IMA NEWS

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INSTITUTE OF MARINE AFFAIRS

The Blue Economy | Driving Economic Diversification:
Possibilities and Challenges for Trinidad and Tobago

There is a lot of wealth to be exploited sustainably from our oceans that can diversify the economy through the adoption of a blue and circular economic approach to wealth generation in Trinidad and Tobago, so says Professor John Agard, who presented the distinguished lecture at the IMA's Distinguished Lecture and Panel Discussion in commemoration of World Ocean's Day 2020 and the United Nations Decade of Ocean Science for Sustainable Development 2021-2030. Professor Agard in Director of the Centre for Innovation and Entrepreneurship at the St Augustine Campus of the University of the West Indies, Trinidad and Tobago. Presenting on the theme **"The Blue Economy; Driving Economic Diversification: Possibilities and Challenges for Trinidad and Tobago"** Professor Agard used the Gunther Paupil definition to give context to his lecture, "The Blue Economy is a sustainable ocean economy, whose economic activity is in balance with the long-term capacity of ocean ecosystems to support this activity and remain resilient and healthy." He highlighted a number of new and emerging areas for generating both wealth and energy from the ocean coming arising from both living and non-living resources. He pointed out that many pharmaceuticals are derived from chemicals within living organisms in the oceans; many from the waters off Trinidad and Tobago, for which the country is not given credit.

He also noted that there are rich mineral deposits in the sea- beds around Trinidad and Tobago including polymetallic modules and polymetallic sulphides (zinc, cobalt and other metals) offering many opportunities to diversify the local economy away from petroleum. Offshore wind energy is also an opportunity for the country to diversify the economy away from the petroleum sector, as there is some wind resource in the country. Ocean thermal energy conversion, offshore wind energy, solar energy are other sources which can aid in securing a Blue Economy and reduce our reliance on natural gas and oil for power generation. To date Tobago has shown to have cold water vents which is a prerequisite for Ocean Thermal Energy Conversion (OTEC). Professor Agard insisted that the potential is there and can be developed using a blend of public and private partnerships.

He also disclosed that the St. Augustine Campus of the University of the West Indies is involved in cutting edge research that has developed bio-plastics from the sargassum seaweed that washes ashore on beaches in Trinidad and Tobago during April – October.

Professor John Agard also noted that there are opportunities for countries to generate revenue through carbon capture initiatives where countries are paid to

Components of the Blue Economy

Activity	Ocean Service	Existing Industries	Related industries	Drivers
Living resources	• Seafood; • Biotechnology	• Fisheries	• Sustainable fisheries; • Aquaculture; • Pharmaceutical chemicals	• Demand for food, cosmetics and pharmaceutical products; • R&D activities
Non-living resources	• Minerals; • Energy; • Freshwater	• Seabed mining; • Oil and gas	• Deep seabed mining; • Renewables, ocean energy; • Desalination	• Demand for minerals, energy, alternative energy and freshwater
Trade & Tourism	• Trade; • Tourism	• Shipping; Port infrastructure and services; • Tourism	• Eco-tourism	• Growth in seaborne trade and tourism; • R&D activities
Ocean Restoration	• Carbon sequestration; • Coastal protection; • Waste disposal		• Carbon sequestration; • Coastal habitat protection and restoration; • Assimilation of nutrients and waste	• R&D in ocean activities

TABLE 1 COMPONETS OF A BLUE ECONOMY. SOURCE: PROFESSOR JOHN AGARD

be green and environmentally friendly. Professor Agard noted that the opportunities are there, but it requires us to think differently. The University lecturer continued that there is money to be made from projects that promote carbon sequestration. He highlighted the capacity of Trinidad and Tobago's mangrove forest to generate revenue via storage of carbon dioxide, which is a major greenhouse gas that contributes to global warming. The IMA, in collaboration with the University of the West Indies is conducting research to quantify the amount of carbon held in mangrove forests in Trinidad and Tobago. It is estimated that the worlds mangrove forest sequesters close to 24 million tons of carbon in soil per year, this is three to five times more than tropical forest.

The Distinguished Lecture was hosted virtually via zoom and Facebook live and saw approximately one hundred and sixty-eight persons in attendance during the meeting with many more engaged subsequently on the Institute's various social media platforms.

Professor Agard was joined by a panel of experts in diverse fields. The panellist included Dr. Thackwray Driver Chief Executive Officer of the Energy Chamber of Trinidad and Tobago, Mr. Baldath Ramkissoon General Manager, Treasury of Republic Bank Ltd, Dr. Ryan S. Mohammed Biologist, Council of President of the Environment, David Ramjohn CEO at AlgEternal, Head of Sustainability KindEarth. Tech and Mr. David A. Simmons Managing Director at Simmons and Associates. The virtual lecture was chaired by Ms Alicia Carter-Fisher, Chief Information Officer at the IMA.

Dr Diver called for investment grade data for business decision making. He noted that the country's experience in the petroleum sector meant that there exist transferable skills for work in a marine environment such as in offshore wind energy. David Ramjohn representing the American Chamber of Trinidad and Tobago spoke to the many opportunities that algae offers for the creation of new and diverse products and he promoted the regenerative properties of an algae-based operation. David Simmons outlined the international protocols and conventions that support the development of a Blue Economy. Baldath Ramkissoon presented on how to finance business interest in new and emerging industries, Dr Mohammed of COPE called for policy development driven by research, more stakeholder involvement, and funding for coastal communities to push towards a Blue Economy.

As a Small Island Developing States with fifteen times more marine area than land, Trinidad and Tobago must explore the significant ocean resources that can be

tapped into sustainably. These large marine area can be used to generate revenue and jobs that can lead to the diversification of the economy.

The current economic model is linear, for example resources are extracted, manufactured, sold, used and then thrown away which is inherently unsustainable. Panellists instead advocated for a regenerative and circular blue economy where all manufactured goods are created with strategies that allow for the reusing, re-making or recycling of items. Trinidad and Tobago already has some aspects of a Blue Economy (fisheries, tourism, petroleum and transport) though not circular or regenerative. Panellists advocated for a conscious deepening of the countries' push towards not only a Blue but Circular Economy.

The Distinguished Lecturer Professor John Agard concluded by signalling the urgency required in transitioning to a Blue Economy as the impact of climate change is already being experienced by the Republic.

