International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 6 Issue 3, March-April 2022 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Coral Life Forms in Biri Coastal Zone Province of Northern Samar

Ogoc, Myrna Nicol, Ph.D

Center for Environmental Studies and Advocacy, University of Eastern Philippines, Catarman N. Samar, Philippines

ABSTRACT

This assessment was part of the project under the German Government (GIZ) supported project of the University of Eastern Philippinesin Biri-Larosa Protected Landscape and Seascape in each aim to establish baseline environmental conditions in Biri island. It involves identifying the present coral life forms, determining the physico-chemical characteristics of water and determining the physic-chemical characteristics of water and determining the human activities which contributes to the present condition of the coral reefs.

This study used descriptive method to describe systematically a situation of interest factually and accurately (Aquino, 1992).

For site 1 the present coral life forms identified were coral foliose with a present cover of 2.12%, Acropora digitate with 40.11%, coral branching with 2.54%, coral mushroom with 0.59% and coral encrusting with 0.42%. There were also abiotics which includes the rubbles with 23.25%, and rock with 1.23%. The dead coral has 25.71% and dead coral with algae has a percent cover of 4.02%.

In site 2, the life forms present were Acropora digitate with 29.65%, coral branching with 4.99%, coral foliose with 4.19%, columnar with 6.61% and coral submassive with 1.31%. there were also abiotics identified which includes rubbles with 29.52% , rock with 1.14% and sand with 0.72%. Biotic which was a sea snake has a 0.25% belongs to others (OT). The dead coral and dead coral with algae has 8.98% and 12.45%. in general, the most abundant coral life form in both sites 1 and site 2 was Acropora digitate.

Environmental parameters measured such as pH which ranged to 8 and 9, temperature to 29 and 29, salinity with 35 and 34 ppt, turbidity in site 1 has 3.5 clarity of water in 4m depth and 3m visibility of water in site 2 w/ 3m depth. The water current was 0.22 m/s and 0.20 m/s. the observed wave action in both sites were normal. This measured parameters were in normal limits and do not influenced the present condition of the coral reefs during the actual conduct of the study.

Anthropogenic activities particularly dynamite fishing was the major contributor of the disturbances of corals in the study area which was observed during the conduct of the study. Identifying the anthropogenic activities was done through observation and the conduct of Focused Group Discussion.

How to cite this paper: Ogoc, Myrna Nicol "Coral Life Forms in Biri Coastal Zone Province of Northern Samar" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-3, April 2022, pp.2216-2223, URL: www.ijtsrd.com/papers/ijtsrd49460.pdf

IJTSRD49460

KEYWORDS: *Coral life forms, Coral reef, Anthropogenic activities, environmental parameters*

INTRODUCTION

Coral refers are complex ecosystem with high biological diversity that occurs in shallow waters through the tropics. The reefs support productive fisheries which provide an essential source of protein. Their proximity to the coast exposes coral reefs not only to subsistence pressures but also to other human induced (Anthropogenic) stresses such as pollution (industrial, chemical and seage) and sedimentation (land clearing, reclamation, mining). Given the potential economic impact of continued degradation of the world's coral reefs, suitable monitoring programs are required to detect any degeneration and

facilitate the development of effective management plans to ensure the future variability of these resources (English et al., 1994)

Coral reefs are precious resource in the ocean because of their beauty and biodiversity. Coral reefs provide shelter for a wide variety of marine life, they provide humans with recreation, they are valuable source of organisms for potential medicines, they create sand for beaches, and serve as a buffer for shorelines (English et al., 1994).

Diving on a sea is like entering another world because of the wonders of corals and their colorful fishes under the sea. But what we do is pollute them with sewage and fish them in destructive ways (i.e. overfishing, chemicals, damaging gears, etc.) (Hapa, Louiela P., 2008).

Biri is one of the towns of Northern Samar, which is one of the popular places in the province because of its diverse ecosystem and magnificent rock formations and is proclaimed as one of the Protected sites in the Philippines.

