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Assesment of dissolved oxygen in coastal waters of Benghazi, Libya

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Abstract

Study was conducted regularly from December 2008 till March 2009 in three habitats in Benghazi coast. The water parameters were taken into consideration and sampling was conducted on surface waters and 30 cm below in the coastal waters by using digital portable meters. Estimation of solid waste material present in the coast was taken to correlate the pollutants present in coastal waters and its influence on dissolved oxygen. A total of 106 samples are sampled and analyzed in three different habitats during December 2008 until March 2009. Caria 56 (52.83%) followed by Zilayana 31 (29.24%) and thirdly Sabre 19 (17.92%). The difference of sampling is because of varied reasons and the available facilities at the site of sampling. Table's 1-17 shows range, mean, standard deviation and coefficient of variance for parameters like water temperature, dissolved oxygen, salinity and pH. Finally, the pollutants in the beach are dominated by plastic in all the three habitats with 36.01% in Zilayana, 33. 47% in Caria and 54.20% in Sabre. Finally it is concluded from the studies that, dissolved oxygen levels will depend on physiochemical parameters, especially temperature, salinity and pH. In addition to that, presence of large amount of plastic and other disposals may pose a severe threat to coastal ecosystem in turn increasing the surface temperatures and over bloom in turn will have an impact on dissolved oxygen and pH.

Keywords: Dissolved oxygen (DO), salinity, temperature, pH, pollutants.

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Introduction

Dissolved oxygen (DO) is the amount of oxygen measured in milligrams or millimeters dissolved in one litre of water.

Oxygen is essential for the respiration of all life including most marine and estuarine organisms. The amount of oxygen available for marine life depends on various factors that affect the solubility of oxygen in marine water. The factor includes salinity, temperature, conductivity, atmospheric exchange, barometric pressure, currents, upwelling tides, biological processes i.e. respiration and photosynthesis (Davis 1975 b) sometimes dissolved oxygen levels in surface, and lower strata of shallow waters may be important in certain species of flora and fauna.

Oxygen levels are maximum in surface waters, particularly coastal waters. The surface water of marine and estuarine readily permits oxygen enrichment through atmospheric exchange, and sufficient light can penetrate surface waters to allow the oxygen-releasing process of photosynthesis to occur (CCME 1999). In the euphotic zone (where light intensity is sufficient to photosynthetic processes), photosynthesis may exceed respiration and there is net production of oxygen; below the euphotic zone, a net consumption of oxygen occurs (EOS 2003). When condition permit, oxygen super saturation is possible and can reach 130% (Davis 1975 a and Topping 1976).

In deeper waters, especially where light is scarce, oxygen is consumed by bacteria during decomposition of organic matter. In these cases, oxygen concentration can be reduced to negligible levels and lead to anoxic. The areas where there are significant low levels of dissolved oxygen are restricted circulation, abundant organic matter, industrial discharge, sewage etc. Oxygen depletion occurs in deep marine waters with thermal or salinity stratification occur (Levings 1980).

Monitoring dissolved oxygen will provide indication of water quality in coastal areas. Anoxic (no oxygen) and hypoxic (very low oxygen) events, and dissolved oxygen were used as a tool in ecosystem integrity and quality (NLWRA 2002). Dissolved oxygen depletion has shown lethal effects on physiological and behavioral changes in variety of organisms (Hughes and Ballintijin 1968). If prolonged changes occur in dissolved oxygen levels in coastal waters, modification can also be expected in the local biotic community structure. Species intolerant of depressed oxygen will either die or try to avoid the environment, while, tolerant species will survive in low dissolved oxygen levels. Wave dominated coastal system is more susceptible to stratification and associated low dissolved oxygen because of low tidal mixing.

Most aquatic animals need optimum oxygen to survive and with the exception of air, breathing animals will use oxygen dissolved in water. Dissolved oxygen levels and concentrations arise from the interaction between:

- Oxygen produced by photosynthesis
- Oxygen consumed by aerobic respiration, nitrification and chemical oxidation within the water environment
- Oxygen exchange with the atmosphere

Natural process and human pollution particularly organic matter may result in severe depletion of dissolved oxygen levels. Both anoxia (no oxygen) and hypoxia (very low oxygen) are harmful to flora and faunal components causing

- Harmful algal blooms associated with invasive species
- Animal kills
- Decrease in available habitat
- Rise in pathogens
- Restricted growth to flora and fauna

In addition to that, low dissolved oxygen levels can also result conditions within the sediments and may cause nutrients and toxicants to be released into the water column.

Further oceanic changes may lie ahead since the detection of rapid, abrupt climate change in Greenland ice cores (EOS 2004). During the later part of the 20th century, many estuaries, enclosed bays, continental shelves and enclosed seas around the world may experience significant reduction of dissolved oxygen concentration in bottom waters, creating what are commonly referred as "Dead Zones" (Boesch 2008).

