BIODIVERSITY IN BENTHIC COMMUNITIES OF CHINNA CREEK

MOAZZAM ALI KHAN[1], WAFRA MATANAT ZAHEEN[2] AND S. SHAHID SHAUKAT[1]

[1]Institute of Environmental Studies, University of Karachi, Karachi-75270, Pakistan
[2]Marine Reference Collection and resource center, University of Karachi, Karachi-5270, Pakistan

Abstract

Chinna creek covers an area of about 6 square Kilometer which extended from Boat Basin to Native Jetty Bridge and joins, Kimari. It is about 5.0 Km long, 300 to 500 m wide with the depth ranges from 1 m to 3 m. The quantitative faunal analysis conducted in this study was performed to determine the abundance and distribution of faunal groups and sub groups. Observations were based on three successive samplings in the year 2006. The individuals found from the study sites belonged to four invertebrate groups i.e. Annelida, Mollusca, Nematoda and Arthropoda. Numbers of individuals of Nematodes (63.62%) were found highest from all the stations followed by Cirripedia (18.71%), Pycnogonida (6.44%), Acarina (6.10), Copepoda (2.36%), Collembola (1.20%), Gastropoda (0.41%), Polychaeta (0.30%), Oligochaeta (0.26%), Coleoptera (0.19%), and Arachnida (0.15%). Remaining collection also included few unidentified specimens and unidentified larval stages. Faunal abundance at Chinna Creek with presence of indicator species in dominance and presence and absence pattern of sensitive, facultative and tolerant groups according to their abilities showed that one possible reason for this pattern of faunal diversity is due to heavy pollution load that is entering in the area.

Introduction

Karachi is situated on the southwestern part of Indus delta. It is the most thickly populated city of Pakistan with a population of over 18 million. Karachi is the biggest hub of industrial activity having more than 8000 industries. Except few well-established industries, which have installed preliminary treatment facilities, all units discharge their wastes directly or indirectly into the Karachi coastal area. (Khan *et al*., 1999a; ACE, 1993), which is causing deterioration of marine environment (Ahmed, 1995).

The coastal zone of Karachi is about 135 km long and is the most affected area along the coast of Pakistan (Khan *et al*., 1999; Ali, and Jilani, 1995; Beg 1997; Beg, *et al*., 1984, Haq, 1976). The Karachi harbor is about 62 km stretching from Sands pit to Chinna Creek,

The study area Chinna creek is about 5.0 Km long, 300 to 500 m wide with the depth ranges from 1 m to 3 m. It covers an area of about 6 square Kilometer which extended from Boat Basin to Native Jetty Bridge and joins, Kimari. At its northern bank, PNS building Lalazar Bungalows, Boat club, Port house, Naval officers residence, Karachi club and KPT officers society are situated and towards its southern bank Shirin Jinnah colony, Sikandar abad, Majeed colony, Okhai colony are present.

Before the construction of Karachi port in 1873 Chinna creek had two entrances one at Manora channel and other at Clifton. When the Clifton entrance was artificially closed for using western break water as an intertidal reservoir, the creek flourished with thick mangrove growth (Khan and Shaukat, 2008) of mostly *Avicennia marina.* Chinna Creek receives about 16 million gallons of untreated wastewater per day and toxic wastes of Karachi city, through Nehr-e-Khayyam, TPX drain and a drain from Habib Public School. In addition, there is an indirect impact of about 200 mgd of wastewater discharged by Lyari River (Khan *et al*., 1999; Ali, and Jilani, 1995). These discharges seriously impair the marine ecosystem resulting in the loss of natural flora and fauna that are important for a stable and beneficial ecosystem (Beg, 1995). Mangroves present in the area are under severe stress due to rise in the toxicity level.

Materials and Methods

Samples were collected from five different sites (locations) all along the Chinna Creek extending from Nehar Khayyam (TPX drain) up to Native Jetty Bridge. Sites for sample collections are presented in Table 1 and Fig. 1(a, b).

Processing of samples for the analysis of benthic fauna**:** Patterson Grab was used for the collection of benthic fauna from the selected sampling sites. A quadrate of 1.0 m^2 at each site was placed randomly and the sediment with benthic organisms were collected and transported in the plastic bags. For ensuring an ample fixing of all the material, 10% Formalin was added to the sample. Rose Bengal (1 % solution in distilled water) was also added to the samples for staining the benthic organisms, which made the sorting of faunal groups convenient.

