Nature Foundation St. Maarten

"Nature is Our Future"

Baseline Environmental and Ecological Assessment of the Mullet Pond Section of the Simpson Bay Lagoon

Photo: Tunicates on Mangrove Root in Mullet Pond
Credit: Tadzio Bervoets

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Table of Contents

1.Executive Summary

The Nature Foundation, over the course of five months, conducted a research project and compiled a report on the Biological Status of the Mullet Pond section of the Simpson Bay Lagoon. The purpose of this report was to create a more in-depth study of both the ecology of the Mullet Pond and to also conduct a valuation study on the contribution the area has, in a dollar amount and in its intact form, to the economy of St. Maarten. The report also outlines the possible uses which can be made of the lagoon, keeping it intact while at the same time ensuring that its economic contribution will grow. The study further has as its aim to convince policy makers that official zoning of the Mullet Pond area as a conservation zone is of essential importance to the stability of the remaining environmental habitat in the Simpson Bay Lagoon.

70% of all mangroves located in the Simpson Bay Lagoon currently survive in Mullet Pond, which forms the largest, continuous area of unbroken mangrove forest on St. Maarten. Mullet Pond is located in the south-eastern most area of the lagoon in the area of Mullet Bay. Baseline surveys included in this report have shown that the area forms one of the most pristine habitat within wetland and aquatic habitats supporting numerous species including juvenile snapper, seahorses, crabs, reptiles and a number of bird species.

Based on the United Nations Environment Program (UNEP) World Conservation Monitoring Center 2006 document *In the front lines: shoreline protection and other ecosystem services from mangroves*, the Value of the 880 square meters of Mangrove Habitat which represents the **Mullet Pond ecosystem is equal to USD $792,000 per year towards the economy of St. Maarten** in its intact form, not counting or taking into consideration the high biological value that the area represents.

The Marketing of the Mullet Pond area as a high Value Eco-Tourism experience is significantly untapped. With increased trends moving towards the marketing of Caribbean islands as eco-tourism destinations Mullet Pond can contribute significantly to eco-tours in the form of snorkelling, diving, limited fishing excursions, kayaking and ample bird and reptile watching opportunities, thus further reinforcing the economic contribution of the ecosystem.

Mullet Pond is increasingly under threat due to development. As it is, the cause for protecting that ecosystem and the value with which it brings far outweighs the perceived benefit development of the area may have. Any type of development would require the destruction of large areas of mangrove trees and the dredging and siltation of extensive sea grass beds, effectively killing both the economic and ecological benefit of the area.

It is therefore essential that the Mullet Pond, located between Point Pirouette and Mullet Beach, be zoned as a protected area in which it is prohibited to remove and/or cut existing vegetation, including mangroves and sea grass, within 15 meters of the lagoon shoreline including the waters contained therein. It is only through official protection that

the protection of the Mullet Pond and the ecosystem it supports will remain an essential part of the St. Maarten landscape.

Once legislation is enacted proper management of that ecosystem would need to occur in order to reduce the risk of the area being a so-called 'paper park'. This management of should involve natural space bio-mapping, integrated use of GIS mapping, mangrove strand management, the possibility of housing injured and sick sea turtles in housing pens close to the island, doing bird monitoring, invasive species checks, and baseline environmental monitoring.

1.Introduction to the Mullet Pond Ecosystem

The unique body of water called Mullet Pond is a semi-enclosed area within the Simpson Bay Lagoon (Figure 1). Tragically, the Simpson Bay lagoon, once the largest enclosed lagoon in the North Eastern Caribbean, continues to be polluted and depleted. Increasingly large strands of Mangroves are still being removed and sea grass habitat is being eroded due to increased and uncontrolled development. Only approximately a fourth of the coastline of the Simpson Bay Lagoon is still populated by aquatic Red Mangrove trees.

70% of these mangroves currently survive in Mullet Pond, which forms the largest, continuous area of unbroken mangrove forest on St. Maarten. Mullet Pond is located in the south-eastern most area of the lagoon in the area of Mullet Bay. Baseline surveys included in this report have shown that the area forms one of the most pristine habitat within wetland and aquatic habitats supporting numerous species.

The species found in Mullet Pond include *Rhizophora mangle* (Red mangrove), *Avicennia germinans* (Black mangrove), *Laguncularia racemosa* (White Mangrove) and *Conocarpus erectus* (Buttonwood). There are also numerous juvenile fish species, including Striped Parrotfish (*Scarus croicensis*), Bluehead (*Thalassoma bifasciatum*), Silversides, Herrings and Anchovies (families *Atherinidae, Clupeidae, Engraulidae*)
The surrounding waters also include numerous molluscs which are unique in the lagoon. These include the Queen Conch (*Strombus gigas*), Milk Conch (*Strombus costatus*), Cushion Stars (*Oreaster reticulata*), Sea Cucumber (*Holothuria mexicana*), Sea Urchins (*Tripneustes venricosus, Lytechinus variegates, Meoma ventricosa*) and the Upside Down Jellyfish (Cassiopeia frondosa) and the Atlantic Triton (*Charonia variegate*).
The Mullet Pond area is also an important bird nursing area with numerous species roosting there. These species include: American Coot (*Felucia Americana*), Moorhen (*Gallinula chloropus*), Yellow-crowned Night Heron (*Nyctanassa violacea*), Green Heron (*Butorides striatus*), Black-winged Stilt (*Himantopus himantopus*) and several plovers.

