An Inventory of Seagrass Communities around Trinidad and Tobago

Coastal Conservation Project

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ABSTRACT

Seagrass ecosystems are highly productive, faunally rich and ecologically important marine resources. They provide nursery habitats for a number of commercially important species, and their loss may significantly impact fisheries. Despite their tremendous importance, very little research has been conducted on these communities in Trinidad and Tobago, while they continue to decline worldwide. Studies on seagrass communities have been sporadic, and while some areas like Bon Accord Lagoon have been well studied, others have been overlooked. It is extremely important to methodically monitor seagrass communities around the islands so that change in extent, distribution, density and species composition, whether positive or negative, can be ascertained. This data can then be used to facilitate sustainable management of the resource.

Prior to designing and implementing a monitoring programme, an inventory of all seagrass beds around Trinidad and Tobago must be undertaken. This involves mapping the distribution of the existing beds as well as surveying the flora and fauna and determining the status of the beds. The Institute of Marine Affairs (IMA), as a component of its ongoing coastal monitoring programme, has conducted this inventory and presents the results in this document. The most extensive seagrass communities in Trinidad are along the northwestern peninsula: in Chaguaramas and Carenage Bay. In Tobago, extensive communities are found around the southwestern side of the island: in Bon Accord Lagoon, and from La Guira Bay to Canoe Bay. These beds, though healthy in some areas are showing signs of human impacts. Further research and monitoring are recommended so that they can be effective managed.

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1.0 INTRODUCTION

Seagrasses are submerged angiosperms that have adapted to life in the marine environment. They have the following faculties, which enable them to colonize the sea successfully:-

- Ability to live in a saline medium
- Ability to function normally when fully submerged
- A well-developed anchoring system
- Ability to complete the generative/ reproductive cycle when fully submerged
- Ability to compete with other organisms under the more or less stable conditions of the marine environment (Arber, 1920; den Hartog, 1970)

Seagrasses are extremely widespread in the shallow water, coastal regions of the world from the arctic to the tropics, except for the most polar areas (McRoy & Helfferich, 1977). There are 48 species of seagrasses globally, grouped into 12 genera that belong to two families- Potamogetonaceae and Hydrocharitaceae (Phillips & Meñez, 1988). Of the 12 genera of seagrasses, 7 are tropical/ subtropical and 5 are temperate. Of the 7 genera of tropical species, all seven are found in the Indo-West Pacific, which is the center of origin and diversity for tropical seagrasses and 4 genera is found in the New World Tropics (Tropical Atlantic Ocean and the Pacific Coast of Central America) (Phillips & Meñez, 1988).

In the Caribbean, six species belonging to the four genera are found (Phillips & Meñez, 1988). These are:-

- *Thalassia testudinum* Banks ex König – Turtle grass
- *Halophila baillonis* Ascherson
- *H. decipiens* Ostenfeld
- *H. engelmannii* Ascherson

- *Halodule wrightii* Ascherson
- *Syringonium filiforme* Kutzing- Manatee grass

The dominant species found in the Caribbean is *Thalassia testudinum,* which is widely distributed in the tropical Atlantic from Venezuela to Cape Canaveral in Florida and also in Bermuda (Phillips & Meñez, 1988). It is absent in Guyana because of the high turbidity of the coastal waters.

It is theorized that the Caribbean and Indo-Pacific seagrass flora originated from a common ancestral flora that was widely distributed in tropical seas (Ostenfeld, 1915; Setchell, 1935). When the Caribbean was separated from the Indo-Pacific by the upheaval of the Central American isthmus in the Miocene period, these ancestral species diverged. There are pairs of species that show only slight morphological differences but have widely separated areas of distribution. These species are:-

Indo – Pacific	**Tropical Atlantic**
Halodule uninervis	*Halodule wrightii*
Syringodium isoetifolium	*Syringodium filiforme*
Thalassia hemprichii	*Thalassia testudinum*

Seagrasses form extremely complex ecosystems that function through detritus-based and herbivore food webs (Phillips & Meñez, 1988). These ecosystems are highly productive, faunally rich and ecologically important (Zieman, 1982). The grass blades offer a suitable substrate for epiphytic algae and diatoms and the beds are mixed with benthic macro-algae. Studies of seagrass meadows have shown that production of algal epiphytes attached to seagrass blades approaches 20% of the seagrass production, and that epiphytes and macro-algae are more important as food for associated fauna (Van Montfrans *et al*., 1984).

In Florida more than 113 species of epiphytic algae were found on *Thalassia* blades (Humm, 1964; Ballantine & Humm, 1975). Since epiphytes may compete with

seagrasses for light and water column nutrients, excessive epiphytic fouling could have serious consequences for seagrass growth (Van Montfrans *et al*., 1984). Algae are sensitive to nutrient enrichment; under eutrophic conditions they can smother seagrasses.

Seagrass communities have been recognized as an important marine resource (den Hartog, 1970; Zieman, 1982; Larkum *et al*., 1989) and worldwide, seagrasses rank with mangroves and coral reefs as some of the most productive coastal habitats (Ogden, 1980). The functions of seagrass beds are:-

- Stabilization of bottom sediments even through the enormous stresses of hurricane and temperate storms, thus preventing erosion
- Slowing and retarding current flow to reduce water velocity
- Filtering of suspended solids and nutrients from coastal waters
- Production of organic matter
- Provision of shelter and refuge for resident and transient adults and juvenile animals, many of which are of commercial and recreational importance
- Provision of feeding pathways- through direct grazing and detrital webs
- Production and trapping of detritus and secretion of dissolved organic matter that tends to internalize nutrient cycling within the ecosystem

Numerous scientists have recognized the importance of tropical seagrass communities to fisheries (Randall, 1964; Randall, 1965; Ogden, 1976; Heck & Weinstein, 1989). Extensive studies have been carried out in Florida Bay and other areas in the Northern Caribbean demonstrating that seagrass beds are major nursery areas as well as lifetime habitats for a number of species, including commercially important species such as grunt, groupers, snappers, seabream, Pink Shrimp (*Penaeus sp.*) and Spiny Lobster, *Panulirus argus* (Robblee, 1989; Sogard *et al.*, 1989; Thayer and Chester, 1989; Van der Velde *et al*., 1992).

Several hypotheses have been proposed to explain the high abundance of juvenile fishes in seagrass beds. These include:-

1. The structural complexity of the grass beds provides excellent shelter against predation. Seagrass biomass and leaf density have been correlated with fish density and species richness (Sogard *et al*., 1987).

2. The beds are often located at a distance from coral reef or from offshore waters and are therefore less frequented by predators (Shulman, 1985)

3. The ecosystem provides a great abundance of food for fishes (Ogden & Zieman, 1977).

4. The beds often cover extensive areas and may intercept planktonic fish larvae more effectively than coral reef (Parrish, 1989)

Tropical seagrass communities not only provide nursery habitats, but seagrasses are a direct food source for a number of different organisms including green turtles, *Chelonia mydas*, Queen conch, *Strombus gigas*, sea urchins, *Lytechinus variegatus* and *Tripneustes ventricosus* and many adult fish species such as parrotfishes (Scaridae) and surgeonfishes (Acanthuridae) (Ogden, 1976; Greenway, 1976; Zieman, 1982; Thayer *et al*., 1984; Heck and Weinstein, 1989). Seagrass feeding in fishes is confined almost exclusively to the Caribbean (Randall, 1965; Ogden, 1976).

In spite of the tremendous importance of seagrass beds, this ecosystem continues to decline worldwide. Over the last decade, 90,000 ha of seagrass loss have been documented, although the actual area is certainly greater (Short *et al*, 1996). Indeed, more seagrass has been lost globally than has been documented or even observed, but the lack of comprehensive monitoring and seagrass mapping makes an accurate assessment of the loss of this resource impossible to determine (Short *et al*, 1996).

Seagrass decline has been due to both natural and human-induced disturbances. Natural disturbances that are most commonly responsible for seagrass loss include hurricanes, earthquakes, disease and grazing by herbivores (Short *et al*, 1996). For example, Hurricane Hugo caused devastation to seagrass beds in the Virgin Islands in September 1989 while seagrass loss in Lameshur Bay, St John was caused by an unusual bluegreen alga that overgrew approximately one quarter of that seagrass meadow (Muehlstein & Beets, 1989).

Human activities most affecting seagrasses are those that alter water quality and clarity: nutrient and sediment loading from land-based runoff and sewage disposal, dredging and filling, pollution, upland development including deforestation and certain fishing practices (Short *et al*, 1996). Short *et al*, (1996) suggests that human population expansion is now the most serious cause of seagrass habitat loss, and specifically that increasing anthropogenic inputs to the coastal oceans are primarily responsible for the worldwide decline in seagrasses. UNEP's Global State of the Environment (1997) reports that 60% of the world's population live within 100 km of the coastline, and that 3 billion people rely on coastal and marine habitats for food, building site, transportation, recreation, and waste disposal. Direct physical alteration and destruction of habitats are now viewed as the most important threats to the coastal environment (GESAMP, 2001).

Loss of seagrass beds may significantly impact fisheries and should not go unnoticed or undocumented, especially in the Caribbean, where fisheries are already stressed from over-fishing and mismanagement of natural resource (Muehlstein & Beets, 1989). A major loss of nursery habitats could cause further depletion of fisheries. Despite this, very little research has been conducted on seagrass communities around Trinidad and Tobago. Most of the historical information available on these communities has been on their location with brief qualitative descriptions in some instances.

Historical records on the occurrence of seagrass communities around the islands were provided by the National Herbarium, UWI, St. Augustine (Table 1). Goreau (1967), Thorslund (1967) and Kenny (1976) briefly described the seagrass beds in Bon Accord

Lagoon. While Hasell (1968) and IMA (1990; 1992) recorded the presence of seagrasses in La Guira Bay, Little Rockly Bay, Milford Bay, King's Bay, Petit Trou Lagoon and Bon Accord Lagoon. A map of the Speyside marine area also indicated the presence of seagrasses within the nearshore area (IMA, 1995).

Massiah (1976) provided sketched maps as well as some information on the flora and fauna of four seagrass communities around Trinidad. She compared the communities at Salybia Bay, Grand Fond Bay, Cocorite (mouth of the Diego Martin River), and St Peter's Bay. Cocorite was described as a low salinity, high turbidity area with high seagrass density and low faunal composition compared to Salybia, which was a high salinity, low turbidity area with low seagrass density and high floral and faunal diversity. Grand Fond Bay and St Peter's Bay were described as intermediate communities.

TABLE 1: Herbarium records of the occurrence of seagrasses around Trinidad and Tobago (Alleng and Juman, undated)

SPECIES	LOCATION	YEAR
Thalassia	Gulf of Paria	1893
testudinum	Pigeon Point	1948
	Monos Island	1953
	Chacachacare	1954
	Speyside	1954
	Balandra Bay	1957
	Scotland Bay	1957; 1977
	Carenage Bay	1926; 1958; 1980
	St. Madeline's Bay, Gaspar Grande	1977
	King's Bay, Tobago	1977
Halophila sp.	Gasparee	1933
	Scotland Bay	1957
	Chacachacare	1961

Alkins and Kenny (1980) in their study of Scotland Bay indicated the presence of *Thalassia testudinum* and *Syringodium filiforme* in small patches throughout the bay, except at the northern extremity of the inner Bay. In this area, well-developed bands were observed adjacent to the coastline. There is still some uncertainty as to whether *Syringodium filiforme* was actually found in Scotland Bay, since the National Herbarium has no record for this species in Trinidad.

Thalassia testudinum productivity and biomass data for the Bon Accord Lagoon, Tobago are available. The Institute of Marine Affairs (IMA) has been measuring these parameters since 1993 as part of a regional programme where it was reported that the lagoon had one of the lowest total biomass and areal productivity in the Caribbean (CARICOMP, 1997). This followed a general pattern for small islands or islands of low relief.

Comprehensive studies were also conducted on this seagrass community during 1998 to 2000 (Juman, 2004). Percentage cover by seagrass and algae, standing crop, productivity and faunal composition of the beds were investigated. The Bon Accord Lagoon had an extensive bed that covered about 54.3 ha. Seagrass productivity varied seasonally and was influenced by water clarity. Standing crop for seagrasses varied between 2.9 metric tonnes in the wet season to 6.0 metric tonnes in the dry season. The grass beds produced 249 metric tonnes of organic material (dry wt.) per annum, which included 18 crops of leaves. Juvenile reef fishes were observed among the seagrasses in the lagoon throughout the year. The most common fish species were grunts (Haemulidae), snappers (Lutjanidae) and parrotfish (Scaridae). Juvenile Queen Conch (*Strombus gigas*) and Spiny Lobster (*Panilarus argus*) were also collected.

Studies on seagrass communities around Trinidad and Tobago have been sporadic and while some areas, like Bon Accord Lagoon, have been well studied others have been neglected. It is extremely important to methodically monitor seagrass communities around the islands so that changes in seagrass extent, density and species composition,

whether positive or negative, can be ascertained. This data can then be used for sustainable management of the resource.

In 1997, the Institute of Marine Affairs (IMA) initiated a seagrass inventory under its Coastal Conservation project, after realizing there was a paucity of information pertaining to seagrass communities around Trinidad and Tobago. Eight areas throughout Trinidad and Tobago were surveyed and mapped (Alleng & Juman, 1997). Limited time and resources precluded surveys of other areas. Areas surveyed were:

1. Williams Bay
2. St. Peter's Bay and environs
3. Scotland Bay
4. Offshore islands, northwest peninsular
5. Pointe-a-Pierre
6. Guayaguayare
7. Bon Accord Lagoon, Tobago
8. Speyside, Tobago

In Trinidad, extensive seagrass communities were reported on the west coast at Williams Bay and between St. Peter's Bay and Point Cumana River (Alleng & Juman, 1997). Smaller communities were recorded near the Trinidad and Tobago Yacht Club and the Pointe-a-Pierre Yacht Club. On the east coast, dense seagrass beds were found in the northeastern section of Guayaguayare Bay while in Tobago, well-developed seagrass communities were found in the Bon Accord Lagoon. *Thalassia* communities once found in Scotland Bay, Grand Fond Bay (Monos Island), the Five Islands, Cocorite and Speyside had disappeared (Alleng & Juman, 1997). The reasons for the disappearance of these beds were not known, except for Cocorite where land reclamation and sedimentation had occurred.

2.0 GOAL AND OBJECTIVES

Prior to designing and implementing a monitoring programme, an inventory of all seagrass beds around the islands must be undertaken. This involves mapping the distribution of existing seagrass meadows as well as surveying the flora and fauna, and determining the status of the beds (whether dense, patchy, or sparse). The goal of this project is to undertake a comprehensive inventory of seagrass communities around Trinidad and Tobago, and to use these data to formulate a monitoring programme. The data collected from the inventory and monitoring programme will be used to inform/ guide policymakers charged with the responsibility of managing and conserving these habitats

The objectives are:-

1. Survey and map seagrass communities around Trinidad and Tobago;

2. Update any previous inventories conducted on these communities;

3.0 METHODOLOGY

3.1 Site Description

Trinidad and Tobago is situated in the southernmost end of the Caribbean island chain between 10° 02' -10° 50'N latitude and 60° 55'-61° 56'W longitude (Figure 1). It is located on the continental shelf of South America, and immediately adjacent to the outflow of the Orinoco River. The country is less exposed to tropical storms and hurricanes than most of the Caribbean nations, because of its southerly location. Its marine ecosystems are influenced by discharge from South American Rivers, mainly the Orinoco River, while its terrestrial biota is largely South American. Trinidad and Tobago has land areas of 4823 km^2, and 300 km^2 respectively. A series of smaller islands are located off the northwest coast of Trinidad, of which the main ones are Gasper Grande, Monos, Huevos, and Chachacare. On the northeast coast of Tobago, there are Little Tobago, Goat Island and St Giles.

The oceanic current flow in the vicinity of Trinidad and Tobago is influenced by the North Brazil Current (NBC), a western boundary current that influences the entire Caribbean. This current separates from the South American coastline at 6º-8ºN, and curves back on itself (retroflect) to feed the eastward North Equatorial Countercurrent, and close the anticyclonic wind-driven gyre (Fratantoni *et al*. 2002). The NBC rings, swirl anticyclonically at speeds approaching 1 m s^{-1} while translating north-westward towards the Caribbean on a course parallel to the South American coastline (Fratantoni *et al*. 1995; 1999). They collide with the Lesser Antilles Passages (Fratantoni *et al*. 1995), and the ring fragments drift westward into the Caribbean, resulting in mesoscale eddies, and meanders with diameters of 100-500 km. These mesoscales eddies travel along the Caribbean Current axis. They advect towards the Yucatan Channel, which they mostly reach within 12 months. The eddies provide the connectivity from upstream to downstream reef and coastal areas and serve as the dispersal mechanisms of pelagic and coastal larvae (Cowan *et al*. 2000), and can in a matter of days transport surface water hundred of kilometres, and not necessarily in the direction of the mean flow (Kjerfve *et al*. 2002).

