|  |
| --- |
| EN202-03 Research |
| CNMI’s Ocean Awareness |
| “What happens if the CNMI loses its fish, sea-creatures, corals, & ocean water quality? |
|  |
| **Raymond C. Villagomez** |
| **5/10/2014** |

Northern Marianas College

EN202 Kimberly Bunts-Anderson

|  |
| --- |
|  |

**Table of Contents**

Abstract……………………………………………………………………………………………………………………………………………..P.03

Intro…………………………………………………………………………………………………………………………………………………..P.04

Ocean Species of the Commonwealth of the Northern Marianas Islands………………………………………….P.05

Food Fishes of the Reef in the Marianas…………………………….…………………………………………....P.05-12

Oceanic and Deep-bottom Fishes of the Marianas…….…………………………………………………….P.12-14

Oceanic (Trolling Fishes)………………………………………………………………………………………….P.14

Deep-bottom Fishes……………………………………………………………………………………………..…P.14

Other Sea-creatures of the Marianas……………………………………………………………………………………P.14

Coral Reefs………………………………………………………………………………………………………………………………………..P.14

Fringing Reefs…………………………………………………………………………………………………………….….…P.14-15

Barrier Reefs…………………………………………………………………………………………………………………….P.15-16

The Environmental Stressors of the CNMI’s Coral Reef Ecosystems………………………………………………….P.17

Coral Bleaching…………………………………………………………………………………….……………………………….P.17

Ocean Acidification…………………………………………………………………………………..………………………P.17-18

Shoreline and Coastal Change………………………………………………………………………………………………P.18

Diseases……………………………………………………………………………………………………………………………….P.18

Tropical Storms……………………………………………………………………………………………..……………………..P.18

Coastal Development and Run-off-……………………………………………………………………………………..P.19

Coastal Pollution…….…………………………………………………………………………………………………………….P.19

NPS…………………………………………………..…………………………………………………………………..…P.19

PS………………………………………………………………………………………………………………………..P.19-20

Tourism & Recreation…………………………………………………………………………………………………………..P.20

Fishing…………………………………………………………………………………………………………………………………..P.20

Ships, Boats, & Groundings…………………………………………………………………………………………………..P.20

High Priority Vessels………………………………………………………………………………………………..P.20

Marine Debris…………………………………………………………………………………………………………………….…P.21

Aquatic Invasive Species……………………………………………………………………………………………………...P.21

Keeping an Eye on the Ocean……………………………………………………………………………………………………….P.21-23

Analysis of Coral Reef Ecosystems………………………………………………………………………………………………..P.23.24

How is Our Water Quality?..................................................................................................................P.24

Interview with PMRI Director: Greg Moretti…………………………………………………………………………………P.25-28

Interview Analysis……………………………………………………………………………………………………………..…P.28

The “Primordial Sea”………………………………………………………………………………………………………..P.28-31

CNMI Ocean Awareness Survey………………………………………………………………………………………………….…..P.31

Conclusion………………………………………………………………………………………………………………………………….P.32-33

Methodology………………………………………………………………………………………………………………………………P.33-34

Acknowledgement ………………………………………………………………………………………………………………………….P.35

**Abstract**

**The main purpose of this research paper was to have a better understanding of the CNMI’s (mainly Saipan) ocean, fish/sea-creatures, corals, and water quality. Since our islands are surrounded and dependent on the ocean and its creatures, I want to have a better understanding of this topic and hopefully have others learn about our ocean. I chose to focus this subject in our local region, because it is more possible and I can relate to it. I wanted to see how the current conditions of our ocean; “what kinds of fish and sea-creatures do we have?” I also included an overview of corals because it is important. “What kinds of factors/stressors are degrading our oceans?” “Are there solutions?” What is being done to protect our ocean and its species?” I also wanted to show other important values and benefits by giving extra information. My main or primary research question: “What happens if the CNMI loses its fish, sea-creatures, corals, and water quality?” This research may open our eyes to the reality of our precious environment.**

**Introduction**

The ocean is a vast area that does not seem so alive above the surface, but once you look underneath, you find a whole new world. Billions, if not, trillions of fish roam around the water-world; both fresh and ocean waters. That’s not all there is to it. There are many, many different or variety of species that are known and still many more to be discovered. You may see tiny plankton and polyps to bus-sized 40 ton whales. The ocean features are astounding; it is a major part of the world and life on the planet. Remember, there is more ocean than there is land.

It is basic and essential for everyone to know the environment is one of the most important factors of our life and our planet. That includes our land, air, and sea. In order for us to live in balance, we must have a functional environment. We humans may live on land, but we have a huge dependency on the ocean for so many reasons. Not only humans, but every being in this planet is affected by the ocean.

There are many issues and factors on the ocean that everyone should know. It is obvious that everyone should know that our ocean is not as good as it was before or how it should be. Ocean water quality is degrading from pollution, coral reefs are also being threatened, fish population seems to be falling, species are being threatened and even extinct, plus many more. This is all negative and pointing towards a negative outcome. Luckily we have government departments that manage the environment plus human environmental movements and groups that act against this situation. However that is not enough. We all need to work together to solve this dilemma. Not everyone is an expert or has the tools, but we can help by doing one thing. That is being aware. So, one of the main purposes of this essay is to raise awareness.

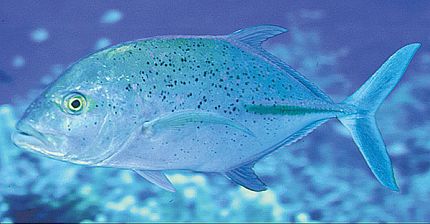
Most of this essay will focus on Saipan and the rest of the CNMI. The CNMI being a chain of islands surrounded by corals and ocean, heavily relies or depends on the ocean for many reasons. It makes me ask, “what kind of species does the ocean have to offer?” Also being a territory of the US, we have regulations and enforcements of our coasts and oceans. It is important to know; “what is being done to protect and conserve our oceans?” which also incorporates to “how is our oceans current condition?” and also “what factors are the cause of the ocean degradation?” The primary question is “what happens if our ocean loses its fish, sea-creatures, and corals, and water quality?”

**Ocean Species of the Commonwealth of the Northern Marianas Islands**

***This section of my research gives an overview of some of the species the ocean has to offer in the Marianas***

**Food Fishes of the Reef in the Marianas**

Fishing on the reef is an activity much treasured in the islands of the Marianas (Includes Guam). There are over hundreds of species of fish. They come in different sizes and shape. Some fish are in groups or some can be from the same family. Tourists come from around the world to see what our islands have to offer. However, locals may view the ocean as a precious resource. It is very likely you will find people throwing their line in the water, trying to scoop fish with throw-nets, free-divers with guns, people setting up traps, and lots more. Whatever beach or style, everyone wants fish. It’s free, healthy, and it can be fun. However, not every fish is favored. Some fish can be poisonous, some fish are not taken for religious or cultural practices, and sometimes; the fish may not taste pleasant. Over the many years, the people of the Marianas have recognized and favored a variety of reef fish. This section will classify some of the most preferred reef food fishes of the reef by its name, other names, its family, its size, weight, geological distribution, habitat, diet, behavior, reproduction, adaptation, conservation status, and its reproduction. .



**Name:** Blue-fin Trevally

**Scientific Name:** *Caranx Melampygus*

**Chamorro:** I’e(Small, baby) Tarakitu’ (Large)

**Japanese:** Madarahata

Carolinian:Langu’

**Tanapag:** Bweyah **Filipino:** Taliktok **Palau:** Oruidl **Hawaii:** Omilu

**Specie Family:** Canangidae

**Size:** up to 1.2m (3.6ft) **Weight:** up to43.5kg (96lb)

**Geological Distribution:** They are found in the Indo-Pacific Ocean, Australia, New South Wales, Eastern Central Pacific (Panama to Mexico); also on the Islands of East Africa.

**Habitat:** Fully grown adults are coastal and pelagic fish. “They inhabit coastal waters of reefs and rocky islands, peaks of outside outer reefs, channels and lagoons, and open water up to 190 m (623ft) in depth.” Juveniles prefer and grow up in shallow waters.

