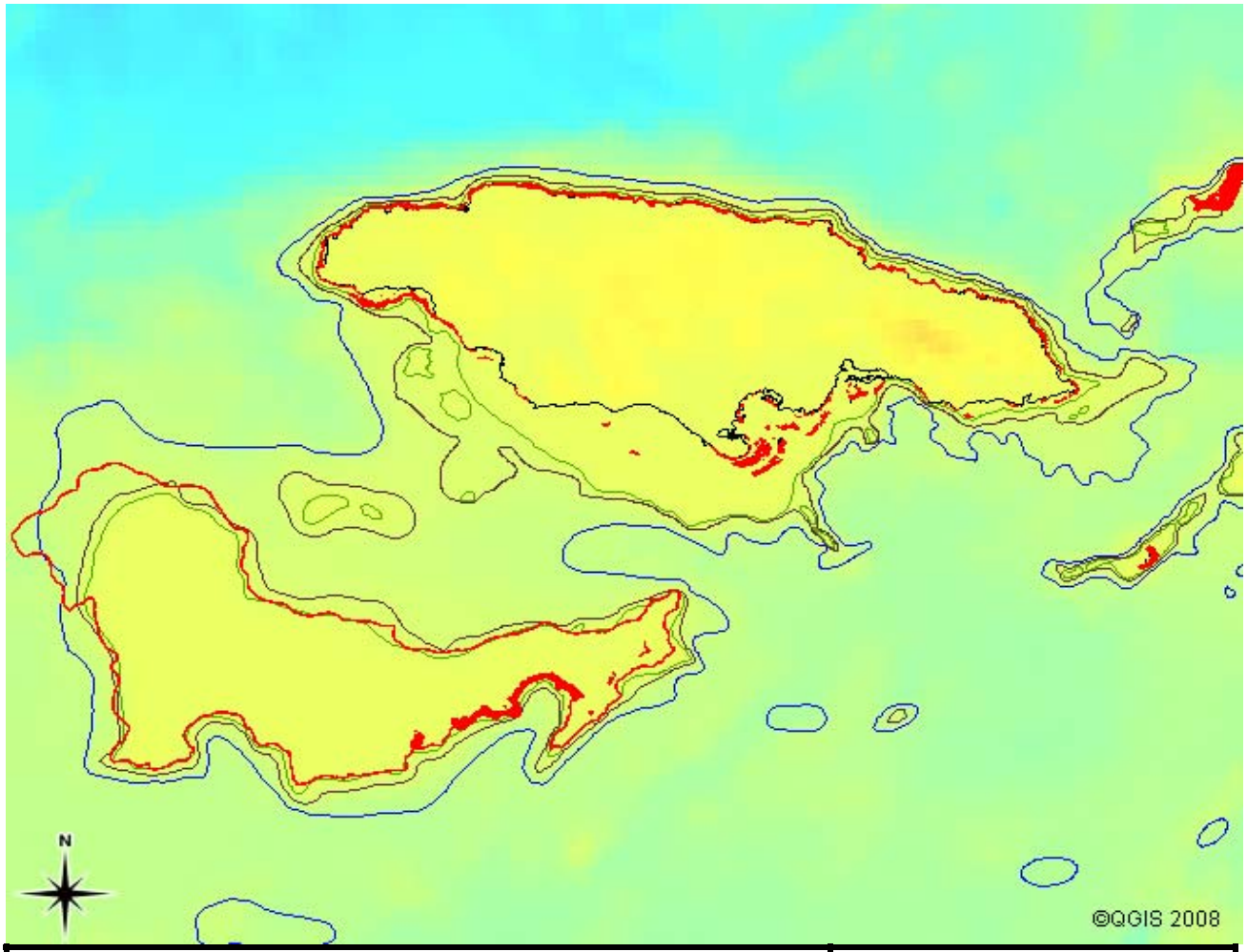
CORAL REEFS OF JAMAICA

STATUS AND TRENDS 2007



Jamaica's National Report

Prepared by
Ecosystems Management Branch
National Environment and Planning Agency

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EXECUTIVE SUMMARY

The influence of natural and man-induced stressors on coastal ecosystems has in most cases resulted in a switch from coral to algal dominated reefs. These stressors have resulted in a decline in coral cover from a high of 50% in the 1970s to less than 5% by the early 1990s. There is however some good news as in recent times the reefs have rebounded from an average of 5% hard coral cover to an average of approximately 15%. It is also noteworthy that some sites have a relatively high and stable coral cover with percentages greater than the Caribbean regional average of 20%.

Routine coral reef monitoring began in 2001. To date, data has been collected from 54 sites across the island using both Reef Check and video monitoring methods of assessment. Regrettably, there are a number of gaps in the data collected with some sites having no information for several years. Every effort is being made to ensure that routine monitoring is conducted at each site to ensure that a comprehensive database of coral reef information is maintained. Continuous monitoring coupled with effective management will go a far way to enhance the recovery of the Jamaican reef systems.

The impacts of the damage associated with hurricanes and coral bleaching events ripple throughout the fabric of the socio-economic environment in Jamaica as they have undoubtedly contributed to the continued decline in the landed fisheries resources of the island. The management responses to combat the decline of reefs in Jamaica have included:

- The implementation of a stringent permit and licensing system mainly for activities which result in impacts on coral reefs
- A programme to increase the number of sites being monitored as well as the frequency of visits.
- The implementation of a public education campaign on the importance of coastal ecosystems with special emphasis on the direct correlation between the loss of habitat and general economic losses of the country.

INTRODUCTION

Jamaica has a long history in coral reef research beginning in the 60's with the work of Dr. Thomas Goreau in Discovery Bay on the north coast. There has been a significant changes to Jamaican coral reefs over the past thirty years due to the combined effects of human influences such as, eutrophication, increased sedimentation, poorly planned coastal developments, over-fishing and natural disturbances such as hurricane damage, coral bleaching episodes and diseases, and the mass mortality of *Diadema antillarum* (Bruckner and Bruckner 1997; CARICOMP 1997; Hughes, 1994; Jones et al., 2004; Richardson, 1998; Woodley, 1992; Woodley et al., 1998; Woodley et al., 2000).

The influence of these stressors on the coastal ecosystems has resulted in a phase-shift from coral to algal dominated reefs. The fish population on Jamaican reefs has also been steadily declining over the years as a result of poor fishing practices and this has had a direct impact on the resilience of these reefs.

In 2000 a team of AGRRA scientists and local coral reef scientists conducted one of the first systematic reef surveys in the island. During this survey, 60 sites along the north coast of the island were assessed. In 2001 Reef Check monitoring was introduced and began with the establishment of four long-term monitoring sites in the Negril Marine Park.