The more or less synchronous development of coastal dead zones around the world are closely linked to increased outputs of nitrogen and phosphorous from human activities, including agriculture discharge, waste discharges and atmospheric deposition of nitrogen resulting from combustion fuels and run off from urbanization (Boesch 2002). As a result, that the longer the region suffers from regularly recurrent hypoxia the more the difficult to restore oxygen conditions in the dead zones back to life (Conley et al. 2007, Turner et al. 2008).

Effects of global warming are already being observed on both land and in ocean and will intensify during this century (IPCC 2007). Multiple climatic drivers that influence the formation of dead zones will be affected, including increased temperature, shift in rainfall pattern, sea level rise and changes in intensity of winds and storms. Changes in wind pattern have resulted in shift in ocean currents, and deep upwelling, causing hypoxia and mass mortalities in all along the coast of Oregon and Washington (Chen 2008).

Future projections and current warning signs of the effects of global warming should provide a sense of urgency in our efforts to keep coastal zones intact from coastal degradation.

Water parameters on the surface waters and 30 cm depth were collected and analyzed for physiochemical parameters in three different habitats by identifying the sediment type of bottom in the coastal waters.

Site I: Caria beach is selected for collecting the samples because of sandy belt. The sand is course to medium and sediment ranges from 0.5-1 mm based on sieve. The coast is dominated with dead Posedonia grass and let out of sewage drains in the northern tip of beach nearby amusement park. The beach is fine resort for human activity during late spring till late autumn season leaving lots of plastic and garbage left behind at the splash zone.

Site II: Zilayana beach is located in the heart of the city adjacent to Bunkina fish market and port. The beach is semi enclosed toward the west and most of the old structures of buildings are located adjacent to the beach. The coastline of Zilayana beach is coarse sand occasionally fine near west touching the mouth of creek, which is entering Bunkina fish market. The beach provides vantage point for angling and different varieties of garbage in the foreshore.

Site III: Sabre beach was selected for sampling because of rocky intertidal zone and has old history of all city sewage and slaughterhouse. Due to rapid urbanization of city, the major drains of sewage were abandoned long back and even slaughter site was shifted. The beach is wide open, the currents are strong, and pebbles and cobble dominate the intertidal belt.

Materials and Methods

Dissolved oxygen levels along with temperature, salinity and pH are measured frequently and regularly and two measurements are taken regularly

- During peak oxygen production (midday-early afternoon)
- At maximum respiration (pre-dawn) to approximate the diurnal range

Observations were made on upper strata of surface water (0-30cm) depth. The sample was collected by lowering the hand approximately 30 cms below and was water drawn by hypodermic syringe with a capacity of 200 ml; the sample of water was collected by using a PVC Niskin bottle. Temperature, pH, salinity and dissolved oxygen were calculated. The seawater pH was determined immediately after collection of seawater by using Digital pH meter (Hana). The pH meter was calibrated with multi-point known pH standards. The temperature was taken with the help of a standard water thermometer. The values were repeatedly with an error of 0.01 pH unit scale. Similarly, dissolved oxygen was calculated by using Hana dissolved oxygen HI 8043 digital potable instrument. Statistical analysis is carried out by using Microsoft Excel on the above parameters, mean, standard deviation and coefficient of variance were calculated.

In addition to the above parameters, studies are conducted on solid waste pollutants in splash zone in all the three habitats. A belt transect with 25 square meters x 25 square meters was laid randomly between splash zone and sub tidal zone. The non-bio degradable waste material were identified and sampled based on (Brower et al. 1997). The sampled was analyzed and presented with range, percentage frequency, mean and standard deviation.

Results

A total of 106 samples are sampled and analyzed in three different habitats during December 2008 till March 2009. Caria 56 (52.83%) followed by Zilayana 31(29.24%) and thirdly Sabre 19 (17.92%). The difference of sampling is because of varied reasons and the available facilities at the site of sampling and the mode of transport. The sample was randomly taken on surface waters and 30-centimeter deep waters at marginal waters near shore. Table 1 shows the Range, Mean, Standard deviation and Coefficient of variance of water parameters during December 2008. Benghazi has witnessed a shift in rainfall pattern and delayed season in turn lead to rise in atmospheric temperature and Ghibli. The surface waters showed temperature range between 19.8º - 21.3º C with mean 20.71 ± 0.05 the salinity was almost constant on surface waters with 37-37.6 ppt, its due to lack of precipitation during December 2008. Dissolved oxygen ranged between 8.4-8.8 with mean 8.58 ± 1.33 and pH varied from 7.5-7.9.