**Diet:** Carniverous

**Behavior:** They are strong and swim over long distances. Adults prefer solitary traveling, though they tend to pair up or travel in groups. “They are aggressive fish, sometimes taking food out of feeding sharks.” (<http://www.aquariumofpacific.org/onlinelearningcenter/species/bluefin_trevally>)

**Reproduction:** Blue-fin Trevallies are considered broadcast spawners. They go through external fertilization usually during May to August. Females can lay eggs as often as every 5 days. **L50=** 13.8 inches (2.7 years)

**Adaptation:** They possess camouflage abilities that help them hunt, hide, or run. Its shape makes it harder for fish on the surface and bottom to see it. Overall, they are one of the most aggressive and fast fish. It depends on its physical abilities for protection and to beat competition.

**Conservation:** This specie is considered safe, not endangered.

**Name:** Blue-spine Unicornfish

**Scientific Name:** *Naso Unicornis*

**Chamorro:** Gasa (Juvenile) , Tataga (Adult)

**Japanese:** Tenguhagi

**Carolinian:** Igh-Falafal

**Tanapag:** Libwoot Merha

**Palau:** Chum

**Specie Family:** Acanthuridae **Size:** Up to 70 cm (27.6 inches) in length **Weight:** Up to 8-11lbs.

**Geological Distribution:** This specie is mainly found in the Indo-Pacific Ocean.

**Habitat:** Juveniles prefer shallow water with algae nearby. While adults feed along with juveniles, they explore deeper regions of the reef. “Found in channels, moats, lagoons and seaward reefs, particularly in areas with strong surges, preferring depths usually no greater than about 33 feet (10 m).”

**Diet:** Their diet consists of coarse and leafy brown algae.

**Behavior:** They usually swim in small groups. On seasonal occurrences, they may roam in bigger groups or in a school.

**Reproduction:** They usually practice pair spawning**,** “particularly at the outermost area of a foraging group.” They have been known to spawn in the outer reef slopes during the full and new moons.

**L50= 13.4 inches (2 years)**

**Adaptation:** Males tend to have a bigger and better developed “rostral horn.” They have 2 sharp blade plates on their tail on either side, used for protection or to carve corals, and several other uses.

**Conservation:** “’Not Evaluated’ on the IUCN Red List.” (<http://animalguide.georgiaaquarium.org/home/galleries/tropical-diver/gallery-animals/bluespine-unicornfish>)

**Name:** Lowfin Rudderfish

**Scientific Name:** *Kyphosus vagiensis*

**Chamorro:** Guili’ ; Guilen Puengi’ (dark phase

**Japanese:** Isuzumi

**Carolinian:** Reel

**Tanapag:** Reen

**Palau:** Komud; Beab (dark phase)

**Size:** Up to 50 cm **Weight:** Up to 14 lbs

**Geological Distribution:** It is found through-out the Indo-Pacific Ocean

**Habitat:** Rudderfish tend to situate themselves in turbulent high energy zones, where food is abundant. Algal ridges are a great habitat. They also travel in shallow inshore reefs and venture out the reef to 25 meters deep.

**Diet:** They mainly feed on algae.

**Behavior:** These kinds of Rudderfish may travel in small to large groups. They are strong because of their tendency to situate themselves in high energy turbulent zones. They are often on the move as they feed during the day and they can be nocturnal as well. They are high energy fish and can be curious.

**Adaptation:** Lowfin Rudderfish have a cloaking ability. They can shade themselves faded or more dark for protection or hunting purposes. They have fairly small mouths, because they feed on algae and soft meat. They rely on their physical strength to run away from predators and survive.

**Conservation:** They are considered safe or there is no threat to their population. Any US or international “sanctuaries” may protect them, because of its generalized protection.

L50= 15.4 inches (4.9 years)

( Link: <ftp://ftp-fc.sc.egov.usda.gov/GU/features/Fish/Guili.pdf> )



**Name:** Bullet-head Parrotfish

**Scientific Name:** *Chlorurus Sordidos*

**Chamorro:** Palaksi (juvenile) Laggua (Adult)

**Japanese:** Hagebudai

**Carolinian:** Ighal-wosch

**Tanapag:** Ighan-wosch

**Filipino:** Loro **Palau:** Derbetelloi, Butiliang **Specie Family:** “Animalia Chordata Actinopterygii Tetraodontiformes Family: Scaridae Genus: ChlorurusSpecies: sordidus” (<http://turtlereef3d.com/pages/SpeciesGuide/BulletheadParrotfish.html>)

**Size:** 10 to 15 inches (25-38 cm) **Weight:** Up to 7 lbs

**Geological Distribution:** All throughout the Indo-Pacific Ocean.

**Habitat:** They scatter mainly through-out coral reefs in the Indo-Pacific Ocean. They are found from shallow waters to about 30 m deep.

**Diet:** They feed on filamentous algae.

**Behavior:** They are described as “not territorial and live in harmony with other species, often found feeding together.”  They are joyful, curious fish; but run off as soon as they feel threatened. They

**Adaptation:** Males are full of color, while females are less attractive. They have powerful beaks that allow them to break dead coral and feed on the filamentous algae. They also may be found digging up algae in soft sediments, like sand or sea-grass. At night, they are able to make “sleeping bags out of slimy bubbles” to protect themselves against predators.

**Reproduction:** “Parrotfish are hermaphrodites and live in harems with a dominant male.”

L50= 5.9 inches (9 months)

**Conservation Status:** They are of “Least Concern” on the IUCN Redlist. Their population is currently facing no major threats. They may find protection from U.S. or international “sanctuaries.”

(<http://www.whatsthatfish.com/fish/bullethead-parrotfish/736>)

**Name:** Black Spot Emperor

**Scientific Name:** *Lethrinus Harak*

**Chamorro:** Mafute’

**Japanese:** Mato-fuefuki

**Carolinian:** Weyaw

**Tanapag:** Weyaw

**Filipino:** Bukatot **Palau:** Itoch **Specie Family:** Lethrinidae

**Size:** Up to 30 cm. **Weight:** Up to 6 lbs.

**Geological Distribution:** The Lethrinidae family is mainly found through-out the Indo-Pacific Ocean.

**Habitat:** This specie mainly dwells in shallow waters such as lagoons, reef flats, grass beds, etc… They may travel to depths more than 200 meters.

**Diet:** They are carnivorous, yet they can eat seaweed and algae. They prey on small fish and crustaceans.

**Behavior:** Juveniles tend to stay in shallow waters, while mature emperors venture out deeper. They can either live solo, in pairs, in small to big groups, and in schools. They are very strong fish, some are known to travel up to 80 miles. Adults prefer meat.

**Adaptation:** Emperors are very successful fish. Their population is in high numbers and they can easily colonize an area. There are often targeted by large predators so they develop extraordinary swimming abilities. They tend to hide in corals or grass and have camouflaging abilities.

**Reproduction:** Many of the Lethrinidaes go through a sex change from female to male, so as they grow large, they may change into a male. That means most large emperors are males, while the small ones are mostly females. They typically spawn in the spring/summer seasons.

**L50= 8.2 inches (1.5 years)**

(<http://www.fish.wa.gov.au/Documents/recreational_fishing/species_id_guides/species_guide_emperors.pdf>)

**Name:** Dash & Dot Goatfish

**Scientific Name:** *Paropeneus Barberinus*

**Chamorro:** Tiao’ (S) Satmonetiyu (M) Satmoneti Pintu (L)

**Japanese:** Osuji Himeji

**Carolinian:** Failighi

**Tanapag:** Fainisi

**Filipino:** Sammulyete

**Palau:** Bang

**Specie Family:** Mullidae **Size:** Up to 60 cm **Weight:** Up to 7 lbs

**Geological Distribution:** Through-out the Indo Pacific and East Africa.

**Habitat:** They are reef associated fish. They inhabit and use the corals, sand and sediments, rocks, and sea-grass and beds. They can venture up to 100 meters deep.

**Diet:** Carnivores. Mainly feed on small creatures in the sand and crabs, even small fish.

**Behavior:** They curios fish, calm and peaceful. They can swim fast, yet it is usual to find them sleeping, eating, or just relaxing. They are not very strong compared to other fish. However they make up for it with their intelligence and ability.

**Adaptation:** Goat fish use their barbells to sift through sand for food. They prefer to roam in small to medium groups. They can often form schools, especially during spawning season. Goatfish are fairly sensitive fish. Their highly developed senses allow them to sense danger and they can run away to as deep as 100 meters. They are also masters of camouflage. Many will attempt to act like an octopus, though its successful on fishes, It is vulnerable to fishermen.

