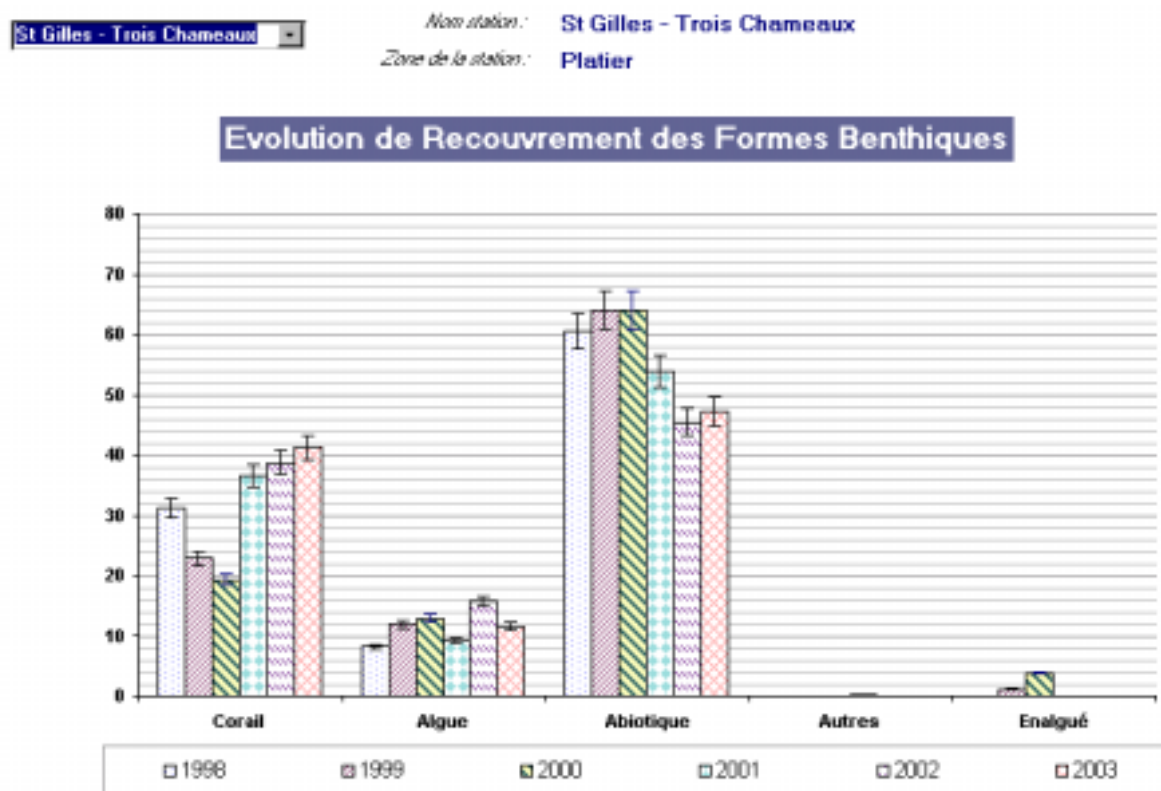


Figure 48 Evolution 1998/2003 of benthic populations for the reef flat station at 3 Chameaux

The coral cover on the reef flat at Trois-Chameaux show since 2000 an increasing trend (more than 10 % since 1998), (Figure 48). At present, the cover, which is in the range of 35-40 %, is in line with normal rates for the St-Gilles sector, in the present environmental situation. This trend is confirmed by the decrease in abiotic substrate, which shows that the substrate is being colonized by corals.

Since 2000, it is interesting to note that the specific cover of *Acropora* (CAC) has increased compared to Non *Acropora* (NAC). Branching *Acropora* (*Acropora formosa*, formerly *muricata*) are the dominant forms at the Trois-Chameaux station, and show a relatively satisfactory vitality. Turf algae with *Stegastes nigricans* characterize the substrate that is covered with algae, which is predominant on the North reef of St Gilles.

Intense tropical cyclones « Dina », then « Harry », as well as heavy rainfall events, and a small bleaching event in 2003, do not seem to have had an important effect on the populations, both in terms of coral bleaching or physical destruction of the coral colonies. *Acropora* suffered from some bleaching, but by April 2003 most of the colonies had recovered.