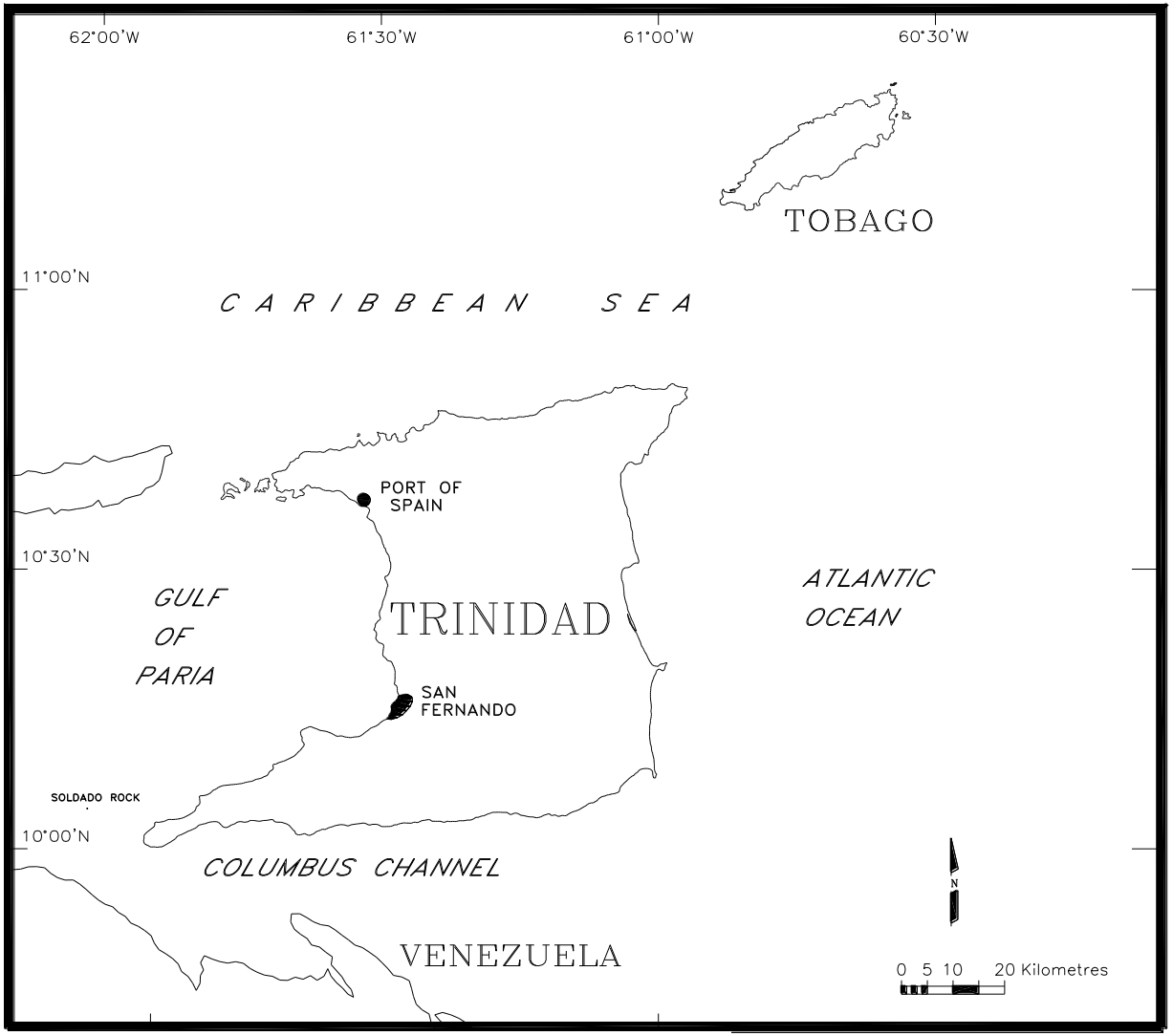

FIGURE 1: MAP OF TRINIDAD AND TOBAGO

Trinidad and Tobago experiences a mixed semi-diurnal tide with a pronounced semi-diurnal inequality (Kjerfve, 1981). The tide is dominated by the principal lunar semidiurnal constituent, M_2, which measures 29 cm in Trinidad and Tobago. Mean tidal range is 0.6 m (Kjerfve, 1981). The country has a tropical climate with two distinct seasons (Henry, 1990). The dry season occurs between January and April, while the wet season extends from June to November. May and December are considered transitional months between the two seasons. In most years, there is a short dry spell during September and October known as 'petite careme'. In Trinidad average annual rainfall is 2,200 mm, of which two-third is recorded during the wet season (Henry, 1990). Southwest Tobago receives a mean total rainfall of 1415 mm yr^{-1}, 84% of which occurs during the wet season (CMI, 1982). The mean annual air temperature range is 22.5°C - 28°C, while average sea surface temperature ranges from 26.5°C in the dry season to 28°C in the wet season (CMI, 1982).

In 2002, the population of Trinidad and Tobago was estimated at 1,163,724 (CSO, 2002). The population is concentrated in urban areas in northwest Trinidad and San Fernando, and approximately 90 % of the population lives along the west coastal area and the foothill of the Northern Range. Most of the population of Tobago is concentrated in the southwest part of the island. The offshore islands on the northwestern peninsula are used for vacation homes and resorts. The coastal areas of Monos, Chacachacare, and Gaspar Grande are built-up.

3.2 Methods

A literature search and herbarium search were conducted to determine previous records of seagrass communities Trinidad and Tobago. Once these areas were identified, these sites as well as other sheltered coastal areas conducive to seagrass establishment were surveyed. In Trinidad, surveys were conducted along the Gulf of Paria coastline from Scotland Bay to Mosquito Creek, around the offshore islands, the northeast coastline, and in Guayaguayare Bay. In Tobago, the entire coastline was surveyed. Surveys were conducted by boat. In Tobago they were conducted in March 2001, while in Trinidad

they were conducted from April – September 2001. Each site was surveyed at least once during the study period.

Seagrass beds were mapped using information obtained form GPS (Global Positioning System) readings, aerial photographs (taken by Survair International Limited in 1994, at elevation 1,800m above sea level, at scale 1:12500; FS160, f/4.0), as well as visual surveys. Maps showing location and extent of seagrass communities were produced using Arc Info Software.

Temperature, salinity, dissolved oxygen, and pH were measured at 1 m depth using a Sonde. Visibility of the water was determined by taking secchi disc readings. Total suspended solids concentration (TSS) was measured at 1 m depth at sites on the west coast of Trinidad. TSS was determined according to the gravimetric (difference) method outlined in APHA/ AWWA/ WEF, 1995. A known quantity of seawater was filtered through a pre-weighed Whatman glass fibre filter paper. The residue was dried for two hours at 105^{o}C and re-weighed. Detection limit is 1mg l^{-1}

Water nutrient concentrations {total nitrogen (TN) and total phosphates (TP)}, as well as Chlorophyll-*a* concentrations were measured at sites on the Northwestern Peninsula of Trinidad. Measurements were made once in the dry season and once in the wet season. TN and TP were determined according to methods outlined in APHA/ AWWA/ WPCF, 1995. Complexing agents were added to produce coloured complexes of each anion. Quantification of these anions was performed using UV/ fluorescence spectrometric analysis. Quantification of ammonia was performed using the method outlined in Grasshoff *et al*. (1983). Chlorophyll-*a* was measured using a method outlined by Strickland and Parson, 1972. Two-litre water samples were collected and the phytoplankton species were filtered onto a Millipore AA glass filter, using a vacuum pump system. Pigments were extracted from the algal cells by soaking in acetone over night, and then measured using a Perkin-Elmer 552A UV/VIS Spectrophotometer. Active chlorophyll-*a* concentrations (C) were calculated using Lorenson's (1967) equation-

$$C = 26.7(D_{665b} - D_{665a}) \times V_{acetone} \times \frac{1}{l} \times \frac{1}{V_{water}}$$

where V acetone= volume of acetone (ml), l= length of cell (mm), and V water= volume of filtered water (l)

Seagrass beds were visually surveyed and observations were made of seagrass and algal species composition, dominant seagrass species, and status of the seagrass beds using the following key:

dense (> 10 shoots per 0.1 m^2);
sparse / sparingly (< 10 shoots per 0.1 m^2);
patchy (<5 shoots per 0.1 m^2).

The macrofaunal compositions of the seagrass beds were determined using a methodology adapted from English *et al*. (1994). A beam trawl (1.3 m wide, 0.5 m high, mesh size-2 inches) was towed behind a small boat over the seagrass beds. Tows were carried out for two minutes at two knots, parallel to the shore and opposite the flow of the surface current. The faunal species collected were counted, measured and identified as far as possible using identification keys. Plant species collected in the trawls were also identified using taxonomic text.

3.3 Limitation to Study

Total suspended solids (TSS), total nitrogen, total phosphates and chlorophyll '*a*' concentration were measured at selected sites with heavy human activities. Limited resources precluded the measurement of these parameters at all sites.

4.0 RESULTS

The distribution of seagrass communities around Trinidad and Tobago is shown in Figures 2, 3 and 4. Three seagrasses species were recorded in Trinidad. They are *Thalassia testudinum*, *Halophila decipiens* and *Halodule wrightii* (Plates 1, 2 and 3). An additional species, *Syringodium filiforme* was recorded in Tobago (Plate 4). In most cases, the seagrass beds were intermixed with fleshy macro-algal species. The most common genera of algae were *Dictyota*, *Acanthophera, Padina*, *Sargassum*, *Caulerpa*, *Chaetomorpha*, and *Codium* (Plates 5-11).

4.1 Seagrass Distribution around Trinidad

4.1.1 Off-shore Islands

Chacachacare Island

Surveys were conducted in Chacachacare Bay, on the southeastern side of the island. Seagrasses were found in Corbeau (Embaracadere) Bay, Perruquier Bay, Sander's Bay, Bulmer's Bay and Rust Bay (Figure 5). These are little inlets within the larger Chacachacare Bay.

In Corbeau Bay, *Halophila decipiens* was observed growing on a sandy substrate amongst Finger Coral (*Porites porites*) and macro-algal species, in the western corner of the bay. *Halophila* was sparsely scattered among the corals, at a depth of about 10 m. Macro-algal species included *Acanthophera spicifera* and *Caulerpa sertularoides*, while the fauna included sponges, *Callinectes* crabs and hermit crabs. White mangrove (*Laguncularia racemosa*) trees were observed fringing the bay. Sparse *Halophila* grasses were also observed growing among *Porites* beds in Perruquier Bay.

