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Introduction

Many elements that occur in low concentration in the Earth's crust are now mined extensively for use. Large quantities of different kinds of elements are discharged into the environment as contaminants each year by human activities. Contamination of heavy metals in the aquatic environment has attracted global attention owing to its abundance, persistence and environmental toxicity (Ali et al., 2016). Both anthropogenic and natural activities are responsible for the abundance of heavy metals in the environment (Ahmed et al., 2015). Sediments provide a temporally indication of the aquatic environment condition and act as a major reservoir for metals, though some sediment can also act as a source of contaminants (Rahman et al., 2013). Besides, heavy metal concentration in aquatic environments is a critical concern, due to toxicity of metal and their accumulation in aquatic habitats. Furthermore, heavy metals, in contrast to most pollutants, are not biodegradable and they undergo a global ecological cycle in which natural waters are the main pathways. A large part of the heavy metal input ultimately accumulates in the estuarine zone and continental shelf, since these areas are important sinks for suspended marine and associated land-derived contaminants (Reddy et al., 2007). Heavy metals have contaminated the aquatic environment in the present century due to intense industrialization and urbanization (Barua et al., 2011). Heavy metals introduced into the environment by dumping domestic and municipal wastes, industrial effluents, urban runoff, agricultural runoff, atmospheric deposition and mining activities as well as upstream runoff are absorbed on the depositions and incorporated into the marine sediments.

A large part of the heavy metal input ultimately accumulates in the estuarine zone and continental shelf. The bioavailability of heavy metals may widely depend on sediment characteristics, water chemistry, hydrographic and biological factors, etc. The increasing pollution by heavy metals have a significant adverse health effects for invertebrates, fish and humans (Khan et al., 2014). The effect of toxic metals on marine biota like fish, mollusks, coelenterate, crustaceans, birds and benthic organisms are increasing with an alarming rate (Table 1). Moreover, sediments act as indicators of the burden of heavy metals in a coastal environment, as they are the principal reservoir for heavy metals (Mohiuddin et al., 2011). Sediments are the sources of organic and inorganic matter in the river, estuaries, oceans and the other water supply systems. Aquatic organisms living in the sediments accumulate heavy metal to a varying degree (Siddique et al., 2012).

Table 1
Effects of Toxic Metals on Marine Biota

Pollutants	Organisms	Effects
Heavy metals	Fish	• At 1 μg-cd/1 earlier hatching occurs • Increase mortality • Reduction body defense system
	Coelenterates	• At 1 μg-cd/1 ctenophores loss growth and survivality • Irregular cell division
	Mollusk	• At 5 μg-cd/1 Crassorstrea virginia gets slightly delayed development • Delayed the maturation system
	Crustaceans	• Increase mortality and delay development • Effects occurs on the shell development • Irregular cell division
	Sea birds	• Mortality increase • Reduction body defense • Retardation of growth • Loss of breeding capacity • Reduction of shell thickness of eggs
	Benthos	• Irregular structure • Acute toxic condition at the bottom • Retardation of growth

Source: Barua et al., 2011

Shipbreaking is the process of ship disposal that involves breaking up ships for scrap recycling, with the hulls being discarded in ship graveyards (Abdullah et al., 2010) and valuable materials such as steel and wood being recovered for reuse or recycling purposes (Reddy et al., 2007). Shipbreaking is a challenging process, due to the structural complexity of ships and the many environmental, safety and health hazards involved (Hossain and Islam, 2006). The history of shipbreaking is as nearly old as ship building. There are approximately 45,000 ships in the world's seawaters (FIDH, 2002). After 25-30 years, the cost of re-investment to acquire this certificate is no longer profitable. As a result, about 700 ships (15-25 million deadweight tons) are sold every year to one of the Asian scrap yards. Most shipbreaking yards are now operating in the South Asian countries due to lower labor costs and less stringent environmental regulations dealing with the disposal of lead paint and other toxic substances. Today, 90 percent of that work is carried out in India, Bangladesh and Pakistan. Ninety percent of the demand for iron and steel within Bangladesh is met by the shipbreaking industry (Ronning, 2000). It is estimated that over 100,000 workers are employed at shipbreaking yards worldwide. Bangladesh holds second position after India in terms of volume of recycling (FIDH, 2002). According to the statistics of NGO Platform on Shipbreaking, 768 ships dismantled worldwide during where Bangladesh and India broke the same amount of 194 ships in 2015. On the other hand, 826 ships scraped worldwide where India broke the large number of scraped ship but Bangladesh broke most in terms of Gas Tanker, indicating that it was the preferred destination for the larger vessel. This data of increased number of large vessel continue in favour of Bangladesh over the 5 years (NGOSP, 2017). For the last 20 years, more than 400 workers have been killed and 6,000 were seriously injured (Muhibbullah, 2013).

