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IDENTIFICATION OF PHYSICAL OCEANOGRAPHIC PARAMETERS AND MIXING TYPES AT THE TRANSITIONAL SEASON I IN THE ESTUARY OF AIR MANNA REGENCY SOUTH BENGKULU

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ABSTRACT

The recent increase in community activity in the Air Manna Estuary of the South Bengkulu regency, will affect the physical condition of the estuary. Therefore, this research were to determine of the physical oceanographic parameters such as temperature, salinity, current velocity, tidal and the mixing type in the Air Manna estuary, South Bengkulu Regency at the transitional season I. The method used is the measurement of field data directly during high tide and low tide conditions as well as descriptive and quantitative data analysis. The results showed that the characteristics of the physical oceanographic pharameters in the Air Manna Estuary were influenced by tidal condition. The highest current speed at the mouth of the estuary is 2.6 m/s at low tide and 2.2 m/s at high tide, with the highest temperature in the upstream estuary of 27.49^{o}C towards the sea during high tide conditions. The low salinity in the middle of the estuary of 0.99 ppt increases towards the sea with a relatively smaller distribution of salinity at low tide.The mixing type in the Air Manna Estuary is the Salt wedge estuary which has a well-certified mixing pattern, with an estuary number of 0.00019.

Keywords: physical oceanographic parameters, mixing type, Air Manna Estuary

INTRODUCTION

One of the river estuaries in Bengkulu, specifically located in the South Bengkulu Regency, is called the Air Manna Estuary [1]. Because the waters in this Estuaryare the center of fish landing in South Bengkulu Regency, which is equipped with a fish auction, the lives of the people who live in the surrounding community are supported in part by this estuary. This estuaryis one of the supporting regions for the lives of the surrounding community. The estuary of the Air Manna River serves a vital purpose for the ecosystem as a whole by providing a habitat for a variety of organisms, including fish [2]. The condition of the waters in the area will be affected by a variety of community activities, such as the disposal of waste from the cleaning process at the fish auction, the disposal of household waste around the estuary, and the transportation activities of fishermen in the area of the Air Manna Estuary [3]. Both directly and indirectly, the numerous community activities that take place in the region have the potential to impact the water quality of the Air Manna Estuary. This is the case because the estuary is located near the river.

The scientific knowledge that has been gathered from the waters of the Air Manna Estuaryis, as of right now, still relatively restricted, particularly with regard to the features of the physical amounts of water in the area. By taking readings of various oceanographic parameters like temperature, current speed, and salinity, one can gain insight into the properties of the water that makes up the physical quantities that are present in a certain region. The previous study conducted research on the characteristics of the Sugihan Muara Sungai, South Sumatra Province with oceanographic parameters (salinity, temperature, and currents) using a purposive sampling method in conditions towards high tide and towards low tide [4]. The results showed that Muara Sugihan belongs to the perfectly mixed estuary type (well mixed estuary). Another study conducted a study of oceanographic parameters to determine the characteristics of the waters by taking water samples from the Parancak estuary, Bali Province [5]. Based on the interaction of fresh water flow and tidal circulation, the Perancak estuary is a partially mixed estuary. In addition, previous studies in the Air Manna estuary [6] showed the characteristics of estuaries with sandy and sandy mud substarts. The sedimentation rate in the Air Manna estuary area is influenced by activity along the river, current velocity and tides [7]. Because the characteristics of physical quantities and the identification of mixing types in this estuary need to be considered to maintain the stability of the estuary ecosystem, and also as an initial consideration in carrying out development plans in the estuary area, research on the characteristics of physical quantities and types of mixing in the waters of the Air Manna Estuarystill needs to be done. Based on the findings of some of these studies, it is clear that more research on these topics is still required.

As a result, it is essential to carry out study on how the physical magnitude and kind of mixing in the waters of the Air Manna Estuary, located in the South Bengkulu Regency, occurred during the first transitional season. This research was conducted in South Bengkulu Regency during the first transitional season with the goal of determining the physical amounts and types of mixing that occurred in the waters of the Air Manna Estuary. It is anticipated that the findings of this study will give relevant parties with information regarding the physical amounts and types of mixing. This information may be used as preliminary data in

development planning and development in the waters of the Air Manna Estuary, which is located in the South Bengkulu Regency.

METHOD

This study was carried out during the first transitional season in the waters of the Air Manna Estuary, which is located in the South Bengkulu Regency and can be seen in FIGURE 1. The research location can be found in this figure.