Professor John Agard's full lecture and the presentations of all panellists may be accessed online using the hyperlink:

https://www.facebook.com/IMAgovTT/videos/1143132512732075/

Living with Nature

Anjani Ganase (PhD)
Coral Reef Ecologist, Institute of Marine Affairs

A School of Smallmouth Grunts of Flying Reef, Tobago
Photo Credit - Jonathan Gomez

Around Trinidad and Tobago, there are Caribbean and Atlantic coasts. Our islands' location along the edge of the South American shelf also provides exceptionally rich and diverse flora and fauna. Within the boundaries of our relatively small islands, the landscapes support wetlands, rainforests, savannahs, rivers and over 500 km of coasts. Our Exclusive Economic Zone (EEZ) extends over an area which is 15 times the combined land mass (approximately 5000 km2 of land). The ocean biome extends from sandy and rocky shores to coral reefs, offshore islands, sandy seafloor, the open ocean and mysterious unknown deep-sea habitats. None of these ecosystems would exist without the other. Our wetlands rely on our forests and rivers to collect rainfall and deliver a supply of freshwater, they also rely on corals and seagrass to buffer the impacts of ocean waves. The same wetlands support ecologically important and culturally iconic species such as the Scarlet Ibis and the West Indian manatee. The health of each of these ecosystems and their connections are fundamental to the healthy and functional island ecosystem that we depend on.

Our natural environments provide us with food, water, jobs and unique cultural value. Consider the agricultural and food sector: Trinidad and Tobago is known internationally for its unique cuisine created by immigrant ancestors, from sources on land and sea. Nearly all of our tourism industry depends on island ecology, from stunning land- and seascapes to the wildlife they support - nesting leatherback turtles, hundreds of birds, insects and native trees. Even carnival and other cultural festivals would not be the same without the environment we enjoy. Whether we acknowledge these inherent natural benefits or not, the mismanagement and destruction of these intangible resources will degrade our livelihoods.

Furthermore, what we do as individuals in our backyards will have serious cumulative consequences to natural and human ecosystems nationwide. For example, unregulated land clearing and construction within a watershed without measures for mitigation and restoration will aggravate flooding in low-lying areas, where poor planning may have already sited residential and agricultural developments. Soil erosion from land clearing inland can impact ecosystems at the coast and in the sea, as waterways carry loose soil to settle and smother nearshore seagrass and coral reef communities. A single activity carried out without forethought can have far-reaching consequences on our livelihoods and infrastructure, causing damage and degradation in areas earmarked for agriculture or tourism.

Fortunately, Trinidad and Tobago can move in the right direction with the establishment of a National Biodiversity Strategy and Action Plan, where the protection of our biodiversity and ecosystem services

align with the national sustainable development goals. One example of aligned activities is combating poverty and hunger and improving health by investing in green industry, agricultural research and technology for higher yields of food, protecting natural habitats including forest and marine areas, managing fish stocks and curbing the threat of climate change that will impact everyone. In addition to this, policies such as the Integrated Coastal Zone Management Policy Framework indicates a shift away from managing ecosystems in isolation towards a more holistic approach that considers the dynamics of the coastal zone and connections between land and sea habitats as well as the sustainability of resources.

Red Mangrove Forest in Caroni Swamp
Photo Credit - Lorraine Barrow

The pillar that supports a health biodiversity is education. As island people, we need to shift our mindset from an individual lifestyle to a collective/community ethos. We must manage the island ecosystem for the benefit and enjoyment of all. The most successful application of this idea is practised by the ancient Hawaiians who have lived sustainably on their islands in the middle of the Pacific for hundreds of years.

The Hawaiian islanders understood the importance of maintaining a continuous ecology from ridge to reef, therefore no fences or walls could be built to disrupt the ridge to reef connections. Instead lands were divided into tracts that extended from the mountains to the ocean within a watershed. Each tract was managed as a single interconnected ecosystem. In the mountains, loggers cut and replanted trees for construction and hunted for game; farming occurred in the lower plains, and fishing and fish farming along the coasts and surrounding seas. The ancient fish farms were established within natural rock ponds called *loko kuapa* that encouraged fish to enter for spawning and juvenile fish to grow. Fishermen would allow a portion of the stocks to be released back into the ocean while keeping a subset for food. All the jobs were done sustainably and to prevent destruction of downstream ecosystems and waterways. Furthermore, all resources were shared within the watershed unit. The name for the integrated managed layout from ridge to reef within each watershed was called *ahupua'a*.

This concept still holds true today for all environments, even those that are not on islands: consider the watershed and where you are located in relation to it. In general, all businesses, residents, government institutions need to consider not only how their actions may impact the neighbouring communities (on a hill or on the coast) but the broader environment, built or natural. Consider how your location may be complementary to the wider community and how it contributes to the sustainability of the city.

These concepts are even more important when we consider climate change. No longer a future potential, climate change is already putting small island nations under considerable pressure as intense hurricane and storm events become more frequent. Patterns of severe heat and drought conditions as well as more intense rainfall have already resulted in losses from flooding and erosion. These are human impacts that have also impaired the functionality of our natural resources and the services they provide. The best strategy to conserve our biodiversity is to reduce as far as possible the stressors caused by human intervention. We need to allow our forests, wetlands, coral reefs, seagrass communities every opportunity to adapt and become more resilient to the long-term global shifts in the climate.

In 2020, now more than ever, we must learn to live in harmony with nature and wild environments, for the sake of our own lives.

Mapping the carbon in Mangrove Forest

Hamish Asmath, Nikia Gooding and Gyasi N. Collins
Institute of Marine Affairs

White Mangroves

Mangrove forests occupy a transitory, ever changing zone between the land and the sea, being inundated at high tide, yet dry at low tide. Mangroves offers a wealth of ecosystem services and are biodiversity hotspot. They provide habitat for snakes, crabs, oysters, birds (including the national bird of Trinidad the scarlet ibis), and are a nursery for baby fish. Mangroves also protect coastal communities from storm surges and act as natural filters to reduce nutrient and sediment pollution from land-based sources before they reach the sea. Mangroves also play a significant role in the mitigation of climate change by sequestering carbon in aboveground (woody parts) and below ground (soil) pools. A preliminary estimate of mangrove forest carbon verses terrestrial forest carbon revealed that per hectare, mangrove forests sequestered 58% more carbon than terrestrial forests in Tobago, while for Trinidad the value was 41%. The belowground soil carbon pool is estimated to be at least 4 times more (and likely considerably higher) than the aboveground pool, making mangrove forests amongst the highest carbon dense ecosystems in the world. However, this pool of carbon is only maintained, and increases, if left undisturbed. Mangrove spatial extent in Trinidad experienced a decrease from 1994 to 2018 (7,331 to 6,878 hectares), while Tobago experienced a slight increase (188 to 197 hectares).

The Institute of Marine Affairs (IMA) in collaboration with the University of the West Indies, St Augustine Centre for Innovation and Entrepreneurship (STACIE) is conducting research to quantify the amount of carbon held in mangrove forests in Trinidad and Tobago. STACIE secured funding through the United Kingdom High Commission for the acquisition of a ground based Light Detection and Ranging (LiDAR), also known as a terrestrial laser scanner (TLS). The TLS is able to

accurately recreate in exceptionally high detail the 3D structure of mangrove trees so that the woody portions can be quantified, which yields the amount of carbon in the tree. Throughout the mangrove forests of Trinidad and Tobago 30 plots have been established within which the diameter at breast height (DBH) and tree height of each tree is measured. The TLS carbon measurements from individual trees is combined with the DBH and tree height data from the plots to develop a highly accurate estimate of carbon in each plot. This is then combined with the mangrove tree height for all of Trinidad and Tobago which was derived from an aerial LiDAR survey in 2014 conducted by the Government of Trinidad and Tobago. The result is a highly accurate estimate of the aboveground carbon held in mangrove forests.

