Vol. 11 • December 2015
Print ISSN 2244-4432 • Online ISSN 2984-7125
DOI: https://doi.org/10.59120/drj.v11i1.17

Sediment Accumulation Rates in Pujada Bay as Determined by Sediment Traps

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ABSTRACT

Sedimentation rates in Pujada Bay were determined using an improvised container traps to collect sediments at eight different stations. The results showed high sedimentation rates of around 21.74 kg ma day-I, 15.43 kg ma day-I, 8.21 kg ma day-I, and 3.20 kg ma day-I in stations S5R2 (first period), S2R2 (fourth sampling S2R2 sampling period), and S3R1 (second sampling period) respectively. The principal source for S5R2 was the nearby upland water run-off from the mountain where soil extraction activities are obvious. Depositions for S2R2 were due to Mati Creek discharge and presence of informal settlers in the vicinity. Sedimentations in S3R1 were due to Sudlon River discharge and presence of large commercial fishing boats in the area.

Keywords: sedimentation, Pujada Bay, discharge, run-off, accumulation

INTRODUCTION

Pujada Bay, is a 21,200 hectares bay along the Pacific coast of the southern Philippine Island of Mindanao. Pujada Bay was as a protected landscape and seascape in 1994 under NIPAS through Presidential Declaration 431 because of its ecological and economic importance. The bay is rich and diverse of marine life as evident in the abundance of its coral reefs, seagrass beds, and mangrove forests[1]. The bay is also home to approximately 850 hectares of mangroves spread along its shore[2]. Although the bay is flourishing for its richness of biota and habitat, Pujada Bay is also susceptible to abuse, over utilization and mismanagement. The presence of informal settlers and agricultural and anthropogenic activities in the surrounding area poses a serious threat to the bay that calls for a unified effort to protect it. One way to measure its exposure is to determine rate of accumulation of sediments that have deposited into the bay.

The rate of sedimentation in water basins depends on many factors, such as die quantity of sediment, distance from the source of sediments, biological processes, seasonal variations, and manmade activities. In the study conducted by Szymczak's group[3'4], sediment build-ups peak in late January and early February and drops to a minimum between June and August. The accumulation rate of marine sediments has also been the subject of investigations for several years.

The rate of sedimentation has a significant impact on many biological processes. It is also crucial for the lives and survival of benthic organisms in the bay[10].

The aim of this study was to determine the sediment accumulation rate specific to Pujada Bay using *in situ* sediment traps. In order to describe adequately the accumulation processes, the mass sediment accumulation was

applied, which quantifies die mass of sediment deposited in unit time on unit surface area (mass accumulation rate, MAR) expressed in kg m^{-2} day^{-1} [14-15].

MATERIALS AND METHODS

Sampling stations

Each sampling site is unique and reflective of the different anthropogenic activities along the coastline of Pujada Bay that may impact its health status. The descriptions of the different sampling sites and Global Positioning System (GPS) coordinates of their respective replicates (Figure 1, Table 1).

Sampling period

Sampling activities were spread from January to June 2014 in consideration to northeast (amihan) and southwest (habagat) monsoons. These phenomena will largely affect the current patterns that consequently will have an impact on the flushing rate and the rate of accumulation of sediments in the bay.

Collection of sediment samples

The rate of sedimentation was established through the use of 1L plastic containers tied securely to a pole and placed in the shallow portions of the sampling sites for 24 hours. After retrieval of the sediment traps, samples were filtered and filtrates were air- or oven-dried and weighed.

Figure 1. Established sampling stations in Pujada Bay.

Table 1. Detailed descriptions and GPS coordinate of the sampling sites.

Sampling Station	Replicates	Description	GPS Coordinates
1	S1R1 S1R2 S1R3	industrial	N 6° 58' 10.1" E 126° 14' 6.1" N 6° 56' 0.2" E 126° 14' 16" N 6° 55' 57.3" E 126° 14' 24"
2	S2R1 S2R2 S2R3	residential and partly commercial area	N 6° 56' 59.4" E 126° 12' 56.2" N 6° 56' 53.1" E 126° 13' 10.1" N 6° 56' 48.7" E 126° 13' 20.6"
3	S3R1 S3R2 S3R3	landing area of commercial fishing boats	N 6° 56' 57.5" E 126° 11' 50.8" N 6° 57' 2.9" E 126° 12' 12.4" N 6° 57' 9.5" E 126° 12' 37.8"
4	S4R1 S4R2 S4R3	mariculture area with floating cages	N 6° 53' 41.4" E 126° 11' 2.2" N 6° 54' 8.9" E 126° 10' 50.4" N 6° 54' 30.4" E 126° 11' 3.5"
5	S5R1 S5R2 S5R3	Bigue within Balite bay where siltation is obvious	N 6° 54' 12.7" E 126° 9' 51.5" N 6° 54' 16.1" E 126° 9' 55.2" N 6° 53' 27.6" E 126° 9' 50.8"
6	S6R1 S6R2 S6R3	Barangay Catmonan with discharge of Jericho river	N 6° 47' 59.5" E 126° 13' 42.4" N 6° 47' 59.4" E 126° 13' 35.4" N 6° 48' 8.8" E 126° 13' 23.2"
7	S7R1 S7R2 S7R3	between Pujada and Waniban islands	N 6° 49' 27.6" E 126° 16' 40.6" N 6° 49' 9.1" E 126° 16' 29.3" N 6° 48' 39.4" E 126° 15' 53.6"
8	S8R1 S8R2 S8R3	tourism area along beach resorts	N 6° 52' 21.1" E 126° 17' 21.5" N 6° 52' 2.9" E 126° 17' 36.4" N 6° 51' 55.5" E 126° 17' 46.7"

