Quality Of The Coastal Water Of Aroma Beach San Jose, Occidental Mindoro

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Abstract.
This is study which focused on the determination of the coastal water quality, of the Aroma Beach, a strip of gray sand which stretches more than one kilometer and located in San Jose, Occidental Mindoro. To determine water quality, water samples were taken monthly from February 2019 to May 2019 and subjected to analysis for pH, DO, temperature and oil and grease. Microbiological tests include determination of total coliform and fecal coliform measured in terms of most probable number per 100ml of the water sampled. Results of the study indicate that the coastal waters at Aroma Beach is safe for contact swimming and other recreational activities, however, values of its oil and grease have exceeded the maximum concentration slightly exceeded the DENR threshold for this pollutant.

Keywords: *coastal water quality, water quality*

I. INTRODUCTION

Seawater pollution has been recognized as a global problem that requires an important public health and environmental concern and the quality of beach water is commonly evaluated in comparison to national and/or international standards which vary from one country to another. (Oluwaseun, et. al, 2019). Coastal waters are facing a wide variety of stressors affecting both the ecosystem and human health via domestic wastewater treatment and disposal practices that may lead to the introduction of nutrients and enteric human pathogens (Santhiya et. al, 2011). The main anthropogenic impact caused by the seasonal population rise in coastal areas during summer is the elevated organic load discharged into the water bodies which are used as sewers (Shirodkar, et. al, 2011) . The public visit the beaches during summer as a source of entertainment. For this reason, beach quality is a matter of major concern in the context of the environmental and public health.Throughout the Philippines, public beaches suffer due to the proliferation of houses and business establishment that incessantly discharge their wastes into the water, polluting the water and making it unfit for bathing and swimming.

Recently, the Boracay island, a world-renowned tourist destination in the province of Aklan was closed down owing to its heavily-polluted waters which became unsafe for bathing, swimming and other water recreational activities. Water quality testing revealed high contamination of the pathogen e-coli, a fecal coliform bacteria normally found in human and animal feces. Occidental Mindoro is an island province that have numerous beaches. It is known for the world-renowned Apo Reef, Inasakan White Beach and White Island. The Aroma Beach is a favorite local destination and a jump off point for island hopping. The Aroma Beach is a strip of gray sand located along the coastline of San Jose, Occidental Mindoro. It is frequented by locals and tourists alike because it offers a picturesque view of the sunset and the fine sand make a stroll along the beach and a dip in the coastal waters 'must not miss" experiences. Moreover, it has a historical value as the second landing site of the American Forces during the second world war. The coastal water is generally a bathing and swimming destination (San Jose Tourism Office, 2018).However, over the last five years, tourism activities and establishments of infrastructure have emerged rapidly without due consideration of their possible impacts on the marine and coastal environment.

The establishment of cottages and other facilities without liquid waste treatment or disposal facilities dump their sewage and septic wastes directly into the water can be sources of pathogens. Fecal contamination at bathing beaches can be hazardous since the human and animal feces may contain bacteria, virus and protozoa which may be ingested by swimmers leading to intestinal disease. Future development

plans for the Aroma Beach include construction of a baywalk and food stalls along the inner lanes and a jetski and other water sports recreation area (San Jose Municipal Planning Office, 2019). Being free and open to the public, the Aroma Beach is frequented by people especially during weekends and holidays. It is also the docking site of small fishing boats. To date, no baseline data exist to establish the quality of Aroma Beach as a swimming and other skin contact water activities.The aim of the present study is to analyze the physico-chemical and microbiological characteristics of the coastal water at Aroma beach to determine its fitness as bathing, swimming and recreational water. Additionally, this endeavored to compare the physico-chemical characteristics of the beach water against DENR standards for marine bathing waters.

II. OBJECTIVES

1. The study aimed to provide baseline data on the physico-chemical characteristics of the aroma beach in San Jose, Occidental Mindoro in terms of pH, temperature, dissolved oxygen; and oil and grease
2. To analyze the microbiological properties of the coastal water at the Aroma Beach in terms of pathogenic elements such as total coliform; and fecal coliform
3. Compare the Aroma Beach characteristics with the Philippine Department of Environment and Natural Resources standards for Class BS coastal/marine waters.