The IMA has also partnered with the Marine Biological Laboratory from Woods Hole, Massachusetts to investigate belowground carbon. Soil cores were taken from a number of sites in the Caroni Swamp and these are being assessed to determine the amount of carbon contained in the soil matrix.

As of 2017, Trinidad and Tobago was the fourth highest emitter of carbon dioxide per capita in the world. By accurately quantifying amount of carbon held in mangrove forests, this value could be incorporated into the National Intended Contributions (NDCs) of the Paris Agreement as a mitigation measure to offset some of our very high carbon emissions.

Previous page & Below:
Scanning and taking physical measurement of mangrove trees

Are the beaches cleaner during the Covid-19 'stay-at-home'?

Sheldon Ramoutar
Microbiologist, Institute of Marine Affairs

The COVID-19 pandemic is currently changing the way we live our daily lives. No public gathering, and social distancing has been in effect since late March 2020 and has left our environment somewhat untouched. Around the world, reports have shown cleaner air quality in large cities and countries like the United Kingdom, China and Spain due to the drop in carbon and nitrogen oxide emissions. There are also reports of better water quality in places like Venice and the Ganges as the watercourses are now more transparent with visible aquatic life.

In Trinidad and Tobago, numerous beaches are continuously polluted and affected by runoffs from rivers, industries, households and by beachgoers. These pollutants can vary from solid waste, chemicals to biological agents such as bacteria from sewage. These biological agents enter through skin contact or ingestion can cause minor irritations to skin, eye, ear and even gastro- intestinal illnesses.

The Institute of Marine Affairs (IMA) routinely monitors various beaches for sewage contamination using specific bacterial indicators such as Escherichia coli (E.coli), enterococci and faecal coliform, which, if over a recommended limit indicates sewage pollution. These indicators are used by United States Environmental Protection Agency (USEPA), World Health Organization (WHO) and established by the Environmental Management Agency (EMA) in the Water Pollution Rules (2019). The recommended limits are provided in the table below.

Recommended limit Colony forming unit (CFU)/100ml		
Indicator	**Single day limit**	**Geometric mean limit** (Average of 5 days in a month)
E. coli	235	126
Enterococci	104	35

Even though a beach may have levels of bacteria above the recommended limit, it does not necessarily imply you will become sick if you bathe there, but rather, you are at a greater risk of getting sick. It all depends on the individual, as the more vulnerable, high risk groups are infants, seniors and immune-compromised individuals. Currently, all recreational beaches and rivers are closed to the public. Given the current regulations on working from home and social distancing, and to ensure the safety of our colleagues, we are slowly restarting our beach monitoring. We completed a single day analysis at three beaches- Maracas, Las Cuevas and Chaguaramas to get a snap shot of bacterial levels. Further testing will continue at these beaches.

The initial results showed that the bacteria levels were much lower than recorded in previous years during the dry season. Generally, water quality is always better in the dry season due to less land-based runoffs into

bathing areas. Runoffs from rainfall transports debris and pollutants from inland to the coastline. The public should always avoid bathing after a heavy rainfall event, especially areas where runoffs are visible, such as by river mouths and drains that empty into the beach.

Maracas Beach during lockdown
Photo Credit - Sheldon Ramoutar

At Maracas Beach, in the dry season, the Maracas River is usually the only location heavily polluted with high bacteria levels above the recommended limit. During May sampling event, the levels were very low. In the last couple of years, this site has never been below the recommended limit. For example, the indicator enterococci (limit 104 CFU/ 100 ml) gave a result of 50CFU/ 100 ml compared to 2018 (>183CFU/ 100 ml), 2017 (>280CFU/ 100 ml).

At Las Cuevas Beach, the bacteria levels were very low (below 30CFU/ 100ml) indicating excellent bathing beach water quality at both the western and eastern ends. In previous years, the eastern side of the bay near the fishing facility had poor water quality due to land-based runoffs while the western side always had good water quality. It should be noted the western side of this beach

Las Cuevas Beach during lockdown
Photo Credit - Sheldon Ramoutar

was once a certified Blue Flag Beach from 2014-2017, this was the only beach in English-speaking southern Caribbean with that status during that time interval.

At Chaguaramas Bay, the water quality varies tremendously as rain, outflows, and current movements affect it in the dry season. The Chaguaramas Peninsula has become industrialised with many outflows from businesses making its way into the waters. The water quality has always been slightly over the established limit. Our sampling for geometric mean uses five sampling events with usually three to four sample days being over the limit. During March month sampling event, the bacteria levels were lower in both Williams Bay and Welcome Bay. In Williams Bay, we recorded E.coli 0- 40CFU/ 100 ml; enterococci 0 - 50CFU/ 100 ml) compared to 2019 (E.coli 100- 400CFU/ 100 ml; enterococci 20 - 300 CFU/ 100 ml). In Welcome Bay, we recorded E.coli 50- 60CFU/ 100 ml; enterococci 0 - 100 CFU/ 100 ml) compared to 2019 (E.coli 10 - >400CFU/ 100 ml; enterococci 20 - >240 CFU/ 100 ml).

Overall, in the initial testing at the three beaches, the bacteria levels were the lowest recorded compared to daily values from previous years. Therefore, what can be the reason for the low bacteria levels at the beaches?