Prior to 2003, reef assessments in Jamaica were mainly concentrated on the reefs of St. Ann and the reefs of Port Royal. Research proved that a number of institutions in the island were conducting limited coral reef assessments in isolation of each other and that most of the information obtained was not compiled nor were they readily available. In 2003, the Caribbean Coastal Data Centre (CCDC), the coordinator of the regional node for the Global Coral Reef Monitoring Network (GCRMN), initiated the formation of the Jamaica Coral Reef Monitoring Network (JCRMN). One of the primary objectives of the network was to prioritize the areas of reefs to be monitored given the limited resources available to coral reef researchers in the island. The network consists of representatives from both government and non-governmental institutions since its inception has facilitated the exchange of coral reef information and the coordination of monitoring events.

Despite the success of the network the development of a sustainable monitoring programme based on external funding and volunteer divers remains the biggest challenge. NEPA as a founding member of both the International Coral Reef Initiative (ICRI) and the JCRMN has increased its efforts to ensure that monitoring of the islands reefs continues through an institutionalized programme. This programme is designed to produce annual status reports to be used to make informed decisions about the activities in the marine environment and the interventions that are needed in a bid to improve the quality and quantity of Jamaica's reef resources. This programme involves not only the systematic monitoring of established sites but where there are geographical gaps seeks to establish new sites in conjunction with the programme of works established by the JCRMN.

Geographic Distribution and Extent of Coral Reefs

Jamaica is the 3rd largest Caribbean island, 230 km long by 80 km wide with 891 km of coastline and a coral reef area of 1,240 km^2. Well developed fringing reefs occur along most of the north and east coasts, while patchy fringing reefs occur on the broader shelf of the south coast. In addition to the reefs surrounding mainland Jamaica there are reefs and corals on the neighboring banks and shoals within Jamaica's Exclusive Economic Zone inclusive of Brune Bank and the Pedro Cays to the south, the Morant Cays to the southwest and the Formigas Banks to the northeast (Figure 1).

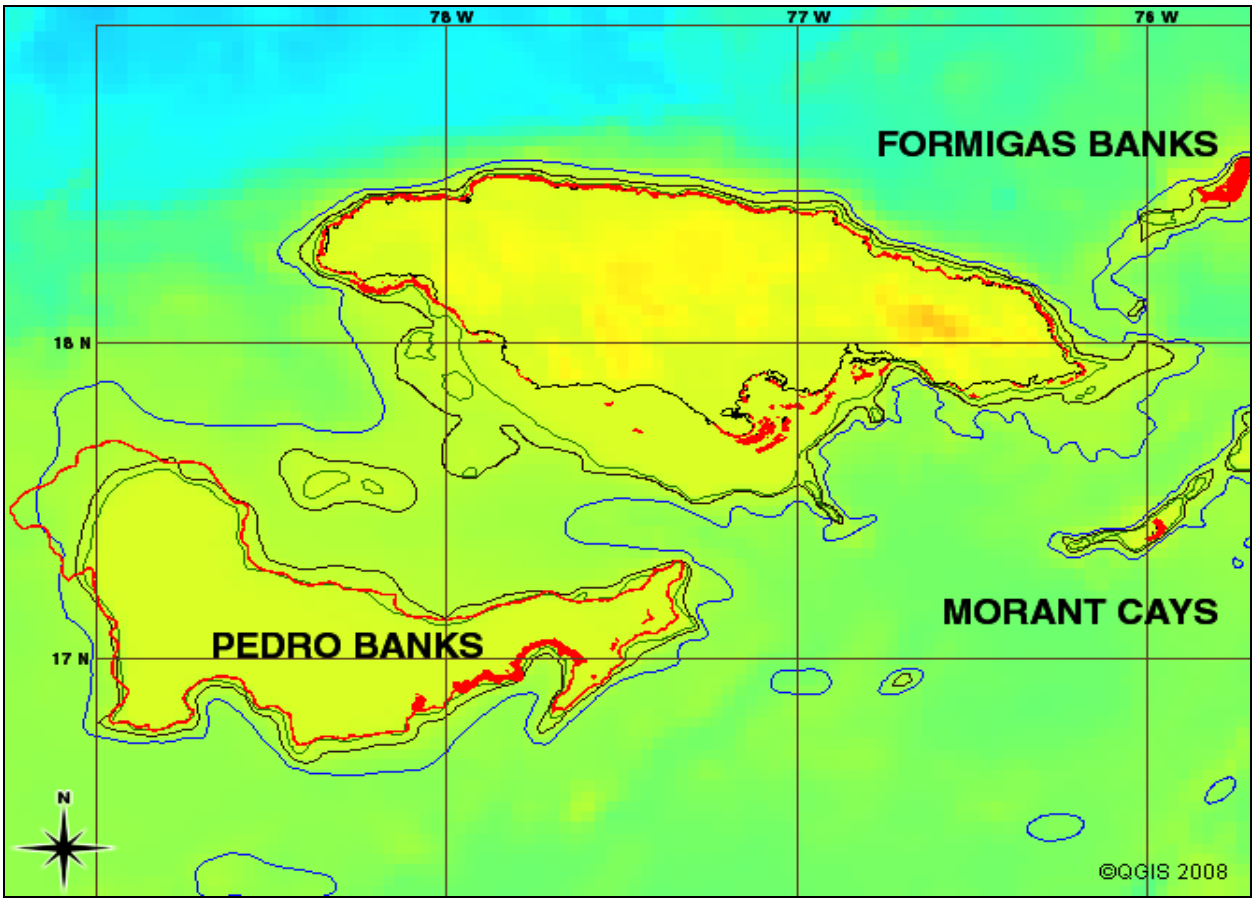

Figure 1. Distribution of coral reef in Jamaica (source The Nature Conservancy)

MONITORING REGIME

The CCDC of the Centre for Marine Sciences (CMS), University of the West Indies (UWI) coordinates the monitoring and manages the funds of the JCRMN Reef Check programme. Most sites are assessed annually however these surveys are usually determined by accessibility of the sites as well as the availability of volunteers and funds. Frequency is also determined by extenuating circumstances such as intense storm surges, hurricanes and outbreaks of bleaching and disease.

Routine coral reef data is now collected from just over 53 sites across the island (Figure 2). Regrettably, there are a number of gaps in the data collected with some sites having no information for several years. Every effort is being made to ensure that routine yearly monitoring is conducted at each site so that a comprehensive database of coral reef information is maintained.