In this context, the researcher conducted this study to know the situation of coral reefs in Brgy. San Antonio, Biri Northern Samar. The particular interest of this study is the assessment of the live coral cover, its composition and the present condition of the coral reefs in the study area and the most abundant life forms present.

The baseline information that might be gathered will serve as the basis of formulating the necessary management interventions that will help in the conservation and protection of the coral reefs monitoring and implementation of laws and ordinances to stop some activities that contribute negative impacts to our marine coastal ecosystem.

Objectives of the study

This aimed to:

1. Identifying the coral life forms present in the reefs of Brgy. San Antonio, Biri Northern Samar.
2. Identifying the most abundant coral life forms present in the study area.
3. Determine the present condition of the coral reefs in the study area as influenced by:

A. Physico-chemical Factors
a) pH
b) Temperature
c) Salinity
d) Turbidity
e) Water Current
f) Wave Action

B. Anthropogenic Factors

Methodology

Locale of the study

The Biri-Larosa Protected Landscape and Seascape was proclaimed on April 23, 2000 by Presidential Proclamation No. 291. These include the island of Bani, San Juan, Gilbert, Cabaungon Grande and Biri under the jurisdiction of the municipalities of Biri, Lavezares, Rosario and San Jose of the Province of Northern Samar (Fig.1). A total of 36 barangays compose the protected area, with 9 barangays in Biri, 12 barangays in Lavezares, 6 in Rosario, and 9 in San Jose. The total area is 33,492 hectares as stated in the Presidential Proclamation. No ground verification has been done.

The BLPLS is the site where the Biri Rock Formations are found. These are composed of an Early Miocene sedimentary unit and an andesitic complex comprised of shallow intrusions and agglomerates (*Fernandez et al., 2011).* Tourist go to the area for these rock formations which was formed by wave action of the Pacific Ocean. The BLPLS is also identified as a key Biodiversity Area with two coral species considered to be the trigger species of the PA as listed by Conservation International (CI) (www.conservation.org): *Anacroporapuertogalerae* and*Gonioporacellulosa.* During the site visit, birds and bats were found roosting in the rock crevices.

1. Location/Area

Biri Group of Islands lies in the geographical coordinates between 12045’39.54” to 12034’52.71” latitudes and 124026’38.77” to 142016’42.60” longitudes. It sits on the east by the wide expanse of the Pacific Ocean, on the west by the San Bernardino Strait, on the north by the Philippine Sea, and on the south by the mainland municipalities of Lavezares, Rosario and San Jose to which the acronym LAROSA was taken from their initials. More particularly, the total land area of the BLPLS is 33,492 hectares constituting certain parcels of land situated in the coastal area of the Municipalities of LAROSA, Biri and neighboring islands such as Bani, San Juan, Gilbert, Cabungon Grande and Biri Islands and its neighbouring reefs.

2. Climate

Northern Samar has a tropical maritime climate characterized by (a) relatively high temperature; (b) high humidity; and (c) abundant rainfall. The average annual temperature is based on 2004 to 2013 temperature records of the closest monitoring station for weather of the Philippine Atmospheric Geophysical and Astronomical Services Authority (PAGASA) in Catarman is around 26.8oC. January is the coldest month having an average temperature of 26.4°C, while the warmest month is in May with an average temperature of 28.8°C

Humidity, which refers to the moisture content of the atmosphere, is relatively high in Northern Samar due to high temperature and the presence of bodies of water surrounding the Samar mainland. The average relative humidity is over 80%, which combined with the warm temperature, gives rise to a high sensible temperature within Northern Samar during March to May when temperature and humidity attain their maximum level. It is especially true in areas where there are clearings or agricultural production. Under mangrove forests, however, temperature and humidity are not as high due to the cooling effect of vegetation, thus, making the climate more comfortable.