Williams Bay, Chaguaramas during lockdown
Photo Credit - Sheldon Ramoutar

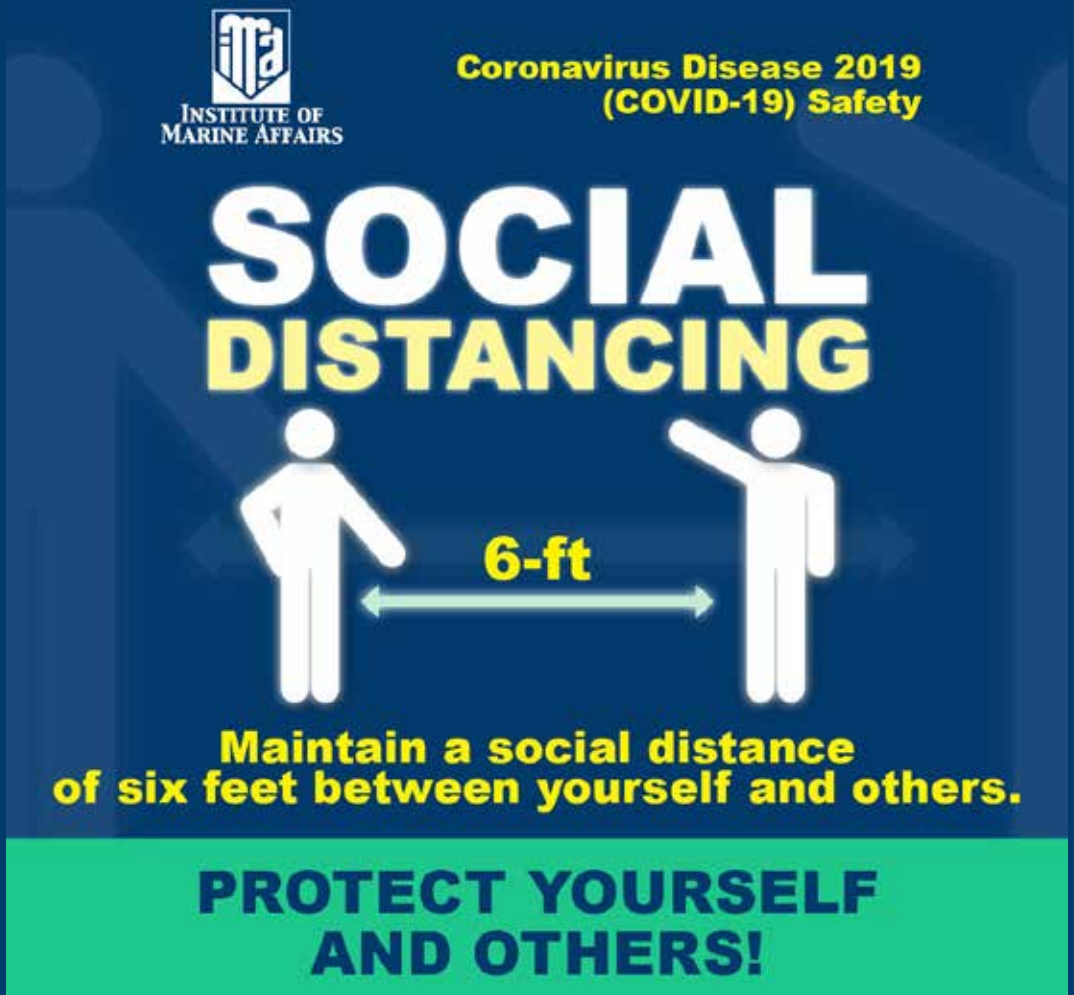
Extreme Dry season

Land-based runoff is the leading cause of pollutants entering the bathing areas and this usually intensifies during rainfall events. Compared to previous years, this dry season had minimal rainfall so can be a leading factor to why the levels are so low.

COVID-19 Pandemic Lockdown

At present, all the beaches are closed to the public and during sampling there was little to no trash and the facilities (toilets, food establishments) were not in use. The sediments on the seafloor that is capable of holding bacteria are usually disturbed by bathers, outflows and boats, and this can result in re-suspension of bacteria into the water column. With no bathers present, there is little to no resuspension of sediment and bacteria, so the water looked clear and enticing on a very hot day.

It will take much more data, and more time to determine if the COVID-19 lockdown contributed to improved bathing beach water quality, but physically being on the beach and seeing no signs of garbage and very clear waters, one will have to believe it did. COVID-19 is currently affecting every aspect of human life, but it is likely having benefits to the environment. We will continue sampling and testing, and a full report will be prepared and made available from the Institute of Marine Affairs.



Farmers Training in Caroni: One step towards Ecosystem-Based Management in Trinidad and Tobago

Darryl Banjoo (PhD)
Deputy Director (Ag); Marine Chemist, Institute of Marine Affairs

Research Officer, Ben Maharaj (Right) with farmers from the Caroni area

On July 27 and August 3 – 4, 2020, the Institute of Marine Affairs (IMA) in collaboration with the Faculty of Science and Technology, University of the West Indies, St Augustine facilitated a series of farmers training workshops at Shri Krishen Mandir, Katwaroo Street, and Felicity. These workshops were part of the regional project, the Caribbean Large Marine Ecosystem + (CLME+), to implement an Ecosystem-Based Management (EBM) approach for addressing the impacts of land-based sources of pollutants on critical coastal habitats such as mangrove swamps. The project focuses on addressing nutrient pollution from agriculture in the southern part of the Caroni Swamp.

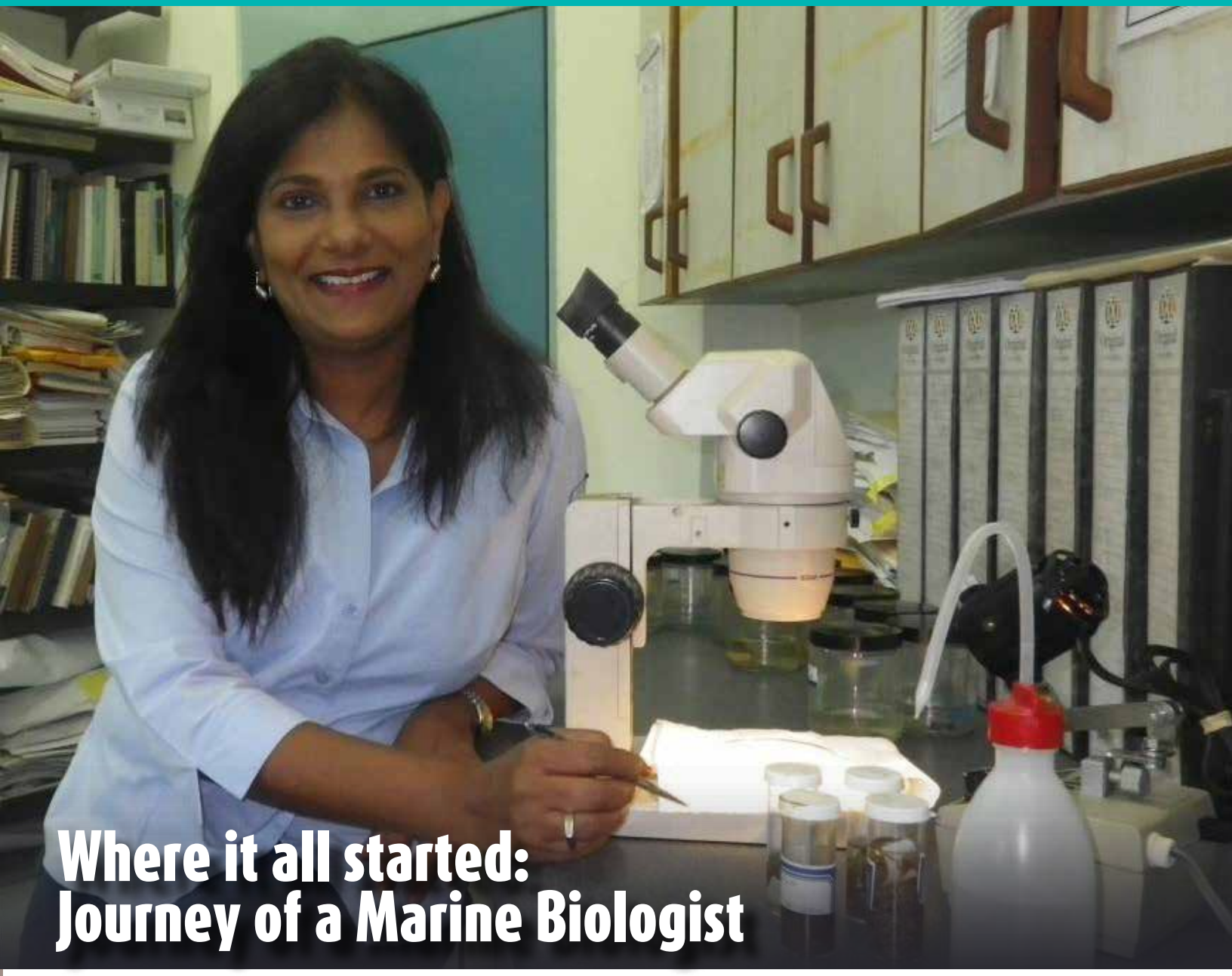
IMA surveyed the farmers in the catchment areas on the southern side of the Caroni Swamp to determine their knowledge on soil health, pests and diseases, and to understand existing farming practices including the use of chemicals such as pesticides and fertilisers.