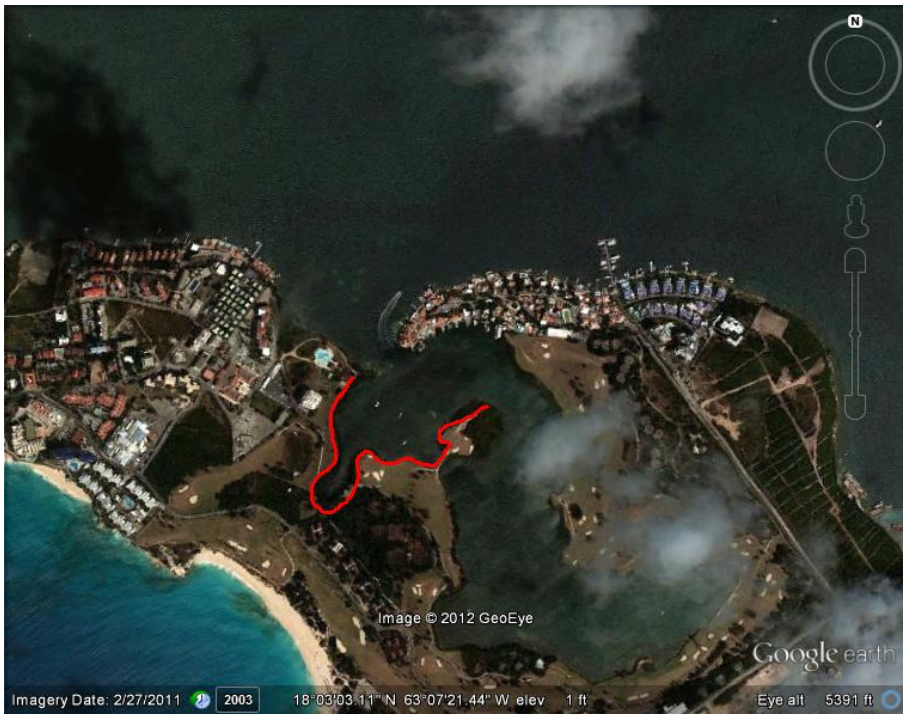


Figure1: Mullet Pond in red outline

2.Ecological significance of the Mullet Pond

Mullet Pond is an area where significant sea grass beds occur. In the shallow areas of slow flowing currents these sea grass beds reduce the water's velocity to almost nothing and act as natural filters removing particles from the water and depositing them as fine sediment. Sea grasses experience rapid growth in Mullet Pond due to the relatively shallow waters which allow for ample sunlight to reach the beds and minimal currents which prevent shearing of sea grass blades. This rapid growth makes sea grass beds highly productive and suitable as feeding and nursery grounds. These ecosystems therefore attract a great diversity of wildlife, including barracuda, stingrays, marine turtles, sea stars, sea cucumbers, sea urchins and the queen conch. Mullet Pond was one of the last locations within the Simpson Bay Lagoon where the West Indian Manatee was last sighted in the 1970's.

3.1 Sea grasses and Algae Composition

Sea grasses are flowering plants that live underwater. Like land plants, sea grasses produce oxygen. The depth at which sea grasses are found is limited by water clarity which determines the amount of light reaching the plant. Sea grass beds form in shallow coastal lagoon areas. The main species of sea grass found around St Maarten are Turtle grass (*Thalassia testudinum*).

Sea grass ecosystems are considered to be amongst the most productive in the world; an average growth rate of sea grass leaves is about 5mm per day, with entire stands of sea

grass being turned over every 16 weeks with 3-4 crops annually. In addition to this, the blades of sea grasses provide a huge surface area for settlement of epiphytes (plants that live on the surface of another organism such as calcareous green algae, crustose coralline red algae, cyanobacteria, diatoms and epifauna (animals that live on the surface of another organism such as sponges, hydroids, bryozoans, foraminiferans). For a square metre of seabed, a dense sea grass stand may have 20m2 of leaf area for other organisms to settle on. The productivity of the epiphytes can be twice that of the sea grasses themselves,

The sea grass stands in Mullet Pond are dominated by Turtle grass (*Thalassia testudinum*) and calcareous alga (*Halimeda sp*). Through a succession of first growth sea grasses can turn vast areas of unconsolidated sediments into highly productive plant dominated, structured habitat with a diversity of microhabitats.