With regards to the fish populations, the main fact is the absence of predators. Among the bio-indicator fish, *C. trifasciatus* (absolute corallivorous fish) is relatively well represented (40 ind./station) as in the previous years.

The evolution of the **Planch' Alizé station** (figure 49) show an important increase in coral cover (50 %), notably between 2002 and 2003. However, the uneven coral cover from one year to the other is a good sign of a typical station with rather unstable opportunistic populations. It is a sign of a disturbed station that has strong variability in its coral abundance from one year to the other.

A more detailed analysis of the results confirm that the Non Acropora are strongly dominant at this station () and that Acropora are nearly absent. At Planch' Alizés, sub-massive forms (*Psammocora circumvallata*, *Pavona spp.*, *Porites synaraea rus*, ...) are still the dominant form in the environment, in permanent competition with algal populations that are also quite important.

The coral bleaching of March 2003 does not seem to have affected a lot the Planch' Alizés station, which is characterized by particular species.

The structure of the population is thus totally different from that observed at a healthy station like 3 Chameaux.

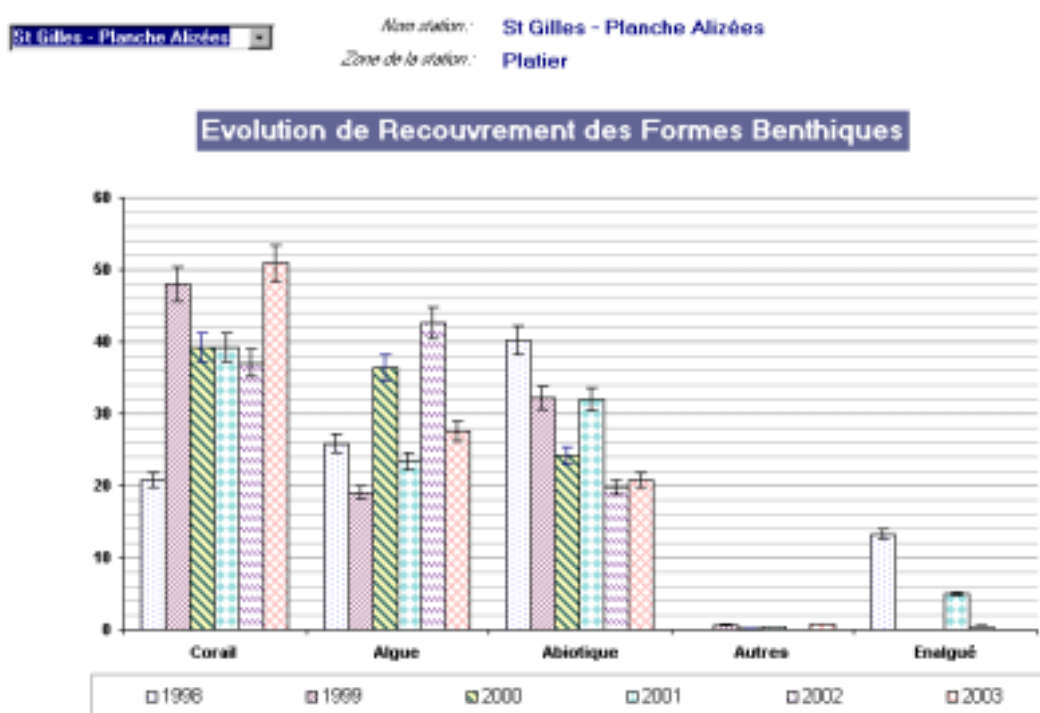


Figure 49 : Evolution 1998/2003 of benthic populations on the reef flat at Saint-Gilles / La Saline « Planch' Alizés » station

The evolution of the reef flat site of Planch' Alizés, a zone that is subjected to numerous inputs of anthropogenic origin, is characteristic of a disturbed zone (specific populations, uneven variation in abundance). It seems however to show in 2003 a relatively good vitality of the coral communities.

There is thus a rather positive evolution of the reef flat areas of the St Gilles / La Saline sector, during these past few years. It is particularly strong at the Toboggan reference site, which shows a regular progression since 1998 (+ 10 % on average) despite the different events that affected this reef. It confirms the exceptional resilience of this zone, notably in terms of growth potential, and confirms the need to declare this area as a reserve.