The marine environment of the coastal water is vital to mankind on a global as well as local basis concerning energy for Bangladesh. The Bay of Bengal, which is a potential bode of marine life as well as for its vast coastal communities is now continually polluted by different types of pollutant through the influx of the land base and other sources and put an alarming signal of awareness about pollution in the sea. Bangladesh is a young developing country. She bore in 1971 after a long, bloody and the pathetic liberation war. After the independence of the country, Bangladesh Government has taken various types of development project for national being, such like the industrial revolution. But unfortunately for the lack of proper knowledge to conserve the environment, at present, the marine and estuarine ecosystem of the Bay of Bengal is threatened by different types of pollutants dumped directly into the ecosystem or washed down through a large number of rivers and tributaries (Hossain et al., 2016). The major sources of marine pollution in the Bay of Bengal are industrial wastes, municipal wastes, agro-chemical wastes and oil pollution (Table 2).

Such a way, shipbreaking industry is the significant causes of marine pollution in Bangladesh but it is one of the prosperous sectors for the country that provided a huge employment opportunity and supplies steel materials. Shipbreaking yards along the coast of Chittagong confined in an area of 10 km has become a paramount importance in the macro and micro-economic context of poverty stricken Bangladesh. Shipbreaking activities offer direct employment opportunities for about 25,000 people. Moreover about 200,000 are also engaged in different business related to shipbreaking activities in Bangladesh (YPSA, 2005).

Oceangoing vessel is a mini version of a city and during scrapping discharges every kind of pollutants a metropolis can generate like liquid, metal, gaseous and solid pollutants. The shipbreaking activities contaminate the coastal soil and sea water environment and thus impair ecological settings. So shipbreaking activities became perilous in respect of environment, human health and biodiversity. The present paper aims to assess the concentration of 9 heavy metals (Fe, Mn, Cr, Ni, Zn, Pb, Cu, Cd and Hg) in the core sediments and its impact on macrobenthic fauna of shipbreaking area and non-shipbreaking area of Chittagong coastal area.

Table 2
Showing Substance and Point of Discharge

Type	Source	Pollutants	Where discharged
Liquid	Oil	Oil tanker, bilge oil, fuel oil, ballast water, direct dumping	Inter-tidal zone
	Lubricant	Oil tanker	
	Grease, H_2SO_4, TBT	Oil tanker, anti fouling agents in painting, engine oil	
Metals	Mercury	Batteries	On water body and the beach
	Lead	Batteries	
	Arsenic	Ballast water	
	Chromium	Ballast water	
	Copper	Electric wire, cathode protector	
	Iron	Body of the ships	
Gaseous	CO_2, CO, SO_2, Cl_2, NH_2, Acid fumes, Iso-cyanide	Burning of electric wires and crude oil	Atmosphere
Solid	PVC, Plastic materials	Body of the scrapped ships	Some are sold and the rests are thrown onto the beach

Source : Barua et al., 2011

Materials and Methods

The study of geomorphology and the physical environmental conditions of the Fauzderhat coastal area belong to south-eastern coastal area of Bangladesh considered as utmost important as the area is facing a great challenge as well as pressure on environmental view point due to various developmental activities including shipbreaking activity. Naturally, Fauzderhat coast offered many advantages such as long uniform inter-tidal zone, tidal difference of about 6 meters, more or less stable weather conditions, low labour costs, some existing transport facilities (connected to the capital Dhaka by road and railway) making the site a suitable ground for shipbreaking.