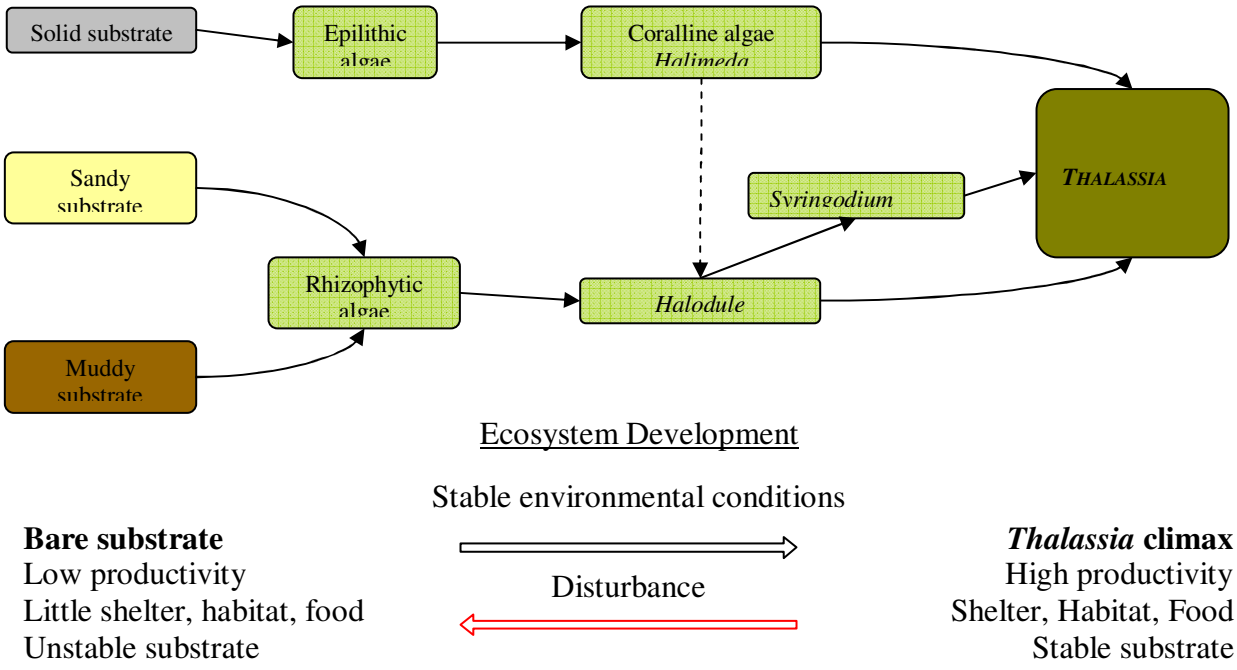


Figure 2: Sea grass succession diagram

Significant invertebrates in the sea grasses in Mullet Pond include Sea Cucumber (*Holothuria mexicana*), Sea Urchins (*Diadema spp.*) and the Upside Down Jellyfish (*Cassiopeia andromeda*).

3.Biological Value

The sea grass beds within Mullet Pond provide a biological filter system for the waters within the Simpson Bay Lagoon and provide a nursery and habitat for numerous commercially and recreationally valued marine animals.

Chosen indicator species for the results of this study are *Thalassia testudinum* (TT), nutrient indicator algae (NIA), *Halophilia decepidens* (HD), *Halophilia stipulacea* (HS),

and *Acetabularia calyculus* (AC). Sponges (SP) were also recorded in the substrate section which shows the presence of suitable water quality and which also provides a filtering mechanism to the ecosystem. Sand (SD), rock (RC), and silt/clay (SI) were also recorded to show substrate damage and sedimentation respectively.

The value Damage (DM) was also included to show damage caused to the substrate. Due to the diverse nature of impacts within the Simpson Bay Lagoon it was chosen to include a general value to reflect damage as is opposed to listing every incidents of damage recorded. Damage includes but is not limited to anchor halos, anchor scarring from dragging, ship groundings, damping of material and any other value which can show damage to substrate.

4.1 Fish

Mullet Pond is an important nursery area for the Simpson Bay Lagoon and invariably the sea surrounding it. The mangroves and sea grass beds provide important habitat for juvenile fish species and also provide habitat for specific fish in general. Five species of indicator species were chosen for the purposes of this study: Butterflyfish, *Haemulidae*, Snapper, Parrotfish, and Moray eel. These represent each segment of niche species represented within the lagoon namely algal grazers (butterflyfish), bottom grazers (*Haemulidae*), predator mobile (snapper), predator sessile (moray eel) and grazers hard substrate (parrotfish).

4.2 Invertebrates

Invertebrates can be commercially valuable and can also have an important ecosystem function, grazing on poorly settled substrate and ensuring proper root placement. Eight invertebrates were chosen to act as indicators for the overall health of the Mullet Pond. They have been divided in molluscs which provide stability (*Bulla Striata, Spondylus spp*), grazers (*Diadema spp., Holothuria mexicana, Echinodermes*), and commercially important species which can show if there is any fishing pressure (*Panulirus argus*). *Echinodermes* were especially included to reflect the natural degradation of the ecosystem. This phylum is especially sensitive to changes in environmental quality and their presence or absence can indicate stressors to the environment.