4.6.3. Evolution of the “St Leu” sector

a) External slope sites

In 2003, the constant increase in coral cover continues at the La Corne site. At present it is close to **80 %**, which is a record for Reunion Island (figure 50). The population is mainly composed of robust Acropora (*Acropora danai*, *A. robusta*), and tabular Acropora (*Acropora hyacinthus*).

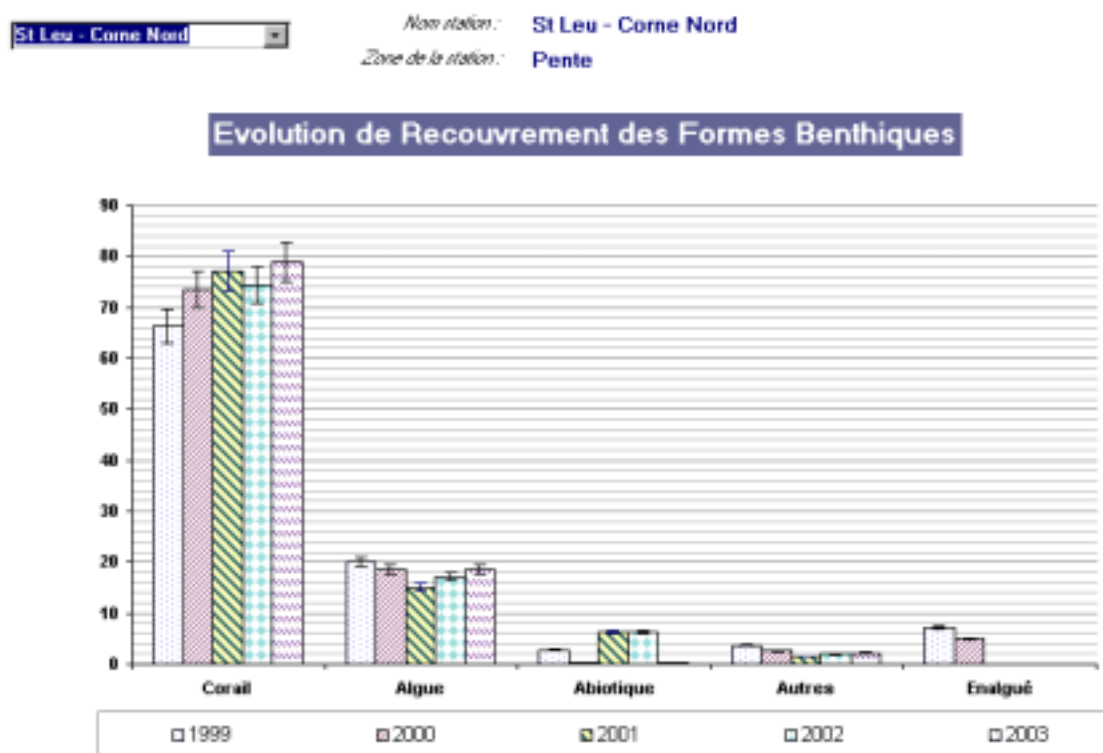


Figure 50 : Evolution of benthic populations between 1999 and 2003 for the external slope station at « La Corne ».

The algal populations are very stable (< à 20 %); the increase in cover makes use of the abiotic substrate.

The impact of cyclones like « Dina, Harry », and the slight bleaching events of 2002 and beginning of 2003 do not seem to have affected (or slightly affected) this area, that shows a good stability and an exceptional vitality in the context of Reunion Island.



Transect on the reef slope station (St Leu / Varangue).

The analysis of the fish populations is fairly identical to the one done in 2002; the communities show a near absence of predator fish and a decrease in the size of species observed at this site. This confirms an underlying problem for this sector (overfishing ?).

On the other hand, on the external slope station of « la Varangue », there is a decrease in coral cover (48 à 42 % en 2003 figure), to the benefit of algal forms, in particular algal turf (AA). This trend is identical to observations done at the St Gilles sector (except for La Corne), which confirms the general decrease observed simultaneously at several external slope stations at La Réunion.

Like at St Gilles, the cyclones of 2002 (Dina, Harry,..) and the bleaching events of beginning 2003 have barely affected the external slopes of St Leu.