**Reproduction:** **L50= 7.6 inches (3.3 years)**

**Conservation:** Not Endangered.

( <http://www.fishbase.org/summary/5987> )

**Name:** Forktail Rabbitfish

**Scientific Name:** *Siganus Argenteus*

**Chamorro:** Manahak lesso’ (s), Sesyun (m) Hiteng Kahlao (L)

**Japanese:** Hana-aigo

**Carolinian:** Llegh, Unwule (L) **Filipino:**Samaral

**Tanapag:** Umwule’ **Palau:** Beduut

**Specie Family:** Rabbitfish

**Size:** up to 36 to 42 cm. **Weight:** up to 5 lbs

**Geological Distribution:** Through-out the Indo Pacific Ocean and native to East Africa’s ocean.

**Habitat:** They are reef associated. They are mainly found feeding and sleeping in the spread through-out the reef in corals and sea-grass beds.

**Diet:** Mainly Algae.

**Behavior:** They are seasonal fish. They occur in large schools, in the thousand ranges. As they mature into adults, they tend to venture on their own. They are not so aggressive, often seen feeding with other fish.

**Adaptation:** Rabbitfish have several kinds of protection, similar to many fish. They tend to resort to hide and cloak abilities when threatened by predators. They act like groupers, hiding and relaxing on rocks and grass; however they are strong swimmers. They are popular for their poisonous spines, which can cause a whole limb numbness and pain with a single poke.

L50= 6.7 inches (7 Months)

**Conservation:** Not Endangered.

<ftp://ftp-fc.sc.egov.usda.gov/GU/features/Fish/Rabbitfish.pdf>

* **(L50 is the targeted range (length) of size of any fish so that 50 percent of its species can produce healthy eggs.)**
* **(Blue Hyperlinks: References, Sources)**

**There are many more reef fishes that can be found in the Marianas; these are just some of the most popular or preferred reef fishes in the Marianas. Other reef fishes that can be found are groupers, snappers, sweet-lips, mullets, surgeonfishes, and some other fishes. There are even more inedible fishes.**

**Oceanic and Deep-bottom Fishes of the Marianas**

The other major category of fish in the Marianas is the Oceanic Fishes. These type of fish are found out in the open water, miles away from land; swimming in waters up to thousands of feet deep. On average, these categories of fish can differentiate a lot from reef fishes. The main methods of harvesting these categories of fishes are by trolling, hand-lines (deep-bottom) & electric reels.

**Oceanic (Trolling Fishes)**

**Bigeye Scad (*Sellar Crumenophthalmus*)**

The Big-eye Scad is referred to as “Atulai” in Chamorro. “It is from the same family of jacks.” It has “large eyes and a compressed body” which distinguishes it from Mackerels. They usually situate themselves in “deep near-shore waters” beyond the reef. However, they migrate to shallow bays during certain times of the year. They are popular and known to form large schools. They feed on zooplankton, fish larvae, small bethnic invertebrates, foraminifera, and shrimp. The average size of this fish is 10 inches; however they can grow up to 15 inches. This is a very popular fish in the Marianas. On moonless nights, fishermen use lights to draw them in to their hook and lines, and in other situations they use large nets to harvest thousands of pounds of “Atulai.” This is known as “tiempon atulai” to the Chamorro people of the Marianas.

(NOAA,SFWR, 1994)

<ftp://ftp-fc.sc.egov.usda.gov/GU/features/Fish/Atulai.pdf>

Skipjack Tuna & Yellow-fin Tuna

“Tuna fishing in the Pacific Ocean has a rich history. For centuries, tuna have provided an important source of food for Pacific Island peoples, and the traditional fishing techniques and equipment are part of their cultural heritage. Today, tuna are also an important source of income and employment for many Pacific Island countries and territories.” (SPC, 2013) The CNMI brings in tons of tuna, skipjack and yellow-fin, many of which end up in the markets and available for sell locally. Many residents with the right equipment venture out to catch their own tuna and even make a living out of it. “My father was a fisherman for about 29 years, from 1970’s to the late 1990’s. About 90% of his business was based of tuna and yellowfin tuna fishing. The rest were of wahoo, mahi, other trolling fishes and deepbottom fishes.” –Luis S. Villagomez (Local resident of Saipan, since 1965, fisherman for 11 years )

(Dr.Rodgers J.,2013)

<http://www.spc.int/crga/sites/default/files/annex_upload/CNMI-Country-Report.pdf>

**Other popular or major Oceanic Fishes:**

Kawakawa

Doubleline Mackeral

Rainbow Runner

Leatherback

Great Barracuda

Mahimahi (Dolphinfish)

Wahoo

Sailfish

Pacific Blue Marlin

There are many other species not mentioned.

**Deepbottom Fishes**

Deepbottom fishing is also very popular in Saipan. Using various types of fishing rods, hand-lines, electric reels, etc… fishermen are able to catch different kinds of fishes. The uniqueness about deepbottom fishing is that your hook and line is dropped thousands of feet deep. “A common technique my father and a lot of fishermen use is the ‘shotgun technique.’ Many hooks are placed on a single line, if the conditions are right; you can land more that 10 fish on one line. They are also considered ‘premium’ because they are expensive and most people consider them tastier and fattier than reef and oceanic fishes.”-Luis S. Villagomez

**Major Deepbottom Fishes**

Eight Banded Grouper

Onaga

Silvermouth, Lehi

Pink Grouper

Greater Amberjack

Ehu

Blueline Gindai

Yellowtail Kalikali

Yellow Banded Grouper

Deepwater Bream

Pink Opakapaka

Opakapaka

Gindai

**Other Sea-creatures of the Marianas**

**The ocean of the Marianas is not only home to fishes. There are many different kinds of species.**

Octopus

“Squid” Cuttlefish

Turtles

Clams

Crabs

Spiny Lobster

Slipper Lobster

Manta Rays (Inedible)

Eagle Rays (Inedible)

Sting Rays (Inedible)

**Coral Reefs**

The Marianas is full of diverse and beautiful corals. There are certain factors and conditions for corals to grow. The reef is mainly calcium carbonate. Larvae must grow on a hard-rock bottom and transform into a polyp. The polyp divides and over time builds a colony of polyps, which produce calcium carbonates and forms reef building corals. In order to survive, coral polyps photosynthesize, which is why most corals are in shallow waters. They need the sun and love waters with over 20\*C (68\*F), which also allows them to grow and reproduce. Salinity, sediments, and pollution are also factors cor conditions that impact coral reefs. This process is what brought us the coral reefs we know today. There are mainly two types of reefs you will see in the Marianas. The most common is the Fringing Reefs and the other type is the Barrier reef. This section will describe the two types of reefs found in the Marianas.

***Fringing Reefs***

Considered to be the “simplest and most common reef,” The fringing reef is commonly seen in the tropics, growing near to the shore. Let’s look at the terminology; fringe -ing, fringe is the root word. A simple definition of the word fringe is to attach itself to, to cling to, to fuse, etc… Fringing reefs attach themselves to suitable location, in this case and for all corals, on hard bottoms of the ocean. How this is done? It is caused by the natural geological process and formation. When land mass sinks down into the water, it creates a solid foundation for coral to grow on. Over time, it eventually builds up and becomes the reefs we know of today. The general rule is, corals need a hard bottom to grow on. Even with just a small area of hard bottoms can produce these mega-structures. Corals can overgrow and also use itself as a foundation. Basically it overlaps itself to make a hard bottom over the soft bottoms, like sand and rubble. The structures of fringing reefs are simple also.

Rocky beaches in Saipan like Obyan, Laolao, Coral Ocean Point, Marine Beach, Tank Beach, and more are all examples of beaches with fringing reefs. Fringing reefs are mainly divided into two sections, an inner reef flat and an outer reef slope. From the beginning of the shore water to the reef crest, which is where the wave crash, is the inner reef flat. It is mainly shallow in this area. There is small corals, rocks sand, and fishes in this section. As you pass or exit the reef crest, you have now entered the outer reef slope. It ranges from shallow to deep according to the formation and slope. Everything is usually bigger; like the fish, predators, corals, rocks, etc… There is less variety of coral species in the outer reef slope, due to less light in deeper water. If you follow the slope out towards the deep ocean, eventually you will see the edge of the slope; which is usually the end of the fringing reef. After you exit the slope; it is mainly sand and rubble or the deep sea community.