The various ecological functions attributed to the Sea grass beds within the Simpson Bay Lagoon include:

- Stabilizing soil and sediments;
- Filtering suspended sediments;
- Reducing siltation, reducing wave action and current energy;
- Nursery grounds for many (reef and pelagic) fish and crustacean species;
- Supporting complex herbivore- and detritus based food webs.

The Simpson Bay Lagoon in general and Mullet Pond more specifically, has served as a nursery for shrimp, lobster, conch and juvenile reef and pelagic fish which supports the

much threatened St. Maarten Fisheries. The Mullet Pond supports a complex food web beginning with microorganisms and scavengers and culminating in higher tropic members such as snappers, barracudas, lobsters and birds. Grunts, groupers, sea trout's, silversides and other commercially valuable fish are dependent on the mangroves in the Simpson Bay Lagoon for breeding and much of their growing. Many species of birds are dependent on the lagoon for food and shelter.

The importance the lagoon plays in local fisheries is essential. Many juvenile fish species are developed in the lagoon, and are subsequently introduced to local coral reef ecosystems and in turn become an important part of local fishery.

In addition to the support of Local Fishery the nursery and shelter value which the area provides to Reef Fish species in particular contributes to the success of the Man of War Shoal Marine Park in the long run. The fact the Mullet Pond specifically and Simpson Bay in more general terms, contributes to the fish population within the Man of War Shoal Marine Park contributes to the Park's function as a Marine Protected Area. With the erosion of suitable nursery areas the Marine Park will have great difficulty in supporting offshore coral reef habitat. The interconnectedness of ecosystems plays a crucial role in both the management of protected areas for their ecological function, but also affects the economic contribution the Marine Park has with regards to its tourism value, which based on a 2010 Nature Foundation Report is set at close to USD $60 Million.

5. Biota and Substrate Surveying

Biota in Mullet Pond was surveyed using a modified version of the Reef Check Monitoring Method. The methodology was adapted in order to reflect the ecosystems found within area, particularly with regards to Sea grasses, invertebrates and fish species.

A modified Reef Check method was used to determine the state of the living biota within the lagoon and is a method used globally to gauge the health of living organisms. Fish, invertebrate and substrate data are collected to get an overall view on the health of the reef ecosystem using indicator species.

Reef Check surveys are conducted using a 100 meter transect line. Data is collected from 0 meter to 20 meter, from 25 meter to 45 meter, from 50 meter to 70 meter and from 75 meter to 95 meter away from the start of the line (Figure 2). There are three different protocols which are filled out during this survey, namely fish, invertebrates and substrate. The fish and invertebrate data is collected using indicator species. For the fish survey a five by five meter square with the transect line in the middle of the bottom of the square is used. All species within this area are counted (Figure 3). All invertebrates which are within 2.5 meters of each side of the line are recorded in the protocol (picture 4). To assess the substrate a one metre squared quadrat (square metal ring) is put down on every 0.5 meters of the transect line and all the substrate which it touches is recorded.

Distance in m: 0 20 25 45 50 70

Figure 2 Reef Check Transect line. This figure shows a transect line used for Reef Check. Data is collected only on the orange part of the line.

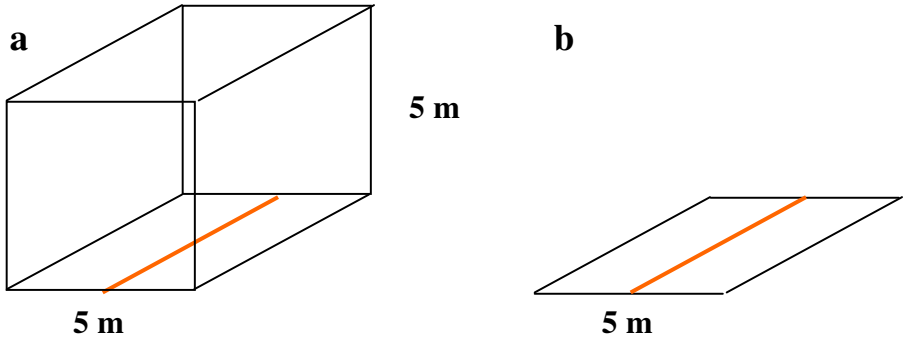


Figure 3 Method to collect fish and invertebrate data. This figure shows how the data for the fish and invertebrates is collected on the transect line. The transect line is shown in orange. a Method to collect fish data. All indicator fish species in a square of five by five meter around the transect line are accounted for. b Method to collect invertebrate data. All indicator invertebrate species within 2.5 meter of either side of the transect line are recorded.