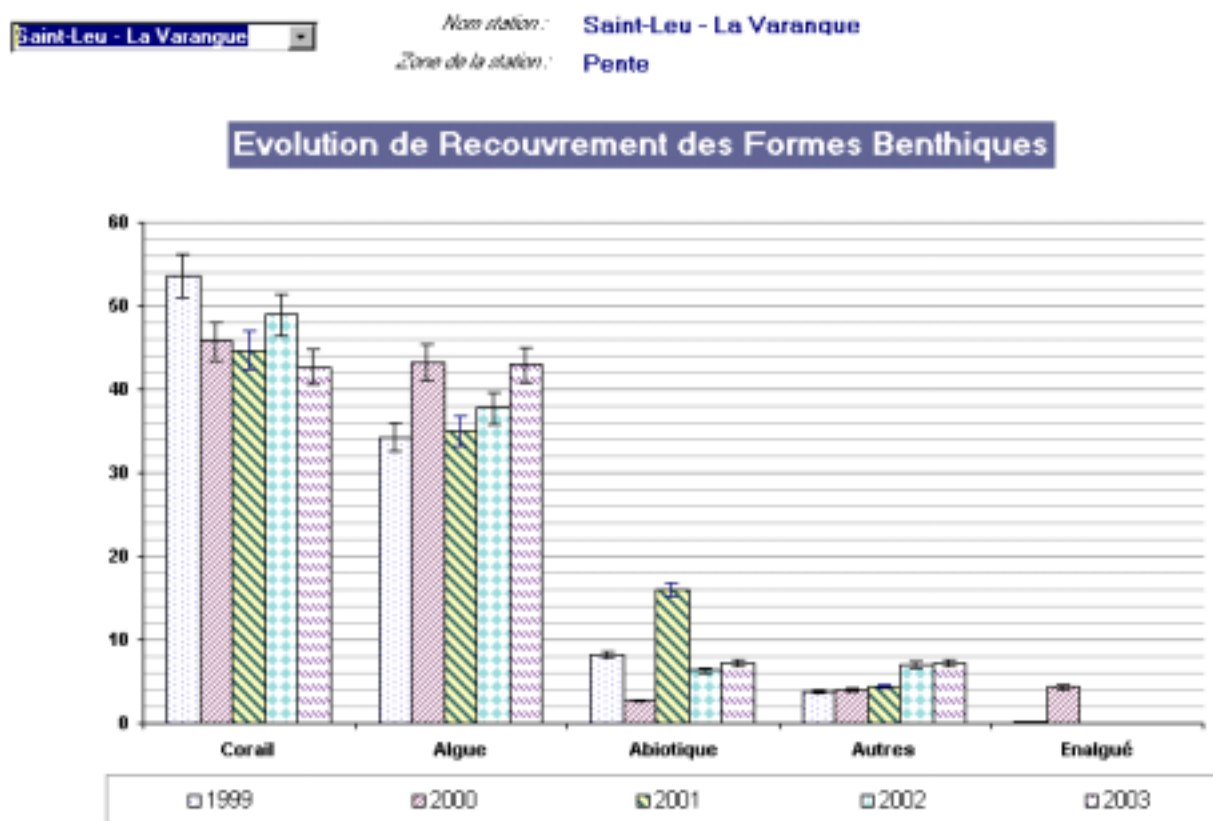


Figure 51 : Evolution of benthic populations between 1999 and 2003 for the external slope stations at « La Varangue ».

The analysis of fish communities show trends that are fairly close to those observed at Planch Alizé with a decrease in high trophic level carnivorous species and plankton feeders. Fluctuations in the abundance of coral cover observed at St Leu are probably linked to an environmental parameter of natural origin (?) that affects most of the external slopes in 2003. The La Corne station is an exception (coral cover), probably due to its spatial location (high hydrodynamic flux) in this global context. This trend is however still very moderate, but should be monitored during further surveys.

b) Reef flat sites

In 2003, there is a marked decrease in coral cover at La Corne (39 %), which was already observed in 2002 and which seems to strengthen. This affects mainly Acropora, which are

dominant at this station (36 %), and should be correlated to the strong increase in algal cover (+ 17 % in AA) observed between 2002 and 2003.