Table 2 shows the water parameters for the month of January 2009. The month of January has witnessed sudden change in weather pattern compared to December 2008. The temperature on surface waters ranged from 15.2º - 16.6ºC with mean 15.96 ± 0.52. The January has witnessed sparingly rainfall with decreased in ambient air temperature lead to sudden decrease in surface water temperatures. There is no significant change in salinity as compared to December 2008. There was rise in dissolved oxygen levels with 9.2-10.1 showing super saturation could be due to under water and surface currents along with high waves. The average means of dissolved oxygen 9.41 ± 0.38 and there was slight drop in pH because of fresh water addition on the top layer.

Table 3 shows the parameters for the month of February 2009. The February month being coldest and wettest month, there was significant change. The surface temperature of water ranged between 14.8- 15.8º C with average mean 15.03 ± 0.3 with salinity was dropping slightly and ranged between 36.1-36.8 ppt due to addition of fresh water from precipitation and run off from the city channels, which joins near the beach. Dissolved oxygen was high and showed super saturation with 9.6-10.4 with average mean 10.07 ± 0.28 all the sampled values showed high concentration of dissolved oxygen levels on surface waters with sunny sky intervals. pH was slightly neutral when compared to previous months.

Table 4 shows parameters for the month of March 2009 in Caria coastal waters. Due to subtle changes in climate in the month of March, the ambient surface water temperature was raising gradually with 18.2-18.4 ºC with average mean 18.30 ± 0.05 not significant changes in deviation within the samples. Salinity was becoming constant with 38-38.3 (average of Mediterranean Sea is 38 ppt). Dissolved oxygen levels falling to normal levels and occasionally low due to strong currents and Ghibli reducing the levels with 7.9-8.4 with average 8.20 ± 0.17 and pH was slightly changing and varying between 7.47-7.55 with not significant change in deviation within the samples.

Table 5 shows parameters of surface waters at rocky intertidal zone near sabre during the month of December 2008. A total of six samples were taken into consideration both at point and at non point sources. As we have mentioned earlier in the table 3 and 3.1 regarding the prolonged dry weather in Benghazi, the ambient surface water temperature ranged between 19.4-19.6º C with average mean temperature 19.25 ± 0.81. The dissolved showed vulnerability near point source of pollution during day and ranged between 7.5-8.5 with average mean 8.11 ± 0.36, Salinity was constant between 38-38.4 ppt a pH was above basic and ranged between 7.88-8.4 with average pH being 8.13 ± 0.18

Table 6 shows parameters of surface waters at rocky intertidal zone near sabre during the month of January 2009. Even though, the atmosphere temperature dropped considerably during January the surface temperature near discharge was slightly warmer compared to other sites. The ambient surface water temperature ranged between 15.6-17.1º C with average mean temperature of 16.30 ± 0.54. The dissolved oxygen levels were high because of strong currents, open sea, and ranged between 9.1-9.8 with average mean levels of dissolved oxygen was 9.45 ± 0.23. The salinity was slightly lower and ranged between 37.2-37.5 ppt and pH was basic with average 8.2 ± 0.18

Table 7 shows parameters of surface waters at rocky intertidal zone near sabre during the month of February 2009. The surface water temperature ranged 14.6-16 with average mean temperature 15.28 ± 0.5. Salinity was little lower than January but not significant change, whereas, dissolved oxygen levels showed similar to previous month with 8.7-9.5 with mean levels of 9.01 ± 0.26. pH was constant with no significant change.

Table 8 presents water parameters at Zilayana December 2008. The beach is partially enclosed due to port and extension of creek and runs into the city (Bunkina). The bottom of the coastal waters is sandy and dominated by heavy patch of Posedonia grass all along the coast. The surface temperature varied between 19.8-19.9º C almost constant through out the sampled period. The mean average temperature 19.45 ± 0.4. Salinity during the month of December is almost constant with 37.17 ± 0.17. The dissolved oxygen levels were normal with 8.5-8.9 with average mean levels of 8.76 ± 0.14. pH was constant because of currents, waves and tides and ions present in the water. The average was 8.15 ± 0.07.

Table 9 shows water parameters at Zilayana for the month of January 2008. The surface water temperature ranges between 15.6-16.1º C with average value 15.81 ± 0.16. Average salinity was 36.1 ± 0.1, whereas, dissolved oxygen were in normal limits not much significant change to the previous month in this habitat with 8.5-9.1 and average mean levels 8.8 ± 0.18.pH was constant with 8.11 ± 0.14.