Sieving and Sorting: In laboratory, each plastic bag containing biotic sample was carefully opened and the content was put on a sieve of 0.5 mm mesh. The bottom of the sieve was gently dipped several times in a sink containing water. The sediment remained on the sieve was transferred to glass Petri plates and the benthic organisms were handpicked, mostly under a stereomicroscope. Care was taken to pick up all the organisms present in the sediment sample. These organisms were put in suitable containers and fresh formalin solution (10%) was added. The containers were properly labeled.

Counting of the biota**:** Individual organisms were counted carefully, either with naked eyes or under a stereomicroscope. Where an organism was not intact, care was taken not to count different parts of the body as separate individuals.

Identification of biota**:** In present study due to complex nature of the invertebrate taxonomy, lacking of expert opinion and missing of species specific characters in preserved specimen, identification of invertebrate fauna was done up to group level only (except few groups where species specific characteristics and expert opinion was available.) Temporary slides of microscopic organisms were made in glycerol jelly, which is a mixture of gelatin (10g), distilled water (60ml), glycerol (70ml) and phenol (0.25g) (Peacock 1966).Lactophenol (Amann's Medium) was used to clear the specimens, especially nematodes and polychaets. The lactophenol was prepared by adding 20 g of phenol to 20 ml of distilled water, when the phenol dissolved completely, 16.8 ml of lactic acid (glacial) was mixed and finally 33.3 ml of glycerol was added (Peacock 1966). The references which were used for the identification of biota include: Wesenberg-Lund (1949), Dance (1974), Oliver (1975), Bemert and Ormond (1982), Burukovskii (1982), Tirmizi and Zehra (1984), Davaney *et al.* (1987), Campbell (1989), Fish and Fish (1989), Allen (1997), Mustaquim (1997) and Shameel (2001).

Measurement of Diversity**:** The general taxa diversity (H) was measured by the popular Shannon-Weiner index (Magurran, 1988). The general diversity was decomposed into its two components, i.e.,: richness (d) and equitablity (J). Richness was assessed using Menhinick index and equitability by Pielou's index (Pielou, 1977; Ahmed and Shaukat, 2012). The variances of diversity and equitability were also determined. Dominance was estimated using Simpson's index (D).