Fringing reefs are very important because they are the reefs closest to land. It may provide an easier and closer access to people, especially fishermen. Certain species thrive in fringing reefs. However, since it is close to land; it is the most vulnerable to land based pollution, like runoffs , freshwater runoffs, and human activity. Fringing reefs are usually smaller than barrier reefs, but under the right conditions, they can be amazing. “The longest reef system in the world(though not the one with the largest coral area) is not the famous Great Barrier Reef in Australia but a fringing reef that runs some 4,000 km(2,500 mi) along the coast of the red sea.”

**Barrier Reefs**

Though they may be complex, barrier reefs share similarities to fringing reefs in many ways. The formation of corals is the same as it is for fringing reefs. They also lie along the coast or land. However the greatest distinction between fringing reefs and barrier reefs is that “barrier reefs occur considerably farther from shore, occasionally 100 km(60 mi) or more.” They also can lie closer to the shore, commonly in islands; like the barrier reef along west coast of Saipan. Barrier reefs may also have fringing reefs within its boundaries under certain areas and conditions. Another great distinction is the formation of the land underwater is larger than fringing reefs. It can be said that the slope is much longer. Barrier reefs also have a reef crest, but at a distance.

From the shore to the reef crest is the lagoon. Lagoons are also a great distinction, because fringing reefs usually have only an inner reef flat within its shores. Since the barrier reef breaks the current and waves at a far distance, the lagoon is considerably calm. This also leads to a soft sediment bottom, like sand and clay. Sea grass and beds also grow in the shallow parts of the lagoon. “Patch reefs, coral knolls, or pinnacles” are scattered coral formations can also grow near the surface depending on their size and shape.

There are three main sections of the barrier reef. “The barrier reef consists of a back reef slope, a reef flat, and a fore reef slope, which corresponds to the reef slope of a fringing reef and has a reef crest.” Both the back and fore reef slope can be steep or gradual. Due to waves washing sediments on the back reef slope, the coral growth is not as live as on the fore reef slope. However if the slope is gradual enough, some corals can thrive on the back reef slope. The reef flat, just like on a fringing reef, is shallow and considerably flat. Sea grass, seaweed beds, patches of dense coral cover, sand and coral rubble patches are found on the reef flat. In some cases, sand cays may form from waves and currents piling up sand. In the United States, they are called keys; like the famous Florida Keys.

After the reef flat is the reef crest. The waves tip on the outer reef crest and crash on the inner reef crest. Due to strong wave action, a strong, well developed algal ridge may form. The algal ridge and outer reef crest usually has the “richest coral growth.” Buttresses or spur-and-grove formations are “series of fingerlike projections alternating with sand channels” that occurs on exposed fore-reef areas. The formations can also be found on fringing reefs and atolls. After the reef crest is the fore-reef slope. The slope can vary from steep to gradual. The steepness is based on the wind and waves. Just like all reefs, the deeper parts have less variety and abundance of corals. Because there is more light on the shallow areas of the reef slope, corals tend to grow upwards or vertical. On the deeper parts of the reef slope, corals grow flat and wide in order to collect more sunlight.References

***“Coral reefs”*** Castro, Peter; Huber,Micheal **“Marine Biology 9th edition”** 2013 McGraw-Hill textbook Pages 316-32

**The Environmental Stressors of the CNMI’s Coral Reef Ecosystems**

**:**

**This section gives an overview of the stressors and threats to our ocean, also the current state according to its issue.**

The Commonwealth of the Northern Marianas Islands, a group of 14 islands, has some of the most pristine waters in the world. Most or all of the islands have coral reefs and different types of corals. Their oceans were once overwhelmed with diverse species and ecosystems. The water clarity and quality were superb. However in this present time, environmental stressors proved to have a heavy toll on our ocean. Environmental stressors can come on different levels, either being local, regional, national, or global scales. These are the main problems that pose a threat to our oceans. This section will classify the major environmental stressors of the CNMI’s coral reef ecosystems.

**Coral Bleaching**

## “When corals are stressed by changes in conditions such as temperature, light, or nutrients, they expel the symbiotic algae living in their tissues, causing them to turn completely white.” (National Ocean Service) When ocean water average temperature rises or gets warmer, it may result in this event. Even when temperature lowers or gets cooler, it can cause bleaching events. The CNMI is situated in a “ENSO” (El Nino Southern Oscillation) core region. This means we have constant warm winds in our area. Other factors are runoffs and pollution. Soil and chemicals from runoffs and pollutions can literally kill coral in masses. If not, debris floating in the water can block the sunlight needed and they become bleached. With more dramatic changes and fluctuation of the climate, aka climate change, coral bleaching has become a threat to our ocean. Basically when a coral is bleached, it does not necessarily means its dead; however its survival or mortality is threatened and it can die. Coral bleaching is also a sign or signal that our ocean is changing.

## *“In 2005, the U.S. lost half of its coral reefs in the Caribbean in one year due to a massive bleaching event. The warm waters centered around the northern Antilles near the Virgin Islands and Puerto Rico expanded southward. Comparison of satellite data from the previous 20 years confirmed that thermal stress from the 2005 event was greater than the previous 20 years combined.”*

## *(NOAA) (SCRCNMI, 438)*

**Ocean Acidification**

Ocean acidification is a global phenomena occurring throughout the world’s oceans. This includes the CNMI. It is caused by the increased amount of carbon dioxide in our atmosphere. Due to the rapid development of human civilization and the excess use of fossil fuels, mainly from the beginning of the industrial revolution, this event has occurred more often and has been globally recognized. Out of all the carbon dioxide released into the atmosphere, the ocean absorbs about a quarter of it. The retained and excessive contributions of carbon dioxide stay on the surface of the ocean and lower the ph of the water and also its carbonate saturation. It can render the suitable living environment of the ocean unsafe and uninhabitable, in the worst case scenario. “Coral reef growth depends in the saturation state of carbonate minerals on surface waters,” this is known as “Ocean Acidification.” This factor is considered to be caused or influenced by Global Climate Change. Not much can be done to treat the process. Lowering carbon emissions and pollution is probably the answer to reversing the process. Research and firsthand look at our ocean is still functional, however this factor is potentially disastrous not worth avoiding.

(SCRECNMI, 439)

**Shoreline and Coastal Change**

This is another climate change related factor. Sea level rise and more frequent El Nino events has made a huge impact to many islands and coastlines. Beaches, especially sandy beaches, are being eaten away at alarming rates. “The University of Hawaii (UH) Department of Geology and Geophysics was contracted to assess Managaha Island’s shoreline stability and create a model of the shoreline in 10 years.” The island is a small sand key in Saipan’s lagoon. It has been showing a fast rate of “erosion north east shore and accretion on the west since 1996.” One of the primary causes was when wreckage was removed from the windward side of Managaha. Sea level rise may further contribute to this factor. Most or all beaches on Saipan have shown major changes on its shorelines. With the use of “Arial and satellite imagery, beach profiles and current models;” scientists were able to conduct studies in June 2007. They indicated that Managaha’s infrastructure is not at risk, but they concluded that the Shearwater bird habitat is on the path to erosion. Further and concurrent study is being conducted on Saipan’s western shore (beaches). “Quarterly beach profiles being taken from 14 sites around the Garapan district. (SCRCNMI, 439-441)

**Diseases**

Corals are living creatures. This means they are susceptible to diseases, just like humans. This is one of the most recent issues of our corals reefs. There are several diseases discovered in our corals of the CNMI. “Pink/purple blemishes, rings and indentations on massive Porites and growth anomalies on Acropora, Isopora, and massive Porites Species” are some of the symptoms of coral diseases. Naming and characterizing diseases is very difficult. One interesting connection is that “diseases were found to be more abundant at site with high levels of diver activity.” Laolao and Obyan are the two of the major dive sites of Saipan. Other diseases like “Coralline Lethal Orange” disease and “target syndrome” affect the coralline algae of the coral reefs. A certain type of Black Fungus affects coralline algae also. The sea-cucumber, “Holuthuria atra,” has been known to cause lesions on corals.

(SCRCNMI, 440)

**Tropical Storms**

The Marianas is known for being a highly active region for typhoons. The archipelago is sometimes referred to as “Typhoon Alley.” Averages of 3 typhoons have “passed within 300 nautical miles of Saipan since 1970. (Landers, 2004) Large waves and extreme currents have heavy impact on our shorelines. Heavy precipitation causes sewer pipes , drainages, soil, sediments, and other pollution to enter our ocean and cause damage.