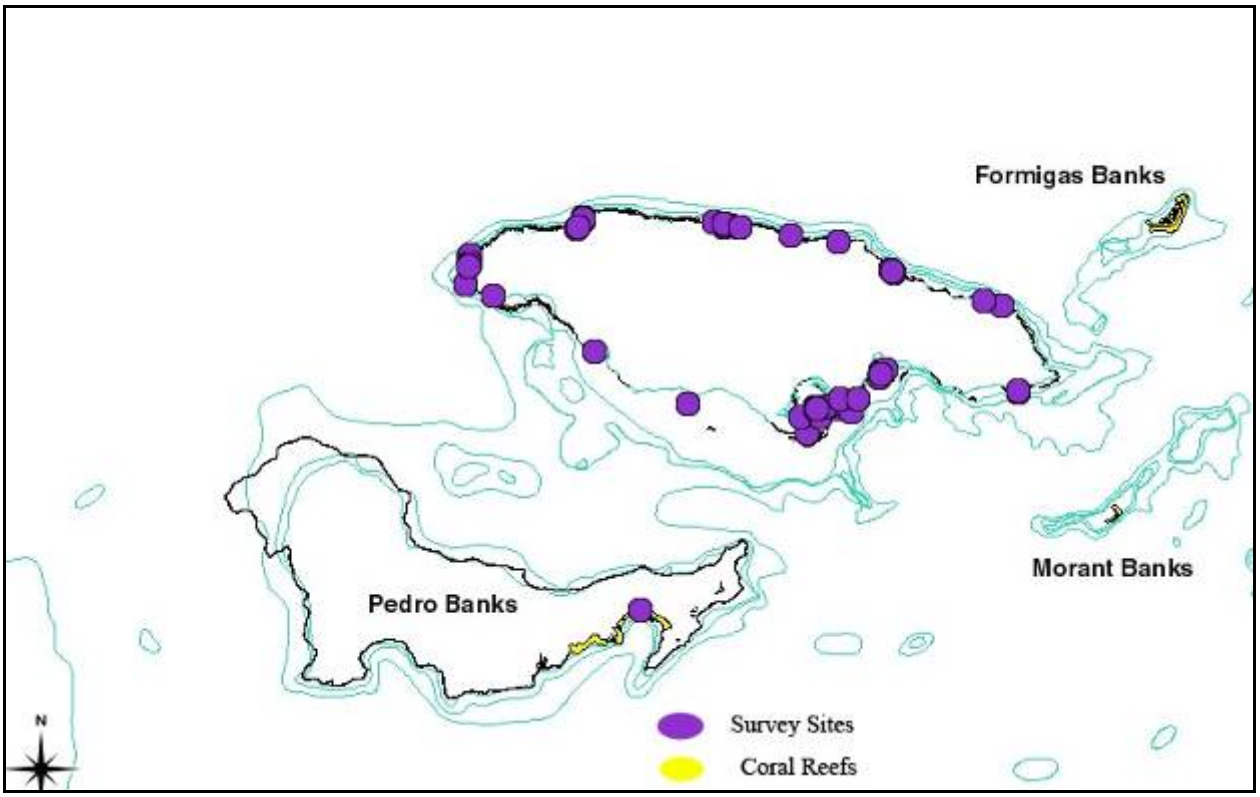

Figure 2. Distribution of sites currently monitored in Jamaica

Monitoring capabilities was also significantly improved in June 2007, when a Coral Reef Early Warning System (CREWS) station, installed at West Fore Reef (latitude 18.4727, longitude -77.4158) in Discovery Bay, St. Ann was commissioned into service. The station measures air temperature, winds, barometric pressure, precipitation, light above and below the water, sea temperature, salinity, and pCO2. It is envisaged that this station will also facilitate the prediction of coral bleaching events.

METHODS OF ASSESSMENTS

Several methods of reef assessments were employed to obtain the data presented in this report namely: the Atlantic Gulf Rapid Reef Assessment (AGRRA), a Video Monitoring method developed to assess benthic cover on Reefs (Miller, 2000) and Reef Check methods.

The results on coral cover obtained from these methods are generally comparable however the level of effort required to collect and analyze the data varies with each methodology. Reef check is simplest method of the three and utilizes the skill of trained volunteers. Ideally, each team consists of six members who collect the data which is then quality checked by a scientist. The main datasets collected using this method include benthic cover and the presence of indicator fish and invertebrate species.

Reef Check monitoring began in Jamaica in 2001 with the establishment of four long-term monitoring sites within the boundaries of the Negril Marine Park. Over the years the location of the sites have been expanded and surveys conducted at several sites island-wide in an effort to fill existing gaps in information and provide a more comprehensive view of the current status of Jamaican reefs.

While both the AGRRA and Video method produce excellent results on coral reef health they require trained coral reef scientist for data analysis and in the case of AGRRA also for data collection. An AGRRA team may consist of 5 members, all of whom require specialized training to collect the data. A trained scientist is generally not required to collect video data for coral reef assessments as any trained diver may collect this information, the data analysis is however very tedious and requires a trained scientist to interpret the data which is recorded to the species level. The video capture method requires a two man team to collect this information and remains a part of the tools used due to the Agency's involvement in the Caribbean Planning for Adaptation to Climate Change project (CPACC) and the ease of deployment in times of urgent need.

Data collected using the video method is analyzed using a visual basic programme Coral Point Count with Excel extensions (CPCe) to estimate the community statistics of the sea floor from still images or frame-grabbed video (Kohler and Gill, 2006). The utilizes the random point count method in which random points are generated and distributed on a still image and the species or substrate underlying these points are identified. The programme then automatically generates analyzed spreadsheets in Microsoft Excel based upon the supplied species/substrate codes.

For the purposes of this document the status of the reef were assessed using the following indicators of reef health: Live Coral Cover and the presence of Nutrient indicating Algae. These were chosen as these parameters were comparable across all monitoring methods employed.

MONITORING RESULTS

The results presented represents summary information drawn from Reef Check, AGRRA and the video monitoring method of reef assessments.

Live Coral Cover

Data collected over the seven-year period (2001-2007) depicts the decline and recovery in some instances of the reef ecosystem as well as the effects of hurricanes. Overall hard coral percentage cover recorded for the period ranged between 2.2 and 37.5 %/100m^2 with an average of 14.79% (Figure 3 & Figure 4).