Table 1: Climatological Data Table

Monthly and Normal Rainfall of Catarman, N. Samar from 2004 to 2013													Yearly
Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
2004	326.20	263.40	217.90	85.20	432.90	77.10	186.10	70.40	150.10	516.90	410.80	399.80	261.40
2005	280.40	104.30	157.40	56.90	102.20	188.50	324.00	239.00	357.10	337.90	319.30	1,009.70	289.73
2006	449.80	438.40	366.00	244.60	361.00	298.30	169.70	70.30	501.70	309.20	265.40	985.60	371.67
2007	471.20	91.50	187.20	60.20	129.00	124.20	172.60	199.10	250.50	607.90	585.80	470.60	279.15
2008	448.30	1,244.00	417.60	486.50	168.30	258.90	257.40	294.10	260.00	256.10	324.10	1,053.60	455.74
2009	1,088.00	396.00	201.00	229.10	132.90	111.20	154.70	103.60	122.10	211.10	372.80	392.20	292.89
2010	466.80	32.40	93.20	87.50	20.20	91.80	251.20	139.60	229.10	324.80	374.90	1,129.70	270.10
2011	1,524.20	511.10	1,516.70	273.30	855.90	273.70	442.40	158.30	86.30	224.20	495.80	721.40	590.28
2012	668.90	423.20	526.90	147.80	188.90	132.40	359.10	42.70	342.40	355.30	304.20	409.90	325.14
2013	382.80	438.50	459.90	47.90	70.80	355.90	214.00	234.80	147.30	151.90	511.90	576.50	299.35
Monthly Avearage	610.66	394.28	414.38	171.90	246.21	191.20	253.12	155.19	244.66	329.53	396.50	714.90	343.54

As per Corona Classification, Type II climate prevails within the PA. Type II climate is characterized by no distinct dry and wet season but normally with pronounced rainfall from October to January. The heaviest rains fall in the early part of the coolest season usually during the month of December. During this period, the monthly average number of rainy days is 12 days (ranges from October to March). The months from May to September are relatively the driest months. Generally, the climate of BLPLS can be gleaned from the monthly and normal rainfall of Catarman, Northern Samar (Table 1) above:

Record of fluctuations in the average temperature throughout the year between 2004 and 2013 showed that extremes are normally experienced in the month of August where the average annual maximum temperature is 28.4o C and its minimum annual temperature is 25.8o C.

Between 1950 and 1990 about 6 cyclones and 15 cyclones per ten years have passed over Northern Samar and Eastern Samar, with wind velocity ranging from 70-90 kilometers per hour. However, Philippine Atmospheric, Geophysical and Astronomical Service Administration (PAGASA) records showed that in the later years between 2004 and 2013 the number of tropical storms within 200 kilometers from Northern Samar have increased to 21 whose wind velocity ranges from 63 to 117 kilometers per hour. Also, 6 typhoons have passed during these later years with wind velocity of more than 117 kilometers per hour. The unprecedented typhoon Yolanda that hit Leyte and Samar on November 8, 2013 known as the strongest typhoon ever recorded in the history had the wind velocity of 350 kilometers per hour. It can be noted that the increase in typhoon occurrence and increase of wind velocity during the last decade was likely due to the climatic feedback or regular variations in weather in the region over the years.

Meanwhile, sufficient sunlight and moderate amount of rainfall contributes to the growth of forest

vegetation in the watershed. It encourages vegetation succession. However, too much rain also contributes to the amount of erosion particularly on bare, open areas which subsequently contributes to water turbidity and sedimentation of river systems. Rains are needed for the growth of lowland agricultural crops. Incessant rains, however, hamper the socio-economic activities of man for they will be confined inside their homes for a longer period of time instead of engaging in productive activities outside. Excessive rainfall also causes water upsurge and flooding which destroys agricultural crops and properties and encourages the occurrence of water-borne diseases like diarrhea, amoebiasis, and other related stomach ailments.