Based on the results of the survey, training workshops were developed by UWI that covered topics such as Soil Fertility & Nutrition Considerations for Productivity and Sustainability, Integrated Crop and Disease Management in Tropical Vegetables, and Use of Biological Inputs and Adoption of Environmentally Sustainable Methods. It is hoped that coming out of these workshops' farmers can reduce fertilisers and pesticides use while maintaining agricultural yield. This will result in less nutrient pollution, and improved ecosystem health.

Dr. Gaius Eudoxie of UWI St Augustine educates famers on soil nutirents at Felicity

Research Officer Lester Doodnath addressing farmers at training workshop

Prof. Jaya Raman, Jerningham Community



Where it all started: Journey of a Marine Biologist

The reality of the glass ceiling for women is undeniable and Judith Gobin has cracked it! For the first time in the history of the St. Augustine Campus of The University of the West Indies and the Faculty of Science - there is a female Professor of Science! Prof. Gobin is also Head of the Department of Life Sciences, the largest Department in the Faculty of Science and Technology. Her marine research career spans more than thirty-eight (38) years and she has made significant academic contributions to the knowledge of Marine Biodiversity in Trinidad and Tobago and the Caribbean.

Prof. Gobin is extremely pleased to highlight - that she grew up at the Institute of Marine Affairs (IMA); for it is here that she began her exciting marine journey- getting her "feet wet" way back in 1981 when she started off as an Intern (working for the July/August university break) and then being permanently hired (starting as a Technician) in 1982 as she graduated from UWI (BSc Zoology/Botany). During the next 16 years she moved up the ranks- Junior Research. Officer, Research. Officer and Senior . Research. Officer and finally Officer in Charge of the Environmental Research Program (ERP).

It is at the IMA, that Prof. Gobin began her taxonomic career- identifying polychaetes (marine worms) and it is as a result of those very long days peering down a microscope- that today she is the most senior Benthic Ecologist in Trinidad and Tobago. Prof. Gobin fondly remembers all of her colleagues in the ERP team and the able Support Service team- without whom she could not have completed her MPhil research degree; especially Mr. Courtney Cohen and the late Mr. Rudolph Quintero. Prof. Gobin left the IMA in 1998 and worked as a

consultant for 2 years, then began lecturing at UWI in 2000. She has published on a number of "new marine scientific records" and "new marine species" (approx. 298) - for Trinidad and Tobago and the Caribbean. Her research concentrations began in soft coastal marine sediments (at the IMA) followed by rocky shores and more recently deep-sea areas (UWI).

Prof. Gobin has been a trailblazer for some time with the following under her belt:

She is the **first** and **only Caribbean and UWI marine scientist** to:

1. Be appointed to the REV Ocean Science and Innovation Committee (SIC) alongside other top global scientists (2019)
   https://www.revocean.org/science/sic/
2. Be appointed to the Global advisory board on Deep Ocean Stewardship Initiative (DOSI) - alongside the top global deep sea scientists (2018)
   https://www.dosi-project.org/management/
3. Contribute to the global project- Census of Marine Life (http://www.coml.org/) - a 10 year scientific initiative, which comprised of 2,700 scientists from 80 nations. (2010)
4. Contribute to the World Ocean Assessment 2015 report
   http://www.un.org/depts/los/global_reporting/WOA_RegProcess.htm

Prof. Gobin's significant contributions are in no way purely academic as she continues at a national, regional and global level to promote and apply scientific knowledge to solve real-world problems. She is globally recognized as a key SIDS marine science expert and has been doing a number of international invited talks. In this respect, she is contributing to the negotiations for an international legally binding instrument, under the UN Convention on the Law of the Sea (UNCLOS)- on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ).

Prof. Gobin wishes to sincerely thank the IMA which will always be dear to her -in respect of her career as well as it is where she made some life-long friends (Naomi Slinger, Gregory De Souza, Paul Gabbadon, Ricky Seegobin, Lori Lee Lum, Richard Hubbard) - to name just a few. She thinks the IMA must still be one of the best places to work where one truly can enjoy their research job and make friends for life!

Her message to colleagues at IMA- do continue to make strides in marine and environmental scientific research; as you are already doing. There is still so much to be done in the Oceans of Trinidad and Tobago and the Caribbean and we (all stakeholders) can do it together!

Photos provided by Prof. Judith Gobin

Tackling the Plastic Waste Crisis:
The Basel Convention Plastic Waste Partnership

Wendy Nelson
Research Officer, Institute of Marine Affairs

Research Officer, Wendy Nelson (centre) with other participants at the Plastic Waste Partnership Working Group meeting in Seychelles, March 2020

Plastic waste pollution continues to be a significant environmental challenge for the world today. Each year, 320 million tonnes of plastic are produced, and more than 8 million tonnes of plastic end up in the ocean, largely due to land-based sources or activities. In fact, it is estimated that 80- 90% of the plastic in our seas originates from these sources or activities. In 2018, the Ocean Conservancy, the organisation that coordinates the annual International Coastal Cleanup, reported that over 97 million items were collected from over 35,000 km of coastline, and the top 10 ten items collected (over 21 million in total) were plastic. Studies have shown that marine life can become entangled in, can be choked by, or can ingest plastics. Plastic debris has also been linked to increases in coral disease outbreaks- it stresses corals and can cause structural damage, thereby giving pathogens a foothold for invasion.