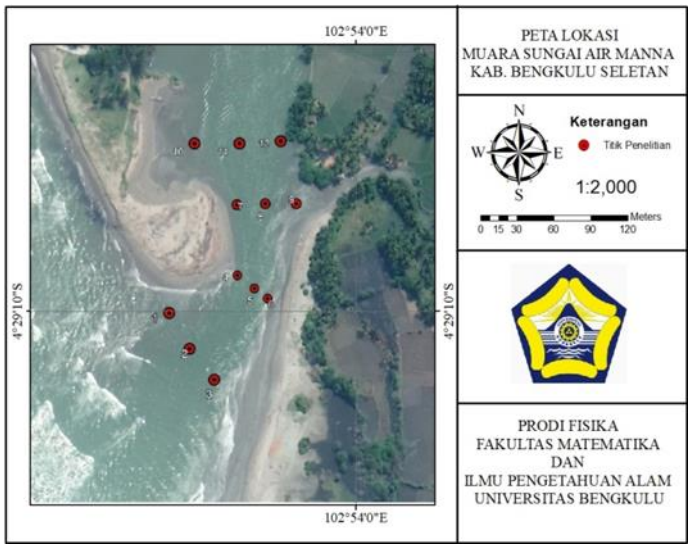

FIGURE 1. A map of where the study will be done in the Air Manna Estuary.

This research used investigation came from direct measurements that were carried out in the field. These measurements included taking salinity and temperature readings at various depths over a period of 24 hours under high tide and low tide circumstances throughout the transitional season. These readings were collected during the transitional season. At each of the twelve places where this measurement is taken, salinity and temperature sensor instruments, as well as current meter sensors, are used to collect data. In the meantime, the processes that are carried out in the data processing of parameter measurement findings include producing vertical and horizontal distribution maps using surfing software and making time series graphs for current data using spreadsheet. The results analysis was carried out descriptive and quntitatively analysis with reference to the classification of different types of estuaries [9].

RESULT AND DISCUSSION

Current

The results of the measurements taken with a current meter indicated that the speed of the current was at its peak at the mouth of the estuary, where it measured 2.2 meters per second, and that it was at its lowest downstream of the estuary, where it measured 0 meters per second

can be seen in FIGURE 2 . The speed of the river is 0.61 meters per second at the middle of the estuary, and it is 0.67 meters per second further upstream. At high tide, the current moves into the river, and at the same time, water moves upstream of the river, pushing against it. As a result, the speed of the current in the waters at high tide will slow down.