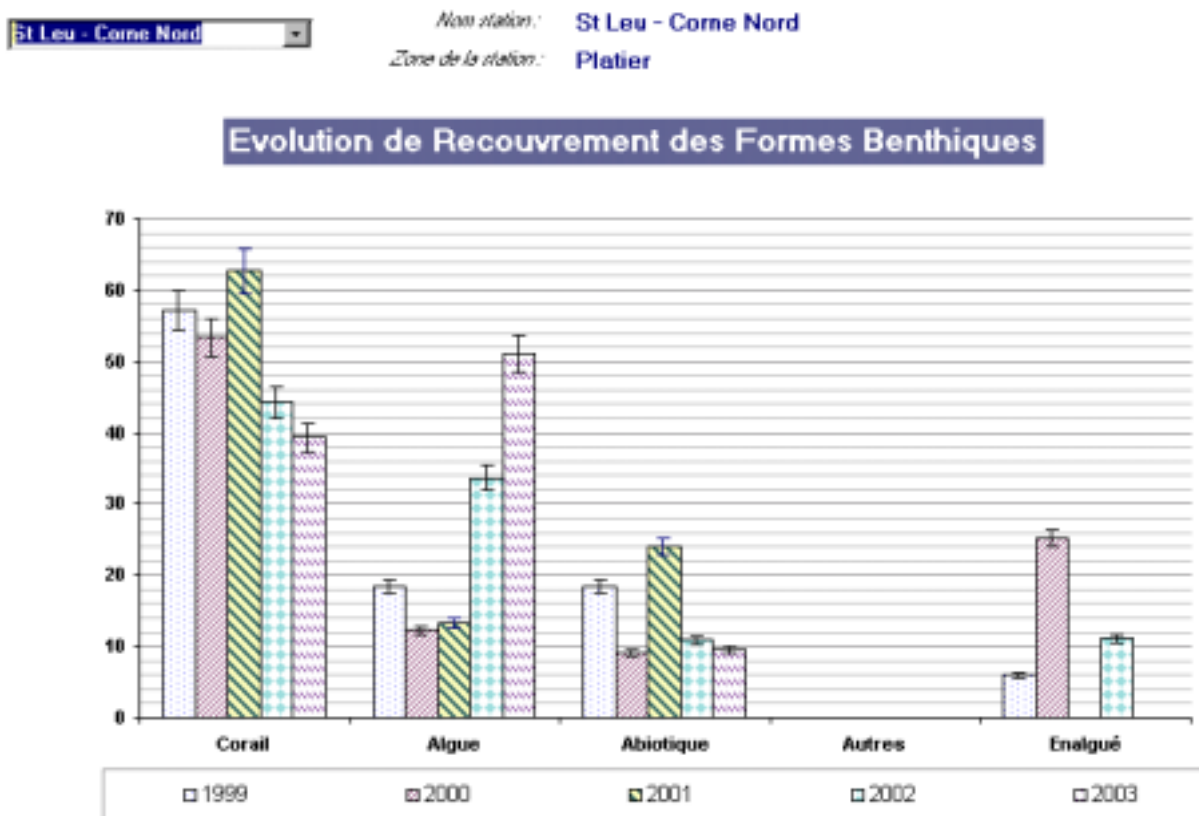


Figure 52 : Evolution 1999/2003 of benthic communities on the reef flat (la Corne).

The decrease in abundance is also observed at the level of species diversity, with a decrease in the number of species (CAC and NAC) observed during the past few years (fig 53). This observation that shows a progressive deterioration of the situation on the reef flat at La Corne Nord at St Leu, seems linked to a combination of factors that have occurred since 2002. These are both of natural and of anthropogenic origin (port and coastal development).



Figure 53 . Evolution 1999/2003 of coral species richness on the reef flat - La Corne.

In fact, the *Acropora* forms were the most affected (10-15% mortality on the GCRMN stations) due to the cyclones of 2002 and small-scale coral bleaching (2002 and early 2003). After death, they have been colonized by algal turf.

With regards to fish communities, the results are fairly close to those obtained at St Gilles, with a relative stability of the populations on the reef flat during the past years. They are mainly characterized in 2003, by a strong abundance of Acanthuridae (*Acanthurus triostegus*, *Stegastes nigricans*) (> 1400 ind./250 m²).