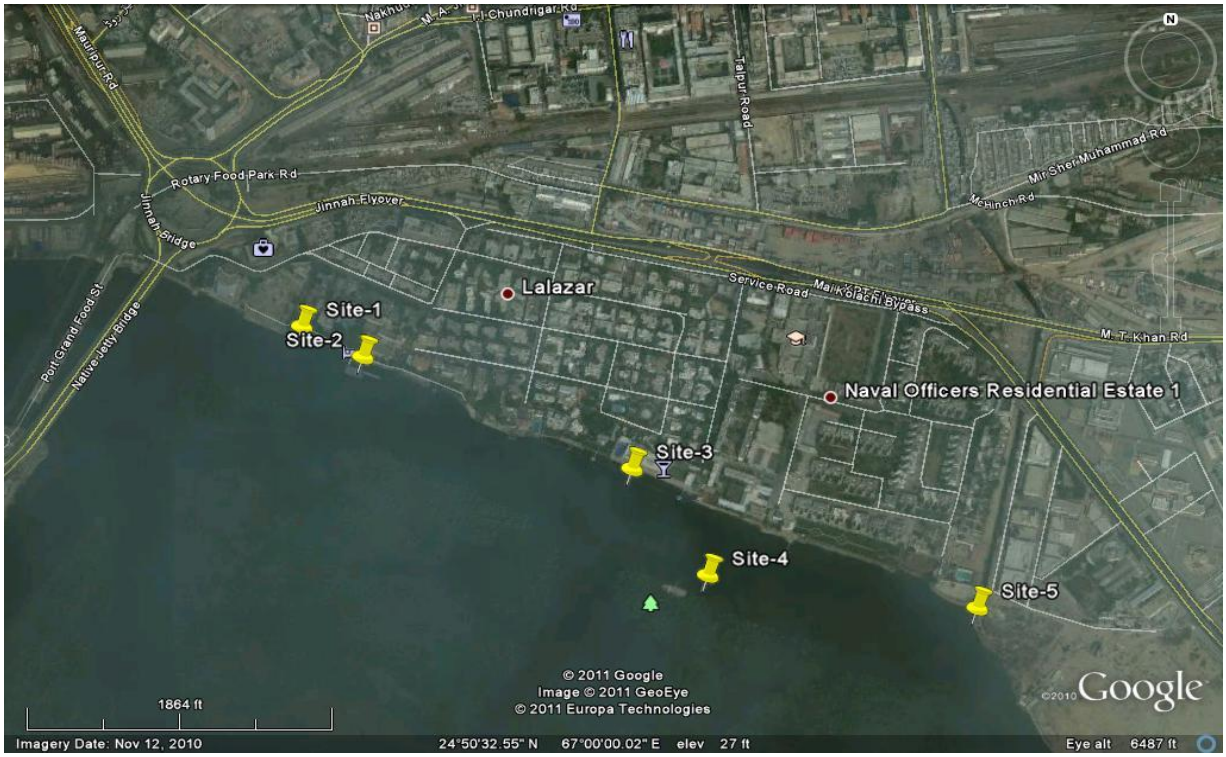

Fig.1. Sites of sample collection

Table 1. Sampling Sites with their Geographic Coordinates

S. No.	Sampling Stations	Adjacent to	Sampling sites coordinates	
1	S-1	TPX drain (Beach Luxury hotel)	24° 50' 17" N	67 ° 0' 24" E
2	S-2	Karachi Club	24 ° 50' 33" N	66 ° 59' 43" E
3	S-3	KPT Mehran II	24 ° 50' 35" N	66 ° 59' 39" E
4	S-4	Habib public School nullah	24 ° 50' 26" N	67 ° 0' 1" E
5	S-5	Near Mangroves	24 ° 50' 26" N	67 ° 0' 1" E

Results and Discussion

The quantitative faunal analysis conducted in this study was performed to determine the abundance and distribution of faunal groups and sub groups. Observations were based on three successive samplings in the year 2006. The results are reported in. Table- 2.

Table 2. Frequency of occurrence of invertebrate groups collected from Chinna Creek

Major Group/Taxa	Sampling sites					Number of Individuals	% Abundance	Ranking
	S-1	S-2	S-3	S-4	S-5			
Annelida								
Polychaeta		6		1	1	8	0.30	8
Oligochaeta (Earthworm)			1		6	7	0.26	9
Mollusca								
Gastropoda	1			10		11	0.41	7
Bivalves								
Nematoda	174	466	484	300	276	1700	63.62	1
Arthropoda								
Crustacea								
Maxillopoda								
Cirripedia			500			500	18.71	2
Copepoda	14	41	5		3	63	2.36	5
Ostracoda								
Malacostraca (shrimps, crabs)								
Decapoda complete								
Uniramia								
Hexapoda								
Collembola (Spring tail)	3	5	1	11	12	32	1.20	6
Coleoptera (Beetles)	2	2			1	5	0.19	10
Chelicerata								
Acarina (Ticks & Mites)	2		159		2	163	6.10	4
Arachnida	1	2			1	4	0.15	
(pseudoscorpion, spiders)								11
Pycnogonida Sea spider	10	2	159		1	172	6.44	
(limpura)								3
Unidentified specimen	1	1			1	3	0.11	12
Unidentified Larval stages	1					1	0.04	13
Unidentified moults.								
Total	210	527	1309	322	304	2672		

Faunal distribution is categorized into four groups on the basis of abundance at different stations of the study area (Ahmed, *et al*., 1982). There were some groups which were found abundantly in all samples they are marked as Group 1. There were some groups which were found fairly abundantly and characterized in Group 2, while some organisms were found in less numbers in few samples they were placed in Group 3. While few were found once or twice in number in one or two samples which belongs to Group 4.

In present study, total 2672 numbers of complete individuals were found along with 2,045 numbers of fragmented specimens at all the stations of Chinna Creek. The individuals found from the study sites belonged to four invertebrate groups i.e. Annelida, Mollusca, Nematoda and Arthropoda. Numbers of individuals of Nematodes (63.62%) were found in highest quantity from all the stations followed by Cirripedia (18.71%), Pycnogonida (6.44%), Acarina (6.10), Copepoda (2.36%), Collembola (1.20%), Gastropoda (0.41%), Polychaeta (0.30%), Oligochaeta (0.26%), Coleoptera (0.19%), and Arachnida (0.15%). Remaining collection also included few unidentified specimens and unidentified larval stages.