(SCRCNMI, 441)

**Coastal Development and Run-off**

The development of resorts, buildings, businesses, and many other structures made by humans play a big role or has a big influence on its area. It has big influence on land, the coast, and the ocean. The busy interactions and activities of development near the coast interfere and even destroy the natural surroundings of its area. The developments of farms also have a great impact as well. As precipitation sweeps the sediments, chemicals, and trash into the ocean; it develops many problems and results in polluting and destroying our coasts and ocean environments, as well as polluting its water quality.

With tourism decline, many major projects of Saipan and the CNMI were stalled. This also stalled more damage to the environments. Lack of erosion control and management for empty venues still pose as a factor. Old buildings and projects from the past “was created when weaker protective measures existing in local” regulations, “resulting in many of today’s focal problems.” Coastal Resource Management (CRM) Office, along with its agencies; in partner with Department of Environmental Quality (DEQ) are in-charge of “managing earth moving and erosion control and water quality concerns.”

(SCRCNMI, 441)

**Coastal Pollution**

“The health and economic well being of the people of the CNMI depends on good water quality for fishing, recreation, and tourism.” Pollution is one of the major threats to the whole world. There are two categories of pollution that applies to both land and aquatic environments. This section will explain Nonpoint Source Pollution and Point Source Pollution.

(SCRCNMI, 441)

***Nonpoint Source Pollution (NPS)***

Nonpoint Sources are sources that can’t be pointed to just a single source. They are also called “diffuse pollution.” Chemicals, oils, dirt, sediments, trash, etc… that settle on land get washed into the ocean by precipitation. This situation is an example of this category. It is known to find large amounts of trash washed up on our beaches from other countries. “NPS pollution remains one of the primary localized treats to coral reefs in the CNMI.” The CNMI Marine Monitor Team (MMT) have done studies on reefs and their data indicated that “a steady declining trend in resiliency at ‘impaired’ (defined by territory 305b water quality reports) localities.” In other words there was a decrease in specie abundance and reproduction. The CRM office partnered with DEQ has long managed NPS in the CNMI. They were funded by a federal grant, “310 NPS Pollution control program,” which was terminated in 2007. This led to the loss of a “highly effective program in the local CRM and has indefinitely stalled several major architectural and engineering best management practices (BMP) from being constructed as well as the implementation of proven local initiatives to combat NPS pollution. (SCRCNMI, 441)

***Point Source Pollution***

Point source pollution is described as a “single, identifiable source of pollution.” Sewage pipes and drainages are examples of this category. If a person throws a piece of trash into the water, they are point source pollution. It is very common in the CNMI and around the world to see illegal dumping of various types of pollutants into the water. Leaking oil and gas from boats and ships are also major threats under this category. In 2006, a project of replacing sewer lines was completed to eliminate “chronic lagoon side sewer lines overflow in San Antonio.” Commonwealth Utilities Corp. (CUC) has also taken measures to “upgrading sewage transfer and treatment infrastructure.” During 2005, EPA found that “nearly all major hotels were illegally dumping hypersaline and nutrient enriched wastewater from reverse osmosis water purification systems into drainages,” which affected water quality in the lagoon of Saipan. EPA actions led to safer dischargements into “deep injection wells.” (EPA, 2014) (SCRCNMI, 441)

**Tourism and Recreation**

Having more than 20 beaches makes the CNMI a good place to kick back, relax, and have fun. Locals, immigrants, tourist, and everyone else will at least have a day or two at the beach. With improper management, any population can affect the environment. It is common to find trash and vandalism on beaches. Humans may also cause physical damage to the corals and can even affect the fishes. “CRM regulates commercial marine recreational sports through its permitting process.” (SCRCNMI, 442)

**Fishing**

Without management, our ocean can be exploited to the extreme. While hooks and lines, spear-guns, and all other fishing equipment can have an impact on the ocean; nets are considered the biggest threat. They were once used regularly and freely in the CNMI, which led to a drastic drop in fish abundance. Not only do “drag, gill, and surround nets” kill fish, they can also have collateral damage to the corals and other untargeted species. “Recent enforcement of a ban on gill, drag and surround nets appears to be having positive effects on fisheries resources in the Saipan Lagoon.” Cast nets (talaya) are legal, but require a permit to use. Local fishermen indicated that there was “an increasing abundance and size of food fishes in the lagoon.” (SCRCNMI, 442)

**Ships, Boats, and Groundings**

Anchors can cause major damage to the coral reefs and ocean environments. The lack of mooring systems in the CNMI, “especially at poplar diving locations,” poses as a threat. There are 36 known mooring systems and NOAA intends to grant 15 more. Also, “current anchoring practices of prepositioned military vessels in coral reef habitat west of Saipan remain a concern as well.” NOAA surveyed 42 abandon vehicle; 19 were considered “navigational threats” and 11 were “high-priority” vessels to be removed by the CNMI Coral Reef Task Force. (SCRCNMI, 443)

**High-Priority Vessels** *(Source: CNMI CRM)*

**Saipan:** \*Mwaalil Saat ($3,500,000),\*Samala (Initial: $56,450),\*Nago No.15 ($49,000),\*Charito

**Rota:** \* #62 Nam Sung ($6000), \*TT Gov’t 1/1830 , \*TT Gov’t 2/1831, \* Rota Queen

**Tinian:** \*Lian Gi, \* Sun Long No.8, \* Unk 2578-2579

(SCRCNMI, 443)

**Marine Debris**

Marine Debris is another form of pollution. Yet this category is of leftovers and scraps of fishing vessels, boats, equipment, materials, etc… that have accumulated in the ocean. (SCRCNMI, 444)

**Aquatic Invasive Species**

The Crown of Thorns Sea-star was once a plague of overpopulation of a invasive specie that devastated much of the corals in the CNMI and around the Pacific. Luckily we no longer have that issue due to the elimination by efforts of fishermen. Recently locals have noticed a “small cat-fish looking fish” that have exploded in the 2000’s. This has not become a major threat, however, it has potential. Invasive species often do not have any natural predators and deprive native species of their food.

Security Training Activities

Military, enforcement, and boat trainings have an impact on the ocean. Impact can vary from little to major threats. Boat and enforcement training usually have small impacts. The military launches training and activities in the ocean ranging from small to large-scales. “The U.S. military is currently proposing a build-up of personnel in the neighboring U.S. Territory of Guam that may number in the tens of thousands.”

References

*(NOAA) National Oceanic & Atmospheric Administration National Ocean Service*

[*http://oceanservice.noaa.gov/facts/coral\_bleach.html*](http://oceanservice.noaa.gov/facts/coral_bleach.html)

*(SCRCNMI) The State of the Coral Reef Ecosystems of the C.N.M.I. C.N.M.I*

*CNMI Coral Reef Management Office, CNMI DEQ, University of Miss., DFW, NOAA, et al.*

**Keeping an Eye on the Ocean**

The ocean of the CNMI is mainly monitored by the CNMI Marine Monitoring Team. They use several programs to monitor coral reef ecosystems and develop methods or strategies. They are funded by NOAA and EPA. Many programs were also influenced by the “Micronesian Challenge.” Here are the programs used in the CNMI:

(**CNMI MMT:** Commonwealth of the Northern Marianas Islands Marine Monitoring Team

**CRM:** Coastal Resource Management

**DEQ:** Department of Environmental Quality

**DFW:** Division of Fish and Wildlife

**PIFSC-CRED:** (NOAA) Pacific Islands Fisheries Science Center, Coral Reef Ecosystem Division)

Coral Reef Early Warning Buoy

This program monitors variables such as “temperature, conductivity, salinity, atmospheric pressure, UV radiation, and photosynthetically available radiation.” It was done continuously in Saipan from 2003 to 2006 with PIFSC-CRED.

Deepwater CTD’s

This program uses sensors that monitor “conductivity, temperature, depth (CTD), dissolved oxygen, and chlorophyll up to depths of 500 m”. It was done around all the islands continuously since 2003 with PIFSC-CRED.

MARAMP REA

This program monitors “coral, fish algal and invertebrate abundance and diversity,” and “benthic cover.” It was done around all the islands biennially since 2003 with PIFSC-CRED.

Marine Monitoring Program

This program covers variables such as “benthic cover, coral community structure, benthic biodiversity, coral recruitment,” and “fish abundance.” It was conducted in Saipan, Tinian, Rota and Aguijan annually since 2000 by CRM and DEQ.