Site Selection for the Experiment

The shipbreaking areas from Bhatiari to Kumira of Sitakunda sub-district belong to Chittagong coast extending about 10 km and the eastern side of Sandwip island has been selected as the study area considering Bhatiary-Kumira as the most affected site and Shiberhat to Guptachara ghat of the eastern side of Sandwip as the control site (Figure 1). Shipbreaking area is laying along the Dhaka-

Chittagong highway and 10 km away from the Chittagong city. The eastern site of Sandwip has been considered as the control site because these are diagonally opposite and off the SBYs and the water and soil qualities are apparently frees from pollutants as revealed from the earlier studies.

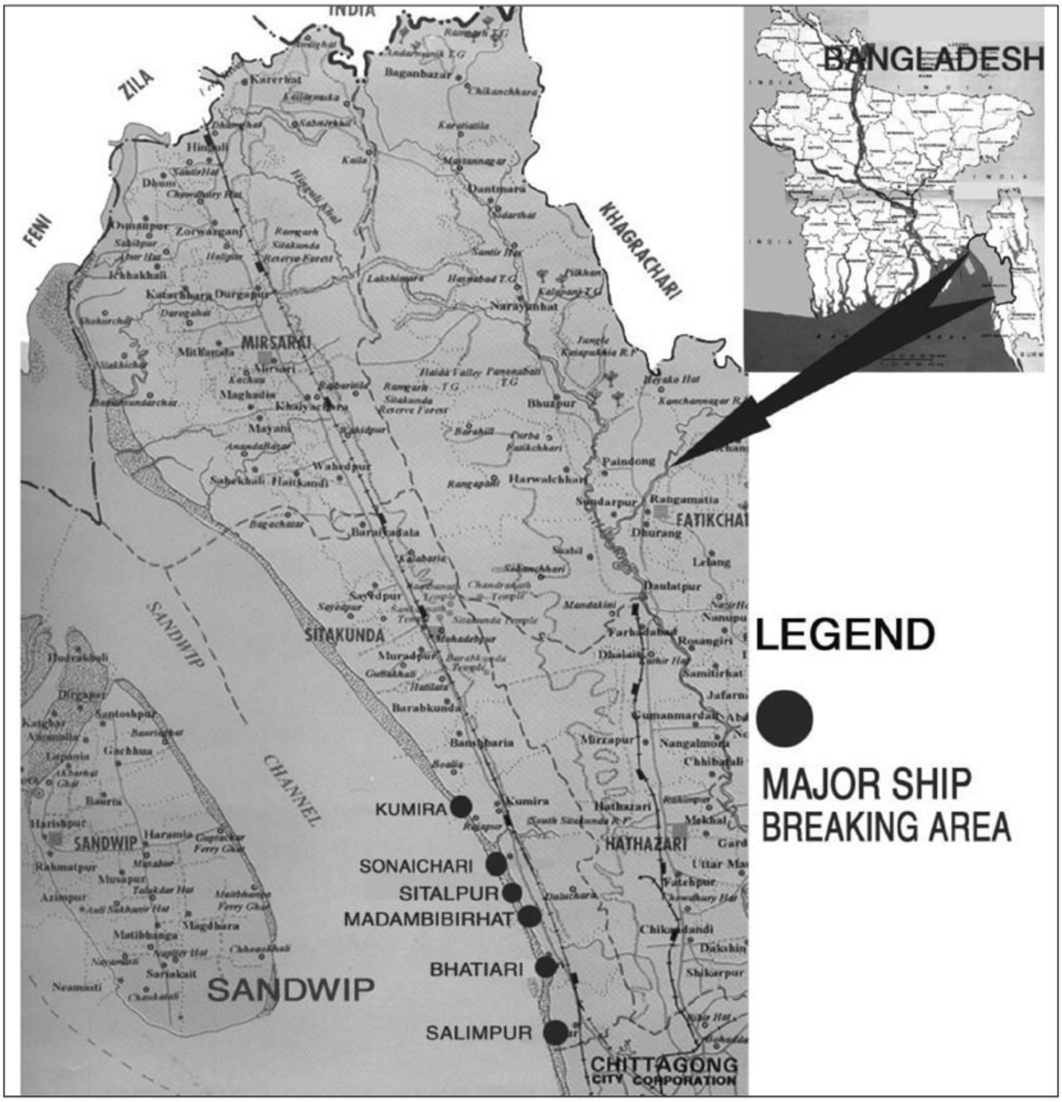

Figure 1. Map of Shipbreaking Area Indicated Black Spot and Sandwip as Control Area

