Abundance of *Rumphella* sp. (black coral) in correlation with physico-chemical properties of marine water in Matabungkay beach, Batangas, Philippines

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**Abstract**

This study investigated the abundance of black coral species in correlation with the physicochemical characteristics of marine water in Matabungkay Beach, Batangas. The black coral species identified was *Rumphella aggregata*. The black coral species was found to be abundant in the third station with a relative abundance of 41.7% of the total relative abundance and the station with least abundant station was the second station with a relative abundance of 25% of the total relative abundance. The parameters have almost all positive correlation except for nitrite and nitrate, ammonia and phosphate having negative or negligible correlation. There is moderately small positive correlation of the frequency with water temperature and salinity while moderately negative correlation of the frequency with hardness. There is very small positive correlation between the frequency with calcium and conductivity while very small negative correlation with the frequency with hardness. There is high positive correlation between the frequency with TDS but high negative correlation between the frequency with DO and transparency. The abundance of black corals indicates the tolerance of the species to the marine environment.

**Keywords:** coral, black corals, gorgonian, *Gorgoniidae*, *Antipathes*

**Introduction**

The earth is concealed with almost 70 percent water in different forms regardless of its breadth and dimensions- the ocean, sea, freshwater and the like that encompasses the marine life. Marine water serves as the habitat of many organisms. The quality of marine water such as the physical and chemical properties would give effect to the growth and development of marine life. It limits the evolution of the marine species dwelling within. Black Corals are treasured for economic purposes. The thorny skeleton of the black coral species produce jewelry and national gem. The collection of Black Corals for use in the jewelry industry as well as for other uses such as nature medicine on the other hand, has caused the black coral populations to diminish and harvesting regulations are on their way. Black corals are now considered as endangered species because of the different human activities such as illegal trade and water contamination. Human activities including dynamite fishing, illegal fishing and boating pollution produce marine water contamination. Since Black Corals depend on the planktons for the growth and reproduction, such contamination of toxic chemicals may adhere to tiny particles which are then taken up by planktons. When these contaminated planktons eaten by the Black Corals, these may likely affect the population of the Black Corals in the area. Consequently, overexploitation of Black Corals without proper management could easily lead to local population extinction.
In the present condition of the waters engulfing the Philippine archipelago, especially in Matabungkay Beach, marine life is at risk of contamination and a decline of the respective growth of Black Corals due to the different human activities. Illegal trade is said to be occurring in the area because of the abundance of the Black Corals. The species were harvested in the area of Matabungkay Beach and traded to different places to produce jewelry. Not knowing the significant abundance of the endangered species and its ecological role in the marine water, human continues to trade the species for money. Matabungkay Beach, Batangas was chosen as the area of concentration due to the presence of the endangered Black Corals that have been dwelling within their waters. On this study, the correlation of the physical and chemical parameters of the Marine water in Matabungkay Beach and the present abundance of Black Corals was observed and identified. The knowledge and awareness of the people regarding the value of Black Corals in the area was also obtained.

**Materials and Methods**

Water sampling was effective in determining the physico-chemical properties of the beach which help in the determining the response of the black corals. The species collected from the beach would be confirmed and identified by the curators in the National Museum. There were three stations to collect the samples. The following features of the collected samples were noted according to its size (mm), color and shape. Likewise, the data and time collected were recorded as well. The physico-chemical properties of the water were tabulated and graphed while the date, time and weather condition during the collection of samples will be recorded. In data gathering, data processes such as determining the Relative Abundance and Relative Frequency was measured.

**Relative abundance**

\[
RA = \left( \frac{n}{N} \right) \times 100\%
\]

Where, RA = relative abundance; \( n \) = number of individual species; \( N \) = total number of individual species

**Relative abundance**

\[
X = Y_1 + Y_2 + Y_3
\]

Where: \( Y_1 \) = number of samples collected in the 1\(^{st} \) station; \( Y_2 \) = number of samples collected in the 2\(^{nd} \) station; \( Y_3 \) = number of samples collected in the 3\(^{rd} \) station.

In determining the significant associations of the physico-chemical properties of seawater and identification of black corals, the Pearson Product Moment Correlation or Pearson r was used.