Table 3. Diversity and dominance measures and their variances calculated for the five sampling sites and for the overall sample.

Diversity index	Site 1	Site 2	Site 3	Site 4	Site 5	Overall
Taxa diversity H	0.7312	0.4828	1.279	0.307	0.465	1.177
Var (H)	0.0079	0.0023	0.0003	0.0024	0.0047	0.0005
Equitability J	0.3175	0.232	0.657	0.2214	0.2039	0.459
Var (J)	0.0015	0.0005	0.00007	0.001	0.0009	0.00007
Richness d	0.691	0.352	0.193	0.223	0.5735	0.251
Simpson's dominance D	0.6989	0.790	0.311	0.869	0.8258	0.449

Taxa diversity and dominance are reported in Table 3. Site 3 showed the highest taxa diversity (H) while site 4 exhibited the lowest taxa diversity. .Equitability (J) was lowest for site 5 and highest for site 3. Diversity (h) and equitability (J) showed an inverse relationship. Likewise, dominance showed inverse trend with taxa diversity. Species richness was highest for site 1. On an overall basis both diversity and equitability were low considering that a number of taxa were included in the sample.

Although, the creek area is a part of Manora channel but in present study a very limited biodiversity is being observed from the creek area which is paradoxical with the previous studies related to Karachi coast Tirmizi and Barkati (1983), Tirmizi *et al.* (1986), Barkati and Tirmizi (1988), Ahmed (1988), Karim (1988), Ayub (1989), Naeem (1993), Zehra *et al.* (1996), Saleem *et al.* (1999), Qureshi and Sultana (2000), Ghani and Nawaz (2000), Kazmi *et al.* (2000), Maqbool and Kazi (2000), Khan and Khan, (2001), Ghory and Siddiqui (2002), Kazmi *et al.* (2004), Barkati and Rahman (2005), Farooq (2006), Ghory and Siddiqui (2006), Ghory and Siddiqui (2007).

According to Walker *et al.* (2001, cited in Cunha, *et al.*, 2006) pollutant affect ecosystem, in three different ways. i) It turns down number of individual as much as they become extinct. ii) Achievement of new equilibrium level so that the population can survive in contaminated environment. iii) Development of resistance in benthic population against pollution which results in increase in size and reached at equilibrium level.

The reduced biodiversity is mainly due to indiscriminate discharge of untreated domestic and industrial effluents into the creek area.

Conclusion: The above study clearly demonstrates that the creek is gravely polluted with variety of toxic pollutants of domestic and industrial origin that are toxic to marine life. It is imperative that the city administrative authorities strictly control the dispersal of waste into the creek area so that the creek may appears into its natural pristine form.

References

ACE, (1993). Lyari and Malir River pollution study. Associated consulting engineers, Karachi 1-24.

Ahmed, M., Rizvi, S.H.N and Moazzam, M. (1982). The distribution and Abundance of intertidal organisms on some beaches of Makran coast in Pakistan (Northern Arabian Sea). *Pakistan Journal of Zoology* 14: 175-184.

Ahmed, M. (1995). Elements of training course in coastal oceanography and pollution or coastal zone management in Pakistan. In: Resources volume or tertiary level education and training in coastal zone management. Hay, J. E., Ponniah, W. and Pradan, M. (Edits.) NETLAP Publication no: 13. UNEP. Bangkok, Thailand 15-29.

Ahmed, M. and Shaukat, S.S. (2012). A Textbook of Vegetation Ecology. Abrar Sons Publishers, Karachi.

Ahmed, M. F., (1988). Fish of Pakistan's mangrove area. In: Thompson, M.F., Tirmizi, N. M. (eds.), Proceeding of marine science of the Arabian Sea. American Institutes of Biological sciences, Washington D. C. ISBN 0-936829-01 X: 429-438.

Ali, I. and Jilani, S., (1995). Study of contamination in the coastal waters of Karachi. In: The Arabian Sea, living marine resources and the environment (Mary-Frances Thompson and Nasima M. Tirmizi) Vanguard book (Pvt.) Ltd., Lahore Pakistan 653 - 658.

Allen, G.R. (1997). Tropical marine life of Malaysia and Singapore 1-64.