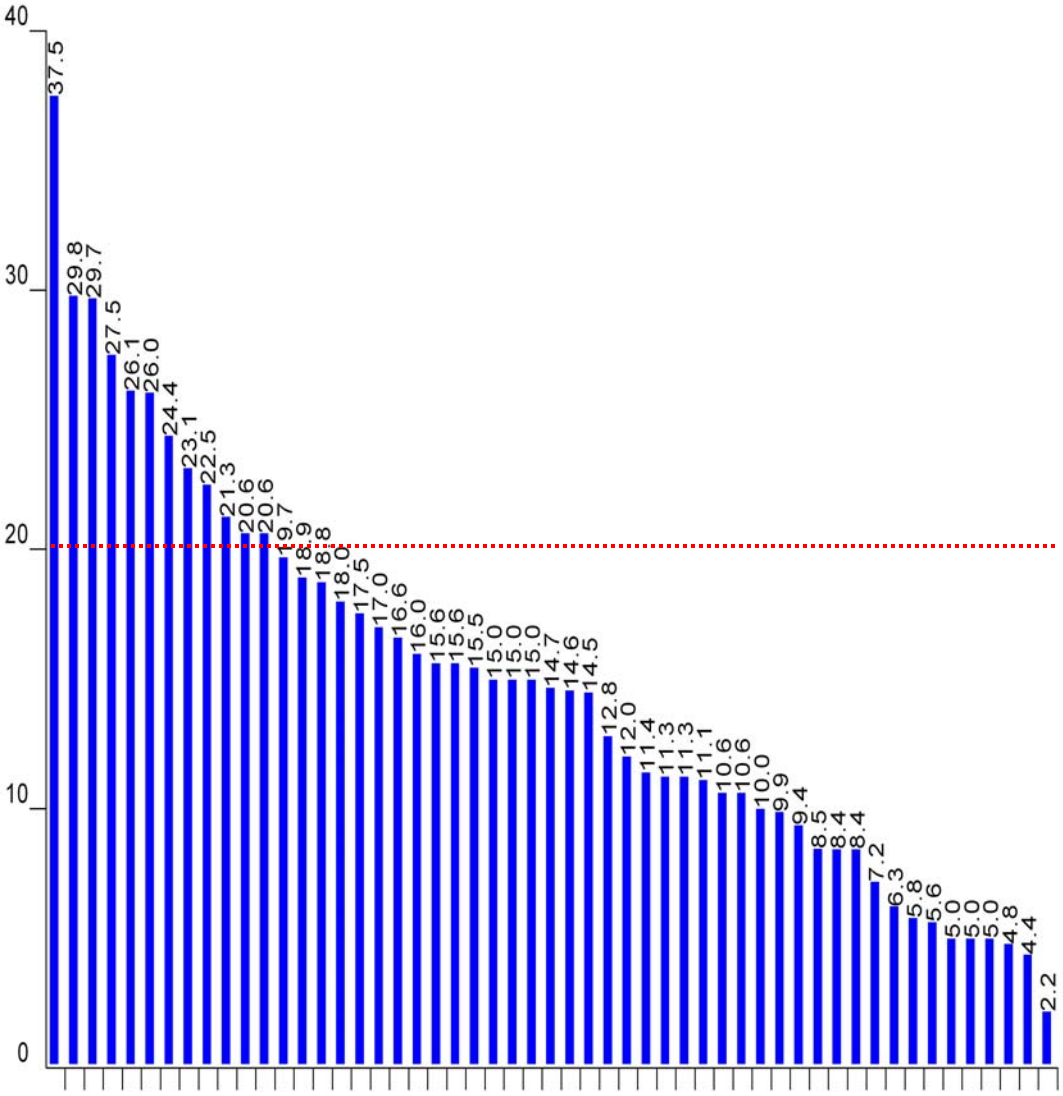

Figure 3. Comparison of Hard Coral Cover by Sites. Red line indicates regional average.

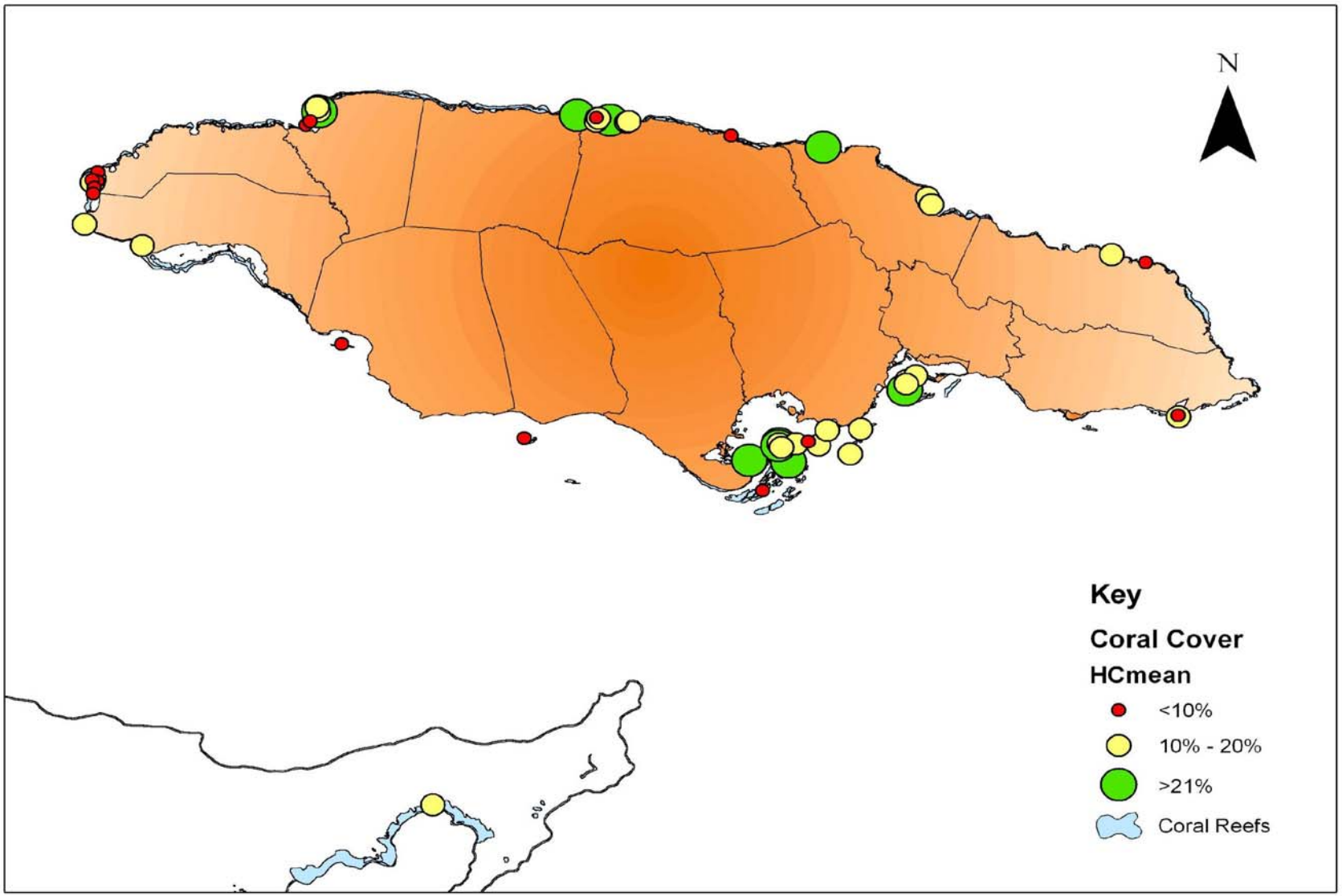

Figure 4. Percentage Hard Coral Cover by Sites

Jamaican reefs continue to show variable cover by hard corals and other benthic substrates. Generally, very shallow reefs (approximately 3m or less) appear to support a lower percentage cover by hard corals than deeper reefs. Approximately 12 of the 53 sites assessed displayed relatively high and stable coral cover in percentages greater than the regional Caribbean average of 20% (AGRRA data 1999 -2004). Eighteen of the 53 sites assessed recorded live coral percentage cover of less than 10%. This implies that these areas have been subjected to severe stressors such as strong hurricanes, prolonged periods of high sea surface temperatures, close proximity to land-based sources of pollution and exposure to high fishing pressures and poor fishing practices. Overall the national average percentage live coral cover of 14.79% is much lower than the regional Caribbean average of 20%.