**Pearson Product:**

\[
R = \frac{N \sum XY - (\sum X)(\sum Y)}{\sqrt{N \sum X^2 - (\sum X)^2} \sqrt{N \sum Y^2 - (\sum Y)^2}}
\]

\( N \) = number of samples

\[
\sum X = \text{total sum obtained from the different parameters used}; \quad \sum Y = \text{frequency of black corals};
\]

\[
\sum XY = \text{summation}. \quad \text{The correlation method will be used to correlate the relation of the abundance of black corals in the physico-chemical properties of the water sample.}
\]

**Results**

*Rhumpella aggregata* (Fig. 1) as the main coral found in the marine waters of Matabungkay Beach marked with the absence of spines. The live specimen appeared with a bushy colony in light brown with rounded branches and surface layer of coenchyme with wart-clubs. The station with the most abundant *Rumphella* sp. is station C with 5 colonies and 41.7% abundance. The measured light absorption of the three stations gave an average of 52.10%.
The collected species was classified as a gorgonian instead of black coral.

**Table 1.** Determination of the relative abundance of *Rumphella* sp. found in Matabungkay beach, Batangas

<table>
<thead>
<tr>
<th>Station</th>
<th>Abundance</th>
<th>Relative Abundance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4</td>
<td>33.3%</td>
</tr>
<tr>
<td>B</td>
<td>3</td>
<td>25%</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>41.7%</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Table 2.** Summarized Physical Properties of Matabungkay beach

<table>
<thead>
<tr>
<th>Stations</th>
<th>Light absorption</th>
<th>Water temp.</th>
<th>Air temp.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>59.2%</td>
<td>29.58°C</td>
<td>35°C</td>
</tr>
<tr>
<td>B</td>
<td>56.25%</td>
<td>29.58°C</td>
<td>34.7°C</td>
</tr>
<tr>
<td>C</td>
<td>40.84%</td>
<td>29.7°C</td>
<td>35°C</td>
</tr>
<tr>
<td>Mean</td>
<td>52.10%</td>
<td>29.62°C</td>
<td>34.9°C</td>
</tr>
</tbody>
</table>

**Discussion**

The identified coral was *Rumphella* sp. which is classified as a gorgonian instead of a black coral. Black corals and gorgonians are often confused with each. The former lacking skeletal spines while the latter possessing such. According to Bruckner et al. (2008) there is considerable confusion regarding the taxonomy of species of black corals. Thus, in most cases identification to genus or
species is possible only if an entire colony is available. Since such corals are endangered and are protected under the EC Wildlife Trade Regulations (Commission Regulation (EC) No 709/2010 on amending Council Regulation (EC) No 338/97 on the protection of species of wild fauna and flora by regulating trade therein) (Anon, 2010), harvest of such is not allowed. Only a fraction of the colony was extracted and used as a specimen. The Station with the highest relative abundance was Station C with 41.7% while the Station B has lowest relative abundance with 25%. The abundance of the Rumphella sp. in each station is greatly influenced by the physicochemical properties of the marine water. The parameters determine the growth and survival of Rumphella sp. The environmental conditions of the marine water are favorable to the development of the Rumphella sp. The physicochemical properties used in the study are the air and water temperature, nitrite and nitrate, ammonia, phosphate, pH, calcium, hardness, salinity, TDS, conductivity, light penetration and DO are measured. The temperature of water has moderately small positive correlation.

Table 3. Standard values of Physico-Chemical parameters of water according to the Department of Environment and Natural Resources (DENR) compared to the average values taken at the three different stations

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Station A</th>
<th>Station B</th>
<th>Station C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water temperature (°C)</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Air temperature (°C)</td>
<td>29.58</td>
<td>29.58</td>
<td>29.7</td>
</tr>
<tr>
<td>Nitrite/Nitrate</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ammonia (mg/L)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Phosphate (ppm)</td>
<td>0.25</td>
<td>0.25</td>
<td>0.25</td>
</tr>
<tr>
<td>pH</td>
<td>8.08</td>
<td>8.12</td>
<td>8.08</td>
</tr>
<tr>
<td>Calcium (ppm)</td>
<td>408</td>
<td>410</td>
<td>408</td>
</tr>
<tr>
<td>Hardness (ppm)</td>
<td>110.98</td>
<td>121.72</td>
<td>94.66</td>
</tr>
<tr>
<td>Salinity (mg/L)</td>
<td>30.55</td>
<td>27.58</td>
<td>30.74</td>
</tr>
<tr>
<td>TDS (mg/L)</td>
<td>30.71</td>
<td>30.68</td>
<td>30.83</td>
</tr>
<tr>
<td>Conductivity (mg/L)</td>
<td>51.09</td>
<td>51.58</td>
<td>51.83</td>
</tr>
<tr>
<td>Transparency (mg/L)</td>
<td>59.25</td>
<td>56.13</td>
<td>40.84</td>
</tr>
</tbody>
</table>