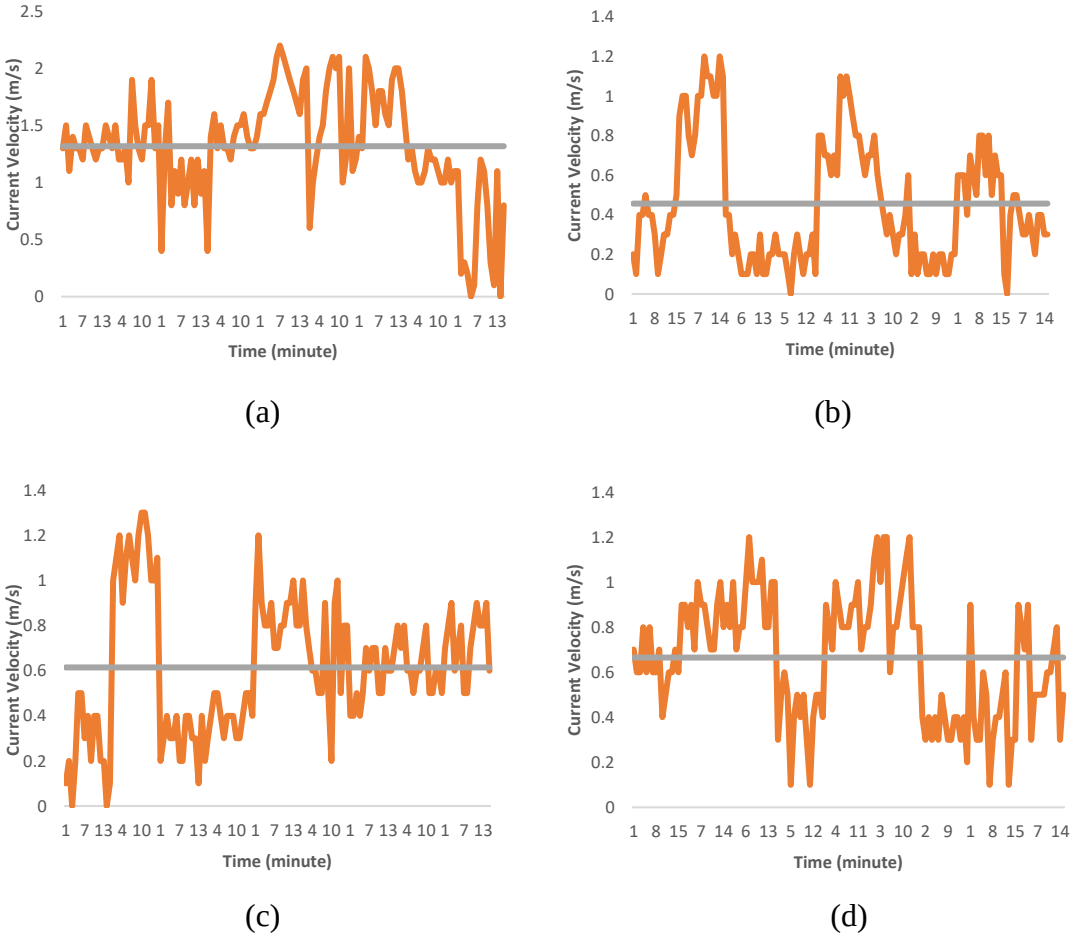

FIGURE 2. Current velocity under high tide conditions at: (a) mouth of estuary (b) downstream of estuary (c) middle of estuary (d) upstream of estuary.

The results of the measurements showed that the highest current speed at low tide was 2.6 meters per second, while the lowest current speed was 0.1 meters per second. The results also showed that the highest current speed was at the mouth of the estuary, while the lowest current speed was in the middle of the estuary. In the meantime, the speed of the current is 1.22 meters per second upstream of the estuary, while it is 1.33 meters per second downstream of the estuary can be seen in FIGURE 3.

It has been noticed that the current velocity at low tide is greater than the current velocity at high tide. The reason for this is that at low tide, the water only pushes out from the upstream of the river to the mouth of the river, which causes this condition to raise the current velocity in the waters. The current velocity at high tide is lower than the current velocity at low tide. Gives an indication of the movement of the water mass and its relationship as a factor that can

alter the distribution of a substance in the water column [13]. Provides an indicator of the movement of the water mass and its relationship as a factor.