Nutrient Indicating Algae

The trend of algal dominated reefs is still visible on most reef systems across the island with coverage by algae (nutrient indicating) ranging between 0% and 62.9% for an island-wide average of 24.20%. (Figures 5 and 6).

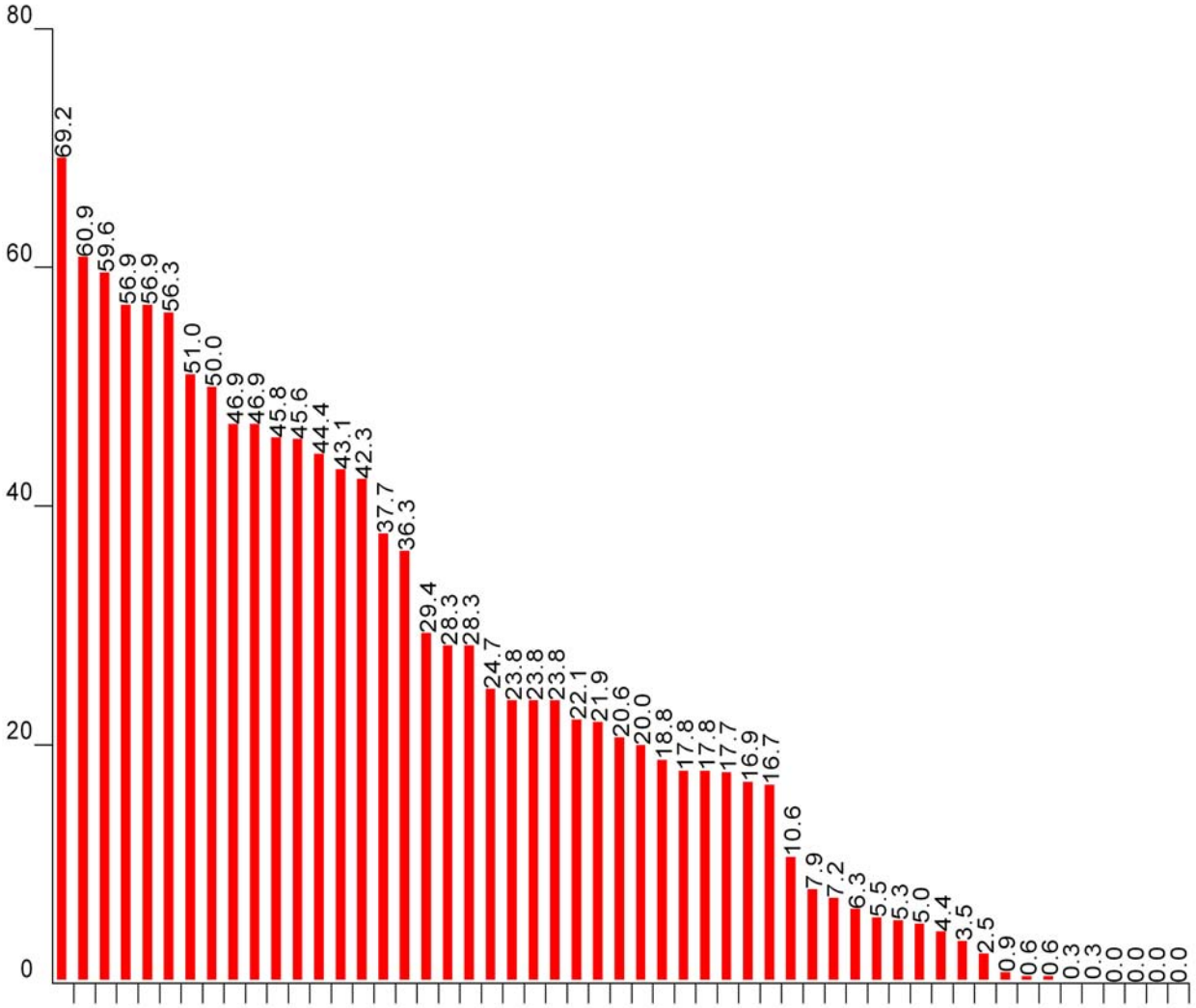

Figure 5. Comparison of Algal Cover by Sites

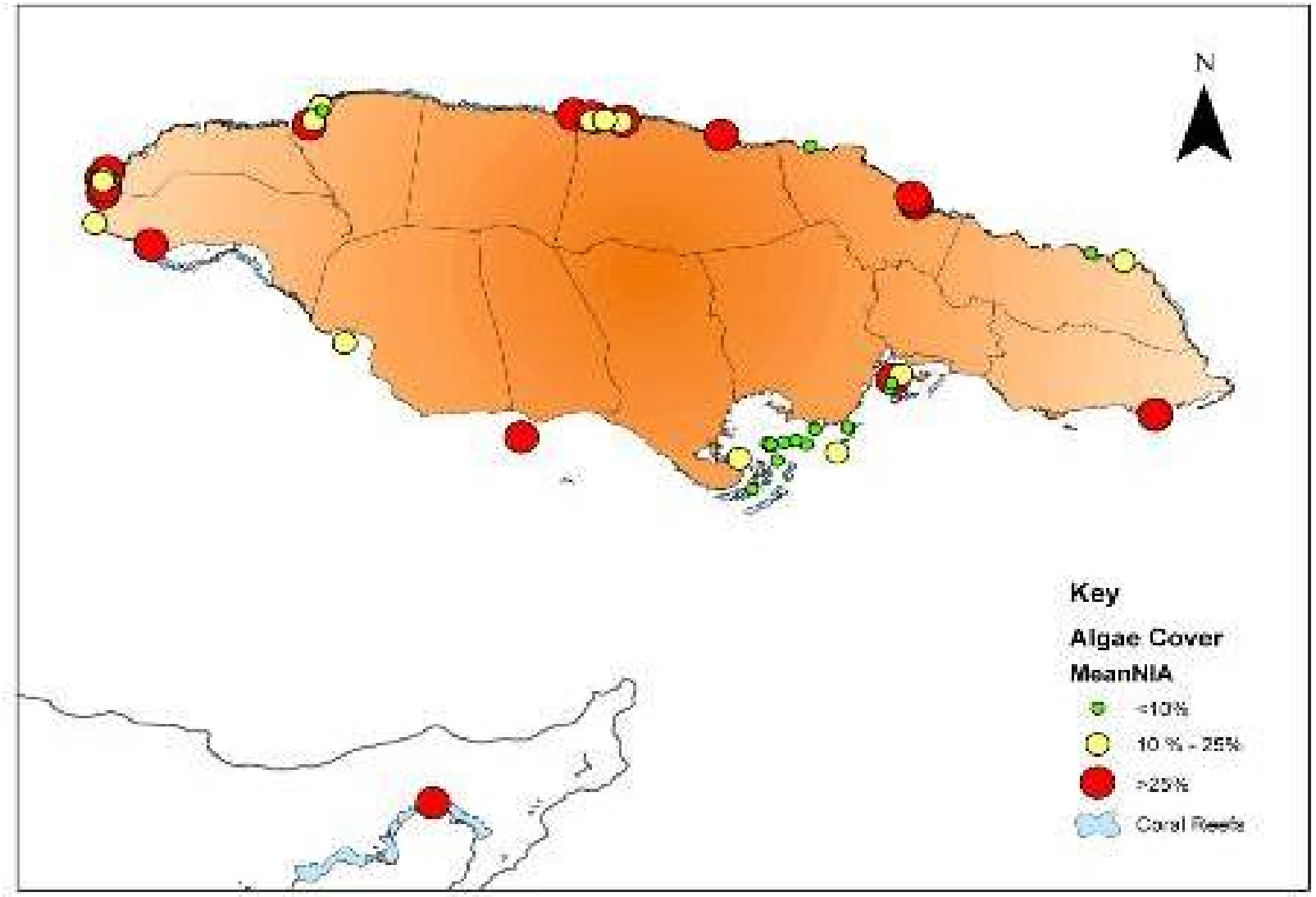

Figure 6. Percentage Algal Cover by Sites

The dominance of algae on Jamaican reefs is directly related to the paucity if herbivores present on the reefs. The unsustainable harvesting of the herbivorous fish population is one of the main factors that has resulted in this reduction. Reef check data of average fish abundance between 2001 and 2006 was 19/100 m^2 which indicates that these reefs are heavily over-fished. Despite the lack of herbivores on the reefs, some reefs have shown signs of resilience which has stimulated an increase the percentage coral cover.

IMPACTS OF HURRICANES, CORAL BLEACHING AND DISEASE

Jamaica's coastal ecosystems have come under increasing pressure from natural and anthropogenic impacts. The frequency and severity of "natural" phenomenon such as hurricanes and bleaching events has increased significantly over the period under review. Between 2001 and 2007 the island has experienced the effects of at least five hurricanes, of which two Ivan and Dean made landfall in 2004 and 2007 respectively as category four systems.