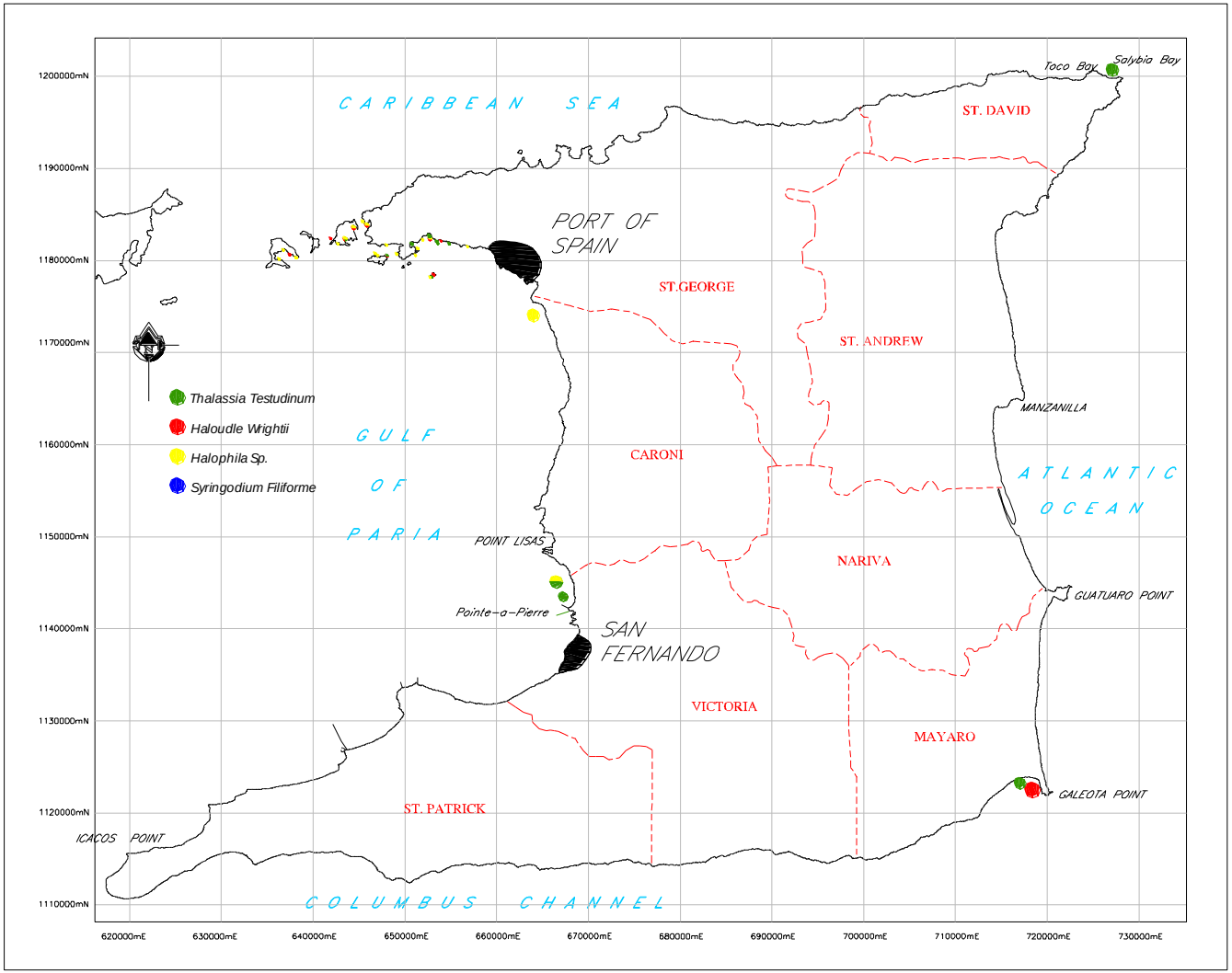

FIGURE 2: SEAGRASS DISTRIBUTION AROUND TRINIDAD

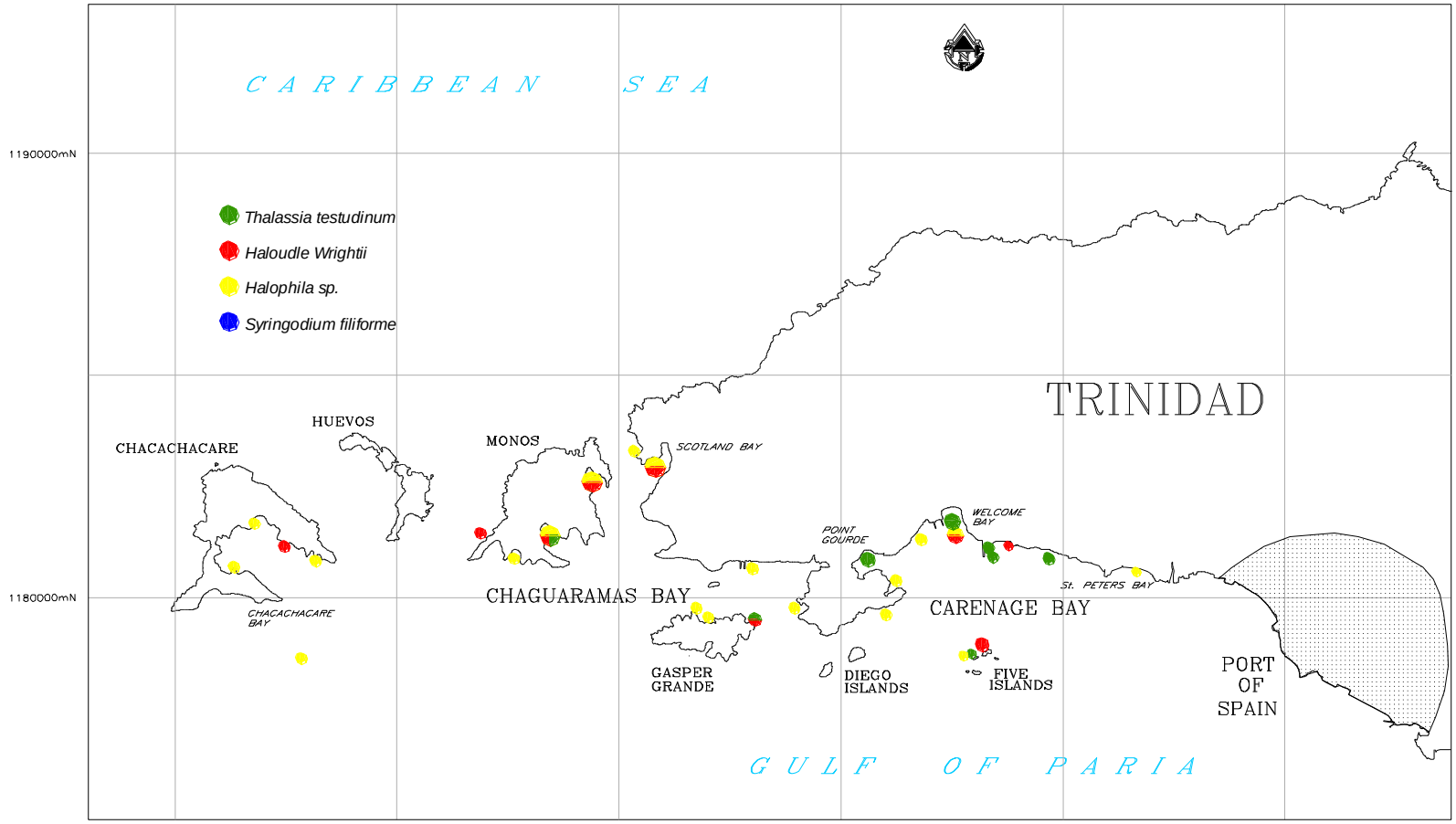

FIGURE 3: SEAGRASS DISTRIBUTION ALONG THE NORTHWESTERN PENINSULA OF TRINIDAD

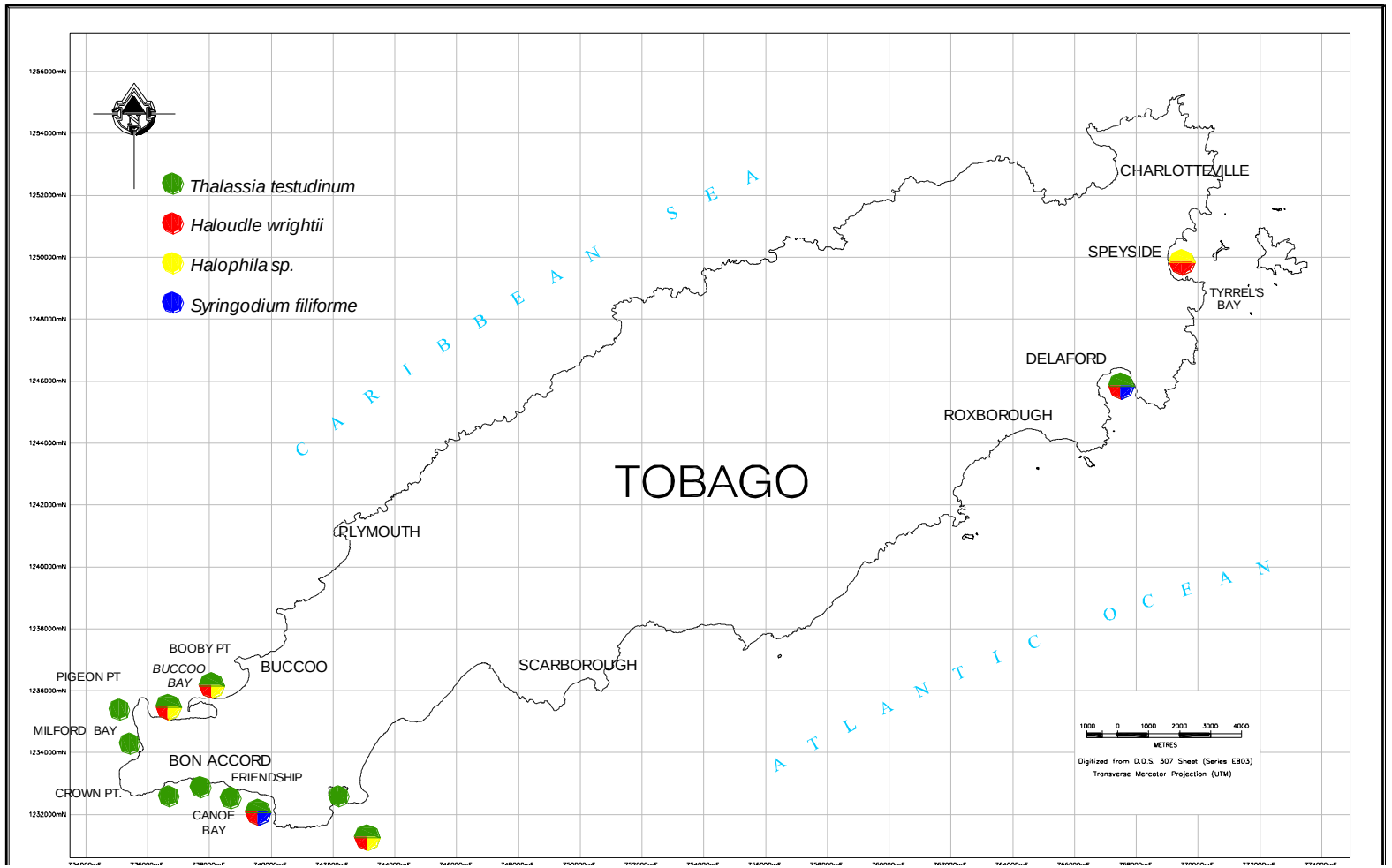

FIGURE 4: SEAGRASS DISTRIBUTION AROUND TOBAGO

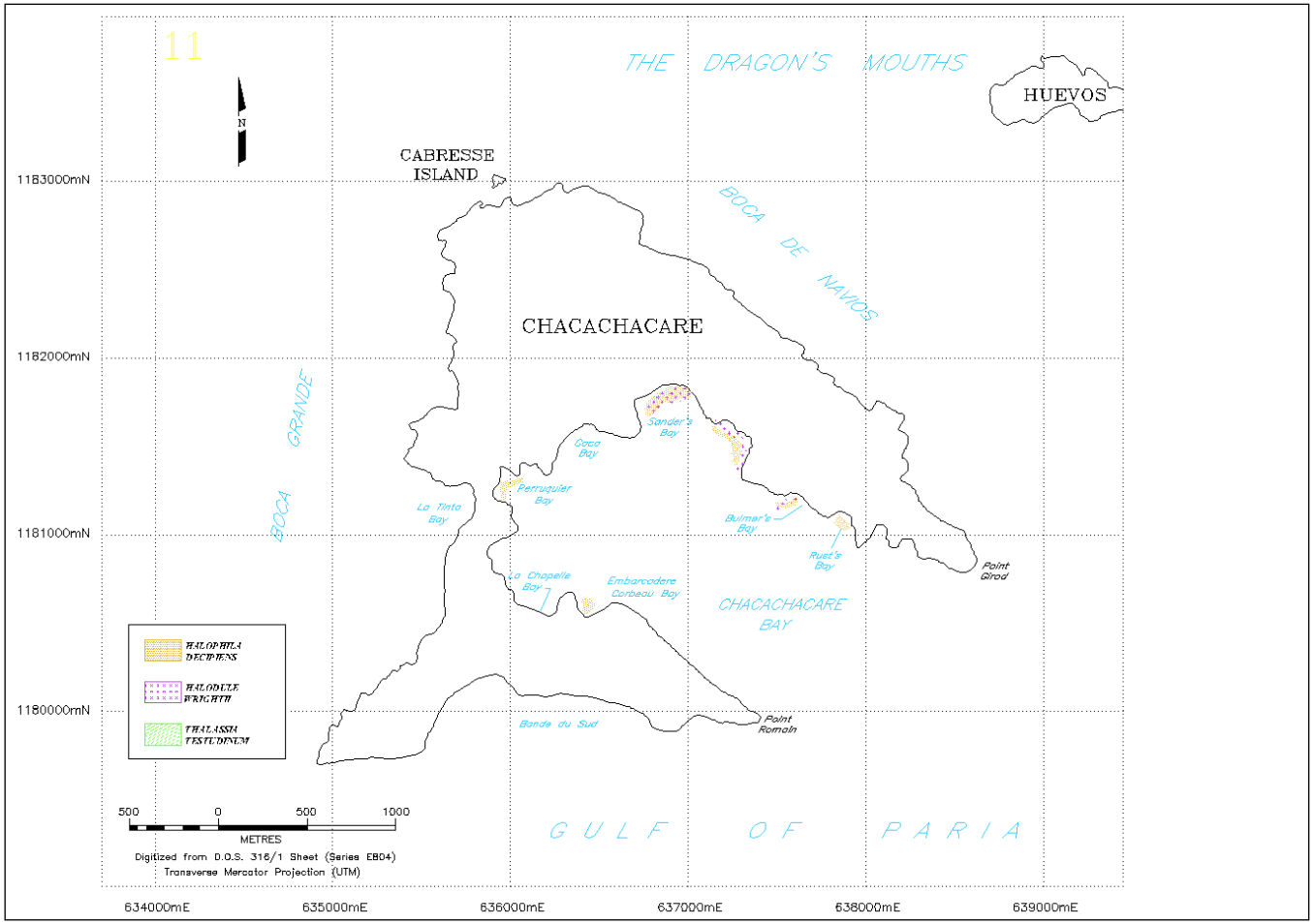

FIGURE 5: SEAGRASS DISTRIBUTION AROUND CHACACHACARE ISLAND, TRINIDAD

In Sander Bay, a popular bathing beach known as Golden Beach, both *Halodule wrightii* and *Halophila* sp. were observed along the entire width of the bay (east to west), about 20 m from the coastline. The seagrasses were sparsely distributed throughout the sandy bay, with some areas being denser, and with *H. wrightii* being the more dominant species, interspersed with *Halophila*. The seagrasses were found from a depth of 0.5 m to 2.0 m and extended to the point on the western end (Figure 5). Outside of the bay, *Codium isthmocladium* was observed.

Just southeast of Sander's Bay, *H. wrightii* and *Halophila* sp. were observed sparsely distributed, along the coastline among *Porites* beds. *Halodule* was found closer inshore, while *Halophila* was found just seaward of *Halodule*. In Bulmer's Bay, both *Halophila sp*. and *Halodule wrightii* were observed sparsely distributed, near the main jetty, on the western end of the bay. On the eastern end of the bay, *Porites* were found interspersed with macroalgae. In Rust's Bay, a relatively dense *Halophila* area was found approximately 100 m off the coastline, in water approximately 2-2.5 m deep. The area was a thin band extended from west to east, growing on a sandy substrate. La Chapelle Bay, Coco Bay and Point Girod were also surveyed but no seagrasses were found, just macro-algal species.

Chacachacare Island was surveyed on the 19th April 2001, in the midst of the dry season. Visibility was extremely good, so much so, the seafloor was visible from the boat up at 11 m depth. Salinity was recorded at 34 ‰, and total suspended solid concentration in La Chapelle Bay was 2.58 mg l^{-1}(Table 2). Beam trawl surveys were not conducted around the island since the beds were sparse. Chacachacare Island had very little built development near the coastline.

TABLE 2: Total Suspended Solids Concentrations (TSS) mg l^{-1} measured at 1m depth

Location	Date	TSS mg l^{-1}
La Chaphelle Bay, Chacachacare Island	19-04-01	2.58
Balmoral Bay, Monos Is	20-04-01	2.20
Grand Fond Bay, Monos Is	25-04-01	2.10
Pierre Bay, Monos Island	02-08-01	1.20
Morris Bay, Monos Island	25-04-01	2.10
East Morris Bay	02-08-01	1.20
West Morris Bay	20-08-01	0.70
St Mary's Bay, Gaspar Grande Is.	08-05-01	2.60
Pelican island	12-06-01	1.10
Ansa Paqua Bay	01-05-01	3.85
Scotland Bay	01-05-01	3.15
	02-08-01	1.20
Chacacabana Beach Resort	03-05-01	2.60
Escondida Cove, Pt. Gourde	03-05-01	5.50
Small Boats, Hart's Cut	15-05-01	5.67
Carenage Bay, by the hanger	11-05-01	5.01
Williams Bay, Carenage	15-05-01	2.60
West of Alcoa, Carenage	15-05-01	4.09
St Peter's Bay, E. of Alcoa	17-05-01	5.41
TTYC, East of Jetty	11-05-01	7.06
Southeast of TTYC	22-05-01	6.08
Hermitage River, Claxton Bay	22-06-01	1.40

Bays on Huevos Island were surveyed on the 20th April 2001. No seagrasses were recorded. Macroalgal species such as *Codium isthmocladium* and *Dictyota* spp. were collected in Tortue Bay.

Monos Island

Bays on the southern, sheltered side of Monos Island from Cape Cola to Blanchette Point were surveyed on the 20th April 2001. Seagrasses were recorded in Balmoral Bay, Grand Fond Bay, Tardieu Bay, Pierre Bay, South of Dominque Point, and Morris Bay (Figure 6).

In Balmoral Bay, a sparse *Halophila* sp. area was observed in the center of the Bay, closer to the western corner. The area extended from about 10 m from the coast at a depth of 4-6 m. The grasses were growing among rocks and were interspersed with macrolagae such as *Sargassum sp.* Salinity in the bay was 35 ‰, and visibility was good even though an oily film was observed on the surface of the water. TSS concentration was 2.2 mg l^{-1}. Houses were situated along the coastline of this bay.

In Grand Fond Bay, *Halophila* sp. was found in sand patches among rocks and *Porites*, on the northwestern end of the Bay (Figure 6). It was sparingly distributed near the coastline at a depth of 2-3 m. *Halodule wrightii* were found on the eastern side of the large jetty that was located in the center of the Bay. *Halodule* was sparsely distributed less than 0.5 m from the shoreline, in shallow waters (0.5-1 m). A small patch of *Thalassia testudinum* (about 1.5 m X 1m) was also found on the eastern side of the large jetty, on the coastline in shallow water (<0.5 m).

Visibility was high in Grand Fond Bay. Secchi reading was 8 m while salinity was 35 ‰. TSS concentration was 2.1 mg l^{-1}. White mangroves (*Laguncularia racemosa*) and coconut trees (*Cocos nucifera*) fringed the inner bay areas. Besides the jetties, there

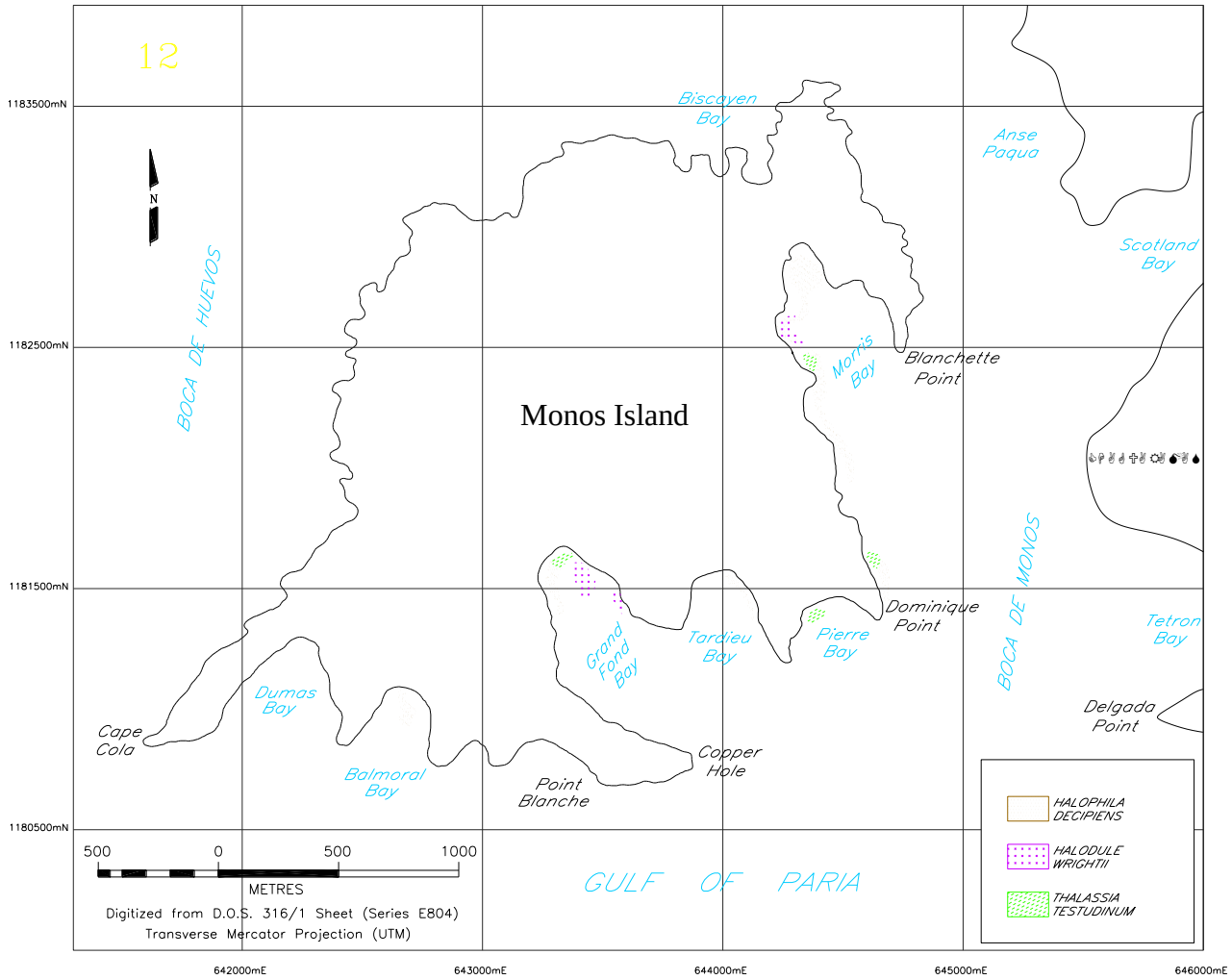

FIGURE 6: SEAGRASS DISTRIBUTION AROUND MONOS ISLAND, TRINIDAD

was very little coastal development. On the southwestern end of the bay, *Porites* beds were observed in water more than 3 m in depth. In the eastern end of Tardieu Bay, *Halophila* sp was observed growing in sandy patches among rocks and *Porites*. The seagrasses were sparsely distributed, about 10 m from the coast. In Pierre Bay, a small patch of *Thalassia testudinum* was found among rocks in the inner (northern end) bay area. This bay is about 2 m deep and had a salinity of 36 ‰. Unlike Grand Fond Bay, Tardieu Bay and Pierre Bay were surrounded by coastal development, mainly houses.