Table 4. Summarized correlation of the abundance of black Coral species to the physicochemical properties of Matabungkay beach

<table>
<thead>
<tr>
<th>Parameters</th>
<th>r</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water temperature °C</td>
<td>0.280566</td>
<td>Moderately small positive correlation</td>
</tr>
<tr>
<td>Air temperature °C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrite/ Nitrate</td>
<td>0</td>
<td>No correlation</td>
</tr>
<tr>
<td>Ammonia</td>
<td>0</td>
<td>No correlation</td>
</tr>
<tr>
<td>Phosphate</td>
<td>0</td>
<td>No correlation</td>
</tr>
<tr>
<td>pH</td>
<td>-0.13207</td>
<td>Very small positive correlation</td>
</tr>
<tr>
<td>Calcium</td>
<td>-0.08239</td>
<td>Very small negative correlation</td>
</tr>
<tr>
<td>Hardness</td>
<td>-0.35384</td>
<td>Moderately small negative correlation</td>
</tr>
<tr>
<td>Salinity</td>
<td>0.347664</td>
<td>Moderately small positive correlation</td>
</tr>
<tr>
<td>TDS</td>
<td>0.562917</td>
<td>High Positive correlation</td>
</tr>
<tr>
<td>Conductivity</td>
<td>0.093314</td>
<td>Very small positive correlation</td>
</tr>
<tr>
<td>DO</td>
<td>-0.44993</td>
<td>High Negative correlation</td>
</tr>
<tr>
<td>Transparency</td>
<td>-0.56965</td>
<td>High Negative correlation</td>
</tr>
</tbody>
</table>

While the temperature of air has a high negative correlation in relation with the marine water in Matabungkay beach. Temperature is a universal factor in influencing the behaviour of living organisms for their survival. The water and air temperature indicate the temperature tolerable for the black coral species to survive (Marsh, 1998; Mader, 2004). An increase in temperature can create physiological stress in the species. Based on the results gathered, it shows that the air temperature is always higher than the water temperature in the different sampling sites. The average pH of the sampling sites was 8.08. The pH concentration of the marine water is maintained at a normal range and is basic which is tolerable.
for the growth of *Rumphella* sp. Low levels of pH may lead to death of aquatic animals and corals preventing normal rate of respiration. An increase of acidity of water can decrease the number of black coral species (Smith, 2000). Nitrite and nitrate as well as ammonia has no correlation with the marine water. Thus, the presence of the such parameters does not affect the growth of *Rumphella* sp. Nitrite and nitrate are toxic compounds, thus high levels indicate a build-up of fish waste and other organic compounds, resulting to poor water quality and preventing marine organisms to carry on normal respiration. Maintaining a low nitrate level improves the health of fish and reefs. Nitrogen compounds and other decaying organic matter also add to the amount of ammonia and phosphate in the water. The levels of nitrite, nitrate and ammonia should always remain at 0 ppm (mg/L) any level above indicates possible pollution of the marine water and toxicity to marine life. Phosphate on the other hand, has a no correlation as well. The precipitates of phosphate dissolve calcium and magnesium ions, inhibiting the growth of hard corals and other reef-building organisms. Phosphate level depends on the purity of the water.

Calcium has a very small negative correlation. Corals use calcium to build a skeleton structurally made up of calcium carbonate. Elevated phosphate precipitates calcium, rendering it unavailable to reef organisms. All reef organisms rely on the combination of calcium and carbonate to build their skeleton structure. Without an adequate concentration of calcium, many corals cannot grow. Carbonate hardness or hardness has a moderately small negative correlation. Carbonate hardness is the measure of carbonate and bicarbonate ions concentration dissolved in water. These minerals are essential to stabilize pH and calcium utilization on reefs. Carbonate hardness is the ability for the water to stabilize the pH. Stony corals have calcium carbonate skeleton which cannot be built without carbonates. The DO has a high negative correlation with the marine water in Matabungkay beach. The average DO absorption of marine water of Matabungkay beach is 92% making it tolerable for the survival of black corals. The amount of DO needed is dependent on the water temperature.

