ORIGINAL ARTICLE

SEASONAL VARIABILITY OF DISSOLVED OXYGEN IN RELATION TO TEMPERATURE AND SALINITY IN GULF OF MEXICO, SOUTH OF COCODRIE, LOUISIANA

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ABSTRACT

Background: Dissolved Oxygen is the amount of free oxygen available for aquatic organisms. It is an important parameter in the determination of water quality in a particular environment. **Objective:** The main objective of the study was to assess the seasonal variability of dissolved oxygen with regards to temperature and salinity and to understand how change in coastal salinity can affect the level of dissolved oxygen in Gulf of Mexico. **Methods:** For the study, data were collected from Louisiana department of environment quality water data project on coastal Louisiana dissolved oxygen survey. The field data comprises of three replicate samples measurement recorded by a precalibrated multiparameter probe in the months of March, June, August and November 2015 making a total of twelve different samples. Field collected data was formatted to reflect only the relevant parameters using excel spreadsheet. The analyses of the data were done using excel software to calculate the average of temperature, salinity and dissolved oxygen for the four months and to generate line graph and column charts. Also, Pearson correlation coefficient was used to measure the strength of the association between the twelve data of temperature with dissolved oxygen and salinity with dissolved oxygen. **Results:** The Pearson correlation coefficient(r) calculated for the data of temperature and dissolved oxygen was -0.8929, which shows that there is a strong negative correlation between temperature and dissolved oxygen. The higher the temperature during summer season, the lower the dissolved oxygen. While the lower the temperatures during winter season the higher the dissolved oxygen. The salinity and dissolved oxygen Pearson correlation coefficient(r) calculated was 0.8784 depicting a strong positive correlation between these collected data. The higher the salinity value for winter season, the higher the dissolved oxygen and the lower the salinity during summer season the lower the dissolved oxygen. **Conclusion:** The water quality of Gulf of Mexico South of Cocodrie, Louisiana after field measurement analyses shows seasonal variability of winter season having higher value than the summer season. Although, pH, temperature, salinity and dissolved oxygen seasonal values were within the acceptable water quality standards, and the inverse correlation between temperature and dissolved oxygen values were consistent with documented literatures. Hence, the direct correlation between salinity and dissolved oxygen values of Gulf of Mexico should be reevaluated because an increase in salinity will definitely result in a decrease dissolved oxygen.

Keywords: *Dissolved Oxygen, Salinity, Temperature, pH and Gulf of Mexico*

1. INTRODUCTION

Dissolved Oxygen is the amount of free oxygen available for aquatic organisms. It is a measure of amount of free O_2 dissolved in the water [1]. It is an important parameter in the determination of water quality in a particular environment. Factors that affect the level of this chemical property of a water body includes sediment load, temperature, salinity, pressure, nutrient pollution, sewage effluent, turbulence, elevation, and aquatic vegetation. In Louisiana, the acceptable total maximum daily load for dissolved oxygen is 3mg/L and 5mg/L for summer and winter season respectively.

Temperature is a measure of how cold or warm a water body is can be affected by intensity of sunlight, overland flow and discharges. The aquatic life tolerance limit temperature is between 25-35°C. Salinity can be classified as oligohaline (0.5-5.0 ppt), mesohaline (5.0-18.0 ppt), or polyhaline (18.0 to 30.0 ppt), and euhaline (>30ppt) at the open sea and ocean [2]. Water salinity can be influenced by inflow of fresh water from rivers, rain and snow precipitation, and melting of ice. In this project, seasonal variability of dissolved oxygen in relation to temperature and salinity will be correlated to the empirical standard and acceptable values of water quality in Louisiana. Increased stress, decreased reproduction and survival rates are some of the negative effects of salinity level outside tolerance range [2].

In coastal Louisiana, dissolved Oxygen study was conducted between the months of March and November 2015 at Golf of Mexico South of Cocodrie, Louisiana. Project WQ2014001,Site 4555,Subsegment LA120806_00was located 13.8 miles south of Cocodrie, Louisiana, 1.7 miles southwest of Wine Island Pass [3] (Figure 1).