Results and Discussion

Rain delivers large amount of water to the coastline that also bring along lots of eroded soil and debris from the surrounding landscape. These sediments may have been contaminated with pollutants that flow directly from industrial and municipal waste canals, while others come from polluted runoff in urban and agricultural areas. It may contain pesticides, fertilizers and toxic materials which can damage or even kill the organisms within the marine ecosystem.

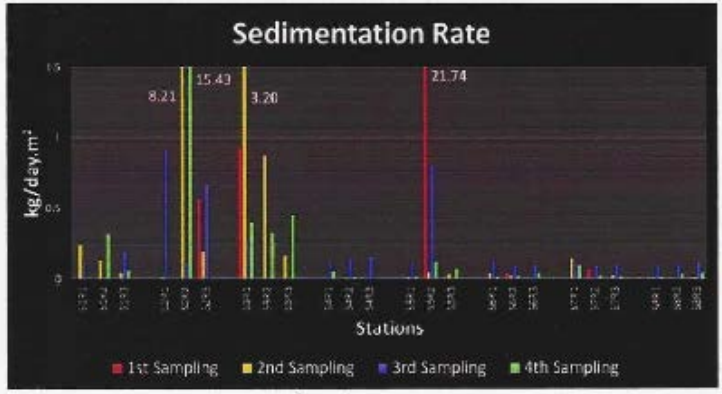

Figure 2. Sedimentation rate in kg $m^{-2}day^{-1}$ in each station for all sampling periods.

These sediments were moved by swift moving water to move further downstream, the summary of results for rate of sedimentation is shown in Figure 2.

The three stations with relatively high rate of sedimentation were in S5R2 (21.74), S2R2 (15.43 and 8.21) and S3R1 (3.20). The S5R2 station is located within the Balite Bay area in Barangay Dawan (Figure 3). This coastline is the catch basin of the eroded soil as a result of soil extraction activities upland. This extremely high rate of sedimentation was more pronounced due to heavy downpour of rain a day before the first sampling. The sedimentation in the area is so bad that it is still visible for a few days even without rain. Station 5 in Barangay Dawan is heavily silted (Figure 3). On the other hand, S2R2 is situated near the coastal residential area of Magsaysay which is close to the mouth of Mati Creek, slaughter house and dockyard where presence of several anthropogenic activities had contributed to its sediment load. The sediment level at S3R1 in barangay Bilawan and Magapo might be attributed to the various "fish landing activities" in the area. Moreover, S3R1 is adjacent to Sudlon Creek's discharge to the bay.

Figure 3. Aerial view of S5R2 site in Barangay Dawan where muddy sediments are amply deposited.

Water circulates within the Bay and the strongest current was observed in the mouth of U-shaped Bay (Station 7) directly exposed to the open Pacific Ocean. The highest sedimentation rate of 21.74kgm^{-2} day^{-1} was in station 5 (Balite Bay) composed mostly of clay materials, followed by stations 2 and 3, respectively. High level of sedimentation rate in the waters may pose health hazards to marine organisms thriving in the area. Stations 5, 3, and 2 were the most vulnerable areas of the Bay in terms of sedimentation and must be given due-attention. Thus, there is a need to revisit the management policy of Pujada Bay. Additionally, activities in the surrounding areas and within bay must be regulated. Strict monitoring of implementation of interventions in order to arrest the declining water quality are highly recommended.

ACKNOWLEDGEMENTS

The authors are grateful to the Department of Natural Resources - Central Office and Region XI the auspices of the Asian Development Bank (ADB), Global Equity Fun (GEF), and of the Government of the Philippines (GOP) for the funding support, the DOSCST through the Regional Integrated Coastal Resources Management Center (RIC XI) for the administrative and logistic support and the field researchers (R. Balaquit, J. Bantayan, M. Bantayan, L. Jimenez, R. Pequiro, R. Vilela and C. Ybañez) for dEir during ffe data gathering.

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