Major hurricanes that have damaged Jamaica's reefs, include 'Allen' in 1980, 'Gilbert' in 1988, 'Ivan' in 2004 and Dean in 2007. The hurricanes in 2004, 2005 and 2006 passed to the south of Jamaica resulting mainly in damage to south coast reefs. Hurricanes Ivan and Dean passed parallel to the south coast in September 2004 and caused damage to the Port Royal Cays, the Portland Bight Cays and the reefs of Negril, with large numbers of fragmented and dead branching corals in shallow water (2-8 m). Other nearby corals were toppled, uprooted and displaced, while some survived virtually undamaged or with only partial mortality. Soft corals such as gorgonians did not escape unscathed as they battered and uprooted by strong wave action, scars and lesions as a result of abrasion from objects being tossed around were noted on several boulder corals. Observations after hurricane Ivan revealed that lesions noted on *Acropora palmata* colonies were being overgrown by fast growing opportunistic algae; however six months later the colonies displayed evidence of resheathing and growth (CMS, 2006). In 2002 and 2005, hurricanes Lili and Dennis respectively, passed to the north of the island; however there was no major damage that could be directly attributable to their passage. This may have been due to the strength of the hurricane (Category 1 or 2) and the distance travelled from shore.

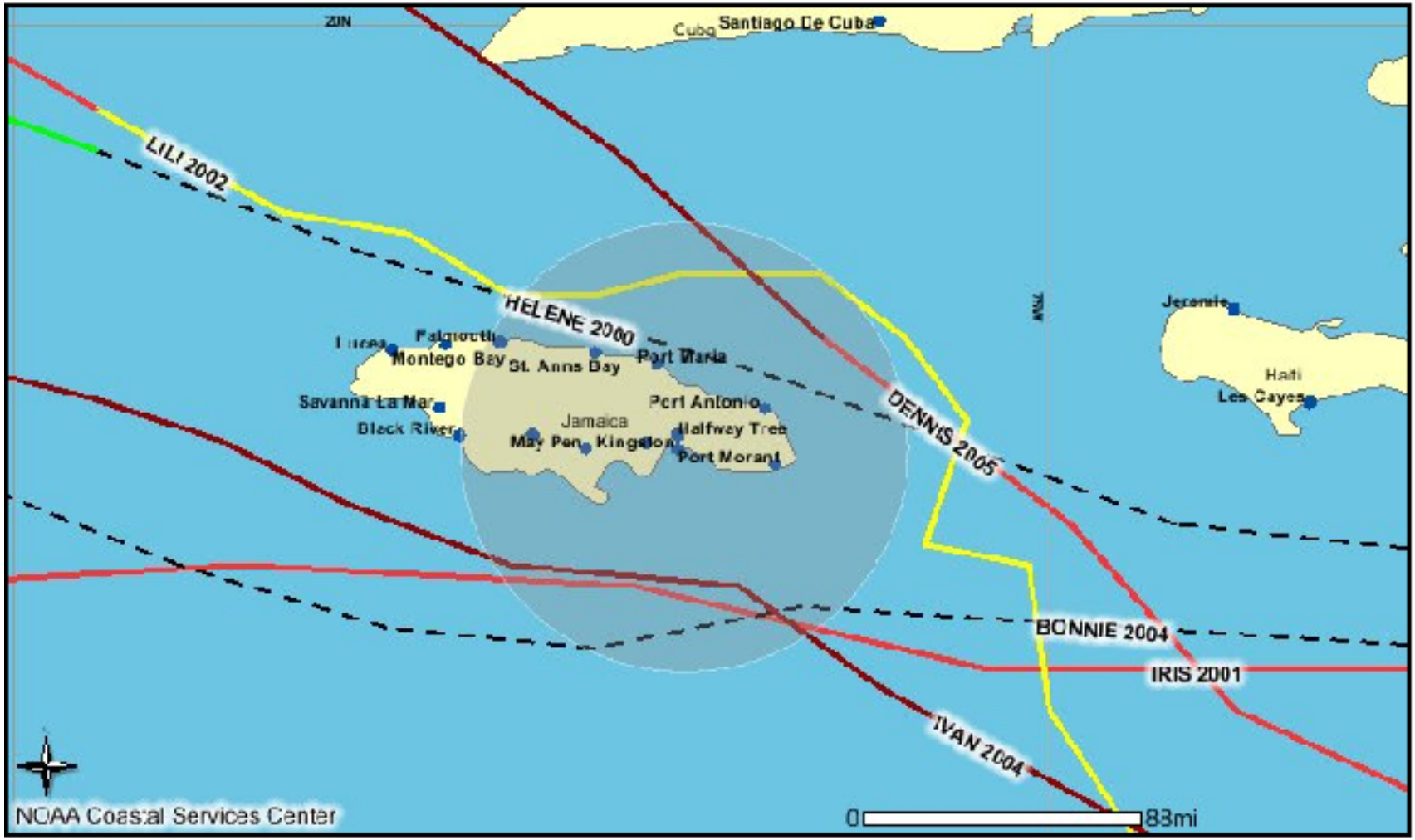

Figure 7. Hurricane Track 2000 – 2006 (Courtesy of NOAA Coastal Services Center)