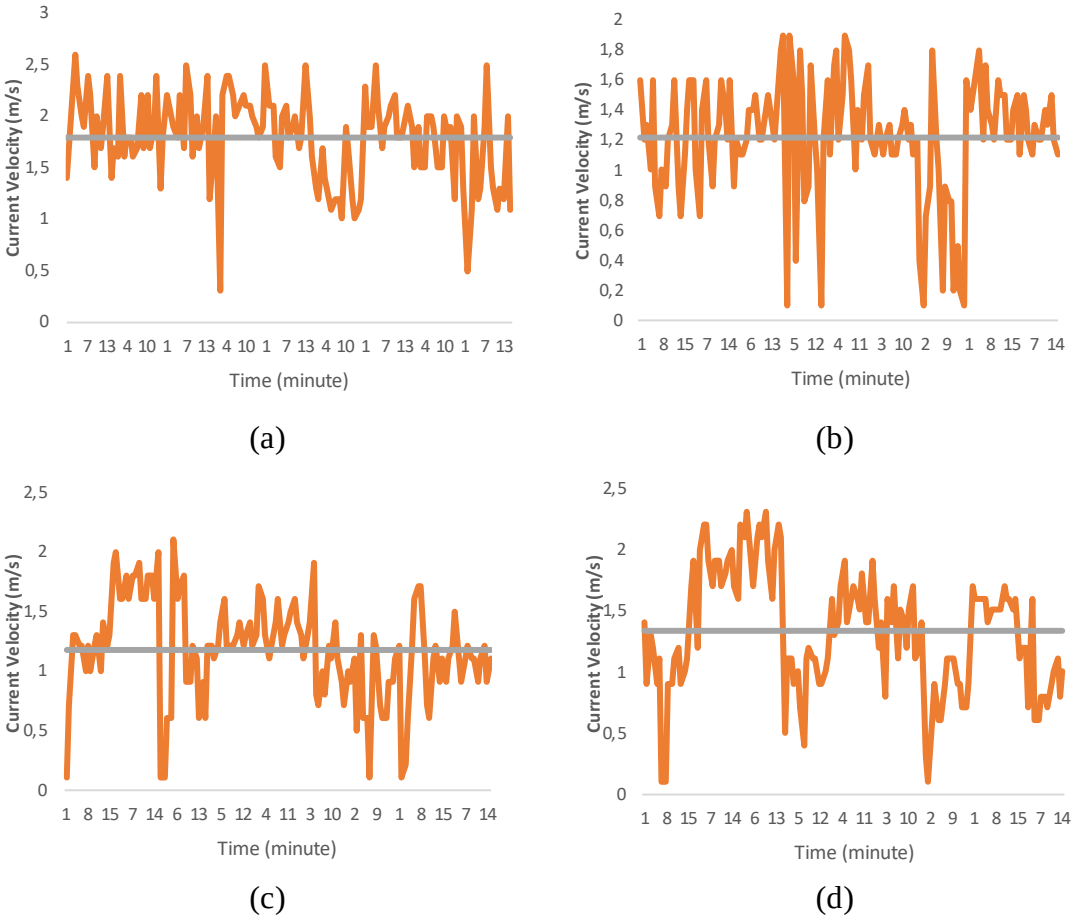

FIGURE 3. Low tide current velocity at: (a) mouth of the estuary (b) downstream of the estuary (c) middle of the estuary (d) upstream of the estuary.

Salinity

The mouth of the estuary had the greatest average salinity, which was 3.89 parts per thousand and was displayed in blue at a depth of four meters. The green tint on the water surface at a depth of 0.2 meters indicated that the water had a salinity of 1.65 parts per thousand, which was the lowest average salinity in the upstream part of the estuary. In the middle of the estuary, the salinity is 2.28 parts per thousand at a depth of 1.97 meters, while the salinity is 3.44 parts per thousand downstream of the estuary at a depth of 2.2 meters as shown by FIGURE 4. It is clear that the value presented in blue becomes increasingly intense in proportion to the growing salt of the water as one moves closer to or further from the estuary's opening. This is because salinity moves inland from the ocean at high tide circumstances alone and distributes itself across the estuary at those areas.

This is consistent with the findings of prior research, which indicate that the magnitude of the salinity range has a considerable impact on the rate of change in salinity values [10]. This finding is supported by the fact that it is the case. Because of the influence of tides, the salinity

of the water will grow or rise in the horizontal direction as the distance from the upstream of the river to the estuary or vice versa increases [11]. This will occur in both directions.

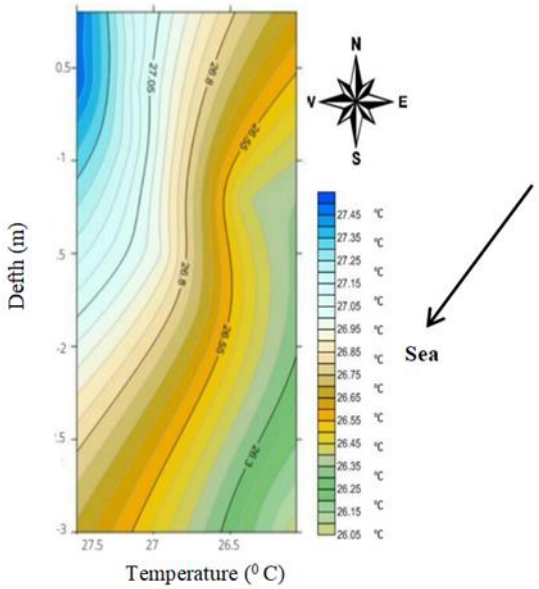

FIGURE 4. Salinity distribution of high tide conditions.

The average salinity is 2.28 parts per thousand at the mouth of the estuary, which is shown in blue at a depth of 3 meters or at the bottom of the water. The salinity is 0.99 parts per thousand in the center of the estuary, which is represented in green at a depth of 0.2 meters or at the top of the water.