3. Geological Characteristics

According to several studies, the Biri Group of Islands is composed of sedimentary rock layers formed by the accumulation of minerals and particulates deposited by the action of wind and water. It looks like a parallel to discordant graded beddings of rocks with fine grains that would have geologic relationship to the Mio-Pliocene Catbalogan Formation occurring in the mainland of Samar Island.

At the Biri head from northern to north-eastern parts of Biri Island where the famous "Rock Formations" are located, the rock outcrops are mostly a series of rocky to coarse-grained sandstone, fine-grained sandstone, siltstone and mudstone. It is believed that the grains of sands are bound together by calcium carbonate and other cementing materials over million years as manifested by the presence of coral cover offshore. The thickness of beds varied considerably from several inches to more or less 3 meters.

Balce, et. al (1996) cited that the rock exposures highlighting the landscape in the island particularly those in the eastern sides are the best of its kind in Region 8 because of its natural grandeur and geological attributes. Its depositional sequences and lithologic characteristics show close affinities to deep ocean sedimentation. The surface morphography and bathemetric profiles around the island fairly suggest that it could be an above sea level horst structure remnants dissected by northwest-southeast trending faults.

In the Western sides of the island, it can be noted that the rock exposures consist of highly to moderately hardened massive stones to thinly bedded sandstone with minor intercalation of polymictic conglomerates. The conglomerates occur sparingly as lenticular bodies in the lower sections of the massive sandstone beds.

Research Design

According to Aquino (1992), descriptive method describes systematically a situation or area of interest factually and accurately. This method was employed in this study, particularly in identifying the present condition of coral reefs in San Antonio, Biri, N. Samar.

Sampling Technique

The Line Intercept Transect (LIT) method was used in this study. This technique, used to assess the benthic community of coral reefs. (English, et al, 1994)

Purposive sampling technique was applied. The two sampling sites was randomly selected to present the whole coral reefs in in the coastal zone of Biri, Northern Samar. Environmental Parameters such as Ph, temperature, salinity, wave action, clarity of water and current velocity was determined in different sites.

Participatory Resources Appraisal (PRA) was conducted in this study, especially with the use of Focus Group Discussion to determine the anthropogenic activities that affects coral reefs.

Data Gathering Procedure

For each sampling sites, 3 transect line was laid in parallel at 3 m depth (shallow water) to the reef crest with 20 m length each transect. All life forms intercepted in the transect was recorded on a prepared data sheet. There were three persons which were the classmates of the researcher dived in water. In determining the life form intercepted in the transect, they brought a laminated life form as a guide. They were also taught in identifying the life form by the licensed divers during the assessment in Biri Northern Samar. The two person determined and measured the life forms intercepted in the transect line while the other one recorded the measurements. Aside from them, the researcher and one assistant were measured the physico-chemical parameters.

Determination of Environmental Parameters

Environmental parameters were measured or determined in the following:

A. **pH**- the pH level of water from different sampling sites was determined through the use of pH paper. It was submerged for 3-5 minutes into the water. After the time required, the pH paper was compared in pH indicator to get the pH level of the sea water.

B. **Temperature**- water temperature was measured using the mercury thermometer. Respectively, at the time of sampling, the thermometer was submerged immediately below the water surface. In getting the temperature of the water, reading

was done while the thermometer was still in the water to avoid the inaccuracy of temperature reading.

C. **Salinity**- was measured using the Atago refracto meter. Water samples was obtain at the surface by using the plastic bottles. Before getting the water samples, plastic bottles was washed thoroughly and dried to avoid contamination.

D. **Clarity of water**- secchi disc was used to measure the clarity or visibility of water. The disc was attached to a rope. The secchi disk has two colors, the black and white. It was put in the water and see if the color white is still visible. The length of the depth of water where the secchi disk is still visible was recorded.