III. MATERIALS AND METHODS

Study site

The study site consisted the whole stretch of the Aroma Beach of 1.125 kilometers from San Roque I to Bubog Road coastline which is used as bathing, swimming and recreation site.

Fig 1. Aerial view of Aroma Beach

Sample Collection

Reconnaissance survey was carried out along the three sampling points identified using the Global Positioning System (GPS). Water samples were collected once a month in March, April and May following the standard procedures for sample collection described in APHA AWWA WEF (2005), US EPA Volunteer Stream Monitoring Manual (1997) and Maglangit, et al. (2014).The water samples were taken in pre-cleaned polyethylene bottles by both improvised sampling using a pail and grab sampling. The hand held Global Positioning System was used to determine the actual coordinates of the sampling sites and to reconfirm the site location during succeeding sampling periods. Sampling locations for recreational areas must reflect water quality within the entire recreational zone.

Sites from upstream peripheral areas and locations adjacent to drains or natural contours that would discharge storm water collections or septic wastes were selected (Saad, 2017) The samples were collected at 15–30 cm below the surface on the seaward side of a recently broken wave, following the descriptions of APHA, *On-site,*the physicochemical analyses were carried out according to the recommended Standard Methods (APHA, 2005) Samples were taken from the swimming area from a uniform depth of approximately 1 m. during the peak bathing of the recognized bathing season which generally includes Saturday, Sunday, and holidays (Hoather, 2011). Samples for analysis were kept in a cool box of about 4 to 6 ^{0}C and brought to the laboratory for chemical analysis (Bouhayene & Djebar, 2014)

Sample Analysis

Water temperature, pH, and DO were measured *in situ* using land type WTW type 197-S. E-coli and total coliform count were quantified in terms of Most Probable Number (MPN) using multi tube fermentation method.

Data Analysis

Data obtained was analysed using descriptive and inferential statistics. The data generated in the study were compared with the DENR standards for swimming and bathing coastal waters. Classified as SB under DO 34 s.1983.

IV. RESULTS AND DISCUSSION

1. Physico-chemical Properties of Aroma Beach

Temperature

Results of the sample analysis revealed that water temperature was highest in April reaching as high as 32ºC. while lowest temperature readings were recorded in February 2019 . For the whole study period, the seawater temperature ranged from 26º C- 33º C. These temperature readings were affected by ambient air temperature and well within the DENR standards of 3º(Cebu & Orale, 2017)

pH

The pH or hydrogen ion concentration ranged from 7.7 to 8.2 which are well within the DENR standards for coastal bathing waters. While pH does not vary greatly in time and space along open oceans , its high variations in near-shore areas can exceed I unit owing to biological activity (Cornwall, et. al, 2013) . The seasonal current and seasonal wind keeps the water well-aerated and dispersed and hence more uniform or values close to each other maybe observed within weeks apart of water sampling (Saad, 2017).

Dissolved Oxygen (DO)

Variations were observed in the DO concentrations of the samples. This could be due to tidal exchange and the production and consumption of oxygen by plants and algae during daytime and respiration at night. Throughout the study period, DO concentrations ranged from 5.2-6.41mg/L. The highest value (6.41) was recorded in February where rains were observed which was brought by faster water undercurrent while lowest was obtained in May which could be due to the presence of organic matter consuming the dissolved oxygen in the water (Bouhayene, 2014).

Low DO values indicate organic pollution. The observed DO values at the Aroma Beach still exceeds the threshold of 5mg/L indicating that the coastal water at the beach is compliant with DENR standards in terms of this variable.

Oil and grease

Oil and grease are of the most significant groups of contaminants of concern in the marine environment, and was identified as a priority parameter for development of ASEAN marine water criteria. (Tong, et al, 2009). The oil and grease content of the sampled waters ranged from 1.02 to 2.36. Although these values fell well within the DENR standards for contact swimming waters such as the coastal waters at Aroma Beach, this a matter of concern especially that young children bathe in the coastal waters. The presence of this contaminant could be attributed to the small fishing boats docking at the shore as well as cargo boats that carry products to and from the island barangays of San Jose. Leakage from the fuels used to drive the engines of these boats contribute to this contaminant although runoffs from domestic cooking and washing and industrial wastes could not be ruled out since a number of small restaurants and cottages that serve food still line the beach front.