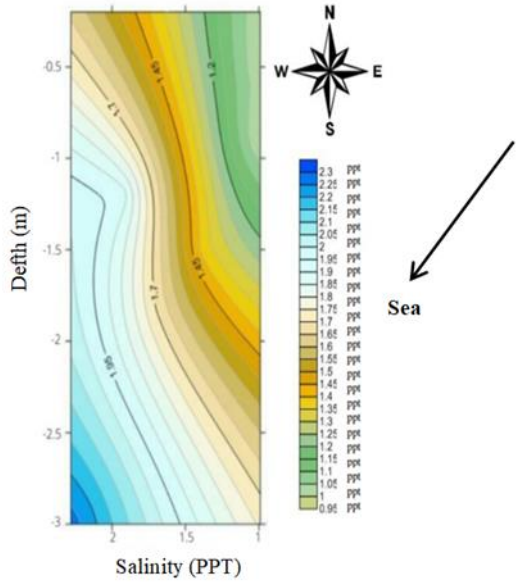

FIGURE 5. Salinity distribution of low tide conditions

The highest salinity is found near the mouth of the estuary. In the portion of the estuary that is located downstream, the salinity is 1.93 parts per thousand at a depth of 1.2 meters, while in the portion of the estuary that is located upstream, the salinity is 1.56 parts per thousand at a

depth of 1.56 meters can be seen in FIGURE 5. Because fresh water tends to float on top of seawater, which is heavier by salt content, the vertical line of salinity is generally lower at the top of the water column than the salinity at the bottom of the waters [14]. This is because the salinity of fresh water is lower than the salinity of seawater. This is in agreement with the information that was gathered, which indicated that the salinity of the water is often higher near the ocean floor.

Temperature

The surface waters upstream of the estuary, seen in blue, have an average temperature of 26.54 degrees Celsius, while the bottom waters at a depth of four meters at the mouth of the estuary, depicted in green, have an average temperature of 24.43 degrees Celsius. The temperature ranges greatly depending on the location. At a depth of 2.2 meters, the temperature in the part of the estuary that is further downstream is 24.89 degrees Celsius, while the temperature in the middle of the estuary, at a depth of 2.6 meters, is 25.57 degrees Celsius can be seen in FIGURE 6. The greater the depth of a body of water, the greater the likelihood that the temperature will remain relatively constant all the way to the bottom of the water [12]. This is in agreement with the data on temperature that was collected from the waters of the Air Manna Estuary, which have a tendency to be consistent with one another as a result of their shallow depth.

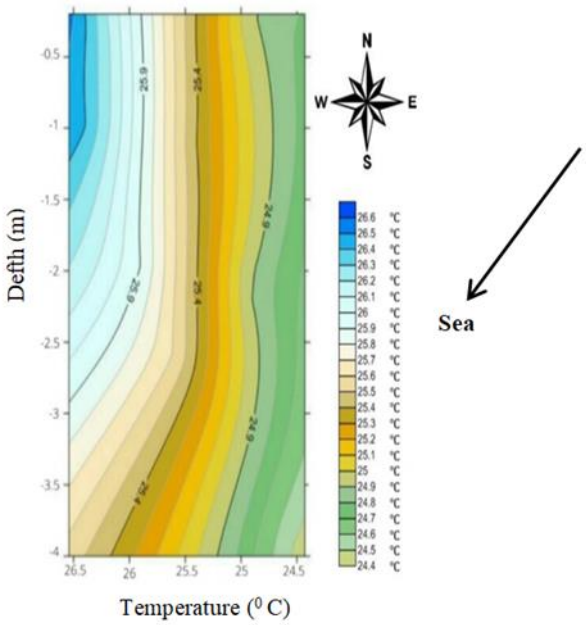

FIGURE 6. Temperature distribution of high tide conditions.

The surface waters upstream of the estuary, seen in blue, have an average temperature of 27.49 degrees Celsius, while the bottom waters at a depth of four meters near the mouth of the estuary, depicted in green, have an average temperature of 26.07 degrees Celsius. The greatest average temperature is found in the surface waters upstream of the estuary. At a depth of 1.2 meters, the temperature in the part of the estuary that is further downstream is 26.41 degrees

Celsius, while the temperature in the middle of the estuary is 26.68 degrees Celsius at a depth of 1.8 meters as shown by FIGURE 7. The temperature distribution in the waters of the Air Manna Estuarytends to be higher in value during low tide conditions. This is because the time of data collection is carried out during the day, and with a relatively shallower depth than at high tide, which allows the water to respond to the heating process more quickly. In addition, the reason for this is that the temperature distribution in the waters of the Air Manna Estuarytends to be higher in value during low tide conditions. Because the temperature will be higher, above 26 degrees Celsius, this indicates that the supply of dissolved oxygen will be higher; consequently, this will have an effect on the ability of biota to survive in these waters [15]. Because the river water discharge that enters the estuary has a tendency to be fairly high, the Air Manna Estuarywas classified as belonging to the group of brackish water when the research was carried out. As a result, the estuary's waters have a salinity that is extremely low, despite the fact that their temperature is rather high. Because of the high temperature, the amount of dissolved oxygen in these waters will also be high, which will have a beneficial impact on the ecosystem of the estuary.