An emerging area of concern is that of microplastics- pieces of plastic that are smaller than 5 mm in diameter. Microplastics have been found in the stomachs of hundreds of different species from all levels of the food web, for example, whales, dolphins, seals, fish, birds, shrimp, oysters and zooplankton. In 2019, a study from a plastic- polluted site in the USA showed that one species of coral preferentially consumed microbeads (used, for example, in soaps and cosmetics) over their natural food- brine shrimp eggs. While the impacts of microplastics are not yet well understood, it is thought that they may pose a potential health risk to humans, as they can absorb and transport chemical contaminants, and are present in the human food web.

Small Island Developing States (SIDS) in the Caribbean are likely to be quite vulnerable to plastic waste pollution, as these states are small in size and have limited resources, which makes it difficult to put the necessary waste management systems in place. There are also potential economic impacts, as many of these states are dependent on fishing and tourism. It has been estimated that if the current trend continues, by the year 2050, there will be more plastics than fish in the ocean. The plastic waste crisis has also been exacerbated by the policy decision taken by China in January 2018 (China's National Sword Policy) to stop importing plastic and other waste for recycling. This waste amounted to almost half the world's recyclable waste and countries now have to find alternative solutions for dealing with their waste.

Last year, in response to the current global situation, the Conference of the Parties to the Basel Convention established a new working group, the Plastic Waste Partnership Working Group (PWPWG). The Basel Convention is a global environmental treaty on hazardous and other wastes, and it seeks to control

the transboundary movements of hazardous wastes and their disposal. The objective of the new working group is "to improve and promote the environmentally sound management of plastic waste at the global, regional and national levels and prevent and minimise their generation so as to, among other things, reduce significantly and in the long-term eliminate the discharge of plastic waste and microplastics into the environment, in particular the marine environment."

The first meeting of the PWPWG was held in Beau Vallon, Seychelles from 2- 5 March 2020. The meeting was hosted by the Government of the Seychelles, and was organised by the Secretariat of the Basel, Rotterdam and Stockholm Conventions, and the Africa Institute for Environmentally Sound Management of Hazardous and Other Wastes, as the Basel Convention Regional Centre for English-speaking countries in South Africa (BCRC South Africa). Canada, Japan, Norway and Switzerland provided financial support for the meeting. Representatives from the Institute of Marine Affairs, the Environmental Management Authority and the Basel Convention Regional Centre for Training and Technology Transfer for the Caribbean participated in the meeting. The purpose of the meeting was to make arrangements to operationalise and initiate the work of the Partnership. Key outcomes included the establishment of four project groups: (1) Plastic waste prevention and minimisation (2) Plastic waste collection, recycling and other recovery including financing and related markets (3) Transboundary movement of plastic waste and (4) Outreach, education and awareness-raising, as well as the prioritization of activities to be undertaken by each project group.

A photography contest, which is open to the public, was launched during the workshop to promote outreach, education and awareness-raising on the global plastic waste crisis. Entries will be accepted in six categories:

1. Let's go outside! - Plastic waste and nature
2. Plastic waste and our health and livelihoods
3. Tiny but everywhere: Microplastics
4. Let's use it! - Plastic waste as a resource
5. Let's do it! - Solutions for avoiding single-use plastic products and
6. Let's fix it! - Alternatives, new technologies and innovation.

The judging panel will include National Geographic Photographer, Sara Hylton, and three winners will be selected per category- one amateur adult, one professional adult and one child (under 18 years). The contest closes on 30 September 2020 and further details are available on the Basel Convention website (see below).

Although the plastic waste crisis requires global action, the problem is not insurmountable, as the majority of land based plastic pollution that ends up in our seas is due to poor waste collection and management. It is important for each of us to take action on a personal level and practice the 5Rs- reduce, refuse, reuse, recycle and remove plastic waste, in order to protect our environment. Our environment needs all the help it can get.

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For more information on the competition:
www.basel.int/Implementation/Plasticwaste/PlasticWastePartnership/Photocontest

Parrotfish - Eating and "pooping" their way to healthy reefs!

Farahnaz Solomon (PhD)
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Present on Tobago's coral reefs and adored by snorkelers and divers because of their often garish coloration, are at least 10 species of parrotfishes (Family: Scaridae). Within recent times much attention has been placed on these enigmatic creatures. The focus, however, is not their fickle coloration during each life-stage, or their sex changing ability, or even their self-extruded protective mucous "sleeping bag". Rather, much of the focus has been on their important role as a sand producing machine and in maintaining coral reef health.

Parrotfish feed mainly on algae extracted from pieces of coral bitten off from the reef using their teeth which have been fused into powerful beaks, much like a parrots' beak – hence their name. As much as 90% of their day may be spent nibbling away at the reef. The rock and coral skeleton ingested is ground up through their teeth and by molar-like teeth in their throats. The indigestible material is then defecated "pooped" out as smooth white sand. Yes, sand! A large parrotfish can poop up to 200 pounds of sand in a year and as much as 85% of the sand produced on a beach can be pooped out by these fishes (Perry et al., 2015). If your beach is near a healthy population of coral-eating parrotfish, you just might be digging your toes into some parrotfish poop on your next visit!

Parrotfish though, perform a far more important function in their grazing – they are the reef's gracious and indispensable gardeners, removing the algae that compete with corals. This prevents the corals from being overgrown and becoming smothered. The transformation of many Caribbean reefs to algal dominated habitats in recent decades have been linked to the loss of herbivorous fish like the parrotfish, due to pollution and overfishing. According to the report "Status and Trends of Caribbean Coral Reefs: 1970 – 2012" (Jackson et al., 2014), there has been more than a 50% loss in living coral cover throughout the Caribbean since the 1970s. What is surprising though, is that the loss of grazers such as sea urchins and parrotfish was found to have played a much bigger role in this loss, than climate change. Results of a subsequent study which analyzed fossilized parrotfish teeth and sea urchin spines from sediment cores also showed that there is indeed a strong correlation between parrotfish abundance and coral reef growth historically – coral reefs grew faster and healthier when parrotfishes were abundant (Cramer et al., 2017).

With climate change being the biggest threat to coral reefs now and in the future, the critical role of parrotfish in maintaining coral-dominated reefs is even more important. While we are somewhat limited in what we can do at the local level regarding climate change, coral reef scientists believe that we can build coral reef resilience through resilience-based management strategies. By resilience we mean "the capacity of a

system to absorb or withstand stressors such that the system maintains its structure and functions in the face of disturbance and change" (Holling, 1973). Macroalgal and algal turf control by grazing parrotfish facilitates the recruitment, growth, and fertility of corals which is a key mechanism promoting reef resilience following a disturbance (Mumby and Steneck, 2008).

For all these reasons combined, several regional and international organizations such as the International Coral Reef Initiative (ICRI), the Global Coral Reef Monitoring Network (GCRMN) and the Caribbean Community Climate Change Center (5Cs) are in support of banning or regulating parrotfish harvesting. Indeed, a number of Caribbean countries including Barbuda, Bermuda, Belize, Bonaire, Turks and Caicos and St Vincent and the Grenadines have already taken that step.