Table10 shows surface water parameters at Zilayana for the month of February 2008. The surface water temperature ranges between 14.1-14.9º C with average mean temperature 14.42 ± 0.26. Salinity on surface waters was being constant with 36.93 ± 0.12. The dissolved oxygen levels showed super saturation because of addition of rainwater and currents. The dissolved oxygen levels were 9.1-10 mg/l with average levels 9.63 ± 0.25.pH was basic with 8.22 ± 0.09.

Table 11 shows water parameters at Zilayana for the month of March 2008. The month of March showed higher temperature and surface water temperature ranges between 18.8-20º C with average mean of 19.24 ± 0.46. Salinity was basic and constant with 37.88 ± 0.14. Due to higher temperature and presence of strong sunlight, dissolved oxygen levels ranges 9.8- 10.5 showing super saturation point with 10.24 ± 0.24. pH was basic with 8.22 ± 0.08

Table 12 shows solid waste items present all along the coast of Caria and it is presented with range of items maximum and minimum with mean, standard deviation and variance of each items. Caria beach is dominated with plastic covers with 5-27 per sample with 16 ± 8.80 followed by paper covers (includes soft cardboard boxes tetra pack) with 2-25 items per sample and average mean 12.8 ± 7.95 with a variance of 0.62. Thirdly, the beach is dominated with cans (soft drinks) 3-13 per sample with 7.4 ± 8.80 even though, wood, coal and iron are recorded in the beach, but the numbers are small. The beach is dominated with plastic material because of summer and autumn resort, the public leaves the food packets and drinks packs in the beach exposing them to environment, which in turn leads to beach pollution.

Table 13 shows solid waste items present all along the coast of Zilayana and it is presented with range of items maximum and minimum with mean, standard deviation and variance of each items. The Zilayana beach or coast has numbers of solid waste items, when compared to Caria. Nine items with Biodegradable and Non Biodegradable are recorded.

Plastic covers both fresh and old are present abundant with 21-66 items per sample with average mean of 44.8 ± 15.43 followed by paper(tetra pack) with 5-44 and mean of 23.4 ± 12.93. Plastic bottles ranging between 13-26 with average mean 19.8 ± 4.70 with variance of 0.23. The beach showed high variation in items with Rubber (tires) Fibre (carpet of different kinds, plant material etc) Cloth, Wood (logs), Cans etc. A total of nine items were recorded in beach with numbers being high.

Table 14 shows solid waste items present all along the coast of Sabre and it is presented with range of items maximum and minimum with mean, standard deviation and variance of each items. A total of five items were recorded during the study period, but sabre is known for point source of pollution from different sources. Plastic covers ranging from 8-17 with average mean 16.8 ± 10.51 with variance of 0.62 followed by Plastic bottles by Plastic bottles 0-12 with 6.6 ± 4.17 and thirdly, Cans with 2-14 per sample 6.4 ± 4.31. Fibre, cloth is present in small numbers.

Figure 1 shows percentage of garbage in Zilayana beach. Plastic covers with 36.01% are present in all the bouts. Paper (18.81%), Plastic bottles (15.91%), Cans (7.07%), Wood (5.46%), Cloth (4.98%) and least of Rubber (3.24%).

Figure 2 shows percentage of garbage in Caria beach during the study period. Plastic (33.47%), Paper covers (26.80%), Cans (15.48%), Plastic bottles (12.55%), Wood (6.27%) and least of Coal (1.35%) are recorded.

Figure 3 shows percentage of garbage in Sabre beach during the study period. Plastic cover (54.20%), Plastic bottles (21.30%) and thirdly Cans (20.64%) cloth and fibre are in small numbers.

Table 1. Range, mean and standard deviation for surface water in sandy coastal waters in December 2008.

Parameters	**Range**	**Mean ± SD**	**CV**
Temperature º C	19.8- 21.3	20.71± 0.5	0.02
Salinity (ppt)	37- 37.6	37.31± 0.2	0.005
Dissolved oxygen (mg/l)	8.4- 8.8	8.58± 1.3	0.15
pH	7.5- 7.9	7.73± 1.3	0.16

Table 2. Range, mean and standard deviation for surface water in sandy coastal waters in January 2009.

Parameters	**Range**	**Mean ± SD**	**CV**
Temperature º C	15.2 – 16.6	15.96 ± 0.5	0.03
Salinity (ppt)	37.1- 37.66	37.29 ± 0.2	0.005
Dissolved oxygen (mg/l)	9.2 – 10.1	9.41 ± 0.3	0.03
pH	7.1- 7.8	7.43 ± 0.2	0.02

Table 3. Range, mean and standard deviation for surface water in sandy coastal waters in February 2009.