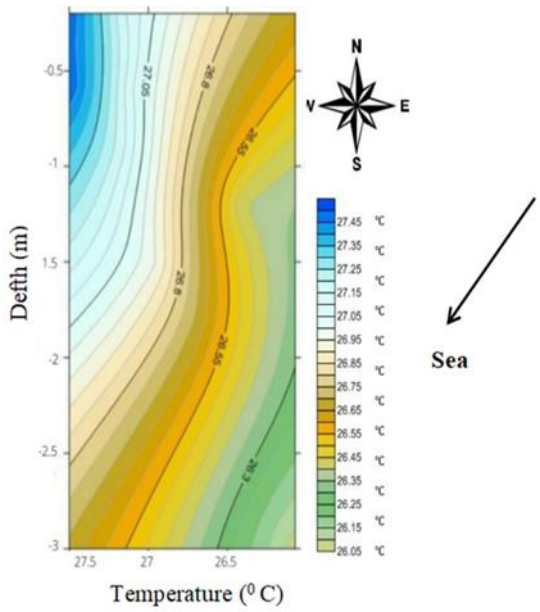

FIGURE 7. Temperature distribution at low tide.

Estuary Number and Mixing Type

The number of estuaries can be determined using the data received from field measurements, which consist of numerous different pieces of information. According to the findings of the analysis of the collected data, the average velocity of the flow on the measuring line d (which is located in the middle of the river) is 0.961 meters per second, whereas the average velocity of the stream at the mouth of the estuary is 1.318 meters per second. The value of the variable representing the average river depth is 2.692 meters, and the value representing the volume of river discharge at the moment of measurement is 432.52 meters per second. According to the findings of Meilestary's research in the year 2020, the highest elevation at high tide measured 1.28 meters, and the lowest elevation at high tide measured 0.15 meters.

According to the findings of the study, the length of the study area is 192.41 meters, its width is 52.95 meters, and the difference in height between the maximum elevation at high tide and the lowest elevation at high tide is 1.13 meters. These measurements were collected during the research process. According to the findings of the calculation, the value of the amount of sea water that is projected to enter the mouth of the estuary during high tide is 14112.95 meters. The tides have a period of 10.5 hours, according to the calculations done in the field. This result is very near to the equivalent value, which demonstrates that the semidiurnal type of tide occurs around every 12 hours and 24 minutes [16].

Calculations have been done to calculate the magnitude of the estuary number. The results show that the estuary number in the waters of the Air Manna Estuary, which is located in the South Bengkulu Regency, is 0.00019, while the volume ratio number obtained is 1158.46. Therefore, according to [17, 18,19], the features of an estuary that may be found in these waters are the characteristics of a salt wedge estuary, which is highly stratified, and has an estuary number classification of less than 0.005 while having a volume ratio number that is greater than 1.

The Air Manna Estuary, in accordance with the characteristics that were derived, has a river discharge that is comparatively larger than the tide. This is because the huge river discharge will carry a significant enough amount of sediment transport from upstream. The speed of the current slows down when it enters the estuary due to the mixing of currents coming in from the sea during high tide conditions. This allows sediments to settle more easily [19]. In addition to this, when the tide is high, there is a faster speed of current flowing from the ocean into the estuary, which transports sedimentary material from the ocean into the estuary. The current goes toward the sea when the tide is low, but because it is not moving at a very fast speed, it is unable to push sediments towards the sea and take them there [20]. Because of this circumstance, during one cycle of the tide, the amount of silt that is deposited in the Air Manna Estuaryis more than the amount that is removed. This condition causes deposition and sedimentation within the estuary. If this process continues unabated, it would eventually result in the formation of a delta, which will have the potential to interfere with the activities of local fisherman.

CONCLUSION

It is possible to draw the following conclusion from the findings of the study that was carried out the conditions of the tides have an effect on the characteristics of the physical oceanographic parameters in the Air Manna Estuary. The highest current speed at the mouth of the estuary is 2.6 m/s at low tide and 2.2 m/s at high tide, with the highest temperature in the upstream estuary of 27.49^{o}C towards the sea during high tide conditions. The low salinity in the middle of the estuary of 0.99 ppt increases towards the sea with a relatively smaller distribution of salinity at low tide. The Air Manna Estuary is a Salt wedge estuary, which has a well-stratified mixing pattern and an estuary number of 0.00019.

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