E. **Water Current**- was determined using a plastic bottles. The bottle was put a rock inside of it to avoid deflection of wind. The bottle was tied in a rope w/ 30m length. Th bottle was put in the starting point. When the rope reach to its length in 30m while the bottle is floating, the stopwatch was stopped and record the time. Water current was computed using the formula: c=d/t (National Environmental Services Center, 2007).

Where: c= is a current, d= is a distance, t= is a time

F. **Wave Action**- was determined only qualitatively, solely by ocular observation.

Determination of Anthropogenic Activities

Anthropogenic activities was determined by *Participatory resource Appraisal (PRA).* PRA was used to collect information from a group of people at the same time. It uses particular tools for a faster collection of specific target information.

The conduct of Participatory Resource Appraisal (PRA) followed a checklist of information needed with particular tools to be used. Focus Group Discussion (FGD) was tool used generally effective to generate information about topics or issues. It involved not only identification of the later in the group or groups of respondents.

Respondents

Participatory Resources Appraisal was participated by selected key informants from the study area. Some of these participants included the barangay officials, fisherfolks, and PO'S who has been residing in the barangay for at least 20 years.

Statistical treatment of Data

Results of this study treated statistically using means and averages.

Data of the percent cover of the life from was done using the formula (English, et. al, 1994).

$$\%\text{cover} = \frac{TC}{T} \times 100$$

Where: TC=is the total length of category

T=is the length of transect

TABLE 1: CRITERIA ON RATING THE PRESENT CONDITION OF CORAL

(Deguit, E.T, R.P., Smitn, W.P., Jatulan, and A.T. White. 2004)

CONDITION	CRITERIA
Excellent	76-100%
Good	51-75%
Fair	26-50%
Poor	0-25%

Summary of Results

This study was conducted in the coastal zone of Biri, Northern Samar. This was done to identify the present and most abundant coral life forms in the study area. Physico-chemical parameters were measured in site 1 and site 2 including the ph, temperature, salinity, water current, turbidity, and wave action which are found with in normal levels, line Intercept Transect method was used in assessing corals, It was laid parallel to the coastline. The area has two study sites. Each sites has three transect line w/ 20m length each transect. Site 1 has 4m depth and site 2 has 3.5m depth.

In site 1, the identified coral life forms were hard corals namely: Coral foliose (CF) w/ 21.12%, Acropora digitate (ACD) w/ 40.11%, Acropora branching (ACB) w/ 2.54%, Coral mushroom (CMR) w/ 0. 59%, and Coral encrusting (CE) w/ 0.42%. Abiotic includes rubbles ® w/ 23.25% and rock (RCK) w/ 1.23%. Dead coral covers 23.71% and dead coral w/ algae (DCA) w/ 4.02%.

In site 2, identified coral life forms were hard coral namely: Acropora digitate (ACD) w/ 29.65%, Acropora branching (ACB) w/ 4.99%. Coral foliose (CF) w/ 4.19%, Columnar 6.61% AND Corla submassive (CSM) w/ 1.31%. the biotic includes sea snake w/ 0.25% which is categorized as others (OT). The abiotic were rubbles ® that covers29.52%, rock (RCK) w/ 1.14% and sand (S) w/ 0.72%. Dead coral (DC) has 8.98% and dead coral w/ algae covers 12.45%.

In physico-chemical factors affecting corals were pH w/c ranged from 9 (site 1) and 8 (site 2). The water temperature were 28ºC (site 1) and 29 ºC (site 2). The salinity were 35 ppt (site 1) and 34 ppt (site 2), the turbidity was clear in both sites. Water current has a velocity of 0.22 m/s (site 1) and 0.20 m/s (site 2) and the wave action observed was normal.

The anthropogenic activities fthat damages the corals were illegal fishing and improper solid waste disposal. The coral reefs in the study is in fair condition.

Conclusions

The most abundant life form in both sites were Acropora digitate (ACD). The measured physic-chemical parameters were in normal levels and that is one of important factors to consider for the better growth of corals.