Parameters	Range	Mean ± SD	CV
Temperature º C	14.8 – 15.8	15.05 ± 0.3	0.01
Salinity (ppt)	36.1- 36.8	36.55 ± 0.2	0.005
Dissolved oxygen (mg/l)	9.6 – 10.4	10.07 ± 0.2	0.01
pH	7.2- 7.6	7.43 ± 0.1	0.01

Table 4. Range, mean and standard deviation for surface water in sandy coastal waters in March 2009.

Parameters	Range	Mean ± SD	CV
Temperature º C	18.2 – 18.4	18.3 ± 0.05	0.002
Salinity (ppt)	38- 38.3	38.11 ± 0.1	0.002
Dissolved oxygen (mg/l)	7.9 – 8.4	8.2 ± 0.1	0.01
pH	7.47- 7.55	7.5 ± 0.02	0.002

Table 5. Mean and standard deviation near point source pollution in sabre during the month of December 2008.

Parameters	Range	Mean ± SD	CV
Temperature º C	19.4-19.6	19.25 ± 0.81	0.04
Salinity (ppt)	38- 38.4	38.18 ± 0.12	0.003
Dissolved oxygen (mg/l)	7.5 – 8.5	8.11 ± 0.36	0.04
pH	7.88- 8.4	8.13 ± 0.18	0.02

Table 6. Mean and standard deviation near point source pollution in sabre during the month of January 2009.

Parameters	Range	Mean ± SD	CV
Temperature º C	15.6-17.1	16.30 ± 0.54	0.03
Salinity (ppt)	37.2- 37.5	37.30 ± 0.11	0.002
Dissolved oxygen (mg/l)	9.1 – 9.8	9.45 ± 0.23	0.02
pH	7.9- 8.5	8.2 ± 0.18	0.02

Table 7. Mean and standard deviation near point source pollution in sabre during the month of February 2009.

Parameters	Range	Mean ± SD	CV
Temperature º C	14.6-16	15.28 ± 0.5	0.03
Salinity (ppt)	36.4- 36.6	36.5 ± 0.07	0.001
Dissolved oxygen (mg/l)	8.7 – 9.5	9.01 ± 0.26	0.02
pH	7.8- 8.2	7.91 ± 0.16	0.02

Table 8. Mean and standard deviation in partially enclosed beach Zilayana during the month of December 2008.

Parameters	**Range**	**Mean ± SD**	**CV**
Temperature º C	19.8 – 19.9	19.45 ± 0.4	0.02
Salinity (ppt)	37- 37.5	37.17 ± 0.17	0.004
Dissolved oxygen (mg/l)	8.5 – 8.9	8.76 ± 0.14	0.01
pH	8 - 8.2	8.15 ± 0.07	0.008

Table 9. Mean and standard deviation in partially enclosed beach Zilayana during the month of January 2009.

Parameters	**Range**	**Mean ± SD**	**CV**
Temperature º C	15.6 – 16.1	15.81 ± 0.16	0.01
Salinity (ppt)	36- 36.3	36.1 ± 0.1	0.002
Dissolved oxygen (mg/l)	8.5 – 9.1	8.8 ± 0.18	0.02
pH	7.9- 8.3	8.11 ± 0.14	0.01

Table 10. Mean and standard deviation in partially enclosed beach Zilayana during the month of February 2009.

Parameters	**Range**	**Mean ± SD**	**CV**
Temperature º C	14.1 – 14.9	14.42± 0.26	0.01
Salinity (ppt)	36.8- 37.1	36.93 ± 0.12	0.003
Dissolved oxygen (mg/l)	9.1 – 10	9.63 ± 0.25	0.02
pH	8.1- 8.3	8.22 ± 0.09	0.01

Table 11. Mean and standard deviation in partially enclosed beach Zilayana during the month of March 2009.

Parameters	**Range**	**Mean ± SD**	**CV**
Temperature º C	18.8 – 20	19.24± 0.46	0.02
Salinity (ppt)	37.6- 38	37.88 ± 0.14	0.003
Dissolved oxygen (mg/l)	9.8 – 10.5	10.24 ± 0.24	0.02
pH	8.1- 8.3	8.22 ± 0.08	0.009

Table 12. Solid waste disposal at Caria beach with Mean, Range and Standard deviation.

Serial	**Item**	**Range**	**Mean ± SD**	**CV**
1	Plastic cover	5-27	16 ± 8.80	0.55
2	Cans	3-13	7.4 ± 3.87	0.52
3	Plastic bottles	3-15	6 ± 4.64	0.77
4	Wood	0-10	3 ± 3.68	1.22
5	Coal	0-2	0.6 ± 0.8	1.33
6	Iron	0-6	2 ± 2.09	1.04
7	Paper covers	2-25	12.8 ± 7.95	0.62

Table 13. Solid waste disposal at semi open Zilayana beach with Mean, Range and Standard deviation.