On the eastern corner of Dominique Point, *Halophila* sp. was found sparsely distributed among dense green filamentous algae (Chaeto*morpha* sp) and *Porites*, at a depth of 2 m. Further north in what is referred to as Tucker's Bay, *Thalassia testudinum* and *Halophila sp.* was found amongst green filamentous algae (*Chaetomorpha* sp) and *Porites*. *Halophila* was also observed along the coastline, southwest of Morris Bay in a narrow strip (< 1m). It was sparsely distributed among macro-algae and rocks at a depth of about 2 m. Fish species observed visually in this area include puffers, mullets, grunts, and French angelfish.

Within Morris Bay, there is coastal development that comprises mainly houses and jetties that separate the larger bay into little pocket beaches. On the southwestern corner of Morris Bay, directly opposite Blanchette Point, a small *Thalassia testudinum* patch (about 3.0 m X 3.0 m) was seen near to a jetty (Figure 6). The bed was mixed with *Halophila* sp. and the brown macroalgae *Dictyota* sp. This seagrass bed was in front of a housing complex.

Throughout most of Morris Bay, *Halophila* sp. was observed growing sparingly on sand. *Halodule wrightii* was found growing along the coastline in the northwestern corner, between Boca Chica and C'est La Vive houses. The *Halodule* area was mixed with the brown macroalgae- *Dicyota* sp., *Padina sanctae-crucis* and *Sargassum* sp. Near the jetty by C'est La Vive, a relatively thicker *Halophila* bed was found, while a small *T. testudinum* (approximately 10 X 2.0 m) bed was found near Chateau J Bees at less than 0.5 m depth. The water in the inner (northern) side of Morris Bay was murky with a

secchi reading of 2.0 m and depth of 2.4 m. TSS concentration in the center of the bay was 2.1 mg l^{-1}.

Relatively dense areas of *Halophila* and *Halodule* were also found on the coastline in the northeastern section of Morris Bay in water less than 0.5 m in depth. At spring low tides, these seagrasses are exposed. This seagrass area fronts a homestead and there is evidence of solid waste disposal in this section of the bay. Faunal species recorded in beam trawl include Crapaud fish (*Bactracoides surinamensis*), Panaeid shrimp and gobies. On the eastern side of the Bay towards Blanchette Point, dense green filamentous algal (*Chaetomorpha* sp) mats were observed growing over *Porites* beds. Fishermen expressed fear that this alga might overgrow the corals. Water quality parameters such as total nitrogen, phosphates and Chlorophyll-*a* concentration were measured for these areas. The results are presented in Tables 3 and 4. Dumas Bay and Biscayen Bay (northern side of the island) were also surveyed but there were no seagrasses.

Gaspar Grande Island

Gasparillo and Gaspar Grande Islands were surveyed for seagrasses on the 8th May 2001. No seagrasses were recorded for Gasparillo Island. However, around Gaspar Grande Island, patches of seagrasses were recorded in St. Madeleine Bay, St Mary's Bay, Goodwill Bay and near Fantasy Island Holiday Resort. These seagrass areas were interspersed with green and brown macro-algae. A large amount of macro-algae were observed around the entire island.

In St Madeleine Bay, the seafloor was covered with mainly macro-algae interspersed with some Finger corals (*Porite sp*.). Macro-algae species recorded included *Padina sanctae-crucis*, species of *Caulerpa*, *Dictyota* sp., *Chaetomorpha* sp., *Codium isthmocladium*, and *Sargassum* sp. Small patches of *Halophila* sp. were observed growing between *Chaetomorpha* (green filamentous alga) in the inner (southern) region of the bay. The depth of the Bay was 5.5 m, salinity was 35 ‰ and the secchi reading

TABLE 3: Water nutrients (N and P) and Chl '*a*' concentrations at 1 m depth measured on 26-04-01 (dry season) and 02-08-01 (wet season)

Location	Bearings	Dry season			Wet season		
		TN µM l^{-1}	**TPO_4-P µM l^{-1}**	**Chlorophyll l-*a* µg l^{-1}**	**Total N µM l^{-1}**	**TPO_4-P µM l^{-1}**	Chlorophyll -*a* µg l^{-1}
Pierre Bay, Monos Island	N-1181348.02 E-64454.62	31.9	0.8	1.0	83.4	0.4	1.0
West Morris Bay, Monos Is.	N-1181911.6 E-644511.94	17.4	0.8	1.0	31.1	0.4	1.8
East Morris Bay, Monos Is.	N-1182652.66 E-644656-07	33.1	0.7	0.8	30.8	0.3	1.4
Scotland Bay	N-1183469.75 E-645955.37	16.5	0.8	1.3	47.7	0.6	2.1

was 5.0 m. In St Mary's Bay, small patches of *Halophila* sp were observed growing among *Chaetomorpha* in the inner, shallow areas of the bay. The entire bay was covered with this green filamentous alga.

Most of Goodwill Bay was covered with a dense area of macro-algae including *Caulerpa mexicana*, *Caulerpa sertularoides*, *Codium* sp., species of *Dictyota* sp., and *Padina sanctae-crucis*. In the center of the bay, close to shore at a depth of < 0.5 m, a small patch of *Thalassia testudinum* (1 m^2) was recorded intermingled with *Halophila sp. Halophila sp* and *Halodule wrightii* were also found near the shoreline, adjacent to the Fantasy Island Holiday Resort in shallow waters, less than 1 m. The grasses were sparingly distributed on sandy substrate in this bathing beach area and were interspersed with algae including *Codium* sp., species of *Caulerpa* and *Dictyota*, *Padina* sp., and *Chaetomorpha* sp.

Winn's Bay, Mikos Bay, L'anse Ma Tome Bay, Bombshell Bay and Borbel Bay were also surveyed. Though macro-algae were observed, seagrasses were not found. Most of the bays in Gaspar Grande Island have coastal infrastructure, mainly guesthouses. A number of houses were still under construction.

Five Islands

The Five Islands were surveyed on the 12th June 2001. Seagrasses were observed around Pelican Island, Caledonia Island, Craig Island and Nelson Island (Figure 7). No seagrasses were found around Lenagan Island. Sparse *Halophila* areas were observed growing among rocks, in sandy patches, on the northern side of Pelican Island. The grasses were found at 2.5 m depth with the macroalgae *Caulerpa* and *Sargassum*. Salinity was 34 ‰ and visibility was good, straight to the bottom.

On the southern side of Caledonia Island, patches of *Thalassia testudinum* intermixed with *Halodule wrightii* were observed in a sandy bay, at a depth of about 1.5 m. *Halophila* sp. was found sparingly distributed near the wall between Caledonia and Craig Islands, while a small *Thalassia* bed was also observed on the western side of Caledonia

FIGURE 7: SEAGRASS DISTRIBUTION AROUND FIVE ISLANDS, TRINIDAD

interspersed with macroalgae, *Codium* and *Caulerpa*, at a depth of about 1-2 m. This area is used as a bathing beach and was heavily littered with plastics and bottles. *Halophila* sp was also found on the northern side of Nelson Island, sparingly distributed at a depth of around 2 m.

4.1.2 North-western Peninsula

Anse Paqua Bay

Just northwest of Scotland Bay, in Anse Paqua Bay, a popular bathing beach, a relatively sparse *Halophila* bed was observed about 200 m offshore at a 3.4 m depth. The bed extended the length of the bay (north to south) and was about 100 m in width, growing on sandy substrate. Further offshore it was mixed with *Porites* porites. Faunal species observed were fighting conch (*Strombus pugilis*), ctenophores and cannonball jellyfishes. Salinity was 36 ‰ and visibility was good. Total suspended solid concentration was 3.85 mg l^{-1}.

Scotland Bay

Scotland Bay was surveyed on the 26th April 2001. On the northern side of Scotland Bay, near the mangrove area, patches of *Halophila* were found interspersed with the macroalgae- *Dictyota* and *Acanthophera spp.* (Figure 8). *Halophila* was found at about 4 m depth growing on a muddy substrate. Faunal species collected include Fighting conch (*Strombus pugilis*), sea cucumber and juvenile scorpionfish (*Scorpaena* sp.).

On the southwestern side of Scotland Bay, around the point, *Halodule wrightii* was found sparingly distributed in the sandy bathing beach area, about 2 m in depth. Further offshore, *Halophila* was found in little pockets being overgrown by a green filamentous alga (*Chaetomorpha* sp.). Depth was more than 11 m, while secchi reading was 6.5 m. Total suspended solid concentration was 3.15 mg l^{-1}.

During surveys in April 2001, a green filamentous alga (*Chaetomorpha* sp.) was observed in dense mats, close to the shoreline overgrowing *Porites* bed and seagrasses (Plate 10). This green filamentous alga was especially noticeable around Gasper Grande

Island, in Morris Bay, Monos Island and on the southwestern side of Scotland Bay. In these areas total nitrogen (TN), total phosphorus (TP) and Chlorophyll *'a*' concentrations were measured in the water at 1m depths (Table 3). TN and chlorophyll '*a*' concentrations were generally higher in the wet season while total phosphorous was higher in the dry season. In the wet season (August 2001), this alga species was not as abundant as in the dry season, and dead plants were found in the Scotland Bay area.

A relatively dense *Halophila* bed was also observed at 1.5 m depth, along the coastline, South of Scotland Bay, directly opposite Blanchette Point, Monos Island. The bed was very narrow (< 10 m in width) and extended for about 30 m along the coastline, about 2 m off shore. The grasses were growing in sandy patches amongst rocks and coral (*Porites*). *Halodule wrightii* was found among the *Halophila*.

Dense *Thalassia testudinum* beds were once recorded in the inner region of Scotland bay, in the early 1980's (Alkins and Kenny, 1980). In 1997 and now in 2001, *Thalassia* beds were not found in Scotland Bay but just sparse areas of *Halodule* and *Halophila*. Scotland Bay is popular for camping and bathing and this is evident by the amount of solid waste seen along the coastline. This beach is also used for anchoring of yachts.

Chaguaramas Bay

Chaguaramas Bay in this study refers to the area west of Point Gourde, from Teteron Bay to Cruise Inn. This area was surveyed on the 3rd May 2001. *Halophila* sp. was only found in the constructed beach area; Chacabana Beach Resort, just southwest of the Dry Dock (Figure 8). The relatively dense *Halophila* bed was observed about 100 m offshore, along the length of the beach at a depth of 4.5 m. The bed was about 10 m wide. Visibility was fairly good in the bay, with a total suspended solid concentration of 2.6 mg l^{-1}. The faunal species observed was *Callinectes* sp.

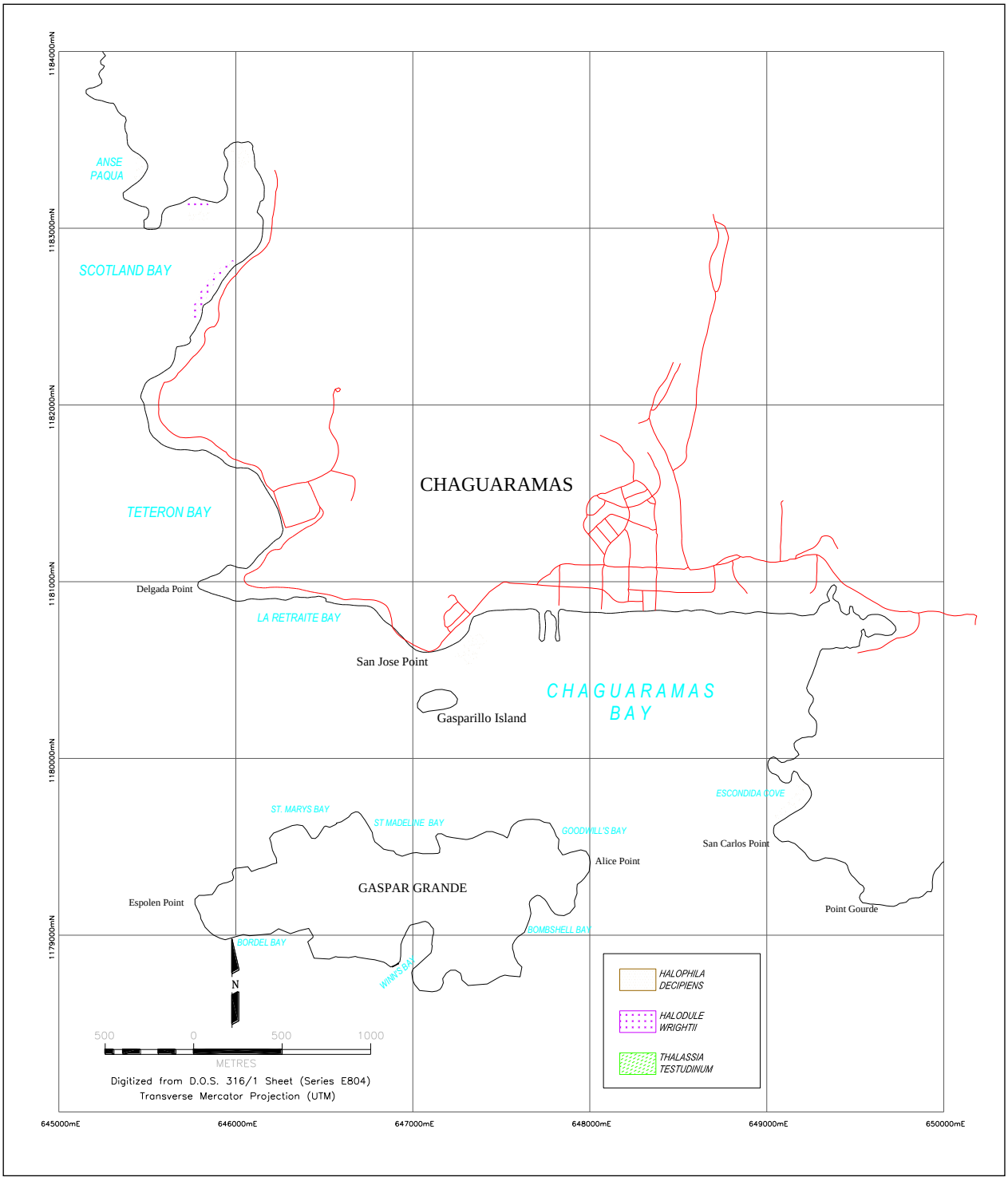

FIGURE 8: SEAGRASS DISTRIBUTION IN SCOTLAND BAY AND CHAGUARAMAS BAY, TRINIDAD

Generally, the water in Chaguaramas Bay had low visibility. This area of coastline is well built up with a number of mariners and dry dock facilities. Parts of the bay have been dredged to facilitate these activities.