Sample Collection and Preparation

Sea water, bottom sediments from intertidal zone were collected one year round of 2015 during high tide from the five sampling stations Salimpur, Bhatiary, Sonaichari, Kumira and Sandwip. Sediment samples were collected with Ekman Grab Sampler in airtight polythene bags. All the samples were collected both at pre-monsoon and monsoon. Then samples were digested by adding hydrochloric, nitric, sulfuric and perchloeic acid. The standard solution of the elements Fe, Cu, Hg, Zn, Pb, Cr, Cd, Ni and Mn were prepared by pipetting the required amount of the solution from the stock solution, manufactured by Fisher-Scientific Company, New Jersey, USA. The standard solution was prepared before every determination of the analysis of the present work. The samples were injected by an automatic sampler and the absorbance and concentration data were automatically printed out and displayed. The analysis of sediment was carried out in BCSIR (Bangladesh Council of Scientific and Industrial Research) laboratories, Chittagong, Bangladesh.

Analysis of Macrobenthos

Qualitative and quantitative analysis of benthos from the intertidal zone of affected (shipbreaking) and reference (non-shipbreaking) area were analyzed through quadrat analysis (1m x 1m) covering an area of 1000m x 500m through random sampling (10-20) in each area. Then the samples were washed and sieved using a net having 0.5mm mesh size to remove the debris and clay particles. Collected samples were preserved in 70 percent alcohol (APHA, 1976). The containers were marked and transferred to the laboratory for analysis. To facilitate sorting of organisms from debris, the samples were stained with "Rose Bengal" preservatives (APHA, 1976). The sorted organisms were preserved in 70 percent ethanol. The sorted organisms were identified and enumerated under major taxa and kept preserved in small vials for further analysis.

Results and Discussion

The poor practices of the present shipbreaking industry produce huge environmental pollution in the coastal areas of Bangladesh. Shipbreaking activities discharge a number of liquid, gaseous and solid pollutants that are hazardous to the environment and human beings (Islam and Hossain, 1986; Hossain and Islam, 2006; Neser et al., 2012; Abdullah et al., 2012). The most common pollutants are oil, physiochemical parameters, asbestos, heavy metals and persistent organic pollutants.

Heavy Metals Concentration in Sediments

Heavy metals of concern associated with shipbreaking activities include lead (Pb), mercury (Hg), cadmium (Cd), iron (Fe), aluminium (Al), zinc (Zn), copper (Cu), chromium (Cr) and manganese (Mn). From the study, maximum concentration of iron (Fe) was observed as 41361.71 $\mu g.g^{-1}$ at Bhatiari of the affected sites and the minimum was as 3393.37 $\mu g.g^{-1}$ at Sandwip which is significantly lower than that of unpolluted marine sediment (27000 $\mu g.g^{-1}$). Fe concentrations in sediments varied from 11932.61 $\mu g.g^{-1}$ to 41361.71 $\mu g.g^{-1}$ in the affected area and 3393.37 $\mu g.g^{-1}$ in the control site. The minimum and maximum concentrations were recorded at Sandwip and Sonaichari. The average value of Fe in the affected site was 27370.63 $\mu g.g^{-1}$ (Table 3). This finding is in well agreement with findings of Banu (1995) in the sediment of the Karnafully River mouth. Fe has frequently been used as an indication of natural changes in the heavy metal carrying capacity of the sediment (Rule, 1986) and its concentration has been related to the abundance of metal reactive compounds not significantly affected by men's action (Luoma, 1990).

Manganese (Mn) is an element of low toxicity having considerable biological significance. It is one of the more biogeochemical and active transition metals in aquatic environment (Evans et al., 1977). Mn concentration in sediment samples varied from 2.32 $\mu g.g^{-1}$ to 8.2 $\mu g.g^{-1}$ in affected area. Maximum level of Mn was observed as 8.25 $\mu g.g^{-1}$ in the affected site, Bhatiary and minimum as 1.80 $\mu g.g^{-1}$ in the control site Sandwip which is significantly higher than that of unpolluted marine sediment (1.17 $\mu g.g^{-1}$), recommended by IAEA (International Atomic Energy Agency) (1990) but reflects the works of Mehedi (1994), Khan (2003) and Hossain (2004). The mean value of Mn in the experimental area was 5.03 $\mu g.g^{-1}$ (Table 3).