For some countries however, this is not an easy decision. In Jamaica, such a ban was rejected in 2018 by the relevant fisheries authorities due to potential negative socio-economic impacts on small-scale fishers. These small-scale fishers are very dependent on the parrotfish fishery due to the collapse of the grouper and snapper fisheries. Instead, Jamaica has opted to employ another resilience-based management strategy - the designation of a network of fish sanctuaries or Special Fisheries Conservation Areas, to protect and replenish fish populations.

What about Trinidad and Tobago? Well, parrotfish harvesting locally occurs mainly in Tobago where parrotfish is harvested mainly by spear-fishers either SCUBA diving or free diving. They may also be caught by baited fishpots. Spearfishing in Tobago is unregulated – there is no permitting system, gear restrictions, size or catch limits, or open or close seasons. Overall, the level of exploitation and the dynamics of the fishery is unknown. Additionally, there is some anecdotal evidence to suggest that there may be cause for concern as many fishermen report a decrease in the abundance and size of parrotfish harvested now compared to the past.

Should we take action? The paucity of information on parrotfish harvesting should not be a deterrent for action. Coral reefs are just too important! "Caribbean reefs generate more than US$3 billion annually from tourism and fisheries". In Tobago, in 2016, Tobago's reef associated tourism and recreation contributed over US$852 million to its GDP with approximately 60, 000 jobs being directly supported by coral reefs. This is expected to increase in the next years 10 years to over US$1 billion.

What can we do? Parrotfish management does not mean a complete ban on harvesting as there are less stringent measures that could be applied for precautionary reasons. Regarding T&T, some of these measures include:

Marine Protected Areas (MPAs) or Networks – The establishment of MPAs which are clearly defined managed areas provide many benefits including an increase in the diversity, density, biomass, body size and reproductive potential of many species within their boundaries. This strategy which can protect parrotfish populations also have additional benefits for the reefs as other local stressors such as pollution and sedimentation are usually also managed. Presently, T&T has just one MPA – The Buccoo Reef Marine Park, which was designated in 1973. Under a soon to be completed national project, IFPAMTT (Improving Forest Protected Area Management in T&T), another has been proposed - The Northeast Tobago Marine Protected Area (NETMPA). These two MPAs are a great place to start.

Size Limits – Minimum and maximum catch size limits would allow younger fish to grow and become sexually mature (increase spawning biomass), and older fish to produce offspring to replenish stocks. In some places a 30 – 50 cm harvest length have been implemented with success. This strategy would require significant levels of enforcement but could be very effective in its impact.

Reef Stewardship – As a consumer, we can play a key role in securing the future of marine ecosystems like coral reefs by making more environmentally responsible choices when purchasing seafood. At the landing site, at the supermarket and at the restaurants, opt for more sustainable choices - fish that are not ecologically important to the reef, and those whose status has been assessed and is being managed accordingly. In Tobago, a good alternative would be the flyingfish, and the invasive lionfish. Snapper, and pelagics such as Kingfish and Mahi Mahi are also better choices.

Overall, management strategies employed should be done in consultation with all stakeholders involved. Management measures must be enforced and coupled with monitoring and surveillance to assess its effectiveness. Of equal importance is public education and awareness, especially for fishers and seafood consumers.

Let us learn from our Caribbean neighbors and be proactive rather than reactive in protecting these important reef inhabitants. Some of the healthiest Caribbean coral reefs are those in areas where governments have regulated parrotfish harvesting, such as in Bermuda and Bonaire. With their bright colors, mucus sleeping bags, toothed beaks, sand poop and undersea green thumb, parrotfishes are certainly stars of the reef realm.

Next time you dive, listen carefully, you may hear them taking a bite off the reef!

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Ocean Science for Climate Change

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Research Officer, Institute of Marine Affairs

Toco by Lighthouse
Photo Credit - Lorraine Barrow

The ocean is a key component of the Earth's climate system and shares a complex relationship with climate change. Despite this, it is acknowledged that we have a limited understanding of climate-related ocean processes, and that our ability to measure these processes are inadequate. Recognising the ocean as a critical driver of global climate and the need for deeper insights, the United Nations (UN) has declared a Decade of Ocean Science for Sustainable Development (2021-2030), which aims to achieve Sustainable Development Goal 14 (SDG 14) – conserve and sustainably use the oceans, seas and marine resources. The UN Decade is a unique opportunity for the ocean's scientific community to increase its understanding of climate-related ocean processes and improve the science-policy interface, to ensure ocean sustainability in the face of climate change. Climate change refers to long term changes of the Earth's weather patterns across various spatial scales. Both human and natural processes such as volcanic activity and changes in the Earth's orbit, influence climate change. However, scientists believe that changes observed in the Earth's climate since the 20th century are primarily driven by human activities, particularly the burning of fossil fuels. The net effect of climate change has been the warming of the Earth's surface, of which the oceans comprise 71%. It is estimated that more than 90% of excess heat is stored in the oceans, resulting in rising ocean temperatures. In 2019, the world's oceans were the warmest in recorded history, and the International Panel on Climate Change estimates that the upper ocean has warmed by 0.11°C per decade, over the past 40 years.

The ocean regulates global climate by storing, moving and transferring heat, water and carbon dioxide (CO2) – a primary greenhouse gas which contributes to climate change. The ocean absorbs the sun's energy particularly in the tropics where upon heating, evaporation occurs forming rain and storms. Through ocean currents, warm water from the equator is transported towards the poles, and cold water from the poles back to the equator, thereby reducing the uneven distribution of the sun's energy on the planet. In addition, the oceans are the world's largest store of carbon, containing 50 times more carbon than the atmosphere. It is estimated that the ocean stores approximately 40% of all CO2 produced by human activity since the start of the industrial revolution, which has increased its acidity by 30%, over the past 200 years.

The ocean therefore mitigates climate change through the uptake of CO2 and is a major carbon sink, storing carbon in the form of biomass and sediments in tidal marshlands, mangroves and seagrasses known as 'blue

Southwest Peninsula, 2013
Photo Credit - Rahanna Juman (PhD)

carbon', but even with its vast capacity to absorb both heat and carbon, scientists believe that the storage capacity of the oceans may be exceeded, and as a result the oceans are experiencing both physical and chemical changes at unprecedented rates. This is evidenced by increases in sea level rise, sea surface temperature, altered ocean circulation, ocean acidification and an increase in the frequency and intensity of storms and hurricanes, all of which have profound effects on coastal and marine ecosystems as well as human lives and livelihoods.