Point Gourde

Point Gourde was surveyed on the 3rd and 11th May 2001. Seagrasses were recorded at Escondida Cove, Telephone Bay, southwest of Alice Point and in Masson's Bay. In Escondida Cove, little pockets of *Halophila sp.* were observed interspersed with macroalgae, throughout the shallow area of the bay, at a depth of 2 m (Figure 8). Macro-algal species included *Codium* sp., *Padina sp*., *Caulerpa sertularoides*, *Caulerpa mexicana* and *Chaetomorpha* sp. Salinity in the bay was 35 ‰ and total suspended solid concentration was 5.5mg l^{-1}. Around the point, north of Escondida Cove, *Porites* sp. was covered with filamentous algae. Further north, the sea was dredged to facilitate docking/ jetties for large ships.

Patches of *Halophila* sp. was found in sandy areas near the coastline in Telephone Bay, at a depth of 3 m (Figure 9). *Halophila* was interspersed with macroalgae and *Porites* sp. Macroalgal species observed included *Padina* sp., *Codium* sp., *Caulerpa* sp. and *Dictyota* sp. *Halophila* patches were also found further out, approximately 100 m offshore. Salinity in the area was 35 ‰. Patches of *Halophila* sp. were also found in sandy areas near the coastline, south of Alice Point. This area of coastline was rocky with high wave energy.

In Masson's Bay, small patches of *Halophila* sp. interspersed with green filamentous algae were observed on the northern end of the bay, close to the shore. This bay was previously a quarry and was dredged to allow large boats to enter. The bay was muddy and is now used as a dumping ground for old barges and boats. Coastal vegetation in this area included white (*Laguncularia racemosa*) and red (*Rhizophora mangle*) mangroves and seaside mahoe (*Thespesia* sp.)

Carenage Bay

Carenage Bay in this study refers to the area east of Point Gourde from Hart's cut to the mouth Diego Martin River. The entire bay was surveyed on the 11th, 15th, 17th and 22nd May 2001. The most extensive *Thalassia testudinum* dominated beds, along the Gulf of Paria coastline, were recorded in Small Boat (north of Hart's cut), Williams Bay and St Peter's Bay while *Halophila decipiens* patches were observed near the Heliport hanger, by Trinidad and Tobago Yacht Club and west of the Diego Martin River mouth (Figure 9).

i. Small Boats

Just North of Hart's Cut, in the bay commonly referred to as Small Boats, a *Thalassia testudinum* bed, approximately 2 m wide extended for about 100 m, west to east. In the eastern side, the bed extended more than 50 m offshore. The *Thalassia* bed was patchy, with some area being denser than others. *Halophila decipiens* were seen growing on the seaward side of the *Thalassia* bed. Macro-algal species recorded amongst the seagrasses were *Caulerpa* sp. and *Dictyota* sp. The grasses were growing on a sandy substrate, at a depth of 1 m. Salinity was 35 ‰ and the water was turbid with a total suspended solid concentration of 5.67 mg l^{-1}. A list of fauna species recorded in beam trawl is presented in Table 4.

Table 4: Faunal species caught in beam trawl surveys in Small Boats, Carenage Bay

# RECORDED	COMMON NAME	SCIENTIFIC NAME	AVE. LENGTH (TOTAL) CM
2	Southern puffer	*Sphoeroides testudinus*	9.7
3	Filefishes	*Monocanthus* sp.	7.5
1	Flounder		9.8
1	Seahorse	*Hippocampus* sp.	11.0
8	Serrette crab	*Callinectes* sp.	
> 100	Snails		

Small Boats is used as a bathing beach, as well as anchorage for yachts. The area is heavily littered with solid waste material, which piles up on the western end of the bay.

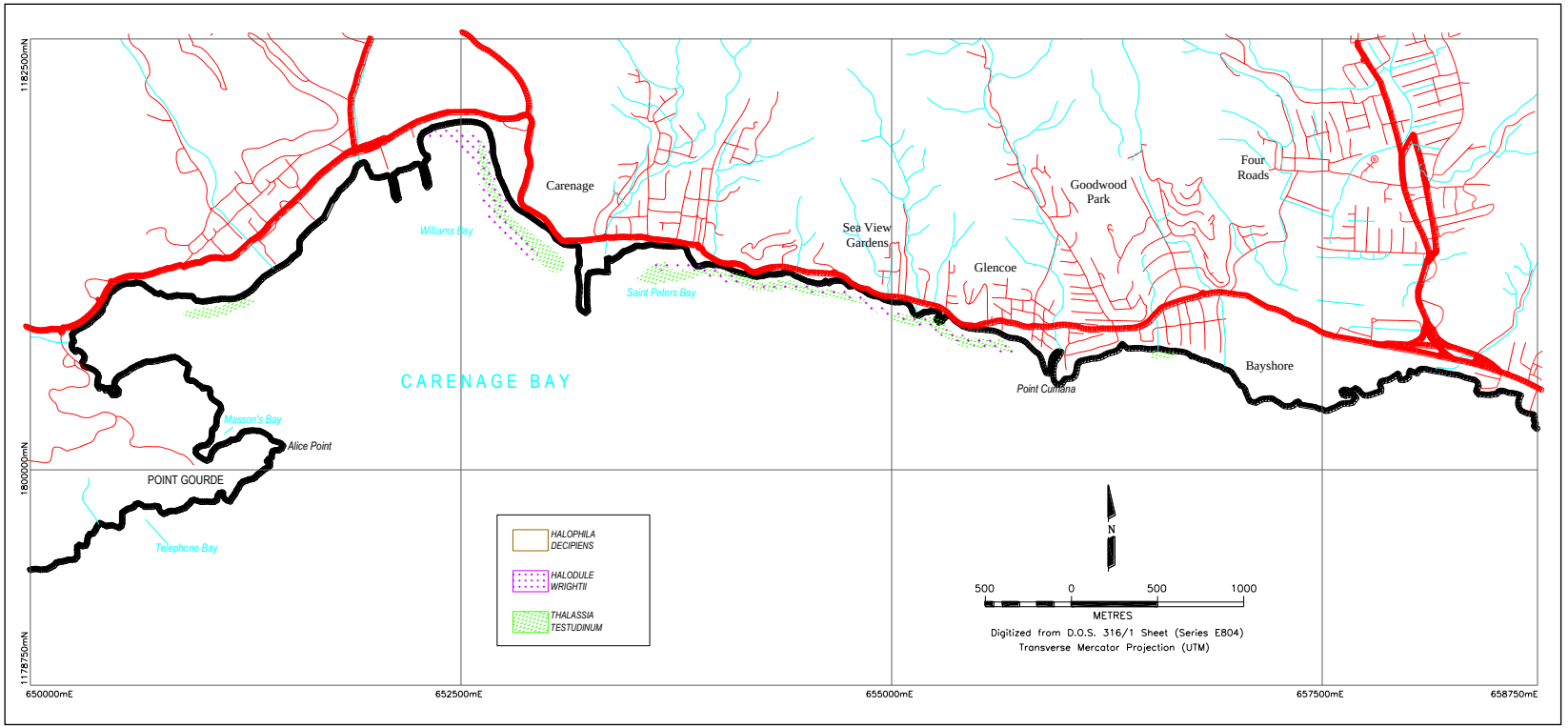

FIGURE 9: SEAGRASS DISTRIBUTION IN CARENAGE BAY, TRINIDAD

In front of the Heliport hanger, east of Small Boats, a concrete platform extends along the coastline. Seaward of this platform, *Halophila* was found growing sparingly on a sandy substrate, at 1.3 m depth. Total suspended solid concentration was 5.01 mg l^{-1}. Just northeast of the hanger, directly in front of the Chaguaramas Convention Centre, an artificial beach was created. *Halophila* was not observed in this area. However, further east, just west of the Cuesa River mouth, approximately 30 m offshore, sparse patches of *Halophila decipiens* were observed. Salinity in this area was 35 ‰.

ii. William's Bay

Extensive seagrass areas dominated by *Thalassia testudinum* and intermixed with *Halodule wrightii* were found in William's Bay. *Halophila decipiens* was found on the seaward side of the *Thalassia* (Figure 10). The beds were not continuous but patchy throughout the bay, except at the western end where they were absent. The seagrass beds were found closer to the middle of the bay and extend seaward to the first Pier One jetty to a depth of about 2.5 m. Seagrasses were found very close to shore, especially in the eastern end, and were sometimes exposed at spring low tide. Some seagrass areas were denser than others. Visibility was fairly good with total suspended solid concentration at 2.6 mg l^{-1}. Faunal species collected in the William's Bay using a beam trawl are listed in Table 5.

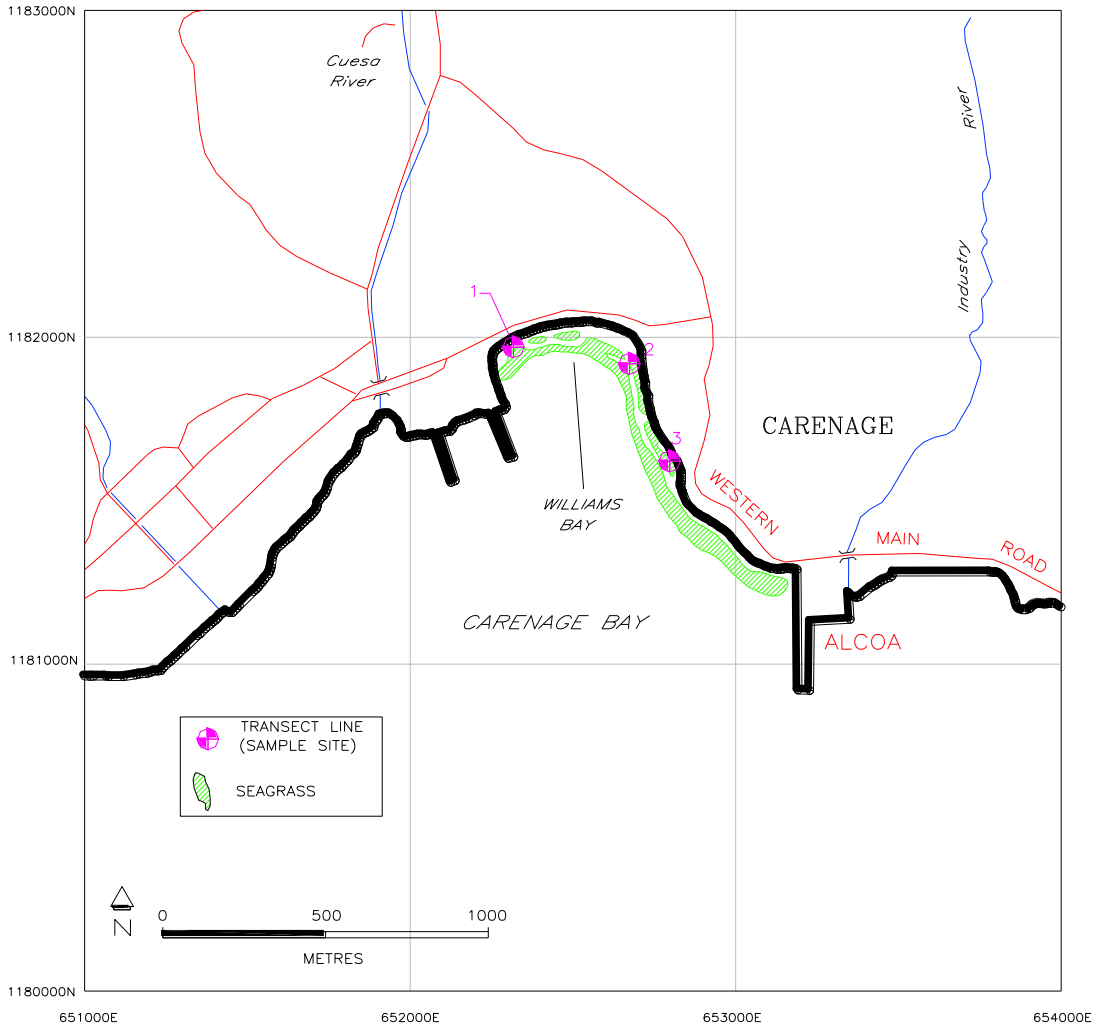

FIGURE 10: SEAGRASS COMMUNITY IN WILLIAM'S BAY, CHAGUARAMAS

Table 5: Faunal species caught in beam trawl surveys in William's Bay

# RECORDED	COMMON NAME	SCIENTIFIC NAME	AVE. LENGTH (TOTAL) CM
1	Grey snapper	*Lutjanus griseus*	13.0
1	Lane snapper	*Lutjanus synagris*	13.0
4	Grunt	*Haemulon* sp.	8.0
14	Southern puffer	*Sphoeroides testudinus.*	9.9
2	Flounder	Fam: Paralichthyidae	6.8
12	Filefish	*Monocanthus* sp.	10.1
1	Cowfish	*Lactophrys* sp.	7.0
1	Unknown fish		2.5
2	Serrette crab	*Callinectes* sp	
1	Sea urchin	*Tripneustes* sp.	
4	Sea urchin	*Lytechinus variegatus*	
2	Sea cucumbers		
8	Seahares	Fam: Cephalopoda	
2	Conch		
3	Snails	*Murex* sp.	
> 50	Snails	Fam: Conidae	
2	Arrowhead crabs		
1	Spider crab	Fam: Majidae	
1	Starfish	*Echinaster* sp.	

On the southeast side of William's Bay, west of Alcoa, a relatively dense *Thalassia* bed extended approximately 100 m offshore. *Halophila decipiens* was found seaward of the *Thalassia*. The beds extended to about 2-3 m in depth. Closer to the Alcoa jetty the bed became patchier, and ended about 40 m off Alcoa. The beds were interspersed with macroalgae, which included *Acanthophera* sp., *Padina* sp. and *Dictyota* sp. French angelfishes were caught in an old fish pot in this area. Other species observed were puffers and crapaud fish (*Bactracoides surinamensis*)

William's Bay is one of the most popular recreational beaches in Chaguaramas. It is used both for bathing and fishing and was re-sanded in August 2001 by the Chaguaramas Development Authority (CDA). The bay is heavily littered with solid waste especially after heavy rains. Waste is washed in from the ocean.

iii. St Peter's Bay

East of Alcoa, directly in front of market, *Halodule wrightii* were found interspersed with macroalgae- *Caulerpa sertularoides* and *Codium* sp. at 2 m depth. Further east, west of the Health Centre, small dense patches of *Thalassia testudinum* interspersed with *Halodule wrightii* were observed. *Halophila decipiens* patches were found between *Thalassia* patches.