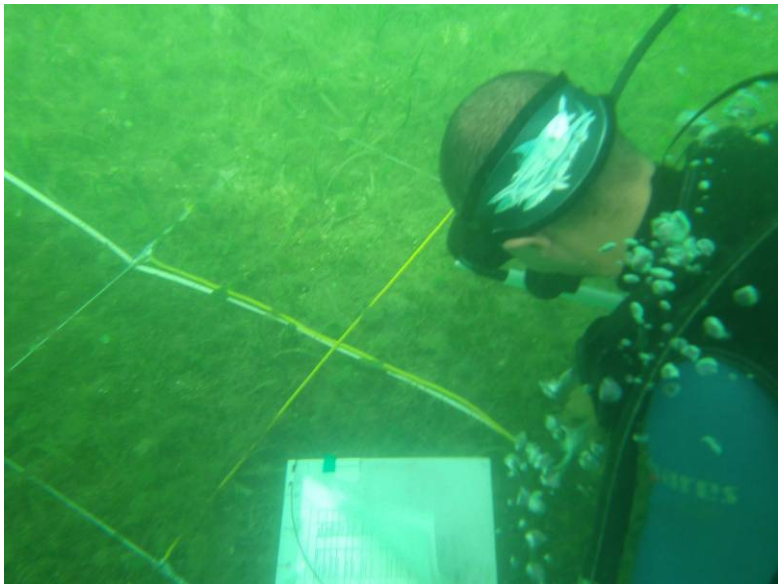


Figure 4: Researcher conducting surveys using quadrats.

For the graphs reflected in this study, the total amount of fish data and invertebrate data per transect line were used.

From the substrate data the percentage of ground covered by substrate type were utilized. Since the transect line is split into segments, the standard error plotted in the graphs is the standard error of the mean of the data sets.

In order to get an idea of the substrate type and cover and fish and invertebrate abundance indicator species were used. Rather than record all species present during the transact lines a subset of species were chosen based on their importance to the ecosystem and their presence or absence being an indicator of overall health and biodiversity.

5.1 Mangroves and Mangrove Surveying

Four species of mangroves were found on the shorelines of Mullet Pond: Red Mangrove (*Rhizophora mangle*), Black Mangrove (*Avicennia germinans*), White Mangrove (Laguncularia *racemosa*) and Button Wood (*Conocarpus erecta*). Red mangrove is easily recognized by its distinctive arching roots. Black mangrove, which often grows more inland, has root projections called pneumatophores, these snorkel like roots help to supply the plant with air in submerged soils. White mangroves often grow even further inland with no outstanding root structures. Button Wood grows in the higher laying areas behind the mangrove stands surrounding the lagoon.

Red Mangroves are the only tree in our region which can grow in salt water. Their extensive prop roots stabilize the coastal soil, especially important during hurricanes, and can actually collect sediment and increase the storm barrier area. Perhaps one of their most astounding attributes, mangroves are able to clean the water through a process called rhizofiltration, removing pollutants from the water.

Figure 5: Mullet Pond mangrove stands

Compared to the rest of the Simpson Bay Lagoon, the Mullet Bay Pond area houses a high density of Mangroves. Mangrove ecosystems have significant ecological, environmental and socio-economic functions and values. Mangrove communities usually occur in sheltered shores and in areas where sediment is gradually trapped forming mud banks. In short, the functions of mangroves include:

- *Soil formation by trapping debris;*
- *Filtering land run-off and trapping terrestrial organic matter;*
- *Maintenance of coastal water quality;*
- *Shoreline protection: reduction in the severity of coastal storm, wave and flood damage;*

- *Nursery areas and feeding grounds for juvenile reef and pelagic (deep sea, open 0cean) fish;*
- *Important habitat and feeding grounds for a range of other benthic and pelagic marine animals.*

6. Results of Biota Surveying

- Aside from the Indicator Species discussed above, twenty-three species from ten phyla were identified from survey photographs. Some specimens could not be identified to species, such as the white sponge.