Table 3
Heavy Metals Concentrations of Sediment at Both the Affected and Control Site

	Stations	**Heavy Metal Concentration**								
		Fe (µg/g)	**Mn (µg/g)**	**Cr (µg/g)**	**Ni (µg/g)**	**Zn (µg/g)**	**Pb (µg/g)**	**Cu (µg/g)**	**Cd (µg/g)**	**Hg (µg/g)**
Affected sites	Salimpur	11932.61	2.64	68.35	23.12	83.78	36.78	21.05	0.57	0.015
	Bhatiari	35216.35	8.25	86.72	35.12	102.05	122.03	39.85	0.83	0.02
	Sonaichhari	41361.71	6.89	78.36	48.96	142.85	147.83	30.67	0.94	0.117
	Kumira	20971.86	2.32	22.89	25.36	119.86	41.57	28.01	0.59	0.05
Control site	Sandwip	3393.37	1.8	19	3.98	22.22	8.82	2.05	0.19	0.02
Standard		27000 a	1.17 b	77.2 a	56.1 a	95.0 b	22.8 b	33.0 b	0.115 a, b	0.02 a

Notes: a = IAEA, 1990;
b = GESAMP (Joint Group of Experts on the Scientific Aspects of Marine Pollution), 1982
Source: Lab Analysis, 2015

Concentration of chromium (Cr) was varied from 22.89 µg.g-1 to 86.72 µg.g-1 (Table 3) among the affected site with the average of 46.53 $\mu g.g^{-1}$ in the affected sites whereas 19 $\mu g.g^{-1}$ in the control site. But the recommended value of Cr is 77.2 $\mu g.g^{-1}$ (IAEA, 1990). Copper (Cu), nickel (Ni) and zinc (Zn) are essential heavy metals for living aquatic organisms. The value of Ni varied from 23.12 $\mu g.g^{-1}$ to 48.96 $\mu g.g^{-1}$ in the affected sites with the highest value at Sonaichhari whereas 3.98 $\mu g.g^{-1}$ at Sandwip (the control site) which are lower than the recommended concentration 56.1 $\mu g.g^{-1}$ (IAEA, 1990). This low concentration of Ni might be due to absorption of Ni from clay minerals. The mean value of Ni in the affected sites was 33.14 $\mu g.g^{-1}$. Cu is intimately related to the aerobic degradation of organic matter (Das and Nolting, 1993). The concentration of Cu ranged from 21.05 $\mu g.g^{-1}$ to 39.85 $\mu g.g^{-1}$ with the average value of 29.00 $\mu g.g^{-1}$ in affected sites with the highest value at Bhatiari and lowest at Salimpur. The present value is higher than that of recommended value 33.00 $\mu g.g^{-1}$ (IAEA, 1990). This finding showed that the Cu concentration is getting harmful for the inhibiting marine biota. The minimum concentration was recorded at Sandwip 2.05 $\mu g.g^{-1}$.

The highest concentration of Zn was found at 162.05 $\mu g.g^{-1}$ at Bhatiary (the affected site) and 22.22 $\mu g.g^{-1}$ at Sandwip (the control site). Concentration of Zn were also higher compared to that of the recommended value of 95 $\mu g.g^{-1}$ (GESAMP, 1982). It is also mentionable that the level of Zn in soft water ranging from 0.1 to 1 $\mu g.g^{-1}$ is lethal to fish. The level of Zn in sediments of the affected area varied from 83.78 $\mu g.g^{-1}$ to 142.85 $\mu g.g^{-1}$ wit the average value of 112.14 $\mu g.g^{-1}$. Literature survey indicates that marine sediment of Bangladesh contains higher amount of Zn than marine sediment from others parts of the world (Salomons and Forster, 1984; GESAMP, 1982).