An extensive seagrass community dominated by *Thalassia testudinum*, extended just east of the Health Centre along the coast to Seaview Gardens, west of the reclaimed point (Figure 11). This community was interspersed with *Halophila decipiens* and *Halodule wrightii* and with macroalgae that were closer to shore. Macro-algal species include *Caulerpa mexicana, Caulerpa sertularoides, Codium* sp., *Sargassum* sp. *Acanthophera spicifera, Padina* sp. and *Dictyota* sp. Faunal species collected in beam trawl surveys are presented in Table 6

This community was not continuous or uniformed; some areas were patchier that others. The bed varied in width from < 4 to about 50m. Most areas were however narrow, less

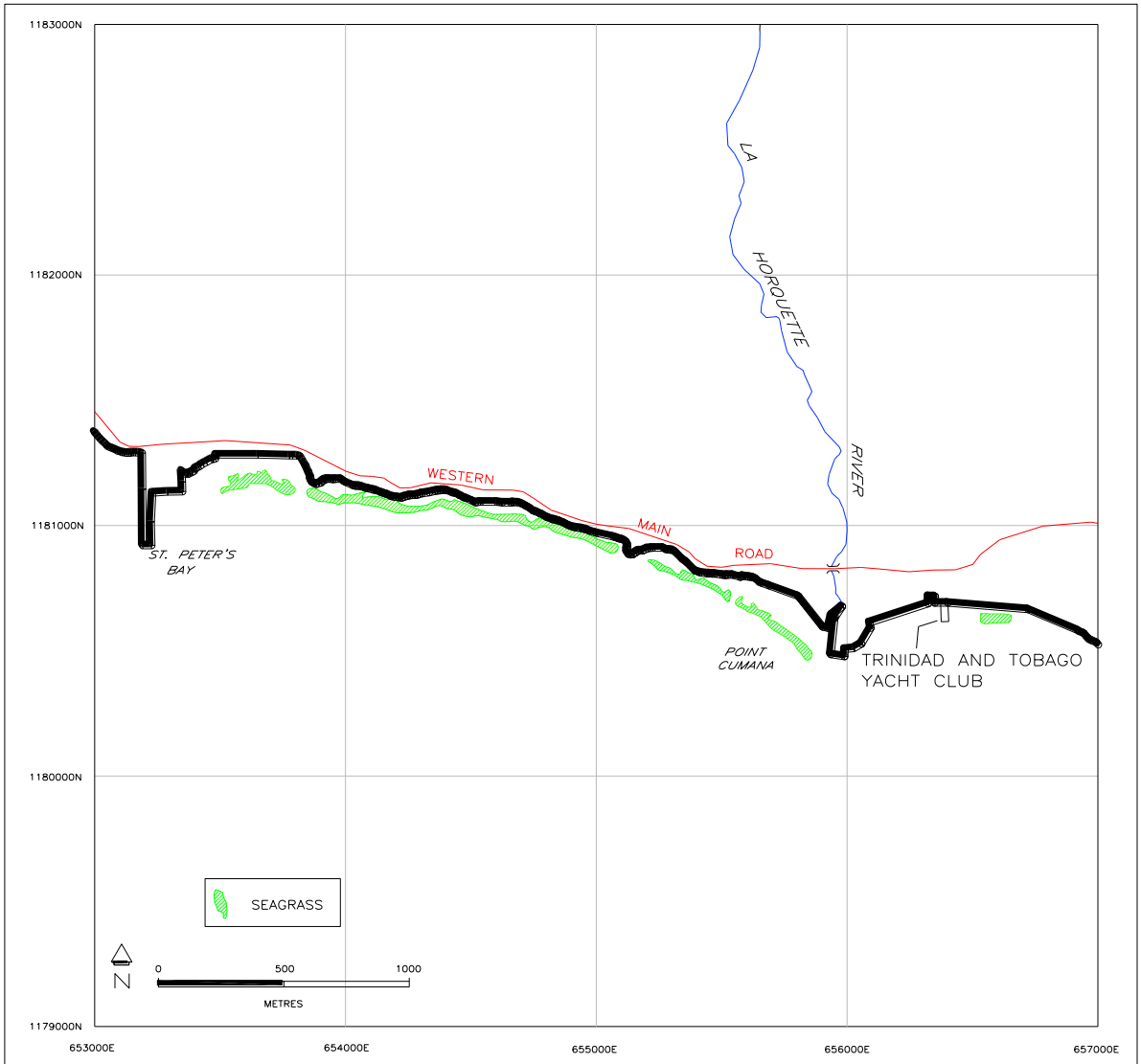

FIGURE 11: SEAGRASS DISTRIBUTION IN ST. PETER'S BAY AND NEAR THE TRINIDAD AND TOBAGO YACHT CLUB *Source: (Alleng and Juman, 1997)*

Table 6: Faunal species caught in beam trawl surveys in St Peter's Bay

# RECORDED	COMMON NAME	SCIENTIFIC NAME	AVE. LENGTH (TOTAL) CM
1	Filefish	*Monocanthus* sp.	9.0
1	Lane snapper	*Lutjanus synagris*	13.0
1	Tongue fish	*Symphurus* sp.	7.2
1	Flying guarnard	*Dactylopterus volitans*	13.8
6	Sea hares		
1	Serrette crab	*Callinectes* sp.	
1	Fighting conch	*Strombus pugilis*	

than 5 m and very close to the shoreline. The beds were found at depth of 0.5 -2.0 m. The water was very turbid; the secchi reading was 2 m, while total suspended solid concentration was 5.4 mg l^{-1}. On the landward side of this seagrass community, there has been hillside deforestation to facilitate housing developments. During rainy spells, extensive sediment plumes are seen over the grass beds from the land and from a reclaimed site, just east of the seagrasses. Along the coastline, a number of squatters were observed.

Large patches of *Thalassia testudinum* interspersed with macro-algae-*Padina* sp.; *Sargassum* sp. and *Acanthophera* sp. were also seen close to the coastline (about 0.5 m) on the eastern side of St Peter's Bay (east of Baba on the Bay's jetty) toward Point Cumana. The grasses were found at depths less than 0.5 m to about 2 m. Faunal species collected in this area included *Callinectes* sp., southern puffers (*Sphoeroides testudinus*), goby, and seabream (*Archosargus rhomboidalis*).

Further east of Point Cumana, in the Bayshore area, *Halophila decipiens* patches were seen on muddy substrate just east of Trinidad and Tobago Yacht Club's jetty. They were found at a depth of 1.2 m in very turbid water; secchi reading was 0.8 m and total

suspended solid concentration was 7.06 mg l^{-1}. About 40 m east of the jetty, a narrow *Thalassia* bed was observed close to the coastline at a depth of about 0.5 m- 1.0 m. There was an oil film on the water surface and visibility was low; total suspended solid concentration was 6.08 l^{-1}. Faunal species collected in beam trawl surveys are listed in Table 7.

Table 7: Faunal Species Caught in Beam Trawl Surveys East of Trinidad and Tobago Yacht Club (TTYC)

# RECORDED	COMMON NAME	SCIENTIFIC NAME	AVE. LENGTH (TOTAL) CM
2	Southern puffer	*Sphoeroides testudinus*	10.5
1	Snapper	*Lutjanus* sp.	16.7
8	Seabream	*Archosargus rhomboidalis*	6.8
1	Goby		6.8
1	Serrette crab	*Callinectes* sp.	

Sparse *Halophila decipiens* patches were seen growing on muddy substrate just west of the mouth of the Diego Martin River, in front of a residential area. This area of the coastline was reclaimed and a seawall constructed. Secchi reading was 1.3 m. Small patches of *Halodule wrightii* were also found in murky waters less than 0.5 m deep, in the Cocorite area in front of the Powder Magazine housing development.

4.1.3 Mucurapo to Caroni Swamp

The coastline from Mucurapo to Caroni Swamp was surveyed on the 22nd and 24th May 2001. No seagrasses were found in Mucurapo, Invader's Bay, Port of Spain and Sealots. It was impossible to survey the entire Caroni Swamp area because of the extensive mudflats and turbid water. However, off the Pier on the northern bank of the Blue River, *Halophila decipiens* was observed growing in patches near the mangrove roots. The patches were seen in shallow water and were most likely exposed at low tides. Salinity in this area was recorded at 37 ‰ while the secchi reading was 0.5 m.

4.1.4 Point Lisas to Godineau River

The coastline from Point Lisas to the mouth of the Godineau River was surveyed on the 29th May and 22nd June 2001. No seagrasses were recorded in the Point Lisas area, however a *Thalassia* dominated bed was found about 500 m south of the Hermitage River mouth, in Claxton Bay. The bed was found growing on a muddy substrate, at 0.5 m depth about 2 m off the coastline. It was interspersed with *Halodule wrightii* and macroalgae. It was difficult to map the exact extent of the bed since the water was murky and the day was overcast. Salinity was 35 ‰ while the total suspended solid concentration was 1.40 mg l^{-1}. Faunal species collected in this area from beam trawls are listed below in Table 8.

In a previous seagrass survey (Alleng & Juman, 1997) seagrasses (*Thalassia* and *Halophila*) were recorded in the Northern Claxton Bay area, in front of mangroves. This area was reclaimed to create an island that was planted with mangrove seedlings. Most of this mangrove island has been washed away. This entire area of the coastline has been modified, either dredged or reclaimed.

Table 8: Faunal species caught in beam trawl surveys in North Claxton Bay

# RECORDED	COMMON NAME	SCIENTIFIC NAME	AVE. LENGTH (TOTAL) CM
2	Southern puffer	*Sphoeroides testudinus*	10.5
1	Tongue fish	*Symphurus* sp.	
1	Seabream	*Archosargus rhomboidalis*	6.8
1	Moonshine	*Selene vomer*	3.0
1	Mojarra	*Gerres cinereus*	12.8
1	Pagua	*Lutjanus* sp.	7.7
14	Serrette crab	*Callinectes* sp.	
2	Fighting conch	*Strombus pugilis*	
8	Starfishes	*Astropecten* sp.	

A sparse *Thalassia testudinum* bed was also found growing at depths ranging from 0.4 to 1.0 m, seaward of the Petrotrin Compound in Pointe-a-Pierre. The seagrass was found growing about 20 m off a beach in muddy substrate, north of the Petrotrin Jetty. Faunal species recorded in this area included juvenile mullet (*Mugil* sp*), Callinectes* crabs, Fighting conch (*Strombus pugilis*), seahare and urchin (*Lytechinus variegatus).* No other seagrass area was recorded between Pointe-a Pierre and the mouth of the Godineau River.

4.1.5 Salybia Bay, Toco

Sparse patches of *Thalassia testudinum* were found among coral rubbles in Salybia Bay, just west of the Salybia River mouth. These patches were found about 40 m offshore and covered an area of about 220 m^2. These were found at a depth of 1.2 m at falling tide. *Thalassia* blades were found among macro-algae species including *Acanthophera specifera*, and *Codium* sp. and the blades were encrusted with coralline algae. Fishes visually observed included southern puffers, mojarras, snappers and grunts. These seagrass patches were found on the landward side of the Salybia fringing reef.

Patience Bay, San Souci Bay, Salibea Beach and Balandra Bay were surveyed during August 2001, however no seagrass communities were found. Seagrasses were once reported in Balandra Bay but none were found during these surveys.

4.1.6 Guayaguayare Bay

Guayaguayare Bay was surveyed on the August 7, 2001 from Pt. Galeota to Gran Cayo Point. Dense *Halodule wrightii* beds were found in the northeastern end of the Bay close to Galeota Point, in line with the eroding coastline. These beds were intermixed with *Thalassia testudinum* at a depth of about 2.5 m at falling tide. The beds were also intermixed with macro-algal species of the following genera- *Caulerpa, Padina, Sargassum* and *Gracilaria*. The water was turbid during the survey and the sea state in that bay is usually turbulent. Secchi reading was 1.9 m. Fish species recorded in beam trawls included Lane snapper, juvenile grunt, and southern puffer.

In 1997, Alleng and Juman surveyed Guayaguayare Bay and reported the presence of *Syringodium filiforme* communities. However, that was a misidentification and the species was confirmed as *Halodule wrightii* by the National Herbarium. IMA (1997) provides a species list for the seagrass bed in Guayaguayare Bay (Appendix 1). In March 2004, *Thalassia* was not observed in the northeastern side of Guayaguayare Bay.

4.2 SEAGRASS DISTRIBUTION AROUND TOBAGO

4.2.1 Buccoo Bay

A dense *Thalassia testudinum* bed was found in the southwestern area of Buccoo Bay towards Sheerbird's Point (Figure 12). The bed was found in water less than 1 m in depth at falling tide and was relatively dense with intermittent sandy patches. The bed extended from about 100 m–300 m seaward and was interspersed with corals, coral rubble, macroalgal species such as *Acanthophera* sp., *Caulerpa* sp., *Dictyota* sp., *Halimeda* sp. and sands in the back-reef area of Buccoo Reef. *Thalassia* was also found in the Buccoo Bay navigational channel and in 2003, there were reports of seagrasses growing in the Nylon Pool, a popular sandy bathing area. This has caused some concerns to Reef Tour Operators who frequently carry visitor to bath in this area. Faunal species recorded in beam trawl surveys are listed in Table 9. Young queen conchs (*Strombus gigas*) were harvested from the navigational channel and sold at Buccoo Bay. Temperature during survey was 28.0°C, salinity was 35 $^{0}/_{00}$, and secchi reading was 1m.

Table 9: Faunal species caught in beam trawl surveys in Buccoo Bay

# RECORDED	COMMON NAME	SCIENTIFIC NAME	AVE. LENGTH (TOTAL) CM
2	Bluestriped grunt	*Haemulon sciurus*	10.3
8	Redband parrotfish	*Sparisome aurofrenatum*	7.3
6	Greenblotch parrotfish	*Sparisoma atomarium*	6.3
	Slippery dick	*Halichoeres bivittatus*	4.5
2	Sea Cucumber	*Holothuria* sp	

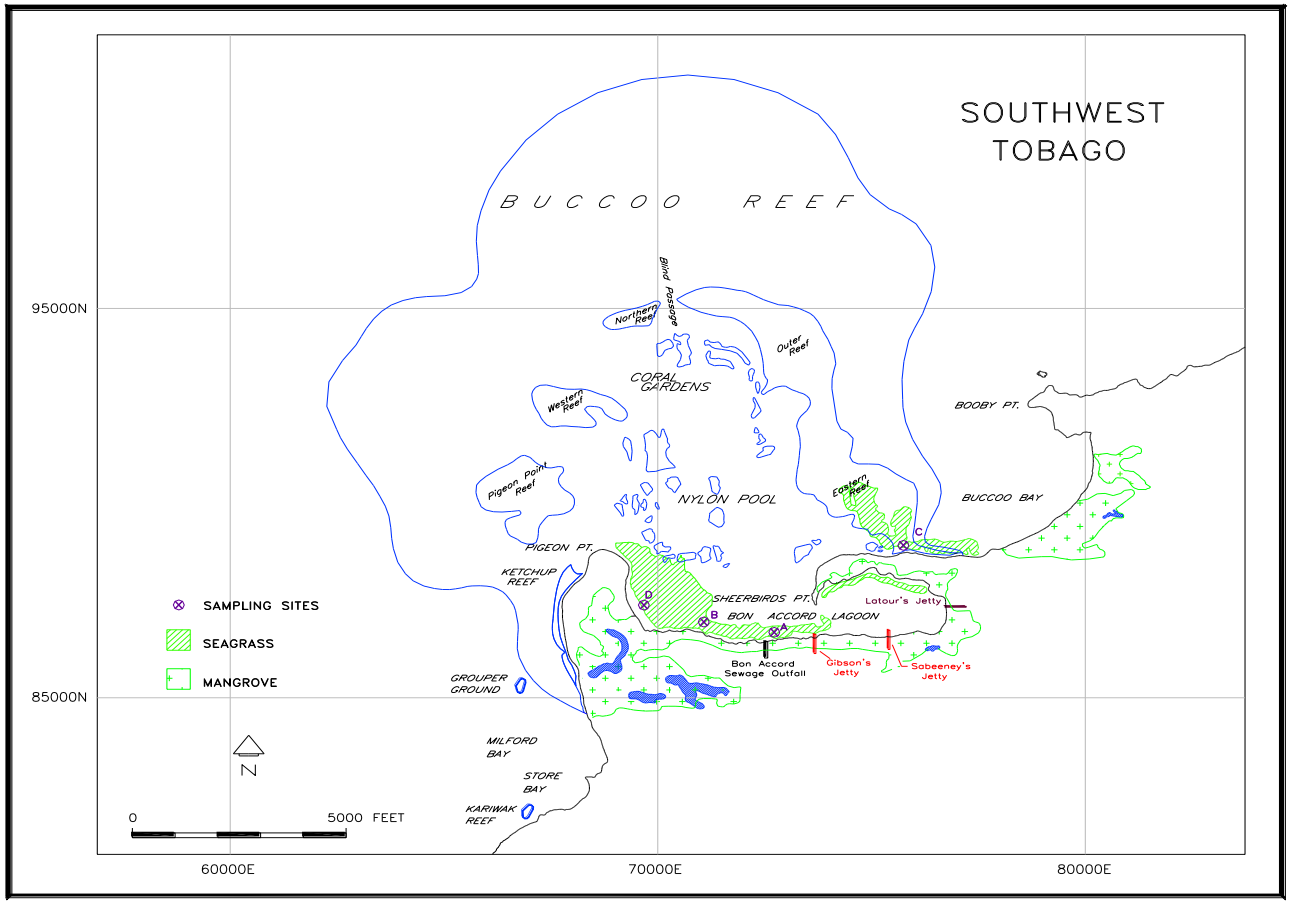

FIGURE 12: SEAGRASS DISTRIBUTION IN FROM BUCCOO BAY TO PIGEON POINT, INCLUDING BON ACCORD LAGOON

4.2.2 Bon Accord Lagoon

The seagrass community in the shallow inshore areas of Bon Accord Lagoon covers an area of approximately 54.3 ha and is one of the largest remaining communities found in the country (Juman, 2004). The seagrass beds extend in some places to a depth of approximately six metres. The grass beds are found in three main areas: north of Sheerbird's Point in the back reef area, south of Sheerbird's Point and in the Lagoon extending from east of Gibson's Jetty straight toward the south-eastern end Pigeon Point (Figure 12). Turtle Grass, *Thalassia testudinum*, was the dominant seagrass species in the Lagoon (Plate I). Smaller areas of *Halophila decipiens* and *Halodule wrightii* were also found interspersed among the Turtle Grass (Juman, 2004). The dominant algal species were from the following genera- *Acanthophora*, *Bryopsis, Padina, Dictyota*, *Halimeda* and *Caulerpa* (Alleng & Juman, 1997). Finger Corals, *Porites porites,* also occurred in the Lagoon among the seagrass beds.