Table 1: Specimen Table

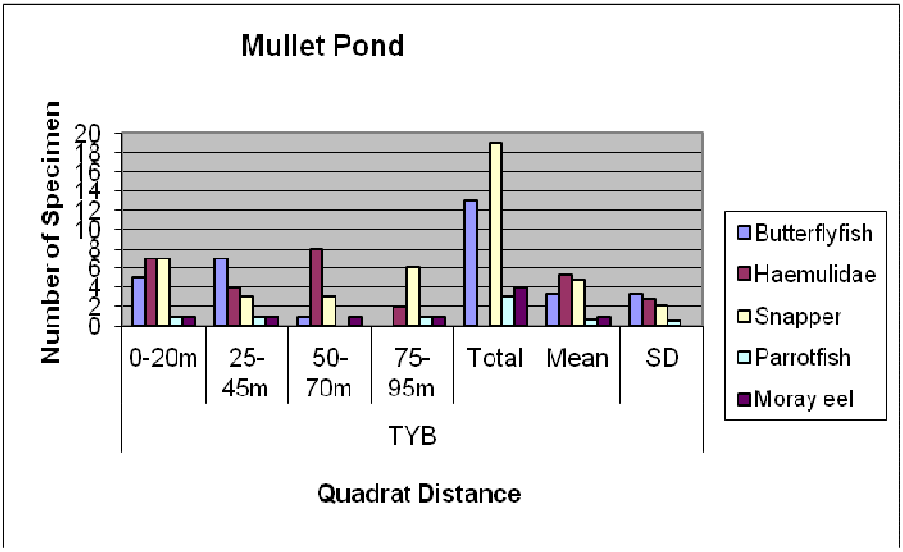
Algae	
Caulerpa sp.	*Caulerpa sp. (C. toxifolia?)*
Green feather algae	*Caulerpa sertlarioides*
Three-loped leaf algae	*Halimeda incrassata*
Mermaid's wineglass	*Acetabularia calyculus*
Seapearls	*Valonia sp.*
Mulusca	
Flat mangrove oyster	*Isognomon alatus*
Echinodermata	
Sea cucumber	
Thorny starfish	*Echinaster spinulosus*
Platyhelminthes - Flatworms	
Lined flatworm/ Tiger flatworm	*Pseudoceros crozeri*
Annelida	
Medusa worm	*Loimia medusa*
Polychaete worm	
Feather duster worm	*Sabella sp. or Bispira sp.*
Cnidaria	
Upside-down jelly	*Casseopia xamachanna*
Ringed anemone	*Bartholomea anulata*
Pale anemone	*Aiptasia pallida*

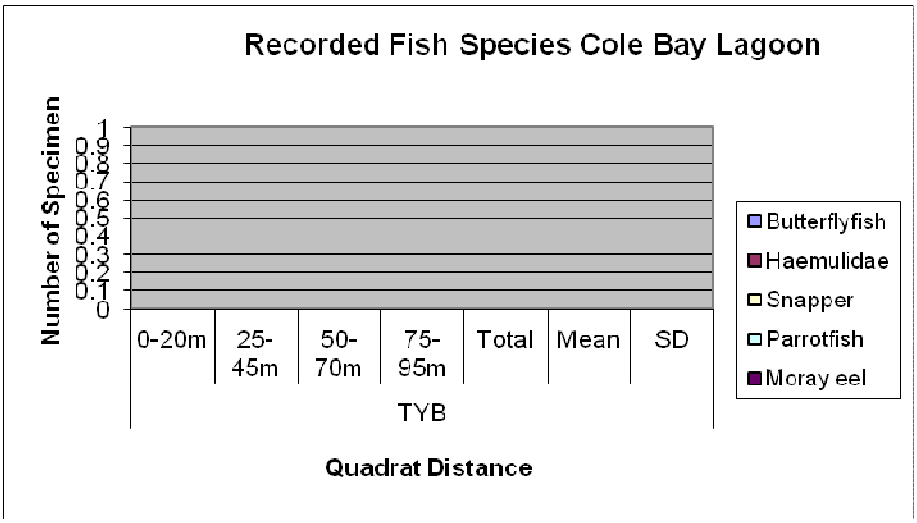
Porifera	
Fire sponge	*Tedania ignis*
Pink mangrove sponge	*Haliclona implexiformis*
Green sponge	*Haliclona viridis*
White sponge	
Chordata	
Mangrove tunicates	*Ecteinascidia turbinata*
Black tunicate	*Ascidea nigra*
Fish	
Mojarra	*Gerres cinereus*
Juvenile schoolmaster	*Lutjannus apodus*
Juvenile barracuda	*Sphyraena barracuda*
Mangrove/grey snapper	*Lutjanus griseus*
Arthropoda	
Barnacles	

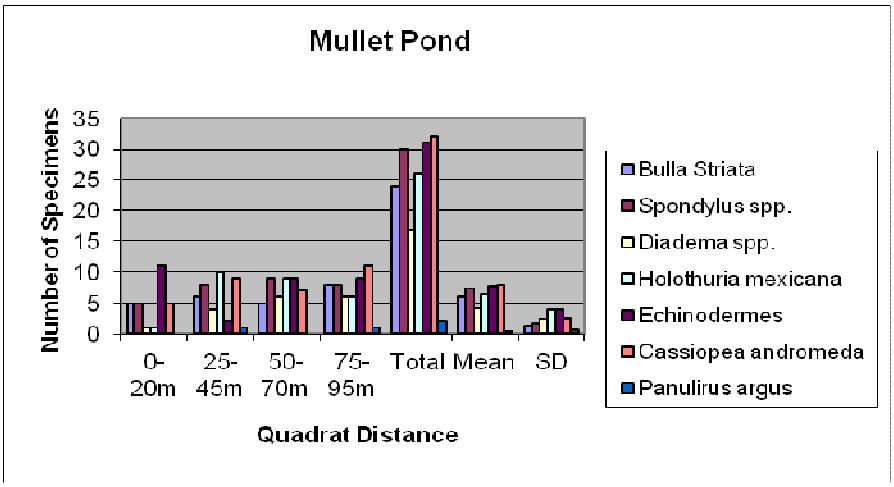
7. Graphical Comparison Mullet Pond/ Cole Bay Corner