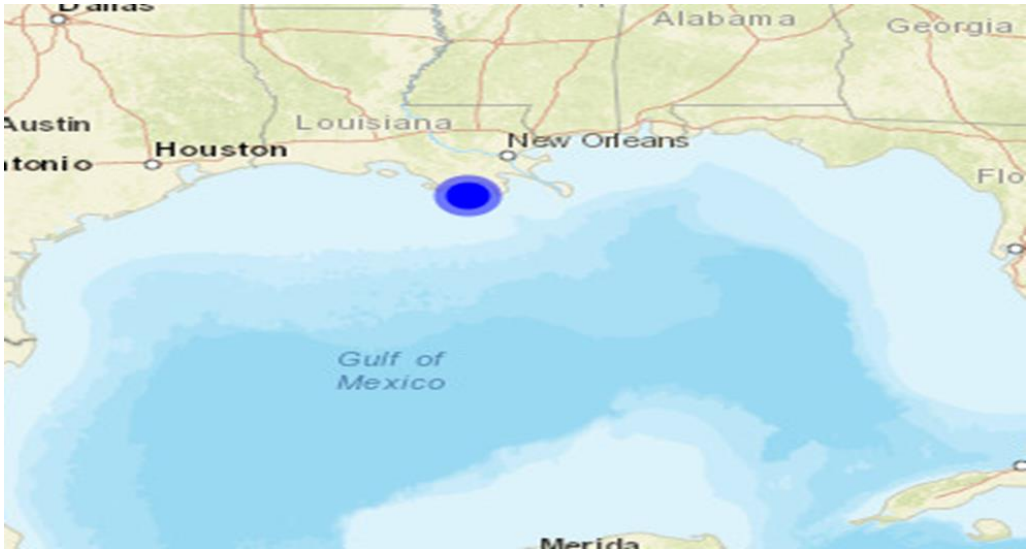

Figure 1: Project site located on Gulf of Mexico south of Cocodrie, LA (Source: Google maps)

The collected field data by Louisiana department of environmental quality from Golf of Mexico South Cocodrie measured the level of dissolved oxygen, temperature, pH and depth of water to determine the water quality [3]. An advantage of field measurement is that surface water quality tests can be carried out on fresh samples whose characteristics have not been contaminated or otherwise changed as a result of storage in a container. Labels that identify the time and place of sampling are highly unlikely to be lost during field analysis. Lastly, whenever there are no laboratories within a reasonable distance of the sampling stations, field analysis may be the only feasible way to obtain water quality information.

The main objective of the study was to assess the seasonal variability of dissolved oxygen with regards to temperature and salinity and to understand how change in coastal salinity can affect the level of dissolved oxygen in Gulf of Mexico.

2. METHODOLOGY

Data were collected from Louisiana department of environment quality water data project on coastal Louisiana dissolved oxygen survey. The field data comprises of three replicate samples measurement recorded by a precalibrated multiparameter probe in the months of March, June, August and November 2015to make total of twelve different samples. Each sample has a recorded value for temperature, salinity, pH, conductivity, and dissolved oxygen.
Field collected data was formatted to reflect only the relevant parameters using excel spreadsheet. The analyses of the data were done using excel software to calculate average of temperature, salinity and dissolved oxygen for the four months and to generate line graph and column charts. Also, the Pearson correlation coefficient was used to measure the strength of the association between the twelve data of temperature with dissolved oxygen and salinity with dissolved oxygen in table 1 using Equation 1.

$$r = \frac{\sum_i (x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum_i (x_i - \overline{x})^2}\sqrt{\sum_i (y_i - \overline{y})^2}}$$

(Equ.1)

Where the value r equals to one (r = 1) means a perfect positive correlation and the value r equals to negative one(r = -1) means a perfect negative correlation.