Nearshore Water Quality Monitoring

This program monitors “coliform bacteria, nitrate, phosphate, temperature, salinity, ph, and dissolved oxygen.” It was conducted in Saipan, along with Managaha, Tinian, and Rota biweekly since 1995 by CRM and DEQ “Environmental Surveillance Laboratory.”

Sanctuary Program

This program sets up several marine preservation areas around the islands. They monitor fish abundance and diversity, invertebrate abundance, and rugosity. It has been conducted by DFW since year 2000.

***Marine Sanctuaries***

Bird Island Sanctuary- “A fully protected no-take area.”

Forbidden Island Sanctuary- “A fully protected no-take area.”

Managaha Island Sanctuary- “ A fully protected no-take area.”

Lighthouse Reef Trochus Sanctuary- A preserved portion of area on the reef of Saipan’s Lagoon specifically for Trochus.

Laulau Bay Sea Cucumber Santuary- A preserved area, Laolao Bay, for the preservation of Seacucumbers.

Sea Surface Temperature

This program monitors the ocean surface “temperature at 0.5 m.” It was conducted in Maug, Pagan, and Rota continuously since 2003 by PIFSC-CRED.

Shallow Water CTDs

This program sets up sensors that monitor “temperature, conductivity,” and “turbidity” of the ocean. It was conducted in all islands of the CNMI since 2003 continuously by PIFSC-CRED.

Subsurface Temperature Recorders

This program is similar to the Sea Surface Temperature program/testing, yet it monitors “temperature between 0.5 and 30 m.” It was first conducted in all the islands of the CNMI from 1995-1996, then continuously since 2001 by PIFSC-CRED and the CNMI MMT.

Water Samples

This program monitors “chlorophyll, nitrate, nitrite, silicate, phosphate concurrent with deep and shallow water CTDs at selected depths.” It was conducted in all islands of the CNMI continuously since 2003 by PIFSC-CRED.

Wave and Tide Recorders

This program monitors “wave and tidal height.” It was conducted on the “Supply Reef and Zelandia Bank” continuously since 2003 by PIFSC-CRED.

Ocean Data Platform

This program monitors “temperature, conductivity (salinity), spectral waves” and “current profile.” It was conducted on the “Santa Rosa Reef” continuously since 2003 by PIFSC-CRED.

**Analysis of Coral Reef Ecosystems**

The ocean monitoring programs have also come up with a number of conclusions and findings. In the CNMI, the most “notable broad-scale reef-community zonation patterns exist between the northern volcanically active islands and the southern raised-limestone islands.” They found that throughout the 40 fringing reefs in the northern islands it showed less “coral diversity and colony surface area” compared to the southern islands. There were five reasons the CNMI MMT argued:

1. “Unfavorable Bathymetry.”
2. Less suitable bottoms for corals to grow on.
3. Strong tidal action.
4. Build up of volcanic ash.
5. “Volcanic Eruptions”

Despite this difference, fish are more abundant in the less populated northern islands. It is obvious because of the major factor of population difference.

(SCRECNMI, 447)

**How is Our Water Quality?**

Since over 95% of the population of the CNMI is in the southern islands of Saipan, Tinian, and Rota; the Department of Environmental Quality (DEQ) Environmental Surveillance Lab mainly focused on this area. Out of 83 monitoring sites, “37.3% were classified as ‘impaired’ due to excess nutrients in 2006. (Table 14.4; Houk, 2006)” They found a trend of “microbiological violations” associated with “beaches near storm water drainages.” Saipan’s lagoon is on the more developed side of the island, with a lot of drainages, is where majority of “impaired” beaches are found. DEQ summed that 42% of Saipan’s shorelines are “Impaired;” 28.2% of Tinian’s shorelines were “impaired;” and 8.7% of Rota’s shoreline were “impaired.”

**Major Current Conservation Projects**

The following section provides an overview of the current conservation projects, programs, activities, and efforts in the CNMI.

**Micronesia Challenge**

The “Micronesia Challenge” was proposed by the President of Palau in March 2006. Its major purpose was to “effectively conserve 30% of marine resources and 20% of terrestrial resources by the year 2020. Five major islands of Micronesia took the challenge, including the CNMI.

**U.S. Coral Reef Initiative (CRI)**

The CNMI actively participates in “U.S. Coral Reef Initiative” activities. The following are the objectives of the Program:

* “Expand the implementation of programs for conservation, restoration and management of sustainable coral reefs and their associated communities among governments and international organizations.
* Incorporate management provisions into existing local, regional, and national development plans that provide for protection, restoration, and sustainable use of corals and their associated communities.
* Strengthen the capacity for development and implementation of management policies and research, and monitoring of coral ecosystems.
* Establish and maintain coordination of international regional and national research and monitoring programs to ensure efficient use of resources and information flow.”

(<http://water.epa.gov/type/oceb/habitat/initiative.cfm>)

**Marine Protected Area Programs**

There are currently nine “Marine Protected Areas (MPA)” being managed by the Division of Fish and Wildlife (DFW) in the CNMI.

**Nonpoint Source (NPS) Pollution Programs**

NPS pollution is considered as “the major anthropogenic stressor of coral reef ecosystems in the CNMI.” The programs primarily targets pollution, mainly on land, that affects the ocean.

* “In Talakhaya, the first two- year phase of the project focused on re-vegetation, which included planting of 25,000 grass and tree seedlings by local volunteers.”
* “In Laulau Bay, Saipan, architectural and engineering designs have been completed to improve stream crossing along the Laulau Bay Road to address sedimentation and runoff from badlands and secondary dirt roads.”
* “ Walk it, Don’t Drive it” campaign began in 2001”

(SCRCNMI, 462)

Interview with PMRI Director: Greg Moretti

Saipan and the CNMI’s Ocean Awareness

The following questions are crucial to my research of “CNMI’s Ocean Awareness.” The purpose of the research is to educate myself and peers on the CNMI’s ocean along with its fish, sea-creatures, corals, and water quality. As a mentor and a Marine Biologist, I will greatly value your professional opinion and it will be of great assistance to me and my peers. Please take your time and there are no wrong answers.

Interview /Questionnaires with Expert: Greg Moretti

1.) Mr. Moretti, what is your profession? Tell me a little bit about yourself.

“I am the Executive Director of the Pacific Marine Resources Institute. I have a master’s degree in Coastal Environmental Management and have been working in that field since 2002.”

2.) Are you well aware of our (Saipan and the CNMI) ocean conditions? How would you describe the present health or condition of our ocean, corals, fish, sea creatures, and ocean quality?

“Yes. I would say that overall, our oceans are experiencing the impacts coming from the pressure that the large population of people living here are putting on it. I would say that our oceans are “relatively healthy” but that we are seeing a number of warning signs that management needs to be constantly improved. I’m going to lump each of those categories all in one since they are all dependent on one another, and we try to consider things from an ecosystem perspective, rather than just looking at the health of fish or corals independently.

3.) How does the present condition compare to the health or conditions of the ocean 5-10 years ago?

“In some places, especially like in our Marine Protected Areas, things are fairly comparable to the way they were 10 years ago, and in some cases could be considered better than they were. In other places, however, we are seeing slow downward trends in ocean health.

4.) How does the present condition compare to the health or conditions of the ocean more than 10 years ago?

“Ask any older fisher how things compare! We experience something called the shifting baseline syndrome, where we think the “best” times for our oceans were when we were young, but the generation before us said the same thing, so their “degraded” condition is our baseline for “best”. Over time, conditions have slowly degraded due to the increasing impacts of human presence and demands on our oceans.”

5.) What major threats are our ocean and marine environments facing? (CNMI)

“Climate change, overfishing, and land-based sources of pollution are the major ones here.”

6.) Would you consider our oceans health or condition as failing or improving?

“It depends, in some cases its staying the same, other areas are failing, and in some of our MPAs perhaps improving due to improved enforcement and management.”

7.) What are the major projects or (and) efforts being done in Saipan & the CNMI towards improving our ocean or marine environments? (Please list as much as you know)

“There is a big working group looking at climate change adaptation. And our agencies such as BECQ and DFW are always working on a number of projects that help address these issues. Some other big ones are the RARE pride campaigns, the recent road imrovements at Laolao Bay addressing land based sources of pollution, and of course, the Micronesia Challenge.”