In addition to climate regulation and climate change mitigation, people worldwide depend on the ocean for both their basic needs as well as recreation. The ocean produces half of the world's oxygen and is a source of both food and medicines used to treat cancer, arthritis and heart disease among others. It also provides many unique recreational activities including sailing, snorkelling and whale watching. Furthermore, large-sectors of the global economy depend on ocean-related commerce including fisheries, tourism, shipping and mineral extraction. The UN estimates that the global ocean-based economy is valued at between USD 3-6 trillion per year, with more than 3 billion people relying on the oceans for their livelihoods.

The oceans are critical for human well-being and many of the SDGs will not be achieved without SDG 14, including SDG 1 – no poverty, SDG 2 – zero hunger and SDG 3 – good health and well-being. In addition, SDG 14 is inextricably linked to SDG 13 - climate action. Rightfully, the oceans no longer receive peripheral attention in global climate research and climate change policy, as evidenced by explicit acknowledgement of the oceans in the 2015 Paris Agreement on Climate Change. It is now widely recognised that any climate action requires a focus on the oceans, and scientists have explicitly expressed the need for climate funding to be made available for ocean research and projects. The Decade ahead is an opportunity to conduct robust ocean science required to expand our understanding of the impacts of climate change on the oceans and on climate-related ocean processes, to inform policies and take the transformative action needed to reverse the declining health of the oceans, upon which all life depends

Poor disposal of rubbish can lead to the clogging of rivers and streams.

This results in flooding, which negatively affects livelihoods.

What can you do to prevent this?

NATURE MAN

Presented by
Institute of Marine Affairs & Sustain T&T

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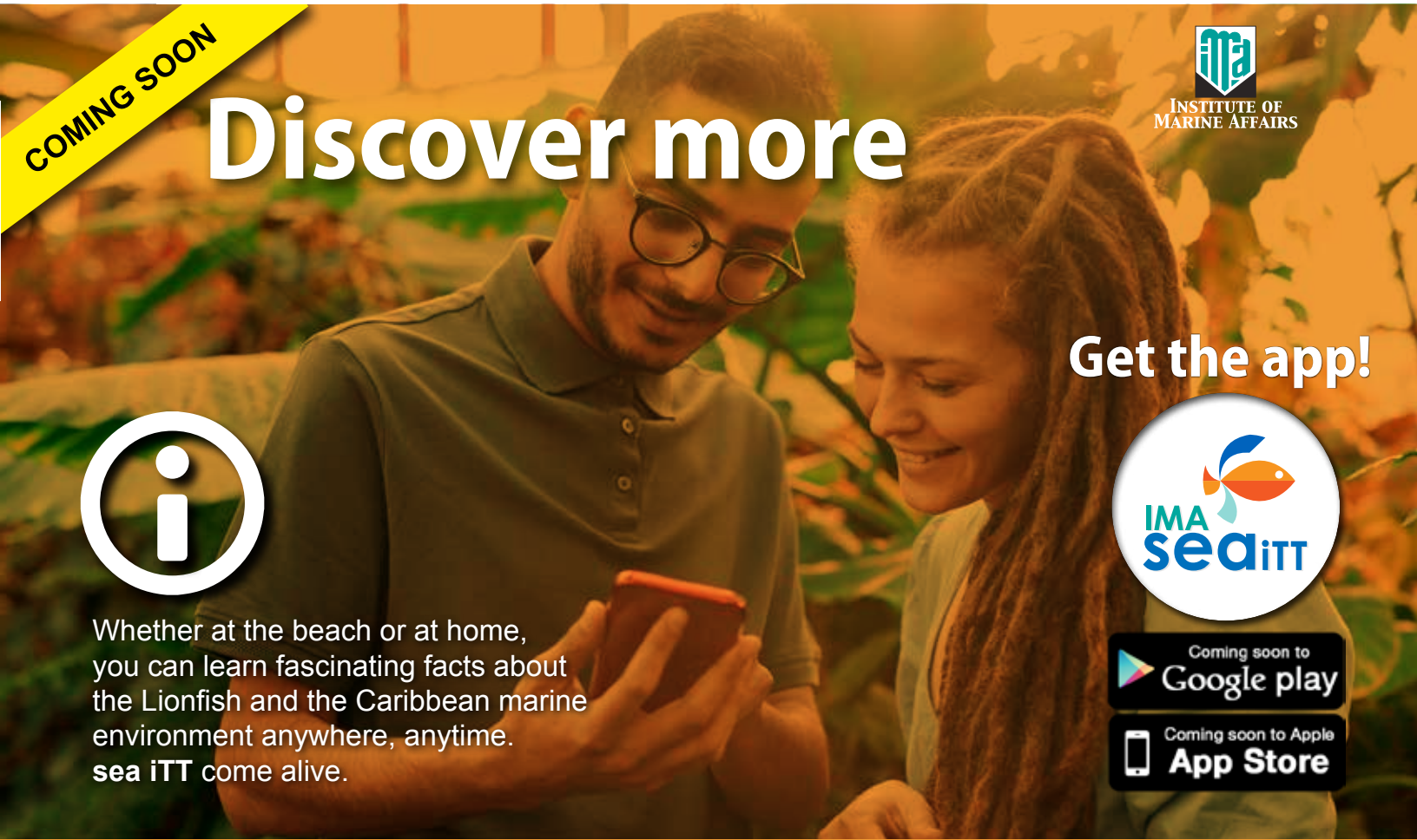
Watch NATURE MAN on YouTube

Cassandra Nanlal (PhD)

Welcome to the IMA
Dr. Cassandra Nanlal

Dr. Cassandra assumed the position of Research Officer, Physical Oceanography at the Institute of Marine Affairs on June 10th 2020 and intends to develop and participate in research that would foster sustainable development within the coastal environment of the Caribbean region and mitigate the impacts of climate change.

Dr. Cassandra Nanlal was awarded her PhD in Surveying and Land Information in June 2019 and completed a BSc Geomatics Engineering with first class honours in 2010. Her doctoral research focused of establishing seamless vertical separation models for Caribbean coastal zones. The method developed utilizes a combination of long- and short-term sea level measurements and hydrodynamic modelling to facilitate transformations among tidal datums such as Lowest Astronomic Tide (LAT) and Mean Sea Level (MSL). She worked as a Graduate Research Assistant in the Department of Geomatics Engineering and Land Management at the UWI for eight (8) years and also took up roles as Instructor II, Demonstrator and Temporary Lecturer during that time. During her tenure at the UWI she was primarily responsible for courses in Hydrography, Numerical Methods, Geodesy and Global Navigation Satellite Systems.



THE BLUE CORNER

Ocean Electric Creatures

Most have heard of the Electric Eel, a slender cylindrical shaped creature that can pack an electrical punch of over 600 volts by utilising special organs made up of electrocytes. The electrical charge can stun prey and keep predators away. Similarly, there are electric rays that can also generate electricity and potentially shock divers that accidentally step on them.

There are reports of divers being stunned and even losing consciousness. The Torpedo ray can generate up to 220 volts. The typical home wall electrical socket sends out 110 volts.

Top:
Torpedo Ray

Left:
Electric Eel

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