Serial	Item	Range	Mean ± SD	CV
1	Plastic cover	21-66	44.8 ± 15.43	0.34
2	Cans	3-17	8.8 ± 4.91	0.55
3	Plastic bottles	13-26	19.8 ± 4.70	0.23
4	Wood	0-22	6.8 ± 8.05	1.18
5	Iron	1-11	5.4 ± 4.63	0.85
6	Paper	5-44	23.4 ± 12.93	0.55
7	Fibre	0-11	5.2 ± 3.65	0.70
8	Cloth	0-13	6.2 ± 5.03	0.81
9	Rubber	1-8	4 ± 2.36	0.59

Table 14. Solid waste disposal at Sabre rocky beach with Mean, Range and Standard deviation.

Serial	Item	Range	Mean± SD	CV
1	Plastic cover	5-35	16.8 ± 10.51	0.62
2	Plastic bottles	0-12	6.6 ± 4.17	0.63
3	Fibre	0-1	0.6 ± 0.48	0.8
4	Cloth	0-2	0.6 ± 0.8	1.33
5	Cans	2-14	6.4 ± 4.31	0.67

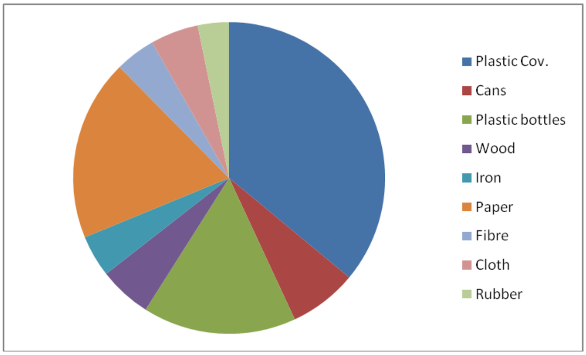

Figure 1. Pie chart shows solid waste disposal at Zilayana semi-enclosed beach.

Plastic cover: 36.01%, Cans: 7.07%, Plastic bottles: 15.91%, Wood: 5.46%, Iron: 4.34%, Paper: 18.81%, Fibre: 4.18%, Cloth: 4.98%, Rubber: 3.24%

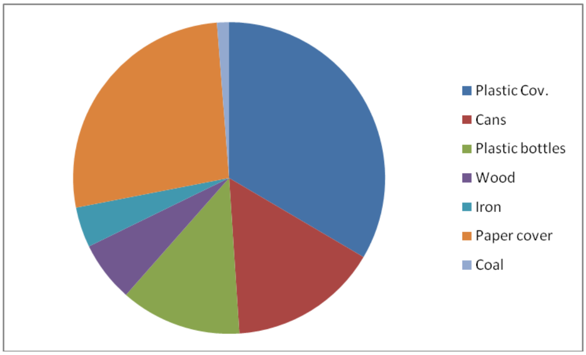

Figure 2. Pie chart shows solid waste disposal at Caria sandy beach.

Plastic cover: 33.47%, Cans: 15.48%, Plastic bottles: 12.55%, Wood: 6.27%, Coal: 1.25%, Iron: 4.18%, Paper covers: 26.80%

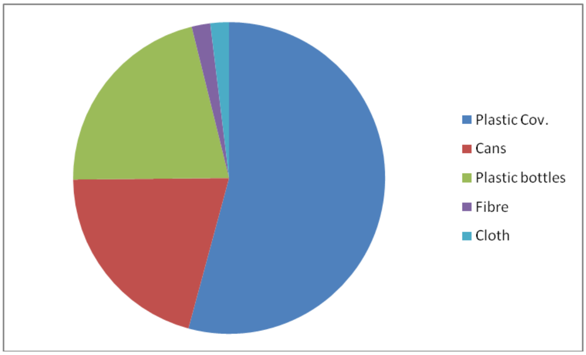

Figure 3. Pie chart shows solid waste disposal at Sabre rocky beach.

Plastic covers: 54.20%, Plastic bottles: 21.30%, Fibre: 1.93%, Cloth: 1.93%, Cans: 20.64%

Discussion

In recent years, there has been much emphasis on better understanding the physiochemical parameters of coastal marine waters especially variability that effect the basic biology, physiology and ecology of many benthic and pelagic organisms. During last decade many estuaries, rivers, coastal marine waters have witnessed a significant tilt and reduction of dissolved oxygen levels especially bottom waters in the sub tidal zone. The areas where there hypoxia it is termed as "Dead Zones" (Boesch 2008).