Ayub, Z. (1989). Species composition of the Jaira and Kalri group of shrimps landing at the Karachi fish harbour as relevant to prawn fisheries. Center of Excellence in Marine Biology University of Karachi. M.phil thesis 135 pp.

Barkati, S. and Tirmizi, N. M. (1988). Allometric growth in the snail, *Telescopium telescopium* (Mollusca: Gastropoda), from Karachi Mangroves. In: Marine science of the Arabian Sea. Editors M. F. Thompson and N. M. Tirmizi, American Institute of biological sciences, Washington D. C. ISBN 0-936829-01-X 417-428.

Barkati, S. and Rahman, S. (2005). Species composition and faunal diversity at three sites of Sindh mangroves. *Pakistan Journal of Zoology* 37(1): 17-31.

Bemert, G. and Ormond, R. (1982). Red Sea coral Reefs. Kegan Paul International Limited, London: 1-92.

Beg, M. A., Mahmood, S. N., Naeem, S., and Yusufzai, A. H. K., (1984). Land based pollution and the marine environment of Karachi coast. *Pakistan Journal of Scientific and Industrial Research* 27(4): 199-205.

Beg, M.A.A., (1995). Ecological imbalances in the coastal area of Pakistan and Karachi harbor. *Pakistan Journal of Marine Sciences* 4(2): 159-174.

Beg, M.A.A., (1997). Pollution of the Karachi coastal environment. *Wildlife and Environment* 5(4):20-22.

Burukovskii, R.N. (1982). Key to Shrimps and Lobsters. Oxonian Press Pvt. Ltd. 1-174.

Campbell, A.C. (1989). The Hamlyn guide to Seashores and shallow Seas of Britain and Europe. The Hamlyn Publishing Group Ltd. 1-320.

Cunha, I., Sousa, A., Lima, D., Santos, M., Reis-Henriques, A. and Guilhermino, L. (2006). Develop Protocols for Type of Monitoring and Seasonality. WP 7: Environmental Monitoring Emergency Response to coastal Oil, Chemical and Inert Pollution from Shipping. (EROCIPS) Task 7.1.1b: Develop Protocols for Type of Monitoring and Seasonality.

Dance, S.P. (1974). The encyclopedia of shells. Blandford Press Limited 1-288.

Davaney, D.M., Reese, E.S., Burch, B.L. and Helfrich, P. (1987). The natural history of *Eniwetok Atoll.* Volume II Biogeography and systematic. United State Department of energy. Office of Scientific and Technical Information 1-347.

Farooq, S. (2006). Comparative study on the Ecology of Mangrove swamps of Pakistan. Center of Excellence in Marine Biology University of Karachi. Ph.D. thesis 143 pages.

Fish, J.D. and Fish, S. (1989). A student's guide to the Seashore. Unwin Hyman, London 1-473.

Ghani, N. and Nawaz, F. (2000). Fauna associated with the weeds of Manora Mangroves. Proceeding of National O.N. R. Symposium on the Arabian Sea as a Resource of Biological Diversity 65-89.

Ghory, F.S. and Siddiqui, F.A. (2002). Occurrence and abundance of Brachyuran larvae in the Manora Channel (Karachi, Pakistan) during 1993. *Pakistan Journal of Marine Sciences* 11(1&2): 27-36.

Ghory, F.S. and Siddiqui, F.A. (2006). Percentage composition of brachyuran larvae collected during 1994 in Manora channel, Karachi, Pakistan. *Pakistan Journal of Marine Sciences* 15(1): 119-130.

Ghory, F.S. and Siddiqui, F.A. (2007). Distributional patterns of brachyuran larvae in Manora Channel (Karachi, Pakistan) collected during 1995. *Pakistan Journal of Marine Sciences* 16(1): 49-67.

Haq, S.M. (1976). Overview on pollution in the coastal environment of Pakistan and its possible implications in marine ecosystem. Proc. Of Intl. Symp. On marine Pollution Res. (Meyers, S.P Ed.). Louisiana State University. Baton Rouge, L.A Centre for Marine Resources USA. 33-35.

Karim, S.I. (1988). Avifauna of Sindh mangrove. In: Marine science of the Arabian Sea. Editors M. F. Thompson and N. M. Tirmizi, American Institute of biological sciences, Washington D. C.ISBN 0-936829-01 X: 457-466.