**Table 6.** Survey response of the community based on the general use of the Matabungkay beach

<table>
<thead>
<tr>
<th>A. Pangkalahatan</th>
<th>Percent</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Paano ginagamit ng komunidad ang karagatan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Pagkain</td>
<td>34%</td>
<td>1</td>
</tr>
<tr>
<td>b. Tirahan</td>
<td>5%</td>
<td>4</td>
</tr>
<tr>
<td>c. Turismo</td>
<td>27%</td>
<td>3</td>
</tr>
<tr>
<td>d. Hanapbuhay</td>
<td>33%</td>
<td>2</td>
</tr>
<tr>
<td>2. Ano ang pinakaintorpante sa karagatan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Mga isda</td>
<td>51%</td>
<td>1</td>
</tr>
<tr>
<td>b. Mga coral reefs</td>
<td>9%</td>
<td>3</td>
</tr>
<tr>
<td>c. Tubig</td>
<td>4%</td>
<td>4</td>
</tr>
<tr>
<td>d. Ibang mga hayop</td>
<td>22%</td>
<td>2</td>
</tr>
<tr>
<td>3. Sino ang pinakanakikinahang sa dagat?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Mangingisda</td>
<td>42%</td>
<td>1</td>
</tr>
<tr>
<td>b. Beach Resort owner</td>
<td>32%</td>
<td>2</td>
</tr>
<tr>
<td>c. Komunidad</td>
<td>26%</td>
<td>3</td>
</tr>
<tr>
<td>4. Ano ang madalas na ginagawang activity sa karagatan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Swimming</td>
<td>34%</td>
<td>1</td>
</tr>
<tr>
<td>b. Fishing</td>
<td>31%</td>
<td>2</td>
</tr>
<tr>
<td>c. Boating</td>
<td>26%</td>
<td>3</td>
</tr>
<tr>
<td>d. Diving</td>
<td>5%</td>
<td>4</td>
</tr>
<tr>
<td>e. Kayak</td>
<td>4%</td>
<td>5</td>
</tr>
</tbody>
</table>

The amount of oxygen consumption varies, depending the activity level of marine organisms and will affect the presence or absence of *Rumphella* sp. Salinity has a moderately small positive correlation making it important in the growth of *Rumphella* sp. In general, the physicochemical properties show positive correlation except nitrite and nitrate, ammonia and phosphate having no or negligible correlation at all. There is a moderately small positive correlation between the frequency of *Rumphella* sp. with water temperature and
Table 7. Survey response of the Community based on the Black Coral abundance in Matabungkay beach

<table>
<thead>
<tr>
<th>B. Black coral</th>
<th>Percent</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Mayroon bang makikitang mga marine animals sa karagatan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Meron</td>
<td>73%</td>
<td>1</td>
</tr>
<tr>
<td>b. Wala</td>
<td>27%</td>
<td>2</td>
</tr>
<tr>
<td>2. Mayroon bang makikitang black corals sa inyong karagatan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Meron</td>
<td>48%</td>
<td>2</td>
</tr>
<tr>
<td>b. Wala</td>
<td>52%</td>
<td>1</td>
</tr>
<tr>
<td>3. Kung meron, marami baa ng nakakaalam tungkol sa presensya ng mga ito?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Oo</td>
<td>79%</td>
<td>1</td>
</tr>
<tr>
<td>b. Hindi</td>
<td>20%</td>
<td>2</td>
</tr>
<tr>
<td>4. Ano ang kahalagahan sa inyong presensya nito?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hanapbuhay</td>
<td>23%</td>
<td>2</td>
</tr>
<tr>
<td>a. Turismo</td>
<td>77%</td>
<td>1</td>
</tr>
<tr>
<td>b. Pagkain</td>
<td>0%</td>
<td>3</td>
</tr>
<tr>
<td>5. Ano ang pinaggagamitan ng mga black corals?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Pagkain</td>
<td>0%</td>
<td>4</td>
</tr>
<tr>
<td>b. Alahas</td>
<td>56%</td>
<td>1</td>
</tr>
<tr>
<td>c. Palamuti</td>
<td>18%</td>
<td>3</td>
</tr>
<tr>
<td>d. Tirahan ng mga isda</td>
<td>27%</td>
<td>2</td>
</tr>
<tr>
<td>6. Binebenta ba ng mga black corals?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Oo</td>
<td>38%</td>
<td>2</td>
</tr>
<tr>
<td>b. Hindi</td>
<td>62%</td>
<td>1</td>
</tr>
<tr>
<td>7. Kung Oo, Sino ang madalas na bumibili ng mga ito?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Mga gumagawa ng alahas</td>
<td>45%</td>
<td>1</td>
</tr>
<tr>
<td>b. Mga turista</td>
<td>36%</td>
<td>2</td>
</tr>
<tr>
<td>c. Mga gumagawa ng palamuti</td>
<td>9%</td>
<td>3</td>
</tr>
<tr>
<td>d. Mga estudyante/researcher</td>
<td>9%</td>
<td>3</td>
</tr>
<tr>
<td>8. Saan madalas binebenta ang mga ito?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Sa palengke</td>
<td>18%</td>
<td>3</td>
</tr>
<tr>
<td>b. Sa tabing dagat</td>
<td>27%</td>
<td>2</td>
</tr>
<tr>
<td>c. Sa mga nangunghuwa mismo</td>
<td>54%</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 8. Survey response of the community based on the sanitation of the Matabungkay beach