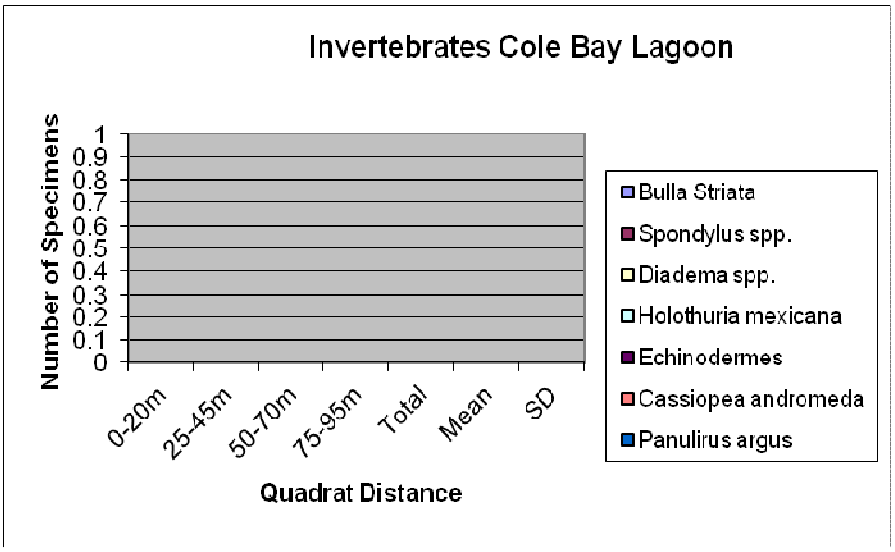
Follows is a graphical comparison of Mullet Pond as is compared to the Cole Bay Section of the Lagoon Figure 6):

Figure 6: Cole Bay Corner and Mullet Pond

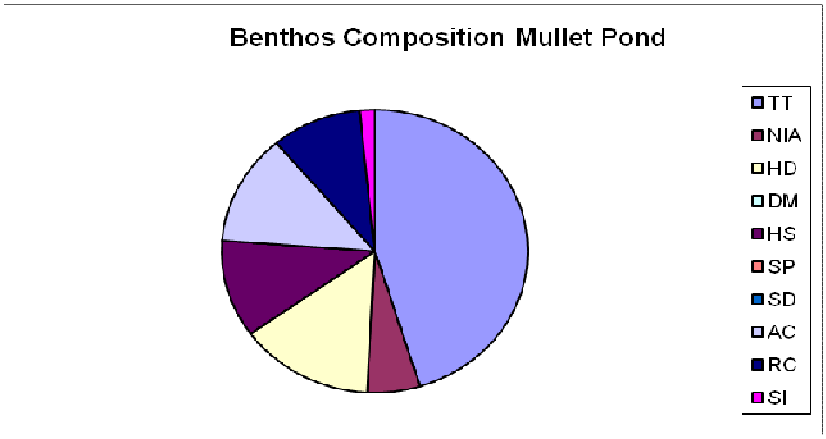


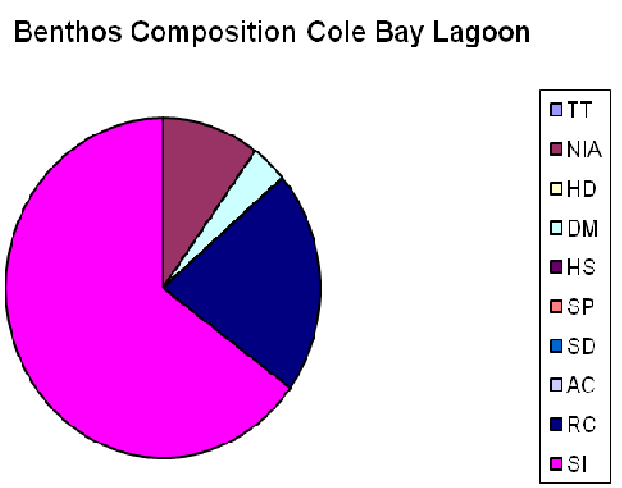

Recorded Fish Species Cole Bay Lagoon
Number of Specimen
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0-20m
25-45m
50-70m
75-95m
Total
Mean
SD
TYB
Quadrat Distance
Butterflyfish
Haemulidae
Snapper
Parrotfish
Moray eel


Mullet Pond
Number of Specimens
35
30
25
20
15
10
5
0
0-20m
25-45m
50-70m
75-95m
Total
Mean
SD
Quadrat Distance
Bulla Striata
Spondylus spp.
Diadema spp.
Holothuria mexicana
Echinodermes
Cassiopea andromeda
Panulirus argus