Lead (Pb) concentration in sediment samples of the affected areas varied from 36.78 $\mu g.g^{-1}$ to 147.83 $\mu g.g^{-1}$ with the average value at 87.05 $\mu g.g^{-1}$. The minimum concentration was recorded at Sandwip 8.82 $\mu g.g^{-1}$. Cadmium (Cd) concentration in sediments of the affected areas varied from 0.57 $\mu g.g^{-1}$ to 0.94 $\mu g.g^{-1}$ with the average value of 0.73 $\mu g.g^{-1}$. The minimum concentration was recorded at Sandwip 0.196 $\mu g.g^{-1}$. Mercury (Hg) level in the sediment samples of the affected sites varied from 0.115 $\mu g.g^{-1}$ to 0.942 $\mu g.g^{-1}$ with the average value of 0.356 $\mu g.g^{-1}$. In the control site it was recorded at 0.231 $\mu g.g^{-1}$.

The recommended value of lead (Pb), cadmium (Cd) and mercury (Hg) are 22.20, 0.11 and 0.01 $\mu g.g^{-1}$ respectively (GESAMP, 1982). The highest concentration of these elements found to be 147.83, 0.94 and 0.942 $\mu g.g^{-1}$ respectively in the affected areas, whereas 8.82, 0.196 and 0.231 $\mu g.g^{-1}$ in the control site. The present values are about six and a half, eight and half, and ninety-four times higher than the certified values respectively. These could be attributed effects of oil and oil spillage, petroleum hydrocarbon from ships, tankers, mechanized boats, etc., as opined by Abu-Hilal (1987) and Laxen (1983).

Heavy Metals Affect on Benthic Organisms

Study on the bottom/sessile organism is a good indicator to know the health of an aquatic environment (Abel, 1996). On the other hand, the bottom living organisms, the benthos play an important role in the food chain (as food of fish) especially in the intertidal zone and it is also well recognized that the richest fisheries of the world are closely related to the benthic community.

During the present investigation, quadrat analysis on the distribution and diversity of benthic fauna at the intertidal zone of shipbreaking and non-shipbreaking area were done. During the benthic fauna study in shipbreaking sampling site, only four (4) major groups of fauna were identified, with a total abundance of population from ten (10) quadrat analysis were only 478 individuals (Table 4). Abundance and percentage distribution of population among the group shows, highest abundance (351 individuals) of crab larvae (73.43 percent), the boring organisms, then polychates (14.44 percent), bivalves (10.04 percent), followed by oligocheate (1.67 percent). Percentage distribution of other unidentified fauna was only 2.09 percent (Table 4). The clear dominance of tolerant crab larvae was found in shipbreaking area, compare to other pollution tolerant marine organisms (polychates, bivalves). The distribution patterns of benthic fauna suggest that, this area is imbalanced in condition and not suitable for the survival of sensitive benthic fauna and the organisms (amphipoda, isopoda, flies, megapoda, mysid, etc.). Unhealthy and imbalanced condition of the intertidal zone can be reflected by the presence of only pollution tolerant organisms and high abundance of a particular pollutant tolerant organism and absence of sensitive fauna in that area.

Quadrat analysis of benthic fauna at the control site Sandwip shows the higher abundance and diversity in the reference zone compare to the affected zone (Table 5). During the present investigation on benthic fauna of non-shipbreaking area a total population of 1385 individuals were found from ten (10) quadrat analysis. The abundance of benthic population shows 2 times higher than the affected zone. The diversity of the benthic group was also higher in the reference area (9 including the unidentified one) and no one group of particular fauna is dominant in abundance, like

Table 4
Percentage Distribution of Different Groups Benthic Organisms in the Shipbreaking Zone through Quadrat Analysis

Name of Benthic Organisms (groups)	No. of Quardrat (1m ×1m)										Total population	Mean (m^2)	Percentage distribution
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th			
Crab	17	25	43	74	39	24	35	36	22	36	351	35.1	73.43
Oligocheate	0	0	0	2	0	1	0	0	3	0	8	0.8	1.67
Polycheate	6	12	5	3	4	9	5	8	9	8	69	6.9	14.44
Bivalve	5	3	4	7	6	5	5	3	4	6	48	4.8	10.04
Others (unidentified)	0	0	0	1	0	0	0	0	0	1	2	0.2	0.42
Total	28	40	54	87	49	39	45	47	38	51	478	47.8	100.00

Table 5
Percentage Distribution of Different Groups of Benthic Organisms in the Sandwip Island (Control Area) through Quadrat Survey