Given their global importance, coastal marine environment are a major focus of concern regarding the potential impacts of anthropogenic climate change. Prolonged oxygen depletion in the coastal marine waters may cause mass mortalities of marine organisms (Diaz and Rosenberg 1995). Earlier the studies in Bunkina showed similar phenomenon regarding the mass mortality (Joel et al. 2009). Other major problems, the consequences of coastal commercial fishing may be disastrous (Baden et al. 1990). In addition to that more addition of nutrients with minimum levels of underwater currents could lead to oxygen depletion and broad scale degradation of marine environment. Our report and studies in Zilayana semi enclosed beach could have a negative impact of these associated changes (see table). Our results will confirm with (Kuwae et al. 2006). Oxygen depletion can be seen on surface waters often starts with dead surface bloom.

Another important factor for reduction of dissolved oxygen levels in coastal waters during winter is turbulence from high winds that often seen during winters in coastal waters of Benghazi, is high winds that mix with water column reduces the strength of the stratification during winters. Another limiting factor is light, which reduces the production of phytoplankton causing fluctuations of oxygen levels in both upper strata and lower strata. From the results, this phenomenon is evident in semi-enclosed sea (see plate). Coastal systems in the world are evident and have been subjected to the above dynamic and associated changes. Our studies also confirms with (Howarth et al. 1996).

Many coastal system have natural propensity for oxygen depletion depending on the bottom sediments, clayey dominated coastal zone are more prone for oxygen depletion because of plasticity and functions of marine sediments. From the results (Tables 3-3.15), the coast of Benghazi has varied habitat the fluctuation of oxygen levels may be directly related to change in water temperature, which will have indirect affect on salinity and pH there by reducing the physiochemical parameters. Our observation and results confirms with the studies of (Norling et al. 2007).

The dissolved oxygen levels in the littoral and sub-littoral zone could have an impact on demersal and benthic communities in the upwelling zones, which could likely to intensify stress in the coastal waters. The catches in the trawl are negligible, when bottom dissolved oxygen levels fails below 2 mg/l. Neuston and Epifauna tends to migrate from the coastal shelf into upper column of water. At this juncture, mass mortalities are likely, due to drop in dissolved oxygen, increase of nutrients, rise in water temperature, increase in pH and salinity. All these combined factors could deplete or worsen the situation could lead to catastrophic disaster. Joel et al. (2009) reported similar conditions in lesser-known creek in Benghazi and confirms with the studies of (Boesch 2008)

Influence of physical environment on dissolved oxygen

Anthropogenically induced climate change has profound implications on marine coastal waters and the economic and social system that depend on them (Harley et al. 2006). The relationship between dissolved oxygen levels and physical environment is well understood and climate related research has emphasized on both abiotic and biotic changes in the marine waters. It will be more complex in the years to come, mainly because of rapid fluctuations in the temperature and added to the changes greenhouse gas effects will play a pivotal role in the years to come.

Water temperatures along with the salinity, is one of the most important physical factors affecting the marine organisms. The ionization constant, surface tension and latent heat of vaporization decrease in a linear fashion as temperature is raised. The viscosity, compressibility, specific heat of water all decrease nonlinearly with increase in temperature. Thermal conductivity (pH), vapor pressure, speed of sound in seawater, its electrical conductivity (ion concentration) will increase as temperature increases. The solubility of gases especially dissolved oxygen levels in contrast decrease as water temperatures rise. Once the oxygen levels attains super saturation mode there will be shift in oxygen levels as it vaporization rises abundantly making the surface waters back to normal as the day progresses See Tables). Our study regarding the vaporization of super saturated oxygen on surface waters confirms with the observation of (Rosenberg et al. 2002 and Kaplan et al. 2003).

Temperatures especially physical environment may affect chemical and biological processes. As a result, biological process such as photosynthesis by plankton and respiration rates, uptake of toxic substances in the coastal waters could decrease behavioral pattern of organisms, which could have direct impact on dissolved oxygen levels leading to decline in population, increase of invasive species especially certain zooplankton, which has been recorded in Zilayana during turbulence conditions of the sea. Our results confirms with the studies of (Aiken and Waddy 1990).

Many species of organisms can adjust to various factors of driving and non- driving variable, which makes species to adjust to new environment or even displace their habitat. The effects of extremely harsh physical environment especially variable like temperatures include insufficient supply of oxygen levels; failures in process of integration, desiccation (intertidal organisms) may lead to catastrophic events in the population structure and redistribution.

When compared to global warming and sea level raise the impacts of chemical changes in the marine water. The pH of seawater relatively remains constant because of the buffering action of the carbon dioxide in water. If seawater become to alkaline or basic by releasing hydrogen ions and decreasing pH and vice versa. However, the reduction in pH accompany increase of carbon dioxide in surface waters may hamper levels of dissolved oxygen levels could be due to limiting factor of light intensity and increase of nutrients from the phytoplankton could increase the turbidity will have an negative affect on dissolved oxygen levels. Through out the studies, pH remains to relatively constant when compared to water temperature and dissolved oxygen levels.