Kazmi, Q.B. and Naushaba, R. *(*2000). A survey of coastal marine interstitial arthropods from sandy area of Karachi. Proceeding of National O.N. R. Symposium on the Arabian Sea as a resource of biological diversity 129-143.

Kazmi, Q.B. (2004). Copepods from Shore and Offshore Waters of Pakistan. *Journal of Marine Science and Technology* 12(4):223-238.

Khan, M.A., Shoukat, S.S., Hashmi, I. and Khan, M.A. (1999). A quantitative study of pollution profile of Karachi coast. Proceeding Seventh Statistics, Seminar, KU. ISBN-969-8397-06X 105-119.

Khan, M.A., Khan, M.A., Hashmi, I., Rashid, A., Niaz, G.R. and Khan, F. (1999). Studies on Lyari river effluent. *Pakistan Journal of Scientific and Industrial Research* 42(2): 230-235.

Khan, M.A. and Khan, M.F. (2001). Effect of Cadmium on Killifish from Mangrove area Sands pit at Karachi coast. *Pakistan Journal of Marine Science* 10(1): 15-19.

Khan, M.A. and Shaukat, S. (2008). Physico-chemical characteristics of water and sediments of Chinna creek and associated benthic biota of its fringes. *International Journal of Biology and Biotechnology* 5(1, 2): 133-141.

Magurran, A.E. (1988). *Ecological Diversity and its Measurement*. Croom Helm, London.

Maqbool, M.A. and Kazi, N. (2000). Biodiversity in free-living marine nematode fauna of Arabian Sea from coastline of Pakistan. Proceeding of National O.N. R. Symposium on the Arabian Sea as a resource of biological diversity 11-17.

Mustaquim, J. (1997). Systematic and ecology of Polychaets worms of the Pakistan coastal waters. Final research report. Pakistan Science Foundation (grant No. S-KU/Bio-260) 1-205.

Naeem, I. (1993). Occurrence and abundance of zooplankton of Manora Channel, during 1989. Proceedings of a National Seminar on Study and management in coastal zones in Pakistan 131-142.

Oliver, A.P.H. (1975). The Hamlyn guide to shells of the world. The Hamlyn publishing group Ltd. London 1-320.

Peacock, H.A. (1966) Elementary micro technique. Third edition, Edward Arnold (publishers) Ltd. London 1-547.

Pielou, E.C. (1977). Mathematical Ecology. Wiley-Interscience. New York.

Qureshi, N. and Sultana, R. (2000). Distribution and abundance of meiobenthose in Sand spit backwater mangrove area, Karachi. Proceeding of national O.N.R. Symposium on the Arabian Sea as a resource of biological diversity 90-103.

Saleem, M., Kazi, G.H. and Memon, M.Q. (1999). Heavy metal concentration in fish and shellfish of Karachi harbor area. Pakistan Journal of Marine biology (Marine Research) 5(2): 143-154.

Shameel, M. (2001). An approach of the classification of algae in the new millennium. *Pakistan Journal of Marine Biology* 7(1&2): 232-250.

Tirmizi, N.M. and Barkati, S. (1983). Molluscans fauna of mangroves of Karachi coast. In: "Mangroves of Pakistan". Proceeding of national workshop on mangroves held at Karachi, Pakistan Agricultural Research Council, Islamabad 40- 44.

Tirmizi, N.M. and Zehra, I. (1984). Marine fauna of Pakistan: 2 Mollusca, Gastropods University Grants Commission 1-105.

Tirmizi, N.M., Ghani, N. and Khan, K. (1986). Mangrove crabs of Karachi, Pakistan. Agriculture Research Council, Islamabad 51pp.

Walker, C.H., Hopkin, S.P., Silby, R.M. and Peakall, D.B. (2001). Principles of ecotoxicology. Taylor & Francis, London. (2nd edition. 1st edition appeared in 1996) 282 pages.

Wesenberg-Lund, E. (1949). Polychaet of the Iranian Gulf. Danish Science Investigation, Iran, 4: 247-400.

Zehra, I., Naz, H. and Naqvi, I.I. (1996). A preliminary study for establishing *Perna viridis* (Mollusca: Bivalvia) as a biological monitor for pollution in Karachi coastal water. *Pakistan Journal of Marine Sciences* 5(1): 31-40.