It is clear from the represented data for both fish species and ivertebrates that there is a significant difference in density with regards to both invertabrates and fish species between Mullet Pond and the Cole Bay area of the Lagoon. An area with significant degredation and one which hardly supports an ecosystem function





TT=*Thalassa testudinum*
NIA= Nutrient Indicator Algue
HD= *Halophilia decepidens*
DM= Damaged Substrate
HS= *Halophilia stipulacae*
SP= Sponge
SD= Sand
RC= Rock
SI= Silt

Similarly the graphical representations show that while Mullet Pond has a highly diverse bottom composition, the benthos within the Cole Bay section of the Lagoon is primarily comprised of Silt and Nutrient Indicator Algae. Both Bottom types do not support any ecosystem function and these areas of the Lagoon can be considered a *de facto* Dead Zone.

The results just highlighted show that it is in the best interest, both in ecological terms and in economic terms to preserve the area within the Simpson Bay Lagoon which has the highest Biological Value. Mullet Pond clearly is clearly representative of an area which still has an intact ecosystem and which can still support the ecosystem functions within the Simpson Bay Lagoon.

8. Economic Value

8.1 Significance of Mullet Pond to the St. Maarten Economy

For the purposes of this study the figures included are based on those outlined in the United Nations Environment Program (UNEP) World Conservation Monitoring Center. 2006 document. *In the front lines: shoreline protection and other ecosystem services from mangroves. This* report has estimated the total economic value of mangroves at US$900.000 per square kilometre per annum. This is a lower estimate and the actual value may indeed be much more significant. This estimate includes the value that mangroves have for fisheries, tourism and shoreline protection.

8.2 Shoreline Protection

Mangroves naturally form barriers and thus inevitably provide some shore protection, a fact long recognized by coastal communities, fishers and vessels which use the sheltered waterways behind these ecosystems. Mangroves can themselves be damaged by strong winds and waves, and so their buffering capacity is a balance between their resilience and their vulnerability. The current consensus is that:

- Mangroves play an important role in shore protection under normal sea conditions and during hurricanes and tropical storms.
- At least 70-90 per cent of the energy of wind generated waves is absorbed, depending on how healthy these ecosystems are and their physical and ecological characteristics.

Due to the significant water movement caused during storms within the Mullet Pond Area, the shoreline protection function of the mangroves allow for a buffering from high levels of water overflow into the adjacent properties and roadways saving millions of dollars in infrastructural repairs which would have been necessary if the strands were removed, thus also contributing to economic stability as part of the recovery after a natural disaster.

8.3 Tourism

The Marketing of the Mullet Pond area as a high Value Eco-Tourism experience is significantly untapped. With increased trends moving towards the marketing of Caribbean islands as eco-tourism destination Mullet Pond can contribute significantly to eco-tours in the form of snorkelling, diving, limited fishing excursions, kayaking and ample bird and reptile watching opportunities, thus further reinforcing the economic contribution of the ecosystem.

Taking the above into consideration, it is quite difficult to come up with an exactly calculated economic value of the aesthetic and ethical benefits of ecosystems, or of the service some ecosystems provide through the cycling of nutrients for example.

But based on the UNEP Report mentioned above, the Value of the 880 square meters of Mangrove Habitat which represents the **Mullet Pond ecosystem is equal to USD $792,000 per year towards the economy of St. Maarten in its intact form, not counting or taking into consideration the high biological value that the area represents**. This number is high considering the relatively small area which was surveyed. If further expansion of the area is taken into account and if protection is enacted the number will increase exponentially.

9. Recommendations

Mullet Pond is increasingly under threat due to planned development which is being looked at for that area. As it is the cause for protecting that ecosystem and the value with which it brings far outweighs the perceived benefit the development of the area may have. Any type of development would require the destruction of large areas of mangrove trees and the dredging and siltation of extensive sea grass beds, effectively killing both the economic and ecological benefit of the area.

It is therefore essential that the Mullet Pond, located between Point Pirouette and Mullet Beach, be zoned as a protected area in which it is prohibited to remove and/or cut existing vegetation, including mangroves and sea grass, within 15 meters of the lagoon shoreline including the waters contained therein. It is only through official protection that the protection of the Mullet Pond and the ecosystem it supports will remain an essential part of the St. Maarten landscape.

It is also recommended that international recognition, for example a Ramsar listing as a wetland of International Importance, be granted to the Mullet Pond in order to increase its viability and its contribution to a wetland which is locally important but also important globally.

Once legislation is enacted proper management of that ecosystem would need to occur in order to reduce the risk of the area being a so-called ‘paper park’. This management of should involve natural space bio-mapping, integrated use of GIS mapping, mangrove strand management, the possibility of housing injured and sick sea turtles in housing pens close to the island, doing bird monitoring, invasive species checks, and baseline environmental monitoring.