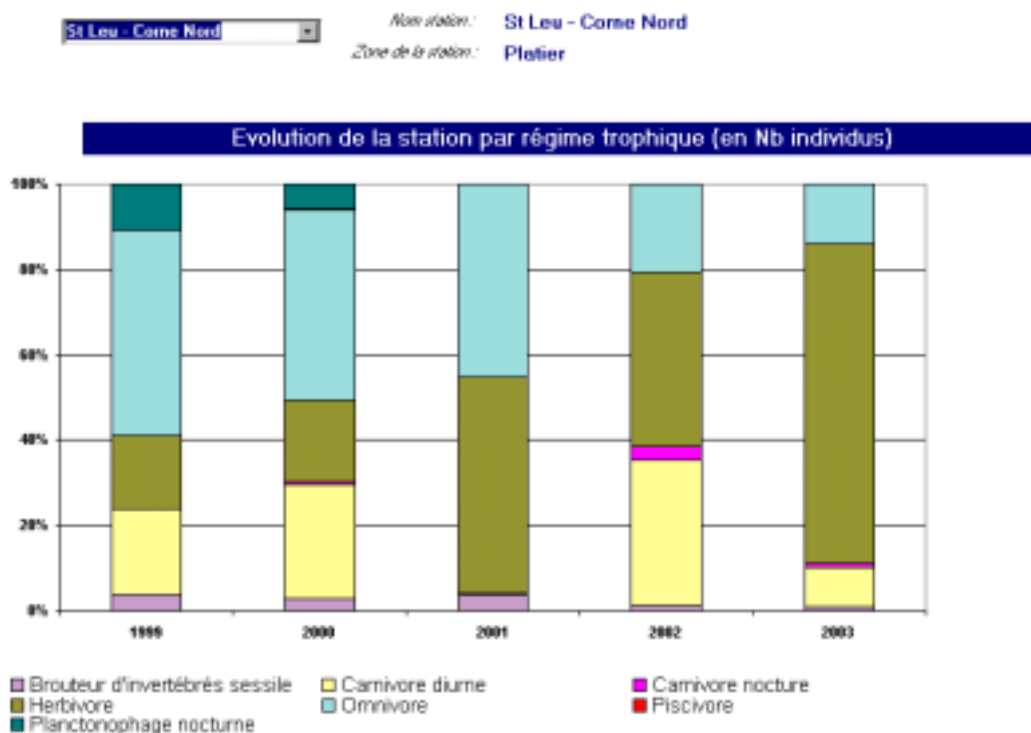


Figure 54 Evolution 1999/2003 des peuplements ichthyologiques (espèces bio-indicatrices) sur le platier de La Corne.

However, for the reef flat station of St Leu Ville « La Varangue », the coral dynamics seem to be quite different from those of La Corne.

There is a clear increase in coral cover at this station, notably between 2002 and 2003 (69 %) characterized by a quite spectacular development of *Acropora* CAC (> à 63 % composed of *Acropora formosa*) and a strong level of vitality in 2003.

This increase in coral cover is correlated with a decrease in algal cover (- 8 % in 2003) and partly in the abiotic substrate (- 4 %).