3. RESULTS AND DISCUSSIONS

The pH of the collected data is almost the same with less than 0.12 variations and an average of 8.28SU. The stream depth of the collected water sample was different within the different months with average of 3m, 3.5m, 3m and 2m for the month of March, June, August, and November respectively. The temperature average from the three replicate water samples were 15.48°C, 29.28°C, 31.73°C, and 16.14°C for the month of March, June, August and November respectively. Similarly, salinity average for the month of March, June, August and November were 37.89ppt, 18.99ppt, 20.51ppt, and

35ppt correspondingly. The average of dissolved oxygen for these months was 8.74 mg/l, 6.74 mg/l, 6.43 mg/l, and 7.77 mg/l as indicated by Tables 1 and 2 below.

The two bar charts presented the graphical correlation between the average value of temperature and dissolved oxygen as well as salinity and dissolved oxygen for the months of March, June, August, and November as shown by Figure 2 and 3 below. The relationship and effect of temperature and salinity on dissolved oxygen for the month of March, June, August and November 2015 is described by line graph of Figure 4.The Pearson correlation coefficient(r) calculated for data of temperature and dissolved oxygen in Table 1 is-0.8929, while the calculated salinity and dissolved oxygen (r)value is 0.8784.

Table 1: Showing the collected data from Gulf of Mexico, South Cocodrie, LA between March 2015 to Nov. 2015.

Collection Date	Collection Time	pH (SU)	Temp. (°C)	Dissolved Oxygen(mg/l)	Salinity(ppt)	Stream Depth(m)
2015-03-02	12:29:00	8.24	15.4	8.59	38.22	3
2015-03-02	12:30:00	8.25	15.49	8.79	37.89	3
2015-03-02	12:32:00	8.25	15.55	8.85	37.57	3
2015-06-19	09:20:00	8.26	29.04	6.2	20.13	3.5
2015-06-19	09:22:00	8.33	29.29	6.72	19.05	3.5
2015-06-19	09:23:00	8.39	29.51	7.32	17.79	3.5
2015-08-14	09:45:00	8.23	31.8	6	21.71	3
2015-08-14	09:48:00	8.33	31.75	6.61	19.99	3
2015-08-14	09:50:00	8.34	31.65	6.68	19.84	3
2015-11-24	09:59:00	8.21	16.14	7.75	35.17	2
2015-11-24	10:00:00	8.23	16.14	7.79	35.13	2
2015-11-24	10:01:00	8.24	16.13	7.78	35.12	2

Table 2: Showing the average values of Temp., Salinity and DO per month.

Month	Temp. (°C)	Salinity(ppt)	Dissolved Oxygen(mg/l)
March	15.48	37.89	8.74
June	29.28	18.99	6.74
August	31.73	20.51	6.43
November	16.14	35.14	7.77