<table>
<thead>
<tr>
<th>C. Kalinisan</th>
<th>Percent</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Naglilinis ba kayo ng karagatan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Oo</td>
<td>87%</td>
<td>1</td>
</tr>
<tr>
<td>b. Hindi</td>
<td>13%</td>
<td>2</td>
</tr>
<tr>
<td>2. Kung Oo, tuwing kalian?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Palagi</td>
<td>81%</td>
<td>1</td>
</tr>
<tr>
<td>b. Minsan</td>
<td>19%</td>
<td>2</td>
</tr>
<tr>
<td>3. Mayroon bang makikitang mga basura ng lumulutang sa karagatan?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Meron</td>
<td>55%</td>
<td>1</td>
</tr>
<tr>
<td>b. Wala</td>
<td>45%</td>
<td>2</td>
</tr>
<tr>
<td>4. Kung Meron, Anu-ano ang mga ito?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a. Plastic</td>
<td>39%</td>
<td>1</td>
</tr>
<tr>
<td>b. Pagkain</td>
<td>27%</td>
<td>2</td>
</tr>
<tr>
<td>c. Sewage-related</td>
<td>21%</td>
<td>3</td>
</tr>
<tr>
<td>d. Fishing-related</td>
<td>39%</td>
<td>1</td>
</tr>
</tbody>
</table>

The survey response showed the awareness, knowledge and value of black coral in the community of the Matabungkay, Batangas. In the general survey for the general use of the Matabungkay Beach, the majority of the respondents assumed the use of Matabungkay Beach as a source of food having a percentage of 34 with it to rank first among the other four choices, followed by Hanapbuhay, Turismo and the least is, Tirahan having a percentage of 5%. The importance of Matabungkay beach was also conducted and assumed Mga isda as the main importance in the Beach with a percentage of 51% among the other choices Mga coral

salinity, while moderately negative correlation between the frequency with hardness. There is a very small positive correlation between the frequency with pH and conductivity while very small negative correlation between the frequency and calcium. There is high positive correlation between the frequency with DO and transparency while high negative correlation between the frequency with TDS.
reefs, Tubig at ibang mga Hayop. The Mangingisda is considered as the most beneficiary of the beach among the beach resort owner and the community having a percentage of 42% and swimming was considered as the usual activity in the Matabungkay beach among the others which are Fishing, Boating, Diving and Kayaking. In the occurrence of the Black Coral in the Matabungkay beach, 48% of the respondent knows the presence of the Black Coral whereas 52% are not aware of its presence. However, those 79% responded to the awareness of black coral suggested that many in the community knows the presence of the coral which is opposite to the 20% respondent that suggested that only few are aware on its presence. Based on the importance of the Black Coral, Turismo or Tourism considered as the most important for the community whereas, Alahas or jewelry considered as the main use of the black coral in the industry. Based on the survey response, 62% answered that black corals are not for sale, which is contrary to the 38% respondent that suggest that the said black corals trade for money to the makers of the jewelries as well as to the tourist visiting the Matabungkay beach. The black corals can be bargained directly to the divers who obtain the black corals, with a price ranging 500 php and above, according to 81% of the respondent. Based on the survey concerning the sanitation of the Matabungkay Beach, 87% answered the proper sanitation of the beach and a percentage of 81% regularity of the proper sanitation. However, 55% respondent answered that the presence of the litter in the Matabungkay beach is present and seen, having the plastic and fishing-related as the usual litter with a percentage of 39% among others which are Sewage-related and Pagkain.

References