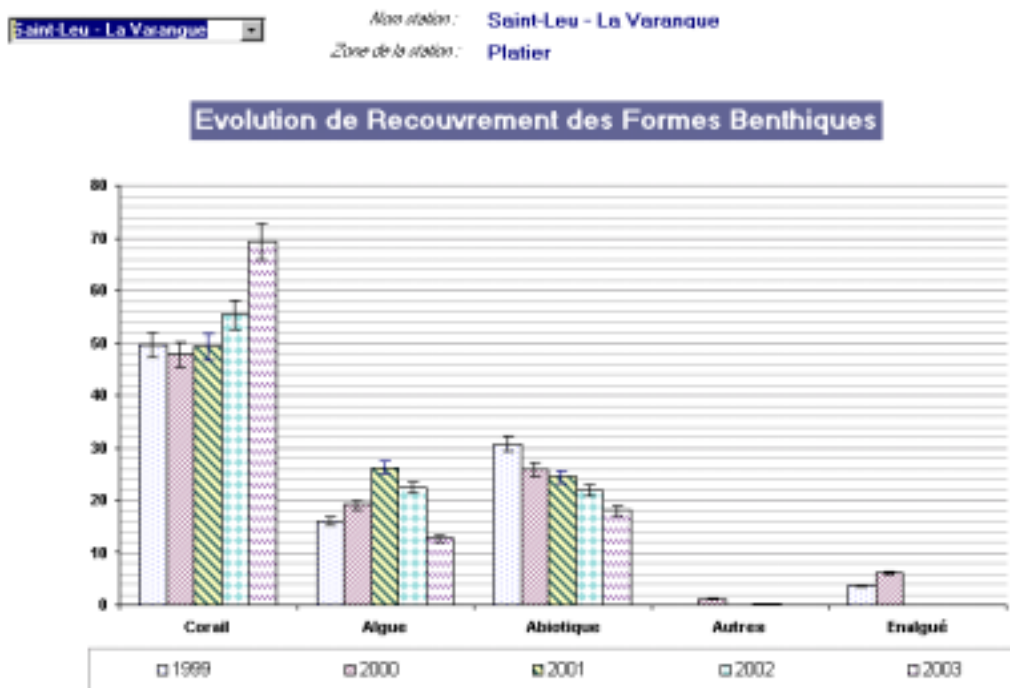


Figure 55 Evolution 1999 –2003 of cover for the reef flat station at La Varangue.

As for the reef flat station of Toboggan (St Gilles), the algal composition is mainly composed of algal turf with *Stegastes* (Algal Turf - AG) that colonize the supra-colonies of *Acropora formosa* (Figure 55), and partly of mixed algal turf. Even if there is a decrease in algal turf in 2003, they remain the major form of the algal component (around 10 %).

It seems that this site, subjected like La Corne to cyclones and bleaching events, has had different dynamics of coral deterioration and growth phase

This station like the previous one has suffered considerably from disturbing events in 2002 and 2003 as proved by the specific surveys done during these events (strong bleaching, high siltation at the base of the colonies)

On the other hand, the growth recovery (post bleaching 2002) has been nearly complete and the growth dynamics of *Acropora* maintained itself against all odds, which is an encouraging sign.

This observation seems to confirm the hypothesis of the strong resilience of communities on the reef flats of St Leu (Naim, 2003, Bigot et al, 2002). This seems to form one of the present characteristics of St-Leu-LaVarangue, with a strong potential for growth (cf. post « Firinga », 1980), and a population structure more in favor of *Madrepora* than bio-constructor algae.

4.6.4. *Recapitulation Reunion Island*

After 5 years of consecutive surveys of reference sites at the Saint-Gilles/La Saline (1998/2003), and Saint-Leu (1999/2003) sectors, a reliable trend in the global environmental situation of these different sectors can be given in terms of dominant reef populations (benthos, fish). It is only a « trend » observed at specific areas that have been chosen as representative of the environment, sampled at fixed time interval. It cannot in any case be generalized and applied to the whole of the reef environment without a more exhaustive study.

At Saint-Gilles / La Saline

The two external slope sites (Trois-Chameaux et Planch'Alizés) show a slight increase in coral cover until 2000. Since, the results show a significant decrease in the percentage of coral cover for the benefit of opportunistic algal populations (algal turf, coralline algae). This trend, also observed at other sites (Petit Moteur), seem more linked to natural factors (cyclones, bleaching, heavy rains) that are at present unfavorable for coral growth.

For the reef flat stations, the 2003 survey confirm the results of the previous years, that is a slight increase in coral cover, notably for the Trois-Chameaux reference site, which is in a satisfactory state. At the same time, an uneven evolution from one year to the other can be observed at Planch'Alizés, which is characteristic of a more disturbed station (unstable opportunistic populations).

At Saint-Leu

The increase in coral cover continues on the external slope at « La Corne ». This area keeps an exceptional vitality with record values (coral cover close to 80 %) for Reunion Island. On the other hand, the decreasing trend at « La Varangue » is comparable to that observed on the external slopes of Saint-Gilles.

The deterioration of the reef flat of « La Corne », identified in 2002 continues and seem linked to a combination of natural and anthropogenic factors, unlike the « La Varangue » site that shows a regular increase in coral cover. These two stations subjected to cyclones in 2002 and to bleaching events (2002, 2003) have evolved in a different manner. The results confirm the increased sensitivity of the coral populations in this particularly exposed area (very high terrigenous sedimentation, salinity drop, ...), but also their exception capability to regenerate despite facing important disturbing events.