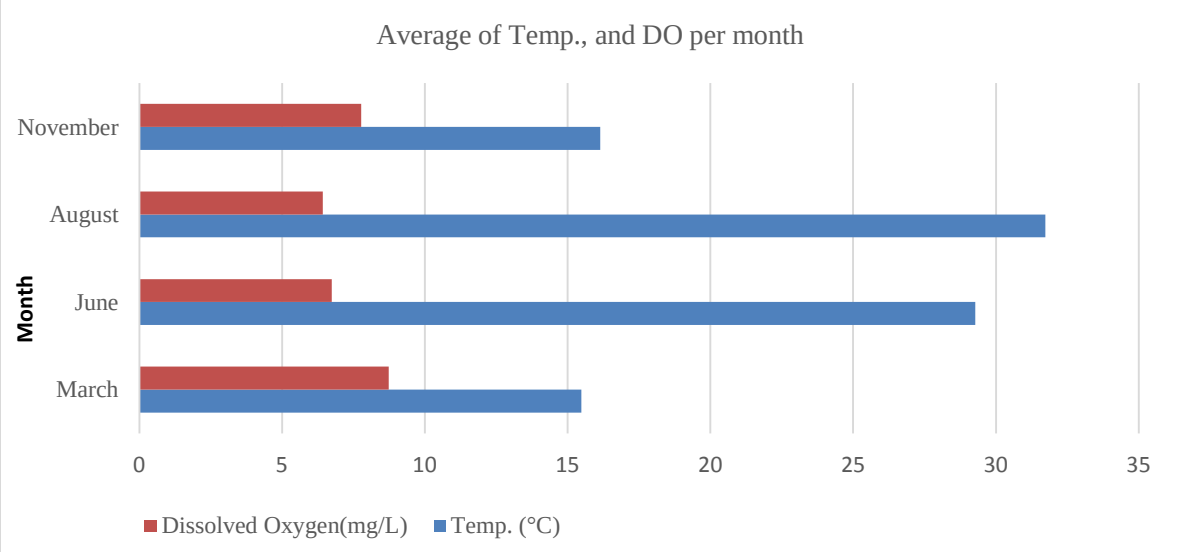

Figure 2: Showing the average of Temperature and Dissolved Oxygen per month

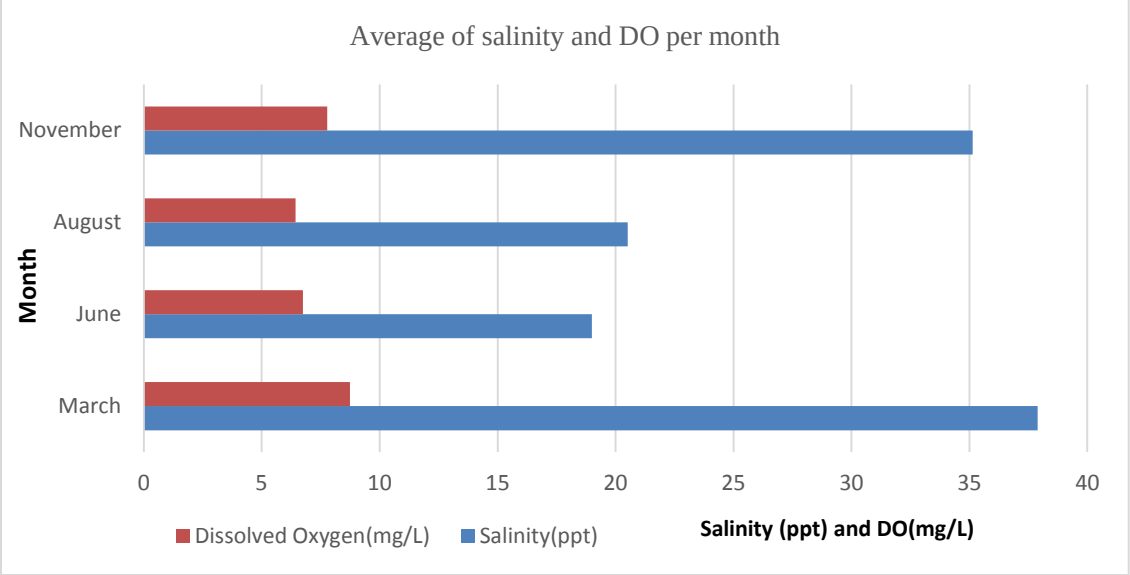

Figure 3: Showing the average of salinity and Dissolved oxygen per month.