8.) Do you feel as if all the projects & efforts are working? Or do you think more has to be done?

“I think most of the projects are working. Part of the challenge is to be able to make good management decisions when we don’t have all the scientific data out there that we need… in other words, we don’t know everything about whats going on but still need to manage how we use the oceans.”

9.) Do you feel as if the CNMI has the ability to restore its fish/seafood stocks and environmental quality (ocean) back to its fullest or maximum potential?

Yes, its certainly not too late. I think one of the keys is the EFFECTIVE management of our marine protected areas, in conjunction with effective fisheries regulation. By effective I mean they need to be well-enforced, otherwise they are not going to do anything. The MC is a big step regionally toward improving management.

10.) What are some factors you know or think is keeping Saipan & the CNMI from restoring our ocean to its full potential?

“I think we need full support across the whole spectrum, from the top at the governor’s level, all the way down through the agencies down to the fishermen and fishing communities. Or perhaps I should put the communities and the fishermen up at the “top”, since they are the ones we are trying to manage the oceans for. Nobody wants to “fish out” our oceans, especially the fishermen and communities who depend on those resources.”

11.) At the current rate, do you think or expect our oceans to improve within the next 5 to 10 years? “Hopefully, with effective management, yes.”

12.) Do you eat fish or seafood? Yes I do!

13.) How would you compare the fish &seafood market from the past to the present?

“I don’t think I’ve been around long enough to notice a difference, but we’ve done some market studies comparing across different jurisdictions in Micronesia, and where there is more pressure from people fishing and less reef area, the composition of the catch looks different. Based on that I would say in the past we would have had larger fish and more carnivorous fish at our markets than what you see today.”

14.) In your opinion, why is our ocean along with its species important? Please Explain.

“Health (food security) and culture. The ocean provides many “ecosystem benefits” and if we lost our reef we lose the food and those services, such as protection from storms.”

15.) My final and primary question of my research is; “What happens if the ocean of Saipan and the CNMI loses it fish, sea-creatures, corals, & water quality?” (Please answer this question with your expertise

“That would be a sad day. Much of the culture of the peoples of Micronesia would be lost. Not to mention impacts on diet and tourism. Our oceans would likely “devolve” into what’s called a “primordial sea” full of jellyfish and algae.”

**Interview Analysis**

After conducting my interview with Pacific Marine Resources Institute Executive Director Greg Moretti, I found many knowledgeable positive, neutral, and unbiased feedbacks. Mr. Moretti stated that our oceans are “relatively healthy” in its current condition. It is somewhat positive, yet it doesn’t mean it is 100% healthy. There are a number of projects and efforts in the CNMI, he feels they have positive impacts. However, more effective management will bring better results. I was surprised how one of my personal opinion of “Luckily we have government departments that manage the environment plus human environmental movements and groups that act against this situation. However that is not enough. We all need to work together to solve this dilemma,” was surprisingly similar to his response in question 10. His response of the CNMI being able to improve within the next 5 to 10 years with “effective management” is a positive opinion and made me realize that though our ocean is not 100% healthy, areas being managed or monitored are effective and worth it. There are some important key points I pointed out from the interview:

Top 3 Stressors

* “Climate Change”
* “Overfishing”
* “Land Based Sources of Pollution”

Another reason why our ocean is being affected:

“I would say that overall, our oceans are experiencing the impacts coming from the pressure that the large population of people living here are putting on it.”

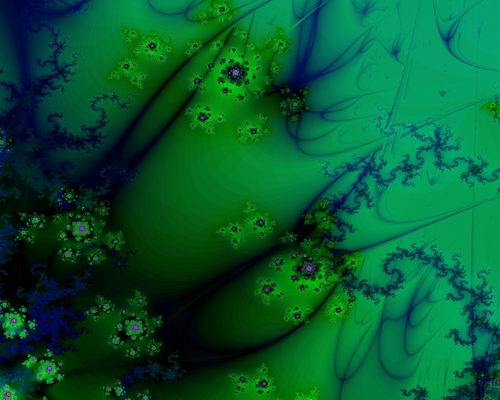
Importance

“Health (food security) and culture. The ocean provides many “ecosystem benefits” and if we lost our reef we lose the food and those services, such as protection from storms.”

The “Primordial Sea”

When I asked Mr. Moretti to answer my Primary Question: “What happens if the ocean of Saipan and the CNMI loses it fish, sea-creatures, corals, & water quality?” He responded; “That would be a sad day. Much of the culture of the peoples of Micronesia would be lost. Not to mention impacts on diet and tourism. Our oceans would likely “devolve” into what’s called a “primordial sea” full of jellyfish and algae.” I have never heard of this term before, but based on his description and research on the term “primordial sea,” resources point the term to the origins of life:

**Single- Celled Organisms (Artwork)**

This is just artwork, since I couldn’t find any actual photo of how “primordial sea’s” are. It’s a concept of how the ocean was full of single celled organisms and “RNA Compounds.”

All Artwork & Design Copyright © 2004 Matthew Dingwall

(<http://homepage.ntlworld.com/ambient-artscapes/fractal/primoridal_ocean.htm>)

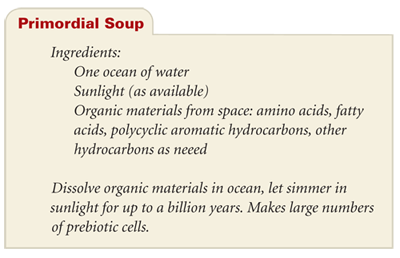
**“Hydrothermal Vents”**

“Origin of life theories often speculate that hydro thermal vents like the in Dominica are responsible for the origin of life. Since these vents exist today, plenty of oxygen in the atmosphere would prevent the formation of useful prebiotic cursors that might give rise to life.”

This picture is evidence and helps visualize how conditions during the “Primordial” era may have been. The corals seem to be covered in algae.

“Copyright Intelligent Design Books Raleigh NC 2005-2012”

(<http://www.lifesorigin.com/chap9/Prebiotic-synthesis-DNA-RNA-Protein-1.php>)

“Primordial Soup Theory”

“The notion that the raw materials for life—perhaps even life itself—simply fell from the sky has been batted about for decades. In this view, organic matter—known to exist in interstellar clouds of gas and dust—was brought to Earth by asteroids, comets, stardust, or other cosmic bodies crashing into our young planet. The extraterrestrial influx of ready-made molecules could have seeded the barren world with the organic ingredients needed to get biology rolling.—Craig Carmer and Jay Schecker”

(1663 Los Alamos Science and Technology Magazine)(Los Alamos National Laboratory)

“Ecosystem models don’t consider jellyfish. Their role isn’t considered. Lisa-ann Gershwin suggests the world’s oceans have passed a silent but significant tipping point. They are on their way to a different state, where all manner of algae and jellyfish are abundant, in place of the diverse life which has existed for so long.

Over-fishing, pollution and increased greenhouse gases dissolving in from the atmosphere are changing ocean water chemistry and applying combined pressure on ocean ecology. Our oceans are undergoing radical simplification. Habitat destruction is widespread.  Complex ecologies such as coral reefs and food webs topped by big animals are being replaced by simple ecosystems dominated by simple animals and plants, featuring boom and bust cycles, and disease.”

**-Lisa-ann Gershwin**

Marine and Atmospheric Research  
CSIRO  
Hobart TAS  
Director  
Australian Marine Stinger Advisory Services

*Publications*

Title: Stung - On jellyfish blooms and the future of the oceans

***“Image: Jellyfish Bloom Mar Menor Spain (Stephanie Booth)”***

Author: Lisa-Ann Gershwin

Publisher: University of Chicago Press



***“Algal bloom of China’s Coast”***

***Ecological Dead Zone (ECOEARTH.INFO)***

Homepage:

(<http://press.uchicago.edu/ucp/books/book/chicago/S/bo15220175.html>)

Article Site: (<http://www.abc.net.au/radionational/programs/scienceshow/the-rise-of-slime3a-jellyfish-and-algae-thrive-in-new-oceanic-/4838478>)

Having gone through the interview with Greg Moretti and doing a research on “primordial seas,” I now have a have a better understanding of the ocean. Many of the topics of “primordial seas” proved to be of high level intelligence or expertise; it was difficult to put or explain the theories in my words. The purpose of this section was to target the primary question of “What happens if the ocean of Saipan and the CNMI loses it fish, sea-creatures, corals, & water quality?” This does not state that it is 100% accurate, in fact, they are theory-based. However, I trust the help of the experts and believe this may answer my question.