Although the continued use of dynamite causes coral rubbles, the coral reef is considered with in fair condition. But it is more better if using illegal fishing and other anthropogenic activities will be stopped and managed resources properly. If this activities will be continued by everyone, our resources will be gone and the environment will be destroyed.

Recommendation

1. The local government must hire bantay-dagat for monitoring and enforcement of local rules, laws related to Coastal Resource Management and lpenalties imposed to violators using illegal practices.
2. The residents must follow and strictly implement the local ordinances for coastal protection.
3. The residents must implement RA 9003, the Ecological solid Waste Management.
4. The Brgy. Officials must formulate local laws focused on coastal resources management.
5. Increase awareness at community level in terms of coastal resources management.

BIBLIOGRAPHY

BOOKS

[1] English S., C. Wilkinson, V. Baker, (1994). **Survey Manual Resource for Tropical Marine Resources**. Australian Institute of Marine Resource.

[2] Hapa, Louiela P., (2008). **Coral Life Forms in San Isidro, Northern Samar**. Bachelor of Science in Environmental Studies Thesis. College of Science, University of Eastern Philippines.

[3] Bonife, Menzie A., (2001). **Taxonomic Classification of Macrobenthic Algae in the Coastal area of Catarman N. Samar**. Bachelor of Science in Biology Thesis. College of Science, University of Eastern Philippines.

[4] Tonog, Merle N. (undated). General Chemistry. College of Science, University of Eastern Philippines.

Journal

[1] Adey WH, Burke RB (1977). **Holocene bioherms of Lesser Antilles: geologic control of development**. America Association of Petroleum Geologists. Stud Geol 4:67-81

[2] Alcal, Angel C. (1985). **Research at Siliman University Marine Laboratory Philippines**. Reef Newsletter 11: 7-8

[3] Brander, L>M., Rehdanz, K., Tol, R.S.J. and va998n Beukering, P. (2012). **The economic impact of ocean acidification on coral reefs**. Climate change Economics. DOI: 10.1142/S201000781250029.

[4] Bryant, D., L. Burke, J. McManus, and M. Spalding. 1998. **Reefs at Risk: A Map-based Indicator of Threats to the World's Coral Reefs**. World Resources Institute. 56 pp. http://www.wri.org/wri/reefsatrisk/.

[5] Burke, L., Reytar, K., Spalding, M., and Perry, A. (eds.), 2011) **Reefs at Risk Revisited**. World Resources Institute, Washington D.C.

[6] Carilli, Jessica E., Richard D. Nores, Bryan A. Black, M. Walsh, Melanie McField, (2009). **Journal: Plos one.** Vol. 4, pages e6324. Public Library of Science.

[7] Cesar H.S. J., (2000). **Coral reefs: Their functions, threats and economic value**. In: HSJ Cesar (Editor), Collected essays on the economics of coral reefs.

[8] Cheroske AG, Williams SL, Carpenter RC (2000) **Effects of physical and biological disturbance on algal turfs in Kaneohe Bay, Hawaii**. J Exp Mar Biol Ecol 248:1-34

[9] Dollar SJ (1982) **Wave stress and coral community structure in Hawaii.** Coral Reefs 1:71-81

[10] Dollar SJ, Tribble GW (1993). **Recurrent storm disturbance and recovery:** a long-term study of coral communities in Hawaii. Coral Reefs 12:223-233

[11] Dudgeon SR, Johnson AS (1992). Thick versus Thin: **thallus morphology and tissue mechanics influence differential drag and dislodgement of two co-dominant seaweeds**. J Exp Mar Biol Ecol 165:23-43

[12] FitzGerald WJ Jr (1978) **Environmental parameters influencing the growth of Enteromorpha clathrata (Roth) J. A. in the intertidal zone on Guam.** Bot Mar 21:207-220

[13] Frances E. C. Stewart and Josef D. Ackerman (2009). **The effects of water velocity and morphology on the photosynthetic rate of the aquatic macrophytes Vallisneria americana and V. Spiralis**. Integrative Biology, Department of Integrative Biology and Faculty of Environmental Sciences, College of Biological Sciences.