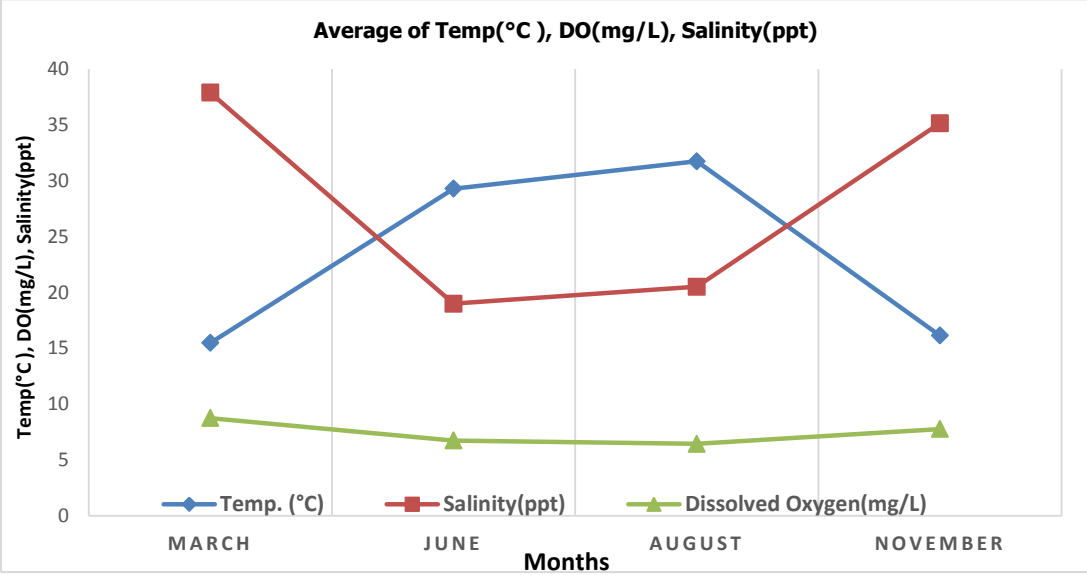

Figure 4: Showing the average values for Temp., Salinity and Dissolved Oxygen

The Gulf of Mexico South of Cocodrie water body is alkaline because pH value for the duration of data collection was almost the same for all seasons with an average value of 8.28(SU) which is within the acceptable standard value of 8.2(SU) for oceans. The stream depth data value of 2m in November was the lowest because of increased level of water table during winter season while highest depth of 3.5m was recorded for the month of June due to low water table during summer season. Dissolved oxygen average of 8.74 mg/l, 6.74 mg/l, 6.43 mg/l and 7.77 mg/l for the months of March, June, August and November of 2015 were above the Louisiana water quality standard value of 3 mg/l for summer and 5 mg/l for winter seasons making the water body safe for aquatic life, free from algae blum, excessive nutrient pollution and sediment load. Seasonal variability of winter season having a higher value of 8.74mg/l than the summer season value of 6.43mg/l for dissolved oxygen was supported by the field data measurement.

The average temperatures of this water body were 15.48°C, 29.28°C, 31.73°C and 16.14°C for the month of March, June, August, and November respectively, showing highest values for summer season and lowest value for winter season which may be due to increased sunlight intensity, reduced water table level and increased pollution during summer. Similarly, salinity average for the month of March, June, August and November are 37.89ppt, 18.99ppt, 20.51ppt, and 35ppt correspondingly. In the analyzed data, winter season has the highest salinity value compare to the summer season with lower values.

The Pearson correlation coefficient(r) calculated for the data of temperature and dissolved oxygen in Table 1 is -0.8929,which shows that there is a strong negative correlation between temperature and dissolved oxygen. The higher the temperature during summer season, the lower the dissolved oxygen. While the lower the temperature during winter season the higher the dissolved oxygen. This inversely proportional relationship is consistent with documented studies.
The salinity and dissolved oxygen Pearson correlation coefficient(r) calculated was 0.8784 depicting a strong positive correlation between these collected data. The higher the salinity value for winter season, the higher the dissolved oxygen and the lower the salinity during summer season the lower the dissolved oxygen. This direct proportionality of salinity and dissolved oxygen is not consistent with documented a literature [4], which states that the increase in salinity of a water body should cause a decrease in the level of dissolved oxygen.

4. CONCLUSION

The water quality of Gulf of Mexico South of Cocodrie, Louisiana after field measurement analyses shows seasonal variability of winter season having higher value than the summer season. Although, pH, temperature, salinity and dissolved oxygen seasonal values were within the acceptable water quality standards, and the inverse correlation between temperature and dissolved oxygen values were consistent with documented literatures. Hence, the direct correlation between salinity and dissolved oxygen values of Gulf of Mexico should be reevaluated because an increase in salinity will definitely result in a decrease dissolved oxygen.

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6. REFERENCES

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