As for the trend analysis of the **fish populations**, the low numbers of high trophic level species (carnivorous, piscivorous) on all the stations surveyed (Saint-Gilles and Saint-Leu) is an important point that has been confirmed *in situ* by numerous persons. This has been aggravated by the intensive fishing event that took place between January and March 2003 following the cancellation by the administrative court of the prefectural regulations on fishing in the Saint-Gilles / La Saline sector.

The results obtained during the past 6 years, must be improved by the perpetuation of the surveys. They must also be confirmed, or adjusted or invalidated by future surveys. They show in particular the necessity of the regular and long-term surveillance of the environment, both in terms of acquisition of quality baseline data, and the development of vulnerability factors (dumping, fishing, intensive use by visitors, ...) or coastal development. This network, which has progressively structured itself since 1998, requires collaborative work (people network) and regular and perpetual supervision (continuous training, quality control, permanent exchanges, ...). This guarantees the quality of the information supplied, both to decision-makers working on ICZM strategies, and technical and scientific partners in these operations.

5. CONCLUSIONS - RECOMMANDATIONS

The coral reef monitoring network of the « Western Indian Ocean » islands / GCRMN (WIO Node) that was created in 1998 under the impetus of the Indian Ocean Commission and with the financial support of donor agencies (GEF / EU) is at present a fully operational structure, in particular from a technical point of view as is confirmed by the results obtained.

The present report puts into effect and recapitulates the important work carried-out by the regional reef monitoring network through all its components, in particular at the technical level by the National Focal Points and their national teams. Several results have been achieved to date:

At the institutional and organizational level

- More than ever, the regional network has become a network of people that has matured (strength and weakness). However, the pool of experts is constantly reinforced (« technical task force operational ») through regular training and the motivation and enthusiasm of the participants.
- The regional network is well integrated in the international networks, as witnessed by the publications produced in 2000 and 2002 (Status of Coral Reef of the World, ITMEMS II),
- It has proved to be an « additional catalyst » in terms of the management of environment problems of reef areas, and is considered to be necessary by all the island states of the IOC.

At the methodological and training level

- The different training workshops (monitoring, mapping, ...) and the regular regional meetings (steering committee, workshops,..) are FUNDAMENTAL moments in the dynamics of the present regional network. Independently of the capacity building and exchanges of experience that it gives to the members of the network, they federate people and help weave a true network of people who are more operational. This is one of the fundamental objectives of the present GEF cooperation programme.
- The reef monitoring method (GCRMN / COI) is at present used with success by the members of the network, and there is a strong wish for additional specialization (strengthening of capacity building),
- The development of database management tools, like the Coremo II reef database tends towards that goal, but more advanced training of trainers need to be planned for 2003/2004 both for the use of the database and for field training.
- In addition to the previous strengthening, a simplification of the method has been done (Reef Check strategy) in order to include new participants (co-management, NGO).

Monitoring results «2003 » and regional report

- A very important increase in the number of sites and stations surveyed took place in 2003. The WIO network has at present **88 survey stations at 55 sites** that are sampled at the end of the year. Considering the objectives of the programme and the resources available, this number is more than adequate. Further thought must be given by the members of the network in order to define the future strategies to put in place (decrease and optimization of sites, increase, other...).

- The 2003 regional report gives a common view of the main results of reef monitoring in the 5 countries of the Indian Ocean area. This year special attention was given to the analysis of trends (TIME-SERIES) of some of the stations that have been surveyed since 1998, which are the MAIN OBJECTIVE OF THE MONITORING surveys (reference sites). The main results are given on a country basis, more detailed information is given in the different national reports produced by the National Focal Points.
As such, the technical results obtained at certain sites that have been surveyed for more than three consecutive years give very important trends (positive or negative) depending on the countries and the sectors studied.
- These results can be used, if necessary, to initiate alerts in case of worrying environmental conditions, to improve management, to propose Marine Protected Areas, to continue long-term surveillance activities.
- As in 2002, an inventory of other activities directly or indirectly linked to existing monitoring activities (GEF programme, other) has been done on a country basis.
- This report legitimates the work done by the different national teams.

Independently from the basic information collected during reef monitoring surveys, that are fundamental elements in ICZM, the activities of the reef network stimulate related activities developed in the Indian Ocean region.

They help the exchange of experiences between the technical and institutional partners during the regional workshops, which are indispensable meetings for the regional network.

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