[14] Fricke, H. And Meischner, D. (1985). **Depth Limits of Bermuda Sclerectinian Corals**. (A Submersible Survey). Marine Biology. 88 Pp. 175-187.

[15] Hay ME (1981) **The functional morphology of turf-forming seaweeds: persistence in stressful marine habitats**. Ecology 62:739-750 Inter-Research, Oldendorf, Allemagne, (1979). **Marine Ecology**.

[16] **Progress Series**. vol. 177, pp. 83-91 (1p.1/4).ISSN 01718630.

[17] Kingsbury JM (1962) **The effect of waves on the composition of the population of marine attached algae**. Bull Torrey Bot Club 89:143-160

[18] McClellan, K. (2010). **Coral degradation through destructive fishing practices.** Retrieved from http://www.eoearth.org/view/article/151482

[19] M. Holcomb, A.A. Venn, E. Tambutté, D. Allemand, J. Trotter and M. McCulloch. 2014. **Coral Calcifying fluid Ph dictates response to Ocean Acidification.** Article number: 5207.

[20] Nemenzo, Francisco. (1988). **Threre New Species from Islets in Center Philippines**. The Philippine Journal of Science. Vol. 117 (3) 215-221.

[21] Palumbi SR (1984) **How body plans limit acclimation: responses of a demosponge to wave force**. Ecology 67:208-214

[22] Palumbi SR (1986) **Tactics of acclimation: morphological changes of sponges in an unpredictable environment**. Science 225:1478- 1480

[23] Rosen BR (1975) **The distribution of reef corals**. Report of the Underwater Association 1:1-16

[24] SUML/UPMSI, (1985). **Coral Reefs of the World**. The IUCN Conservation Monitoring Center: Campbridge, U.K. Vol. 3: 1988 p. 229.

[25] UNEP, 2006. **Marine and Coastal Ecosystems and Human Well Being:** A Synthesis Report Based on the Findings of the Millennium Ecosystem Assessment. UN Environment Programme, Nairobi.

[26] Veron, J.E.N., Hoegh-Guldberg, O., Lenton, I T.M., Lough, On J.M., Obura, D.O., Pearce-Kelly, P., Sheppard, C.R.C., Spalding, M., Stafford-Smith, M.G., and Rogers, A.D., (2009) **The coral reef crisis:** The critical importance of <350 ppm CO2. Marine Pollution Bulletin 58: 1428-1436>

PROCEEDINGS

[1] Alcala, Anger C. and Teodolo Luc haven (1981). **Fish Yield of the Coral Reef surrounding Apo Island, Negros Oriental, Central Visayas, Philippines**. Proc. 4th intri. Coral Reef Symposium, Manila. 1: 69-73. Carrascal de Celis, N. (1977). **Marine Plants of Hundred Islands, Pangasinan**. Sylvatrop. Philippines Forest Research Journal. 2(4); 239-250.

[2] McManus, John W.,. Ramon I. Miclat & Virgilio P. Palaganas. (1981). **Coral and Fish Community Structure of Sombrero Island, Batangas, Philippines.** Proc. 4th Int'l. Coral Reef Symposium, Manila. 1: 69-73.

[3] Pichon, M. (1977). **Physiography, Morphology and Ecology of the Double Barrier Reef of North Bohol Philippines**. Proc.3rd Int'l. Coral Reef Symposium, Manila. 2: 261-267.

[4] Ross, Michael and Gregor Hodgson. (1981). **A Quantitative Study of Hermatypic Coral Diversity and Zonation of Apo Reef, Mindoro, Philippines**. Proc. 4th Int'l. Coral Reef Symposium, Manila. 2: 281-291.