Table 1. Physico-chemical Test Results

Sampling Site	February 2019			Average	DENR Standards
	1	2	3		
pH	7.7	8.1	7.7		6.0-8.5
Temperature	26.6	26.7	26.5		3º C rise
DO	6.41	6.23	6.31		5mg/L
Oil and Grease	1.03	1.04	1.06		2mg/L

Sampling Site	1	2	3	Average	DENR Standards
			March 2019		
pH	7.8	8.1	7.9		6.0-8.5
Temperature	31.6	31.7	31.2		3° C rise
DO	6.34	6.23	6.32		5mg/L
Oil and Grease	2.21	2.32	2.36		2mg/L
			April 2019		
Sampling Site	**1**	**2**	**3**	**Average**	**DENR Standards**
pH	7.7	8.2	7.6		6.0-8.5
Temperature	33.6	33.7	33.7		3° C rise
DO	5.67	5.71	5.74		5mg/L
Oil and Grease	2.1	2.1	2.3		2mg/L
			May 2019		
Sampling Site	**1**	**2**	**3**	**Average**	**DENR Standards**
pH	7.9	8.2	7.9		6.0-8.5
Temperature	32.6	32.7	32.7		3° C rise
DO	5.1	5.2	5.2		5mg/L
Oil and Grease	2.1	2.1	2.2		2mg/L

Microbiological Properties of Aroma Beach

E. coli is the most suitable fecal indicator bacteria to judge the quality of recreational water for contact swimming (Thoe, et. al, 2018). The results in table 2 indicate that for all sampling sites, the total and fecal coliform counts were within the DENR standards of 1000/MPN/100ml and 200MPN/100ml sample for total and fecal coliform respectively. However, elevated concentrations of these pathogens could adversely affect the quality of the coastal water to the public using it for recreational skin contact activities.

Table 2. Microbiological Test Results

Sampling Site	1	2	3	DENR Standards
			February 2019	
Total Coliform	79	90	92	1000MPN/100ml
Fecal Coliform	34	19	19	200MPN/100ml
			March 2019	
Total Coliform	89	56	97	1000MPN/100ml
Fecal Coliform	17	17	13	200MPN/100ml
			April 2019	
Total Coliform	28	17	67	1000MPN/100ml
Fecal Coliform	89	18	17	200MPN/100ml
			May 2019	
Total Coliform	78	27	53	1000MPN/100ml
Fecal Coliform	32	16	11	200MPN/100ml

V. CONCLUSIONS

Based from the findings, the following conclusions are drawn:

1. The physico-chemical properties of the Aroma Beach in terms of pH, temperature and dissolved oxygen (DO) are well within the standards set by the Department of Environment and Natura Resources in its DO No. 34 re Water Usage and classification for Fresh Surface and Coastal Waters class SB coastal waters .

2. The oil and grease is slightly above the threshold of 2mg/L indicating slight pollution which could be due to spillage/leakage of fuel oils used by small fishing boats docking along the beach.

3. The total and e-coli bacteria concentration of the coastal waters at the Aroma Beach are within the threshold of 1000MPN/100 ml and 200MPN/100 ml, respectively indicating that the coastal waters are still fit for contact swimming and other recreational activities.

VI. RECOMMENDATION

Based from the findings of the study, the following are recommended:

1.A regular water quality monitoring should be established to assure the public who use the Beach of its fitness for skin contact water activities like swimming;

2. Unregulated docking of small fishing at the beach should be regulated to curb the spillage/leaks of fuels, oils and grease which pollute the water;

3. Environmental awareness signages may be put in strategic locations to remind the beach visitors of the fragile beach ecosystem which could be damaged by incessant anthropogenic activities; and

4. Stringent regulations on the disposal of solid and liquid wastes, including those disposing their septic wastes to the sea should be in place.

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