The first documented productivity and biomass measurements for the seagrass beds in Bon Accord Lagoon (CARICOMP, 1997c), are listed below:

- Areal productivity-1.8 g (dry wt) m^{-2} d^{-1} for 1993-1995. Yearly average turnover rate for 1994-1995 was 3.2 % per day.
- Total seagrass biomass was recorded at 450 g m^{-2}, which is very low compared to other sites in the Caribbean.

Juman (2004) also measured seagrass productivity and biomass in Bon Accord Lagoon and reported that this community was subjected to nutrient enriched conditions from sewage effluent. Productivity of the seagrass community varied seasonally. Seagrass standing crop biomass and areal productivity was highest in the dry season and at the start of the rainy season (March - June). These parameters were also higher in the backreef area (N. of Sheerbird's Point) as oppose to the eutrophic Lagoon. Overall, seagrass standing crop varied between 2.9 metric tonnes dry wt. in the wet season and 6.0 in the dry season. Mean annual productivity was estimated at 4.2 g dry wt m^{-2} d^{-1} giving a total production of 682.0 kg dry wt d^{-1} and an annual production of 249 metric tonnes of

dry wt., which included 18 crops of leaves (Juman, 2004). Juman (2004) provides a list of fish species in the Lagoon (Appendix 2).

The most common invertebrate species found within this seagrass beds was the sea urchin, *Lytechinus variegatus* (Juman, 2004). Up to 150 *L. variegatus* were collected during a 60 m trawl in the Lagoon at night. Fewer *Tripneustes esculentus* were associated with the *L. variegates.* Crustacean species found in the seagrass bed included juvenile Spiny Lobster, penaeid shrimp which was caught only at night, snapping shrimp, and a variety of crabs including, *Callinectes spp*., which were most common.

Gastropods found in the seagrasses included *Murex brevifrons, Voluta musica, Antigona listeri, Bulla striata umbrilicata, Oliva recticularis, Cymatium vespaceum,* and *Strombus gigas*. Bivalves included *Ostrea frons, Chione cancellata, Pinctada imbricata,* and *Phacoides pectinatus* (Juman, 2004). Holothurians, ophinoids, ascidians and nudibranchs were found among the seagrasses while amphipods were found on the grass blades. Green turtles were also observed in the seagrass beds on several occasions (Juman, 2004). The turtles and sea urchins were major herbivores in the seagrass beds.

4.2.3 Pigeon Point

A dense *Thalassia testudinum* bed was found in the southeastern end of Pigeon Point Beach (as described in 4.2.2) while smaller sparse patches were found in the western end towards Milford Bay (Figure 12). In the southeastern end, the bed was found 10-20 m from the high water mark at a depth of about 1 m at falling tide, was interspersed with *Halophila decipiens* and macroalgae species such as *Dictyota* sp., *Acanthophera specifera, Caulerpa* sp., *Sargassum* sp., *Padina* sp., *Codium* sp. and extended from 100-300 m seaward. The blades were covered with fleshy epiphytes. No seagrasses were found in the vicinity of the Pigeon Point Beach Resort however sparse patches were found on the western side towards Milford Bay. These patches were found on the inside of the reef interspersed with coral rubble and macro-algae. Secchi reading in the western end was 2.0 m during survey. Faunal species caught in beam trawl surveys are listed in Table 10.

Table 10: Faunal species caught in beam trawl surveys in Pigeon Point

# Recorded	Common name	Scientific name	Ave. length (total) cm
2	Bluestriped grunt	*Haemulon sciurus*	10.1
1	Grey sanpper	*Lutjanus griseus*	11.0
2	Redband parrotfish	*Sparisome aurofrenatum*	6.8
1	Redlip blenny	*Ophioblennius atlanticus*	7.0
1	Sharpnose puffer	*Canthigaster rostrata*	7.5
2	Crab	*Callinectes* sp.	
2	Varigated urchin	*Lytechinus variegatus*	

4.2.4 La Guira Bay to Canoe Bay

An extensive, contiguous seagrass community was found on the windward side of Tobago from La Guira (in line with the Crown Point runway) extending east-northeast toward Canoe Bay including Kilgwyn and Friendship Bays (Figure 13). This *Thalassia testudinum* dominated bed was found 10-20 m from the high tide mark in the backreef area of Flying Reef and extended >300 m seaward in some areas. The bed was found at about 0.4 m in depth at ebb tide and was intermixed with macro-algae such as *Caulerpa* sp., *Halimeda* sp. and *Dictyota* sp. and with coral rubble, sandy patches and *Porites porites* (Finger coral). The macro-algae in this community were not as abundant as in Bon Accord Lagoon.

This seagrass community was not uniform. It was densest in La Guira Bay and in front of the Kilgywn wetland. Further east-northeast towards Friendship Estate, nearer the stone jetty, it became patchier and was intermixed with *Syringodium filiforme* and

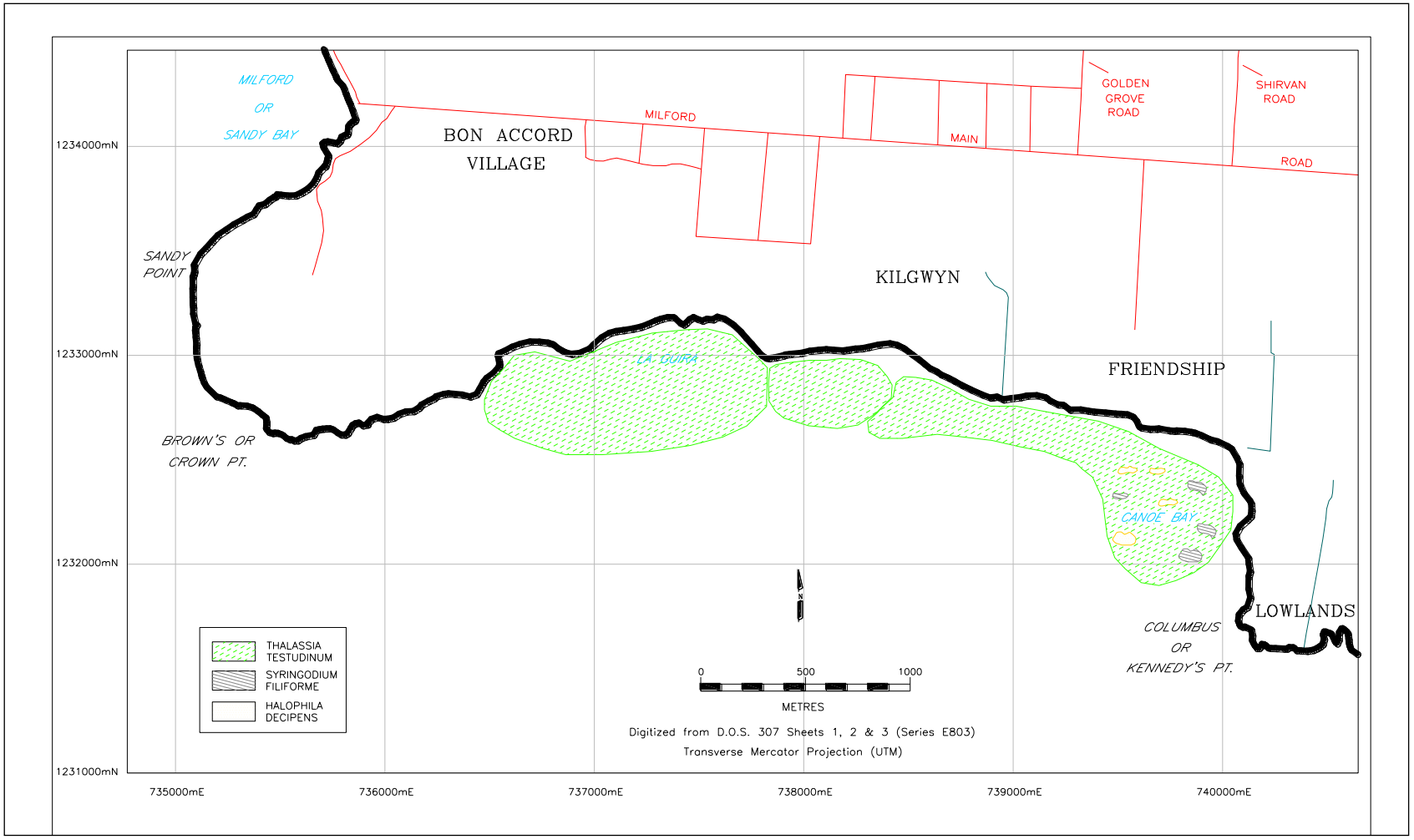

FIGURE 13: SEAGRASS DISTRIBUTION FROM LA GUIRA BAY TO CANOE BAY

Halodule wrightii. In Canoe Bay the seagrass patches were interspersed with large rocky outcrops, coral boulders and sandy areas. *Thalassia* blades were slightly encrusted with algal epiphytes. Secchi reading in this area was 1.5 m.

The seagrass bed in La Guira Bay was described briefly in IMA (1990). A large section of this bed was damaged when the area was dredged to extent the Crown Point airport. The bed is however showing signs of recovery. Impacts on the bed include physical damage from boat anchors, sea bathing and from turbulence sea condition. Sand mining once occurred in this area in the late eighties and early nineties but has since ceased. The Kilgwyn area is a fish-landing site and the faunal species caught in beam trawls in this area (Table 11) were indicative of the proximity of this bed to a coral reef.

Table 11: Faunal species caught in beam trawl surveys from La Guira Bay to Canoe Bay

# recorded	Common name	Scientific name	Ave. length (total) cm.
3	Redband parrotfish	*Sparisome aurofrenatum*	10.1
4	Greenblotch parrotfish	*Sparisoma atomarium*	5.6
2	Rainbow parrotfish	*Scarus croicensis*	11.0
1	Slippery dick	*Halichoeres bivittatus*	6.5
	Crab	*Callinectes* sp	

4.2.5 Petit Trou Lagoon

A small seagrass community was found in the middle of Petit Trou Lagoon growing on sandy substrate at a depth of 1-1.5 m (Figure 14). The bed extended about 300 m across the Lagoon from west to east and was dominated by *Thalassia testudinum* interspersed with macro-algae such as *Dictyota* sp., *Halimeda* sp., *Caulerpa* sp., *Acanthophera* sp., *Sargassum* sp., *Bryopsis* sp., *Gracilaria* sp. The seagrass blades were encrusted with fleshy algae. Red mangroves (*Rhizophora mangle*) once surrounded this Lagoon, however some of it was cleared to facilitate the Plantation Development, which includes the Tobago Hilton Hotel and townhouses. Seaward of the Lagoon is a reef crest (IMA, 1991) which makes the Lagoon difficult to access by sea.

Fauna species observed in this Lagoon include Redband parrotfish (*Sparisome aurofrenatum*), Bluehead wrasse (*Thalassoma bifasciatum*), Greenblotch parrotfish (*Sparisoma atomarium*), Yellowtail snapper (*Ocyurus chrysurus*), Yellowfin moharra (*Gerres cinereus*), Silver jenny (*Eucinostomus gula*) and *Callinectes* crabs.

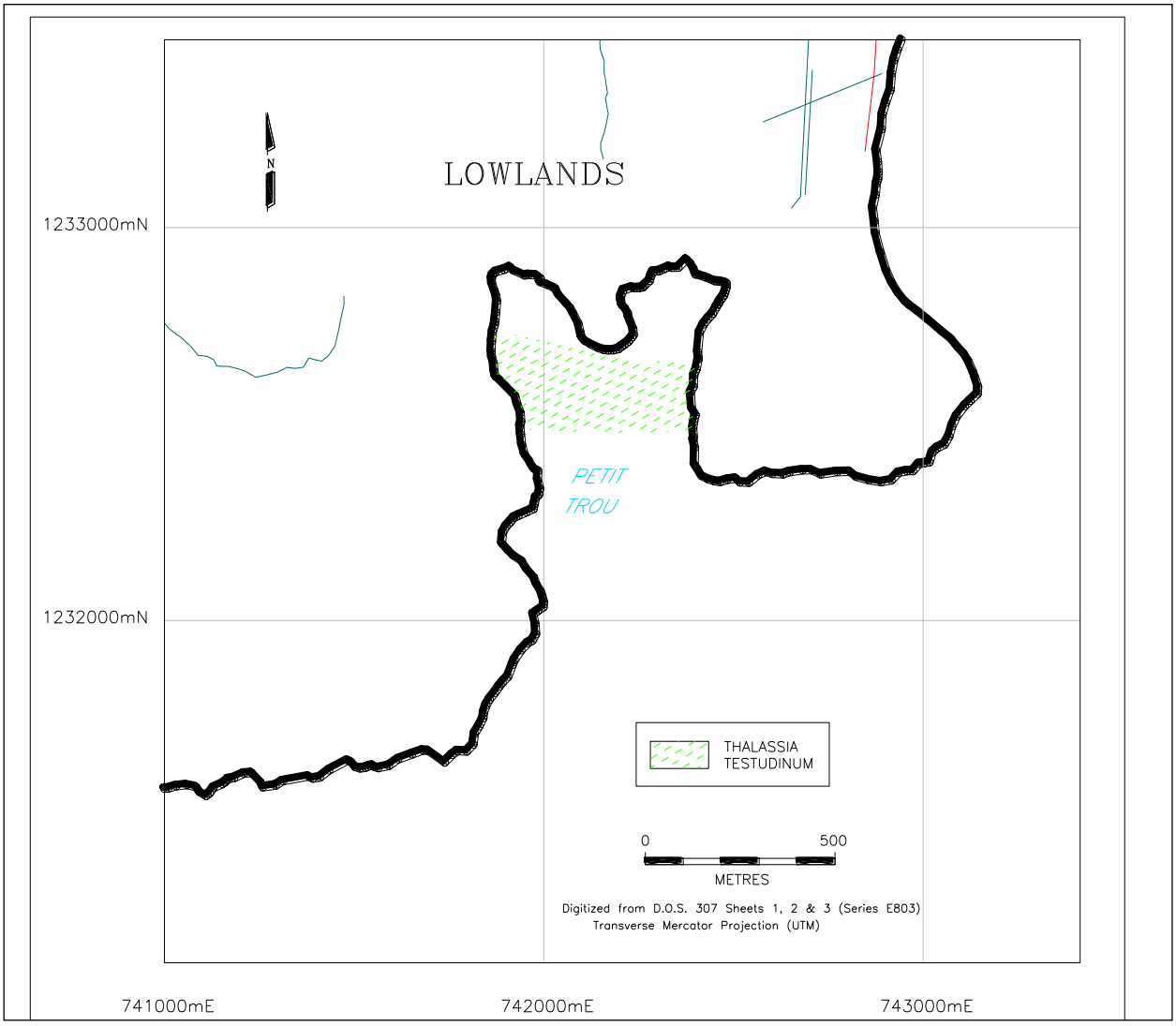

FIGURE 14: SEAGRASS DISTRIBUTION IN PETIT TROU LAGOON

4.2.6 King's Bay

The seagrass community in King's Bay was not extensive. Seagrasses were found on the eastern side of the Bay along the rocky headland and bands extended approximately 150-200 m seaward, on gravelly substrate at depths greater than 3 m (Figure 15). *Thalassia testudinum* was dominant, and occurred in a narrow pure zone near to the shoreline as well as in mixed patches with Sy*ringodium filiforme*, *Halodule wrightii* and *Halophilia decipiens* more seaward. The seagrasses did not grow densely within a bed, and appeared in sporadic patches in which different species zones could be detected. Small sparse patches of *Halophilia decipiens* were also found in the nearshore area of the beach and towards the western side of the bay. Macro-algae species recorded among the seagrasses were *Caulerpa* sp., *Sargassum* sp., and *Dictyota* sp. *Thalassia* blades appeared to be generally healthy being only slightly encrusted with algal epiphytes. No fauna species were captured with the beam trawl.

4.2.7 Speyside

Although *Thalassia testudinum* was recorded in Speyside in the fifties (National Herbarium Records) and seagrass areas were shown on a map produced by the IMA in 1985, no *Thalassia* was found during this survey and in a survey done in 1997. The only seagrass species found in Speyside was *Halophila decipiens*. Sparse patches of this species were found in the vicinity of the jetty at Bishop's Bay, approximately 50 m from highwater mark interspersed with macroalgae such as *Dictyota* sp., *Caulerpa* sp., *Halimeda* sp.

Surveys were also conducted in March 2001 on other bays along the windward and leeward coasts of Tobago. However, no other seagrass area was found.