[5] Ruiz, Ed Vince A. (1995). **Coral community Structure of Fringing Reefs in Naawan, Misamis, Oriental**. Proceedings Annual Convention. Federation of Institutions for Marine and Fresh Water Sciences. October 23-25 1995. University of San Carlos, Cebu City. Pp, 9-10.

UNPUBLISHED MATERIAL

[1] Alcala, Angel C. (1984). **A Report on Coral Reefs Survey of Certain Island in the Sulu Sea of South China Sea and Visayan Sea**.

[2] MPRDP, (1983). **Provisionary Listing and Synoptic Description of Candidates Site.** Unpub. Rept., Marine Park/ Reserve Development Program.

[3] NMRC, (1979). **Preliminary Study on the used of Landsat MSS Waters in Bolinao, Pangasinan Coastal Resources and Environmental Survey using Landsat Multi-Special Scanner Data**. First Annual Technical Report. Natural Resources Management Center, Manila.

[4] NMRC, (1984). **Biological and Socio-economic Survey of Coastal Barangays along Honda Bay**. Unpub.Rept., Natural Resources Management Center, Manila.

[5] UPMSC, (1979). **Investigation of the Coral P. sources of the Philippines.** Final Report, Phase 2. Submitted to the Ministry of Natural Resources and Fisheries Industry Development Council. University of the Philippines Marine Science Center, Quezon City.

[6] UPMSC, (1980). **Investigation of the Coral Resources of the Philippines.** Annual Report, Phase 3 A. Submitted to the Ministry of Natural Resources and Fisheries Industry Development Council. University of the Philippines Marine Science Center, Quezon City.

[7] UPMSC, (1982). **Investigation of the Coral Resources of the Philippines.** Final Report, Phase 3 A. Submitted to the Ministry of Natural Resources and Fisheries Industry Development Council. University of the Philippines Marine Science Center, Quezon City.

Encyclopedia

[1] **Grolier Encyclopedia of knowledge.** Vol. 5, pp. 252. Copyright (a MCMXCL by Grolier Incorporated Printed and Manufactured. in United States of America

Electronic Sources

[1] National Environmental Services Center, 2007. Basic Water & Wastewater Formula s Product # DWPCOM84.

[2] http://www.nesc.wvu.edu/pdf/dw/publications/ontap/2009tb/basicformulasdwfsom103.pdf)

[3] http://marinebiology.org/oceans/corals-reefs/

[4] www.coralhub.info/terms/corals-as-colonies

[5] http://www.flmnh.ufl.edu/Fish/southflorida/coral/Habitat.html

[6] http://oceanworld.tamu.edu/students/coral/coral2.html).

[7] http://www.livestrong.com/article/124375-effects-improper-garbage-disposal/

[8] http://oceanservice.noaa.gov/facts/coralbleach.html

[9] http://www.Coralhub.info/terms/digitate-v-columnar/

[10] http://www.windows2universe.org/earth/climate/ocean acidification.html

[11] http//www.ncbi.nlm.nih.gov/pmc/articles/PMC4047535/

[12] http://www.Dfw.gov.mp/downloads/ReefEcol…

[13] http://www.fondriest.com/environmentalmeasurements/parameters/water-quality-temperature/

[14] http://oceanservice.noaa.gov/facts/current.html

[15] http://www.answers.com/Q/Whatis wave action

[16] http://water.epa.gov/type/rsl/monitoring/vms55.cfm

[17] (https://books.google.ph/books?id=7RWfiECRgC8C&pg=PA399&lpg=PA399&dg=a+study+of+corals+that+states+poor+and+good+condition+not+in+pdf&source=bl&ots=uBRUcf3Ibn&sig=06Pm13ovBBw0GWckYcYxZHx4wIQ&hl=en&sa=X&ved=OCEgQ6AEwCGoVChMI7bfQvam8yAIVw3amCh1NMA4n#v=onepage&q=a%20study%20of%20corals%20that%20states%2Opoor%20and%20good%20condition%20not%20in%20pdf&f =false)