Name of Benthic Organisms (groups)	No. of Quadrate (1m × 1m)										Total Population	Mean Individual/m^2	Percentage Distribution (%)
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th			
Carb	11	5	15	41	15	18	18	19	16	25	183	18.3	13.21
Oligocheate	3	7	5	4	8	2	1	2	7	0	39	3.9	2.82
Polycheate	20	72	73	91	85	66	19	56	84	10	578	57.8	41.73
Bivalve	21	15	49	75	61	63	39	78	85	36	522	4.8	37.69
Crustacea	4	1	3	0	4	0	4	0	2	3	21	2.1	1.52
Gratropoda (Univalve)	0	1	0	2	0	2	0	0	2	1	8	0.8	0.58
Insecta	1	0	2	1	0	0	2	0	1	0	7	0.7	0.51
Amphioda	0	1	0	0	2	0	0	0	0	2	5	0.5	0.36
Others (unidentified)	5	0	3	1	4	0	1	5	0	3	22	2.2	1.59
Total	65	102	150	215	179	151	84	160	197	80	1385	91.1	100.00

the affected area (Tables 4 and 5). It means that, this intertidal area is still suitable, productive and relatively balanced in the distribution of benthic fauna, compare to polluted or highly impacted zone. Study of different authors in different parts of the world on similar aspects, suggested that in polluted areas, only the pollution tolerant species/groups can survive and their number may increase, whereas the rest will be eliminated.

Conclusions and Recommendation

The shipbreaking industry started its operations in the 1960s when a Greek ship “MD Alpine” was stranded on the shores of Sitakund, Chittagong after a severe cyclone. The ship remained there for a long time before the Chittagong Steel House brought the vessel and scrapped it. During the Liberation War in 1971, a Pakistani ship “Al Abbas” was damaged by bombing. It was later salvaged and brought to the Fauzdarhat seashore. In 1974, Karnafully Metal Works Ltd. bought it as scrap, introducing commercial shipbreaking in Bangladesh. The industry flourished during the 1980s. Today it has become large and profitable industry for Bangladesh.

The shipbreaking process starts a long way from the Bangladesh coast. Considering the positive role of shipbreaking in national economy shipbreaking cannot be stopped. The shipbreaking activities contaminate the coastal soil and sea water environment and thus change their ecological settings. Different study about shipbreaking activities impact in the coastal area, it is normally found that grave environmental pollution, such as physiochemical properties, heavy metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyl compounds (PCBs), organotins, oil and grease pollution, asbestos and other atmospheric pollutants, and its impact on marine ecosystems, biodiversity, forestry, fisheries and human health are the main obstacles for the development of a sustainable shipbreaking industry. Rather a sustainable approach should be taken to minimize the negative consequences of shipbreaking activities in our coastal zone. Wastes of the scrapped ships are drained and dumped into the Bay of Bengal. These wastes, especially oil and oil substances, PCBs, TBTs, PAHs, etc., and different types of heavy metals (Fe, Cr, Hg, Zn, Mn, Ni, Pb, Cd) are being accumulated into the marine biota. As a result, marine fisheries diversity of the Chittagong coastal region that supports highly diversified marine water fishes, mollusks and benthic organism, etc., are at stake at this moment. So, the indiscriminate expansion of shipbreaking activities poses a potential threat to the coastal intertidal zone and its habitat. The coast of the shipbreaking area is inhabited by 20,000 poor fishing families who absolutely depend for their survival on the availability of the fishes in the shallow coastal area. The abundance and distribution pattern of benthic fauna in affected and non-affected area shows a clear difference in abundance and species diversity, with dominancy of pollutant indicator benthic fauna in shipbreaking activity area.

Finally, it could be said that, the shipbreaking operation involves serious environmental hazards. If the shipbreaking industry is to develop in the country, the same may only be allowed ensuring minimization of pollution effect. Currently, there is lack of co-ordination among the different agency/department/ministry responsible for shipbreaking activities. Co-ordination should be developed for improving the effectiveness of current regulatory bodies. Bangladesh government should have a separate Environmental Management Plan (EMP), specially developed for shipbreaking industries and this industry should be included in “Red category” instead of “Yellow category” (as mentioned in Environment Conservation Rules (ECR), 1995) for the purpose of issuing clearance certificate of ship scrapping as well as compliance with Environmental Impact Assessment (EIA) and EMP. Preventive measures against environmental and health hazards inherent in the process of shipbreaking, should be undertaken at the right time before it is too late.

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