Bleaching in corals is a phenomenon which occurs as a result of exposure to prolonged periods of high sea-surface temperatures. In Jamaica this usually occurs between the months of August to October with the peak occurring in September. Between 2001 and 2007 the island experienced two bleaching episodes in 2003 and 2005. From mid October to late November 2003 temperature above 29°C were detected in the Port Royal Cays. This was as a result of a hot spot located along the South Coast of the island. Severe bleaching was detected at the tops of the colonies while the sides were either pale or unbleached. The coral species most affected was *Montastrea annularis* which displayed partial mortality on subsequent observations (CMS, 2006). In 2005, Jamaica and nearby countries again experienced high sea surface temperatures which lasted for 5 to 6 weeks and culminated in a massive bleaching event. Locally, bleaching of coral colonies was noted down to depths in excess of 30 metres. This was first observed on the north coast in late August to early September and on the south coast in late September to early October.

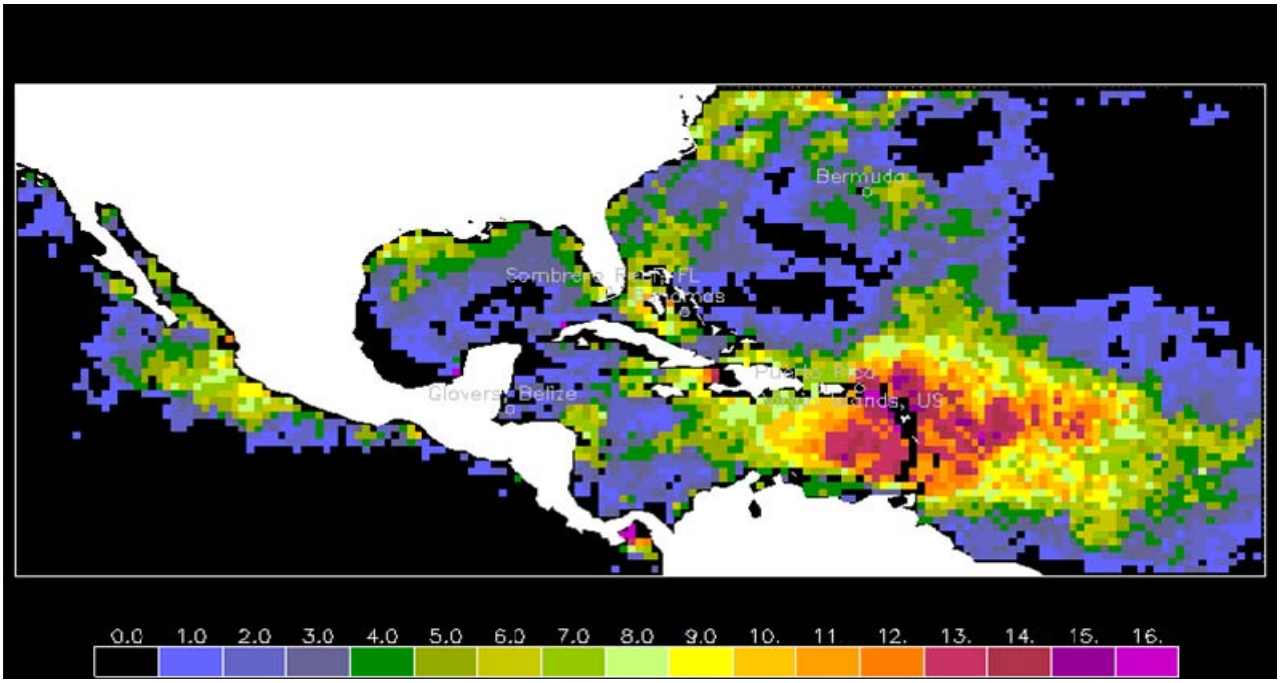

Figure 8: Degree heating map (courtesy of NOAA)

In late 2005 to early 2006 bleaching assessments were conducted at 16 sites across the island. The bleaching that was observed ranged from 10% to a high of 95% in some cases. The monitoring activities revealed that the species were most commonly affected were *Montastraea annularis, Montastraea faveolata, Montastraea cavernosa, Siderastrea siderea, Diploria strigosa, Porites porites, Millepora complanata* and *Agaricia spp.* Reassessments conducted in February and March, when sea temperatures began to cool, revealed that approximately 50% of the bleached corals had recovered. The surveys also revealed noticeable increases in the percentage cover of recently killed coral and nutrient indicating algae (NIA) which usually indicate nutrient pollution. This increase in NIA may have been as a result of opportunistic algae colonizing the skeleton of recently killed coral.

The increase in bleaching events being observed are directly related to climate change and in particular the increased sea temperatures. It is predicted that severe bleaching will be an annual event by 2100 if current trends of greenhouse gas emissions are not reduced (Wilkinson & Souter, 2008).

Coral diseases were first discovered more than 30 years ago, since then approximately 30 diseases of corals have been recognized. In the last 20 years, coral disease has had a major impact on Caribbean reefs and has lead to unprecedented decreases (~80%) in live coral and altering the function and productivity of coral reef ecosystems. Diseases and diminishing health condition among corals have dramatically increased in frequency and distribution over the last decade. Scientists believe that the increased abundance in some areas may be linked to higher sea temperatures because more diseases are seen in summer. It is now known that five coral diseases are positively correlated with high water temperature – these are bacterial bleaching, black band disease, plague, aspergillosis and dark spots disease. Some scientists also believe that run-off of nutrients and sediment from the land may allow coral diseases to thrive. Both biotic stresses such as bacteria, fungi and viruses, and/or and abiotic stresses such as increased sea water temperatures, ultraviolet radiation, sedimentation and pollutants are usually precursor to outbreaks of coral diseases as the corals are weakened and are unable to effectively resist disease (Santavy & Peters, 1997).