CNMI Ocean Awareness Survey

During the semester, I gave out several surveys to get a visualization of the knowledge of the peers in my EN202 class about our ocean. Out of 11 students, seven successfully completed the survey. Majority(71%) claim to have “a little bit” of knowledge about our oceans. They also figured that there was “less fish and aquatic life” and “less cleaner environments” of our ocean compared to the past. They all agreed that coral reefs should be protected. One suggestion that caught my attention was; “Get children involved with aqua days from an early age and have companies and government agencies sponsor similar events for families and adult employees.” My perception changed as well when they suggested;” Humans and technological advances cause global warming. The wastes from humans that causes pollution contributed to global warming.” Instead of being separate categories, I now think they go “hand in-hand.”

A more broad survey with a wider audience may have different results. Though it was a basic survey and had few participants, I have gain knowledge and gained a perspective of how my peers may think.

**Conclusion**

There are three categories many locals and fishermen categorize fishes in the CNMI. Based on food fishes, there are three categories. There are reef fishes, oceanic fishes, and deep-bottom fishes. The oceans of the CNMI also have species other than fishes such as manta rays, turtles, crabs, lobsters, octopus, etc… Many depend on the fish and other species as a food source. The CNMI is also home to coral reefs. There are two types of reef in the CNMI; fringing (most common) and barrier reefs.

There are certain influences that can harm our ocean and its ecosystems. Many call it “environmental stressors.” The major stressors are coral bleaching, ocean acidification, shoreline and coastal change, diseases, tropical storms, coastal development and run-off, coastal pollution (nonpoint source and point source), tourism and recreation, fishing; ships, boats, and groundings; marine debris, aquatic invasive species, and security training. The top three stressor of the CNMI is stressors from climate change, overfishing, and land based sources of pollution.

To monitor and manage our coastal and ocean resources, various programs were set up across the CNMI. The major programs are Coral Reef Early Warning Bouy, Deepwater CTDs, MARAMP REA, Marine Monitoring Program, Nearshore Water Quality Monitoring, Sanctuary Program, Sea Surface Temperature, Shallow-water CTDs, Subsurface Temperature Recorders, Water Samples, Wave and Tide Recorders, and Ocean Data Platform. The programs found that throughout the 40 fringing reefs in the northern islands it showed less “coral diversity and colony surface area” compared to the southern islands.

Over 95% of the CNMI population is concentrated in the southern islands. Population greatly affects the environment. Out of 83 monitoring sites, “37.3% were classified as ‘impaired’ due to excess nutrients in 2006. (Table 14.4; Houk, 2006)” They found a trend of “microbiological violations” associated with “beaches near storm water drainages.” Saipan’s lagoon is on the more developed side of the island, with a lot of drainages, is where majority of “impaired” beaches are found. DEQ summed that 42% of Saipan’s shorelines are “Impaired;” 28.2% of Tinian’s shorelines were “impaired;” and 8.7% of Rota’s shoreline were “impaired.” The major conservation projects in the CNMI are the “Micronesia Challenge,” “U.S. Coral Initiative,” “Marine Protected Area Programs,” and “Nonpoint Source Pollution Programs.” Another major project/program I did not include is the research “National Marine Monument.”

The expert interview with Greg Moretti was extremely helpful in my research. His opinions were very accurate with my sources. A major part of the interview was his answer to my primary question. If we did lose our oceans species and water quality, it may “devolve” into a “Primordial Sea.” Though my research may not be 100% accurate, it gave me a better visualization and understanding. The subject of “primordial seas” was difficult, since it is theory based. Resouces theorized “primordial seas” existed way back to the origins of life. I researched hydrothermal vents, single-celled organisms, and the “primordial soup theory.”

Overall, I was very satisfied with the research I conducted. I saw that there is still more I didn’t cover and could’ve done; however I did learn so much about our ocean. The topic of oceans can seem “If I gave out more surveys and interviewed more experts, results may differ.

**METHODOLOGY**

The following is the process of collecting data on the study of CNMI’s Ocean Awareness. Saipan’s Ocean Awareness is the title I selected for my research. The primary purpose of this research is to gain knowledge and educate on the conditions and activities on our ocean. Ocean characteristics vary around the world, so the focus was narrowed down according to our area in the world. Saipan is the main island of the Commonwealth of the Northern Marianas Islands (CNMI). The chain of islands, along with Guam, is located in the Pacific North-West and is a part of Micronesia. It also lies on the Philippine Sea. This became the focus area because the conditions are strongly related and a lot of research extension is exchanged or correlated in the region. This methodology will explain the methods of how I conducted my research in the following process:

**Preparing**

Brainstorming, formulating questions, and outlining is used to prepare the research. This can also be described as the foundation for the research. “What happens if Saipan and the CNMI loses all of the fish, sea-creatures, corals, and safe water quality in our ocean?” through brainstorming, became my primary question. Originally, the question was to focus on the whole world. However due to academic purposes and other requirements, it was modified. Other primary questions are “What is the importance of our ocean?”, “What is the current condition of Saipan and the CNMI’s ocean?”, “What are the current major problems or situations in our oceans and coasts of Saipan and the CNMI?”, and “What is our current solutions and what is being done?” Secondary questions aid or supplement the Primary Questions and is used to provide extra information. After brainstorming and formulating questions, outlining it is the final step in this sub-process. The research outline is based on College APA format.

**Conducting the Research**

After the first sub-process, the research is now ready to be conducted. There were several methods involved in conducting the research. Academic books like “Marine Biology 9th Edition” (Castro-Huber, 2013) was used in finding several factual information. Magazines such as “Marianas Fishing” and more were used to get local and regional perspectives and stories. Online sources also became references and were used to find other factual information; the sources can be found on the reference page. Works, articles, and researches from colleagues and previous personal researches were also depended upon; it can be found on the reference page or acknowledgement page.

Conducting surveys was one of the very useful methods to collecting data. It was used to gather public opinion, measure their knowledge and awareness, and also serve the purpose of educating and raising the awareness of our ocean. “Survey Monkey.com” is a great online application used to develop, send, receive, and analyze surveys. Since the target audience was the public, basic and simple questions were formulated. A limit of 10 questions was formulated and sent to several, around 15 students, and was analyzed to add to the research. The site(s) can be found on the reference page.

Interviews and Questionnaires are methods also used to collect data. This was used to interview experts. Either in-person interviews or questionnaires were used to gather expert opinions from professionals. A letter to an expert was sent to several professionals. The feedback and results are also used to add to the data and research.

**Concluding the Research**

This is the next sub-process in the research. After analyzing and gathering all the data, a final review or conclusion is made to answer all the questions. The conclusion basically summarizes all the research into one paragraph, page or section. This reviews all the answers you found for the primary questions researched.

**Peer Review and Feed-back**

Classmates or colleagues were asked to review and spot-check any errors made on the first draft. Three reviews are at least needed to be safe. Dr. Kimberly Bunts-Anderson (EN202 Instructor) also gives her review. Feed-backs were given, and updates were made to improve the draft. Names and references are found on the reference page or acknowledgement.

**Final Draft and Presentation**

The final steps in the whole process are the final draft and presentation. After all modifications, updates, and corrections were made; the final draft is now ready to be submitted. Presentation to the class is the last required step of the research. Questions, comments, reviews, opinions, suggestions, and more are given afterwards.

The whole process just presented was the process or methodology of how I conducted my research. The whole process contained sub-processes and steps to doing my research. Brainstorming, formulating questions, and outlining is used to prepare the research. After the first sub-process, the research is now ready to be conducted. After gathering all the data, it must be reviewed and analyzed. After analyzing and gathering all the data, a final review or conclusion is made to summarize the research. Peer-review and spot-check any errors made on the first draft and updates were made to improve the draft. The final steps in the whole process are the final draft and presentation.

**Acknowledgement**

I would like to thank and give full credit to every source and person that made this research possible. I would like to thank PMRI Executive Director, Greg Moretti, for accepting my interview and giving me a better understanding of our ocean. I would like to thank all the participants who took the survey. Also all my NRM and EN202 peers for assisting me when in need. Also to all my instructors; especially Mrs. Kimberly Bunts- Anderson. Finally, to all my sources, none would be possible without the help to all mentioned.

(Resources are Divided to each section accordingly)