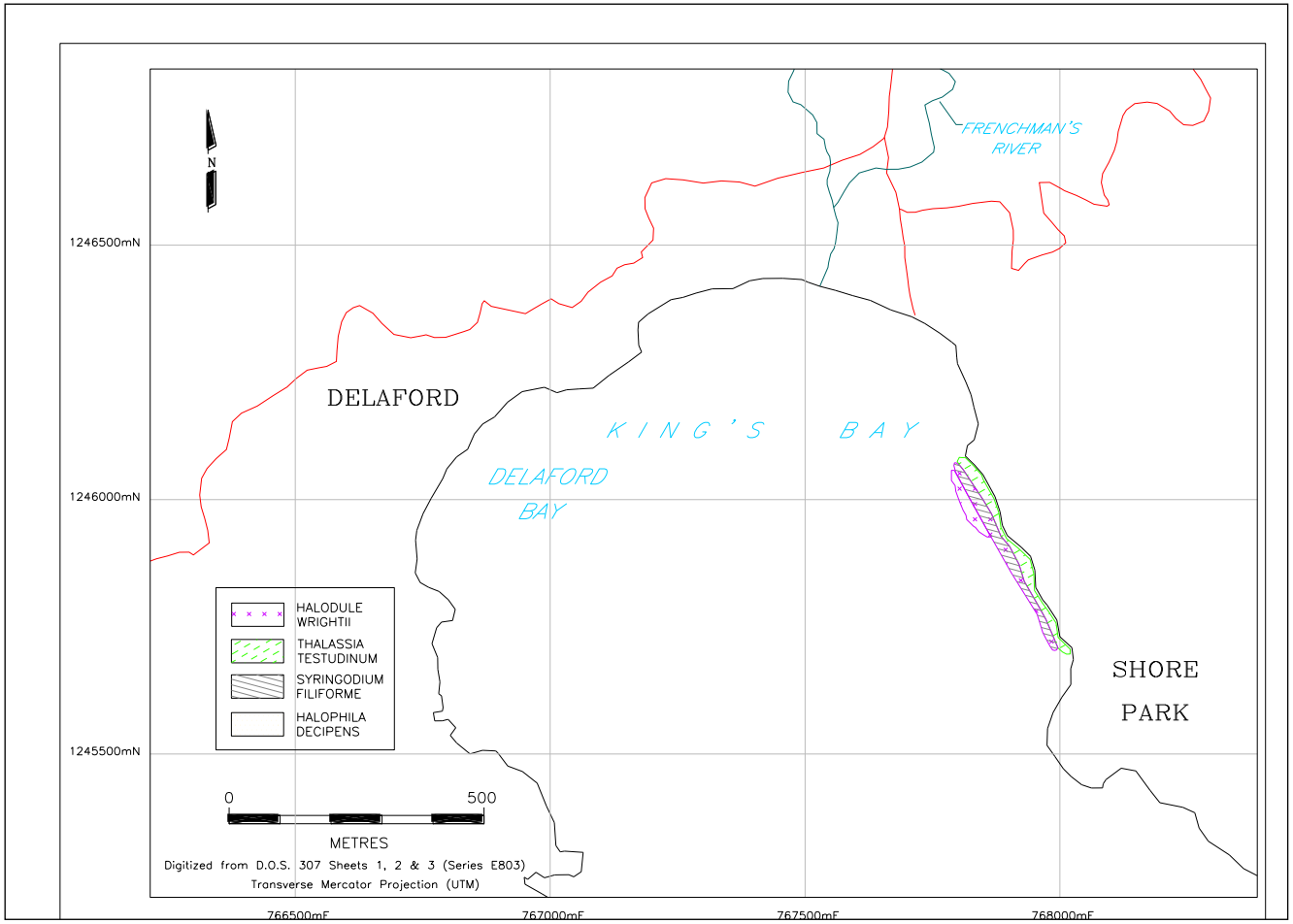

FIGURE 15: SEAGRASS DISTRIBUTION IN KING'S BAY

5.0 DISCUSSION

Certain conditions are critical for seagrass existence and functioning. These include favourable temperature, salinity, waves, currents, depth, substrate and day-length, which regulate the physiological activities of the plant. Also important are natural phenomena that limit photosynthetic activity of the plant such as light, nutrient, epiphytes and disease, and anthropogenic inputs in the form of nutrient and sediment loading. These factors inhibit the availability of plant resources (Zieman, 1972; Dennison, 1987; Fonseca & Kenworthy, 1987; Marba *et al*. 1994, Short & Coles, 2001).

There are thriving seagrass communities around Trinidad and Tobago that support a diversity of flora and fauna particularly juvenile fish and invertebrate species. The most extensive *Thalassia* communities in Trinidad are found along the northwestern peninsula from Williams Bay to St Peter's Bay, while extensive beds are found in Bon Accord Lagoon, and La Guira Bay to Canoe Bay, Tobago amid mangrove swamps and coral reef. *Thalassia* communities that were once present in Scotland Bay, Grand Fond Bay (Monos Island), Five Islands, Cocorite and Speyside, Tobago (refer to Table 1) were not found during this survey. These communities have been replaced by sparse *Halodule wrightii* and *Halophila decipiens* beds.

In Trinidad and Tobago, and throughout the Caribbean, turtle grass, *Thalassia testudinum* is the dominant seagrass species and the climax species (Fourqurean & Zieman, 1991). *H. wrightii* is the primary species found in stressed-fringed-perennial, ephemeral and newly colonized seagrass meadows (Lewis *et al*. 1985). It is a small, pioneer species that appear to be the first to recolonise a gap after a disturbance. *Halophila decipiens* is another pioneer species. Through the succession process, these species are replaced by *Syringodium filiforme* and finally by *T. testudinum*, the climax species, during recovery (Williams, 1990).

It is uncertain when and why *Thalassia* communities changed, and in some cases disappeared, except in Cocorite where the bed was buried by land reclamation. Scattered patches of *Thalassia* beds were reported in Cocorite near the mouth of the Diego Martin

River (Massiah, 1976). River diversion and reclamation for housing development occurred in this area in the 1970's and later in the mid 1990's resulting in the disappearance of *Thalassia* patches. Extirpation of marine plants in some areas is also being reflected in some macro-algal species (pers. comm. Duncan, J., 1997). This presents a measure of concern, since most of the remaining seagrass communities are under stress. Possible causes of stress on existing seagrass communities are those factors that affect water clarity and quality.

TSS concentrations were higher in Chaguaramas (mean 4.6 ± 1.7 mg l^{-1}; range 2.6-5.7 mg l^{-1}) and Carenage Bay (mean 5.0 ± 1.6 mg l^{-1}; range 2.6-7.1 mg l^{-1}) compared to the offshore islands (mean 1.7 ± 0.7 mg l^{-1}; range 0.7-2.6 mg l^{-1}). Unlike the offshore islands these bays receive riverine inflow. In the Buccoo Reef / Bon Accord Lagoon, an area subjected to sewage pollution (Laydoo & Heileman, 1987), TSS concentration ranged from 2.6 mg l^{-1} across the reef to 30.0 mg l^{-1} inside the lagoon (Juman, 2004). TSS concentration is inversely correlated with light attenuation, that is the amount of light available to the plant for photosynthesis. Plants grow best where sunlight can penetrate (0.5-5m). In area where there is water clarity, they can grow to a depth of > 20m. (Cuba and Virgin Islands) (Phillips & Menez, 1988).

Seagrasses community changes are initiated by nutrient enrichment above some threshold level (Birkeland, 1987). These threshold levels are still contentious. Threshold concentrations of 1.0 µM for dissolved inorganic nitrogen (DIN= NO_2+NO_3+NH_3) and 0.1 µM for soluble reactive phosphorous (SRP) were experimentally determined by Lapointe *et al*. (1993) for macroalgal overgrowth of seagrass communities along natural gradient along the Belize Barrier Reef. Hemminga (1998) gives an average water column ammonium concentration of 3.1 µM, nitrate concentrate of 2.7 µM and phosphate concentration of 0.4 µM, based on a compilation of data on the nutrient environment of seagrass meadows worldwide. The total nitrogen (TN) and phosphorous (TPO_4-P) measurements taken at selected locations in the wet and dry season far exceeded those threshold values. Also, TN concentrations were higher in the wet season and in areas with denser coastal development, for instance Pierre Bay, (83.4 µM) Monos Island.

Although there were no built developments in Scotland Bay, the nitrogen and phosphorous levels (47.7µM and 0.6 µM respectively) measured could be attributed to the yachting activity in the area.

Nitrogen enrichment enhances the proliferation of faster growing phytoplankton, epiphytic and macro-algae that compete with seagrasses for light and space (Cambridge *et al*. 1986; Raffaelli *et al*. 1998; Hauxwell *et al*. 2001; Deegan *et al*. 2002). Seagrasses have a median atomic C:N:P ratio of 435:20:1 (Duarte, 1992) that varies with the nutrient environment, while phytoplankton has a C:N:P ratio of 106:16:1 (Redfield *et al*. 1963). For this reason, seagrasses require about 4 times less N and P for biomass production on a carbon unit weight basis than phytoplankton. Seagrasses also require 8 times less N and 1.5 times less P than macroalgae (Hemminga *et al*. 2000).

Proliferation of macro-algae was observed around Monos, Chacachacare, Gasparee and Five Islands, and in Chaguaramas Bay, Guayaguayare Bay and Bon Accord Lagoon. Competition with algae leads to diminished growth and stature; increased shoot mortality and decline in shoot density and total habitat area of seagrasses (Duarte, 1995; Taylor *et al*. 1995; Kenworthy & Fonseca, 1996; Short & Burdick, 1996). In nutrient enriched areas where seagrass meadows have been mapped over time, the spatial configuration of the meadow usually becomes more fragmented, with large distances between patches compared to initial conditions (Costa, 1988; Batiuk *et al*. 1992). This fragmentation of dense seagrass areas was observed in Carenage (St Peter's Bay) and Chaguaramas Bay (Small Boats) and within the Bon Accord Lagoon. While the seagrass bed in the Bon Accord Lagoon is diminishing in the vicinity of the sewage outfall, the grass beds are extending out and colonizing new areas such as the Nylon Pool, a popular bathing area used by reef tour operators.

Colonization and replacement of *Thalassia* community by *Halodule wrightii* has been reported as a consequence of long-term enrichment (Reyes & Merino, 1991; Lapointe *et al*. 1994; Fourqurean *et al*. 1995). This phenomenon has been observed in most seagrass communities in Trinidad and Tobago. Around Monos and Chacachacare Islands and in

Scotland Bay, *Thalassia* beds have now been replaced by sparse *H. wrightii* and *H. decipiens* beds (< 50 shoots per m^2). Areas in the northeastern end of Guayaguayare Bay where *Thalassia* was reported in 1997 (IMA, 1997) are now colonised by dense *Halodule wrightii* bed, the densest *Halodule* bed in the country. *H. wrightii* and *H. decipiens* are also found among *Thalassia* in the Bon Accord Lagoon (Juman, 2004). The fast growing *H. wrightii* is more resistant to high nutrient loading.

Thalassia beds, because of its structure, support a diversity of marine organisms. The grass blades offer a suitable substrate for epiphytic algae and diatoms and the beds are mixed with benthic macro-algae. These epiphytes are believed to play a significant role in productivity and the food web. Seagrass beds provide habitats and feeding areas for a variety of species, including juvenile fish species (Hemminga & Duarte, 2000; Nagelkerken *et al*. 2001). Twenty-nine fish species were recorded in the seagrasses in Bon Accord Lagoon (Juman, 2004) while 20 species were recorded in William's Bay and environs.

6.0 CONCLUSION

Seagrass beds in Trinidad and Tobago are exhibiting signs of stress such as replacement of climax *Thalassia* community by pioneer species (*Halodule wrightii* and *Halophila wrightii*), macro-algal overgrowth and fragmentation of beds. They however produce organic matter and provide habitats for a diversity of organisms including juvenile fish of commercial species. Loss or replacement of these beds will result in the loss of these functions, and biodiversity in these areas.

7.0 RECOMMENDATIONS

There is a critical need for research on the structure and function of the remaining seagrass communities around Trinidad and Tobago since these communities are changing, and in some areas are diminishing. A monitoring programme needs to be developed and implemented so that changes in spatial distribution and community structure over time can be ascertained. Parameters that should be monitored in the seagrass beds are shoot density, areal productivity and total biomass. These parameters are part of an on-going monitored programme in the Caribbean and comparisons can be made once similar methodologies are applied.

The factors that may be accelerating or influencing these changes also have to be monitored. These include parameters that affect water clarity and quality, such as total suspended solids (TSS), total nitrogen, soluble reactive phosphates, and chlorophyll-a. Poor water quality has been reported as being the main factor affecting seagrasses worldwide, and in Trinidad and Tobago there have been major coastal and hillside development projects. The datasets generated from the monitoring project together with the spatial data (seagrass maps) can be put into a GIS database, where it can be easily accessed to inform decision makers on coastal development and management plans.

In the scientific literature it is reported that seagrass beds are nursery areas for juvenile fish and invertebrates. Whether the existing seagrass beds in Trinidad and Tobago are providing these functions needs to be examined. Seagrasses have also been shown to increases biodiversity in coastal areas. An assessment of the faunal communities found in seagrass beds around Trinidad and Tobago need to be undertaken. Also, the inter-linkages between coral reef, seagrass beds and mangrove swamp that are in close proximity should also be examined. If the research proves that Trinidad and Tobago seagrass beds are productive systems that functions as nurseries, and as a reservoir for biodiversity, then rehabilitation of impacted seagrass beds would be an important management option.

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PLATES

PLATE 1: *Thalassia testudinum*

PLATE 2: *Halophila decipiens*

PLATE 3: *Halodule wrightii*

PLATE 4: *Syringodium filiforme*

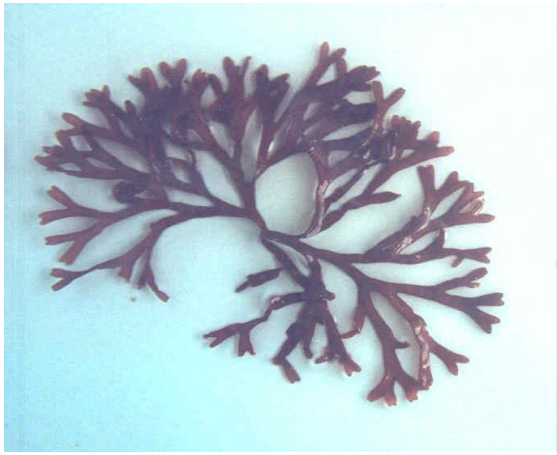

PLATE 5: *Dictyota* sp.

PLATE 6: *Acanthophera* sp.

PLATE 7: *Padina* sp.

PLATE 8: *Sargassum* sp.

PLATE 9: *Caulerpa* sp.

PLATE 10: *Chaetomorpha* sp.

PLATE 11: *Codium* sp.

APPENDICES

Appendix 1: List of fish species recorded in beam trawl catches in Guayaguayare Bay

Common Name	Scientific name
Barbi threadfin	*Polydactylus virginicus*
Zelwan	*Trachinotus falcatus*
Moonshine	*Selene vomer*
Torroto grunt	*Genyatremus luteus*
Croaker	*Bairdiella sp.*
Guiana longfin herring	*Odontognathus micronatus*
Spadefish	*Chaetodipterus faber*
Checkered puffer	*Sphoeroides testudinus*
Spotted scorpionfish	*Scorpaena plumieri*
Grey snapper	*Lutjanus griseus*
Lane snapper	*Lutjanus synagris*
Crapaudfish (adult)	*Batrachoides surinamensis*
Flounders	Not identified

Source: Alleng et al. 1997, IMA unpublished, present study

Appendix 2: List of fish species recorded in beam trawl catches in Bon Accord Lagoon, Tobago

Common Name	Scientific name
Striped grunt	*Haemulon striatus*
French grunt	*H. flavolineatus*
Atlantic seabream	*Archosargus rhomboidalis*
Doctorfish	*Acanthus chirurgus*
Grey snapper	*Lutjanus griseus*
Mutton snapper	*L. analis*
Lane snapper	*L. synagris*
Barred hamlet	*Hypoplectrus puella*
Blenny	*Labrisomus nigricinctus*
Cocoa damselfish	*Pomacentrus variabilis*
Dusky damselfish	*P. fuscus*
Foureye butterflyfish	*Chaetodon capistratus*
Spotfin butterflyfish	*C. ocellatus*
Hogfish	*Lachnolaimus maximus*
Lizardfish	*Synodus saurus*
Yellowtail snapper	*Ocyurus chrysurus*
Porcupine fish	*Diodon hystrix*
Rock hind	*Epinephelus adscensionis*
Spotted goatfish	*Pseudupeneus maculates*
Bridled burrfish	*Chilomycterus antennatus*
Crapaudfish	*Batrachoides surinamensis*
Southern stingray	*Dasyatis americana*
Silver jenny	*Eucinostomus gula*
Parrotfish	*Scarus* sp.
Parrotfish	*Sparisoma* sp.
Puffers	Family – Tetraodontidae

Source: Juman (2004)