Disease surveys were conducted in the Port Royal Cays over the period 2005 to 2006. Results indicated that in April 2005 black band disease was observed on *Acropora palmata* colonies located at the Rackhams Cay coral relocation site. The presence of this disease eventually resulted in the death of the colonies on which they were detected (CMS, 2006). In September 2006 black band and white plague diseases were noted mainly on Lime Cay and South-East Cay. White plague was reported to have been the most prevalent disease since January 2006 and affected the massive corals *Siderastrea* sp., *Montastrea* sp. and *Diploria* sp. (Kenny, in prep). It should be noted that diseases are often present on most reefs at low levels,

CONCLUSION

Jamaican reefs continue to show variable cover by hard corals and other benthic substrates. There is also evidence that reefs have rebounded from the 5% hard coral cover recorded in the early 1990s and according to current estimates has increased to approximately 15%. It is also noteworthy that some sites have a relatively high and stable coral cover in percentages greater than the Caribbean regional average of 20%.

Continued monitoring coupled with effective management will go a far way to continuing existing trends and lead to the recovery of the Jamaican reef systems. It is important to maintain current monitoring programmes which inform on the status of the reefs thus providing information for decision making. This information is also pertinent for determining intervention needs and location.

As can be extrapolated from the data, the fishing population in the near-shore fishery has been on the decline for several years. This bleak outlook will continue unless the practices currently being employed are changed. This is going to require a series of public education campaigns coupled with continued monitoring and effective management.

The increased frequency and incidence of intense hurricanes coupled with abnormally high sea temperatures, resulting in coral bleaching, are now common dilemmas facing the islands reefs on an annual basis. Coastal ecosystems are now stressed more frequently and as such have less time to recover before the next catastrophic event. The impacts of the damage associated with these events will ripple throughout the fabric of the socio-economic environment in Jamaica as they have undoubtedly contributed to the continued decline in the landed fisheries resources of the island.

The management responses implemented in Jamaica thus far have included:

- The implementation of a stringent permit and licensing system mainly for activities which result in impacts on coral reefs
- A programme to increase the number of sites being monitored as well as the frequency of visits.
- The implementation of a public education programme on the importance of coastal ecosystems with special emphasis on the direct correlation between the loss of habitat and general economic losses.

The quandary faced by managers remains, trying to achieve a balance between conservation and economic growth. There is also a chronic shortage of the required human and financial resources to implement effective monitoring and restoration/rehabilitation programmes. This processes is also hindered by outdated legislation and fines that are ineffective in halting the continued degradation of the island's natural resources

NEXT STEPS

The goal of the Ecosystems Management Branch of NEPA is to ensure that current and correct data is used when decisions about the sustainable development and management of the island's natural resources are being made. This will be made possible through monitoring, research and public education.

Short-term

- To systematically increase monitoring sites island-wide until a representative number is achieved so that the data being gathered can properly inform management decisions.
- Increase the number of public education articles, brochures and posters produced by the branch
- Reef protection will be highlighted as the major theme for 2008 which has been designated as the International Year of the Reef.

Medium

- To improve local capacity to manage and protect reef systems by conducting training activities geared towards those who have been entrusted with the duty to manage and protect the environment.
- Mooring and demarcation bouys will be deployed in a new protected area to compliment ongoing public education, monitoring and enforcement efforts.

Long-term

- It is the intention to improve the management of protected areas through the promulgation of zoning plans and regulations for all existing protected (especially marine) areas.

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APPENDIX – Site Summary

Site	Latitude_N	Longitude_W	Hard Coral mean %	Algae mean %
Airport Reef West	18.4978	-77.9328	15.00	20.00
Alligator Reef North	17.8127	-77.5483	7.19	46.88
Big Pelican East	17.7982	-77.0006	20.63	0.00
Big Pelican West	17.8060	-77.0205	4.38	0.00
Big Portland Cay	17.7049	-77.1050	5.63	0.94
Bloody Bay	18.3404	-78.3521	17.54	16.88
Channel Edge	18.4123	-76.9927	37.50	0.31
Columbus Park	18.4653	-77.4139	11.41	17.81
Dairy Bull	18.4679	-77.3885	26.04	16.67
Dancing Lady	18.4728	-77.4119	12.03	45.78
Doctor's Cave Buoy	18.4867	-77.9312	12.81	7.19
Doctor's Cave South	18.4866	-77.9299	21.25	0.00
Drunken Man's Cay	17.9120	-76.8406	26.12	5.54
El Punto Negrilo	18.2543	-78.3673	17.02	21.92
Fish Point	18.3458	-78.3534	5.00	45.63
Garden of Eels	18.4581	-77.9549	9.38	36.25
Grand Lido	18.3432	-78.3438	8.44	24.69
Great White	18.3473	-78.3496	20.63	20.63
Gun Cay	17.9319	-76.8357	15.00	28.33
Hans Reef	17.7680	-77.1300	24.38	10.63
Hotch Kyn Patches	17.7811	-76.9418	14.50	23.75
Ireland Pen	18.3609	-78.3433	9.90	37.71
Island Point	18.3090	-76.7978	11.25	56.25
Jack's Bay	18.2942	-76.7907	10.63	56.88
Lighthouse Reef	17.8016	-77.0744	19.69	6.25
Lime Cay	17.9417	-76.8193	15.00	22.13
Little Bay	18.2095	-78.2596	15.99	28.33
Long Hole	18.3004	-76.7933	15.63	56.88
Middle Shoal	18.3294	-78.3487	5.00	42.29
Monkey Island	18.1753	-76.3914	4.79	17.71
Mooring 1	18.4722	-77.4095	11.13	46.88
Morris Shoal	17.7645	-77.0572	23.13	0.00
Navy Island	18.1917	-76.4546	15.63	4.38
Pear Tree Bottom	18.4636	-77.3573	18.93	23.75
Pigeon Island East	17.8016	-77.0748	27.50	0.63
Pigeon Island West	17.7975	-77.0757	22.50	5.00
Pigican	17.8016	-77.0429	18.75	2.50
Rackhams Cay	17.9241	-76.8378	14.58	3.54
Rio Bueno East	18.4790	-77.4491	29.79	44.38
Sandy Cay	18.3176	-78.3511	2.19	43.13
Sergeant Major	18.4949	-77.9338	10.00	18.75
South East Reef	17.7974	-77.0692	29.69	0.31
South West Reef	17.7936	-77.0700	10.63	0.63
Sunset Beach Mooring	18.4664	-77.9474	8.44	17.81
Tern Cay	17.8294	-76.9849	11.25	7.92
West Fore Reef	18.4732	-77.4138	6.25	29.38
Wreck Reef	17.8323	-76.9222	14.69	5.31

Site	Latitude_N	Longitude_W	Hard Coral mean %	Algae mean %
RIU3	18.4364	-77.1642	5.79	59.58
Pear Tree Vid	18.4656	-77.3533	16.62	51.03
Nakhle's Reef	17.8577	-76.3309	15.45	69.21
Donnie's Reef	17.8597	-76.3318	8.46	60.91
Pedro Banks	17.0578	-77.7179	18.00	50.00
Shallow Reef Black River	18.0074	-77.8876	5.00	23.75