Dissolved oxygen is controlled by range of process. Firstly, Oxygen produced in surface waters by biological production and it is removed or depleted due to respiration or by sinking organic matter (biological pump). Secondly, Air-sea gas exchange equilibrium, where oxygen is transported to deep sea for circulation the overall partitioning of oxygen between ocean and atmosphere and are sensitive to ocean circulation (surface currents, waves and Pycnocline) where, temperature and salinity determines the oxygen solubility.

In marine ecosystem, slight changes in environmental variables could lead to upwelling strength, ultraviolet radiation; pollution could diminish the wetlands, which are associated with coastal waters and nursery sites (Chen 2008). The dissolved oxygen levels is influenced not only by physical transport, but also by mineralization of organic matter (dead bloom) will play a key factor on semi-enclosed sea or calmer seas where there is little action of waves.

Impact of pollution on dissolved oxygen

Major pollutants in Benghazi coastal zones comes either from dredged material, different kinds of solid waste and human interference. Benghazi coastline subjected dynamic changes due to rapid urbanization and heavy influence of multi national companies. All of them either pollute Benghazi either by point source or non- point source pollution.

It is evident from the results, the three habitats, which have studied showed different kinds of garbage and trash depending on season and month. In addition to that, land based or sea based activities and from both point sources, such as industrial discharge, oil spill incidents, domestic sewage and non point source pollution like agricultural run off nearby coast can affect water quality, marine sediment condition particularly pelagic and benthic animals. The maximum affect will be on sessile organisms, which live in intertidal zone.

During the study period, Zilayana coast is subjected to various kinds of garbage (land filling) especially adding of new kinds of garbage based on age and freshness of the garbage. The plastic covers, which are left in the beach during summer and autumn season are pushed by runoff water from the city during winter rains and slowly pushed by long shore currents during winter, slowly settles at the coastal zones. Due to turbulence of water, the plastic covers which life expectancy around 350 years to desiccate will stop the regular cycles in coastal water zones by reducing oxygen thereby increasing carbon dioxide, ammonia, nitrates will increase the water temperatures in turn reducing dissolved oxygen levels. The plankton is subjected to hypoxia with minimum sunlight, will affect the photosynthesis causing dead bloom.

This phenomenon during harsh winters and summer will reduce dissolved oxygen levels and the coastal zone is subjected to change. Our study also confirms with (Hays et al. 2005) studied extensively on marine plankton and climate change.

In Zilayana, it is not only plastic is posing threat to ecosystem, furniture material, carpets; fibers from different sources, rubber are major concern for depletion of dissolved oxygen levels. This factor is evident during high turbulent sea waves, where mixing of water column shows dark brown water near the coast (Figure 3-3.2). At this period, the water sample showed wide varieties of tolerant species (plates). If this phenomenon of dumping of garbage at the Zilayana coast continues, it will pose threat to different kinds of organisms and even to human who venture into sea for swimming during hot and humid months.

Along with these associated changes on upper surface waters, presence of high organic content in creek, oil coated surface waters nearby fish market (spills from boat) and finally garbage disposal may increase high levels of carbon dioxide, high levels of soil nitrate and ammonia may induce negative impact on the organisms in the littoral zone. Similar studies were also studied in Aqaba Gulf coastal waters, where minor changes in water variables (water temperature, salinity, pH and DO) reveal that absence of high population could be the factor for minimal changes (Halim et al. 2007).

Finally, it is clear from the results, the garbage near the shore waters will have negative impact on ecosystem followed by addition of pollutants from point source or non point source can affect the quality of coastal waters especially depletion of dissolved oxygen concentration.

It is concluded from the studies that, dissolved oxygen levels will depend on physiochemical parameters, especially temperature, salinity and pH. Recent years due to greenhouse gas emissions added to that, global warming, raise in sea level could play the negative impact on water parameters. The results showed some areas in the coastal zone are susceptible for subtle variations in the environmental factors, especially fluctuation of dissolved oxygen levels. The presence of large amount of plastic and other disposals may pose a severe threat to coastal ecosystem in turn increasing the surface temperatures; over bloom in turn will have an impact on dissolved oxygen and pH.

Due to lack of significant tides in the Mediterranean Sea, the intermixing zones are very restricted and the phenomenon around salinity and pH are very intense and localized to certain zone could lead depletion of dissolved oxygen. Another notable point to remember is Climate-change induced warming (inter-annual patterns such as ENSO, inter decadal oscillations). Together with anthropogenic climatic forcing greenhouse gas predominatly, CO_2 emissions increases in global mean temperatures will result in cascade of physical and chemical changes in coastal zone in marine system.

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